Engineering Evaluation & Construction Considerations
Coal Refuse Impoundment No. 1
Bulldog Mine
Allerton-Homer, Illinois
Patriot Project No.: 2-11-0383

Prepared For:

Sunrise Coal, LLC

Prepared By:

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June 7, 2012

ISSUED FOR REVIEW ONLY
(FOR PERMIT APPLICATION)

TECHNICAL MEMORANDUM

To: Scott Gambill & Sam Elder – Sunrise Coal, LLC
From: Salim M. Ilmudeen, P.E., William D. Dubois, P.E. & Brian J. Swenty, Ph.D., P.E.
Patriot Engineering & Environmental, Inc.
Copy: Timothy Govert – Patriot Engineering & Environmental, Inc.

Date: June 7, 2012

Re: Engineering Evaluation & Construction Considerations
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1.0 INTRODUCTION

The purpose of this Technical Memorandum is to present a synopsis of our geotechnical engineering evaluation and construction design recommendations for the proposed Coal Refuse Impoundment No.1 to be located at the Bulldog Mine located near Allerton and Homer, Illinois. This Technical Memorandum is being produced for review and consideration by the applicable regulatory agencies, including the United States Mine Safety and Health Administration (MSHA), State of Illinois Department of Natural Resources (DNR) and Association of State Dam Safety Officials.

Patriot Engineering & Environmental, Inc. (Patriot) has been engaged by Sunrise Coal, LLC (Sunrise) to perform various Geotechnical Engineering aspects relating to the development of this new mine site in east central Illinois. The initial name designated by Sunrise for this facility was “Allerton Mine”. Patriot’s initial involvement in this project commenced in April, 2011 in the form of six (6) preliminary borings that were very widely-spaced between CR 700N & CR1150N and from CR 000N (County Line Road) to CR 200E. These borings were conducted to determine the general characterization of the soils across the area in order to assist Sunrise in site selection.

Subsequent preliminary investigations included the installation of six (6) monitoring wells in September, 2011, as well as (18) Geotechnical soil borings and one (1) monitoring well in October-November, 2011. These borings and monitoring well installations also fell within the area described previously, except the well installed in November, 2011, which was located on CR400E north of CR 900N adjacent to old limestone quarry works.

Final Geotechnical borings for design were conducted within the proposed impoundment area in April and May, 2012. These borings focused on the site that was selected for the impoundment, which is located at the northeastern quarter of the section positioned southwest from the intersection of CR 800N and CR 200E. A total of (16) soil borings were performed in order to supplement the information obtained from seven (7) prior borings conducted within this particular quarter during the November, 2011 investigational effort. This technical memo presents the borings, samples, laboratory tests and engineering evaluation of this parcel which is proposed as the Refuse Impoundment #1 for the Bulldog Mine.

2.0 PROJECT OVERVIEW

The proposed location for the Coal Refuse Impoundment #1 to serve the Bulldog Mine is positioned to the southwest from the intersection of CR 800N and CR 200E in Vermilion County, Illinois. The project parcel was previously deeded to Mayo Warters and covers an area of approximately 153.68-acres. The parcel entails the northeastern quarter of Section 35 in Sidell Township, excluding a 6-acre parcel at the extreme northeastern corner that is not owned by Sunrise. The site is positioned approximately 4.75-miles north and 1.75-miles east of the Town of Allerton, Illinois.

The area proposed for the Refuse Impoundment #1 represents only a portion of the overall surface area to be permitted for the Bulldog Mine. The impoundment will be developed on a site positioned to the southeast of the main mine facility, which is anticipated to be on the north side of CR 800N.

The proposed refuse impoundment is to be developed as a downstream, staged impoundment that will also incorporate an incised/excavated pond. Initial constructed embankment would use site soils, while the subsequent stages would utilize coarse refuse for constructed embankment. The base elevation for the constructed impoundment is to be 680-ft msl, with the overall side grading developed to shed surface water from north to south and west to east. Ponds serving the water storage needs of the facility are to be positioned at the east/southeastern portion of the site, along CR200E. Topsoil and subsoil stockpiles for future reclamation of the facility will be constructed along the western and southern borders, with perhaps minor storage at the northeastern property edge. Site drainage ditches will be developed to further facilitate drainage to the southeastern pond features.

Stage 1 (Phase 1) of the development will commence with the excavation of the center area to an elevation of 656-ft msl, representing a depth of 24-feet below the base embankment grade. This initial subgrade feature will incorporate approximately 18-acres of footprint area and will form the center of the concentrically-growing impoundment. Following the excavation of this incised pond, a minimum 4-ft. thick, low permeability clay liner will be constructed for groundwater protection purposes. The final pond bottom would therefore be established at elevation 660-ft +/- msl. The low permeability clay liner would continue across the pond bottom, up the side slopes and outward laterally to cover the entire impoundment site drainage area. Embankment for the Stage 1 construction phase would commence above elevation 680-ft. msl, and would consist of compacted earth fill utilizing suitable soils obtained from the interior excavation activities of the pond. The crest of the Stage 1 embankment would exist at elevation 710-ft msl, forming an above-grade constructed section 30-ft. in height. Incised slopes as well as constructed upstream slopes will be created at 3h:1v, with benches as necessary for stability. The downstream slope for the Stage 1soil embankment will be developed at 4h:1v, with benches as necessary for stability.

Stage 2 (Phase 2) construction would proceed upward and outward from Stage 1 using coarse refuse material generated from the mining operations. The crest of Stage 1 will serve as a bench, with Stage 2 continuing upward and outward at 3h:1v to an elevation of 725-ft. msl. This will increase the crest height of the impounded area to 45-feet above the base elevation.

Stage 3 (Phase 3) construction would subsequently develop upward and outward using coarse refuse material, with similar benching and slope parameters as the previous stage. The completed crest height of Stage 3 would be 735-ft. msl, increasing the overall crest height to 55-feet above the base elevation.

Stages 4 and 5 (Phases 4 and 5) will be developed similarly as Stages 2 & 3, but will only increase the crest height by 10-ft and 5-ft, respectively. Stage 4 will crest at elevation 750-ft. msl. Stage 5 will crest at elevation 755-ft msl, 75-ft. above the base elevation, and will serve as the final stage for the life of this impoundment. The completed facility would be designed to impound approximately 44-acres at maximum crest height, with necessary freeboard clearance. At the completion of Stage 5 (or the final stage if the impoundment construction is reduced prior to full, stage 5 construction), the downstream slope will receive at least 4-feet of uncompacted soil (subsoil and topsoil) material to support the application of a vegetative grass layer.

3.0 SITE AND SUBSURFACE CONDITIONS

Site Conditions

The site proposed for the development of the refuse impoundment is comprised of 153.68-acres currently serving as agricultural fields. The parcel has been split into two agricultural fields, which consisted of corn & bean fallow at the time of our investigations. The area surrounding the project site is almost exclusively comprised of agricultural farmland, with very sparse single-family dwellings and farmsteads. The exception to the agricultural land use is present in the form of an active limestone quarrying operation located approximately 3-miles north/northeast of the proposed impoundment project. Old quarry workings also exist to the southeast of the current quarry.

The project site is gently rolling, with no distinct or well-defined surface drainage features. The highest portion of the site exists in a knob feature in the northwestern quadrant of the site, exhibiting an elevation at or near 688-ft. The lowest topography of the project site is a slightly depressed area in the southeastern corner of the parcel. This low area possesses an elevation of approximately 680-ft. msl. The overall elevation variation across the site, based on available topographical information provided by Sunrise, is approximately 8-feet. As stated previously, the proposed base elevation for the site developments has been established at elevation 680-ft msl. Therefore, site cuts will outweigh site fills to develop the base elevation.

Regional & General Site Geology

The surfacial geology in this region is largely controlled by glacial soil deposition placed upon underlying fine grained, clastic Pennsylvania bedrock. The bedrock formations are typically comprised of shale, sandstone, and limestone, with relatively thin beds of coal. Bedrock in the region tends to range from about 50-feet to 200-feet below the ground surface. Deeper bedrock formations tend to coincide with larger aquifers, such as the Mohamet Aquifer located northwest of the project site.

The site resides within an area significantly influenced by glacial events. Quaternary soil deposition above the bedrock is predominantly comprised of Wisconsian aged soils, with isolated areas underlain by Illinoian and pre-Illinoian-aged deposits. The Wisconsian Glacial episode, which ended approximately 12,000 to 13,000 years ago, had the greatest effect on the geology at this site. During advances, the Wisconsian Glacial ice gouged and plowed the underlying Illinoian and Pre-Illinoian deposits and Pennsylvanian-aged rock. Subsequent recession and advanced served to further gouge, deposit and consolidate materials. The result is glacial drift comprised of non-homogenous blends of silts, clays, sands and gravels. The soils that were overrun by sheet ice during advances formed sometimes thick sections of highly consolidated layers referred to as *glacial till*. The flowing meltwater and other characteristics associated with glaciations also resulted in formations such as *kames, kettles* and *eskers,* often comprised of granular soils contained within otherwise cohesive or till formations. These formations can present themselves as subsurface conditions in the rock overburden, or can manifest in surface features. The project site also exists within the southern extent of the Wisconsian Glacial event, where terminal moraine features exist as the result of large-scale deposits placed as the result of dying glaciers. Terminal moraine features can be seen throughout the area, often times as long, stretching low-lying ridgelines compared to the otherwise flat or rolling topography of the region. These deposits as well as various other Aeloian (wind-transported) soils represent the unconsolidated soil profile above the bedrock and till that comprise the surfacial geology and topography at this project site.

Mining

The mining operation for the Bulldog Mine is centered on the harvesting of the Co-6, Herrin member seam, which is part of the upper Carbondale Formation. Mine information for workings nearby in Vermilion County, Illinois indicate that the Herrin seam ranges from approximately 204-ft. to 251-ft. below the surface, and generally comprises a 4.5 to 10-ft. thick seam, averaging about 6-feet in profile thickness. Exploratory drilling by Sunrise at the proposed Bulldog Mine site indicates that the nominal depth of the target seam is approximately 335-ft. It is our understanding that an anticline in this seam exists just west of the subject site, near the county line. The anticline runs generally north-south, tilted approximately 15-degrees NW-SE.

Current plans for the Bulldog Mine indicate the placement of the primary shaft, tipple and storage to the north/northwest of the planned impoundment, north of CR 800N and east of CR 100E. A rail spur will be developed to the north, connecting with the railroad mainline near Homer, Illinois. The mine operations are expected to utilize modern room and pillar techniques. The underground workings associated with the Bulldog Mine will not extend beneath the proposed refuse impoundment.

Site Soil Profile

Our interpretation of the subsurface conditions is based upon twenty-four (24) soil borings drilled at the approximate locations shown on the Boring Location Map (Figure No. 2) in Appendix “A”. The following discussion is general; for more specific information, please refer to the boring logs presented in Appendix “A”. It should be noted that the dashed stratification lines shown on the soil boring logs indicate approximate transitions between soil types. In-situ stratification changes could occur gradually or at different depths. All depths discussed below refer to depths below the existing ground surface.

Overburden Conditions

The twenty-four (24) borings performed in the area of the proposed coal refuse impoundment were completed in areas that appear to have agricultural land and were covered with topsoil, a surficial layer of material that is a blend of silts, sands, and clays, with varying amounts of organic matter. The topsoil layers were observed to be 6 to 36 inches thick in the borings.

The surficial soils were generally underlain by brown and gray, moist to very moist, medium stiff to stiff, silty clay and/or sandy silty clay, which typically extends to depths between 8 and 22 feet below the existing ground surface; which corresponds to elevations between about 674 feet and 659 feet. The natural moisture contents of these materials range from 14 to 27 percent (%), with an average of about 18 percent (%). The silty clays and sandy silty clays exhibit liquid limits ranging from 19 to 48 percent (%) and plasticity indices varying from 6 to 30 percent (Refer to the chart below for general qualitative indicators for plasticity). These soils have unconfined compressive strengths, as determined by a hand penetrometer (q_p), of 0.5 to 3.0 tons per square foot (tsf). Mechanical laboratory tested unconfined compressive strength (Q_u) of a representative sample of the possible fill material yielded strengths 0.5 to 1.0 tsf. Standard Penetration Test N-values (blow counts) in these materials generally varied from 6 to 14 blows per foot, with an average of about 9 blows per foot.

TABLE NO.1: GENERAL QUALITATIVE INDICATORS FOR PLASTICITY

PLASTICITY INDEX (PI)	DESCRIPTION
0	Non-Plastic
1-5	Slightly Plastic
5-10	Low Plasticity
10-20	Medium Plasticity
20-40	High Plasticity
>40	Very High Plasticity

Below the upper medium stiff to stiff silty clays and/or sandy silty clays, gray, slightly moist to moist, very stiff to hard, silty clays and/or sandy silty clays were generally encountered to the termination of the borings or auger refusal in rock. Termination and auger refusal depths ranged from 30 to 111 feet below the existing ground surface; which corresponds to elevations between about 658 feet and 562 feet. The natural moisture contents of these materials range from 10 to 24 percent (%), with an average of about 13 percent (%). The lower silty clays and sandy silty clays exhibit liquid limits ranging from 19 to 20 percent (%) and plasticity indices varying from 2 to 17 percent (%) (Refer to the chart above for general qualitative indicators for plasticity). These soils have unconfined compressive strengths, as determined by a hand penetrometer (q_p), of 2.5 to greater than 4.5 tsf. Standard Penetration Test N-values in these materials generally varied from 16 blows per foot to 50 blows for 4 inches, with an average of about 24 blows per foot.

It should be recognized that highly plastic clays were encountered within the upper about 5 feet of nine (9) of the twenty-four (24) soil borings. The highly plastic clays exhibit liquid limits ranging from 54 to 65 percent (%) and plasticity indices varying from 31 to 39 percent (%) (Refer to the chart above for general qualitative indicators for plasticity). Additionally, very soft to soft clays were encountered within the upper about 8 in five (5) of the twenty-four (24) soil borings. Standard Penetration Test N-values in these very soft to soft clays varied from 3 to 5 blows per foot.

Rock Conditions

Below the overburden soils, rock was encountered at depths between 43 and 111 feet below the existing ground surface; which corresponds to elevations between about 641 feet and 562 feet (Refer to Table No. 2 below for *"Summary of Initial Rock Depth"*). As can be seen from the rock depths referenced, the rock in this region typically exhibits an irregular surface pattern with potential pinnacles, ridges, channels and/or broken slabs or rock in the soil matrix.

TABLE NO.2: SUMMARY OF INITIAL ROCK DEPTH

BORING NUMBER	APPROXIMATE SURFACE ELEVATION[1] (FEET)	INITIAL ROCK SURFACE	
		DEPTH[2] (FEET)	APPROXIMATE ELEVATION (FEET)
B-18	684.6	68	616.6
B-19	681.3	98	583.3
B-20	684.0	48	636.0
B-21	683.6	43	640.6
B-22	682.6	111	571.6
B-23A	682.2	82	600.2
B-24	618.2	56	562.2

[1]BASED ON TOPOGRAPHICAL MAP PROVIDED BY CLIENT
[2]REFERS TO DEPTH BELOW THE EXISTING GROUND SURFACE

In order to evaluate the quality of rock encountered, rock core sampling was performed in seven (7) of the twenty-four (24) soil borings (B-19 through B-24). The rock encountered at the parcel generally varies between limestone and shale, which is typically light gray to gray in color, highly weathered to weathered, highly fractured and is interbedded with occasional silt and/or clay seams. Based on the recoveries and Rock Quality Designation (RQD) of the core samples, the overall mass quality of the rock was generally "poor" to "fair" (Refer to the *"Rock Quality Chart"* below for a qualitative description of the quality of rock).

TABLE NO.3: ROCK QUALITY CHART

ROCK QUALITY DESIGNATION (RQD %)	ROCK QUALITY
0 to 25	VERY POOR
25 to 50	POOR
50 to 75	FAIR
75 to 90	GOOD
90 to 100	EXCELLENT

It should be noted that the limestone encountered in Boring B-24 was observed to have an approximately 1 foot void between about 57 and 58 feet below the existing ground surface. In addition to a void within the limestone, appreciable "vugs" were also observed. Vugs are solution features or visible pore space within the limestone, which is characteristic of carbonate rocks.

Groundwater

The term groundwater pertains to any water that percolates through the soil found on site. This includes any overland flow that permeates through a given depth of soil, perched water, and water that occurs below the "water table", a zone that remains saturated and water-bearing year round.

Groundwater was observed during drilling in eighteen (18) of the twenty-four (24) soil borings at depths between 6 and 48 feet below the existing ground surface. Immediately after the borings were completed and the augers were removed from the boreholes, water was observed at depths of 6 and 47 feet below the existing ground surface in twenty-two (22) of the soil borings. However, it should be recognized that the groundwater that was observed in Borings B-18, B-19, B-20, B-21, B-22, B-23, B-23A and B-24 was due to the introduction of water to facilitate rock coring in the borings; which obscures the observation. The remaining two (2) borings (B-37 and B-40) were dry at the cave-in depths shown on the boring logs.

It should be recognized that fluctuations in the groundwater level should be expected over time due to variations in rainfall and other environmental or physical factors. The true static groundwater level can only be determined through observations made in cased holes over a long period of time.

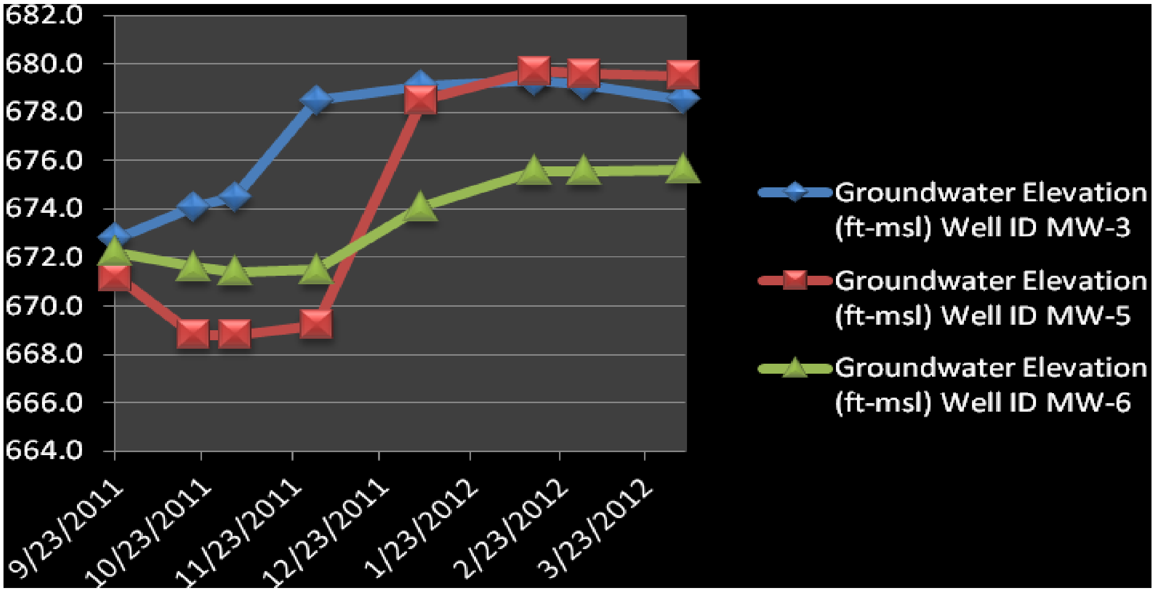
Three (3) monitoring wells were installed in September 2011 at the proposed refuse area parcel. The wells are generally installed at the northwest, southwest and southeast corners of the project parcel, and are given identifications of MW-3, MW-5 and MW-6, respectively. Well logs for these monitoring wells are included in the appendices of this report.

The primary purpose of these monitoring wells is for groundwater quality sampling and testing. However, groundwater elevation data has also been collected during routine sampling efforts. The following table and chart show data for eight (8) months for these monitoring wells:

TABLE NO. 4: GROUNDWATER ELEVATION TABLE

Groundwater Elevation (ft-msl)			
Sample	Well ID		
Date	MW-3	MW-5	MW-6
9/23/2011	672.8	671.2	672.2
10/20/2011	674.1	668.8	671.6
11/3/2011	674.5	668.8	671.4
12/1/2011	678.5	669.2	671.5
1/6/2012	679.1	678.5	674.1
2/14/2012	679.3	679.7	675.6
3/2/2012	679.1	679.6	675.6
4/5/2012	678.5	679.5	675.6

DIAGRAM NO. 1: GROUNDWATER ELEVATION CHART



In addition to the relatively short-term groundwater data from the monitoring wells, soil coloration may provide indications of longer-term variations in groundwater elevations. A gray coloring of soil typically indicates the soil has previously been wet or submerged below water for an extended period of time and therefore subjected to low oxygen levels which in turn removes iron from the soil and brings out the gray color of the soil minerals. Based on the gray coloring of layers and seams observed in the borings performed throughout the parcel, groundwater should be considered to be prevalent between about 10 and 13.5 feet below the existing ground surface.

Laboratory Testing

Representative samples recovered in the borings were selected for testing in the laboratory to evaluate their physical properties and engineering characteristics. Laboratory analyses included visual classifications and the following tests:

- Natural moisture content determinations (ASTM D 2216).
- Unconfined compressive strength (q_u) tests (ASTM D 2166) on select samples and an estimate of the unconfined compressive strength (q_u) of the cohesive soil samples utilizing a calibrated hand penetrometer (q_p).
- Atterberg Limit tests (ASTM D 4318).
- Unit Weight tests (ASTM D 2166).
- Consolidation tests (ASTM D 2435).
- Moisture – Density (Standard Proctor) tests (ASTM D 698).
- Permeabilty tests (ASTM D 5084) on remolded clay samples.
- Consolidated Undrained (CU) Triaxial Compression tests with pore water pressure measurements (ASTM D 4767) on natural soils and remolded clay samples.

The results of the laboratory tests are presented in Appendix B.

4.0 ENGINEERING EVALUATION & DESIGN RECOMMENDATIONS

General

Our geotechnical engineering evaluation of the project included

- Seepage Analysis
- Slope Stability Analysis
- Hydrologic and Hydraulic Analysis

The details and results of these analyses are presented elsewhere in the report under separate sections.

General Geometry & Staging

As indicated previously and shown on the project plans (see Appendix F), the impoundment will be constructed in 5 phases. The impervious compacted clay liner will form the base of the impoundment.

SEEPAGE ANALYSIS

Analyses of steady state seepage through the perimeter embankment slopes were performed for each phases to evaluate the magnitude of potential seepage/piping of the soils within the embankment and to evaluate the potential build-up of pore pressures that could trigger instability within the embankment slopes. The cross-sections representing the critical section of each phase were modeled for the seepage analysis, then subsequently evaluated for slope stability (please refer next section). The numerical seepage model for the impoundment area was developed using SEEP/W 2007, a finite element code tailored for modeling groundwater seepage problems in soil and rock. SEEP/W is distributed by GEOSLOPE International, Ltd, of Calgary, Alberta, Canada (www.geo-slope.com).

For the numerical analysis, each cross section was subdivided into a mesh of elements consisting of first-order quadrilateral and triangular finite elements. For seepage problems, where the primary unknown (hydraulic head) is a scalar quantity, first order elements provide for efficient, effective modeling. Given appropriate hydraulic conductivity properties and applied boundary conditions, the finite element method (as implemented in the SEEP/W code) was then used to simulate steady seepage across the mesh. The total hydraulic head is computed at each nodal location, from which pore water pressures and seepage gradients can be determined.

Steady-state seepage was assumed for the analysis, with static water levels on both the upstream and downstream side of the embankments, where applicable. For boundary conditions, a total head vertical boundary line equal to the pool elevation was input into the model. For this scenario, the hydraulic head at each node was constant with depth and equal to the pool elevation on that side of the embankment. At other locations along the ground surface where potential seepage might occur, a total flux condition was modeled and potential seepage reviewed.

For each cross section (phase) analyzed, a representative subsurface profile was compiled based on boring logs and the soil profiles presented in Appendix A. Soil layer properties were estimated based on available laboratory data and typical values for similar soils. Soil layer properties used in the seepage analysis are summarized in Table 5

Table. 5: Seepage Model Parameters

Soil Type	Saturated k_v (cm/sec)	Volumetric Water Content - Saturated (%)
Native Clayey Soils	1×10^{-5}	45
Embankment Fills - Phase 1 (Compacted Clayey Soils)	1×10^{-5}	45
Compacted Clay Liner	1×10^{-7}	55
Compacted Coarse Refuse	1×10^{-3}	18

Significant engineering judgment is needed to select appropriate hydraulic properties for earth material. Unlike other key properties, hydraulic conductivity can vary over several orders of magnitude for a range of soils, often with substantial anisotropy for seepage in horizontal versus vertical directions. Laboratory test samples often do not represent important variations within a larger soil deposit. The ratio of horizontal hydraulic conductivity (k_h) to vertical hydraulic conductivity (k_v) was estimated based on the known depositional environment of the given material. Details of our seepage analysis are presented in Appendix D.

SLOPE STABILITY ANALYSIS

The slope stability analyses were performed using SLOPE/W computer program. SLOPE/W is distributed by GEOSLOPE International, Ltd, of Calgary, Alberta, Canada (www.geo-slope.com). All of the stability analyses presented in this report were analyzed for static, long-term conditions with steady-state flow parameters. In this study, steady-state pore pressures were obtained from the SEEP/W.

The effective soil strength parameters obtained from the CU triaxial tests were used for the analysis. A series of triaxial tests were conducted on the natural soils and re-molded soils. The parameters from the re-molded soil samples were used to model the Phase 1 embankment section which will constructed using the excavated clayey soils from the impoundment area. Some of these CU triaxial tests are still in progress and we will submit these results once the tests are completed. The completed test results are presented in Appendix B.

Based on the triaxial test results and our experience, we used the following strength parameters for each soil layers in our slope stability analysis.

Table. 6: Soil Strength Parameters for Slope Stability Analysis

Soil Type	Wet Unit Weight (pcf)	Effective Cohesion (c') (psf)	Angle of Internal Friction (ϕ') (deg.)
Natural Clayey Soil Layer 1	120	300	18
Natural Clayey Soil Layer 2	125	350	18
Natural Clayey Soil Layer 3	125	350	22
Compacted Clay Liner	130	500	0
Compacted Embankment Soil (Phase 1)	125	500	10
Coal Refuse	105	0	35

Since the actual coal refuse materials are not available at this time, we used angle of internal friction (ϕ') of 35 degrees and an effective cohesion (c') of 0 pounds per square foot (psf) for the coal refuse that are used to model the embankments for Phases 2 through 5. During the operation of the mine and prior to the construction of the Phase 2 embankments, samples collected from the coal refuse materials should be tested to ensure that the coal refuse has adequate strength (ϕ' is equal or more than 35 degrees). We recommend that adequate samples of the actual coal refusal material be collected within 30 days after the Bulldog Mine facilities are operational and CU triaxial compression tests be performed on these samples to verify the strength parameters used in this evaluation. Based on the test results, if necessary, the slope stability analysis will be re-evaluated using the actual strength parameters for the coal refuse and the underlying soil materials.

Since drains and a drainage blanket will be provided for the proposed embankment sections at each phase, the phreatic surface was modeled based on the SEEP/W results. Details of our slope stability analysis are presented in Appendix D. A summary of the analysis is presented in Table 7. In summary, the calculated factors of safety range from 1.3 to 3.4. Based on our slope stability analyses, the proposed new cross sections for Phases 1 through 5 will have a minimum factor of safety of 1.2 or more.

Table. 7: Summary of Slope Stability Analysis

Analysis Description	Factor of Safety				
	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5
Impoundment Side Normal Pool	2.64	2.84	3.35	3.29	3.30
Land Side Normal Pool	2.11	1.73	1.89	1.87	1.84
Impoundment Side Seismic Stability	2.35	2.69	3.13	2.98	3.06
Land Side Seismic Stability	1.92	1.62	1.80	1.79	1.78
Impoundment Side Seismic Deformation	1.67	1.87	2.17	2.13	2.12
Land Side Seismic Deformation	1.52	1.31	1.45	1.44	1.45

HYDROLOGIC AND HYDRAULIC ANALYSIS

Sunrise Coal, LLC plans to construct a mine waste impoundment structure at the Bulldog Mine. The impoundment will be located in the NE ¼, Section 35, Township 18N, R14W in Vermillion County, Illinois. The proposed impoundment structure will be constructed in five phases. The final dam height will be 75 feet. The storage volume will be 2315 acre-ft at a Phase 5 normal pool elevation of 750.0 ft and 2544 acre-ft at a Phase 5 dam crest elevation of 755 ft. The height and storage capacity of the dam result in it being classified as an intermediate sized structure (17 Ill. Adm. Code 3702.3). The dam will be a rectangular shaped dike impoundment structure and will be built using a downstream method of construction. The surface area will be 43.65 acres at the final normal pool elevation (750.0). The spillway and decant system were designed to meet the state of Illinois Class I (high hazard) criteria (17 Ill. Adm. Code 3702).

Description of Dam and Appurtenant Structures

Description of Dam and Embankment

The Bulldog Mine Impoundment Dam will be constructed in five phases according to the elevation schedule in Table 7. The downstream slope of the Phase I structure will be 4H:1V and the upstream slope will be 3H:1V. All subsequent phases will have 3H:1V upstream and downstream slopes.

Table 8. Normal Pool and Dam Crest Elevations

	Impoundment Pool Elev.	Dam Crest Elev.	Dam Height
Phase I	705	710	30
Phase II	720	725	45
Phase III	735	740	60
Phase IV	745	750	70
Phase V	750	755	75

Description of Principal and Emergency Spillways

At the beginning of Phase I construction, a riprap lined discharge channel, a 36-inch diameter reinforced concrete pipe (RCP), and four manholes will be constructed near the southeast corner of the diked impoundment structure. The four manholes will be constructed at points along the RCP alignment that correspond to the location of the toe of the dam during phases I, II, III, and IV. The RCP will be an ASTM C76 Class III pipe and will be constructed on a concrete cradle. A 2’ x 2’ reinforced concrete inlet will be constructed near the southeast interior of the Phase I impoundment to produce an initial normal pool elevation of 705.0 feet. Water entering the inlet will flow east through a buried 18-inch diameter DR 13.5 HDPE pipe to the manhole at the toe of the dam. The manhole will direct runoff east through the 36-inch diameter RCP to the discharge channel. As the dam is raised in phases, a new inlet structure and HDPE pipe will be constructed and connected to the corresponding manhole. After each phase of construction, the HDPE spillway pipe for the previous phase will be grouted shut with cement grout. A profile of the proposed decant system is shown in Figure 1.

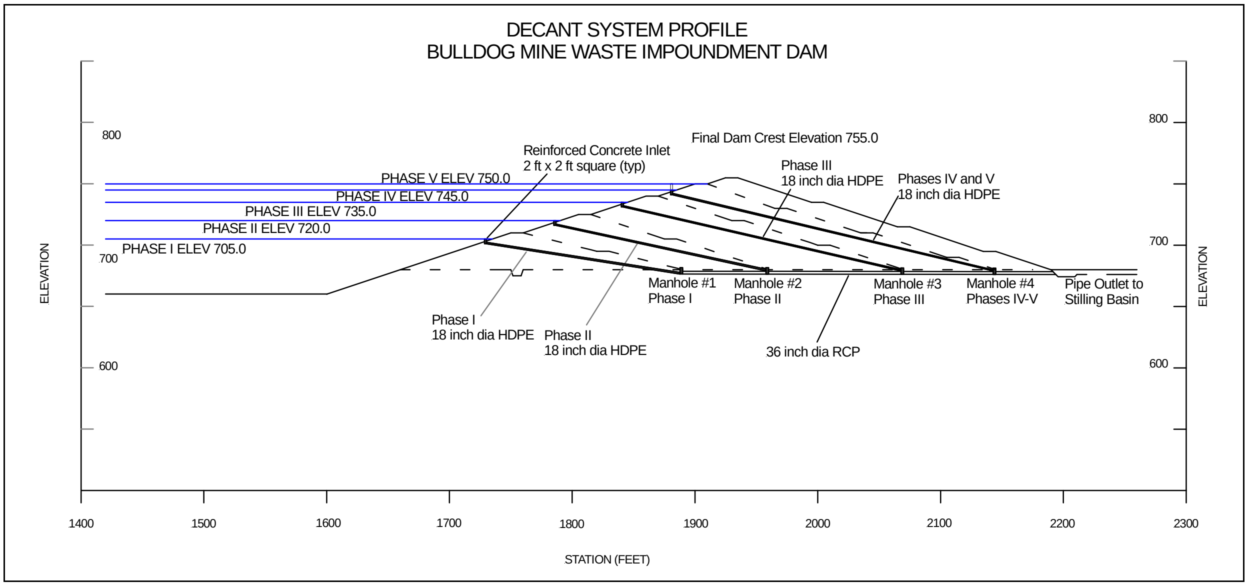


Figure 1. Profile of Decant System for the Bulldog Mine Impoundment Structure

Description and Location of Water Withdrawal Works

There will be no water withdrawal works at the Bulldog Mine Waste Impoundment Dam.

Description of Location of Discharge Channels

As water exits the end of the spillway pipe, it will flow through a 45 degree reinforced concrete flared end section to a 6 ft wide riprap lined open channel east of the dam.

Spillway Capacity

The Bulldog Mine Waste Impoundment Dam will be 75 feet high and retain a mixture of water and mine waste material. The final (Phase V) impoundment size (at elevation 750.0) will be 43.65acres. There is no external source of runoff that flows into the impoundment. Because it is a dike impoundment structure, the only water flowing into the reservoir area is from the rainfall that occurs within the boundary of the dike crest. The parameters used in the hydrologic and hydraulic analysis of the dam, as well as a summary of the data used in the HEC-HMS watershed model, are summarized in the following sections.

Watershed Area

The watershed area will expand as the Bulldog Impoundment dam is raised. The watershed area includes the impoundment area and the dam crest area at each phase of construction. The watershed area will increase from 27.35 acres during Phase I construction to 48.28 acres during Phase V construction.

Phase	Watershed Area
I	27.35 acres
II	33.32 acres
III	39.85 acres
IV	44.95 acres
V	48.28 acres

SCS Runoff Curve Number

The predominant soils in the watershed are Drummer silty clay loam (61%) and Flanagan silt loam (37%). Because the watershed is restricted to the area bounded by the crest of the impoundment dike, surface runoff is rapid. A Runoff Curve Number (CN) of 98 was used in the hydrologic computations.

Time of Concentration

The time of concentration for each phase of construction will be minimal. Rather than compute a time of concentration value, a unit hydrograph duration (D) of 1 minute was selected for use in the Corps of Engineers HEC-HMS model. This corresponds to a time of concentration (T_c) of approximately 7.5 minutes using the NRCS dimensionless unit hydrograph.

$$D = 0.133\,T_c$$

Design Rainfall (U.S. Weather Service, 1978, NOAA, 2012)

The 24 hour duration PMP was used to compute the probable maximum flood. Shorter durations were not analyzed (Illinois DNR).

Rainfall Event	24 hour Rainfall Duration
100-year	6.83 inches
PMP	33.0 inches

Storage in the Reservoir

The Bulldog Mine Waste Impoundment Dam will store approximately 2419 acre-feet of water and mine waste materials at the Phase V normal pool elevation (750.0). The reservoir area versus elevation data for each phase of construction is shown in Table 9 and Figure 2.

Table 9. Storage Data for the Bulldog Mine Waste Impoundment, Phases I-V

Elevation	Area	Elevation	Area
	(Acres)		(Acres)
660.0	11.69	710.0	26.33
665.0	12.77	715.0	28.93
670.0	13.89	720.0	30.54
675.0	15.05	725.0	32.20
680.0	16.25	730.0	35.05
685.0	18.34	735.0	36.82
690.0	19.66	740.0	38.62
695.0	21.01	745.0	41.73
700.0	23.36	750.0	43.65
705.0	24.82	755.0	46.54

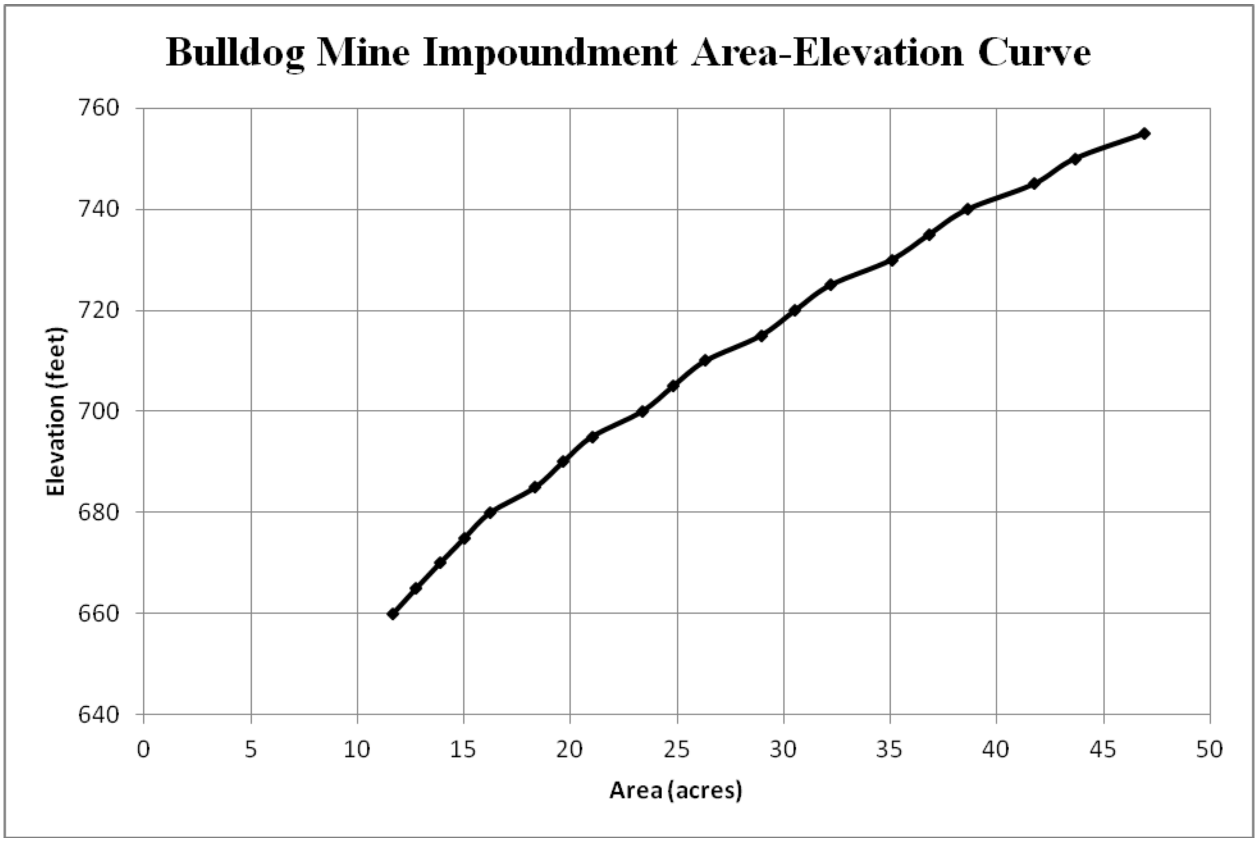


Figure 2. Area versus Elevation Curve for the Bulldog Mine Impoundment

The area versus elevation data was input directly into the Corps of Engineers HEC-HMS model as paired data (Hydrologic Engineering Center, 2008). HEC-HMS uses the conic method to determine stage-storage data for the impoundment. The Modified Puls method was used to route the inflow hydrograph through the impoundment and out the decant pipe.

Spillway Rating Data

For each phase of construction, the spillway will consist of a 2 ft x 2 ft reinforced concrete drop inlet structure that is connected to an 18-inch diameter DR 13.5 HDPE pipe. The spillway inlet was rated for weir, orifice, and full pipe flow, and the outlet pipe was sized to insure that it flowed no more than 50% full during the 100-year rainfall event and 75% full during the 100% PMF. The spillway rating curve is summarized in Table 10 and Figure 3. Orifice flow controlled the discharge through the reinforced concrete drop inlet structure for all five phases of construction.

Table 10. Spillway Rating Data for weir, orifice, and full pipe flow (Phase V)

Elevation	H_1	Q_w	Q_o	H_2	Q_{FP}	Q_{total}
750.0	0.0	0.0	0.0	70.5	44.5	0.0
750.5	0.5	8.8	13.8	71.0	44.6	8.8
751.0	1.0	24.8	19.6	71.5	44.8	19.6
751.5	1.5	45.6	24.0	72.0	44.9	24.0
752.0	2.0	70.1	27.7	72.5	45.1	27.7
752.5	2.5	98.0	31.0	73.0	45.3	31.0
753.0	3.0	128.9	33.9	73.5	45.4	33.9
753.5	3.5	162.4	36.6	74.0	45.6	36.6
754.0	4.0	198.4	39.2	74.5	45.7	39.2
754.5	4.5	236.7	41.5	75.0	45.9	41.5
755.0	5.0	277.3	43.8	75.5	46.0	43.8

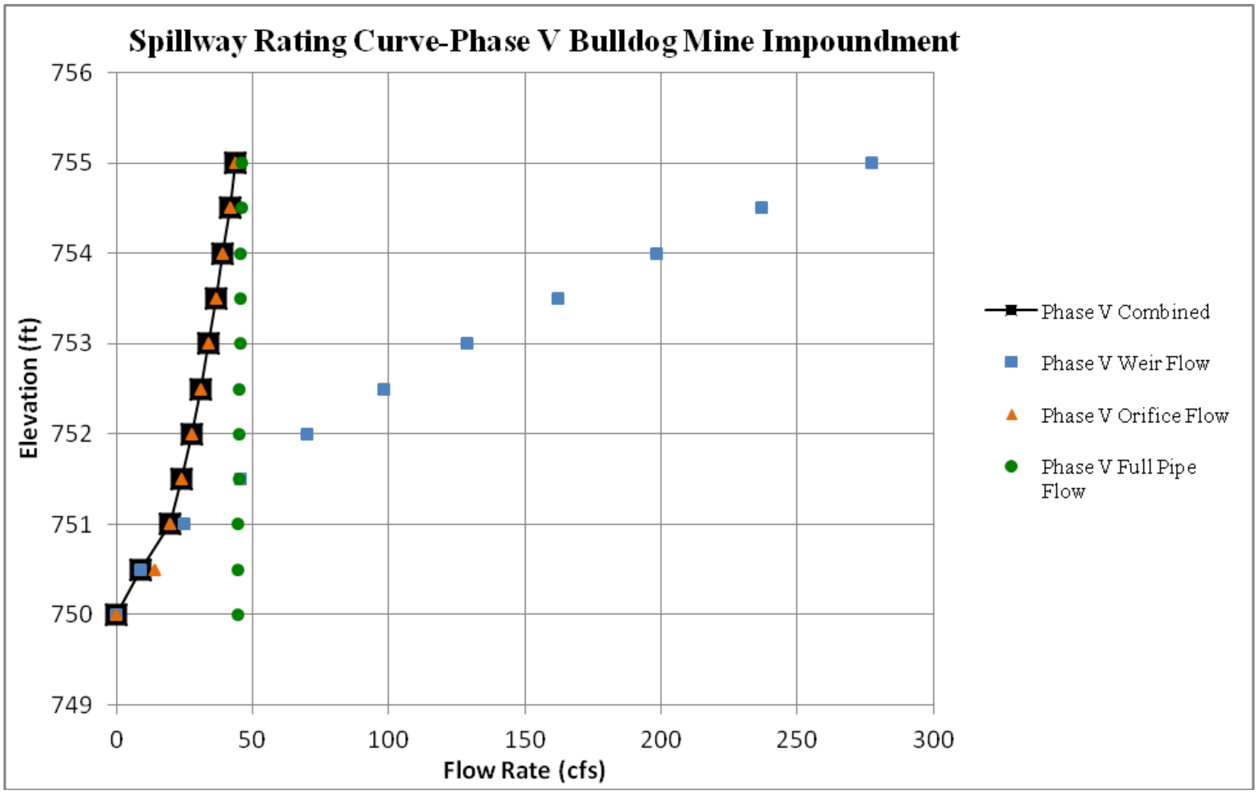


Figure 3. Spillway Rating Curve for the Phase V Bulldog Mine Impoundment Structure

Inflow Hydrograph

A 1-minute SCS Dimensionless Unit Hydrograph was selected for use in modeling rainfall-runoff in the watershed. The 24-hour PMP was distributed using Huff's Third Quartile Distribution (Huff, 1990).

Outflow Hydrograph

The Modified Puls reservoir routing method was utilized to route the inflow hydrograph through the impoundment and out the decant system. An overtopping analysis of the Bulldog Mine Impoundment Dam was conducted using the HEC-HMS model for PMP and 100-year storms of 24-four hour duration. The HEC-HMS results indicate that the impoundment structure will have more than 2.8 feet of freeboard during the probable maximum flood (PMF) for all five phases of construction. All stored floodwaters will exit the impoundment in less than nine days.

The PMF peak inflow and peak outflow during all five phases of construction are summarized in Table 11.

Table 11. Summary of Phases I-V PMF flow rates at the Bulldog Mine Impoundment Structure

	Q_{peak} Inflow (cfs)	**Q_{peak} Outflow** (cfs)	**Max Reservoir Elev** (feet)	**Dam Crest Elev** (feet)
Phase I	98.6	26.4	706.8	710.0
Phase II	120.1	27.2	721.9	725.0
Phase III	143.6	28.0	737.0	740.0
Phase IV	162.0	28.5	747.1	750.0
Phase V	174.0	29.0	752.2	755.0

PMF hydrographs and 100-year runoff hydrographs are included in Appendix C

Energy Dissipation Structure

The flow velocity in the 18-inch diameter HDPE spillway pipe will range from 33 fps (Phase I) to 39 fps (Phase V) during the PMF. The mass flux in the pipe will be approximately 56.0 slugs/sec during the Phase V PMF. The jet exiting the HDPE pipe will produce a momentum force of 2172 pounds during the PMF and 367 pounds during the 100-year event. HDPE pipe will discharge into a reinforced concrete manhole and the jet will strike the east wall of the manhole. The energy from the jet will be dissipated in the manhole and will flow out a 36-inch diameter RCP collector pipe. The maximum flow through the HDPE pipe during the PMF is 29.0 cfs and the maximum capacity of the RCP is 36.6 cfs. The flow depth in the RCP collection pipe will be 24.8 inches (70% full) during the PMF.

Decant System Outlet Structure

During the PMF, water will flow in the 36-inch diameter RCP collector pipe at a velocity of approximately 5.8 fps. This corresponds to a Froude number of 0.71 which indicates that subcritical flow conditions will exist in the RCP. A flared end section will be constructed at the end of the RCP to further dissipate energy and lower the velocity. From the flared end section, water will discharge into a 6 ft wide riprap lined trapezoidal shaped open channel. The channel will have 3H:1V side slopes. A water surface profile was computed for the discharge channel using the Corps of Engineers HEC-RAS model and a maximum PMF flow rate of 29.0 cfs. The results indicate that the maximum velocity in the riprap lined channel will be 1.72 fps at a maximum channel depth of 1.57 feet. Subcritical flow conditions will exist in the channel during the PMF. A HEC-RAS printout for the design flow rate is shown in Appendix C.

Alignment of the Spillway Discharge Channel

The spillway discharge channel is located southeast of the impoundment structure and will direct runoff to the east. The location and orientation of the spillway will not result in any erosion to the impoundment structure.

DESIGN RECOMMENDATIONS

Erosion Control

The surfaces of the proposed dam will need to be protected from elements such as wind, frost, rainfall runoff, and waves. Provided below are recommendations for erosion control methods for protection of the proposed upstream slope, downstream slope, crest and downstream areas. However, care will have to be taken during construction with the placement of the slope protection and bedding as they intersect the crest. The thickness of the slope protection may have to be varied as it approaches the crest in order to allow for proper matching of the slopes with the crest surface elevation.

Impoundment Slope Face

A 5 feet thick compacted clay layer should be placed along the impoundment embankment slope for the Phase 2 through 5 to minimize the seepage through the embankments.

If necessary, riprap protection could be utilized on the up-stream embankment. The riprap should consist of a heterogeneous mixture (large to small) of irregular shaped stone underlain by a suitable granular filter layer. The gradation of the riprap should be determined such that the maximum size and weight of the stone is suitable to dissipate the force of the maximum predicted wave action. Prior to the installation of any riprap protection, the durability of the riprap should be determined by appropriate testing procedures. The riprap protection should extend from the crest of the dam to a minimum of 3 feet below the lowest anticipated pool level.

Downstream Embankment Slope Face

It is our understanding that the construction of the embankments for this impoundment will be an ongoing process as coarse refuse is produced from coal production. In essence, materials will be transported from the mine tipple and placed directly into the new dam structures. In this regard the slopes and crest elements will be continually worked, maintained and covered with new embankment materials. Proper maintenance of the constructed sections must be undertaken with vigilance and care to insure that erosion, surficial slips or other degradation do not occur as the result of exposure and weathering of the materials. <u>If construction will cease for an appreciable amount of time, or if maintenance cannot be applied to prevent such degredation, the slopes must receive erosion control systems such as blankets, seeding, etc</u>. Failure to adequately maintain the exposed surfaces of the dam will reduce stability and overall factor of safety built into the structure.

Upon completion of the final stage and/or for the purpose of reclamation of the site, the embankment slopes should be properly seeded with adequate erosion control measures so that any erosion or softening of the slope surface can be avoided. The slopes may be hydro seeded with erosion control blankets or equivalent such that the slope will have adequate grass cover to minimize erosion and isolated small areas of soft spots. The crest of the embankment should be sloped towards the impoundment side so that surface water can be diverted away from the land side. Prior to the placement of sod or seeding of the downstream slope, a minimum 12-inch thick layer of suitable topsoil should be placed over at least 36-inches of suitable subsoil over the embankment as a bedding material in which the vegetation can establish roots, as well as providing a protective cover until establishment of adequate vegetation. The subsoil and topsoil for this purpose is to be stockpiled in the margins surrounding the impoundment. These activities will ultimately serve the reclamation requirements set forth in the operating permit.

Impoundment Crest

The crest should have a surface cover which can adequately protect against wave splash, rainfall, wind, and frost; along with potential traffic if the crest is to be traversed by vehicles (including small all-terrain vehicles). We recommend that a minimum 12 inch thick layer of topsoil and a vegetative cover (sod or planted with native grasses).

Key Trench or Partial Cutoff Trench and Embankment Keys

A key trench or partial cutoff trench (approximately 5 feet in depth, with a bottom width of at least 20 feet) is recommended to be utilized in the design of the embankment in Phase 1 in order to provide additional stability to the impoundment embankments, as well as reducing the potential seepage flow underneath the embankments by increasing the vertical path of the seepage.

In addition, embankment keys are recommended for Phase 2 and Phase 5. These embankment keys are minimum 3 feet in depth with a bottom width of at least 10 feet. The design of the key trench and embankment keys are drawings included in Appendix F.

Horizontal Clay Liner (Cutoff Blanket)

Due to regulations specified by MSHA, the use of a horizontal impervious cutoff blanket (clay liners) is recommended. The horizontal impervious cutoff blanket should help increase the length of the seepage path in the pervious foundation; therefore, reducing the potential seepage flow and increasing the storage capacity ability of the impoundment.

We recommend that the clay liner should not be less than 4 feet in thickness. The impervious clay liner should extend from the impoundment as well as under the embankments. Alternatively, the amount of on-site clay soils to be utilized for construction of the impervious blanket may be reduced by the use of geosynthetic clay liners (GCL) in conjunction with a portion of the on-site clay materials.

Toe Drains and Drainage

To collect and control the ground water within the embankment, we recommend the installation of a drainage blanket or chimney drain and toe drain within the downstream portion of the embankments. The drainage blanket would then need to be connected to a toe drain at the base of the land side embankment slopes and should be discharged to a suitable location. We also recommend horizontal drainage blankets. Schematic details of the drainage blanket and toe drain are presented in Appendix F.

5.0 CONSTRUCTION CONSIDERATIONS & RECOMMENDATIONS

Preparation of Impoundment Embankment & Impoundment Areas

The areas to be occupied by the proposed embankment and ancillary structures (i.e. primary spillway, auxiliary spillway, etc…) should be cleared of all trees, stumps, exposed roots, brush, loose surficial soil or “topsoil, relatively soft material, relatively wet soils, deleterious material, and soils that exhibit a high organic content. Additionally, we recommend that the trees and brush should also be cleared from within 25 feet of any portion of the proposed embankment and ancillary structures.

Foundation Recommendations

Care must be exercised during grading and fill placement operations. The combination of heavy construction equipment traffic and excess surface moisture can cause pumping and deterioration of the near surface soils. The severity of this potential problem depends to a great extent on the weather conditions prevailing during construction. The contractor must exercise discretion when selecting equipment sizes and also make a concerted effort to control construction traffic and surface water while the subgrade soils are exposed. If such problems do arise, the operations in the affected area should be halted and the *Patriot* representative contacted to evaluate the condition.

Excavation slopes should be maintained within all requirements set-forth by the Occupational

Safety and Health Standards (OSHA), but specifically Section 1926 Subpart "P" - *"Excavations"*. For determination of sloping and benching of excavations based on OSHA Soil Classification, we recommend that Type "C" parameters be utilized. We recommend that any surcharge fill or heavy equipment be kept at least 5 feet away from the edge of the excavation.

Additionally, surface water diversion and groundwater dewatering should be anticipated during construction.

Earth Embankment Foundation
Upon completion of the subgrade preparation and key trench excavation, but prior to the placement of any embankment fill, a *Patriot* representative should check the exposed subgrade to confirm that a bearing surface of adequate strength has been reached. Based on the proposed conceptual dam design, the depth and width of the designated key trench or partial cutoff trench should allow for the removal of the majority of the unsuitable soils (i.e. soft, loose and/or organic) which were encountered in the borings observed throughout the proposed dam alignment. However, some additional undercutting of unsuitable soils may be required in isolated locations in order to obtain adequate support soils.

Surface Water Diversion
During construction, appropriate measures should be taken to route surface water flows from the drainage basin in a manner in which the flows will not impede construction, along with preventing the disturbance or weakening of the foundation soils for the embankment. When selecting the method of diversion, consideration will also need to be given to the flood potential of the drainage basin and any potential impacts the diversion could have downstream of the proposed dam.

Groundwater and Dewatering
Groundwater was observed during our field activities at depths between 6 and 47 feet below the existing ground surface

Based on our groundwater observations during our field activities, groundwater infiltration should be expected in the excavations. Therefore, because it will be important that the excavations along with the placement of embankment fill material be completed under dry conditions, it should be anticipated that the use of conventional dewatering methods such as gravity drainage and pumping from sumps to dewater the excavations will be necessary on this project. Considerations may also need to be given to the construction of temporary cofferdams outside of the limits of the excavations to help isolate and help control groundwater seepage. It should be recognized that the extent of dewatering and the type of dewatering methods necessary for this project may only be adequately determined during the time of construction.

Material Specifications
The following sections identify the recommended material types, minimum compaction requirements, moisture control requirements, and minimum testing requirements for the proposed embankment, along with including recommendations for suitable drainage blanket materials, filter materials encompassing the proposed toe drain, and the impervious blanket material. Additionally, recommendations are also provided below for obtaining adequate bondings between subsequent lifts or adjacent dissimilar materials.

Impervious Clay Liner
The materials to be utilized for the construction of the impervious clay liner should be clean and free of organic material, debris, deleterious materials and frozen soils. The use of a relatively impervious homogeneous soil, with a permeability characteristic of 1×10^{-6} centimeters per second ($^{cm}/_{sec}$) or slower, would be the most desirable. Provided that a suitable amount of homogeneous

material is available, a fine-grained (cohesive) soil (more than 50 percent (%) of the soil by weight passing the No. 200 sieve) with liquid limits ranging between 30 and 50 percent (%) and plasticity indices ranging between 10 to 20 percent (%) would be recommended. Avoidance of highly plastic clays (liquid limit above 50 and plastic index above 20) is recommended.

In general, the clay soils encountered within the proposed impoundment area are suitable for use for the construction of the clay liner. Based on laboratory testing, the shallow clay soils encountered within the borrow area have liquid limits (29 to 39 percent (%)) and plastic limits (17 to 19 percent (%)) within the recommended range provided above, and have permeability characteristics slower than the recommended minimum ($1x10^{-7}$ to $9.2x10^{-8}$ centimeters per second ($^{cm}/_{sec}$)).

However, some of the clays from the borrow area are expected to be about 4 to 18 percent wetter (%) than the optimum moisture content; determined by laboratory testing at 12 percent (%). Therefore, scarifying and drying of these soils may be needed to achieve adequate compaction of portions of the borrow clay materials.

Geosynthetic Clay Liners (GCL)
In order to reduce the amount of on-site clay soils, or potentially suitable clays from an off-site borrow source, necessary for construction of the proposed upstream pervious blanket, the use of geosynthetic clay liners (GCL) in conjunction with a portion of the on-site or off-site borrow materials may be an alternative. Geosynthetic Clay Liners typically consist of the combination of geotextiles encasing a layer of bentonite. The bentonite has a high swell potential and low permeability, which provides for an adequate liner.

Patriot recommends that if geosynthetic clay liners (GCL) are chosen to be utilized for the referenced project, the Client should retain a specialty firm (such as CETCO) qualified to supply, design, install and warrant the performance of an appropriate liner which can provide a permeability of $1x10^{-6}$ centimeters per second ($^{cm}/_{sec}$) or slower. However, do to the anticipated hydrostatic pressure from an approximately 18 feet head of water or greater, we recommend that a minimum of 1.5 feet of the on-site or off-site borrow clay materials be utilized in conjunction with the geosynthetic clay liners (GCL) in order to increase the thickness of the impervious blanket.

Fill Placement Control
The placement and gradation of the embankment and upstream blanket fill materials shall be such that the materials are free of lenses, pockets, streaks, voids or layers of material differing substantially in texture, gradation, or water content from surrounding material. We recommend that the embankment and upstream blanket fill materials should be compacted to a dry density of at least 98 percent (%) of the Standard Proctor maximum dry density.

The embankment fill materials shall be placed and compacted in layers not exceeding eight (8) inches in loose thickness (the loose lift thickness should be reduced to 6 inches when utilizing small hand compactors), and within the range of 0 to 3 percentage (%) points above the optimum moisture content value. All fill placement should be monitored by a *Patriot* representative. Each lift should be tested for proper compaction at a frequency of at least one (1) test every 5,000 square feet (ft^2) per lift for the dam embankment and at a frequency of at least one (1) test every 10,000 square feet (ft^2) per lift for the upstream blanket areas.

Additionally, we recommend that fill material placed within close proximity and directly next to or over the proposed principal spillway pipe should be compacted with a hand compactor. The operation of equipment over the structure shall be in accordance with the culvert manufacturer recommendations. In the absence of specific recommendations, we recommend that the when the level of fill reaches the top of the structure, two (2) lifts should be carefully spread and hand compacted over the structure without traversing the structure with heavy equipment.

Bonding of Fill Materials
In order to achieve proper bonding between layers of soil during the construction of the proposed earth embankment, the existing foundation soils or recently placed fill material may need to be moistened, scarified and/or re-compacted. Additionally, benching of existing foundation soils and new embankment fill material will be required at the abutments. In general, we recommend that following requirements be utilized for obtaining proper bonding between soils.

Prior to the placement of the first layer of embankment fill on the foundation soils, after stripping of any vegetation, the upper 12 inches of the surface of the foundations soils, upon which the new embankment will be constructed, should be scarified and compacted to a dry density of at least 98 percent (%) of the Standard Proctor maximum dry density (ASTM D-698). Furthermore, depending on the amount of time lapsed between the placement of a subsequent lift, scarification and re-compaction of the recently placed embankment material may also be required. In either case, moistening of the existing foundation soils or recently placed fill materials may also be required to obtain adequate bonding.

During Phase 2 through 5, in order to reduce the potential for a zone of weakness to form between the coarse refuse materials and clayey fills along the upstream slope, as well as to reduce the seepage, the interface should be benched. Benching of the interface at a 4:1 gradient should be suitable, though we recommend that vertical cuts not exceed more than 3 feet in height.

APPENDICES:

Appendix A:	**FIELD INVESTIGATIONAL PROCEDURES** Site Vicinity Map (Figure No. 1) Boring Location Map (Figure No. 2) Boring Logs Monitoring Well Logs Boring Log Key Unified Soil Classification System (USCS)
Appendix B:	**LABORATORY TEST DATA**
Appendix C:	**HYDROLOGIC AND HYDRAULIC ANALYSIS**
Appendix D:	**SEEPAGE ANALYSIS**
Appendix E:	**SLOPE STABILITY ANALYSIS**
Appendix F:	**DRAWINGS**
Appendix G:	General Qualifications Standard Clause for Unanticipated Subsurface Conditions

APPENDIX A

VICINITY MAP
(FIGURE NO. 1)

BORING LOCATION MAP
(FIGURE NO. 2)

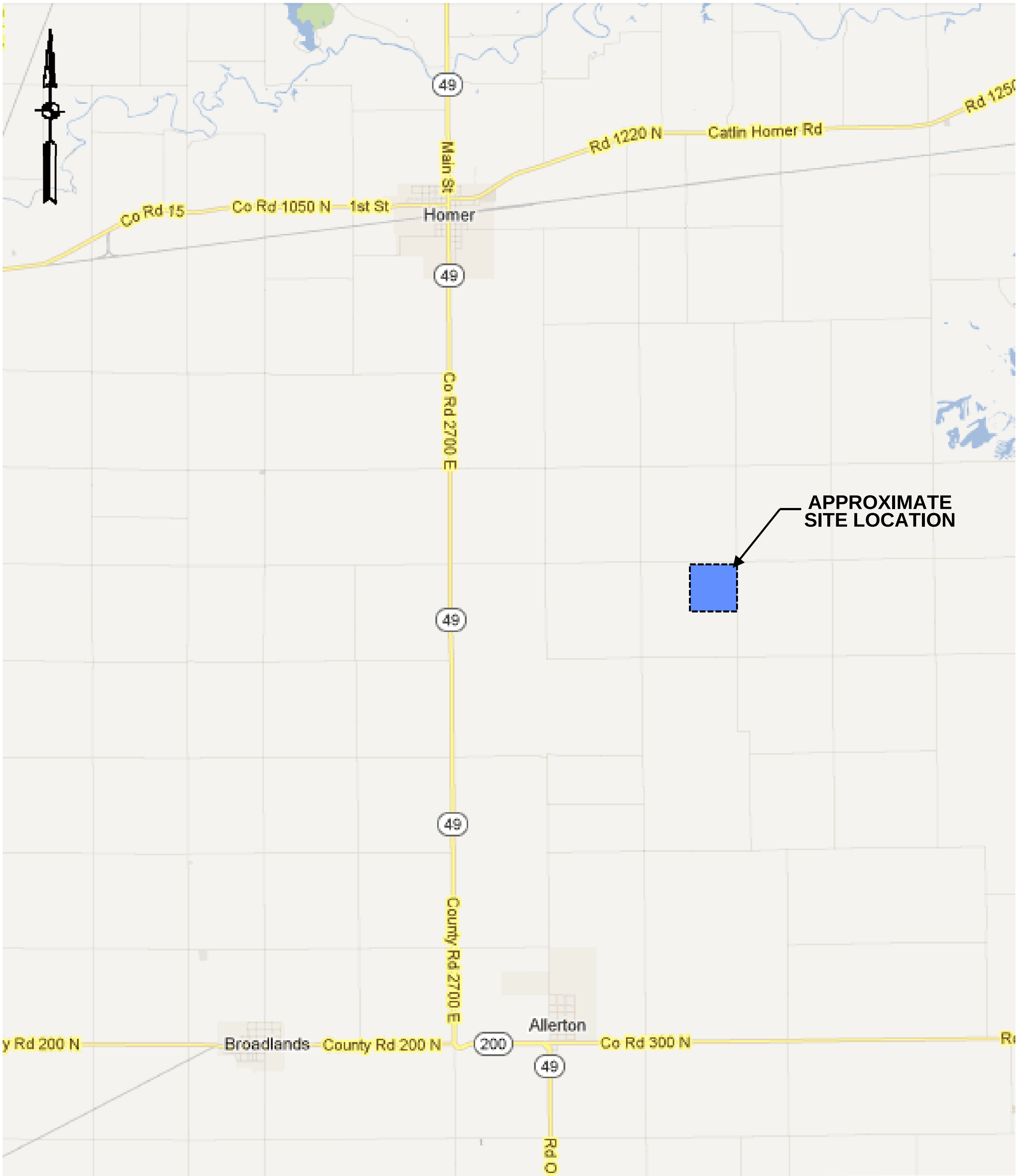
BORING LOGS

MONITORING WELL LOGS

BORING LOG KEY

UNIFIED SOIL CLASSIFICATION SYSTEM
(USCS)

VICINITY MAP
(FIGURE NO. 1)



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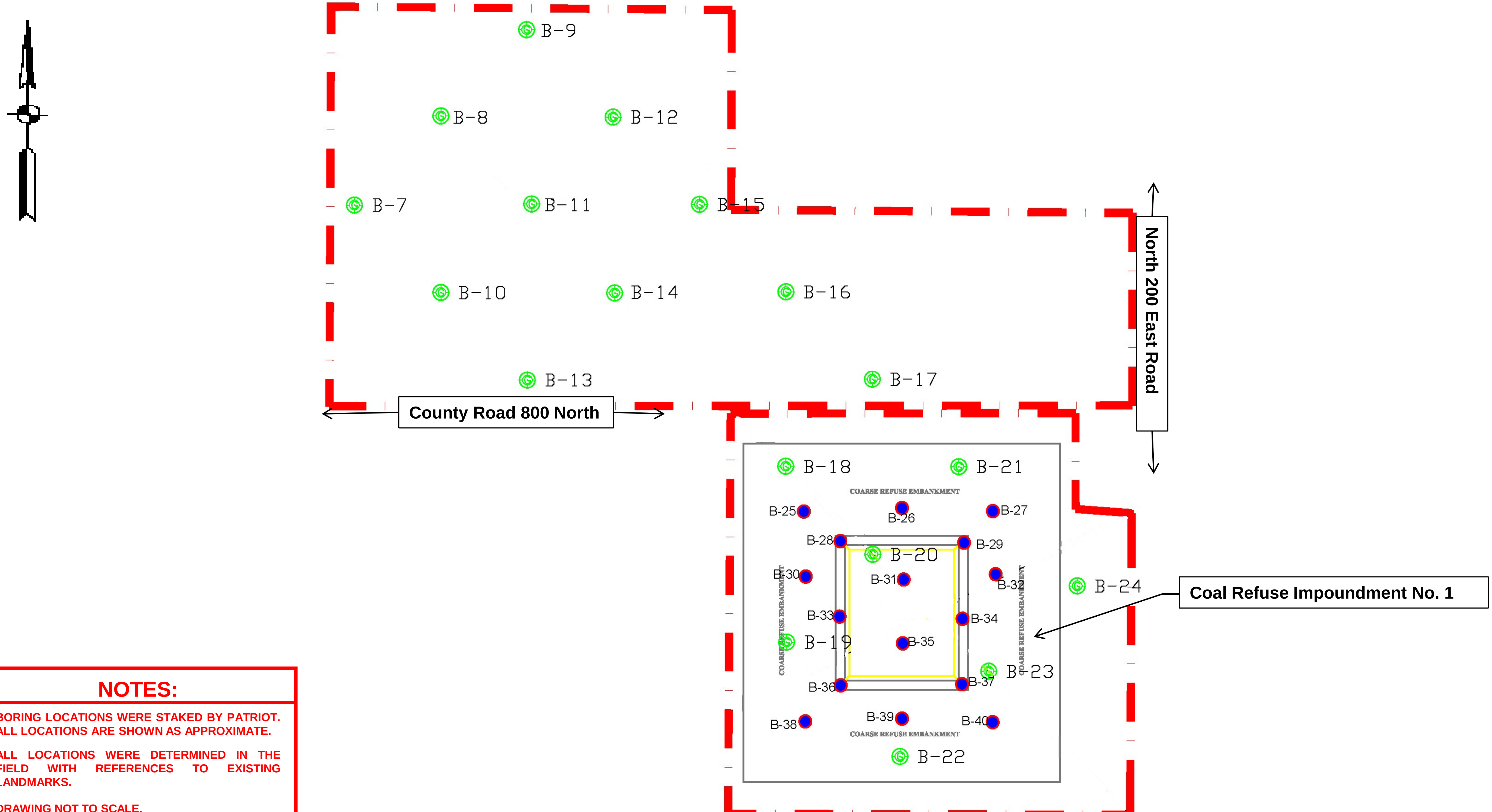
Indianapolis, Indiana 46250

Site Vicinity Map
Coal Refuse Impoundment No. 1
Bulldog Mine
Allerton-Homer, Illinois

Job No.	2-11-0383	**Figure**	1

BORING LOCATION MAP
(FIGURE NO. 2)



NOTES:

BORING LOCATIONS WERE STAKED BY PATRIOT. ALL LOCATIONS ARE SHOWN AS APPROXIMATE.

ALL LOCATIONS WERE DETERMINED IN THE FIELD WITH REFERENCES TO EXISTING LANDMARKS.

DRAWING NOT TO SCALE.

PATRIOT ENGINEERING
and Environmental, Inc.
Indianapolis, Indiana 46250

Boring Location Map
Coal Refuse Impoundment No. 1
Bulldog Mine
Allerton-Homer, Illinois

Job No.	2-11-0383	**Figure**	2

BORING LOGS

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LOG OF BORING B-18

Coal Refuse Impoundment No. 1
Bulldog Mine
Allerton - Homer, Illinois

Client Name	: Sunrise Coal, LLC	Driller	: Gary Taylor
Project Number	: 2-11-0383	Sampling	: Splitspoon; NQ core
Logged By	: T. Govert	Weather	: Mostly Cloudy, 55F
Start Date	: 11/14/11	Latitude	: 39.9810531
Drilling Method	: HSA	Longitude	: -87.9089755

Water Levels
▼ During Drilling: Dry
▽ After Completion: 15 feet (Influenced by Coring)
◆ After 24-hours:

Surf. Elev. 684.6

Depth in Feet	USCS	DESCRIPTION
0		TOPSOIL (10")
	CL	Tan & Brown Mottled, moist, medium stiff to stiff, SILTY CLAY
	CL	Light Brown, slightly moist, stiff, SILTY CLAY with trace fine sand
	CL	Light Brown, moist, stiff to very stiff, SILTY CLAY with trace to a little sand
	ML	Gray, slightly moist, very stiff to hard, CLAYEY SILT with trace sand
	GC	Gray, moist, medium dense, CLAYEY GRAVEL with trace sand
	CL	Gray, moist, very stiff to hard, SILTY CLAY with trace sand and trace small gravel
	CL	Bluish Gray, slightly moist, hard, SILTY CLAY

Samples	Rec %	SPT Results	Qp tsf	w %	REMARKS
1	100	4/5/5			
2	100	5/6/5			
3	67	5/5/6	1.75		
4	100	4/5/7	3.0		
5	100	9/8/9	>4.5		
6	67	9/10/10			
7	100	6/7/10	>4.5		
8	100	9/11/12	4.5		
9	100	9/7/9			
10	100	8/9/13	4.5		
11	100	12/15/17	>4.5		
12	100	16/15/18	>4.5		

Depth scale (Feet): 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50
Elevation scale: 684, 679, 674, 669, 664, 659, 654, 649, 644, 639

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LOG OF BORING B-18

Coal Refuse Impoundment No. 1
Bulldog Mine
Allerton - Homer, Illinois

Client Name	: Sunrise Coal, LLC	Driller	: Gary Taylor
Project Number	: 2-11-0383	Sampling	: Splitspoon; NQ core
Logged By	: T. Govert	Weather	: Mostly Cloudy, 55F
Start Date	: 11/14/11	Latitude	: 39.9810531
Drilling Method	: HSA	Longitude	: -87.9089755

Water Levels
- During Drilling: Dry
- After Completion: 15 feet (Influenced by Coring)
- After 24-hours:

Depth in Feet	Surf. Elev. 684.6	Water Level	USCS	DESCRIPTION	Samples	Rec %	SPT Results	Qp tsf	w %	REMARKS
50	634		CL	Bluish Gray, slightly moist, hard, SILTY CLAY						Boring caved to 51 feet upon auger removal.
55	629		ML	Gray, slightly moist, hard, CLAYEY SILT with trace sand	13	100	18/33/50-5"	>4.5		
60	624				14	100	20/27/31	>4.5		
65	619		CL	Bluish Gray, slightly moist, very stiff to hard, SILTY CLAY	15	100	11/17/18	3.5		
70	614		LS	Light Gray, heavily fractured, weathered, LIMESTONE	16	85				Auger refusal encountered at 68 feet. Sample No. 16: Rock cored from 68 to 78 feet Rock Quality Designation: RQD = 56%
75	609									
80	604			Boring terminated at 78 feet.						
85	599									
90	594									
95	589									
100										

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LOG OF BORING B-19

Coal Refuse Impoundment No. 1
Bulldog Mine
Allerton - Homer, Illinois

Client Name	: Sunrise Coal, LLC	Driller	: Gary Taylor
Project Number	: 2-11-0383	Sampling	: Splitspoon; NQ core
Logged By	: T. Govert	Weather	: Mostly Cloudy, 55F
Start Date	: 11/15/11	Latitude	: 39.9779168
Drilling Method	: HSA	Longitude	: -87.9089784

Water Levels
- During Drilling: Dry
- After Completion: 11feet (Influenced by Coring)
- After 24-hours:

Depth in Feet	Surf. Elev. 681.3	Water Level	USCS	GRAPHIC	DESCRIPTION	Samples	Rec %	SPT Results	Qp tsf	w %	REMARKS
0	681				TOPSOIL (30")	1	56	3/3/4			
			CL		Grayish Tan, moist, medium stiff to stiff, SILTY CLAY	2	22	3/3/3	1.75		
5	676		CL		Tan, very moist, medium stiff to stiff, SILTY CLAY with trace sand	3	100	3/3/4	1.5		
						4	100	3/5/5	2.0		
10	671										
			CL		Gray, moist, medium stiff to stiff, SANDY SILTY CLAY						
15	666					5	78	5/4/5	1.25		
20	661					6	100	4/5/7	3.0		
			ML		Gray, moist, medium dense, SANDY SILT with trace clay						
25	656					7	100	8/9/11			
			CL		Gray, slightly moist, stiff to very stiff, SILTY CLAY with trace sand						
30	651					8	100	4/5/8	2.5		
			CL		Brown to Gray, slightly moist, hard, SANDY SILTY CLAY with trace gravel						
35	646					9	0	50-5"			
40	641					10	22	13/14/16	>4.5		
45	636					11	100	8/14/22	>4.5		
50						12	100	10/16/24	>4.5		

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LOG OF BORING B-19

Coal Refuse Impoundment No. 1
Bulldog Mine
Allerton - Homer, Illinois

Client Name	: Sunrise Coal, LLC	Driller	: Gary Taylor
Project Number	: 2-11-0383	Sampling	: Splitspoon; NQ core
Logged By	: T. Govert	Weather	: Mostly Cloudy, 55F
Start Date	: 11/15/11	Latitude	: 39.9779168
Drilling Method	: HSA	Longitude	: -87.9089784

Water Levels
- During Drilling: Dry
- After Completion: 11feet (Influenced by Coring)
- After 24-hours:

Depth in Feet	Surf. Elev. 681.3	Water Level	USCS	GRAPHIC	DESCRIPTION	Samples	Rec %	SPT Results	Qp tsf	w %	REMARKS
50	631		CL		Brown to Gray, slightly moist, hard, SANDY SILTY CLAY with trace gravel						
55	626					13	0	16/14/17			
60	621					14	33	11/14/15	4.5		
65	616					15	100	9/9/17	4.25		
70	611					16	67	8/11/17	4.0		
75	606					17	67	22/17/28	4.5		Boring caved to 72 feet upon auger removal.
80	601		ML		Gray, moist, very stiff to hard, CLAYEY SILT with trace peat inclusions	18	78	11/15/19	3.75		
85	596					19	0	10/11/14			
90	591		CL		Gray, moist, very stiff, SILTY CLAY with trace fine sand	20	100	10/12/17	3.25		
95	586					21	100	8/17/22	3.0		
100			SH		Gray, heavily fractured, weathered SHALE with interbedded clay and silt seams	22	100				Auger refusal encountered at 98 feet.

