APPENDIX C
LONG-TERM STATIC SLOPE STABILITY EVALUATION

TECHNICAL MEMORANDUM

Project No: 3612112201

Date: December 5, 2014

To: Mark A. Peters, P.E.

From: Nicholas D. Langlais, EIT; Stephen J. Rabasca, P.E.

Subject: **Long-Term Static Slope Stability Evaluation of the Tailings Impoundment OU 3 Draft Final Design Callahan Mine Superfund Site Brooksville, Maine**

1.0 INTRODUCTION

This Technical Memorandum summarizes a static slope stability evaluation performed to support the Operable Unit 3 (OU 3) Draft Final Remedial Design for the Tailings Impoundment at Callahan Mine Superfund Site (Site) in Brooksville, Maine. The evaluation was made utilizing SLOPE/W, an industry-standard two-dimensional slope stability software program. The primary objective of the evaluation was to assess the minimum long-term static factor of safety (FOS) for the impoundment relative to global (deep-seated) stability for the planned remediation.

The remedy for the Tailings Impoundment requires stabilization measures (e.g., dewatering and crest improvements) to improve both static and seismic stability and thereby minimize the potential for a slope failure to occur. The stabilization measures are required because prior geotechnical investigations and stability evaluations indicate that the impoundment, in its present condition/configuration, is marginally stable (i.e., FOS less than 1.2) under long-term static conditions and that it may become unstable during or immediately following a long-term-design-magnitude earthquake.

This Technical Memorandum constitutes Appendix C of the Draft Final Basis of Design (BOD) Report. The following sections will review the Tailings Impoundment background information and present the methodology, assumptions, and results of this long-term static slope stability evaluation.

2.0 TAILINGS IMPOUNDMENT BACKGROUND INFORMATION

The Tailings Impoundment is located at the southern end of the Site, adjacent to a Salt Marsh at the edge of South Goose Pond. The coordinates at the crest of the impoundment dam are 44.342^{O} north latitude and 68.805^{O} west longitude.

2.1 Existing Conditions

The Tailings Impoundment encompasses an approximately 17-acre trapezoidal-shaped footprint. The impoundment contains fine sand, silt, and clay-sized rock particles (i.e., tailings) from the Callahan-era mining operations.

The tailings are contained by a three-sided dam constructed against a sloping hillside. This dam configuration is commonly termed a side-hill impoundment (USEPA, 1994). Most of the dam is constructed with angular cobble and boulder-sized waste rock materials. The bottom part of the dam (i.e., the starter dam) is interpreted to either be constructed with waste rock and back-stopped with clay fill/re-work (from site) or constructed with clay fill/re-work and then faced extensively with waste rock. The eastern side of the dam is about 60 feet tall and has an average slope of about 1.3H to 1V (horizontal to vertical).

The existing ground surface elevation is roughly +75 feet along the crest of the dam and about +70 feet in central portions of the impoundment. The impoundment surface is concave and surface water ponds in the middle. The surface water pond covers about 2 to 2.5 acres of the impoundment.

The existing ground surface elevation averages about +15 feet along the eastern toe. East of the toe, the existing ground surface slopes down gradually to the edge of the Salt Marsh/Goose Pond floodplain (at approximately elevation +7 feet). In some areas, the salt marsh/floodplain extends to the east on the order of 1500 feet.

The existing features and topography of the Tailings Impoundment are depicted in Figure C-1.

2.1.1 Impoundment Soils

The soils within and/or beneath the Tailings Impoundment consist of the following principal strata:

- Tailings;
- Clay (Fill/Re-Work);
- Clay (Presumpscot Formation); and
- Glacial Till.

The thickness of the tailings ranges from about 5 to 60 feet, and the thickness generally increases from west to east. Tailings “slimes” dominate central portions of the impoundment. The slimes consist almost exclusively of silt and clay-sized particles with trace amounts of fine sand. Conversely, tailings “sands”, consisting primarily of loose silty fine-grained sand, dominate the perimeter of the impoundment (i.e., in close proximity to the dam). A zone of highly stratified and/or laminated tailings is generally found in between the slimes and the sands.

Clay fill/re-work (interpreted to have been derived from the site) materials were encountered beneath waste rock and/or tailings in explorations performed on or immediately adjacent to the crest of the impoundment dam. The location and depth of the clay fill/re-work materials indicates that the starter dam is constructed of waste rock and back-stopped with clay fill/re-work.

Native clay was identified and/or inferred in most of the explorations and is estimated to be widespread, but may not necessarily be continuous across the footprint of the impoundment. The thickness of the clay beneath the impoundment ranges from approximately 1 to 15 feet. The clay is described as very stiff to soft and usually transitions from very stiff/stiff to medium stiff to soft with increasing depth below the ground surface (bgs). The clay is typically underlain by a thin layer of glacial till.

2.1.2 Impoundment Water Levels

The phreatic surface slopes from an elevation of about +70 feet on the west side of the impoundment to an elevation of about +50 feet near the eastern dam face. As a result, most of the tailings are presently saturated. There is a slight downward gradient through the tailings in the eastern two-thirds of the impoundment.

2.1.3 Impoundment Toe Conditions

The principal soil strata along the eastern toe of the impoundment dam typically consist of the following:

- Organic Silt/Clay, Peat, and Clay (Estuarine);
- Clay (Presumpscot Formation); and
- Glacial Till.

Soft estuarine soils/sediments are found at the ground surface in the Salt Marsh beyond the toe of the impoundment dam. The estuarine deposit ranges from about 1 to 5 feet in thickness beyond the toe. It appears that most of this deposit was removed prior to construction of the starter dam. Test pits excavated at the toe of the dam indicate that waste rock extends about 1 to 2 feet bgs and that the rock at the toe is founded on clay soils and/or fill materials. The native clay along the toe ranges from about 5 to 30 feet in thickness. The clay is described as very stiff to soft and typically transitions from very stiff/stiff to medium stiff to soft with increasing depth bgs. The clay is usually underlain by a thin layer of glacial till.

2.2 Upstream Raised Embankment Construction

Review of site-specific exploration data, geotechnical laboratory testing results, historical site photographs, and anecdotal information in conjunction with published tailings-specific literature/technical documents indicates that the side-hill Tailings Impoundment was constructed as an “upstream” raised embankment/dam with the “whole” tailings slurry discharged via a series of spigots spaced around the perimeter of the topmost lift of the dam.

Upstream raised embankments begin with the construction of a starter dam at the downstream toe of the embankment/impoundment. Site-specific exploration data indicate that the Tailings Impoundment starter dam was constructed with waste rock and back-stopped with clay fill/re-work (from from site).

The whole tailings are discharged via spigots spaced peripherally along the crest of the starter dam. Most of the coarse-grained tailings (i.e., sand-sized) settle-out from the slurry relatively close to the point of discharge (i.e., near the dam) and the fine-grained tailings (i.e., silt/clay-sized) are carried to the effluent pond in central portions of the impoundment where they eventually settle-out in standing water (Vick, 1990). The above-water sandy "beach" then becomes the foundation for the next lift of the embankment/dam (Vick, 1990), which in this case was constructed with waste rock materials. Although not specifically confirmed with the explorations, it is likely that the starter dams above the initial dam were also "chinked" with clay material or other fill, otherwise the tailings would have likely piped through the waste rock.

2.3 Prior Stability Evaluations

AMEC issued a Geotechnical Evaluation Report in January of 2009 (MACTEC, 2009). The report documented the 2006 and 2007 geotechnical investigation and testing programs and presented preliminary static and seismic slope stability evaluations for the Tailings Impoundment. Subsequently, Credere Associates LLC (Credere), under contract to Charter Environmental, the prime contractor hired by Maine DEP for the OU 1 remediation, conducted a supplemental geotechnical investigation at the Tailings Impoundment as part of the OU 1 remedial action. Credere issued a Supplemental Geotechnical Investigation Report on February 29, 2012 (Credere, 2012). The report supplements AMEC's prior geotechnical investigation(s) and preliminary evaluations of stability and liquefaction/cyclic softening (MACTEC, 2009). In general terms, both the preliminary and the supplemental evaluations reached the same principal conclusions relative to the baseline geotechnical stability of the Tailings Impoundment:

- The impoundment appears to be marginally stable under long-term static conditions (i.e., the FOS is on the order of 1.1 to 1.2, but it does not meet the applicable regulatory standard FOS of 1.50); and

  The impoundment appears to be susceptible to liquefaction and/or cyclic softening during a magnitude 5.5 earthquake and a peak ground acceleration (PGA) of 0.11g (0.11 x acceleration due to gravity). As such, the impoundment may become unstable (i.e., FOS < 1.0) during or immediately following a seismic event of this magnitude. The 0.11g PGA used for prior stability evaluations was based on 2002 USGS seismic hazard mapping data for a 2 percent probability of exceedance in 50 years.

2.4 Planned Remediation

The selected remedy for the Tailings Impoundment requires the construction of a cover system and necessary stabilization measures (e.g., dewatering and crest improvements) to provide for acceptable FOS relative to both static and seismic stability.

The Draft Final Design calls for dewatering via a series of horizontal drains, crest improvements consisting of extensive cuts along the impoundment perimeter, and installation of a low-permeability cover system. The proposed drains and proposed subgrade are depicted in Figure C-1.

3.0 LONG-TERM STATIC SLOPE STABILITY EVALUATION

A static slope stability evaluation of the Tailings Impoundment was made utilizing SLOPE/W (GeoStudio 2012, Version 8.12.3.7901), an industry-standard two-dimensional slope stability software program developed and distributed by Geo-Slope International, Ltd. The primary objective of this evaluation is to estimate the minimum long-term static FOS relative to global stability following implementation of the remedy, as described herein.

Development of the SLOPE/W model, the analyses conducted, and the results are summarized in the subsections below. A narrative with additional details, notes, and assumptions is provided for each profile (S2, E1, E2, E3, E4, and N1) in Attachments S2-A, E1-A, E2-A, E3-A, E4-A, and N1-A, respectively.

3.1 Model Development

AMEC identified seven profiles of interest (designated S1, S2, E1, E2, E3, E4, and N1) considering the existing impoundment dam configuration (i.e., steepness, height, etc.), the planned remediation, and the available geotechnical and hydro-geologic data. The profile locations are shown in Figure C-1.

AMEC developed SLOPE/W models for six of the profiles, S2, E1, E2, E3, E4, and N1, for the Draft Final Design. SLOPE/W modeling for profile S1 is not warranted based on the results of the six profiles that have been evaluated, as described herein.

3.1.1 Existing Conditions

AMEC developed an existing conditions model for Profiles S2, E1, E2, E3, E4, and N1 as follows:

A. Define overall geometry:

- The overall geometry was defined based on site-specific topographic data. Existing topography is shown in Figure C-1.
- SLOPE/W “points” for Profiles S2, E1, E2, E3, E4, and N1 are listed in Attachments S2-B, E1-B, E2-B, E3-B, E4-B, and N1-B, respectively.

B. Establish impoundment dam configuration:

- The impoundment dam configuration was established considering upstream raised embankment construction methods, anecdotal information, and available geotechnical investigation data. Refer to Attachments S2-C (Profile S2), E1-C

(Profile E1), E2-C (Profile E2), E3-C (Profile E3), E4-C (Profile E4), and N1-C (Profile N1) for details of the interpreted configuration.

- The dam is interpreted to have been constructed in five total lifts (starter dam plus four subsequent 10 to 15-foot tall raises). A backslope (i.e., interior face) of 1.3 H:1V to 2H:1V was assumed for each lift.
- The starter dam is interpreted to have been constructed with waste rock and back-stopped with clay fill/re-work. The top of the starter dam is estimated to range between the elevations of +30.0 feet and +35.0 feet, depending on the profile location. The clay fill/re-work materials extend laterally up to 50 feet behind the waste rock.
- Subsequent lifts/raises of the upstream embankment/impoundment dam consist of waste rock. It is likely that the waste rock was back-stopped with clay fill/re-work, but not as extensively as the starter dam. As such, clay-fill/re-work on subsequent lifts/raises was ignored in the analyses. Each lift is assumed to have a crest width of about 25 feet.

C. Define soil stratigraphy:

- Soil stratigraphy was defined based on geotechnical investigation data. Tables C-1, C-2, C-3, C-4, C-5, and C-6 summarize the stratigraphy used for Profiles S2, E1, E2, E3, E4, and N1, respectively.
- The stratigraphy of the stratified tailings deposit was simplified for this design evaluation. The tailings were grossly divided into three types of tailings; sands, slimes, or mixed.
- Historic (i.e., pre-mining) topography, based on 1965 site operations layout/plan, is also presented in Figure C-1. A comparison of the native soil depths/elevations identified at the geotechnical exploration locations with the pre-construction topography suggests that much of the impoundment footprint was “cut” by several feet during the initial stages of construction, especially at the southern end of the impoundment.

D. Assign soil unit weight and strength parameters:

- Soil unit weight and strength parameters were assigned based on soil type, in-situ conditions (e.g., relative compactness/consistency, above/below water table, etc.), in-situ testing, laboratory testing, empirical correlations to published literature values, and engineering judgment. The primary unit weight and strength parameters utilized for this evaluation are summarized in Table C-7.
- In some cases, the assigned unit weight is based on average bulk density measurements from Shelby tube samples.
- Strength parameters for the tailings, the underlying native clay, and the glacial till were developed on the basis of the field and laboratory testing programs.

- Strength parameters for the impoundment dam (i.e., waste rock fill) were assumed based on published literature values for cobble and boulder-sized angular rock.
- The shear strength of the native clay soils beneath the impoundment dam was estimated by interpolating between data points (i.e., a boring at the toe and a boring near the crest). AMEC estimated strength increases (relative to strengths measured in borings/CPTs at the toe) for native soft and medium stiff clays based on the effective stress increase imposed by the impoundment dam (and the impoundment).
    - Winstress software was utilized to estimate the effective stress increase (in the underlying clay soils) at various intervals between the toe and the crest of the dam. Assumptions and Winstress output files (if applicable) are included in Attachments S2-D (Profile S2), E1-D (Profile E1), E2-D (Profile E2), E3-D (Profile E3), E4-D (Profile E4), and N1-D (Profile N1).
    - Shear strength increases for soft clays were estimated, assuming normally consolidated conditions, based on a S_u/σ'_c relationship of 0.20 (from site-specific DSS testing and in general agreement with literature values). Shear strength increases for medium stiff and stiff clays (only for those with S_u less than 1,500 psf) were based on more conservative S_u/σ'_c ratios of 0.15 and 0.10, respectively.
    - The soft and/or medium stiff clay soils were subdivided into multiple zones between the toe and the crest of the dam and the corresponding estimated shear strength increase was applied.
- The Strength parameters for the tailings, the native clay within the impoundment and/or beyond the toe of the impoundment, and the glacial till were developed on the basis of the field and laboratory testing programs.

E. Define impoundment water levels:

- Impoundment water levels were defined based on hydro-geological data obtained from site-specific borings, wells, piezometers, and pore pressure dissipation tests.
- It is assumed that the backslope toe of each impoundment dam lift controls the location of the upper phreatic surface (i.e., pore pressure equal to zero feet of water at these locations).

3.1.2 Post-Remediation Conditions

The existing conditions SLOPE/W model is then adjusted to incorporate the features of the planned remediation, based on the Draft Final Remedial Design:

- The overall geometry (i.e., grading) is revised based on the proposed grading. The proposed grading is depicted in plan on Figure C-1 and in cross-section on Figures C-2 and C-3.

- The crest of the impoundment dam will be cut back significantly to create a bench, beginning at an elevation of about +53 feet to +60 feet, depending on location.
- Along the eastern side of the impoundment, the bench surface will extend back into the impoundment horizontally for approximately 10 feet and then slope downward at a 33H:1V slope for about 100 linear feet before rising at a 5H:1V slope to the new/re-graded crest, located about 250 feet inward from the former crest location.
- Tailings excavated (following dewatering) from cut areas will be placed as cap subgrade fill across the western half of the impoundment.
- Long-term steady-state groundwater levels (following drain installation and capping) were applied. The impoundment water levels were updated based on the locations and elevations of the proposed horizontal drains (Figure C-1) and the results of groundwater modeling (Appendix A). The results of the model indicate that the drains will effectively draw impoundment water levels down to the bottom of the tailings/top of the native clay within 100 to 150 feet of the dam in about 10 years time.
- The Draft Final Design will include improvements (e.g., prefabricated vertical drains and a geogrid reinforced working surface) in central portions of the impoundment (i.e., area dominated by tailings slimes) to facilitate placement of excavated tailings as fill in this area. These improvements will provide strength gain and/or improved drainage in the slimes area. The strength gain and improved drainage is conservatively ignored for this evaluation of long-term static slope stability; however, further analyses, described in Appendix J related to the staged construction filling over the tailings slimes do rely on strength gain and geogrid in order to achieve adequate factors of safety during construction.

3.2 Overview of Analyses

The primary objective of this evaluation is to estimate the minimum long-term static FOS relative to global stability following implementation of the remedy after the tailings have fully drained, as described herein. As such, AMEC performed effective stress (i.e., long-term conditions) stability analyses using the Spencer method, a limit equilibrium analysis method that evaluates stability with respect to both moment equilibrium and horizontal force equilibrium.

First, long-term static stability was assessed for existing impoundment conditions to check and/or calibrate the SLOPE/W model. Multiple “runs” were evaluated, considering both circular (i.e., rotational) and composite (i.e., part circular and part planar) failure surfaces from impoundment dam crest to impoundment dam toe. Selected SLOPE/W output files (with the resulting minimum FOS and the critical slip surface) are provided in Attachments S2-E (Profile S2), E1-E (Profile E1), E2-E (Profile E2), E3-E (Profile E3), E4-E (Profile E4), and N1-E (Profile N1).

Second, static stability was assessed considering the long-term post-remediation conditions following the installation of horizontal drains, excavation/unloading at the crest of the impoundment, filling atop central and western portions of the impoundment, and installation of

the low-permeability cover system. Attachments S2-F (Profile S2), E1-F (Profile E1), E2-F (Profile E2), E3-F (Profile E3), E4-F (Profile E4), and N1-F (Profile N1) summarize the post-remediation conditions (i.e., proposed grading, cover system, and long-term water levels) analyzed at each profile location. Three potential modes of failure were evaluated:

1. Impoundment dam crest to impoundment dam toe;
2. Fill slope crest to impoundment dam toe; and
3. Fill slope crest to fill slope toe.

Multiple model runs were evaluated for each failure mode, considering both circular and composite failure surfaces. Selected SLOPE/W output files are included in Attachments S2-G (Profile S2), E1-G (Profile E1), E2-G (Profile E2), E3-G (Profile E3), E4-G (Profile E4), and N1-G (Profile N1).

3.3 Summary of Results

The results of our analyses indicate that the static FOS ranges from 1.03 to 1.46 for existing conditions. The results are summarized in Table C-8. Based on the results, AMEC believes that the SLOPE/W models were developed conservatively. It is likely that impoundment conditions have historically been worse, relative to global stability. Immediately following the pumping of tailings slurry into the impoundment the phreatic surface would have been at/near the top of the tailings, and the tailings would have been fully saturated. Since the end of construction, nearly 45 years ago, the conditions with respect to drainage have improved. The reported FOS for existing conditions at Sections E1 and E3, ranging from 1.03 to 1.08, are therefore likely conservative.

The results of our analyses indicate that the long-term static FOS is 1.50 or greater for long-term post-remediation conditions. The results are summarized in Table C-9. The critical failure surfaces following the remediation remain near the eastern perimeter of the impoundment. The FOS were achieved by cutting up to approximately 23 feet from, and extending a distance of approximately 100 to 150 feet to the west of, the crest. Additional ground improvements necessary in central/western portions of the impoundment, beyond the cut area, were not considered in the evaluation.

Table C-8
Summary of Static FOS for Existing Conditions

Profile	Potential Mode of Failure	
	Impoundment Dam Crest to Impoundment Dam Toe	
	Estimated Minimum FOS	
	Composite	Circular
S2	1.27	1.35
E1	1.08	1.14
E2	1.18	1.32
E3	1.03	1.15
E4	1.46	1.53
N1	1.21	1.34

Table C-9
Summary of Long-Term Static FOS for Post-Remediation Conditions

Profile	Potential Mode of Failure					
	Impoundment Dam Crest to Impoundment Dam Toe		Fill Slope Crest to Impoundment Dam Toe		Fill Slope Crest to Fill Slope Toe	
	Estimated Minimum FOS		Estimated Minimum FOS		Estimated Minimum FOS	
	Composite	Circular	Composite	Circular	Composite	Circular
S2	2.10	2.25	2.34	3.03	NA	NA
E1	1.60	1.72	1.84	2.80	2.87	3.25
E2	1.50	1.75	2.55	2.55	3.71	3.71
E3	1.50	1.76	2.30	3.42	3.60	3.60
E4	1.97	1.97	3.71	3.78	3.67	3.67
N1	1.65	1.88	2.24	2.35	NA	NA

These results satisfy the applicable regulatory standard FOS (1.50), indicating that the impoundment is expected to be stable following implementation of the remedy as described herein.

4.0 REFERENCES

Credere, 2012, "2011 Supplemental Geotechnical Investigation; Tailings Impoundment Area – OU 1 Remedial Action," Credere Associates, LLC. February 2012.

MACTEC, 2009a. "Geotechnical Evaluation Report, Callahan Mine Superfund Site, Brooksville, Maine", January 2009.

MACTEC, 2009b. "Final Remedial Investigation Report, Callahan Mine Superfund Site, Brooksville, Maine", March 2009.

MACTEC, 2009c. "Operable Unit 1 Feasibility Study Report, Callahan Mine Superfund Site, Brooksville, Maine." July 2009.

USEPA, 1994. "Technical Report, Design and Evaluation of Tailings Dams." August 1994.

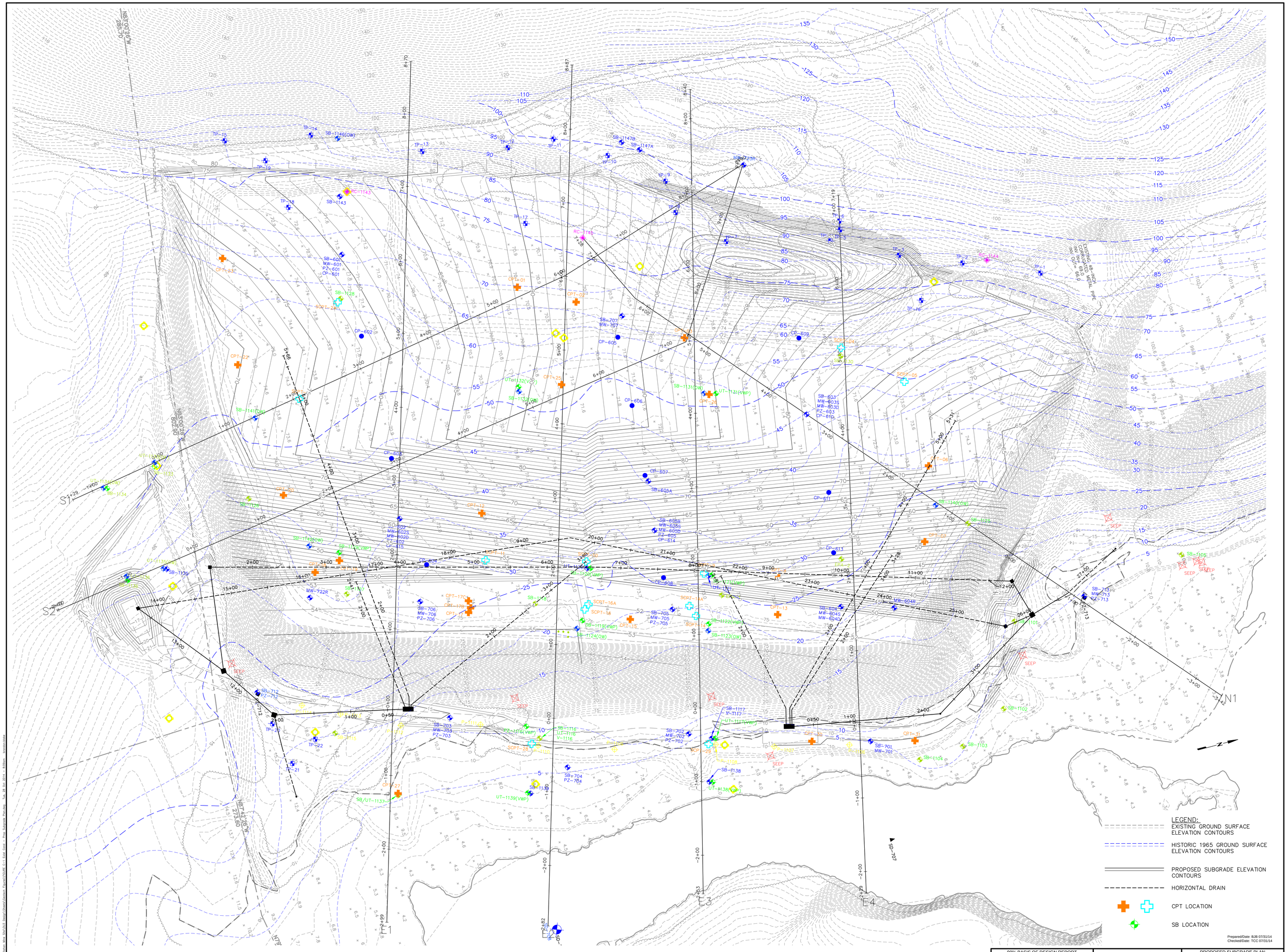
Vick, S.G., 1990. Planning, Design, and Analysis of Tailings Dams, BiTech Publishers Ltd., Vancouver, B.C., Canada.

FIGURES

Figure C-1: Existing and Proposed Conditions Plan

Figure C-2: Profiles – S1, S2, E1, and E2

Figure C-3: Profiles – E3, E4, and N1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HISTORIC 1965 GROUND SURFACE ELEVATION CONTOURS
PROPOSED SUBGRADE ELEVATION CONTOURS
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TAILINGS IMPOUNDMENT
CALAHAN MINE SUPERFUND SITE
BROOKSVILLE, MAINE
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PROPOSED SUBGRADE PLAN
SLOPE STABILITY EVALUATION
Project 3612-11-2201
Figure C-1
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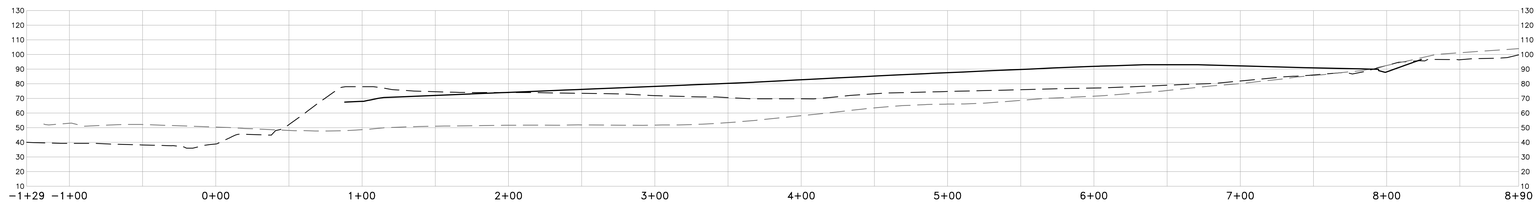
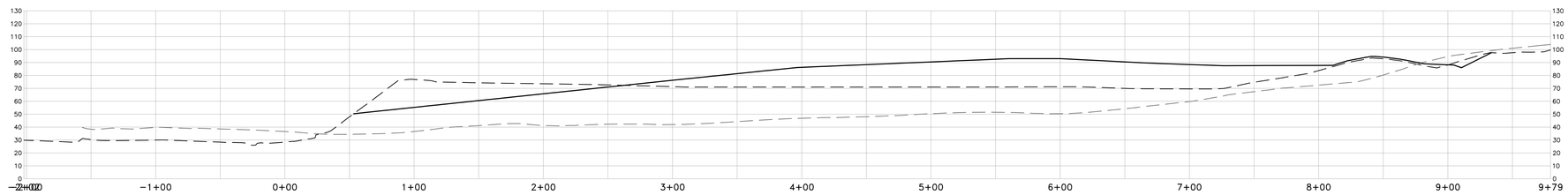


Alignment – S1 Profile



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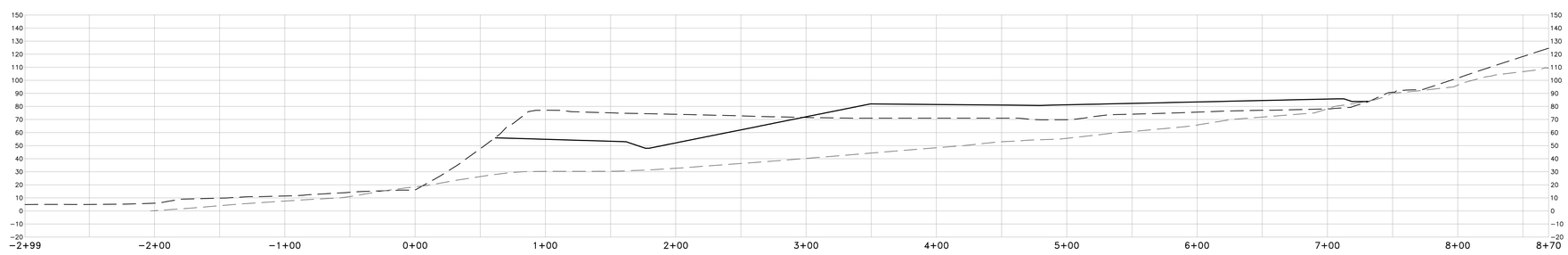
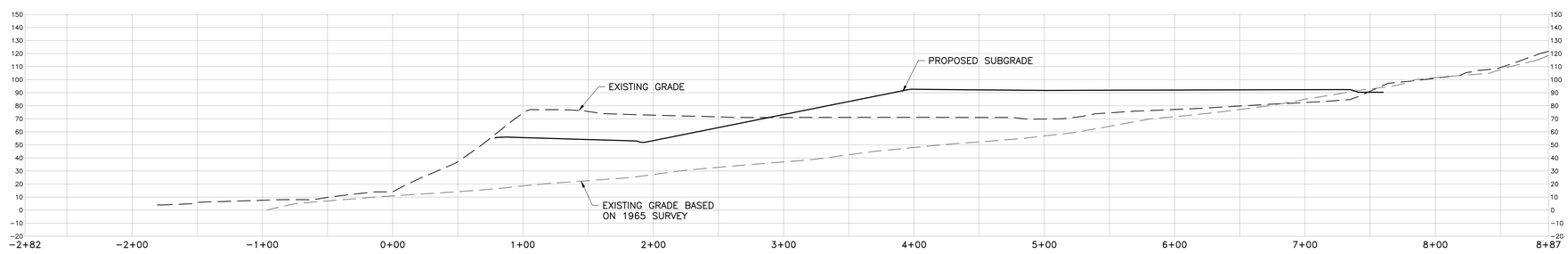


Alignment – E1 Profile



Alignment – E2 Profile

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90% BASIS OF DESIGN REPORT
TAILINGS IMPOUNDMENT
CALAHAN MINE SUPERFUND SITE
BROOKSVILLE, MAINE

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PROFILE 1
SLOPE STABILITY EVALUATION
Project 3612-11-2201
Figure C-2

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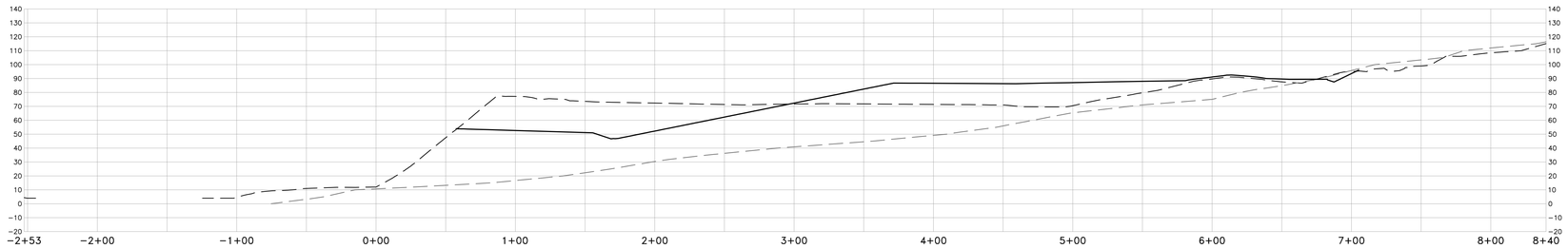
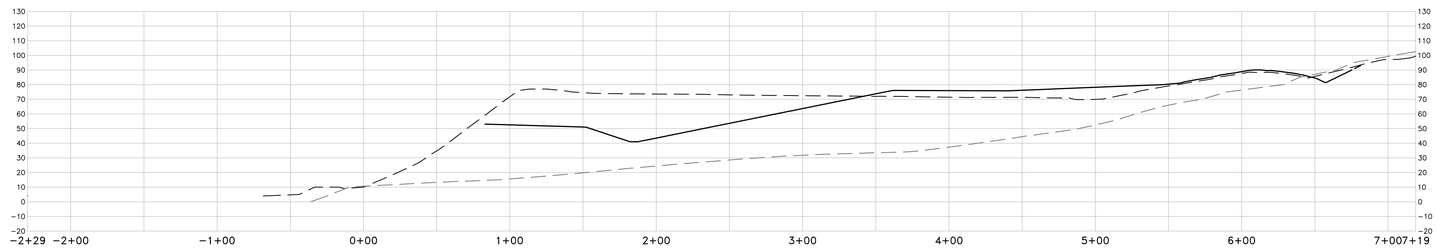


Alignment – E3 Profile



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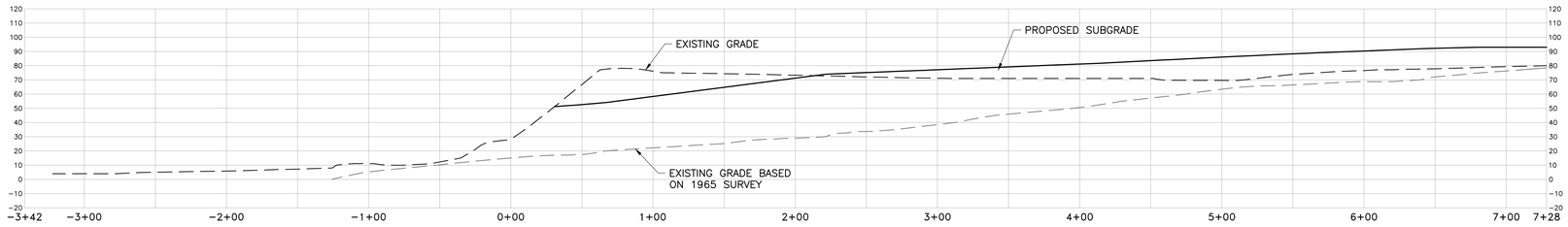

Alignment – N1 Profile

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90% BASIS OF DESIGN REPORT
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PROFILE 2
SLOPE STABILITY EVALUATION
Project 3612-11-2201
Figure C-3

TABLES

Table C-1: Summary of Overburden Soil Stratigraphy along Profile S2

Table C-2: Summary of Overburden Soil Stratigraphy along Profile E1

Table C-3: Summary of Overburden Soil Stratigraphy along Profile E2

Table C-4: Summary of Overburden Soil Stratigraphy along Profile E3

Table C-5: Summary of Overburden Soil Stratigraphy along Profile E4

Table C-6: Summary of Overburden Soil Stratigraphy along Profile N1

Table C-7: Summary of Material Properties Used for the Slope Stability Evaluation

Table C-1
Summary of Overburden Soil Stratigraphy along Profile S2

Primary Stratum		Exploration No.	MW-723R	TP-07	CPT-03	CPT-25	SB-1132	CP-603	CPT-20	SB-1126	SB-1135	SB-1136
		Profile No.	E3/S2/E4	E3/S2	E3/N1/S2	S2	S2	E1/S2	S2	S2	S2	S2
		Station, X-Coordinate (ft) on S2	9+79	8+72	7+30	5+48	4+91	2+97	1+42	0+96	-0+43	-0+98
		Ground Surface Elevation (ft)	**99.8**	**80.3**	**69.6**	**69.3**	**69.7**	**70.8**	**73.5**	**76.4**	**27.7**	**29.7**
		1965 Ground Surface Elev. (ft)	**104.0**	**87.0**	**65.0**	**52.0**	**52.0**	**43.0**	**42.0**	**41.0**	**38.0**	**40.0**
		Existing Water Level Elev. (ft)	88.0	None	69.0	60.0	66.2	59.0	53.5	N/A	24.2	N/A
FILL MATERIALS	Fill - Crest	Top Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-
		Bottom Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-
	Gravel	Top Elevation (ft)	-	-	-	-	-	-	-	-	-	-
	Reworked	Bottom Elevation (ft)	-	-	-	-	-	-	-	-	-	-
	Misc.	Thickness (ft)	-	-	-	-	-	-	-	-	-	-
	Fill - Upland	Top Depth (ft bgs)	0.0	-	-	-	-	-	-	0.0	-	-
		Bottom Depth (ft bgs)	2.0	-	-	-	-	-	-	-	-	-
	Angular Rock	Top Elevation (ft)	99.8	-	-	-	-	-	-	76.4	-	-
	Waste Rock	Bottom Elevation (ft)	97.8	-	-	-	-	-	-	-	-	-
		Thickness (ft)	2.0	-	-	-	-	-	-	-	-	-
	Tailings	Top Depth (ft bgs)	-	-	0.0	0.0	0.0	0.0	0.0	-	-	-
		Bottom Depth (ft bgs)	-	-	14.0	19.0	19.8	36.0	49.0	-	-	-
		Top Elevation (ft)	-	-	69.6	69.3	69.7	70.8	73.5	-	-	-
		Bottom Elevation (ft)	-	-	55.6	50.3	49.9	34.8	24.5	-	-	-
		Thickness (ft)	-	-	14.0	19.0	19.8	36.0	49.0	-	-	-
	Fill - Deep1	Top Depth (ft bgs)	-	-	-	-	19.8	-	-	-	-	-
		Bottom Depth (ft bgs)	-	-	-	-	21.6	-	-	48.0	-	-
	Rework Clay/Till	Top Elevation (ft)	-	-	-	-	49.9	-	-	-	-	-
	Granular	Bottom Elevation (ft)	-	-	-	-	**48.1**	-	-	28.4	-	-
	Organics	Thickness (ft)	-	-	-	-	1.8	-	-	-	-	-
	Tailings	Top Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-
		Bottom Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-
		Top Elevation (ft)	-	-	-	-	-	-	-	-	-	-
		Bottom Elevation (ft)	-	-	-	-	-	-	-	-	-	-
		Thickness (ft)	-	-	-	-	-	-	-	-	-	-
	Fill - Deep2	Top Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-
		Bottom Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-
	Rework Clay/Till	Top Elevation (ft)	-	-	-	-	-	-	-	-	-	-
	Granular	Bottom Elevation (ft)	-	-	-	-	-	-	-	-	-	-
	Organics	Thickness (ft)	-	-	-	-	-	-	-	-	-	-
	Fill - Toe 1	Top Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-
		Bottom Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-
	Gravel/Sand/Silt	Top Elevation (ft)	-	-	-	-	-	-	-	-	-	-
	Reworked	Bottom Elevation (ft)	-	-	-	-	-	-	-	-	-	-
	Misc.	Thickness (ft)	-	-	-	-	-	-	-	-	-	-
	Fill - Toe 2	Top Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-
		Bottom Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-
	Fine-Grained	Top Elevation (ft)	-	-	-	-	-	-	-	-	-	-
	Clay/Organic	Bottom Elevation (ft)	-	-	-	-	-	-	-	-	-	-
	Misc.	Thickness (ft)	-	-	-	-	-	-	-	-	-	-
NATIVE SOILS & BEDROCK	Topsoil/Estuarine	Top Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-
		Bottom Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-
	Topsoil	Top Elevation (ft)	-	-	-	-	-	-	-	-	-	-
	Salt Marsh Org.	Bottom Elevation (ft)	-	-	-	-	-	-	-	-	-	-
	Salt Marsh Clay	Thickness (ft)	-	-	-	-	-	-	-	-	-	-
	Presumpscot Clay	Top Depth (ft bgs)	-	-	14.0	-	-	36.0	49.0	48.0	0.0	0.0
		Bottom Depth (ft bgs)	-	-	15.0	-	-	40.5	56.2	63.8	20.5	27.3
		Top Elevation (ft)	-	-	55.6	-	-	34.8	24.5	28.4	27.7	29.7
		Bottom Elevation (ft)	-	-	54.6	-	-	30.3	17.3	12.6	7.2	2.4
		Thickness (ft)	-	-	1.0	-	-	4.5	7.2	15.8	20.5	27.3
	Glacial Till	Top Depth (ft bgs)	2.0	0.0	15.0	19.0	-	40.5	56.2	63.8	20.5	27.3
		Bottom Depth (ft bgs)	10.0	1.5	15.4	22.6	-	41.3	66.6	76.9	34.2	31.0
		Top Elevation (ft)	97.8	80.3	54.6	50.3	-	30.3	17.3	12.6	7.2	2.4
		Bottom Elevation (ft)	**89.8**	**78.8**	**54.2**	**46.7**	-	**29.5**	**6.9**	**(0.5)**	**(6.5)**	**(1.4)**
		Thickness (ft)	8.0	1.5	0.4	3.6	-	0.8	10.4	13.1	13.7	3.7
	Bedrock	Top Depth (ft bgs)	10.0	1.5	15.4	22.6	21.6	41.3	66.6	76.9	34.2	31.0
		Bottom Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-
		Top Elevation (ft)	**89.8**	**78.8**	**54.2**	**46.7**	**48.1**	**29.5**	**6.9**	**(0.5)**	**(6.5)**	**(1.4)**
		Bottom Elevation (ft)	-	-	-	-	-	-	-	-	-	-
		Thickness (ft)	-	-	-	-	-	-	-	-	-	-

Notes:

Red Text	= Data based on CPT refusal. Values are approximate, but reasonable considering relatively thin layer of Glacial Till identified in most soil borings.
Highlighted Text	= Elevations adjusted to match "base" map/existing conditions topography.

By/Date: NDL Jul 2014
Chk/Date: TCC Jul 2014

Table C-2
Summary of Overburden Soil Stratigraphy along Profile E1

West — East

	Primary Stratum	Exploration No.	TP-13	RC-1143	SB-601	CP-601	CP-602	CP-603	SB-602	CP-615	CP-604	SB-706	SB-703	SB-1137	CPT-27	SD-708
		Profile No.	E1	E1	E1	E1	E1	E1/S2	E1	E1	E1	E1	E1	E1	E1	E1/E2
		Station, X-Coordinate (ft)	748.0	688.0	605.0	605.0	497.0	330.0	248.0	248.0	187.0	133.0	-22.0	-125.0	-125.0	-305.0
		Ground Surface Elev. (ft)	**90.7**	**70.8**	**71.4**	**71.5**	**70.6**	**70.8**	**72.7**	**72.2**	**72.8**	**74.1**	**12.3**	**6.0**	**6.2**	**1.5**
		1965 Ground Surface Elev. (ft)	0.0	0.0	0.0	0.0	0.0	43.0	36.0	36.0	30.0	27.5	11.5	5.5	5.5	-
		Existing Water Level Elev. (ft)	-	70.0	70.0	70.0	68.0	-	60.0	60.0	-	54.0	9.0	-	-	4.0
FILL MATERIALS	Fill - Crest	Top Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Bottom Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Gravel	Top Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Reworked	Bottom Elevation (ft)	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	Misc.	Thickness (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Fill - Upland	Top Depth (ft bgs)	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-
		Bottom Depth (ft bgs)	6.0	-	-	-	-	-	-	-	-	-	-	-	-	-
	Angular Rock	Top Elevation (ft)	90.7	-	-	-	-	-	-	-	-	-	-	-	-	-
	Waste Rock	Bottom Elevation (ft)	**84.7**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
		Thickness (ft)	6.0	-	-	-	-	-	-	-	-	-	-	-	-	-
	Tailings	Top Depth (ft bgs)	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-	-	-
		Bottom Depth (ft bgs)	-	3.0	11.8	12.0	23.0	36.0	46.0	45.5	51.5	53.5	-	-	-	-
		Top Elevation (ft)	-	70.8	71.4	71.5	70.6	70.8	72.7	72.2	72.8	74.1	-	-	-	-
		Bottom Elevation (ft)	**-**	**67.8**	**59.6**	**59.5**	**47.6**	**34.8**	**26.7**	**26.7**	**21.3**	**20.6**	**-**	**-**	**-**	**-**
		Thickness (ft)	-	3.0	11.8	12.0	23.0	36.0	46.0	45.5	51.5	53.5	-	-	-	-
	Fill - Deep1	Top Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Bottom Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Rework Clay/Till	Top Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Granular	Bottom Elevation (ft)	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	Organics	Thickness (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Tailings	Top Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Bottom Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Top Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Bottom Elevation (ft)	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
		Thickness (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Fill - Deep2	Top Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Bottom Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Rework Clay/Till	Top Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Granular	Bottom Elevation (ft)	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	Organics	Thickness (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Fill - Toe 1	Top Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	0.0	-	-	-
		Bottom Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	2.0	-	-	-
	Gravel/Sand/Silt	Top Elevation (ft)	-	-	-	-	-	-	-	-	-	-	12.3	-	-	-
	Reworked	Bottom Elevation (ft)	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**10.3**	**-**	**-**	**-**
	Misc.	Thickness (ft)	-	-	-	-	-	-	-	-	-	-	2.0	-	-	-
	Fill - Toe 2	Top Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	2.0	-	-	-
		Bottom Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	4.5	-	-	-
	Fine-Grained	Top Elevation (ft)	-	-	-	-	-	-	-	-	-	-	10.3	-	-	-
	Clay/Organic	Bottom Elevation (ft)	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**7.8**	**-**	**-**	**-**
	Misc.	Thickness (ft)	-	-	-	-	-	-	-	-	-	-	2.5	-	-	-
NATIVE SOILS & BEDROCK	Topsoil/Estuarine	Top Depth (ft bgs)	6.0	-	-	-	-	-	-	-	-	-	4.5	0.0	0.0	0.0
		Bottom Depth (ft bgs)	6.5	-	-	-	-	-	-	-	-	-	6.8	4.0	4.5	6.5
	Topsoil	Top Elevation (ft)	84.7	-	-	-	-	-	-	-	-	-	7.8	6.0	6.2	1.5
	Salt Marsh Org.	Bottom Elevation (ft)	**84.2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**5.5**	**2.0**	**1.7**	**(5.0)**
	Salt Marsh Clay	Thickness (ft)	0.5	-	-	-	-	-	-	-	-	-	2.3	4.0	4.5	6.5
	Presumpscot Clay	Top Depth (ft bgs)	-	3.0	11.8	12.0	23.0	36.0	46.0	45.5	51.5	53.5	6.8	4.0	4.5	6.5
		Bottom Depth (ft bgs)	-	20.5	28.5	28.0	31.5	40.5	56.0	55.5	61.0	66.8	20.1	35.4	34.5	-
		Top Elevation (ft)	-	67.8	59.6	59.5	47.6	34.8	26.7	26.7	21.3	20.6	5.5	2.0	1.7	(5.0)
		Bottom Elevation (ft)	**-**	**50.3**	**42.9**	**43.5**	**39.1**	**30.3**	**16.7**	**16.7**	**11.8**	**7.3**	**(7.8)**	**(29.4)**	**(28.3)**	**< (8.5)**
		Thickness (ft)	-	17.5	16.7	16.0	8.5	4.5	10.0	10.0	9.5	13.3	13.3	31.4	30.0	> 3.5
	Glacial Till	Top Depth (ft bgs)	6.5	20.5	28.5	28.0	31.5	40.5	56.0	55.5	61.0	66.8	20.1	35.4	34.5	-
		Bottom Depth (ft bgs)	10.0	36.6	32.0	29.5	37.4	41.3	57.7	56.1	64.5	68.0	21.2	35.7	34.8	-
		Top Elevation (ft)	84.2	50.3	42.9	43.5	39.1	30.3	16.7	16.7	11.8	7.3	(7.8)	(29.4)	(28.3)	-
		Bottom Elevation (ft)	**80.7**	**34.2**	**39.4**	**42.0**	**33.2**	**29.5**	**15.0**	**16.1**	**8.3**	**6.1**	**(8.9)**	**(29.7)**	**(28.6)**	**-**
		Thickness (ft)	3.5	16.1	3.5	1.5	5.9	0.8	1.7	0.6	3.5	1.2	1.1	0.3	0.3	-
	Bedrock	Top Depth (ft bgs)	10.0	36.6	32.0	29.5	37.4	41.3	57.7	56.1	64.5	68.0	21.2	35.7	34.8	-
		Bottom Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Top Elevation (ft)	**80.7**	**34.2**	**39.4**	**42.0**	**33.2**	**29.5**	**15.0**	**16.1**	**8.3**	**6.1**	**(8.9)**	**(29.7)**	**(28.6)**	**-**
		Bottom Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Thickness (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes:

Red Text	= Data based on CPT refusal. Values are approximate, but reasonable considering relatively thin layer of Glacial Till identified in most soil borings.
Highlighted Text	= Elevations adjusted to match "base" map/existing conditions topography.

Prepared By/Date: NDL/TCC Jul 2014
Checked By/Date: TCC Jul 2014

Table C-3
Summary of Overburden Soil Stratigraphy along Profile E2

			West															East
Primary Stratum		Exploration No.	**TP-11**	**RC-1145**	**SCPT-02**	**CPT-25**	**CP-616**	**SCPT-10**	**SB-1120**	**SCPT-16A**	**SCPT-16**	**SB-1119**	**SB-1124**	**SB-1116**	**SCPT-28**	**SB-704**	**SB-1139**	**SD-708**
		Profile No.	E2	N1/E2	E2	S2	E2	E2	E3	E2	E2	E2	E2	E2	E2	E2	E2	E1/E2
		Station, X-Coordinate (ft)	7+88	6+55	5+65	4+53	3+93	2+10	2+10	1+55	1+55	1+34	1+22	-0+31	-0+31	-0+66	-1+03	-2+83
		Ground Surface Elev. (ft)	**97.9**	**71.4**	**69.6**	**69.3**	**69.1**	**71.9**	**72.2**	**73.3**	**73.4**	**75.5**	**76.6**	**10.0**	**10.4**	**5.4**	**5.6**	**1.5**
		1965 Ground Surface Elev. (ft)	100.0	78.0	67.0	52.0	45.0	28.5	27.5	22.5	22.5	21.0	20.5	8.5	8.0	5.5	0.0	-
		Existing Water Level Elev. (ft)	N/E	65.8	69.0	60.0	~66	59.5	~58	61.0	N/E	53.0	49.0	10.0	10.0	5.4	-	3.0
FILL MATERIALS	Fill - Crest	Top Depth (ft bgs)	0.0	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Bottom Depth (ft bgs)	3.0	1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Gravel	Top Elevation (ft)	97.9	71.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Reworked	Bottom Elevation (ft)	94.9	**70.4**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	Misc.	Thickness (ft)	3.0	1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Fill - Upland	Top Depth (ft bgs)	-	-	-	-	-	-	-	-	-	0.0	0.0	-	-	-	-	-
		Bottom Depth (ft bgs)	-	-	-	-	-	-	-	-	-	10.7	25.0	-	-	-	-	-
	Angular Rock	Top Elevation (ft)	-	-	-	-	-	-	-	-	-	75.5	76.6	-	-	-	-	-
	Waste Rock	Bottom Elevation (ft)	-	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	64.8	51.6	-	**-**	**-**	**-**	**-**
		Thickness (ft)	-	-	-	-	-	-	-	-	-	10.7	25.0	-	-	-	-	-
	Tailings	Top Depth (ft bgs)	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.7	25.0	-	-	-	-	-
		Bottom Depth (ft bgs)	-	-	10.0	19.0	26.5	55.3	55.0	50.0	6.6	56.2	53.0	-	-	-	-	-
		Top Elevation (ft)	-	-	69.6	69.3	69.1	71.9	72.2	73.3	73.4	64.8	51.6	-	-	-	-	-
		Bottom Elevation (ft)	**-**	**-**	59.6	50.3	42.6	16.6	17.2	23.3	**66.8**	19.3	23.6	**-**	**-**	**-**	**-**	**-**
		Thickness (ft)	-	-	10.0	19.0	26.5	55.3	55.0	50.0	6.6	45.5	28.0	-	-	-	-	-
	Fill - Deep1	Top Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Bottom Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Rework Clay/Till	Top Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Granular	Bottom Elevation (ft)	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	Organics	Thickness (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Tailings	Top Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Bottom Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Top Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Bottom Elevation (ft)	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
		Thickness (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Fill - Deep2	Top Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	53.0	-	-	-	-	-
		Bottom Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	61.1	-	-	-	-	-
	Rework Clay/Till	Top Elevation (ft)	-	-	-	-	-	-	-	-	-	-	23.6	-	-	-	-	-
	Granular	Bottom Elevation (ft)	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	15.5	**-**	**-**	**-**	**-**	**-**
	Organics	Thickness (ft)	-	-	-	-	-	-	-	-	-	-	8.1	-	-	-	-	-
	Fill - Toe 1	Top Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	-	0.0	0.0	0.0	-	-
		Bottom Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	-	4.0	4.5	0.5	-	-
	Gravel/Sand/Silt	Top Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	10.0	10.4	5.4	-	-
	Reworked	Bottom Elevation (ft)	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	6.0	5.9	4.9	-	**-**
	Misc.	Thickness (ft)	-	-	-	-	-	-	-	-	-	-	-	4.0	4.5	0.5	-	-
	Fill - Toe 2	Top Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	-	-	-	0.5	-	-
		Bottom Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	-	-	-	2.0	-	-
	Fine-Grained	Top Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	4.9	-	-
	Clay/Organic	Bottom Elevation (ft)	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	3.4	-	**-**
	Misc.	Thickness (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	1.5	-	-
NATIVE SOILS & BEDROCK	Topsoil/Estuarine	Top Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	-	4.0	4.5	2.0	0.0	0.0
		Bottom Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	-	6.8	8.0	4.5	11.3	6.5
	Topsoil	Top Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	6.0	5.9	3.4	5.6	1.5
	Salt Marsh Org.	Bottom Elevation (ft)	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	3.2	2.4	0.9	(5.8)	(5.0)
	Salt Marsh Clay	Thickness (ft)	-	-	-	-	-	-	-	-	-	-	-	2.8	3.5	2.5	11.3	6.5
	Presumpscot Clay	Top Depth (ft bgs)	-	-	-	-	-	-	-	50.0	-	56.2	61.1	6.8	8.0	4.5	11.3	6.5
		Bottom Depth (ft bgs)	-	-	-	-	-	-	-	61.5	-	66.7	67.8	31.0	30.0	27.5	33.4	-
		Top Elevation (ft)	-	-	-	-	-	-	-	23.3	-	19.3	15.5	3.2	2.4	0.9	(5.8)	(5.0)
		Bottom Elevation (ft)	**-**	**-**	**-**	**-**	**-**	**-**	**-**	11.8	**-**	8.8	**8.8**	(21.0)	(19.6)	(22.1)	(27.9)	**< (8.5)**
		Thickness (ft)	-	-	-	-	-	-	-	11.5	-	10.5	6.7	24.2	22.0	23.0	22.1	> 3.5
	Glacial Till	Top Depth (ft bgs)	3.0	-	10.0	19.0	26.5	55.3	55.0	61.5	-	66.7	-	31.0	30.0	27.5	33.4	-
		Bottom Depth (ft bgs)	10.0	-	11.5	22.6	31.3	57.7	57.9	62.3	-	67.4	-	31.7	31.0	28.8	35.9	-
		Top Elevation (ft)	94.9	-	59.6	50.3	42.6	16.6	17.2	11.8	-	8.8	-	(21.0)	(19.6)	(22.1)	(27.9)	-
		Bottom Elevation (ft)	**87.9**	**-**	**58.1**	**46.7**	**37.8**	**14.2**	**14.3**	**11.0**	**-**	**8.1**	**-**	**(21.7)**	**(20.6)**	**(23.4)**	**(30.4)**	**-**
		Thickness (ft)	7.0	-	1.5	3.6	4.8	2.4	2.9	0.8	-	0.7	-	0.7	1.0	1.3	2.5	-
	Bedrock	Top Depth (ft bgs)	10.0	1.0	11.5	22.6	31.3	57.7	57.9	62.3	-	67.4	67.8	31.7	31.0	28.8	35.9	-
		Bottom Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Top Elevation (ft)	**87.9**	**70.4**	**58.1**	**46.7**	**37.8**	**14.2**	**14.3**	**11.0**	**-**	**8.1**	**8.8**	**(21.7)**	**(20.6)**	**(23.4)**	**(30.4)**	**-**
		Bottom Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Thickness (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes:

Red Text	= Data based on CPT refusal. Values are approximate, but reasonable considering relatively thin layer of Glacial Till identified in most soil borings.
Highlighted Text	= Elevations adjusted to match "base" map/existing conditions topography.