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LOG OF BORING B-19

Coal Refuse Impoundment No. 1
Bulldog Mine
Allerton - Homer, Illinois

Client Name	: Sunrise Coal, LLC	Driller	: Gary Taylor
Project Number	: 2-11-0383	Sampling	: Splitspoon; NQ core
Logged By	: T. Govert	Weather	: Mostly Cloudy, 55F
Start Date	: 11/15/11	Latitude	: 39.9779168
Drilling Method	: HSA	Longitude	: -87.9089784

Water Levels
▼ During Drilling: Dry
▽ After Completion: 11feet (Influenced by Coring)
◆ After 24-hours:

Depth in Feet	Surf. Elev. 681.3	Water Level	USCS	GRAPHIC	DESCRIPTION	Samples	Rec %	SPT Results	Qp tsf	w %	REMARKS
100	581		SH		Gray, heavily fractured, weathered SHALE with interbedded clay and silt seams	22	100				Sample No. 22: Rock cored from 98 to 108 feet. Rock Quality Designation: RQD = 71%
105	576										
110	571				Boring terminated at 108 feet.						
115	566										
120	561										
125	556										
130	551										
135	546										
140	541										
145	536										
150											

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LOG OF BORING B-20

Coal Refuse Impoundment No. 1
Bulldog Mine
Allerton - Homer, Illinois

Client Name	: Sunrise Coal, LLC	Driller	: Gary Taylor
Project Number	: 2-11-0383	Sampling	: Splitspoon; NQ core
Logged By	: T. Govert	Weather	: Mostly Sunny, 60F
Start Date	: 11/16/11	Latitude	: 39.9794776
Drilling Method	: HSA	Longitude	: -87.9069697

Water Levels
▼ During Drilling: 25 feet
▽ After Completion: 14 feet (Influenced by Coring)
◆ After 24-hours:

Surf. Elev. 684.0

Depth in Feet	USCS	DESCRIPTION	Samples	Rec %	SPT Results	Qp tsf	w %	REMARKS
0		TOPSOIL (10")						
0.8–5	CL	Brown, moist, medium stiff to stiff, SILTY CLAY	1	100	3/4/4	2.5		
			2	78	4/5/6	2.0		
5–11	CL	Reddish Gray to Tan, very moist, medium stiff to stiff, SILTY CLAY with trace fine sand	3	100	2/3/3	1.0		
			4	67	4/5/5	1.5		
11–16	CL	Gray, moist, very stiff to hard, SANDY SILTY CLAY with trace gravel	5	100	8/8/9	4.5		
16–22	ML	Gray, moist, medium dense, SILT with trace clay	6	100	5/6/13			
22–26	CL	Gray, moist, very stiff, SILTY CLAY	7	100	13/11/8	2.75		
26–36	ML	Gray, moist, stiff, CLAYEY SILT	8	100	3/6/7	4.0		
			9	100	5/11/14			
36–44	CL	Reddish Brown, moist, very stiff to hard, SANDY SILTY CLAY with a little gravel						Boring caved to 36 feet upon auger removal.
			10	100	6/8/13	4.5		
44–48	LS	Light Gray, highly weathered, LIMESTONE	11	28	50-5"			
48–50	LS	Light Gray, weathered, LIMESTONE	12	90				Auger refusal encountered at 48 feet.

Water level during drilling ▼ at 25 feet.

Elevation scale: 681, 676, 671, 666, 661, 656, 651, 646, 641, 636

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LOG OF BORING B-20

Coal Refuse Impoundment No. 1
Bulldog Mine
Allerton - Homer, Illinois

Client Name	: Sunrise Coal, LLC	Driller	: Gary Taylor
Project Number	: 2-11-0383	Sampling	: Splitspoon; NQ core
Logged By	: T. Govert	Weather	: Mostly Sunny, 60F
Start Date	: 11/16/11	Latitude	: 39.9794776
Drilling Method	: HSA	Longitude	: -87.9069697

Water Levels
- During Drilling: 25 feet
- After Completion: 14 feet (Influenced by Coring)
- After 24-hours:

Depth in Feet	Surf. Elev. 684.0	Water Level	USCS	GRAPHIC	DESCRIPTION	Samples	Rec %	SPT Results	Qp tsf	w %	REMARKS
50–58	634–626		LS		Light Gray, weathered, LIMESTONE	12	90				Sample No. 12: Rock cored from 48 to 58 feet. Rock Quality Designation: RQD = 44%

Boring terminated at 58 feet.

Depth scale: 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 100
Elevation scale: 631, 626, 621, 616, 611, 606, 601, 596, 591, 586

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LOG OF BORING B-21

Coal Refuse Impoundment No. 1
Bulldog Mine
Allerton - Homer, Illinois

Client Name	: Sunrise Coal, LLC	Driller	: Gary Taylor
Project Number	: 2-11-0383	Sampling	: Splitspoon; NQ core
Logged By	: T. Govert	Weather	: Mostly Sunny, 45F
Start Date	: 11/16/11	Latitude	: 39.9810384
Drilling Method	: HSA	Longitude	: -87.9049609

Water Levels
- ▼ During Drilling: 19 feet
- ▽ After Completion: 12 feet (Influenced by Coring)
- ◆ Ater 24-hours:

Depth in Feet	Surf. Elev. 683.6	USCS	DESCRIPTION	Samples	Rec %	SPT Results	Qp tsf	w %	REMARKS
0	683		TOPSOIL (10")						
		CL	Brown, moist, medium stiff to stiff, SILTY CLAY with trace sand and small gravel	1	100	3/4/4	2.0		
5	678			2	100	4/4/4	2.0		
				3	100	3/4/5	2.5		
10	673			4	100	5/6/7	2.25		
		CL	Gray, moist, medium stiff to stiff, SILTY CLAY with trace sand						
15	668			5	100	5/5/5	2.0		
		ML	Gray, moist, medium dense, SILT with trace clay						
20	663			6	100	11/9/9			
		CL	Gray, very moist, medium stiff to stiff, SILTY CLAY with trace fine sand						
25	658			7	100	4/5/5	1.0		
		CL	Gray, moist, very stiff to hard, SILTY CLAY with sand and small gravel	8	100	6/9/12	4.5		
30	653								Boring caved to 33 feet upon auger removal.
35	648			9	100	6/7/11			
40	643		limestone fragments encountered at about 39 feet.	10	67	12/9/15			
		GR	GRANITE cobble						Auger refusal encountered at 43 feet.
		LS	Light Gray, highly weathered, LIMESTONE						
45	638	SH	Gray, weathered, SHALE and MUDSTONE	11	60				Sample No. 11: Rock cored from 43 to 53 feet. Rock Quality Designation: RQD = 35%
50									

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LOG OF BORING B-21

Coal Refuse Impoundment No. 1
Bulldog Mine
Allerton - Homer, Illinois

Client Name	: Sunrise Coal, LLC	Driller	: Gary Taylor
Project Number	: 2-11-0383	Sampling	: Splitspoon; NQ core
Logged By	: T. Govert	Weather	: Mostly Sunny, 45F
Start Date	: 11/16/11	Latitude	: 39.9810384
Drilling Method	: HSA	Longitude	: -87.9049609

Water Levels
- During Drilling: 19 feet
- After Completion: 12 feet (Influenced by Coring)
- Ater 24-hours:

Depth in Feet	Surf. Elev. 683.6	Water Level	USCS	GRAPHIC	DESCRIPTION	Samples	Rec %	SPT Results	Qp tsf	w %	REMARKS
50	633		SH		Gray, weathered, SHALE and MUDSTONE	11	60				
			LS		Light Gray, LIMESTONE						
55	628				Boring terminated at 53 feet.						
60	623										
65	618										
70	613										
75	608										
80	603										
85	598										
90	593										
95	588										
100											

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LOG OF BORING B-22

Coal Refuse Impoundment No. 1
Bulldog Mine
Allerton - Homer, Illinois

Client Name	: Sunrise Coal, LLC	Driller	: Gary Taylor
Project Number	: 2-11-0383	Sampling	: Splitspoon; NQ core
Logged By	: T. Govert	Weather	: Mostly Sunny, 55F
Start Date	: 11/1/11&11/17/11	Latitude	: 39.9758633
Drilling Method	: HSA	Longitude	: -87.9063575

Water Levels
- ▼ During Drilling: 48 feet
- ▽ After Completion: 47feet
- ◆ After 24-hours:

Depth in Feet: 0–50; Surf. Elev. 682.6 (682, 677, 672, 667, 662, 657, 652, 647, 642, 637)

USCS	DESCRIPTION
	TOPSOIL (6")
CL	Grayish Tan, moist, medium stiff to stiff, SILTY CLAY
ML	Grayish tan, slightly moist, loose to medium dense, SANDY SILT with trace clay
ML	Tan, moist, medium stiff to stiff, CLAYEY SILT with trace fine sand and trace small gravel
SC	Gray, moist, dense, CLAYEY SAND with a little gravel
CL	Gray, slightly moist, very stiff to hard, SILTY CLAY with trace sand

Samples	Rec %	SPT Results	Qp tsf	w %
1	93	3/3/4	2.25	
2	100	5/5/5		
3	100	7/5/6	2.5	
4	100	3/4/6	2.25	
5	89	4/14/21		
6	100	5/7/8	4.5	
7	100	5/6/9		
8	100	7/7/9	4.5	
9	0	50-5"		
10	100	14/18/19	>4.5	
11	100	14/23/28	>4.5	
12	27	14/14/19	>4.5	

REMARKS

Boring conducted to 100-feet on November 1, 2011 then terminated. Boring was then extended to the termination depth shown on log on November 17, 2011.

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LOG OF BORING B-22

Coal Refuse Impoundment No. 1
Bulldog Mine
Allerton - Homer, Illinois

Client Name	: Sunrise Coal, LLC	Driller	: Gary Taylor
Project Number	: 2-11-0383	Sampling	: Splitspoon; NQ core
Logged By	: T. Govert	Weather	: Mostly Sunny, 55F
Start Date	: 11/1/11&11/17/11	Latitude	: 39.9758633
Drilling Method	: HSA	Longitude	: -87.9063575

Water Levels
- ▼ During Drilling: 48 feet
- ▽ After Completion: 47feet
- ◆ After 24-hours:

Depth in Feet	Surf. Elev. 682.6
50	632
55	627
60	622
65	617
70	612
75	607
80	602
85	597
90	592
95	587
100	

Water Level	USCS	DESCRIPTION	Samples	Rec %	SPT Results	Qp tsf	w %	REMARKS
	CL	Gray, slightly moist, very stiff to hard, SILTY CLAY with trace sand						
	CH	Bluish Gray, moist, hard, CLAY with trace sand	13	67	23/24/24			
	ML	Gray, slightly moist, hard, CLAYEY SILT with trace sand and small gravel	14	100	20/27/32	4.5		
			15	100	14/20/29	>4.5		
			16	100	7/14/18	>4.5		
			17	100	7/14/21	>4.5		
			18	100	9/13/18	>4.5		Boring caved to 81feet upon auger removal.
	ML	Dark Gray, slightly moist, hard, CLAYEY SILT	19	100	13/19/28	4.25		
			20	100	18/38/49	4.5		
	CL	Gray, slightly moist, hard, SILTY CLAY with trace sand	21	100	15/16/21	>4.5		
	ML	Gray, slightly moist, hard, CLAYEY SILT with trace fine sand	22	100	12/19/19	4.5		

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LOG OF BORING B-22

Coal Refuse Impoundment No. 1
Bulldog Mine
Allerton - Homer, Illinois

Client Name	: Sunrise Coal, LLC	Driller	: Gary Taylor
Project Number	: 2-11-0383	Sampling	: Splitspoon; NQ core
Logged By	: T. Govert	Weather	: Mostly Sunny, 55F
Start Date	: 11/1/11&11/17/11	Latitude	: 39.9758633
Drilling Method	: HSA	Longitude	: -87.9063575

Water Levels
- During Drilling: 48 feet
- After Completion: 47feet
- After 24-hours:

Depth in Feet	Surf. Elev. 682.6	Water Level	USCS	GRAPHIC	DESCRIPTION	Samples	Rec %	SPT Results	Qp tsf	w %	REMARKS
100	582		ML		Gray, slightly moist, hard, CLAYEY SILT with trace fine sand						
			CH		Bluish Gray, moist, hard, CLAY	23	100	21/29/19			
105	577										
						24	11	50-2"			
110	572		SH		Light Gray, highly weathered, SHALE with interbedded silt seams						Auger refusal encountered at 111 feet.
			SH		Gray, weathered, SHALE						
115	567					25	99				Sample No. 25: Rock cored from 111 to 121 feet. Rock Quality Designation: RQD = 75%
120	562										
125	557										
130	552										
135	547										
140	542										
145	537										
150											

Boring terminated at 121feet.

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LOG OF BORING B-23

Coal Refuse Impoundment No. 1
Bulldog Mine
Allerton - Homer, Illinois

Client Name	: Sunrise Coal, LLC	Driller	: Gary Taylor
Project Number	: 2-11-0383	Sampling	: Splitspoon; NQ core
Logged By	: T. Govert	Weather	: Mostly Sunny, 55F
Start Date	: 11/1/11	Latitude	: 39.9773797
Drilling Method	: HSA	Longitude	: -87.9042923

Water Levels
▼ During Drilling: 48 feet
▽ After Completion: 47 feet
◆ After 24-hours:

Depth in Feet	Surf. Elev. 682.2	Water Level	USCS	GRAPHIC	DESCRIPTION	Samples	Rec %	SPT Results	Qp tsf	w %	REMARKS
0	682				TOPSOIL (36")	1	100	4/4/4	2.75		
5	677		CL		Light brown, moist, medium stiff to stiff, SILTY CLAY	2	100	4/3/4	3.0		
						3	100	3/4/7	4.0		
10	672		CL		Brown, moist, very stiff to hard, SANDY CLAY	4	93	7/9/11	4.5		
15	667		CL		Gray, moist to slightly moist, stiff to very stiff, SANDY SILTY CLAY	5	67	6/7/7	4.5		
20	662		CL		Gray, moist to slightly moist, very stiff to hard, SANDY SILTY CLAY	6	100	6/8/10	>4.5		
25	657					7	67	9/13/13	>4.5		
30	652		CL		Gray, moist to slightly moist, stiff to very stiff, SANDY SILTY CLAY	8	100	5/5/7	>4.5		
35	647		CL		Gray, moist to slightly moist, very stiff to hard, SANDY SILTY CLAY with a little gravel	9	100	12/9/13	>4.5		
			CL		Brown, slightly moist, very stiff to hard, SANDY SILTY CLAY with some gravel						
40	642					10	100	8/12/11	>4.5		Boring caved to 41feet upon auger removal.
45	637				Granite Cobble encountered at 45 feet.	11	27	50-5"	>4.5		Auger refusal encountered at 45 feet.
		▽ ▼				12	100				
50											

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LOG OF BORING B-23

Coal Refuse Impoundment No. 1
Bulldog Mine
Allerton - Homer, Illinois

Client Name	: Sunrise Coal, LLC	Driller	: Gary Taylor
Project Number	: 2-11-0383	Sampling	: Splitspoon; NQ core
Logged By	: T. Govert	Weather	: Mostly Sunny, 55F
Start Date	: 11/1/11	Latitude	: 39.9773797
Drilling Method	: HSA	Longitude	: -87.9042923

Water Levels
▼ During Drilling: 48 feet
▽ After Completion: 47 feet
◆ After 24-hours:

Depth in Feet	Surf. Elev. 682.2	Water Level	USCS	GRAPHIC	DESCRIPTION	Samples	Rec %	SPT Results	Qp tsf	w %	REMARKS
50	632		CL	▨	Brown, slightly moist, very stiff to hard, SANDY SILTY CLAY with some gravel	12	100				Sample No. 12: Cored from 45 to 55 feet. Soil conditions encountered classified based on field observations.
55	627		CL	▨	Grayish Brown, slighly moist, hard, SILTY CLAY with trace sand	13	40				Sample No. 13: Cored from 55 to 60 feet. Soil conditions encountered classified based on field observations.
60	622				Boring terminated at 60 feet.						
65	617										
70	612										
75	607										
80	602										
85	597										
90	592										
95	587										
100											

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LOG OF BORING B-23A

Coal Refuse Impoundment No. 1
Bulldog Mine
Allerton - Homer, Illinois

Client Name	: Sunrise Coal, LLC	Driller	: Gary Taylor
Project Number	: 2-11-0383	Sampling	: Splitspoon; NQ core
Logged By	: T. Govert	Weather	: Mostly Sunny, 55F
Start Date	: 11/17/11	Latitude	: 39.9773797
Drilling Method	: HSA	Longitude	: -87.9042923

Water Levels
▼ During Drilling: 48 feet
▽ After Completion: 47 feet
◆ After 24-hours:

Depth in Feet	Surf. Elev. 682.2	Water Level	USCS	GRAPHIC	DESCRIPTION	Samples	Rec %	SPT Results	Qp tsf	w %	REMARKS
0	682				Blank drilled from 0 to 63.5 feet. Refer to Boring B-23 for descriptions of soil strata.						Boring B-23A offset 5 feet east of Boring B-23.
5	677										
10	672										
15	667										
20	662										
25	657										
30	652										
35	647										
40	642										
45	637	▽ ▼									Boring caved to 45 feet upon auger removal.
50											

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LOG OF BORING B-23A

Coal Refuse Impoundment No. 1
Bulldog Mine
Allerton - Homer, Illinois

Client Name	: Sunrise Coal, LLC	Driller	: Gary Taylor
Project Number	: 2-11-0383	Sampling	: Splitspoon; NQ core
Logged By	: T. Govert	Weather	: Mostly Sunny, 55F
Start Date	: 11/17/11	Latitude	: 39.9773797
Drilling Method	: HSA	Longitude	: -87.9042923

Water Levels
▼ During Drilling: 48 feet
▽ After Completion: 47 feet
◆ After 24-hours:

Depth in Feet	Surf. Elev. 682.2	Water Level	USCS	GRAPHIC	DESCRIPTION	Samples	Rec %	SPT Results	Qp tsf	w %	REMARKS
50	632				Blank drilled from 0 to 63.5 feet. Refer to Boring B-23 for descriptions of soil strata.						
55	627										
60	622										
65	617		CL		Grayish brown, slighlty moist, hard, SILTY CLAY with trace sand	1	0	50-5"			
70	612		ML		Gray, slightly moist, very stiff to hard, CLAYEY SILT with trace peat inclusions	2	100	17/21/31	>4.5		
75	607					3	100	6/10/11	4.5		
80	602		GR		Gray, GRANITE fragments	4	27	50-5"			
			LS		Gray, fractured, LIMESTONE						Auger refusal encountered at 82 feet.
85	597		SH		Black to gray, weathered, SHALE with interbedded clay seams	5	90				Sample No. 5: Rock cored from 82 to 92 feet. Rock Quality Designation: RQD = 28%
90	592										
95	587				Boring terminated at 92 feet.						
100											

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LOG OF BORING B-23B

Coal Refuse Impoundment No. 1
Bulldog Mine
Allerton - Homer, Illinois

Client Name	: Sunrise Coal, LLC	Driller	: Gary Taylor
Project Number	: 2-11-0383	Sampling	: Shelby Tube
Logged By	: T. Smith	Weather	: Sunny, 70F
Start Date	: 5/14/12		
Drilling Method	: HSA		

Water Levels
- During Drilling: 6 feet
- After Completion: Dry
- After 24-hours:

Depth in Feet	Surf. Elev. 683.54	Water Level	USCS	GRAPHIC	DESCRIPTION	Samples	Rec %	SPT Results	Qp tsf	w %	REMARKS
0–15	683–668	▼ (6 ft)			Boring B-23B offset 5 feet east from boring B-23A. Refer to Boring B-23 for a description of soil strata.	1	44			23	Sample No. 1: Shelby tube pushed from 1 to 3 feet. Loss On Ignition (LOI) Organic Content = 5.4% Boring caved to 4 feet upon auger removal.
						2	58			24	Sample No. 2: Shelby tube pushed from 3 to 5 feet.
						3	100			24	Sample No. 3: Shelby tube pushed from 5 to 7 feet.
						4	38			19	Sample No. 4: Shelby tube pushed from 8 to 10 feet.

Boring terminated at 15 feet.

Depth scale: 0, 5, 10, 15, 20, 25, 30 feet; Elevation: 683, 678, 673, 668, 663, 658

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LOG OF BORING B-24

Coal Refuse Impoundment No. 1
Bulldog Mine
Allerton - Homer, Illinois

Client Name	: Sunrise Coal, LLC	Driller	: Gary Taylor
Project Number	: 2-11-0383	Sampling	: Splitspoon; NQ core
Logged By	: T. Govert	Weather	: Sunny, 60F
Start Date	: 10/31/11	Latitude	: 39.9788961
Drilling Method	: HSA	Longitude	: -87.9022270

Water Levels
- During Drilling: Dry
- After Completion: 7 feet (Influenced by Coring)
- After 24-hours:

Depth in Feet	Surf. Elev. 681.2	Water Level	USCS	DESCRIPTION	Samples	Rec %	SPT Results	Qp tsf	w %	REMARKS
0	681			TOPSOIL (18")						
			CL	Dark Gray, moist, medium stiff to stiff, SILTY CLAY	1	33	3/4/6	2.0		
5	676		CL	Light Brown, moist, medium stiff to stiff, SILTY CLAY with trace sand	2	33	3/3/4			
					3	100	5/5/7			
10	671				4	89	4/5/7			
15	666		ML	Gray, moist, stiff to very stiff, SANDY CLAYEY SILT with trace gravel	5	56	7/7/7	4.5		
20	661		SM	Light Brown, slightly moist, medium dense, fine grained, SILTY SAND	6	33	7/8/9			
25	656		CL	Grayish Tan, moist, very stiff, SANDY SILTY CLAY	7	33	8/9/10	3.0		
30	651				8	27	9/9/13	4.0		
35	646		ML	Gray & Brown, slighly moist, hard, CLAYEY SILT with some sand and gravel	9	0	40/40/35			
40	641				10	33	26/28/33	>4.5		
45	636				11	100	28/36/26			
50			CL	Tannish Gray, moist, very stiff to hard, SILTY CLAY with trace fine sand	12	100	12/15/16	4.0		

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LOG OF BORING B-24

Coal Refuse Impoundment No. 1
Bulldog Mine
Allerton - Homer, Illinois

Client Name	: Sunrise Coal, LLC	Driller	: Gary Taylor
Project Number	: 2-11-0383	Sampling	: Splitspoon; NQ core
Logged By	: T. Govert	Weather	: Sunny, 60F
Start Date	: 10/31/11	Latitude	: 39.9788961
Drilling Method	: HSA	Longitude	: -87.9022270

Water Levels
During Drilling: Dry
After Completion: 7 feet (Influenced by Coring)
After 24-hours:

Depth in Feet	Surf. Elev. 681.2	Water Level	USCS	GRAPHIC	DESCRIPTION	Samples	Rec %	SPT Results	Qp tsf	w %	REMARKS
50	631		CL		Tannish Gray, moist, very stiff to hard, SILTY CLAY with trace fine sand	13	33	10/8/15	4.5		Boring caved to 51feet upon auger removal.
55	626		SS		Tan and Brown, highly weathered, SANDSTONE						Auger refusal encountered at 56 feet.
60	621		LS		Light Gray, highly fractured, highly weathered, LIMESTONE with appreciable vugs Void encountered from 57 to 58 feet.	14	80				Sample No. 14: Rock cored from 56 to 66 feet. Rock Qualtiy Designation: RQD = 52%
65	616										
					Boring terminated at 66 feet.						
70	611										
75	606										
80	601										
85	596										
90	591										
95	586										
100											

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LOG OF BORING B-25

Coal Refuse Impoundment No. 1
Bulldog Mine
Allerton - Homer, Illinois

Client Name	: Sunrise Coal, LLC	Driller	: Gary Taylor
Project Number	: 2-11-0383	Sampling	: Splitspoon; Shelby Tube
Logged By	: T. Govert	Weather	: Sunny, 60F
Start Date	: 4/6/12	Latitude	: 39.58'49.2851"
Drilling Method	: HSA	Longitude	: -87.54'30.8355"

Water Levels
▼ During Drilling: 8 feet
▽ After Completion: 14 feet
◆ After 24-hours:

Depth in Feet: 0, 5, 10, 15, 20, 25, 30
Surf. Elev. 684.8: 684, 679, 674, 669, 664, 659

USCS	DESCRIPTION	Samples	Rec %	SPT Results	Qp tsf	w %	REMARKS
	Topsoil (10")						
CL	Dark Brown to Brown, moist, medium stiff, SILTY CLAY	1	67	2/3/4		21	
CL	Gray & Tan Mottled, moist, soft to medium stiff, SILTY CLAY with trace sand	2	33	2/2/2	1.0	17	
CL	Light Brown, moist, medium stiff, SILTY CLAY with a little sand and trace gravel	3	92			16	Sample No. 3: Shelby tube pushed from 5 to 7 feet. Unconfined Compressive Strength Test: Qu = 1.0 tsf
CL	Light Brown, moist, medium stiff to stiff, SANDY CLAY	4	100	4/4/5	1.75	12	
CL	Gray, slightly moist, stiff to very stiff, SANDY CLAY with trace to a little gravel	5	100	7/5/7	4.0	11	
		6	100	7/9/9	4.5	10	Sample No. 6: Atterberg Limits Tests: LL=19, PL=12, PI=17
		7	78	13/13/10	>4.5	11	
ML	Gray, slighltly moist to moist, very stiff to hard, SANDY CLAYEY SILT	8	67	6/7/10	>4.5	12	
		9	78	13/12/8		21	Sample No. 9: Atterberg Limits Tests: LL=20, PL=18, PI=2
SM	Gray, wet, medium dense, SILTY SAND with trace clay	10	0	8/12/13			Sample No. 10: Splitspoon sampler driven twice with no recovery. Classification based on field observation.
ML	Gray, moist, stiff, CLAYEY SILT	11	56	6/7/8		19	Boring caved to 26 feet upon auger removal.
CL	Gray, moist, very stiff to hard, SILTY CLAY with a little sand and trace small gravel	12	100	9/11/17	>4.5	12	

Boring terminated at 30 feet.

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LOG OF BORING B-26

Coal Refuse Impoundment No. 1
Bulldog Mine
Allerton - Homer, Illinois

Client Name	: Sunrise Coal, LLC	Driller	: Gary Taylor
Project Number	: 2-11-0383	Sampling	: Splitspoon; Shelby Tube
Logged By	: T. Govert	Weather	: Sunny, 60F
Start Date	: 4/10/12	Latitude	: 39.58'49.1903"
Drilling Method	: HSA	Longitude	: -87.54'23.3440"

Water Levels
- ▼ During Drilling: 21feet
- ▽ After Completion: 8 feet
- ◆ After 24-hours:

Depth in Feet | Surf. Elev. 683.54

Depth in Feet	Surf. Elev. 683.54
0	683
5	678
10	673
15	668
20	663
25	658
30	

USCS	DESCRIPTION
	TOPSOIL (36")
CL	Gray & Brown Mottled, very moist to moist, medium stiff to stiff, SILTY CLAY with trace to some gravel
CL	Light Brown, moist, very stiff, SILTY CLAY with trace sand and small gravel
CL	Light Brown, moist, very stiff, SANDY SILTY CLAY
ML	Gray, moist, stiff to very stiff, CLAYEY SILT

Samples	Rec %	SPT Results	Qp tsf	w %
1	33	5/5/7	2.5	25
2	56	2/3/3	1.0	27
3	54		2.0	17
4	100	3/5/5	1.5	15
5	78	4/5/6	1.75	14
6	56	11/12/7		17
7	0	9/9/10		
8	0	50-4"		
9	100	4/5/5	1.25	17
10	56	5/6/5	1.5	19
11	100	12/13/17	2.0	18
12	67	11/10/11	2.0	20

REMARKS

Sample No. 2:
Atterberg Limits Tests:
LL=48, PL=18, PI=30

Sample No. 3:
Shelby tube pushed from 5 to 7 feet.

Samples No. 7 & No. 8:
Splitspoon sampler driven twice with no recovery.
Classifications based on field observations.

Boring caved to 18 feet upon auger removal.

Boring terminated at 30 feet.

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LOG OF BORING B-26A

Coal Refuse Impoundment No. 1
Bulldog Mine
Allerton - Homer, Illinois

Client Name	: Sunrise Coal, LLC	Driller	: Gary Taylor
Project Number	: 2-11-0383	Sampling	: Shelby Tube
Logged By	: T. Smith	Weather	: Sunny, 70F
Start Date	: 5/14/12		
Drilling Method	: HSA		

Water Levels
- During Drilling: 7.5 feet
- After Completion: 5.5 feet
- After 24-hours:

Depth in Feet	Surf. Elev. 683.54	Water Level	USCS	GRAPHIC	DESCRIPTION	Samples	Rec %	SPT Results	Qp tsf	w %	REMARKS
0	683				Boring B-26A offset 5 feet east from boring B-26. Refer to Boring B-26 for a description of soil strata.	1	40			24	Sample No. 1: Shelby tube pushed from 1 to 3 feet. Loss on Ignition (LOI) Organic Content = 3.8%
						2	71			29	Sample No. 2: Shelby tube pushed from 3 to 5 feet.
5	678	▽ (5.5)				3	92				Sample No. 3: Shelby tube pushed from 5 to 7 feet.
		▼ (7.5)				4	100			18	Sample No. 4: Shelby tube pushed from 8 to 10 feet.
10	673										Boring caved to 10.5 feet upon auger removal.
						5	42			17	Sample No. 5: Shelby tube pushed from 13 to 15 feet
15	668				Boring terminated at 15.5 feet.						
20	663										
25	658										
30											

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LOG OF BORING B-27

Coal Refuse Impoundment No. 1
Bulldog Mine
Allerton - Homer, Illinois

Client Name	: Sunrise Coal, LLC	Driller	: Gary Taylor
Project Number	: 2-11-0383	Sampling	: Splitspoon; Shelby Tube
Logged By	: T. Govert	Weather	: Sunny, 50F
Start Date	: 4/10/12	Latitude	: 39.58'49.1972"
Drilling Method	: HSA	Longitude	: -87.54'14.0688"

Water Levels
▼ During Drilling: 6 feet
▽ After Completion: 6 feet
◆ After 24-hours:

Depth in Feet	Surf. Elev. 681.37	Water Level	USCS	GRAPHIC	DESCRIPTION	Samples	Rec %	SPT Results	Qp tsf	w %	REMARKS
0	681				TOPSOIL (12")						
			CL		Grayish Brown, moist, medium stiff to stiff, SILTY CLAY	1	44	3/3/4	1.25	24	
5	676	▼	CL		Gray & Brown Mottled, very moist, medium stiff, SILTY CLAY with trace sand and small gravel	2	67	7/3/3	0.75	25	Sample No. 2: Atterberg Limits Tests: LL=41, PL=18, PI=23
			CL		Light Brown, moist, medium stiff, SANDY CLAY	3	100	3/3/3	0.75	15	
						4	0	5/6/9			Sample No. 4: Split-spoon sampler driven twice with no recovery. Classification based on field observation.
10	671		ML		Gray, moist, hard, CLAYEY SILT with trace fine sand	5	89	11/22/32		17	
15	666					6	78	16/26/27			
						7	67	11/24/20		20	Boring caved to 17.5 feet upon auger removal
			SC		Gray, very moist, loose, CLAYEY SAND	8	100	3/3/5			
20	661		SM		Gray, moist, medium dense, fine to medium grained, SILTY SAND with trace clay	9	100	11/16/9			
			ML		Gray, moist, medium stiff to stiff, CLAYEY SILT with trace fine sand	10	100	3/3/4	0.5	18	
25	656					11	67	4/4/5	1.0	21	
			CL		Gray, slightly moist, very stiff to hard, SANDY SILTY CLAY with trace small gravel	12	100	8/10/12	4.25	10	
30											

Boring terminated at 30 feet

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LOG OF BORING B-28

Coal Refuse Impoundment No. 1
Bulldog Mine
Allerton - Homer, Illinois

Client Name	: Sunrise Coal, LLC	Driller	: Gary Taylor
Project Number	: 2-11-0383	Sampling	: Splitspoon; Shelby Tube
Logged By	: T. Govert	Weather	: Sunny, 60F
Start Date	: 4/9/12	Latitude	: 39.58'47.0257"
Drilling Method	: HSA	Longitude	: -87.54'27.2669"

Water Levels
▼ During Drilling: 16 feet
▽ After Completion: 13 feet
◆ After 24-hours:

Depth in Feet	Surf. Elev. 688.35	USCS	DESCRIPTION	Samples	Rec %	SPT Results	Qp tsf	w %	REMARKS
0	688		TOPSOIL (10")						
		CH	Brown to Light Brown, moist, medium stiff to soft, CLAY with trace sand	1	56	3/4/5		24	Sample No. 1: Atterberg Limits Tests: LL=54, PL=23, PI=31
				2	0	3/1/2			Sample No. 2: Splitspoon sampler driven twice with no recovery. Classification based on field observation.
5	683	CL	Brown, moist to very moist, very stiff, SILTY CLAY	3	100		2.0	20	Sample No. 3: Shelby tube pushed from 5 to 7 feet.
		CL	Brown, very moist, medium stiff, SILTY SANDY CLAY with some gravel						
		SC	Brown, moist, CLAYEY SAND						
		CL	Brown, moist, stiff, SILTY CLAY with trace sand and gravel	4	50		1.5	16	Sample No. 4: Shelby tube pushed from 8 to 10 feet.
10	678			5	100	12/8/10	1.75	15	
				6	100		1.0	16	Sample No. 6: Shelby tube pushed from 13 to 15 feet.
15	673	SC	Light Brown, wet, dense, CLAYEY SAND and gravel	7	67	10/15/25			
		CL	Brown, moist, very stiff, SANDY CLAY with trace gravel	8	56	9/9/10		13	
20	668	ML	Gray, moist, dense, SANDY SILT with trace clay	9	56	16/18/13			Boring caved to 21 feet upon auger removal.
		ML	Gray, moist, hard, CLAYEY SILT with trace fine sand	10	89	5/16/31		18	
25	663			11	78	10/13/13		19	
		CH	Gray, moist, medium stiff to stiff, CLAY	12	100	6/4/5	1.25	22	
30									

Boring terminated at 30 feet.

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LOG OF BORING B-29

Coal Refuse Impoundment No. 1
Bulldog Mine
Allerton - Homer, Illinois

Client Name	: Sunrise Coal, LLC	Driller	: Gary Taylor
Project Number	: 2-11-0383	Sampling	: Splitspoon; Shelby Tube
Logged By	: T. Govert	Weather	: Sunny, 50F
Start Date	: 4/10/12	Latitude	: 39.58'47.0484"
Drilling Method	: HSA	Longitude	: -87.54'16.5033"

Water Levels
- ▼ During Drilling: 18 feet
- ▽ After Completion: 10 feet
- ◆ After 24-hours:

Depth in Feet / Surf. Elev. 681.21: 0 – 681; 5 – 676; 10 – 671; 15 – 666; 20 – 661; 25 – 656; 30

Depth (ft)	USCS	DESCRIPTION
0 – 11"		TOPSOIL (11")
11" – 8	CH	Gray & Brown Mottled, very moist to moist, medium stiff to stiff, CLAY with trace fine sand
8 – 15.5	SM	Brown, very moist, loose, fine grained, SILTY SAND with trace clay
15.5 – 18	SC	Gray, very moist, dense, CLAYEY SAND with some gravel
18 – 25	SC	Gray, very moist, loose to medium dense, fine grained, CLAYEY SAND
25 – 30	CL	Gray, moist, stiff to very stiff, SANDY CLAY

Samples	Rec %	SPT Results	Qp tsf	w %	REMARKS
1	67	4/4/5	2.0	25	
2	58		2.0	27	Sample No. 2: Shelby tube pushed from 3 to 5 feet.
3	100	3/3/5	2.5	15	
4	100	3/4/5			
5	67	4/3/4			
6	0	6/7/7			Sample No. 6: Splitspoon sampler driven twice with no recovery. Classification based on field observation.
7	67	7/13/30			
8	78	3/2/7			Boring caved to 18 feet upon auger removal.
9	67	4/5/6			
10	0	7/13/12			Sample No. 10: Splitspoon sampler driven twice with no recovery. Classification based on field observation.
11	67	6/7/7	2.5		
12	0	19/20/20			Sample No. 12: Splitspoon sampler driven twice with no recovery. Classification based on field observation.

Boring terminated at 30 feet.

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LOG OF BORING B-30

Coal Refuse Impoundment No. 1
Bulldog Mine
Allerton - Homer, Illinois

Client Name	: Sunrise Coal, LLC	Driller	: Gary Taylor
Project Number	: 2-11-0383	Sampling	: Splitspoon
Logged By	: T. Govert	Weather	: Sunny, 50F
Start Date	: 4/6/12	Latitude	: 39.58'44.7713"
Drilling Method	: HSA	Longitude	: -87.54'30.9270

Water Levels
▼ During Drilling: 27 feet
▽ After Completion: 7 feet
◆ After 24-hours:

Depth in Feet	Surf. Elev. 686.64	USCS	DESCRIPTION	Samples	Rec %	SPT Results	Qp tsf	w %	REMARKS
0	686		TOPSOIL (18")						
		CL	Gray & Tan Mottled, moist, medium stiff to stiff, SANDY SILTY CLAY	1	67	4/4/5		21	
5	681			2	67	4/3/4		14	
		CL	Tan, moist, medium stiff to very stiff, SANDY SILTY CLAY	3	78	4/5/6	3.0	15	
10	676			4	100	5/5/5		15	
				5	78	7/7/9	4.0	12	
15	671	CL	Gray, moist, stiff to very stiff, SANDY SILTY CLAY with trace small gravel	6	67	6/5/8		12	
		ML	Gray, moist, medium dense, SANDY SILT with trace clay	7	78	7/9/10			
20	666	CL	Gray, slighlty moist, hard, SANDY SILTY CLAY with some gravel	8	100	7/11/12	>4.5	10	Boring caved to 19 feet upon auger removal
				9	0	10/11/24			Sample No. 9: Splitspoon sampler driven twice with no recovery. Classification based on field observation.
25	661	SC	Gray, very moist, medium dense, fine to medium grained, CLAYEY SAND	10	67	9/9/8			
		CL	Gray, slightly moist, very stiff, SILTY CLAY with a little sand	11	100	8/8/10	2.5	14	
30		CL	Gray, slightly moist, very stiff to hard, SANDY SILTY CLAY with trace small gravel	12	78	6/9/12	>4.5	11	

Boring terminated at 30 feet.

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LOG OF BORING B-31

Coal Refuse Impoundment No. 1
Bulldog Mine
Allerton - Homer, Illinois

Client Name	: Sunrise Coal, LLC	Driller	: Gary Taylor
Project Number	: 2-11-0383	Sampling	: Splitspoon; Shelby Tube
Logged By	: T. Govert	Weather	: Sunny, 60F
Start Date	: 4/9/12	Latitude	: 39.58'44.7209"
Drilling Method	: HSA	Longitude	: -87.54'21.6723"

Water Levels
- ▼ During Drilling: 10 feet
- ▽ After Completion: 6 feet
- ◆ After 24-hours:

Depth in Feet: 0, 5, 10, 15, 20, 25, 30
Surf. Elev. 682.69: 682, 677, 672, 667, 662, 657

USCS	DESCRIPTION
	TOPSOIL (13")
CH	Grayish Tan, very moist, medium stiff to stiff, CLAY
CL	Grayish Tan, moist, medium stiff to stiff, SILTY CLAY with some sand
CL	Brown, moist, medium stiff to stiff, SANDY SILTY CLAY
SP	Grayish Brown, wet, medium dense to dense, medium to coarse grained, SAND with trace silt and gravel
SM	Brown, wet, medium dense, fine grained, SILTY SAND
ML	Gray, moist to very moist, medium stiff to stiff, CLAYEY SILT with trace gravel
SP-SM	Grayish Tan, wet, medium dense, SAND with some silt
ML	Gray, very moist, medium stiff to stiff, CLAYEY SILT with trace fine sand
SP	Grayish Brown, wet, fine to medium grained, SAND
CL	Gray, moist, stiff to very stiff, SILTY CLAY with trace sand and gravel

Samples	Rec %	SPT Results	Qp tsf	w %	REMARKS
1	56	4/3/4	1.0	26	Sample No.1: Atterberg Limits Tests: LL=59, PL=22, PI=37
2	67	2/3/4	2.5	17	Sample No. 2: Atterberg Limits Tests: LL=28, PL=16, PI=12
3	89	3/4/5		17	Sample No. 3: Atterberg Limits Tests: LL=26, PL=16, PI=10
4	100	5/5/6	3.25	14	Sample No. 4: Atterberg Limits Tests: LL=25, PL=14, PI=11
5	67	6/7/6	3.0	15	Sample No. 5: Atterberg Limits Tests: LL=23, PL=15, PI=8
6	100	13/14/16			Boring caved to 14 feet upon auger removal.
7	67	11/10/10			
8	50			23	Sample No. 8: Shelby tube pushed from 18 to 20 feet.
9	78	17/13/12			
10	0				
11	67	3/5/5	1.25		
12	100		3.0	21	Sample No. 12: Shelby tube pushed from 28 to 30 feet.

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LOG OF BORING B-31

Coal Refuse Impoundment No. 1
Bulldog Mine
Allerton - Homer, Illinois

Client Name	: Sunrise Coal, LLC	Driller	: Gary Taylor
Project Number	: 2-11-0383	Sampling	: Splitspoon; Shelby Tube
Logged By	: T. Govert	Weather	: Sunny, 60F
Start Date	: 4/9/12	Latitude	: 39.58'44.7209"
Drilling Method	: HSA	Longitude	: -87.54'21.6723"

Water Levels
▼ During Drilling: 10 feet
▽ After Completion: 6 feet
◆ After 24-hours:

Depth in Feet	Surf. Elev. 682.69	Water Level	USCS	GRAPHIC	DESCRIPTION	Samples	Rec %	SPT Results	Qp tsf	w %	REMARKS
30	652		CL		Gray, moist, stiff to very stiff, SILTY CLAY with trace sand and gravel						
			CL		Gray, slightly moist, hard, SANDY SILTY CLAY with trace small gravel	13	78	9/13/17	>4.5	11	
						14	67	5/8/10	>4.5	13	
35	647		CH		Gray, moist, stiff, CLAY with trace sand	15	78	6/6/7	1.0	17	
			CL		Gray, slightly moist, hard, SANDY CLAY with trace small gravel	16	89	17/21/29	4.5	10	
40	642				Boring terminated at 40 feet.						
45	637										
50	632										
55	627										
60											

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LOG OF BORING B-32

Coal Refuse Impoundment No. 1
Bulldog Mine
Allerton - Homer, Illinois

Client Name	: Sunrise Coal, LLC	Driller	: Gary Taylor
Project Number	: 2-11-0383	Sampling	: Splitspoon
Logged By	: T. Govert	Weather	: Sunny, 40F
Start Date	: 4/10/12	Latitude	: 39.58'44.7623
Drilling Method	: HSA	Longitude	: -87.54'13.9746

Water Levels
- ▼ During Drilling: 14 feet
- ▽ After Completion: 12 feet
- ◆ After 24-hours:

Depth in Feet	Surf. Elev. 681.32	USCS	DESCRIPTION	Samples	Rec %	SPT Results	Qp tsf	w %	REMARKS
0	681		TOPSOIL (36")	1	56	3/3/4	1.75	23	
3–5		CL	Gray & Tan Mottled, moist, medium stiff to stiff, SILTY CLAY with trace sand	2	56	3/3/3	1.25	20	Sample No. 2: Atterberg Limits Tests: LL=28, PL=15, PI=13
5	676	CL	Grayish Tan, moist, stiff to very stiff, SANDY SILTY CLAY	3	67	5/5/6	2.0	16	Sample No. 3: Atterberg Limits Tests: LL=26, PL=15, PI=11
				4	0	11/6/7			Sample No. 4: Splitspoon sampler driven twice with no recovery. Classification based on field observation.
10	671	CL	Gray, slightly moist, very stiff to stiff, SANDY SILTY CLAY	5	67	10/10/8	2.75	13	Sample No. 5: Atterberg Limits Tests: LL=19, PL=13, PI=6
15	666			6	56	5/5/6	2.5	13	
				7	67	6/5/7	2.5	11	
17		ML	Gray, moist, stiff to very stiff, CLAYEY SILT with trace fine sand	8	78	5/7/8	2.75	20	
20	661			9	89	6/6/8	2.5	20	Boring caved to 21 feet upon auger removal.
23		CL	Gray, moist, stiff, SILTY CLAY with trace sand	10	67	6/7/8		17	
25	656	ML	Gray, moist, stiff to very stiff, CLAYEY SILT	11	67	7/5/7	3.5	18	
28		CL	Gray, slightly moist, stiff, SANDY SILTY CLAY	12	100	7/7/10	1.75	12	
30									

Boring terminated at 30 feet.

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LOG OF BORING B-32A

Coal Refuse Impoundment No. 1
Bulldog Mine
Allerton - Homer, Illinois

Client Name	: Sunrise Coal, LLC	Driller	: Gary Taylor
Project Number	: 2-11-0383	Sampling	: Shelby Tube
Logged By	: T. Smith	Weather	: Sunny, 70F
Start Date	: 5/14/12		
Drilling Method	: HSA		

Water Levels
- ▼ During Drilling: 6 feet
- ▽ After Completion: 8.5 feet
- ◆ After 24-hours:

Depth in Feet	Surf. Elev. 683.54	Water Level	USCS	GRAPHIC	DESCRIPTION	Samples	Rec %	SPT Results	Qp tsf	w %	REMARKS
0	683				Boring B-32A offset 5 feet east from boring B-32. Refer to Boring B-32 for a description of soil strata.	1	33			23	Sample No. 1: Shelby tube pushed from 1 to 3 feet.
						2	71			21	Sample No. 2: Shelby tube pushed from 3 to 5 feet.
5	678	▼				3	100				Sample No. 3: Shelby tube pushed from 5 to 7 feet.
		▽				4	100			16	Sample No. 4: Shelby tube pushed from 8 to 10 feet.
10	673										Boring caved to 10 feet upon auger removal.
						5	77			15	Sample No. 5: Shelby tube pushed from 13 to 15 feet
15	668				Boring terminated at 15 feet.						
20	663										
25	658										
30											

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LOG OF BORING B-33

Coal Refuse Impoundment No. 1
Bulldog Mine
Allerton - Homer, Illinois

Client Name	: Sunrise Coal, LLC	Driller	: Gary Taylor
Project Number	: 2-11-0383	Sampling	: Splitspoon; Shelby Tube
Logged By	: T. Govert	Weather	: Sunny, 60F
Start Date	: 4/6/12	Latitude	: 39.58'42.1937"
Drilling Method	: HSA	Longitude	: -87.54'27.1562

Water Levels
▼ During Drilling: 18 feet
▽ After Completion: 10 feet
◆ After 24-hours:

Depth in Feet	Surf. Elev. 683.16	Water Level	USCS	GRAPHIC	DESCRIPTION	Samples	Rec %	SPT Results	Qp tsf	w %	REMARKS
0	683				TOPSOIL (36")	1	22	2/2/4		21	
			CL		Gray & Brown Mottled, moist, medium stiff, SANDY SILTY CLAY	2	0	2/3/3			
5	678					3	63		1.0	19	Sample No. 3: Shelby tube pushed from 6 to 8 feet. Unconfined Compressive Strength Test: Qu = 0.9 tsf
		▽				4	89	3/3/5	1.0	15	
10	673		CL		Grayish Brown, moist, stiff to very stiff, SILTY CLAY with trace sand	5	89	4/5/6	2.0	15	
			CL		Gray, slightly moist, very stiff to hard, SANDY SILTY CLAY with trace small gravel	6	78	5/9/9	4.25	10	
15	668		ML		Gray, very moist to moist, stiff to medium stiff, CLAYEY SILT with trace sand	7	78	7/7/8	4.0	24	
		▼				8	78	4/5/7		24	
20	663					9	67	4/2/7		13	
			CL		Gray, slightly moist, very stiff to hard, SILTY CLAY with a little sand and trace gravel	10	78	3/7/7	4.5	11	Boring caved to 23 feet upon auger removal.
25	658					11	67	5/8/9	>4.5	11	
			ML		Gray, moist, very stiff to hard, CLAYEY SILT	12	89	8/12/11	4.5	18	
30											

Boring terminated at 30 feet.

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LOG OF BORING B-33A

Coal Refuse Impoundment No. 1
Bulldog Mine
Allerton - Homer, Illinois

Client Name	: Sunrise Coal, LLC	Driller	: Gary Taylor
Project Number	: 2-11-0383	Sampling	: Shelby Tube
Logged By	: T. Smith	Weather	: Sunny, 70F
Start Date	: 5/14/12		
Drilling Method	: HSA		

Water Levels
▼ During Drilling: Dry
▽ After Completion: Dry
◆ After 24-hours:

Depth in Feet	Surf. Elev. 683.54	Water Level	USCS	GRAPHIC	DESCRIPTION	Samples	Rec %	SPT Results	Qp tsf	w %	REMARKS
0	683				Boring B-33A offset 5 feet east from boring B-33. Refer to Boring B-33 for a description of soil strata.						
						1	42			21	Sample No. 1: Shelby tube pushed from 1 to 3 feet.
						2	50			24	Sample No. 2: Shelby tube pushed from 3 to 5 feet.
5	678					3	71			26	Sample No. 3: Shelby tube pushed from 5 to 7 feet.
						4	100			17	Sample No. 4: Shelby tube pushed from 8 to 10 feet.
10	673										Boring caved to 10 feet upon auger removal.
						5	100			17	Sample No. 5: Shelby tube pushed from 13 to 15 feet.
15	668				Boring terminated at 15 feet.						
20	663										
25	658										
30											

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LOG OF BORING B-34

Coal Refuse Impoundment No. 1
Bulldog Mine
Allerton - Homer, Illinois

Client Name	: Sunrise Coal, LLC	Driller	: Gary Taylor
Project Number	: 2-11-0383	Sampling	: Splitspoon; Shelby Tube
Logged By	: T. Govert	Weather	: Sunny, 60F
Start Date	: 4/9/12	Latitude	: 39.58'42.3296
Drilling Method	: HSA	Longitude	: -87.54'16.4633

Water Levels
▼ During Drilling: 13.5 feet
▽ After Completion: 9 feet
◆ After 24-hours:

Depth in Feet	Surf. Elev. 682.16	USCS	DESCRIPTION	Samples	Rec %	SPT Results	Qp tsf	w %	REMARKS
0	682		TOPSOIL (18")						
		SM	Gray & Tan Mottled, very moist, SILTY SAND with trace clay	1	42				Sample No. 1: Shelby tube pushed from 1 to 3 feet.
5	677	CL	Gray, Tan & Brown mottled, moist, soft to medium stiff, SILTY SANDY CLAY	2	100	2/3/3	0.50	16	
		CL	Grayish Tan, moist, medium stiff to stiff, SILTY SANDY CLAY with trace small gravel	3	67	3/4/5		17	
10	672			4	78	3/6/8	2.75	14	
				5	67	4/3/4	3.0	14	Borings caved to 12 feet upon auger removal.
15	667	ML	Gray, wet, medium dense to loose, SANDY SILT with trace clay	6	67	9/12/14			
				7	78	10/11/13			
20	662			8	67	3/4/5			
		CL	Gray, moist, stiff, SILTY CLAY with trace to a little sand	9	67	5/6/6	1.5	18	
25	657	CL	Gray, moist, very stiff to hard, SILTY CLAY with a little sand and trace small gravel	10	89	7/8/8	4.5	12	
				11	67	8/9/11	>4.5	11	
30				12	100	7/11/13	>4.5	12	

Boring terminated at 30 feet.

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LOG OF BORING B-35

Coal Refuse Impoundment No. 1
Bulldog Mine
Allerton - Homer, Illinois

Client Name	: Sunrise Coal, LLC	Driller	: Gary Taylor
Project Number	: 2-11-0383	Sampling	: Splitspoon; Shelby Tube
Logged By	: T. Govert	Weather	: Sunny, 60F
Start Date	: 4/9/12	Latitude	: 39.58"40.0127
Drilling Method	: HSA	Longitude	: -87.54'21.6799"

Water Levels
- ▼ During Drilling: 10 feet
- ▽ After Completion: 10 feet
- ◆ After 24-hours:

Depth in Feet	Surf. Elev. 683.4	Water Level	USCS	DESCRIPTION	Samples	Rec %	SPT Results	Qp tsf	w %	REMARKS
0	683			TOPSOIL (7")						
			CH	Gray & Brown Mottled, very moist, medium stiff, CLAY with trace sand	1	67	3/3/4		32	
			CL	Brown, slightly moist, medium stiff to stiff, SANDY SILTY CLAY	2	56	3/4/6		14	Sample No. 2: Atterberg Limits Tests: LL=25, PL=15, PI=10
5	678				3	78	3/4/5	2.25	12	Sample No. 3: Standard Proctor & Remolded Permeability Testing
			CL	Gray, slightly moist, stiff to very stiff, SILTY CLAY with trace sand and gravel						
			CL	Brown, slightly moist, stiff to very stiff, SILTY SANDY CLAY with trace small gravel	4	100		2.5	13	Sample No. 4: Shelby tube pushed from 8 to 10 feet.
10	673	▼								
			CL	Brownish Gray, moist, stiff to very stiff, SILTY CLAY with a little sand and trace gravel	5	100	5/6/8	4.5	12	
					6	0	7/6/7			Sample No. 6: Splitspoon sampler driven twice with no recovery. Classification based on field observation.
15	668									
					7	56	6/8/13	4.5	12	
			CL	Tan, moist to very moist, soft, SILTY CLAY with trace to some sand and trace small gravel	8	100		0.25	22	Sample No. 8: Shelby tube pushed from 18 to 20 feet.
20	663		SP	Gray, wet, medium dense, medium to coarse grained, SAND with trace silt						Boring caved to 20 feet upon auger removal.
					9	67	9/8/8			
			CL	Gray, slightly moist, hard, SILTY CLAY with some sand and gravel	10	92		3.5	12	Sample No. 10: Shelby tube pushed from 23 to 25 feet.
25	658									
					11	89	11/15/18	>4.5	12	
					12	67	7/8/11	>4.5	12	
30										

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LOG OF BORING B-35

Coal Refuse Impoundment No. 1
Bulldog Mine
Allerton - Homer, Illinois

Client Name	: Sunrise Coal, LLC	Driller	: Gary Taylor
Project Number	: 2-11-0383	Sampling	: Splitspoon; Shelby Tube
Logged By	: T. Govert	Weather	: Sunny, 60F
Start Date	: 4/9/12	Latitude	: 39.58"40.0127
Drilling Method	: HSA	Longitude	: -87.54'21.6799"

Water Levels
- During Drilling: 10 feet
- After Completion: 10 feet
- After 24-hours:

Depth in Feet	Surf. Elev. 683.4	Water Level	USCS	GRAPHIC	DESCRIPTION	Samples	Rec %	SPT Results	Qp tsf	w %	REMARKS
30	653		CL		Gray, slightly moist, hard, SILTY CLAY with some sand and gravel	13	67	9/10/12	4.5	11	
			CL		Gray, slightly moist, very stiff to hard, SANDY SILTY CLAY	14	78	5/11/25	3.5	13	
35	648		CL		Gray, slightly moist, hard, SILTY CLAY with some sand and gravel	15	67	7/10/19	>4.5	10	Sample No. 16: Splitspoon sampler driven twice with no recovery. Classification based on field observation.
						16	0	11/17/25			
40	643				Boring terminated at 40 feet.						
45	638										
50	633										
55	628										
60											

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LOG OF BORING B-36

Coal Refuse Impoundment No. 1
Bulldog Mine
Allerton - Homer, Illinois

Client Name	: Sunrise Coal, LLC	Driller	: Gary Taylor
Project Number	: 2-11-0383	Sampling	: Splitspoon; Shelby Tube
Logged By	: T. Govert	Weather	: Sunny, 60F
Start Date	: 4/6/12	Latitude	: 39.58'37.5154
Drilling Method	: HSA	Longitude	: -87.54'27.2718"

Water Levels
▼ During Drilling: 9 feet
▽ After Completion: 10 feet
◆ After 24-hours:

Depth in Feet	Surf. Elev. 682.77	Water Level	USCS	DESCRIPTION	Samples	Rec %	SPT Results	Qp tsf	w %	REMARKS
0	682			TOPSOIL (36")	1	56	3/3/4	1.75	25	
5	677		CL	Grayish Tan, very moist, medium stiff to soft, SILTY CLAY with trace sand	2	56	2/2/3		24	
			CL	Light Brown, moist, medium stiff, SANDY SILTY CLAY	3	100		0.5	17	Sample No. 3: Shelby tube pushed from 6 to 8 feet.
10		▼ ▽	CL	Grayish Brown, moist, medium stiff to stiff, SILTY CLAY with a little fine to medium grained sand and trace small gravel	4	67	3/4/6	2.25	15	
	672		CL	Grayish Brown, moist, stiff to very stiff, SILTY CLAY with trace fine sand	5	33	5/6/11	1.5	15	
15			CL	Gray, moist, very stiff, SILTY SANDY CLAY with a little small gravel	6	54		4.0	20	Sample No. 6: Shelby tube pushed from 13 to 15 feet.
	667		ML	Gray, moist, medium dense, SANDY SILT with trace clay	7	89	5/9/13			
20	662		CL	Gray, moist, very stiff to hard, SANDY SILTY CLAY with trace small gravel	8	89	6/6/7		11	Boring caved to 18 feet upon auger removal.
					9	78	6/8/9	4.5	13	
25	657				10	100	4/5/8		13	
					11	100	5/7/8	4.5	13	
30					12	89	4/7/10	>4.5	12	

Boring terminated at 30 feet.

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LOG OF BORING B-36A

Coal Refuse Impoundment No. 1
Bulldog Mine
Allerton - Homer, Illinois

Client Name	: Sunrise Coal, LLC	Driller	: Gary Taylor
Project Number	: 2-11-0383	Sampling	: Shelby Tube
Logged By	: T. Smith	Weather	: Sunny, 75F
Start Date	: 5/14/12		
Drilling Method	: HSA		

Water Levels
- During Drilling: Dry
- After Completion: Dry
- After 24-hours:

Depth in Feet	Surf. Elev. 683.54	Water Level	USCS	GRAPHIC	DESCRIPTION	Samples	Rec %	SPT Results	Qp tsf	w %	REMARKS
0	683				Boring B-36A offset 5 feet east from boring B-36. Refer to Boring B-36 for a description of soil strata.	1	34			25	Sample No. 1: Shelby tube pushed from 1 to 3 feet. Boring caved to 3 feet upon auger removal.
						2	34			27	Sample No. 2: Shelby tube pushed from 3 to 5 feet.
5	678					3	80			21	Sample No. 3: Shelby tube pushed from 5 to 7 feet.
						4	100			25	Sample No. 4: Shelby tube pushed from 8 to 10 feet.
10	673										
						5	34				Sample No. 5: Shelby tube pushed from 13 to 15 feet
15	668				Boring terminated at 15 feet.						
20	663										
25	658										
30											

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LOG OF BORING B-37

Coal Refuse Impoundment No. 1
Bulldog Mine
Allerton - Homer, Illinois

Client Name	: Sunrise Coal, LLC	Driller	: Gary Taylor
Project Number	: 2-11-0383	Sampling	: Splitspoon; Shelby Tube
Logged By	: T. Govert	Weather	: Sunny, 60F
Start Date	: 4/9/12	Latitude	: 39.58'37.5293
Drilling Method	: HSA	Longitude	: -87.54'16.4345"

Water Levels
▼ During Drilling: Dry
▽ After Completion: Dry
◆

Depth in Feet: 0, 5, 10, 15, 20, 25, 30

Surf. Elev. 681.86: 681, 676, 671, 666, 661, 656

Water Level	USCS	DESCRIPTION
		TOPSOIL (8")
	CH	Grayish Brown, moist to very moist, medium stiff to soft, CLAY
	CL	Tan, moist, medium stiff to stiff, SILTY CLAY with trace sand and small gravel
	CL	Brown, moist, medium stiff to stiff, SILTY CLAY with trace sand and gravel
	CL	Brown, moist, medium stiff to stiff, SILTY CLAY with trace sand and small gravel
	CL	Gray, slightly moist, very stiff to hard, SANDY SILTY CLAY with trace small gravel

Samples	Rec %	SPT Results	Qp tsf	w %	REMARKS
1	56	3/3/3		24	Sample No.1: Atterberg Limits Tests: LL=57, PL=22, PI=35
2	17	3/2/2		24	
3	63		1.25	21	Sample No. 3: Shelby tube pushed from 5 to 7 feet.
4	83		0.75	20	Sample No. 4: Shelby tube pushed from 8 to 10 feet.
5	100	10/7/9	4.0	12	
6	100	6/6/7		11	Sample No. 6: Shelby tube pushed from 13 to 15 feet.
7	67	5/7/8	4.25	11	
8	78	5/8/11	4.25	13	Boring caved to 18 feet upon auger removal.
9	67	6/7/6		13	
10	100	5/7/9	4.5	11	
11	67	6/10/12	>4.5	11	
12	89	7/8/8	4.5	11	

Boring terminated at 30 feet.

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LOG OF BORING B-38

Coal Refuse Impoundment No. 1
Bulldog Mine
Allerton - Homer, Illinois

Client Name	: Sunrise Coal, LLC	Driller	: Gary Taylor
Project Number	: 2-11-0383	Sampling	: Splitspoon
Logged By	: T. Govert	Weather	: Sunny, 60F
Start Date	: 4/6/12	Latitude	: 39.58'35.0803"
Drilling Method	: HSA	Longitude	: -87.54'30.8938"

Water Levels
▼ During Drilling: 7 feet
▽ After Completion: 12 feet
◆ After 24-hours:

Depth in Feet	Surf. Elev. 682.87	Water Level	USCS	DESCRIPTION	Samples	Rec %	SPT Results	Qp tsf	w %	REMARKS
0–2.5			CH	Dark Brown, very moist, medium stiff, CLAY	1	67	3/3/4		26	Sample No. 1: Atterberg Limits Tests: LL=60, PL=25, PI=35
2.5–7.5		▼ (7 ft)	CL	Gray, Tan & Brown mottled, moist to very moist, medium stiff to very soft, SANDY SILTY CLAY	2	0	4/4/4			Sample No. 2: Splitspoon sampler driven twice with no recovery. Classification based on field observation.
					3	56	1/1/2		23	Sample No. 3: Unconfined Compressive Strength Test: Qu=0.5 tsf
7.5–10.5			CL	Gray & Tan Mottled, moist, stiff, SILTY CLAY with a little sand	4	100	4/7/7	1.75	15	
10.5–23		▽ (12 ft)	CL	Grayish Brown, slightly moist, stiff to very stiff, SANDY SILTY CLAY with trace gravel	5	100	6/7/7		11	Boring caved to 12 feet upon auger removal.
					6	0	9/17/18			Sample No. 6: Splitspoon sampler driven twice with no recovery. Classification based on field observation.
					7	100	6/7/8	4.0	12	
					8	89	9/8/8	3.75	13	
					9	100	5/8/9	3.5	12	
23–28			CH	Gray, moist, very stiff, CLAY with a little sand and gravel	10	67	9/10/13	3.0	14	
					11	67	9/11/14	3.0	14	
28–30			CL	Gray, moist, very stiff to hard, SILTY CLAY with a little sand and trace small gravel	12	100	9/7/11	4.0	12	

Depth scale (feet): 0, 5, 10, 15, 20, 25, 30
Elevation scale: 682, 677, 672, 667, 662, 657

Boring terminated at 30 feet.

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LOG OF BORING B-39

Coal Refuse Impoundment No. 1
Bulldog Mine
Allerton - Homer, Illinois

Client Name	: Sunrise Coal, LLC	Driller	: Gary Taylor
Project Number	: 2-11-0383	Sampling	: Splitspoon
Logged By	: T. Govert	Weather	: Sunny, 50F
Start Date	: 4/6/12	Latitude	: 39.58'35.0337"
Drilling Method	: HSA	Longitude	: -87.54'21.7327"

Water Levels
- During Drilling: Dry
- After Completion: 23 feet
- After 24-hours:

Depth in Feet	Surf. Elev. 681.21	Water Level	USCS	GRAPHIC	DESCRIPTION	Samples	Rec %	SPT Results	Qp tsf	w %	REMARKS
0	681				TOPSOIL (36")	1	33	4/4/4		25	Sample No. 1: Atterberg Limits Tests: LL=65, PL=26, PI=39
			CL		Brown, moist, medium stiff to very stiff, SANDY CLAY with trace small gravel	2	67	3/3/4	1.5	14	
5	676					3	78	6/4/6	1.75	15	Sample No. 3: Atterberg Limits Tests: LL=23, PL=15, PI=18
						4	67	6/7/10	2.25	17	
10	671		CL		Gray, slightly moist, very stiff, SANDY SILTY CLAY with trace gravel	5	78	6/8/11	3.0	13	
			CL		Gray, slightly moist, hard to very stiff, SANDY SILTY CLAY with trace small gravel	6	100	9/13/17	>4.5	12	
15	666					7	67	8/8/10	>4.5	12	
						8	89	5/7/6	>4.5	11	
20	661					9	89	5/5/6	2.5	11	
		∇ (23 ft)				10	67	5/6/7		13	Boring caved to 24 feet upon auger removal.
25	656					11	100	6/7/9	4.5	13	
						12	0	6/7/8			Sample No. 12: Splitspoon sampler driven twice with no recovery. Classification based on field observation.
30											

Boring terminated at 30 feet.

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LOG OF BORING B-39A

Coal Refuse Impoundment No. 1
Bulldog Mine
Allerton - Homer, Illinois

Client Name	: Sunrise Coal, LLC	Driller	: Gary Taylor
Project Number	: 2-11-0383	Sampling	: Shelby Tube
Logged By	: T. Smith	Weather	: Sunny, 70F
Start Date	: 5/14/12		
Drilling Method	: HSA		

Water Levels
▼ During Drilling: 6.5 feet
▽ After Completion: 9.5 feet
◆ After 24-hours:

Depth in Feet	Surf. Elev. 683.54	Water Level	USCS	GRAPHIC	DESCRIPTION	Samples	Rec %	SPT Results	Qp tsf	w %	REMARKS
0–3	683				Boring B-39A offset 5 feet east from boring B-39. Refer to Boring B-39 for a description of soil strata.	1	55			26	Sample No. 1: Shelby tube pushed from 1 to 3 feet. Loss on Ignition (LOI) Organic Content = 7.1%
3–5						2	92			28	Sample No. 2: Shelby tube pushed from 3 to 5 feet.
5–7	678	▼				3	100			32	Sample No. 3: Shelby tube pushed from 5 to 7 feet.
8–10		▽				4	100			18	Sample No. 4: Shelby tube pushed from 8 to 10 feet.
10	673										Boring caved to 10 feet upon auger removal.
13–14.5						5					Sample No. 4: Shelby tube pushed from 13 to 14.5 feet.
15	668				Boring terminated at 14.5 feet.						
20	663										
25	658										
30											

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LOG OF BORING B-40

Coal Refuse Impoundment No. 1
Bulldog Mine
Allerton - Homer, Illinois

Client Name	: Sunrise Coal, LLC	Driller	: Gary Taylor
Project Number	: 2-11-0383	Sampling	: Splitspoon; Shelby Tube
Logged By	: T. Govert	Weather	: Sunny, 60F
Start Date	: 4/9/12	Latitude	: 39.58'35.0720
Drilling Method	: HSA	Longitude	: -87.54'13.9931"

Water Levels
- During Drilling: Dry
- After Completion: Dry
- After 24-hours:

Depth in Feet: 0, 5, 10, 15, 20, 25, 30
Surf. Elev. 682.77: 682, 677, 672, 667, 662, 657

USCS	DESCRIPTION
	TOPSOIL (10")
CH	Dark Gray, moist, medium stiff, CLAY
ML	Reddish Gray, moist, medium stiff to stiff, CLAYEY SILT with trace fine sand
ML	Grayish Tan, moist, stiff to very stiff, CLAYEY SILT with a little fine sand
CL	Gray, slightly moist, stiff to very stiff, SILTY CLAY with trace fine sand and trace gravel
ML	Gray, slightly moist, stiff, CLAYEY SILT with trace fine sand

Boring terminated at 30 feet.

Samples	Rec %	SPT Results	Qp tsf	w %
1	78	3/3/5		21
2	50			
3	100	2/3/4	1.5	20
4	78	2/4/8	3.75	20
5	67	4/5/7	3.25	21
6	67	6/5/6		13
7	56	6/7/7		11
8	100	6/8/9	4.5	13
9	67	7/8/10	3.5	12
10	78	5/6/6	2.0	12
11	67	5/7/6	2.5	13
12	89	6/5/7		12

REMARKS

Sample No. 1:
Atterberg Limits Tests:
LL=54, PL=20, PI=34

Sample No. 2:
Shelby tube pushed from 3 to 5 feet.

Boring caved to 20 feet upon auger removal.

MONITORING WELL LOGS

PATRIOT ENGINEERING and Environmental Inc.
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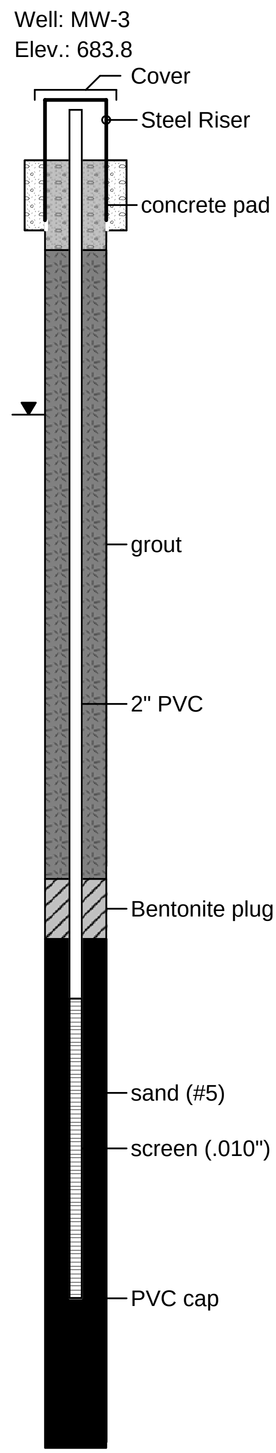
LOG OF BORING MW-3

Monitoring Well
Allerton Mine
Allerton-Homer, Illinois

Client Name	: Sunrise Coal, LLC	Latitude:	: 39.58'55"
Logged By	: T. Govert	Longitude	: 87.54'37"
Start Date	: 9/9/11		
Drilling Method	: HSA/ Washboring		
Driller	: G Taylor		

Depth in Feet	Surf. Elev. 681.8	DESCRIPTION	REMARKS
0	682	Topsoil (6")	
0.5		Brown & Gray Clay	
5	677		
			Initial groundwater @ 673.3' on 9/13/11 prior to developing; Bailed clear to 20-ft
10	672		
15	667		
		Glacial Till	
20	662		
25	657		
30	652		
35	647		
		Limestone	Auger-drilled to 38-feet (refusal on rock); rotary drilled to 43-feet
40	642		
			Boring terminated at 43-ft.
45			



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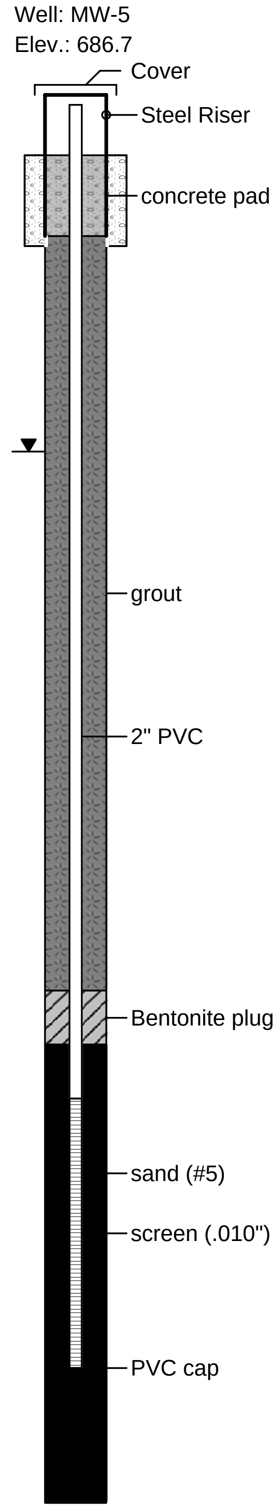
LOG OF BORING MW-5

Monitoring Well
Allerton Mine
Allerton-Homer, Illinois

Client Name	: Sunrise Coal, LLC	Latitude:	: 39.58'29"
Logged By	: T. Govert	Longitude	: 87.54'37"
Start Date	: 9/9/11		
Drilling Method	: HSA/ Washboring		
Driller	: G Taylor		

Depth in Feet	Surf. Elev. 683.7	Water Level	GRAPHIC	DESCRIPTION	REMARKS
0	683			Topsoil (9")	
				Brown & Gray Clay	
5	678				
10	673	▼			Initial groundwater @ 672.7' on 9/13/11 prior to developing; Bailed clear to 23.4-ft
15	668				
20	663			Glacial Till	
25	658				
30	653				
35	648				
40	643				
45	638			Limestone	Auger-drilled to 45-feet (refusal on rock); rotary drilled to 50-feet
50					Boring terminated at 50-ft.



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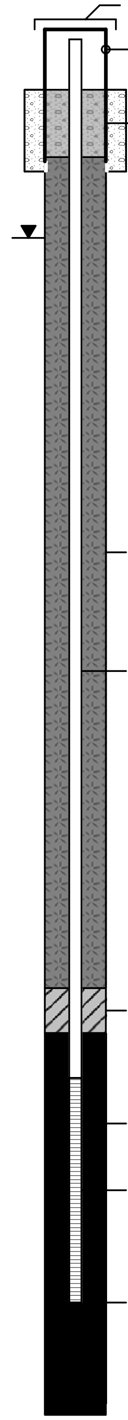
LOG OF BORING MW-6

(Page 1 of 1)

Monitoring Well
Allerton Mine
Allerton-Homer, Illinois

Client Name	: Sunrise Coal, LLC	Latitude:	: 39.58'29"
Logged By	: T. Govert	Longitude	: 87.54'03"
Start Date	: 9/9/11		
Drilling Method	: HSA/ Washboring		
Driller	: G Taylor		

Depth in Feet	Surf. Elev. 679.2	Water Level	GRAPHIC	DESCRIPTION	REMARKS
0	679			Topsoil (9") Brown & Gray Clay	
5	674	▼			Initial groundwater @ 672.6' on 9/13/11 prior to developing; Bailed clear to 34.3-ft
10	669				
15	664				
20	659				
25	654			Glacial Till	
30	649				
35	644				
40	639				
45	634				
50	629				
55	624			Limestone	Auger-drilled to 54-feet (refusal on rock); rotary drilled to 59-feet
60					Boring terminated at 59-ft.



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BORING LOG KEY

PATRIOT ENGINEERING and Environmental, Inc.
Engineering Value for Project Success

BORING LOG KEY

UNIFIED SOIL CLASSIFICATION SYSTEM
FIELD CLASSIFICATION SYSTEM
FOR SOIL EXPLORATION

NON COHESIVE SOILS
(Silt, Sand, Gravel and Combinations)

Density

Very Loose	-4 blows/ft. or less
Loose	-5 to 10 blows/ft.
Medium Dense	-11 to 30 blows/ft.
Dense	-31 to 50 blows/ft.
Very Dense	-51 blows/ft. or more

Grain Size Terminology

Soil Fraction		Particle Size	US Standard Sieve Size
Boulders		Larger than 12”	Larger than 12”
Cobbles		3” to12”	3” to 12”
Gravel:	Coarse	¾” to 3”	¾” to 3”
	Small	4.76mm to ¾”	#4 to ¾”
Sand:	Coarse	2.00mm to 4.76mm	#10 to #4
	Medium	0.42mm to 2.00mm	#40 to #10
	Fine	0.074mm to 0.42mm	#200 to #40
Silt		0.005mm to 0.074 mm	Smaller than #200
Clay		Smaller than 0.005mm	Smaller than #200

RELATIVE PROPORTIONS FOR SOILS

Descriptive Term	Percent
Trace	1 - 10
Little	11 - 20
Some	21 - 35
And	36 - 50

COHESIVE SOILS
(Clay, Silt and Combinations)

Consistency	Field Identification	Unconfined Compressive Strength (tons/sq. ft.)
Very Soft	Thumb will penetrate soil more than 1 inch	Less than 0.25
Soft	Thumb will penetrate soil about 1 inch	0.25 – < 0.5
Medium Stiff	Thumb will penetrate soil about ½ inch	0.5 - < 1.0
Stiff	Thumb will indent soil about ¼ inch	1.0 - < 2.0
Very Stiff	Readily indented by thumbnail	2.0 - < 4.0
Hard	Indented with difficulty by thumbnail	Over 4.0

Classification on logs are made by visual inspection.

Standard Penetration Test - Driving a 2.0” O.D., $1^{3/8}$” I.D., sampler a distance of 1.0 foot into undisturbed soil with a 140 pound hammer free falling a distance of 30.0 inches. It is customary for **Patriot** to drive the spoon 6.0 inches to seat into undisturbed soil, then perform the test. The number of hammer blows for seating the spoon and making the tests are recorded for each 6.0 inches of penetration on the drill log (Example - 6/8/9). The standard penetration test results can be obtained by adding the last two figures (i.e. 8 + 9 = 17 blows/ft.).

Strata Changes - In the column “Soil Descriptions” on the drill log the horizontal lines represent strata changes. A solid line (———) represents an actually observed change, a dashed line (- - - - - -) represents an estimated change.