Prepared By/Date: NDL Aug 2014
Checked By/Date: TCC

Table C-4
Summary of Overburden Soil Stratigraphy along Profile E3

West — East

	Primary Stratum	Exploration No.	MW-723R	TP-09	TP-08	TP-07	CPT-03	SB-1131	CPT-26	SB-605B	SB-1121	SCPT-09	SB-705	CPT-14A	SB-1122	SB-1123	SB-702	SCPT-29	SB-1138	SD-707
		Profile No.	E3/S2/E4	E3	E3	E3/S2	E3/N1/S2	E3/N1	E3/N1	E3	E3	E3	E3	E3	E3	E3	E3	E3	E3	E3
		Station, X-Coordinate (ft)	757.00	715.00	657.00	637.00	503.00	426.00	426.00	241.00	181.00	181.00	132.00	139.00	119.00	105.00	-37.00	-47.00	-100.00	-185.00
		Ground Surface Elev. (ft)	**99.8**	**95.6**	**87.0**	**80.3**	**69.6**	**69.3**	**69.4**	**70.7**	**72.3**	**72.1**	**73.2**	**72.9**	**75.7**	**77.0**	**10.4**	**9.7**	**4.0**	**1.5**
		1965 Ground Surface Elev. (ft)	104.0	97.0	87.5	87.0	65.0	52.5	52.5	33.0	27.5	27.5	20.0	20.5	18.5	17.5	7.5	4.5	4.0	-
		Existing Water Level Elev. (ft)	88.0	88.6	None	None	69.0	66.3	60.0	61.5	60.0	-	56.0	-	54.0	47.5	7.0	-	3.0	3.0
FILL MATERIALS	Fill - Crest	Top Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Bottom Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Gravel Reworked Misc.	Top Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Bottom Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Thickness (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Fill - Upland	Top Depth (ft bgs)	0.0	0.0	-	-	-	-	-	-	-	-	-	-	0.0	0.0	-	-	-	-
		Bottom Depth (ft bgs)	2.0	7.0	-	-	-	-	-	-	-	-	-	-	17.0	33.5	-	-	-	-
	Angular Rock Waste Rock	Top Elevation (ft)	99.8	95.6	-	-	-	-	-	-	-	-	-	-	75.7	77.0	-	-	-	-
		Bottom Elevation (ft)	**97.8**	**88.6**	-	-	-	-	-	-	-	-	-	-	**58.7**	**43.5**	-	-	-	-
		Thickness (ft)	2.0	7.0	-	-	-	-	-	-	-	-	-	-	17.0	33.5	-	-	-	-
	Tailings	Top Depth (ft bgs)	-	-	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.0	33.5	-	-	-	-
		Bottom Depth (ft bgs)	-	-	-	-	14.0	29.5	28.5	40.0	51.0	50.2	30.8	43.5	56.0	56.0	-	-	-	-
		Top Elevation (ft)	-	-	-	-	69.6	69.3	69.4	70.7	72.3	72.1	73.2	72.9	58.7	43.5	-	-	-	-
		Bottom Elevation (ft)	-	-	-	-	**55.6**	**39.8**	**40.9**	**30.7**	**21.3**	**21.9**	**42.4**	**29.4**	**19.7**	**21.0**	-	-	-	-
		Thickness (ft)	-	-	-	-	14.0	29.5	28.5	40.0	51.0	50.2	30.8	43.5	39.0	22.5	-	-	-	-
	Fill - Deep1	Top Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	30.8	-	-	-	-	-	-	-
		Bottom Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	31.6	-	-	-	-	-	-	-
	Rework Clay/Till Granular Organics	Top Elevation (ft)	-	-	-	-	-	-	-	-	-	-	42.4	-	-	-	-	-	-	-
		Bottom Elevation (ft)	-	-	-	-	-	-	-	-	-	-	**41.6**	-	-	-	-	-	-	-
		Thickness (ft)	-	-	-	-	-	-	-	-	-	-	0.8	-	-	-	-	-	-	-
	Tailings	Top Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	31.6	-	-	-	-	-	-	-
		Bottom Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	43.8	-	-	-	-	-	-	-
		Top Elevation (ft)	-	-	-	-	-	-	-	-	-	-	41.6	-	-	-	-	-	-	-
		Bottom Elevation (ft)	-	-	-	-	-	-	-	-	-	-	**29.4**	-	-	-	-	-	-	-
		Thickness (ft)	-	-	-	-	-	-	-	-	-	-	12.2	-	-	-	-	-	-	-
	Fill - Deep2	Top Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	43.8	43.5	56.0	56.0	-	-	-	-
		Bottom Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	56.0	56.8	63.5	66.2	-	-	-	-
	Rework Clay/Till Granular Organics	Top Elevation (ft)	-	-	-	-	-	-	-	-	-	-	29.4	29.4	19.7	21.0	-	-	-	-
		Bottom Elevation (ft)	-	-	-	-	-	-	-	-	-	-	**17.2**	**16.1**	**12.2**	**10.8**	-	-	-	-
		Thickness (ft)	-	-	-	-	-	-	-	-	-	-	12.2	13.3	7.5	10.2	-	-	-	-
	Fill - Toe 1	Top Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0	0.0	-	-
		Bottom Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.5	5.0	-	-
	Gravel/Sand/Silt Reworked Misc.	Top Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10.4	9.7	-	-
		Bottom Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**5.9**	**4.7**	-	-
		Thickness (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.5	5.0	-	-
	Fill - Toe 2	Top Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Bottom Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Fine-Grained Clay/Organic Misc.	Top Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Bottom Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Thickness (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NATIVE SOILS & BEDROCK	Topsoil/Estuarine	Top Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	56.0	-	-	-	4.5	5.0	0.0	0.0
		Bottom Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	56.5	-	-	-	8.0	8.3	8.0	6.0
	Topsoil Salt Marsh Org. Salt Marsh Clay	Top Elevation (ft)	-	-	-	-	-	-	-	-	-	-	17.2	-	-	-	5.9	4.7	4.0	1.5
		Bottom Elevation (ft)	-	-	-	-	-	-	-	-	-	-	**16.7**	-	-	-	**2.4**	**1.5**	**(4.0)**	**(4.5)**
		Thickness (ft)	-	-	-	-	-	-	-	-	-	-	0.5	-	-	-	3.5	3.3	8.0	6.0
	Presumpscot Clay	Top Depth (ft bgs)	-	-	-	-	14.0	-	28.5	40.0	-	50.2	56.5	56.8	63.5	66.2	8.0	8.3	8.0	6.0
		Bottom Depth (ft bgs)	-	-	-	-	15.0	-	30.5	43.2	-	51.2	63.0	59.4	65.4	68.4	23.5	25.8	23.0	10.0
		Top Elevation (ft)	-	-	-	-	55.6	-	40.9	30.7	-	21.9	16.7	16.1	12.2	10.8	2.4	1.5	(4.0)	(4.5)
		Bottom Elevation (ft)	-	-	-	-	**54.6**	-	**38.9**	**27.5**	-	**20.9**	**10.2**	**13.5**	**10.3**	**8.6**	**(13.1)**	**(16.1)**	**(19.0)**	**< (8.5)**
		Thickness (ft)	-	-	-	-	1.0	-	2.0	3.2	-	1.0	6.5	2.6	1.9	2.2	15.5	17.6	15.0	> 4.0
	Glacial Till	Top Depth (ft bgs)	2.0	7.0	0.0	0.0	15.0	29.5	30.5	43.2	51.0	51.2	63.0	59.4	-	-	23.5	25.8	23.0	-
		Bottom Depth (ft bgs)	10.0	9.0	1.5	1.5	15.4	30.5	31.0	45.1	52.7	52.0	64.6	60.9	-	-	26.2	30.8	27.8	-
		Top Elevation (ft)	97.8	88.6	87.0	80.3	54.6	39.8	38.9	27.5	21.3	20.9	10.2	13.5	-	-	(13.1)	(16.1)	(19.0)	-
		Bottom Elevation (ft)	**89.8**	**86.6**	**85.5**	**78.8**	**54.2**	**38.8**	**38.4**	**25.6**	**19.6**	**20.1**	**8.6**	**12.0**	-	-	**(15.8)**	**(21.1)**	**(23.8)**	-
		Thickness (ft)	8.0	2.0	1.5	1.5	0.4	1.0	0.5	1.9	1.7	0.8	1.6	1.5	-	-	2.7	5.0	4.8	-
	Bedrock	Top Depth (ft bgs)	10.0	9.0	1.5	1.5	15.4	30.5	31.0	45.1	52.7	52.0	64.6	60.9	65.4	68.4	26.2	30.8	27.8	-
		Bottom Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Top Elevation (ft)	**89.8**	**86.6**	**85.5**	**78.8**	**54.2**	**38.8**	**38.4**	**25.6**	**19.6**	**20.1**	**8.6**	**12.0**	**10.3**	**8.6**	**(15.8)**	**(21.1)**	**(23.8)**	-
		Bottom Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Thickness (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes:

Red Text	= Data based on CPT refusal. Values are approximate, but reasonable considering relatively thin layer of Glacial Till identified in most soil borings.
Highlighted Text	= Elevations adjusted to match "base" map/existing conditions topography.

Prepared By/Date: NDL/TCC Jul 2014
Checked By/Date: TCC Jul 2014

Table C-5
Summary of Overburden Soil Stratigraphy along Profile E4

West — East

Primary Stratum		Exploration No.	MW-723R	TP-06	TP-05	TP-04	SCPT-04	SB-1130	SB-603	CP-610	CP-611	CP-613	SB-604	CP-612	SB-701	P-1106	CPT-30	SB-1104	SD-707
		Profile No.	E3/S2/E4	E4	E4	E4	E4	E4	N1/E4	N1/E4	N1/E4	E4	E4	E4	E4	E4	E4	E4	E3
		Station, X-Coordinate (ft) on E4	7+19	6+84	6+72	6+57	5+10	5+00	4+22	4+22	3+16	2+35	1+58	1+58	-0+22	-0+28	-0+33	-0+44	-1+57
		Ground Surface Elev. (ft)	**99.8**	**94.9**	**91.4**	**85.2**	**70.2**	**69.9**	**70.1**	**70.0**	**71.5**	**72.6**	**73.9**	**73.6**	**9.5**	**10.0**	**9.7**	**4.2**	**1.5**
		1965 Ground Surface Elev. (ft)	104.0	96.0	93.0	88.0	55.0	53.0	45.0	45.0	35.0	28.8	22.0	22.0	5.0	3.0	1.0	5.5	-
		Existing Water Level Elev. (ft)	88.0	None	None	None	67.2	~65.0	64.5	58.0	55.5	53.3	53.0	46.4	7.4	N/A	9.0	N/A	4.0
FILL MATERIALS	Fill - Crest	Top Depth (ft bgs)	-	-	-	-	-	-	0.0	-	-	-	-	-	-	-	-	-	-
		Bottom Depth (ft bgs)	-	-	-	-	-	-	0.2	-	-	-	-	-	-	-	-	-	-
	Gravel	Top Elevation (ft)	-	-	-	-	-	-	70.1	-	-	-	-	-	-	-	-	-	-
	Reworked	Bottom Elevation (ft)	-	-	-	-	-	-	69.9	-	-	-	-	-	-	-	-	-	-
	Misc.	Thickness (ft)	-	-	-	-	-	-	0.2	-	-	-	-	-	-	-	-	-	-
	Fill - Upland	Top Depth (ft bgs)	0.0	0.0	0.0	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-
		Bottom Depth (ft bgs)	2.0	1.5	1.5	0.8	-	-	-	-	-	-	-	-	-	-	-	-	-
	Angular Rock	Top Elevation (ft)	99.8	94.9	91.4	85.2	-	-	-	-	-	-	-	-	-	-	-	-	-
	Waste Rock	Bottom Elevation (ft)	**97.8**	**93.4**	**89.9**	**84.4**	-	-	-	-	-	-	-	-	-	-	-	-	-
		Thickness (ft)	2.0	1.5	1.5	0.8	-	-	-	-	-	-	-	-	-	-	-	-	-
	Tailings	Top Depth (ft bgs)	-	-	-	-	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
		Bottom Depth (ft bgs)	-	-	-	-	14.5	17.4	26.9	26.0	35.0	50.5	56.5	57.0	-	-	-	-	-
		Top Elevation (ft)	-	-	-	-	70.2	69.9	69.9	70.0	71.5	72.6	73.9	73.6	-	-	-	-	-
		Bottom Elevation (ft)	-	-	-	-	55.7	52.5	43.2	44.0	36.5	22.1	17.4	16.6	-	-	-	-	-
		Thickness (ft)	-	-	-	-	14.5	17.4	26.7	26.0	35.0	50.5	56.5	57.0	-	-	-	-	-
	Fill - Deep1	Top Depth (ft bgs)	-	-	-	-	-	-	26.9	26.0	-	-	-	-	-	-	-	-	-
		Bottom Depth (ft bgs)	-	-	-	-	-	-	33.0	28.4	-	-	-	-	-	-	-	-	-
	Rework Clay/Till	Top Elevation (ft)	-	-	-	-	-	-	43.2	44.0	-	-	-	-	-	-	-	-	-
	Granular	Bottom Elevation (ft)	-	-	-	-	-	-	37.1	**41.6**	-	-	-	-	-	-	-	-	-
	Organics	Thickness (ft)	-	-	-	-	-	-	6.1	2.4	-	-	-	-	-	-	-	-	-
	Tailings	Top Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Bottom Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Top Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Bottom Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Thickness (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Fill - Deep2	Top Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Bottom Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Rework Clay/Till	Top Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Granular	Bottom Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Organics	Thickness (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Fill - Toe 1	Top Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	-	-	0.0	0.0	0.0	-	-
		Bottom Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	-	-	2.0	6.0	6.0	-	-
	Gravel/Sand/Silt	Top Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	9.5	10.0	9.7	-	-
	Reworked	Bottom Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	7.5	4.0	3.7	-	-
	Misc.	Thickness (ft)	-	-	-	-	-	-	-	-	-	-	-	-	2.0	6.0	6.0	-	-
	Fill - Toe 2	Top Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	-	-	2.0	-	-	-	-
		Bottom Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	-	-	2.5	-	-	-	-
	Fine-Grained	Top Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	7.5	-	-	-	-
	Clay/Organic	Bottom Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	7.0	-	-	-	-
	Misc.	Thickness (ft)	-	-	-	-	-	-	-	-	-	-	-	-	0.5	-	-	-	-
NATIVE SOILS & BEDROCK	Topsoil/Estuarine	Top Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	56.5	-	2.5	-	6.0	0.0	0.0
		Bottom Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	58.5	-	4.5	-	7.5	6.0	6.0
	Topsoil	Top Elevation (ft)	-	-	-	-	-	-	-	-	-	-	17.4	-	7.0	-	3.7	4.2	1.5
	Salt Marsh Org.	Bottom Elevation (ft)	-	-	-	-	-	-	-	-	-	-	15.4	-	5.0	-	2.2	(1.8)	(4.5)
	Salt Marsh Clay	Thickness (ft)	-	-	-	-	-	-	-	-	-	-	2.0	-	2.0	-	1.5	6.0	6.0
	Presumpscot Clay	Top Depth (ft bgs)	-	-	-	-	-	-	33.0	-	-	-	58.5	57.0	4.5	6.0	7.5	-	6.0
		Bottom Depth (ft bgs)	-	-	-	-	-	-	41.8	-	-	-	60.0	60.0	8.2	9.0	13.5	-	10.0
		Top Elevation (ft)	-	-	-	-	-	-	37.1	-	-	-	15.4	16.6	5.0	4.0	2.2	-	(4.5)
		Bottom Elevation (ft)	-	-	-	-	-	-	28.3	-	-	-	13.9	13.6	1.3	1.0	(3.8)	-	**< (8.5)**
		Thickness (ft)	-	-	-	-	-	-	8.8	-	-	-	1.5	3.0	3.7	3.0	6.0	-	> 4.0
	Glacial Till	Top Depth (ft bgs)	2.0	-	-	-	14.5	17.4	41.8	-	35.0	50.5	60.0	60.0	8.2	9.0	13.5	6.0	-
		Bottom Depth (ft bgs)	10.0	-	-	-	19.5	17.8	48.5	-	41.2	51.5	61.7	63.0	9.5	12.5	14.1	8.1	-
		Top Elevation (ft)	97.8	-	-	-	55.7	52.5	28.3	-	36.5	22.1	13.9	13.6	1.3	1.0	(3.8)	(1.8)	-
		Bottom Elevation (ft)	**89.8**	-	-	-	**50.7**	**52.1**	**21.6**	-	**30.3**	**21.1**	**12.2**	**10.6**	**0.0**	**(2.5)**	**(4.4)**	**(3.9)**	-
		Thickness (ft)	8.0	-	-	-	5.0	0.4	6.7	-	6.2	1.0	1.7	3.0	1.3	3.5	0.6	2.1	-
	Bedrock	Top Depth (ft bgs)	10.0	1.5	1.5	0.8	19.5	17.8	48.5	-	41.2	51.5	61.7	63.0	9.5	12.5	14.1	8.1	-
		Bottom Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Top Elevation (ft)	**89.8**	**93.4**	**89.9**	**84.4**	**50.7**	**52.1**	**21.6**	-	**30.3**	**21.1**	**12.2**	**10.6**	**0.0**	**(2.5)**	**(4.4)**	**(3.9)**	-
		Bottom Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Thickness (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes:

Red Text	= Data based on CPT refusal. Values are approximate, but reasonable considering relatively thin layer of Glacial Till identified in most soil borings.
Highlighted Text	= Elevations adjusted to match "base" map/existing conditions topography.

Prepared By/Date: NDL Jul 2014
Checked By/Date: TCC Jul 2014

Table C-6
Summary of Overburden Soil Stratigraphy along Profile N1

	Primary Stratum	Exploration No.	RC-1145	SB-707	CPT-03	SB-1131	CPT-26	SB-603	CP-610	CP-611	CPT-06	SB-1140	CPT-07	SB-1125	SB-1101	SB-713
		Profile No.	N1/E2	N1	E3/N1/S2	E3/N1	E3/N1	N1/E4	N1/E4	N1/E4	N1	N1	N1	ALL	N1	N1
		Station, X-Coordinate (ft) on N1	7+28	6+20	5+33	4+58	4+58	3+40	3+40	2+55	1+63	1+25	1+10	0+74	-0+28	-1+11
		Ground Surface Elevation (ft)	**71.4**	**69.2**	**69.6**	**69.3**	**69.4**	**70.1**	**70.0**	**71.5**	**73.6**	**74.0**	**74.1**	**77.8**	**18.9**	**10.3**
		1965 Ground Surface Elev. (ft)	**78.0**	**67.0**	**65.0**	**52.5**	**52.5**	**45.0**	**45.0**	**35.0**	**30.0**	**23.0**	**22.0**	**20.5**	**8.0**	**4.0**
		Existing Water Level Elev. (ft)	65.8	64.2	69.0	66.3	60.0	64.5	58.0	55.5	63.0	53.0	50.0	-	-	7.0
FILL MATERIALS	Fill - Crest	Top Depth (ft bgs)	0.0	-	-	-	-	0.0	-	-	-	-	-	-	-	-
		Bottom Depth (ft bgs)	1.0	-	-	-	-	0.2	-	-	-	-	-	-	-	-
	Gravel	Top Elevation (ft)	71.4	-	-	-	-	70.1	-	-	-	-	-	-	-	-
	Reworked	Bottom Elevation (ft)	**70.4**	-	-	-	-	69.9	-	-	-	-	-	-	-	-
	Misc.	Thickness (ft)	1.0	-	-	-	-	0.2	-	-	-	-	-	-	-	-
	Fill - Upland	Top Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	-	0.0	-	-
		Bottom Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	-	51.0	-	-
	Angular Rock	Top Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	77.8	-	-
	Waste Rock	Bottom Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	26.8	-	-
		Thickness (ft)	-	-	-	-	-	-	-	-	-	-	-	51.0	-	-
	Tailings	Top Depth (ft bgs)	-	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	-	-	-
		Bottom Depth (ft bgs)	-	7.8	14.0	29.5	28.5	26.9	26.0	35.0	50.5	55.8	57.0	-	-	-
		Top Elevation (ft)	-	69.2	69.6	69.3	69.4	69.9	70.0	71.5	73.6	74.0	74.1	-	-	-
		Bottom Elevation (ft)	-	61.4	55.6	39.8	40.9	43.2	44.0	36.5	23.1	18.2	17.1	-	-	-
		Thickness (ft)	-	7.8	14.0	29.5	28.5	26.7	26.0	35.0	50.5	55.8	57.0	-	-	-
	Fill - Deep1	Top Depth (ft bgs)	-	-	-	-	-	26.9	26.0	-	-	-	-	-	-	-
		Bottom Depth (ft bgs)	-	-	-	-	-	33.0	28.4	-	-	-	-	-	-	-
	Rework Clay/Till	Top Elevation (ft)	-	-	-	-	-	43.2	44.0	-	-	-	-	-	-	-
	Granular	Bottom Elevation (ft)	-	-	-	-	-	37.1	**41.6**	-	-	-	-	-	-	-
	Organics	Thickness (ft)	-	-	-	-	-	6.1	2.4	-	-	-	-	-	-	-
	Tailings	Top Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Bottom Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Top Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Bottom Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Thickness (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Fill - Deep2	Top Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	-	51.0	-	-
		Bottom Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	-	63.5	-	-
	Rework Clay/Till	Top Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	26.8	-	-
	Granular	Bottom Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	14.3	-	-
	Organics	Thickness (ft)	-	-	-	-	-	-	-	-	-	-	-	12.5	-	-
	Fill - Toe 1	Top Depth (ft bgs)		-	-	-	-	-	-	-	-	-	-	-	0.0	0.0
		Bottom Depth (ft bgs)		-	-	-	-	-	-	-	-	-	-	-	6.5	6.5
	Gravel/Sand/Silt	Top Elevation (ft)		-	-	-	-	-	-	-	-	-	-	-	18.9	10.3
	Reworked	Bottom Elevation (ft)		-	-	-	-	-	-	-	-	-	-	-	12.4	3.8
	Misc.	Thickness (ft)		-	-	-	-	-	-	-	-	-	-	-	6.5	6.5
	Fill - Toe 2	Top Depth (ft bgs)		-	-	-	-	-	-	-	-	-	-	-	6.5	-
		Bottom Depth (ft bgs)		-	-	-	-	-	-	-	-	-	-	-	11.0	-
	Fine-Grained	Top Elevation (ft)		-	-	-	-	-	-	-	-	-	-	-	12.4	-
	Clay/Organic	Bottom Elevation (ft)		-	-	-	-	-	-	-	-	-	-	-	7.9	-
	Misc.	Thickness (ft)		-	-	-	-	-	-	-	-	-	-	-	4.5	-
NATIVE SOILS & BEDROCK	Topsoil/Estuarine	Top Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	-	63.5	-	6.5
		Bottom Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	-	66.0	-	9.3
	Topsoil	Top Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	14.3	-	3.8
	Salt Marsh Org.	Bottom Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	11.8	-	1.0
	Salt Marsh Clay	Thickness (ft)	-	-	-	-	-	-	-	-	-	-	-	2.5	-	2.8
	Presumpscot Clay	Top Depth (ft bgs)	-	-	14.0	-	28.5	33.0	-	-	50.5	-	57.0	66.0	11.0	9.3
		Bottom Depth (ft bgs)	-	-	15.0	-	30.5	41.8	-	-	60.5	-	61.0	73.5	27.5	19.3
		Top Elevation (ft)	-	-	55.6	-	40.9	37.1	-	-	23.1	-	17.1	11.8	7.9	1.0
		Bottom Elevation (ft)	-	-	54.6	-	38.9	28.3	-	-	13.1	-	13.1	4.3	(8.6)	(9.0)
		Thickness (ft)	-	-	1.0	-	2.0	8.8	-	-	10.0	-	4.0	7.5	16.5	10.0
	Glacial Till	Top Depth (ft bgs)	-	7.8	15.0	29.5	30.5	41.8	-	35.0	60.5	55.8	61.0	73.5	27.5	19.3
		Bottom Depth (ft bgs)	-	8.5	15.4	30.5	31.0	48.5	-	41.2	60.9	57.3	64.5	76.8	29.6	19.8
		Top Elevation (ft)	-	61.4	54.6	39.8	38.9	28.3	-	36.5	13.1	18.2	13.1	4.3	(8.6)	(9.0)
		Bottom Elevation (ft)	-	**60.7**	**54.2**	**38.8**	**38.4**	**21.6**	**-**	**30.3**	12.7	**16.7**	9.6	**1.0**	**(10.7)**	**(9.5)**
		Thickness (ft)	-	0.7	0.4	1.0	0.5	6.7	-	6.2	0.4	1.5	3.5	3.3	2.1	0.5
	Bedrock	Top Depth (ft bgs)	1.0	8.5	15.4	30.5	31.0	48.5	-	41.2	60.9	57.3	64.5	76.8	29.6	19.8
		Bottom Depth (ft bgs)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Top Elevation (ft)	**70.4**	**60.7**	**54.2**	**38.8**	**38.4**	**21.6**	**-**	**30.3**	**12.7**	**16.7**	**9.6**	**1.0**	**(10.7)**	**(9.5)**
		Bottom Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Thickness (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes:

Red Text	= Data based on CPT refusal. Values are approximate, but reasonable considering relatively thin layer of Glacial Till identified in most soil borings.
Highlighted Text	= Elevations adjusted to match "base" map/existing conditions topography.

Prepared By/Date: NDL Jun 2014
Checked By/Date: TCC Jul 2014

Table C-7
Summary of Material Properties used for the Long-Term Static Slope Stability Evaluation

Material	Effective Stress Parameters (long-term)				Comments
	Unit Weight		Strength		
	Above Water Table	Below Water Table			
	γ_t (pcf)	γ_{SAT} (pcf)	c' (psf)	ϕ' (deg)	
Cover Materials (crushed rock/aggregate)	100	125	0	41	
Waste Rock	95	120	0	42	
Waste Rock/Dewatered Tailings Mix	115	125	0	38	To be placed as fill atop central portions of the impoundment.
Tailings - Sands	110	120	0	37	
Tailings - Mixed	110	117	0	36	
Tailings - Slimes	110	114	0	35	
Fill - Rock/Sand/Fines Mix	120	130	25	36	
Fill - Sand/Fines/Org Mix	115	120	25	32	
Fill - Reworked Clay/Till	120	125	2,000	0	Part of and/or located behind the starter dam.
Salt-Marsh - Clay/Org.	105	120	750	0	
	105	125	375	0	
Clay	125		2,750	0	Other unit weight/strength combinations may be applied to small zones within a specific profile, based on strength increase methodology. Actual weight/strength combinations used for each SLOPE/W "run" are provided on the output page(s).
	125		2,250	0	
	123		1,750	0	
	123		1,500	0	
	122		1,250	0	
	122		1,075	0	
	121		875	0	
	121		750	0	
	120		625	0	
	120		550	0	
	119		475	0	
	118		375	0	
Glacial Till	130	135	50	36	For circular/rotational failure surfaces.
	Impenetrable				Selected runs to force composite failure surface.
Bedrock	Impenetrable				

Prepared By/Date:	NDL	Mar 2013
Checked By/Date:	TCC	Jul 2014

ATTACHMENT S2

PROFILE S2
LONG-TERM STATIC SLOPE STABILITY EVALUATION

ATTACHMENT S2-A

PROFILE S2
LONG-TERM STATIC SLOPE STABILITY EVALUATION

SLOPE/W MODEL DEVELOPMENT: EXISTING CONDITIONS

ATTACHMENT S2-A

PROFILE S2 - SLOPE/W MODEL DEVELOPMENT - EXISTING CONDITIONS

- See Figure C-1 for profile location.

A. Define Overall Geometry/Topography

- Existing site-specific topography is shown on Figure C-1.
    - Define Profile Station 0+00 as the "toe" of the rock dam.
        - Positive station numbers to the north
        - Negative station numbers to the south
- See Attachment S2-B for definition of key SLOPE/W points.

B. Impoundment Dam Configuration

- The assumed/interpreted configuration of the impoundment dam is as follows:
    - Constructed via "upstream" raised embankment methods.
    - 5 total lifts (starter dam plus 4 subsequent raises).
    - Starter dam constructed with clay and glacial till from on-site (and adjacent property to the south) and faced extensively with waste rock.
        - Top of starter dam at Elev. +36 ft (+/-) (~grade break).
        - Crest width of waste rock approximately 25 ft (+/-).
        - Backslope of waste rock approximately 1.3H:1V to 1.5H:1V.
        - Clay/glacial till extends 50 ft (+/-) behind the starter dam.
    - Subsequent raises/lifts constructed with waste rock and possibly lined/"chinked" with clay/till fill (limited extent/thickness).
        - Each lift/raise approximately 10 to 15 ft tall
        - Crest width of each waste rock lift/raise approximately 25 ft (+/-).
        - Backslope of each waste rock lift/raise approximately 1.3H:1V to 2.0H:1V.
- See Attachment S2-C for discussion, supporting data/evaluation, and sketches/cross-sections.

C. Define Subsurface Profile

- Geotechnical explorations along or in close proximity to Profile S2 are shown on Figure C-1.
    - MW-723R North
    - TP-07
    - CPT-03
    - CPT-25
    - SB-1132
    - CP-603
    - CPT-20
    - SB-1126 Crest
    - SB-1135
    - SB-1136
- Logs/records of these explorations are provided in prior investigation reports:
    - Credere, 2012 Supplemental Geotechnical Investigation
    - MACTEC, 2009a Geotechnical Evaluation Report
    - MACTEC, 2009b Remedial Investigation Report
- Table C-1 summarizes the primary soil strata encountered at these exploration locations.
    - Fill
    - Tailings
        - Tailings are further subdivided into "zones" of sand, mixed/stratified, or slimes based on description of sand, fines, and layering/thickness.
    - Clay/Till Fill
    - Native Estuarine
    - Presumpscot Clay
        - Native clay is further divided into layers/zones based on strength data.
    - Glacial Till
    - Other, as necessary

D. Assign Soil Unit Weight & Strength Parameters

- Assign unit weights based on soil type, in-situ conditions (e.g., density, consistency, saturation, etc.), published literature, and in conjunction with/comparison with bulk density measurements from Shelby tube samples.

- Strength parameters for Tailings developed based on site-specific field and laboratory testing programs and in conjunction with applicable mine-tailings-specific references (i.e., Vick 1990).

  Note: +/- adjustments to Tailings effective stress/strength parameters have negligible impact on estimated FOS.

- Strength parameters for Clay and Estuarine deposits developed based on site-specific field and laboratory testing programs.

  - FVST data
  - CPT Data
  - SPT Data
  - Strength adjustments for unexplored locations (beneath the waste rock impoundment dam) are presented in Attachment S2-D.

- Strength Parameters for Glacial Till and various Fill materials developed based on site-specific field and laboratory testing programs and published values.

- Strength parameters for impoundment berm (i.e., crushed/angular waste rock) developed based on published FHWA values/data (see Sheet 6).

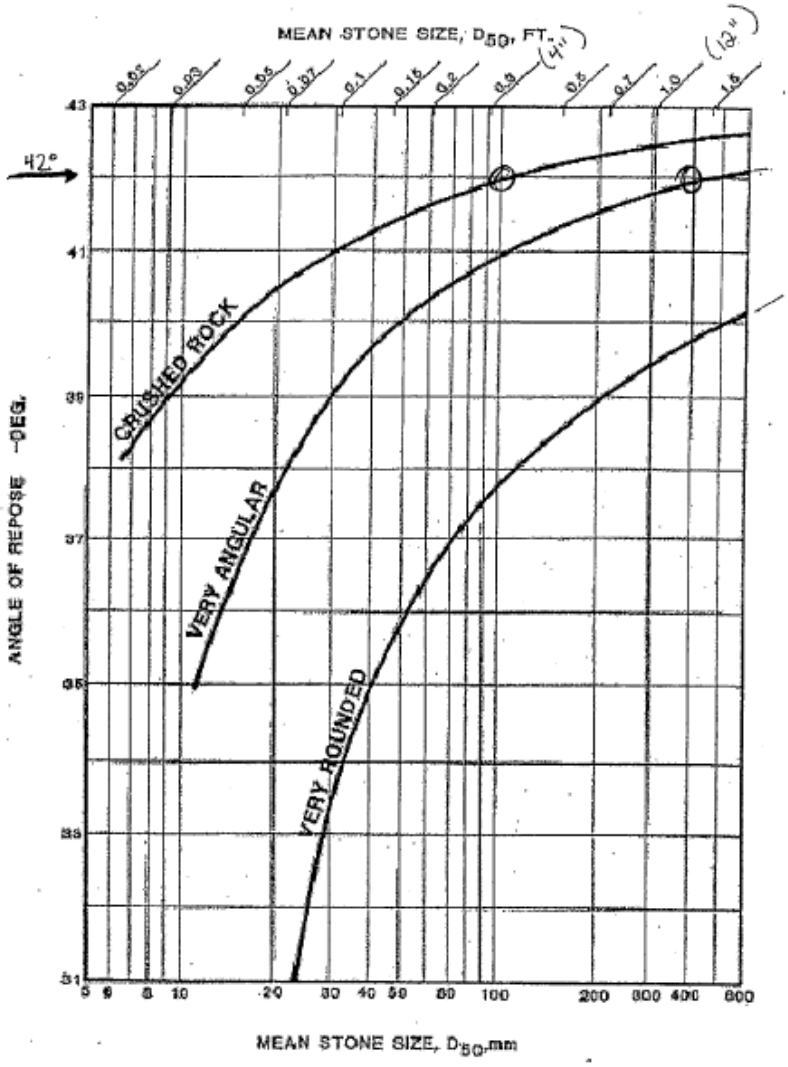
- Actual weight and strength parameters for each soil type are listed on Slope/W output files.

E. Estimate Shear Strength Increase in Clay Beneath Impoundment Dam

- Clay strengths known at crest (SB-1126) and at toe (SB-1135). Use procedures below to provide reasonable estimates of clay strength in between the known points.
- See Attachment S2-C for sketch comparing existing conditions vs. historic (pre-mining) topography.
- Estimate gross effective stress increase - Pre-mining "cuts" approximately equal to net effective stress increase. See Attachment S2-D.
- Use Winstress software to estimate effective stress increase in clay soils at various intervals between the crest and toe. See Attachment S2-D for Winstress setup and associated output files.
- Estimate strength increase in soft/normally consolidated clay soils based on $Su/\sigma`v = 0.2$ (relationship based on site-specific lab testing and in agreement with literature values. Strength increase in medium stiff clay soils based on $Su/\sigma`v = 0.15$. Strength increase in stiff clay soils based on $Su/\sigma`v = 0.1$. No strength increase applied to very stiff clay. See Attachment S2-D.
- Apply strength increase to the "toe" conditions in segmented/zoned areas beneath the berm. See Attachment S2-D.
- See Slope/W output files for zones and strengths assigned.

F. Define Phreatic Surface/Water Table and/or Pore Pressure Grid

- Site-specific water levels measured in the installed/existing PZs, MWs, OWs, and/or VWPs provide information on impoundment water levels. This info indicates a slightly downward gradient (decreasing piezometric surface/pressure within the tailings with increasing depth bgs).
    - Water level data is available or formerly available at the following locations along or proximate to Profile S2:
        - MW-723R
        - CPT-03
        - CPT-25
        - SB-1132
        - CP-603
        - CPT-20
        - SB-1135
- A pore pressure grid can be utilized in Slope/W to model decreasing pore pressure gradients with depth. This approach is applicable for existing conditions. However, the remedial design includes installation of drainage features.
- For this evaluation, the pore pressures are modelled in Slope/W via a piezometric line and not a pore pressure grid. This is considered conservative for evaluation of existing conditions, but more reasonable/applicable for representing the long-term post-remediation impoundment water levels predicted by the groundwater model (Appendix A).
- The impoundment water levels used for existing conditions are shown in Table C-1.
    - This data is supplemented by the global assumption that the "heel" of each lift of the impoundment berm generally controls the phreatic surface. The water pressure is approximately zero near the heel of each lift.



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ATTACHMENT S2-B

PROFILE S2
LONG-TERM STATIC SLOPE STABILITY EVALUATION

EXISTING CONDITIONS SLOPE/W POINTS (GEOMETRY)

ATTACHMENT S2-B

PROFILE S2 - SLOPE/W MODEL DEVELOPMENT - EXISTING CONDITIONS

- Define cross-section perpendicular to impoundment dam "face".
- Define STA. 0+00 at Elev. +27.0 ft MSL (~"toe"/grade break of the impoundment dam).
- Define existing topography:

Point	STA.	Ground Surface EL. (ft)	Exploration	As-Drilled GS EL. (ft)
1	9+79	99		
2	9+67	98		
3	9+57	98		
4	9+43	97		
5	9+27	96		
6	9+24	95		
7	9+21	94		
8	9+18	93		
9	9+15	92		
10	9+11	91		
11	9+08	90		
12	9+04	89		
13	8+95	88		
14	8+86	87		
15	8+78	86		
16	8+72	85.3	$TP-07$	
17	8+70	85		
18	8+62	84		
19	8+56	83		
20	8+50	82		
21	8+41	81		
22	8+20	80		
23	8+00	79		
24	7+79	78		
25	7+66	77		
26	7+60	76		
27	7+55	75		
28	7+48	74		
29	7+40	73		
30	7+35	72		
31	7+30	71	$CPT-03$	
32	7+27	70		
33	6+85	71		

Point	STA.	Ground Surface EL. (ft)	Exploration	As-Drilled GS EL. (ft)
34	6+44	71		
35	5+48	71	$CPT-25$	
36	5+16	71		
37	4+19	71	$SB-1132$	
38	4+60	70		
39	4+43	70		
40	3+89	71		
41	3+10	71		
42	2+97	71.5	$CP-603$	
43	2+75	72		
44	2+35	73		
45	1+66	74		
46	1+46	74.5		
47	1+42	74.5	$CPT-20$	
48	1+17	75		
49	1+12	76		
50	0+99	77		
51	0+96	77	$SB-1126$	
52	0+88	76		
53	0+87	75		
54	0+78	70		
55	0+72	65		
56	0+65	60		
57	0+58	55		
58	0+52	50		
59	0+45	45		
60	0+38	40		
61	0+33	36		
62	0+28	35		
63	0+24	34		
64	0+19	33		
65	0+16	32		
66	0+13	31		
67	0+11	30		
68	0+08	29		
69	0+06	28		
70	0+00	27		
71	−0+21	27		
72	−0+22	26		
73	−0+23	27		
74	−0+35	28		

Point	STA.	Ground Surface EL. (ft)	Exploration	As-Drilled GS EL. (ft)
75	$-0+43$	28	$SB-1135$	27.7
76	$-0+68$	29		
77	$-0+94$	30		
78	$-0+98$	30	$SB-1136$	29.7
79	$-1+47$	30		
80	$-2+00$	30		
81	$-2+50$	30		

ATTACHMENT S2-C

PROFILE S2
LONG-TERM STATIC SLOPE STABILITY EVALUATION

IMPOUNDMENT DAM CONFIGURATION

ATTACHMENT S2-C

PROFILE S2 - DAM IMPOUNDMENT CONFIGURATION

A. Objective:

- To assess the configuration of the existing impoundment dam, including number of lifts/raises above the starter dam and the crest width and backslope of of each lift.

B. Discussion:

- Anecdotal information, historic photographs, and subsurface exploration data indicate that the impoundment dam was constructed via upstream raised embankment methods. Tailings were discharged via spigots placed peripherally along the crest of the starter dam (and each subsequent "lift" of the dam/embankment raise).

- Borings/wells drilled near the crest of the dam typically identify clay/glacial till fill "at depth" beneath the tailings.

C. Data Evaluation:

- MW-604R

  - Location: Northeastern corner of impoundment
  - Crest EL.: +75 to +77 ft (including surface gravel)
  - Toe EL.: +10 ft
  - Existing GS EL.: +77 ft
  - Horiz. Distance from Crest Grade Break (northern): 37 ft
  - Horiz. Distance from Crest Grade Break (eastern): 46 ft

  - Data Summary:

    - 0.0-1.5 ft bgs: Road base gravel;
    - 1.5-5.0 ft bgs: Gravel and cobbles;
    - 5.0-15.0 ft bgs: Poor recovery/limited soil description/stratigraphy due to sonic drilling method. In general, Waste Rock over Sand tailings, over Slime tailings @ ~12-15 ft bgs; and
    - 62.0-65.0 ft bgs: Possible reworked clay/glacial till.

  - Conclusions:

    - Gravel and cobbles at shallow depth may not be associated with the impoundment dam. Rather, used for support of present-day roadway.
    - Impoundment dam may not have been encountered at this boring. This suggests max crest width of uppermost dam ~25 ft for northern side, assuming ~10 ft tall lift (25+10*1.3=38 ft) OR ~20 ft for northern side, assuming a ~15 ft tall lift. Using the same criteria, a 25 to 30 ft wide crest is possible for the eastern side.
    - Slimes @ ~12-15 ft bgs suggest bottom of uppermost lift at ~EL. +65 ft, OR no spigot in the corner.
    - Clay/till fill at depth likely part of starter dam.

C. Data Evaluation - continued:

- MW-722R

  - Location: Southeastern corner of impoundment
  - Crest EL.: +75 to +77 ft
  - Toe EL.: +20 ft
  - Existing GS EL.: +77 ft
  - Horiz. Distance from Crest Grade Break (eastern): 37 ft
  - Horiz. Distance from Crest Grade Break (southern): 37 ft

  - Data Summary:

    - 0.0-1.0 ft bgs: Road base gravel;
    - 1.0- 10-15 ft bgs: Gravel, cobbles, and boulders;
    - >10-15 ft bgs: Sand/silt;
    - Limited soil description/stratigraphy at depth due to sonic drilling methods.

  - Conclusions:

    - Impoundment dam encountered at this location.
    - Some of the shallow gravel, cobbles, and boulders may be associated with support of present-day roadway.
    - Suggests crest width of 25 to 30 ft, assuming 10 to 15 ft lift.
    - Suggests 10 to 15 ft height for uppermost lift.
    - Suggests bottom of uppermost lift at ~EL. +62 to +67 ft.

- SB-1124 & SB-1119

  - Location: Eastern side (~E2 profile)
  - Crest EL.: +75 to +77 ft
  - Toe EL.: +15 ft
  - Existing GS EL.: +76.5 ft (SB-1124); +75.5 ft (SB-1119)
  - Horiz. Distance from Crest Grade Break: 22 ft (SB-1124); 32 ft (SB-1119)

  - Data Summary:

SB-1124		SB-1119	
0-1 ft bgs:	Roadway gravel	0-1 ft bgs:	Roadway gravel
1-25 ft bgs:	Waste rock	1-11 ft bgs:	Waste rock
25-43 ft bgs:	Sand tailings	11-28.5 ft bgs:	Sand tailings
- Obstruction ~33 ft bgs		- Boney ~19 ft bgs	
43-48.5 ft bgs:	Waste rock/tailings	28.5-56 ft bgs:	Mixed tailings
48.5-53 ft bgs:	Sand tailings	- Gravelly ~33 ft bgs	
53-61 ft bgs:	Reworked clay	56-61 ft bgs:	Clay, possible rework
61-68 ft bgs:	Native clay	61-67 ft bgs:	Native clay

C. Data Evaluation - continued:

- SB-1124 & SB-1119 - continued

  - Conclusions:

    - Empoundment dam encountered at these locations.
    - Suggests bottom of the uppermost lift at ~EL. +65.
    - Suggests 10-11 ft lift height for uppermost lift.
    - Suggests 25-30 ft wide crest width for uppermost lift.
    - SB-1119, SCPT-16 (refusal at 6.5 ft bgs, 14 ft from SB-1119), and SCPT-16A (No refusal, 23 ft from SB-1119) suggest ~2H:1V backslope on uppermost lift.
    - SB-1124 suggests 25-30 ft wide crest for 2nd uppermost lift.
    - SB-1124 sugests bottom of the 2nd uppermost lift at ~EL. +50 to +55 ft.
    - SB-1124 & SB-1119 indicate reworked clay fill at 53 ft and 56 ft bgs, respectively. Suggests clay fill with 2.5H:1V backslope. Indicates clay fill behind starter dam.

- SB-1123 & SB-1122

  - Location: Eastern side (~E3 profile)
  - Crest EL.: +75 to +78 ft
  - Toe EL.: +12 ft
  - Existing GS EL.: +77ft (SB-1123); +75.5 ft (SB-1122)
  - Horiz. Distance from Crest Grade Break: 20 ft (SB-1123); 29 ft (SB-1129)

  - Data Summary:

SB-1123		SB-1122
0-1.5 ft bgs:	Roadway gravel	0-8 ft bgs (+/-): Roadway gravel
1.5-23 ft bgs:	Waste rock	8-17 ft bgs (+/-): Waste rock
23-33.5 ft bgs:	Waste rock/tailings	17-33.5 ft bgs: Sand tailings
33.5-39.5 ft bgs:	Sand/mixed tailings	- Gravel/obstruction at 32.5 ft bgs
39.5-55.5 ft bgs:	Mixed tailings	33.5-56 ft bgs: Mixed tailings
55.5-66 ft bgs:	Reworked clay	56-63.5 ft bgs: Reworked clay
66-68.5 ft bgs:	Native clay	- "Boney" material at 59' bgs
68.5 ft bgs:	Till/bedrock	63.5-65.5 ft bgs: Native clay
		65.5 ft bgs: Till/bedrock

C. Data Evaluation - continued:

- SB-1123 & SB-1122 - continued
  - Conclusions:
    - Empoundment dam encountered at these locations.
    - Suggests bottom of the uppermost lift at ~EL. +65.
    - Suggests 10 ft lift height for uppermost lift.
    - Suggests 25-30 ft wide crest width for uppermost lift.
    - SB-1122, SCPT-14 (refusal at 6.5 ft bgs, 10 ft from SB-1122), and SCPT-14A (No refusal, 25 ft from SB-1122) suggest ~1.3H:1V backslope on uppermost lift.
    - SB-1123 suggests 25-30 ft wide crest for 2nd uppermost lift.
    - SB-1123 sugests bottom of the 2nd uppermost lift at ~EL. +50 to +55 ft.
    - SB-1123 & SB-1122 indicate reworked clay fill at 55 ft and 56 ft bgs, respectively. Suggests clay fill with 3H:1V backslope. Indicates clay fill behind starter dam.

- SB-1125
  - Location: Northern side
  - Crest EL: +75 to +78 ft
  - Toe EL.: +28 ft
  - Existing GS EL.: +78 ft
  - Horiz. Distance from Crest Grade Break: 14 ft
  - Data Summary:
    - 0-36 ft bgs: Waste Rock
    - 36-51 ft bgs: Waste rock/tailings mix
    - 51-63.5 ft bgs: Clay/till fill
    - 63.5-66 ft bgs: Native organic silt
    - 66-73.5 ft bgs: Native clay
    - 73.5-77 ft bgs: Glacial till
  - Conclusions:
    - Impoundment dam encountered at this location.
    - Suggests bottom of 3rd uppermost lift at ~EL. +40 to +45 ft.
    - Indicates 25 ft wide crest for the 2nd uppermost lift.
    - Indicates clay/till fill behind the starter dam. Thickness of fill (and top elevation of fill) appears to increase as distance from crest/toe/starter dam decreases.

C. Data Evaluation - continued:

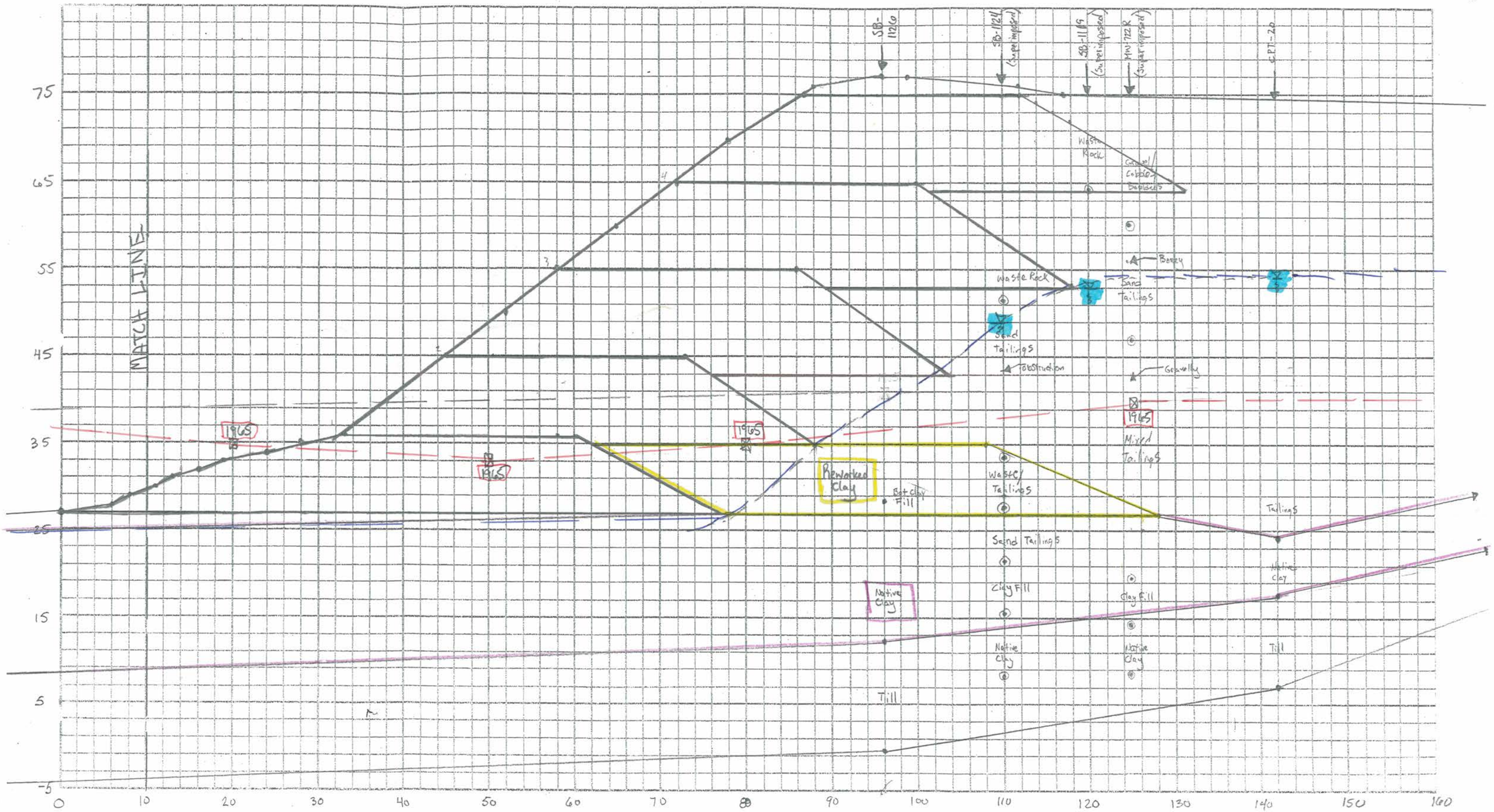
- SB-1126
  - Location: Southern side
  - Crest EL.: +75 to +77 ft
  - Existing GS EL.: +77 ft
  - Horiz. Distance from Grade Break: 20 ft
  - Data Summary:
    - Advanced 0-45 ft bgs via air hammer drilling methods:
      - Waste rock;
      - Waste rock/Dense tailings mix; and/or
      - Very stiff/stiff clay/till fill
    - 48 ft bgs: Bottom of clay/till fill
    - 48-64 ft bgs: Native clay
    - 64-77 ft bgs: Glacial till
    - 77 ft bgs: Probable bedrock

- A sketch of the interpreted impoundment dam configuration is shown on Sheet 6.

Y = Elevation (ft) = 1" = 10'

X = Distance from Toe = 1" = 10'

Profile S2 → Interpreted Rock Dam Configuration	PROJECT Callahan Mine Tailings Impoundment Slope Stability Evaluation	COMP BY NDL	JOB NO. 3612112201
		CHK BY TCC	DATE 07/2014

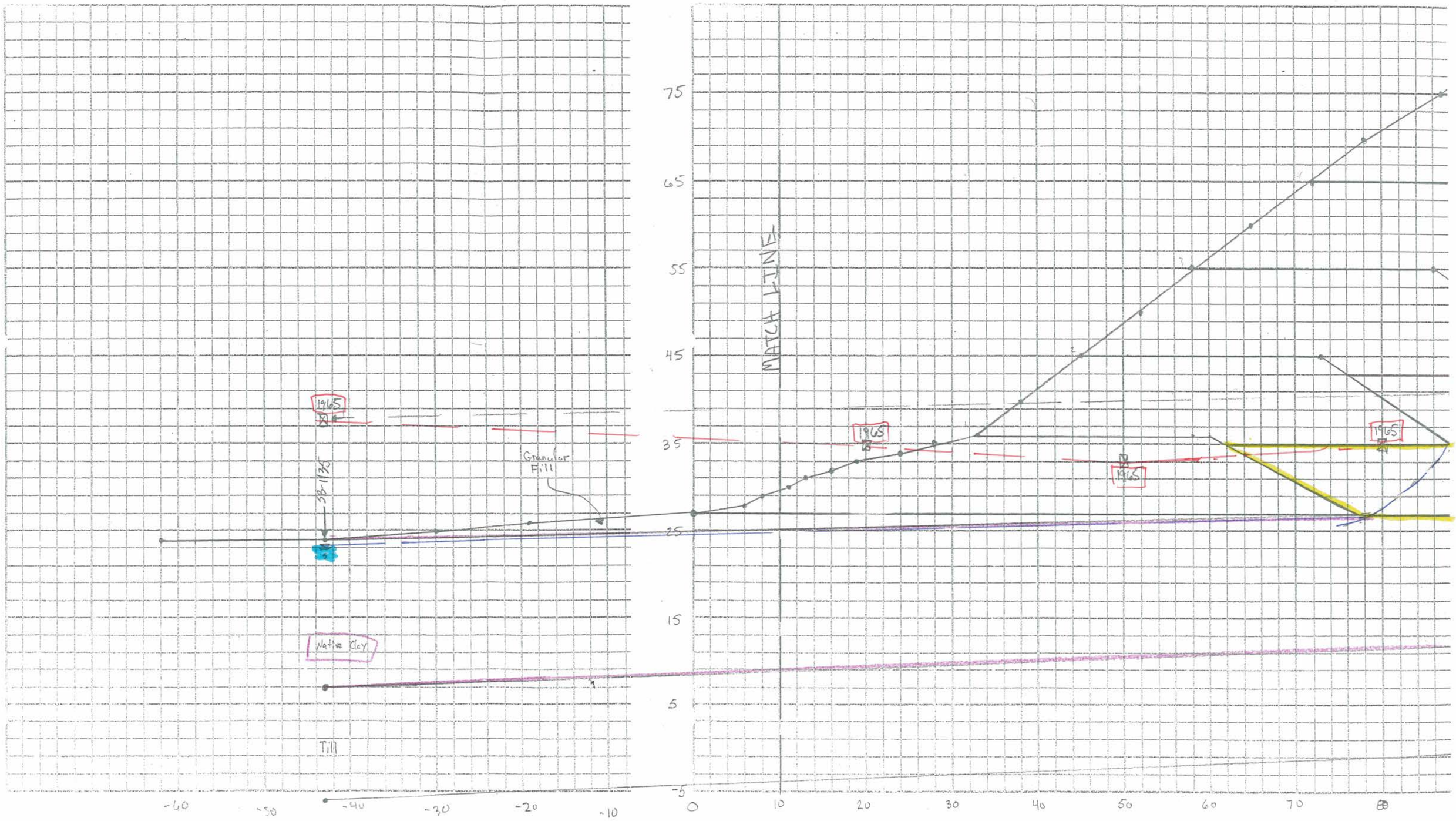


Y = Elevation (ft) = 1" = 10'

X = Distance from Toe = 1" = 10'

Profile S2

Interpreted Rock Dam Configuration



ATTACHMENT S2-D

PROFILE S2
LONG-TERM STATIC SLOPE STABILITY EVALUATION

ESTIMATES OF CLAY SHEAR STRENGTH VIA SHANSEP METHOD

ATTACHMENT S2-D

PROFILE S2 - ESTIMATE CLAY SHEAR STRENGTH BENEATH IMPOUNDMENT DAM

- Clay thickness and shear strength profile are "known" near the toe of the impoundment dam.
  - SB-1135/UT-1135 17.5 ft thick (adjusted thickness down due to basemap vs. as-drilled elevation differences)
    - 0-5 ft (below top of clay): 2000-2250 psf
    - 5-8 ft: 1500 psf
    - 8-11.5 ft: 750 psf
    - 11.5-15.5 ft: 500 psf
    - 15.5-17.5 ft: 400 psf
  - SB-1136/UT-1136 24 ft thick (adjusted thickness down due to basemap vs. as-drilled elevation differences)
    - 0-5 ft (below top of clay): 2000-2250 psf
    - 5-9 ft: 1500 psf
    - 9-15 ft: 750 psf
    - 15-21 ft: 500 psf
    - 21-24 ft: 400 psf
- Clay thickness and shear strength profile are "known" at/near the crest of the impoundment dam.
  - CPT-20 7.5 ft thick
    - 0-2 ft (below top of clay): 2000 psf
    - 2-4 ft: 1500 psf
    - 3.5 ft: 1000 psf
- Clay thickness will be interpolated between CPT-20 and SB-1135/SB-1136.
  - Distance ~= 120 ft
- Clay strength profile will be interpolated between these points using $Su/\sigma'v$ (also called c/p) ratios, based on site specific laboratory test results and literature values:
  - Soft: $\Delta Su/\Delta\sigma'v = 0.20$
  - Medium stiff: $\Delta Su/\Delta\sigma'v = 0.15$
  - Stiff (<1500 psf): $\Delta Su/\Delta\sigma'v = 0.10$
    - Apply strength increase (ΔSu) to clay strength profile at toe based on effective stress increase ($\Delta\sigma'v$) imposed by the impoundment dam.
    - See Attachment S2-C for a sketch of existing conditions/topo, 1965 topo, and soil boring locations relative to the toe of the dam.
    - Use Winstress software to estimate $\Delta\sigma'v$ applied to clay soils at various stations/zones beneath the impoundment dam.

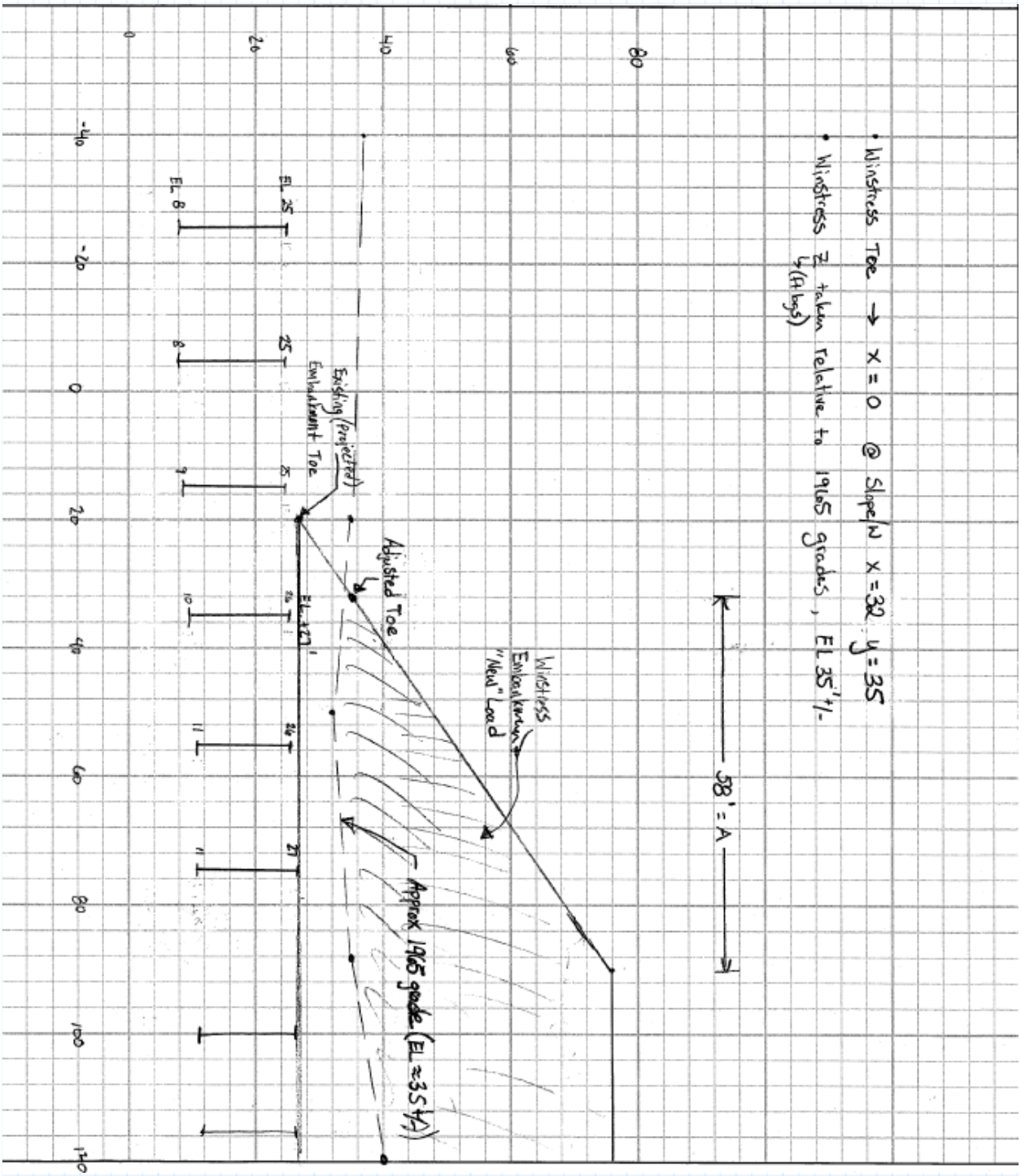
- Estimate embankment load imposed by the impoundment:
  - Beneath crest point:
    - 41 ft tall dam/impoundment (relative to 1965 grade of ~+35 ft)
      - $\sigma'v$ = 41 ft unsaturated waste rock/tailings = 41' x 105 pcf = 4,305 psf
      - Assume 3 ft rise in pore pressure in clay = -3' x 62.4 pcf = -187 psf
        - Load imposed beneath crest ~= 4,118 psf
  - Beneath CPT-20:
    - 33 ft tall dam (relative to 1965 grade of ~+42)
      - $\sigma'v$ = 21 ft unsaturated tailings = 21' x 110 pcf = 2,310 psf
      - $\sigma'v$ = 12 ft saturated tailings = 12' x 120 pcf = 1,440 psf
      - u = 12 ft of water = -12' x 62.4 pcf = -749 psf
      - Assume 3 ft rise in pore pressure in clay = -3' x 62.4 pcf = -187 psf
        - Load imposed beneath CPT-20 ~= 2,814 psf
  - Average embankment/terrace load = 3,450 psf

- Use Winstress software with the following inputs:
  - Load at crest = 3,450 psf
  - A=Distance toe to crest = 58 ft
  - B=Distance to to end of load = 200 ft
  - x = 0 @ toe of "new" embankment load

- Vary x to estimate Ds'v with depth (z) below the embankment.