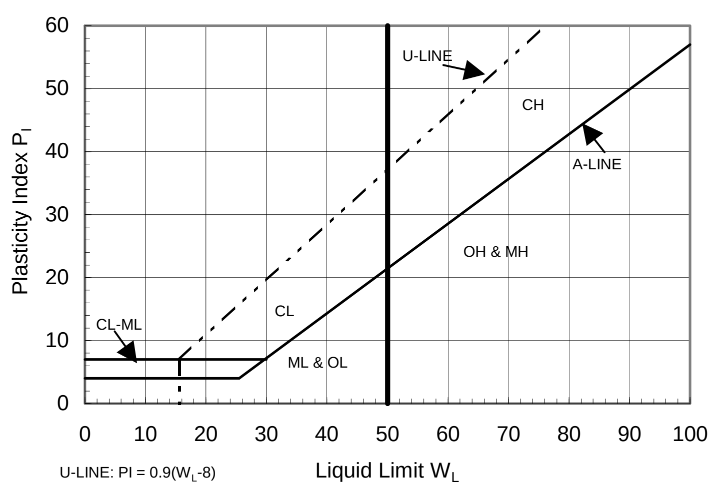
Groundwater observations were made at the times indicated. Porosity of soil strata, weather conditions, site topography, etc., may cause changes in the water levels indicated on the logs.

Groundwater symbols: ▼-observed groundwater elevation, encountered during drilling; ∇-observed groundwater elevation upon completion of boring.

UNIFIED SOIL CLASSIFICATION SYSTEM
(USCS)

Unified Soil Classification System

Major Divisions			Group Symbol		Typical Names	Classification Criteria for Coarse-Grained Soils		
Coarse-grained soils (more than half of material is larger than No. 200)	Gravels (more than half of coarse fraction is larger than No. 4 sieve size)	Clean gravels (little or no fines)	GW		Well-graded gravels, gravel-sand mixtures, little or no fines	$C_U \geq 4$ $1 \leq C_C \leq 3$	$C_U = \frac{D_{60}}{D_{10}}$	$C_C = \frac{D^2_{30}}{D_{10}\,D_{60}}$
			GP		Poorly graded gravels, gravel-sand mixtures, little or no fines	Not meeting all gradation requirements for GW ($C_U < 4$ or $1 > C_C > 3$)		
		Gravels with fines (appreciable amount of fines)	GM	*d* *u*	Silty gravels, gravel-sand-silt mixtures	Atterberg limits below A line or $P_I < 4$	Above A line with $4 < P_I < 7$ are borderline cases requiring use of dual symbols	
			GC		Clayey gravels, gravel-sand-clay mixtures	Atterberg limits above A line or $P_I > 7$		
	Sands (more than half of coarse fraction is smaller than No. 4 sieve size)	Clean sands (little or no fines)	SW		Well-graded sands, gravelly sands, little or no fines	$C_U \geq 6$ $1 \leq C_C \leq 3$	$C_U = \frac{D_{60}}{D_{10}}$	$C_C = \frac{(D_{30})^2}{D_{10}\,D_{60}}$
			SP		Poorly graded sands, gravelly sands, little or no fines	Not meeting all gradation requirements for SW ($C_U < 6$ or $1 > C_c > 3$)		
		Sands with fines (appreciable amount of fines)	SM	*d* *u*	Silty sands, sand-silt mixtures	Atterberg limits below A line or $P_I < 4$	Limits plotting in hatched zone with $4 \leq P_I \leq 7$ are borderline cases requiring use of dual symbols	
			SC		Clayey sands, sand-clay mixtures	Atterberg limits above A line with $P_I > 7$		
Fine-grained soils (more than half of material is smaller than No. 200)	Silt and clays (liquid limit <50)		ML		Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity	1. Determine percentages of sand and gravel from grain size curve. 2. Depending on percentages of fines (fraction smaller than 200 sieve size), coarse-grained soils are classified as follows: Less than 5% - GW, GP, SW, SP More than 12% - GM, GC, SM, SC 5-12% - Borderline cases requiring dual symbols		
			CL		Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays			
			OL		Organic silts and organic silty clays of low plasticity			
	Silts and clays (liquid limit >50)		MH		Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts			
			CH		Inorganic clays or high plasticity, fat clays			
			OH		Organic clays of medium to high plasticity, organic silts			
	Highly organic soils		PT		Peat and other highly organic soils			



U-LINE: PI = 0.9(W_L-8)
A-LINE: PI = 0.73(W_L-20)

Plasticity Chart

APPENDIX B

LABORATORY TESTING RESULTS

ATTERBERG LIMITS
TEST RESULTS

PATRIOT ENGINEERING and Environmental, Inc.
Engineering Value for Project Success
Consulting Environmental, Geotechnical and Materials Engineers

SUMMARY OF ATTERBERG LIMITS TEST RESULTS

Project Name: Coal Refuse Impoundment No. 1
Client: Sunrise Coal
Patriot Project No.: 2-11-0383
Client Address:
Project Location: Allerton-Homer, Illinois

TEST NUMBER	BORING NUMBER	SAMPLE NUMBER	SAMPLE DEPTH (FEET)	CLASSIFICATION (USCS)	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTIC INDEX (PI)
1	B-25	SS-6	13.5 - 15	SANDY CLAY	19	12	17
2	B-25	SS-9	21 - 22.5	SANDY CLAYEY SILT	20	18	2
3	B-26	SS-2	3.5 - 5	SILTY CLAY	48	18	30
4	B-27	SS-2	3.5 - 5	SILTY CLAY	41	18	23
5	B-28	SS-1	1 - 2.5	CLAY	54	23	31
6	B-31	SS-1	1 - 2.5	CLAY	59	22	37
7	B-31	SS-2	3.5 - 5	SILTY CLAY	28	16	12
8	B-31	SS-3	6 - 7.5	SANDY SILTY CLAY	26	16	10
9	B-31	SS-4	8.5 - 10	SANDY SILTY CLAY	25	14	11
10	B-31	SS-5	11 - 12.5	SANDY SILTY CLAY	23	15	8
11	B-32	SS-2	3.5 - 5	SILTY CLAY	28	15	13
12	B-32	SS-3	6 - 7.5	SILTY CLAY	26	15	11
13	B-32	SS-5	11 - 12.5	SANDY SILTY CLAY	19	13	6
14	B-35	SS-2	3.5 - 5	SANDY SILTY CLAY	25	15	10
15	B-36	ST-3	5 - 7	SILTY CLAY	29	17	12
16	B-36	ST-4	8 - 10	SILTY CLAY	39	19	20
17	B-37	SS-1	1 - 2.5	CLAY	57	22	35
18	B-38	SS-1	1 - 2.5	CLAY	60	25	35
19	B-39	SS-1	1 - 2.5	ORGANIC	65	26	39
20	B-39	SS-3	6 - 7.5	SANDY CLAY	23	15	18
21	B-40	SS-1	1 - 2.5	CLAY	54	20	34

LOSS ON IGNITION (LOI) TEST RESULTS
(ORGANIC CONTENT)

PATRIOT ENGINEERING and Environmental, Inc.
Engineering Value for Project Success
Consulting Environmental, Geotechnical and Materials Engineers

SUMMARY OF LOSS ON IGNITION TEST RESULTS (ORGANIC CONTENT)

Project Name: Coal Refuse Impoundment No. 1
Patriot Project No.: 2-11-0383
Project Location: Allerton-Homer, Illinois
Client: Sunrise Coal
Client Address:

TEST NUMBER	BORING NUMBER	SAMPLE NUMBER	SAMPLE DEPTH (FEET)	CLASSIFICATION (USCS)	NATURAL MOISTURE CONTENT (PERCENT (%))	ORGANIC CONTENT (PERCENT (%))
1	B-23B	ST-1	1 - 3	NOT APPLICABLE (TOPSOIL)	22	5.4
2	B-26A	ST-1	1 - 3	NOT APPLICABLE (TOPSOIL)	24	3.8
3	B-39A	ST-1	1 - 3	NOT APPLICABLE (TOPSOIL)	26	7.1

NATURAL DENSITY TEST RESULTS
(UNIT WEIGHTS)

PATRIOT ENGINEERING and Environmental, Inc.
Engineering Value for Project Success
Consulting Environmental, Geotechnical and Materials Engineers

SUMMARY OF NATURAL DENSITY TEST RESULTS (UNIT WEIGHTS)

Project Name: Coal Refuse Impoundment No. 1
Patriot Project No.: 2-11-0383
Project Location: Allerton-Homer, Illinois
Client: Sunrise Coal
Client Address:

TEST NUMBER	BORING NUMBER	SAMPLE NUMBER	SAMPLE DEPTH (FEET)	CLASSIFICATION (USCS)	WET UNIT WEIGHT (POUNDS PER CUBIC FOOT (pcf))	DRY UNIT WEIGHT (POUNDS PER CUBIC FOOT (pcf))
1	B-23B	ST-3	5 - 7	SILTY CLAY	123	99
2	B-26A	ST-3	5 - 7	SILTY CLAY	139	117
3	B-26A	ST-5	13 - 15	SILTY CLAY	134	114
4	B-32A	ST-4	8 - 10	SANDY CLAY	143	123
5	B-32A	ST-5	13 - 15	SANDY CLAY	139	121
6	B-33A	ST-1	1 - 3	NOT APPLICABLE (TOPSOIL)	115	96
7	B-33A	ST-2	3 - 5	SILTY CLAY	128	103
8	B-33A	ST-4	8 - 10	SILTY CLAY	139	119
9	B-33A	ST-5	13 - 15	SANDY CLAY	141	120
10	B-36A	ST-1	1 - 3	NOT APPLICABLE (TOPSOIL)	117	93
11	B-36A	ST-2	3 - 5	SILTY CLAY	122	97
12	B-36A	ST-3	5 - 7	SILTY CLAY	129	106
13	B-36A	ST-4	8 - 10	SILTY CLAY	124	99
14	B-39A	ST-2	3 - 5	SILTY CLAY	127	99
15	B-39A	ST-4	8 - 10	SILTY CLAY	137	119

UNCONFINED COMPRESSIVE STRENGTH TEST RESULTS

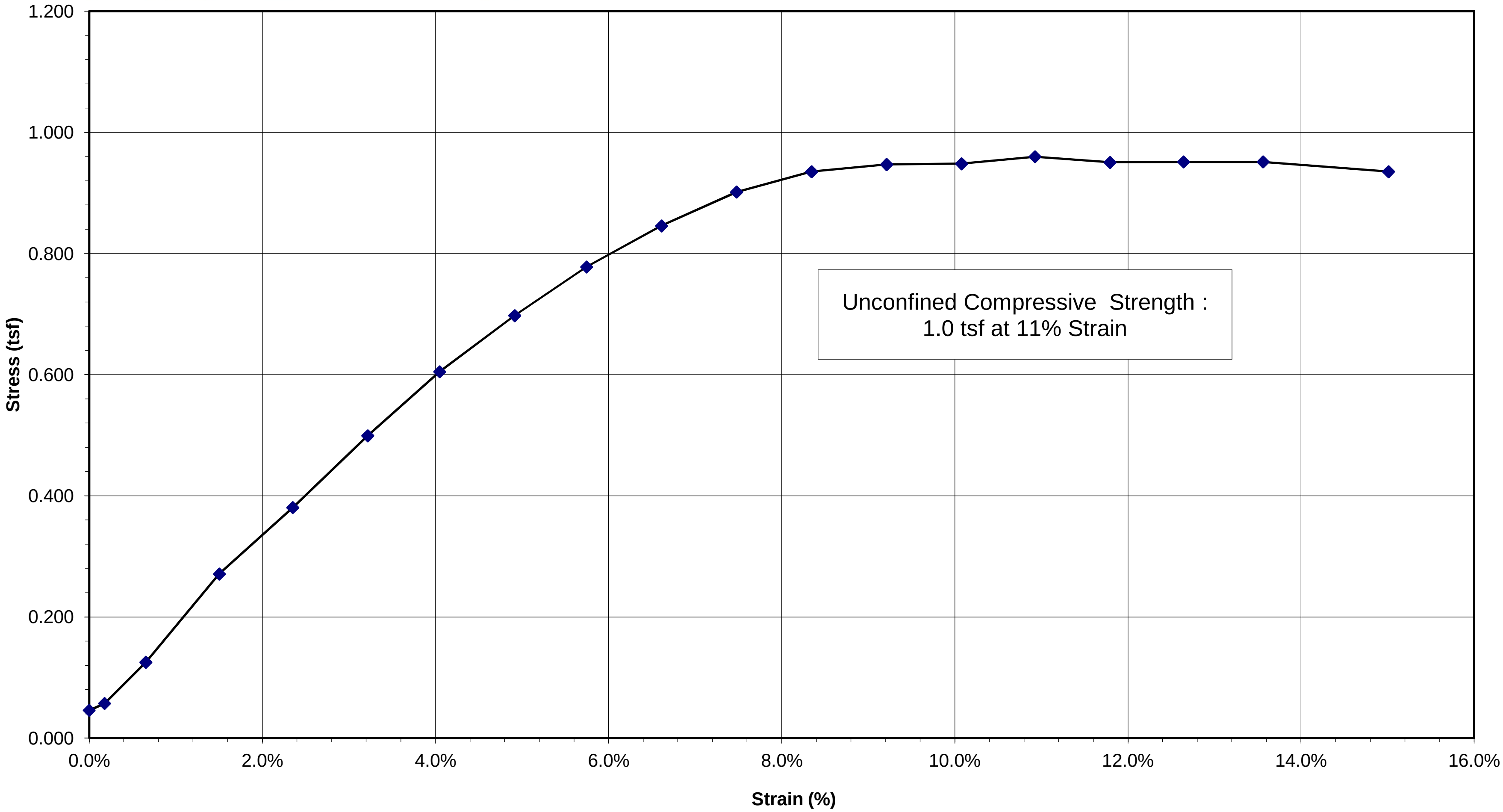
PATRIOT ENGINEERING and Environmental, Inc.
Engineering Value for Project Success
Consulting Environmental, Geotechnical and Materials Engineers

SUMMARY OF
UNCONFINED COMPRESSIVE STRENGTH TEST RESULTS

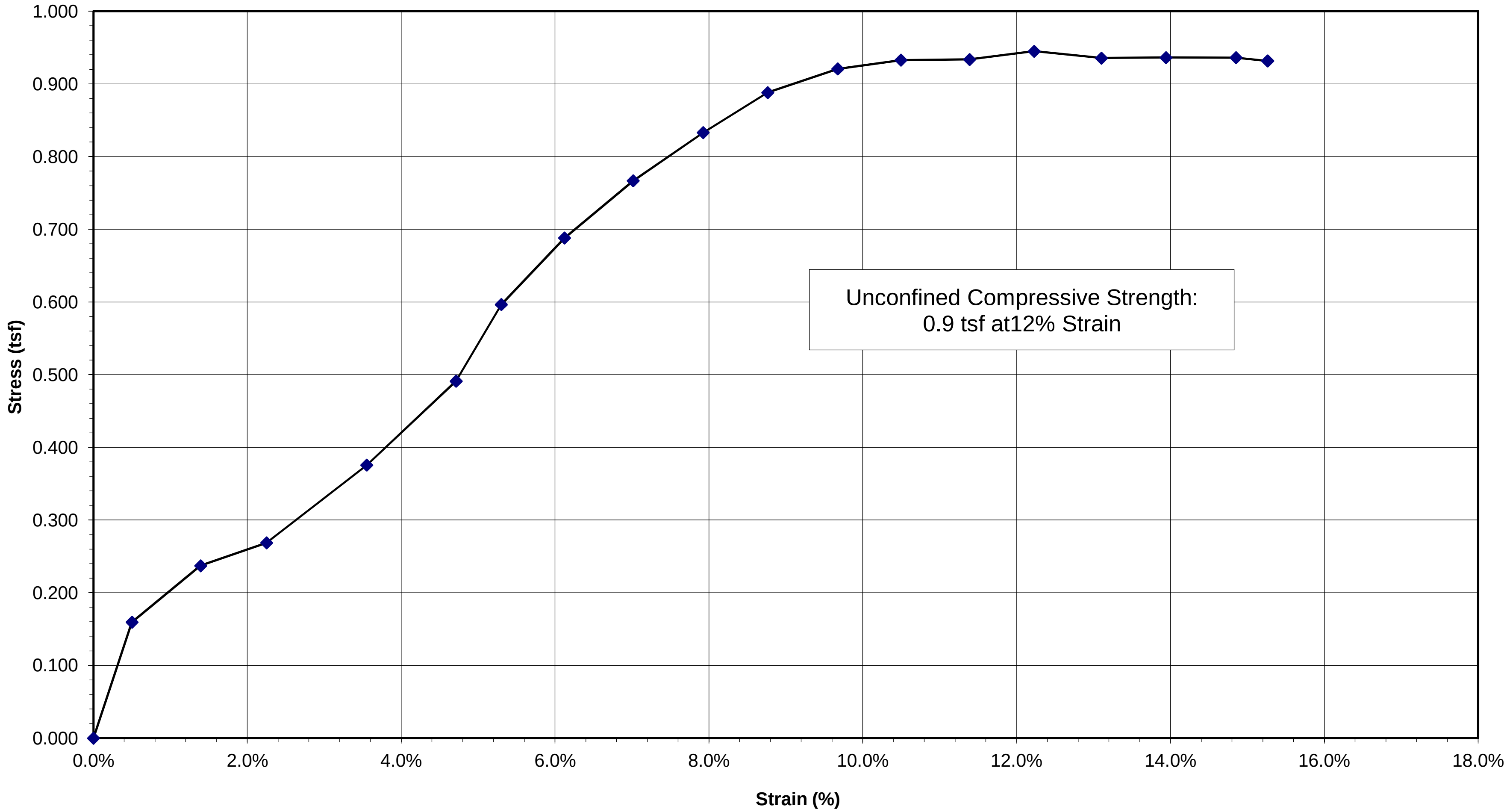
Project Name: Coal Refuse Impoundment No. 1
Client: Sunrise Coal
Patriot Project No.: 2-11-0383
Client Address:
Project Location: Allerton-Homer, Illinois

TEST NUMBER	BORING NUMBER	SAMPLE NUMBER	SAMPLE DEPTH (FEET)	CLASSIFICATION (USCS)	UNCONFINED COMPRESSIVE STRENGTH (TONS PER SQUARE FOOT (tsf))	STRAIN AT FAILURE (PERCENT (%))
1	B-25	ST-3	5 - 7	SILTY CLAY	1.0	11.0
2	B-33	ST-3	6 - 8	SANDY SILTY CLAY	0.9	12.0
3	B-36A	ST-4	8 - 10	SILTY CLAY	0.4	15
4	B-37	ST-4	8 - 10	SILTY CLAY	1.7	12
5	B-37	SS-10	23.5 - 25	SANDY SILTY CLAY	5.3	15
6	B-37	SS-11	26 - 27.5	SANDY SILTY CLAY	4.0	15
7	B-38	SS-3	6 - 7.5	SANDY SILTY CLAY	0.5	15
8	B-38	SS-8	18.5 - 20	SANDY SILTY CLAY	2.8	15
9	B-38	SS-9	21 - 22.5	SANDY SILTY CLAY	2.1	15
10	B-38	SS-12	28.5 - 30	SILTY CLAY	4.7	15

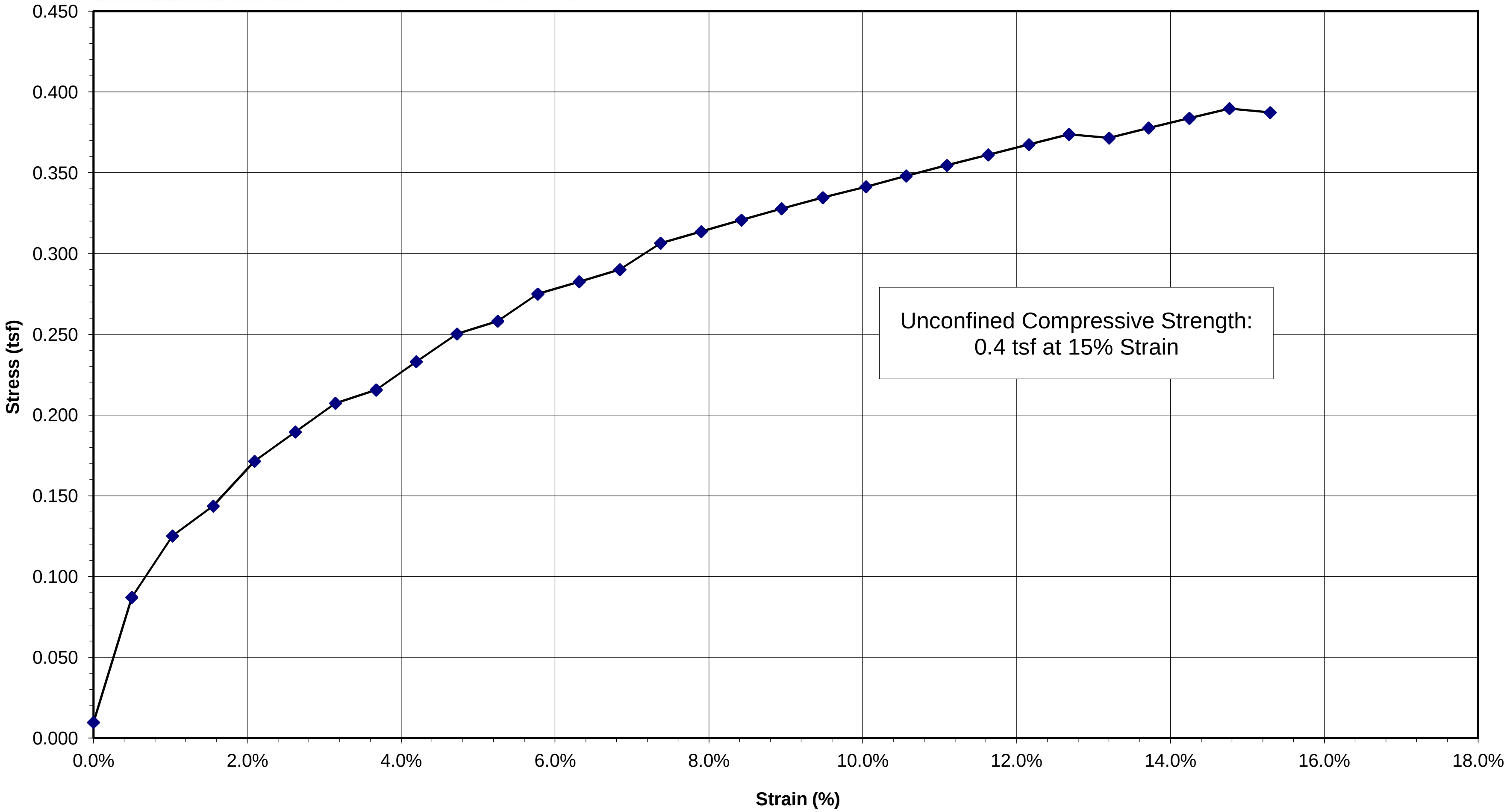
Unconfined Compressive Strength
Bulldog Mine
Patriot Project No.: 2-11-0383
B-25 (5 - 7 feet)



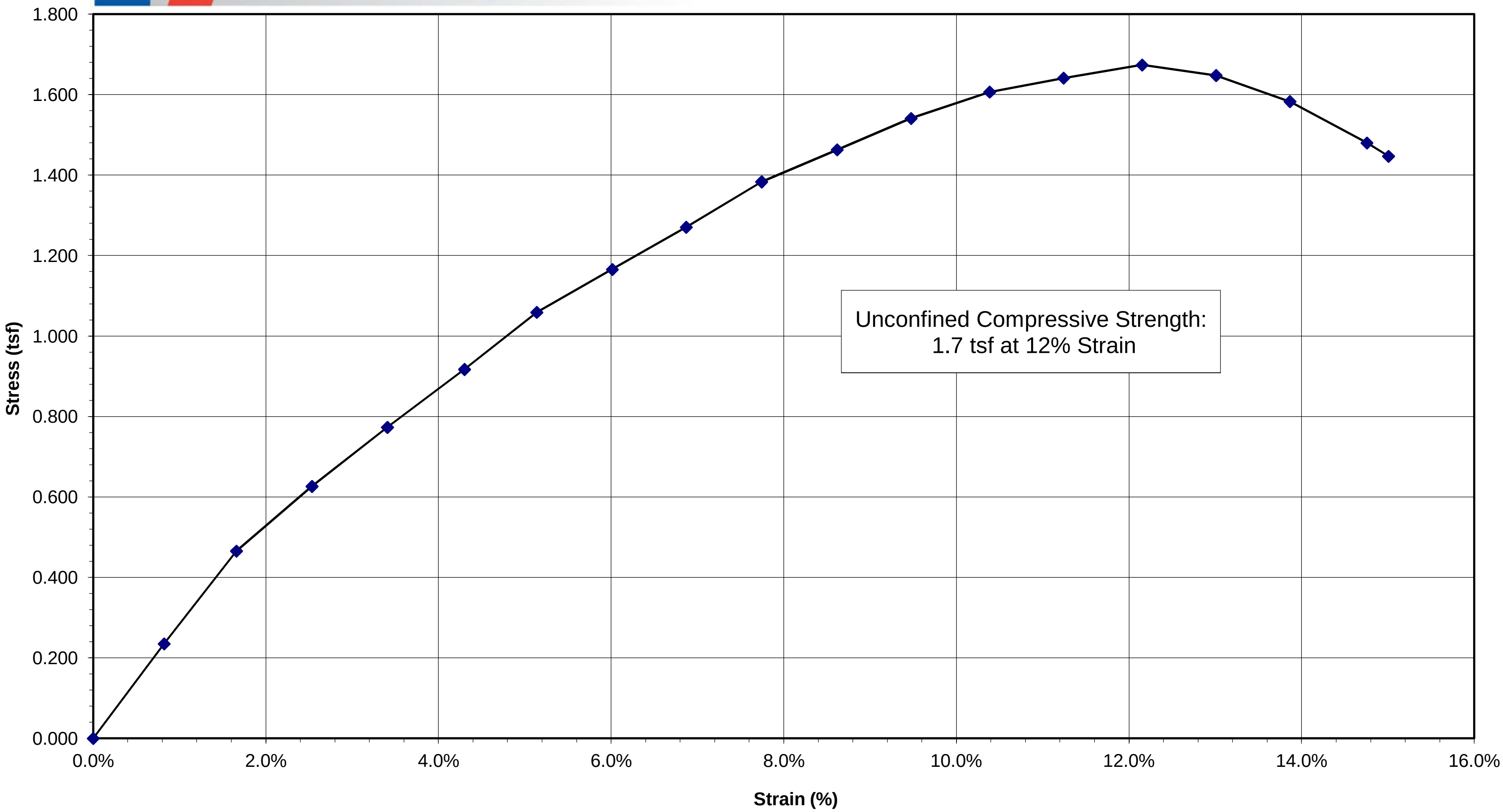
Unconfined Compressive Strength
Bulldog Mine
Patriot Project No.: 2-11-0383
B-33 (6 - 8 feet)



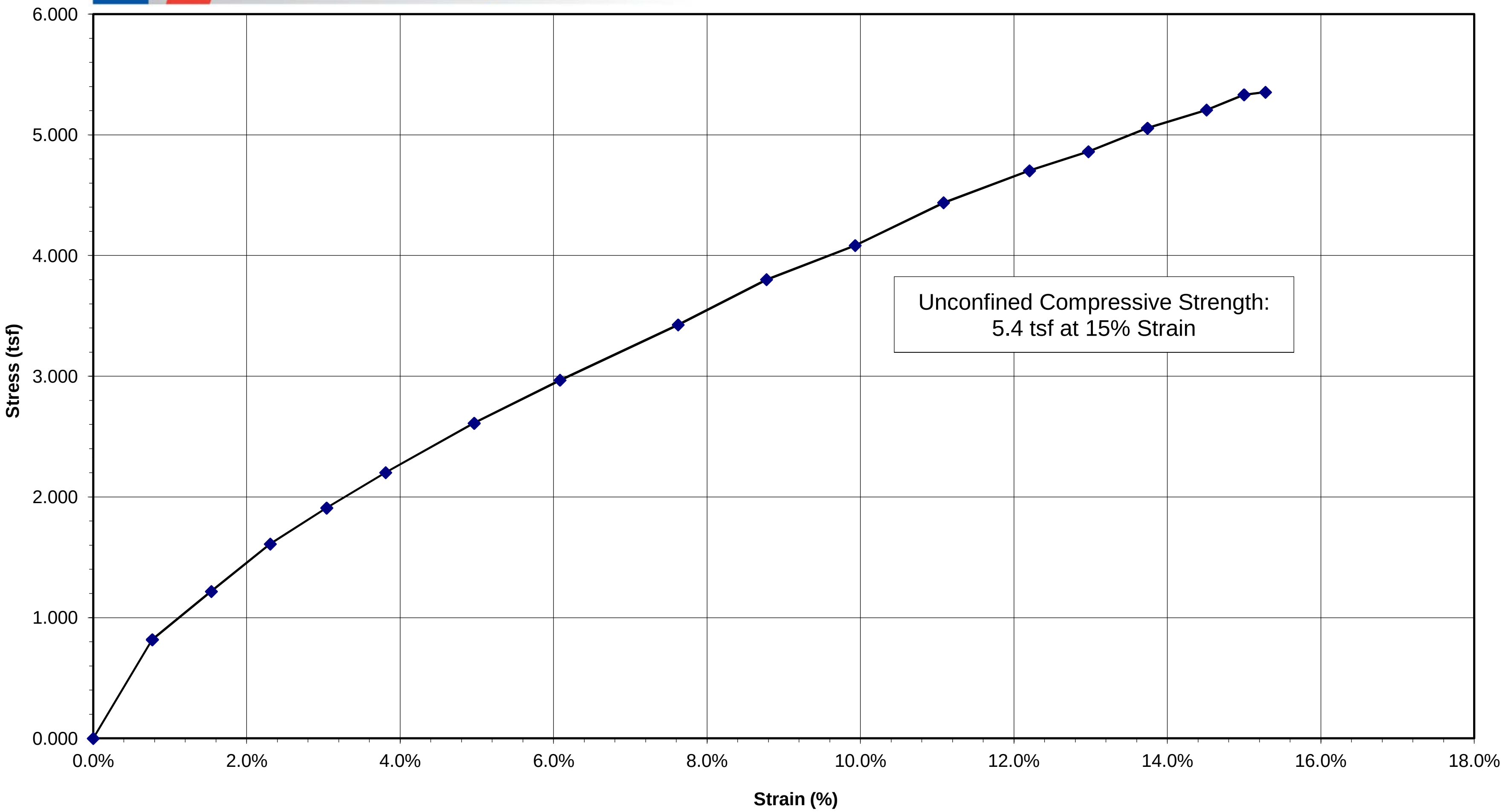
Unconfined Compressive Strength
Bulldog Mine
Patriot Project No.: 2-11-0383
B-36A (8 - 10 feet): Sample A



Unconfined Compressive Strength
Bulldog Mine
Patriot Project No.: 2-11-0383
B-37 (8 - 10 feet)



Unconfined Compressive Strength
Bulldog Mine
Patriot Project No.: 2-11-0383
B-37 (23.5 - 25 feet)



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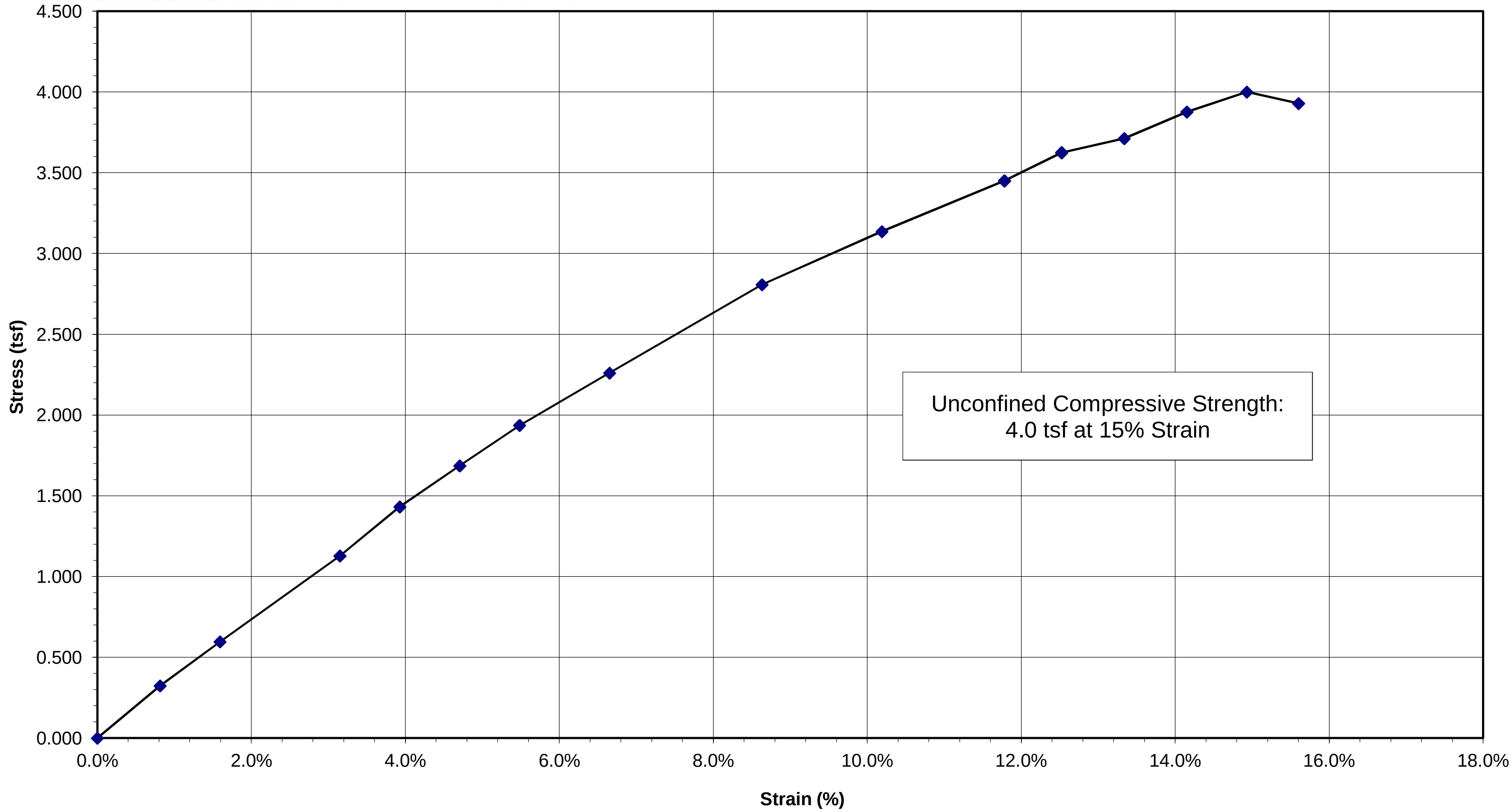
Unconfined Compressive Strength
Bulldog Mine
Patriot Project No.: 02-11-0383
B-37 (26 - 27.5 feet)



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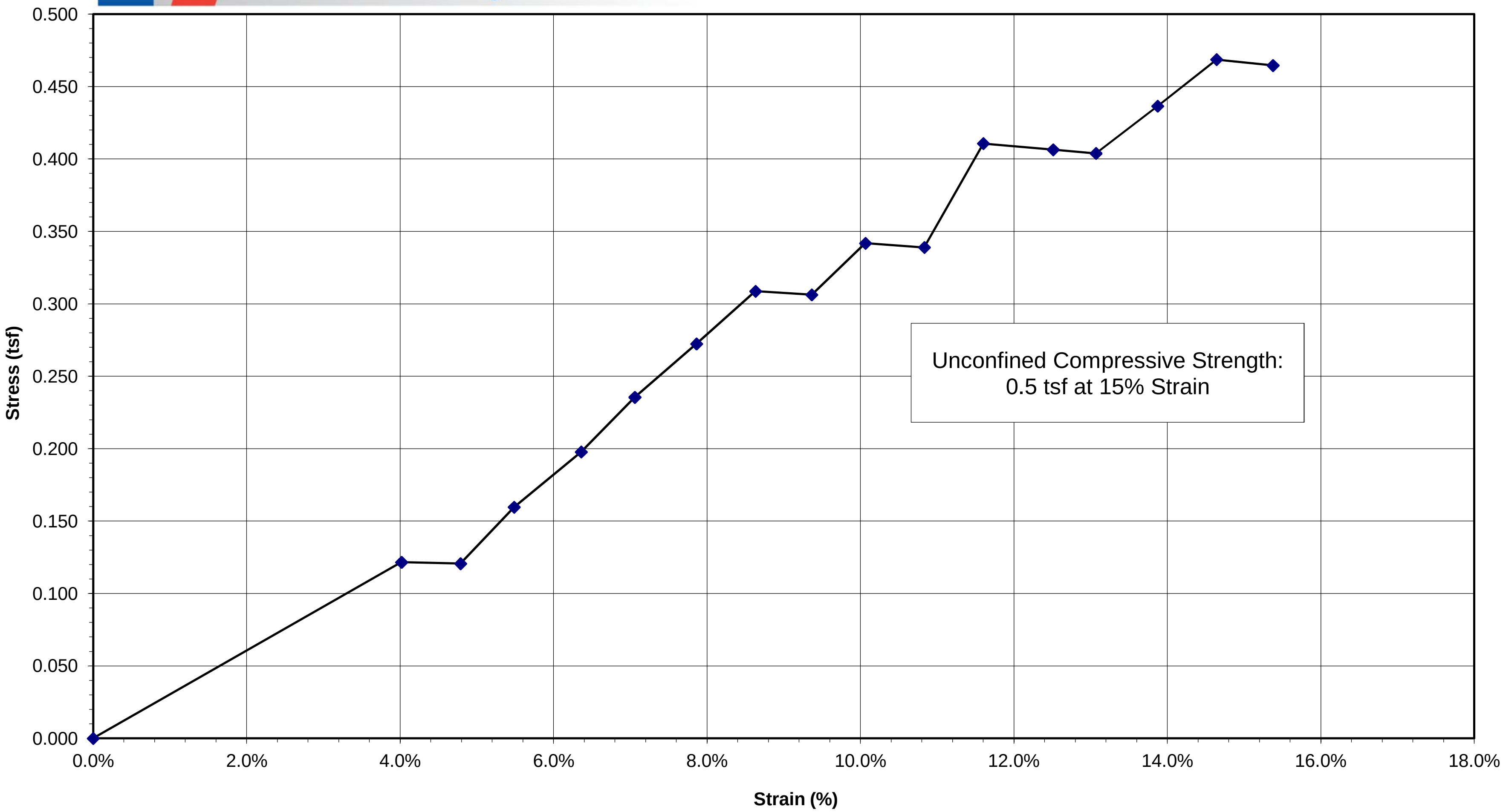
Unconfined Compressive Strength
Bulldog Mine
Patriot Project No.: 2-11-0383
B-38 (6 - 7.5 feet)



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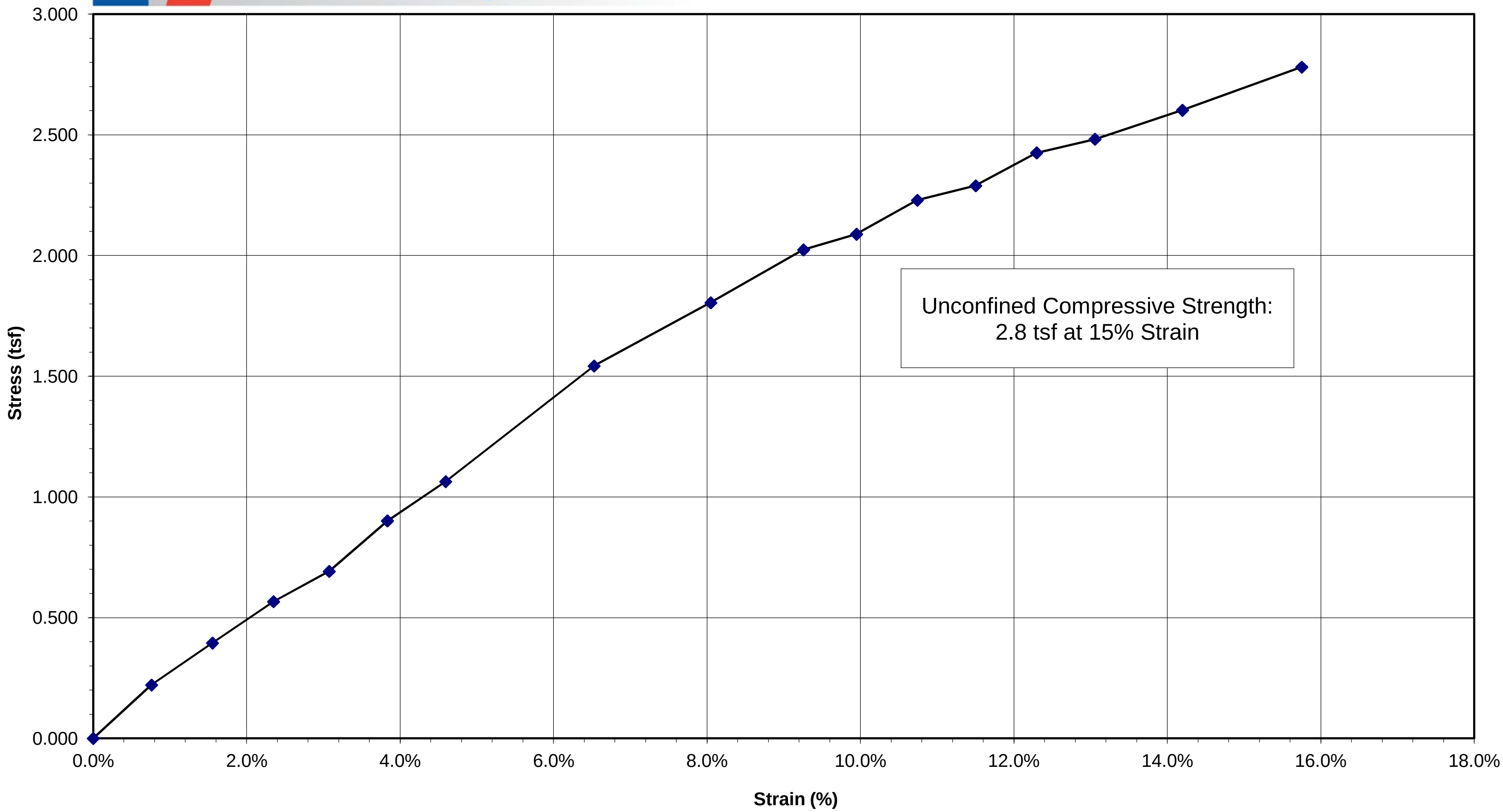
Unconfined Compressive Strength
Bulldog Mine
Patriot Project No.: 02-11-0383
B-38 (18.5 - 20 feet)



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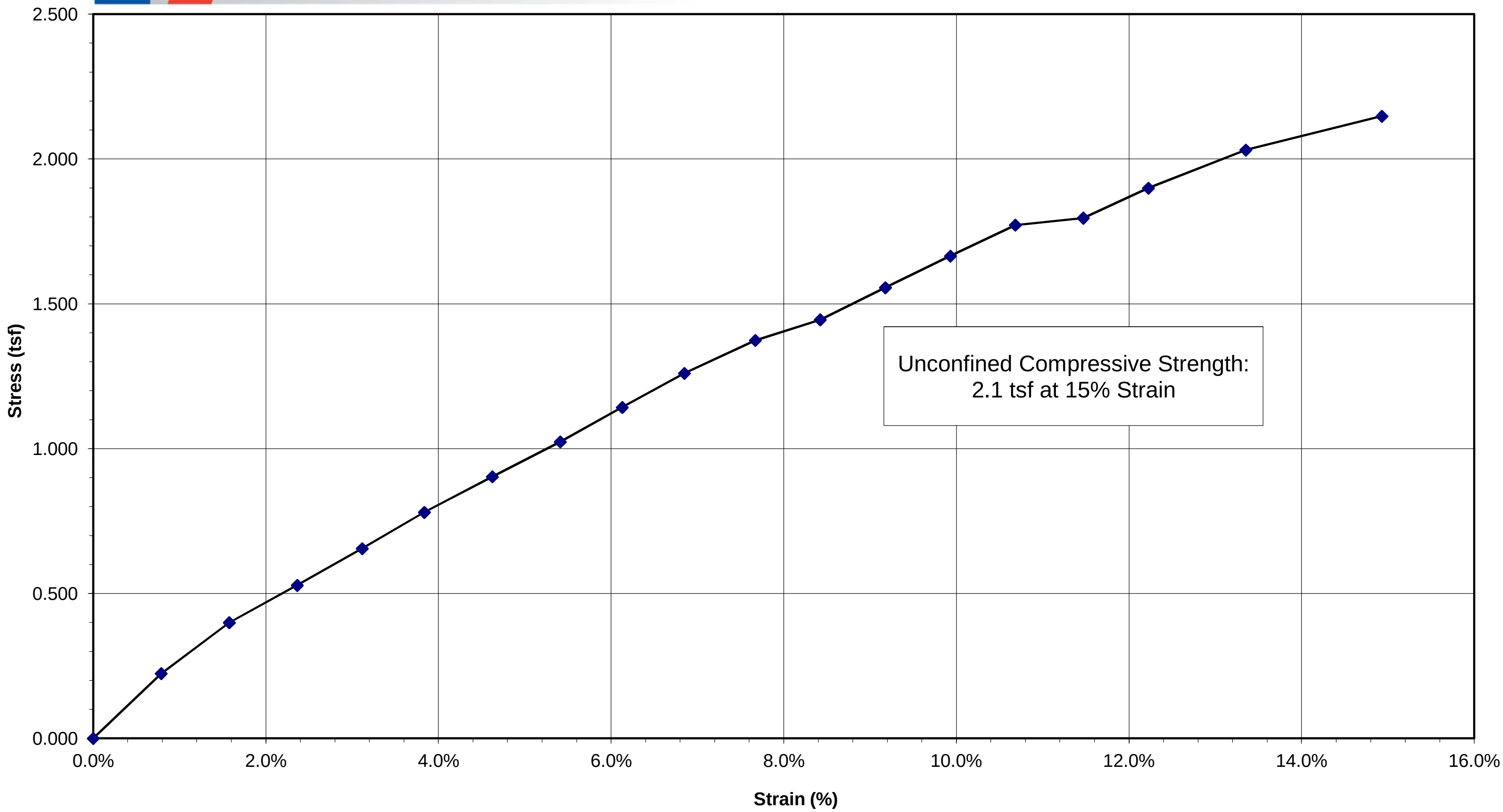
Unconfined Compressive Strength
Bulldog Mine
Patriot Project No.: 02-11-0383
B-38 (21 - 22.5 feet)



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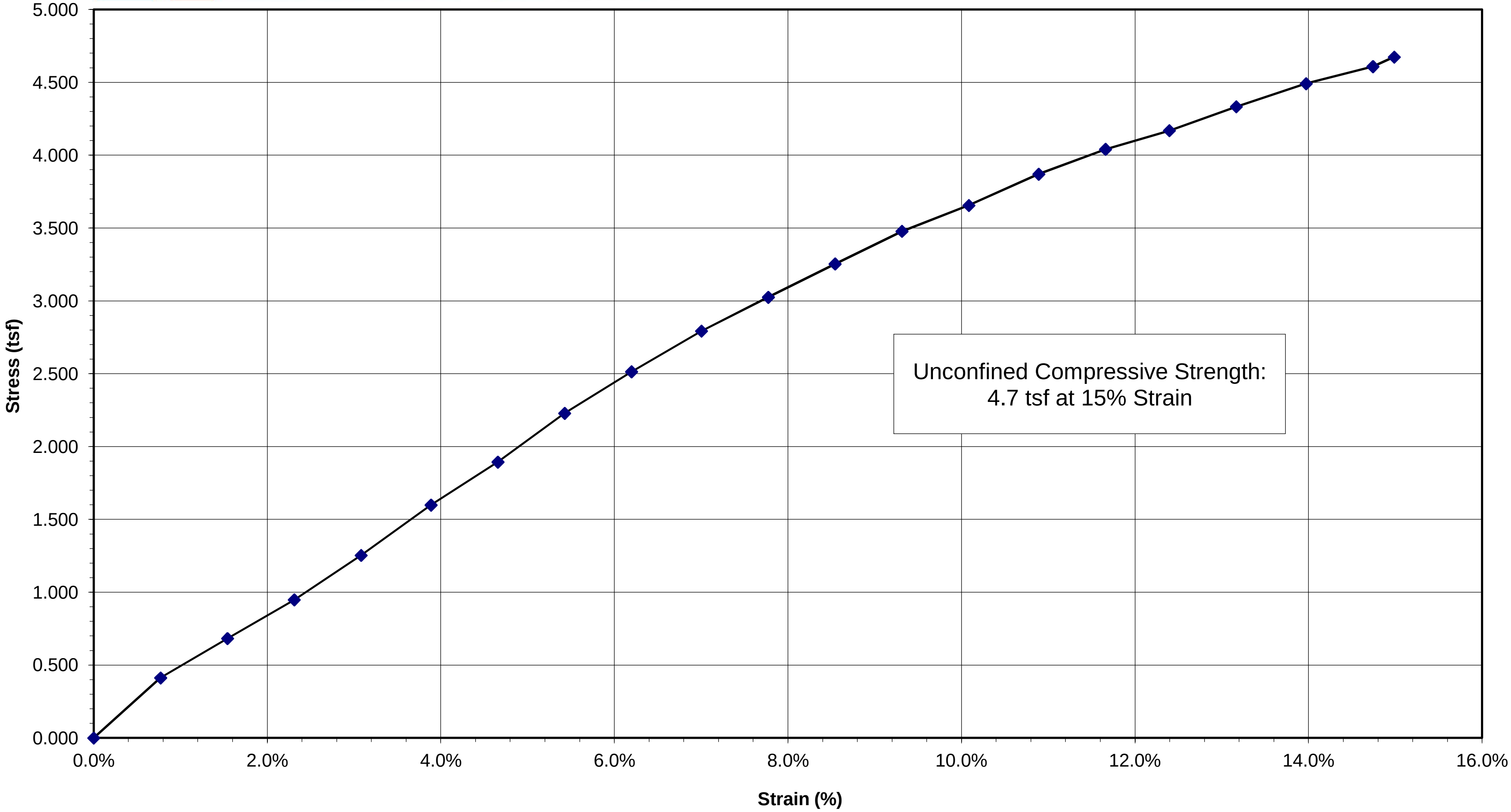
Unconfined Compressive Strength
Bulldog Mine
Patriot Project No.: 02-11-0383
B-38 (28.5 - 30 feet)



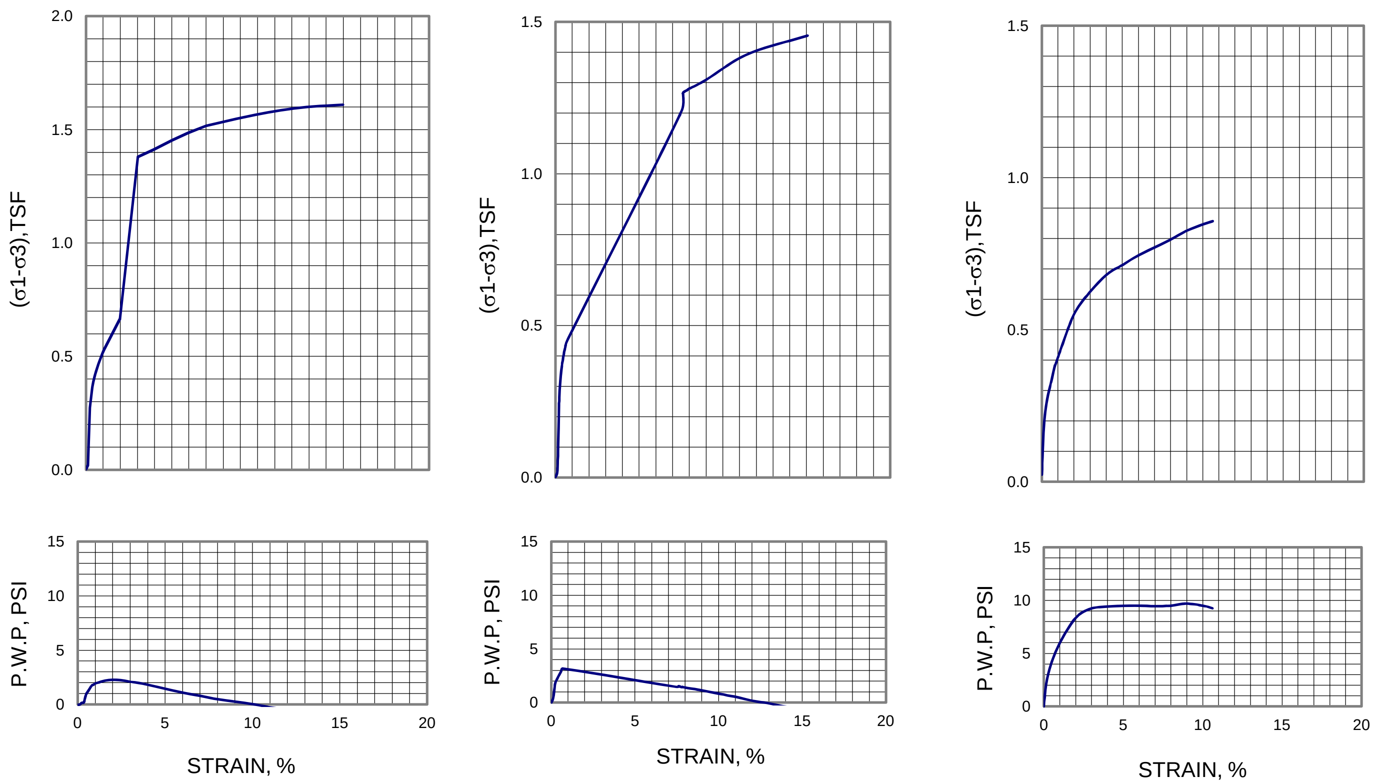
CONSOLIDATED UNDRAINED TRIAXIAL TEST RESULTS

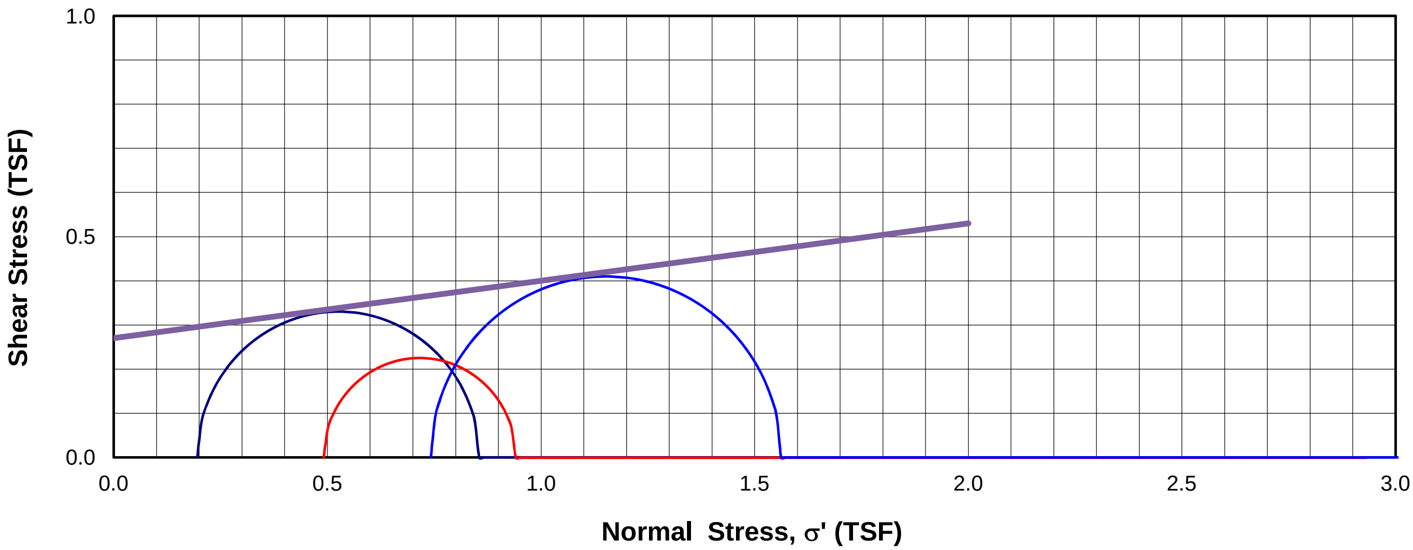
PATRIOT ENGINEERING and Environmental, Inc.
Engineering Value for Project Success
Consulting Environmental, Geotechnical and Materials Engineers

SUMMARY OF CONSOLIDATED UNDRAINED TRIAXIAL TEST RESULTS

Project Name: Coal Refuse Impoundment No. 1
Patriot Project No.: 2-11-0383
Project Location: Allerton-Homer, Illinois
Client: Sunrise Coal
Client Address:

TEST NUMBER	BORING NUMBER	SAMPLE NUMBER	SAMPLE DEPTH (FEET)	CLASSIFICATION (USCS)	COHESION (c') (POUNDS PER SQUARE FOOT (psf))	ANGLE OF INTERNAL FRICTION (Φ) (DEGREES)
1	B-26A	ST-3	5 - 7	SILTY CLAY	540	7.4
2	B-31, B-35 & B-36	COMPOSIT	13 - 20	SILTY CLAY	540	10.2
3	B-31 & B-35	COMPOSIT	23 - 30	SILTY CLAY	340	27





Confing Pressure psi	Sample #	Sample Dimension		Dry Density pcf	Water Content W %
		Dia (in)	Height (in)		
5	1	2.788	5.252	117.0	19.2
10	2	2.810	5.261	116.9	19.2
20	3	2.845	5.610	105.5	20.9

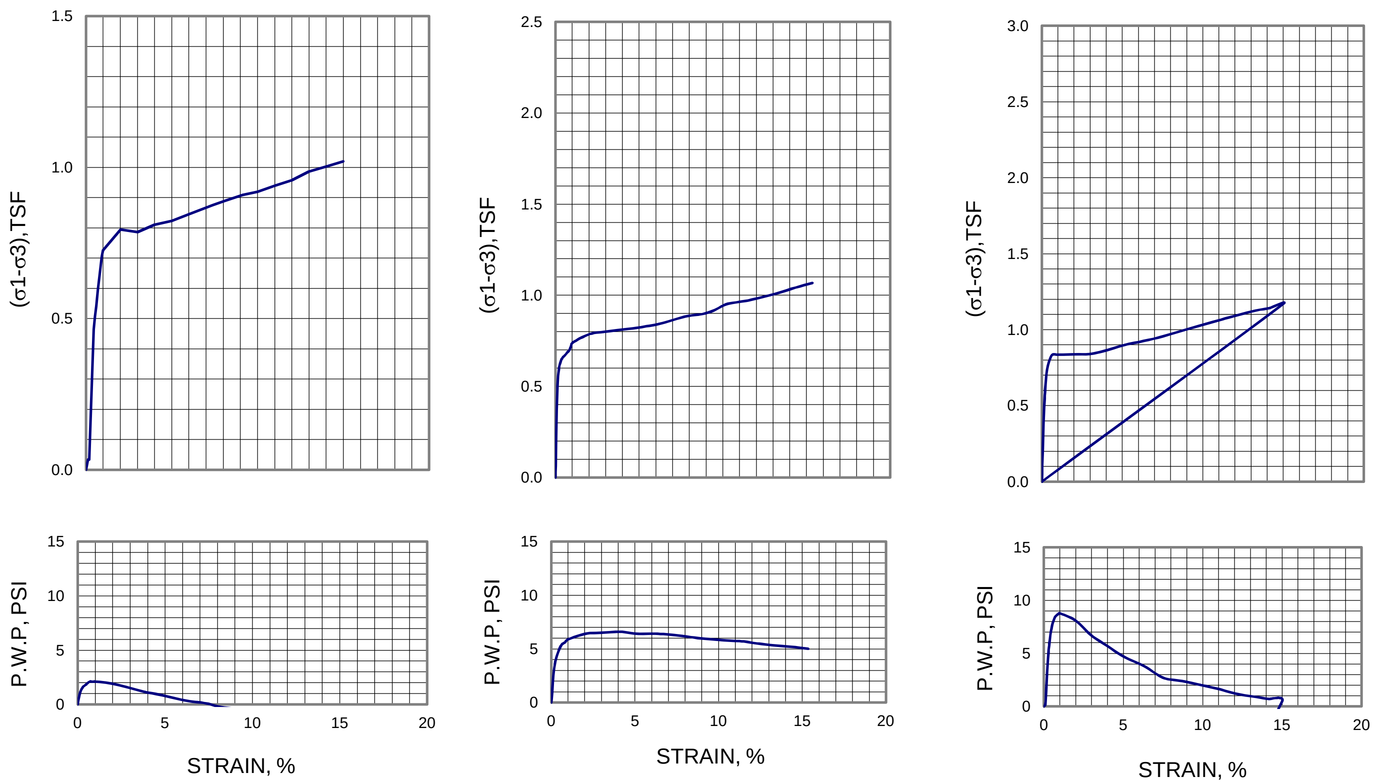
PATRIOT ENGINEERING and Environmental, Inc.
Engineering Value for Project Success
Consulting Environmental, Geotechnical and Materials Engineers

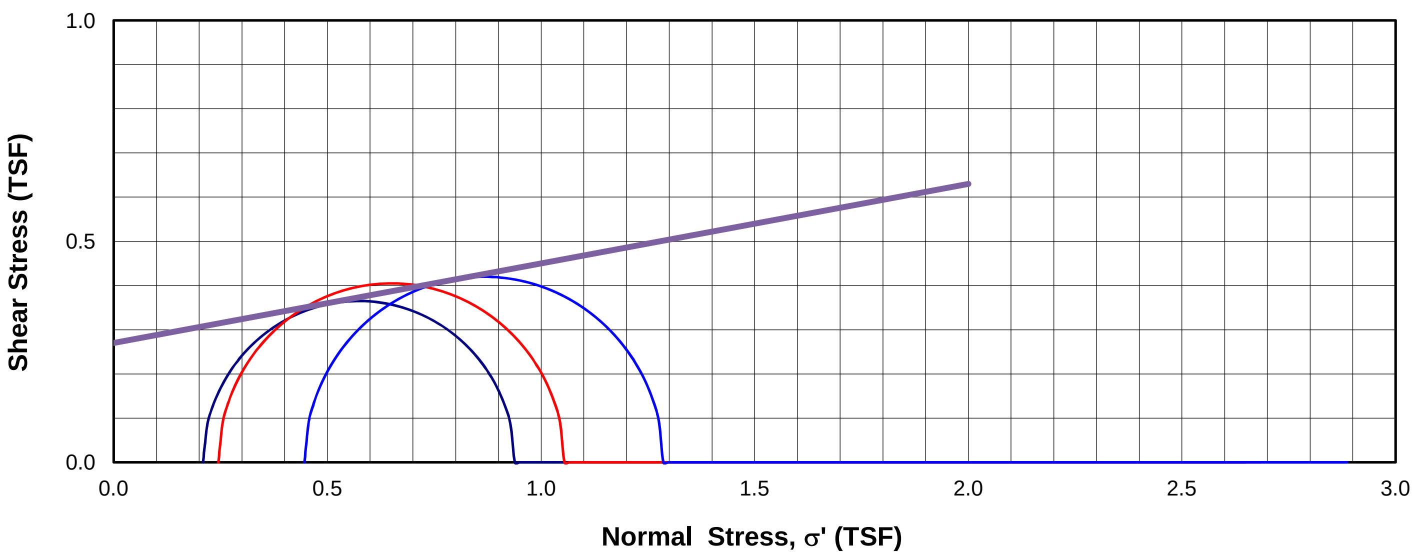
Consolidated Undrained Triaxial Test
Effective Stress Envelope at Pore Water Peak

Sample Number: B-26A, 5'-7'

Patriot Project Number: 2-11-0383

Figure:





Confing Pressure psi	Sample #	Sample Dimension		Dry Density pcf	Water Content W %
		Dia (in)	Height (in)		
5	1	2.873	5.725	120.0	11.7
10	2	2.865	5.626	120.4	11.4
15	3	2.872	5.744	117.3	11.5

PATRIOT ENGINEERING and Environmental, Inc.

Engineering Value for Project Success

Consulting Environmental, Geotechnical and Materials Engineers

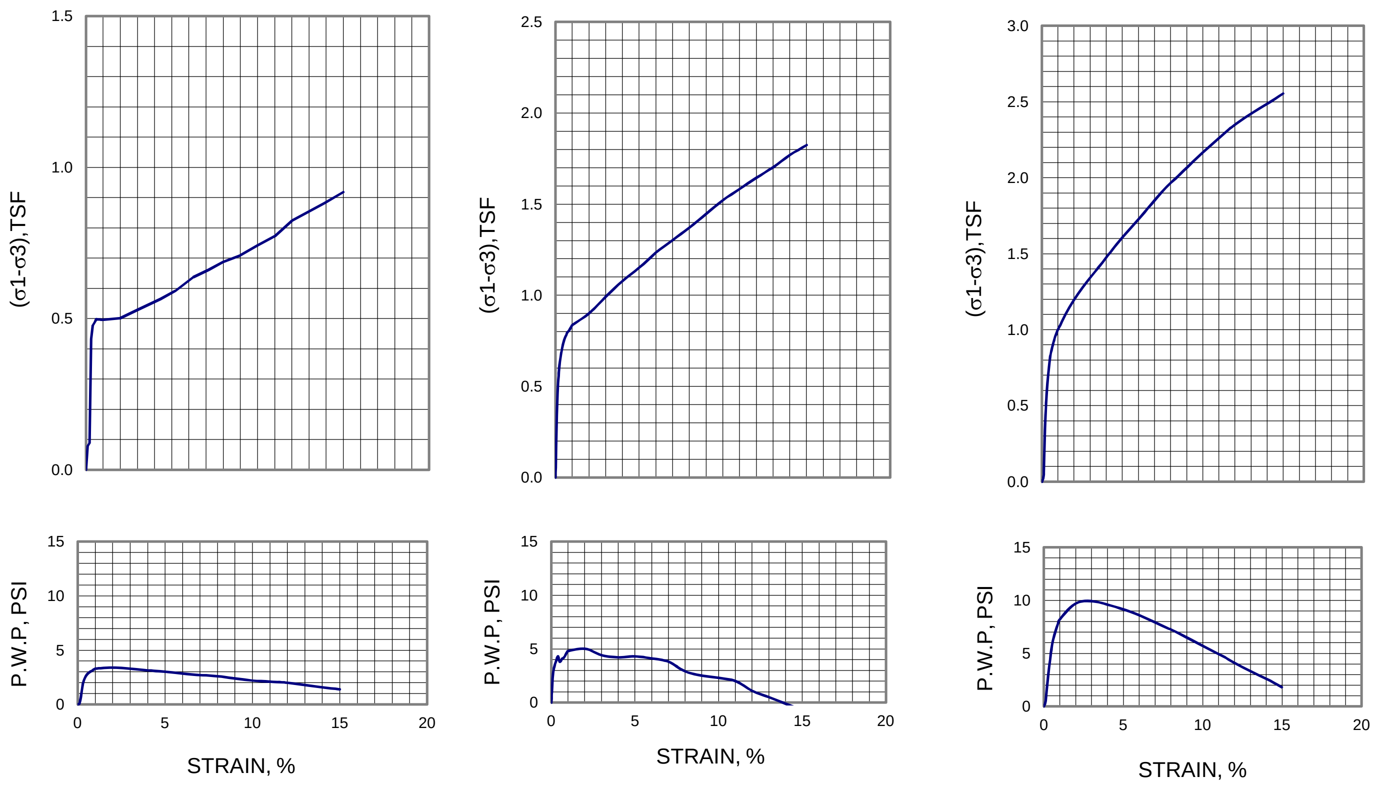
Consolidated Undrained Triaxial Test

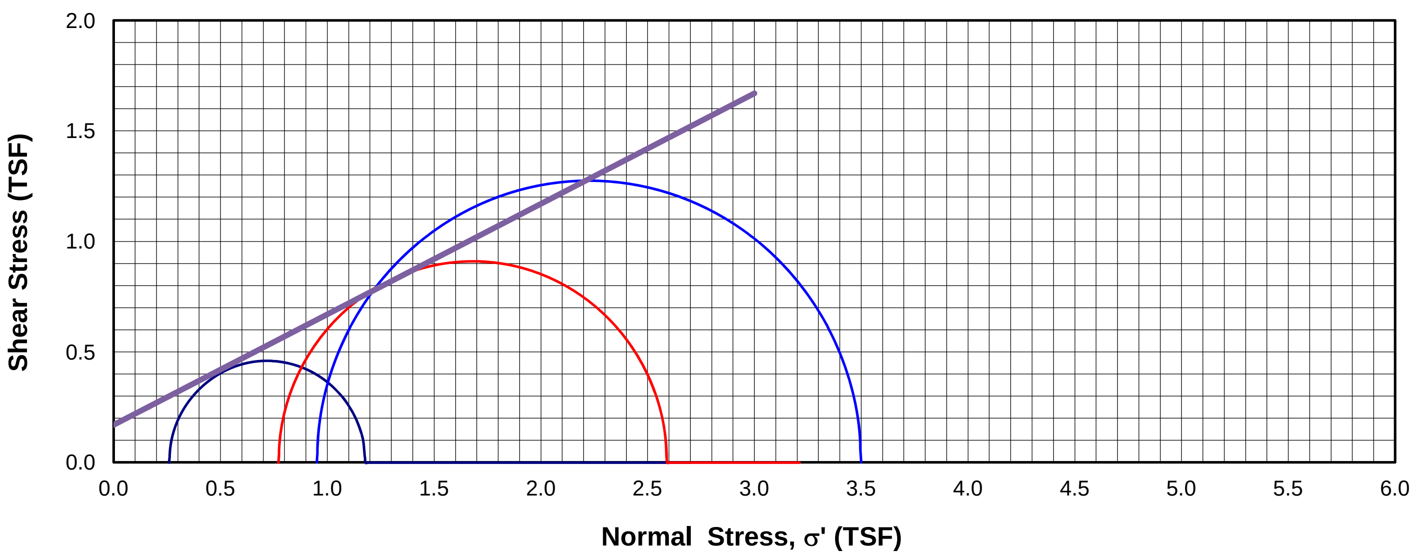
Effective Stress Envelope

Sample Number: Remold #2

Patriot Project Number: 02-11-0383

Figure:





Confing Pressure psi	Sample #	Sample Dimension Dia (in)	Height (in)	Dry Density pcf	Water Content W %
5	1	2.870	5.753	123.1	10.1
10	2	2.871	5.750	124.0	10.4
15	3	2.870	5.583	126.4	10.4

PATRIOT ENGINEERING and Environmental, Inc.