- Winstress software input/analysis definitions:

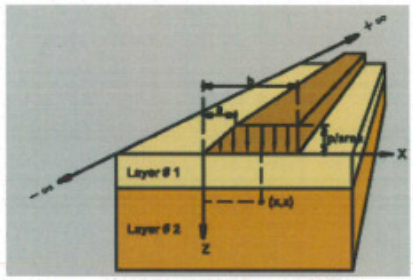
X-Range (Slope/W coords.)	Analysis Point (Winstress)	Discussion
-35 to -15	x = -57	Toe @ +32 in Slope/W;
-15 to +5	x = -37	See attached output files;
+5 to +25	x = -17	Soft: c/p = 0.20
+25 to +45	x = +3	M. Stiff: c/p = 0.15
+45 to +65	x = +23	Stiff: c/p = 0.10
+65 to +85	x = +43	V. Stiff: N/A
+85 to +115	x = +68	
+115 to +140	x = +96	


• Winstress Toe → x = 0 @ Slope/N x = 32 y = 35
• Winstress Z taken relative to 1965 grades, EL 35'+/- (Ft bgs)
58' = A
Winstress Embankment "New" Load
Approx 1965 grade (EL ≈ 35'+/-)
Adjusted Toe
Existing (Projected) Embankment Toe
EL 120'
EL 25
EL 8
80
60
40
20
0
-40
-20
0
20
40
60
80
100
120

Increment of stress calculation = vertical $\Delta\sigma z$

STRIP FOOTING

Width of strip A = 58.00
Width of strip B = 200.00
p load/unit area = 3450.000



POINTS FOR COMPUTATION OF INCREMENT OF STRESS

calculate in = z direction

x1 coordinate = -57.00

z1 coordinate = 0.00
z2 coordinate = 30.00
delta z = 1.00

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@ x = -57

Clay EL.	Relative to 1965 Grade (~35')
+ 25'	10' bgs
to	to
+ 8'	27' bgs

LOADING ON AN INFINITE STRIP
VERTICAL EMBANKMENT LOADING

Project Name: Callahan Mine
Client : MDOT
Date : 8/20/2014

Project Number : 3612112201
Project Manager: P. Baker
Computed by : NDL

Embank. slope a = 58.00 (ft)
Embank. width b = 200.00 (ft)
p load/unit area = 3450.000(psf)

INCREMENT OF STRESSES FOR Z-DIRECTION
X = -57.00(ft)

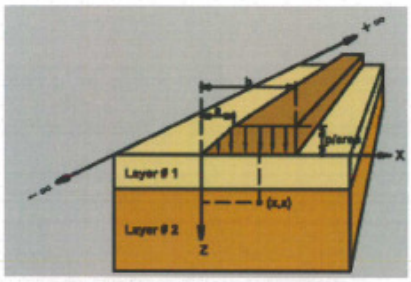
Z (ft)	Vert. Dsz (psf)
0.00	0.00
1.00	0.00
2.00	0.01
3.00	0.04
4.00	0.09
5.00	0.18
6.00	0.30
7.00	0.48
8.00	0.72
9.00	1.02
10.00	1.39
11.00	1.84
12.00	2.38
13.00	3.00
14.00	3.73
15.00	4.56
16.00	5.49
17.00	6.54
18.00	7.70
19.00	8.99
20.00	10.39
21.00	11.92
22.00	13.58
23.00	15.37
24.00	17.30
25.00	19.35
26.00	21.54
27.00	23.86
28.00	26.31
29.00	28.90
30.00	31.62

Insignificant $\Delta\sigma'_v$
$\Delta S_u = 0$

Increment of stress calculation = vertical $\Delta\sigma z$

STRIP FOOTING

Width of strip A = 58.00
Width of strip B = 200.00
p load/unit area = 3450.000



POINTS FOR COMPUTATION OF INCREMENT OF STRESS

calculate in = z direction

x1 coordinate = -37.00

z1 coordinate = 0.00
z2 coordinate = 30.00
delta z = 1.00

Ok | Cancel | Print Screen | Save Screen

@ x = -37

Clay EL.	Relative to 1965 Grade (~35')
+ 25'	10' bgs
to	to
+ 8'	27' bgs

LOADING ON AN INFINITE STRIP
VERTICAL EMBANKMENT LOADING

Project Name: Callahan Mine
Client : MDOT
Date : 8/20/2014

Project Number : 3612112201
Project Manager: P. Baker
Computed by : NDL

Embank. slope a = 58.00 (ft)
Embank. width b = 200.00 (ft)
p load/unit area = 3450.000(psf)

INCREMENT OF STRESSES FOR Z-DIRECTION
X = -37.00(ft)

Z (ft)	Vert. Dsz (psf)
0.00	0.00
1.00	0.00
2.00	0.03
3.00	0.10
4.00	0.24
5.00	0.48
6.00	0.82
7.00	1.29
8.00	1.91
9.00	2.70
10.00	3.67
11.00	4.83
12.00	6.21
13.00	7.80
14.00	9.62
15.00	11.67
16.00	13.97
17.00	16.51
18.00	19.30
19.00	22.34
20.00	25.63
21.00	29.17
22.00	32.95
23.00	36.97
24.00	41.23
25.00	45.73
26.00	50.45
27.00	55.39
28.00	60.54
29.00	65.89
30.00	71.45

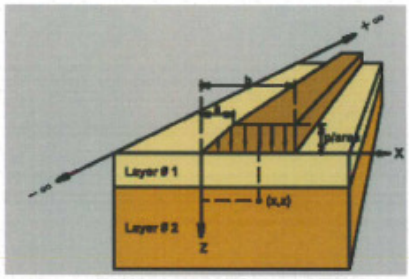
Insignificant $\Delta\sigma'_v$

$\Delta s_u = 0$

Increment of stress calculation = vertical $\Delta\sigma z$

STRIP FOOTING

Width of strip A = 58.00
Width of strip B = 200.00
p load/unit area = 3450.000



POINTS FOR COMPUTATION OF INCREMENT OF STRESS

calculate in = z direction

x1 coordinate = -17.00

z1 coordinate = 0.00
z2 coordinate = 30.00
delta z = 1.00

Ok | Cancel | Print Screen | Save Screen

@ x = -17

Clay EL.	Relative to 1965 Grade (~35')
+ 25'	10' bgs
to	to
+ 9'	26' bgs

LOADING ON AN INFINITE STRIP
VERTICAL EMBANKMENT LOADING

Project Name: Callahan Mine
Client : MDOT
Date : 8/20/2014

Project Number : 3612112201
Project Manager: P. Baker
Computed by : NDL

Embank. slope a = 58.00 (ft)
Embank. width b = 200.00 (ft)
p load/unit area = 3450.000(psf)

INCREMENT OF STRESSES FOR Z-DIRECTION
X = -17.00(ft)

Z (ft)	Vert. Dsz (psf)	
0.00	0.00	
1.00	0.02	
2.00	0.16	
3.00	0.55	
4.00	1.28	
5.00	2.45	
6.00	4.14	
7.00	6.40	
8.00	9.29	
9.00	12.82	
10.00	17.01	
11.00	21.85	
12.00	27.33	
13.00	33.43	
14.00	40.11	ΔSu = 0
15.00	47.36	
16.00	55.13	
17.00	63.38	
18.00	72.07	
19.00	81.18	
20.00	90.66	
21.00	100.47	x 0.15 ≅ ΔSu ≅ 14psf ≈ 0
22.00	110.58	
23.00	120.97	
24.00	131.58	
25.00	142.41	x 0.20 ≅ ΔSu ≅ 27 psf
26.00	153.42	
27.00	164.59	
28.00	175.88	
29.00	187.29	
30.00	198.79	

v. Stiff/ Stiff

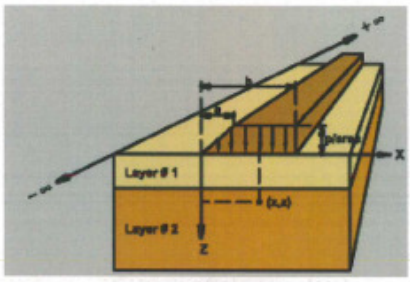
M. Stiff

Soft

Increment of stress calculation = vertical $\Delta\sigma z$

STRIP FOOTING

Width of strip A = 58.00
Width of strip B = 200.00
p load/unit area = 3450.000



POINTS FOR COMPUTATION OF INCREMENT OF STRESS

x1 coordinate = 3.00
z1 coordinate = 0.00
z2 coordinate = 30.00
delta z = 1.00

calculate in = z direction

Ok | Cancel | Print Screen | Save Screen

@ x = 3

Clay EL.	Relative to 1965 Grade (~35')
+ 26'	9' bgs
to	to
+ 10'	25' bgs

LOADING ON AN INFINITE STRIP
VERTICAL EMBANKMENT LOADING

Project Name: Callahan Mine
Client : MDOT
Date : 8/20/2014

Project Number : 3612112201
Project Manager: P. Baker
Computed by : NDL

Embank. slope a = 58.00 (ft)
Embank. width b = 200.00 (ft)
p load/unit area = 3450.000(psf)

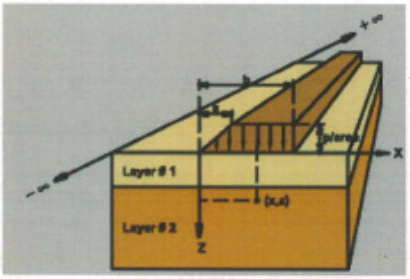
INCREMENT OF STRESSES FOR Z-DIRECTION
X = 3.00(ft)

Z (ft)		Vert. Dsz (psf)	
0.00		178.45	
1.00		179.10	
2.00		182.90	
3.00		190.58	
4.00		201.37	
5.00		214.32	
6.00		228.70	
7.00		244.02	
8.00		259.97	
9.00		276.34	
10.00		292.98	
11.00		309.78	
12.00	Very stiff/	326.68	$\Delta S_u = 0$
13.00	stiff	343.60	
14.00		360.52	
15.00		377.38	
16.00		394.17	
17.00		410.86	
18.00		427.42	
19.00		443.85	
20.00	M.stiff	460.12	$\times 0.15 \cong \Delta S_u \cong 69$ psf
21.00		476.23	
22.00		492.16	
23.00		507.91	
24.00	Soft	523.46	$\times 0.20 \cong \Delta S_u \cong 103$ psf
25.00		538.82	
26.00		553.96	
27.00		568.89	
28.00		583.61	
29.00		598.10	
30.00		612.37	

Increment of stress calculation = vertical $\Delta\sigma z$

STRIP FOOTING

Width of strip A = 58.00
Width of strip B = 200.00
p load/unit area = 3450.000



POINTS FOR COMPUTATION OF INCREMENT OF STRESS

calculate in = z direction

x1 coordinate = 23.00

z1 coordinate = 0.00
z2 coordinate = 30.00
delta z = 1.00

Ok | Cancel | Print Screen | Save Screen

@ x = 23

Clay EL

+ 26'
to
+ 11'

Relative to 1965 Grade (~35)

9' bgs
to
24' bgs

LOADING ON AN INFINITE STRIP
VERTICAL EMBANKMENT LOADING

Project Name: Callahan Mine
Client : MDOT
Date : 8/20/2014

Project Number : 3612112201
Project Manager: P. Baker
Computed by : NDL

Embank. slope a = 58.00 (ft)
Embank. width b = 200.00 (ft)
p load/unit area = 3450.000(psf)

INCREMENT OF STRESSES FOR Z-DIRECTION
X = 23.00(ft)

Z (ft)	Vert. Dsz (psf)	
0.00	1368.10	
1.00	1368.11	
2.00	1368.16	
3.00	1368.28	
4.00	1368.52	
5.00	1368.90	
6.00	1369.46	
7.00	1370.21	
8.00	1371.18	
9.00	1372.37	
10.00	1373.80	
11.00	1375.45	
12.00	1377.34	
13.00	1379.46	
14.00	1381.78	
15.00	1384.31	
16.00	1387.03	
17.00	1389.91	
18.00	1392.95	
19.00	1396.12	
20.00	1399.40	
21.00	1402.79	
22.00	1406.25	
23.00	1409.78	
24.00	1413.35	
25.00	1416.96	
26.00	1420.59	
27.00	1424.22	
28.00	1427.85	
29.00	1431.46	
30.00	1435.05	

v. stiff/stiff: $\Delta S_u = 0$

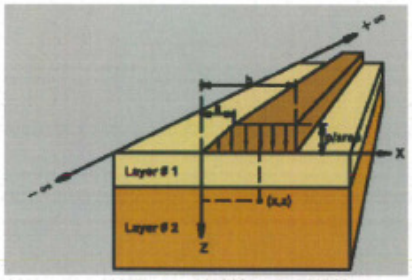
M. stiff: $1396.12 \times 0.15 \cong \Delta S_u \cong 209$ psf

Soft: $1409.78 \times 0.20 \cong \Delta S_u \cong 282$ psf

Increment of stress calculation = vertical $\Delta\sigma z$

STRIP FOOTING

Width of strip A = 58.00
Width of strip B = 200.00
p load/unit area = 3450.000



POINTS FOR COMPUTATION OF INCREMENT OF STRESS

x1 coordinate = 43.00

z1 coordinate = 0.00
z2 coordinate = 30.00
delta z = 1.00

calculate in = z direction

Ok | Cancel | Print Screen | Save Screen

@ x = 43

Clay EL.	Relative to 1965 Grade (~35')
+ 27'	8' bgs
to	to
+ 11'	24' bgs

LOADING ON AN INFINITE STRIP
VERTICAL EMBANKMENT LOADING

Project Name: Callahan Mine
Client : MDOT
Date : 8/20/2014

Project Number : 3612112201
Project Manager: P. Baker
Computed by : NDL

Embank. slope a = 58.00 (ft)
Embank. width b = 200.00 (ft)
p load/unit area = 3450.000(psf)

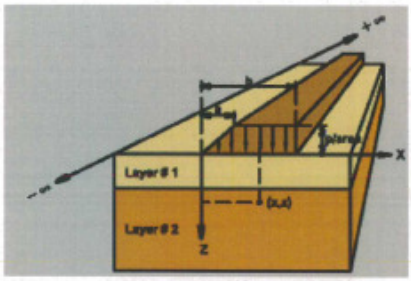
INCREMENT OF STRESSES FOR Z-DIRECTION
X = 43.00(ft)

Z (ft)	Vert. Dsz (psf)	
0.00	2557.76	
1.00	2557.73	
2.00	2557.56	
3.00	2557.11	
4.00	2556.24	
5.00	2554.87	
6.00	2552.91	
7.00	2550.31	
8.00	2547.06	
9.00	2543.12	
10.00	2538.54	
11.00	2533.31	
12.00	2527.50	v. stiff/ stiff; $\Delta S_u = 0$
13.00	2521.13	
14.00	2514.25	
15.00	2506.92	
16.00	2499.19	
17.00	2491.11	
18.00	2482.71	
19.00	2474.06	M. stiff; $\times 0.15 \cong \Delta S_u \cong$ 370 psf
20.00	2465.19	
21.00	2456.13	
22.00	2446.93	
23.00	2437.62	Soft; $\times 0.2 \cong \Delta S_u \cong$ 487 psf
24.00	2428.22	
25.00	2418.77	
26.00	2409.28	
27.00	2399.77	
28.00	2390.27	
29.00	2380.80	
30.00	2371.35	

Increment of stress calculation = vertical $\Delta\sigma z$

STRIP FOOTING

Width of strip A = 58.00
Width of strip B = 200.00
p load/unit area = 3450.000



POINTS FOR COMPUTATION OF INCREMENT OF STRESS

calculate in = z direction

x1 coordinate = 68.00

z1 coordinate = 0.00
z2 coordinate = 30.00
delta z = 1.00

Ok | Cancel | Print Screen | Save Screen

@ x = 68

Clay EL	Relative to 1965 Grade (~35)
+ 27'	8' bgs
to	to
+ 13'	22' bgs

LOADING ON AN INFINITE STRIP
VERTICAL EMBANKMENT LOADING

Project Name: Callahan Mine
Client : MDOT
Date : 8/20/2014

Project Number : 3612112201
Project Manager: P. Baker
Computed by : NDL

Embank. slope a = 58.00 (ft)
Embank. width b = 200.00 (ft)
p load/unit area = 3450.000(psf)

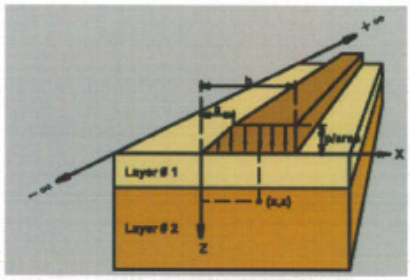
INCREMENT OF STRESSES FOR Z-DIRECTION
X = 68.00(ft)

Z (ft)		Vert. Dsz (psf)	
0.00		3450.00	
1.00		3449.94	
2.00		3449.52	
3.00		3448.41	
4.00		3446.38	
5.00		3443.25	
6.00		3438.94	
7.00		3433.45	
8.00		3426.81	
9.00		3419.10	
10.00		3410.40	
11.00		3400.81	
12.00	v. stiff/	3390.44	ΔSu = 0
13.00	stiff	3379.37	
14.00		3367.69	
15.00		3355.49	
16.00		3342.84	
17.00		3329.79	
18.00	M. Stiff	3316.41	x0.15 ≅ ΔSu ≅ 496 psf
19.00		3302.75	
20.00		3288.86	
21.00	Soft	3274.76	x0.2 ≅ ΔSu ≅ 654 psf
22.00		3260.49	
23.00		3246.10	
24.00		3231.59	
25.00		3217.00	
26.00		3202.35	
27.00		3187.65	
28.00		3172.93	
29.00		3158.19	
30.00		3143.45	

Increment of stress calculation = vertical $\Delta\sigma z$

STRIP FOOTING

Width of strip A = 58.00
Width of strip B = 200.00
p load/unit area = 3450.000



POINTS FOR COMPUTATION OF INCREMENT OF STRESS

x1 coordinate = 96.00

z1 coordinate = 0.00
z2 coordinate = 30.00
delta z = 1.00

calculate in = z direction

Ok | Cancel | Print Screen | Save Screen

@ x = 96

Clay EL	Relative to 1965 Grade (~40')
+ 25'	15' bgs
to	to
+ 16'	24' bgs

LOADING ON AN INFINITE STRIP
VERTICAL EMBANKMENT LOADING

Project Name: Callahan Mine
Client : MDOT
Date : 8/20/2014

Project Number : 3612112201
Project Manager: P. Baker
Computed by : NDL

Embank. slope a = 58.00 (ft)
Embank. width b = 200.00 (ft)
p load/unit area = 3450.000(psf)

INCREMENT OF STRESSES FOR Z-DIRECTION
X = 96.00(ft)

Z (ft)		Vert. Dsz (psf)	
0.00		3450.00	
1.00		3450.00	
2.00		3449.97	
3.00		3449.88	
4.00		3449.72	
5.00		3449.46	
6.00		3449.08	
7.00		3448.54	
8.00		3447.84	
9.00		3446.94	
10.00		3445.84	
11.00		3444.51	
12.00		3442.93	
13.00		3441.10	
14.00		3439.01	
15.00		3436.63	
16.00		3433.96	
17.00	V. Stiff/	3430.99	
18.00	Stiff	3427.72	ΔSu = 0
19.00		3424.14	
20.00		3420.25	
21.00		3416.05	
22.00	M. Stiff	3411.53	x 0.15 ≅ ΔSu ≅ 510 psf
23.00		3406.70	
24.00	Soft	3401.56	x 0.20 ≅ ΔSu ≅ 680 psf
25.00		3396.11	
26.00		3390.35	
27.00		3384.28	
28.00		3377.92	
29.00		3371.27	
30.00		3364.32	

ATTACHMENT S2-E

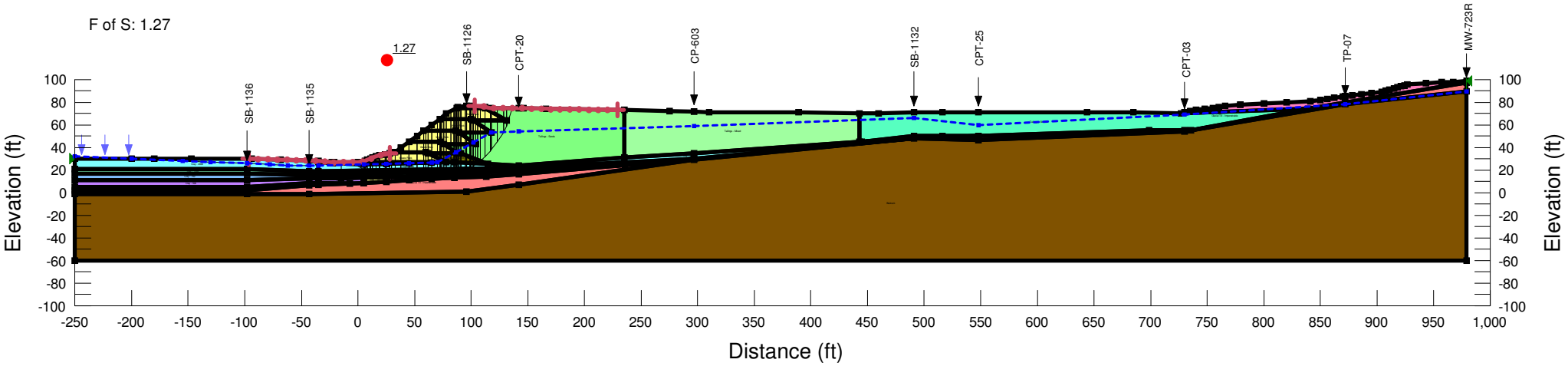
PROFILE S2
LONG-TERM STATIC SLOPE STABILITY EVALUATION

SLOPE/W OUTPUT: EXISTING CONDITIONS

Title: Callahan Mine OU3 - Profile S2
Date: 10/15/2014
File Name: Tailings_Profile S2_Existing Conditions_90%.gsz

Name: Profile S2b - Existing -Ent/Exit - Till Imp
Method: Spencer

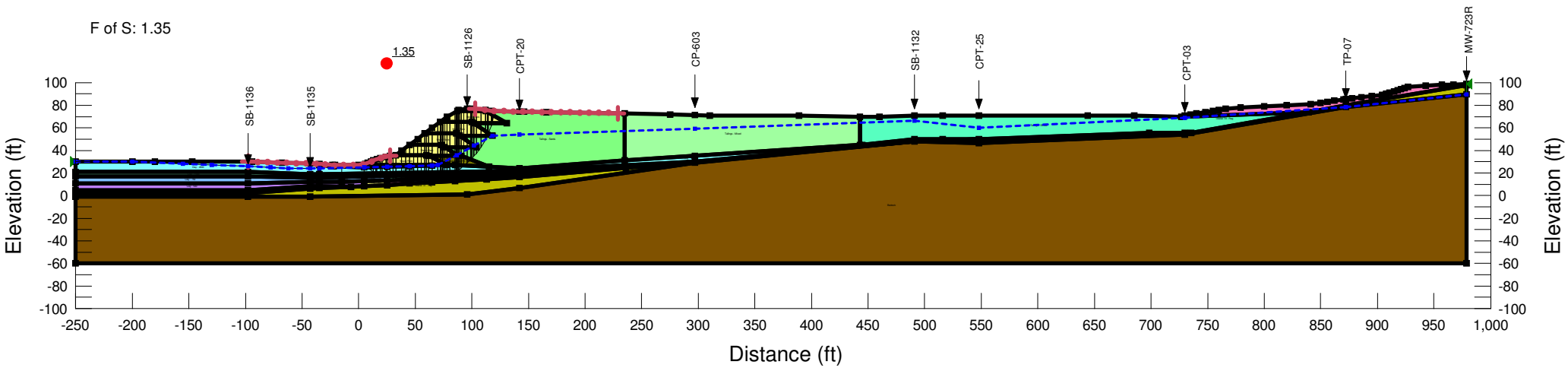
Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 117 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Gravel Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38 ° Constant Unit Wt. Above Water Table: 125 pcf Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Clay - 1250 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,250 psf Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Reworked Clay/Till - Su Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Clay - 750 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 750 psf Piezometric Line: 1
Name: Clay - 500 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 500 psf Piezometric Line: 1
Name: Glacial Till - Impenetrable Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Clay - 525 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 525 psf Piezometric Line: 1
Name: Clay - 950 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 950 psf Piezometric Line: 1
Name: Clay - 1175 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,175 psf Piezometric Line: 1
Name: Clay - 775 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 775 psf Piezometric Line: 1
Name: Clay - 825 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 825 psf Piezometric Line: 1
Name: Clay - 400 Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 400 psf Piezometric Line: 1
Name: Clay - 1500 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,500 psf Piezometric Line: 1
Name: Clay - 2000 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 2,000 psf Piezometric Line: 1
Name: Clay - 600 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 600 psf Piezometric Line: 1
Name: Clay - 1125 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,125 psf Piezometric Line: 1
Name: Clay - 975 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 975 psf Piezometric Line: 1
Name: Clay - 1150 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,150 psf Piezometric Line: 1



Title: Callahan Mine OU3 - Profile S2
Date: 10/15/2014
File Name: Tailings_Profile S2_Existing Conditions_90%.gsz

Name: Profile S2a - Existing -Ent/Exit - Till Reg
Method: Spencer

Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 117 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Glacial Till - Reg Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 50 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 130 pcf Piezometric Line: 1
Name: Gravel Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38 ° Constant Unit Wt. Above Water Table: 125 pcf Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Clay - 1250 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,250 psf Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Reworked Clay/Till - Su Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Clay - 750 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 750 psf Piezometric Line: 1
Name: Clay - 500 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 500 psf Piezometric Line: 1
Name: Clay - 525 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 525 psf Piezometric Line: 1
Name: Clay - 950 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 950 psf Piezometric Line: 1
Name: Clay - 1175 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,175 psf Piezometric Line: 1
Name: Clay - 775 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 775 psf Piezometric Line: 1
Name: Clay - 825 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 825 psf Piezometric Line: 1
Name: Clay - 400 Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 400 psf Piezometric Line: 1
Name: Clay - 1500 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,500 psf Piezometric Line: 1
Name: Clay - 2000 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 2,000 psf Piezometric Line: 1
Name: Clay - 600 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 600 psf Piezometric Line: 1
Name: Clay - 1125 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,125 psf Piezometric Line: 1
Name: Clay - 975 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 975 psf Piezometric Line: 1
Name: Clay - 1150 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,150 psf Piezometric Line: 1



ATTACHMENT S2-F

PROFILE S2
LONG-TERM STATIC SLOPE STABILITY EVALUATION

SLOPE/W MODEL DEVELOPMENT: POST-REMEDIATION CONDITIONS

ATTACHMENT S2-F

PROFILE S2 - SLOPE/W MODEL DEVELOPMENT - PROPOSED CONDITIONS

- See Figure C-1 for profile location.

A. Define Proposed Subgrade/Final Grade Topography

- Proposed subgrade topography is shown on Figure C-1.
- A profile section view is shown on Figure C-2.
- Define long-term post-remediation topography:

Point	STA.	Subgrade EL. (ft)	Final Grade EL. (ft)*
1	9+32	97	98.5
2	9+18	87	88.5
3	9+08	87	88.5
4	9+05	88	89.5
5	8+85	88	89.5
6	8+52	94	95.5
7	8+38	94	95.5
8	8+12	88	89.5
9	7+08	88	89.5
10	6+85	89	90.5
11	6+60	90	91.5
12	6+00	93	94.5
13	5+61	93	94.5
14	5+37	92	93.5
15	5+12	91	92.5
16	4+89	90	91.5
17	4+66	89	90.5
18	4+42	88	89.5
19	4+18	87	88.5
20	3+95	86	87.5
21	3+85	85	86.5
22	0+60	51	52.5
23	−0+73	29	29
24	−0+90	26	26
25	−1+27	26	26
26	−1+50	30	30

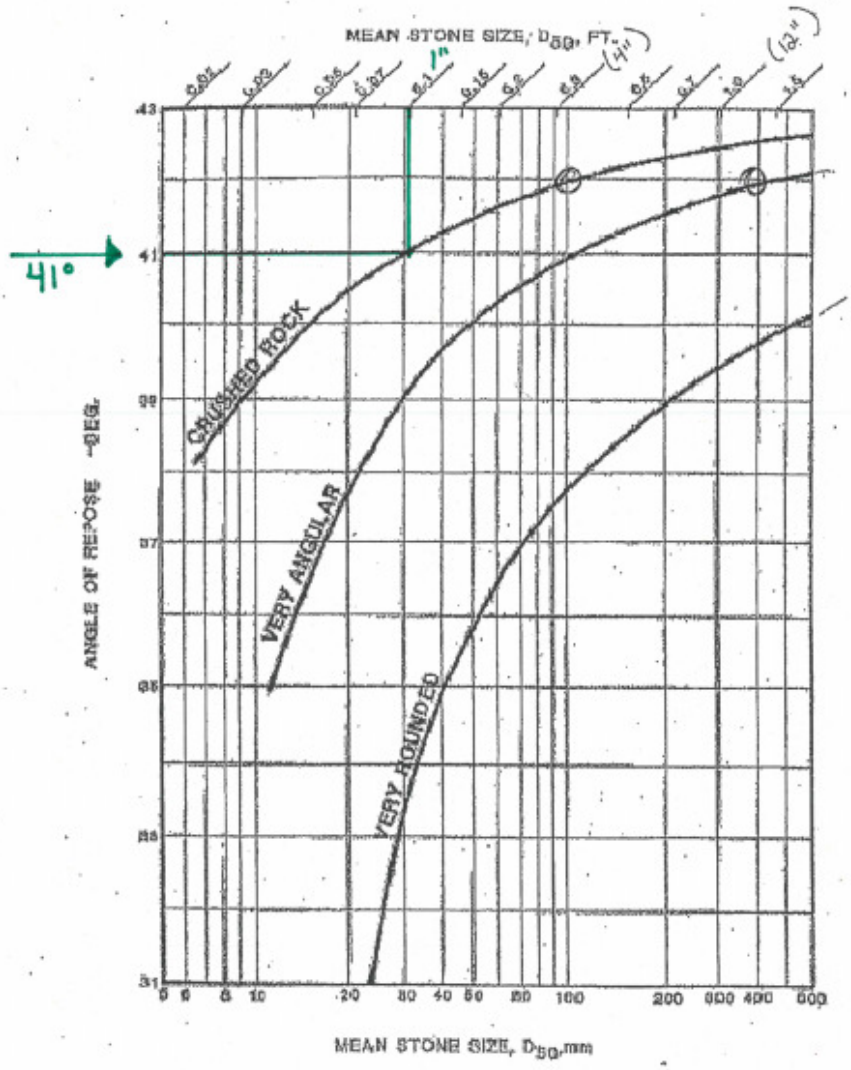
*Note: Final grade assumes 1.5 ft of aggregate cover atop subgrade. Cover does not apply to points 23-26.

B. Low-Permeability Cover

- The proposed low-permeability cover system consists of approximately 15 inches of crushed gravel/aggregate over a GDL, FML, and a GCL.
- The crushed gravel (1" < D_{50} < 6") is modeled in Slope/W with the following parameters:
  - Unit Weight = 100 pcf (assume loosely placed, 40% porosity).
  - Friction Angle = 41° (see Sheet 3 - conservatively assume D_{50} = 1").
- The unit weight and strength of the GDL, FML, and GCL are considered insignificant, and these materials were not included in the Slope/W model.

C. Long-Term Groundwater Levels

- Proposed horizontal drain locations are shown on Figure C-1.
- The water levels used for long-term post-remediation conditions are based on the current groundwater model for horizontal drain(s) located at/near the bottom of the tailings, approximately elevation +29 feet (+/-) and approximately 120 feet back from the existing crest, and a low perm cover system.
  - The long-term post-remediation groundwater levels used in the Slope/W models is assumed based on the drain location(s) and as per the current groundwater model (Appendix A).



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ATTACHMENT S2-G

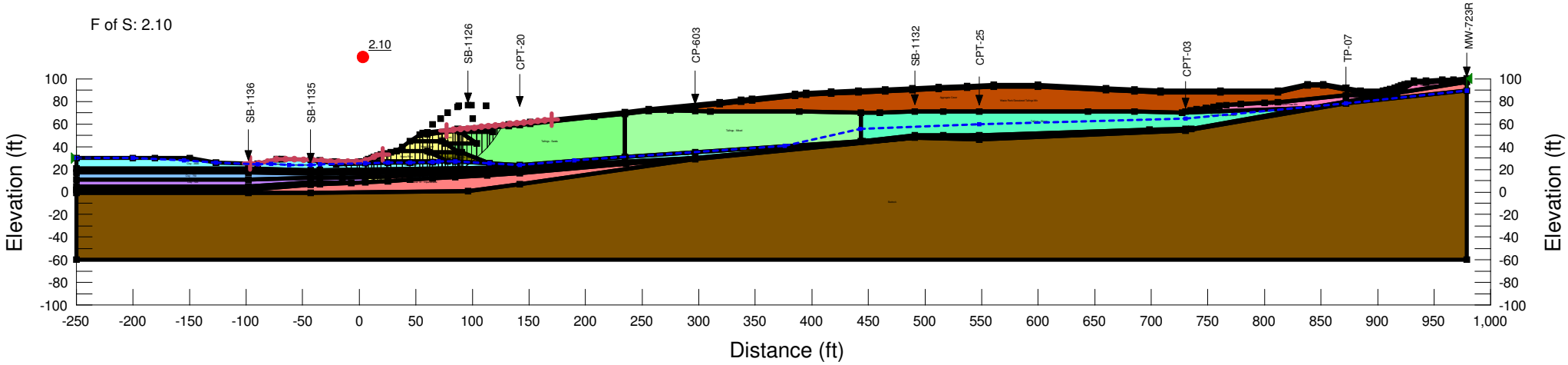
PROFILE S2
LONG-TERM STATIC SLOPE STABILITY EVALUATION

SLOPE/W OUTPUT: POST-REMEDIATION CONDITIONS

Title: Callahan Mine OU3 - Profile S2
Date: 10/16/2014
File Name: Tailings_Profile S2_Proposed Cond_90%.gsz

Name: Profile S2; a2 - Proposed - Ent/Exit - Crest-Toe - Till Imp
Method: Spencer

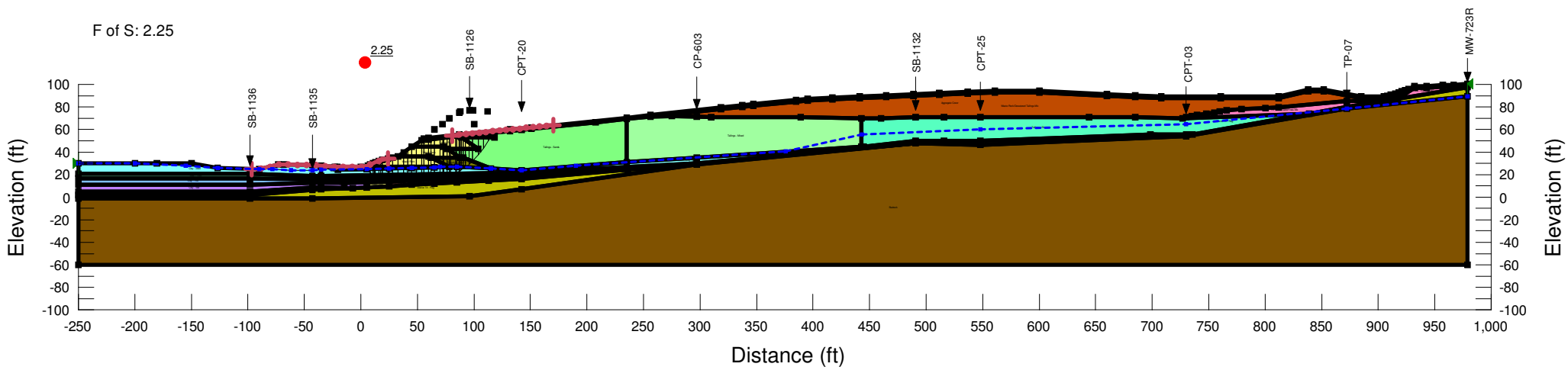
Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 117 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Clay - 1250 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,250 psf Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Reworked Clay/Till - Su Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Clay - 750 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 750 psf Piezometric Line: 1
Name: Clay - 500 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 500 psf Piezometric Line: 1
Name: Waste Rock/Dewatered Tailings Mix Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 38 ° Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
Name: Glacial Till - Impenetrable Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Clay - 525 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 525 psf Piezometric Line: 1
Name: Clay - 950 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 950 psf Piezometric Line: 1
Name: Clay - 1175 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,175 psf Piezometric Line: 1
Name: Clay - 775 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 775 psf Piezometric Line: 1
Name: Clay - 825 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 825 psf Piezometric Line: 1
Name: Clay - 400 Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 400 psf Piezometric Line: 1
Name: Clay - 1500 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,500 psf Piezometric Line: 1
Name: Clay - 2000 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 2,000 psf Piezometric Line: 1
Name: Aggregate Cover Model: Mohr-Coulomb Unit Weight: 100 pcf Cohesion': 0 psf Phi': 41 ° Piezometric Line: 1
Name: Clay - 600 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 600 psf Piezometric Line: 1
Name: Clay - 1125 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,125 psf Piezometric Line: 1
Name: Clay - 975 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 975 psf Piezometric Line: 1
Name: Clay - 1150 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,150 psf Piezometric Line: 1



Title: Callahan Mine OU3 - Profile S2
Date: 10/16/2014
File Name: Tailings_Profile S2_Proposed Cond_90%.gsz

Name: Profile S2; a1 - Proposed - Ent/Exit - Crest-Toe - Till Reg
Method: Spencer

Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 117 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Glacial Till - Reg Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 50 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 130 pcf Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Clay - 1250 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,250 psf Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Reworked Clay/Till - Su Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Clay - 750 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 750 psf Piezometric Line: 1
Name: Clay - 500 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 500 psf Piezometric Line: 1
Name: Waste Rock/Dewatered Tailings Mix Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 38 ° Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
Name: Clay - 525 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 525 psf Piezometric Line: 1
Name: Clay - 950 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 950 psf Piezometric Line: 1
Name: Clay - 1175 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,175 psf Piezometric Line: 1
Name: Clay - 775 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 775 psf Piezometric Line: 1
Name: Clay - 825 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 825 psf Piezometric Line: 1
Name: Clay - 400 Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 400 psf Piezometric Line: 1
Name: Clay - 1500 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,500 psf Piezometric Line: 1
Name: Clay - 2000 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 2,000 psf Piezometric Line: 1
Name: Aggregate Cover Model: Mohr-Coulomb Unit Weight: 100 pcf Cohesion': 0 psf Phi': 41 ° Piezometric Line: 1
Name: Clay - 600 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 600 psf Piezometric Line: 1
Name: Clay - 1125 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,125 psf Piezometric Line: 1
Name: Clay - 975 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 975 psf Piezometric Line: 1
Name: Clay - 1150 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,150 psf Piezometric Line: 1



Title: Callahan Mine OU3 - Profile S2
Date: 10/16/2014
File Name: Tailings_Profile S2_Proposed Cond_90%.gsz

Name: Profile S2; b2 - Proposed - Ent/Exit - Fill-Toe - Till Imp
Method: Spencer

Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 117 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Clay - 1250 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,250 psf Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Reworked Clay/Till - Su Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Clay - 750 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 750 psf Piezometric Line: 1
Name: Clay - 500 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 500 psf Piezometric Line: 1
Name: Waste Rock/Dewatered Tailings Mix Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 38 ° Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
Name: Glacial Till - Impenetrable Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Clay - 525 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 525 psf Piezometric Line: 1
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Name: Clay - 1500 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,500 psf Piezometric Line: 1
Name: Clay - 2000 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 2,000 psf Piezometric Line: 1
Name: Aggregate Cover Model: Mohr-Coulomb Unit Weight: 100 pcf Cohesion': 0 psf Phi': 41 ° Piezometric Line: 1
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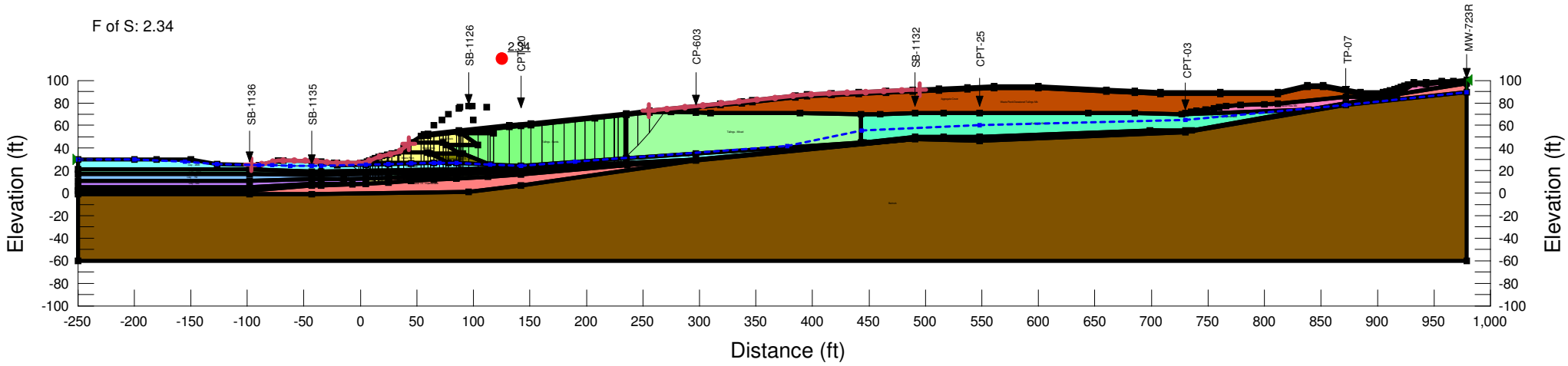
Name: Clay - 975 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 975 psf Piezometric Line: 1
Name: Clay - 1150 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,150 psf Piezometric Line: 1



Title: Callahan Mine OU3 - Profile S2
Date: 10/16/2014
File Name: Tailings_Profile S2_Proposed Cond_90%.gsz

Name: Profile S2; b1 - Proposed - Ent/Exit - Fill-Toe - Till Reg
Method: Spencer

Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 117 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Glacial Till - Reg Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 50 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 130 pcf Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Clay - 1250 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,250 psf Piezometric Line: 1
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Name: Clay - 1175 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,175 psf Piezometric Line: 1
Name: Clay - 775 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 775 psf Piezometric Line: 1
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Name: Clay - 1500 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,500 psf Piezometric Line: 1
Name: Clay - 2000 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 2,000 psf Piezometric Line: 1
Name: Aggregate Cover Model: Mohr-Coulomb Unit Weight: 100 pcf Cohesion': 0 psf Phi': 41 ° Piezometric Line: 1
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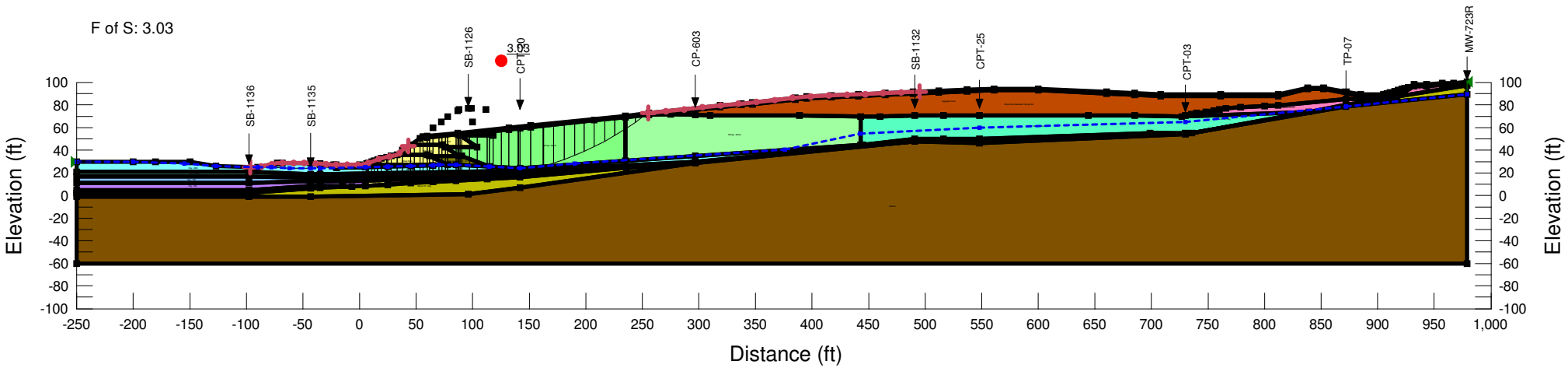
Name: Clay - 1150 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,150 psf Piezometric Line: 1



ATTACHMENT E1

PROFILE E1
LONG-TERM STATIC SLOPE STABILITY EVALUATION

ATTACHMENT E1-A

PROFILE E1
LONG-TERM STATIC SLOPE STABILITY EVALUATION

SLOPE/W MODEL DEVELOPMENT: EXISTING CONDITIONS

ATTACHMENT E1-A

PROFILE E1 - SLOPE/W MODEL DEVELOPMENT - EXISTING CONDITIONS

- See Figure C-1 for profile location.

A. Define Overall Geometry/Topography

- Existing site-specific topography is shown on Figure C-1.
    - Define Profile Station 0+00 as the "toe" of the rock dam.
        - Positive station numbers to the west
        - Negative station numbers to the east
- See Attachment E1-B for definition of SLOPE/W points.
- Minor adjustment to modelled edge of Marsh Creek vs. actual edge to allow perpendicular projection of SD-708 to the profile.

B. Impoundment Dam Configuration

- The assumed/interpreted configuration of the impoundment dam is as follows:
    - Constructed via "upstream" raised embankment methods.
    - 5 total lifts (starter dam plus 4 subsequent raises).
    - Starter dam constructed with clay and glacial till from on-site (and adjacent property to the south) and faced extensively with waste rock.
        - Top of starter dam at Elev. +30 ft (+/-).
        - Crest width of waste rock approximately 25 ft (+/-).
        - Backslope of waste rock approximately 1.3H:1V to 1.5H:1V.
        - Clay/glacial till extends 50 ft (+/-) behind the starter dam.
    - Subsequent raises/lifts constructed with waste rock and possibly lined/"chinked" with clay/till fill (limited extent/thickness).
        - Each lift/raise approximately 10 to 15 ft tall
        - Crest width of each waste rock lift/raise approximately 25 ft (+/-).
        - Backslope of each waste rock lift/raise approximately 1.3H:1V to 2.0H:1V.
- See Attachment E1-C for discussion, supporting data/evaluation, and sketches/cross-sections.

C. Define Subsurface Profile

- Geotechnical explorations along or in close proximity to Profile E1 are shown on Figure C-1.
    - TP-13 — West
    - SB/RC-1143
    - SB-601/CP-601 (former well/piezo location)
    - CP-602
    - CP-603
    - SB-602/CP-615 (nested wells/piezos)
    - CP-604
    - SB-706 (nested well/piezo) — Crest
    - SB-703/P-1112 (nested well/piezo)
    - SB/UT-1137/CPT-27
    - SD-708 (projected) — East
- Logs/records of these explorations are provided in prior investigation reports:
    - Credere, 2012 — Supplemental Geotechnical Investigation
    - MACTEC, 2009a — Geotechnical Evaluation Report
    - MACTEC, 2009b — Remedial Investigation Report
- Table C-2 summarizes the primary soil strata encountered at these exploration locations.
    - Fill
    - Tailings
        - Tailings are further subdivided into "zones" of sand, mixed/stratified, or slimes based on description of sand, fines, and layering/thickness.
    - Clay/Till Fill
    - Native Estuarine
    - Presumpscot Clay
        - Native clay is further divided into layers/zones based on strength data.
    - Glacial Till
    - Other, as necessary

D. Assign Soil Unit Weight & Strength Parameters

- Assign unit weights based on soil type, in-situ conditions (e.g., density, consistency, saturation, etc.), published literature, and in conjunction with/comparison with bulk density measurements from Shelby tube samples.

- Strength parameters for Tailings developed based on site-specific field and laboratory testing programs and in conjunction with applicable mine-tailings-specific references (i.e., Vick 1990)

  Note: +/- adjustments to Tailings effective stress/strength parameters have negligible impact on estimated FOS.

- Strength parameters for Clay and Estuarine deposits developed based on site-specific field and laboratory testing programs.

  - FVST data
  - CPT Data
  - SPT Data
  - Strength adjustments for unexplored locations (beneath the waste rock impoundment dam) are presented in Attachment E1-D.

- Strength Parameters for Glacial Till and various Fill materials developed based on site-specific field and laboratory testing programs and published values.

- Strength parameters for impoundment berm (i.e., crushed/angular waste rock) developed based on published FHWA values/data (see Sheet 6).

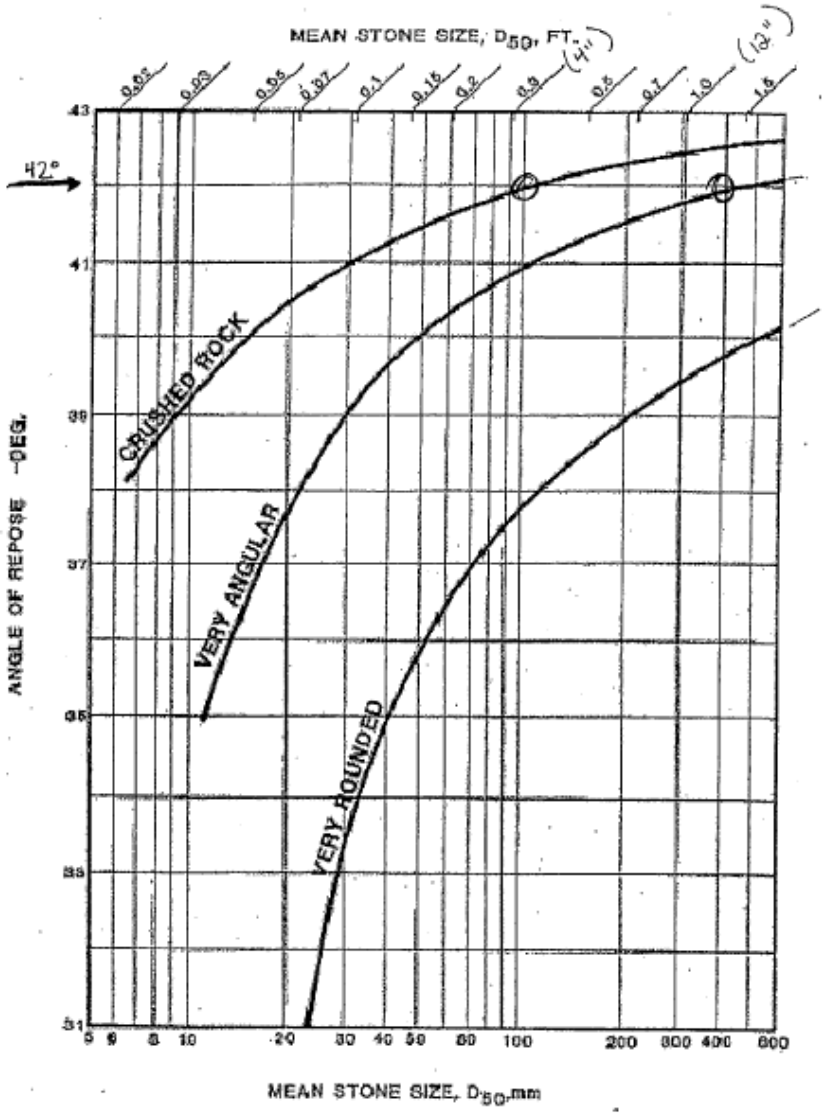
- Actual weight and strength parameters for each soil type are listed on Slope/W output files.

E. Estimate Shear Strength Increase in Clay Beneath Impoundment Dam

- Clay strengths known at crest (SB-706) and at toe (SB-703). Use procedures below to provide reasonable estimates of clay strength in between the known points.
- See Attachment E1-C for sketch comparing existing conditions vs. historic (pre-mining) topography.
- Estimate gross effective stress increase - Pre-mining "cuts" approximately equal to net effective stress increase. See Attachment E1-D.
- Use Winstress software to estimate effective stress increase in clay soils at various intervals between the crest and toe. See Attachment E1-D for Winstress setup and associated output files.
- Estimate strength increase in soft/normally consolidated clay soils based on $Su/\sigma`v = 0.2$ (relationship based on site-specific lab testing and in agreement with literature values. Strength increase in medium stiff clay soils based on $Su/\sigma`v = 0.15$. Strength increase in stiff clay soils based on $Su/\sigma`v = 0.1$. No strength increase applied to very stiff clay. See Attachment E1-D.
- Apply strength increase to the "toe" conditions in segmented/zoned areas beneath the berm. See Attachment E1-D.
- See Slope/W output files for zones and strengths assigned.

F. Define Phreatic Surface/Water Table and/or Pore Pressure Grid

- Site-specific water levels measured in the installed/existing PZs, MWs, OWs, and/or VWPs provide information on impoundment water levels. This info indicates a slightly downward gradient (decreasing piezometric surface/pressure within the tailings with increasing depth bgs).
    - Water level data is available or formerly available at the following locations along or proximate to Profile E1:
        - PZ/MW-601 (formerly available, since destroyed)
        - PZ/MW-602
        - PZ/MW-706
        - PZ/MW-703
    - Water level data from OWs installed in the impoundment dam are considered representative for each profile:
        - OWs at SB-1123 and SB-1124
- A pore pressure grid can be utilized in Slope/W to model decreasing pore pressure gradients with depth. This approach is applicable for existing conditions. However, the remedial design includes installation of drainage features.
- For this evaluation, the pore pressuresare modelled in Slope/W via a piezometric line and not a pore pressure grid. This is considered conservative for evaluation of existing conditions, but more reasonable/applicable for representing the long-term post-remediation impoundment water levels predicted by current groundwater model (Appendix A).
- The impoundment water levels used for existing conditions are shown in Table C-2.
    - Additional data from SB-1123 and/or SB-1124 (OWs) are used for existing conditions.



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ATTACHMENT E1-B

PROFILE E1
LONG-TERM STATIC SLOPE STABILITY EVALUATION

EXISTING CONDITIONS SLOPE/W POINTS (GEOMETRY)

ATTACHMENT E1-B

PROFILE E1 - SLOPE/W MODEL DEVELOPMENT - EXISTING CONDITIONS

- Define cross-section perpendicular to impoundment dam "face".
- Define STA. 0+00 at Elev. +16.0 ft MSL (~"toe" of the impoundment dam).
- Define existing topography:

Point	STA.	Ground Surface EL. (ft)	Exploration	As-Drilled GS EL. (ft)
1	7+92	100		
2	7+76	95		
3	7+70	93		
4	7+50	92		
5	7+47	91	TP−13	
6	7+46	90.5		
7	7+45	90		
8	7+30	85		
9	7+18	80		
10	7+05	75		
11	7+02	74		
12	6+98	73		
13	6+90	72	RC−1143	70.8
14	6+86	72		
15	6+03	71.5	SB−601 CP−601	
16	5+85	71		
17	4+95	70.5	CP−602	
18	3+38	71		
19	3+30	71	CP−603	
20	2+81	72		
21	2+48	72.5	SB−602 CP−615	
22	2+42	73		
23	2+00	74		
24	1+86	74.5	CP−604	
25	1+52	75		
26	1+32	75.5		
27	1+19	76		
28	1+11	77		
29	0+92	77		
30	0+86	76		
31	0+85	75		
32	0+79	70		
33	0+72	65		
34	0+66	60		

Point	STA.	Ground Surface EL. (ft)	Exploration		As-Drilled GS EL. (ft)
35	0+60	55			
36	0+53	50			
37	0+46	45			
38	0+39	40			
39	0+33	35			
40	0+24	30			
41	0+16	25			
42	0+07	20			
43	0+00	16			
44	−0+22	16	$SB-703$		12.3
45	−0+35	15			
46	−0+45	14.5			
47	−0+53	14			
48	−0+71	13			
49	−0+86	12			
50	−1+18	11			
51	−1+25	11	$SB-1137$	$CPT-27$	6.0
52	−1+43	10			
53	−1+78	9			
54	−1+97	6			
55	−2+41	5			
56	−3+05	1.5	$SD-708$		

Note: Elevations of some explorations were adjusted in Slope/W model to better match the base map topography at the profile location.

ATTACHMENT E1-C

PROFILE E1
LONG-TERM STATIC SLOPE STABILITY EVALUATION

IMPOUNDMENT DAM CONFIGURATION

ATTACHMENT E1-C

PROFILE E1 - DAM IMPOUNDMENT CONFIGURATION

A. Objective:

- To assess the configuration of the existing impoundment dam, including number of lifts/raises above the starter dam and the crest width and backslope of of each lift.

B. Discussion:

- Anecdotal information, historic photographs, and subsurface exploration data indicate that the impoundment dam was constructed via upstream raised embankment methods. Tailings were discharged via spigots placed peripherally along the crest of the starter dam (and each subsequent "lift" of the dam/embankment raise).

- Borings/wells drilled near the crest of the dam typically identify clay/glacial till fill "at depth" beneath the tailings.

C. Data Evaluation:

- MW-604R

  - Location: Northeastern corner of impoundment
  - Crest EL.: +75 to +77 ft (including surface gravel)
  - Toe EL.: +10 ft
  - Existing GS EL.: +77 ft
  - Horiz. Distance from Crest Grade Break (northern): 37 ft
  - Horiz. Distance from Crest Grade Break (eastern): 46 ft

  - Data Summary:

    - 0.0-1.5 ft bgs: Road base gravel;
    - 1.5-5.0 ft bgs: Gravel and cobbles;
    - 5.0-15.0 ft bgs: Poor recovery/limited soil description/stratigraphy due to sonic drilling method. In general, Waste Rock over Sand tailings, over Slime tailings @ ~12-15 ft bgs; and
    - 62.0-65.0 ft bgs: Possible reworked clay/glacial till.

  - Conclusions:

    - Gravel and cobbles at shallow depth may not be associated with the impoundment dam. Rather, used for support of present-day roadway.
    - Impoundment dam may not have been encountered at this boring. This suggests max crest width of uppermost dam ~25 ft for northern side, assuming ~10 ft tall lift (25+10*1.3=38 ft) OR ~20 ft for northern side, assuming a ~15 ft tall lift. Using the same criteria, a 25 to 30 ft wide crest is possible for the eastern side.
    - Slimes @ ~12-15 ft bgs suggest bottom of uppermost lift at ~EL. +65 ft, OR no spigot in the corner.
    - Clay/till fill at depth likely part of starter dam.

C. Data Evaluation - continued:

- MW-722R

  - Location: Southeastern corner of impoundment
  - Crest EL.: +75 to +77 ft
  - Toe EL.: +20 ft
  - Existing GS EL.: +77 ft
  - Horiz. Distance from Crest Grade Break (eastern): 37 ft
  - Horiz. Distance from Crest Grade Break (southern): 37 ft

  - Data Summary:

    - 0.0-1.0 ft bgs: Road base gravel;
    - 1.0- 10-15 ft bgs: Gravel, cobbles, and boulders;
    - >10-15 ft bgs: Sand/silt;
    - Limited soil description/stratigraphy at depth due to sonic drilling methods.

  - Conclusions:

    - Impoundment dam encountered at this location.
    - Some of the shallow gravel, cobbles, and boulders may be associated with support of present-day roadway.
    - Suggests crest width of 25 to 30 ft, assuming 10 to 15 ft lift.
    - Suggests 10 to 15 ft height for uppermost lift.
    - Suggests bottom of uppermost lift at ~EL. +62 to +67 ft.

- SB-1124 & SB-1119

  - Location: Eastern side (~E2 profile)
  - Crest EL.: +75 to +77 ft
  - Toe EL.: +15 ft
  - Existing GS EL.: +76.5 ft (SB-1124); +75.5 ft (SB-1119)
  - Horiz. Distance from Crest Grade Break: 22 ft (SB-1124); 32 ft (SB-1119)

  - Data Summary:

SB-1124		SB-1119	
0-1 ft bgs:	Roadway gravel	0-1 ft bgs:	Roadway gravel
1-25 ft bgs:	Waste rock	1-11 ft bgs:	Waste rock
25-43 ft bgs:	Sand tailings	11-28.5 ft bgs:	Sand tailings
- Obstruction ~33 ft bgs		- Boney ~19 ft bgs	
43-48.5 ft bgs:	Waste rock/tailings	28.5-56 ft bgs:	Mixed tailings
48.5-53 ft bgs:	Sand tailings	- Gravelly ~33 ft bgs	
53-61 ft bgs:	Reworked clay	56-61 ft bgs:	Clay, possible rework
61-68 ft bgs:	Native clay	61-67 ft bgs:	Native clay

C. Data Evaluation - continued:

- SB-1124 & SB-1119 - continued

  - Conclusions:

    - Empoundment dam encountered at these locations.
    - Suggests bottom of the uppermost lift at ~EL. +65.
    - Suggests 10-11 ft lift height for uppermost lift.
    - Suggests 25-30 ft wide crest width for uppermost lift.
    - SB-1119, SCPT-16 (refusal at 6.5 ft bgs, 14 ft from SB-1119), and SCPT-16A (No refusal, 23 ft from SB-1119) suggest ~2H:1V backslope on uppermost lift.
    - SB-1124 suggests 25-30 ft wide crest for 2nd uppermost lift.
    - SB-1124 sugests bottom of the 2nd uppermost lift at ~EL. +50 to +55 ft.
    - SB-1124 & SB-1119 indicate reworked clay fill at 53 ft and 56 ft bgs, respectively. Suggests clay fill with 2.5H:1V backslope. Indicates clay fill behind starter dam.

- SB-1123 & SB-1122

  - Location: Eastern side (~E3 profile)
  - Crest EL.: +75 to +78 ft
  - Toe EL.: +12 ft
  - Existing GS EL.: +77ft (SB-1123); +75.5 ft (SB-1122)
  - Horiz. Distance from Crest Grade Break: 20 ft (SB-1123); 29 ft (SB-1129)

  - Data Summary:

SB-1123		SB-1122
0-1.5 ft bgs:	Roadway gravel	0-8 ft bgs (+/-): Roadway gravel
1.5-23 ft bgs:	Waste rock	8-17 ft bgs (+/-): Waste rock
23-33.5 ft bgs:	Waste rock/tailings	17-33.5 ft bgs: Sand tailings
33.5-39.5 ft bgs:	Sand/mixed tailings	- Gravel/obstruction at 32.5 ft bgs
39.5-55.5 ft bgs:	Mixed tailings	33.5-56 ft bgs: Mixed tailings
55.5-66 ft bgs:	Reworked clay	56-63.5 ft bgs: Reworked clay
66-68.5 ft bgs:	Native clay	- "Boney" material at 59' bgs
68.5 ft bgs:	Till/bedrock	63.5-65.5 ft bgs: Native clay
		65.5 ft bgs: Till/bedrock

C. Data Evaluation - continued:

- SB-1123 & SB-1122 - continued
  - Conclusions:
    - Empoundment dam encountered at these locations.
    - Suggests bottom of the uppermost lift at ~EL. +65.
    - Suggests 10 ft lift height for uppermost lift.
    - Suggests 25-30 ft wide crest width for uppermost lift.
    - SB-1122, SCPT-14 (refusal at 6.5 ft bgs, 10 ft from SB-1122), and SCPT-14A (No refusal, 25 ft from SB-1122) suggest ~1.3H:1V backslope on uppermost lift.
    - SB-1123 suggests 25-30 ft wide crest for 2nd uppermost lift.
    - SB-1123 sugests bottom of the 2nd uppermost lift at ~EL. +50 to +55 ft.
    - SB-1123 & SB-1122 indicate reworked clay fill at 55 ft and 56 ft bgs, respectively. Suggests clay fill with 3H:1V backslope. Indicates clay fill behind starter dam.

- SB-1125
  - Location: Northern side
  - Crest EL: +75 to +78 ft
  - Toe EL.: +28 ft
  - Existing GS EL.: +78 ft
  - Horiz. Distance from Crest Grade Break: 14 ft
  - Data Summary:
    - 0-36 ft bgs: Waste Rock
    - 36-51 ft bgs: Waste rock/tailings mix
    - 51-63.5 ft bgs: Clay/till fill
    - 63.5-66 ft bgs: Native organic silt
    - 66-73.5 ft bgs: Native clay
    - 73.5-77 ft bgs: Glacial till
  - Conclusions:
    - Impoundment dam encountered at this location.
    - Suggests bottom of 3rd uppermost lift at ~EL. +40 to +45 ft.
    - Indicates 25 ft wide crest for the 2nd uppermost lift.
    - Indicates clay/till fill behind the starter dam. Thickness of fill (and top elevation of fill) appears to increase as distance from crest/toe/starter dam decreases.

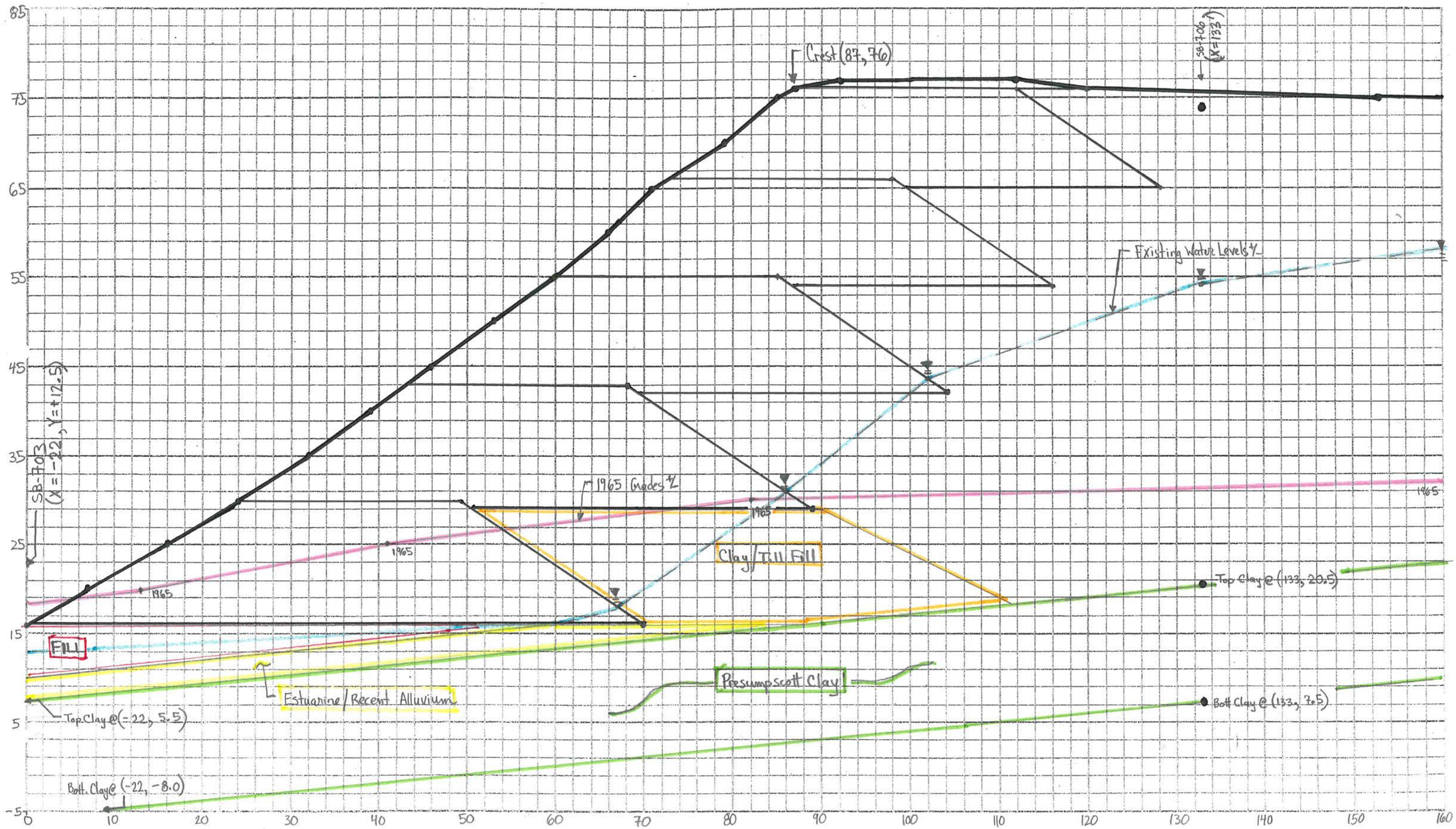
C. Data Evaluation - continued:

- SB-1126
  - Location: Southern side
  - Crest EL.: +75 to +77 ft
  - Existing GS EL.: +77 ft
  - Horiz. Distance from Grade Break: 20 ft
  - Data Summary:
    - Advanced 0-45 ft bgs via air hammer drilling methods:
      - Waste rock;
      - Waste rock/Dense tailings mix; and/or
      - Very stiff/stiff clay/till fill
    - 48 ft bgs: Bottom of clay/till fill
    - 48-64 ft bgs: Native clay
    - 64-77 ft bgs: Glacial till
    - 77 ft bgs: Probable bedrock

- A sketch of the interpreted impoundment dam configuration is shown on Sheet 6.

Y = Elevation (feet) : 1" = 10'
X = Distance from Toe (feet) : 1" = 10'

Profile E1 Interpreted Rock Dam Configuration	PROJECT Callahan Mine Tailings Impoundment Slope Stability Evaluation	COMP BY TCC	JOB NO. 3612-11-2201
		CHK BY	DATE 03/2013



ATTACHMENT E1-D

PROFILE E1
LONG-TERM STATIC SLOPE STABILITY EVALUATION

ESTIMATES OF CLAY SHEAR STRENGTH VIA SHANSEP METHOD

ATTACHMENT E1-D

PROFILE E1 - ESTIMATE CLAY SHEAR STRENGTH BENEATH IMPOUNDMENT DAM

- Clay thickness and shear strength profile are "known" near the toe of the impoundment dam.
  - SB-703 13.5 ft thick Transitions from hard/v. stiff crust to soft
- Clay thickness and shear strength profile are "known" at/near the crest of the impoundment dam.
  - SB-706 13 ft thick Transitions from hard/v. stiff crust to stiff
- Clay thickness is approximately the same between these two points.
  - Distance ~= 150 ft
- Clay strength profile will be interpolated between these points using $Su/\sigma'v$ (also called c/p) ratios, based on site specific laboratory test results and literature values:
  - Soft: $\Delta Su/\Delta\sigma'v = 0.20$
  - Medium stiff: $\Delta Su/\Delta\sigma'v = 0.15$
  - Stiff (<1500 psf): $\Delta Su/\Delta\sigma'v = 0.10$
    - Apply strength increase (ΔSu) to clay strength profile at toe based on effective stress increase ($\Delta\sigma'v$) imposed by the impoundment dam.
    - See Attachment E1-C for a sketch of existing conditions/topo, 1965 topo, and soil boring locations relative to the toe of the dam.
    - Use Winstress software to estimate $\Delta\sigma'v$ applied to clay soils at various stations/zones beneath the impoundment dam.

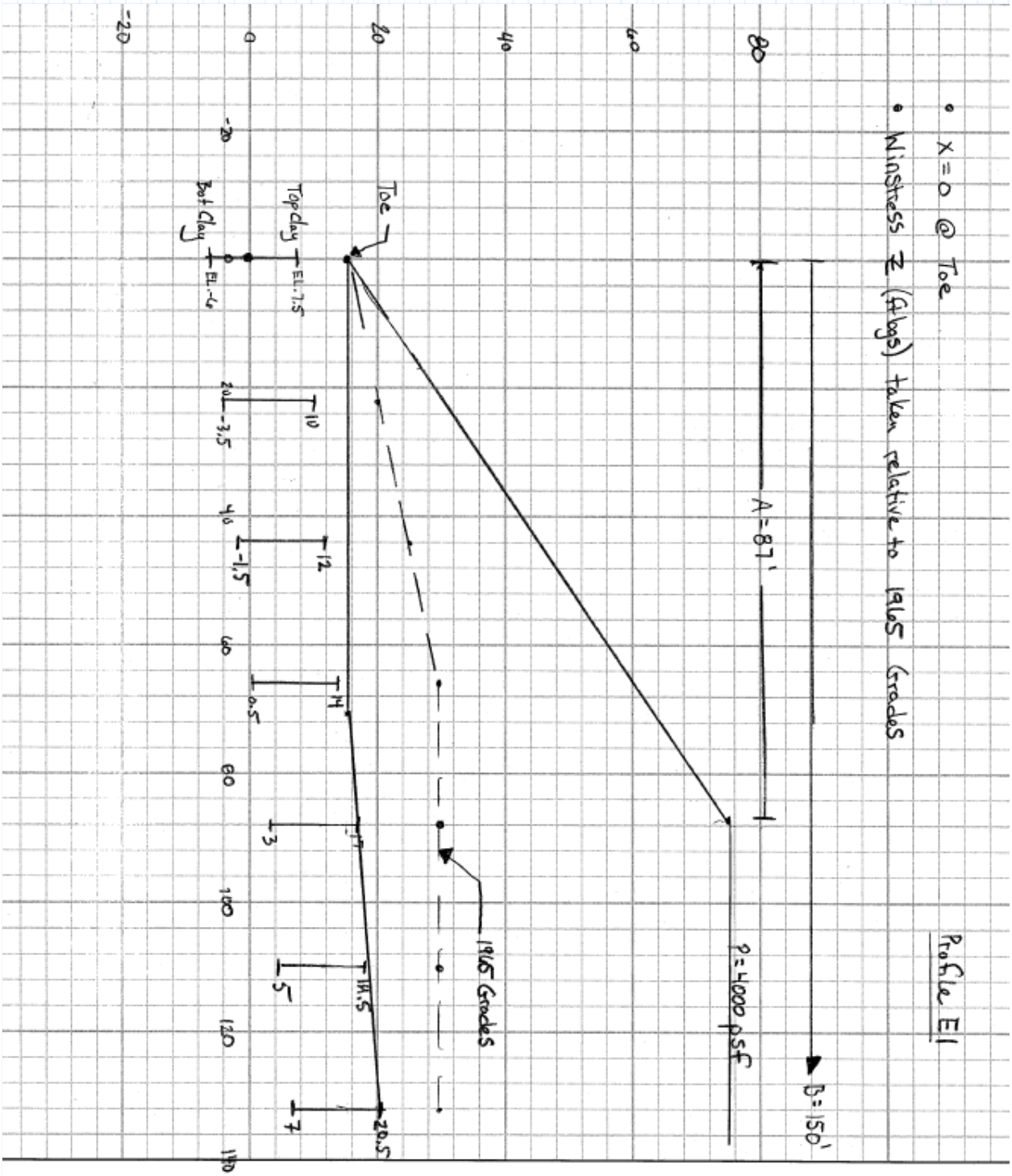
- Estimate embankment load imposed by the impoundment:
  - Beneath crest point:
    - 45 ft tall dam/impoundment (relative to 1965 grade of ~+30 ft)
      - $\sigma'v$ = 41 ft unsaturated waste rock/tailings = 45' x 105 pcf = 4,725 psf
      - Assume 3 ft rise in pore pressure in clay = -3' x 62.4 pcf = -187 psf
        - Load imposed beneath crest ~= 4,538 psf
  - Beneath SB-706:
    - 45 ft tall dam (relative to 1965 grade of ~+30 ft)
      - $\sigma'v$ = 20 ft unsaturated tailings = 20' x 110 pcf = 2,200 psf
      - $\sigma'v$ = 25 ft saturated tailings = 25' x 120 pcf = 3,000 psf
      - u = 25 ft of water = -25' x 62.4 pcf = -1,560 psf
      - Assume 3 ft rise in pore pressure in clay = -3' x 62.4 pcf = -187 psf
        - Load imposed beneath SB-706 ~= 3,453 psf
  - Average embankment/terrace load = 4,000 psf

- Use Winstress software with the following inputs:
  - Load at crest = 4,000 psf
  - A=Distance toe to crest = 87 ft
  - B=Distance to to end of load = 150 ft
  - x = 0 @ toe of embankment load

- Vary x to estimate $\Delta\sigma'v$ with depth (z) below the embankment.

- Winstress software input/analysis definitions:

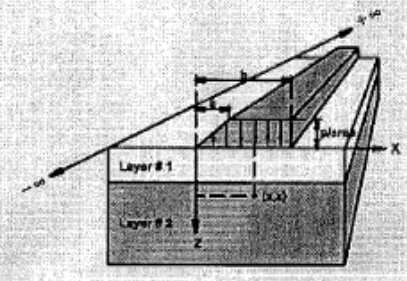
X-Range (Slope/W coords.)	Analysis Point (Winstress)	Discussion
-22 to -11	x = N/A	
-11 to +11	x = 0	See attached output files;
+11 to +33	x = +22	Soft: c/p = 0.20
+33 to +55	x = +44	M. Stiff: c/p = 0.15
+55 to +77	x = +66	Stiff: c/p = 0.10
+77 to +99	x = +88	V. Stiff: N/A
+99 to +121	x = +110	
+121 to +143	x = +132	


Profile E1
• X=0 @ Toe
• WinStress Z (ft bgs) taken relative to 1965 Grades
A=87'
B=150'
P=4000 psf
1965 Grades
Toe
Top clay
Bot clay
EL. 7.5
EL. -6
20.5
14
17
14.5
10
12
7
5
3
0.5
-1.5
-3.5
20
40
60
80
100
120
140
-20
0
20
40
60
80

Increment of stress calculation = vertical $\Delta\sigma z$

STRIP FOOTING

Width of strip A = 87.00
Width of strip B = 150.00
p load/unit area = 4000.000



POINTS FOR COMPUTATION OF INCREMENT OF STRESS

x1 coordinate = 0.00
z1 coordinate = 0.00
z2 coordinate = 30.00
delta z = 1.00

calculate in = z direction

Ok | Cancel | Print Screen | Save Screen

@ X = 0

Clay Elev.	Relative to Elev. +15' (+1965 Grade)
+7.5'	7.5' bgs
to	to
-6.0'	21' bgs

LOADING ON AN INFINITE STRIP
VERTICAL EMBANKMENT LOADING

Embank. slope a = 87.00 (ft)
Embank. width b = 150.00 (ft)
p load/unit area = 4000.000(psf)

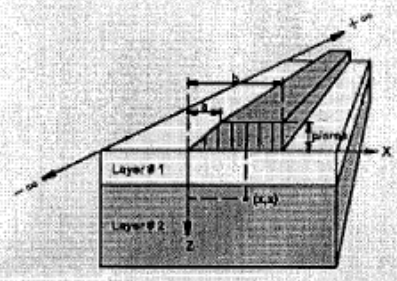
INCREMENT OF STRESSES FOR Z-DIRECTION
X = 0.00(ft)

Z (ft)		Vert. Dsz (psf)	
0.00		0.00	
1.00		14.63	
2.00		29.26	
3.00		43.88	
4.00		58.48	
5.00		73.06	
6.00		87.62	
7.00		102.14	
8.00		116.62	
9.00		131.07	
10.00		145.46	
11.00		159.80	
12.00		174.09	
13.00		188.31	
14.00	Stiff	202.46	x 0.10 ≅ 20 psf ≅ ΔSu Not Applied
15.00		216.55	
16.00		230.56	
17.00	M. Stiff	244.48	x 0.15 ≅ 35 psf ≅ ΔSu
18.00		258.32	
19.00		272.07	
20.00	Soft	285.73	x 0.2 ≅ 60 psf ≅ ΔSu
21.00		299.29	
22.00		312.75	
23.00		326.10	
24.00		339.34	
25.00		352.47	
26.00		365.49	
27.00		378.38	
28.00		391.15	
29.00		403.80	
30.00		416.31	

Increment of stress calculation = vertical $\Delta\sigma z$

STRIP FOOTING

Width of strip A = 87.00
Width of strip B = 150.00
p load/unit area = 4000.000



POINTS FOR COMPUTATION OF INCREMENT OF STRESS

x1 coordinate = 22.00
z1 coordinate = 0.00
z2 coordinate = 30.00
delta z = 1.00

calculate in = z direction

Ok | Cancel | Print Screen | Save Screen

@ X = 22

Clay Elev.	Relative to Elev + 20' (~1965 Grade)
+ 10.0'	10' bgs
to	to
-3.5'	23.5' bgs

LOADING ON AN INFINITE STRIP
VERTICAL EMBANKMENT LOADING

Embank. slope a = 87.00 (ft)
Embank. width b = 150.00 (ft)
p load/unit area = 4000.000(psf)

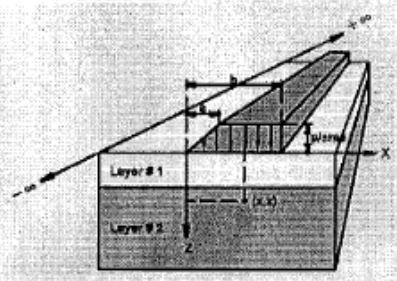
INCREMENT OF STRESSES FOR Z-DIRECTION
X = 22.00(ft)

Z (ft)		Vert. Dsz (psf)	
0.00		1011.49	
1.00		1011.50	
2.00		1011.56	
3.00		1011.72	
4.00		1012.03	
5.00		1012.52	
6.00		1013.24	
7.00		1014.22	
8.00		1015.49	
9.00		1017.06	
10.00		1018.94	
11.00		1021.15	
12.00		1023.69	
13.00		1026.56	
14.00		1029.74	
15.00		1033.23	
16.00		1037.01	
17.00	Stiff	1041.07	x 0.1 ≅ 100psf ≅ ΔSu Not Applied
18.00		1045.39	
19.00		1049.96	
20.00	M. Stiff	1054.75	x 0.15 ≅ 155psf ≅ ΔSu
21.00		1059.74	
22.00		1064.91	
23.00	Soft	1070.25	x 0.2 ≅ 215psf = ΔSu
24.00		1075.73	
25.00		1081.33	
26.00		1087.04	
27.00		1092.83	
28.00		1098.70	
29.00		1104.61	
30.00		1110.56	

Increment of stress calculation = vertical $\Delta\sigma z$

STRIP FOOTING

Width of strip A = 87.00
Width of strip B = 150.00
p load/unit area = 4000.000



POINTS FOR COMPUTATION OF INCREMENT OF STRESS

x1 coordinate = 44.00
z1 coordinate = 0.00
z2 coordinate = 30.00
delta z = 1.00

calculate in = z direction

Ok | Cancel | Print Screen | Save Screen

@ X = 44

Clay Elev.	Relative to Elev. + 25' (~1965 grade)
+12.0'	13' bgs
to	to
-1.5'	26.5' bgs

LOADING ON AN INFINITE STRIP
VERTICAL EMBANKMENT LOADING

Embank. slope a = 87.00 (ft)
Embank. width b = 150.00 (ft)
p load/unit area = 4000.000(psf)

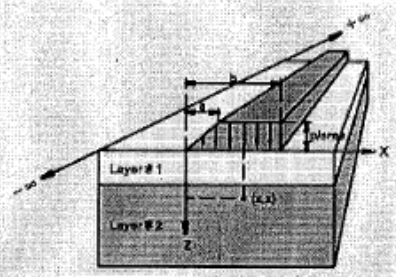
INCREMENT OF STRESSES FOR Z-DIRECTION
X = 44.00(ft)

Z (ft)		Vert. Dsz (psf)	
0.00		2022.99	
1.00		2022.99	
2.00		2022.98	
3.00		2022.97	
4.00		2022.94	
5.00		2022.89	
6.00		2022.81	
7.00		2022.71	
8.00		2022.57	
9.00		2022.39	
10.00		2022.17	
11.00		2021.91	
12.00		2021.59	
13.00		2021.22	
14.00		2020.78	
15.00		2020.29	
16.00		2019.73	
17.00		2019.10	
18.00		2018.40	
19.00		2017.62	
20.00	Stiff	2016.77	x 0.1 ≅ 200psf ≅ Δ Su Not Applied
21.00		2015.83	
22.00		2014.82	
23.00	M. Stiff	2013.71	x 0.15 ≅ 300psf ≅ Δ Su
24.00		2012.52	
25.00		2011.24	
26.00	Soft	2009.87	x 0.2 ≅ 400psf = Δ Su
27.00		2008.41	
28.00		2006.85	
29.00		2005.20	
30.00		2003.45	

Increment of stress calculation = vertical $\Delta\sigma z$

STRIP FOOTING

Width of strip A = 87.00
Width of strip B = 150.00
p load/unit area = 4000.000



POINTS FOR COMPUTATION OF INCREMENT OF STRESS

x1 coordinate = 66.00
z1 coordinate = 0.00
z2 coordinate = 30.00
delta z = 1.00

calculate in = z direction

Ok | Cancel | Print Screen | Save Screen

@ X = 66

Clay Elev.	Relative to Elev. + 30' (~ 1965 Grade)
+14.0'	16' bgs
to	to
+0.5'	29.5' bgs

LOADING ON AN INFINITE STRIP
VERTICAL EMBANKMENT LOADING

Embank. slope a = 87.00 (ft)
Embank. width b = 150.00 (ft)
p load/unit area = 4000.000(psf)

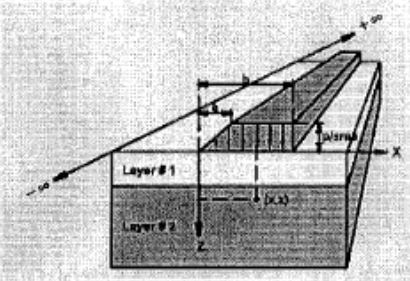
INCREMENT OF STRESSES FOR Z-DIRECTION
X = 66.00(ft)

Z (ft)	Vert. Dsz (psf)	
0.00	3034.48	
1.00	3034.47	
2.00	3034.39	
3.00	3034.18	
4.00	3033.77	
5.00	3033.11	
6.00	3032.14	
7.00	3030.82	
8.00	3029.11	
9.00	3026.98	
10.00	3024.41	
11.00	3021.39	
12.00	3017.90	
13.00	3013.93	
14.00	3009.50	
15.00	3004.59	
16.00	2999.23	
17.00	2993.42	
18.00	2987.18	
19.00	2980.51	
20.00	2973.44	
21.00	2965.98	
22.00	2958.15	x 0.1 ≅ 300 psf ≅ ΔSu Not Applied
23.00	2949.96	
24.00	2941.43	
25.00	2932.57	x 0.15 ≅ 440 psf ≅ ΔSu
26.00	2923.41	
27.00	2913.96	
28.00	2904.23	x 0.2 ≅ 575 psf ≅ ΔSu
29.00	2894.24	
30.00	2884.00	

Increment of stress calculation = vertical $\Delta\sigma z$

STRIP FOOTING

Width of strip A = 87.00
Width of strip B = 150.00
p load/unit area = 4000.000



POINTS FOR COMPUTATION OF INCREMENT OF STRESS

x1 coordinate = 88.00
z1 coordinate = 0.00
z2 coordinate = 30.00
delta z = 1.00

calculate in = z direction

Ok | Cancel | Print Screen | Save Screen

@ X = 88

Clay Elev.	Relative to Elev. +30' (~1965 Grade)
+ 17.0'	13' bgs
to	to
+ 3.0'	27' bgs

LOADING ON AN INFINITE STRIP
VERTICAL EMBANKMENT LOADING

Embank. slope a = 87.00 (ft)
Embank. width b = 150.00 (ft)
p load/unit area = 4000.000(psf)

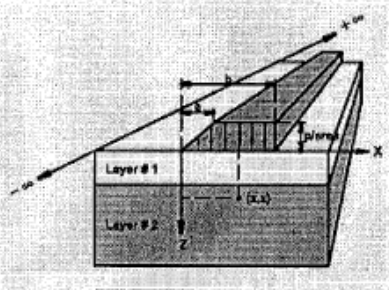
INCREMENT OF STRESSES FOR Z-DIRECTION
X = 88.00(ft)

Z (ft)	Vert. Dsz (psf)	
0.00	4000.00	
1.00	3996.86	
2.00	3986.91	
3.00	3974.30	
4.00	3960.68	
5.00	3946.56	
6.00	3932.14	
7.00	3917.48	
8.00	3902.62	
9.00	3887.58	
10.00	3872.35	
11.00	3856.94	
12.00	3841.34	
13.00	3825.55	
14.00	3809.55	
15.00	3793.35	
16.00	3776.95	
17.00	3760.32	
18.00	3743.49	
19.00	3726.43	x 0.1 ≅ 375 psf ≅ ΔSu Not Applied
20.00	3709.15	
21.00	3691.66	
22.00	3673.94	x 0.15 ≅ 550 psf ≅ ΔSu Less Applied
23.00	3656.01	
24.00	3637.87	
25.00	3619.51	
26.00	3600.95	x 0.2 ≅ 725 psf ≅ ΔSu
27.00	3582.19	
28.00	3563.23	
29.00	3544.09	
30.00	3524.77	

Increment of stress calculation = vertical $\Delta\sigma z$

STRIP FOOTING

Width of strip A = 87.00
Width of strip B = 150.00
p load/unit area = 4000.000



POINTS FOR COMPUTATION OF INCREMENT OF STRESS

x1 coordinate = 110.00
z1 coordinate = 0.00
z2 coordinate = 30.00
delta z = 1.00

calculate in = z direction

Ok | Cancel | Print Screen | Save Screen

@ X = 110

Clay Elev.	Relative to Elev. +30' (~1965 grade)
+18.5'	11.5' bgs
to	to
+5.0'	25' bgs

LOADING ON AN INFINITE STRIP
VERTICAL EMBANKMENT LOADING

Embank. slope a = 87.00 (ft)
Embank. width b = 150.00 (ft)
p load/unit area = 4000.000(psf)

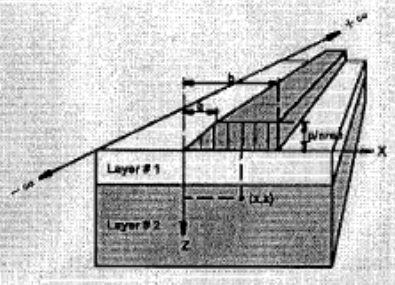
INCREMENT OF STRESSES FOR Z-DIRECTION
X = 110.00(ft)

Z (ft)	Vert. Dsz (psf)	
0.00	4000.00	
1.00	3999.98	
2.00	3999.82	
3.00	3999.41	
4.00	3998.61	
5.00	3997.30	
6.00	3995.38	
7.00	3992.75	
8.00	3989.32	
9.00	3985.02	
10.00	3979.77	
11.00	3973.54	
12.00	3966.28	
13.00	3957.97	
14.00	3948.59	
15.00	3938.14	
16.00	3926.63	
17.00	3914.07	
18.00	3900.48	
19.00	3885.90	x 0.15 ≅ 575 psf ≅ ΔSu Less Applied
20.00	3870.35	
21.00	3853.87	
22.00	3836.52	
23.00	3818.33	x 0.20 ≅ 760 psf ≅ ΔSu
24.00	3799.35	
25.00	3779.63	
26.00	3759.23	
27.00	3738.19	
28.00	3716.57	
29.00	3694.41	
30.00	3671.77	

Increment of stress calculation = vertical $\Delta\sigma z$

STRIP FOOTING

Width of strip A = 87.00
Width of strip B = 150.00
p load/unit area = 4000.000



POINTS FOR COMPUTATION OF INCREMENT OF STRESS

x1 coordinate = 132.00
z1 coordinate = 0.00
z2 coordinate = 30.00
delta z = 1.00

calculate in = z direction

Ok | Cancel | Print Screen | Save Screen

@ X = 132' (~ SB-706)

Clay Elev.	Relative to Elev. +30' (~1965 Grade)
+20.5'	9.5' bgs
to	to
+7.0'	23' bgs

LOADING ON AN INFINITE STRIP
VERTICAL EMBANKMENT LOADING

Embank. slope a = 87.00 (ft)
Embank. width b = 150.00 (ft)
p load/unit area = 4000.000(psf)

INCREMENT OF STRESSES FOR Z-DIRECTION
X = 132.00(ft)

Z (ft)	Vert. Dsz (psf)	
0.00	4000.00	
1.00	3999.85	
2.00	3998.84	
3.00	3996.14	
4.00	3991.07	
5.00	3983.10	
6.00	3971.85	
7.00	3957.15	
8.00	3938.98	
9.00	3917.45	
10.00	3892.81	
11.00	3865.36	
12.00	3835.47	
13.00	3803.51	
14.00	3769.88	
15.00	3734.92	
16.00	3699.00	
17.00	3662.40	x 0.15 ≈ 550 psf ≈ ΔSu Less Applied
18.00	3625.40	
19.00	3588.23	
20.00	3551.09	
21.00	3514.15	
22.00	3477.54	x 0.2 ≈ 700 psf ≈ ΔSu
23.00	3441.37	
24.00	3405.72	
25.00	3370.65	
26.00	3336.22	
27.00	3302.46	
28.00	3269.38	
29.00	3237.01	
30.00	3205.33	

ATTACHMENT E1-E

PROFILE E1
LONG-TERM STATIC SLOPE STABILITY EVALUATION

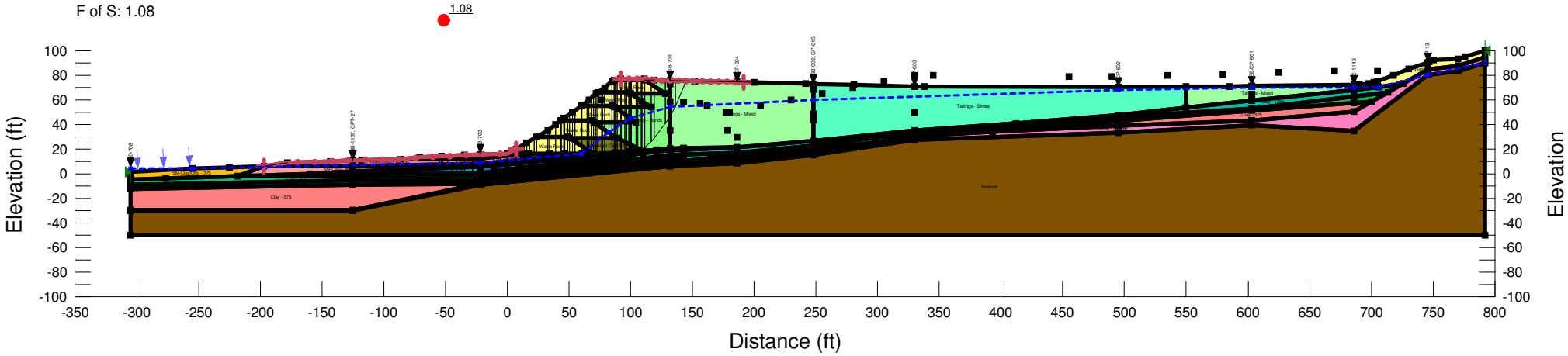
SLOPE/W OUTPUT: EXISTING CONDITIONS

Title: Callahan Mine OU3 - Profile E1
Date: 10/14/2014
File Name: Tailings_Profile E1_Existing-Cond-90%.gsz

Name: Profile E1b - Existing - Ent/Exit - Till Imp.
Method: Spencer

Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 116 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Gravel Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38 ° Constant Unit Wt. Above Water Table: 125 pcf Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Fill - Sand/Fines/Org. Mix Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 25 psf Phi': 32 ° Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 375 Model: Undrained (Phi=0) Unit Weight: 105 pcf Cohesion': 375 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: Clay - 2750 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,750 psf Piezometric Line: 1
Name: Clay - 2250 Model: Undrained (Phi=0) Unit Weight: 124 pcf Cohesion': 2,250 psf Piezometric Line: 1
Name: Clay - 1750 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,750 psf Piezometric Line: 1
Name: Clay - 1250 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,250 psf Piezometric Line: 1
Name: Clay - 875 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 875 psf Piezometric Line: 1
Name: Clay - 625 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 625 psf Piezometric Line: 1
Name: Clay - 475 Model: Undrained (Phi=0) Unit Weight: 119 pcf Cohesion': 475 psf Piezometric Line: 1
Name: Clay - 375 Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 375 psf Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Reworked Clay/Till Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Clay - 1075 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,075 psf Piezometric Line: 1
Name: SM-Clay-Org. - 750 Model: Undrained (Phi=0) Unit Weight: 105 pcf Cohesion': 750 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: SM-Clay - 1000 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 1,000 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 525 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 525 psf Piezometric Line: 1
Name: Clay - 1375 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,375 psf Piezometric Line: 1
Name: Clay - 1175 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,175 psf Piezometric Line: 1
Name: Clay - 925 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 925 psf Piezometric Line: 1
Name: Clay - 675 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 675 psf Piezometric Line: 1
Name: Clay - 1050 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,050 psf Piezometric Line: 1
Name: Clay - 1200 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,200 psf Piezometric Line: 1
Name: Clay - 1225 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,225 psf Piezometric Line: 1
Name: Clay - 950 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 950 psf Piezometric Line: 1
Name: Clay - 1325 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,325 psf Piezometric Line: 1
Name: Glacial Till - Imp Model: Bedrock (Impenetrable) Piezometric Line: 1

F of S: 1.08

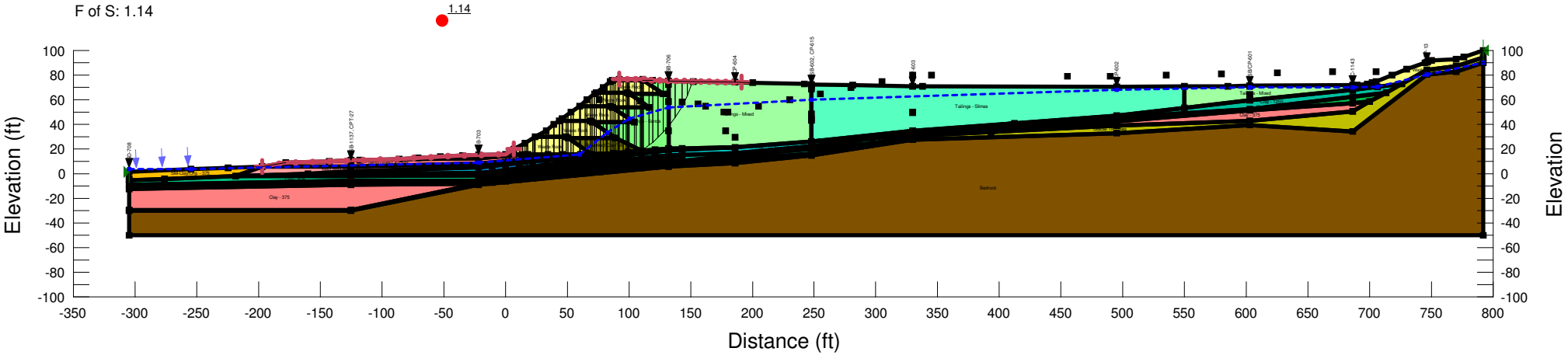


Title: Callahan Mine OU3 - Profile E1
Date: 10/14/2014
File Name: Tailings_Profile E1_Existing-Cond-90%.gsz

Name: Profile E1a - Existing - Ent/Exit - Till Reg.
Method: Spencer

Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 116 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Glacial Till - Reg Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 50 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 130 pcf Piezometric Line: 1
Name: Gravel Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38 ° Constant Unit Wt. Above Water Table: 125 pcf Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Fill - Sand/Fines/Org. Mix Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 25 psf Phi': 32 ° Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 375 Model: Undrained (Phi=0) Unit Weight: 105 pcf Cohesion': 375 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: Clay - 2750 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,750 psf Piezometric Line: 1
Name: Clay - 2250 Model: Undrained (Phi=0) Unit Weight: 124 pcf Cohesion': 2,250 psf Piezometric Line: 1
Name: Clay - 1750 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,750 psf Piezometric Line: 1
Name: Clay - 1250 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,250 psf Piezometric Line: 1
Name: Clay - 875 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 875 psf Piezometric Line: 1
Name: Clay - 625 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 625 psf Piezometric Line: 1
Name: Clay - 475 Model: Undrained (Phi=0) Unit Weight: 119 pcf Cohesion': 475 psf Piezometric Line: 1
Name: Clay - 375 Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 375 psf Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Reworked Clay/Till Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Clay - 1075 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,075 psf Piezometric Line: 1
Name: SM-Clay-Org. - 750 Model: Undrained (Phi=0) Unit Weight: 105 pcf Cohesion': 750 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: SM-Clay - 1000 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 1,000 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 525 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 525 psf Piezometric Line: 1
Name: Clay - 1375 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,375 psf Piezometric Line: 1
Name: Clay - 1175 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,175 psf Piezometric Line: 1
Name: Clay - 925 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 925 psf Piezometric Line: 1
Name: Clay - 675 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 675 psf Piezometric Line: 1
Name: Clay - 1050 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,050 psf Piezometric Line: 1
Name: Clay - 1200 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,200 psf Piezometric Line: 1
Name: Clay - 1225 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,225 psf Piezometric Line: 1
Name: Clay - 950 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 950 psf Piezometric Line: 1
Name: Clay - 1325 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,325 psf Piezometric Line: 1

F of S: 1.14



ATTACHMENT E1-F

PROFILE E1
LONG-TERM STATIC SLOPE STABILITY EVALUATION

SLOPE/W MODEL DEVELOPMENT: POST-REMEDIATION CONDITIONS

ATTACHMENT E1-F

PROFILE E1 - SLOPE/W MODEL DEVELOPMENT - PROPOSED CONDITIONS

- See Figure C-1 for profile location.

A. Define Proposed Subgrade/Final Grade Topography

- Proposed subgrade topography is shown on Figure C-1.
- A profile section view is shown on Figure C-2.
- Define long-term post-remediation topography:

Point	STA.	Subgrade EL. (ft)	Final Grade EL. (ft)*
1	7+31	84	85.5
2	7+18	84	85.5
3	7+15	85	86.5
4	6+70	85	86.5
5	6+25	84	85.5
6	5+80	83	84.5
7	5+35	82	83.5
8	4+90	81	82.5
9	4+60	81	82.5
10	3+45	81	82.5
11	1+80	48	49.5
12	1+77	48	49.5
13	1+71	50	51.5
14	1+62	53	54.5
15	1+29	54	55.5
16	0+95	55	56.5
17	0+62	56	57.5

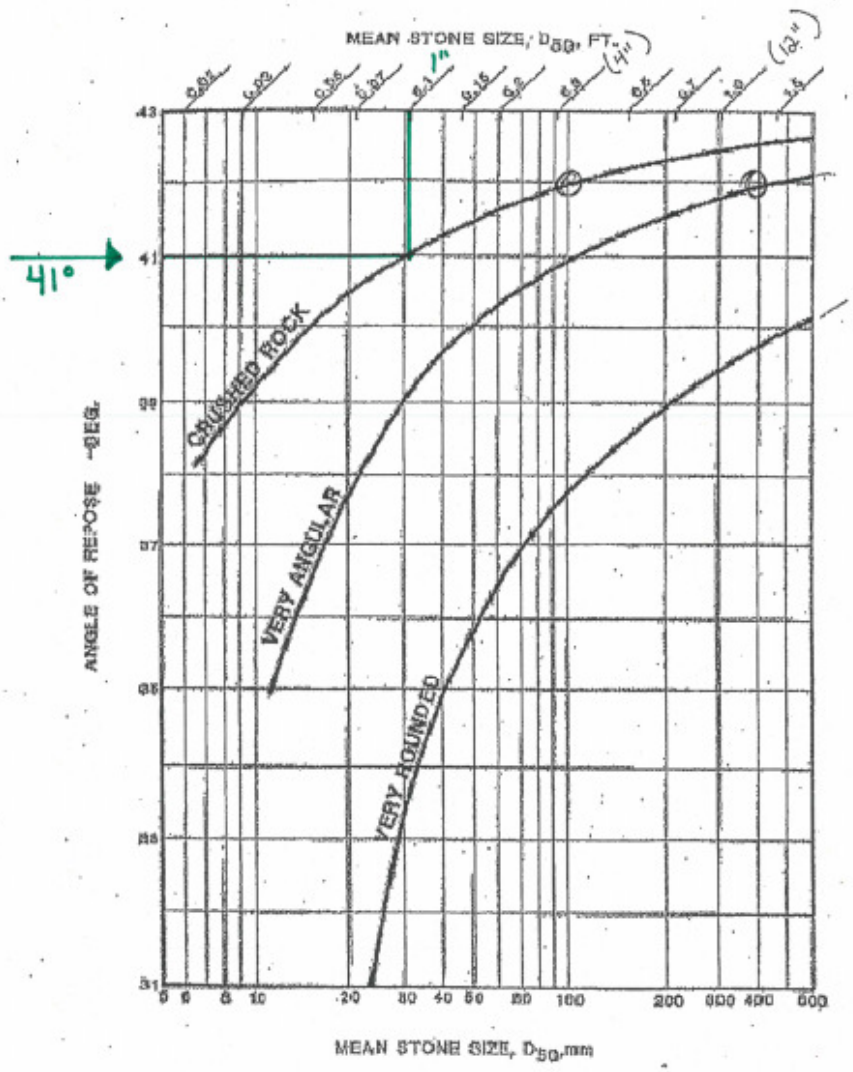
*Note: Final grade assumes 1.5 ft of aggregate cover over subgrade.

B. Low-Permeability Cover

- The proposed low perm cover system consists of approximately 15 inches of crushed gravel/aggregate over a GDL, FML, and a GCL.
- The crushed gravel (1" < D_{50} < 6") is modeled in Slope/W with the following parameters:
  - Unit Weight = 100 pcf (assume loosely placed, 40% porosity).
  - Friction Angle = 41° (see Sheet 3 - conservatively assume D_{50} = 1").
- The unit weight and strength of the GDL, FML, and GCL are considered insignificant, and these materials were not included in the Slope/W model.

C. Long-Term Groundwater Levels

- Proposed horizontal drain locations are shown on Figure C-1.
- The water levels used for long-term post-remediation conditions are based on the current groundwater model for horizontal drain(s) located at/near the bottom of the tailings, approximately elevation +22 feet (+/-) and approximately 100 feet back from the existing crest and a low perm cover system.
  - The long-term post-remediation groundwater levels used in the Slope/W models is assumed based on the drain location(s) and as per the groundwater model (Appendix A).



http://www.fhwa.dot.gov/engineering/hydraulics/pubs/05114/images/hec15fig06_01.gif

ATTACHMENT E1-G

PROFILE E1
LONG-TERM STATIC SLOPE STABILITY EVALUATION

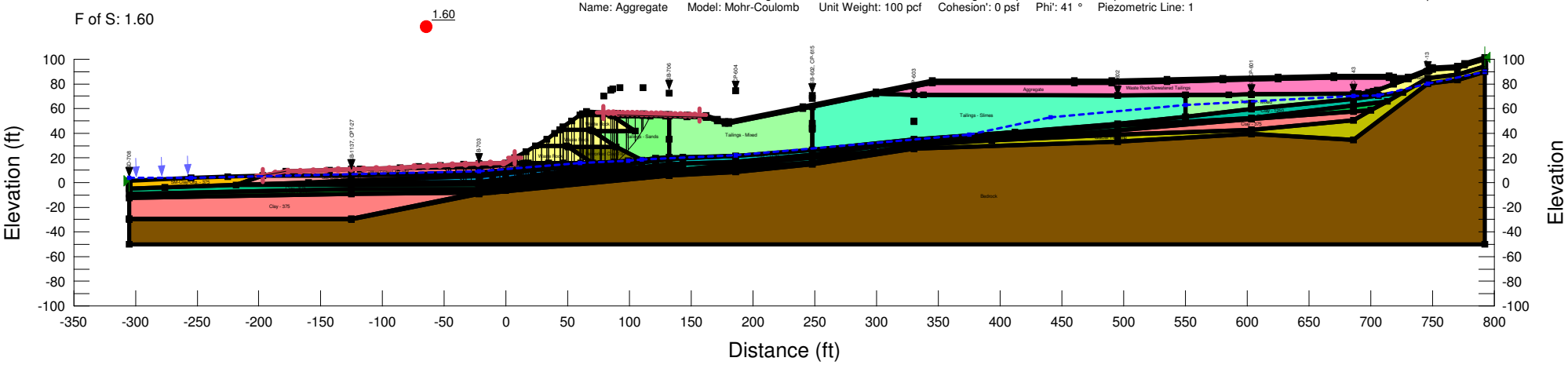
SLOPE/W OUTPUT: POST-REMEDIATION CONDITIONS

Title: Callahan Mine OU3 - Profile E1
Date: 10/16/2014
File Name: Tailings_Profile E1_Proposed-Cond_90%.gsz

Name: Profile E1; a2 - Proposed - Static - Crest/Toe - Till Imp
Method: Spencer

Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 116 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Glacial Till - Imp Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Fill - Sand/Fines/Org. Mix Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 25 psf Phi': 32 ° Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 375 Model: Undrained (Phi=0) Unit Weight: 105 pcf Cohesion': 375 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: Clay - 2750 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,750 psf Piezometric Line: 1
Name: Clay - 2250 Model: Undrained (Phi=0) Unit Weight: 124 pcf Cohesion': 2,250 psf Piezometric Line: 1
Name: Clay - 1750 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,750 psf Piezometric Line: 1
Name: Clay - 1250 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,250 psf Piezometric Line: 1
Name: Clay - 875 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 875 psf Piezometric Line: 1
Name: Clay - 625 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 625 psf Piezometric Line: 1
Name: Clay - 475 Model: Undrained (Phi=0) Unit Weight: 119 pcf Cohesion': 475 psf Piezometric Line: 1
Name: Clay - 375 Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 375 psf Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Reworked Clay/Till Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Clay - 1075 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,075 psf Piezometric Line: 1
Name: SM-Clay-Org. - 750 Model: Undrained (Phi=0) Unit Weight: 105 pcf Cohesion': 750 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: SM-Clay - 1000 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 1,000 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 525 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 525 psf Piezometric Line: 1
Name: Clay - 1375 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,375 psf Piezometric Line: 1
Name: Clay - 1175 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,175 psf Piezometric Line: 1
Name: Clay - 925 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 925 psf Piezometric Line: 1
Name: Clay - 675 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 675 psf Piezometric Line: 1
Name: Clay - 1050 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,050 psf Piezometric Line: 1
Name: Clay - 1200 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,200 psf Piezometric Line: 1
Name: Clay - 1225 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,225 psf Piezometric Line: 1
Name: Clay - 950 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 950 psf Piezometric Line: 1
Name: Clay - 1325 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,325 psf Piezometric Line: 1
Name: Waste Rock/Dewatered Tailings Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 38 ° Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
Name: Aggregate Model: Mohr-Coulomb Unit Weight: 100 pcf Cohesion': 0 psf Phi': 41 ° Piezometric Line: 1

F of S: 1.60



Title: Callahan Mine OU3 - Profile E1
Date: 10/16/2014
File Name: Tailings_Profile E1_Proposed-Cond_90%.gsz

Name: Profile E1; a1 - Proposed - Static - Crest/Toe - Till Reg
Method: Spencer

Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 116 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Fill - Sand/Fines/Org. Mix Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 25 psf Phi': 32 ° Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 375 Model: Undrained (Phi=0) Unit Weight: 105 pcf Cohesion': 375 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: Clay - 2750 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,750 psf Piezometric Line: 1
Name: Clay - 2250 Model: Undrained (Phi=0) Unit Weight: 124 pcf Cohesion': 2,250 psf Piezometric Line: 1
Name: Clay - 1750 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,750 psf Piezometric Line: 1
Name: Clay - 1250 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,250 psf Piezometric Line: 1
Name: Clay - 875 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 875 psf Piezometric Line: 1
Name: Clay - 625 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 625 psf Piezometric Line: 1
Name: Clay - 475 Model: Undrained (Phi=0) Unit Weight: 119 pcf Cohesion': 475 psf Piezometric Line: 1
Name: Clay - 375 Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 375 psf Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Reworked Clay/Till Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Clay - 1075 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,075 psf Piezometric Line: 1
Name: SM-Clay-Org. - 750 Model: Undrained (Phi=0) Unit Weight: 105 pcf Cohesion': 750 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: SM-Clay - 1000 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 1,000 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 525 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 525 psf Piezometric Line: 1
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Name: Clay - 1225 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,225 psf Piezometric Line: 1
Name: Clay - 950 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 950 psf Piezometric Line: 1
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Name: Aggregate Model: Mohr-Coulomb Unit Weight: 100 pcf Cohesion': 0 psf Phi': 41 ° Piezometric Line: 1
Name: Glacial Till - Reg Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 50 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 130 pcf Piezometric Line: 1

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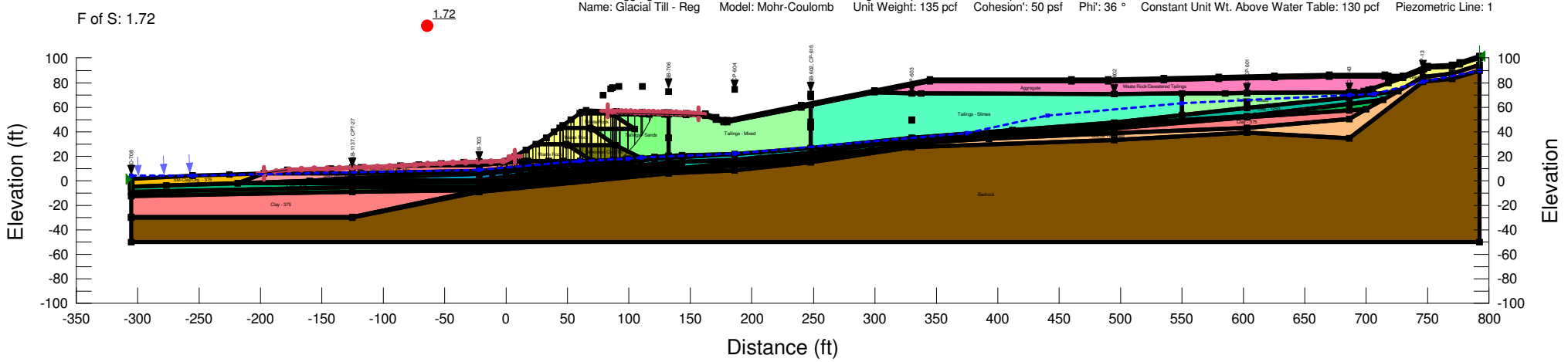

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Method: Spencer

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Name: Aggregate Model: Mohr-Coulomb Unit Weight: 100 pcf Cohesion': 0 psf Phi': 41 ° Piezometric Line: 1

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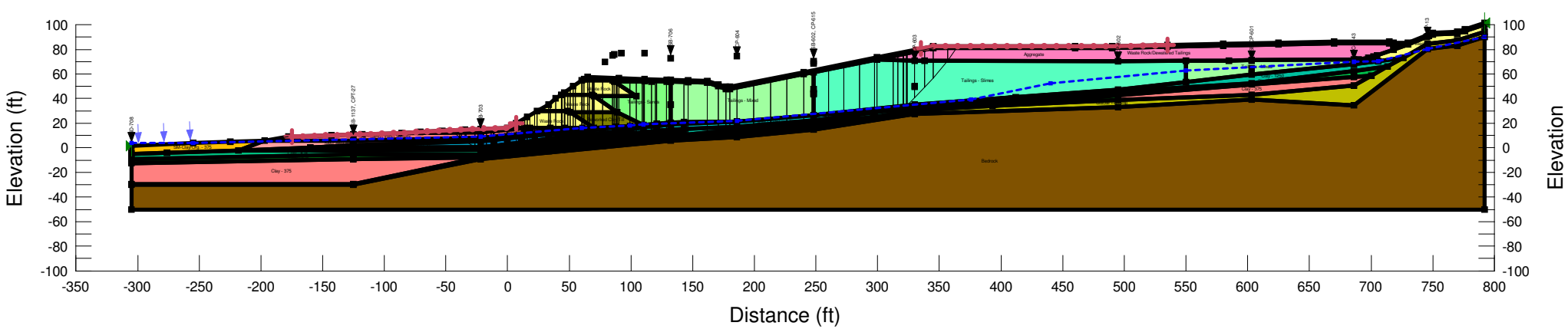

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Method: Spencer

Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
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Name: Aggregate Model: Mohr-Coulomb Unit Weight: 100 pcf Cohesion': 0 psf Phi': 41 ° Piezometric Line: 1
Name: Glacial Till - Reg Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 50 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 130 pcf Piezometric Line: 1

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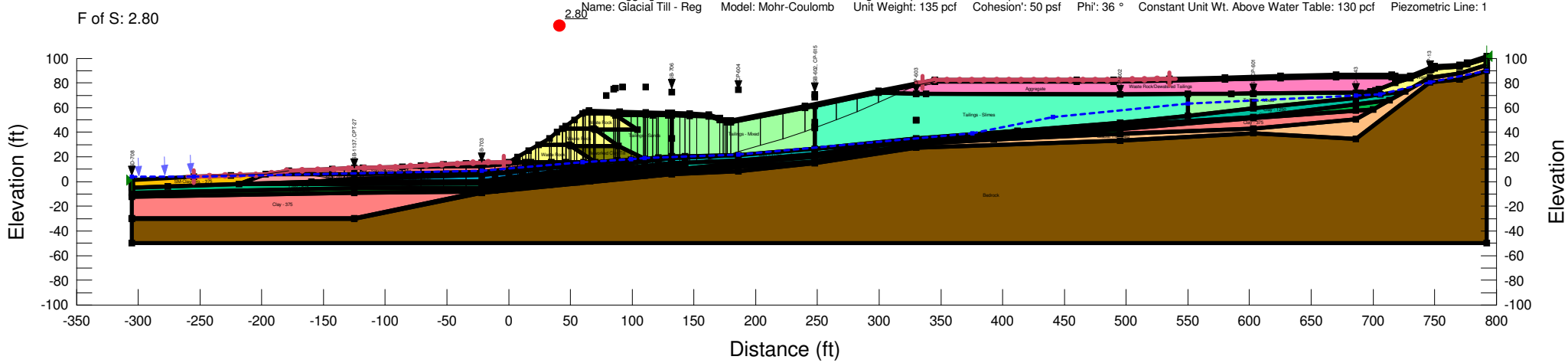

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Date: 10/16/2014
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Name: Profile E1; c2 - Proposed - Static - Fill Slope - Till Imp
Method: Spencer

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Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
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Name: Aggregate Model: Mohr-Coulomb Unit Weight: 100 pcf Cohesion': 0 psf Phi': 41 ° Piezometric Line: 1

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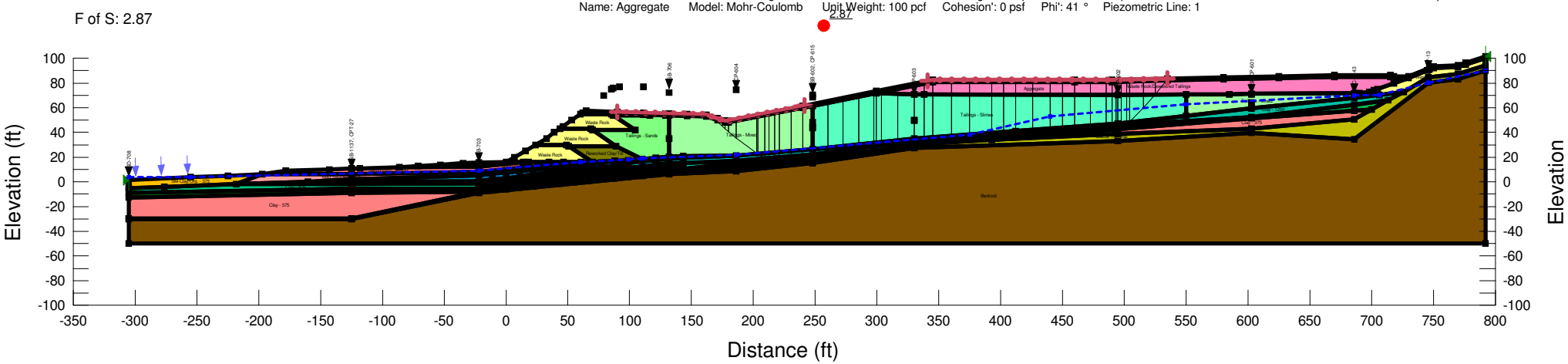

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Name: Profile E1; c1 - Proposed - Static - Fill Slope - Till Reg
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Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
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Name: Glacial Till - Reg Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 50 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 130 pcf Piezometric Line: 1

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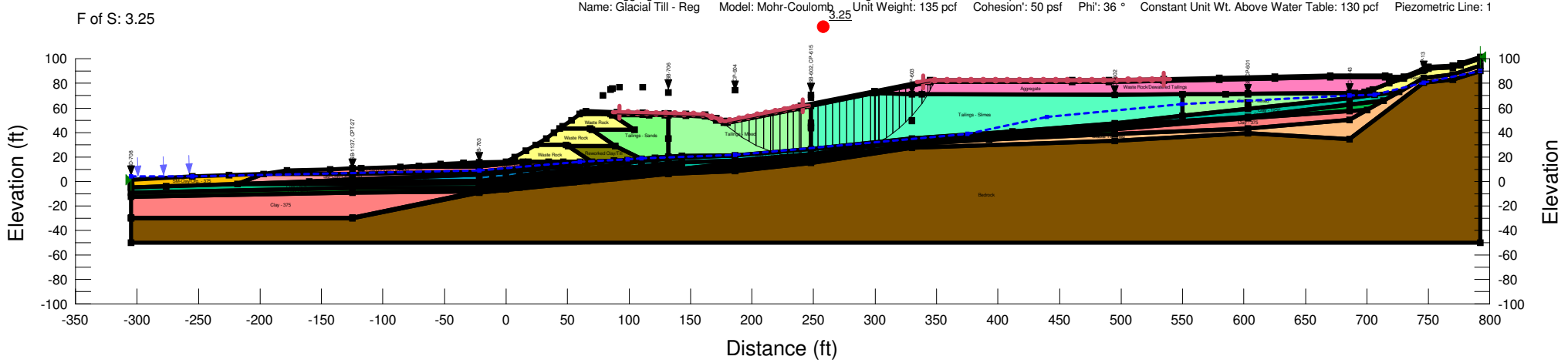


ATTACHMENT E2

PROFILE E2
LONG-TERM STATIC SLOPE STABILITY EVALUATION

ATTACHMENT E2-A

PROFILE E2
LONG-TERM STATIC SLOPE STABILITY EVALUATION

SLOPE/W MODEL DEVELOPMENT: EXISTING CONDITIONS

ATTACHMENT E2-A

PROFILE E2 - SLOPE/W MODEL DEVELOPMENT - EXISTING CONDITIONS

- See Figure C-1 for profile location.