Engineering Value for Project Success

Consulting Environmental, Geotechnical and Materials Engineers

Consolidated Undrained Triaxial Test

Effective Stress Envelope

Sample Number: Composite Remold #3

Patriot Project Number: 02-11-0383

Figure:

REMOLDED PERMEABILITY TEST RESULTS
(HYDRAULIC CONDUCTIVITY)

PATRIOT ENGINEERING and Environmental, Inc.
Engineering Value for Project Success
Consulting Environmental, Geotechnical and Materials Engineers

SUMMARY OF REMOLDED PERMEABILITY TEST RESULTS (HYDRAULIC CONDUCTIVITY)

Project Name: Coal Refuse Impoundment No. 1

Patriot Project No.: 2-11-0383

Project Location: Allerton-Homer, Illinois

Client: Sunrise Coal

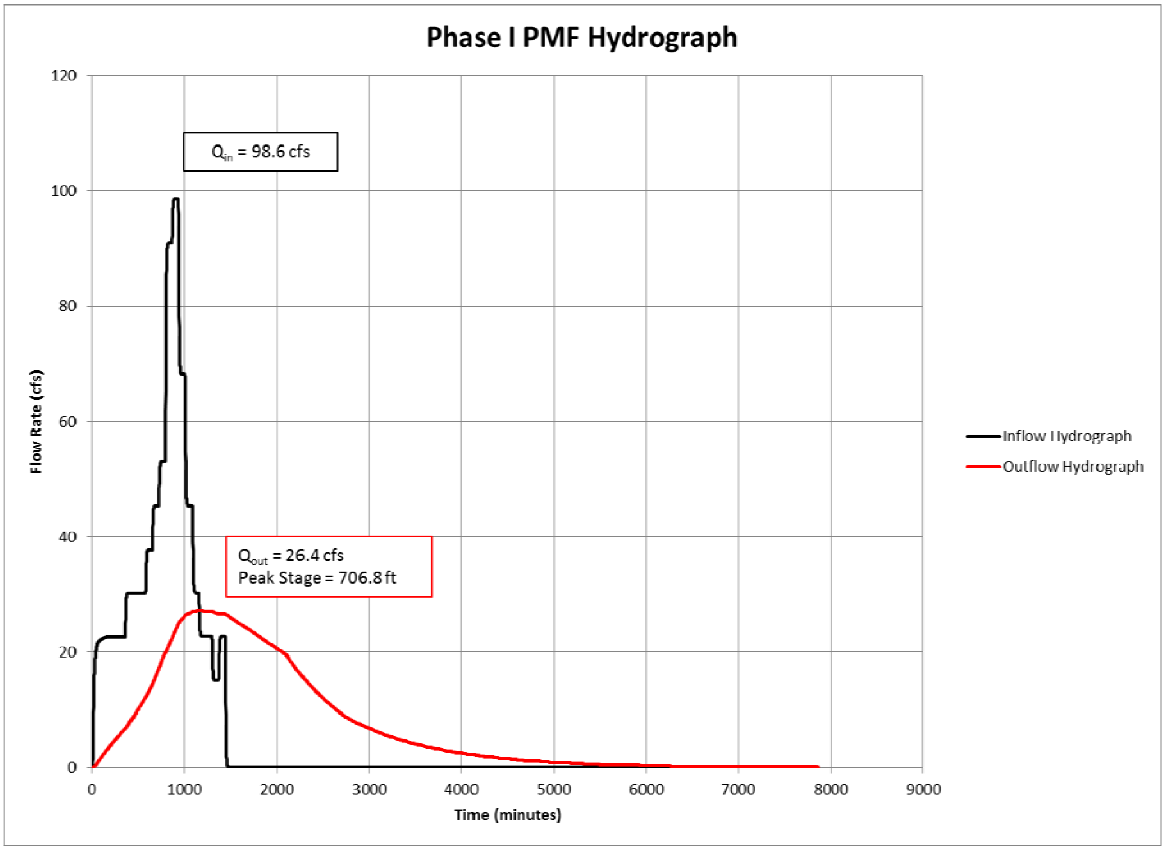
Client Address:

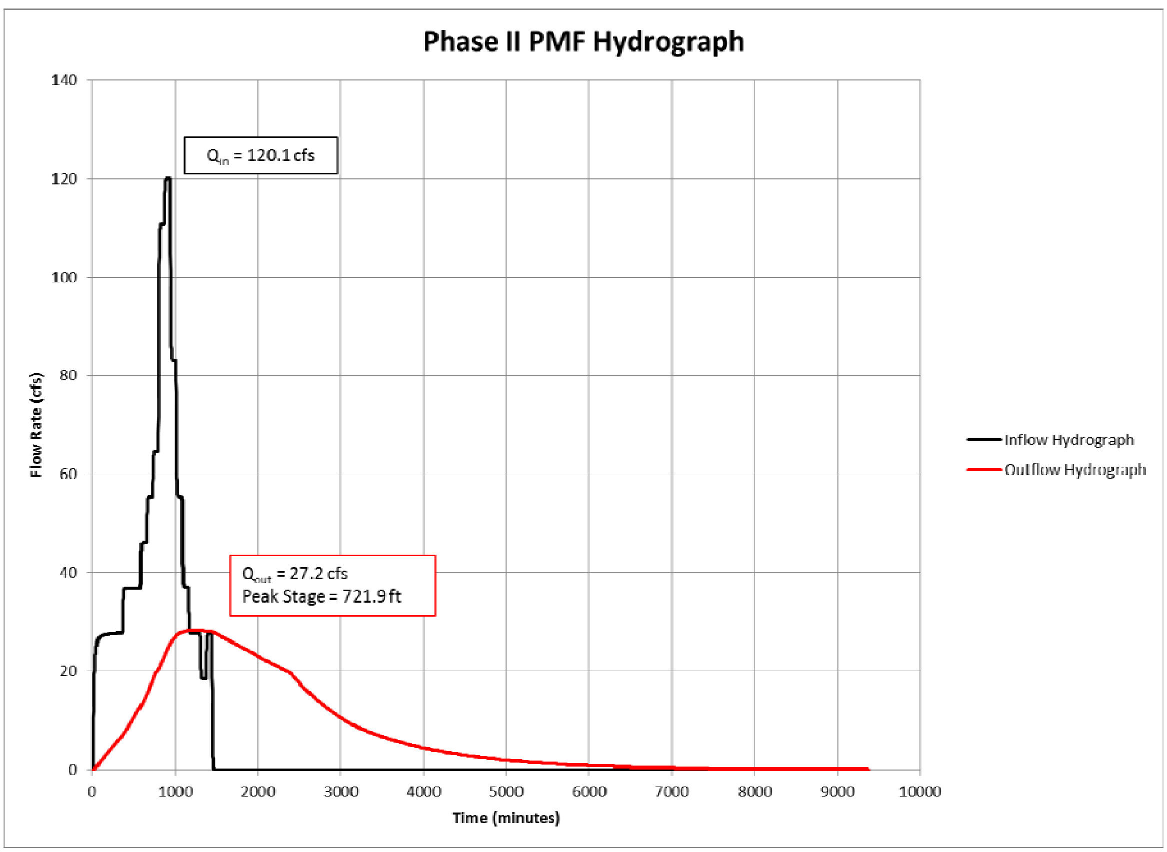
TEST NUMBER	BORING NUMBER	SAMPLE NUMBER	SAMPLE DEPTH (FEET)	CLASSIFICATION (USCS)	REMOLDED DENSITY (STANDARD PROCTOR)	REMOLDED MOISTURE CONTENT (PERCENT (%))	HYDRAULIC CONDUCTIVITY (k) ($^{cm}/_{sec}$)
1	B-28	BULK	5 - 15	SILTY CLAY	98%	12.5	$9.2x10^{-8}$
2	B-35	SS-4	8 - 10	SILTY SANDY CLAY	95%	12	$1x10^{-7}$

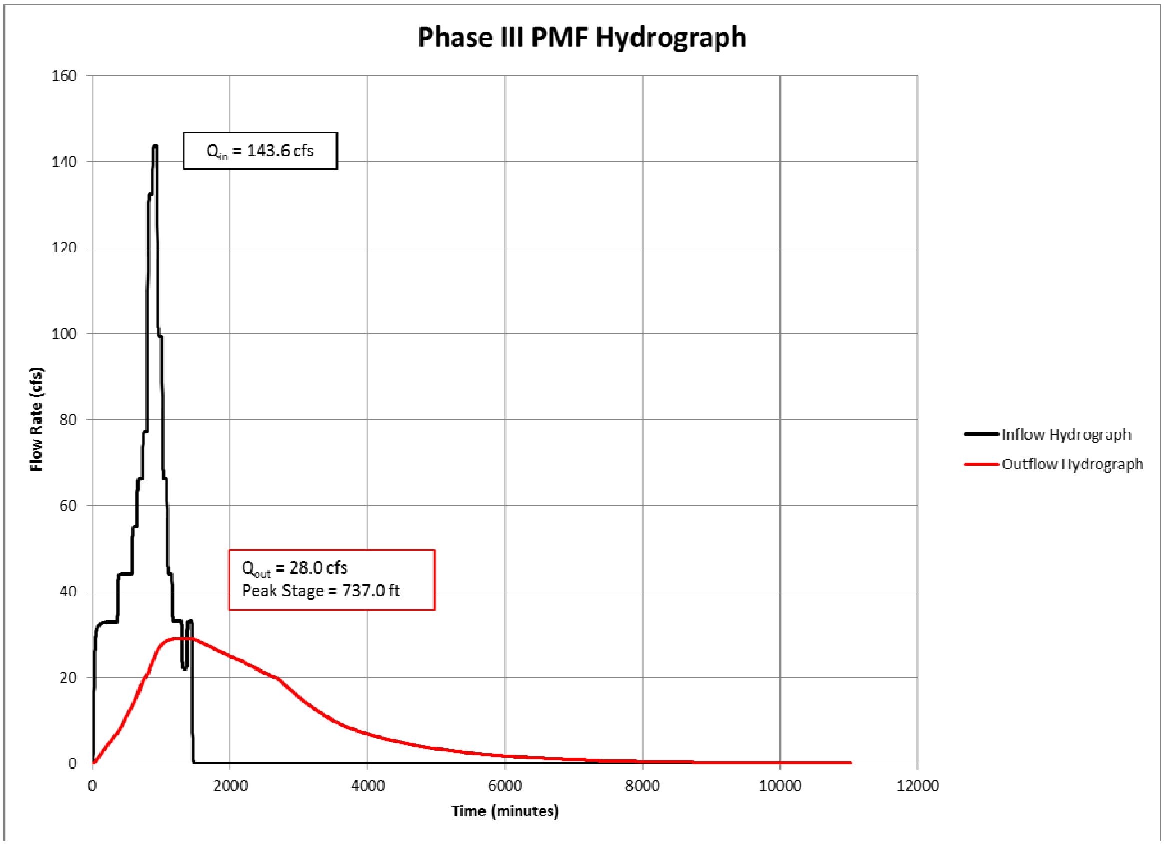
APPENDIX C

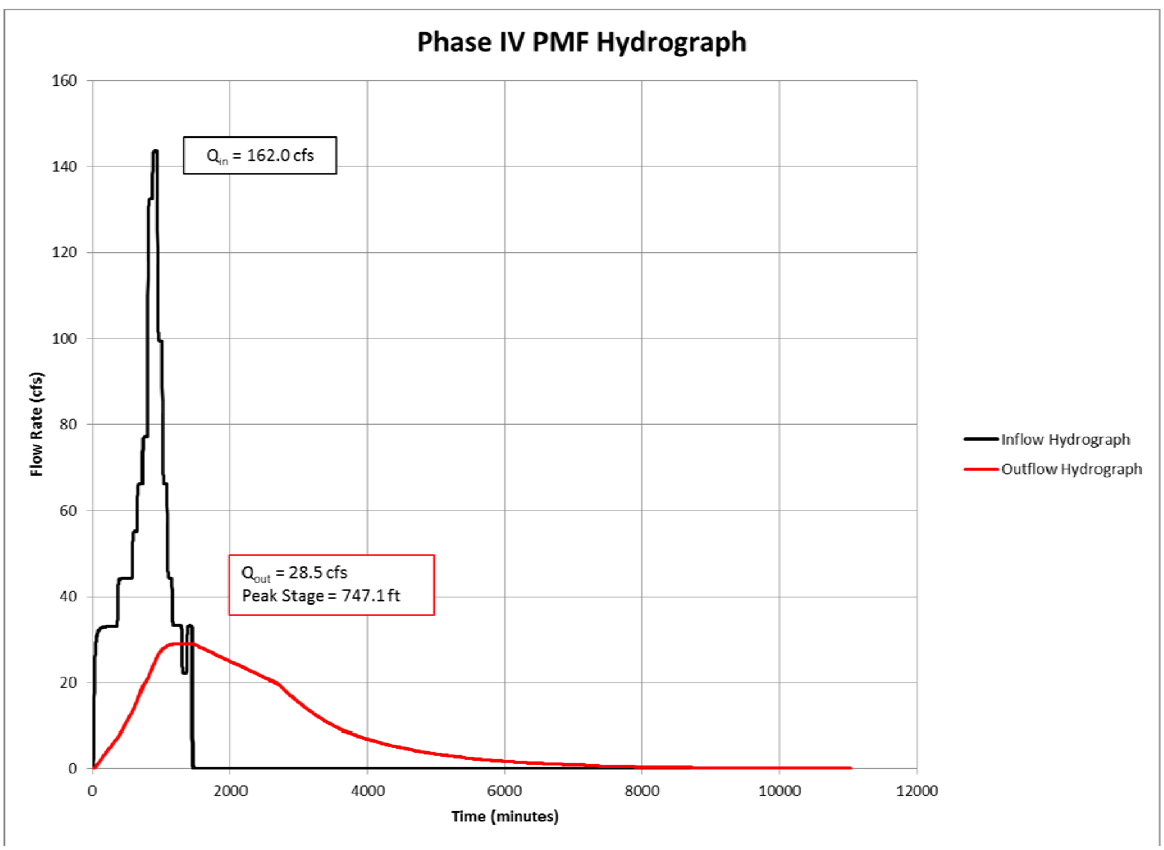
HYDROLOGIC AND HYDRAULIC ANALYSIS

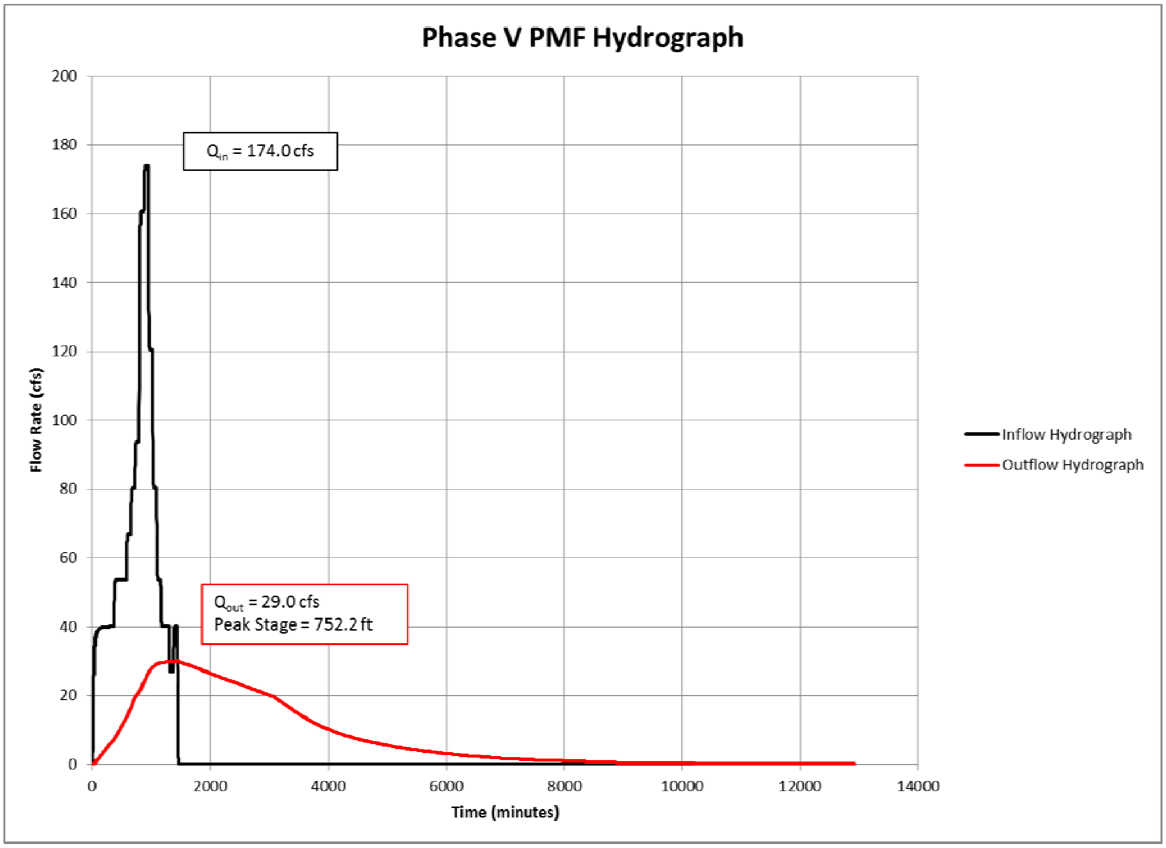
HEC-HMS Summary Tables
PMF Hydrographs for Phases I, II, II, IV, and V

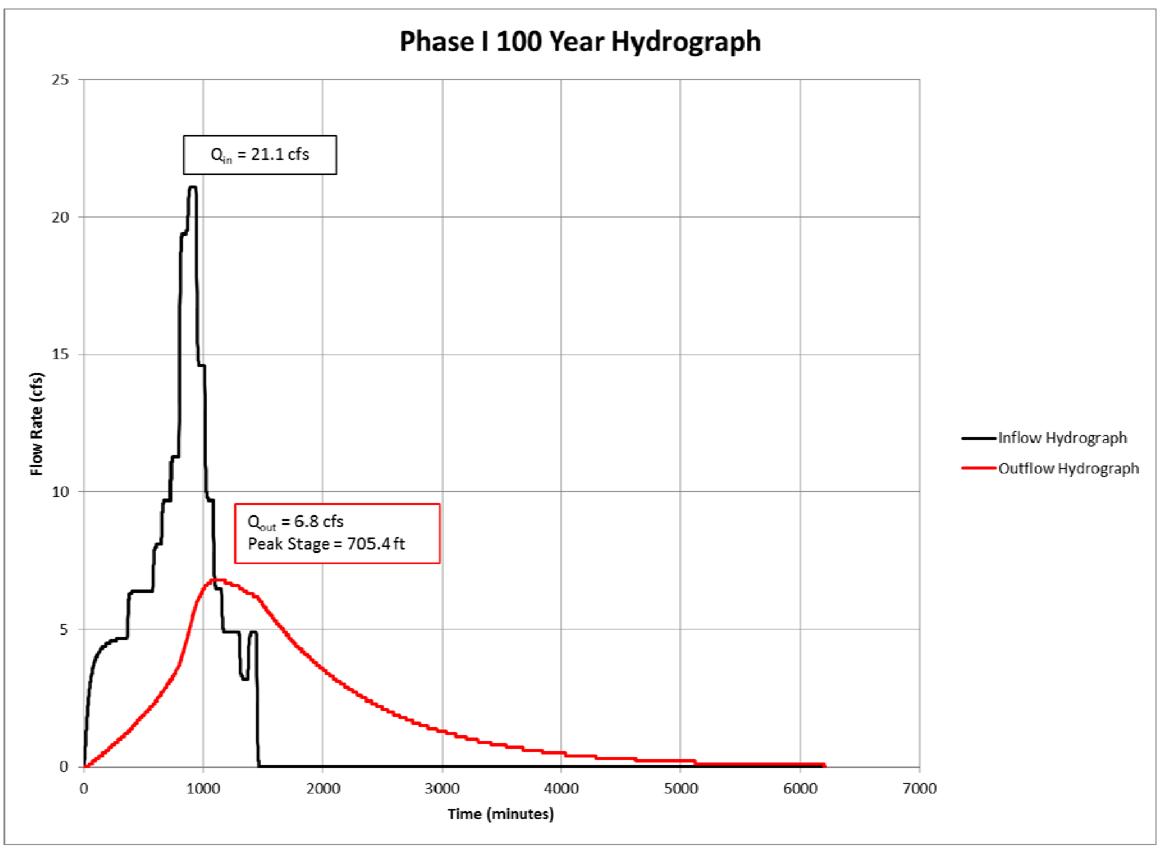

Phase I PMF Hydrograph
Q_{in} = 98.6 cfs
Q_{out} = 26.4 cfs
Peak Stage = 706.8 ft
Flow Rate (cfs)
Time (minutes)
Inflow Hydrograph
Outflow Hydrograph

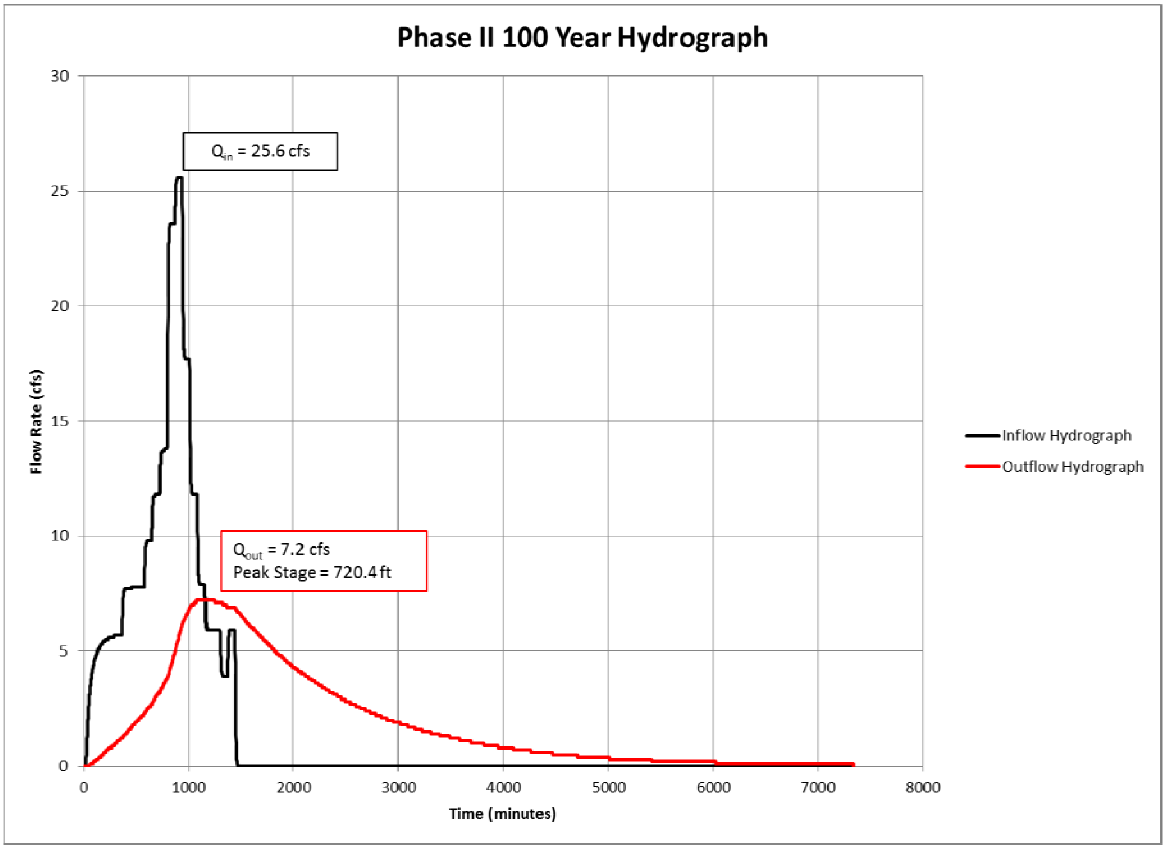

Phase II PMF Hydrograph
Q_{in} = 120.1 cfs
Q_{out} = 27.2 cfs
Peak Stage = 721.9 ft
Flow Rate (cfs)
Time (minutes)
Inflow Hydrograph
Outflow Hydrograph

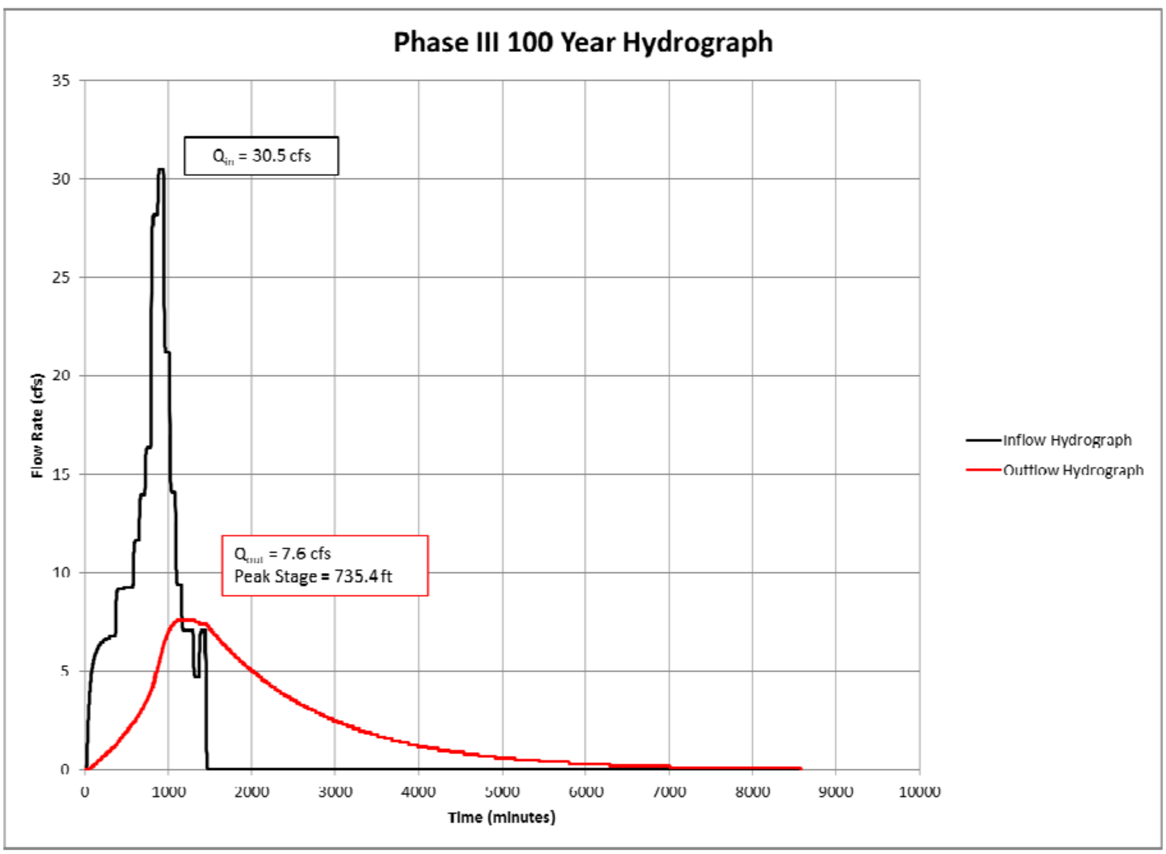

Phase III PMF Hydrograph
160
140
120
100
80
60
40
20
0
Flow Rate (cfs)
0
2000
4000
6000
8000
10000
12000
Time (minutes)
Q_{in} = 143.6 cfs
Q_{out} = 28.0 cfs
Peak Stage = 737.0 ft
Inflow Hydrograph
Outflow Hydrograph

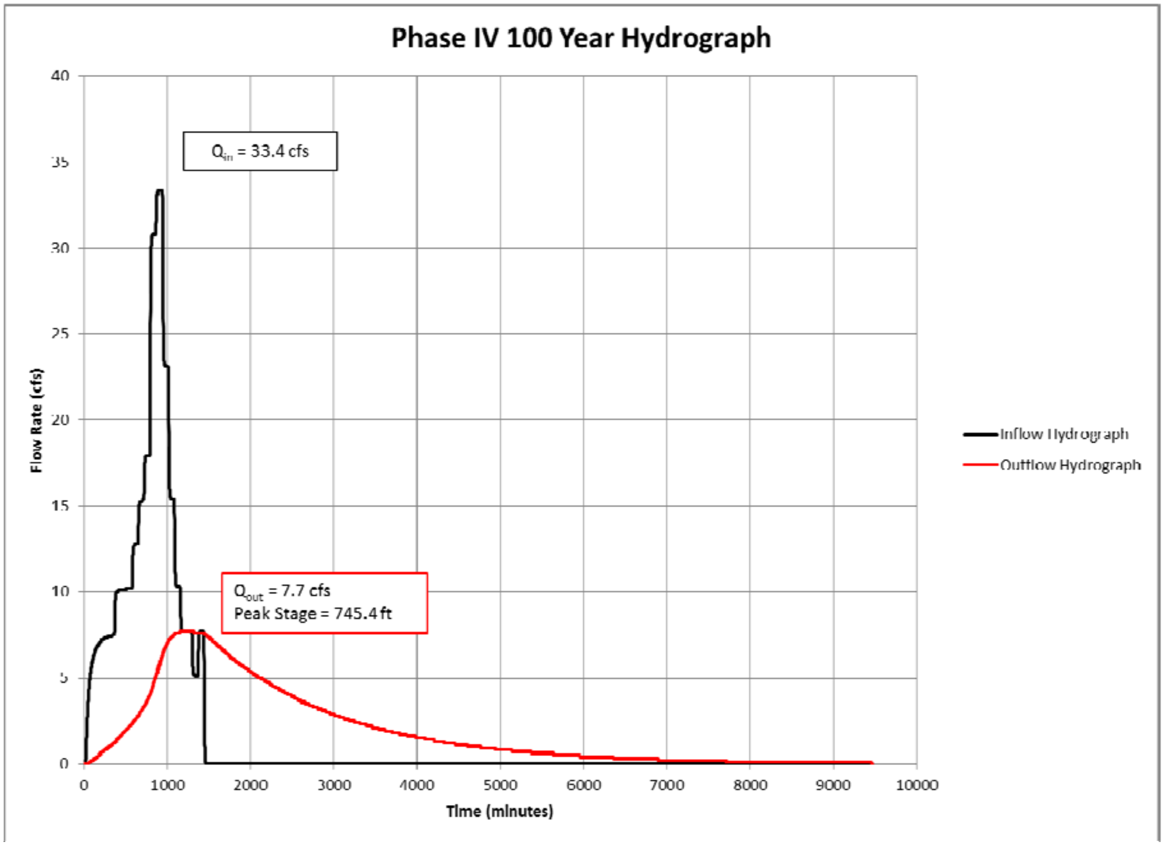

Phase IV PMF Hydrograph
160
140
120
100
80
60
40
20
0
Flow Rate (cfs)
0
2000
4000
6000
8000
10000
12000
Time (minutes)
Q_{in} = 162.0 cfs
Q_{out} = 28.5 cfs
Peak Stage = 747.1 ft
Inflow Hydrograph
Outflow Hydrograph


Phase V PMF Hydrograph
Flow Rate (cfs)
Time (minutes)
Q_{in} = 174.0 cfs
Q_{out} = 29.0 cfs
Peak Stage = 752.2 ft
Inflow Hydrograph
Outflow Hydrograph
0
20
40
60
80
100
120
140
160
180
200
0
2000
4000
6000
8000
10000
12000
14000

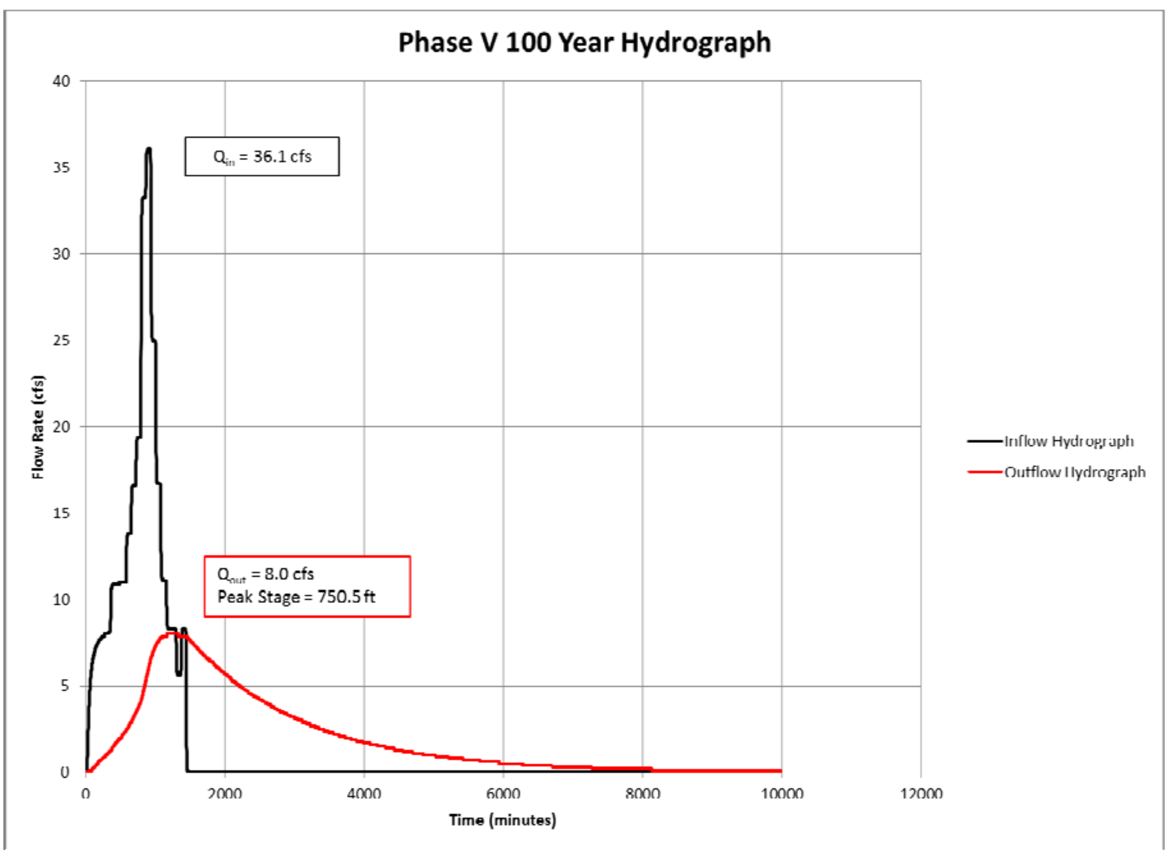

Phase I 100 Year Hydrograph
Flow Rate (cfs)
Time (minutes)
Q_{in} = 21.1 cfs
Q_{out} = 6.8 cfs
Peak Stage = 705.4 ft
Inflow Hydrograph
Outflow Hydrograph
0
5
10
15
20
25
0
1000
2000
3000
4000
5000
6000
7000


Phase II 100 Year Hydrograph
Qin = 25.6 cfs
Qout = 7.2 cfs
Peak Stage = 720.4 ft
Flow Rate (cfs)
Time (minutes)
Inflow Hydrograph
Outflow Hydrograph


Phase III 100 Year Hydrograph
Qin = 30.5 cfs
Qout = 7.6 cfs
Peak Stage = 735.4 ft
Flow Rate (cfs)
Time (minutes)
Inflow Hydrograph
Outflow Hydrograph



Phase IV 100 Year Hydrograph
Flow Rate (cfs)
Time (minutes)
Q_in = 33.4 cfs
Q_out = 7.7 cfs
Peak Stage = 745.4 ft
Inflow Hydrograph
Outflow Hydrograph



Phase V 100 Year Hydrograph
Flow Rate (cfs)
Time (minutes)
Q_in = 36.1 cfs
Q_out = 8.0 cfs
Peak Stage = 750.5 ft
Inflow Hydrograph
Outflow Hydrograph

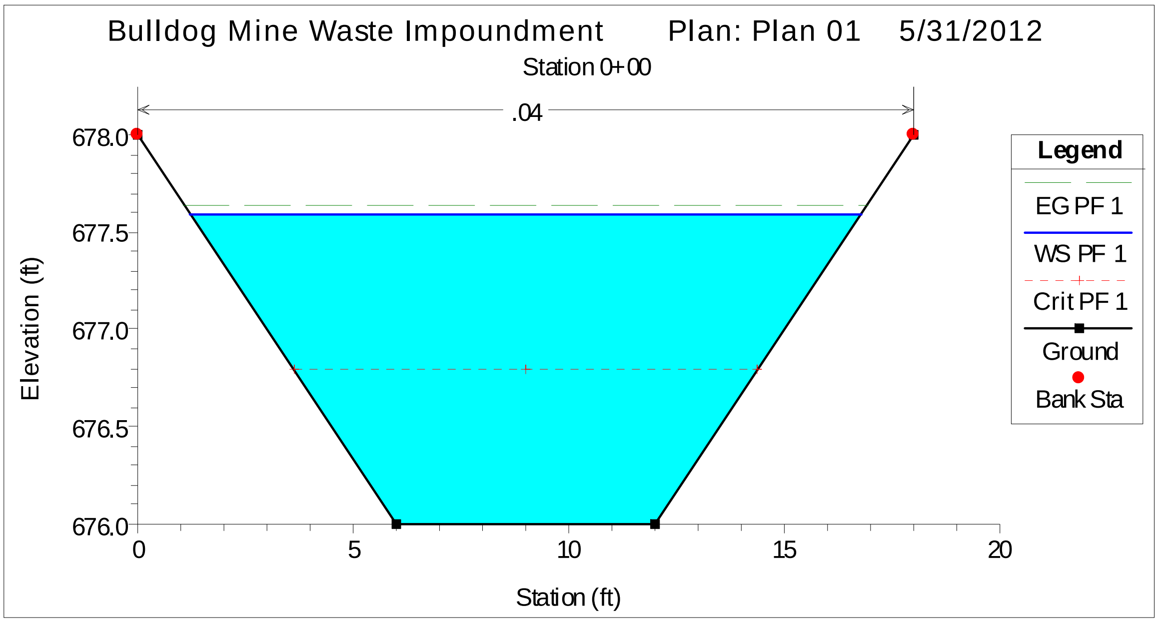
HEC-RAS Output

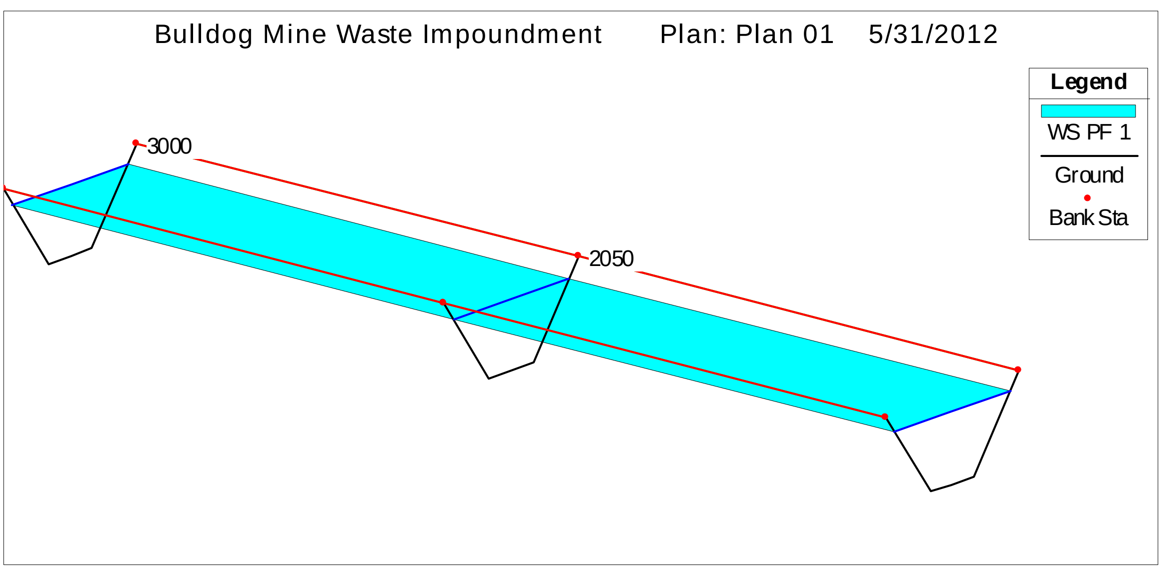
Bulldog Mine Waste Impoundment
Vermillion County, Illinois

Coal Impoundment Location

N 39° 58' 38" Latitude E 87° 54' 25" Longitude

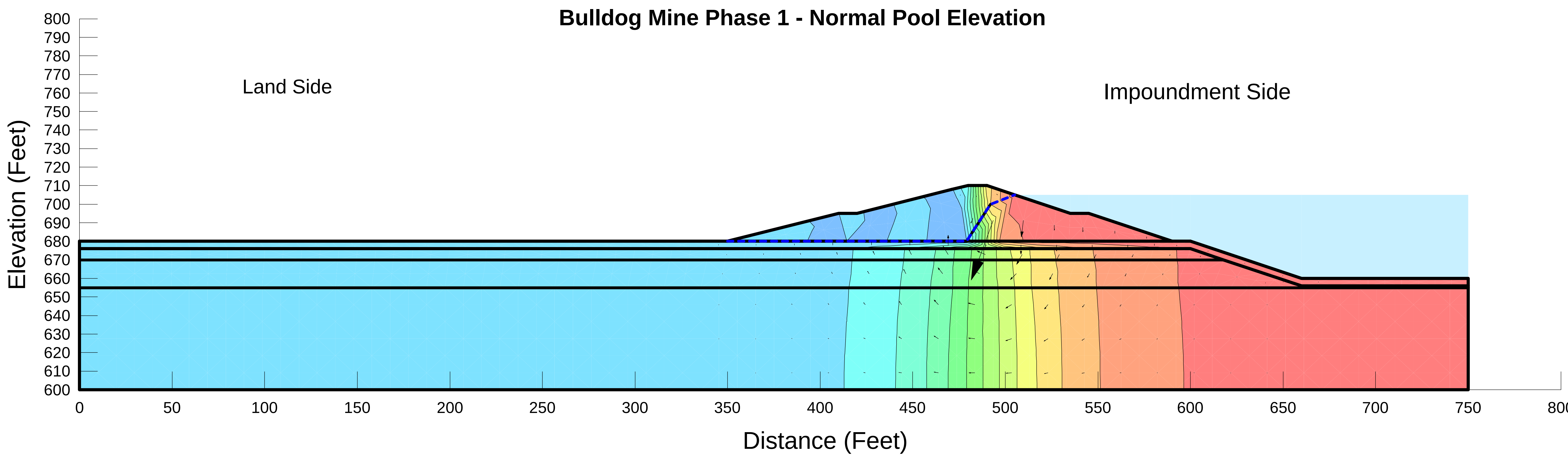
Reach	River Sta	Q Total	Min Ch El	Chl Dpth	W.S. Elev	Crit W.S.	LOB Elev	ROB Elev	Vel Chnl	Froude #
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft/s)	
Bulldog Decant	0+00	29.0	676.0	1.57	677.57	676.78	678.0	678.0	1.72	0.29
Bulldog Decant	0+50	29.0	675.9	1.57	677.47	676.68	677.9	677.9	1.72	0.29
Bulldog Decant	1+00	29.0	675.8	1.57	677.37	676.58	677.8	677.8	1.72	0.29



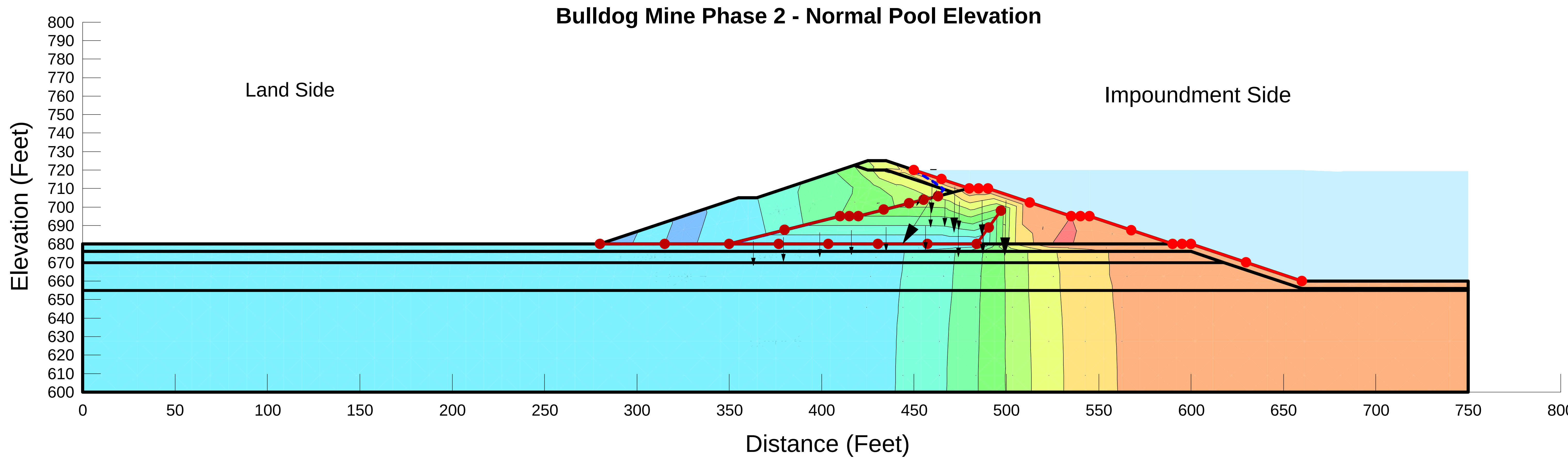


APPENDIX D

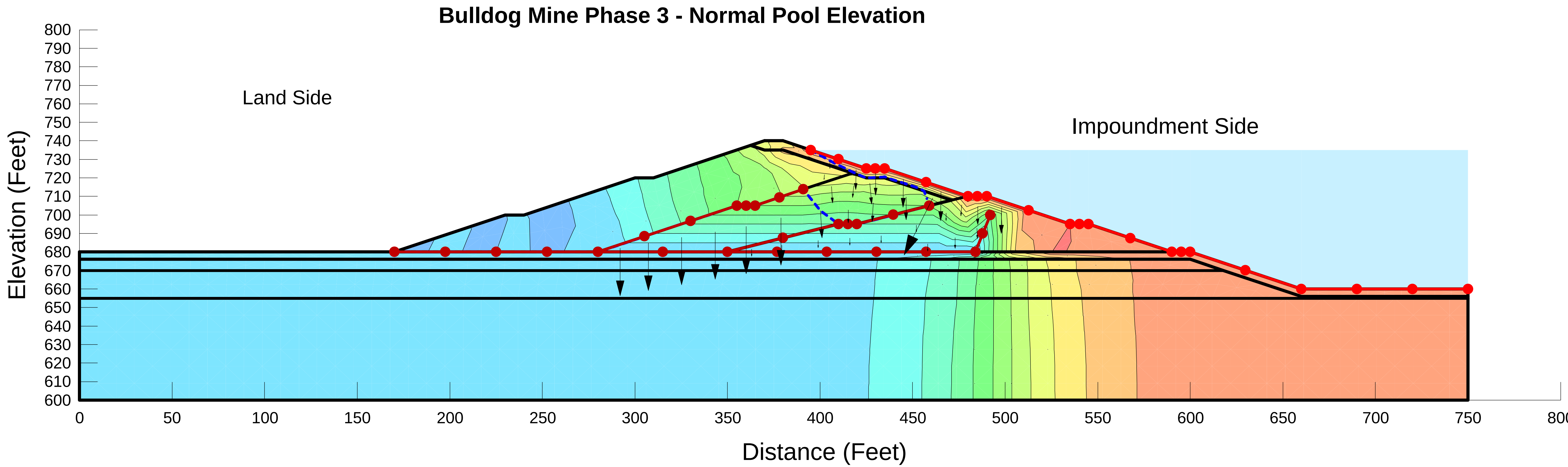
SEEPAGE ANALYSIS



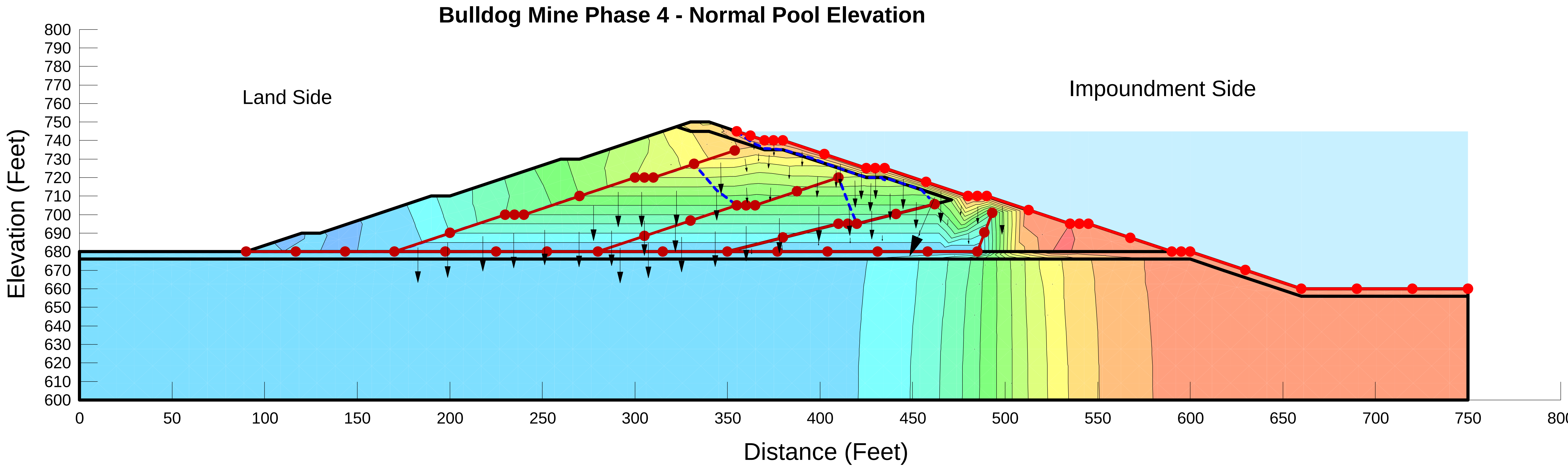
Bulldog Mine Phase 1 - Normal Pool Elevation
Land Side
Impoundment Side
Elevation (Feet)
Distance (Feet)
800
790
780
770
760
750
740
730
720
710
700
690
680
670
660
650
640
630
620
610
600
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
800



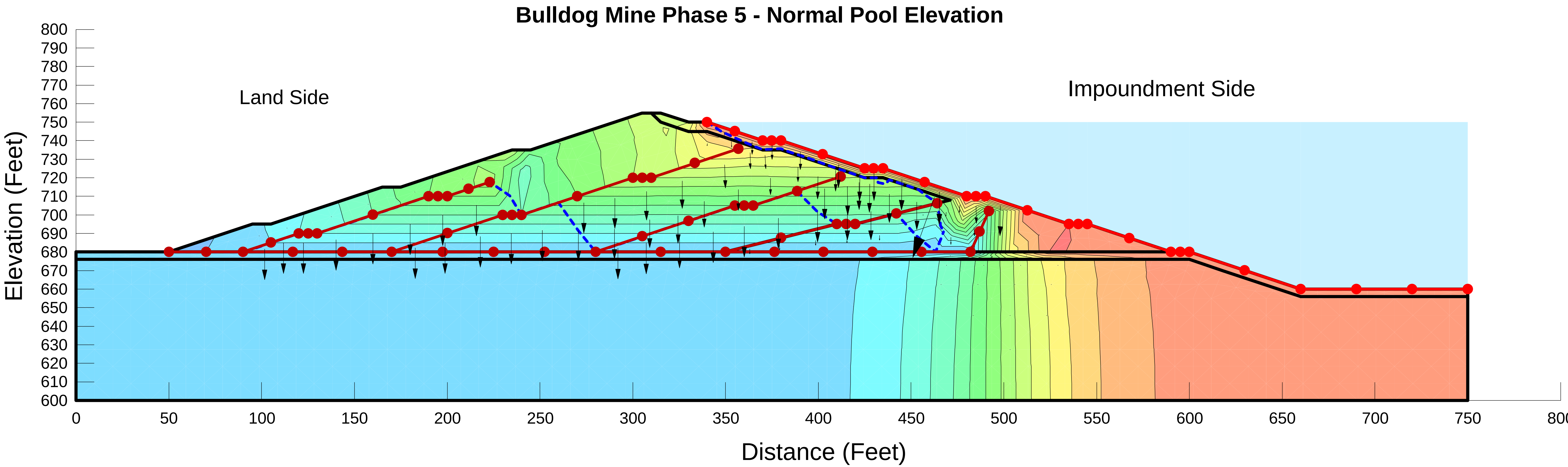
Bulldog Mine Phase 2 - Normal Pool Elevation
Land Side
Impoundment Side
Elevation (Feet)
800
790
780
770
760
750
740
730
720
710
700
690
680
670
660
650
640
630
620
610
600
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
800
Distance (Feet)



Bulldog Mine Phase 3 - Normal Pool Elevation
Land Side
Impoundment Side
Elevation (Feet)
Distance (Feet)
800
790
780
770
760
750
740
730
720
710
700
690
680
670
660
650
640
630
620
610
600
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
800



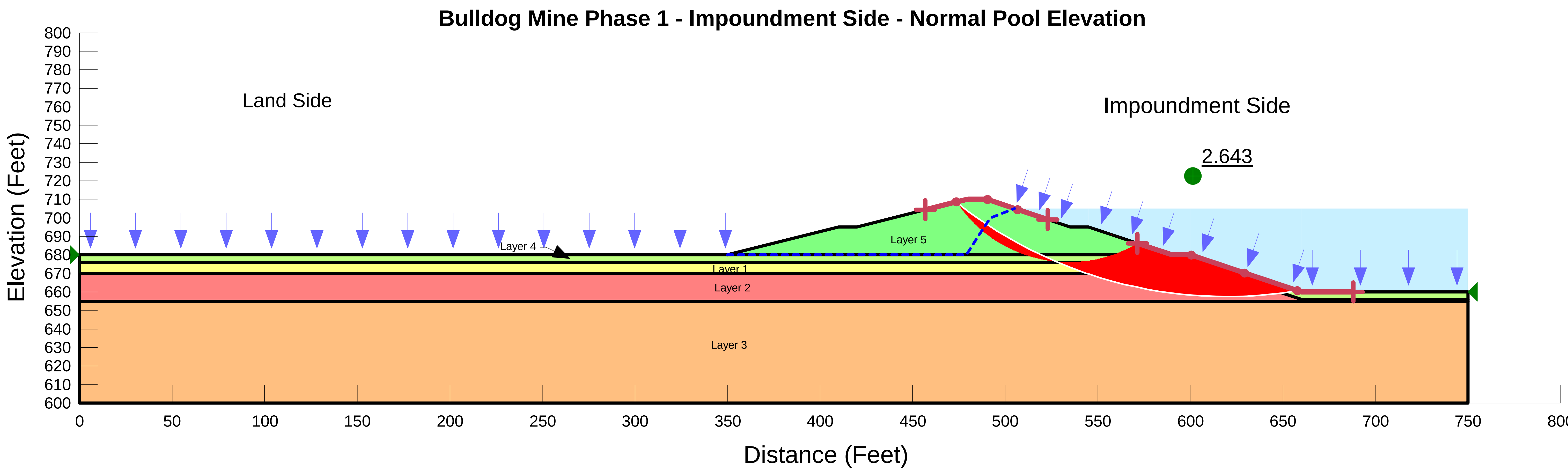
Bulldog Mine Phase 4 - Normal Pool Elevation
Land Side
Impoundment Side
Elevation (Feet)
800
790
780
770
760
750
740
730
720
710
700
690
680
670
660
650
640
630
620
610
600
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
800
Distance (Feet)



Bulldog Mine Phase 5 - Normal Pool Elevation
Land Side
Impoundment Side
Elevation (Feet)
Distance (Feet)
800
790
780
770
760
750
740
730
720
710
700
690
680
670
660
650
640
630
620
610
600
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
800

APPENDIX E

SLOPE STABILITY ANALYSIS



Engineering Parameters

Name: Layer 4	Unit Weight: 130 pcf	Cohesion: 500 psf	Phi: 0 °
Name: Layer 5	Unit Weight: 125 pcf	Cohesion: 500 psf	Phi: 10 °
Name: Layer 1	Unit Weight: 120 pcf	Cohesion: 300 psf	Phi: 18 °
Name: Layer 2	Unit Weight: 125 pcf	Cohesion: 350 psf	Phi: 18 °
Name: Layer 3	Unit Weight: 125 pcf	Cohesion: 350 psf	Phi: 22 °

SLOPE/W Analysis

Report generated using GeoStudio 2007, version 7.19. Copyright © 1991-2012 GEO-SLOPE International Ltd.

File Information

Created By: Eric Wenz
Revision Number: 99
Last Edited By: Eric Wenz
Date: 6/7/2012
Time: 12:50:38 PM
File Name: Phase 1 - Impoundment Side - Normal Pool.gsz
Directory: I:\GEOTECH\PROJECTS\2011\2-0383\Stability Analysis\5-30-12 Cross Sections\Phase 1\WITH SEEPAGE ANALYSIS\
Last Solved Date: 6/7/2012
Last Solved Time: 12:50:42 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Description: Allerton Mine Stage 1
Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Other GeoStudio Analysis
- PWP Other Analysis: "..\..\..\..\Seepage\Phase 1\Phase 1 - Impoundment Side - Normal Pool SEEPAGE WITH DRAIN.gsz" - Steady-State Seepage [(all)]

Slip Surface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

FOS Distribution

FOS Calculation Option: Constant

Advanced

Number of Slices: 30

Optimization Tolerance: 0.01

Minimum Slip Surface Depth: 0.1 ft

Optimization Maximum Iterations: 2000

Optimization Convergence Tolerance: 1e-007

Starting Optimization Points: 8

Ending Optimization Points: 16

Complete Passes per Insertion: 1

Driving Side Maximum Convex Angle: 5 °

Resisting Side Maximum Convex Angle: 1 °

Materials

Layer 4

Model: Mohr-Coulomb

Unit Weight: 130 pcf

Cohesion: 500 psf

Phi: 0 °

Phi-B: 0 °

Layer 5

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion: 500 psf

Phi: 10 °

Phi-B: 0 °

Layer 1

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion: 300 psf

Phi: 18 °

Phi-B: 0 °

Layer 2

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion: 350 psf

Phi: 18 °

Phi-B: 0 °

Layer 3

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 350 psf
Phi: 22 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (456.94731, 704.41794) ft
Left-Zone Right Coordinate: (523, 699) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (571.47502, 686.17499) ft
Right-Zone Right Coordinate: (688, 660) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 680) ft
Right Coordinate: (750, 660) ft

Regions

	Material	Points	Area (ft^2)
Region 1	Layer 4	1,16,9,2,3,4,5,6,18,7,8	3000
Region 2	Layer 5	9,10,11,12,23,13,14,15,16	3757.5
Region 3	Layer 1	8,17,18,7	3654
Region 4	Layer 2	19,20,5,6,18,17	9696
Region 5	Layer 3	19,21,22,20	41250

Points

	X (ft)	Y (ft)
Point 1	0	680
Point 2	600	680
Point 3	660	660
Point 4	750	660
Point 5	750	656

Point 6	660	656
Point 7	600	676
Point 8	0	676
Point 9	590	680
Point 10	545	695
Point 11	535	695
Point 12	490	710
Point 13	471	708
Point 14	420	695
Point 15	410	695
Point 16	350	680
Point 17	0	670
Point 18	618	670
Point 19	0	655
Point 20	750	655
Point 21	0	600
Point 22	750	600
Point 23	480	710

Critical Slip Surfaces

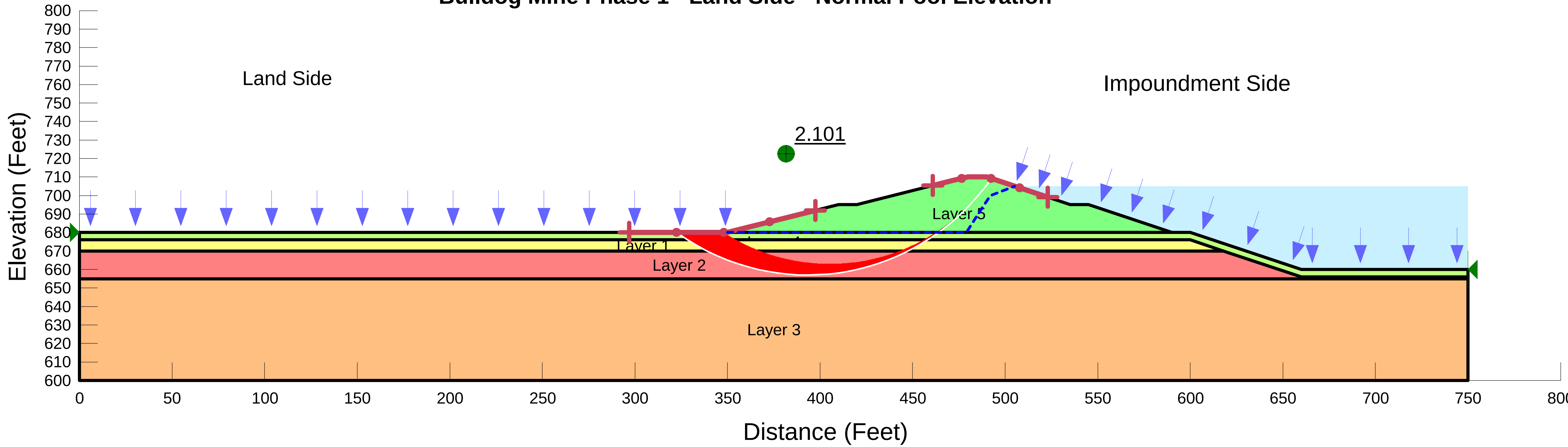
	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	42	2.643	(619.465, 891.508)	233.996	(473.562, 708.569)	(657.919, 660.693)

Slices of Slip Surface: 42

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	42	476.78105	706.0923	-1515.6165	241.28979	42.5459	500
2	42	482.5	701.81015	-872.96054	841.38958	148.35968	500
3	42	487.5	698.2976	-265.73247	1261.4117	222.42092	500
4	42	492.93725	694.70175	158.3813	1580.5197	250.76136	500
5	42	498.81175	691.04555	667.30052	1802.6871	200.19929	500
6	42	504.6862	687.62415	1005.3556	1989.3506	173.50487	500

7	42	510.56065	684.4259	1232.8807	2256.9415	180.56955	500
8	42	516.43515	681.4406	1456.5802	2506.9551	185.20944	500
9	42	523.83785	678	1520.7837	2823.1885	0	500
10	42	531.65165	674.6442	1617.8829	3055.6934	467.17296	300
11	42	539.52195	671.6442	1856.9824	3343.1919	482.89872	300
12	42	544.52195	669.83835	1990.4904	3561.4818	510.44603	350
13	42	548.2143	668.6491	2080.4172	3669.6598	516.37622	350
14	42	554.64285	666.6947	2231.235	3804.9672	511.33658	350
15	42	561.0714	664.9395	2362.5303	3918.2695	505.4903	350
16	42	567.5	663.3789	2478.296	4008.9546	497.34115	350
17	42	573.9286	662.00895	2583.0453	4076.6616	485.30536	350
18	42	580.35715	660.8263	2669.817	4120.6712	471.41109	350
19	42	586.7857	659.828	2744.0591	4140.3486	453.68194	350
20	42	592.5	659.08455	2801.4104	4153.144	439.20489	350
21	42	597.5	658.5588	2840.999	4237.8036	453.84933	350
22	42	603	658.11145	2875.5205	4288.8415	459.21583	350
23	42	609	657.7655	2904.5906	4233.9257	431.92716	350
24	42	615	657.57395	2922.9675	4154.9098	400.2823	350
25	42	621.1613	657.5396	2929.7429	4042.5518	361.57352	350
26	42	627.48385	657.67095	2926.3601	3895.3326	314.83825	350
27	42	633.8064	657.9735	2912.1551	3720.5872	262.6755	350
28	42	640.129	658.4479	2885.759	3518.3037	205.52625	350
29	42	646.4516	659.0953	2848.2084	3288.8959	143.18806	350
30	42	653.76615	660.07795	2796.1448	2982.9912	0	500

Bulldog Mine Phase 1 - Land Side - Normal Pool Elevation



Engineering Parameters

Name: Layer 4	Unit Weight: 130 pcf	Cohesion: 500 psf	Phi: 0 °
Name: Layer 5	Unit Weight: 125 pcf	Cohesion: 500 psf	Phi: 10 °
Name: Layer 1	Unit Weight: 120 pcf	Cohesion: 300 psf	Phi: 18 °
Name: Layer 2	Unit Weight: 125 pcf	Cohesion: 350 psf	Phi: 18 °
Name: Layer 3	Unit Weight: 125 pcf	Cohesion: 350 psf	Phi: 22 °

SLOPE/W Analysis

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File Information

Created By: Eric Wenz
Revision Number: 102
Last Edited By: Eric Wenz
Date: 6/7/2012
Time: 12:54:53 PM
File Name: Phase 1 - Land Side - Normal Pool.gsz
Directory: I:\GEOTECH\PROJECTS\2011\2-0383\Stability Analysis\5-30-12 Cross Sections\Phase 1\WITH SEEPAGE ANALYSIS\
Last Solved Date: 6/7/2012
Last Solved Time: 12:54:58 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Description: Allerton Mine Stage 1
Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Other GeoStudio Analysis
- PWP Other Analysis: "..\..\..\..\Seepage\Phase 1\Phase 1 - Impoundment Side - Normal Pool SEEPAGE WITH DRAIN.gsz" - Steady-State Seepage [(all)]

Slip Surface
- Direction of movement: Right to Left
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
FOS Distribution
FOS Calculation Option: Constant
Advanced
Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Layer 4
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 500 psf
Phi: 0 °
Phi-B: 0 °

Layer 5
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 500 psf
Phi: 10 °
Phi-B: 0 °

Layer 1
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 300 psf
Phi: 18 °
Phi-B: 0 °

Layer 2
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 350 psf
Phi: 18 °
Phi-B: 0 °

Layer 3

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 350 psf
Phi: 22 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (297, 680) ft
Left-Zone Right Coordinate: (397.44649, 691.86162) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (461, 705.45098) ft
Right-Zone Right Coordinate: (522.97503, 699.00832) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 680) ft
Right Coordinate: (750, 660) ft

Regions

	Material	Points	Area (ft^2)
Region 1	Layer 4	1,16,9,2,3,4,5,6,18,7,8	3000
Region 2	Layer 5	9,10,11,12,23,13,14,15,16	3757.5
Region 3	Layer 1	8,17,18,7	3654
Region 4	Layer 2	19,20,5,6,18,17	9696
Region 5	Layer 3	19,21,22,20	41250

Points

	X (ft)	Y (ft)
Point 1	0	680
Point 2	600	680
Point 3	660	660
Point 4	750	660
Point 5	750	656

Point 6	660	656
Point 7	600	676
Point 8	0	676
Point 9	590	680
Point 10	545	695
Point 11	535	695
Point 12	490	710
Point 13	471	708
Point 14	420	695
Point 15	410	695
Point 16	350	680
Point 17	0	670
Point 18	618	670
Point 19	0	655
Point 20	750	655
Point 21	0	600
Point 22	750	600
Point 23	480	710

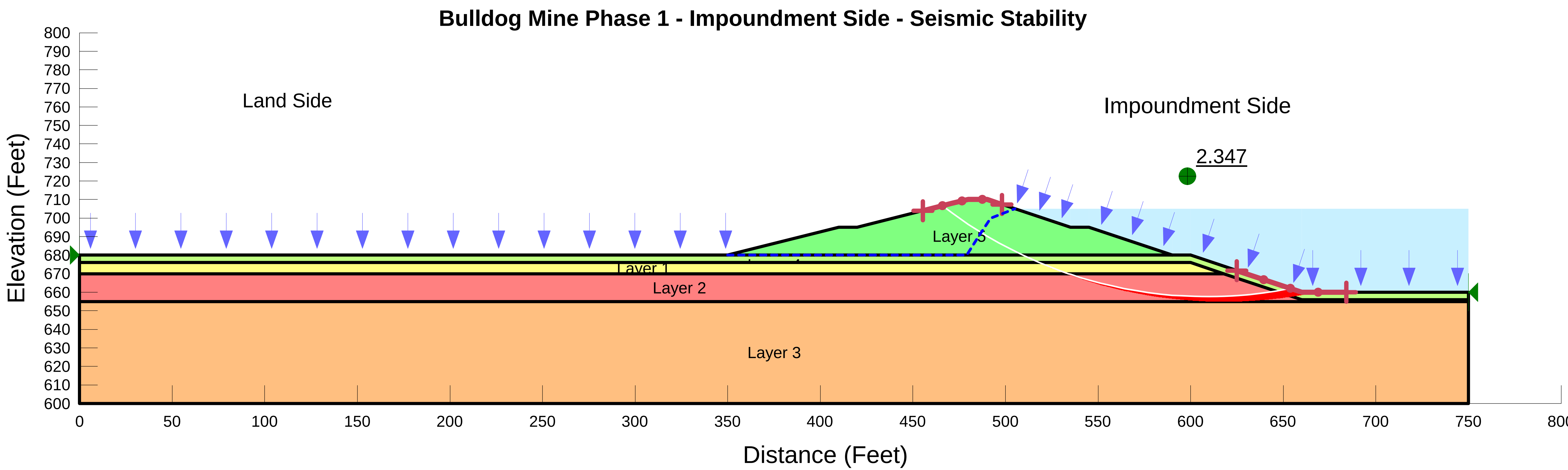
Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	38	2.101	(393.246, 777.503)	120.479	(492.476, 709.175)	(322.477, 680)

Slices of Slip Surface: 38

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	38	325.4103	678	165.45452	475.78913	0	500
2	38	330.972	674.41245	388.1966	930.08895	176.0715	300
3	38	336.22815	671.41245	575.06351	1316.2192	240.81609	300
4	38	341.64215	668.6789	745.79112	1691.8545	307.39462	350
5	38	347.21405	666.20555	900.68201	2022.1728	364.39443	350
6	38	352.72725	664.079	1033.9173	2401.5279	444.36361	350

7	38	358.1818	662.2748	1147.6794	2829.4284	546.43336	350
8	38	363.63635	660.7532	1246.2419	3206.0133	636.76832	350
9	38	369.0909	659.5032	1327.7032	3530.9268	715.87075	350
10	38	374.54545	658.51625	1392.6462	3804.9422	783.80251	350
11	38	380	657.78585	1444.4132	4029.0942	839.81375	350
12	38	385.45455	657.3073	1481.2857	4205.6387	885.19596	350
13	38	390.9091	657.07755	1502.5553	4337.2163	921.03719	350
14	38	396.36365	657.0952	1509.3726	4426.5669	947.85387	350
15	38	401.8182	657.3604	1504.9347	4476.9869	965.6783	350
16	38	407.27275	657.87475	1484.9297	4491.3336	976.83986	350
17	38	412.5	658.59935	1451.2969	4398.5094	957.60741	350
18	38	417.5	659.5181	1407.8619	4206.64	909.37813	350
19	38	422.76365	660.7306	1351.6995	4065.8157	881.8698	350
20	38	428.291	662.26965	1276.272	3971.4088	875.70301	350
21	38	433.81835	664.09885	1182.9291	3849.8045	866.52034	350
22	38	439.3457	666.2326	1075.5433	3701.1966	853.12648	350
23	38	444.87305	668.6888	956.03176	3524.7429	834.62485	350
24	38	450.26475	671.41245	819.2665	3339.4406	818.85422	300
25	38	455.5209	674.41245	664.53303	3128.3063	800.52847	300
26	38	461.08265	678	310.81341	3001.8117	0	500
27	38	467.50815	682.7363	-171.29201	2499.051	440.65012	500
28	38	473.25	687.472	-469.33602	2115.7828	373.0696	500
29	38	477.75	691.687	-692.75855	1750.6202	308.68158	500
30	38	482.5	696.66275	-574.06548	1241.6715	218.94019	500
31	38	487.5	702.5674	-503.59967	562.23534	99.13726	500
32	38	491.2379	707.4433	-495.01334	-55.719539	-9.8248582	500



Engineering Parameters

Name: Layer 4	Unit Weight: 130 pcf	Cohesion: 400 psf	Phi: 0 °
Name: Layer 5	Unit Weight: 125 pcf	Cohesion: 400 psf	Phi: 10 °
Name: Layer 1	Unit Weight: 120 pcf	Cohesion: 240 psf	Phi: 18 °
Name: Layer 2	Unit Weight: 125 pcf	Cohesion: 280 psf	Phi: 18 °
Name: Layer 3	Unit Weight: 125 pcf	Cohesion: 280 psf	Phi: 22 °

SLOPE/W Analysis

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File Information

Created By: Eric Wenz
Revision Number: 104
Last Edited By: Eric Wenz
Date: 6/7/2012
Time: 12:53:34 PM
File Name: Phase 1 - Impoundment Side - Seismic Stability.gsz
Directory: I:\GEOTECH\PROJECTS\2011\2-0383\Stability Analysis\5-30-12 Cross Sections\Phase 1\WITH SEEPAGE ANALYSIS\
Last Solved Date: 6/7/2012
Last Solved Time: 12:53:38 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Description: Allerton Mine Stage 1
Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Other GeoStudio Analysis
- PWP Other Analysis: "..\..\..\..\Seepage\Phase 1\Phase 1 - Impoundment Side - Normal Pool SEEPAGE WITH DRAIN.gsz" - Steady-State Seepage [(all)]

Slip Surface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
FOS Distribution
FOS Calculation Option: Constant
Advanced
Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Layer 4
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 400 psf
Phi: 0 °
Phi-B: 0 °

Layer 5
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 400 psf
Phi: 10 °
Phi-B: 0 °

Layer 1
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 240 psf
Phi: 18 °
Phi-B: 0 °

Layer 2
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 280 psf
Phi: 18 °
Phi-B: 0 °

Layer 3

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 280 psf
Phi: 22 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (455.30769, 704) ft
Left-Zone Right Coordinate: (498, 707.33333) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (625, 671.66667) ft
Right-Zone Right Coordinate: (684, 660) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 680) ft
Right Coordinate: (750, 660) ft

Regions

	Material	Points	Area (ft²)
Region 1	Layer 4	1,16,9,2,3,4,5,6,18,7,8	3000
Region 2	Layer 5	9,10,11,12,23,13,14,15,16	3757.5
Region 3	Layer 1	8,17,18,7	3654
Region 4	Layer 2	19,20,5,6,18,17	9696
Region 5	Layer 3	19,21,22,20	41250

Points

	X (ft)	Y (ft)
Point 1	0	680
Point 2	600	680
Point 3	660	660
Point 4	750	660
Point 5	750	656

Point 6	660	656
Point 7	600	676
Point 8	0	676
Point 9	590	680
Point 10	545	695
Point 11	535	695
Point 12	490	710
Point 13	471	708
Point 14	420	695
Point 15	410	695
Point 16	350	680
Point 17	0	670
Point 18	618	670
Point 19	0	655
Point 20	750	655
Point 21	0	600
Point 22	750	600
Point 23	480	710

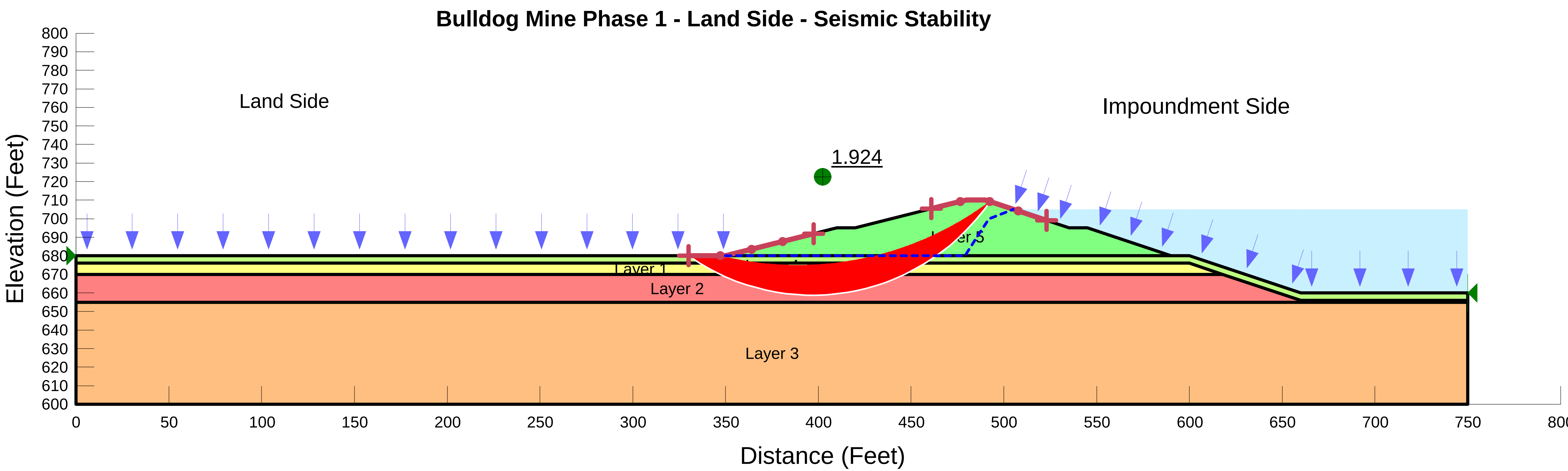
Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	37	2.347	(608.87, 890.397)	232.753	(465.93, 706.708)	(653.884, 662.039)

Slices of Slip Surface: 37

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	37	468.4648	704.7898	-1558.3053	181.56005	32.013936	400
2	37	475.5	699.7244	-1231.8848	980.86436	172.95285	400
3	37	482.5	694.96025	-487.4045	1664.6927	293.53024	400
4	37	487.5	691.81575	35.913435	2038.593	353.12644	400
5	37	493.2228	688.4423	506.96175	2329.9642	321.44451	400
6	37	499.6684	684.88435	1135.1108	2520.6113	244.30112	400

7	37	506.11395	681.58595	1374.7267	2689.1229	231.76351	400
8	37	513.8052	678	1458.7511	3026.4771	0	400
9	37	520.90205	674.92695	1525.93	3213.9951	548.48561	240
10	37	526.1588	672.85455	1689.1665	3365.4593	544.66056	240
11	37	531.4156	670.9276	1845.179	3502.1805	538.39245	240
12	37	534.522	669.83885	1935.0874	3574.8021	532.77561	280
13	37	537.5	668.87225	2016.9081	3677.645	539.6061	280
14	37	542.5	667.323	2135.8694	3882.214	567.42173	280
15	37	548.2143	665.7115	2262.0021	4053.3419	582.0416	280
16	37	554.64285	664.07365	2394.3639	4155.3438	572.17706	280
17	37	561.0714	662.62895	2505.403	4234.842	561.9288	280
18	37	567.5	661.37375	2602.9404	4291.3922	548.61122	280
19	37	573.9286	660.305	2689.3664	4324.0251	531.13279	280
20	37	580.35715	659.4201	2757.1384	4332.1608	511.75582	280
21	37	586.7857	658.7169	2813.2255	4314.6861	487.85412	280
22	37	592.5	658.23425	2854.5128	4294.737	467.95721	280
23	37	597.5	657.9357	2879.757	4350.5984	477.90536	280
24	37	603	657.7377	2898.9105	4367.2764	477.101	280
25	37	609	657.6637	2910.8328	4274.3326	443.02793	280
26	37	615	657.7444	2912.3228	4156.3911	404.2223	280
27	37	621.51055	658.0144	2900.543	3992.9221	354.93547	280
28	37	628.5316	658.503	2875.2866	3778.8873	293.59766	280
29	37	635.55265	659.2058	2836.4373	3530.1597	225.40406	280
30	37	642.57375	660.1248	2782.4644	3247.5238	151.10695	280
31	37	649.98425	661.3386	2716.8584	2906.395	0	400



Engineering Parameters

Name: Layer 4	Unit Weight: 130 pcf	Cohesion: 400 psf	Phi: 0 °
Name: Layer 5	Unit Weight: 125 pcf	Cohesion: 400 psf	Phi: 10 °
Name: Layer 1	Unit Weight: 120 pcf	Cohesion: 240 psf	Phi: 18 °
Name: Layer 2	Unit Weight: 125 pcf	Cohesion: 280 psf	Phi: 18 °
Name: Layer 3	Unit Weight: 125 pcf	Cohesion: 280 psf	Phi: 22 °

SLOPE/W Analysis

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File Information

Created By: Eric Wenz
Revision Number: 109
Last Edited By: Eric Wenz
Date: 6/7/2012
Time: 12:57:27 PM
File Name: Phase 1 - Land Side - Seismic Stability.gsz
Directory: I:\GEOTECH\PROJECTS\2011\2-0383\Stability Analysis\5-30-12 Cross Sections\Phase 1\WITH SEEPAGE ANALYSIS\
Last Solved Date: 6/7/2012
Last Solved Time: 12:57:30 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Description: Allerton Mine Stage 1
Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Other GeoStudio Analysis
- PWP Other Analysis: "..\..\..\..\Seepage\Phase 1\Phase 1 - Impoundment Side - Normal Pool SEEPAGE WITH DRAIN.gsz" - Steady-State Seepage [(all)]

Slip Surface
- Direction of movement: Right to Left
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
FOS Distribution
FOS Calculation Option: Constant
Advanced
Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Layer 4
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 400 psf
Phi: 0 °
Phi-B: 0 °

Layer 5
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 400 psf
Phi: 10 °
Phi-B: 0 °

Layer 1
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 240 psf
Phi: 18 °
Phi-B: 0 °

Layer 2
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 280 psf
Phi: 18 °
Phi-B: 0 °

Layer 3

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 280 psf
Phi: 22 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (330, 680) ft
Left-Zone Right Coordinate: (397.44649, 691.86162) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (461, 705.45098) ft
Right-Zone Right Coordinate: (522.97503, 699.00832) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 680) ft
Right Coordinate: (750, 660) ft

Regions

	Material	Points	Area (ft^2)
Region 1	Layer 4	1,16,9,2,3,4,5,6,18,7,8	3000
Region 2	Layer 5	9,10,11,12,23,13,14,15,16	3757.5
Region 3	Layer 1	8,17,18,7	3654
Region 4	Layer 2	19,20,5,6,18,17	9696
Region 5	Layer 3	19,21,22,20	41250

Points

	X (ft)	Y (ft)
Point 1	0	680
Point 2	600	680
Point 3	660	660
Point 4	750	660
Point 5	750	656

Point 6	660	656
Point 7	600	676
Point 8	0	676
Point 9	590	680
Point 10	545	695
Point 11	535	695
Point 12	490	710
Point 13	471	708
Point 14	420	695
Point 15	410	695
Point 16	350	680
Point 17	0	670
Point 18	618	670
Point 19	0	655
Point 20	750	655
Point 21	0	600
Point 22	750	600
Point 23	480	710