A. Define Overall Geometry/Topography

- Existing site-specific topography is shown on Figure C-1.
  - Define Profile Station 0+00 as the "toe" of the rock dam.
    - Positive station numbers to the west
    - Negative station numbers to the east
- See Attachment E2-B for definition of SLOPE/W points.

B. Impoundment Dam Configuration

- The assumed/interpreted configuration of the impoundment dam is as follows:
  - Constructed via "upstream" raised embankment methods.
  - 5 total lifts (starter dam plus 4 subsequent raises).
  - Starter dam constructed with clay and glacial till from on-site (and adjacent property to the south) and faced extensively with waste rock.
    - Top of starter dam at Elev. +30 ft (+/-).
    - Crest width of waste rock approximately 25 ft (+/-).
    - Backslope of waste rock approximately 1.3H:1V to 1.5H:1V.
    - Clay/glacial till extends 50 ft (+/-) behind the starter dam.
  - Subsequent raises/lifts constructed with waste rock and possibly lined/"chinked" with clay/till fill (limited extent/thickness).
    - Each lift/raise approximately 10 to 15 ft tall
    - Crest width of each waste rock lift/raise approximately 25 ft (+/-).
    - Backslope of each waste rock lift/raise approximately 1.3H:1V to 2.0H:1V.
- See Attachment E2-C for discussion, supporting data/evaluation, and sketches/cross-sections.

C. Define Subsurface Profile

- Geotechnical explorations along or in close proximity to Profile E2 are shown on Figure C-1.
    - TP-11 West
    - RC-1145
    - SCPT-02
    - CPT-25
    - CP-616
    - SCPT-10/SB-1120
    - SCPT-16A/SCPT-16
    - SB-1119
    - SB-1124 Crest
    - SB-1116/SCPT-28
    - SB-704
    - SB-1139
    - SD-708 East
- Logs/records of these explorations are provided in prior investigation reports:
    - Credere, 2012 Supplemental Geotechnical Investigation
    - MACTEC, 2009a Geotechnical Evaluation Report
    - MACTEC, 2009b Remedial Investigation Report
- Table C-3 summarizes the primary soil strata encountered at these exploration locations.
    - Fill
    - Tailings
        - Tailings are further subdivided into "zones" of sand, mixed/stratified, or slimes based on description of sand, fines, and layering/thickness.
    - Clay/Till Fill
    - Native Estuarine
    - Presumpscot Clay
        - Native clay is further divided into layers/zones based on strength data.
    - Glacial Till
    - Other, as necessary

D. Assign Soil Unit Weight & Strength Parameters

- Assign unit weights based on soil type, in-situ conditions (e.g., density, consistency, saturation, etc.), published literature, and in conjunction with/comparison with bulk density measurements from Shelby tube samples.

- Strength parameters for Tailings developed based on site-specific field and laboratory testing programs and in conjunction with applicable mine-tailings-specific references (i.e., Vick 1990)

  Note: +/- adjustments to Tailings effective stress/strength parameters have negligible impact on estimated FOS.

- Strength parameters for Clay and Estuarine deposits developed based on site-specific field and laboratory testing programs.

  - FVST data
  - CPT Data
  - SPT Data
  - Strength adjustments for unexplored locations (beneath the waste rock impoundment dam) are presented in Attachment E2-D.

- Strength Parameters for Glacial Till and various Fill materials developed based on site-specific field and laboratory testing programs and published values.

- Strength parameters for impoundment berm (i.e., crushed/angular waste rock) developed based on published FHWA values/data (see Sheet 6).

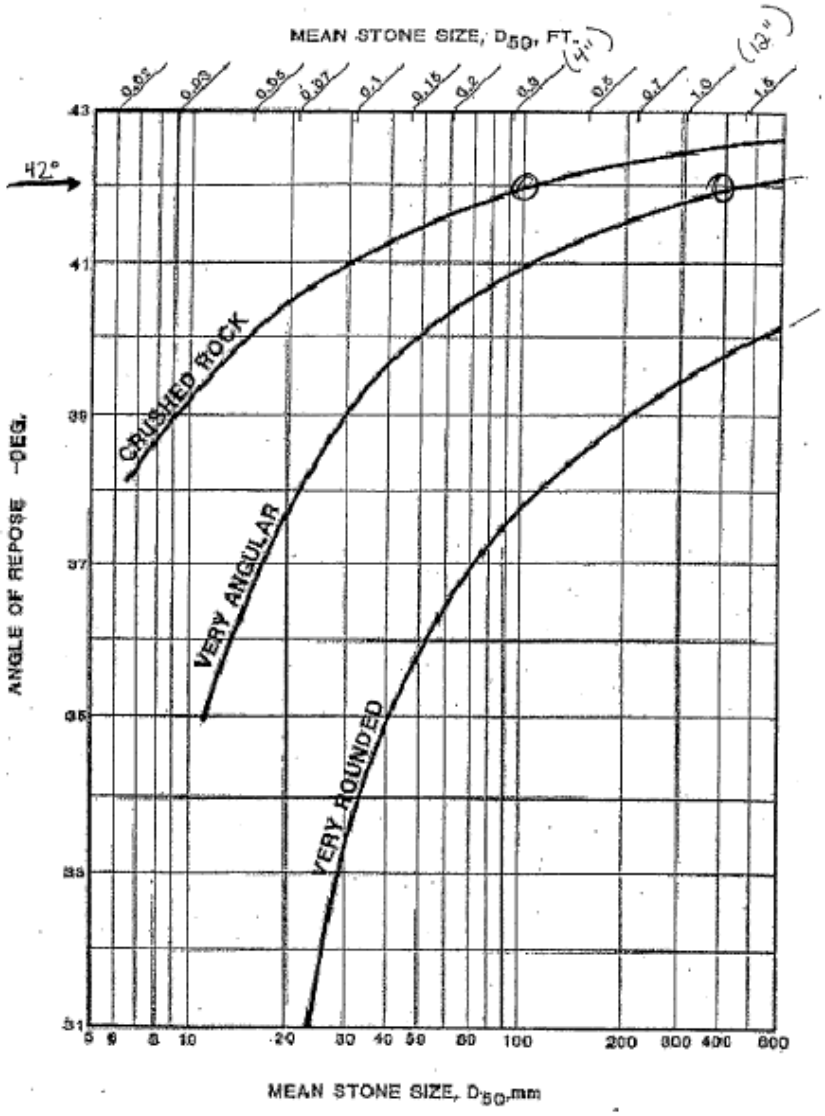
- Actual weight and strength parameters for each soil type are listed on Slope/W output files.

E. Estimate Shear Strength Increase in Clay Beneath Impoundment Dam

- Clay strengths known at crest (SB-1124) and at toe (SB-1116/SCPT-28/SB-704). Use procedures below to provide reasonable estimates of clay strength in between the known points.
- See Attachment E2-C for sketch comparing existing conditions vs. historic (pre-mining) topography.
- Estimate gross effective stress increase - Pre-mining "cuts" approximately equal to net effective stress increase. See Attachment E2-D.
- Use Winstress software to estimate effective stress increase in clay soils at various intervals between the crest and toe. See Attachment E2-D for Winstress etup and associated output files.
- Estimate strength increase in soft/normally consolidated clay soils based on $Su/\sigma`v = 0.2$ (relationship based on site-specific lab testing and in agreement with literature values. Estimate strength increase in medium stiff clay soils based on $Su/\sigma`v = 0.15$. See Attachment E2-D.
- Apply strength increase to the "toe" conditions in segmented/zoned areas beneath the berm. See Attachment E2-D.
- See Slope/W output files for zones and strengths assigned.

F. Define Phreatic Surface/Water Table and/or Pore Pressure Grid

- Site-specific water levels measured in the installed/existing PZs, MWs, OWs, and/or VWPs provide information on impoundment water levels. This info indicates a slightly downward gradient (decreasing piezometric surface/pressure within the tailings with increasing depth bgs).
    - Water level data is available or formerly available at the following locations along or proximate to Profile E2:
        - RC-1145
        - SCPT-02
        - CPT-25
        - SCPT-10
        - SCPT-16A
        - SB-1119
        - SB-1124
        - SB-1116
        - SB-704
- A pore pressure grid can be utilized in Slope/W to model decreasing pore pressure gradients with depth. This approach is applicable for existing conditions. However, the remedial design includes installation of drainage features.
- For this evaluation, the pore pressuresare modelled in Slope/W via a piezometric line and not a pore pressure grid. This is considered conservative for evaluation of existing conditions, but more reasonable/applicable for representing the long-term post-remediation impoundment water levels predicted by current groundwater model (Appendix A).
- The impoundment water levels used for existing conditions are shown in Table C-3.



http://www.fhwa.dot.gov/engineering/hydraulics/pubs/05114/images/hec15fig06_01.gif

ATTACHMENT E2-B

PROFILE E2
LONG-TERM STATIC SLOPE STABILITY EVALUATION

EXISTING CONDITIONS SLOPE/W POINTS (GEOMETRY)

ATTACHMENT E2-B

PROFILE E2 - SLOPE/W MODEL DEVELOPMENT - EXISTING CONDITIONS

- Define cross-section perpendicular to impoundment dam "face".
- Define STA. 0+00 at Elev. +14.0 ft MSL (~"toe" of the impoundment dam).
- Define existing topography:

Point	STA.	Ground Surface EL. (ft)	Exploration	As-Drilled GS EL. (ft)
1	8+87	122		
2	8+55	111		
3	8+50	110		
4	8+00	101		
5	7+88	100	$TP-11$	98
6	7+75	95		
7	7+30	84		
8	7+10	83		
9	6+87	82		
10	6+71	81		
11	6+55	80	$RC-1145$	71.4
12	6+20	78		
13	5+97	77		
14	5+78	76		
15	5+65	75.5	$CPT-02$	69.6
16	5+55	75		
17	5+42	74		
18	5+35	73		
19	5+30	72		
20	5+22	71		
21	5+09	70		
22	4+97	71		
23	4+53	71	$CPT-25$	69.3
24	3+93	71	$CP-616$	69.1
25	2+80	71		
26	2+35	72		
27	2+10	72.5	$SCPT-10$ $SB-1120$	72.2
28	1+92	73		
29	1+61	74		
30	1+55	75	$SCPT-16$ $SCPT-16\ A$	73.3
31	1+47	76		
32	1+34	77	$SB-1119$	75.5
33	1+30	77		
34	1+22	77	$SB-1124$	76.6

Point	STA.	Ground Surface EL. (ft)	Exploration		As-Drilled GS EL. (ft)
35	1+05	77			
36	1+00	75			
37	0+94	70			
38	0+87	65			
39	0+81	60			
40	0+75	55			
41	0+68	50			
42	0+62	45			
43	0+55	40			
44	0+46	35			
45	0+35	30			
46	0+22	25			
47	0+12	20			
48	0+02	15			
49	0+00	14			
50	−0+06	14			
51	−0+18	13			
52	−0+23	13			
53	−0+31	12	$SB-1116$	$SCPT-28$	10.4
54	−0+48	10			
55	−0+66	8	$SB-704$		5.4
56	−1+03	7.5	$SB-1139$		5.6
57	−1+77	4			
58	−2+82	1.5	$SD-708$		1.5

Note: Ground surface elevations at SB-704 and SB-1139 were adjusted in the Slope/W model to reflect the "as-drilled" elevations of the explorations.

ATTACHMENT E2-C

PROFILE E2
LONG-TERM STATIC SLOPE STABILITY EVALUATION

IMPOUNDMENT DAM CONFIGURATION

ATTACHMENT E2-C

PROFILE E2 - DAM IMPOUNDMENT CONFIGURATION

A. Objective:

- To assess the configuration of the existing impoundment dam, including number of lifts/raises above the starter dam and the crest width and backslope of of each lift.

B. Discussion:

- Anecdotal information, historic photographs, and subsurface exploration data indicate that the impoundment dam was constructed via upstream raised embankment methods. Tailings were discharged via spigots placed peripherally along the crest of the starter dam (and each subsequent "lift" of the dam/embankment raise).

- Borings/wells drilled near the crest of the dam typically identify clay/glacial till fill "at depth" beneath the tailings.

C. Data Evaluation:

- MW-604R

  - Location: Northeastern corner of impoundment
  - Crest EL.: +75 to +77 ft (including surface gravel)
  - Toe EL.: +10 ft
  - Existing GS EL.: +77 ft
  - Horiz. Distance from Crest Grade Break (northern): 37 ft
  - Horiz. Distance from Crest Grade Break (eastern): 46 ft

  - Data Summary:

    - 0.0-1.5 ft bgs: Road base gravel;
    - 1.5-5.0 ft bgs: Gravel and cobbles;
    - 5.0-15.0 ft bgs: Poor recovery/limited soil description/stratigraphy due to sonic drilling method. In general, Waste Rock over Sand tailings, over Slime tailings @ ~12-15 ft bgs; and
    - 62.0-65.0 ft bgs: Possible reworked clay/glacial till.

  - Conclusions:

    - Gravel and cobbles at shallow depth may not be associated with the impoundment dam. Rather, used for support of present-day roadway.
    - Impoundment dam may not have been encountered at this boring. This suggests max crest width of uppermost dam ~25 ft for northern side, assuming ~10 ft tall lift (25+10*1.3=38 ft) OR ~20 ft for northern side, assuming a ~15 ft tall lift. Using the same criteria, a 25 to 30 ft wide crest is possible for the eastern side.
    - Slimes @ ~12-15 ft bgs suggest bottom of uppermost lift at ~EL. +65 ft, OR no spigot in the corner.
    - Clay/till fill at depth likely part of starter dam.

C. Data Evaluation - continued:

- MW-722R

  - Location: Southeastern corner of impoundment
  - Crest EL.: +75 to +77 ft
  - Toe EL.: +20 ft
  - Existing GS EL.: +77 ft
  - Horiz. Distance from Crest Grade Break (eastern): 37 ft
  - Horiz. Distance from Crest Grade Break (southern): 37 ft

  - Data Summary:

    - 0.0-1.0 ft bgs: Road base gravel;
    - 1.0- 10-15 ft bgs: Gravel, cobbles, and boulders;
    - >10-15 ft bgs: Sand/silt;
    - Limited soil description/stratigraphy at depth due to sonic drilling methods.

  - Conclusions:

    - Impoundment dam encountered at this location.
    - Some of the shallow gravel, cobbles, and boulders may be associated with support of present-day roadway.
    - Suggests crest width of 25 to 30 ft, assuming 10 to 15 ft lift.
    - Suggests 10 to 15 ft height for uppermost lift.
    - Suggests bottom of uppermost lift at ~EL. +62 to +67 ft.

- SB-1124 & SB-1119

  - Location: Eastern side (~E2 profile)
  - Crest EL.: +75 to +77 ft
  - Toe EL.: +15 ft
  - Existing GS EL.: +76.5 ft (SB-1124); +75.5 ft (SB-1119)
  - Horiz. Distance from Crest Grade Break: 22 ft (SB-1124); 32 ft (SB-1119)

  - Data Summary:

SB-1124		SB-1119	
0-1 ft bgs:	Roadway gravel	0-1 ft bgs:	Roadway gravel
1-25 ft bgs:	Waste rock	1-11 ft bgs:	Waste rock
25-43 ft bgs:	Sand tailings	11-28.5 ft bgs:	Sand tailings
- Obstruction ~33 ft bgs		- Boney ~19 ft bgs	
43-48.5 ft bgs:	Waste rock/tailings	28.5-56 ft bgs:	Mixed tailings
48.5-53 ft bgs:	Sand tailings	- Gravelly ~33 ft bgs	
53-61 ft bgs:	Reworked clay	56-61 ft bgs:	Clay, possible rework
61-68 ft bgs:	Native clay	61-67 ft bgs:	Native clay

C. Data Evaluation - continued:

- SB-1124 & SB-1119 - continued

  - Conclusions:

    - Empoundment dam encountered at these locations.
    - Suggests bottom of the uppermost lift at ~EL. +65.
    - Suggests 10-11 ft lift height for uppermost lift.
    - Suggests 25-30 ft wide crest width for uppermost lift.
    - SB-1119, SCPT-16 (refusal at 6.5 ft bgs, 14 ft from SB-1119), and SCPT-16A (No refusal, 23 ft from SB-1119) suggest ~2H:1V backslope on uppermost lift.
    - SB-1124 suggests 25-30 ft wide crest for 2nd uppermost lift.
    - SB-1124 sugests bottom of the 2nd uppermost lift at ~EL. +50 to +55 ft.
    - SB-1124 & SB-1119 indicate reworked clay fill at 53 ft and 56 ft bgs, respectively. Suggests clay fill with 2.5H:1V backslope. Indicates clay fill behind starter dam.

- SB-1123 & SB-1122

  - Location: Eastern side (~E3 profile)
  - Crest EL.: +75 to +78 ft
  - Toe EL.: +12 ft
  - Existing GS EL.: +77ft (SB-1123); +75.5 ft (SB-1122)
  - Horiz. Distance from Crest Grade Break: 20 ft (SB-1123); 29 ft (SB-1129)

  - Data Summary:

SB-1123		SB-1122
0-1.5 ft bgs:	Roadway gravel	0-8 ft bgs (+/-): Roadway gravel
1.5-23 ft bgs:	Waste rock	8-17 ft bgs (+/-): Waste rock
23-33.5 ft bgs:	Waste rock/tailings	17-33.5 ft bgs: Sand tailings
33.5-39.5 ft bgs:	Sand/mixed tailings	- Gravel/obstruction at 32.5 ft bgs
39.5-55.5 ft bgs:	Mixed tailings	33.5-56 ft bgs: Mixed tailings
55.5-66 ft bgs:	Reworked clay	56-63.5 ft bgs: Reworked clay
66-68.5 ft bgs:	Native clay	- "Boney" material at 59' bgs
68.5 ft bgs:	Till/bedrock	63.5-65.5 ft bgs: Native clay
		65.5 ft bgs: Till/bedrock

C. Data Evaluation - continued:

- SB-1123 & SB-1122 - continued
  - Conclusions:
    - Empoundment dam encountered at these locations.
    - Suggests bottom of the uppermost lift at ~EL. +65.
    - Suggests 10 ft lift height for uppermost lift.
    - Suggests 25-30 ft wide crest width for uppermost lift.
    - SB-1122, SCPT-14 (refusal at 6.5 ft bgs, 10 ft from SB-1122), and SCPT-14A (No refusal, 25 ft from SB-1122) suggest ~1.3H:1V backslope on uppermost lift.
    - SB-1123 suggests 25-30 ft wide crest for 2nd uppermost lift.
    - SB-1123 sugests bottom of the 2nd uppermost lift at ~EL. +50 to +55 ft.
    - SB-1123 & SB-1122 indicate reworked clay fill at 55 ft and 56 ft bgs, respectively. Suggests clay fill with 3H:1V backslope. Indicates clay fill behind starter dam.

- SB-1125
  - Location: Northern side
  - Crest EL: +75 to +78 ft
  - Toe EL.: +28 ft
  - Existing GS EL.: +78 ft
  - Horiz. Distance from Crest Grade Break: 14 ft
  - Data Summary:
    - 0-36 ft bgs: Waste Rock
    - 36-51 ft bgs: Waste rock/tailings mix
    - 51-63.5 ft bgs: Clay/till fill
    - 63.5-66 ft bgs: Native organic silt
    - 66-73.5 ft bgs: Native clay
    - 73.5-77 ft bgs: Glacial till
  - Conclusions:
    - Impoundment dam encountered at this location.
    - Suggests bottom of 3rd uppermost lift at ~EL. +40 to +45 ft.
    - Indicates 25 ft wide crest for the 2nd uppermost lift.
    - Indicates clay/till fill behind the starter dam. Thickness of fill (and top elevation of fill) appears to increase as distance from crest/toe/starter dam decreases.

C. Data Evaluation - continued:

- SB-1126

  - Location: Southern side
  - Crest EL.: +75 to +77 ft
  - Existing GS EL.: +77 ft
  - Horiz. Distance from Grade Break: 20 ft
  - Data Summary:

    - Advanced 0-45 ft bgs via air hammer drilling methods:

      - Waste rock;
      - Waste rock/Dense tailings mix; and/or
      - Very stiff/stiff clay/till fill

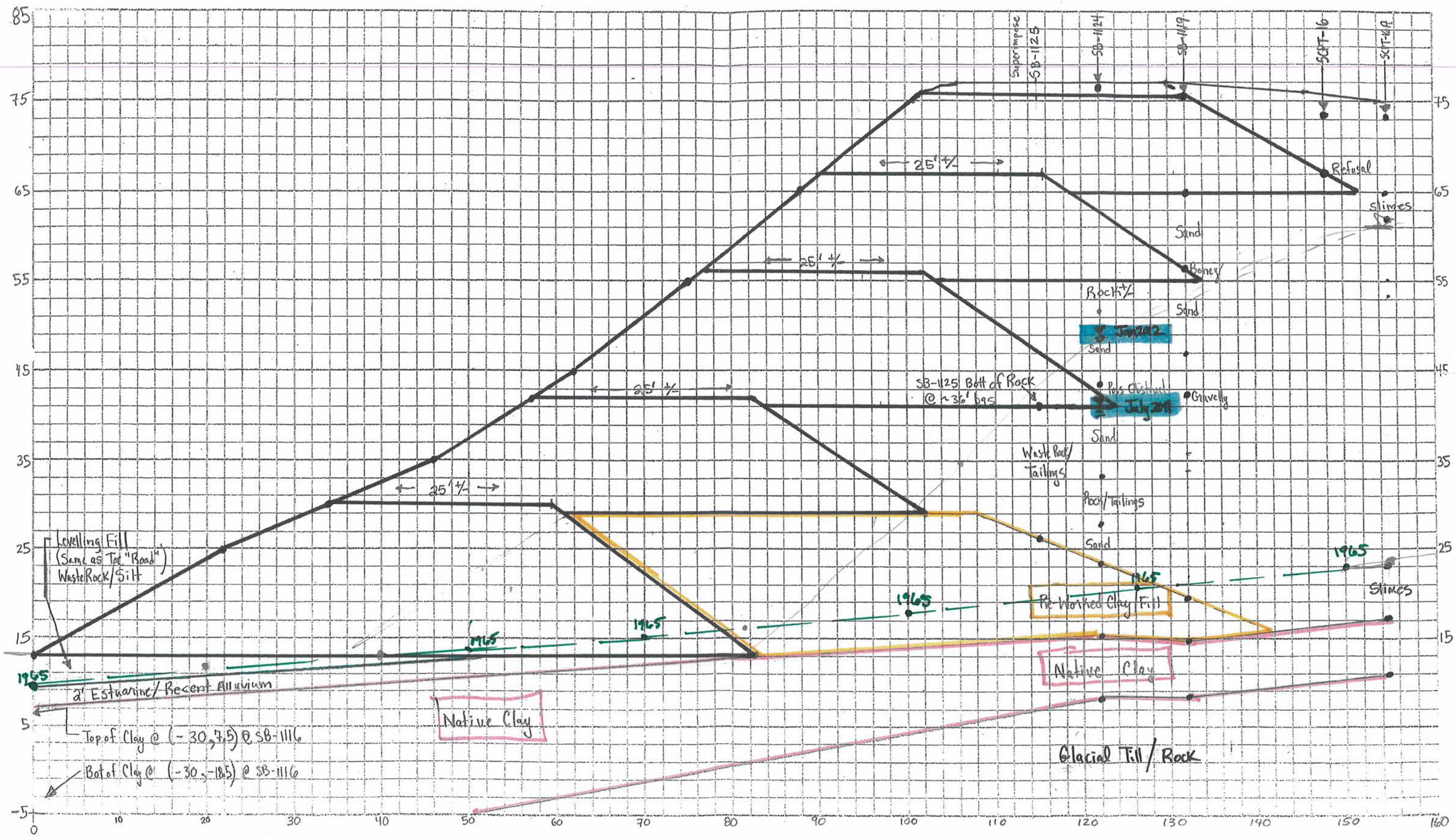
    - 48 ft bgs: Bottom of clay/till fill
    - 48-64 ft bgs: Native clay
    - 64-77 ft bgs: Glacial till
    - 77 ft bgs: Probable bedrock

- A sketch of the interpreted impoundment dam configuration is shown on Sheet 6.

Y= Elevation (feet) : 1" = 10'
X= Distance from Toe (feet) : 1" = 10'

Profile E2
Interpreted Rock Dam

PROJECT	COMP BY	JOB NO.
Callahan Mine Tailings Impoundment Slope Stability Evaluation	TCC	3612-11-2201
	CHK BY	DATE 03/2013



ATTACHMENT E2-D

PROFILE E2
LONG-TERM STATIC SLOPE STABILITY EVALUATION

ESTIMATES OF CLAY SHEAR STRENGTH VIA SHANSEP METHOD

ATTACHMENT E2-D

PROFILE E2 - ESTIMATE CLAY SHEAR STRENGTH BENEATH IMPOUNDMENT DAM

- Clay thickness and shear strength profile are "known" near the toe of the impoundment dam.
  - SB-1116/SCPT-28 ~26 ft thick clay
    - 6 ft Fill
    - 3 ft Estuarine 1250 psf
    - 3 ft Clay 2750-3000 psf
    - 4 ft Clay 1750 psf
    - 4 ft Clay 675 psf
    - 2 ft Clay 575 psf
    - 6 ft Clay 475 psf
    - 3 ft Clay 575 psf
    - 1 ft Clay 675 psf
- Clay thickness and shear strength profile are "known" at/near the crest of the impoundment dam.
  - SB-1124/SB-1119/SCPT-16A ~6 ft thick
    - 6 ft Clay 3000 psf
- Clay thickness is interpolated between these points (~150 ft).
- Clay strength profile will be interpolated between these points using $Su/\sigma'v$ (also called c/p) ratios, based on site specific laboratory test results and literature values:
  - Soft: $\Delta Su/\Delta\sigma'v = 0.20$
  - Medium stiff: $\Delta Su/\Delta\sigma'v = 0.15$
  - Stiff (<1500 psf): $\Delta Su/\Delta\sigma'v = 0.10$
    - Apply strength increase (ΔSu) to clay strength profile at toe based on effective stress increase ($\Delta\sigma'v$) imposed by the impoundment dam.
    - See Attachment E2-C for a sketch of existing conditions/topo, 1965 topo, and soil boring locations relative to the toe of the dam.
    - Use Winstress software to estimate $\Delta\sigma'v$ applied to clay soils at various stations/zones beneath the impoundment dam.

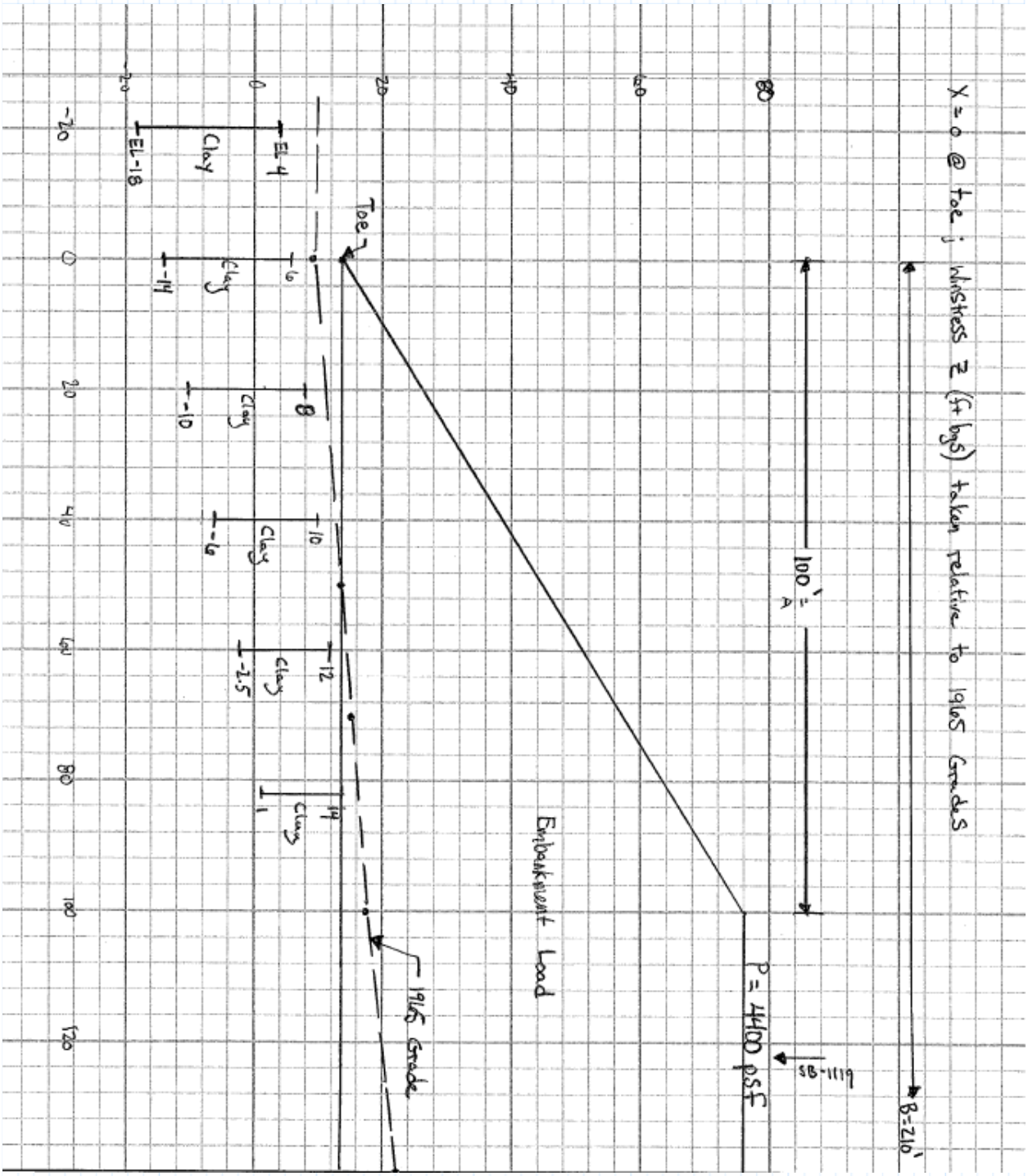
- Estimate embankment load imposed by the impoundment:
  - Beneath crest point:
    - 59 ft tall dam/impoundment (relative to 1965 grade of ~+18 ft)
      - $\sigma'v$ = 42 ft unsaturated waste rock/tailings = 42' x 105 pcf = 4,410 psf
      - $\sigma'v$ = 6 ft saturated tailings = 6' x 120 pcf = 720 psf
      - $\sigma'v$ = 11 ft saturated clay rework = 11' x 125 pcf = 1,375 psf
      - u = 17 ft water = -17' x 62.4 pcf = -1,061 psf
      - Assume 3 ft rise in pore pressure in clay = -3' x 62.4 pcf = -187 psf
        - Load imposed beneath crest ~= 5,257 psf
  - Beneath SCPT-16A:
    - 52 ft tall dam (relative to 1965 grade of ~+23 ft)
      - $\sigma'v$ = 14 ft unsaturated tailings = 14' x 110 pcf = 1,540 psf
      - $\sigma'v$ = 38 ft saturated tailings = 38' x 120 pcf = 4,560 psf
      - u = 38 ft of water = -38' x 62.4 pcf = -2,371 psf
      - Assume 3 ft rise in pore pressure in clay = -3' x 62.4 pcf = -187 psf
        - Load imposed beneath SCPT-16A ~= 3,542 psf
  - Average embankment/terrace load = 4,400 psf

- Use Winstress software with the following inputs:
  - Load at crest = 4,000 psf
  - A=Distance toe to crest = 100 ft
  - B=Distance to to end of load = 210 ft
  - x = 0 @ toe of embankment load

- Vary x to estimate $\Delta\sigma'v$ with depth (z) below the embankment.

- Winstress software input/analysis definitions:

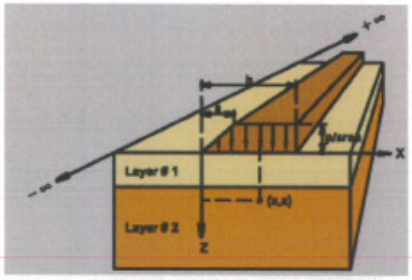
X-Range (Slope/W coords.)	Analysis Point (Winstress)	Discussion
-30 to -10	x = -20	
-10 to +10	x = 0	See attached output files;
+10 to +30	x = +20	Soft: c/p = 0.20
+30 to +50	x = +40	M. Stiff: c/p = 0.15
+50 to +70	x = +60	Stiff: c/p = 0.10
+70 to +95	x = +82	V. Stiff: N/A


X = 0 @ toe ; Windstress Z (ft bgs) taken relative to 1965 Grade
B=210'
P = 4400 psf
SB-1119
100' = A
Embankment Load
1965 Grade
Toe
EL 4
EL-18
Clay
6
-14
8
-10
10
-6
12
-2.5
14
1
-20
0
20
40
60
80
100
120

Increment of stress calculation = vertical $\Delta\sigma z$

STRIP FOOTING

Width of strip A = 100.00
Width of strip B = 210.00
p load/unit area = 4400.000



POINTS FOR COMPUTATION OF INCREMENT OF STRESS

calculate in = z direction

x1 coordinate = -20.00

z1 coordinate = 10.00
z2 coordinate = 35.00
delta z = 1.00

Ok | Cancel | Print Screen | Save Screen

@ x = -20

Clay EL	Relative to 1965 grade (~ +8)
+4'	4' bgs
to	to
-18'	26' bgs

LOADING ON AN INFINITE STRIP
VERTICAL EMBANKMENT LOADING

Project Name: Callahan Mine
Client : MDOT
Date : 8/7/2014

Project Number :
Project Manager: P. Baker
Computed by : NDL

Embank. slope a = 100.00 (ft)
Embank. width b = 210.00 (ft)
p load/unit area = 4400.000(psf)

INCREMENT OF STRESSES FOR Z-DIRECTION
X = -20.00(ft)

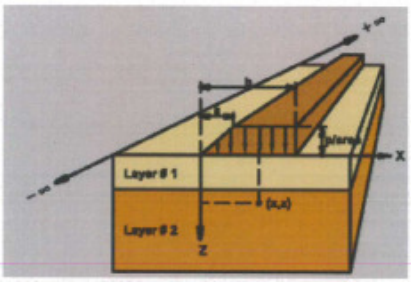
Z (ft)	Vert. Dsz (psf)
10.00	9.78
11.00	12.68
12.00	16.00
13.00	19.75
14.00	23.91
15.00	28.49
16.00	33.46
17.00	38.81
18.00	44.52
19.00	50.57
20.00	56.95
21.00	63.64
22.00	70.60
23.00	77.84
24.00	85.32
25.00	93.02
26.00	100.94
27.00	109.06
28.00	117.35
29.00	125.80
30.00	134.41
31.00	143.14
32.00	152.00
33.00	160.97
34.00	170.03
35.00	179.18

* Clay strengths in this zone based on SCPT -28 data.

Increment of stress calculation = vertical $\Delta\sigma z$

STRIP FOOTING

Width of strip A = 100.00
Width of strip B = 210.00
p load/unit area = 4400.000



POINTS FOR COMPUTATION OF INCREMENT OF STRESS

calculate in = z direction

x1 coordinate = 0.00

z1 coordinate = 10.00
z2 coordinate = 35.00
delta z = 1.00

Ok | Cancel | Print Screen | Save Screen

@ X = 0 (Toe)

Clay EL	Relative to 1965 grade (~+9)
+6'	3' bgs
to	to
-14'	23' bgs

LOADING ON AN INFINITE STRIP
VERTICAL EMBANKMENT LOADING

Project Name: Callahan Mine
Client : MDOT
Date : 8/7/2014

Project Number :
Project Manager: P. Baker
Computed by : NDL

Embank. slope a = 100.00 (ft)
Embank. width b = 210.00 (ft)
p load/unit area = 4400.000(psf)

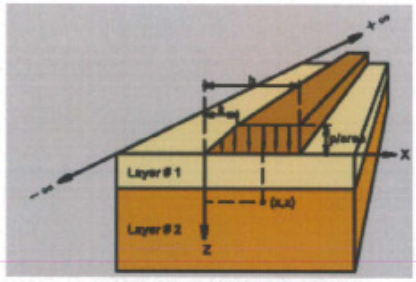
INCREMENT OF STRESSES FOR Z-DIRECTION
X = 0.00(ft)

Z (ft)		Vert. Dsz (psf)	
	V. stiff/ stiff	No ΔSu	
10.00		139.49	
11.00		153.31	
12.00		167.09	x0.15 ≅ ΔSu ≅ 25psf
13.00	M. Stiff	180.84	
14.00		194.54	
15.00		208.19	
16.00		221.80	x0.15 ≅ ΔSu ≅ 35psf
17.00	M. Stiff	235.35	
18.00		248.85	
19.00		262.29	
20.00		275.67	
21.00	Soft	288.98	x 0.20 ≅ ΔSu ≅ 57psf
22.00		302.23	
23.00		315.41	
24.00		328.52	
25.00		341.56	
26.00		354.52	
27.00		367.40	
28.00		380.20	
29.00		392.92	
30.00		405.55	
31.00		418.09	
32.00		430.54	
33.00		442.91	
34.00		455.18	
35.00		467.35	

Increment of stress calculation = vertical $\Delta\sigma z$

STRIP FOOTING

Width of strip A = 100.00
Width of strip B = 210.00
p load/unit area = 4400.000



POINTS FOR COMPUTATION OF INCREMENT OF STRESS

calculate in = z direction

x1 coordinate = 20.00
z1 coordinate = 10.00
z2 coordinate = 30.00
delta z = 1.00

Ok | Cancel | Print Screen | Save Screen

x @ 20'

Clay EL.	Relative to 1965 grade (~+12)
+8'	4' bgs
to	to
-10'	22' bgs

LOADING ON AN INFINITE STRIP
VERTICAL EMBANKMENT LOADING

Project Name: Callahan Mine
Client : MDOT
Date : 8/7/2014

Project Number :
Project Manager: P. Baker
Computed by : NDL

Embank. slope a = 100.00 (ft)
Embank. width b = 210.00 (ft)
p load/unit area = 4400.000(psf)

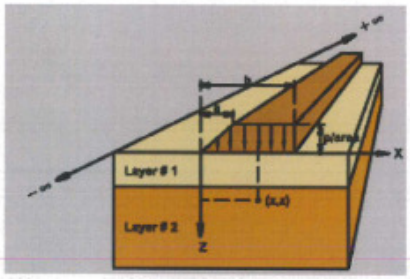
INCREMENT OF STRESSES FOR Z-DIRECTION
X = 20.00(ft)

Z (ft)		Vert. Dsz (psf)
		ΔSu=0
10.00	V. Stiff/ Stiff	889.32
11.00		892.07
12.00		895.21
13.00	M. Stiff	898.75 x 0.15 ≅ ΔSu ≅ 135 psf
14.00		902.67
15.00		906.96
16.00	M. Stiff	911.62 x 0.15 ≅ ΔSu ≅ 137 psf
17.00		916.61
18.00		921.92
19.00		927.52
20.00		933.41
21.00	Soft	939.56 x 0.20 ≅ ΔSu ≅ 186 psf
22.00		945.94
23.00		952.53
24.00		959.32
25.00		966.29
26.00		973.41
27.00		980.67
28.00		988.06
29.00		995.54
30.00		1003.12

Increment of stress calculation = vertical $\Delta\sigma z$

STRIP FOOTING

Width of strip A = 100.00
Width of strip B = 210.00
p load/unit area = 4400.000



POINTS FOR COMPUTATION OF INCREMENT OF STRESS

calculate in = z direction

x1 coordinate = 40.00

z1 coordinate = 10.00
z2 coordinate = 30.00
delta z = 1.00

Ok | Cancel | Print Screen | Save Screen

X @ 40'

Clay EL	Relative to 1965 (~ +13)
10'	3' bgs
to	to
-6'	19' bgs

LOADING ON AN INFINITE STRIP
VERTICAL EMBANKMENT LOADING

Project Name: Callahan Mine
Client : MDOT
Date : 8/7/2014

Project Number :
Project Manager: P. Baker
Computed by : NDL

Embank. slope a = 100.00 (ft)
Embank. width b = 210.00 (ft)
p load/unit area = 4400.000(psf)

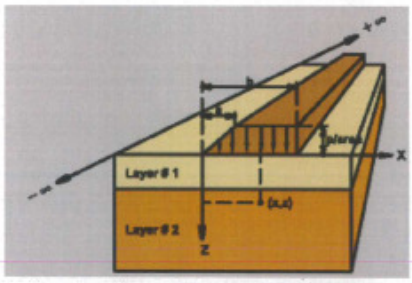
INCREMENT OF STRESSES FOR Z-DIRECTION
X = 40.00(ft)

Z (ft)		Vert. Dsz (psf)
	v. stiff/ stiff	ΔSu=0
10.00		1761.35
11.00		1761.77
12.00		1762.27
13.00		1762.85
14.00	M. Stiff	1763.50 x0.15 ≅ ΔSu ≅ 265 psf
15.00		1764.24
16.00		1765.05 x0.15 ≅ ΔSu ≅ 265 psf
17.00	M. Stiff	1765.95
18.00		1766.94
19.00	Soft	1768.00 x0.20 ≅ ΔSu ≅ 350 psf
20.00		1769.14
21.00		1770.35
22.00		1771.64
23.00		1773.00
24.00		1774.43
25.00		1775.92
26.00		1777.47
27.00		1779.08
28.00		1780.73
29.00		1782.43
30.00		1784.17

Increment of stress calculation = vertical $\Delta\sigma z$

STRIP FOOTING

Width of strip A = 100.00
Width of strip B = 210.00
p load/unit area = 4400.000



POINTS FOR COMPUTATION OF INCREMENT OF STRESS

calculate in = z direction

x1 coordinate = 60.00

z1 coordinate = 10.00
z2 coordinate = 30.00
delta z = 1.00

Ok | Cancel | Print Screen | Save Screen

@ x = 60

Clay EL	Relative to 1965 Grade (~ +14)
12'	2' bgs
to	to
-2.5'	16.5' bgs

LOADING ON AN INFINITE STRIP
VERTICAL EMBANKMENT LOADING

Project Name: Callahan Mine
Client : MDOT
Date : 8/7/2014

Project Number :
Project Manager: P. Baker
Computed by : NDL

Embank. slope a = 100.00 (ft)
Embank. width b = 210.00 (ft)
p load/unit area = 4400.000(psf)

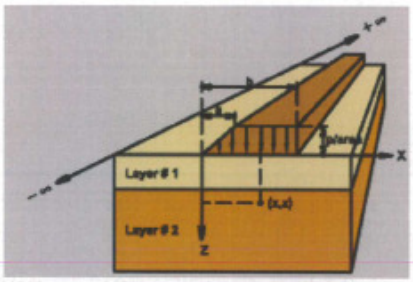
INCREMENT OF STRESSES FOR Z-DIRECTION
X = 60.00(ft)

Z (ft)		Vert. Dsz (psf)
	V. Stiff/ Stiff	ΔSu=0
10.00		2638.19
11.00		2637.61
12.00		2636.93
13.00	M. Stiff	2636.14 x0.15 ≅ ΔSu ≅ 395 psf
14.00		2635.23
15.00		2634.20
16.00	M. Stiff	2633.06 x0.15 ≅ ΔSu ≅ 395 psf
17.00		2631.78
18.00		2630.39
19.00		2628.86
20.00		2627.20
21.00		2625.42
22.00		2623.50
23.00		2621.46
24.00		2619.29
25.00		2617.00
26.00		2614.59
27.00		2612.05
28.00		2609.40
29.00		2606.64
30.00		2603.76

Increment of stress calculation = vertical Δσz

STRIP FOOTING

Width of strip A = 100.00
Width of strip B = 210.00
p load/unit area = 4400.000



POINTS FOR COMPUTATION OF INCREMENT OF STRESS

calculate in = z direction

x1 coordinate = 82.00

z1 coordinate = 10.00
z2 coordinate = 30.00
delta z = 1.00

Ok | Cancel | Print Screen | Save Screen

@ X = 82

Clay EL — Relative to 1965 Grade (~+14)

14' — 2' bgs

to

1' — 15' bgs

LOADING ON AN INFINITE STRIP
VERTICAL EMBANKMENT LOADING

Project Name: Callahan Mine
Client : MDOT
Date : 8/7/2014

Project Number :
Project Manager: P. Baker
Computed by : NDL

Embank. slope a = 100.00 (ft)
Embank. width b = 210.00 (ft)
p load/unit area = 4400.000(psf)

INCREMENT OF STRESSES FOR Z-DIRECTION
X = 82.00(ft)

Z (ft)	Vert. Dsz (psf)
10.00	3596.03
11.00	3592.55
12.00	3588.59
13.00	3584.15
14.00	3579.24
15.00	3573.88
16.00	3568.09
17.00	3561.89
18.00	3555.30
19.00	3548.34
20.00	3541.05
21.00	3533.43
22.00	3525.51
23.00	3517.32
24.00	3508.87
25.00	3500.17
26.00	3491.26
27.00	3482.14
28.00	3472.82
29.00	3463.34
30.00	3453.69

V.Stiff/Stiff $\Delta S_u = 0$

M.Stiff $\times 0.15 \cong \Delta S_u \cong 535$ psf

ATTACHMENT E2-E

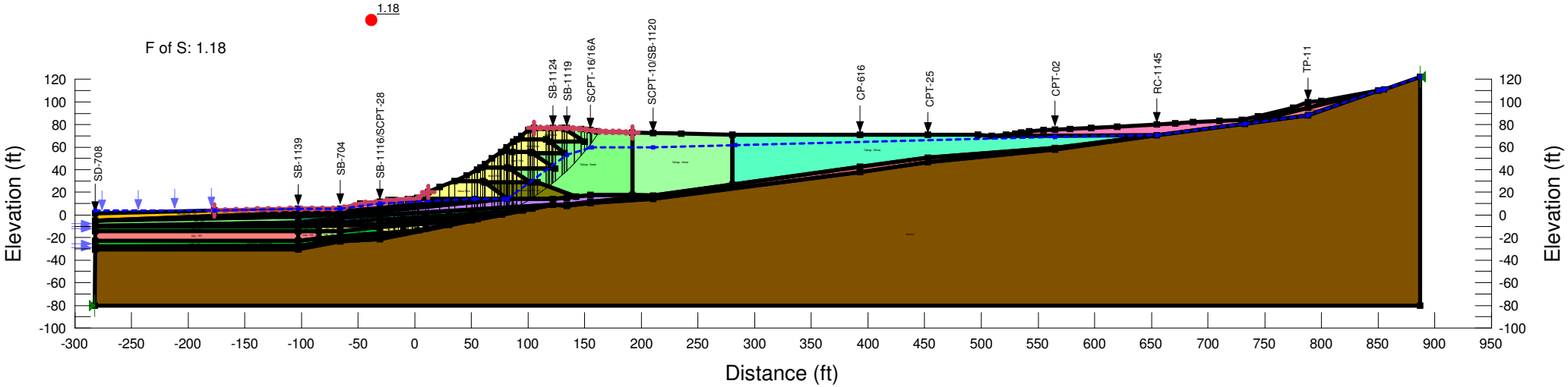
PROFILE E2
LONG-TERM STATIC SLOPE STABILITY EVALUATION

SLOPE/W OUTPUT: EXISTING CONDITIONS

Title: Callahan Mine OU3 - Profile E2
Date: 10/14/2014
File Name: Tailings_Profile E2_Existing Conditions-90%.gsz

Name: Profile E2; a2 - Proposed - Static - Crest-Toe - Till Imp
Method: Spencer

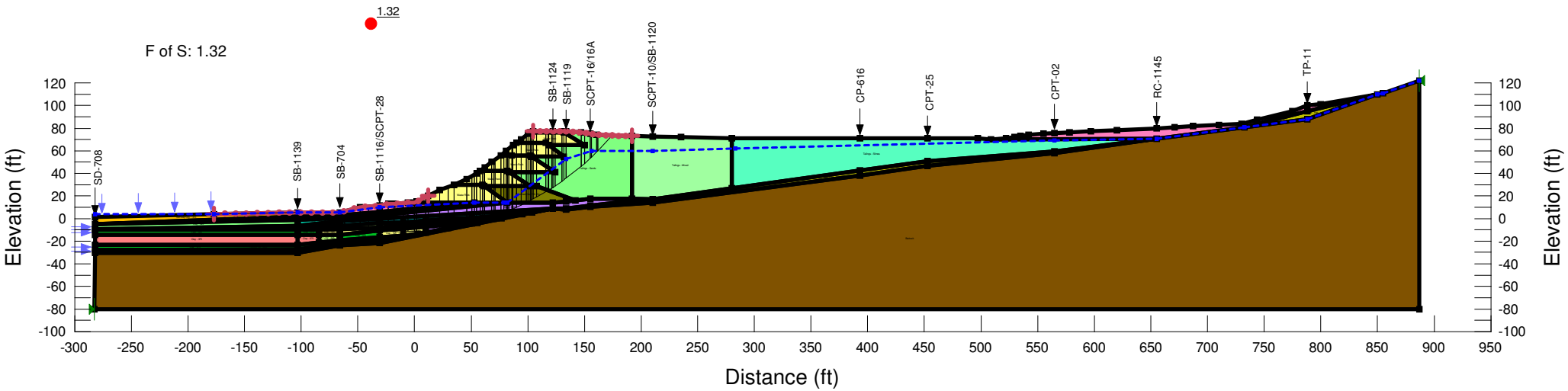
Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 117 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Gravel Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38 ° Constant Unit Wt. Above Water Table: 125 pcf Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 375 Model: Undrained (Phi=0) Unit Weight: 105 pcf Cohesion': 375 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 750 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 750 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 2750 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,750 psf Piezometric Line: 1
Name: Clay - 1750 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,750 psf Piezometric Line: 1
Name: Clay - 1250 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,250 psf Piezometric Line: 1
Name: Clay - 625 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 625 psf Piezometric Line: 1
Name: Clay - 475 Model: Undrained (Phi=0) Unit Weight: 119 pcf Cohesion': 475 psf Piezometric Line: 1
Name: Clay - 375 Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 375 psf Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Reworked Clay/Till - Su Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Clay - 1075 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,075 psf Piezometric Line: 1
Name: SM-Clay - 1000 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 1,000 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Glacial Till - Impenetrable Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Clay - 525 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 525 psf Piezometric Line: 1
Name: Clay - 675 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 675 psf Piezometric Line: 1
Name: Clay - 925 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 925 psf Piezometric Line: 1
Name: Clay - 1225 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,225 psf Piezometric Line: 1
Name: Clay - 825 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 825 psf Piezometric Line: 1
Name: Clay - 575 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 575 psf Piezometric Line: 1
Name: Clay - 725 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 725 psf Piezometric Line: 1
Name: Clay - 700 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 700 psf Piezometric Line: 1
Name: Clay - 425 Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 425 psf Piezometric Line: 1
Name: SM-Clay - 1250 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 1,250 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 3000 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 3,000 psf Piezometric Line: 1
Name: Clay - 975 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 975 psf Piezometric Line: 1



Title: Callahan Mine OU3 - Profile E2
Date: 10/14/2014
File Name: Tailings_Profile E2_Existing Conditions-90%.gsz

Name: Profile E2; a1 - Proposed - Static - Crest-Toe - Till Reg
Method: Spencer

Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 117 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Glacial Till - Reg Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 50 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 130 pcf Piezometric Line: 1
Name: Gravel Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38 ° Constant Unit Wt. Above Water Table: 125 pcf Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 375 Model: Undrained (Phi=0) Unit Weight: 105 pcf Cohesion': 375 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 750 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 750 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 2750 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,750 psf Piezometric Line: 1
Name: Clay - 1750 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,750 psf Piezometric Line: 1
Name: Clay - 1250 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,250 psf Piezometric Line: 1
Name: Clay - 625 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 625 psf Piezometric Line: 1
Name: Clay - 475 Model: Undrained (Phi=0) Unit Weight: 119 pcf Cohesion': 475 psf Piezometric Line: 1
Name: Clay - 375 Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 375 psf Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Reworked Clay/Till - Su Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Clay - 1075 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,075 psf Piezometric Line: 1
Name: SM-Clay - 1000 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 1,000 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 525 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 525 psf Piezometric Line: 1
Name: Clay - 675 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 675 psf Piezometric Line: 1
Name: Clay - 925 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 925 psf Piezometric Line: 1
Name: Clay - 1225 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,225 psf Piezometric Line: 1
Name: Clay - 825 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 825 psf Piezometric Line: 1
Name: Clay - 575 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 575 psf Piezometric Line: 1
Name: Clay - 725 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 725 psf Piezometric Line: 1
Name: Clay - 700 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 700 psf Piezometric Line: 1
Name: Clay - 425 Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 425 psf Piezometric Line: 1
Name: SM-Clay - 1250 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 1,250 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 3000 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 3,000 psf Piezometric Line: 1
Name: Clay - 975 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 975 psf Piezometric Line: 1



ATTACHMENT E2-F

PROFILE E2
LONG-TERM STATIC SLOPE STABILITY EVALUATION

SLOPE/W MODEL DEVELOPMENT: POST-REMEDIATION CONDITIONS

ATTACHMENT E2-F

PROFILE E2 - SLOPE/W MODEL DEVELOPMENT - PROPOSED CONDITIONS

- See Figure C-1 for profile location.