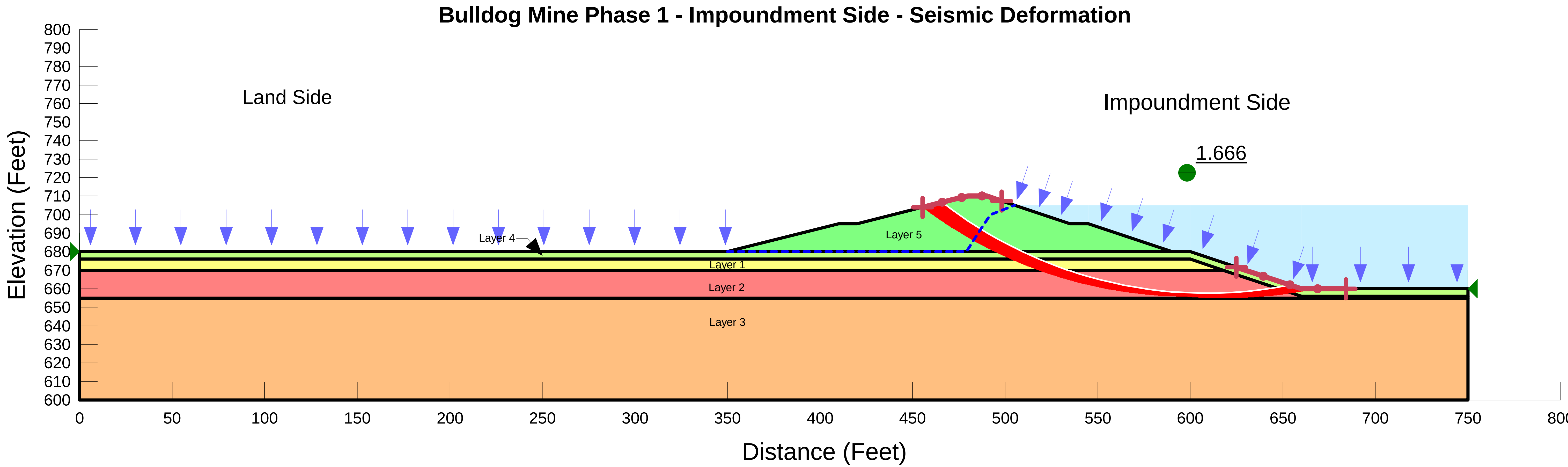
Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	13	1.924	(396.848, 774.724)	115.937	(492.476, 709.175)	(330, 680)

Slices of Slip Surface: 13

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	13	333.0313	678	165.77878	446.65685	0	400
2	13	338.8237	674.40305	388.1772	902.7632	167.19913	240
3	13	344.34585	671.40305	575.82807	1293.5306	233.19568	240
4	13	348.55345	669.3371	705.20014	1579.9286	284.21651	280
5	13	352.72725	667.55145	817.02997	1925.8539	360.27875	280
6	13	358.1818	665.46355	948.09362	2409.9417	474.98325	280

7	13	363.63635	663.6827	1063.0052	2840.5353	577.55456	280
8	13	369.0909	662.19425	1159.4984	3216.0722	668.22136	280
9	13	374.54545	660.98675	1238.3189	3536.0749	746.58619	280
10	13	380	660.0513	1302.6058	3800.7634	811.7006	280
11	13	385.45455	659.3812	1351.5372	4011.9743	864.42838	280
12	13	390.9091	658.97185	1384.1061	4172.312	905.94302	280
13	13	396.36365	658.8205	1401.1311	4284.8293	936.97034	280
14	13	401.8182	658.92615	1406.7965	4352.9093	957.25006	280
15	13	407.27275	659.2895	1396.3229	4380.8892	969.7444	280
16	13	412.5	659.8765	1371.3832	4296.8805	950.55169	280
17	13	417.5	660.66985	1335.3462	4110.7558	901.78525	280
18	13	422.65895	661.7299	1288.4655	3977.0033	873.55889	280
19	13	427.97685	663.07865	1224.2606	3892.0648	866.82213	280
20	13	433.29475	664.7008	1143.1312	3781.103	857.12899	280
21	13	438.6126	666.60875	1046.9804	3645.2325	844.22328	280
22	13	443.93045	668.81795	941.69544	3484.3625	826.1626	280
23	13	449.3505	671.40305	813.82452	3305.5063	809.59648	240
24	13	454.8727	674.40305	660.80887	3094.3819	790.71582	240
25	13	460.6651	678	308.35871	2979.7775	0	400
26	13	467.3482	682.8007	-175.30958	2478.7357	437.06799	400
27	13	473.25	687.5739	-475.73747	2101.4663	370.5452	400
28	13	477.75	691.73995	-695.46093	1748.7166	308.34592	400
29	13	482.5	696.6771	-574.79293	1253.8487	221.08736	400
30	13	487.5	702.5612	-503.24172	589.16438	103.88558	400
31	13	491.2379	707.4382	-494.68111	-18.463499	-3.2556131	400



Engineering Parameters

Name: Layer 4	Unit Weight: 130 pcf	Cohesion: 400 psf	Phi: 0 °
Name: Layer 5	Unit Weight: 125 pcf	Cohesion: 400 psf	Phi: 10 °
Name: Layer 1	Unit Weight: 120 pcf	Cohesion: 240 psf	Phi: 18 °
Name: Layer 2	Unit Weight: 125 pcf	Cohesion: 280 psf	Phi: 18 °
Name: Layer 3	Unit Weight: 125 pcf	Cohesion: 280 psf	Phi: 22 °

SLOPE/W Analysis

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File Information

Created By: Eric Wenz
Revision Number: 110
Last Edited By: Eric Wenz
Date: 6/7/2012
Time: 12:52:20 PM
File Name: Phase 1 - Impoundment Side - Seismic Deformation.gsz
Directory: I:\GEOTECH\PROJECTS\2011\2-0383\Stability Analysis\5-30-12 Cross Sections\Phase 1\WITH SEEPAGE ANALYSIS\
Last Solved Date: 6/7/2012
Last Solved Time: 12:52:22 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Description: Allerton Mine Stage 1
Kind: SLOPE/W
Method: Morgenstern-Price
Settings
  Side Function
    Interslice force function option: Half-Sine
  PWP Conditions Source: Other GeoStudio Analysis
  PWP Other Analysis: "..\..\..\..\Seepage\Phase 1\Phase 1 - Impoundment Side - Normal Pool SEEPAGE WITH DRAIN.gsz" - Steady-State Seepage [(all)]
Slip Surface
  Direction of movement: Left to Right
  Use Passive Mode: No
  Slip Surface Option: Entry and Exit
  Critical slip surfaces saved: 1
  Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

FOS Distribution

FOS Calculation Option: Constant

Advanced

Number of Slices: 30

Optimization Tolerance: 0.01

Minimum Slip Surface Depth: 0.1 ft

Optimization Maximum Iterations: 2000

Optimization Convergence Tolerance: 1e-007

Starting Optimization Points: 8

Ending Optimization Points: 16

Complete Passes per Insertion: 1

Driving Side Maximum Convex Angle: 5 °

Resisting Side Maximum Convex Angle: 1 °

Materials

Layer 4

Model: Mohr-Coulomb

Unit Weight: 130 pcf

Cohesion: 400 psf

Phi: 0 °

Phi-B: 0 °

Layer 5

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion: 400 psf

Phi: 10 °

Phi-B: 0 °

Layer 1

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion: 240 psf

Phi: 18 °

Phi-B: 0 °

Layer 2

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion: 280 psf

Phi: 18 °

Phi-B: 0 °

Layer 3

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 280 psf
Phi: 22 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (455.30769, 704) ft
Left-Zone Right Coordinate: (498, 707.33333) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (625, 671.66667) ft
Right-Zone Right Coordinate: (684, 660) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 680) ft
Right Coordinate: (750, 660) ft

Seismic Loads

Horz Seismic Load: 0.056
Ignore seismic load in strength: No

Regions

	Material	Points	Area (ft^2)
Region 1	Layer 4	1,16,9,2,3,4,5,6,18,7,8	3000
Region 2	Layer 5	9,10,11,12,23,13,14,15,16	3757.5
Region 3	Layer 1	8,17,18,7	3654
Region 4	Layer 2	19,20,5,6,18,17	9696
Region 5	Layer 3	19,21,22,20	41250

Points

	X (ft)	Y (ft)
Point 1	0	680

Point 2	600	680
Point 3	660	660
Point 4	750	660
Point 5	750	656
Point 6	660	656
Point 7	600	676
Point 8	0	676
Point 9	590	680
Point 10	545	695
Point 11	535	695
Point 12	490	710
Point 13	471	708
Point 14	420	695
Point 15	410	695
Point 16	350	680
Point 17	0	670
Point 18	618	670
Point 19	0	655
Point 20	750	655
Point 21	0	600
Point 22	750	600
Point 23	480	710

Critical Slip Surfaces

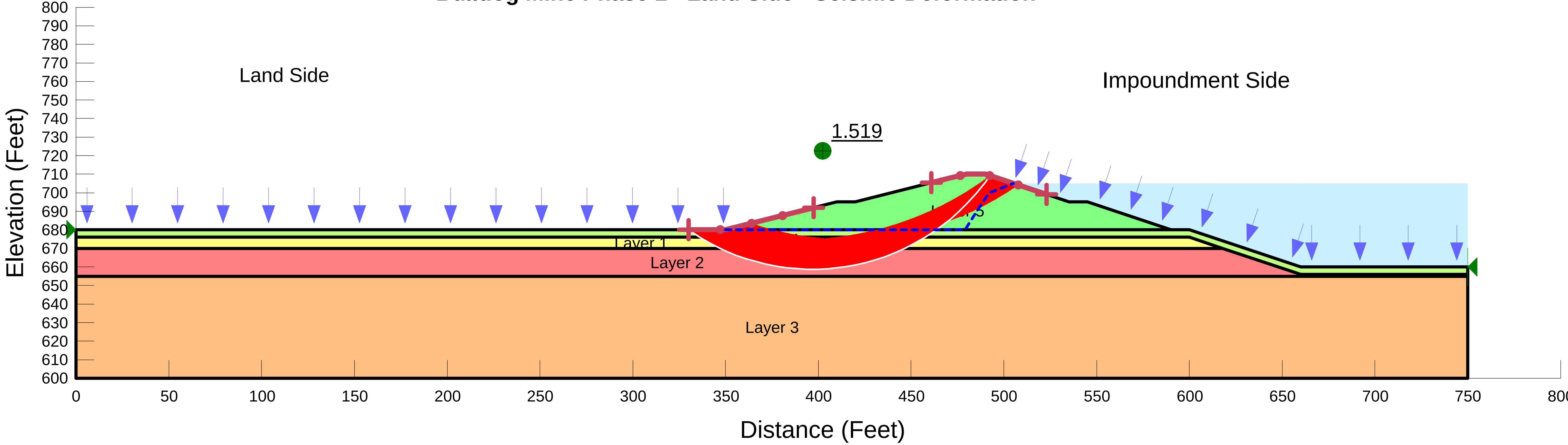
	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	37	1.666	(608.87, 890.397)	232.753	(465.93, 706.708)	(653.884, 662.039)

Slices of Slip Surface: 37

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	37	468.4648	704.7898	-1558.3053	129.86192	22.89816	400
2	37	475.5	699.7244	-1231.8848	915.03637	161.3456	400

3	37	482.5	694.96025	-487.4045	1584.7994	279.4429	400
4	37	487.5	691.81575	35.913435	1950.7079	337.62993	400
5	37	493.2228	688.4423	506.96175	2241.6447	305.87141	400
6	37	499.6684	684.88435	1135.1108	2434.9834	229.20261	400
7	37	506.11395	681.58595	1374.7267	2601.8426	216.37364	400
8	37	513.8052	678	1458.7511	2944.8736	0	400
9	37	520.90205	674.92695	1525.93	3121.7088	518.49996	240
10	37	526.1588	672.85455	1689.1665	3276.553	515.77315	240
11	37	531.4156	670.9276	1845.179	3418.2272	511.11436	240
12	37	534.522	669.83885	1935.0874	3493.426	506.3349	280
13	37	537.5	668.87225	2016.9081	3591.6004	511.64852	280
14	37	542.5	667.323	2135.8694	3799.2099	540.45207	280
15	37	548.2143	665.7115	2262.0021	3985.1605	559.8881	280
16	37	554.64285	664.07365	2394.3639	4100.1288	554.23662	280
17	37	561.0714	662.62895	2505.403	4193.8896	548.62256	280
18	37	567.5	661.37375	2602.9404	4265.3689	540.15574	280
19	37	573.9286	660.305	2689.3664	4313.4134	527.68485	280
20	37	580.35715	659.4201	2757.1384	4336.4836	513.16036	280
21	37	586.7857	658.7169	2813.2255	4333.1136	493.8416	280
22	37	592.5	658.23425	2854.5128	4306.9068	471.91142	280
23	37	597.5	657.9357	2879.757	4371.5733	484.72053	280
24	37	603	657.7377	2898.9105	4412.7619	491.88014	280
25	37	609	657.6637	2910.8328	4326.6659	460.03206	280
26	37	615	657.7444	2912.3228	4212.7049	422.51976	280
27	37	621.51055	658.0144	2900.543	4050.2361	373.55792	280
28	37	628.5316	658.503	2875.2866	3832.9586	311.16649	280
29	37	635.55265	659.2058	2836.4373	3576.9926	240.62102	280
30	37	642.57375	660.1248	2782.4644	3283.0374	162.64603	280
31	37	649.98425	661.3386	2716.8584	2927.4686	0	400

Bulldog Mine Phase 1 - Land Side - Seismic Deformation



Engineering Parameters

Name: Layer 4	Unit Weight: 130 pcf	Cohesion: 400 psf	Phi: 0 °
Name: Layer 5	Unit Weight: 125 pcf	Cohesion: 400 psf	Phi: 10 °
Name: Layer 1	Unit Weight: 120 pcf	Cohesion: 240 psf	Phi: 18 °
Name: Layer 2	Unit Weight: 125 pcf	Cohesion: 280 psf	Phi: 18 °
Name: Layer 3	Unit Weight: 125 pcf	Cohesion: 280 psf	Phi: 22 °

SLOPE/W Analysis

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File Information

Created By: Eric Wenz
Revision Number: 111
Last Edited By: Eric Wenz
Date: 6/7/2012
Time: 12:56:13 PM
File Name: Phase 1 - Land Side - Seismic Deformation.gsz
Directory: I:\GEOTECH\PROJECTS\2011\2-0383\Stability Analysis\5-30-12 Cross Sections\Phase 1\WITH SEEPAGE ANALYSIS\
Last Solved Date: 6/7/2012
Last Solved Time: 12:56:16 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Description: Allerton Mine Stage 1
Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Other GeoStudio Analysis
- PWP Other Analysis: "..\..\..\..\Seepage\Phase 1\Phase 1 - Impoundment Side - Normal Pool SEEPAGE WITH DRAIN.gsz" - Steady-State Seepage [(all)]

Slip Surface
- Direction of movement: Right to Left
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
FOS Distribution
FOS Calculation Option: Constant
Advanced
Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Layer 4

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 400 psf
Phi: 0 °
Phi-B: 0 °

Layer 5

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 400 psf
Phi: 10 °
Phi-B: 0 °

Layer 1

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 240 psf
Phi: 18 °
Phi-B: 0 °

Layer 2

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 280 psf
Phi: 18 °
Phi-B: 0 °

Layer 3

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 280 psf
Phi: 22 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (330, 680) ft
Left-Zone Right Coordinate: (397.44649, 691.86162) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (461, 705.45098) ft
Right-Zone Right Coordinate: (522.97503, 699.00832) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 680) ft
Right Coordinate: (750, 660) ft

Seismic Loads

Horz Seismic Load: 0.056
Ignore seismic load in strength: No

Regions

	Material	Points	Area (ft^2)
Region 1	Layer 4	1,16,9,2,3,4,5,6,18,7,8	3000
Region 2	Layer 5	9,10,11,12,23,13,14,15,16	3757.5
Region 3	Layer 1	8,17,18,7	3654
Region 4	Layer 2	19,20,5,6,18,17	9696
Region 5	Layer 3	19,21,22,20	41250

Points

	X (ft)	Y (ft)
Point 1	0	680

Point 2	600	680
Point 3	660	660
Point 4	750	660
Point 5	750	656
Point 6	660	656
Point 7	600	676
Point 8	0	676
Point 9	590	680
Point 10	545	695
Point 11	535	695
Point 12	490	710
Point 13	471	708
Point 14	420	695
Point 15	410	695
Point 16	350	680
Point 17	0	670
Point 18	618	670
Point 19	0	655
Point 20	750	655
Point 21	0	600
Point 22	750	600
Point 23	480	710

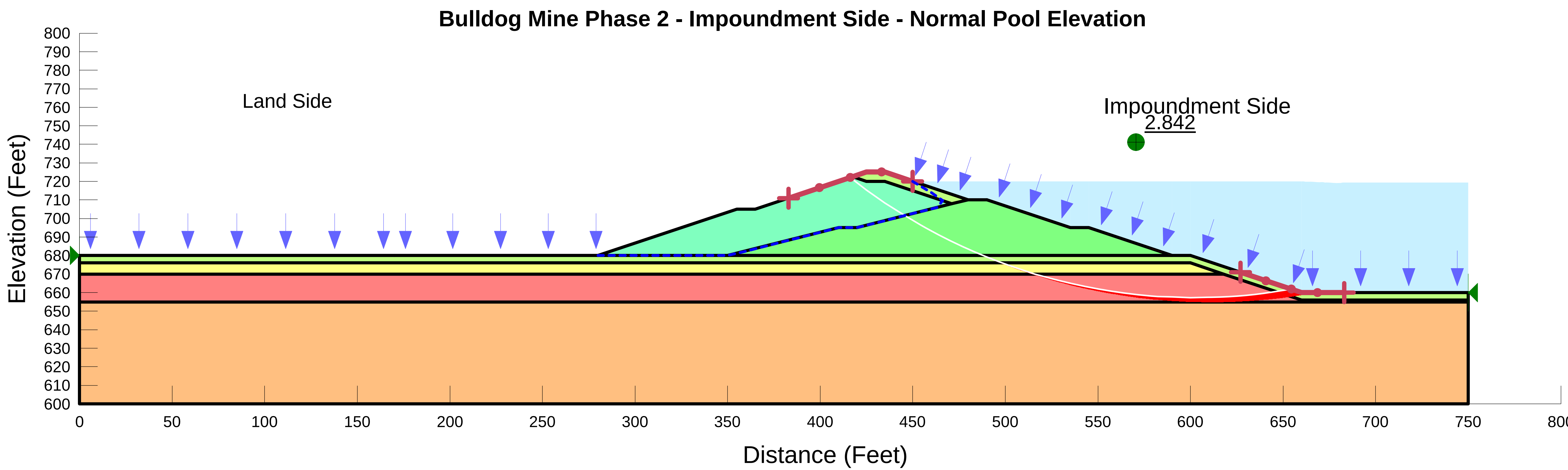
Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	13	1.519	(396.848, 774.724)	115.937	(492.476, 709.175)	(330, 680)

Slices of Slip Surface: 13

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	13	333.0313	678	165.77878	487.78144	0	400
2	13	338.8237	674.40305	388.1772	957.12651	184.86283	240

3	13	344.34585	671.40305	575.82807	1360.7385	255.03286	240
4	13	348.55345	669.3371	705.20014	1660.3721	310.35417	280
5	13	352.72725	667.55145	817.02997	2017.2303	389.96872	280
6	13	358.1818	665.46355	948.09362	2514.3311	508.9014	280
7	13	363.63635	663.6827	1063.0052	2952.2457	613.85147	280
8	13	369.0909	662.19425	1159.4984	3329.1011	704.94668	280
9	13	374.54545	660.98675	1238.3189	3643.8393	781.60096	280
10	13	380	660.0513	1302.6058	3897.2608	843.0545	280
11	13	385.45455	659.3812	1351.5372	4091.7029	890.33379	280
12	13	390.9091	658.97185	1384.1061	4231.0847	925.03942	280
13	13	396.36365	658.8205	1401.1311	4319.6623	948.28828	280
14	13	401.8182	658.92615	1406.7965	4362.4339	960.34478	280
15	13	407.27275	659.2895	1396.3229	4364.4561	964.40495	280
16	13	412.5	659.8765	1371.3832	4257.2469	937.67394	280
17	13	417.5	660.66985	1335.3462	4051.7159	882.602	280
18	13	422.65895	661.7299	1288.4655	3900.0077	848.54152	280
19	13	427.97685	663.07865	1224.2606	3798.5987	836.45316	280
20	13	433.29475	664.7008	1143.1312	3674.3567	822.44503	280
21	13	438.6126	666.60875	1046.9804	3528.2328	806.20778	280
22	13	443.93045	668.81795	941.69544	3360.3014	785.85272	280
23	13	449.3505	671.40305	813.82452	3178.2907	768.26163	240
24	13	454.8727	674.40305	660.80887	2965.8413	748.95042	240
25	13	460.6651	678	308.35871	2872.1128	0	400
26	13	467.3482	682.8007	-175.30958	2362.1596	416.51248	400
27	13	473.25	687.5739	-475.73747	1994.3543	351.65847	400
28	13	477.75	691.73995	-695.46093	1650.3811	291.00672	400
29	13	482.5	696.6771	-574.79293	1166.8014	205.73856	400
30	13	487.5	702.5612	-503.24172	515.03771	90.815045	400
31	13	491.2379	707.4382	-494.68111	-83.049406	-14.643851	400



Engineering Parameters

Name: Layer 4 Unit Weight: 130 pcf Cohesion: 500 psf Phi: 0 °
Name: Layer 5 Unit Weight: 125 pcf Cohesion: 500 psf Phi: 10 °
Name: Layer 6 Unit Weight: 105 pcf Cohesion: 0 psf Phi: 35 °
Name: Layer 1 Unit Weight: 120 pcf Cohesion: 300 psf Phi: 18 °
Name: Layer 2 Unit Weight: 125 pcf Cohesion: 350 psf Phi: 18 °
Name: Layer 3 Unit Weight: 125 pcf Cohesion: 350 psf Phi: 22 °

SLOPE/W Analysis

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File Information

Created By: Eric Wenz
Revision Number: 98
Last Edited By: Eric Wenz
Date: 6/7/2012
Time: 1:02:12 PM
File Name: Phase 2 - Impoundment Side - Normal Pool.gsz
Directory: I:\GEOTECH\PROJECTS\2011\2-0383\Stability Analysis\5-30-12 Cross Sections\Phase 2\WITH SEEPAGE ANALYSIS\
Last Solved Date: 6/7/2012
Last Solved Time: 1:02:16 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Description: Allerton Mine Stage 1
Kind: SLOPE/W
Method: Morgenstern-Price
Settings
    Side Function
        Interslice force function option: Half-Sine
    PWP Conditions Source: Other GeoStudio Analysis
    PWP Other Analysis: "..\..\..\..\Seepage\Phase 2\Phase 2 - Impoundment Side - Normal Pool SEEPAGE.gsz" - Steady-State Seepage [(all)]
Slip Surface
    Direction of movement: Left to Right
    Use Passive Mode: No
    Slip Surface Option: Entry and Exit
    Critical slip surfaces saved: 1
    Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
FOS Distribution
FOS Calculation Option: Constant
Advanced
Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Layer 4

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 500 psf
Phi: 0 °
Phi-B: 0 °

Layer 5

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 500 psf
Phi: 10 °
Phi-B: 0 °

Layer 6

Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 1

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 300 psf
Phi: 18 °
Phi-B: 0 °

Layer 2

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 350 psf
Phi: 18 °
Phi-B: 0 °

Layer 3

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 350 psf
Phi: 22 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (383, 711) ft
Left-Zone Right Coordinate: (450, 720) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (627, 671) ft
Right-Zone Right Coordinate: (683, 660) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 680) ft
Right Coordinate: (750, 660) ft

Regions

	Material	Points	Area (ft^2)
Region 1	Layer 4	1,22,21,16,9,2,3,4,5,6,24,7,8	3000
Region 2	Layer 5	9,10,11,12,29,13,14,15,16	3757.5
Region 3	Layer 6	13,17,30,18,19,20,21,16,15,14	3196.25
Region 4	Layer 1	8,23,24,7	3654
Region 5	Layer 2	25,26,5,6,24,23	9696
Region 6	Layer 3	25,27,28,26	41250
Region 7	Layer 4	13,17,30,18,31,32,29	271.25

Points

	X (ft)	Y (ft)
Point 1	0	680
Point 2	600	680
Point 3	660	660
Point 4	750	660
Point 5	750	656
Point 6	660	656
Point 7	600	676
Point 8	0	676
Point 9	590	680
Point 10	545	695
Point 11	535	695
Point 12	490	710
Point 13	471	708
Point 14	420	695
Point 15	410	695
Point 16	350	680
Point 17	435	720
Point 18	417.5	722.5
Point 19	365	705
Point 20	355	705
Point 21	280	680
Point 22	170	680
Point 23	0	670
Point 24	618	670
Point 25	0	655
Point 26	750	655
Point 27	0	600
Point 28	750	600
Point 29	480	710
Point 30	425	720
Point 31	425	725
Point 32	435	725

Critical Slip Surfaces

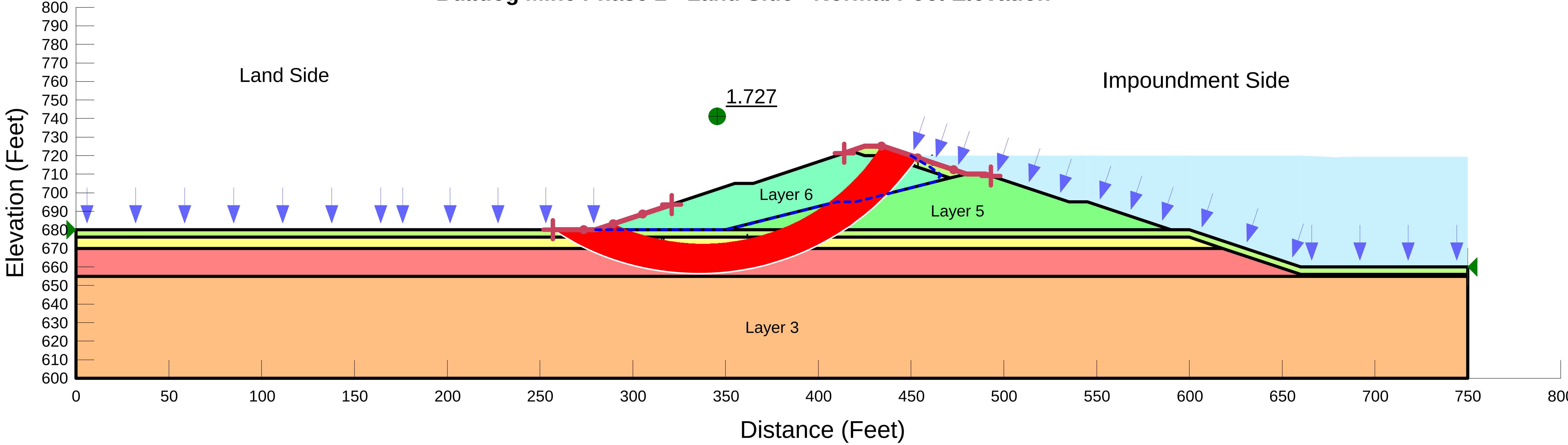
	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	62	2.842	(602.411, 957.295)	299.973	(416.243, 722.081)	(654.41, 661.863)

Slices of Slip Surface: 62

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	62	416.8717	721.58655	-1383.0856	61.883668	43.331411	0
2	62	421.25	718.25005	-1132.3579	537.67874	376.48671	0
3	62	430	711.89525	-684.81146	1270.9756	889.94672	0
4	62	440.32685	704.9608	-273.46813	1745.1985	1222.0011	0
5	62	449.87805	699.0441	2.0386406	2179.0749	383.87022	500
6	62	458.3268	694.2352	7.4129892	2683.5623	471.87733	500
7	62	466.7756	689.77955	20.581278	3151.7984	552.11807	500
8	62	475.5	685.53625	75.128163	3535.0758	610.08212	500
9	62	483.99675	681.7174	30.792289	3895.1844	681.39659	500
10	62	488.99675	679.5903	554.22367	4251.5858	0	500
11	62	494.10705	677.5903	1256.7571	4439.1793	0	500
12	62	502.6916	674.4216	1689.3964	4591.1015	942.82113	300
13	62	511.6466	671.4216	2092.6	4797.0893	878.74186	300
14	62	520.84305	668.6664	2461.7613	4974.1976	816.34003	350
15	62	530.281	666.16365	2762.3278	5127.5691	768.51347	350
16	62	540	663.9308	3032.5349	5313.0004	740.96815	350
17	62	548.75	662.1852	3225.1175	5514.118	743.74133	350
18	62	556.25	660.91925	3373.4615	5546.1995	705.96535	350
19	62	563.75	659.8478	3486.0113	5551.9672	671.26976	350
20	62	571.25	658.9687	3587.6821	5531.2419	631.50088	350
21	62	578.75	658.28025	3665.7419	5483.3937	590.59088	350
22	62	586.25	657.7812	3726.047	5408.0005	546.49983	350
23	62	595	657.4553	3777.9477	5352.7674	511.68993	350
24	62	604.5	657.36305	3806.9078	5325.4266	493.39666	350
25	62	613.5	657.5609	3815.8336	5131.3779	427.44626	350

26	62	621.5418	657.95375	3802.7533	4918.5582	362.54699	350
27	62	628.62535	658.49085	3779.0557	4695.4121	297.74222	350
28	62	635.7089	659.1972	3743.8875	4446.5065	228.29476	350
29	62	642.7925	660.074	3693.9878	4172.2604	155.40018	350
30	62	650.3721	661.2093	3647.0444	3844.7006	0	500

Bulldog Mine Phase 2 - Land Side - Normal Pool Elevation



Engineering Parameters

Name: Layer 4 Unit Weight: 130 pcf Cohesion: 500 psf Phi: 0 °
Name: Layer 5 Unit Weight: 125 pcf Cohesion: 500 psf Phi: 10 °
Name: Layer 6 Unit Weight: 105 pcf Cohesion: 0 psf Phi: 35 °
Name: Layer 1 Unit Weight: 120 pcf Cohesion: 300 psf Phi: 18 °
Name: Layer 2 Unit Weight: 125 pcf Cohesion: 350 psf Phi: 18 °
Name: Layer 3 Unit Weight: 125 pcf Cohesion: 350 psf Phi: 22 °

SLOPE/W Analysis

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File Information

Created By: Eric Wenz
Revision Number: 101
Last Edited By: Eric Wenz
Date: 6/7/2012
Time: 1:10:22 PM
File Name: Phase 2 - Land Side - Normal Pool.gsz
Directory: I:\GEOTECH\PROJECTS\2011\2-0383\Stability Analysis\5-30-12 Cross Sections\Phase 2\WITH SEEPAGE ANALYSIS\
Last Solved Date: 6/7/2012
Last Solved Time: 1:10:26 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Description: Allerton Mine Stage 1
Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Other GeoStudio Analysis
- PWP Other Analysis: "..\..\..\..\Seepage\Phase 2\Phase 2 - Impoundment Side - Normal Pool SEEPAGE.gsz" - Steady-State Seepage [(all)]

Slip Surface
- Direction of movement: Right to Left
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
FOS Distribution
FOS Calculation Option: Constant
Advanced
Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Layer 4

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 500 psf
Phi: 0 °
Phi-B: 0 °

Layer 5

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 500 psf
Phi: 10 °
Phi-B: 0 °

Layer 6

Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 1

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 300 psf
Phi: 18 °
Phi-B: 0 °

Layer 2

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 350 psf
Phi: 18 °
Phi-B: 0 °

Layer 3

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 350 psf
Phi: 22 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (257, 680) ft
Left-Zone Right Coordinate: (321, 693.66667) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (414, 721.33333) ft
Right-Zone Right Coordinate: (493, 709) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 680) ft
Right Coordinate: (750, 660) ft

Regions

	Material	Points	Area (ft^2)
Region 1	Layer 4	1,22,21,16,9,2,3,4,5,6,24,7,8	3000
Region 2	Layer 5	9,10,11,12,29,13,14,15,16	3757.5
Region 3	Layer 6	13,17,30,18,19,20,21,16,15,14	3196.25
Region 4	Layer 1	8,23,24,7	3654
Region 5	Layer 2	25,26,5,6,24,23	9696
Region 6	Layer 3	25,27,28,26	41250
Region 7	Layer 4	13,17,30,18,31,32,29	271.25

Points

	X (ft)	Y (ft)
Point 1	0	680
Point 2	600	680
Point 3	660	660
Point 4	750	660
Point 5	750	656
Point 6	660	656
Point 7	600	676
Point 8	0	676
Point 9	590	680
Point 10	545	695
Point 11	535	695
Point 12	490	710
Point 13	471	708
Point 14	420	695
Point 15	410	695
Point 16	350	680
Point 17	435	720
Point 18	417.5	722.5
Point 19	365	705
Point 20	355	705
Point 21	280	680
Point 22	170	680
Point 23	0	670
Point 24	618	670
Point 25	0	655
Point 26	750	655
Point 27	0	600
Point 28	750	600
Point 29	480	710
Point 30	425	720
Point 31	425	725
Point 32	435	725

Critical Slip Surfaces

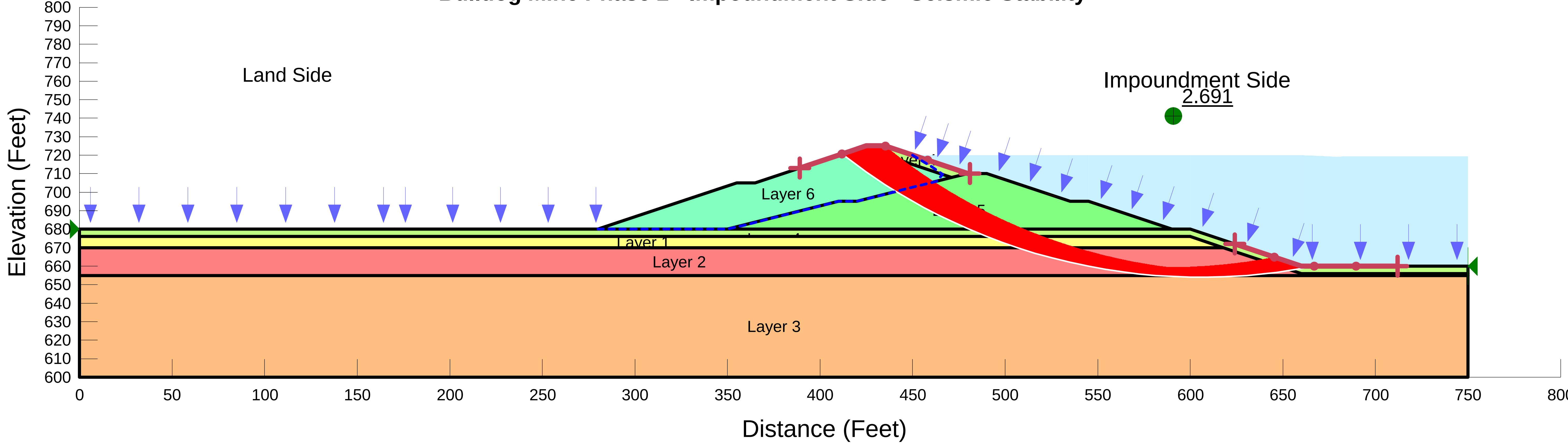
	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	13	1.727	(335.609, 798.8)	142.453	(453.5, 718.833)	(257, 680)

Slices of Slip Surface: 13

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	13	260.204	678	135.70276	465.9512	0	500
2	13	266.2444	674.4182	357.87636	922.61126	183.49349	300
3	13	271.9172	671.4182	544.92291	1326.4137	253.92176	300
4	13	277.3768	668.82475	706.63769	1704.1303	324.10498	350
5	13	283.1818	666.38965	858.94732	2180.7902	429.4928	350
6	13	289.54545	664.04215	1005.9554	2770.3475	573.28576	350
7	13	295.9091	662.03095	1131.9576	3300.9332	704.74287	350
8	13	302.2727	660.3413	1238.5939	3769.0091	822.18175	350
9	13	308.63635	658.96145	1326.0741	4172.8547	924.97509	350
10	13	315	657.88235	1394.7653	4512.1284	1012.8927	350
11	13	321.36365	657.09715	1446.0468	4787.7383	1085.7814	350
12	13	327.7273	656.60095	1479.5231	5002.1927	1144.5847	350
13	13	334.0909	656.39065	1495.145	5158.864	1190.4144	350
14	13	340.45455	656.465	1494.2546	5261.8668	1224.1714	350
15	13	346.8182	656.8245	1476.0385	5315.6309	1247.5592	350
16	13	352.5	657.3743	1445.4875	5340.0504	1265.4202	350
17	13	357.5	658.06175	1406.5869	5260.7438	1252.2915	350
18	13	362.5	658.93125	1357.7743	5075.6466	1208.01	350
19	13	368.1465	660.1503	1287.8921	4948.814	1189.5056	350
20	13	374.4395	661.7804	1193.0896	4872.621	1195.5522	350
21	13	380.7325	663.7232	1081.4549	4765.8895	1197.1454	350
22	13	387.02555	665.99245	951.20688	4630.0001	1195.3124	350
23	13	393.3186	668.6053	799.63519	4465.1613	1191.0016	350
24	13	399.30145	671.4182	635.42543	4296.3469	1189.5055	300
25	13	404.9742	674.4182	464.93905	4110.0741	1184.3762	300
26	13	408.9053	676.6569	312.92995	4200.7542	0	500

27	13	412.1093	678.6569	125.33857	4070.979	0	500
28	13	415.8593	681.1188	0	3713.029	654.70719	500
29	13	418.75	683.13615	0	3588.3528	632.72341	500
30	13	422.5	685.95975	0	3450.7004	608.45157	500
31	13	427.5	689.9962	0	3138.7733	553.45042	500
32	13	432.5	694.4284	0	2676.7871	471.98979	500
33	13	436.38975	698.1406	0	2248.0489	396.39167	500
34	13	440.9969	703.0741	-158.48876	1484.3692	1039.3665	0
35	13	447.43165	710.69995	-337.41018	773.95739	541.9308	0
36	13	452.0745	716.8085	-200.91597	-39.765229	0	500

Bulldog Mine Phase 2 - Impoundment Side - Seismic Stability



Engineering Parameters

Name: Layer 4	Unit Weight: 130 pcf	Cohesion: 400 psf	Phi: 0 °
Name: Layer 5	Unit Weight: 125 pcf	Cohesion: 400 psf	Phi: 10 °
Name: Layer 6	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Layer 1	Unit Weight: 120 pcf	Cohesion: 240 psf	Phi: 18 °
Name: Layer 2	Unit Weight: 125 pcf	Cohesion: 280 psf	Phi: 18 °
Name: Layer 3	Unit Weight: 125 pcf	Cohesion: 280 psf	Phi: 22 °

SLOPE/W Analysis

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File Information

Created By: Eric Wenz
Revision Number: 100
Last Edited By: Eric Wenz
Date: 6/7/2012
Time: 1:05:14 PM
File Name: Phase 2 - Impoundment Side - Seismic Stability.gsz
Directory: I:\GEOTECH\PROJECTS\2011\2-0383\Stability Analysis\5-30-12 Cross Sections\Phase 2\WITH SEEPAGE ANALYSIS\
Last Solved Date: 6/7/2012
Last Solved Time: 1:09:20 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Description: Allerton Mine Stage 1
Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Other GeoStudio Analysis
- PWP Other Analysis: "..\..\..\..\Seepage\Phase 2\Phase 2 - Impoundment Side - Normal Pool SEEPAGE.gsz" - Steady-State Seepage [(all)]

Slip Surface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No

Tension Crack
    Tension Crack Option: (none)

FOS Distribution
    FOS Calculation Option: Constant

Advanced
    Number of Slices: 30
    Optimization Tolerance: 0.01
    Minimum Slip Surface Depth: 0.1 ft
    Optimization Maximum Iterations: 2000
    Optimization Convergence Tolerance: 1e-007
    Starting Optimization Points: 8
    Ending Optimization Points: 16
    Complete Passes per Insertion: 1
    Driving Side Maximum Convex Angle: 5 °
    Resisting Side Maximum Convex Angle: 1 °

Materials

Layer 4

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 400 psf
Phi: 0 °
Phi-B: 0 °

Layer 5

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 400 psf
Phi: 10 °
Phi-B: 0 °

Layer 6

Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 1

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 240 psf
Phi: 18 °
Phi-B: 0 °

Layer 2

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 280 psf
Phi: 18 °
Phi-B: 0 °

Layer 3

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 280 psf
Phi: 22 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (389, 713) ft
Left-Zone Right Coordinate: (481, 710) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (624, 672) ft
Right-Zone Right Coordinate: (712, 660) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 680) ft
Right Coordinate: (750, 660) ft

Regions

	Material	Points	Area (ft^2)
Region 1	Layer 4	1,22,21,16,9,2,3,4,5,6,24,7,8	3000
Region 2	Layer 5	9,10,11,12,29,13,14,15,16	3757.5
Region 3	Layer 6	13,17,30,18,19,20,21,16,15,14	3196.25
Region 4	Layer 1	8,23,24,7	3654
Region 5	Layer 2	25,26,5,6,24,23	9696
Region 6	Layer 3	25,27,28,26	41250
Region 7	Layer 4	13,17,30,18,31,32,29	271.25

Points

	X (ft)	Y (ft)
Point 1	0	680
Point 2	600	680
Point 3	660	660
Point 4	750	660
Point 5	750	656
Point 6	660	656
Point 7	600	676
Point 8	0	676
Point 9	590	680
Point 10	545	695
Point 11	535	695
Point 12	490	710
Point 13	471	708
Point 14	420	695
Point 15	410	695
Point 16	350	680
Point 17	435	720
Point 18	417.5	722.5
Point 19	365	705
Point 20	355	705
Point 21	280	680
Point 22	170	680
Point 23	0	670
Point 24	618	670
Point 25	0	655
Point 26	750	655
Point 27	0	600
Point 28	750	600
Point 29	480	710
Point 30	425	720
Point 31	425	725
Point 32	435	725

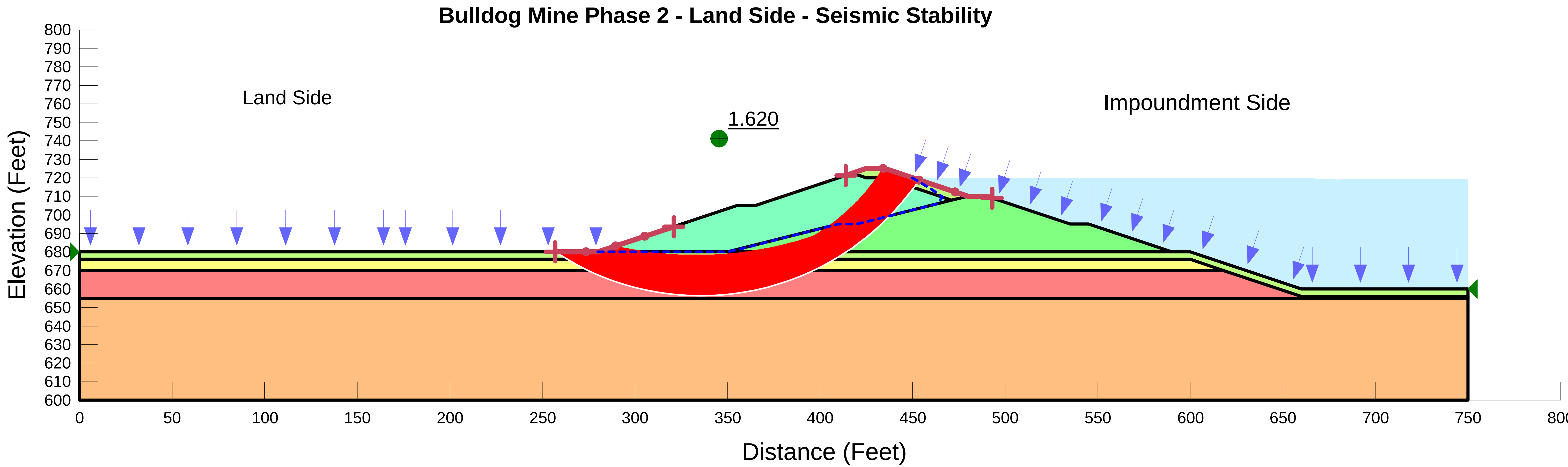
Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	37	2.691	(605.884, 969.982)	315.954	(411.859, 720.62)	(667.026, 660)

Slices of Slip Surface: 37

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	37	414.67945	718.4753	-1316.0936	269.9473	189.01913	0
2	37	421.25	713.63015	-990.02595	943.79531	660.85259	0
3	37	430	707.5779	-583.9393	1652.7697	1157.2818	0
4	37	438.0634	702.3059	-157.30078	2045.1176	1432.0068	0
5	37	444.86095	698.17315	0	2439.6232	430.17139	400
6	37	452.32925	693.8842	3.2207139	2787.6266	490.96587	400
7	37	459.79755	689.86	6.1407752	3208.8794	564.72924	400
8	37	467.26585	686.0893	19.285229	3602.9255	631.89246	400
9	37	475.5	682.227	29.610014	3943.0089	690.03782	400
10	37	485	678.11715	640.95907	4452.7882	0	400
11	37	494.20355	674.45775	1467.837	4727.4098	1059.0994	240
12	37	502.5519	671.4346	1868.5256	4944.5079	999.44725	240
13	37	511.41395	668.52175	2265.5421	5144.6284	935.47187	280
14	37	520.8484	665.7251	2636.9028	5333.0137	876.01954	280
15	37	530.2828	663.24405	2941.3139	5482.6997	825.74629	280
16	37	540	661.0152	3209.0509	5667.9671	798.9503	280
17	37	549.5141	659.13045	3421.7503	5871.2292	795.88394	280
18	37	558.5423	657.6277	3589.7459	5906.1773	752.65419	280
19	37	567.57045	656.392	3724.5557	5905.4592	708.6185	280
20	37	576.5986	655.42025	3834.0303	5868.5015	661.03976	280
21	37	585.55635	654.7135	3914.2211	5794.2464	759.57954	280
22	37	595	654.25465	3976.5379	5745.2873	714.62113	280
23	37	604.5	654.06255	4012.295	5736.723	696.71412	280
24	37	613.5	654.15135	4027.6066	5562.0493	619.9551	280
25	37	624.32735	654.62995	4013.8589	5284.9681	513.56146	280

26	37	634.6436	655.36465	3980.861	4965.8716	320.04936	280
27	37	642.6214	656.1963	3934.3601	4682.5882	243.11404	280
28	37	650.59925	657.2336	3874.0788	4368.5603	160.66675	280
29	37	657.2941	658.2502	3826.2967	4078.624	0	400
30	37	663.51315	659.34825	3770.5201	3851.122	0	400



Engineering Parameters

Name: Layer 4 Unit Weight: 130 pcf Cohesion: 400 psf Phi: 0 °
Name: Layer 5 Unit Weight: 125 pcf Cohesion: 400 psf Phi: 10 °
Name: Layer 6 Unit Weight: 105 pcf Cohesion: 0 psf Phi: 35 °
Name: Layer 1 Unit Weight: 120 pcf Cohesion: 240 psf Phi: 18 °
Name: Layer 2 Unit Weight: 125 pcf Cohesion: 280 psf Phi: 18 °
Name: Layer 3 Unit Weight: 125 pcf Cohesion: 280 psf Phi: 22 °

SLOPE/W Analysis

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File Information

Created By: Eric Wenz
Revision Number: 104
Last Edited By: Eric Wenz
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Time: 1:14:10 PM
File Name: Phase 2 - Land Side - Seismic Stability.gsz
Directory: I:\GEOTECH\PROJECTS\2011\2-0383\Stability Analysis\5-30-12 Cross Sections\Phase 2\WITH SEEPAGE ANALYSIS\
Last Solved Date: 6/7/2012
Last Solved Time: 1:14:14 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Description: Allerton Mine Stage 1
Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Other GeoStudio Analysis
- PWP Other Analysis: "..\..\..\..\Seepage\Phase 2\Phase 2 - Impoundment Side - Normal Pool SEEPAGE.gsz" - Steady-State Seepage [(all)]

Slip Surface
- Direction of movement: Right to Left
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
FOS Distribution
FOS Calculation Option: Constant
Advanced
Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Layer 4

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 400 psf
Phi: 0 °
Phi-B: 0 °

Layer 5

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 400 psf
Phi: 10 °
Phi-B: 0 °

Layer 6

Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 1

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 240 psf
Phi: 18 °
Phi-B: 0 °

Layer 2

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 280 psf
Phi: 18 °
Phi-B: 0 °

Layer 3

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 280 psf
Phi: 22 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (257, 680) ft
Left-Zone Right Coordinate: (321, 693.66667) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (414, 721.33333) ft
Right-Zone Right Coordinate: (493, 709) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 680) ft
Right Coordinate: (750, 660) ft

Regions

	Material	Points	Area (ft^2)
Region 1	Layer 4	1,22,21,16,9,2,3,4,5,6,24,7,8	3000
Region 2	Layer 5	9,10,11,12,29,13,14,15,16	3757.5
Region 3	Layer 6	13,17,30,18,19,20,21,16,15,14	3196.25
Region 4	Layer 1	8,23,24,7	3654
Region 5	Layer 2	25,26,5,6,24,23	9696
Region 6	Layer 3	25,27,28,26	41250
Region 7	Layer 4	13,17,30,18,31,32,29	271.25

Points

	X (ft)	Y (ft)
Point 1	0	680
Point 2	600	680
Point 3	660	660
Point 4	750	660
Point 5	750	656
Point 6	660	656
Point 7	600	676
Point 8	0	676
Point 9	590	680
Point 10	545	695
Point 11	535	695
Point 12	490	710
Point 13	471	708
Point 14	420	695
Point 15	410	695
Point 16	350	680
Point 17	435	720
Point 18	417.5	722.5
Point 19	365	705
Point 20	355	705
Point 21	280	680
Point 22	170	680
Point 23	0	670
Point 24	618	670
Point 25	0	655
Point 26	750	655
Point 27	0	600
Point 28	750	600
Point 29	480	710
Point 30	425	720
Point 31	425	725
Point 32	435	725

Critical Slip Surfaces

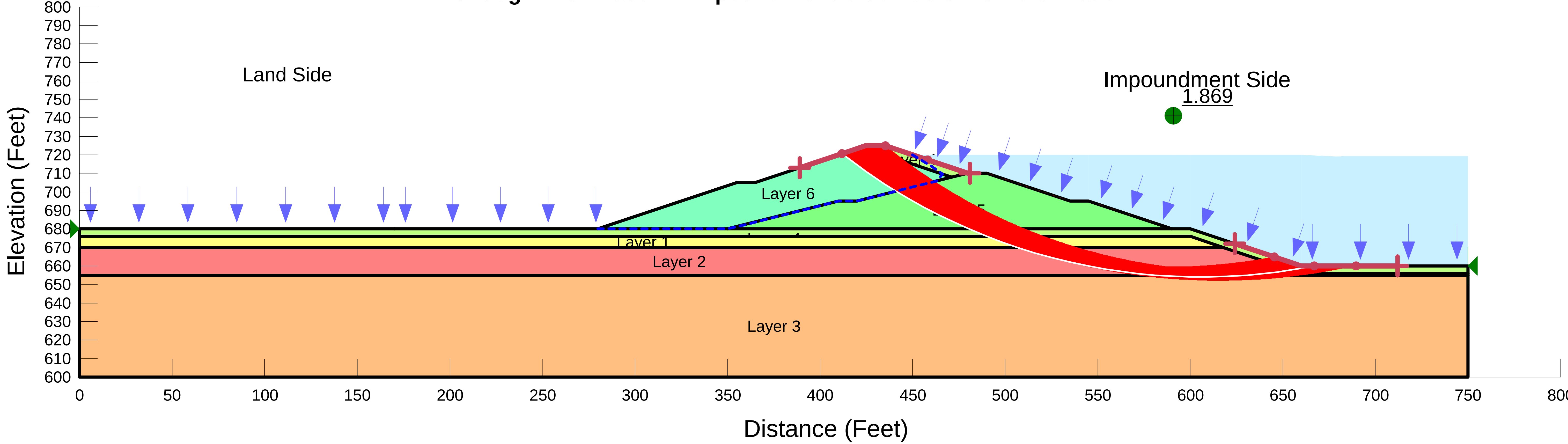
	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	13	1.620	(335.609, 798.8)	142.453	(453.5, 718.833)	(257, 680)

Slices of Slip Surface: 13

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	13	260.204	678	135.70276	438.13815	0	400
2	13	266.2444	674.4182	357.87636	908.72421	178.98132	240
3	13	271.9172	671.4182	544.92291	1315.1561	250.26393	240
4	13	277.3768	668.82475	706.63769	1692.8934	320.45389	280
5	13	283.1818	666.38965	858.94732	2173.1927	427.0242	280
6	13	289.54545	664.04215	1005.9554	2767.0762	572.22285	280
7	13	295.9091	662.03095	1131.9576	3301.5368	704.93901	280
8	13	302.2727	660.3413	1238.5939	3772.6757	823.37311	280
9	13	308.63635	658.96145	1326.0741	4178.8723	926.93034	280
10	13	315	657.88235	1394.7653	4519.5918	1015.3177	280
11	13	321.36365	657.09715	1446.0468	4796.0251	1088.4739	280
12	13	327.7273	656.60095	1479.5231	5010.3516	1147.2357	280
13	13	334.0909	656.39065	1495.145	5166.5635	1192.9162	280
14	13	340.45455	656.465	1494.2546	5268.3059	1226.2636	280
15	13	346.8182	656.8245	1476.0385	5320.4872	1249.1371	280
16	13	352.5	657.3743	1445.4875	5343.2278	1266.4526	280
17	13	357.5	658.06175	1406.5869	5262.1271	1252.741	280
18	13	362.5	658.93125	1357.7743	5075.4502	1207.9461	280
19	13	368.1465	660.1503	1287.8921	4946.8028	1188.8522	280
20	13	374.4395	661.7804	1193.0896	4868.6459	1194.2606	280
21	13	380.7325	663.7232	1081.4549	4760.1622	1195.2844	280
22	13	387.02555	665.99245	951.20688	4622.5907	1192.9049	280
23	13	393.3186	668.6053	799.63519	4456.1542	1188.0751	280
24	13	399.30145	671.4182	635.42543	4284.6793	1185.7145	240
25	13	404.9742	674.4182	464.93905	4096.8337	1180.0741	240
26	13	408.9053	676.6569	312.92995	4210.1536	0	400

27	13	412.1093	678.6569	125.33857	4082.5761	0	400
28	13	415.8593	681.1188	0	3715.5468	655.15115	400
29	13	418.75	683.13615	0	3592.5751	633.46793	400
30	13	422.5	685.95975	0	3456.8804	609.54129	400
31	13	427.5	689.9962	0	3148.858	555.22862	400
32	13	432.5	694.4284	0	2692.4708	474.75525	400
33	13	436.38975	698.1406	0	2269.0245	400.09023	400
34	13	440.9969	703.0741	-158.48876	1456.0528	1019.5391	0
35	13	447.43165	710.69995	-337.41018	756.7421	529.87652	0
36	13	452.0745	716.8085	-200.91597	19.52159	0	400

Bulldog Mine Phase 2 - Impoundment Side - Seismic Deformation



Engineering Parameters

Name: Layer 4	Unit Weight: 130 pcf	Cohesion: 400 psf	Phi: 0 °
Name: Layer 5	Unit Weight: 125 pcf	Cohesion: 400 psf	Phi: 10 °
Name: Layer 6	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Layer 1	Unit Weight: 120 pcf	Cohesion: 240 psf	Phi: 18 °
Name: Layer 2	Unit Weight: 125 pcf	Cohesion: 280 psf	Phi: 18 °
Name: Layer 3	Unit Weight: 125 pcf	Cohesion: 280 psf	Phi: 22 °

SLOPE/W Analysis

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File Information

Created By: Eric Wenz
Revision Number: 104
Last Edited By: Eric Wenz
Date: 6/7/2012
Time: 1:03:19 PM
File Name: Phase 2 - Impoundment Side - Seismic Deformation.gsz
Directory: I:\GEOTECH\PROJECTS\2011\2-0383\Stability Analysis\5-30-12 Cross Sections\Phase 2\WITH SEEPAGE ANALYSIS\
Last Solved Date: 6/7/2012
Last Solved Time: 1:03:22 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Description: Allerton Mine Stage 1
Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Other GeoStudio Analysis
- PWP Other Analysis: "..\..\..\..\Seepage\Phase 2\Phase 2 - Impoundment Side - Normal Pool SEEPAGE.gsz" - Steady-State Seepage [(all)]

Slip Surface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
FOS Distribution
FOS Calculation Option: Constant
Advanced
Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Layer 4
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 400 psf
Phi: 0 °
Phi-B: 0 °

Layer 5
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 400 psf
Phi: 10 °
Phi-B: 0 °

Layer 6
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 1
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 240 psf
Phi: 18 °
Phi-B: 0 °

Layer 2

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 280 psf
Phi: 18 °
Phi-B: 0 °

Layer 3

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 280 psf
Phi: 22 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (389, 713) ft
Left-Zone Right Coordinate: (481, 710) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (624, 672) ft
Right-Zone Right Coordinate: (712, 660) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 680) ft
Right Coordinate: (750, 660) ft

Seismic Loads

Horz Seismic Load: 0.056
Ignore seismic load in strength: No

Regions

	Material	Points	Area (ft^2)
Region 1	Layer 4	1,22,21,16,9,2,3,4,5,6,24,7,8	3000
Region 2	Layer 5	9,10,11,12,29,13,14,15,16	3757.5
Region 3	Layer 6	13,17,30,18,19,20,21,16,15,14	3196.25
Region 4	Layer 1	8,23,24,7	3654
Region 5	Layer 2	25,26,5,6,24,23	9696

Region 6	Layer 3	25,27,28,26	41250
Region 7	Layer 4	13,17,30,18,31,32,29	271.25

Points

	X (ft)	Y (ft)
Point 1	0	680
Point 2	600	680
Point 3	660	660
Point 4	750	660
Point 5	750	656
Point 6	660	656
Point 7	600	676
Point 8	0	676
Point 9	590	680
Point 10	545	695
Point 11	535	695
Point 12	490	710
Point 13	471	708
Point 14	420	695
Point 15	410	695
Point 16	350	680
Point 17	435	720
Point 18	417.5	722.5
Point 19	365	705
Point 20	355	705
Point 21	280	680
Point 22	170	680
Point 23	0	670
Point 24	618	670
Point 25	0	655
Point 26	750	655
Point 27	0	600
Point 28	750	600
Point 29	480	710
Point 30	425	720

Point 31	425	725
Point 32	435	725

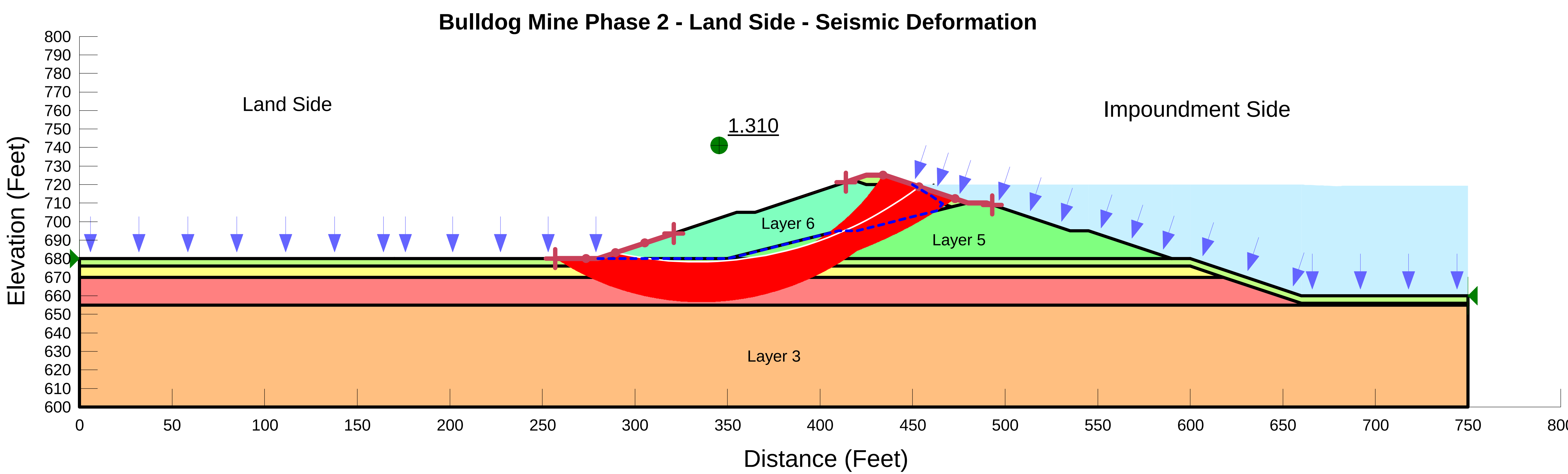
Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	37	1.869	(605.884, 969.982)	315.954	(411.859, 720.62)	(667.026, 660)

Slices of Slip Surface: 37

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	37	414.67945	718.4753	-1316.0936	251.5171	176.11417	0
2	37	421.25	713.63015	-990.02595	881.24925	617.05737	0
3	37	430	707.5779	-583.9393	1547.6078	1083.6466	0
4	37	438.0634	702.3059	-157.30078	1920.3833	1344.6668	0
5	37	444.86095	698.17315	0	2345.5035	413.57555	400
6	37	452.32925	693.8842	3.2207139	2685.82	473.01464	400
7	37	459.79755	689.86	6.1407752	3099.1782	545.38595	400
8	37	467.26585	686.0893	19.285229	3487.2959	611.50385	400
9	37	475.5	682.227	29.610014	3824.9009	669.21217	400
10	37	485	678.11715	640.95907	4355.5024	0	400
11	37	494.20355	674.45775	1467.837	4606.5736	1019.8374	240
12	37	502.5519	671.4346	1868.5256	4834.1588	963.59264	240
13	37	511.41395	668.52175	2265.5421	5046.1134	903.4624	280
14	37	520.8484	665.7251	2636.9028	5249.7141	848.95385	280
15	37	530.2828	663.24405	2941.3139	5416.3194	804.17804	280
16	37	540	661.0152	3209.0509	5600.3865	776.99204	280
17	37	549.5141	659.13045	3421.7503	5837.2253	784.8354	280
18	37	558.5423	657.6277	3589.7459	5891.1739	747.7793	280
19	37	567.57045	656.392	3724.5557	5908.9775	709.76167	280
20	37	576.5986	655.42025	3834.0303	5889.1252	667.74082	280
21	37	585.55635	654.7135	3914.2211	5831.5258	774.64139	280
22	37	595	654.25465	3976.5379	5772.771	725.72525	280

23	37	604.5	654.06255	4012.295	5796.3891	720.82079	280
24	37	613.5	654.15135	4027.6066	5626.8083	646.11941	280
25	37	624.32735	654.62995	4013.8589	5349.6556	539.69691	280
26	37	634.6436	655.36465	3980.861	5022.2935	338.38193	280
27	37	642.6214	656.1963	3934.3601	4730.7686	258.76881	280
28	37	650.59925	657.2336	3874.0788	4405.2896	172.60084	280
29	37	657.2941	658.2502	3826.2967	4103.9662	0	400
30	37	663.51315	659.34825	3770.5201	3866.3748	0	400



Engineering Parameters

Name: Layer 4	Unit Weight: 130 pcf	Cohesion: 400 psf	Phi: 0 °
Name: Layer 5	Unit Weight: 125 pcf	Cohesion: 400 psf	Phi: 10 °
Name: Layer 6	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Layer 1	Unit Weight: 120 pcf	Cohesion: 240 psf	Phi: 18 °
Name: Layer 2	Unit Weight: 125 pcf	Cohesion: 280 psf	Phi: 18 °
Name: Layer 3	Unit Weight: 125 pcf	Cohesion: 280 psf	Phi: 22 °

SLOPE/W Analysis

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File Information

Created By: Eric Wenz
Revision Number: 114
Last Edited By: Eric Wenz
Date: 6/7/2012
Time: 1:11:18 PM
File Name: Phase 2 - Land Side - Seismic Deformation.gsz
Directory: I:\GEOTECH\PROJECTS\2011\2-0383\Stability Analysis\5-30-12 Cross Sections\Phase 2\WITH SEEPAGE ANALYSIS\
Last Solved Date: 6/7/2012
Last Solved Time: 1:11:22 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Description: Allerton Mine Stage 1
Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Other GeoStudio Analysis
- PWP Other Analysis: "..\..\..\..\Seepage\Phase 2\Phase 2 - Impoundment Side - Normal Pool SEEPAGE.gsz" - Steady-State Seepage [(all)]

Slip Surface
- Direction of movement: Right to Left
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
FOS Distribution
FOS Calculation Option: Constant
Advanced
Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Layer 4
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 400 psf
Phi: 0 °
Phi-B: 0 °

Layer 5
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 400 psf
Phi: 10 °
Phi-B: 0 °

Layer 6
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 1
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 240 psf
Phi: 18 °
Phi-B: 0 °

Layer 2

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 280 psf
Phi: 18 °
Phi-B: 0 °

Layer 3

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 280 psf
Phi: 22 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (257, 680) ft
Left-Zone Right Coordinate: (321, 693.66667) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (414, 721.33333) ft
Right-Zone Right Coordinate: (493, 709) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 680) ft
Right Coordinate: (750, 660) ft

Seismic Loads

Horz Seismic Load: 0.056
Ignore seismic load in strength: No

Regions

	Material	Points	Area (ft^2)
Region 1	Layer 4	1,22,21,16,9,2,3,4,5,6,24,7,8	3000
Region 2	Layer 5	9,10,11,12,29,13,14,15,16	3757.5
Region 3	Layer 6	13,17,30,18,19,20,21,16,15,14	3196.25
Region 4	Layer 1	8,23,24,7	3654
Region 5	Layer 2	25,26,5,6,24,23	9696

Region 6	Layer 3	25,27,28,26	41250
Region 7	Layer 4	13,17,30,18,31,32,29	271.25

Points

	X (ft)	Y (ft)
Point 1	0	680
Point 2	600	680
Point 3	660	660
Point 4	750	660
Point 5	750	656
Point 6	660	656
Point 7	600	676
Point 8	0	676
Point 9	590	680
Point 10	545	695
Point 11	535	695
Point 12	490	710
Point 13	471	708
Point 14	420	695
Point 15	410	695
Point 16	350	680
Point 17	435	720
Point 18	417.5	722.5
Point 19	365	705
Point 20	355	705
Point 21	280	680
Point 22	170	680
Point 23	0	670
Point 24	618	670
Point 25	0	655
Point 26	750	655
Point 27	0	600
Point 28	750	600
Point 29	480	710
Point 30	425	720

Point 31	425	725
Point 32	435	725

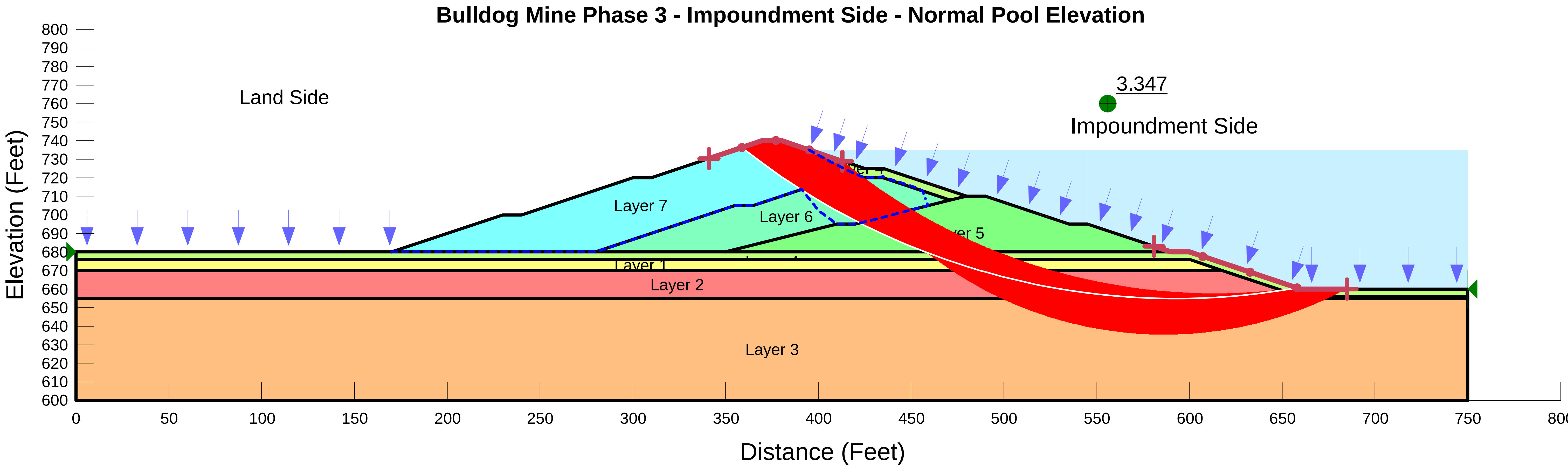
Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	62	1.310	(333.322, 876.82)	198.501	(453.5, 718.833)	(289.59, 683.197)

Slices of Slip Surface: 62

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	62	292.58295	682.56905	-160.32767	198.53332	139.01453	0
2	62	298.5686	681.4091	-87.929119	596.29355	417.52924	0
3	62	304.5542	680.4384	-27.339395	986.80687	690.96961	0
4	62	310.20035	679.6888	20.501595	1236.7773	0	400
5	62	315.507	679.13845	57.006889	1503.9992	0	400
6	62	320.8136	678.73175	84.569089	1744.6054	0	400
7	62	326.1202	678.4679	103.01843	1957.3953	0	400
8	62	331.4268	678.34625	112.14912	2141.9434	0	400
9	62	336.73345	678.3665	111.90214	2298.6752	0	400
10	62	342.0401	678.52875	102.36557	2428.3913	0	400
11	62	347.3467	678.83335	82.51067	2532.3699	0	400
12	62	352.5	679.264	52.845583	2622.6713	0	400
13	62	357.04875	679.75335	17.710563	2628.9742	0	400
14	62	362.04875	680.4317	0	2599.1913	458.30755	400
15	62	367.8125	681.3597	0	2553.6157	450.27134	400
16	62	373.4375	682.4364	0	2582.3827	455.34374	400
17	62	379.0625	683.68285	0	2590.7372	456.81687	400
18	62	384.6875	685.10245	0	2581.1435	455.12524	400
19	62	390.3125	686.69905	0	2555.5657	450.61519	400
20	62	395.9375	688.47715	0	2515.4752	443.54615	400
21	62	401.5625	690.44195	0	2462.0283	434.12201	400
22	62	407.1875	692.5994	0	2395.7481	422.43503	400

23	62	411.48565	694.36355	0	2331.8083	411.16071	400
24	62	415.23565	696.02595	-59.818371	2162.5605	1514.2412	0
25	62	421.25	698.9052	-204.36453	2085.8403	1460.5211	0
26	62	427.5	702.1061	-302.43925	1928.8226	1350.5762	0
27	62	432.5	704.89585	-390.67616	1677.269	1174.4364	0
28	62	437.3054	707.75595	-426.8364	1372.2869	960.88561	0
29	62	441.9162	710.68075	-402.73345	1014.4402	710.3187	0
30	62	446.52695	713.7884	-428.58649	652.64221	456.98499	0
31	62	451.16615	717.11125	-230.76239	129.85168	0	400



Engineering Parameters

Name: Layer 4 Unit Weight: 130 pcf Cohesion: 500 psf Phi: 0 °
Name: Layer 5 Unit Weight: 125 pcf Cohesion: 500 psf Phi: 10 °
Name: Layer 6 Unit Weight: 105 pcf Cohesion: 0 psf Phi: 35 °
Name: Layer 7 Unit Weight: 105 pcf Cohesion: 0 psf Phi: 35 °
Name: Layer 1 Unit Weight: 120 pcf Cohesion: 300 psf Phi: 18 °
Name: Layer 2 Unit Weight: 125 pcf Cohesion: 350 psf Phi: 18 °
Name: Layer 3 Unit Weight: 125 pcf Cohesion: 350 psf Phi: 22 °

SLOPE/W Analysis

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File Information

Created By: Eric Wenz
Revision Number: 87
Last Edited By: Eric Wenz
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Time: 3:10:22 PM
File Name: Phase 3 - Impoundment Side - Normal Pool.gsz
Directory: I:\GEOTECH\PROJECTS\2011\2-0383\Stability Analysis\5-30-12 Cross Sections\Phase 3\WITH SEEPAGE\
Last Solved Date: 6/7/2012
Last Solved Time: 3:10:26 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Description: Allerton Mine Stage 1
Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Other GeoStudio Analysis
- PWP Other Analysis: "..\..\..\..\Seepage\Phase 3\Phase 3 - Impoundment Side - Normal Pool SEEPAGE.gsz" - Steady-State Seepage [(all)]

Slip Surface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
FOS Distribution
FOS Calculation Option: Constant
Advanced
Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Layer 4
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 500 psf
Phi: 0 °
Phi-B: 0 °

Layer 5
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 500 psf
Phi: 10 °
Phi-B: 0 °

Layer 6
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 7
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 1

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 300 psf
Phi: 18 °
Phi-B: 0 °

Layer 2

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 350 psf
Phi: 18 °
Phi-B: 0 °

Layer 3

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 350 psf
Phi: 22 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (341, 730.33333) ft
Left-Zone Right Coordinate: (413, 729) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (581, 683) ft
Right-Zone Right Coordinate: (685, 660) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 680) ft
Right Coordinate: (750, 660) ft

Regions

	Material	Points	Area (ft^2)
Region 1	Layer 4	1,28,21,16,9,2,3,4,5,6,30,7,8	3000
Region 2	Layer 5	9,10,11,12,35,13,14,15,16	3757.5
Region 3	Layer 6	13,17,36,18,19,20,21,16,15,14	3196.25

Region 4	Layer 7	18,22,37,23,24,25,26,27,28,21,20,19	5400
Region 5	Layer 1	8,29,30,7	3654
Region 6	Layer 2	31,32,5,6,30,29	9696
Region 7	Layer 3	31,33,34,32	41250
Region 8	Layer 4	13,17,36,18,22,37,23,38,39,40,41,35	546.25

Points

	X (ft)	Y (ft)
Point 1	0	680
Point 2	600	680
Point 3	660	660
Point 4	750	660
Point 5	750	656
Point 6	660	656
Point 7	600	676
Point 8	0	676
Point 9	590	680
Point 10	545	695
Point 11	535	695
Point 12	490	710
Point 13	471	708
Point 14	420	695
Point 15	410	695
Point 16	350	680
Point 17	435	720
Point 18	417.5	722.5
Point 19	365	705
Point 20	355	705
Point 21	280	680
Point 22	380	735
Point 23	362.5	737.5
Point 24	310	720
Point 25	300	720
Point 26	240	700
Point 27	230	700

Point 28	170	680
Point 29	0	670
Point 30	618	670
Point 31	0	655
Point 32	750	655
Point 33	0	600
Point 34	750	600
Point 35	480	710
Point 36	425	720
Point 37	370	735
Point 38	370	740
Point 39	380	740
Point 40	425	725
Point 41	435	725

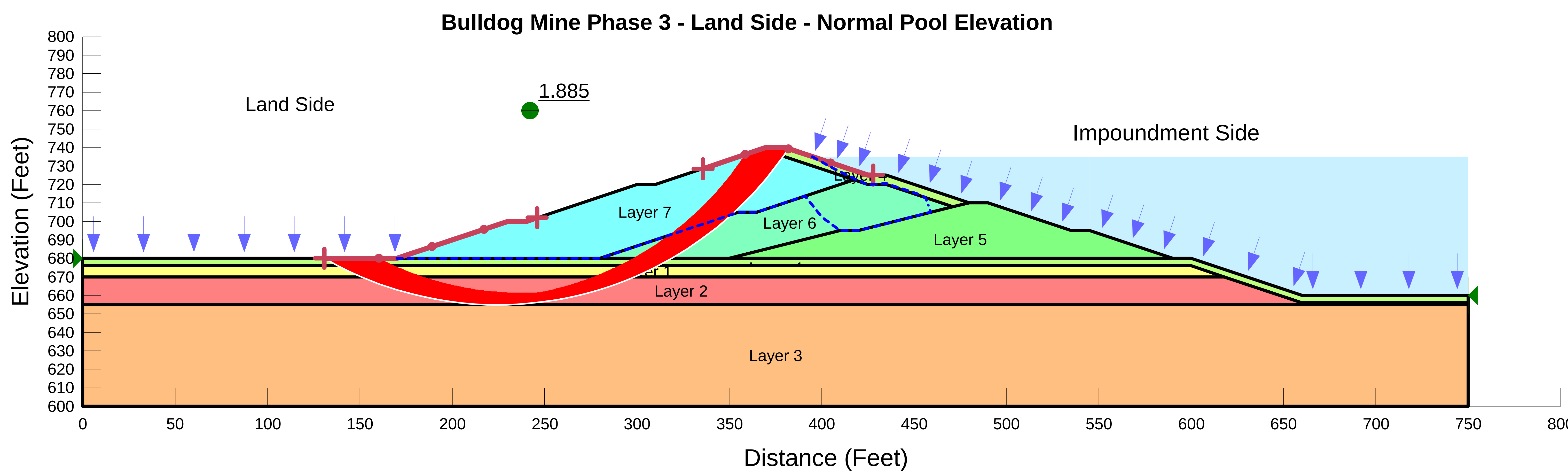
Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	42	3.347	(592.829, 1031.88)	376.972	(358.872, 736.291)	(658.166, 660.611)

Slices of Slip Surface: 42

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	42	360.68585	734.87265	-1415.6922	182.39138	127.71182	0
2	42	366.25	730.63415	-1189.708	788.41462	552.05386	0
3	42	375	724.27285	-753.60878	1539.8941	1078.2455	0
4	42	385.40705	717.1684	-266.96254	2035.5739	1425.3242	0
5	42	395.26175	710.86735	-36.120597	2330.778	1632.0284	0
6	42	404.15705	705.55845	-83.835599	2726.2968	1908.9736	0
7	42	413.05235	700.5735	-64.370083	3097.0679	2168.5903	0
8	42	419.9628	696.8892	-21.269203	3370.8863	2360.32	0
9	42	423.7128	694.97215	0	3715.6215	655.16432	500
10	42	430	691.9311	0	4095.621	722.16849	500

11	42	440.64735	687.04395	0	4678.7368	824.98753	500
12	42	451.942	682.27585	0.49818925	5174.7103	912.3532	500
13	42	463.04255	678	442.05615	5723.4965	0	500
14	42	469.7479	675.5675	1100.1678	5857.5217	1545.758	300
15	42	475.5	673.66105	1341.434	5986.614	1509.3105	300
16	42	483.6125	671.09355	1748.8944	6193.3277	1444.0839	300
17	42	488.6125	669.60085	2026.52	6383.9344	1415.8098	350
18	42	494.5	667.98575	2338.7866	6532.4914	1362.6173	350
19	42	503.5	665.6721	2787.9214	6667.0689	1260.4114	350
20	42	512.5	663.5929	3217.6824	6771.897	1154.8343	350
21	42	521.5	661.7442	3567.253	6845.9269	1065.3057	350
22	42	530.5	660.1225	3869.4357	6889.9428	981.42225	350
23	42	540	658.66025	4126.4633	6973.4814	925.05225	350
24	42	549.92635	657.3881	4343.7721	7086.687	891.22708	350
25	42	559.7791	656.3901	4510.1358	7030.146	818.80095	350
26	42	569.63185	655.65275	4642.6807	6937.176	745.52671	350
27	42	579.4846	655.1745	4736.2181	6807.3372	672.9474	350
28	42	587.2055	654.9583	4792.0642	6683.0565	764.01046	350
29	42	595	654.9454	4829.9179	6605.7877	717.49798	350
30	42	600.62355	654.9871	4846.8105	6622.2962	717.34278	350
31	42	605.43535	655.14015	4853.8783	6510.0983	538.1385	350
32	42	613.8118	655.5138	4857.1701	6301.7219	469.36335	350
33	42	623.35625	656.1825	4836.1705	6020.2312	384.72464	350
34	42	634.0687	657.20725	4794.0318	5656.4119	280.20429	350
35	42	644.78115	658.54215	4724.7145	5248.3062	170.12525	350
36	42	654.15175	659.9494	4664.2992	4851.466	0	500



Engineering Parameters

Name: Layer 4	Unit Weight: 130 pcf	Cohesion: 500 psf	Phi: 0 °
Name: Layer 5	Unit Weight: 125 pcf	Cohesion: 500 psf	Phi: 10 °
Name: Layer 6	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Layer 7	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Layer 1	Unit Weight: 120 pcf	Cohesion: 300 psf	Phi: 18 °
Name: Layer 2	Unit Weight: 125 pcf	Cohesion: 350 psf	Phi: 18 °
Name: Layer 3	Unit Weight: 125 pcf	Cohesion: 350 psf	Phi: 22 °

SLOPE/W Analysis

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File Information

Created By: Eric Wenz
Revision Number: 91
Last Edited By: Eric Wenz
Date: 6/7/2012
Time: 3:17:53 PM
File Name: Phase 3 - Land Side - Normal Pool.gsz
Directory: I:\GEOTECH\PROJECTS\2011\2-0383\Stability Analysis\5-30-12 Cross Sections\Phase 3\WITH SEEPAGE\
Last Solved Date: 6/7/2012
Last Solved Time: 3:17:56 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Description: Allerton Mine Stage 1
Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Other GeoStudio Analysis
- PWP Other Analysis: "..\..\..\..\Seepage\Phase 3\Phase 3 - Impoundment Side - Normal Pool SEEPAGE.gsz" - Steady-State Seepage [(all)]

Slip Surface
- Direction of movement: Right to Left
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

FOS Distribution

FOS Calculation Option: Constant

Advanced

Number of Slices: 30

Optimization Tolerance: 0.01

Minimum Slip Surface Depth: 0.1 ft

Optimization Maximum Iterations: 2000

Optimization Convergence Tolerance: 1e-007

Starting Optimization Points: 8

Ending Optimization Points: 16

Complete Passes per Insertion: 1

Driving Side Maximum Convex Angle: 5 °

Resisting Side Maximum Convex Angle: 1 °

Materials

Layer 4

Model: Mohr-Coulomb

Unit Weight: 130 pcf

Cohesion: 500 psf

Phi: 0 °

Phi-B: 0 °

Layer 5

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion: 500 psf

Phi: 10 °

Phi-B: 0 °

Layer 6

Model: Mohr-Coulomb

Unit Weight: 105 pcf

Cohesion: 0 psf

Phi: 35 °

Phi-B: 0 °

Layer 7

Model: Mohr-Coulomb

Unit Weight: 105 pcf

Cohesion: 0 psf

Phi: 35 °

Phi-B: 0 °

Layer 1

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 300 psf
Phi: 18 °
Phi-B: 0 °

Layer 2

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 350 psf
Phi: 18 °
Phi-B: 0 °

Layer 3

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 350 psf
Phi: 22 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (130.71188, 680) ft
Left-Zone Right Coordinate: (246, 702) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (335.70415, 728.56805) ft
Right-Zone Right Coordinate: (428, 725) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 680) ft
Right Coordinate: (750, 660) ft

Regions

	Material	Points	Area (ft^2)
Region 1	Layer 4	1,28,21,16,9,2,3,4,5,6,30,7,8	3000
Region 2	Layer 5	9,10,11,12,35,13,14,15,16	3757.5
Region 3	Layer 6	13,17,36,18,19,20,21,16,15,14	3196.25

Region 4	Layer 7	18,22,37,23,24,25,26,27,28,21,20,19	5400
Region 5	Layer 1	8,29,30,7	3654
Region 6	Layer 2	31,32,5,6,30,29	9696
Region 7	Layer 3	31,33,34,32	41250
Region 8	Layer 4	13,17,36,18,22,37,23,38,39,40,41,35	546.25

Points

	X (ft)	Y (ft)
Point 1	0	680
Point 2	600	680
Point 3	660	660
Point 4	750	660
Point 5	750	656
Point 6	660	656
Point 7	600	676
Point 8	0	676
Point 9	590	680
Point 10	545	695
Point 11	535	695
Point 12	490	710
Point 13	471	708
Point 14	420	695
Point 15	410	695
Point 16	350	680
Point 17	435	720
Point 18	417.5	722.5
Point 19	365	705
Point 20	355	705
Point 21	280	680
Point 22	380	735
Point 23	362.5	737.5
Point 24	310	720
Point 25	300	720
Point 26	240	700
Point 27	230	700

Point 28	170	680
Point 29	0	670
Point 30	618	670
Point 31	0	655
Point 32	750	655
Point 33	0	600
Point 34	750	600
Point 35	480	710
Point 36	425	720
Point 37	370	735
Point 38	370	740
Point 39	380	740
Point 40	425	725
Point 41	435	725

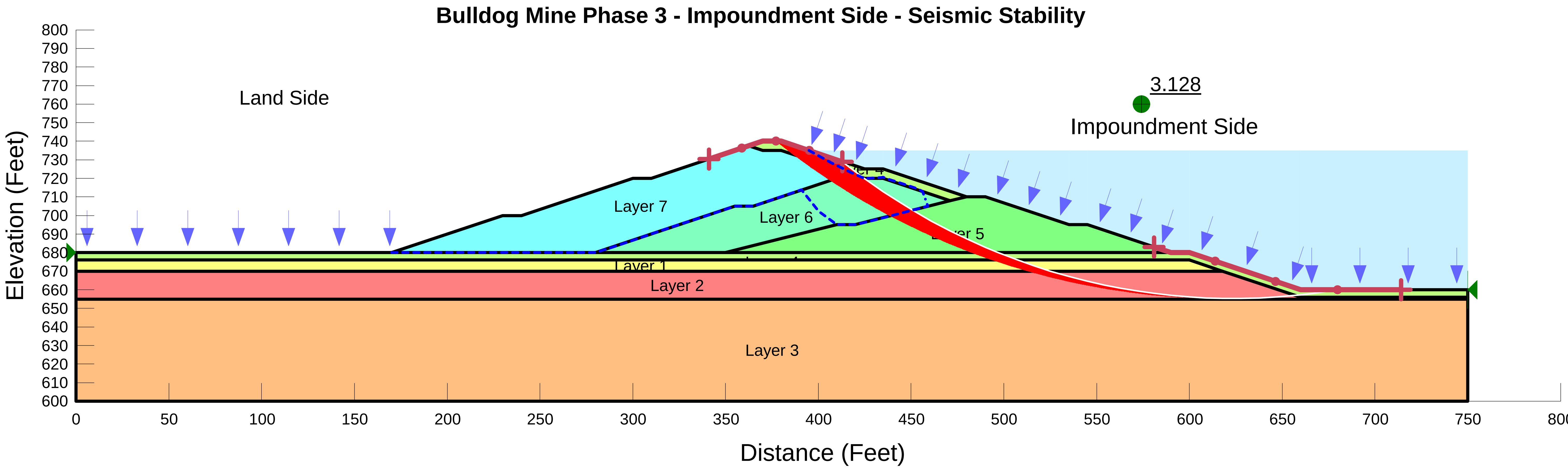
Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	13	1.885	(224.763, 843.573)	188.684	(382.032, 739.323)	(130.712, 680)

Slices of Slip Surface: 13

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	13	134.37555	678	125.65886	416.51898	0	500
2	13	141.2233	674.4274	348.59272	871.53107	169.91297	300
3	13	147.5915	671.4274	535.77795	1272.8362	239.48475	300
4	13	155.5817	668.1051	743.0761	1749.7522	327.08891	350
5	13	165.1939	664.6105	961.14685	2245.6471	417.35945	350
6	13	174.0242	661.88695	1131.1213	2784.4826	537.20967	350
7	13	182.07255	659.82815	1259.6326	3376.1251	687.69011	350
8	13	190.1209	658.14145	1364.9906	3898.9438	823.33129	350
9	13	198.16925	656.81665	1447.805	4350.7954	943.23877	350
10	13	206.2176	655.84605	1508.6175	4731.2303	1047.0904	350

11	13	214.266	655.22425	1547.6035	5041.2798	1135.1642	350
12	13	224.1451	654.98085	1563.2072	5361.0193	1534.4157	350
13	13	230.61755	654.98085	1563.5179	5484.6137	1584.2255	350
14	13	235.61755	655.2526	1546.7906	5344.6285	1233.9923	350
15	13	244	655.91525	1506.1069	5277.9645	1225.5508	350
16	13	252	656.909	1444.701	5309.3998	1255.7168	350
17	13	260	658.25325	1361.7273	5293.4093	1277.4809	350
18	13	268	659.9557	1256.509	5234.0955	1292.3962	350
19	13	276	662.0265	1128.3482	5134.3127	1301.6168	350
20	13	284.6874	664.726	961.64923	4981.1486	1306.0145	350
21	13	294.06225	668.1483	750.15228	4769.4304	1305.9426	350
22	13	299.37485	670.26915	619.02313	4641.6267	1307.0231	300
23	13	305	672.88875	457.5455	4322.8719	1255.9207	300
24	13	310.74305	675.6196	289.18343	4002.8895	1206.6562	300
25	13	315.14975	678	133.99618	4012.3388	0	500
26	13	322.90865	682.4953	0	3368.6056	2358.723	0
27	13	331.0992	687.78595	0	3080.356	2156.8885	0
28	13	339.2898	693.71095	0	2760.0524	1932.6095	0
29	13	347.48035	700.34955	0	2403.2235	1682.7552	0
30	13	357.0378	709.2369	-268.80216	1924.3576	1347.4497	0
31	13	366.25	718.87005	-721.05144	1453.7754	1017.9445	0
32	13	374.53955	729.0624	-769.4541	839.83019	588.05543	0
33	13	379.53955	735.6604	-630.35961	186.71686	0	500
34	13	381.01585	737.8218	-888.23819	-149.69312	0	500



Engineering Parameters

Name: Layer 4	Unit Weight: 130 pcf	Cohesion: 400 psf	Phi: 0 °
Name: Layer 5	Unit Weight: 125 pcf	Cohesion: 400 psf	Phi: 10 °
Name: Layer 6	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Layer 7	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Layer 1	Unit Weight: 120 pcf	Cohesion: 240 psf	Phi: 18 °
Name: Layer 2	Unit Weight: 125 pcf	Cohesion: 280 psf	Phi: 18 °
Name: Layer 3	Unit Weight: 125 pcf	Cohesion: 280 psf	Phi: 22 °

SLOPE/W Analysis

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File Information

Created By: Eric Wenz
Revision Number: 90
Last Edited By: Eric Wenz
Date: 6/7/2012
Time: 3:15:41 PM
File Name: Phase 3 - Impoundment Side - Seismic Stability.gsz
Directory: I:\GEOTECH\PROJECTS\2011\2-0383\Stability Analysis\5-30-12 Cross Sections\Phase 3\WITH SEEPAGE\
Last Solved Date: 6/7/2012
Last Solved Time: 3:15:44 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Description: Allerton Mine Stage 1
Kind: SLOPE/W
Method: Morgenstern-Price
Settings
  Side Function
    Interslice force function option: Half-Sine
  PWP Conditions Source: Other GeoStudio Analysis
  PWP Other Analysis: "..\..\..\..\Seepage\Phase 3\Phase 3 - Impoundment Side - Normal Pool SEEPAGE.gsz" - Steady-State Seepage [(all)]
Slip Surface
  Direction of movement: Left to Right
  Use Passive Mode: No
  Slip Surface Option: Entry and Exit
  Critical slip surfaces saved: 1
  Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
FOS Distribution
FOS Calculation Option: Constant
Advanced
Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Layer 4

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 400 psf
Phi: 0 °
Phi-B: 0 °

Layer 5

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 400 psf
Phi: 10 °
Phi-B: 0 °

Layer 6

Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 7

Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 1

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 240 psf
Phi: 18 °
Phi-B: 0 °

Layer 2

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 280 psf
Phi: 18 °
Phi-B: 0 °

Layer 3

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 280 psf
Phi: 22 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (341, 730.33333) ft
Left-Zone Right Coordinate: (413, 729) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (581, 683) ft
Right-Zone Right Coordinate: (714, 660) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 680) ft
Right Coordinate: (750, 660) ft

Regions

	Material	Points	Area (ft^2)
Region 1	Layer 4	1,28,21,16,9,2,3,4,5,6,30,7,8	3000
Region 2	Layer 5	9,10,11,12,35,13,14,15,16	3757.5
Region 3	Layer 6	13,17,36,18,19,20,21,16,15,14	3196.25

Region 4	Layer 7	18,22,37,23,24,25,26,27,28,21,20,19	5400
Region 5	Layer 1	8,29,30,7	3654
Region 6	Layer 2	31,32,5,6,30,29	9696
Region 7	Layer 3	31,33,34,32	41250
Region 8	Layer 4	13,17,36,18,22,37,23,38,39,40,41,35	546.25

Points

	X (ft)	Y (ft)
Point 1	0	680
Point 2	600	680
Point 3	660	660
Point 4	750	660
Point 5	750	656
Point 6	660	656
Point 7	600	676
Point 8	0	676
Point 9	590	680
Point 10	545	695
Point 11	535	695
Point 12	490	710
Point 13	471	708
Point 14	420	695
Point 15	410	695
Point 16	350	680
Point 17	435	720
Point 18	417.5	722.5
Point 19	365	705
Point 20	355	705
Point 21	280	680
Point 22	380	735
Point 23	362.5	737.5
Point 24	310	720
Point 25	300	720
Point 26	240	700
Point 27	230	700

Point 28	170	680
Point 29	0	670
Point 30	618	670
Point 31	0	655
Point 32	750	655
Point 33	0	600
Point 34	750	600
Point 35	480	710
Point 36	425	720
Point 37	370	735
Point 38	370	740
Point 39	380	740
Point 40	425	725
Point 41	435	725

Critical Slip Surfaces

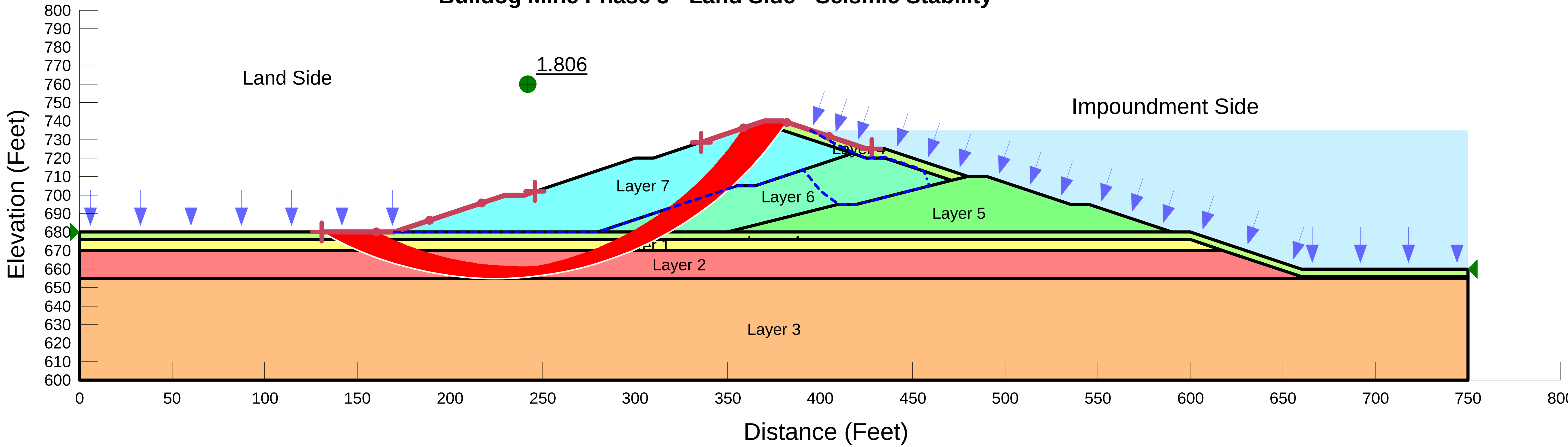
	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	117	3.128	(623.748, 993.564)	338.244	(413, 729)	(679.817, 660)

Slices of Slip Surface: 117

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	117	419	724.4353	198.89282	734.71429	0	400
2	117	430	716.37575	-113.40352	1427.7893	999.74881	0
3	117	438.95825	710.29875	-43.080684	1946.9888	1363.2962	0
4	117	446.8747	705.288	-19.304957	2324.1316	1627.3745	0
5	117	455.8747	699.9765	0.58428471	2981.9458	525.69447	400
6	117	465.95825	694.4341	145.45078	3578.7278	605.37937	400
7	117	475.5	689.58005	382.38449	4037.2627	644.45365	400
8	117	485	685.1362	79.877723	4472.0326	774.45541	400
9	117	493.45795	681.44345	1148.211	4892.9402	660.29678	400
10	117	502.10425	678	2368.4106	5242.533	0	400
11	117	511.76515	674.4306	2528.8345	5412.6321	937.00263	240

12	117	520.7103	671.4306	2983.4129	5609.272	853.19334	240
13	117	530.09145	668.5854	3344.8276	5779.4761	791.06524	280
14	117	540	665.89285	3692.7951	6018.9218	755.80437	280
15	117	549.5	663.60235	3954.2385	6240.6247	742.89192	280
16	117	558.5	661.70505	4174.3052	6308.229	693.35387	280
17	117	567.5	660.0613	4350.3384	6342.7553	647.37549	280
18	117	576.5	658.66745	4504.8331	6344.9438	597.88822	280
19	117	585.5	657.5204	4623.4821	6314.6741	549.5016	280
20	117	595	656.58165	4728.6256	6335.0909	521.97222	280
21	117	604.5	655.8986	4803.4247	6360.1198	505.80093	280
22	117	613.5	655.5057	4856.9912	6245.1314	451.03408	280
23	117	622.8869	655.35685	4886.6412	6081.7765	388.32299	280
24	117	632.66065	655.47325	4899.7904	5866.9431	314.24696	280
25	117	642.4344	655.8725	4887.3651	5613.5078	235.93806	280
26	117	652.20815	656.5556	4855.9685	5321.2769	151.18787	280
27	117	658.5475	657.11855	4831.7582	5112.8774	0	400
28	117	664.95425	657.87695	4797.3399	4976.0469	0	400
29	117	674.8627	659.24255	4723.1581	4799.5778	0	400

Bulldog Mine Phase 3 - Land Side - Seismic Stability



Engineering Parameters

Name: Layer 4	Unit Weight: 130 pcf	Cohesion: 400 psf	Phi: 0 °
Name: Layer 5	Unit Weight: 125 pcf	Cohesion: 400 psf	Phi: 10 °
Name: Layer 6	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Layer 7	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Layer 1	Unit Weight: 120 pcf	Cohesion: 240 psf	Phi: 18 °
Name: Layer 2	Unit Weight: 125 pcf	Cohesion: 280 psf	Phi: 18 °
Name: Layer 3	Unit Weight: 125 pcf	Cohesion: 280 psf	Phi: 22 °

SLOPE/W Analysis

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File Information

Created By: Eric Wenz
Revision Number: 95
Last Edited By: Eric Wenz
Date: 6/7/2012
Time: 3:19:33 PM
File Name: Phase 3 - Land Side - Seismic Stability.gsz
Directory: I:\GEOTECH\PROJECTS\2011\2-0383\Stability Analysis\5-30-12 Cross Sections\Phase 3\WITH SEEPAGE\
Last Solved Date: 6/7/2012
Last Solved Time: 3:19:36 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Description: Allerton Mine Stage 1
Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Other GeoStudio Analysis
- PWP Other Analysis: "..\..\..\..\Seepage\Phase 3\Phase 3 - Impoundment Side - Normal Pool SEEPAGE.gsz" - Steady-State Seepage [(all)]

Slip Surface
- Direction of movement: Right to Left
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
FOS Distribution
FOS Calculation Option: Constant
Advanced
Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Layer 4

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 400 psf
Phi: 0 °
Phi-B: 0 °

Layer 5

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 400 psf
Phi: 10 °
Phi-B: 0 °

Layer 6

Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 7

Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 1

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 240 psf
Phi: 18 °
Phi-B: 0 °

Layer 2

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 280 psf
Phi: 18 °
Phi-B: 0 °

Layer 3

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 280 psf
Phi: 22 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (130.71188, 680) ft
Left-Zone Right Coordinate: (246, 702) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (335.70415, 728.56805) ft
Right-Zone Right Coordinate: (428, 725) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 680) ft
Right Coordinate: (750, 660) ft

Regions

	Material	Points	Area (ft^2)
Region 1	Layer 4	1,28,21,16,9,2,3,4,5,6,30,7,8	3000
Region 2	Layer 5	9,10,11,12,35,13,14,15,16	3757.5
Region 3	Layer 6	13,17,36,18,19,20,21,16,15,14	3196.25

Region 4	Layer 7	18,22,37,23,24,25,26,27,28,21,20,19	5400
Region 5	Layer 1	8,29,30,7	3654
Region 6	Layer 2	31,32,5,6,30,29	9696
Region 7	Layer 3	31,33,34,32	41250
Region 8	Layer 4	13,17,36,18,22,37,23,38,39,40,41,35	546.25

Points

	X (ft)	Y (ft)
Point 1	0	680
Point 2	600	680
Point 3	660	660
Point 4	750	660
Point 5	750	656
Point 6	660	656
Point 7	600	676
Point 8	0	676
Point 9	590	680
Point 10	545	695
Point 11	535	695
Point 12	490	710
Point 13	471	708
Point 14	420	695
Point 15	410	695
Point 16	350	680
Point 17	435	720
Point 18	417.5	722.5
Point 19	365	705
Point 20	355	705
Point 21	280	680
Point 22	380	735
Point 23	362.5	737.5
Point 24	310	720
Point 25	300	720
Point 26	240	700
Point 27	230	700

Point 28	170	680
Point 29	0	670
Point 30	618	670
Point 31	0	655
Point 32	750	655
Point 33	0	600
Point 34	750	600
Point 35	480	710
Point 36	425	720
Point 37	370	735
Point 38	370	740
Point 39	380	740
Point 40	425	725
Point 41	435	725

Critical Slip Surfaces

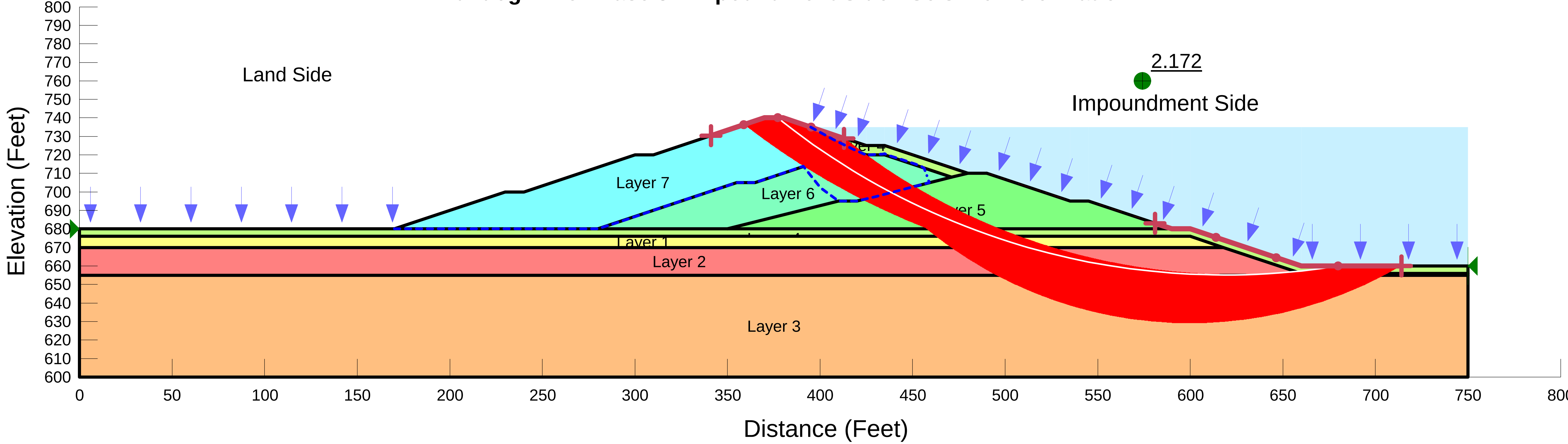
	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	13	1.806	(224.763, 843.573)	188.684	(382.032, 739.323)	(130.712, 680)

Slices of Slip Surface: 13

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	13	134.37555	678	125.65886	391.4471	0	400
2	13	141.2233	674.4274	348.59272	856.84622	165.14157	240
3	13	147.5915	671.4274	535.77795	1259.2666	235.07571	240
4	13	155.5817	668.1051	743.0761	1735.2347	322.37187	280
5	13	165.1939	664.6105	961.14685	2232.7162	413.15792	280
6	13	174.0242	661.88695	1131.1213	2773.473	533.63242	280
7	13	182.07255	659.82815	1259.6326	3367.4113	684.85882	280
8	13	190.1209	658.14145	1364.9906	3892.2263	821.14865	280
9	13	198.16925	656.81665	1447.805	4345.8751	941.64006	280
10	13	206.2176	655.84605	1508.6175	4727.6445	1045.9253	280

11	13	214.266	655.22425	1547.6035	5038.7986	1134.3581	280
12	13	224.1451	654.98085	1563.2072	5361.6171	1534.6572	280
13	13	230.61755	654.98085	1563.5179	5485.5848	1584.6179	280
14	13	235.61755	655.2526	1546.7906	5343.8312	1233.7333	280
15	13	244	655.91525	1506.1069	5277.4671	1225.3892	280
16	13	252	656.909	1444.701	5309.1524	1255.6364	280
17	13	260	658.25325	1361.7273	5293.4093	1277.4809	280
18	13	268	659.9557	1256.509	5234.2172	1292.4357	280
19	13	276	662.0265	1128.3482	5134.6736	1301.734	280
20	13	284.6874	664.726	961.64923	4981.6543	1306.1788	280
21	13	294.06225	668.1483	750.15228	4770.3233	1306.2327	280
22	13	299.37485	670.26915	619.02313	4641.7736	1307.0709	240
23	13	305	672.88875	457.5455	4323.4149	1256.0971	240
24	13	310.74305	675.6196	289.18343	4003.8479	1206.9676	240
25	13	315.14975	678	133.99618	4028.6301	0	400
26	13	322.90865	682.4953	0	3351.9236	2347.0422	0
27	13	331.0992	687.78595	0	3061.5998	2143.7552	0
28	13	339.2898	693.71095	0	2739.8749	1918.481	0
29	13	347.48035	700.34955	0	2382.4557	1668.2134	0
30	13	357.0378	709.2369	-268.80216	1904.4637	1333.5199	0
31	13	366.25	718.87005	-721.05144	1435.9669	1005.4748	0
32	13	374.53955	729.0624	-769.4541	827.65486	579.53017	0
33	13	379.53955	735.6604	-630.35961	247.39286	0	400
34	13	381.01585	737.8218	-888.23819	-85.962984	0	400

Bulldog Mine Phase 3 - Impoundment Side - Seismic Deformation



Engineering Parameters

Name: Layer 4	Unit Weight: 130 pcf	Cohesion: 400 psf	Phi: 0 °
Name: Layer 5	Unit Weight: 125 pcf	Cohesion: 400 psf	Phi: 10 °
Name: Layer 6	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Layer 7	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Layer 1	Unit Weight: 120 pcf	Cohesion: 240 psf	Phi: 18 °
Name: Layer 2	Unit Weight: 125 pcf	Cohesion: 280 psf	Phi: 18 °
Name: Layer 3	Unit Weight: 125 pcf	Cohesion: 280 psf	Phi: 22 °

SLOPE/W Analysis

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File Information

Created By: Eric Wenz
Revision Number: 93
Last Edited By: Eric Wenz
Date: 6/7/2012
Time: 3:13:22 PM
File Name: Phase 3 - Impoundment Side - Seismic Deformation.gsz
Directory: I:\GEOTECH\PROJECTS\2011\2-0383\Stability Analysis\5-30-12 Cross Sections\Phase 3\WITH SEEPAGE\
Last Solved Date: 6/7/2012
Last Solved Time: 3:13:26 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Description: Allerton Mine Stage 1
Kind: SLOPE/W
Method: Morgenstern-Price
Settings
  Side Function
    Interslice force function option: Half-Sine
  PWP Conditions Source: Other GeoStudio Analysis
  PWP Other Analysis: "..\..\..\..\Seepage\Phase 3\Phase 3 - Impoundment Side - Normal Pool SEEPAGE.gsz" - Steady-State Seepage [(all)]
Slip Surface
  Direction of movement: Left to Right
  Use Passive Mode: No
  Slip Surface Option: Entry and Exit
  Critical slip surfaces saved: 1
  Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
FOS Distribution
FOS Calculation Option: Constant
Advanced
Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Layer 4
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 400 psf
Phi: 0 °
Phi-B: 0 °

Layer 5
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 400 psf
Phi: 10 °
Phi-B: 0 °

Layer 6
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 7
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 1

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 240 psf
Phi: 18 °
Phi-B: 0 °

Layer 2

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 280 psf
Phi: 18 °
Phi-B: 0 °

Layer 3

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 280 psf
Phi: 22 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (341, 730.33333) ft
Left-Zone Right Coordinate: (413, 729) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (581, 683) ft
Right-Zone Right Coordinate: (714, 660) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 680) ft
Right Coordinate: (750, 660) ft

Seismic Loads

Horz Seismic Load: 0.056
Ignore seismic load in strength: No

Regions

	Material	Points	Area (ft²)
Region 1	Layer 4	1,28,21,16,9,2,3,4,5,6,30,7,8	3000
Region 2	Layer 5	9,10,11,12,35,13,14,15,16	3757.5
Region 3	Layer 6	13,17,36,18,19,20,21,16,15,14	3196.25
Region 4	Layer 7	18,22,37,23,24,25,26,27,28,21,20,19	5400
Region 5	Layer 1	8,29,30,7	3654
Region 6	Layer 2	31,32,5,6,30,29	9696
Region 7	Layer 3	31,33,34,32	41250
Region 8	Layer 4	13,17,36,18,22,37,23,38,39,40,41,35	546.25

Points

	X (ft)	Y (ft)
Point 1	0	680
Point 2	600	680
Point 3	660	660
Point 4	750	660
Point 5	750	656
Point 6	660	656
Point 7	600	676
Point 8	0	676
Point 9	590	680
Point 10	545	695
Point 11	535	695
Point 12	490	710
Point 13	471	708
Point 14	420	695
Point 15	410	695
Point 16	350	680
Point 17	435	720
Point 18	417.5	722.5
Point 19	365	705
Point 20	355	705
Point 21	280	680
Point 22	380	735

Point 23	362.5	737.5
Point 24	310	720
Point 25	300	720
Point 26	240	700
Point 27	230	700
Point 28	170	680
Point 29	0	670
Point 30	618	670
Point 31	0	655
Point 32	750	655
Point 33	0	600
Point 34	750	600
Point 35	480	710
Point 36	425	720
Point 37	370	735
Point 38	370	740
Point 39	380	740
Point 40	425	725
Point 41	435	725

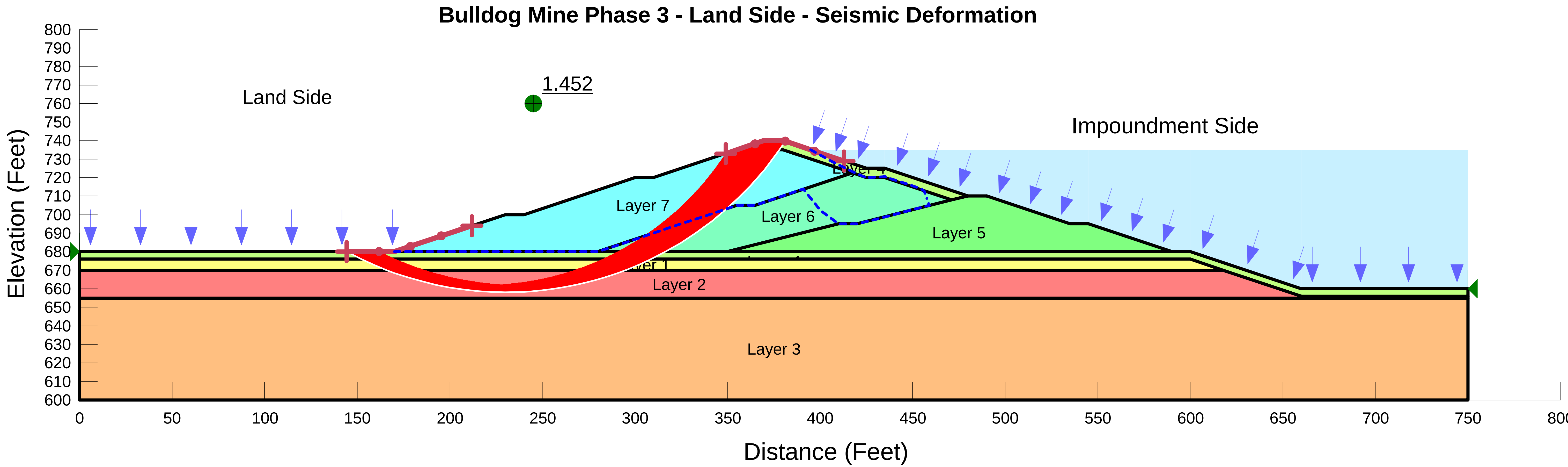
Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	67	2.172	(618.672, 1041.34)	386.21	(377.108, 740)	(679.817, 660)

Slices of Slip Surface: 67

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	67	378.5541	738.8522	-1062.6248	3.2428014	0	400
2	67	383.0981	735.3195	-617.63421	332.29682	0	400
3	67	391.2208	729.2724	-382.62598	693.14972	485.34866	0
4	67	401.27	722.18755	-151.04687	1127.2179	789.28646	0
5	67	411.8973	715.2126	-128.80722	1620.6043	1134.7594	0

6	67	421.25	709.42975	-157.01689	2033.1292	1423.6124	0
7	67	430	704.3994	-45.593633	2448.0348	1714.1324	0
8	67	436.75955	700.6601	-6.2847	2780.6389	1947.0243	0
9	67	443.9326	696.97365	0.094151504	3375.3203	595.14344	400
10	67	454.75955	691.6889	1.1671229	3926.8717	692.20763	400
11	67	465.5865	686.81355	34.540214	4435.4336	775.99624	400
12	67	475.5	682.67965	95.675408	4803.9446	830.19489	400
13	67	481.15915	680.44165	21.079893	4963.1282	871.41646	400
14	67	486.15915	678.5969	805.07847	5337.7213	0	400
15	67	491.7149	676.5969	1677.05	5583.1909	0	400
16	67	498.20555	674.432	2073.181	5592.1776	1143.3913	240
17	67	507.75705	671.432	2577.3124	5791.9329	1044.4935	240
18	67	518.1496	668.4857	3100.6359	5973.677	933.50764	280
19	67	529.3832	665.6365	3507.8162	6135.5389	853.79886	280
20	67	540	663.2612	3849.9344	6314.6404	800.83152	280
21	67	550.625	661.21385	4116.2569	6515.9776	779.71652	280
22	67	561.875	659.3705	4345.2916	6546.6001	715.24848	280
23	67	573.125	657.866	4534.9667	6531.4218	648.6876	280
24	67	584.375	656.69635	4668.5903	6469.8003	585.24859	280
25	67	595	655.8877	4771.6103	6438.2703	541.53066	280
26	67	604.5	655.41535	4833.52	6461.2007	528.86553	280
27	67	613.5	655.18985	4876.6738	6326.9882	471.23571	280
28	67	622.8647	655.1824	4897.4226	6146.2386	405.76493	280
29	67	632.59415	655.4107	4903.5664	5915.6075	328.83207	280
30	67	642.3236	655.8847	4886.465	5648.7954	247.69616	280
31	67	652.05305	656.6053	4852.7564	5345.6913	160.16425	280
32	67	658.4589	657.187	4827.8045	5127.606	0	400
33	67	664.95425	657.9447	4793.6017	4979.366	0	400
34	67	674.8627	659.2714	4721.4989	4805.4726	0	400



Engineering Parameters

Name: Layer 4	Unit Weight: 130 pcf	Cohesion: 400 psf	Phi: 0 °
Name: Layer 5	Unit Weight: 125 pcf	Cohesion: 400 psf	Phi: 10 °
Name: Layer 6	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Layer 7	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Layer 1	Unit Weight: 120 pcf	Cohesion: 240 psf	Phi: 18 °
Name: Layer 2	Unit Weight: 125 pcf	Cohesion: 280 psf	Phi: 18 °
Name: Layer 3	Unit Weight: 125 pcf	Cohesion: 280 psf	Phi: 22 °

SLOPE/W Analysis

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File Information

Created By: Eric Wenz
Revision Number: 104
Last Edited By: Eric Wenz
Date: 6/7/2012
Time: 3:18:40 PM
File Name: Phase 3 - Land Side - Seismic Deformation.gsz
Directory: I:\GEOTECH\PROJECTS\2011\2-0383\Stability Analysis\5-30-12 Cross Sections\Phase 3\WITH SEEPAGE\
Last Solved Date: 6/7/2012
Last Solved Time: 3:18:44 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Description: Allerton Mine Stage 1
Kind: SLOPE/W
Method: Morgenstern-Price
Settings
    Side Function
        Interslice force function option: Half-Sine
    PWP Conditions Source: Other GeoStudio Analysis
    PWP Other Analysis: "..\..\..\..\Seepage\Phase 3\Phase 3 - Impoundment Side - Normal Pool SEEPAGE.gsz" - Steady-State Seepage [(all)]
Slip Surface
    Direction of movement: Right to Left
    Use Passive Mode: No
    Slip Surface Option: Entry and Exit
    Critical slip surfaces saved: 1
    Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
FOS Distribution
FOS Calculation Option: Constant
Advanced
Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Layer 4
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 400 psf
Phi: 0 °
Phi-B: 0 °

Layer 5
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 400 psf
Phi: 10 °
Phi-B: 0 °

Layer 6
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 7
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 1

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 240 psf
Phi: 18 °
Phi-B: 0 °

Layer 2

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 280 psf
Phi: 18 °
Phi-B: 0 °

Layer 3

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 280 psf
Phi: 22 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (144.27767, 680) ft
Left-Zone Right Coordinate: (212, 694) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (349, 733) ft
Right-Zone Right Coordinate: (413, 729) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 680) ft
Right Coordinate: (750, 660) ft

Seismic Loads

Horz Seismic Load: 0.056
Ignore seismic load in strength: No

Regions

	Material	Points	Area (ft²)
Region 1	Layer 4	1,28,21,16,9,2,3,4,5,6,30,7,8	3000
Region 2	Layer 5	9,10,11,12,35,13,14,15,16	3757.5
Region 3	Layer 6	13,17,36,18,19,20,21,16,15,14	3196.25
Region 4	Layer 7	18,22,37,23,24,25,26,27,28,21,20,19	5400
Region 5	Layer 1	8,29,30,7	3654
Region 6	Layer 2	31,32,5,6,30,29	9696
Region 7	Layer 3	31,33,34,32	41250
Region 8	Layer 4	13,17,36,18,22,37,23,38,39,40,41,35	546.25

Points

	X (ft)	Y (ft)
Point 1	0	680
Point 2	600	680
Point 3	660	660
Point 4	750	660
Point 5	750	656
Point 6	660	656
Point 7	600	676
Point 8	0	676
Point 9	590	680
Point 10	545	695
Point 11	535	695
Point 12	490	710
Point 13	471	708
Point 14	420	695
Point 15	410	695
Point 16	350	680
Point 17	435	720
Point 18	417.5	722.5
Point 19	365	705
Point 20	355	705
Point 21	280	680
Point 22	380	735

Point 23	362.5	737.5
Point 24	310	720
Point 25	300	720
Point 26	240	700
Point 27	230	700
Point 28	170	680
Point 29	0	670
Point 30	618	670
Point 31	0	655
Point 32	750	655
Point 33	0	600
Point 34	750	600
Point 35	480	710
Point 36	425	720
Point 37	370	735
Point 38	370	740
Point 39	380	740
Point 40	425	725
Point 41	435	725

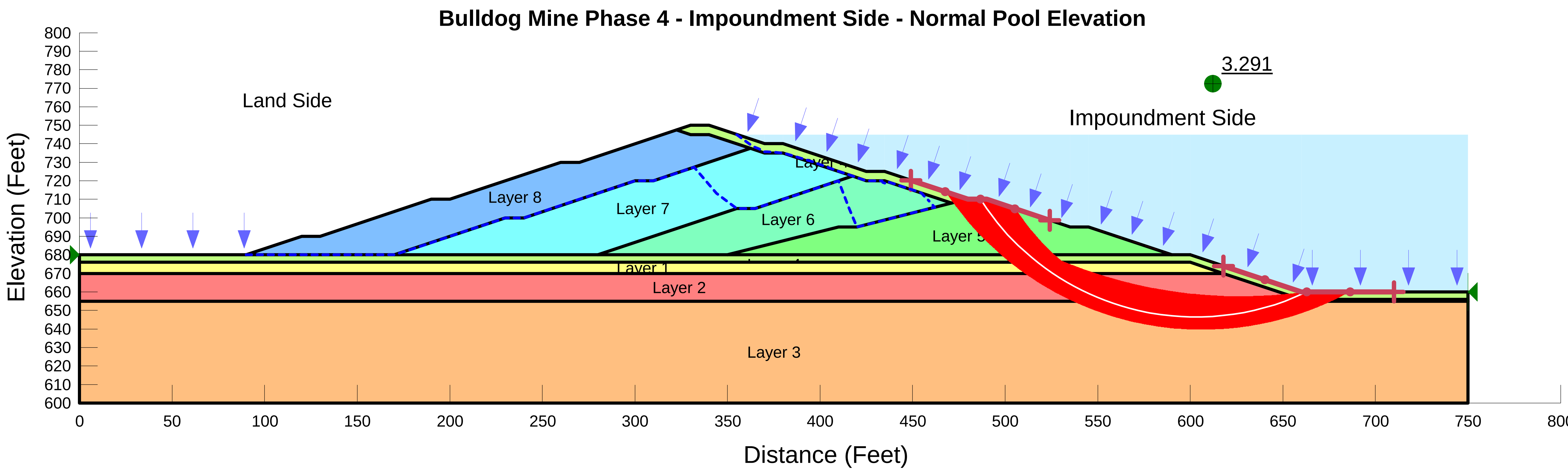
Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	13	1.452	(230.366, 838.662)	180.513	(381.257, 739.581)	(144.278, 680)

Slices of Slip Surface: 13

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	13	148.18775	678	125.68681	418.3868	0	400
2	13	155.58305	674.41315	349.45733	902.5439	179.70872	240
3	13	162.55355	671.41315	536.64759	1323.877	255.78633	240
4	13	168.0194	669.271	670.33942	1648.971	317.97668	280
5	13	173.75	667.303	793.14991	2097.5447	423.82356	280

6	13	181.25	665.0034	936.68237	2745.7558	587.80359	280
7	13	188.75	663.0541	1058.4308	3330.2927	738.17266	280
8	13	196.25	661.4435	1159.0381	3844.3445	872.50896	280
9	13	203.75	660.1624	1239.1663	4283.7054	989.23074	280
10	13	211.25	659.20375	1299.1963	4646.3793	1087.5657	280
11	13	218.75	658.5624	1339.4832	4933.3485	1167.7176	280
12	13	226.25	658.23495	1360.3126	5147.5936	1230.5622	280
13	13	235	658.27785	1358.0518	5125.3086	1224.0559	280
14	13	244	658.70935	1331.6836	5038.934	1204.5587	280
15	13	252	659.4954	1283.3039	5056.7708	1226.0737	280
16	13	260	660.64425	1212.4412	5022.2661	1237.8872	280
17	13	268	662.163	1118.7389	4942.5202	1242.4219	280
18	13	276	664.0613	1001.3517	4823.2357	1241.8054	280
19	13	283.6735	666.24245	866.74366	4676.7539	1237.9474	280
20	13	291.02055	668.6891	715.69528	4507.9957	1232.1931	280
21	13	297.34705	671.06025	569.13264	4351.2745	1228.8924	240
22	13	304.31755	674.06025	384.13145	4028.0774	1183.9898	240
23	13	309.31755	676.3319	243.01346	3861.1099	0	400
24	13	313.2276	678.3319	111.49364	3724.2989	0	400
25	13	320.6137	682.40175	0	3157.1672	2210.6723	0
26	13	328.93075	687.5153	0	2868.4106	2008.4828	0
27	13	337.2478	693.28445	0	2556.7403	1790.2488	0
28	13	345.5648	699.79145	0	2217.5274	1552.7294	0
29	13	352.9175	706.1962	-118.59197	1893.2661	1325.6792	0
30	13	359.30585	712.41355	-440.95685	1582.5822	1108.136	0
31	13	366.25	719.96895	-780.7207	1247.476	873.49211	0
32	13	374.0734	729.63105	-783.24042	724.19135	507.08424	0
33	13	379.0734	736.3467	-739.31675	80.07659	0	400
34	13	380.6283	738.63725	-992.46151	-260.12316	0	400



Engineering Parameters

Name: Layer 4	Unit Weight: 130 pcf	Cohesion: 500 psf	Phi: 0 °
Name: Layer 5	Unit Weight: 125 pcf	Cohesion: 500 psf	Phi: 10 °
Name: Layer 6	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Layer 7	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Layer 8	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Layer 1	Unit Weight: 120 pcf	Cohesion: 300 psf	Phi: 18 °
Name: Layer 2	Unit Weight: 125 pcf	Cohesion: 350 psf	Phi: 18 °
Name: Layer 3	Unit Weight: 125 pcf	Cohesion: 350 psf	Phi: 22 °

SLOPE/W Analysis

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File Information

Created By: Eric Wenz
Revision Number: 91
Last Edited By: Eric Wenz
Date: 6/7/2012
Time: 4:04:08 PM
File Name: Phase 4 - Impoundment Side - Normal Pool.gsz
Directory: I:\GEOTECH\PROJECTS\2011\2-0383\Stability Analysis\5-30-12 Cross Sections\Phase 4\WITH SEEPAGE\
Last Solved Date: 6/7/2012
Last Solved Time: 4:04:20 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Description: Allerton Mine Stage 1
Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Other GeoStudio Analysis
- PWP Other Analysis: "..\..\..\..\Seepage\Phase 4\Phase 4 - Impoundment Side - Normal Pool SEEPAGE.gsz" - Steady-State Seepage [(all)]

Slip Surface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

FOS Distribution

FOS Calculation Option: Constant

Advanced

Number of Slices: 30

Optimization Tolerance: 0.01

Minimum Slip Surface Depth: 0.1 ft

Optimization Maximum Iterations: 2000

Optimization Convergence Tolerance: 1e-007

Starting Optimization Points: 8

Ending Optimization Points: 16

Complete Passes per Insertion: 1

Driving Side Maximum Convex Angle: 5 °

Resisting Side Maximum Convex Angle: 1 °

Materials

Layer 4

Model: Mohr-Coulomb

Unit Weight: 130 pcf

Cohesion: 500 psf

Phi: 0 °

Phi-B: 0 °

Layer 5

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion: 500 psf

Phi: 10 °

Phi-B: 0 °

Layer 6

Model: Mohr-Coulomb

Unit Weight: 105 pcf

Cohesion: 0 psf

Phi: 35 °

Phi-B: 0 °

Layer 7

Model: Mohr-Coulomb

Unit Weight: 105 pcf

Cohesion: 0 psf

Phi: 35 °

Phi-B: 0 °

Layer 8

Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 1

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 300 psf
Phi: 18 °
Phi-B: 0 °

Layer 2

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 350 psf
Phi: 18 °
Phi-B: 0 °

Layer 3

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 350 psf
Phi: 22 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (449, 720.33333) ft
Left-Zone Right Coordinate: (524, 698.66667) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (618, 674) ft
Right-Zone Right Coordinate: (710, 660) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 680) ft
Right Coordinate: (750, 660) ft

Regions

	Material	Points	Area (ft^2)
Region 1	Layer 4	1,37,28,21,16,9,2,3,4,5,6,39,7,8	3000
Region 2	Layer 5	9,10,11,12,44,13,14,15,16	3757.5
Region 3	Layer 6	13,17,45,18,19,20,21,16,15,14	3196.25
Region 4	Layer 7	18,22,46,23,24,25,26,27,28,21,20,19	5400
Region 5	Layer 8	23,29,47,30,31,32,33,34,35,36,37,28,27,26,25,24	4700
Region 6	Layer 1	8,38,39,7	3654
Region 7	Layer 2	40,41,5,6,39,38	9696
Region 8	Layer 3	40,42,43,41	41250
Region 9	Layer 4	13,17,45,18,22,46,23,29,47,30,48,49,50,51,52,53,44	746.25

Points

	X (ft)	Y (ft)
Point 1	0	680
Point 2	600	680
Point 3	660	660
Point 4	750	660
Point 5	750	656
Point 6	660	656
Point 7	600	676
Point 8	0	676
Point 9	590	680
Point 10	545	695
Point 11	535	695
Point 12	490	710
Point 13	471	708
Point 14	420	695
Point 15	410	695
Point 16	350	680
Point 17	435	720
Point 18	417.5	722.5
Point 19	365	705
Point 20	355	705
Point 21	280	680

Point 22	380	735
Point 23	362.5	737.5
Point 24	310	720
Point 25	300	720
Point 26	240	700
Point 27	230	700
Point 28	170	680
Point 29	340	745
Point 30	322.5	747.5
Point 31	270	730
Point 32	260	730
Point 33	200	710
Point 34	190	710
Point 35	130	690
Point 36	120	690
Point 37	90	680
Point 38	0	670
Point 39	618	670
Point 40	0	655
Point 41	750	655
Point 42	0	600
Point 43	750	600
Point 44	480	710
Point 45	425	720
Point 46	370	735
Point 47	330	745
Point 48	330	750
Point 49	340	750
Point 50	370	740
Point 51	380	740
Point 52	425	725
Point 53	435	725

Critical Slip Surfaces

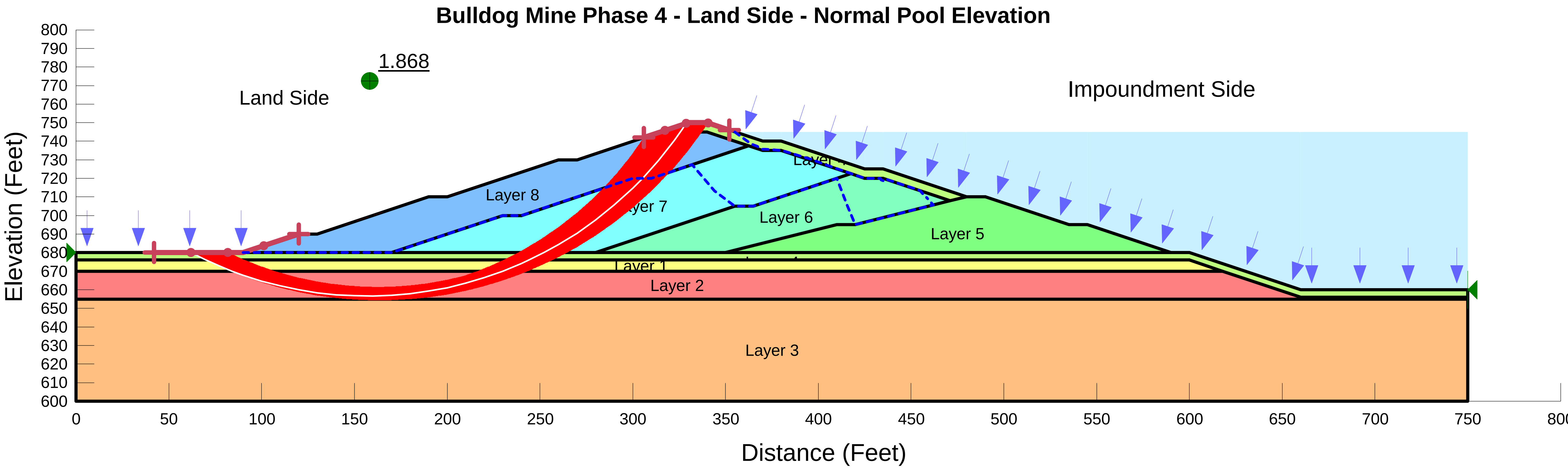
	Slip	FOS	Center (ft)	Radius	Entry (ft)	Exit (ft)

	Surface			(ft)		
1	63	3.291	(603.076, 784.964)	138.53	(486.581, 710)	(662.864, 660)

Slices of Slip Surface: 63

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	63	488.29055	707.468	1692.3044	2226.6732	94.223643	500
2	63	492.83375	701.2062	62.749148	2809.8673	484.39105	500
3	63	498.5013	694.21105	1175.7789	3613.0308	429.75327	500
4	63	504.16885	688.05355	2409.0833	4309.0349	335.01273	500
5	63	509.83635	682.5807	3287.9524	4896.8366	283.68969	500
6	63	515.10185	678	3268.1934	5443.4953	0	500
7	63	521.65915	673	3333.3497	5800.2068	801.53048	300
8	63	528.08855	668.51645	3753.9683	6223.3433	802.34859	350
9	63	532.6962	665.67365	4043.9031	6501.5733	798.54547	350
10	63	537.5	662.9706	4319.8485	6783.3001	800.42396	350
11	63	542.5	660.4109	4553.4386	7117.4793	833.10735	350
12	63	547.5294	658.08765	4778.9619	7407.2008	853.96659	350
13	63	552.58815	655.99015	4996.1777	7595.8762	844.69325	350
14	63	558.0244	654.00005	5178.8223	7748.3899	1038.1727	350
15	63	563.83815	652.14135	5356.0453	7903.0082	1029.0398	350

16	63	569.6519	650.5597	5516.7749	8024.2785	1013.0972	350
17	63	575.46565	649.24545	5648.2301	8112.3147	995.5548	350
18	63	581.2794	648.19085	5752.7407	8167.1694	975.49251	350
19	63	587.09315	647.3899	5841.6015	8188.4936	948.20593	350
20	63	592.5	646.86075	5910.0964	8188.4259	920.50487	350
21	63	597.5	646.5686	5949.3739	8258.101	932.78632	350
22	63	603	646.46625	5979.1657	8287.1653	932.49237	350
23	63	609	646.59305	5996.6727	8186.1668	884.61302	350
24	63	615	646.98075	5993.1635	8045.6804	829.27067	350
25	63	620.75285	647.5942	5970.3697	7869.2795	767.20934	350
26	63	626.25855	648.4158	5933.7803	7659.1016	697.07506	350
27	63	631.7642	649.46605	5883.0073	7413.108	618.20083	350
28	63	637.26985	650.75025	5811.4331	7130.6133	532.98339	350
29	63	642.77555	652.27525	5725.0703	6810.7125	438.62792	350
30	63	648.28125	654.04945	5622.9708	6452.5444	335.1695	350
31	63	653.77835	656.07955	5503.3129	6050.1175	177.66759	350
32	63	658.2613	657.91435	5406.8368	5701.1941	0	500
33	63	661.43205	659.3348	5339.1945	5465.5416	0	500



Engineering Parameters

Name: Layer 4 Unit Weight: 130 pcf Cohesion: 500 psf Phi: 0 °
Name: Layer 5 Unit Weight: 125 pcf Cohesion: 500 psf Phi: 10 °
Name: Layer 6 Unit Weight: 105 pcf Cohesion: 0 psf Phi: 35 °
Name: Layer 7 Unit Weight: 105 pcf Cohesion: 0 psf Phi: 35 °
Name: Layer 8 Unit Weight: 105 pcf Cohesion: 0 psf Phi: 35 °
Name: Layer 1 Unit Weight: 120 pcf Cohesion: 300 psf Phi: 18 °
Name: Layer 2 Unit Weight: 125 pcf Cohesion: 350 psf Phi: 18 °
Name: Layer 3 Unit Weight: 125 pcf Cohesion: 350 psf Phi: 22 °

SLOPE/W Analysis

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File Information

Created By: Eric Wenz
Revision Number: 91
Last Edited By: Eric Wenz
Date: 6/7/2012
Time: 4:19:37 PM
File Name: Phase 4 - Land Side - Normal Pool.gsz
Directory: I:\GEOTECH\PROJECTS\2011\2-0383\Stability Analysis\5-30-12 Cross Sections\Phase 4\WITH SEEPAGE\
Last Solved Date: 6/7/2012
Last Solved Time: 4:19:40 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Description: Allerton Mine Stage 1
Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Other GeoStudio Analysis
- PWP Other Analysis: "..\..\..\..\Seepage\Phase 4\Phase 4 - Impoundment Side - Normal Pool SEEPAGE.gsz" - Steady-State Seepage [(all)]

Slip Surface
- Direction of movement: Right to Left
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
FOS Distribution
FOS Calculation Option: Constant
Advanced
Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Layer 4
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 500 psf
Phi: 0 °
Phi-B: 0 °

Layer 5
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 500 psf
Phi: 10 °
Phi-B: 0 °

Layer 6
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 7
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 8

Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 1

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 300 psf
Phi: 18 °
Phi-B: 0 °

Layer 2

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 350 psf
Phi: 18 °
Phi-B: 0 °

Layer 3

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 350 psf
Phi: 22 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (42, 680) ft
Left-Zone Right Coordinate: (120, 690) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (306, 742) ft
Right-Zone Right Coordinate: (352, 746) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 680) ft
Right Coordinate: (750, 660) ft

Regions

	Material	Points	Area (ft²)
Region 1	Layer 4	1,37,28,21,16,9,2,3,4,5,6,39,7,8	3000
Region 2	Layer 5	9,10,11,12,44,13,14,15,16	3757.5
Region 3	Layer 6	13,17,45,18,19,20,21,16,15,14	3196.25
Region 4	Layer 7	18,22,46,23,24,25,26,27,28,21,20,19	5400
Region 5	Layer 8	23,29,47,30,31,32,33,34,35,36,37,28,27,26,25,24	4700
Region 6	Layer 1	8,38,39,7	3654
Region 7	Layer 2	40,41,5,6,39,38	9696
Region 8	Layer 3	40,42,43,41	41250
Region 9	Layer 4	13,17,45,18,22,46,23,29,47,30,48,49,50,51,52,53,44	746.25

Points

	X (ft)	Y (ft)
Point 1	0	680
Point 2	600	680
Point 3	660	660
Point 4	750	660
Point 5	750	656
Point 6	660	656
Point 7	600	676
Point 8	0	676
Point 9	590	680
Point 10	545	695
Point 11	535	695
Point 12	490	710
Point 13	471	708
Point 14	420	695
Point 15	410	695
Point 16	350	680
Point 17	435	720
Point 18	417.5	722.5
Point 19	365	705
Point 20	355	705
Point 21	280	680

Point 22	380	735
Point 23	362.5	737.5
Point 24	310	720
Point 25	300	720
Point 26	240	700
Point 27	230	700
Point 28	170	680
Point 29	340	745
Point 30	322.5	747.5
Point 31	270	730
Point 32	260	730
Point 33	200	710
Point 34	190	710
Point 35	130	690
Point 36	120	690
Point 37	90	680
Point 38	0	670
Point 39	618	670
Point 40	0	655
Point 41	750	655
Point 42	0	600
Point 43	750	600
Point 44	480	710
Point 45	425	720
Point 46	370	735
Point 47	330	745
Point 48	330	750
Point 49	340	750
Point 50	370	740
Point 51	380	740
Point 52	425	725
Point 53	435	725

Critical Slip Surfaces

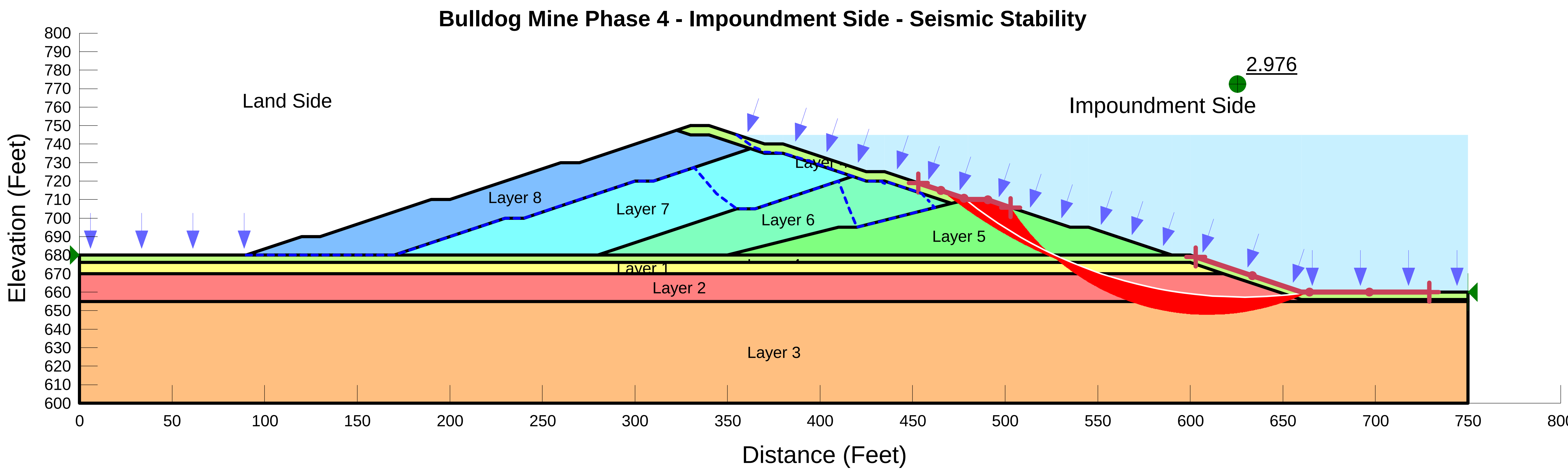
	Slip	FOS	Center (ft)	Radius	Entry (ft)	Exit (ft)

	Surface			(ft)		
1	38	1.868	(157.019, 861.689)	205.079	(328.743, 749.581)	(61.9057, 680)

Slices of Slip Surface: 38

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	38	65.93928	678	124.93888	403.91351	0	500
2	38	73.51223	674.4217	348.21717	859.87926	166.24909	300
3	38	80.590945	671.4217	535.41613	1259.5204	235.27575	300
4	38	87.06515	668.9349	690.59893	1614.2748	300.12048	350
5	38	95	666.28285	856.0865	2185.7528	432.03476	350
6	38	105	663.3843	1037.0147	2983.8475	632.56432	350
7	38	115	661.0257	1184.2155	3691.9258	814.80446	350
8	38	125	659.18815	1298.8642	4111.4238	913.856	350
9	38	135	657.85745	1381.9598	4434.3012	991.76587	350
10	38	145	657.02365	1434.0292	4848.3463	1109.3789	350
11	38	155	656.6808	1455.5301	5165.752	1205.5242	350
12	38	165	656.82635	1446.602	5391.2081	1281.6802	350
13	38	175	657.46135	1407.0575	5531.1057	1339.9845	350
14	38	185	658.59045	1336.7728	5592.6716	1382.8253	350
15	38	195	660.2219	1235.2412	5414.2284	1357.8352	350
16	38	204.9846	662.364	1101.8311	5178.7428	1324.6689	350
17	38	214.95385	665.03195	935.71933	5053.3732	1337.9068	350
18	38	224.96925	668.26775	734.28967	4871.9468	1344.4063	350
19	38	235	672.0916	496.25444	4650.3218	1349.7383	300
20	38	242.0326	675.07405	310.62387	4474.4522	1352.9098	300
21	38	248.0988	678	126.64915	4441.7159	0	500
22	38	256.0662	682.17045	0	3840.5419	2689.1764	0
23	38	265	687.43935	0	3413.255	2389.9869	0
24	38	275	694.05685	0	2924.2487	2047.581	0
25	38	285	701.5724	0	2526.9746	1769.4066	0
26	38	295	710.12065	0	2076.6673	1454.0981	0
27	38	302.6406	717.3362	0	1699.6354	1190.0975	0
28	38	309.5859	724.79765	-254.48512	1303.958	913.04119	0

29	38	318.1953	735.07505	-678.29872	760.93617	532.81324	0
30	38	324.48585	743.36545	-925.30575	348.97104	244.35216	0
31	38	327.60755	747.8786	-1107.057	-224.95135	0	500



Engineering Parameters

Name: Layer 4	Unit Weight: 130 pcf	Cohesion: 400 psf	Phi: 0 °
Name: Layer 5	Unit Weight: 125 pcf	Cohesion: 400 psf	Phi: 10 °
Name: Layer 6	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Layer 7	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Layer 8	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Layer 1	Unit Weight: 120 pcf	Cohesion: 240 psf	Phi: 18 °
Name: Layer 2	Unit Weight: 125 pcf	Cohesion: 280 psf	Phi: 18 °
Name: Layer 3	Unit Weight: 125 pcf	Cohesion: 280 psf	Phi: 22 °

SLOPE/W Analysis

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File Information

Created By: Eric Wenz
Revision Number: 96
Last Edited By: Eric Wenz
Date: 6/7/2012
Time: 4:17:56 PM
File Name: Phase 4 - Impoundment Side - Seismic Stability.gsz
Directory: I:\GEOTECH\PROJECTS\2011\2-0383\Stability Analysis\5-30-12 Cross Sections\Phase 4\WITH SEEPAGE\
Last Solved Date: 6/7/2012
Last Solved Time: 4:17:58 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Description: Allerton Mine Stage 1
Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Other GeoStudio Analysis
- PWP Other Analysis: "..\..\..\..\Seepage\Phase 4\Phase 4 - Impoundment Side - Normal Pool SEEPAGE.gsz" - Steady-State Seepage [(all)]

Slip Surface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
FOS Distribution
FOS Calculation Option: Constant
Advanced
Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Layer 4

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 400 psf
Phi: 0 °
Phi-B: 0 °

Layer 5

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 400 psf
Phi: 10 °
Phi-B: 0 °

Layer 6

Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 7

Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 8

Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 1

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 240 psf
Phi: 18 °
Phi-B: 0 °

Layer 2

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 280 psf
Phi: 18 °
Phi-B: 0 °

Layer 3

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 280 psf
Phi: 22 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (453, 719) ft
Left-Zone Right Coordinate: (503, 705.66667) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (603, 679) ft
Right-Zone Right Coordinate: (729, 660) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 680) ft
Right Coordinate: (750, 660) ft

Regions

	Material	Points	Area (ft^2)
Region 1	Layer 4	1,37,28,21,16,9,2,3,4,5,6,39,7,8	3000
Region 2	Layer 5	9,10,11,12,44,13,14,15,16	3757.5
Region 3	Layer 6	13,17,45,18,19,20,21,16,15,14	3196.25
Region 4	Layer 7	18,22,46,23,24,25,26,27,28,21,20,19	5400
Region 5	Layer 8	23,29,47,30,31,32,33,34,35,36,37,28,27,26,25,24	4700
Region 6	Layer 1	8,38,39,7	3654
Region 7	Layer 2	40,41,5,6,39,38	9696
Region 8	Layer 3	40,42,43,41	41250
Region 9	Layer 4	13,17,45,18,22,46,23,29,47,30,48,49,50,51,52,53,44	746.25

Points

	X (ft)	Y (ft)
Point 1	0	680
Point 2	600	680
Point 3	660	660
Point 4	750	660
Point 5	750	656
Point 6	660	656
Point 7	600	676
Point 8	0	676
Point 9	590	680
Point 10	545	695
Point 11	535	695
Point 12	490	710
Point 13	471	708
Point 14	420	695
Point 15	410	695
Point 16	350	680
Point 17	435	720
Point 18	417.5	722.5
Point 19	365	705
Point 20	355	705
Point 21	280	680

Point 22	380	735
Point 23	362.5	737.5
Point 24	310	720
Point 25	300	720
Point 26	240	700
Point 27	230	700
Point 28	170	680
Point 29	340	745
Point 30	322.5	747.5
Point 31	270	730
Point 32	260	730
Point 33	200	710
Point 34	190	710
Point 35	130	690
Point 36	120	690
Point 37	90	680
Point 38	0	670
Point 39	618	670
Point 40	0	655
Point 41	750	655
Point 42	0	600
Point 43	750	600
Point 44	480	710
Point 45	425	720
Point 46	370	735
Point 47	330	745
Point 48	330	750
Point 49	340	750
Point 50	370	740
Point 51	380	740
Point 52	425	725
Point 53	435	725

Critical Slip Surfaces

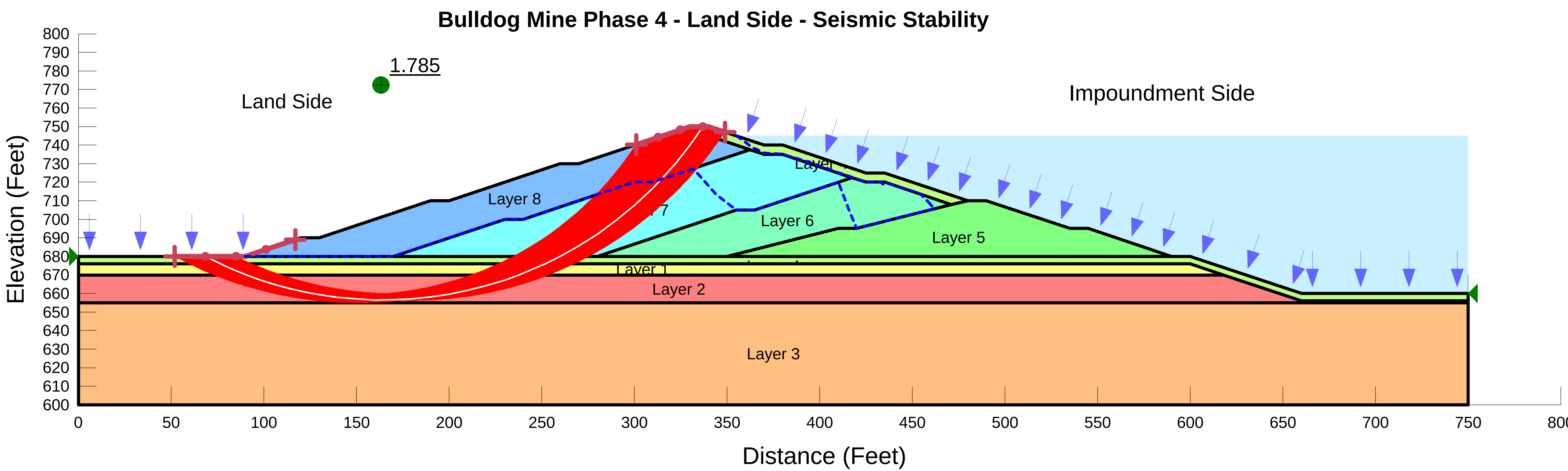
	Slip	FOS	Center (ft)	Radius	Entry (ft)	Exit (ft)

	Surface			(ft)		
1	62	2.976	(628.787, 897.601)	240.264	(477.743, 710.752)	(664.458, 660)

Slices of Slip Surface: 62

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	62	478.3548	710.26125	2063.549	2078.9163	0	400
2	62	479.4831	709.3603	2061.3166	2163.9352	18.09444	400
3	62	482.5	707.03125	1852.8431	2422.07	100.37006	400
4	62	487.5	703.29435	1024.7682	2837.0706	319.5578	400
5	62	493.07685	699.3701	98.644177	3218.7247	550.15438	400
6	62	499.23055	695.2933	1215.705	3636.1944	426.7976	400
7	62	505.38425	691.4808	2360.4915	4018.5521	292.36081	400
8	62	511.5379	687.9182	3127.6226	4355.3539	216.48214	400
9	62	517.69155	684.59295	3456.0152	4649.0364	210.36182	400
10	62	523.84525	681.4941	3848.4916	4917.5089	188.4966	400
11	62	530.96105	678.19915	3711.9168	5225.0628	0	400
12	62	535.47245	676.19915	3504.4143	5389.9813	0	400
13	62	540.47245	674.2101	3703.7026	5576.4535	608.49366	240
14	62	548.4083	671.2101	3995.8598	5894.2527	616.82523	240
15	62	554.99855	668.97305	4228.4164	6043.543	589.77037	280
16	62	561.36245	667.01565	4420.8608	6172.1925	569.04217	280
17	62	567.72635	665.249	4588.9197	6276.7668	548.41476	280
18	62	574.09025	663.66885	4748.1915	6358.3107	523.15944	280
19	62	580.45415	662.27135	4878.1411	6416.144	499.72742	280
20	62	586.81805	661.05325	4992.5046	6450.8952	473.85983	280
21	62	592.5	660.10675	5086.7671	6493.4423	457.0565	280
22	62	597.5	659.3964	5154.3295	6592.3781	467.25031	280
23	62	603	658.74415	5216.6867	6647.2075	464.80439	280
24	62	609	658.17235	5276.5115	6614.118	434.61471	280
25	62	615	657.75195	5324.0442	6560.3366	401.69576	280
26	62	620.873	657.4848	5355.5659	6483.0352	366.33697	280
27	62	626.61905	657.3642	5377.5735	6382.7469	326.60065	280
28	62	632.3651	657.3811	5390.7685	6263.2729	283.49386	280

29	62	638.11115	657.53545	5391.1304	6124.6483	238.33441	280
30	62	643.8572	657.8276	5381.792	5966.4333	189.96149	280
31	62	649.6032	658.25805	5362.4225	5788.9336	138.58183	280
32	62	656.2381	658.9406	5345.1731	5551.686	0	400
33	62	662.2292	659.68665	5320.7427	5364.7213	0	400



Engineering Parameters

Name: Layer 4	Unit Weight: 130 pcf	Cohesion: 400 psf	Phi: 0 °
Name: Layer 5	Unit Weight: 125 pcf	Cohesion: 400 psf	Phi: 10 °
Name: Layer 6	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Layer 7	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Layer 8	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Layer 1	Unit Weight: 120 pcf	Cohesion: 240 psf	Phi: 18 °
Name: Layer 2	Unit Weight: 125 pcf	Cohesion: 280 psf	Phi: 18 °
Name: Layer 3	Unit Weight: 125 pcf	Cohesion: 280 psf	Phi: 22 °