A. Define Proposed Subgrade/Final Grade Topography

- Proposed subgrade topography is shown on Figure C-1.
- A profile section view is shown on Figure C-2.
- Define long-term post-remediation topography:

Point	STA.	Subgrade EL. (ft)	Final Grade EL. (ft)*
1	7+40	91	92.5
2	7+37	92	93.5
3	3+95	92	93.5
4	1+94	52	53.5
5	1+91	52	53.5
6	1+88	53	54.5
7	1+54	54	55.5
8	1+20	55	56.5
9	0+87	56	57.5

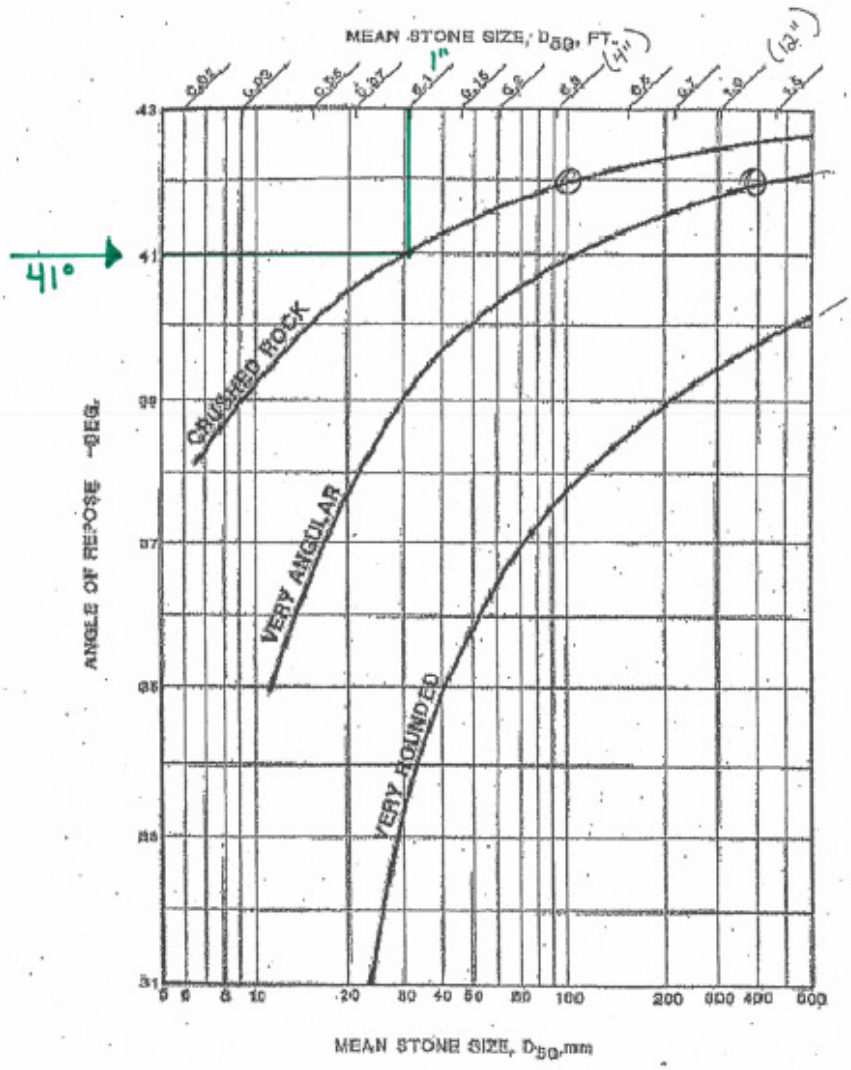
*Note: Final grade assumes 1.5 ft of aggregate cover over subgrade.

B. Low-Permeability Cover

- The proposed low permeability cover system consists of approximately 15 inches of crushed gravel/aggregate over a GDL, FML, and a GCL.
- The crushed gravel (1" < D_{50} < 6") is modeled in Slope/W with the following parameters:
  - Unit Weight = 100 pcf (assume loosely placed, 40% porosity).
  - Friction Angle = 41° (see Sheet 3 - conservatively assume D_{50} = 1").
- The unit weight and strength of the GDL, FML, and GCL are considered insignificant, and these materials were not included in the Slope/W model.

C. Long-Term Groundwater levels

- Proposed horizontal drain locations are shown on Figure C-1.
- The water levels used for long-term post-remediation conditions are based on the current groundwater model for horizontal drain(s), located at/near the bottom of the tailings, approximately elevation +18 feet (+/-), and approximately 100 feet back from the existing crest, and a low perm cover system.
  - The long-term post-remediation groundwater levels used in the Slope/W models is assumed based on the drain location(s) and as per the groundwater model (Appendix A).



http://www.fhwa.dot.gov/engineering/hydraulics/pubs/05114/images/hec15fig06_01.gif

ATTACHMENT E2-G

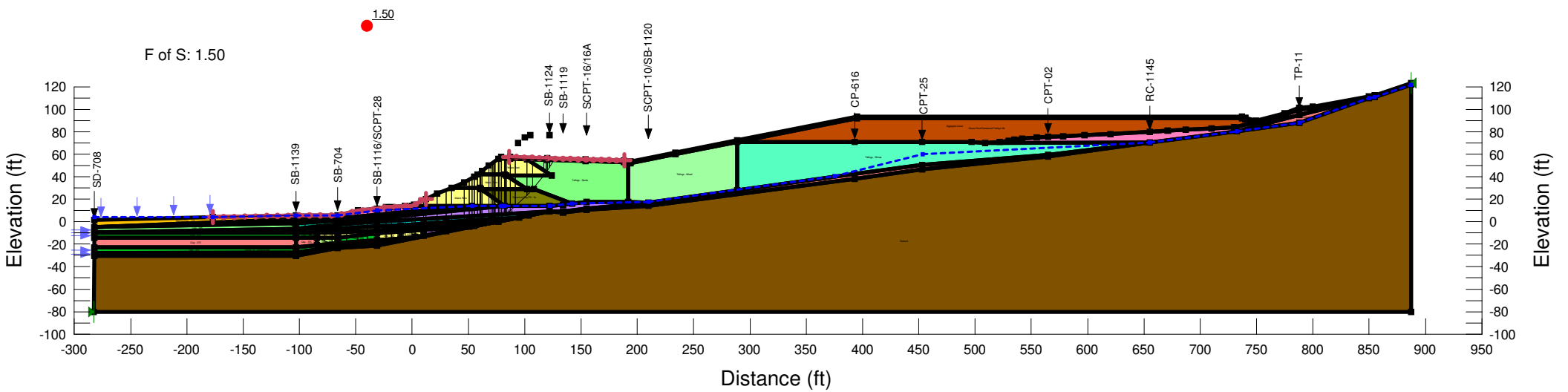
PROFILE E2
LONG-TERM STATIC SLOPE STABILITY EVALUATION

SLOPE/W OUTPUT: POST-REMEDIATION CONDITIONS

Title: Callahan Mine OU3 - Profile E2
Date: 10/16/2014
File Name: Tailings_Profile E2_Proposed Cond_90%.gsz

Name: Profile E2; a1 - Proposed - Static - Crest-Toe - Till Imp
Method: Spencer

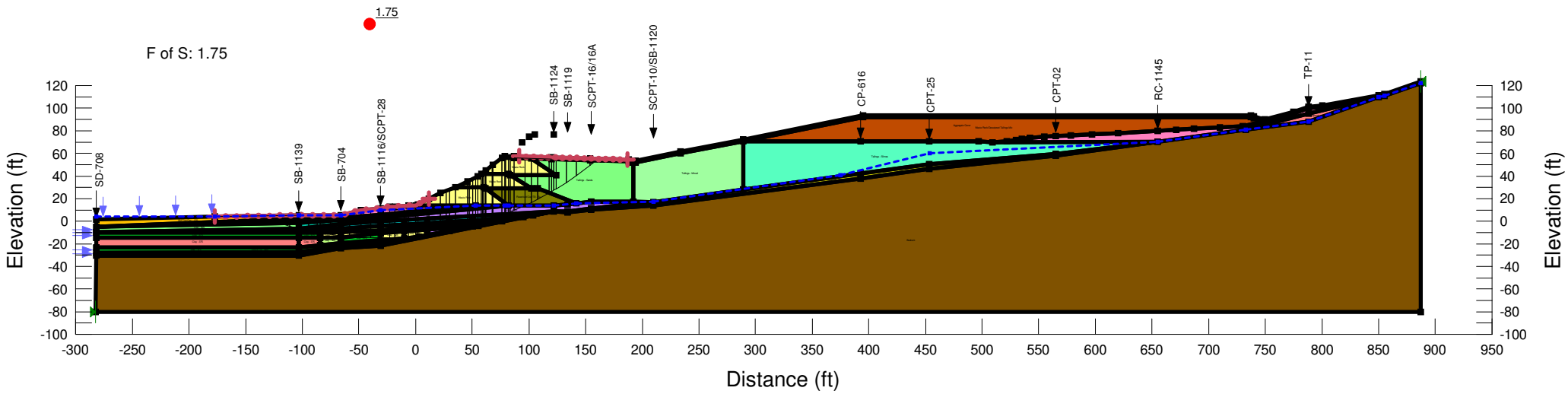
Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 117 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 375 Model: Undrained (Phi=0) Unit Weight: 105 pcf Cohesion': 375 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 750 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 750 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 2750 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,750 psf Piezometric Line: 1
Name: Clay - 1750 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,750 psf Piezometric Line: 1
Name: Clay - 1250 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,250 psf Piezometric Line: 1
Name: Clay - 625 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 625 psf Piezometric Line: 1
Name: Clay - 475 Model: Undrained (Phi=0) Unit Weight: 119 pcf Cohesion': 475 psf Piezometric Line: 1
Name: Clay - 375 Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 375 psf Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Reworked Clay/Till - Su Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Clay - 1075 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,075 psf Piezometric Line: 1
Name: SM-Clay - 1000 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 1,000 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Waste Rock/Dewatered Tailings Mix Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 38 ° Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line
Name: Glacial Till - Impenetrable Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Clay - 525 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 525 psf Piezometric Line: 1
Name: Clay - 675 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 675 psf Piezometric Line: 1
Name: Clay - 925 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 925 psf Piezometric Line: 1
Name: Clay - 1225 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,225 psf Piezometric Line: 1
Name: Clay - 825 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 825 psf Piezometric Line: 1
Name: Clay - 575 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 575 psf Piezometric Line: 1
Name: Clay - 725 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 725 psf Piezometric Line: 1
Name: Clay - 700 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 700 psf Piezometric Line: 1
Name: Clay - 425 Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 425 psf Piezometric Line: 1
Name: SM-Clay - 1250 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 1,250 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Aggregate Cover Model: Mohr-Coulomb Unit Weight: 100 pcf Cohesion': 0 psf Phi': 41 ° Piezometric Line: 1
Name: Clay - 3000 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 3,000 psf Piezometric Line: 1
Name: Clay - 975 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 975 psf Piezometric Line: 1



Title: Callahan Mine OU3 - Profile E2
Date: 10/16/2014
File Name: Tailings_Profile E2_Proposed Cond_90%.gsz

Name: Profile E2; a2 - Proposed - Static - Crest-Toe - Till Reg
Method: Spencer

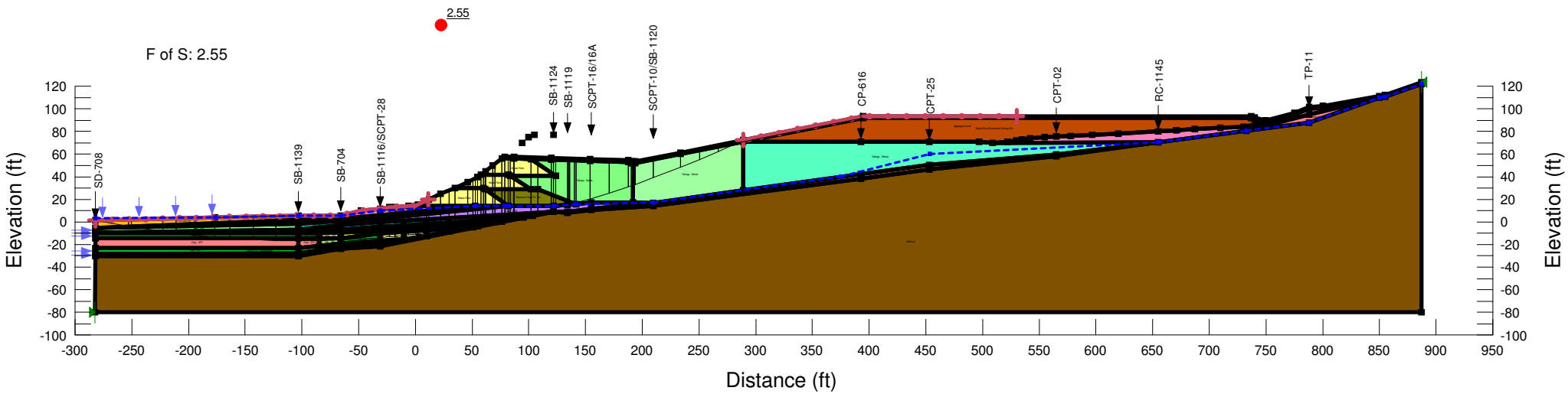
Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 117 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Glacial Till - Reg Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 50 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 130 pcf Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 375 Model: Undrained (Phi=0) Unit Weight: 105 pcf Cohesion': 375 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 750 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 750 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 2750 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,750 psf Piezometric Line: 1
Name: Clay - 1750 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,750 psf Piezometric Line: 1
Name: Clay - 1250 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,250 psf Piezometric Line: 1
Name: Clay - 625 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 625 psf Piezometric Line: 1
Name: Clay - 475 Model: Undrained (Phi=0) Unit Weight: 119 pcf Cohesion': 475 psf Piezometric Line: 1
Name: Clay - 375 Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 375 psf Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Reworked Clay/Till - Su Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Clay - 1075 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,075 psf Piezometric Line: 1
Name: SM-Clay - 1000 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 1,000 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Waste Rock/Dewatered Tailings Mix Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 38 ° Constant Unit Wt. Above Water Table: 115 pcf Piezometric Li
Name: Glacial Till - Impenetrable Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Clay - 525 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 525 psf Piezometric Line: 1
Name: Clay - 675 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 675 psf Piezometric Line: 1
Name: Clay - 925 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 925 psf Piezometric Line: 1
Name: Clay - 1225 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,225 psf Piezometric Line: 1
Name: Clay - 825 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 825 psf Piezometric Line: 1
Name: Clay - 575 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 575 psf Piezometric Line: 1
Name: Clay - 725 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 725 psf Piezometric Line: 1
Name: Clay - 700 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 700 psf Piezometric Line: 1
Name: Clay - 425 Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 425 psf Piezometric Line: 1
Name: SM-Clay - 1250 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 1,250 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Aggregate Cover Model: Mohr-Coulomb Unit Weight: 100 pcf Cohesion': 0 psf Phi': 41 ° Piezometric Line: 1
Name: Clay - 3000 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 3,000 psf Piezometric Line: 1
Name: Clay - 975 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 975 psf Piezometric Line: 1



Title: Callahan Mine OU3 - Profile E2
Date: 10/16/2014
File Name: Tailings_Profile E2_Proposed Cond_90%.gsz

Name: Profile E2; b1 - Proposed - Static - Fill-Toe - Till Imp
Method: Spencer

Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 117 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 375 Model: Undrained (Phi=0) Unit Weight: 105 pcf Cohesion': 375 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 750 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 750 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 2750 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,750 psf Piezometric Line: 1
Name: Clay - 1750 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,750 psf Piezometric Line: 1
Name: Clay - 1250 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,250 psf Piezometric Line: 1
Name: Clay - 625 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 625 psf Piezometric Line: 1
Name: Clay - 475 Model: Undrained (Phi=0) Unit Weight: 119 pcf Cohesion': 475 psf Piezometric Line: 1
Name: Clay - 375 Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 375 psf Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Reworked Clay/Till - Su Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Clay - 1075 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,075 psf Piezometric Line: 1
Name: SM-Clay - 1000 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 1,000 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Waste Rock/Dewatered Tailings Mix Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 38 ° Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
Name: Glacial Till - Impenetrable Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Clay - 525 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 525 psf Piezometric Line: 1
Name: Clay - 675 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 675 psf Piezometric Line: 1
Name: Clay - 925 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 925 psf Piezometric Line: 1
Name: Clay - 1225 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,225 psf Piezometric Line: 1
Name: Clay - 825 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 825 psf Piezometric Line: 1
Name: Clay - 575 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 575 psf Piezometric Line: 1
Name: Clay - 725 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 725 psf Piezometric Line: 1
Name: Clay - 700 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 700 psf Piezometric Line: 1
Name: Clay - 425 Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 425 psf Piezometric Line: 1
Name: SM-Clay - 1250 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 1,250 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Aggregate Cover Model: Mohr-Coulomb Unit Weight: 100 pcf Cohesion': 0 psf Phi': 41 ° Piezometric Line: 1
Name: Clay - 3000 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 3,000 psf Piezometric Line: 1
Name: Clay - 975 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 975 psf Piezometric Line: 1



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Name: Profile E2; b2 - Proposed - Static - Fill-Toe - Till Reg
Method: Spencer

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Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
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Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
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Name: Clay - 2750 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,750 psf Piezometric Line: 1
Name: Clay - 1750 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,750 psf Piezometric Line: 1
Name: Clay - 1250 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,250 psf Piezometric Line: 1
Name: Clay - 625 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 625 psf Piezometric Line: 1
Name: Clay - 475 Model: Undrained (Phi=0) Unit Weight: 119 pcf Cohesion': 475 psf Piezometric Line: 1
Name: Clay - 375 Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 375 psf Piezometric Line: 1
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Name: Clay - 1075 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,075 psf Piezometric Line: 1
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Name: Clay - 925 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 925 psf Piezometric Line: 1
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Name: Clay - 825 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 825 psf Piezometric Line: 1
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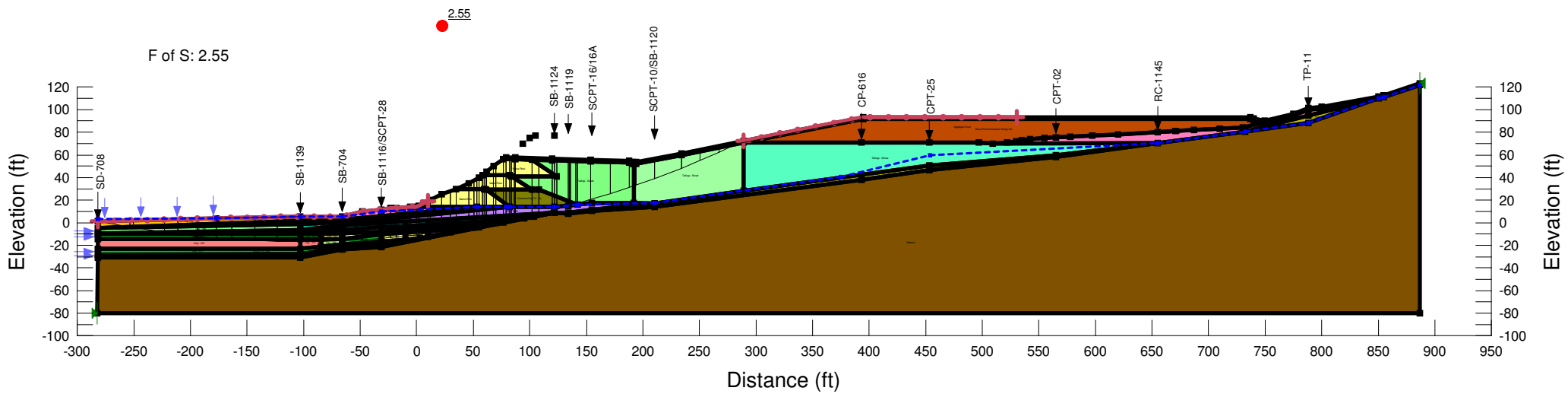
Name: Clay - 725 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 725 psf Piezometric Line: 1
Name: Clay - 700 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 700 psf Piezometric Line: 1
Name: Clay - 425 Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 425 psf Piezometric Line: 1
Name: SM-Clay - 1250 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 1,250 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Aggregate Cover Model: Mohr-Coulomb Unit Weight: 100 pcf Cohesion': 0 psf Phi': 41 ° Piezometric Line: 1
Name: Clay - 3000 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 3,000 psf Piezometric Line: 1
Name: Clay - 975 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 975 psf Piezometric Line: 1



Title: Callahan Mine OU3 - Profile E2
Date: 10/16/2014
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Name: Profile E2; c1 - Proposed - Static - Fill-Slope - Till Imp
Method: Spencer

Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
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Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 117 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
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Name: SM-Clay/Org. - 375 Model: Undrained (Phi=0) Unit Weight: 105 pcf Cohesion': 375 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 750 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 750 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 2750 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,750 psf Piezometric Line: 1
Name: Clay - 1750 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,750 psf Piezometric Line: 1
Name: Clay - 1250 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,250 psf Piezometric Line: 1
Name: Clay - 625 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 625 psf Piezometric Line: 1
Name: Clay - 475 Model: Undrained (Phi=0) Unit Weight: 119 pcf Cohesion': 475 psf Piezometric Line: 1
Name: Clay - 375 Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 375 psf Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Reworked Clay/Till - Su Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Clay - 1075 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,075 psf Piezometric Line: 1
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Name: Clay - 525 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 525 psf Piezometric Line: 1
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Name: Clay - 825 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 825 psf Piezometric Line: 1
Name: Clay - 575 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 575 psf Piezometric Line: 1
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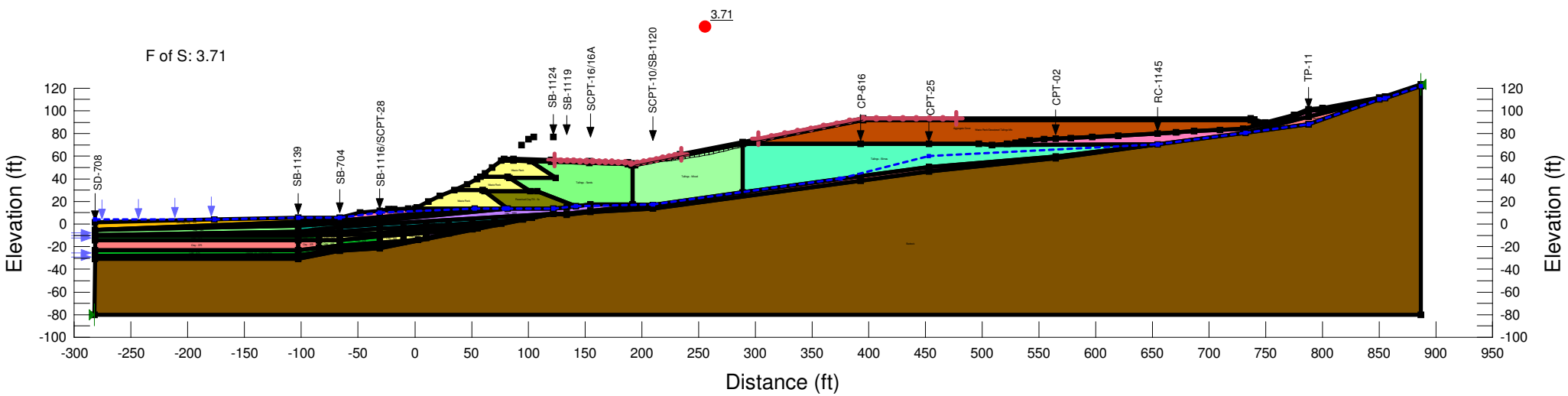
Name: SM-Clay - 1250 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 1,250 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Aggregate Cover Model: Mohr-Coulomb Unit Weight: 100 pcf Cohesion': 0 psf Phi': 41 ° Piezometric Line: 1
Name: Clay - 3000 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 3,000 psf Piezometric Line: 1
Name: Clay - 975 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 975 psf Piezometric Line: 1



Title: Callahan Mine OU3 - Profile E2
Date: 10/16/2014
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Name: Profile E2; c2 - Proposed - Static - Fill-Slope - Till Reg
Method: Spencer

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Name: Clay - 725 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 725 psf Piezometric Line: 1
Name: Clay - 700 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 700 psf Piezometric Line: 1
Name: Clay - 425 Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 425 psf Piezometric Line: 1
Name: SM-Clay - 1250 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 1,250 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Aggregate Cover Model: Mohr-Coulomb Unit Weight: 100 pcf Cohesion': 0 psf Phi': 41 ° Piezometric Line: 1
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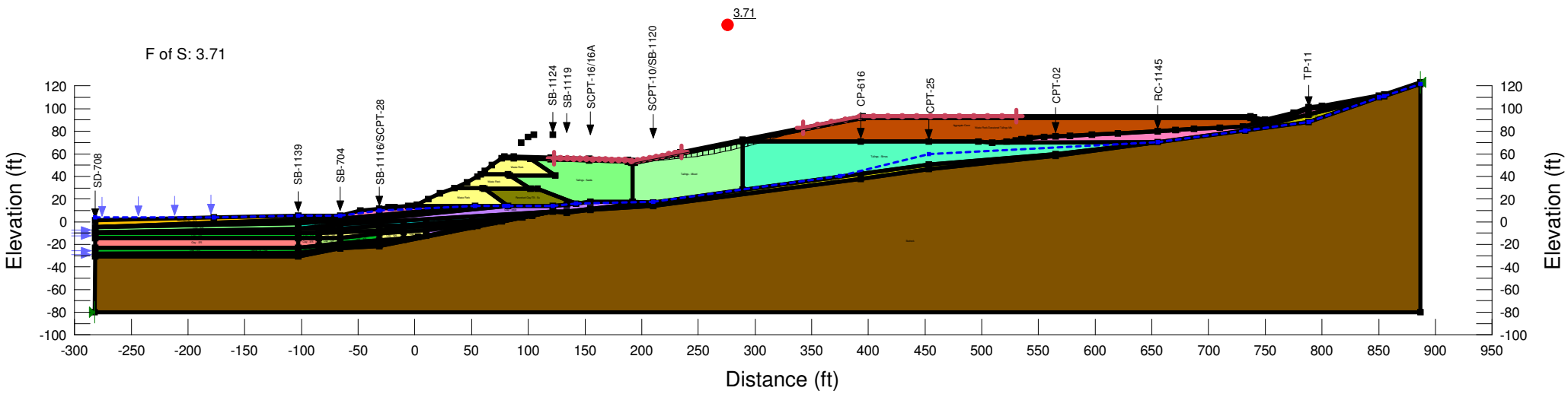
Name: Clay - 975 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 975 psf Piezometric Line: 1



ATTACHMENT E3

PROFILE E3
LONG-TERM STATIC SLOPE STABILITY EVALUATION

ATTACHMENT E3-A

PROFILE E3
LONG-TERM STATIC SLOPE STABILITY EVALUATION

SLOPE/W MODEL DEVELOPMENT: EXISTING CONDITIONS

ATTACHMENT E3-A

PROFILE E3 - SLOPE/W MODEL DEVELOPMENT - EXISTING CONDITIONS

- See Figure C-1 for profile location.

A. Define Overall Geometry/Topography

- Existing site-specific topography is shown on Figure C-1.
  - Define Profile Station 0+00 as the "toe" of the rock dam.
    - Positive station numbers to the west
    - Negative station numbers to the east
- See Attachment E3-B for definition of key SLOPE/W points.

B. Impoundment Dam Configuration

- The assumed/interpreted configuration of the impoundment dam is as follows:
  - Constructed via "upstream" raised embankment methods.
  - 5 total lifts (starter dam plus 4 subsequent raises).
  - Starter dam constructed with clay and glacial till from on-site (and adjacent property to the south) and face extensively with waste rock.
    - Top of starter dam at Elev. +30 ft (+/-).
    - Crest width of waste rock approximately 25 ft (+/-).
    - Backslope of waste rock approximately 1.3H:1V to 1.5H:1V.
    - Clay/glacial till extends 50 ft (+/-) behind the starter dam.
  - Subsequent raises/lifts constructed with waste rock and possibly lined/"chinked" with clay/till fill (limited extent/thickness).
    - Each lift/raise approximately 10 to 15 ft tall
    - Crest width of each waste rock lift/raise approximately 25 ft (+/-).
    - Backslope of each waste rock lift/raise approximately 1.3H:1V to 2.0H:1V.
- See Attachment E3-C for discussion, supporting data/evaluation, and sketches/cross-sections.

C. Define Subsurface Profile

- Geotechnical explorations along or in close proximity to Profile E3 are shown on Figure C-1.
    - MW-723R — West
    - TP-09
    - TP-08
    - TP-07
    - CPT-03
    - SB-1131/CPT-26
    - SB-605B
    - SB-1121/SCPT-09
    - SCPT-14A/SB-705
    - SB-1122
    - SB-1123 — Crest
    - SB-702
    - SCPT-29
    - SB-1138
    - SD-707 — East
- Logs/records of these explorations are provided in prior investigation reports:
    - Credere, 2012 — Supplemental Geotechnical Investigation
    - MACTEC, 2009a — Geotechnical Evaluation Report
    - MACTEC, 2009b — Remedial Investigation Report
- Table C-4 summarizes the primary soil strata encountered at these exploration locations.
    - Fill
    - Tailings
        - Tailings are further subdivided into "zones" of sand, mixed/stratified, or slimes based on description of sand, fines, and layering/thickness.
    - Clay/Till Fill
    - Native Estuarine
    - Presumpscot Clay
        - Native clay is further divided into layers/zones based on strength data.
    - Glacial Till
    - Other, as necessary

D. Assign Soil Unit Weight & Strength Parameters

- Assign unit weights based on soil type, in-situ conditions (e.g., density, consistency, saturation, etc.), published literature, and in conjunction with/comparison with bulk density measurements from Shelby tube samples.

- Strength parameters for Tailings developed based on site-specific field and laboratory testing programs and in conjunction with applicable mine-tailings-specific references (i.e., Vick 1990)

  Note: +/- adjustments to Tailings effective stress/strength parameters have negligible impact on estimated FOS.

- Strength parameters for Clay and Estuarine deposits developed based on site-specific field and laboratory testing programs.

  - FVST data
  - CPT Data
  - SPT Data
  - Strength adjustments for unexplored locations (beneath the waste rock impoundment dam) are presented in Attachment E3-D.

- Strength Parameters for Glacial Till and various Fill materials developed based on site-specific field and laboratory testing programs and published values.

- Strength parameters for impoundment berm (i.e., crushed/angular waste rock) developed based on published FHWA values/data (see Sheet 6).

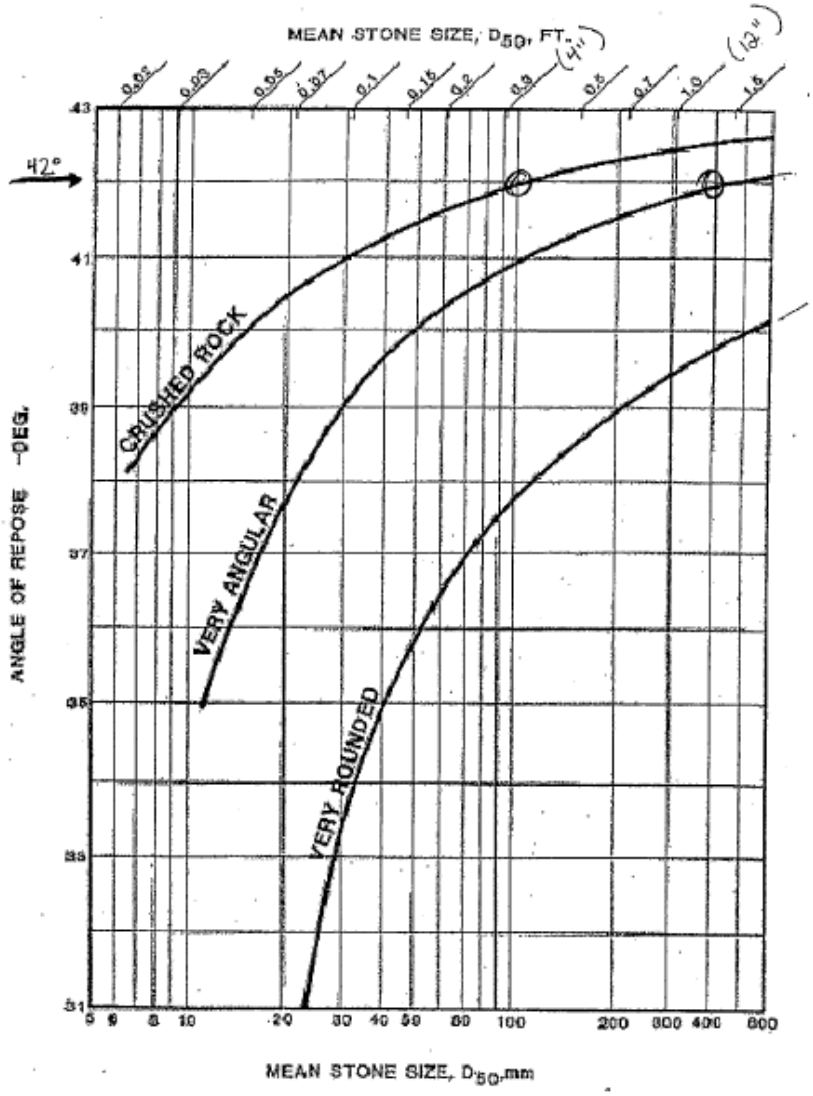
- Actual weight and strength parameters for each soil type are listed on Slope/W output files.

E. Estimate Shear Strength Increase in Clay Beneath Impoundment Dam

- Clay strengths known at crest (SB-1122) and at toe (SB-702). Use procedures below to provide reasonable estimates of clay strength in between the known points.
- See Attachment E3-C for sketch comparing existing conditions vs. historic (pre-mining) topography.
- Estimate gross effective stress increase - Pre-mining "cuts" approximately equal to net effective stress increase. See Attachment E3-D.
- Use Winstress software to estimate effective stress increase in clay soils at various intervals between the crest and toe. See Attachment E3-D for Winstress setup and associated output files.
- Estimate strength increase in soft/normally consolidated clay soils based on $Su/\sigma`v = 0.2$ (relationship based on site-specific lab testing and in agreement with literature values. Strength increase in medium stiff clay soils based on $Su/\sigma`v = 0.15$. Strength increase in stiff clay soils based on $Su/\sigma`v = 0.1$. No strength increase applied to very stiff clay. See Attachment E3-D.
- Apply strength increase to the "toe" conditions in segmented/zoned areas beneath the berm. See Attachment E3-D.
- See Slope/W output files for zones and strengths assigned.

F. Define Phreatic Surface/Water Table and/or Pore Pressure Grid

- Site-specific water levels measured in the installed/existing PZs, MWs, OWs, and/or VWPs provide information on impoundment water levels. This info indicates a slightly downward gradient (decreasing piezometric surface/pressure within the tailings with increasing depth bgs).
    - Water level data is available or formerly available at the following locations along or proximate to Profile E3:
        - TP-09
        - SB-1131 (OW)
        - SB-605B
        - SB-1121
        - SB-1122 (VWP)
        - SB-1123 (OW)
        - PZ/MW-702
        - UT-1117 (VWP)
        - UT-1138 (VWP)
- A pore pressure grid can be utilized in Slope/W to model decreasing pore pressure gradients with depth. This approach is applicable for existing conditions. However, the remedial design includes installation of drainage features.
- For this evaluation, the pore pressures are modelled in Slope/W via a piezometric line and not a pore pressure grid. This is considered conservative for evaluation of existing conditions, but more reasonable/applicable for representing the long-term post-remediation impoundment water levels predicted by the groundwater model (Appendix A).
- The impoundment water levels used for existing conditions are shown in Table C-4.
    - This data is supplemented by the global assumption that the "heel" of each lift of the impoundment berm generally controls the phreatic surface. The water pressure is approximately zero near the heel of each lift.



http://www.fhwa.dot.gov/engineering/hydraulics/pubs/05114/images/hec15fig06_01.gif

ATTACHMENT E3-B

PROFILE E3
LONG-TERM STATIC SLOPE STABILITY EVALUATION

EXISTING CONDITIONS SLOPE/W POINTS (GEOMETRY)

ATTACHMENT E3-B

PROFILE E3 - SLOPE/W MODEL DEVELOPMENT - EXISTING CONDITIONS

- Define cross-section perpendicular to impoundment dam "face".
- Define STA. 0+00 at Elev. +12.0 ft MSL (~"toe" of the impoundment dam).
- Define existing topography:

Point	STA.	Ground Surface EL. (ft)	Exploration
1	8+40	115	
2	8+21	110	
3	8+06	109	
4	7+95	108	
5	7+86	107	
6	7+78	106	
7	7+67	106	
8	7+65	105	
9	7+56	100	
10	7+49	99	
11	7+36	98.5	$MW-723\ R$
12	7+32	98	
13	7+17	97	
14	7+15	96.5	$TP-9$
15	7+07	96	
16	6+80	95	
17	6+67	90	
18	6+57	87	$TP-8$
19	6+53	85	
20	6+39	80	
21	6+37	80.5	$TP-7$
22	6+18	76	
23	6+11	75	
24	6+03	74	
25	5+96	73	
26	5+92	73	
27	5+78	74	
28	5+69	74	
29	5+64	73	
30	5+62	72	
31	5+60	71	
32	5+02	70.5	$CPT-03$
33	4+41	71	
34	4+26	71	$SB-1131$ $CPT-26$

Point	STA.	Ground Surface EL. (ft)	Exploration
35	2+41	70.5	$SB-605\ B$
36	2+18	72	
37	1+80	72.5	$CPT-09\quad SB-1121$
38	1+75	72.5	
39	1+60	73	
40	1+38	74	$SCPT-14\ A$
41	1+36	75	
42	1+31	75	$SB-705$
43	1+23	75	
44	1+17	75	
45	1+13	76	$SB-1122$
46	1+07	77	
47	1+03	77	$SB-1123$
48	0+87	77	
49	0+84	75	
50	0+78	70	
51	0+72	65	
52	0+66	60	
53	0+60	55	
54	0+54	50	
55	0+48	45	
56	0+42	40	
57	0+35	35	
58	0+30	30	
59	0+23	25	
60	0+15	20	
61	0+06	15	
62	0+00	12	
63	−0+37	11.5	$SB-702$
64	−0+46	11.5	$CPT-29\quad SB-1117$
65	−0+49	11	
66	−0+59	10	
67	−0+76	9	
68	−0+86	8	
69	−0+98	5	
70	−1+01	4	$SB-1138$
71	−1+83	4	$SD-707$
72	−2+55	5	

ATTACHMENT E3-C

PROFILE E3
LONG-TERM STATIC SLOPE STABILITY EVALUATION

IMPOUNDMENT DAM CONFIGURATION

ATTACHMENT E3-C

PROFILE E3 - DAM IMPOUNDMENT CONFIGURATION

A. Objective:

- To assess the configuration of the existing impoundment dam, including number of lifts/raises above the starter dam and the crest width and backslope of of each lift.

B. Discussion:

- Anecdotal information, historic photographs, and subsurface exploration data indicate that the impoundment dam was constructed via upstream raised embankment methods. Tailings were discharged via spigots placed peripherally along the crest of the starter dam (and each subsequent "lift" of the dam/embankment raise).

- Borings/wells drilled near the crest of the dam typically identify clay/glacial till fill "at depth" beneath the tailings.

C. Data Evaluation:

- MW-604R

  - Location: Northeastern corner of impoundment
  - Crest EL.: +75 to +77 ft (including surface gravel)
  - Toe EL.: +10 ft
  - Existing GS EL.: +77 ft
  - Horiz. Distance from Crest Grade Break (northern): 37 ft
  - Horiz. Distance from Crest Grade Break (eastern): 46 ft

  - Data Summary:

    - 0.0-1.5 ft bgs: Road base gravel;
    - 1.5-5.0 ft bgs: Gravel and cobbles;
    - 5.0-15.0 ft bgs: Poor recovery/limited soil description/stratigraphy due to sonic drilling method. In general, Waste Rock over Sand tailings, over Slime tailings @ ~12-15 ft bgs; and
    - 62.0-65.0 ft bgs: Possible reworked clay/glacial till.

  - Conclusions:

    - Gravel and cobbles at shallow depth may not be associated with the impoundment dam. Rather, used for support of present-day roadway.
    - Impoundment dam may not have been encountered at this boring. This suggests max crest width of uppermost dam ~25 ft for northern side, assuming ~10 ft tall lift (25+10*1.3=38 ft) OR ~20 ft for northern side, assuming a ~15 ft tall lift. Using the same criteria, a 25 to 30 ft wide crest is possible for the eastern side.
    - Slimes @ ~12-15 ft bgs suggest bottom of uppermost lift at ~EL. +65 ft, OR no spigot in the corner.
    - Clay/till fill at depth likely part of starter dam.

C. Data Evaluation - continued:

- MW-722R

  - Location: Southeastern corner of impoundment
  - Crest EL.: +75 to +77 ft
  - Toe EL.: +20 ft
  - Existing GS EL.: +77 ft
  - Horiz. Distance from Crest Grade Break (eastern): 37 ft
  - Horiz. Distance from Crest Grade Break (southern): 37 ft

  - Data Summary:

    - 0.0-1.0 ft bgs: Road base gravel;
    - 1.0- 10-15 ft bgs: Gravel, cobbles, and boulders;
    - >10-15 ft bgs: Sand/silt;
    - Limited soil description/stratigraphy at depth due to sonic drilling methods.

  - Conclusions:

    - Impoundment dam encountered at this location.
    - Some of the shallow gravel, cobbles, and boulders may be associated with support of present-day roadway.
    - Suggests crest width of 25 to 30 ft, assuming 10 to 15 ft lift.
    - Suggests 10 to 15 ft height for uppermost lift.
    - Suggests bottom of uppermost lift at ~EL. +62 to +67 ft.

- SB-1124 & SB-1119

  - Location: Eastern side (~E2 profile)
  - Crest EL.: +75 to +77 ft
  - Toe EL.: +15 ft
  - Existing GS EL.: +76.5 ft (SB-1124); +75.5 ft (SB-1119)
  - Horiz. Distance from Crest Grade Break: 22 ft (SB-1124); 32 ft (SB-1119)

  - Data Summary:

SB-1124		SB-1119	
0-1 ft bgs:	Roadway gravel	0-1 ft bgs:	Roadway gravel
1-25 ft bgs:	Waste rock	1-11 ft bgs:	Waste rock
25-43 ft bgs:	Sand tailings	11-28.5 ft bgs:	Sand tailings
- Obstruction ~33 ft bgs		- Boney ~19 ft bgs	
43-48.5 ft bgs:	Waste rock/tailings	28.5-56 ft bgs:	Mixed tailings
48.5-53 ft bgs:	Sand tailings	- Gravelly ~33 ft bgs	
53-61 ft bgs:	Reworked clay	56-61 ft bgs:	Clay, possible rework
61-68 ft bgs:	Native clay	61-67 ft bgs:	Native clay

C. Data Evaluation - continued:

- SB-1124 & SB-1119 - continued

  - Conclusions:

    - Empoundment dam encountered at these locations.
    - Suggests bottom of the uppermost lift at ~EL. +65.
    - Suggests 10-11 ft lift height for uppermost lift.
    - Suggests 25-30 ft wide crest width for uppermost lift.
    - SB-1119, SCPT-16 (refusal at 6.5 ft bgs, 14 ft from SB-1119), and SCPT-16A (No refusal, 23 ft from SB-1119) suggest ~2H:1V backslope on uppermost lift.
    - SB-1124 suggests 25-30 ft wide crest for 2nd uppermost lift.
    - SB-1124 sugests bottom of the 2nd uppermost lift at ~EL. +50 to +55 ft.
    - SB-1124 & SB-1119 indicate reworked clay fill at 53 ft and 56 ft bgs, respectively. Suggests clay fill with 2.5H:1V backslope. Indicates clay fill behind starter dam.

- SB-1123 & SB-1122

  - Location: Eastern side (~E3 profile)
  - Crest EL.: +75 to +78 ft
  - Toe EL.: +12 ft
  - Existing GS EL.: +77ft (SB-1123); +75.5 ft (SB-1122)
  - Horiz. Distance from Crest Grade Break: 20 ft (SB-1123); 29 ft (SB-1129)

  - Data Summary:

SB-1123		SB-1122
0-1.5 ft bgs:	Roadway gravel	0-8 ft bgs (+/-): Roadway gravel
1.5-23 ft bgs:	Waste rock	8-17 ft bgs (+/-): Waste rock
23-33.5 ft bgs:	Waste rock/tailings	17-33.5 ft bgs: Sand tailings
33.5-39.5 ft bgs:	Sand/mixed tailings	- Gravel/obstruction at 32.5 ft bgs
39.5-55.5 ft bgs:	Mixed tailings	33.5-56 ft bgs: Mixed tailings
55.5-66 ft bgs:	Reworked clay	56-63.5 ft bgs: Reworked clay
66-68.5 ft bgs:	Native clay	- "Boney" material at 59' bgs
68.5 ft bgs:	Till/bedrock	63.5-65.5 ft bgs: Native clay
		65.5 ft bgs: Till/bedrock

C. Data Evaluation - continued:

- SB-1123 & SB-1122 - continued
  - Conclusions:
    - Empoundment dam encountered at these locations.
    - Suggests bottom of the uppermost lift at ~EL. +65.
    - Suggests 10 ft lift height for uppermost lift.
    - Suggests 25-30 ft wide crest width for uppermost lift.
    - SB-1122, SCPT-14 (refusal at 6.5 ft bgs, 10 ft from SB-1122), and SCPT-14A (No refusal, 25 ft from SB-1122) suggest ~1.3H:1V backslope on uppermost lift.
    - SB-1123 suggests 25-30 ft wide crest for 2nd uppermost lift.
    - SB-1123 sugests bottom of the 2nd uppermost lift at ~EL. +50 to +55 ft.
    - SB-1123 & SB-1122 indicate reworked clay fill at 55 ft and 56 ft bgs, respectively. Suggests clay fill with 3H:1V backslope. Indicates clay fill behind starter dam.

- SB-1125
  - Location: Northern side
  - Crest EL: +75 to +78 ft
  - Toe EL.: +28 ft
  - Existing GS EL.: +78 ft
  - Horiz. Distance from Crest Grade Break: 14 ft
  - Data Summary:
    - 0-36 ft bgs: Waste Rock
    - 36-51 ft bgs: Waste rock/tailings mix
    - 51-63.5 ft bgs: Clay/till fill
    - 63.5-66 ft bgs: Native organic silt
    - 66-73.5 ft bgs: Native clay
    - 73.5-77 ft bgs: Glacial till
  - Conclusions:
    - Impoundment dam encountered at this location.
    - Suggests bottom of 3rd uppermost lift at ~EL. +40 to +45 ft.
    - Indicates 25 ft wide crest for the 2nd uppermost lift.
    - Indicates clay/till fill behind the starter dam. Thickness of fill (and top elevation of fill) appears to increase as distance from crest/toe/starter dam decreases.

C. Data Evaluation - continued:

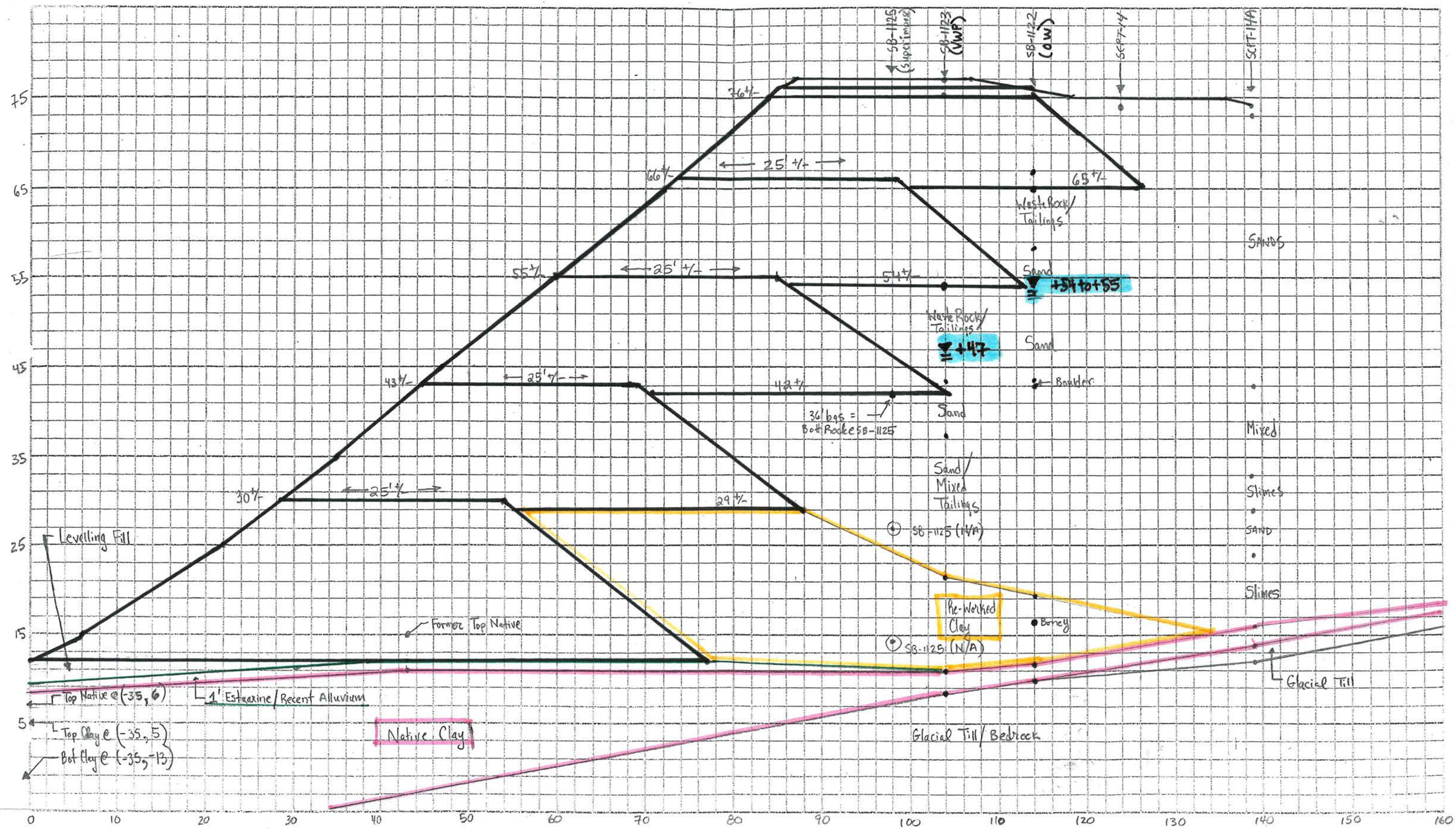
- SB-1126
  - Location: Southern side
  - Crest EL.: +75 to +77 ft
  - Existing GS EL.: +77 ft
  - Horiz. Distance from Grade Break: 20 ft
  - Data Summary:
    - Advanced 0-45 ft bgs via air hammer drilling methods:
      - Waste rock;
      - Waste rock/Dense tailings mix; and/or
      - Very stiff/stiff clay/till fill
    - 48 ft bgs: Bottom of clay/till fill
    - 48-64 ft bgs: Native clay
    - 64-77 ft bgs: Glacial till
    - 77 ft bgs: Probable bedrock

- A sketch of the interpreted impoundment dam configuration is shown on Sheet 6.

Y = Elevation (feet) : 1" = 10'

X = Distance from Toe (feet) : 1" = 10'

PROFILE E3 Interpreted Rock Dam Configuration	PROJECT Callahan Mine Tailings Impoundment Slope Stability Evaluation	COMP BY TCC	JOB NO. 3612-11-2201
		CHK BY	DATE 03/2013



ATTACHMENT E3-D

PROFILE E3
LONG-TERM STATIC SLOPE STABILITY EVALUATION

ESTIMATES OF CLAY SHEAR STRENGTH VIA SHANSEP METHOD

ATTACHMENT E3-D

PROFILE E3 - ESTIMATE CLAY SHEAR STRENGTH BENEATH IMPOUNDMENT DAM

- Clay thickness and shear strength profile are "known" near the toe of the impoundment dam.
  - SB-702 15.5 ft thick Transitions from v. stiff crust to soft
- Clay thickness and shear strength profile are "known" at/near the crest of the impoundment dam.
  - SB-1123 2.2 ft thick Described as "stiff" with blow counts of5&9 from bottom half of S-9 (65-67' bgs)
- Clay thickness is approximately the same between these two points.
  - Distance ~= 140 ft
- Clay strength profile will be interpolated between these points using $Su/\sigma'v$ (also called c/p) ratios, based on site specific laboratory test results and literature values:
  - Soft: $\Delta Su/\Delta\sigma'v = 0.20$
  - Medium stiff: $\Delta Su/\Delta\sigma'v = 0.15$
  - Stiff (<1500 psf): $\Delta Su/\Delta\sigma'v = 0.10$
    - Apply strength increase (ΔSu) to clay strength profile at toe based on effective stress increase ($\Delta\sigma'v$) imposed by the impoundment dam.
    - See Attachment E3-C for a sketch of existing conditions/topo, 1965 topo, and soil boring locations relative to the toe of the dam.
    - Use Winstress software to estimate $\Delta\sigma'v$ applied to clay soils at various stations/zones beneath the impoundment dam.

- Estimate embankment load imposed by the impoundment:
  - Beneath crest point:
    - 60 ft tall dam/impoundment (relative to 1965 grade of ~+15 ft)
      - $\sigma'v$ = 40 ft unsaturated waste rock/tailings = 40' x 105 pcf = 4,200 psf
      - $\sigma'v$ = 20 ft saturated clay/tailings = 20' x 125 pcf = 2,500 psf
      - u = 20 ft water = -20' x 62.4 pcf = -1,248 psf
      - Assume 3 ft rise in pore pressure in clay = -3' x 62.4 pcf = -187 psf
        - Load imposed beneath crest ~= 5,265 psf
  - Beneath SB-1122:
    - 60 ft tall dam (relative to 1965 grade of ~+15 ft)
      - $\sigma'v$ = 10 ft unsaturated tailings = 10' x 110 pcf = 1,100 psf
      - $\sigma'v$ = 10 ft unsaturated rock/tailings = 10' x 105 pcf = 1,050 psf
      - $\sigma'v$ = 40 ft saturated tailings = 40' x 120 pcf = 4,800 psf
      - u = 40 ft of water = -40' x 62.4 pcf = -2,496 psf
      - Assume 3 ft rise in pore pressure in clay = -3' x 62.4 pcf = -187 psf
        - Load imposed beneath SB-1122 ~= 4,267 psf
  - Average embankment/terrace load = 4,750 psf

- Use Winstress software with the following inputs:
  - Load at crest = 4,750 psf
  - A=Distance toe to crest = 84 ft
  - B=Distance to to end of load = 168 ft
  - x = 0 @ toe of embankment load

- Vary x to estimate $\Delta\sigma'v$ with depth (z) below the embankment.

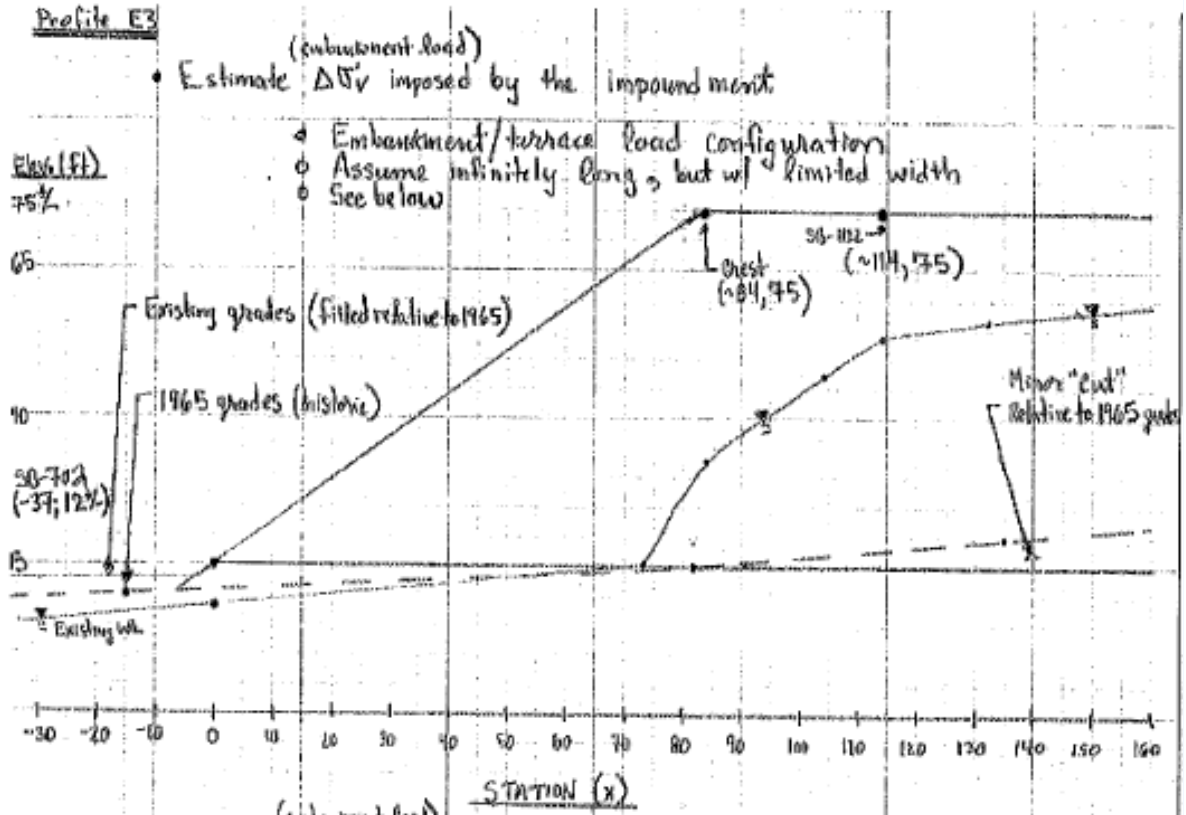
- Winstress software input/analysis definitions:

X-Range (Slope/W coords.)	Analysis Point (Winstress)	Discussion
-37 to -10	x = -24	
-10 to +10	x = 0	See attached output files;
+10 to +30	x = +20	Soft: c/p = 0.20
+30 to +50	x = +40	M. Stiff: c/p = 0.15
+50 to +70	x = +60	Stiff: c/p = 0.10
+70 to +90	x = +80	V. Stiff: N/A
+90 to +110	x = +100	
+110 to +130	x = +120	
+130 to +150	x = +140	

Profile E3

(embankment load)

- Estimate $\Delta\sigma'_v$ imposed by the impoundment
  - Embankment/terrace load configuration
  - Assume infinitely long, but w/ limited width
  - See below



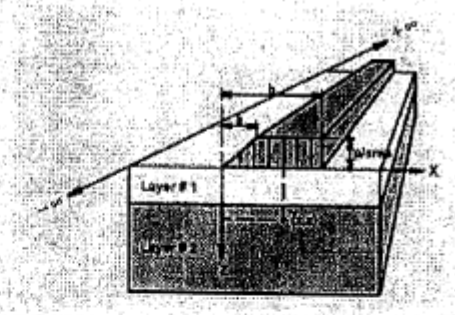
(embankment load)

- Estimate $\Delta\sigma'_v$ imposed by the impoundment – Continued
  - Beneath crest point:
    - 60' Tall Dam/impoundment
    - σ'_v ≅
      - 20' Soft Clay/Tailings ≅ 20' x 125 pcf
      - 40' Hard Waste Rock/Tailings ≅ 40' x 108 pcf
      - – 20' Water ≅ – 20' x 62.4 pcf
      - ≅ 5,450 psf
      - Assume impound water has caused 3' rise in porepressure head in underlying clay – 3' x 62.4 pcf
      - ≅ 5,263 psf

Increment of stress calculation = vertical $\Delta\sigma z$

STRIP FOOTING

Width of strip A = 84.00
Width of strip B = 168.00
p load/unit area = 4750.000



POINTS FOR COMPUTATION OF INCREMENT OF STRESS

calculate in = z direction

x1 coordinate = -24.00

z1 coordinate = 0.00
z2 coordinate = 32.00
delta z = 1.00

Ok | Cancel | Print Screen | Save Screen

@ x = -24

Clay Elev.	Relative to Elev. 15'
+4'	11' bgs
to	to
-11'	26' bgs

LOADING ON AN INFINITE STRIP
VERTICAL EMBANKMENT LOADING

Sheet 5

Project Name: Callahan Mine - Tailings
Client : MaineDOT
Date : 3/25/2013

Project Number : 3612112201
Project Manager: PSB
Computed by : TCC

Embank. slope a = 84.00 (ft)
Embank. width b = 168.00 (ft)
p load/unit area = 4750.000(psf)

INCREMENT OF STRESSES FOR Z-DIRECTION
X = -24.00(ft)

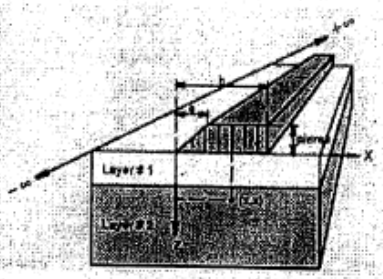
Z (ft)	Vert. Dsz (psf)	
0.00	0.00	
1.00	0.00	
2.00	0.08	
3.00	0.26	
4.00	0.61	
5.00	1.19	
6.00	2.03	
7.00	3.18	
8.00	4.67	
9.00	6.53	
10.00	8.80	
11.00	11.47	Negligible ΔS_u
12.00	14.58	
13.00	18.11	
14.00	22.09	
15.00	26.49	
16.00	31.32	
17.00	36.58	
18.00	42.23	
19.00	48.29	
20.00	54.71	
21.00	61.51	
22.00	68.64	
23.00	76.10	$\times 0.2 \cong 15\text{-}25$ psf $\cong \Delta S_u$
24.00	83.87	
25.00	91.92	
26.00	100.25	
27.00	108.82	
28.00	117.63	
29.00	126.66	
30.00	135.89	
31.00	145.29	
32.00	154.87	

Soft

Increment of stress calculation = vertical Δσz

STRIP FOOTING

Width of strip A = 84.00
Width of strip B = 168.00
p load/unit area = 4750.000



Sheet 6

POINTS FOR COMPUTATION OF INCREMENT OF STRESS

x1 coordinate = 0.00
z1 coordinate = 0.00
z2 coordinate = 32.00
delta z = 1.00

calculate in = z direction

Ok | Cancel | Print Screen | Save Screen

@ X = 0

Clay Elev.	Relative to Elev. +15
+5'	10' bgs
to	to
-7'	22' bgs

LOADING ON AN INFINITE STRIP
VERTICAL EMBANKMENT LOADING

Sheet: 7

Project Name: Callahan Mine - Tailings
Client : MaineDOT
Date : 3/25/2013

Project Number : 3612112201
Project Manager: PSB
Computed by : TCC

Embank. slope a = 84.00 (ft)
Embank. width b = 168.00 (ft)
p load/unit area = 4750.000(psf)

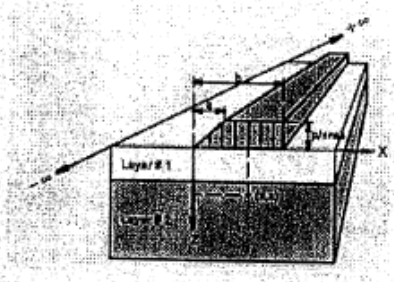
INCREMENT OF STRESSES FOR Z-DIRECTION
X = 0.00(ft)

Z (ft)	Vert. Dsz (psf)	
0.00	0.00	
1.00	18.00	
2.00	35.99	
3.00	53.97	
4.00	71.93	
5.00	89.87	
6.00	107.77	
7.00	125.63	
8.00	143.46	
9.00	161.23	
10.00	178.94	
11.00	196.59	
12.00	214.18	
13.00	231.69	
14.00	249.12	
15.00	Stiff 266.47	$\times 0.10 \cong 25_{psf} \cong \Delta S_u$
16.00	283.72	
17.00	300.88	
18.00	M.Stiff 317.94	$\times 0.15 \cong 50_{psf} \cong \Delta S_u$
19.00	334.90	
20.00	351.74	
21.00	Soft 368.47	$\times 0.2 \cong 75_{psf} \cong \Delta S_u$
22.00	385.08	
23.00	401.56	
24.00	417.91	
25.00	434.13	
26.00	450.22	
27.00	466.16	
28.00	481.96	
29.00	497.61	
30.00	513.12	
31.00	528.46	
32.00	543.65	

Increment of stress calculation = vertical Δσz

STRIP FOOTING

Width of strip A = 84.00
Width of strip B = 168.00
p load/unit area = 4750.000



POINTS FOR COMPUTATION OF INCREMENT OF STRESS

calculate in = z direction

x1 coordinate = 20.00

z1 coordinate = 0.00
z2 coordinate = 32.00
delta z = 1.00

Ok | Cancel | Print Screen | Save Screen

Sheet 8

@ X = +20

Clay Elev.	Relative to Elev. +15
+7'	8' bgs
to	to
-4'	19' bgs

LOADING ON AN INFINITE STRIP
VERTICAL EMBANKMENT LOADING

Sheet 9

Project Name: Callahan Mine - Tailings
Client : MaineDOT
Date : 3/25/2013

Project Number : 3612112201
Project Manager: PSB
Computed by : TCC

Embank. slope a = 84.00 (ft)
Embank. width b = 168.00 (ft)
p load/unit area = 4750.000(psf)

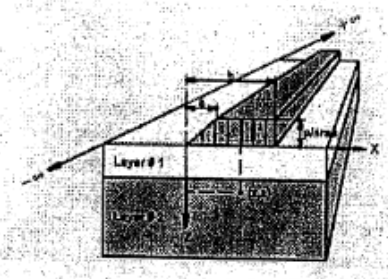
INCREMENT OF STRESSES FOR Z-DIRECTION
X = 20.00(ft)

Z (ft)		Vert. Dsz (psf)	
0.00		1130.95	
1.00		1130.97	
2.00		1131.06	
3.00		1131.30	
4.00		1131.78	
5.00		1132.54	
6.00		1133.65	
7.00		1135.14	
8.00		1137.07	
9.00		1139.44	
10.00		1142.29	
11.00		1145.60	
12.00		1149.39	
13.00	Stiff	1153.64	x 0.10 ≅ 100-125psf ≅ ΔSu
14.00		1158.34	
15.00		1163.47	
16.00	M.Stiff	1169.00	x 0.15 ≅ 175psf ≅ ΔSu
17.00		1174.92	
18.00		1181.20	
19.00	Soft	1187.80	x 0.2 ≅ 225psf ≅ ΔSu
20.00		1194.70	
21.00		1201.87	
22.00		1209.28	
23.00		1216.90	
24.00		1224.71	
25.00		1232.68	
26.00		1240.78	
27.00		1249.00	
28.00		1257.31	
29.00		1265.68	
30.00		1274.11	
31.00		1282.57	
32.00		1291.04	

Increment of stress calculation = vertical $\Delta\sigma z$

STRIP FOOTING

Width of strip A = 84.00
Width of strip B = 168.00
p load/unit area = 4750.000



Sheet 1
10

POINTS FOR COMPUTATION OF INCREMENT OF STRESS

calculate in = z direction

x1 coordinate = 40.00

z1 coordinate = 0.00
z2 coordinate = 32.00
delta z = 1.00

Ok | Cancel | Print Screen | Save Screen

@ X = +40

Clay Elev.	Relative to Elev. +15'
+9'	6' bgs
to	to
-1'	16' bgs

LOADING ON AN INFINITE STRIP
VERTICAL EMBANKMENT LOADING

Sheet 11

Project Name: Callahan Mine - Tailings
Client : MaineDOT
Date : 3/25/2013

Project Number : 3612112201
Project Manager: PSB
Computed by : TCC

Embank. slope a = 84.00 (ft)
Embank. width b = 168.00 (ft)
p load/unit area = 4750.000(psf)

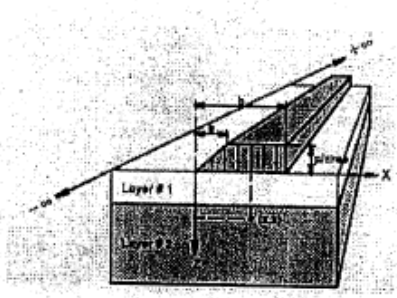
INCREMENT OF STRESSES FOR Z-DIRECTION
X = 40.00(ft)

Z (ft)		Vert. Dsz (psf)	
0.00		2261.90	
1.00		2261.90	
2.00		2261.91	
3.00		2261.91	
4.00		2261.92	
5.00		2261.92	
6.00		2261.94	
7.00	V. Stiff	2261.96	
8.00		2261.98	
9.00		2262.01	
10.00	Stiff	2262.04	$\times 0.10 \cong 225$ psf $\cong \Delta S_u$
11.00		2262.07	
12.00		2262.11	
13.00		2262.14	
14.00	M. Stiff	2262.18	$\times 0.15 \cong 325$ psf $\cong \Delta S_u$
15.00		2262.21	
16.00	Soft	2262.23	$\rightarrow \times 0.2 \cong 450$ psf $\cong \Delta S_u$
17.00		2262.25	
18.00		2262.26	

Increment of stress calculation = vertical $\Delta\sigma z$

STRIP FOOTING

Width of strip A = 84.00
Width of strip B = 168.00
p load/unit area = 4750.000



Sheet 1: 12

POINTS FOR COMPUTATION OF INCREMENT OF STRESS

x1 coordinate = 60.00
z1 coordinate = 0.00
z2 coordinate = 32.00
delta z = 1.00

calculate in = z direction

Ok | Cancel | Print Screen | Save Screen

@ X = +60

Clay Elev.	Relative to Elev. +15'
+11'	4' bgs
to	to
+2'	13' bgs

LOADING ON AN INFINITE STRIP
VERTICAL EMBANKMENT LOADING

Sheet 1 13

Project Name: Callahan Mine - Tailings
Client : MaineDOT
Date : 3/25/2013

Project Number : 3612112201
Project Manager: PSB
Computed by : TCC

Embank. slope a = 84.00 (ft)
Embank. width b = 168.00 (ft)
p load/unit area = 4750.000(psf)

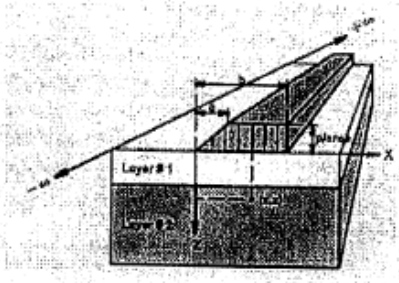
INCREMENT OF STRESSES FOR Z-DIRECTION
X = 60.00(ft)

Z (ft)		Vert. Dsz (psf)	
0.00		3392.86	
1.00		3392.85	
2.00		3392.78	
3.00		3392.60	
4.00		3392.26	
5.00		3391.70	
6.00	V. Stiff	3390.87	N/A
7.00		3389.75	
8.00		3388.29	
9.00	Stiff	3386.47	x0.1 ≅ 325psf ≅ ΔSu
10.00		3384.25	
11.00		3381.64	
12.00	M. Stiff	3378.60	x0.15 ≅ 500psf ≅ ΔSu
13.00		3375.15	
14.00	Soft	3371.26	OR 0.2 ≅ 675psf ≅ ΔSu
15.00		3366.96	
16.00		3362.23	
17.00		3357.10	
18.00		3351.66	

Increment of stress calculation = vertical $\Delta\sigma z$

STRIP FOOTING

Width of strip A = 84.00
Width of strip B = 168.00
p load/unit area = 4750.000



Sheet 1
14

POINTS FOR COMPUTATION OF INCREMENT OF STRESS

calculate in = z direction

x1 coordinate = 80.00

z1 coordinate = 0.00
z2 coordinate = 32.00
delta z = 1.00

Ok | Cancel | Print Screen | Save Screen

@ X = +80

Clay Elev.	Relative to Elev. +15
+11'	4' bgs
to	to
+5'	10' bgs

LOADING ON AN INFINITE STRIP
VERTICAL EMBANKMENT LOADING

Sheet 15

Project Name: Callahan Mine - Tailings
Client : MaineDOT
Date : 3/25/2013

Project Number : 3612112201
Project Manager: PSB
Computed by : TCC

Embank. slope a = 84.00 (ft)
Embank. width b = 168.00 (ft)
p load/unit area = 4750.000(psf)

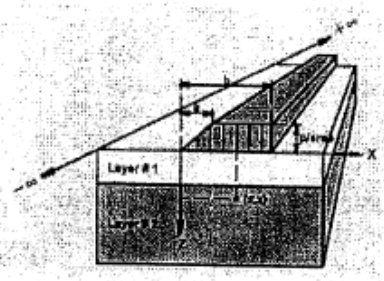
INCREMENT OF STRESSES FOR Z-DIRECTION
X = 80.00(ft)

Z (ft)	Vert. Dsz (psf)	
0.00	4523.81	
1.00	4523.45	
2.00	4521.19	
3.00	4516.13	
4.00	4508.32	
5.00	4498.26	
6.00	4486.46	
7.00	4473.35	Stiff x 0.10 ≅ 450psf ≅ ΔSu
8.00	4459.25	
9.00	4444.41	M. Stiff x 0.15 ≅ 650psf ≅ ΔSu
10.00	4428.98	Soft x 0.20 ≅ 875psf ≅ ΔSu
11.00	4413.10	
12.00	4396.84	
13.00	4380.28	
14.00	4363.46	
15.00	4346.42	
16.00	4329.20	
17.00	4311.80	
18.00	4294.26	

Increment of stress calculation = vertical Δσz

STRIP FOOTING

Width of strip A = 84.00
Width of strip B = 168.00
p load/unit area = 4750.000



Sheet 1 - 16

POINTS FOR COMPUTATION OF INCREMENT OF STRESS

x1 coordinate = 100.00

z1 coordinate = 0.00
z2 coordinate = 32.00
delta z = 1.00

calculate in = z direction

Ok | Cancel | Print Screen | Save Screen

@ X = + 100

Clay Elev.	Relative to Elev. + 15'
+ 11'	4' bgs
to	to
+ 8'	7' bgs

LOADING ON AN INFINITE STRIP
VERTICAL EMBANKMENT LOADING

Sheet 1 17

Project Name: Callahan Mine - Tailings
Client : MaineDOT
Date : 3/25/2013

Project Number : 3612112201
Project Manager: PSB
Computed by : TCC

Embank. slope a = 84.00 (ft)
Embank. width b = 168.00 (ft)
p load/unit area = 4750.000(psf)

INCREMENT OF STRESSES FOR Z-DIRECTION
X = 100.00(ft)

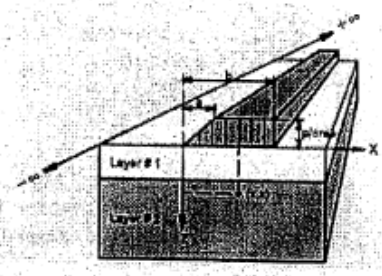
Z (ft)	Vert. Dsz (psf)	
0.00	4750.00	
1.00	4749.97	
2.00	4749.79	
3.00	4749.31	
4.00	4748.39	
5.00	4746.91	
6.00	4744.77	0.1 ≅ 475 ΔSu
7.00	4741.89	
8.00	4738.22	
9.00	4733.71	0.15 ≅ 700 psf
10.00	4728.35	0.2 = 950 psf
11.00	4722.12	
12.00	4715.02	
13.00	4707.07	
14.00	4698.28	
15.00	4688.69	
16.00	4678.31	
17.00	4667.18	
18.00	4655.32	
19.00	4642.76	
20.00	4629.54	
21.00	4615.69	
22.00	4601.23	
23.00	4586.19	
24.00	4570.59	
25.00	4554.47	
26.00	4537.85	
27.00	4520.75	
28.00	4503.20	
29.00	4485.21	
30.00	4466.82	
31.00	4448.04	
32.00	4428.88	

Stiff

Increment of stress calculation = vertical Δσz

STRIP FOOTING

Width of strip A = 84.00
Width of strip B = 168.00
p load/unit area = 4750.000



Sheet 1
18

POINTS FOR COMPUTATION OF INCREMENT OF STRESS

x1 coordinate = 120.00
z1 coordinate = 0.00
z2 coordinate = 32.00
delta z = 1.00

calculate in = z direction

Ok | Cancel | Print Screen | Save Screen

@ X = +120

Clay Elev.	Relative to Elev. +15'
+13'	2' bgs
to	to
+10.5'	4.5' bgs

LOADING ON AN INFINITE STRIP
VERTICAL EMBANKMENT LOADING

Sheet 19

Project Name: Callahan Mine - Tailings
Client : MaineDOT
Date : 3/25/2013

Project Number : 3612112201
Project Manager: PSB
Computed by : TCC

Embank. slope a = 84.00 (ft)
Embank. width b = 168.00 (ft)
p load/unit area = 4750.000(psf)

INCREMENT OF STRESSES FOR Z-DIRECTION
X = 120.00(ft)

Z (ft)	Vert. Dsz (psf)
0.00	4750.00
1.00	4749.99
2.00	4749.89
3.00	4749.64
4.00	4749.15
5.00	4748.36
6.00	4747.17
7.00	4745.54
8.00	4743.39
9.00	4740.67
10.00	4737.33
11.00	4733.31
12.00	4728.57
13.00	4723.08
14.00	4716.80
15.00	4709.72
16.00	4701.81
17.00	4693.07
18.00	4683.48
19.00	4673.04
20.00	4661.76
21.00	4649.65
22.00	4636.71
23.00	4622.96
24.00	4608.42
25.00	4593.11
26.00	4577.06
27.00	4560.30
28.00	4542.84
29.00	4524.73
30.00	4505.99
31.00	4486.65
32.00	4466.75

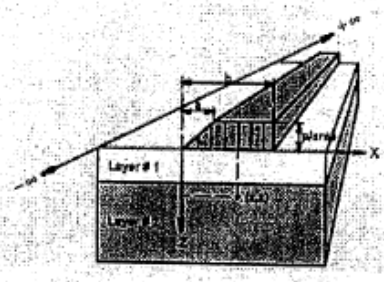
Stiff

$\times 0.1 \cong 475$ psf $\cong \Delta S_u$
$\times 0.15 \cong 700$ psf $\cong \Delta S_u$
$\times 0.2 \cong 950$ psf $\cong \Delta S_u$

Increment of stress calculation = vertical $\Delta\sigma z$

STRIP FOOTING

Width of strip A = 84.00
Width of strip B = 168.00
p load/unit area = 4750.000



Sheet 20

POINTS FOR COMPUTATION OF INCREMENT OF STRESS

x1 coordinate = 140.00

z1 coordinate = 0.00
z2 coordinate = 32.00
delta z = 1.00

calculate in = z direction

Ok | Cancel | Print Screen | Save Screen

@ X = +140

Clay Elev.	Relative to Elev. +15'
+ 16'	-1' bgs
to	to
+12'	3' bgs

LOADING ON AN INFINITE STRIP
VERTICAL EMBANKMENT LOADING

Sheet 21

Project Name: Callahan Mine - Tailings
Client : MaineDOT
Date : 3/25/2013

Project Number : 3612112201
Project Manager: PSB
Computed by : TCC

Embank. slope a = 84.00 (ft)
Embank. width b = 168.00 (ft)
p load/unit area = 4750.000(psf)

INCREMENT OF STRESSES FOR Z-DIRECTION
X = 140.00(ft)

Z (ft)	Vert. Dsz (psf)	
0.00	4750.00	x 0.10 ≅ 475 psf ≅ ΔSu
1.00	4749.95	x 0.15 ≅ 700 psf ≅ ΔSu
2.00	4749.62	x 0.20 ≅ 950 psf ≅ ΔSu
3.00	4748.73	
4.00	4747.03	
5.00	4744.27	
6.00	4740.26	
7.00	4734.81	
8.00	4727.80	
9.00	4719.11	
10.00	4708.69	
11.00	4696.51	
12.00	4682.56	
13.00	4666.89	
14.00	4649.54	
15.00	4630.60	
16.00	4610.15	
17.00	4588.30	
18.00	4565.16	

ATTACHMENT E3-E

PROFILE E3
LONG-TERM STATIC SLOPE STABILITY EVALUATION

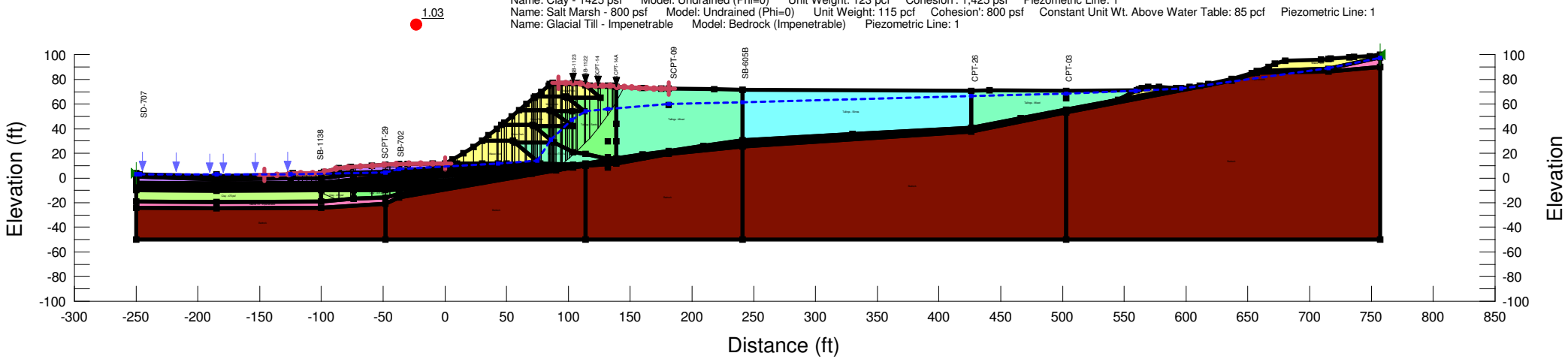
SLOPE/W OUTPUT: EXISTING CONDITIONS

Title: Callahan Mine OU3 - Profile E3
Date: 10/14/2014
File Name: Tailings_Profile-E3_Existing-Cond-90%.gsz

Name: Profile E3b - Existing - Ent/Exit - Till Imp
Method: Spencer

F of S: 1.03

Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 117 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 108 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 106 pcf Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 125 pcf Piezometric Line: 1
Name: Salt Marsh - 1000 psf Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 1,000 psf Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
Name: Salt Marsh - 625 psf Model: Undrained (Phi=0) Unit Weight: 115 pcf Cohesion': 625 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: Salt Marsh - 375 psf Model: Undrained (Phi=0) Unit Weight: 110 pcf Cohesion': 375 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 2750 psf Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,750 psf Piezometric Line: 1
Name: Clay - 2250 psf Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,250 psf Piezometric Line: 1
Name: Clay - 1750 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,750 psf Piezometric Line: 1
Name: Clay - 1500 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,500 psf Piezometric Line: 1
Name: Clay - 1250 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,250 psf Piezometric Line: 1
Name: Clay - 875 psf Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 875 psf Piezometric Line: 1
Name: Clay - 750 psf Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 750 psf Piezometric Line: 1
Name: Clay - 625 psf Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 625 psf Piezometric Line: 1
Name: Clay - 550 psf Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 550 psf Piezometric Line: 1
Name: Clay - 475 psf Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 475 psf Piezometric Line: 1
Name: Clay - 375 psf Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 375 psf Piezometric Line: 1
Name: Fill - Clay/Till - Su Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Gravel Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 125 pcf Piezometric Line: 1
Name: Clay - 800 psf Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 800 psf Piezometric Line: 1
Name: Clay - 1075 psf Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,075 psf Piezometric Line: 1
Name: Clay - 400 psf Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 400 psf Piezometric Line: 1
Name: Clay - 450 psf Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 450 psf Piezometric Line: 1
Name: Clay - 700 psf Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 700 psf Piezometric Line: 1
Name: Clay - 925 psf Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 925 psf Piezometric Line: 1
Name: Clay - 1350 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,350 psf Piezometric Line: 1
Name: Clay - 1425 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,425 psf Piezometric Line: 1
Name: Salt Marsh - 800 psf Model: Undrained (Phi=0) Unit Weight: 115 pcf Cohesion': 800 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: Glacial Till - Impenetrable Model: Bedrock (Impenetrable) Piezometric Line: 1

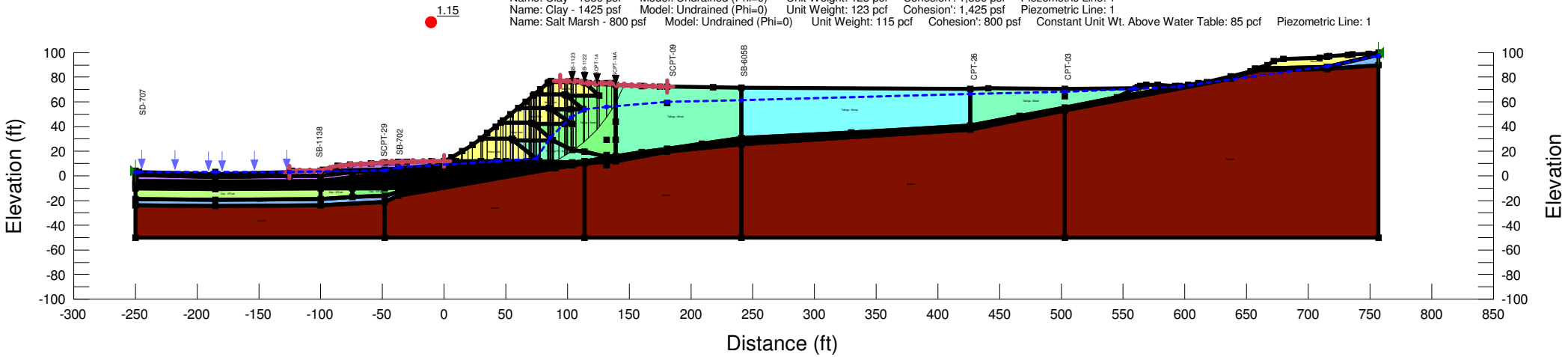


Title: Callahan Mine OU3 - Profile E3
Date: 10/14/2014
File Name: Tailings_Profile-E3_Existing-Cond-90%.gsz

Name: Profile E3a - Existing - Ent/Exit - Till Reg
Method: Spencer

F of S: 1.15

Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 117 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 108 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 106 pcf Piezometric Line: 1
Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 50 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 130 pcf Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 125 pcf Piezometric Line: 1
Name: Salt Marsh - 1000 psf Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 1,000 psf Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
Name: Salt Marsh - 625 psf Model: Undrained (Phi=0) Unit Weight: 115 pcf Cohesion': 625 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: Salt Marsh - 375 psf Model: Undrained (Phi=0) Unit Weight: 110 pcf Cohesion': 375 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 2750 psf Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,750 psf Piezometric Line: 1
Name: Clay - 2250 psf Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,250 psf Piezometric Line: 1
Name: Clay - 1750 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,750 psf Piezometric Line: 1
Name: Clay - 1500 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,500 psf Piezometric Line: 1
Name: Clay - 1250 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,250 psf Piezometric Line: 1
Name: Clay - 875 psf Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 875 psf Piezometric Line: 1
Name: Clay - 750 psf Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 750 psf Piezometric Line: 1
Name: Clay - 625 psf Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 625 psf Piezometric Line: 1
Name: Clay - 550 psf Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 550 psf Piezometric Line: 1
Name: Clay - 475 psf Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 475 psf Piezometric Line: 1
Name: Clay - 375 psf Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 375 psf Piezometric Line: 1
Name: Fill - Clay/Till - Su Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Gravel Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 125 pcf Piezometric Line: 1
Name: Clay - 800 psf Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 800 psf Piezometric Line: 1
Name: Clay - 1075 psf Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,075 psf Piezometric Line: 1
Name: Clay - 400 psf Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 400 psf Piezometric Line: 1
Name: Clay - 450 psf Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 450 psf Piezometric Line: 1
Name: Clay - 700 psf Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 700 psf Piezometric Line: 1
Name: Clay - 925 psf Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 925 psf Piezometric Line: 1
Name: Clay - 1350 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,350 psf Piezometric Line: 1
Name: Clay - 1425 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,425 psf Piezometric Line: 1
Name: Salt Marsh - 800 psf Model: Undrained (Phi=0) Unit Weight: 115 pcf Cohesion': 800 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1



ATTACHMENT E3-F

PROFILE E3
LONG-TERM STATIC SLOPE STABILITY EVALUATION

SLOPE/W MODEL DEVELOPMENT: POST-REMEDIATION CONDITIONS

ATTACHMENT E3-F

PROFILE E3 - SLOPE/W MODEL DEVELOPMENT - PROPOSED CONDITIONS

- See Figure C-1 for profile location.

A. Define Proposed Subgrade/Final Grade Topography

- Proposed subgrade topography is shown on Figure C-1.
- A profile section view is shown on Figure C-3.
- Define long-term post-remediation topography:

Point	STA.	Subgrade EL. (ft)	Final Grade EL. (ft)*
1	7+05	96	97.5
2	6+90	89	90.5
3	6+88	88	89.5
4	6+85	88	89.5
5	6+82	89	90.5
6	6+39	90	91.5
7	6+21	92	93.5
8	6+06	92	93.5
9	5+85	89	90.5
10	5+50	88	89.5
11	5+00	87	88.5
12	3+69	86	87.5
13	1+75	47	48.5
14	1+68	47	48.5
15	1+55	51	52.5
16	1+22	52	53.5
17	0+88	53	54.5

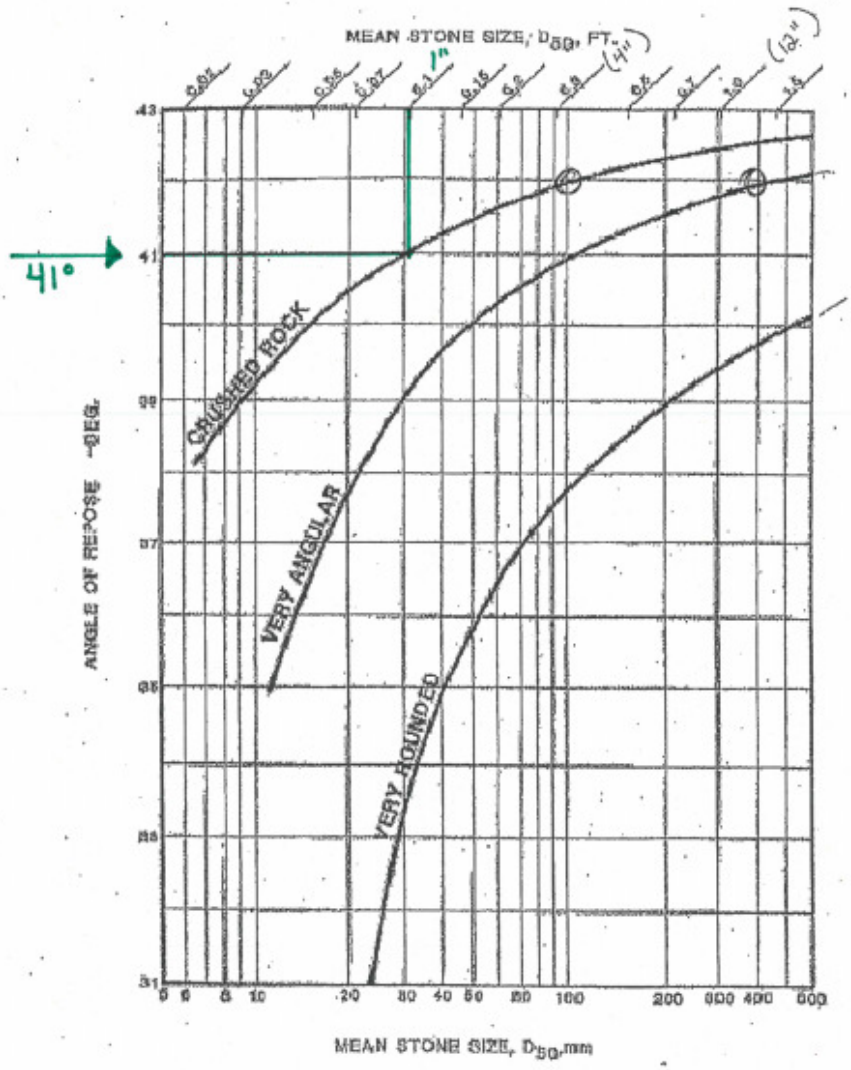
*Note: Final grade assumes 1.5 ft of aggregate cover over subgrade.

B. Low-Permeability Cover

- The proposed low permeability cover system consists of approximately 15 inches of crushed gravel/aggregate over a GDL, FML, and a GCL.
- The crushed gravel (1" < D_{50} < 6") is modeled in Slope/W with the following parameters:
  - Unit Weight = 100 pcf (assume loosely placed, 40% porosity).
  - Friction Angle = 41° (see Sheet 3 - conservatively assume D_{50} = 1").
- The unit weight and strength of the GDL, FML, and GCL are considered insignificant, and these materials were not included in the Slope/W model.

C. Long-Term Groundwater levels

- Proposed horizontal drain locations are shown on Figure C-1.
- The water levels used for long-term post-remediation conditions are based on the current groundwater model for horizontal drain(s), located at/near the bottom of the tailings, approximately elevation +23 feet (+/-), and approximately 100 feet back from the existing crest, and a low perm cover system.
  - The long-term post-remediation groundwater levels used in the Slope/W models is assumed based on the drain location(s) and as per the groundwater model (Appendix A).



http://www.fhwa.dot.gov/engineering/hydraulics/pubs/05114/images/hec15fig06_01.gif

ATTACHMENT E3-G

PROFILE E3
LONG-TERM STATIC SLOPE STABILITY EVALUATION

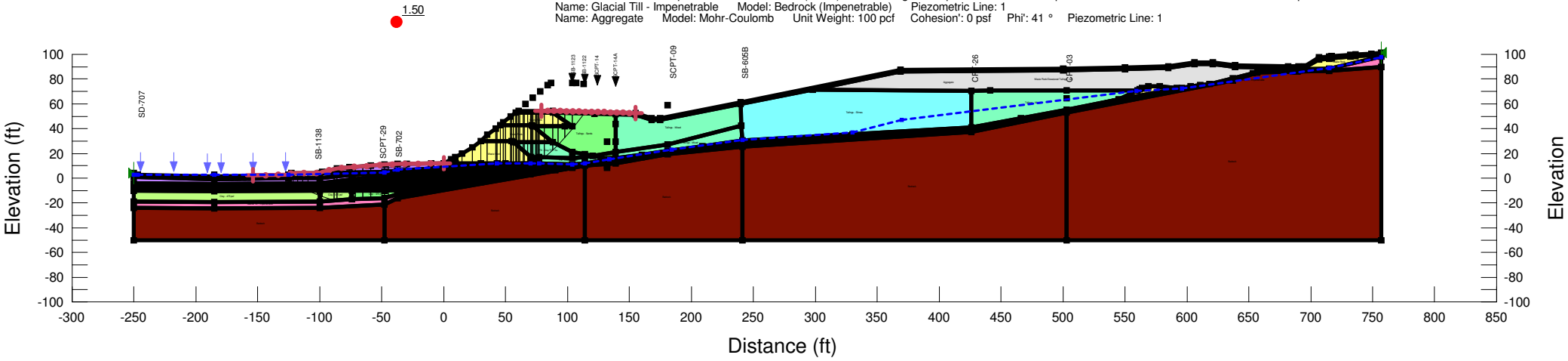
SLOPE/W OUTPUT: POST-REMEDIATION CONDITIONS

Title: Callahan Mine OU3 - Profile E3
Date: 10/16/2014
File Name: Tailings_Profile-E3_Proposed-Cond_90%.gsz

Name: Profile E-3; a2 - Proposed - Static - Crest/Toe - Till Imp
Method: Spencer

F of S: 1.50

Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 117 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 108 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 106 pcf Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 125 pcf Piezometric Line: 1
Name: Salt Marsh - 1000 psf Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 1,000 psf Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
Name: Salt Marsh - 625 psf Model: Undrained (Phi=0) Unit Weight: 115 pcf Cohesion': 625 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: Salt Marsh - 375 psf Model: Undrained (Phi=0) Unit Weight: 110 pcf Cohesion': 375 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 2750 psf Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,750 psf Piezometric Line: 1
Name: Clay - 2250 psf Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,250 psf Piezometric Line: 1
Name: Clay - 1750 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,750 psf Piezometric Line: 1
Name: Clay - 1500 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,500 psf Piezometric Line: 1
Name: Clay - 1250 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,250 psf Piezometric Line: 1
Name: Clay - 875 psf Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 875 psf Piezometric Line: 1
Name: Clay - 750 psf Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 750 psf Piezometric Line: 1
Name: Clay - 625 psf Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 625 psf Piezometric Line: 1
Name: Clay - 550 psf Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 550 psf Piezometric Line: 1
Name: Clay - 475 psf Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 475 psf Piezometric Line: 1
Name: Clay - 375 psf Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 375 psf Piezometric Line: 1
Name: Fill - Clay/Till - Su Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Waste Rock/Dewatered Tailings - Mix Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 38 ° Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Clay - 800 psf Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 800 psf Piezometric Line: 1
Name: Clay - 1075 psf Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,075 psf Piezometric Line: 1
Name: Clay - 400 psf Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 400 psf Piezometric Line: 1
Name: Clay - 450 psf Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 450 psf Piezometric Line: 1
Name: Clay - 700 psf Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 700 psf Piezometric Line: 1
Name: Clay - 925 psf Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 925 psf Piezometric Line: 1
Name: Clay - 1350 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,350 psf Piezometric Line: 1
Name: Clay - 1425 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,425 psf Piezometric Line: 1
Name: Salt Marsh - 800 psf Model: Undrained (Phi=0) Unit Weight: 115 pcf Cohesion': 800 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: Glacial Till - Impenetrable Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Aggregate Model: Mohr-Coulomb Unit Weight: 100 pcf Cohesion': 0 psf Phi': 41 ° Piezometric Line: 1

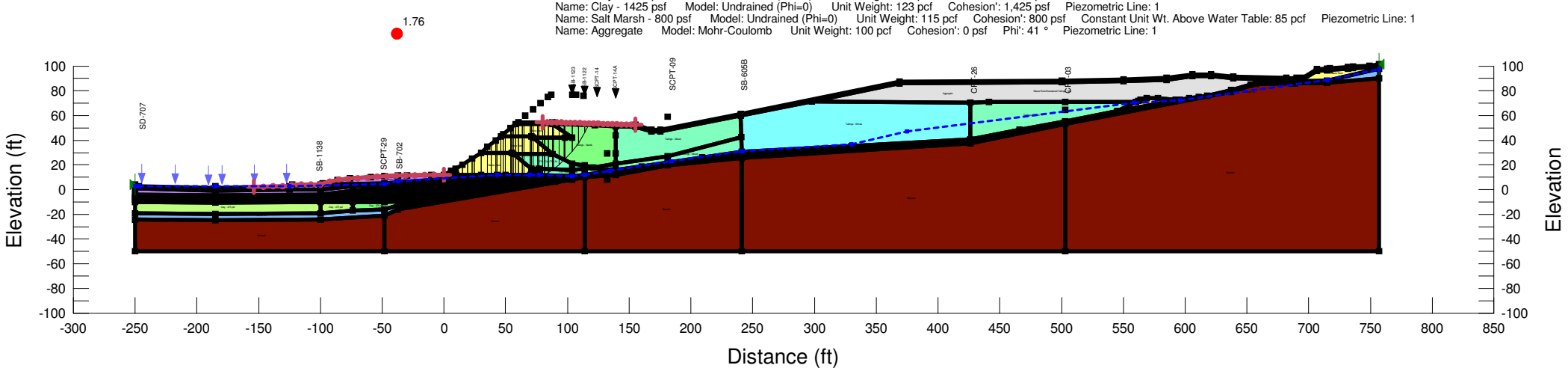


Title: Callahan Mine OU3 - Profile E3
Date: 10/16/2014
File Name: Tailings_Profile-E3_Proposed-Cond_90%.gsz

Name: Profile E-3; a1 - Proposed - Static - Crest/Toe - Till Reg
Method: Spencer

F of S: 1.76

Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 117 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 108 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 106 pcf Piezometric Line: 1
Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 50 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 130 pcf Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 125 pcf Piezometric Line: 1
Name: Salt Marsh - 1000 psf Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 1,000 psf Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
Name: Salt Marsh - 625 psf Model: Undrained (Phi=0) Unit Weight: 115 pcf Cohesion': 625 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: Salt Marsh - 375 psf Model: Undrained (Phi=0) Unit Weight: 110 pcf Cohesion': 375 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 2750 psf Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,750 psf Piezometric Line: 1
Name: Clay - 2250 psf Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,250 psf Piezometric Line: 1
Name: Clay - 1750 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,750 psf Piezometric Line: 1
Name: Clay - 1500 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,500 psf Piezometric Line: 1
Name: Clay - 1250 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,250 psf Piezometric Line: 1
Name: Clay - 875 psf Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 875 psf Piezometric Line: 1
Name: Clay - 750 psf Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 750 psf Piezometric Line: 1
Name: Clay - 625 psf Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 625 psf Piezometric Line: 1
Name: Clay - 550 psf Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 550 psf Piezometric Line: 1
Name: Clay - 475 psf Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 475 psf Piezometric Line: 1
Name: Clay - 375 psf Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 375 psf Piezometric Line: 1
Name: Fill - Clay/Till - Su Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Waste Rock/Dewatered Tailings - Mix Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 38 ° Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Clay - 800 psf Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 800 psf Piezometric Line: 1
Name: Clay - 1075 psf Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,075 psf Piezometric Line: 1
Name: Clay - 400 psf Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 400 psf Piezometric Line: 1
Name: Clay - 450 psf Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 450 psf Piezometric Line: 1
Name: Clay - 700 psf Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 700 psf Piezometric Line: 1
Name: Clay - 925 psf Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 925 psf Piezometric Line: 1
Name: Clay - 1350 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,350 psf Piezometric Line: 1
Name: Clay - 1425 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,425 psf Piezometric Line: 1
Name: Salt Marsh - 800 psf Model: Undrained (Phi=0) Unit Weight: 115 pcf Cohesion': 800 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: Aggregate Model: Mohr-Coulomb Unit Weight: 100 pcf Cohesion': 0 psf Phi': 41 ° Piezometric Line: 1



Title: Callahan Mine OU3 - Profile E3
Date: 10/16/2014
File Name: Tailings_Profile-E3_Proposed-Cond_90%.gsz

Name: Profile E-3; b2 - Proposed - Static - Fill/Toe - Till Imp
Method: Spencer

F of S: 2.30

Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 117 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 108 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 106 pcf Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 125 pcf Piezometric Line: 1
Name: Salt Marsh - 1000 psf Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 1,000 psf Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
Name: Salt Marsh - 625 psf Model: Undrained (Phi=0) Unit Weight: 115 pcf Cohesion': 625 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: Salt Marsh - 375 psf Model: Undrained (Phi=0) Unit Weight: 110 pcf Cohesion': 375 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 2750 psf Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,750 psf Piezometric Line: 1
Name: Clay - 2250 psf Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,250 psf Piezometric Line: 1
Name: Clay - 1750 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,750 psf Piezometric Line: 1
Name: Clay - 1500 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,500 psf Piezometric Line: 1
Name: Clay - 1250 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,250 psf Piezometric Line: 1
Name: Clay - 875 psf Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 875 psf Piezometric Line: 1
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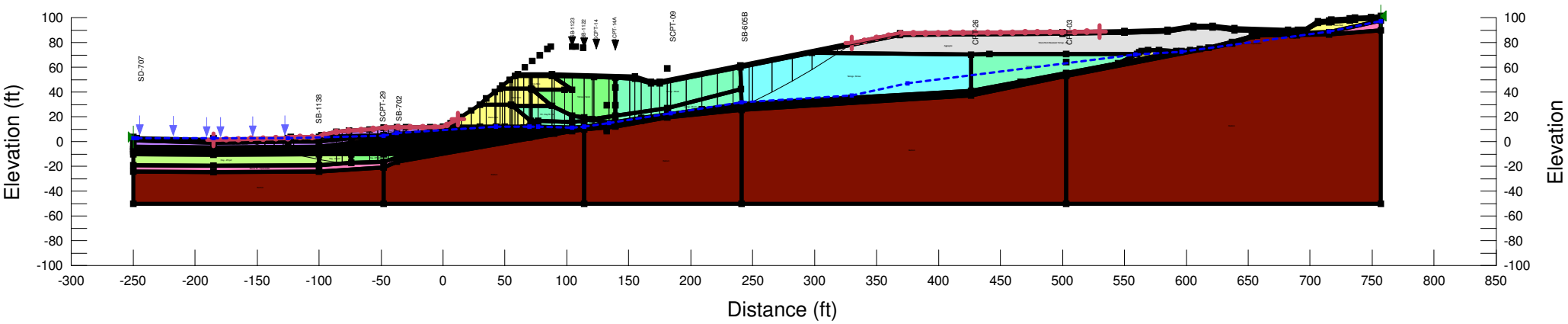
Name: Clay - 625 psf Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 625 psf Piezometric Line: 1
Name: Clay - 550 psf Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 550 psf Piezometric Line: 1
Name: Clay - 475 psf Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 475 psf Piezometric Line: 1
Name: Clay - 375 psf Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 375 psf Piezometric Line: 1
Name: Fill - Clay/Till - Su Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Waste Rock/Dewatered Tailings - Mix Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 38 ° Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Clay - 800 psf Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 800 psf Piezometric Line: 1
Name: Clay - 1075 psf Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,075 psf Piezometric Line: 1
Name: Clay - 400 psf Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 400 psf Piezometric Line: 1
Name: Clay - 450 psf Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 450 psf Piezometric Line: 1
Name: Clay - 700 psf Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 700 psf Piezometric Line: 1
Name: Clay - 925 psf Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 925 psf Piezometric Line: 1
Name: Clay - 1350 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,350 psf Piezometric Line: 1
Name: Clay - 1425 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,425 psf Piezometric Line: 1
Name: Salt Marsh - 800 psf Model: Undrained (Phi=0) Unit Weight: 115 pcf Cohesion': 800 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: Glacial Till - Impenetrable Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Aggregate Model: Mohr-Coulomb Unit Weight: 100 pcf Cohesion': 0 psf Phi': 41 ° Piezometric Line: 1



Title: Callahan Mine OU3 - Profile E3
Date: 10/16/2014
File Name: Tailings_Profile-E3_Proposed-Cond_90%.gsz

Name: Profile E-3; b1 - Proposed - Static - Fill/Toe - Till Reg
Method: Spencer

F of S: 3.42

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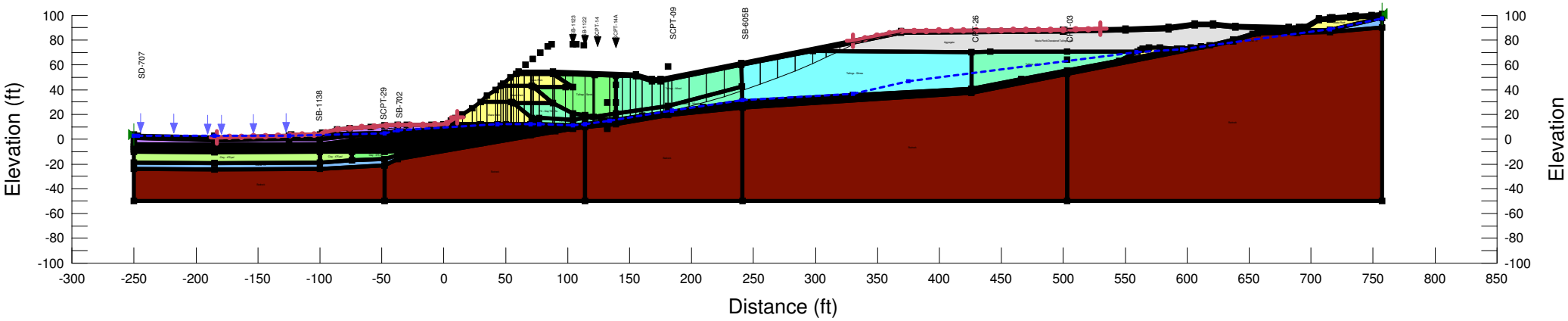
Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 117 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 108 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 106 pcf Piezometric Line: 1
Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 50 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 130 pcf Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 125 pcf Piezometric Line: 1
Name: Salt Marsh - 1000 psf Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 1,000 psf Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
Name: Salt Marsh - 625 psf Model: Undrained (Phi=0) Unit Weight: 115 pcf Cohesion': 625 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: Salt Marsh - 375 psf Model: Undrained (Phi=0) Unit Weight: 110 pcf Cohesion': 375 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 2750 psf Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,750 psf Piezometric Line: 1
Name: Clay - 2250 psf Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,250 psf Piezometric Line: 1
Name: Clay - 1750 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,750 psf Piezometric Line: 1
Name: Clay - 1500 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,500 psf Piezometric Line: 1
Name: Clay - 1250 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,250 psf Piezometric Line: 1
Name: Clay - 875 psf Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 875 psf Piezometric Line: 1
Name: Clay - 750 psf Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 750 psf Piezometric Line: 1
Name: Clay - 625 psf Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 625 psf Piezometric Line: 1
Name: Clay - 550 psf Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 550 psf Piezometric Line: 1
Name: Clay - 475 psf Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 475 psf Piezometric Line: 1
Name: Clay - 375 psf Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 375 psf Piezometric Line: 1
Name: Fill - Clay/Till - Su Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Waste Rock/Dewatered Tailings - Mix Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 38 ° Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Clay - 800 psf Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 800 psf Piezometric Line: 1
Name: Clay - 1075 psf Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,075 psf Piezometric Line: 1
Name: Clay - 400 psf Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 400 psf Piezometric Line: 1
Name: Clay - 450 psf Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 450 psf Piezometric Line: 1
Name: Clay - 700 psf Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 700 psf Piezometric Line: 1
Name: Clay - 925 psf Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 925 psf Piezometric Line: 1
Name: Clay - 1350 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,350 psf Piezometric Line: 1
Name: Clay - 1425 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,425 psf Piezometric Line: 1
Name: Salt Marsh - 800 psf Model: Undrained (Phi=0) Unit Weight: 115 pcf Cohesion': 800 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: Aggregate Model: Mohr-Coulomb Unit Weight: 100 pcf Cohesion': 0 psf Phi': 41 ° Piezometric Line: 1



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Date: 10/16/2014
File Name: Tailings_Profile-E3_Proposed-Cond_90%.gsz

Name: Profile E-3; c2 - Proposed - Static - Fill Slope - Till Imp
Method: Spencer

F of S: 3.60

Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 117 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 108 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 106 pcf Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 125 pcf Piezometric Line: 1
Name: Salt Marsh - 1000 psf Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 1,000 psf Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
Name: Salt Marsh - 625 psf Model: Undrained (Phi=0) Unit Weight: 115 pcf Cohesion': 625 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: Salt Marsh - 375 psf Model: Undrained (Phi=0) Unit Weight: 110 pcf Cohesion': 375 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 2750 psf Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,750 psf Piezometric Line: 1
Name: Clay - 2250 psf Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,250 psf Piezometric Line: 1
Name: Clay - 1750 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,750 psf Piezometric Line: 1
Name: Clay - 1500 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,500 psf Piezometric Line: 1
Name: Clay - 1250 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,250 psf Piezometric Line: 1
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Name: Clay - 375 psf Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 375 psf Piezometric Line: 1
Name: Fill - Clay/Till - Su Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Waste Rock/Dewatered Tailings - Mix Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 38 ° Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
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Name: Clay - 1350 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,350 psf Piezometric Line: 1
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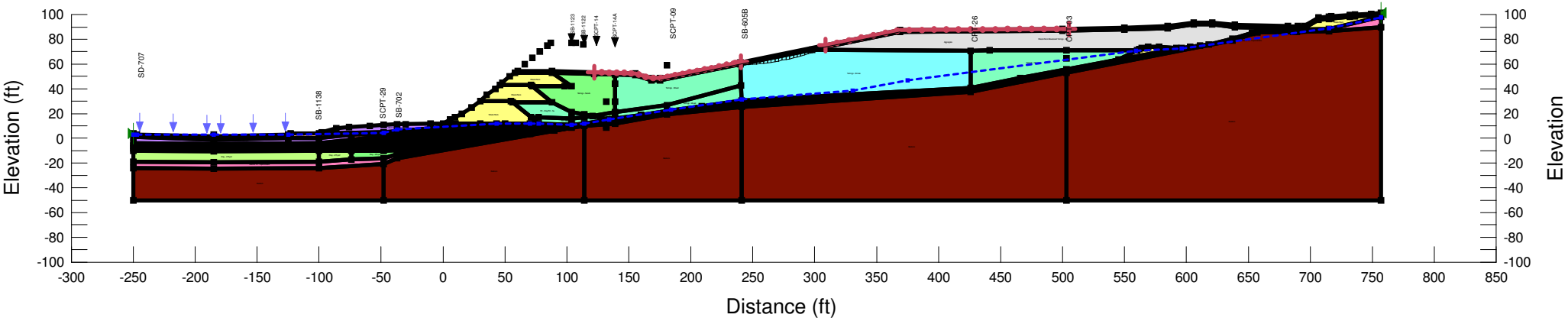
Name: Salt Marsh - 800 psf Model: Undrained (Phi=0) Unit Weight: 115 pcf Cohesion': 800 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: Glacial Till - Impenetrable Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Aggregate Model: Mohr-Coulomb Unit Weight: 100 pcf Cohesion': 0 psf Phi': 41 ° Piezometric Line: 1



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Date: 10/16/2014
File Name: Tailings_Profile-E3_Proposed-Cond_90%.gsz

Name: Profile E-3; c1 - Proposed - Static - Fill Slope - Till Reg
Method: Spencer

F of S: 3.60

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Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 117 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 108 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 106 pcf Piezometric Line: 1
Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 50 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 130 pcf Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 125 pcf Piezometric Line: 1
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Name: Clay - 1500 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,500 psf Piezometric Line: 1
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Name: Fill - Clay/Till - Su Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Waste Rock/Dewatered Tailings - Mix Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 38 ° Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
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Name: Clay - 1075 psf Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,075 psf Piezometric Line: 1
Name: Clay - 400 psf Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 400 psf Piezometric Line: 1
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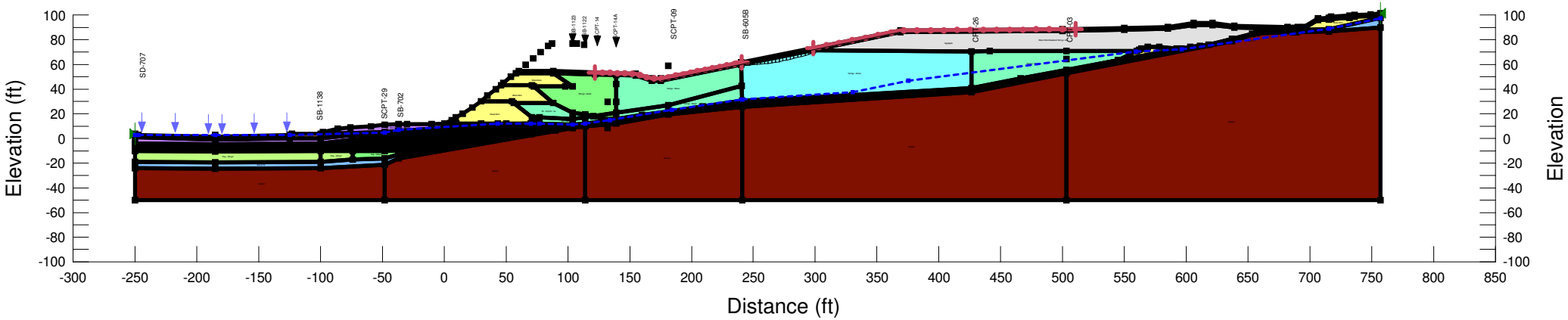
Name: Aggregate Model: Mohr-Coulomb Unit Weight: 100 pcf Cohesion': 0 psf Phi': 41 ° Piezometric Line: 1



ATTACHMENT E4

PROFILE E4
LONG-TERM STATIC SLOPE STABILITY EVALUATION

ATTACHMENT E4-A

PROFILE E4
LONG-TERM STATIC SLOPE STABILITY EVALUATION

SLOPE/W MODEL DEVELOPMENT: EXISTING CONDITIONS

ATTACHMENT E4-A

PROFILE E4 - SLOPE/W MODEL DEVELOPMENT - EXISTING CONDITIONS

- See Figure C-1 for profile location.