SLOPE/W Analysis

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File Information

Created By: Eric Wenz
Revision Number: 99
Last Edited By: Eric Wenz
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Time: 4:22:20 PM
File Name: Phase 4 - Land Side - Seismic Stability.gsz
Directory: I:\GEOTECH\PROJECTS\2011\2-0383\Stability Analysis\5-30-12 Cross Sections\Phase 4\WITH SEEPAGE\
Last Solved Date: 6/7/2012
Last Solved Time: 4:22:22 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Description: Allerton Mine Stage 1
Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Other GeoStudio Analysis
- PWP Other Analysis: "..\..\..\..\Seepage\Phase 4\Phase 4 - Impoundment Side - Normal Pool SEEPAGE.gsz" - Steady-State Seepage [(all)]

Slip Surface
- Direction of movement: Right to Left
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
FOS Distribution
FOS Calculation Option: Constant
Advanced
Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Layer 4

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 400 psf
Phi: 0 °
Phi-B: 0 °

Layer 5

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 400 psf
Phi: 10 °
Phi-B: 0 °

Layer 6

Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 7

Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 8

Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 1

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 240 psf
Phi: 18 °
Phi-B: 0 °

Layer 2

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 280 psf
Phi: 18 °
Phi-B: 0 °

Layer 3

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 280 psf
Phi: 22 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (52, 680) ft
Left-Zone Right Coordinate: (117, 689) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (301, 740.33333) ft
Right-Zone Right Coordinate: (349, 747) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 680) ft
Right Coordinate: (750, 660) ft

Regions

	Material	Points	Area (ft^2)
Region 1	Layer 4	1,37,28,21,16,9,2,3,4,5,6,39,7,8	3000
Region 2	Layer 5	9,10,11,12,44,13,14,15,16	3757.5
Region 3	Layer 6	13,17,45,18,19,20,21,16,15,14	3196.25
Region 4	Layer 7	18,22,46,23,24,25,26,27,28,21,20,19	5400
Region 5	Layer 8	23,29,47,30,31,32,33,34,35,36,37,28,27,26,25,24	4700
Region 6	Layer 1	8,38,39,7	3654
Region 7	Layer 2	40,41,5,6,39,38	9696
Region 8	Layer 3	40,42,43,41	41250
Region 9	Layer 4	13,17,45,18,22,46,23,29,47,30,48,49,50,51,52,53,44	746.25

Points

	X (ft)	Y (ft)
Point 1	0	680
Point 2	600	680
Point 3	660	660
Point 4	750	660
Point 5	750	656
Point 6	660	656
Point 7	600	676
Point 8	0	676
Point 9	590	680
Point 10	545	695
Point 11	535	695
Point 12	490	710
Point 13	471	708
Point 14	420	695
Point 15	410	695
Point 16	350	680
Point 17	435	720
Point 18	417.5	722.5
Point 19	365	705
Point 20	355	705
Point 21	280	680

Point 22	380	735
Point 23	362.5	737.5
Point 24	310	720
Point 25	300	720
Point 26	240	700
Point 27	230	700
Point 28	170	680
Point 29	340	745
Point 30	322.5	747.5
Point 31	270	730
Point 32	260	730
Point 33	200	710
Point 34	190	710
Point 35	130	690
Point 36	120	690
Point 37	90	680
Point 38	0	670
Point 39	618	670
Point 40	0	655
Point 41	750	655
Point 42	0	600
Point 43	750	600
Point 44	480	710
Point 45	425	720
Point 46	370	735
Point 47	330	745
Point 48	330	750
Point 49	340	750
Point 50	370	740
Point 51	380	740
Point 52	425	725
Point 53	435	725

Critical Slip Surfaces

	Slip	FOS	Center (ft)	Radius	Entry (ft)	Exit (ft)

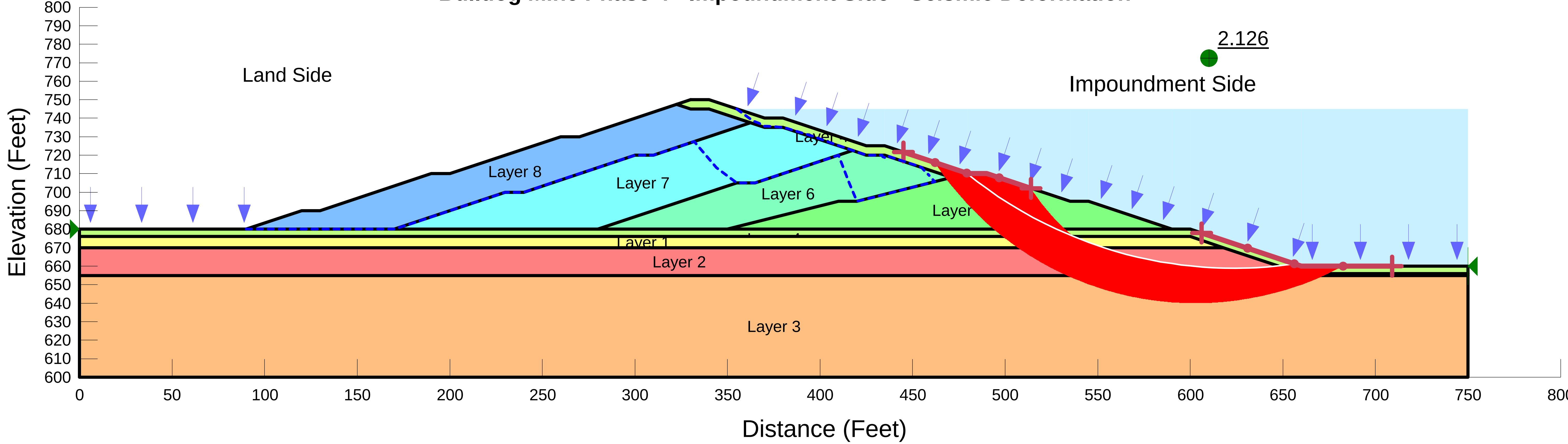
	Surface			(ft)		
1	43	1.785	(164.254, 862.751)	206.264	(336.973, 750)	(68.6151, 680)

Slices of Slip Surface: 43

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	43	72.64878	678	124.9371	381.35245	0	400
2	43	83.34122	673.15825	427.05511	1017.6365	191.89153	240
3	43	90.412725	670.15825	614.26002	1436.1352	267.04345	240
4	43	95.687875	668.2856	731.11623	1922.1015	386.97459	280
5	43	105.4127	665.12345	928.44598	2758.0287	594.46746	280
6	43	115.13755	662.4832	1093.1734	3513.0155	786.25436	280
7	43	125	660.32115	1228.2219	3992.5311	898.17851	280
8	43	135	658.635	1333.4746	4384.5982	991.37016	280
9	43	145	657.4495	1407.5238	4867.7404	1124.2925	280
10	43	155	656.75595	1450.8376	5250.1079	1234.4578	280
11	43	165	656.5494	1463.7898	5534.9613	1322.8038	280
12	43	175	656.82845	1446.5313	5728.1041	1391.1673	280
13	43	185	657.595	1398.8658	5836.5337	1441.8857	280
14	43	195	658.8546	1320.5709	5696.5999	1421.858	280
15	43	205	660.6165	1210.9419	5495.0667	1391.9965	280
16	43	215	662.89395	1069.173	5403.0504	1408.1621	280
17	43	225	665.7049	894.23102	5254.1902	1416.6366	280
18	43	233.841	668.62315	712.63291	5081.3772	1419.4911	280
19	43	238.841	670.44955	598.96135	4973.2454	1421.2911	240
20	43	245.9125	673.44955	412.39331	4788.5425	1421.8971	240
21	43	255.9125	678.0282	125.25608	4675.0508	0	400
22	43	265	682.85655	0	3847.617	2694.1304	0
23	43	275	688.8407	0	3378.7021	2365.7927	0
24	43	285	695.6374	0	3010.6532	2108.082	0
25	43	295	703.3513	0	2598.4158	1819.4303	0
26	43	305	712.1245	0	2133.9806	1494.2293	0
27	43	312.2958	719.1635	0	1766.3443	1236.8076	0
28	43	318.5458	725.99165	-177.93039	1405.4773	984.12581	0

29	43	326.25	735.21605	-511.19339	962.75579	674.12886	0
30	43	331.80185	742.48965	-782.94596	584.21196	409.06962	0
31	43	335.28835	747.5	-1051.9725	-5.2658335	0	400

Bulldog Mine Phase 4 - Impoundment Side - Seismic Deformation



Engineering Parameters

Name: Layer 4 Unit Weight: 130 pcf Cohesion: 400 psf Phi: 0 °
Name: Layer 5 Unit Weight: 125 pcf Cohesion: 400 psf Phi: 10 °
Name: Layer 6 Unit Weight: 105 pcf Cohesion: 0 psf Phi: 35 °
Name: Layer 7 Unit Weight: 105 pcf Cohesion: 0 psf Phi: 35 °
Name: Layer 8 Unit Weight: 105 pcf Cohesion: 0 psf Phi: 35 °
Name: Layer 1 Unit Weight: 120 pcf Cohesion: 240 psf Phi: 18 °
Name: Layer 2 Unit Weight: 125 pcf Cohesion: 280 psf Phi: 18 °
Name: Layer 3 Unit Weight: 125 pcf Cohesion: 280 psf Phi: 22 °

SLOPE/W Analysis

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File Information

Created By: Eric Wenz
Revision Number: 104
Last Edited By: Eric Wenz
Date: 6/7/2012
Time: 4:15:50 PM
File Name: Phase 4 - Impoundment Side - Seismic Deformation.gsz
Directory: I:\GEOTECH\PROJECTS\2011\2-0383\Stability Analysis\5-30-12 Cross Sections\Phase 4\WITH SEEPAGE\
Last Solved Date: 6/7/2012
Last Solved Time: 4:15:54 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Description: Allerton Mine Stage 1
Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Other GeoStudio Analysis
- PWP Other Analysis: "..\..\..\..\Seepage\Phase 4\Phase 4 - Impoundment Side - Normal Pool SEEPAGE.gsz" - Steady-State Seepage [(all)]

Slip Surface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

FOS Distribution

FOS Calculation Option: Constant

Advanced

Number of Slices: 30

Optimization Tolerance: 0.01

Minimum Slip Surface Depth: 0.1 ft

Optimization Maximum Iterations: 2000

Optimization Convergence Tolerance: 1e-007

Starting Optimization Points: 8

Ending Optimization Points: 16

Complete Passes per Insertion: 1

Driving Side Maximum Convex Angle: 5 °

Resisting Side Maximum Convex Angle: 1 °

Materials

Layer 4

Model: Mohr-Coulomb

Unit Weight: 130 pcf

Cohesion: 400 psf

Phi: 0 °

Phi-B: 0 °

Layer 5

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion: 400 psf

Phi: 10 °

Phi-B: 0 °

Layer 6

Model: Mohr-Coulomb

Unit Weight: 105 pcf

Cohesion: 0 psf

Phi: 35 °

Phi-B: 0 °

Layer 7

Model: Mohr-Coulomb

Unit Weight: 105 pcf

Cohesion: 0 psf

Phi: 35 °

Phi-B: 0 °

Layer 8

Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 1

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 240 psf
Phi: 18 °
Phi-B: 0 °

Layer 2

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 280 psf
Phi: 18 °
Phi-B: 0 °

Layer 3

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 280 psf
Phi: 22 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (445, 721.66667) ft
Left-Zone Right Coordinate: (514, 702) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (606, 678) ft
Right-Zone Right Coordinate: (709, 660) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 680) ft
Right Coordinate: (750, 660) ft

Seismic Loads

Horz Seismic Load: 0.056

Ignore seismic load in strength: No

Regions

	Material	Points	Area (ft²)
Region 1	Layer 4	1,37,28,21,16,9,2,3,4,5,6,39,7,8	3000
Region 2	Layer 5	9,10,11,12,44,13,14,15,16	3757.5
Region 3	Layer 6	13,17,45,18,19,20,21,16,15,14	3196.25
Region 4	Layer 7	18,22,46,23,24,25,26,27,28,21,20,19	5400
Region 5	Layer 8	23,29,47,30,31,32,33,34,35,36,37,28,27,26,25,24	4700
Region 6	Layer 1	8,38,39,7	3654
Region 7	Layer 2	40,41,5,6,39,38	9696
Region 8	Layer 3	40,42,43,41	41250
Region 9	Layer 4	13,17,45,18,22,46,23,29,47,30,48,49,50,51,52,53,44	746.25

Points

	X (ft)	Y (ft)
Point 1	0	680
Point 2	600	680
Point 3	660	660
Point 4	750	660
Point 5	750	656
Point 6	660	656
Point 7	600	676
Point 8	0	676
Point 9	590	680
Point 10	545	695
Point 11	535	695
Point 12	490	710
Point 13	471	708
Point 14	420	695
Point 15	410	695
Point 16	350	680
Point 17	435	720

Point 18	417.5	722.5
Point 19	365	705
Point 20	355	705
Point 21	280	680
Point 22	380	735
Point 23	362.5	737.5
Point 24	310	720
Point 25	300	720
Point 26	240	700
Point 27	230	700
Point 28	170	680
Point 29	340	745
Point 30	322.5	747.5
Point 31	270	730
Point 32	260	730
Point 33	200	710
Point 34	190	710
Point 35	130	690
Point 36	120	690
Point 37	90	680
Point 38	0	670
Point 39	618	670
Point 40	0	655
Point 41	750	655
Point 42	0	600
Point 43	750	600
Point 44	480	710
Point 45	425	720
Point 46	370	735
Point 47	330	745
Point 48	330	750
Point 49	340	750
Point 50	370	740
Point 51	380	740
Point 52	425	725
Point 53	435	725

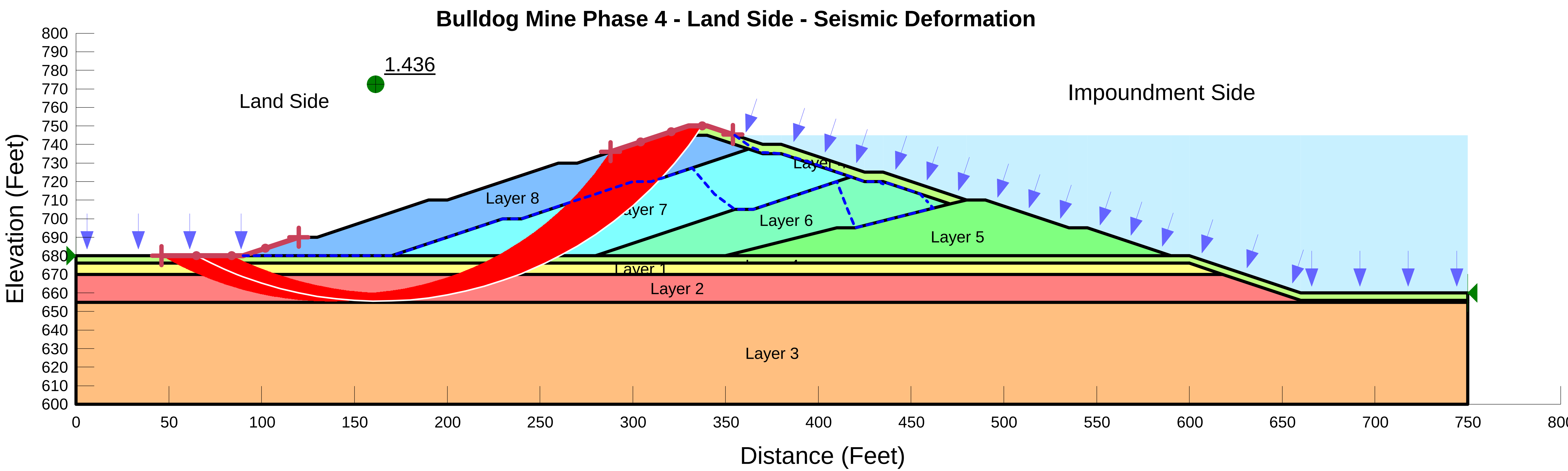
Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	62	2.126	(623.733, 888)	229.067	(479.243, 710.252)	(656.243, 661.252)

Slices of Slip Surface: 62

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	62	479.4468	710.08725	2143.458	2032.3426	0	400
2	62	479.8251	709.78105	2142.3703	2068.1871	-13.080497	400
3	62	482.5	707.6817	1926.7501	2297.8664	65.437815	400
4	62	487.5	703.8739	1119.2661	2701.2166	278.94056	400
5	62	493.1481	699.8394	83.23631	3070.4741	526.73062	400
6	62	499.44435	695.62075	1226.7031	3517.6347	403.95306	400
7	62	505.7406	691.69465	2398.9708	3924.9574	269.07261	400
8	62	512.03685	688.04385	3136.3102	4275.2488	200.8256	400
9	62	518.3331	684.65355	3472.4778	4576.7162	194.70701	400
10	62	524.62935	681.5109	3875.222	4851.9028	172.21518	400
11	62	531.38875	678.4089	3752.8247	5150.9955	0	400
12	62	535.98605	676.4089	3535.7775	5318.561	0	400
13	62	540.98605	674.4447	3696.9889	5490.7178	582.81787	240
14	62	549.1975	671.4447	3992.9726	5808.7383	589.97805	240
15	62	556.4454	669.0625	4244.4469	5970.7414	560.90706	280
16	62	562.54625	667.2794	4416.1136	6089.8077	543.81618	280
17	62	568.6471	665.678	4571.4517	6186.1686	524.65335	280
18	62	574.7479	664.25435	4718.0876	6260.3607	501.11492	280
19	62	580.84875	663.0051	4835.5585	6311.5696	479.58507	280
20	62	586.9496	661.9274	4939.2855	6340.1788	455.17783	280
21	62	592.5	661.087	5025.6185	6367.3685	435.961	280
22	62	597.5	660.45465	5088.8942	6461.2049	445.89076	280
23	62	603	659.89375	5145.4571	6518.2982	446.06313	280
24	62	609	659.42775	5198.2137	6475.5632	415.03601	280
25	62	615	659.1199	5239.3542	6409.8358	380.31253	280

26	62	620.94925	658.9696	5263.5353	6317.1239	342.33168	280
27	62	626.8477	658.9739	5277.8464	6197.6638	298.86679	280
28	62	632.74615	659.13015	5282.2079	6055.3709	251.2159	280
29	62	638.6446	659.4387	5274.0724	5890.551	200.30604	280
30	62	644.54305	659.90015	5254.1394	5703.0712	145.86678	280
31	62	651.8675	660.7108	5235.5213	5428.4382	0	400



Engineering Parameters

Name: Layer 4	Unit Weight: 130 pcf	Cohesion: 400 psf	Phi: 0 °
Name: Layer 5	Unit Weight: 125 pcf	Cohesion: 400 psf	Phi: 10 °
Name: Layer 6	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Layer 7	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Layer 8	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Layer 1	Unit Weight: 120 pcf	Cohesion: 240 psf	Phi: 18 °
Name: Layer 2	Unit Weight: 125 pcf	Cohesion: 280 psf	Phi: 18 °
Name: Layer 3	Unit Weight: 125 pcf	Cohesion: 280 psf	Phi: 22 °

SLOPE/W Analysis

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File Information

Created By: Eric Wenz
Revision Number: 121
Last Edited By: Eric Wenz
Date: 6/7/2012
Time: 4:20:59 PM
File Name: Phase 4 - Land Side - Seismic Deformation.gsz
Directory: I:\GEOTECH\PROJECTS\2011\2-0383\Stability Analysis\5-30-12 Cross Sections\Phase 4\WITH SEEPAGE\
Last Solved Date: 6/7/2012
Last Solved Time: 4:21:02 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Description: Allerton Mine Stage 1
Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Other GeoStudio Analysis
- PWP Other Analysis: "..\..\..\..\Seepage\Phase 4\Phase 4 - Impoundment Side - Normal Pool SEEPAGE.gsz" - Steady-State Seepage [(all)]

Slip Surface
- Direction of movement: Right to Left
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
FOS Distribution
FOS Calculation Option: Constant
Advanced
Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Layer 4
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 400 psf
Phi: 0 °
Phi-B: 0 °

Layer 5
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 400 psf
Phi: 10 °
Phi-B: 0 °

Layer 6
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 7
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 8

Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 1

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 240 psf
Phi: 18 °
Phi-B: 0 °

Layer 2

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 280 psf
Phi: 18 °
Phi-B: 0 °

Layer 3

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 280 psf
Phi: 22 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (46, 680) ft
Left-Zone Right Coordinate: (120, 690) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (288, 736) ft
Right-Zone Right Coordinate: (354, 745.33333) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 680) ft
Right Coordinate: (750, 660) ft

Seismic Loads

Horz Seismic Load: 0.056

Ignore seismic load in strength: No

Regions

	Material	Points	Area (ft^2)
Region 1	Layer 4	1,37,28,21,16,9,2,3,4,5,6,39,7,8	3000
Region 2	Layer 5	9,10,11,12,44,13,14,15,16	3757.5
Region 3	Layer 6	13,17,45,18,19,20,21,16,15,14	3196.25
Region 4	Layer 7	18,22,46,23,24,25,26,27,28,21,20,19	5400
Region 5	Layer 8	23,29,47,30,31,32,33,34,35,36,37,28,27,26,25,24	4700
Region 6	Layer 1	8,38,39,7	3654
Region 7	Layer 2	40,41,5,6,39,38	9696
Region 8	Layer 3	40,42,43,41	41250
Region 9	Layer 4	13,17,45,18,22,46,23,29,47,30,48,49,50,51,52,53,44	746.25

Points

	X (ft)	Y (ft)
Point 1	0	680
Point 2	600	680
Point 3	660	660
Point 4	750	660
Point 5	750	656
Point 6	660	656
Point 7	600	676
Point 8	0	676
Point 9	590	680
Point 10	545	695
Point 11	535	695
Point 12	490	710
Point 13	471	708
Point 14	420	695
Point 15	410	695
Point 16	350	680
Point 17	435	720

Point 18	417.5	722.5
Point 19	365	705
Point 20	355	705
Point 21	280	680
Point 22	380	735
Point 23	362.5	737.5
Point 24	310	720
Point 25	300	720
Point 26	240	700
Point 27	230	700
Point 28	170	680
Point 29	340	745
Point 30	322.5	747.5
Point 31	270	730
Point 32	260	730
Point 33	200	710
Point 34	190	710
Point 35	130	690
Point 36	120	690
Point 37	90	680
Point 38	0	670
Point 39	618	670
Point 40	0	655
Point 41	750	655
Point 42	0	600
Point 43	750	600
Point 44	480	710
Point 45	425	720
Point 46	370	735
Point 47	330	745
Point 48	330	750
Point 49	340	750
Point 50	370	740
Point 51	380	740
Point 52	425	725
Point 53	435	725

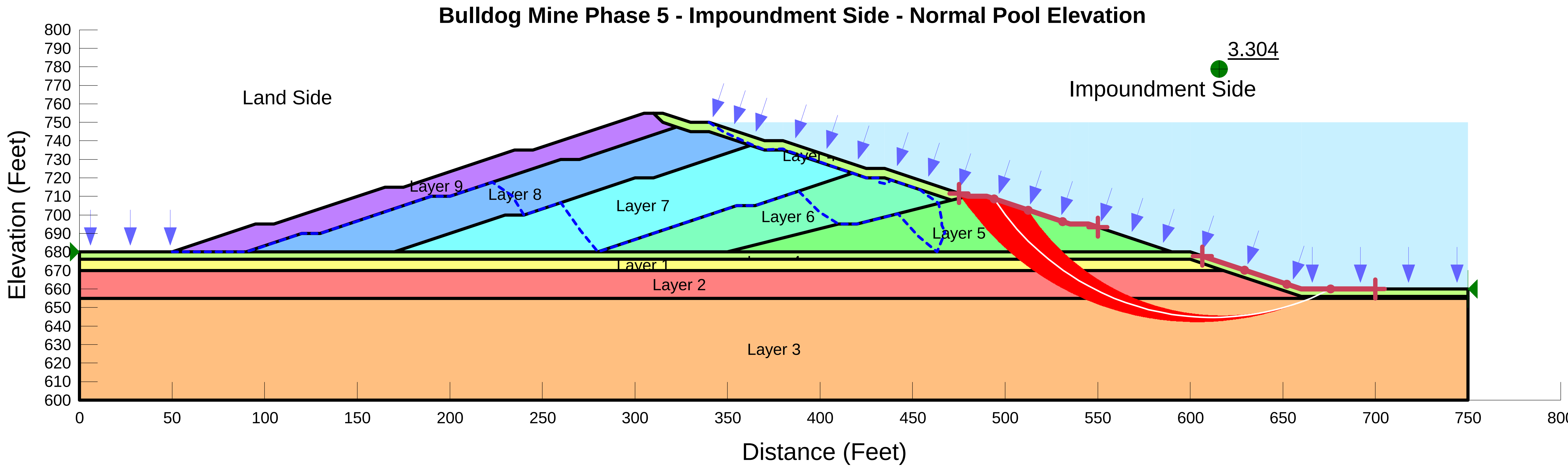
Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	43	1.436	(162.867, 864.289)	208.708	(337.5, 750)	(64.9057, 680)

Slices of Slip Surface: 43

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	43	68.86942	678	124.94024	415.16108	0	400
2	43	76.284775	674.426	347.95628	893.52274	177.26529	240
3	43	83.18803	671.426	535.14576	1310.599	251.96004	240
4	43	88.31983	669.35745	664.23288	1621.8767	311.15735	280
5	43	95	666.995	811.6519	2179.5539	444.45829	280
6	43	105	663.8317	1009.0966	3059.7637	666.30215	280
7	43	115	661.2098	1172.6654	3845.3265	868.40022	280
8	43	125	659.10855	1303.8814	4323.6859	981.19398	280
9	43	135	657.51195	1403.5122	4691.3898	1068.2962	280
10	43	145	656.4084	1472.471	5142.2406	1192.3804	280
11	43	155	655.79005	1511.1256	5481.1029	1289.9238	280
12	43	165	655.6525	1519.821	5714.2029	1362.8373	280
13	43	175	655.9949	1498.5599	5850.8828	1414.1554	280
14	43	185	656.8196	1447.2866	5901.8072	1447.3615	280
15	43	195	658.13235	1365.6103	5708.6678	1411.1449	280
16	43	205	659.9426	1252.9443	5460.7335	1367.1936	280
17	43	215	662.2638	1108.4871	5327.1867	1370.7386	280
18	43	225	665.11385	931.11592	5144.9699	1369.1641	280
19	43	234.5467	668.3368	730.54946	4930.7467	1364.7268	280
20	43	239.5467	670.17905	615.88824	4811.3865	1363.2	240
21	43	246.44995	673.17905	429.32702	4617.7798	1360.9108	240
22	43	256.44995	677.7813	140.97865	4488.0533	0	400
23	43	260.4137	679.7813	13.914198	4365.2029	0	400
24	43	265.4137	682.5884	0	3670.0235	2569.7781	0
25	43	275	688.36375	0	3223.2277	2256.9283	0

26	43	285	695.1614	0	2857.5992	2000.9125	0
27	43	295	702.8648	0	2458.1925	1721.2449	0
28	43	305	711.6122	0	2016.9749	1412.301	0
29	43	312.67435	719.0249	0	1652.3954	1157.0197	0
30	43	318.92435	725.8125	-160.64604	1318.2832	923.0718	0
31	43	326.25	734.5651	-479.71294	929.99309	651.18817	0
32	43	332.06175	742.14405	-760.35076	560.245	392.28778	0
33	43	335.81175	747.5	-1050.1722	-82.394432	0	400



Engineering Parameters

Name: Layer 4	Unit Weight: 130 pcf	Cohesion: 500 psf	Phi: 0 °
Name: Layer 5	Unit Weight: 125 pcf	Cohesion: 500 psf	Phi: 10 °
Name: Layer 6	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Layer 7	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Layer 8	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Layer 9	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Layer 1	Unit Weight: 120 pcf	Cohesion: 300 psf	Phi: 18 °
Name: Layer 2	Unit Weight: 125 pcf	Cohesion: 350 psf	Phi: 18 °
Name: Layer 3	Unit Weight: 125 pcf	Cohesion: 350 psf	Phi: 22 °

SLOPE/W Analysis

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File Information

Created By: Eric Wenz
Revision Number: 80
Last Edited By: Eric Wenz
Date: 6/7/2012
Time: 5:08:00 PM
File Name: Phase 5 - Impoundment Side - Normal Pool.gsz
Directory: I:\GEOTECH\PROJECTS\2011\2-0383\Stability Analysis\5-30-12 Cross Sections\Phase 5\WITH SEEPAGE\
Last Solved Date: 6/7/2012
Last Solved Time: 5:08:04 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Description: Allerton Mine Stage 1
Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Other GeoStudio Analysis
- PWP Other Analysis: "..\..\..\..\Seepage\Phase 5\Phase 5 - Impoundment Side - Normal Pool SEEPAGE.gsz" - Steady-State Seepage [(all)]

Slip Surface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
FOS Distribution
FOS Calculation Option: Constant
Advanced
Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Layer 4

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 500 psf
Phi: 0 °
Phi-B: 0 °

Layer 5

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 500 psf
Phi: 10 °
Phi-B: 0 °

Layer 6

Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 7

Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 8

Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 9

Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 1

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 300 psf
Phi: 18 °
Phi-B: 0 °

Layer 2

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 350 psf
Phi: 18 °
Phi-B: 0 °

Layer 3

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 350 psf
Phi: 22 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (475, 711.66667) ft
Left-Zone Right Coordinate: (550, 693.33333) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (606.55217, 677.81594) ft
Right-Zone Right Coordinate: (700, 660) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 680) ft
Right Coordinate: (750, 660) ft

Regions

	Material	Points	Area (ft²)
Region 1	Layer 4	1,46,37,28,21,16,9,2,3,4,5,6,48,7,8	3000
Region 2	Layer 5	9,10,11,12,53,13,14,15,16	3757.5
Region 3	Layer 6	13,17,54,18,19,20,21,16,15,14	3196.25
Region 4	Layer 7	18,22,55,23,24,25,26,27,28,21,20,19	5400
Region 5	Layer 8	23,29,56,30,31,32,33,34,35,36,37,28,27,26,25,24	4700
Region 6	Layer 9	30,57,38,39,40,41,42,43,44,45,46,37,36,35,34,33,32,31	3006.25
Region 7	Layer 1	8,47,48,7	3654
Region 8	Layer 2	49,50,5,6,48,47	9696
Region 9	Layer 3	49,51,52,50	41250
Region 10	Layer 4	13,17,54,18,22,55,23,29,56,30,57,38,58,59,60,61,62,63,64,53	815

Points

	X (ft)	Y (ft)
Point 1	0	680
Point 2	600	680
Point 3	660	660
Point 4	750	660
Point 5	750	656
Point 6	660	656
Point 7	600	676
Point 8	0	676
Point 9	590	680
Point 10	545	695
Point 11	535	695
Point 12	490	710
Point 13	471	708
Point 14	420	695
Point 15	410	695
Point 16	350	680

Point 17	435	720
Point 18	417.5	722.5
Point 19	365	705
Point 20	355	705
Point 21	280	680
Point 22	380	735
Point 23	362.5	737.5
Point 24	310	720
Point 25	300	720
Point 26	240	700
Point 27	230	700
Point 28	170	680
Point 29	340	745
Point 30	322.5	747.5
Point 31	270	730
Point 32	260	730
Point 33	200	710
Point 34	190	710
Point 35	130	690
Point 36	120	690
Point 37	90	680
Point 38	310	755
Point 39	305	755
Point 40	245	735
Point 41	235	735
Point 42	175	715
Point 43	165	715
Point 44	105	695
Point 45	95	695
Point 46	50	680
Point 47	0	670
Point 48	618	670
Point 49	0	655
Point 50	750	655
Point 51	0	600
Point 52	750	600

Point 53	480	710
Point 54	425	720
Point 55	370	735
Point 56	330	745
Point 57	315	750
Point 58	315	755
Point 59	330	750
Point 60	340	750
Point 61	370	740
Point 62	380	740
Point 63	425	725
Point 64	435	725

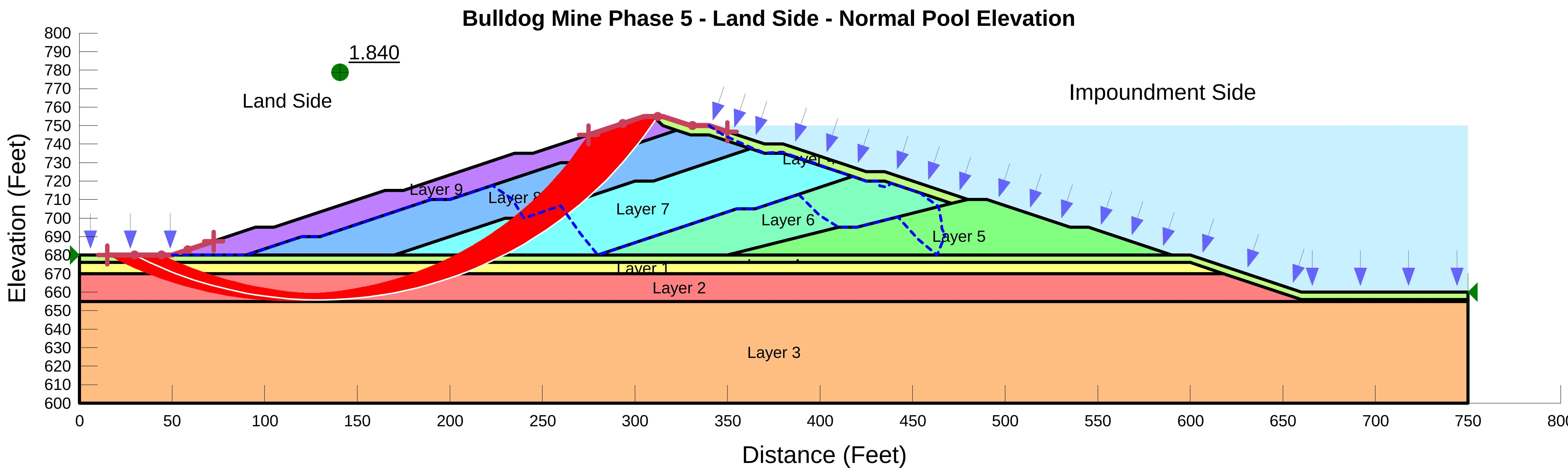
Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	43	3.304	(611.989, 785.362)	140.721	(494.007, 708.664)	(675.915, 660)

Slices of Slip Surface: 43

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	43	497.0944	704.2886	1485.5381	2743.2788	221.77362	500
2	43	503.26995	696.14975	2045.7489	3632.7554	279.83206	500
3	43	509.4455	689.09765	3191.4401	4419.3177	216.50796	500
4	43	515.6211	682.90425	3696.99	5063.9433	241.03075	500
5	43	521.0706	678	3808.6449	5638.4876	0	500
6	43	527.4182	673	3731.2311	6008.0758	739.79171	300
7	43	533.20205	668.7849	4134.6735	6406.7279	738.23522	350
8	43	537.5	666.0095	4414.5882	6704.256	743.95818	350
9	43	542.5	663.02915	4673.2897	7083.4085	783.09506	350
10	43	548.4995	659.83905	4969.9332	7456.2385	807.84956	350
11	43	555.4985	656.5345	5285.5643	7759.8113	803.9316	350
12	43	562.0982	653.82415	5525.6825	7979.0114	991.20919	350

13	43	568.2986	651.6354	5731.1756	8165.2082	983.41301	350
14	43	574.499	649.7654	5908.1208	8313.3712	971.78425	350
15	43	580.6994	648.20105	6048.5767	8424.0114	959.73793	350
16	43	586.8998	646.93195	6171.0067	8497.9488	940.14564	350
17	43	592.5	646.02045	6266.2097	8542.0584	919.50256	350
18	43	597.5	645.412	6326.1891	8651.163	939.35045	350
19	43	603	644.9611	6378.6086	8728.2984	949.3363	350
20	43	609	644.70525	6421.2176	8681.2076	913.09523	350
21	43	615	644.70575	6442.5236	8597.1965	870.54435	350
22	43	621	644.96255	6443.242	8470.5704	819.09386	350
23	43	627	645.47705	6427.9274	8300.0121	756.37134	350
24	43	633	646.2521	6394.6355	8089.5773	684.80093	350
25	43	639	647.2921	6339.6525	7838.4073	605.53623	350
26	43	645	648.60315	6267.6554	7545.1321	516.13408	350
27	43	651	650.19315	6178.1683	7208.9306	416.45498	350
28	43	657	652.0721	6067.2238	6828.3309	307.50723	350
29	43	662.48955	654.0426	5949.8035	6484.7984	216.15198	350
30	43	666.17735	655.5	5862.7198	6289.0224	138.51411	350
31	43	671.64545	658	5725.9584	5960.1039	0	500



Engineering Parameters

Name: Layer 4	Unit Weight: 130 pcf	Cohesion: 500 psf	Phi: 0 °
Name: Layer 5	Unit Weight: 125 pcf	Cohesion: 500 psf	Phi: 10 °
Name: Layer 6	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Layer 7	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Layer 8	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Layer 9	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Layer 1	Unit Weight: 120 pcf	Cohesion: 300 psf	Phi: 18 °
Name: Layer 2	Unit Weight: 125 pcf	Cohesion: 350 psf	Phi: 18 °
Name: Layer 3	Unit Weight: 125 pcf	Cohesion: 350 psf	Phi: 22 °

SLOPE/W Analysis

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File Information

Created By: Eric Wenz
Revision Number: 91
Last Edited By: Eric Wenz
Date: 6/7/2012
Time: 5:15:58 PM
File Name: Phase 5 - Land Side - Normal Pool.gsz
Directory: I:\GEOTECH\PROJECTS\2011\2-0383\Stability Analysis\5-30-12 Cross Sections\Phase 5\WITH SEEPAGE\
Last Solved Date: 6/7/2012
Last Solved Time: 5:16:00 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Description: Allerton Mine Stage 1
Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Other GeoStudio Analysis
- PWP Other Analysis: "..\..\..\..\Seepage\Phase 5\Phase 5 - Impoundment Side - Normal Pool SEEPAGE.gsz" - Steady-State Seepage [(all)]

Slip Surface
- Direction of movement: Right to Left
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
FOS Distribution
FOS Calculation Option: Constant
Advanced
Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Layer 4
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 500 psf
Phi: 0 °
Phi-B: 0 °

Layer 5
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 500 psf
Phi: 10 °
Phi-B: 0 °

Layer 6
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 7
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 8

Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 9

Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 1

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 300 psf
Phi: 18 °
Phi-B: 0 °

Layer 2

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 350 psf
Phi: 18 °
Phi-B: 0 °

Layer 3

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 350 psf
Phi: 22 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (15, 680) ft
Left-Zone Right Coordinate: (72.5, 687.5) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (275, 745) ft
Right-Zone Right Coordinate: (350, 746.66667) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 680) ft
Right Coordinate: (750, 660) ft

Regions

	Material	Points	Area (ft²)
Region 1	Layer 4	1,46,37,28,21,16,9,2,3,4,5,6,48,7,8	3000
Region 2	Layer 5	9,10,11,12,53,13,14,15,16	3757.5
Region 3	Layer 6	13,17,54,18,19,20,21,16,15,14	3196.25
Region 4	Layer 7	18,22,55,23,24,25,26,27,28,21,20,19	5400
Region 5	Layer 8	23,29,56,30,31,32,33,34,35,36,37,28,27,26,25,24	4700
Region 6	Layer 9	30,57,38,39,40,41,42,43,44,45,46,37,36,35,34,33,32,31	3006.25
Region 7	Layer 1	8,47,48,7	3654
Region 8	Layer 2	49,50,5,6,48,47	9696
Region 9	Layer 3	49,51,52,50	41250
Region 10	Layer 4	13,17,54,18,22,55,23,29,56,30,57,38,58,59,60,61,62,63,64,53	815

Points

	X (ft)	Y (ft)
Point 1	0	680
Point 2	600	680
Point 3	660	660
Point 4	750	660
Point 5	750	656
Point 6	660	656
Point 7	600	676
Point 8	0	676
Point 9	590	680
Point 10	545	695
Point 11	535	695
Point 12	490	710
Point 13	471	708
Point 14	420	695
Point 15	410	695
Point 16	350	680

Point 17	435	720
Point 18	417.5	722.5
Point 19	365	705
Point 20	355	705
Point 21	280	680
Point 22	380	735
Point 23	362.5	737.5
Point 24	310	720
Point 25	300	720
Point 26	240	700
Point 27	230	700
Point 28	170	680
Point 29	340	745
Point 30	322.5	747.5
Point 31	270	730
Point 32	260	730
Point 33	200	710
Point 34	190	710
Point 35	130	690
Point 36	120	690
Point 37	90	680
Point 38	310	755
Point 39	305	755
Point 40	245	735
Point 41	235	735
Point 42	175	715
Point 43	165	715
Point 44	105	695
Point 45	95	695
Point 46	50	680
Point 47	0	670
Point 48	618	670
Point 49	0	655
Point 50	750	655
Point 51	0	600
Point 52	750	600

Point 53	480	710
Point 54	425	720
Point 55	370	735
Point 56	330	745
Point 57	315	750
Point 58	315	755
Point 59	330	750
Point 60	340	750
Point 61	370	740
Point 62	380	740
Point 63	425	725
Point 64	435	725

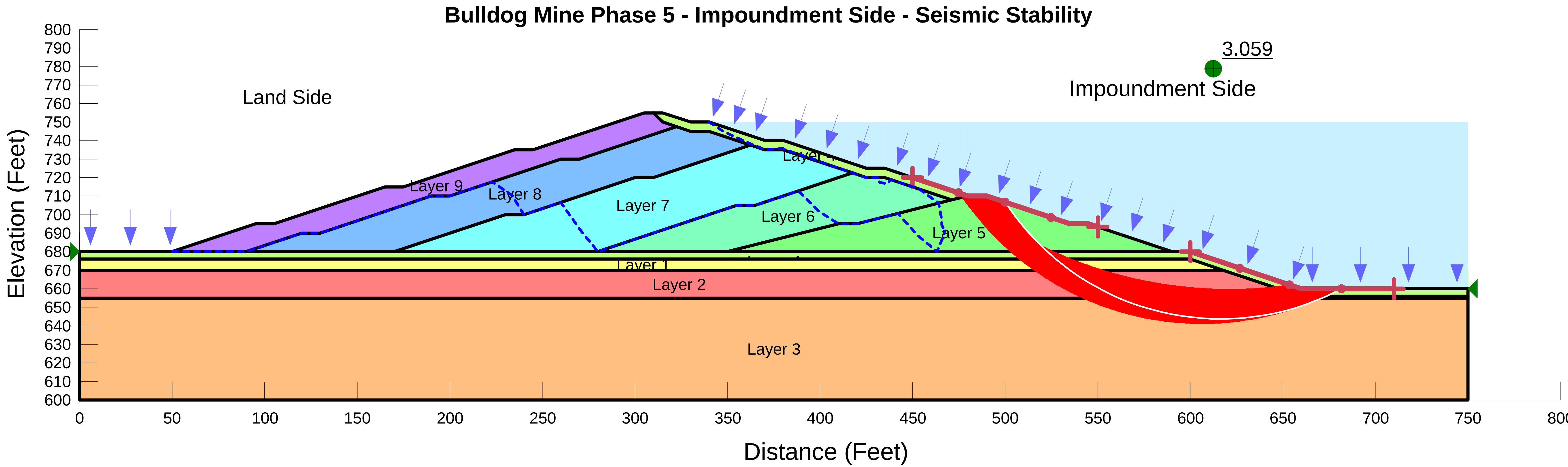
Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	38	1.840	(129.487, 874.05)	218.213	(312.365, 755)	(29.6793, 680)

Slices of Slip Surface: 38

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	38	33.775945	678	124.8571	403.99784	0	500
2	38	43.93631	673.41445	410.98769	996.14301	190.12849	300
3	38	51.07629	670.41445	598.18325	1439.8364	273.46967	300
4	38	56.88351	668.33035	728.23565	1976.5115	405.5894	350
5	38	66.345365	665.23015	921.69409	2793.2362	608.10089	350
6	38	75.80722	662.5986	1085.9464	3539.544	797.22218	350
7	38	85.269075	660.41835	1221.9514	4207.4372	970.04315	350
8	38	92.5	659.0091	1309.9243	4666.8689	1090.7374	350
9	38	100	657.897	1379.3247	4886.0454	1139.4026	350
10	38	108.75	656.85685	1444.2318	5118.4553	1193.8276	350
11	38	116.25	656.27085	1480.8669	5418.666	1279.4685	350
12	38	125	655.94005	1501.5817	5698.3919	1363.6263	350

13	38	134.375	655.93525	1501.9086	5926.969	1437.7893	350
14	38	143.125	656.3073	1478.7026	6071.0756	1492.1524	350
15	38	151.875	657.0326	1433.5351	6154.6517	1533.9838	350
16	38	160.625	658.1148	1366.0987	6182.5668	1564.9653	350
17	38	167.5	659.188	1299.2438	6087.6635	1555.8519	350
18	38	172.5	660.13295	1240.3352	5891.8764	1511.3774	350
19	38	178.75	661.50475	1154.8274	5753.7441	1494.2786	350
20	38	186.25	663.38435	1037.7109	5662.9685	1502.8373	350
21	38	195	665.969	876.62821	5516.8296	1507.6928	350
22	38	203.41115	668.7716	701.99222	5347.6518	1509.4663	350
23	38	210.3923	671.42545	536.64755	5188.0178	1511.3218	300
24	38	217.5323	674.42545	349.7103	5004.612	1512.4692	300
25	38	225.19895	678	125.85517	4939.7743	0	500
26	38	229.6478	680.18195	0	4425.3	3098.6284	0
27	38	232.5	681.7028	0	4337.8716	3037.4104	0
28	38	237.5	684.46605	0	4111.1737	2878.6748	0
29	38	242.5	687.4041	0	3809.325	2667.3181	0
30	38	248.75	691.36595	0	3523.9317	2467.4835	0
31	38	256.25	696.4913	0	3247.5738	2273.9757	0
32	38	265	703.1328	- 0.02173761 4	2891.8448	2024.8915	0
33	38	272.70415	709.44995	- 0.01032464	2559.6782	1792.3059	0
34	38	279.8827	716.0622	-157.58483	2209.1014	1546.8294	0
35	38	288.83155	725.10855	-533.9328	1732.6185	1213.1925	0
36	38	297.7804	735.32355	-1018.4775	1194.2535	836.22529	0
37	38	303.6274	742.56955	-1351.5895	816.60364	571.79202	0
38	38	307.5	747.91575	-1596.6037	477.81325	334.56844	0
39	38	310.71375	752.50825	-1805.6611	178.76736	125.17425	0
40	38	311.89615	754.28625	-1890.6131	-318.90262	0	500



Engineering Parameters

Name: Layer 4	Unit Weight: 130 pcf	Cohesion: 400 psf	Phi: 0 °
Name: Layer 5	Unit Weight: 125 pcf	Cohesion: 400 psf	Phi: 10 °
Name: Layer 6	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Layer 7	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Layer 8	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Layer 9	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Layer 1	Unit Weight: 120 pcf	Cohesion: 240 psf	Phi: 18 °
Name: Layer 2	Unit Weight: 125 pcf	Cohesion: 280 psf	Phi: 18 °
Name: Layer 3	Unit Weight: 125 pcf	Cohesion: 280 psf	Phi: 22 °

SLOPE/W Analysis

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File Information

Created By: Eric Wenz
Revision Number: 86
Last Edited By: Eric Wenz
Date: 6/7/2012
Time: 5:14:01 PM
File Name: Phase 5 - Impoundment Side - Seismic Stability.gsz
Directory: I:\GEOTECH\PROJECTS\2011\2-0383\Stability Analysis\5-30-12 Cross Sections\Phase 5\WITH SEEPAGE\
Last Solved Date: 6/7/2012
Last Solved Time: 5:14:04 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Description: Allerton Mine Stage 1
Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Other GeoStudio Analysis
- PWP Other Analysis: "..\..\..\..\Seepage\Phase 5\Phase 5 - Impoundment Side - Normal Pool SEEPAGE.gsz" - Steady-State Seepage [(all)]

Slip Surface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
FOS Distribution
FOS Calculation Option: Constant
Advanced
Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Layer 4
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 400 psf
Phi: 0 °
Phi-B: 0 °

Layer 5
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 400 psf
Phi: 10 °
Phi-B: 0 °

Layer 6
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 7
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 8

Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 9

Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 1

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 240 psf
Phi: 18 °
Phi-B: 0 °

Layer 2

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 280 psf
Phi: 18 °
Phi-B: 0 °

Layer 3

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 280 psf
Phi: 22 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (450, 720) ft
Left-Zone Right Coordinate: (550, 693.33333) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (600, 680) ft
Right-Zone Right Coordinate: (710, 660) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 680) ft
Right Coordinate: (750, 660) ft

Regions

	Material	Points	Area (ft^2)
Region 1	Layer 4	1,46,37,28,21,16,9,2,3,4,5,6,48,7,8	3000
Region 2	Layer 5	9,10,11,12,53,13,14,15,16	3757.5
Region 3	Layer 6	13,17,54,18,19,20,21,16,15,14	3196.25
Region 4	Layer 7	18,22,55,23,24,25,26,27,28,21,20,19	5400
Region 5	Layer 8	23,29,56,30,31,32,33,34,35,36,37,28,27,26,25,24	4700
Region 6	Layer 9	30,57,38,39,40,41,42,43,44,45,46,37,36,35,34,33,32,31	3006.25
Region 7	Layer 1	8,47,48,7	3654
Region 8	Layer 2	49,50,5,6,48,47	9696
Region 9	Layer 3	49,51,52,50	41250
Region 10	Layer 4	13,17,54,18,22,55,23,29,56,30,57,38,58,59,60,61,62,63,64,53	815

Points

	X (ft)	Y (ft)
Point 1	0	680
Point 2	600	680
Point 3	660	660
Point 4	750	660
Point 5	750	656
Point 6	660	656
Point 7	600	676
Point 8	0	676
Point 9	590	680
Point 10	545	695
Point 11	535	695
Point 12	490	710
Point 13	471	708
Point 14	420	695
Point 15	410	695
Point 16	350	680

Point 17	435	720
Point 18	417.5	722.5
Point 19	365	705
Point 20	355	705
Point 21	280	680
Point 22	380	735
Point 23	362.5	737.5
Point 24	310	720
Point 25	300	720
Point 26	240	700
Point 27	230	700
Point 28	170	680
Point 29	340	745
Point 30	322.5	747.5
Point 31	270	730
Point 32	260	730
Point 33	200	710
Point 34	190	710
Point 35	130	690
Point 36	120	690
Point 37	90	680
Point 38	310	755
Point 39	305	755
Point 40	245	735
Point 41	235	735
Point 42	175	715
Point 43	165	715
Point 44	105	695
Point 45	95	695
Point 46	50	680
Point 47	0	670
Point 48	618	670
Point 49	0	655
Point 50	750	655
Point 51	0	600
Point 52	750	600

Point 53	480	710
Point 54	425	720
Point 55	370	735
Point 56	330	745
Point 57	315	750
Point 58	315	755
Point 59	330	750
Point 60	340	750
Point 61	370	740
Point 62	380	740
Point 63	425	725
Point 64	435	725

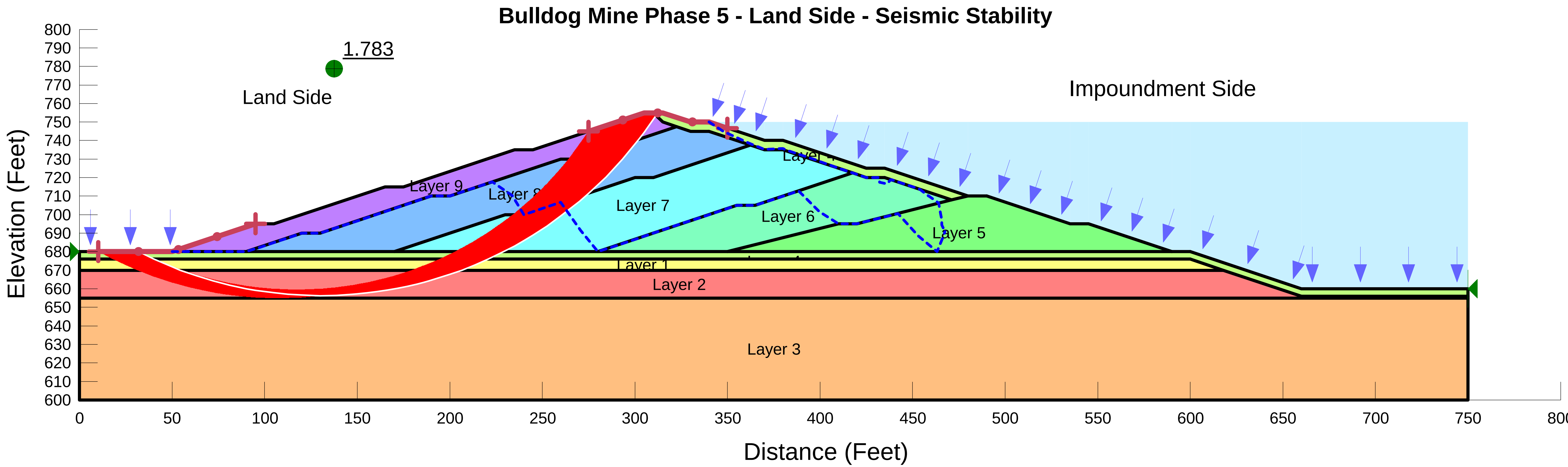
Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	68	3.059	(616.404, 782.845)	139.115	(500, 706.667)	(681.689, 660)

Slices of Slip Surface: 68

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	68	502.8405	702.64455	1698.9128	2858.4301	204.45419	400
2	68	508.5215	695.12885	2887.4476	3717.9691	146.44335	400
3	68	514.2025	688.5564	3378.1078	4411.9983	182.3028	400
4	68	519.8835	682.73875	3904.0359	5018.0084	196.42341	400
5	68	525.0186	678	3908.0402	5568.9286	0	400
6	68	531.1566	673.0168	3826.4584	5927.9583	682.81871	240
7	68	537.51165	668.30365	4280.1911	6404.1378	690.11211	280
8	68	542.51165	665.01325	4555.3992	6816.0756	734.5383	280
9	68	547.75875	661.88715	4831.8842	7186.3519	765.01294	280
10	68	553.27625	658.91625	5111.836	7467.5797	765.4275	280
11	68	558.79375	656.2555	5339.3173	7712.4571	771.07989	280
12	68	564.39725	653.85305	5550.0783	7905.7685	951.7606	280

13	68	570.08675	651.7014	5747.5189	8094.2567	948.14362	280
14	68	575.77625	649.82785	5913.3045	8249.8481	944.02491	280
15	68	581.46575	648.2207	6052.7689	8373.8079	937.76063	280
16	68	587.15525	646.8705	6176.6813	8466.3458	925.08449	280
17	68	592.5	645.82245	6278.5772	8530.5663	909.86266	280
18	68	597.5	645.04335	6348.9384	8662.2726	934.6477	280
19	68	603	644.40995	6412.8437	8768.4941	951.74457	280
20	68	609	643.95955	6467.4839	8750.5756	922.42893	280
21	68	615	643.76935	6500.6685	8696.0565	886.99434	280
22	68	621	643.8383	6513.1073	8598.6342	842.60757	280
23	68	627	644.1667	6509.3596	8457.5144	787.10563	280
24	68	633	644.75645	6487.8115	8276.44	722.6528	280
25	68	639	645.61095	6444.2285	8054.3811	650.54389	280
26	68	645	646.7352	6383.9587	7790.2565	568.18116	280
27	68	651	648.136	6306.3444	7482.5085	475.20113	280
28	68	657	649.82205	6207.5276	7130.1842	372.77745	280
29	68	662.81375	651.7336	6094.13	6789.6448	281.00621	280
30	68	668.44125	653.8648	5966.7718	6510.419	219.64775	280
31	68	672.39225	655.5	5868.136	6288.726	136.65797	280
32	68	677.60905	658	5728.6135	5953.8843	0	400



Engineering Parameters

Name: Layer 4	Unit Weight: 130 pcf	Cohesion: 400 psf	Phi: 0 °
Name: Layer 5	Unit Weight: 125 pcf	Cohesion: 400 psf	Phi: 10 °
Name: Layer 6	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Layer 7	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Layer 8	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Layer 9	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Layer 1	Unit Weight: 120 pcf	Cohesion: 240 psf	Phi: 18 °
Name: Layer 2	Unit Weight: 125 pcf	Cohesion: 280 psf	Phi: 18 °
Name: Layer 3	Unit Weight: 125 pcf	Cohesion: 280 psf	Phi: 22 °

SLOPE/W Analysis

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File Information

Created By: Eric Wenz
Revision Number: 104
Last Edited By: Eric Wenz
Date: 6/7/2012
Time: 5:19:22 PM
File Name: Phase 5 - Land Side - Seismic Stability.gsz
Directory: I:\GEOTECH\PROJECTS\2011\2-0383\Stability Analysis\5-30-12 Cross Sections\Phase 5\WITH SEEPAGE\
Last Solved Date: 6/7/2012
Last Solved Time: 5:19:24 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Description: Allerton Mine Stage 1
Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Other GeoStudio Analysis
- PWP Other Analysis: "..\..\..\..\Seepage\Phase 5\Phase 5 - Impoundment Side - Normal Pool SEEPAGE.gsz" - Steady-State Seepage [(all)]

Slip Surface
- Direction of movement: Right to Left
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
FOS Distribution
FOS Calculation Option: Constant
Advanced
Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Layer 4
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 400 psf
Phi: 0 °
Phi-B: 0 °

Layer 5
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 400 psf
Phi: 10 °
Phi-B: 0 °

Layer 6
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 7
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 8

Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 9

Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 1

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 240 psf
Phi: 18 °
Phi-B: 0 °

Layer 2

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 280 psf
Phi: 18 °
Phi-B: 0 °

Layer 3

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 280 psf
Phi: 22 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (10, 680) ft
Left-Zone Right Coordinate: (95, 695) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (275, 745) ft
Right-Zone Right Coordinate: (350, 746.66667) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 680) ft
Right Coordinate: (750, 660) ft

Regions

	Material	Points	Area (ft²)
Region 1	Layer 4	1,46,37,28,21,16,9,2,3,4,5,6,48,7,8	3000
Region 2	Layer 5	9,10,11,12,53,13,14,15,16	3757.5
Region 3	Layer 6	13,17,54,18,19,20,21,16,15,14	3196.25
Region 4	Layer 7	18,22,55,23,24,25,26,27,28,21,20,19	5400
Region 5	Layer 8	23,29,56,30,31,32,33,34,35,36,37,28,27,26,25,24	4700
Region 6	Layer 9	30,57,38,39,40,41,42,43,44,45,46,37,36,35,34,33,32,31	3006.25
Region 7	Layer 1	8,47,48,7	3654
Region 8	Layer 2	49,50,5,6,48,47	9696
Region 9	Layer 3	49,51,52,50	41250
Region 10	Layer 4	13,17,54,18,22,55,23,29,56,30,57,38,58,59,60,61,62,63,64,53	815

Points

	X (ft)	Y (ft)
Point 1	0	680
Point 2	600	680
Point 3	660	660
Point 4	750	660
Point 5	750	656
Point 6	660	656
Point 7	600	676
Point 8	0	676
Point 9	590	680
Point 10	545	695
Point 11	535	695
Point 12	490	710
Point 13	471	708
Point 14	420	695
Point 15	410	695
Point 16	350	680

Point 17	435	720
Point 18	417.5	722.5
Point 19	365	705
Point 20	355	705
Point 21	280	680
Point 22	380	735
Point 23	362.5	737.5
Point 24	310	720
Point 25	300	720
Point 26	240	700
Point 27	230	700
Point 28	170	680
Point 29	340	745
Point 30	322.5	747.5
Point 31	270	730
Point 32	260	730
Point 33	200	710
Point 34	190	710
Point 35	130	690
Point 36	120	690
Point 37	90	680
Point 38	310	755
Point 39	305	755
Point 40	245	735
Point 41	235	735
Point 42	175	715
Point 43	165	715
Point 44	105	695
Point 45	95	695
Point 46	50	680
Point 47	0	670
Point 48	618	670
Point 49	0	655
Point 50	750	655
Point 51	0	600
Point 52	750	600

Point 53	480	710
Point 54	425	720
Point 55	370	735
Point 56	330	745
Point 57	315	750
Point 58	315	755
Point 59	330	750
Point 60	340	750
Point 61	370	740
Point 62	380	740
Point 63	425	725
Point 64	435	725

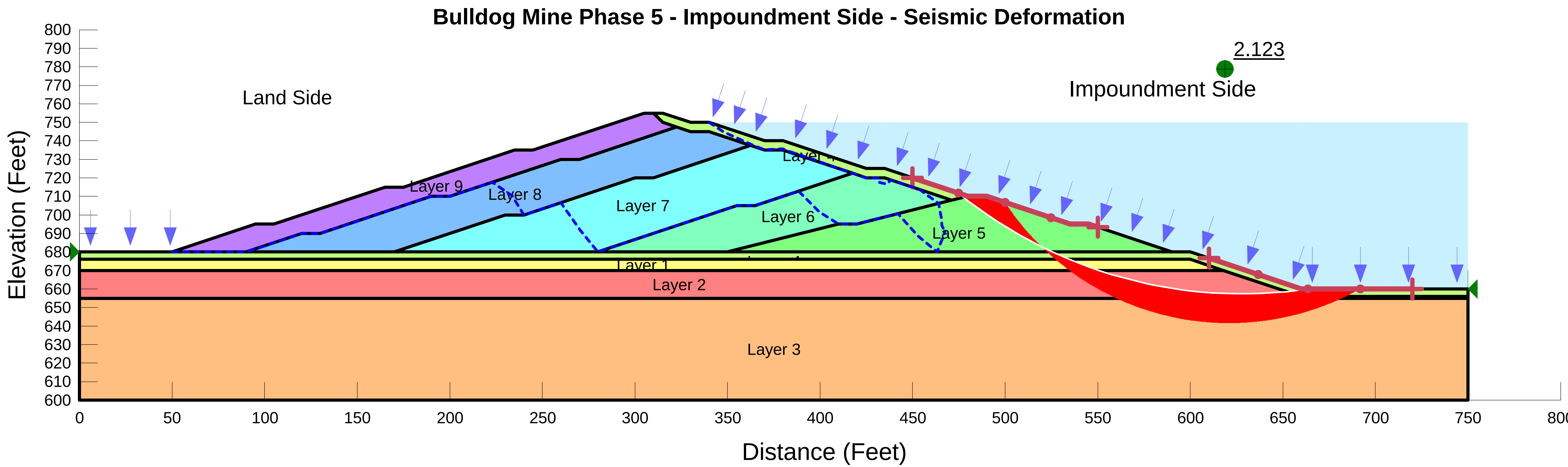
Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	38	1.783	(130.466, 873.26)	216.962	(312.365, 755)	(31.8585, 680)

Slices of Slip Surface: 38

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	38	35.99219	678	124.8567	378.68588	0	400
2	38	45.06292	673.8852	381.61742	916.99707	173.95539	240
3	38	52.291555	670.8852	568.81925	1409.0728	273.01492	240
4	38	59.01022	668.4554	720.43605	2026.7329	424.44158	280
5	38	67.864445	665.57635	900.09271	2790.4193	614.20435	280
6	38	76.71867	663.10965	1054.0293	3491.9848	792.13978	280
7	38	85.57289	661.0409	1183.1831	4124.7876	955.78523	280
8	38	92.5	659.66005	1269.3059	4573.1245	1073.4757	280
9	38	100	658.5064	1341.2712	4802.2202	1124.5305	280
10	38	108.75	657.4198	1409.1527	5045.5945	1181.5516	280
11	38	116.25	656.7962	1448.0806	5354.998	1269.4344	280
12	38	125	656.4239	1471.3321	5644.3051	1355.8811	280

13	38	134.375	656.37675	1474.3891	5882.0162	1432.1248	280
14	38	143.125	656.71135	1453.5184	6033.2422	1488.0425	280
15	38	151.875	657.40105	1410.5648	6122.8723	1531.1215	280
16	38	160.625	658.44925	1345.2062	6155.7388	1563.0368	280
17	38	167.5	659.4966	1279.9725	6063.8678	1554.3818	280
18	38	172.5	660.42345	1222.212	5870.0159	1510.163	280
19	38	178.75	661.77335	1138.0625	5734.0536	1493.328	280
20	38	186.25	663.6274	1022.5351	5645.7894	1502.1864	280
21	38	195	666.18355	863.23174	5502.2932	1507.3224	280
22	38	203.174	668.8709	695.78681	5341.1433	1509.3678	280
23	38	209.9623	671.42355	536.75299	5187.5868	1511.1475	240
24	38	217.19095	674.42355	349.80899	5004.7525	1512.4828	240
25	38	224.93895	678	125.84754	4946.2502	0	400
26	38	229.5363	680.238	0	4414.0613	3090.759	0
27	38	232.5	681.8084	0	4322.6252	3026.7347	0
28	38	237.5	684.55885	0	4095.0974	2867.4181	0
29	38	242.5	687.48455	0	3792.8708	2655.7967	0
30	38	248.75	691.43165	0	3506.8656	2455.5338	0
31	38	256.25	696.5403	0	3229.7969	2261.5281	0
32	38	265	703.16415	-0.021773658	2873.9252	2012.3441	0
33	38	272.69295	709.45705	-0.010247458	2542.5876	1780.339	0
34	38	279.86585	716.05275	-157.34749	2193.3508	1535.8007	0
35	38	288.82575	725.0985	-533.42402	1718.4007	1203.2371	0
36	38	297.7856	735.321	-1018.2153	1182.7115	828.14351	0
37	38	303.63275	742.56675	-1351.3019	807.97453	565.74986	0
38	38	307.5	747.9091	-1596.187	472.59201	330.91249	0
39	38	310.7141	752.50585	-1805.5243	176.54241	123.61632	0
40	38	311.8965	754.2859	-1890.6248	-247.62559	0	400



Engineering Parameters

Name: Layer 4	Unit Weight: 130 pcf	Cohesion: 400 psf	Phi: 0 °
Name: Layer 5	Unit Weight: 125 pcf	Cohesion: 400 psf	Phi: 10 °
Name: Layer 6	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Layer 7	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Layer 8	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Layer 9	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Layer 1	Unit Weight: 120 pcf	Cohesion: 240 psf	Phi: 18 °
Name: Layer 2	Unit Weight: 125 pcf	Cohesion: 280 psf	Phi: 18 °
Name: Layer 3	Unit Weight: 125 pcf	Cohesion: 280 psf	Phi: 22 °

SLOPE/W Analysis

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File Information

Created By: Eric Wenz
Revision Number: 89
Last Edited By: Eric Wenz
Date: 6/7/2012
Time: 5:11:11 PM
File Name: Phase 5 - Impoundment Side - Seismic Deformation.gsz
Directory: I:\GEOTECH\PROJECTS\2011\2-0383\Stability Analysis\5-30-12 Cross Sections\Phase 5\WITH SEEPAGE\
Last Solved Date: 6/7/2012
Last Solved Time: 5:11:14 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Description: Allerton Mine Stage 1
Kind: SLOPE/W
Method: Morgenstern-Price
Settings
  Side Function
    Interslice force function option: Half-Sine
  PWP Conditions Source: Other GeoStudio Analysis
  PWP Other Analysis: "..\..\..\..\Seepage\Phase 5\Phase 5 - Impoundment Side - Normal Pool SEEPAGE.gsz" - Steady-State Seepage [(all)]
Slip Surface
  Direction of movement: Left to Right
  Use Passive Mode: No
  Slip Surface Option: Entry and Exit
  Critical slip surfaces saved: 1
  Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
FOS Distribution
FOS Calculation Option: Constant
Advanced
Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Layer 4

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 400 psf
Phi: 0 °
Phi-B: 0 °

Layer 5

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 400 psf
Phi: 10 °
Phi-B: 0 °

Layer 6

Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 7

Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 8

Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 9

Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 1

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 240 psf
Phi: 18 °
Phi-B: 0 °

Layer 2

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 280 psf
Phi: 18 °
Phi-B: 0 °

Layer 3

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 280 psf
Phi: 22 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (450, 720) ft
Left-Zone Right Coordinate: (550, 693.33333) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (610, 676.66667) ft
Right-Zone Right Coordinate: (720, 660) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 680) ft
Right Coordinate: (750, 660) ft

Seismic Loads

Horz Seismic Load: 0.056
Ignore seismic load in strength: No

Regions

	Material	Points	Area (ft^2)
Region 1	Layer 4	1,46,37,28,21,16,9,2,3,4,5,6,48,7,8	3000
Region 2	Layer 5	9,10,11,12,53,13,14,15,16	3757.5
Region 3	Layer 6	13,17,54,18,19,20,21,16,15,14	3196.25
Region 4	Layer 7	18,22,55,23,24,25,26,27,28,21,20,19	5400
Region 5	Layer 8	23,29,56,30,31,32,33,34,35,36,37,28,27,26,25,24	4700
Region 6	Layer 9	30,57,38,39,40,41,42,43,44,45,46,37,36,35,34,33,32,31	3006.25
Region 7	Layer 1	8,47,48,7	3654
Region 8	Layer 2	49,50,5,6,48,47	9696
Region 9	Layer 3	49,51,52,50	41250
Region 10	Layer 4	13,17,54,18,22,55,23,29,56,30,57,38,58,59,60,61,62,63,64,53	815

Points

	X (ft)	Y (ft)
Point 1	0	680
Point 2	600	680
Point 3	660	660
Point 4	750	660
Point 5	750	656
Point 6	660	656
Point 7	600	676
Point 8	0	676
Point 9	590	680
Point 10	545	695
Point 11	535	695
Point 12	490	710

Point 13	471	708
Point 14	420	695
Point 15	410	695
Point 16	350	680
Point 17	435	720
Point 18	417.5	722.5
Point 19	365	705
Point 20	355	705
Point 21	280	680
Point 22	380	735
Point 23	362.5	737.5
Point 24	310	720
Point 25	300	720
Point 26	240	700
Point 27	230	700
Point 28	170	680
Point 29	340	745
Point 30	322.5	747.5
Point 31	270	730
Point 32	260	730
Point 33	200	710
Point 34	190	710
Point 35	130	690
Point 36	120	690
Point 37	90	680
Point 38	310	755
Point 39	305	755
Point 40	245	735
Point 41	235	735
Point 42	175	715
Point 43	165	715
Point 44	105	695
Point 45	95	695
Point 46	50	680
Point 47	0	670
Point 48	618	670

Point 49	0	655
Point 50	750	655
Point 51	0	600
Point 52	750	600
Point 53	480	710
Point 54	425	720
Point 55	370	735
Point 56	330	745
Point 57	315	750
Point 58	315	755
Point 59	330	750
Point 60	340	750
Point 61	370	740
Point 62	380	740
Point 63	425	725
Point 64	435	725

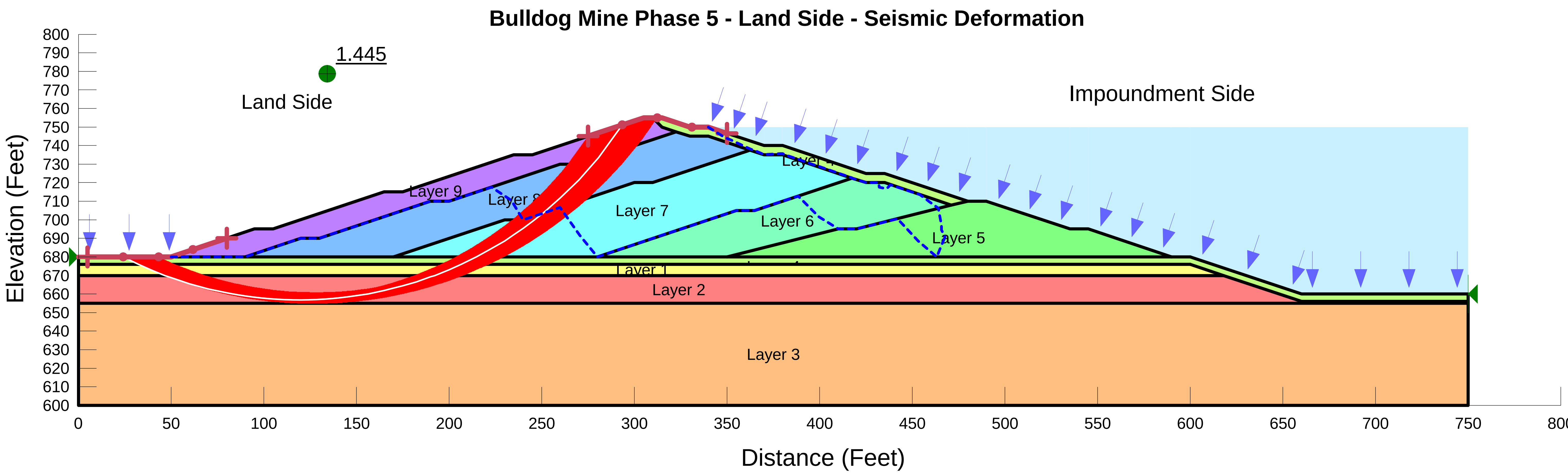
Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	37	2.123	(628.151, 901.075)	243.674	(474.743, 711.752)	(663.648, 660)

Slices of Slip Surface: 37

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	37	476.17475	710.6101	2163.6296	2351.573	0	400
2	37	478.80305	708.53955	2167.1295	2534.1599	64.717358	400
3	37	482.5	705.7469	1947.3947	2823.6101	154.50041	400
4	37	487.5	702.11535	784.21068	3190.3113	424.26045	400
5	37	492.9723	698.3659	384.72444	3568.0326	561.30312	400
6	37	498.91685	694.5241	1516.6329	3974.6193	433.40931	400
7	37	504.8614	690.9207	2638.2636	4346.9032	301.27925	400
8	37	510.80595	687.54355	3291.2913	4667.6629	242.69145	400

9	37	516.7505	684.3821	3667.0552	4950.2477	226.26146	400
10	37	522.69505	681.42705	4135.1491	5212.0045	189.87866	400
11	37	530.33365	677.95425	3954.0144	5546.042	0	400
12	37	537.5	674.90645	3874.0025	5739.5311	606.14699	240
13	37	542.5	672.9657	4085.1152	5980.8798	615.97125	240
14	37	547.90565	671.0135	4283.7154	6192.6617	620.25428	240
15	37	554.07705	668.95785	4503.9611	6333.0253	594.29898	280
16	37	560.6085	666.97345	4708.8341	6468.9466	571.89521	280
17	37	567.13995	665.18655	4882.6214	6579.9772	551.50431	280
18	37	573.6714	663.5927	5047.375	6666.8089	526.18598	280
19	37	580.20285	662.188	5182.6025	6729.052	502.47192	280
20	37	586.7343	660.9692	5299.8671	6766.8472	476.65071	280
21	37	592.5	660.03615	5395.5013	6801.2083	456.7419	280
22	37	597.5	659.3494	5462.4599	6901.1398	467.45544	280
23	37	603	658.72105	5524.3307	6966.5848	468.61678	280
24	37	609	658.17315	5583.672	6934.48	438.90412	280
25	37	615	657.77445	5630.78	6881.2878	406.31461	280
26	37	621.42225	657.51775	5663.7323	6794.142	367.29238	280
27	37	628.2667	657.4248	5687.3701	6669.6238	319.15357	280
28	37	635.11115	657.5242	5697.3179	6516.7701	266.25617	280
29	37	641.95565	657.8162	5690.0507	6335.666	209.77315	280
30	37	648.8001	658.3015	5669.5309	6126.0632	148.33632	280
31	37	656.11115	659.0418	5650.8742	5863.4063	0	400
32	37	661.82385	659.7455	5629.3446	5676.8599	0	400



Engineering Parameters

Name: Layer 4	Unit Weight: 130 pcf	Cohesion: 400 psf	Phi: 0 °
Name: Layer 5	Unit Weight: 125 pcf	Cohesion: 400 psf	Phi: 10 °
Name: Layer 6	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Layer 7	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Layer 8	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Layer 9	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Layer 1	Unit Weight: 120 pcf	Cohesion: 240 psf	Phi: 18 °
Name: Layer 2	Unit Weight: 125 pcf	Cohesion: 280 psf	Phi: 18 °
Name: Layer 3	Unit Weight: 125 pcf	Cohesion: 280 psf	Phi: 22 °

SLOPE/W Analysis

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File Information

Created By: Eric Wenz
Revision Number: 101
Last Edited By: Eric Wenz
Date: 6/7/2012
Time: 5:17:15 PM
File Name: Phase 5 - Land Side - Seismic Deformation.gsz
Directory: I:\GEOTECH\PROJECTS\2011\2-0383\Stability Analysis\5-30-12 Cross Sections\Phase 5\WITH SEEPAGE\
Last Solved Date: 6/7/2012
Last Solved Time: 5:17:22 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Description: Allerton Mine Stage 1
Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Other GeoStudio Analysis
- PWP Other Analysis: "..\..\..\..\Seepage\Phase 5\Phase 5 - Impoundment Side - Normal Pool SEEPAGE.gsz" - Steady-State Seepage [(all)]

Slip Surface
- Direction of movement: Right to Left
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
FOS Distribution
FOS Calculation Option: Constant
Advanced
Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Layer 4
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 400 psf
Phi: 0 °
Phi-B: 0 °

Layer 5
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 400 psf
Phi: 10 °
Phi-B: 0 °

Layer 6
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 7
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 8

Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 9

Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Layer 1

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 240 psf
Phi: 18 °
Phi-B: 0 °

Layer 2

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 280 psf
Phi: 18 °
Phi-B: 0 °

Layer 3

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 280 psf
Phi: 22 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (5, 680) ft
Left-Zone Right Coordinate: (80, 690) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (275, 745) ft
Right-Zone Right Coordinate: (350, 746.66667) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 680) ft
Right Coordinate: (750, 660) ft

Seismic Loads

Horz Seismic Load: 0.056
Ignore seismic load in strength: No

Regions

	Material	Points	Area (ft^2)
Region 1	Layer 4	1,46,37,28,21,16,9,2,3,4,5,6,48,7,8	3000
Region 2	Layer 5	9,10,11,12,53,13,14,15,16	3757.5
Region 3	Layer 6	13,17,54,18,19,20,21,16,15,14	3196.25
Region 4	Layer 7	18,22,55,23,24,25,26,27,28,21,20,19	5400
Region 5	Layer 8	23,29,56,30,31,32,33,34,35,36,37,28,27,26,25,24	4700
Region 6	Layer 9	30,57,38,39,40,41,42,43,44,45,46,37,36,35,34,33,32,31	3006.25
Region 7	Layer 1	8,47,48,7	3654
Region 8	Layer 2	49,50,5,6,48,47	9696
Region 9	Layer 3	49,51,52,50	41250
Region 10	Layer 4	13,17,54,18,22,55,23,29,56,30,57,38,58,59,60,61,62,63,64,53	815

Points

	X (ft)	Y (ft)
Point 1	0	680
Point 2	600	680
Point 3	660	660
Point 4	750	660
Point 5	750	656
Point 6	660	656
Point 7	600	676
Point 8	0	676
Point 9	590	680
Point 10	545	695
Point 11	535	695
Point 12	490	710

Point 13	471	708
Point 14	420	695
Point 15	410	695
Point 16	350	680
Point 17	435	720
Point 18	417.5	722.5
Point 19	365	705
Point 20	355	705
Point 21	280	680
Point 22	380	735
Point 23	362.5	737.5
Point 24	310	720
Point 25	300	720
Point 26	240	700
Point 27	230	700
Point 28	170	680
Point 29	340	745
Point 30	322.5	747.5
Point 31	270	730
Point 32	260	730
Point 33	200	710
Point 34	190	710
Point 35	130	690
Point 36	120	690
Point 37	90	680
Point 38	310	755
Point 39	305	755
Point 40	245	735
Point 41	235	735
Point 42	175	715
Point 43	165	715
Point 44	105	695
Point 45	95	695
Point 46	50	680
Point 47	0	670
Point 48	618	670

Point 49	0	655
Point 50	750	655
Point 51	0	600
Point 52	750	600
Point 53	480	710
Point 54	425	720
Point 55	370	735
Point 56	330	745
Point 57	315	750
Point 58	315	755
Point 59	330	750
Point 60	340	750
Point 61	370	740
Point 62	380	740
Point 63	425	725
Point 64	435	725

Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	33	1.445	(119.47, 864.528)	207.691	(293.493, 751.164)	(24.1557, 680)

Slices of Slip Surface: 33

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	33	28.24509	678	124.84973	410.61909	0	400
2	33	35.92794	674.42085	348.19349	890.44491	176.18817	240
3	33	43.11484	671.42085	535.39457	1308.1758	251.09185	240
4	33	48.354145	669.40015	661.4776	1612.2357	308.92003	280
5	33	55	667.167	800.83498	2149.8058	438.30719	280
6	33	65	664.17435	987.55377	3001.6462	654.41831	280
7	33	75	661.71865	1140.7969	3757.9194	850.35462	280
8	33	85	659.7805	1261.7435	4406.1917	1021.6931	280

9	33	92.5	658.6113	1334.7403	4824.1975	1133.7934	280
10	33	100	657.81295	1384.5719	4968.9076	1164.6213	280
11	33	108.75	657.14815	1426.0959	5106.5151	1195.8407	280
12	33	116.25	656.89615	1441.8266	5319.2269	1259.8437	280
13	33	125	656.9712	1437.1898	5490.7508	1317.0818	280
14	33	134.375	657.41925	1409.2695	5601.0569	1361.9943	280
15	33	143.125	658.23575	1358.4129	5635.5287	1389.7192	280
16	33	151.875	659.42865	1284.0718	5613.5668	1406.7382	280
17	33	160.625	661.00455	1185.8274	5542.2254	1415.4795	280
18	33	167.5	662.4835	1093.5851	5378.3223	1392.1955	280
19	33	172.5	663.7381	1015.365	5141.1202	1340.5392	280
20	33	178.75	665.5154	904.55048	4949.6176	1314.322	280
21	33	186.25	667.90605	755.54523	4794.8621	1312.4536	280
22	33	191.116	669.58985	650.60296	4685.1319	1310.8979	280
23	33	196.116	671.54255	528.84282	4562.3192	1310.5559	240
24	33	203.3029	674.54255	341.85617	4375.4487	1310.5937	240
25	33	210.6952	678	125.53071	4290.0551	0	400
26	33	218.58845	682.06635	0	3719.6684	2604.5399	0
27	33	226.19615	686.41195	0	3468.414	2428.6097	0
28	33	232.5	690.3132	0	3251.2583	2276.5556	0
29	33	237.5	693.66215	0	3006.6084	2105.2499	0
30	33	242.5	697.22755	0	2694.6261	1886.7975	0
31	33	247.868	701.32235	0	2423.1601	1696.7149	0
32	33	255.368	707.5897	-138.72364	2106.1513	1474.743	0
33	33	265	716.51685	-435.37879	1664.4193	1165.439	0
34	33	275.3276	727.49235	-902.59811	1128.48	790.17022	0
35	33	287.0743	742.3581	-1605.5392	407.98948	285.67731	0

APPENDIX F

CONCEPTUAL PLANS

Bulldog Mine Refuse Impoundment #1

Allerton-Homer, Illinois

June 7, 2012

SUNRISE COAL LLC

PATRIOT ENGINEERING and Environmental, Inc.
Consulting Environmental, Geotechnical and Construction Materials Engineers

GENERAL NOTES

GENERAL CONDITIONS

1. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING OR VERIFYING THAT ALL PERMITS AND APPROVALS ARE OBTAINED FROM THE RESPECTIVE CITY, COUNTY AND STATE AGENCIES PRIOR TO STARTING CONSTRUCTION.
2. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES IN THE VICINITY OF THE CONSTRUCTION AREA PRIOR TO STARTING CONSTRUCTION.
3. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY FOR NOTIFICATION AND COORDINATION OF ALL CONSTRUCTION WITH THE RESPECTIVE UTILITY COMPANIES.
4. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO MAINTAIN QUALITY CONTROL THROUGHOUT THE PROJECT; FAILURE TO DO SO MAY RESULT IN REMOVAL AND REPLACEMENT OF THE DEFECTIVE WORK. IT IS REQUIRED THAT THE CONTRACTOR HAVE A QUALIFIED SUPERINTENDENT ON THE JOB SITE AT ALL TIMES DURING CONSTRUCTION.
5. IT IS ESSENTIAL THAT THE WORK TO BE DONE IN CONJUNCTION WITH THIS PROJECT SHALL BE INSTALLED ACCORDING TO THESE SPECIFICATIONS.
6. THE DESIGNATION A.S.T.M. SHALL REFER TO THE AMERICAN SOCIETY OF TESTING AND MATERIALS STANDARDS. THE LATEST REVISION OF LISTED A.S.T.M. STANDARDS SHALL PREVAIL.
7. ALL QUANTITIES GIVEN ON THESE PRINTS, VERBALLY OR IN THE SCOPE OF WORK SECTION ARE ESTIMATES AND SHALL BE CONFIRMED BY THE BIDDING CONTRACTORS.
8. OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA) STANDARDS FOR EXCAVATIONS; FINAL RULE 29 CFR PART 1926, SUBPART "P" APPLIES TO ALL EXCAVATIONS EXCEEDING FIVE (5) FEET IN DEPTH.
9. IN ADDITION, EXCAVATION EXCEEDING TWENTY (20) FEET IN DEPTH REQUIRE THE DESIGN OF A TRENCH SAFETY SYSTEM BY A REGISTERED PROFESSIONAL ENGINEER.
10. THE ENGINEER AND/OR OWNER DISCLAIM ANY ROLE IN THE CONSTRUCTION MEANS AND METHODS ASSOCIATED WITH THE PROJECT AS SET FORTH IN THESE PLANS.
11. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR THAT ALL LANDSCAPE REQUIREMENTS ARE MET AND CONFORM TO APPLICABLE LOCAL STANDARDS.
12. BEARINGS, DIMENSIONS AND EASEMENTS ARE SHOWN FOR REFERENCE ONLY. SEE RECORD SURVEYS & PLAT FOR EXACT INFORMATION.

CLEARING AND GRUBBING

1. CLEARING AND GRUBBING SHALL CONSIST OF CUTTING, REMOVAL AND SATISFACTORY DISPOSAL OF ALL TRESS, DOWN TIMBER, BRUSH, PROJECTING ROOTS, STUMPS, RUBBISH, BOULDERS, BROKEN CONCRETE, FENCING (AS DESIGNATED), AND OTHER MATERIAL ON THE PROJECT SITE AND WITHIN THE BOUNDARY AS SHOWN ON THE CONSTRUCTION DOCUMENTS AND/OR AS DESIGNATED BY "CONSTRUCTION LIMITS".
2. ALL "UNSUITABLE MATERIAL" FROM CLEARING OPERATIONS SHALL BE REMOVED TO DISPOSAL AREAS(S) OFF OF THE PROJECT SITE.
3. MATERIALS SHALL NOT BE DISPOSED OF BY BURNING UNLESS APPROVED BY THE LOCAL FIRE MARSHAL.

GRADING

1. THE CONTRACTOR SHALL PERFORM ALL GRADING OPERATIONS TO BRING SUB-GRADES, AFTER FINAL COMPACTION, TO THE REQUIRED GRADES AND SECTIONS FOR SITE IMPROVEMENT.
2. ALL FILL MATERIAL SHALL BE FORMED FROM SOIL FREE OF DELETERIOUS MATERIAL. PRIOR TO PLACEMENT OF FILL, A SAMPLE OF THE PROPOSED FILL MATERIAL SHOULD BE SUBMITTED TO THE SOILS ENGINEER FOR HIS APPROVAL.
3. PRIOR TO PLACEMENT OF FILL, THE FILL AREA SHOULD BE GRUBBED AND CLEARED OF ANY LOOSE, SOFT OR ORGANIC MATERIALS.
4. THE FILL MATERIAL SHOULD BE PLACED ON PREPARED SUBGRADE IN LOOSE LIFT THICKNESS NOT EXCEEDING EIGHT (8") INCHES AND SHOULD BE COMPACTED TO A MINIMUM OF 98 PERCENT OF THE STANDARD PROCTOR MAXIMUM DRY DENSITY (ASTM D698) AT MOISTURE CONTENTS BETWEEN 0 AND 3 PERCENT WET OF OPTIMUM.
5. THE EXISTING EMBANKMENT SLOPE SHOULD BE SUITABLY BENCHED PRIOR TO PLACING ANY NEW FILL.
6. THE EARTHWORK AND OTHER REMEDIAL MEASURES SHOULD BE PERFORMED IN ACCORDANCE WITH THE RECOMMENDATIONS OF THE GEOTECHNICAL ENGINEERING REPORT PREPARED BY PATRIOT ENGINEERING AND ENVIRONMENTAL, INC. FOR THE PROJECT.

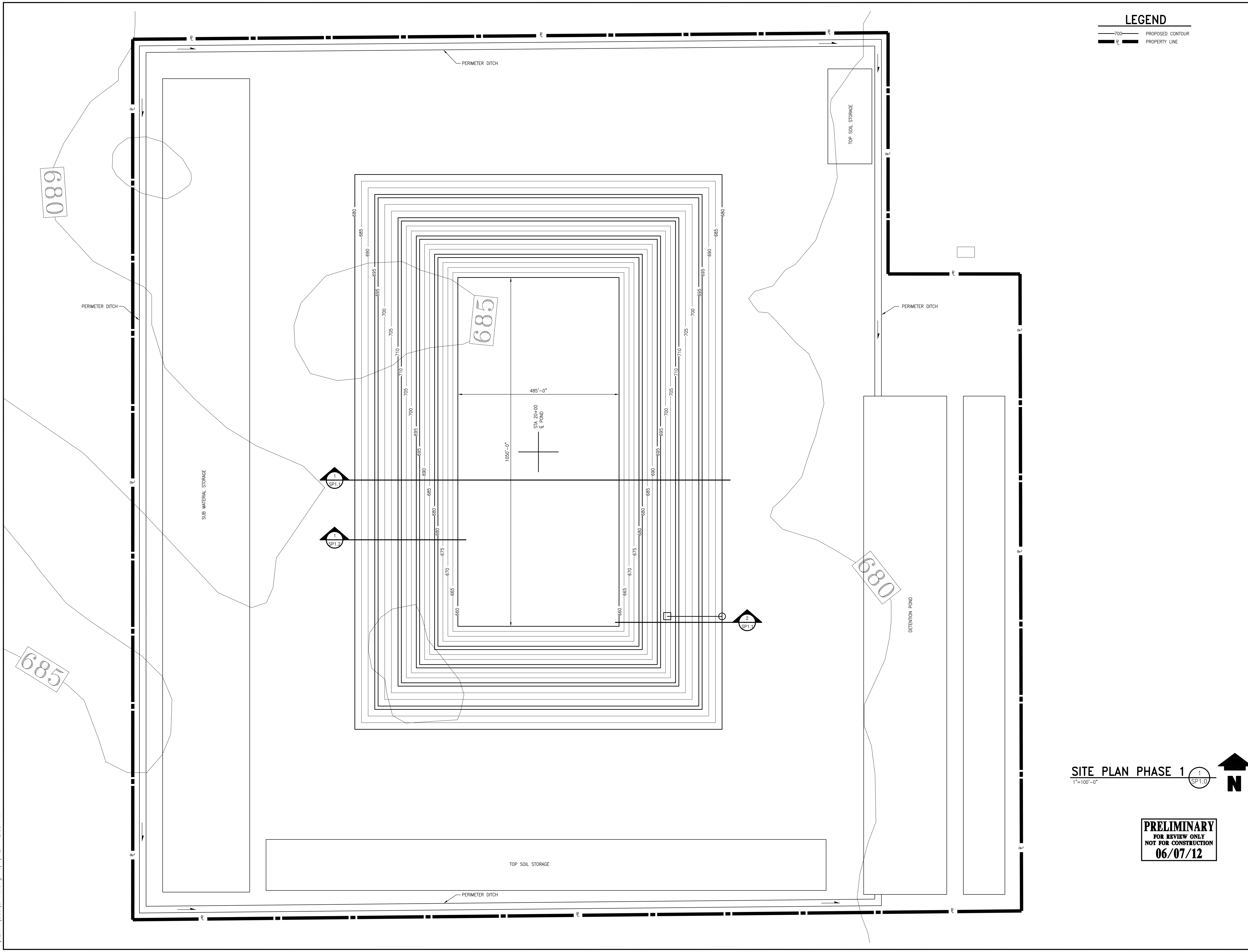
EROSION PROTECTION DURING CONSTRUCTION

1. THE CONTRACTOR SHALL PROVIDE ADEQUATE EROSION PROTECTION MEASURES DURING CONSTRUCTION.

SUBGRADE DRAINAGE

1. THE SUBGRADE DRAINAGE MAT AND PERFORATED DRAIN TILE IS TO BE INSTALLED IN STRICT ADHERENCE TO THE PLANS.

DRAWING INDEX



SITE PLAN PHASE 1 (1 / SP1.0)

1"=100'-0"

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PATRIOT ENGINEERING and Environmental, Inc.
Consulting Environmental, Geotechnical and Construction Materials Engineers

CERTIFIED BY

SUNRISE COAL, LLC.
1183 E. CANVASBACK DR.
TERRE HAUTE, INDIANA 47802

BULLDOG MINE
REFUSE IMPOUNDMENT #1
ALLERTON-HOMER, ILLINOIS

SYM.	REVISION	DATE
A	ISSUE FOR REVIEW	6/1/12
B	ISSUE FOR PERMIT APPLICATION	6/7/12

TITLE SITE PLAN PHASE 1

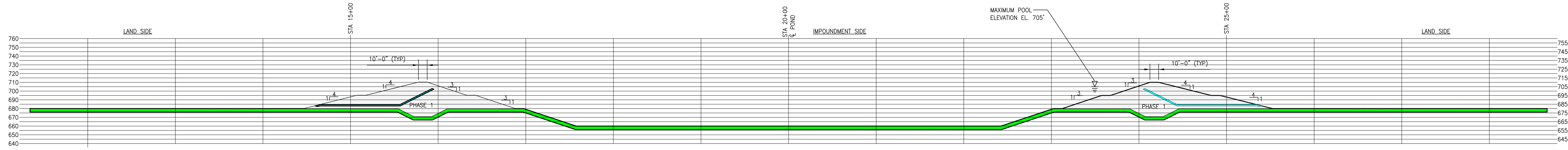
CHECKED BY SAJ

DRAWN BY JES

SCALE 1"=100'-0"

DATE

SHEET NO. SP1.0



SECTION 1 SP1.1
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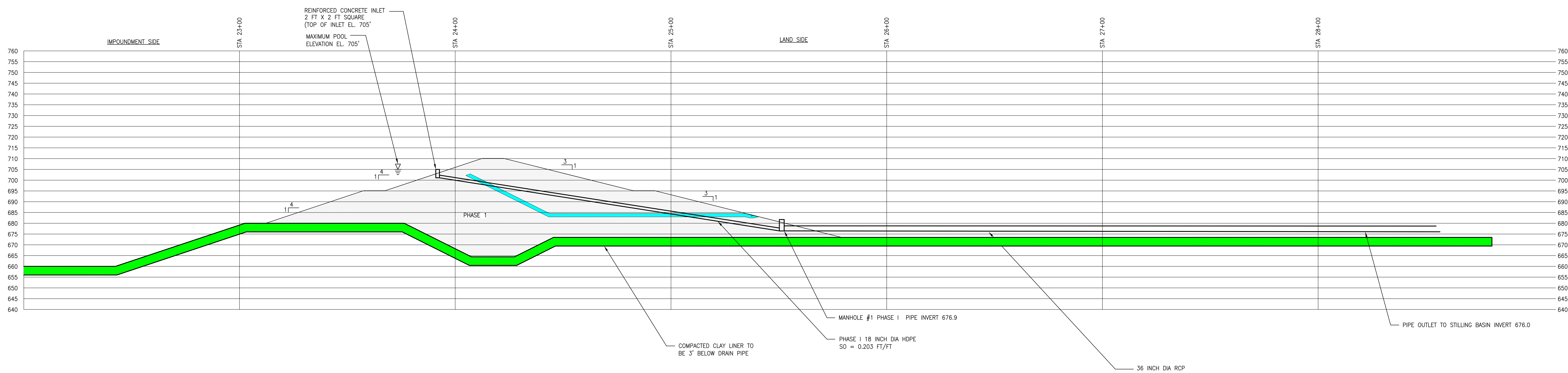
LEGEND

- 4' COMPACTED CLAY LINER
- PHASE 1 – COMPACTED CLAY
- DRAINAGE BLANKET – SEE SP6.0



SECTION 2 SP1.1
1"=20'-0"

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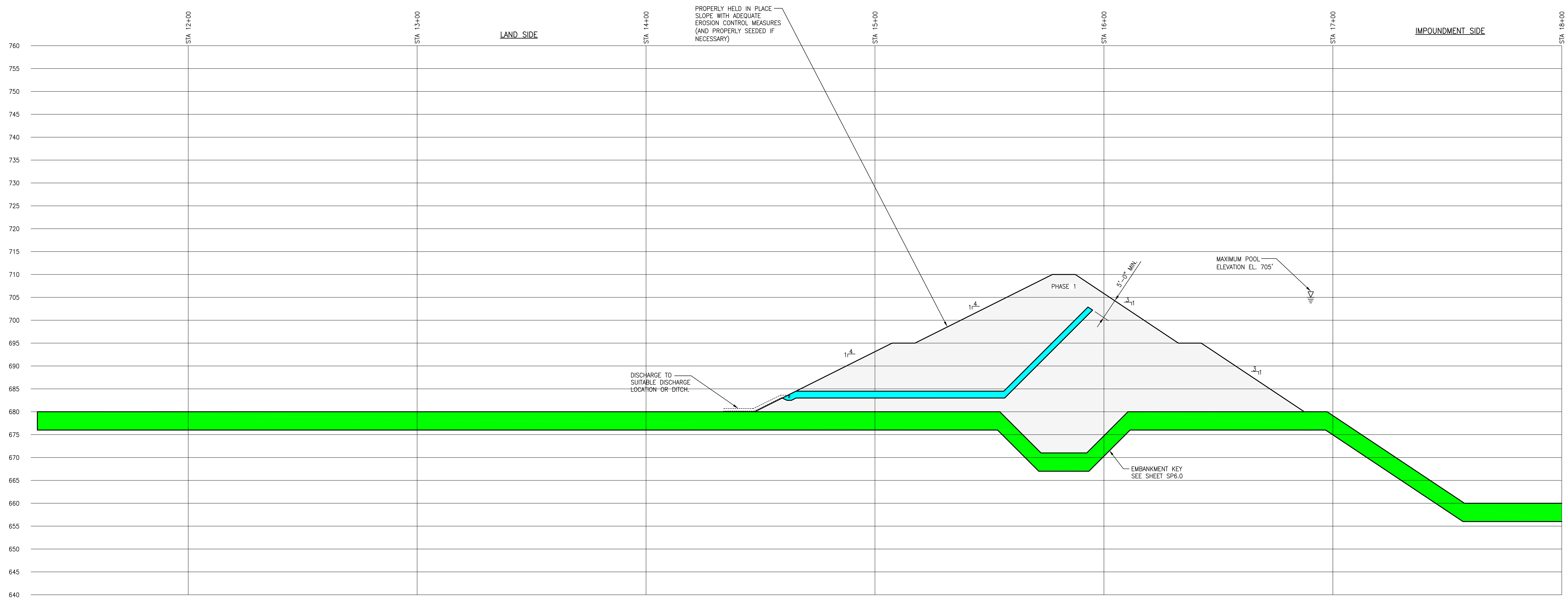
TITLE
CROSS SECTION & SECTION
@ OVERFLOW PIPING
PHASE 1

CHECKED BY SAJ
DRAWN BY JES
SCALE 1"=50'-0"
DATE
SHEET NO.
SP1.1



SECTION 1 / SP1.2

1"=10'-0" VERT.
1"=20'-0" HORIZ.

LEGEND

- 4' COMPACTED CLAY LINER
- PHASE 1 – COMPACTED CLAY
- DRAINAGE BLANKET – SEE SP6.0

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SECTION THROUGH
EMBANKMENT
PHASE 1

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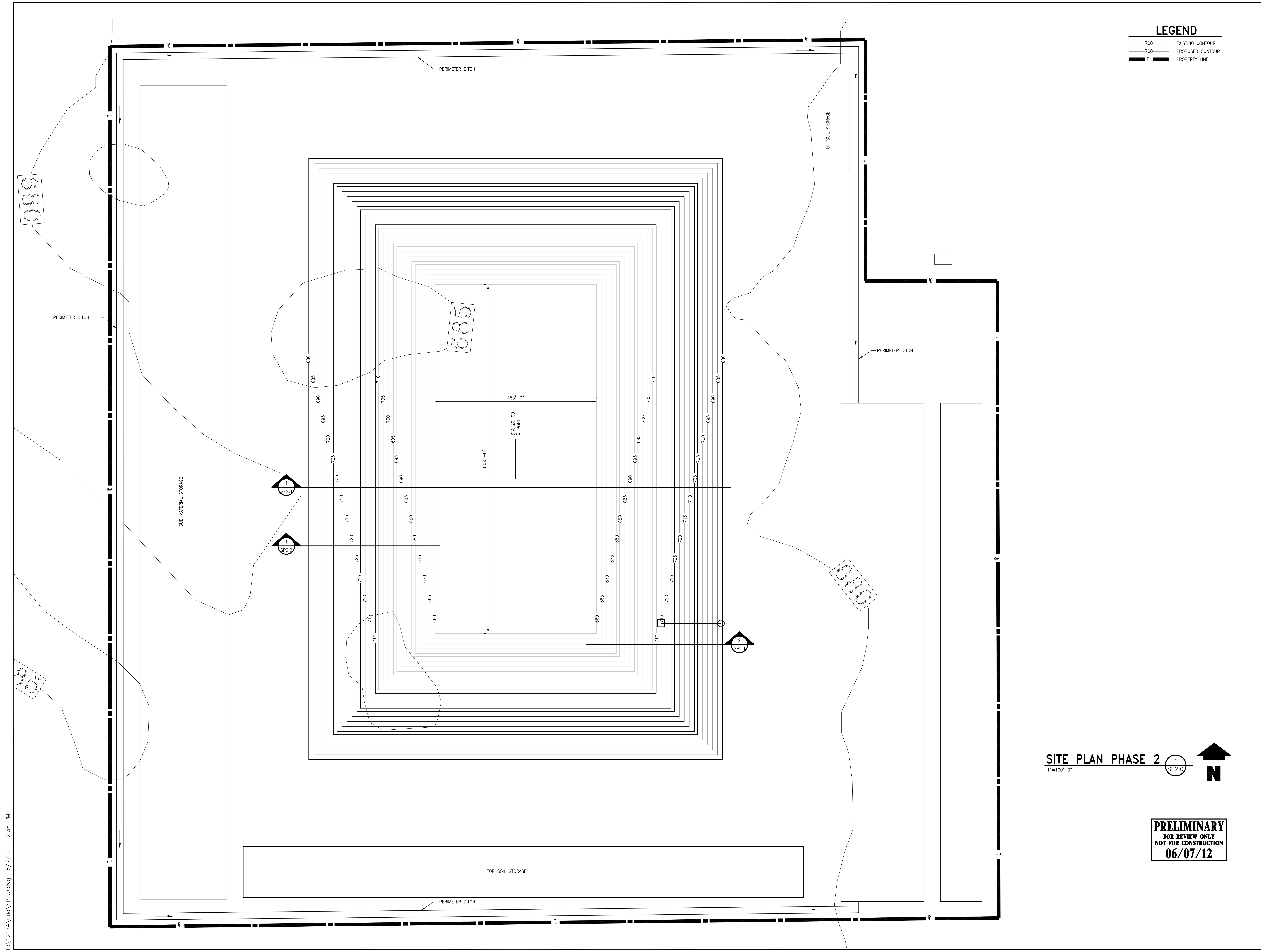
SHEET NO. SP1.2



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A	ISSUE FOR REVIEW	6/1/12
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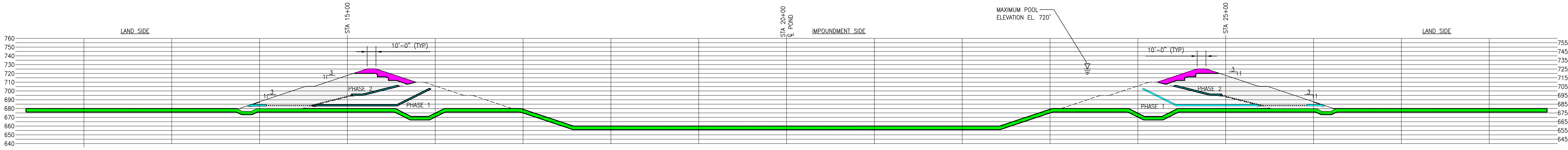
TITLE
SITE PLAN
PHASE 2

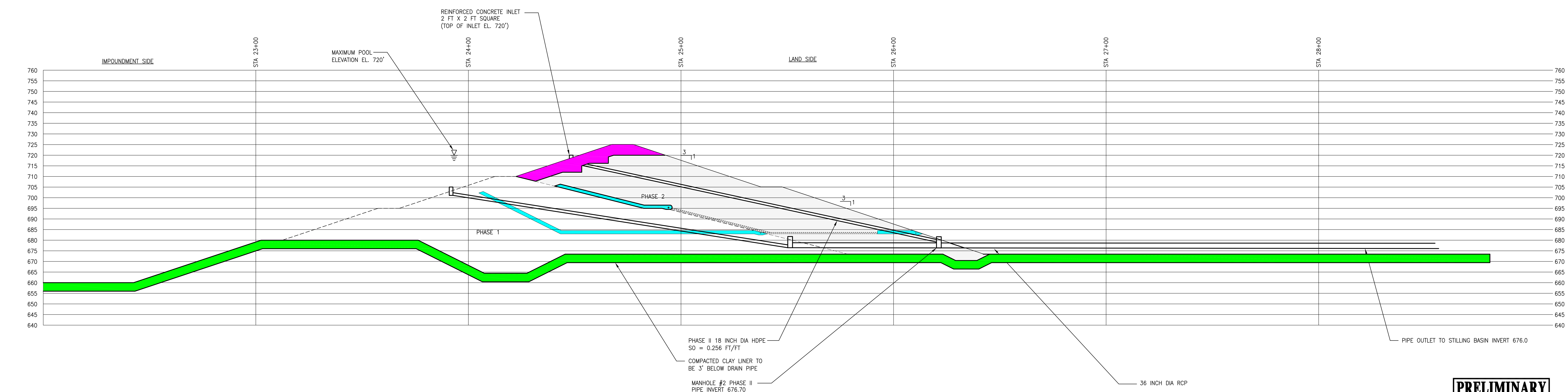
CHECKED BY SAJ
DRAWN BY JES
SCALE 1"=100'-0"
DATE
SHEET NO. SP2.0



SECTION 1 SP2.1
1"=50'-0"

LEGEND

- 4' COMPACTED CLAY LINER
- PHASE 2 – COARSE REFUSE
- DRAINAGE BLANKET – SEE SP6.0
- UPSTREAM IMPERVIOUS ZONE (5' MIN. COMPACTED CLAY) SEE SP6.0



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SECTION 2 SP2.1
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B	ISSUE FOR PERMIT APPLICATION	6/7/12

TITLE
CROSS SECTION & SECTION
@ OVERFLOW PIPING
PHASE 2

CHECKED BY SAJ
DRAWN BY JES
SCALE 1"=50'-0"
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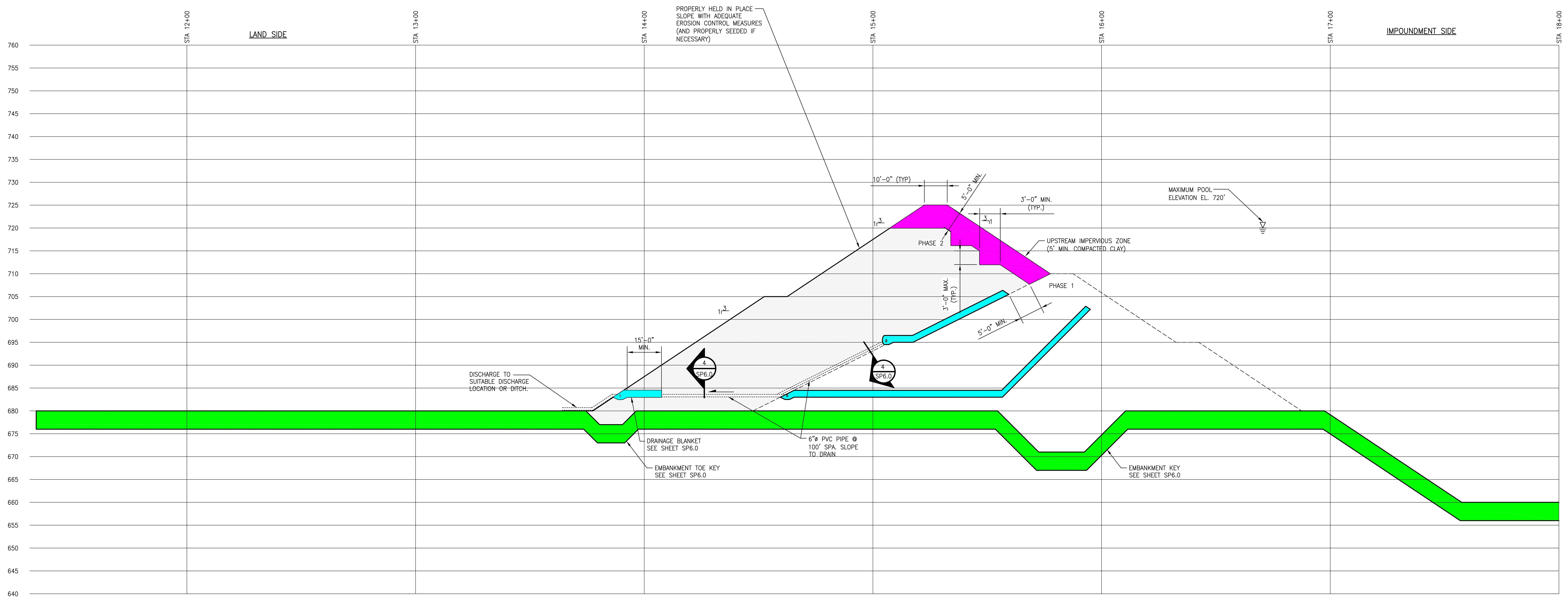
SHEET NO. SP2.1



SECTION (1/SP2.2)

1"=10'-0" VERT.
1"=20'-0" HORIZ.

LEGEND

- 4' COMPACTED CLAY LINER
- PHASE 2 – COARSE REFUSE
- DRAINAGE BLANKET – SEE SP6.0
- UPSTREAM IMPERVIOUS ZONE (5' MIN. COMPACTED CLAY) SEE SP6.0

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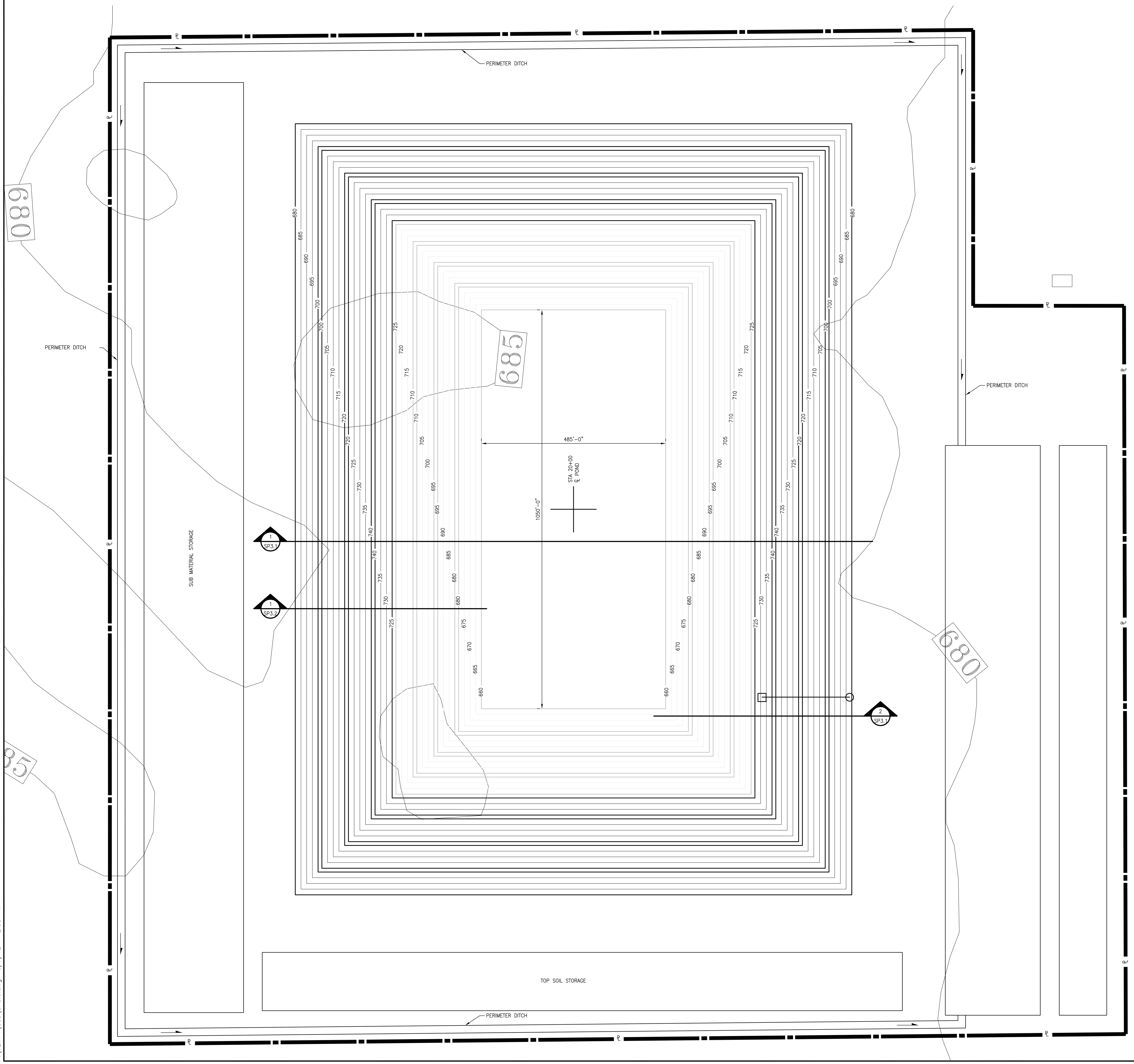
TITLE
SECTION THROUGH EMBANKMENT PHASE 2

CHECKED BY SAJ
DRAWN BY JES
SCALE
DATE
SHEET NO. SP2.2



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700	EXISTING CONTOUR
700	PROPOSED CONTOUR
℄	PROPERTY LINE

SITE PLAN PHASE 3 (1/SP3.0)

1"=100'-0"

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TITLE
SITE PLAN
PHASE 3

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SCALE 1"=100'-0"
DATE
SHEET NO. SP3.0

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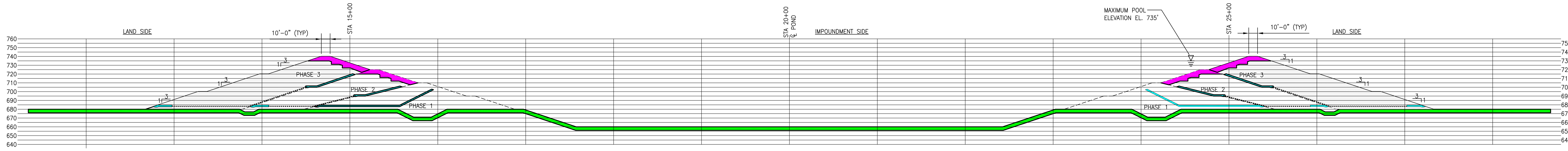
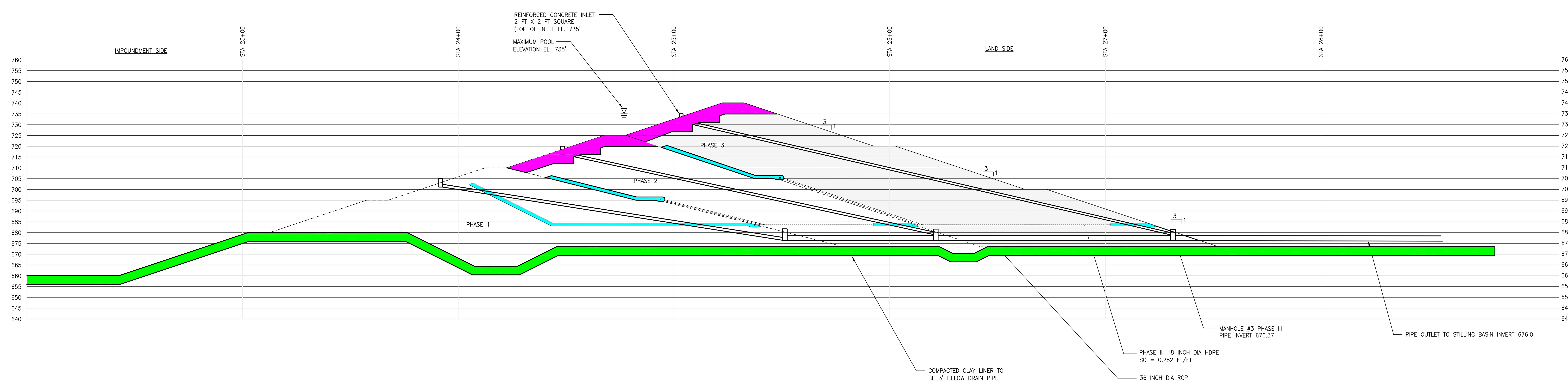


SECTION 1 / SP3.1
1"=50'-0"

LEGEND

- 4' COMPACTED CLAY LINER
- PHASE 3 – COARSE REFUSE
- DRAINAGE BLANKET – SEE SP6.0
- UPSTREAM IMPERVIOUS ZONE (5' MIN. COMPACTED CLAY) SEE SP6.0



SECTION 2 / SP3.1
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B	ISSUE FOR PERMIT APPLICATION	6/7/12

TITLE: CROSS SECTION & SECTION @ OVERFLOW PIPING PHASE 3

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DRAWN BY: JES
SCALE: 1"=50'-0"
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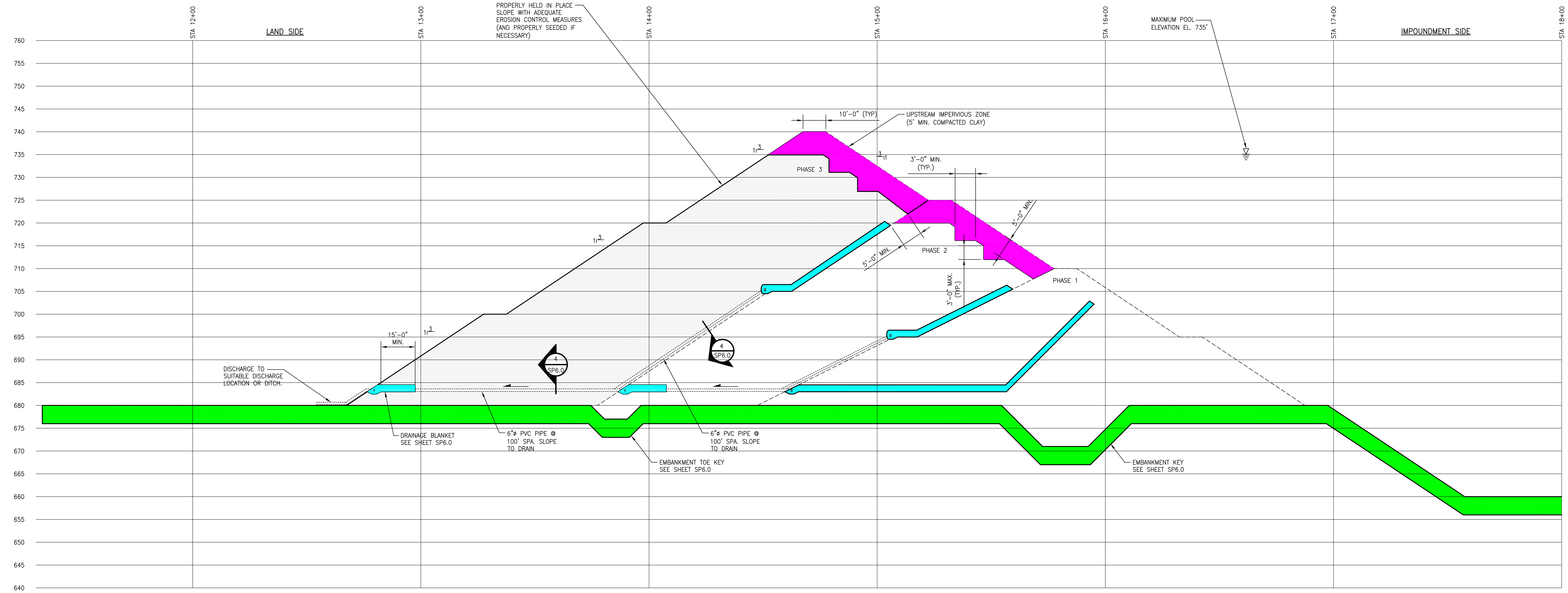
SHEET NO. SP3.1



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1"=20'-0" HORIZ.

LEGEND

- 4' COMPACTED CLAY LINER
- PHASE 3 – COARSE REFUSE
- DRAINAGE BLANKET – SEE SP6.0
- UPSTREAM IMPERVIOUS ZONE (5' MIN. COMPACTED CLAY) SEE SP6.0

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TITLE
SECTION THROUGH EMBANKMENT PHASE 3

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SCALE
DATE
SHEET NO. SP3.2

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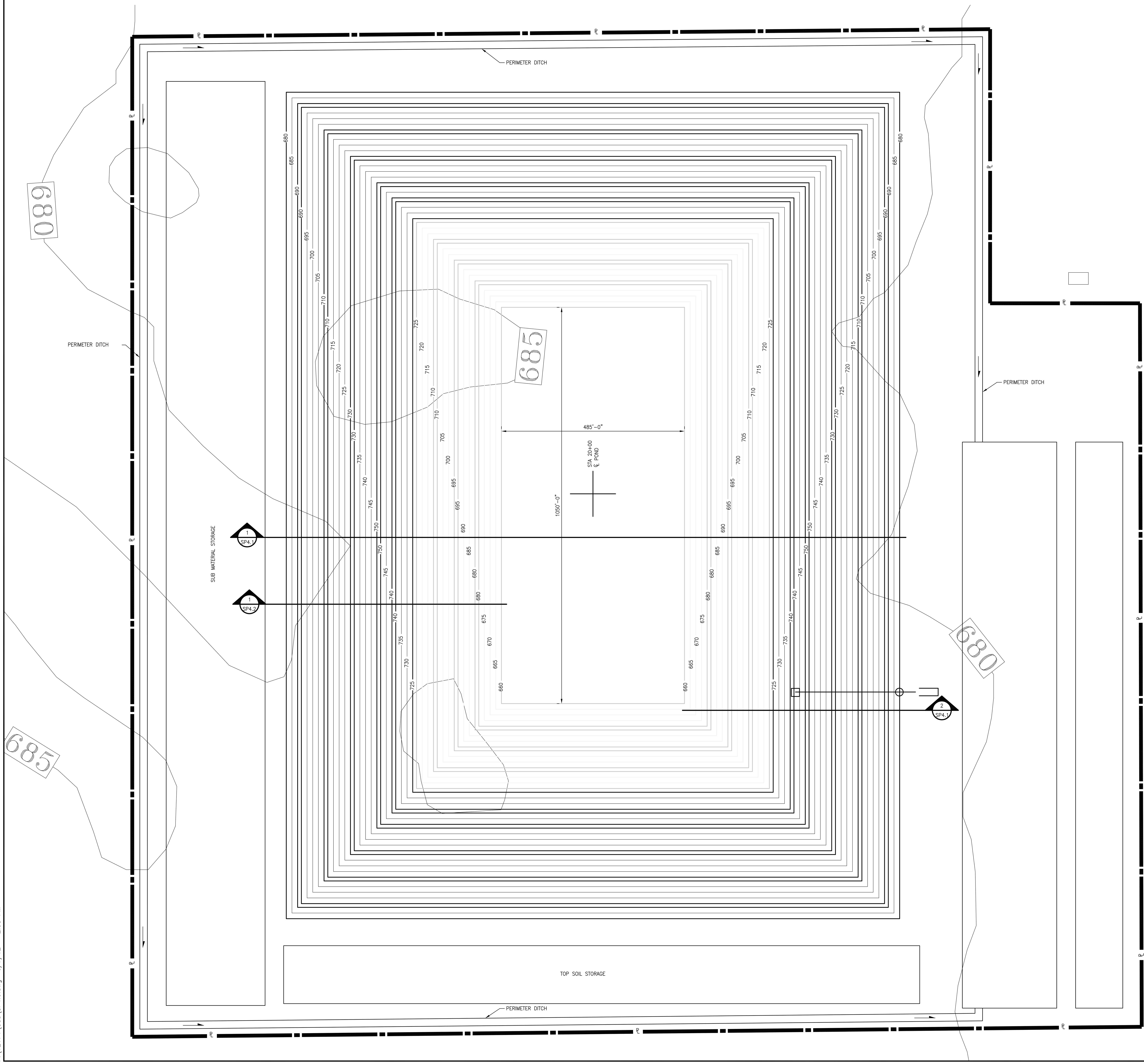

LEGEND

700	EXISTING CONTOUR
700	PROPOSED CONTOUR
℄	PROPERTY LINE

SITE PLAN PHASE 4 (1 / SP4.0)

1"=100'-0"

N

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Consulting Environmental, Geotechnical and Construction Materials Engineers

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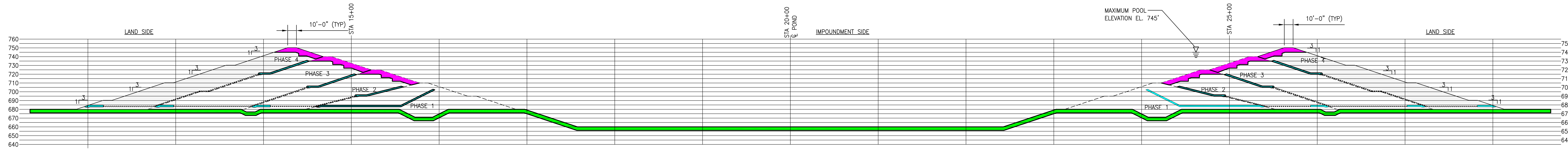
REFUSE IMPOUNDMENT #1
ALLERTON-HOMER, ILLINOIS

SYM.	REVISION	DATE
A	ISSUE FOR REVIEW	6/1/12
B	ISSUE FOR PERMIT APPLICATION	6/7/12

TITLE
SITE PLAN
PHASE 4

CHECKED BY SAJ
DRAWN BY JES
SCALE 1"=100'-0"
DATE
SHEET NO. SP4.0

P:\12174\Cad\SP4.0.dwg 6/7/12 – 2:38 PM

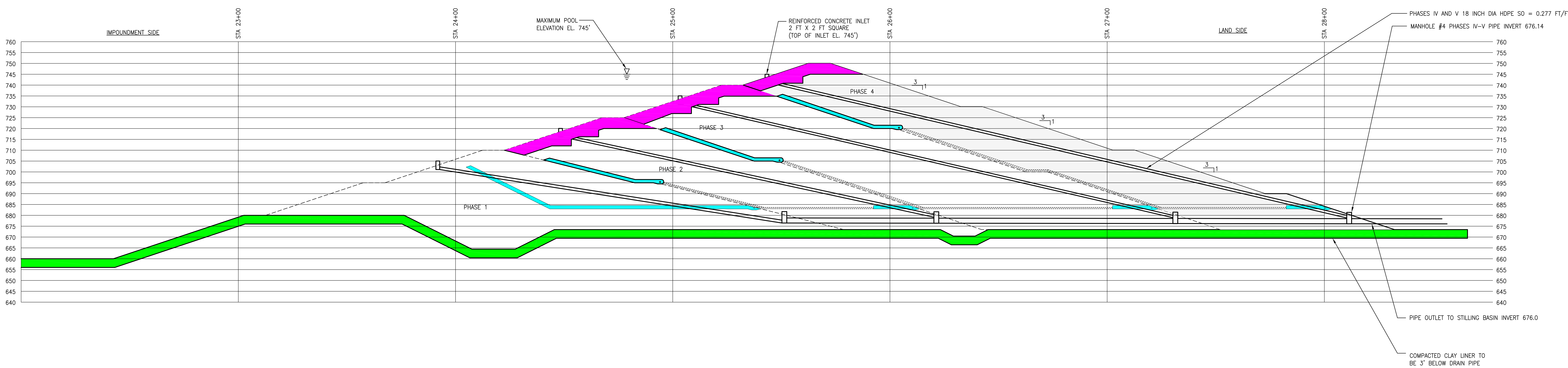


SECTION 1 / SP4.1

1"=50'-0"

LEGEND

- 4' COMPACTED CLAY LINER
- PHASE 4 – COARSE REFUSE
- DRAINAGE BLANKET – SEE SP6.0
- UPSTREAM IMPERVIOUS ZONE (5' MIN. COMPACTED CLAY) SEE SP6.0



SECTION 2 / SP4.1

1"=20'-0"

PRELIMINARY
FOR REVIEW ONLY
NOT FOR CONSTRUCTION
06/07/12

PATRIOT ENGINEERING and Environmental, Inc.
Consulting Environmental, Geotechnical and Construction Materials Engineers

CERTIFIED BY

SUNRISE COAL, LLC.
1183 E. CANVASBACK DR.
TERRE HAUTE, INDIANA 47802

BULLDOG MINE
REFUSE IMPOUNDMENT #1
ALLERTON-HOMER, ILLINOIS

SYM.	REVISION	DATE
A	ISSUE FOR REVIEW	6/1/12
B	ISSUE FOR PERMIT APPLICATION	6/7/12

TITLE
CROSS SECTION & SECTION
@ OVERFLOW PIPING
PHASE 4

CHECKED BY SAJ
DRAWN BY JES
SCALE 1"=50'-0"
DATE
SHEET NO. SP4.1

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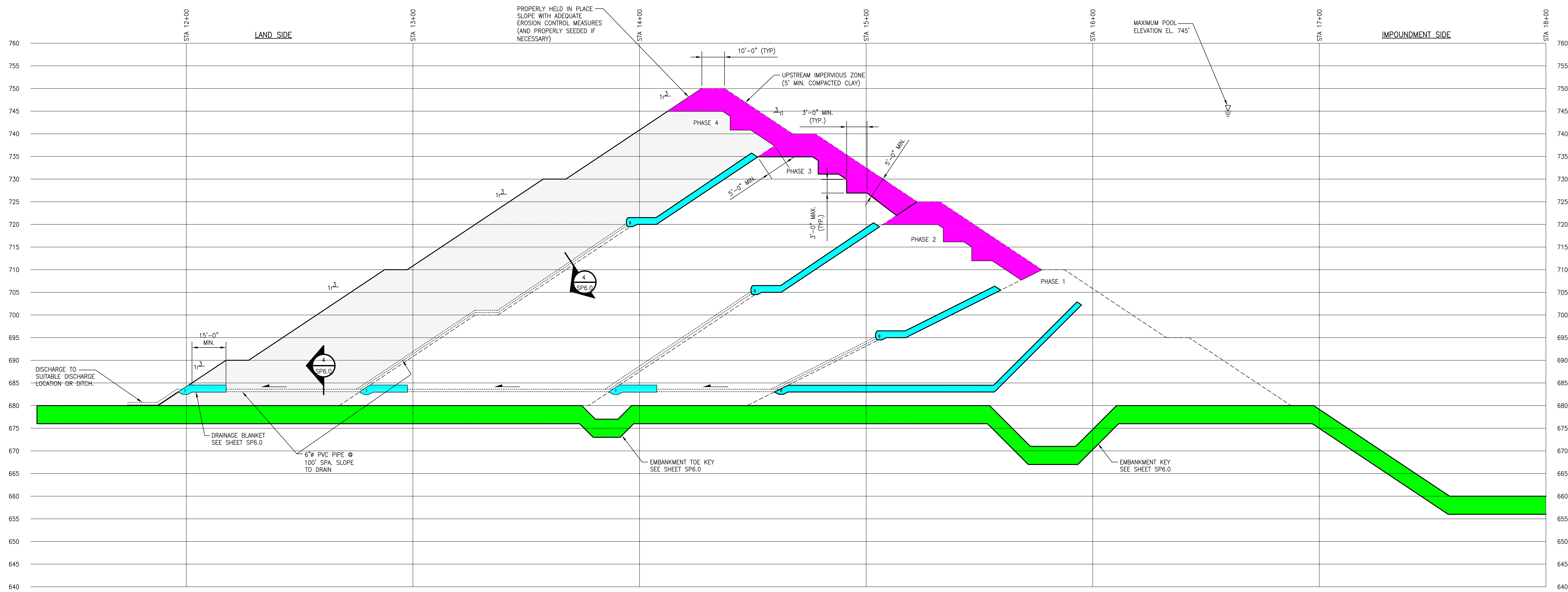

SECTION 1 SP4.2

1"=10'-0" VERT.
1"=20'-0" HORIZ.

LEGEND

- 4' COMPACTED CLAY LINER
- PHASE 5 – COARSE REFUSE
- DRAINAGE BLANKET – SEE SP6.0
- UPSTREAM IMPERVIOUS ZONE (5' MIN. COMPACTED CLAY) SEE SP6.0

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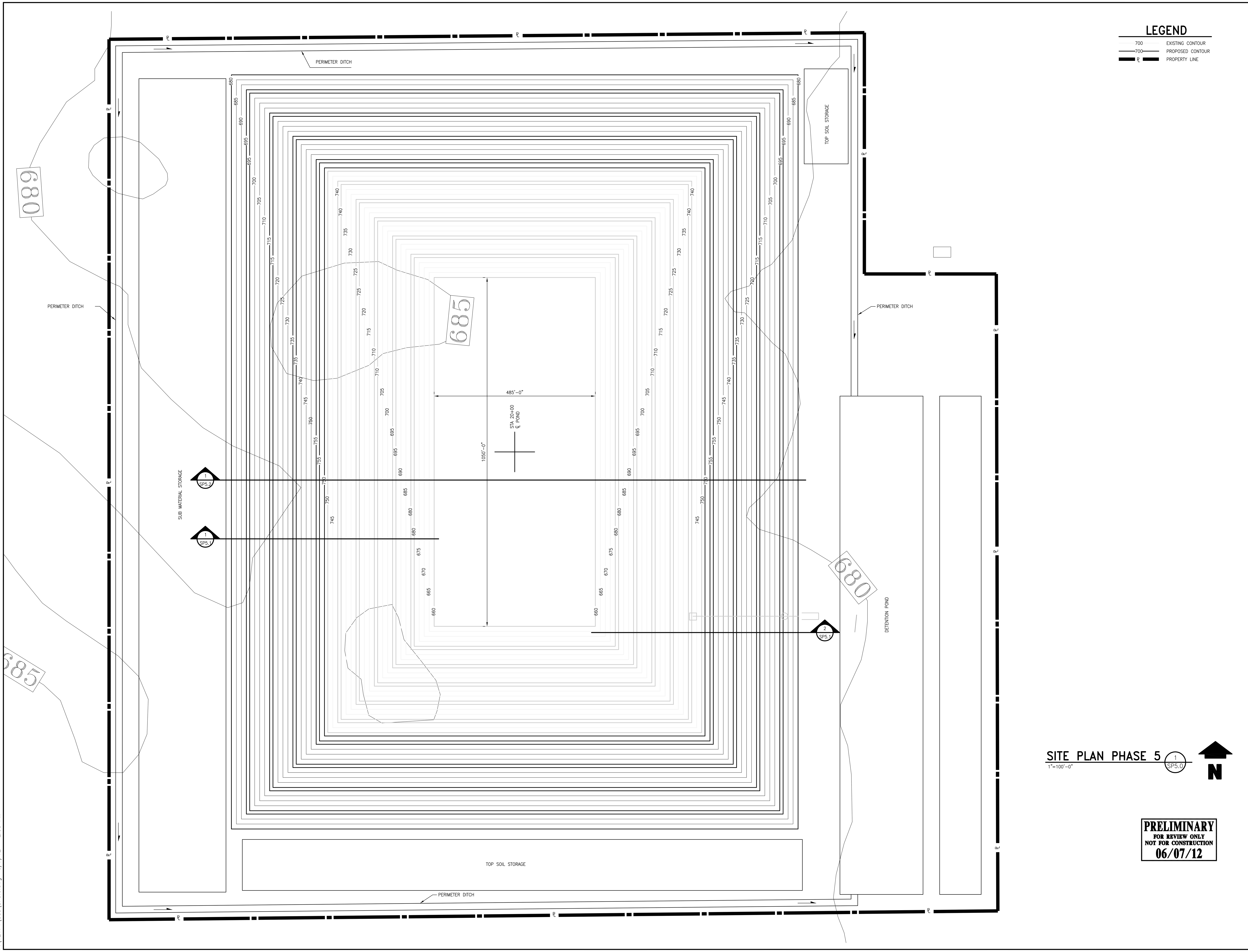
A	ISSUE FOR REVIEW	6/1/12
B	ISSUE FOR PERMIT APPLICATION	6/7/12

TITLE
SECTION THROUGH EMBANKMENT PHASE 4

CHECKED BY SAJ
DRAWN BY JES
SCALE
DATE
SHEET NO. SP4.2



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SYM.	REVISION	DATE
A	ISSUE FOR REVIEW	6/1/12
B	ISSUE FOR PERMIT APPLICATION	6/7/12

TITLE
SITE PLAN
PHASE 5

CHECKED BY SAJ
DRAWN BY JES
SCALE 1"=100'-0"
DATE
SHEET NO. SP5.0

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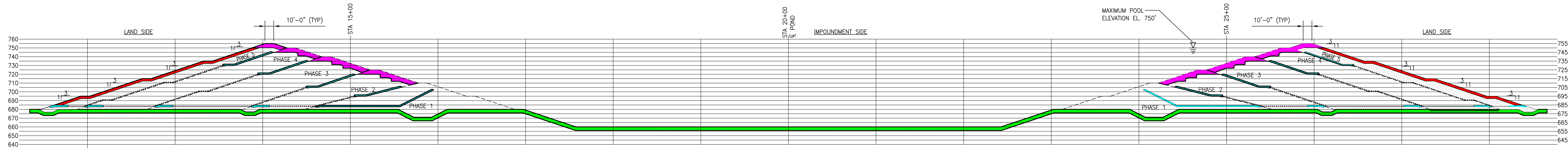
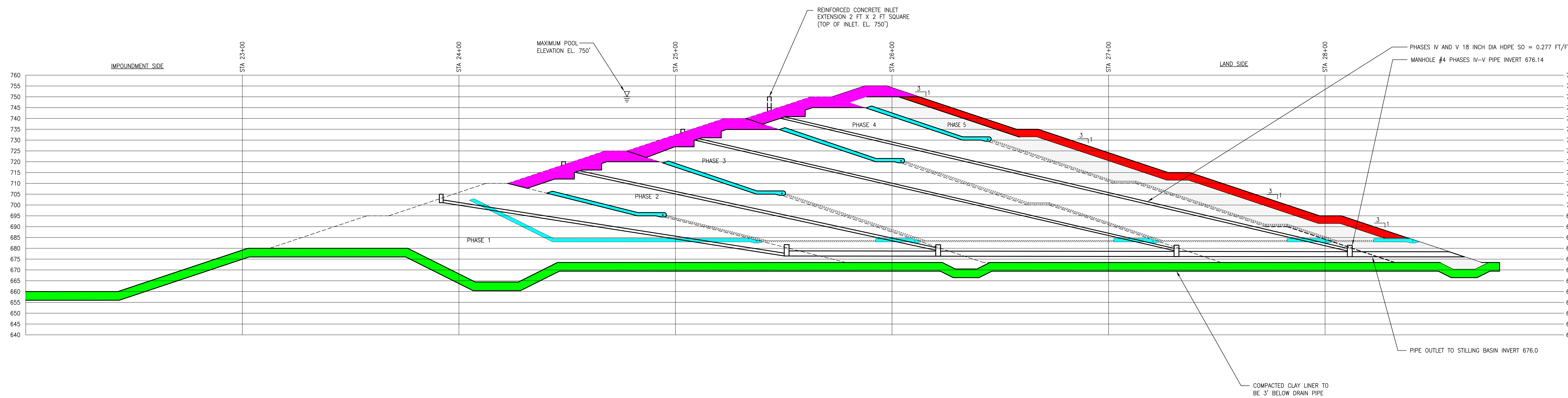


SECTION 1 / SP5.1
1"=50'-0"

LEGEND

- 4' COMPACTED CLAY LINER
- PHASE 5 – COARSE REFUSE
- DRAINAGE BLANKET – SEE SP6.0
- UPSTREAM IMPERVIOUS ZONE (5' MIN. COMPACTED CLAY) SEE SP6.0
- CLAY CAP & TOPSOIL



SECTION 2 / SP5.1
1"=20'-0"

PRELIMINARY
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06/07/12

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A	ISSUE FOR REVIEW	6/1/12
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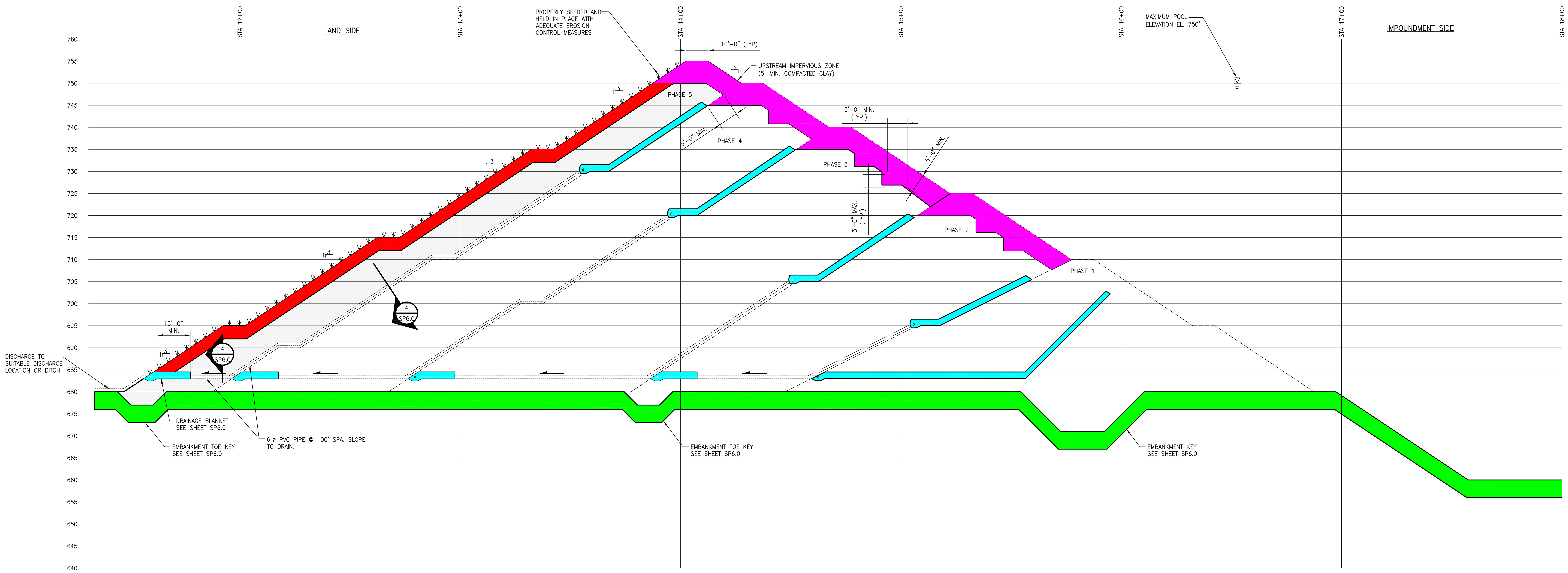
TITLE
CROSS SECTION & SECTION @ OVERFLOW PIPING
PHASE 5

CHECKED BY SAJ
DRAWN BY JES
SCALE 1"=50'-0"
DATE

SHEET NO. SP5.1



SECTION 1 SP5.2

1"=10'-0" VERT.
1"=20'-0" HORIZ.

LEGEND

- 4' COMPACTED CLAY LINER
- PHASE 5 – COARSE REFUSE
- DRAINAGE BLANKET – SEE SP6.0
- UPSTREAM IMPERVIOUS ZONE (5' MIN. COMPACTED CLAY) SEE SP6.0
- CLAY CAP & TOP SOIL

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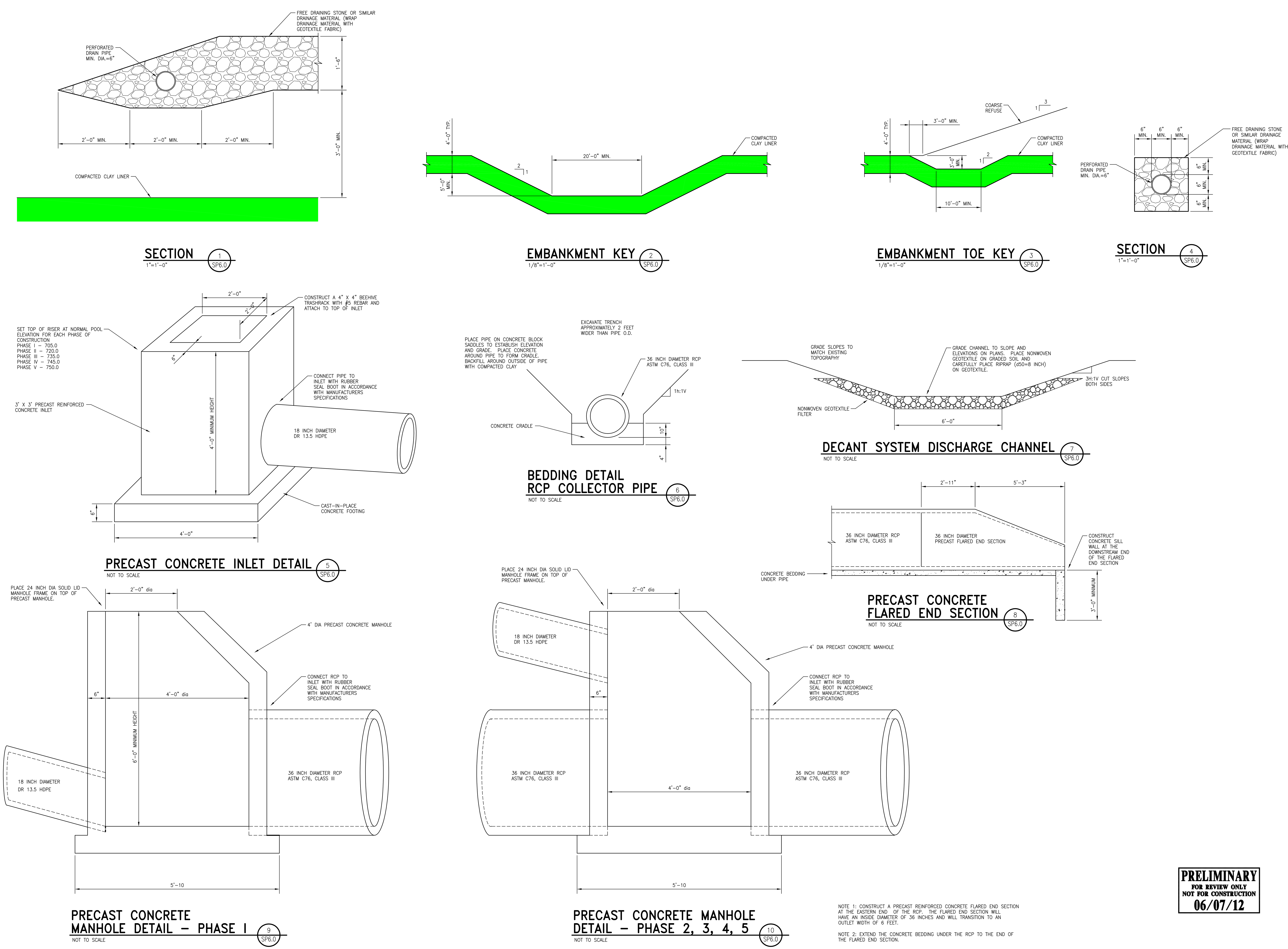
SYM.	REVISION	DATE
A	ISSUE FOR REVIEW	6/1/12
B	ISSUE FOR PERMIT APPLICATION	6/7/12

TITLE: SECTION THROUGH EMBANKMENT PHASE 5

CHECKED BY: SAJ
DRAWN BY: JES
SCALE:
DATE:
SHEET NO. SP5.2



NOTE 1: CONSTRUCT A PRECAST REINFORCED CONCRETE FLARED END SECTION AT THE EASTERN END OF THE RCP. THE FLARED END SECTION WILL HAVE AN INSIDE DIAMETER OF 36 INCHES AND WILL TRANSITION TO AN OUTLET WIDTH OF 6 FEET.

NOTE 2: EXTEND THE CONCRETE BEDDING UNDER THE RCP TO THE END OF THE FLARED END SECTION.

NOTE 3: CONSTRUCT A 3 FT DEEP, 6 INCH WIDE CONCRETE SILL WALL UNDER THE EASTERN EDGE OF THE FLARED END SECTION. THE SILL WALL WILL BE 6 FEET LONG AND ORIENTED PERPENDICULAR TO THE DIRECTION OF FLOW.

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SYM.	REVISION	DATE
A	ISSUE FOR REVIEW	6/1/12
B	ISSUE FOR PERMIT APPLICATION	6/7/12

TITLE SECTIONS

CHECKED BY SAJ
DRAWN BY SLH
SCALE AS NOTED
DATE
SHEET NO. SP6.0

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<u>**APPENDIX G**</u>

GENERAL QUALIFICATIONS

STANDARD CLAUSE FOR
UNANTICIPATED SUBSURFACE CONDITIONS

GENERAL QUALIFICATIONS

GENERAL QUALIFICATIONS

of Patriot Engineering's Geotechnical Engineering Investigation

This report has been prepared at the request of our client for his use on this project. Our professional services have been performed, findings obtained, and recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices. This warranty is in lieu of all other warranties either expressed or implied.

The scope of our services did not include any environmental assessment or investigation for the presence or absence of wetlands, hazardous or toxic materials in the soil, groundwater, or surface water within or beyond the site studied. Any statements in this report or on the test borings logs regarding vegetation types, odors or staining of soils, or other unusual conditions observed are strictly for the information of our client and the owner.

This report may not contain sufficient information for purposes of other parties or other uses. This company is not responsible for the independent conclusions, opinions or recommendations made by others based on the field and laboratory data presented in this report. Should there be any significant differences in structural arrangement, loading or location of the structure, our analysis should be reviewed.

The recommendations provided herein were developed from the information obtained in the test borings, which depict subsurface conditions only at specific locations. The analysis, conclusions, and recommendations contained in our report are based on site conditions as they existed at the time of our exploration. Subsurface conditions at other locations may differ from those occurring at the specific drill sites. The nature and extent of variations between borings may not become evident until the time of construction. If, after performing on-site observations during construction and noting the characteristics of any variation, substantially different subsurface conditions from those encountered during our explorations are observed or appear to be present beneath excavations, we must be advised promptly so that we can review these conditions and reconsider our recommendations where necessary.

If there is a substantial lapse of time between the submission of our report and the start of work at the site, or if conditions have changed due to natural causes or construction operations at or adjacent to the site, we urge that our report be reviewed to determine the applicability of the conclusions and recommendations considering the changed conditions and time lapse.

We urge that Patriot be retained to review those portions of the plans and specifications that pertain to earthwork and foundations to determine whether they are consistent with our recommendations. In addition, we are available to observe construction, particularly the compaction of structural backfill and preparation of the foundations, and such other field observations as may be necessary.

In order to fairly consider changed or unexpected conditions that might arise during construction, we recommend the following verbiage (Standard Clause for Unanticipated Subsurface Conditions) be included in the project contract.

STANDARD CLAUSE FOR
UNANTIICAPTED SUBSURFACE CONDITIONS

STANDARD CLAUSE FOR UNANTICIPATED SUBSURFACE CONDITIONS

"The owner has had a subsurface exploration performed by a soils consultant, the results of which are contained in the consultant's report. The consultant's report presents his conclusions on the subsurface conditions based on his interpretation of the data obtained in the exploration. The contractor acknowledges that he has reviewed the consultant's report and any addenda thereto, and that his bid for earthwork operations is based on the subsurface conditions as described in that report. It is recognized that a subsurface exploration may not disclose all conditions as they actually exist and further, conditions may change, particularly groundwater conditions, between the time of a subsurface exploration and the time of earthwork operations. In recognition of these facts, this clause is entered in the contract to provide a means of equitable additional compensation for the contractor if adverse unanticipated conditions are encountered and to provide a means of rebate to the owner if the conditions are more favorable than anticipated.

At any time during construction operations that the contractor encounters conditions that are different than those anticipated by the soils consultant's report, he shall immediately (within 24 hours) bring this fact to the owner's attention. If the owner's representative on the construction site observes subsurface conditions which are different than those anticipated by the consultant's report, he shall immediately (within 24 hours) bring this fact to the contractor's attention. Once a fact of unanticipated conditions has been brought to the attention of either the owner or the contractor, and the consultant has concurred, immediate negotiations will be undertaken between the owner and the contractor to arrive at a change in contract price for additional work or reduction in work because of the unanticipated conditions. The contract agrees that the following unit prices would apply for additional or reduced work under the contract. For changed conditions for which unit prices are not provided, the additional work shall be paid for on a time and materials basis."

Another example of a changed conditions clause can be found in paper No. 4035 by Robert F. Borg, published in ASCE Construction Division Journal, No. CO2, September 1964, page 37.