A. Define Overall Geometry/Topography

- Existing site-specific topography is shown on Figure C-1.
    - Define Profile Station 0+00 as the "toe" of the rock dam.
        - Positive station numbers to the west
        - Negative station numbers to the east
- See Attachment E4-B for definition of key SLOPE/W points.

B. Impoundment Dam Configuration

- The assumed/interpreted configuration of the impoundment dam is as follows:
    - Constructed via "upstream" raised embankment methods.
    - 5 total lifts (starter dam plus 4 subsequent raises).
    - Starter dam constructed with clay and glacial till from on-site (and adjacent property to the south) and faced extensively with waste rock.
        - Top of starter dam at Elev. +30 ft (+/-).
        - Crest width of waste rock approximately 25 ft (+/-).
        - Backslope of waste rock approximately 1.3H:1V to 1.5H:1V.
        - Clay/glacial till extends 50 ft (+/-) behind the starter dam.
    - Subsequent raises/lifts constructed with waste rock and possibly lined/"chinked" with clay/till fill (limited extent/thickness).
        - Each lift/raise approximately 10 to 15 ft tall
        - Crest width of each waste rock lift/raise approximately 25 ft (+/-).
        - Backslope of each waste rock lift/raise approximately 1.3H:1V to 2.0H:1V.
- See Attachment E4-C for discussion, supporting data/evaluation, and sketches/cross-sections.

C. Define Subsurface Profile

- Geotechnical explorations along or in close proximity to Profile E4 are shown on Figure C-1.
    - MW-723R — West
    - TP-06
    - TP-05
    - TP-04
    - SCPT-04
    - SB-1130
    - SB-603/CP-610
    - CP-611
    - CP-613
    - SB-604/CP-612 — Crest
    - SB-701
    - P-1106
    - CPT-30
    - SB-1104
    - SD-707 — East
- Logs/records of these explorations are provided in prior investigation reports:
    - Credere, 2012 — Supplemental Geotechnical Investigation
    - MACTEC, 2009a — Geotechnical Evaluation Report
    - MACTEC, 2009b — Remedial Investigation Report
- Table C-5 summarizes the primary soil strata encountered at these exploration locations.
    - Fill
    - Tailings
        - Tailings are further subdivided into "zones" of sand, mixed/stratified, or slimes based on description of sand, fines, and layering/thickness.
    - Clay/Till Fill
    - Native Estuarine
    - Presumpscot Clay
        - Native clay is further divided into layers/zones based on strength data.
    - Glacial Till
    - Other, as necessary

D. Assign Soil Unit Weight & Strength Parameters

- Assign unit weights based on soil type, in-situ conditions (e.g., density, consistency, saturation, etc.), published literature, and in conjunction with/comparison with bulk density measurements from Shelby tube samples

- Strength parameters for Tailings developed based on site-specific field and laboratory testing programs and in conjunction with applicable mine-tailings-specific references (i.e., Vick 1990)

  Note: +/- adjustments to Tailings effective stress/strength parameters have negligible impact on estimated FOS.

- Strength parameters for Clay and Estuarine deposits developed based on site-specific field and laboratory testing programs.

  - FVST data
  - CPT data
  - SPT data
  - Strength adjustments for unexplored locations (beneath the waste rock impoundment dam) are presented in Attachment E4-D.

- Strength Parameters for Glacial Till and various Fill materials developed based on site-specific field and laboratory testing programs and published values.

- Strength parameters for impoundment berm (i.e., crushed/angular waste rock) developed based on published FHWA values/data (see Sheet 6).

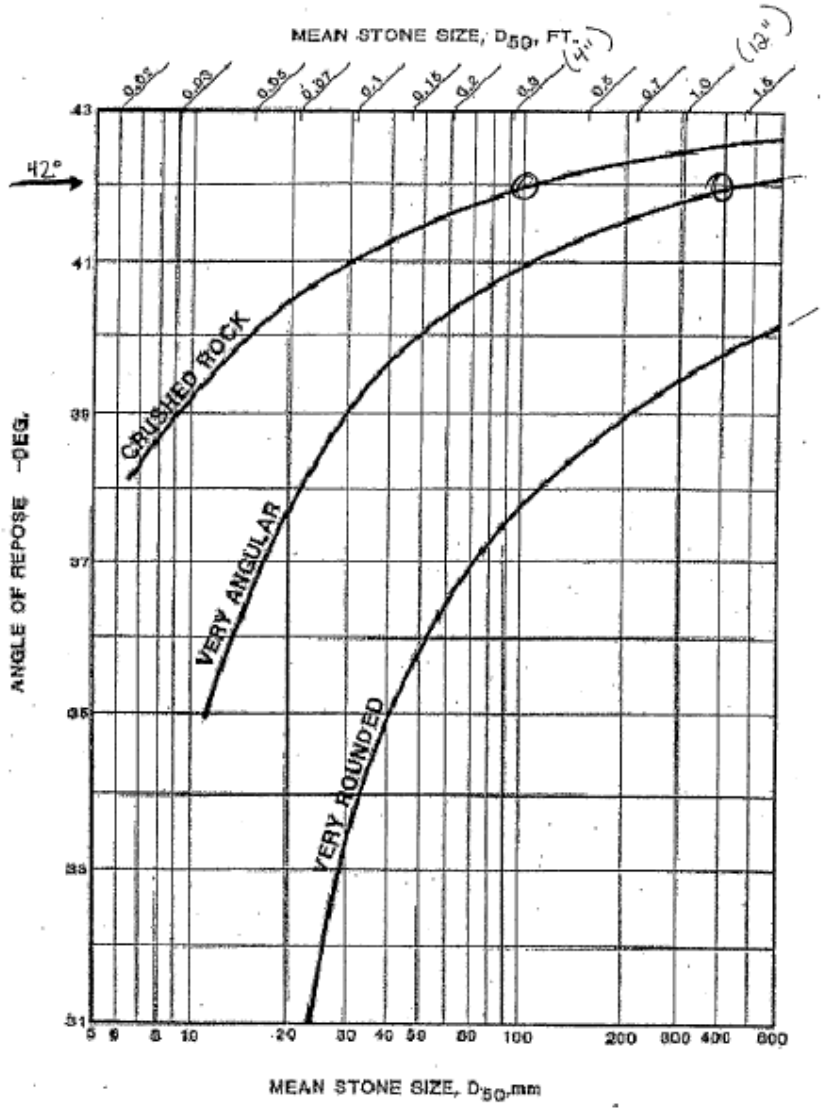
- Actual weight and strength parameters for each soil type are listed on Slope/W output files.

E. Estimate Shear Strength Increase in Clay Beneath Impoundment Dam

- Clay strengths known at crest (SB-604) and at toe (SB-701). Use procedures below to provide reasonable estimates of clay strength in between the known points.
- See Attachment E4-C for sketch comparing existing conditions vs. historic (pre-construction) topography.
- Estimate gross effective stress increase - Pre-mining "cuts" approximately equal to net effective stress increase. See Attachment E4-D.
- Apply strength increase, if applicable, to the "toe" conditions in segmented/zoned areas beneath the berm. See Attachment E4-D.
- See Slope/W output files for zones and strengths assigned.

F. Define Phreatic Surface/Water Table and/or Pore Pressure Grid

- Site-specific water levels measured in the installed/existing PZs, MWs, OWs, and/or VWPs provide information on impoundment water levels. This info indicates a slightly downward gradient (decreasing piezometric surface/pressure within the tailings with increasing depth bgs).
    - Water level data is available or formerly available at the following locations along or proximate to Profile E4:
        - MW-723R
        - SCPT-04
        - MW-603
        - CP-610
        - CP-611
        - CP-613
        - MW-604
        - CP-612
        - MW-701
- A pore pressure grid can be utilized in Slope/W to model decreasing pore pressure gradients with depth. This approach is applicable for existing conditions. However, the remedial design includes installation of drainage features.
- For this evaluation, the pore pressures are modelled in Slope/W via a piezometric line and not a pore pressure grid. This is considered conservative for evaluation of existing conditions, but more reasonable/applicable for representing the long-term post-remediation impoundment water levels predicted by the groundwater model (Appendix A).
- The impoundment water levels used for existing conditions are shown in Table C-5.
    - This data is supplemented by the global assumption that the "heel" of each lift of the impoundment berm generally controls the phreatic surface. The water pressure is approximately zero near the heel of each lift.



http://www.fhwa.dot.gov/engineering/hydraulics/pubs/05114/images/hec15fig06_01.gif

ATTACHMENT E4-B

PROFILE E4
LONG-TERM STATIC SLOPE STABILITY EVALUATION

EXISTING CONDITIONS SLOPE/W POINTS (GEOMETRY)

ATTACHMENT E4-B

PROFILE E4 - SLOPE/W MODEL DEVELOPMENT - EXISTING CONDITIONS

- Define cross-section perpendicular to impoundment dam "face".
- Define STA. 0+00 at Elev. +10.0 ft MSL (~"toe" of the impoundment dam).
- Define existing topography:

Point	STA.	Ground Surface EL. (ft)	Exploration
1	7+19	100	$MW-723\ R$
2	7+17	99	
3	7+07	98	
4	6+99	97	
5	6+92	96	
6	6+88	95	
7	6+84	94	$TP-06$
8	6+79	93	
9	6+75	92	
10	6+72	91	$TP-05$
11	6+69	90	
12	6+66	89	
13	6+63	88	$TP-04$
14	6+57	87	
15	6+45	86	
16	6+36	85	
17	6+31	84	
18	6+26	83	
19	6+23	82	
20	6+20	81	
21	6+00	80	
22	5+80	79	
23	5+60	78	
24	5+46	77	
25	5+41	76	
26	5+36	75	
27	5+24	74	
28	5+17	73	
29	5+10	72	$SCPT-04$
30	5+06	71	
31	5+00	70	$SB-1130$
32	4+95	70	
33	4+65	71	
34	4+22	71.5	$SB-603$ $CP-610$

Point	STA.	Ground Surface EL. (ft)	Exploration
35	3+60	72	
36	3+16	72.5	CP−611
37	2+51	73	
38	2+35	73	CP−613
39	1+58	74	SB−604 CP−612
40	1+42	75	
41	1+36	76	
42	1+20	77	
43	1+14	77	
44	1+06	76	
45	1+04	75	
46	1+00	72	
47	0+97	70	
48	0+91	65	
49	0+84	60	
50	0+78	55	
51	0+70	50	
52	0+64	45	
53	0+58	40	
54	0+50	35	
55	0+42	30	
56	0+34	25	
57	0+23	20	
58	0+12	15	
59	0+00	10	
60	−0+17	10	
61	−0+22	10	SB−701
62	−0+28	10	P−1106
63	−0+33	10	CPT−30
64	−0+44	5	SB−1104
65	−0+69	4	
66	−1+57	1.5	SD−707
67	−2+29	4	

ATTACHMENT E4-C

PROFILE E4
LONG-TERM STATIC SLOPE STABILITY EVALUATION

IMPOUNDMENT DAM CONFIGURATION

ATTACHMENT E4-C

PROFILE E4 - DAM IMPOUNDMENT CONFIGURATION

A. Objective:

- To assess the configuration of the existing impoundment dam, including number of lifts/raises above the starter dam and the crest width and backslope of of each lift.

B. Discussion:

- Anecdotal information, historic photographs, and subsurface exploration data indicate that the impoundment dam was constructed via upstream raised embankment methods. Tailings were discharged via spigots placed peripherally along the crest of the starter dam (and each subsequent "lift" of the dam/embankment raise).

- Borings/wells drilled near the crest of the dam typically identify clay/glacial till fill "at depth" beneath the tailings.

C. Data Evaluation:

- MW-604R

  - Location: Northeastern corner of impoundment
  - Crest EL.: +75 to +77 ft (including surface gravel)
  - Toe EL.: +10 ft
  - Existing GS EL.: +77 ft
  - Horiz. Distance from Crest Grade Break (northern): 37 ft
  - Horiz. Distance from Crest Grade Break (eastern): 46 ft

  - Data Summary:

    - 0.0-1.5 ft bgs: Road base gravel;
    - 1.5-5.0 ft bgs: Gravel and cobbles;
    - 5.0-15.0 ft bgs: Poor recovery/limited soil description/stratigraphy due to sonic drilling method. In general, Waste Rock over Sand tailings, over Slime tailings @ ~12-15 ft bgs; and
    - 62.0-65.0 ft bgs: Possible reworked clay/glacial till.

  - Conclusions:

    - Gravel and cobbles at shallow depth may not be associated with the impoundment dam. Rather, used for support of present-day roadway.
    - Impoundment dam may not have been encountered at this boring. This suggests max crest width of uppermost dam ~25 ft for northern side, assuming ~10 ft tall lift (25+10*1.3=38 ft) OR ~20 ft for northern side, assuming a ~15 ft tall lift. Using the same criteria, a 25 to 30 ft wide crest is possible for the eastern side.
    - Slimes @ ~12-15 ft bgs suggest bottom of uppermost lift at ~EL. +65 ft, OR no spigot in the corner.
    - Clay/till fill at depth likely part of starter dam.

C. Data Evaluation - continued:

- MW-722R

  - Location: Southeastern corner of impoundment
  - Crest EL.: +75 to +77 ft
  - Toe EL.: +20 ft
  - Existing GS EL.: +77 ft
  - Horiz. Distance from Crest Grade Break (eastern): 37 ft
  - Horiz. Distance from Crest Grade Break (southern): 37 ft

  - Data Summary:

    - 0.0-1.0 ft bgs: Road base gravel;
    - 1.0- 10-15 ft bgs: Gravel, cobbles, and boulders;
    - >10-15 ft bgs: Sand/silt;
    - Limited soil description/stratigraphy at depth due to sonic drilling methods.

  - Conclusions:

    - Impoundment dam encountered at this location.
    - Some of the shallow gravel, cobbles, and boulders may be associated with support of present-day roadway.
    - Suggests crest width of 25 to 30 ft, assuming 10 to 15 ft lift.
    - Suggests 10 to 15 ft height for uppermost lift.
    - Suggests bottom of uppermost lift at ~EL. +62 to +67 ft.

- SB-1124 & SB-1119

  - Location: Eastern side (~E2 profile)
  - Crest EL.: +75 to +77 ft
  - Toe EL.: +15 ft
  - Existing GS EL.: +76.5 ft (SB-1124); +75.5 ft (SB-1119)
  - Horiz. Distance from Crest Grade Break: 22 ft (SB-1124); 32 ft (SB-1119)

  - Data Summary:

SB-1124		SB-1119	
0-1 ft bgs:	Roadway gravel	0-1 ft bgs:	Roadway gravel
1-25 ft bgs:	Waste rock	1-11 ft bgs:	Waste rock
25-43 ft bgs:	Sand tailings	11-28.5 ft bgs:	Sand tailings
- Obstruction ~33 ft bgs		- Boney ~19 ft bgs	
43-48.5 ft bgs:	Waste rock/tailings	28.5-56 ft bgs:	Mixed tailings
48.5-53 ft bgs:	Sand tailings	- Gravelly ~33 ft bgs	
53-61 ft bgs:	Reworked clay	56-61 ft bgs:	Clay, possible rework
61-68 ft bgs:	Native clay	61-67 ft bgs:	Native clay

C. Data Evaluation - continued:

- SB-1124 & SB-1119 - continued

  - Conclusions:

    - Empoundment dam encountered at these locations.
    - Suggests bottom of the uppermost lift at ~EL. +65.
    - Suggests 10-11 ft lift height for uppermost lift.
    - Suggests 25-30 ft wide crest width for uppermost lift.
    - SB-1119, SCPT-16 (refusal at 6.5 ft bgs, 14 ft from SB-1119), and SCPT-16A (No refusal, 23 ft from SB-1119) suggest ~2H:1V backslope on uppermost lift.
    - SB-1124 suggests 25-30 ft wide crest for 2nd uppermost lift.
    - SB-1124 sugests bottom of the 2nd uppermost lift at ~EL. +50 to +55 ft.
    - SB-1124 & SB-1119 indicate reworked clay fill at 53 ft and 56 ft bgs, respectively. Suggests clay fill with 2.5H:1V backslope. Indicates clay fill behind starter dam.

- SB-1123 & SB-1122

  - Location: Eastern side (~E3 profile)
  - Crest EL.: +75 to +78 ft
  - Toe EL.: +12 ft
  - Existing GS EL.: +77ft (SB-1123); +75.5 ft (SB-1122)
  - Horiz. Distance from Crest Grade Break: 20 ft (SB-1123); 29 ft (SB-1129)

  - Data Summary:

SB-1123		SB-1122
0-1.5 ft bgs:	Roadway gravel	0-8 ft bgs (+/-): Roadway gravel
1.5-23 ft bgs:	Waste rock	8-17 ft bgs (+/-): Waste rock
23-33.5 ft bgs:	Waste rock/tailings	17-33.5 ft bgs: Sand tailings
33.5-39.5 ft bgs:	Sand/mixed tailings	- Gravel/obstruction at 32.5 ft bgs
39.5-55.5 ft bgs:	Mixed tailings	33.5-56 ft bgs: Mixed tailings
55.5-66 ft bgs:	Reworked clay	56-63.5 ft bgs: Reworked clay
66-68.5 ft bgs:	Native clay	- "Boney" material at 59' bgs
68.5 ft bgs:	Till/bedrock	63.5-65.5 ft bgs: Native clay
		65.5 ft bgs: Till/bedrock

C. Data Evaluation - continued:

- SB-1123 & SB-1122 - continued
  - Conclusions:
    - Empoundment dam encountered at these locations.
    - Suggests bottom of the uppermost lift at ~EL. +65.
    - Suggests 10 ft lift height for uppermost lift.
    - Suggests 25-30 ft wide crest width for uppermost lift.
    - SB-1122, SCPT-14 (refusal at 6.5 ft bgs, 10 ft from SB-1122), and SCPT-14A (No refusal, 25 ft from SB-1122) suggest ~1.3H:1V backslope on uppermost lift.
    - SB-1123 suggests 25-30 ft wide crest for 2nd uppermost lift.
    - SB-1123 sugests bottom of the 2nd uppermost lift at ~EL. +50 to +55 ft.
    - SB-1123 & SB-1122 indicate reworked clay fill at 55 ft and 56 ft bgs, respectively. Suggests clay fill with 3H:1V backslope. Indicates clay fill behind starter dam.

- SB-1125
  - Location: Northern side
  - Crest EL: +75 to +78 ft
  - Toe EL.: +28 ft
  - Existing GS EL.: +78 ft
  - Horiz. Distance from Crest Grade Break: 14 ft
  - Data Summary:
    - 0-36 ft bgs: Waste Rock
    - 36-51 ft bgs: Waste rock/tailings mix
    - 51-63.5 ft bgs: Clay/till fill
    - 63.5-66 ft bgs: Native organic silt
    - 66-73.5 ft bgs: Native clay
    - 73.5-77 ft bgs: Glacial till
  - Conclusions:
    - Impoundment dam encountered at this location.
    - Suggests bottom of 3rd uppermost lift at ~EL. +40 to +45 ft.
    - Indicates 25 ft wide crest for the 2nd uppermost lift.
    - Indicates clay/till fill behind the starter dam. Thickness of fill (and top elevation of fill) appears to increase as distance from crest/toe/starter dam decreases.

C. Data Evaluation - continued:

- SB-1126

  - Location: Southern side
  - Crest EL.: +75 to +77 ft
  - Existing GS EL.: +77 ft
  - Horiz. Distance from Grade Break: 20 ft
  - Data Summary:

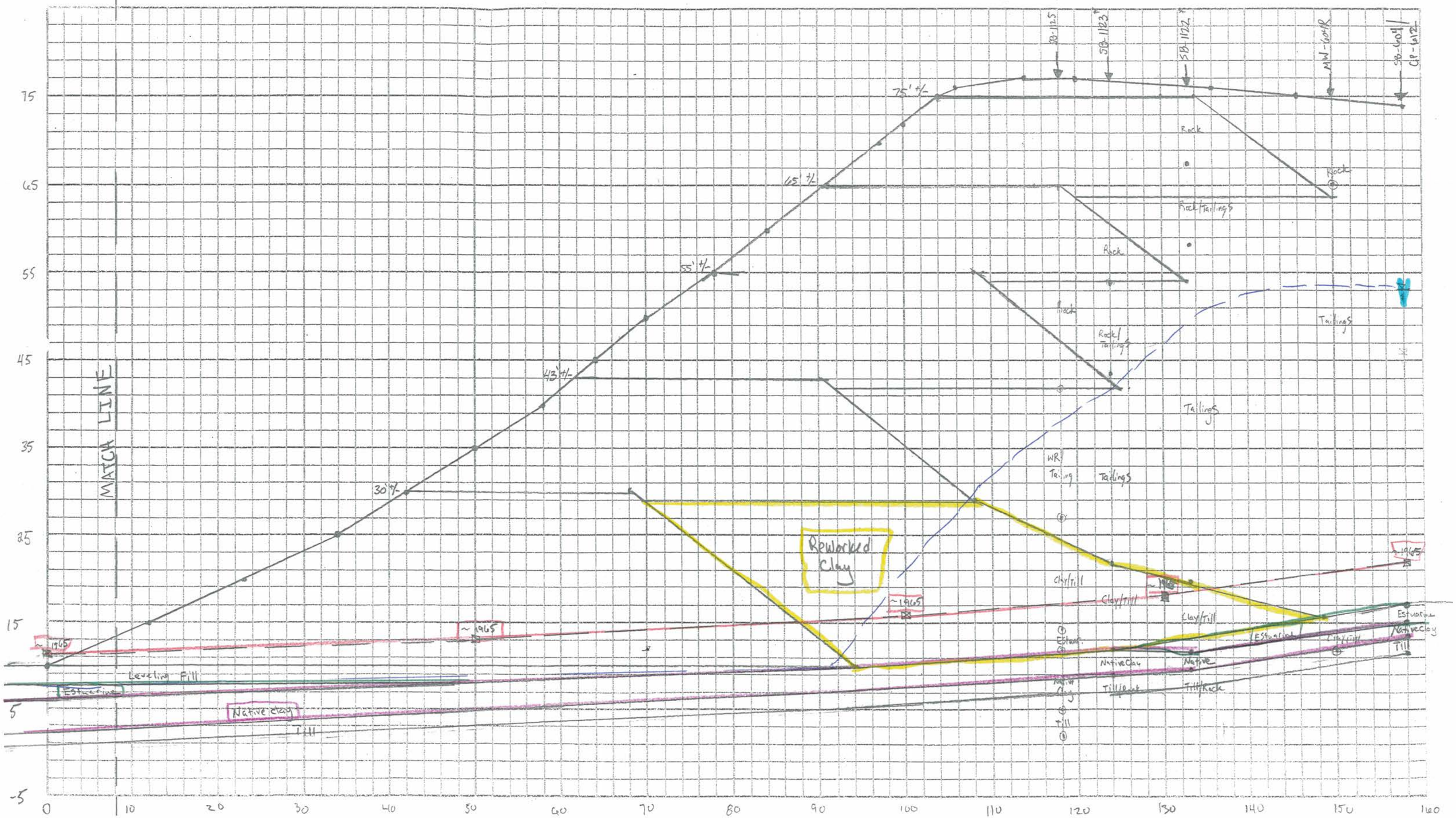
    - Advanced 0-45 ft bgs via air hammer drilling methods:

      - Waste rock;
      - Waste rock/Dense tailings mix; and/or
      - Very stiff/stiff clay/till fill

    - 48 ft bgs: Bottom of clay/till fill
    - 48-64 ft bgs: Native clay
    - 64-77 ft bgs: Glacial till
    - 77 ft bgs: Probable bedrock

- A sketch of the interpreted impoundment dam configuration is shown on Sheet 6.

Y = Elevation (ft) → 1" = 10'	Profile E4 Interpreted Rock Dam Configuration	PROJECT Callahan Mine Tailings Impoundment Slope Stability Evaluation	COMP BY NDL CHK BY TCC
x = Distance from Toe (ft) → 1" = 10'			JOB NO. 36121122 01 DATE 7/2014



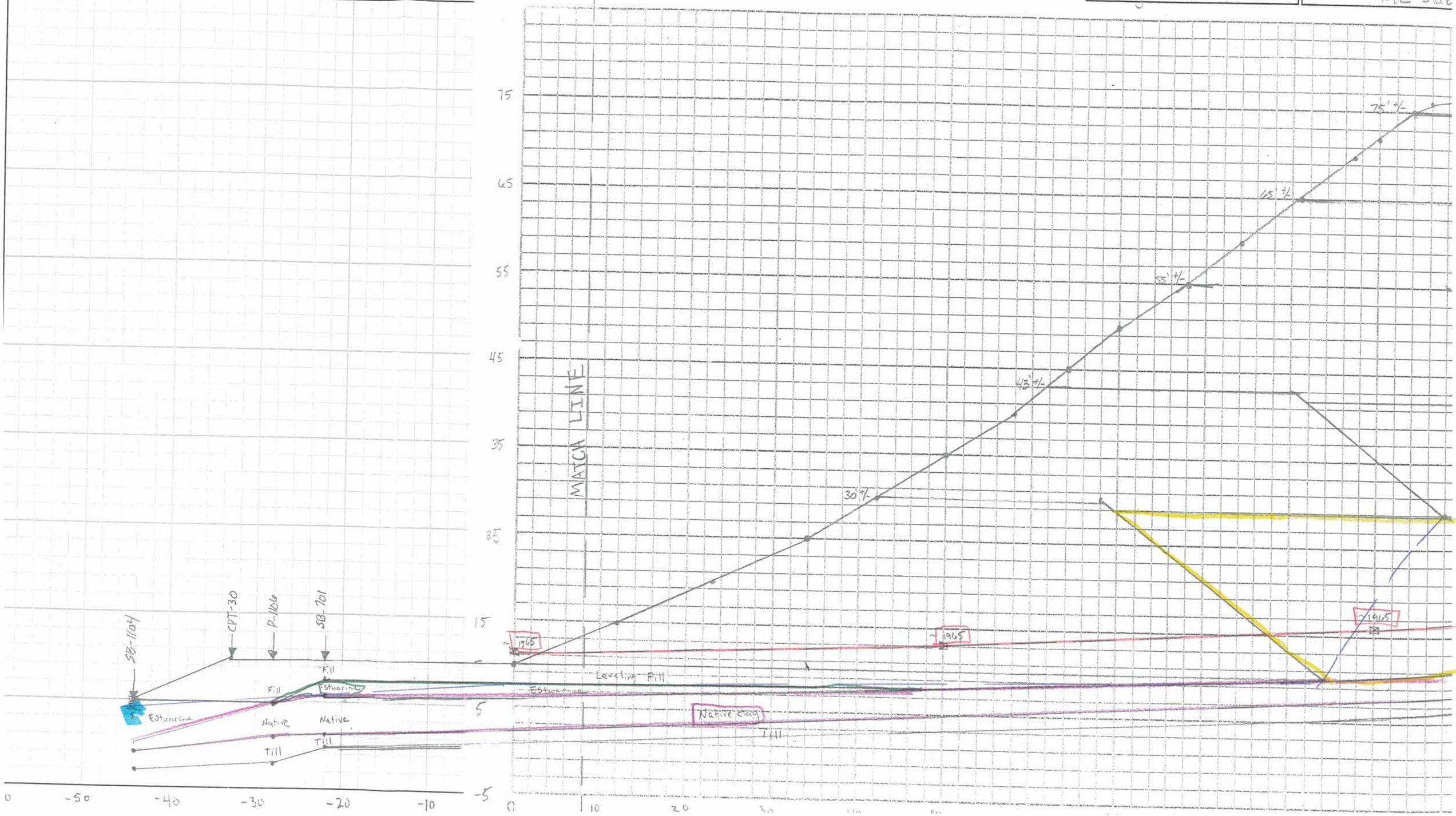
JOB NO. _____ SHEET _____ OF _____
PHASE _____ TASK _____
JOB NAME _____
BY _____ DATE _____
CHECKED BY _____ DATE _____

511 Congress Street S
Portland, ME 04101
+1 (207) 775-5401 F

Y = Elevation (ft) → 1" = 10'
x = Distance from Toe (ft) → 1" = 10'

Profile E4
Interpreted Rock Dam Configuration

PROJECT Callah Tailings Slope Stab



ATTACHMENT E4-D

PROFILE E4
LONG-TERM STATIC SLOPE STABILITY EVALUATION

ESTIMATES OF CLAY SHEAR STRENGTH

ATTACHMENT E4-D

PROFILE E4 - ESTIMATE CLAY SHEAR STRENGTH BENEATH IMPOUNDMENT DAM

- Clay/estuarine thickness and shear strength profile are "known" near the toe of the impoundment dam.
    - SB-701 ~6 ft thick Stiff to very stiff
        - 2 ft Estuarine Su = 1500 psf
        - 4 ft Clay Su > 2500 psf
- Clay/estuarine thickness and shear strength profile are "known" at/near the crest of the impoundment dam.
    - SB-604 ~3.5 ft thick Medium stiff to very stiff
        - 2 ft Estuarine Su = 900-1500 psf
        - 1.5 ft Clay Su > 2000 psf
- Clay thickness is interpolated between these two points.
- SB-701 (at the toe) indicates stiff to very stiff clay. SB-604 (at the crest) indicates stiff to very stiff clay.
    - As such, the relatively thin layer of clay beneath the impoundment dam will be interpreted as stiff to very stiff.
    - Winstress software will not be utilized on this profile, and no strength increase will be applied to the clay.

ATTACHMENT E4-E

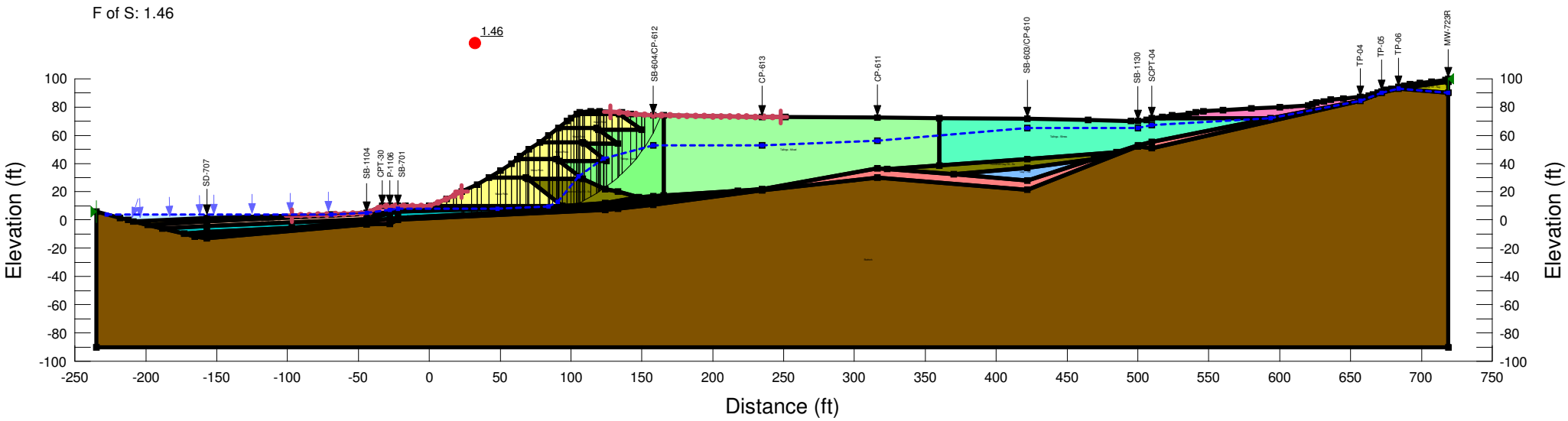
PROFILE E4
LONG-TERM STATIC SLOPE STABILITY EVALUATION

SLOPE/W OUTPUT: EXISTING CONDITIONS

Title: Callahan Mine OU3 - Profile E4
Date: 10/15/2014
File Name: Tailings_Profile E4_Existing-Cond-90%.gsz

Name: Profile E4b - Existing -Ent/Exit - Till Imp
Method: Spencer

Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 117 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Glacial Till - Reg Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 50 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 130 pcf Piezometric Line: 1
Name: Gravel Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38 ° Constant Unit Wt. Above Water Table: 125 pcf Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 375 Model: Undrained (Phi=0) Unit Weight: 105 pcf Cohesion': 375 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 750 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 750 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 1750 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,750 psf Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Reworked Clay/Till - Su Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: SM-Clay - 1000 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 1,000 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 750 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 750 psf Piezometric Line: 1
Name: Glacial Till - Impenetrable Model: Bedrock (Impenetrable) Piezometric Line: 1



Title: Callahan Mine OU3 - Profile E4
Date: 10/15/2014
File Name: Tailings_Profile E4_Existing-Cond-90%.gsz

Name: Profile E4a - Existing - Ent/Exit - Till Reg
Method: Spencer

Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 117 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Glacial Till - Reg Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 50 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 130 pcf Piezometric Line: 1
Name: Gravel Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38 ° Constant Unit Wt. Above Water Table: 125 pcf Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 375 Model: Undrained (Phi=0) Unit Weight: 105 pcf Cohesion': 375 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 750 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 750 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 1750 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,750 psf Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Reworked Clay/Till - Su Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: SM-Clay - 1000 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 1,000 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 750 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 750 psf Piezometric Line: 1

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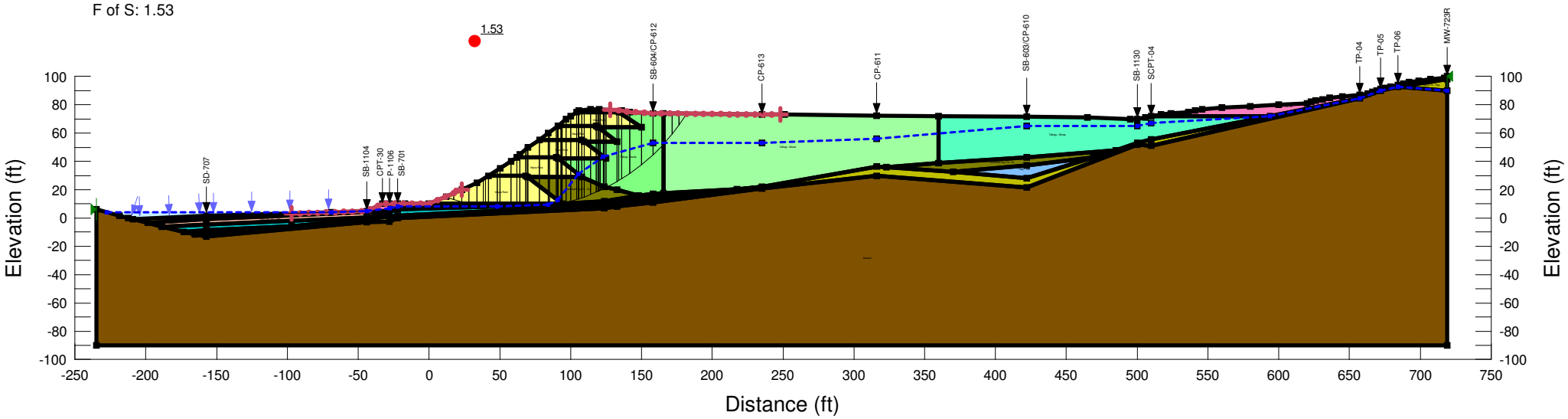


ATTACHMENT E4-F

PROFILE E4
LONG-TERM STATIC SLOPE STABILITY EVALUATION

SLOPE/W MODEL DEVELOPMENT: POST-REMEDIATION CONDITIONS

ATTACHMENT E4-F

PROFILE E4 - SLOPE/W MODEL DEVELOPMENT - PROPOSED CONDITIONS

- See Figure C-1 for profile location.

A. Define Proposed Subgrade/Final Grade Topography

- Proposed subgrade topography is shown on Figure C-1.
- A profile section view is shown on Figure C-3.
- Define long-term post-remediation topography:

Point	STA.	Subgrade EL. (ft)	Final Grade EL. (ft)*
1	6+72	91	92.5
2	6+65	89	90.5
3	6+56	90	91.5
4	6+47	90	91.5
5	6+30	94	95.5
6	6+01	94	95.5
7	5+80	85	86.5
8	5+46	80	81.5
9	5+20	79	80.5
10	4+71	77	78.5
11	4+47	76	77.5
12	3+62	76	77.5
13	1+88	41	42.5
14	1+82	41	42.5
15	1+70	45	46.5
16	1+55	50	51.5
17	1+52	51	52.5
18	1+18	52	53.5
19	0+84	53	54.5

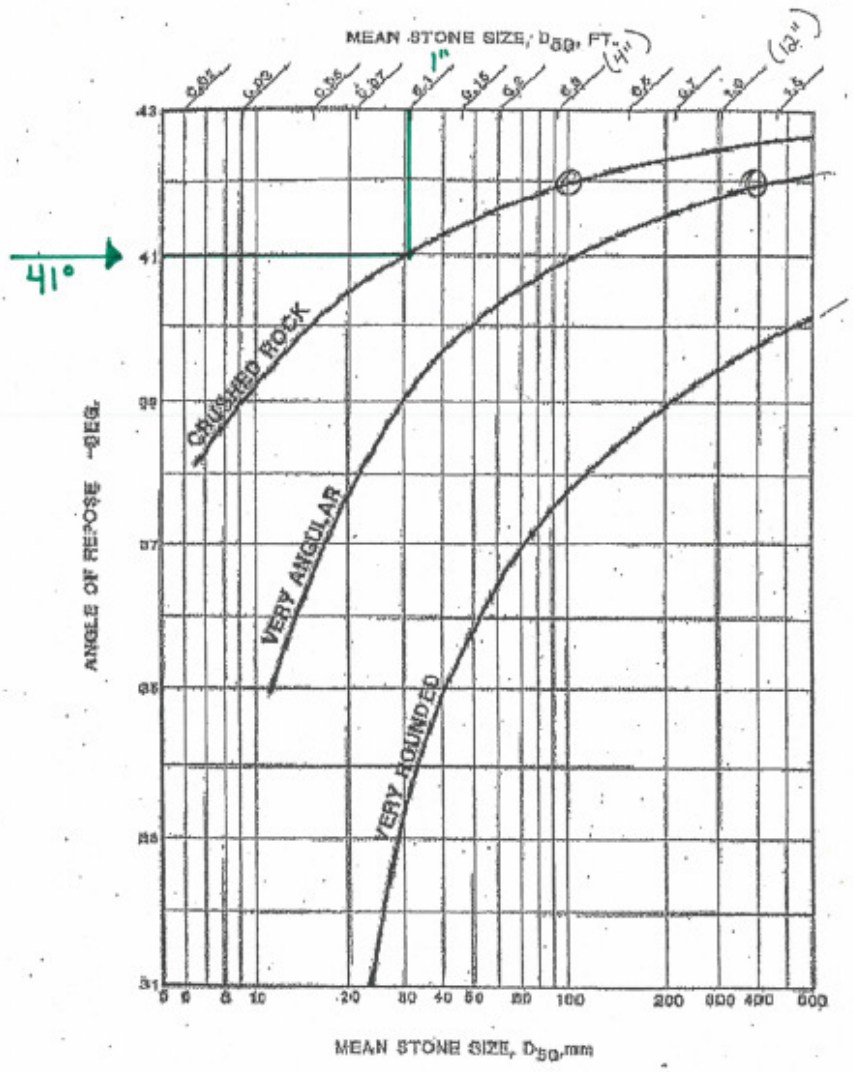
*Note: Final grade assumes 1.5 feet of cover aggregate/crushed stone.

B. Low-Permeability Cover

- The proposed low-permeability cover system consists of approximately 15 inches of crushed gravel/aggregate over a GDL, FML, and a GCL.
- The crushed gravel (1" < D_{50} < 6") is modeled in Slope/W with the following parameters:
  - Unit Weight = 100 pcf (assume loosely placed, 40% porosity).
  - Friction Angle = 41° (see Sheet 3 - conservatively assume D_{50} = 1").
- The unit weight and strength of the GDL, FML, and GCL are considered insignificant, and these materials were not included in the Slope/W model.

C. Long-Term Groundwater Levels

- Proposed horizontal drain locations are shown on Figure C-1.
- The water levels used for long-term post-remediation conditions are based on the current groundwater model for horizontal drain(s) located at/near the bottom of the tailings, approximately elevation +21 feet (+/-) and approximately 100 feet back from the existing crest, and a low perm cover system.
  - The long-term post-remediation groundwater levels used in the Slope/W models is assumed based on the drain location(s) and as per the groundwater model (Appendix A).



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ATTACHMENT E4-G

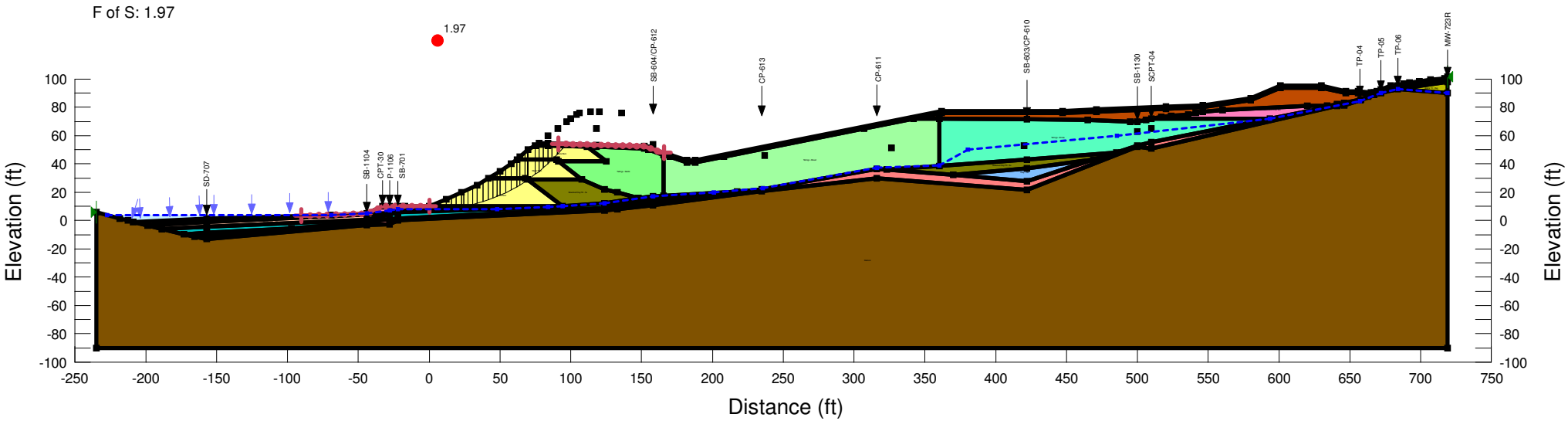
PROFILE E4
LONG-TERM STATIC SLOPE STABILITY EVALUATION

SLOPE/W OUTPUT: POST-REMEDIATION CONDITIONS

Title: Callahan Mine OU3 - Profile E4
Date: 10/16/2014
File Name: Tailings_Profile E4_Proposed-Cond_90%.gsz

Name: Profile E4; a2 - Proposed - Static - Crest/Toe - Till Imp
Method: Spencer

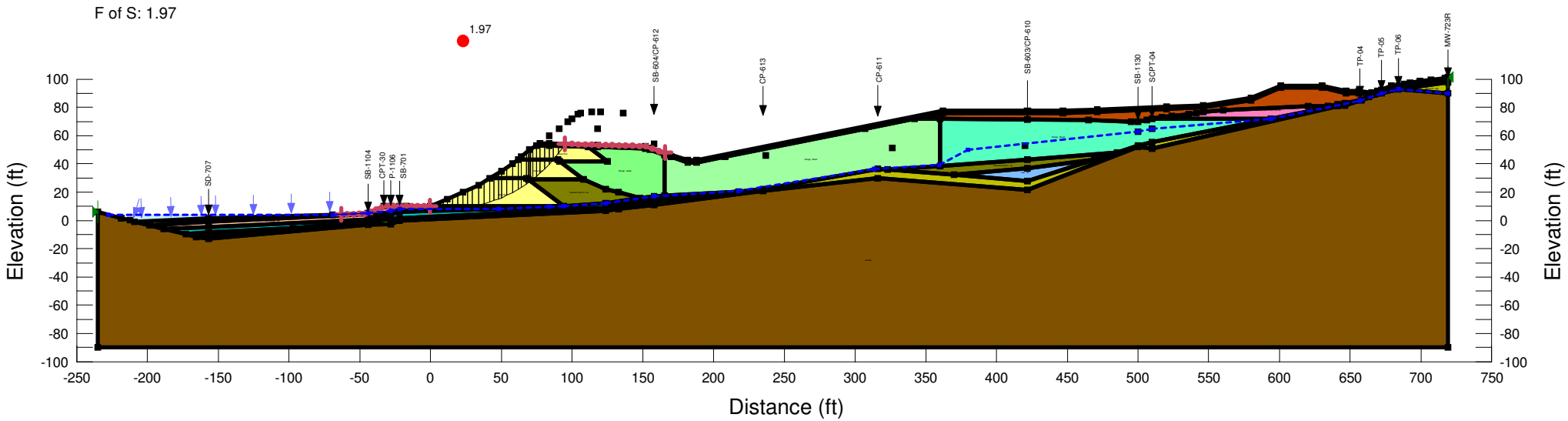
Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 117 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Glacial Till - Reg Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 50 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 130 pcf Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 375 Model: Undrained (Phi=0) Unit Weight: 105 pcf Cohesion': 375 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 750 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 750 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 1750 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,750 psf Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Reworked Clay/Till - Su Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: SM-Clay - 1000 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 1,000 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 750 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 750 psf Piezometric Line: 1
Name: Waste Rock/Dewatered Tailings Mix Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 38 ° Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
Name: Glacial Till - Impenetrable Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Aggregate Model: Mohr-Coulomb Unit Weight: 100 pcf Cohesion': 0 psf Phi': 41 ° Piezometric Line: 1



Title: Callahan Mine OU3 - Profile E4
Date: 10/16/2014
File Name: Tailings_Profile E4_Proposed-Cond_90%.gsz

Name: Profile E4; a1 - Proposed - Static - Crest/Toe - Till Reg
Method: Spencer

Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 117 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Glacial Till - Reg Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 50 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 130 pcf Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 375 Model: Undrained (Phi=0) Unit Weight: 105 pcf Cohesion': 375 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 750 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 750 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 1750 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,750 psf Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Reworked Clay/Till - Su Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: SM-Clay - 1000 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 1,000 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 750 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 750 psf Piezometric Line: 1
Name: Waste Rock/Dewatered Tailings Mix Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 38 ° Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
Name: Aggregate Model: Mohr-Coulomb Unit Weight: 100 pcf Cohesion': 0 psf Phi': 41 ° Piezometric Line: 1



Title: Callahan Mine OU3 - Profile E4
Date: 10/16/2014
File Name: Tailings_Profile E4_Proposed-Cond_90%.gsz

Name: Profile E4; b2 - Proposed - Static - Fill/Toe - Till Imp
Method: Spencer

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Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 117 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Glacial Till - Reg Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 50 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 130 pcf Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 375 Model: Undrained (Phi=0) Unit Weight: 105 pcf Cohesion': 375 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 750 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 750 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 1750 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,750 psf Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Reworked Clay/Till - Su Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: SM-Clay - 1000 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 1,000 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 750 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 750 psf Piezometric Line: 1
Name: Waste Rock/Dewatered Tailings Mix Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 38 ° Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
Name: Glacial Till - Impenetrable Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Aggregate Model: Mohr-Coulomb Unit Weight: 100 pcf Cohesion': 0 psf Phi': 41 ° Piezometric Line: 1

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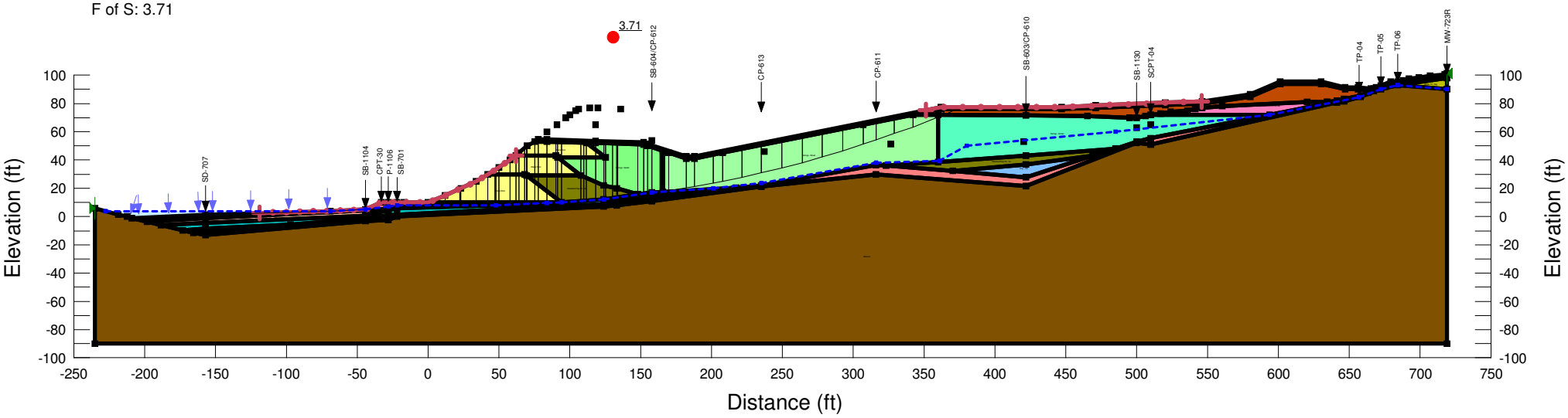

Title: Callahan Mine OU3 - Profile E4
Date: 10/16/2014
File Name: Tailings_Profile E4_Proposed-Cond_90%.gsz

Name: Profile E4; b1 - Proposed - Static - Fill/Toe - Till Reg
Method: Spencer

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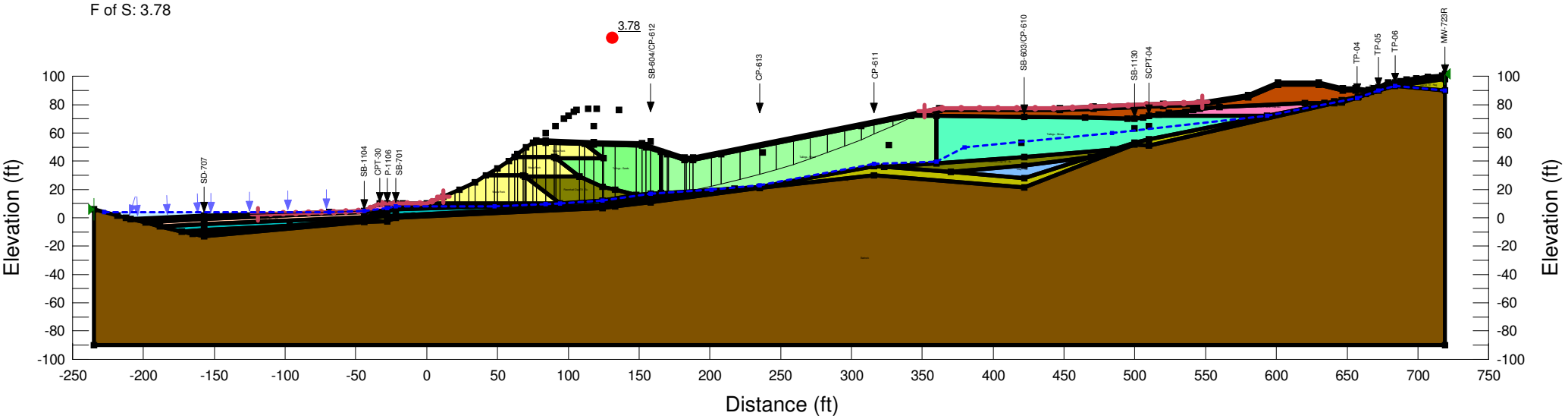
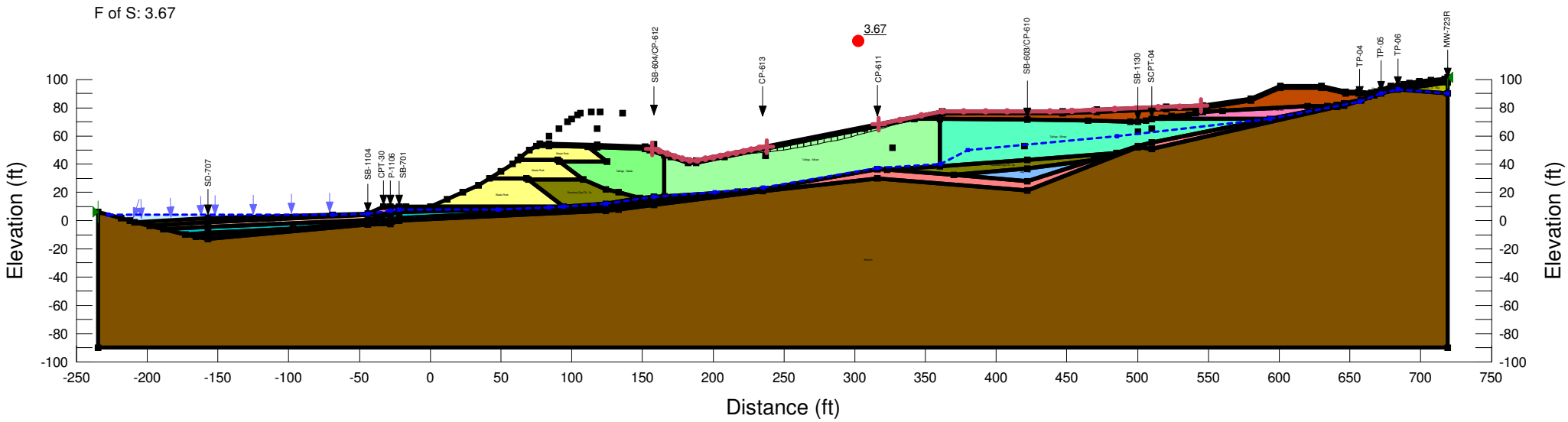
Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 117 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Glacial Till - Reg Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 50 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 130 pcf Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 375 Model: Undrained (Phi=0) Unit Weight: 105 pcf Cohesion': 375 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 750 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 750 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 1750 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,750 psf Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Reworked Clay/Till - Su Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: SM-Clay - 1000 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 1,000 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 750 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 750 psf Piezometric Line: 1
Name: Waste Rock/Dewatered Tailings Mix Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 38 ° Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line:
Name: Aggregate Model: Mohr-Coulomb Unit Weight: 100 pcf Cohesion': 0 psf Phi': 41 ° Piezometric Line: 1



Title: Callahan Mine OU3 - Profile E4
Date: 10/16/2014
File Name: Tailings_Profile E4_Proposed-Cond_90%.gsz

Name: Profile E4; c2 - Proposed - Static - Fill Slope - Till Imp
Method: Spencer

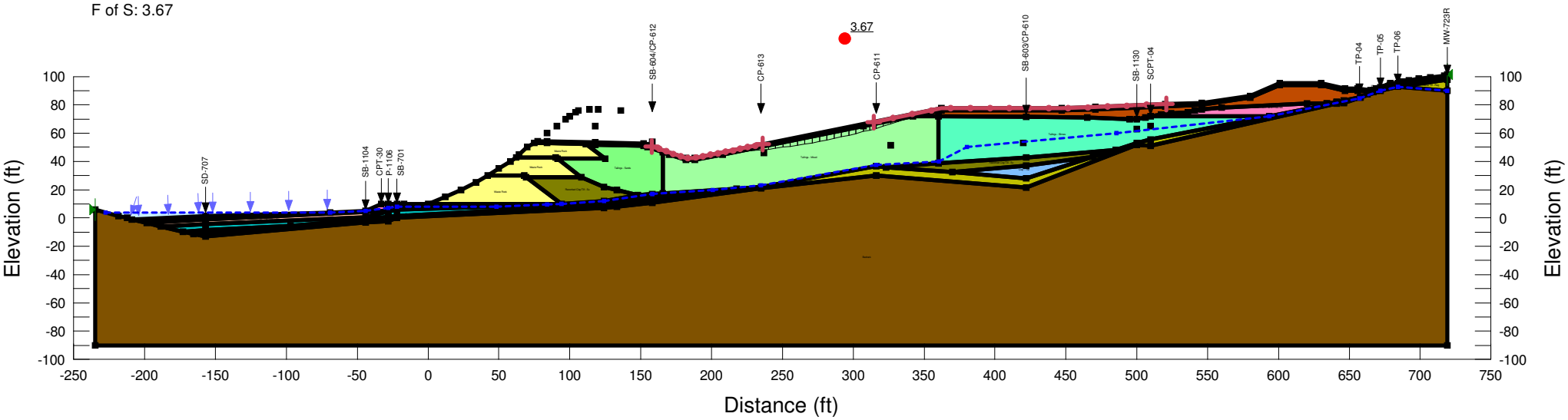
Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 117 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Glacial Till - Reg Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 50 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 130 pcf Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 375 Model: Undrained (Phi=0) Unit Weight: 105 pcf Cohesion': 375 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 750 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 750 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 1750 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,750 psf Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Reworked Clay/Till - Su Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: SM-Clay - 1000 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 1,000 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 750 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 750 psf Piezometric Line: 1
Name: Waste Rock/Dewatered Tailings Mix Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 38 ° Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
Name: Glacial Till - Impenetrable Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Aggregate Model: Mohr-Coulomb Unit Weight: 100 pcf Cohesion': 0 psf Phi': 41 ° Piezometric Line: 1



Title: Callahan Mine OU3 - Profile E4
Date: 10/16/2014
File Name: Tailings_Profile E4_Proposed-Cond_90%.gsz

Name: Profile E4; c1 - Proposed - Static - Fill Slope - Till Reg
Method: Spencer

Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 117 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Glacial Till - Reg Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 50 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 130 pcf Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 375 Model: Undrained (Phi=0) Unit Weight: 105 pcf Cohesion': 375 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 750 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 750 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 1750 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,750 psf Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Reworked Clay/Till - Su Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: SM-Clay - 1000 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 1,000 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 750 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 750 psf Piezometric Line: 1
Name: Waste Rock/Dewatered Tailings Mix Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 38 ° Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
Name: Aggregate Model: Mohr-Coulomb Unit Weight: 100 pcf Cohesion': 0 psf Phi': 41 ° Piezometric Line: 1



ATTACHMENT N1

PROFILE N1
LONG-TERM STATIC SLOPE STABILITY EVALUATION

ATTACHMENT N1-A

PROFILE N1
LONG-TERM STATIC SLOPE STABILITY EVALUATION

SLOPE/W MODEL DEVELOPMENT: EXISTING CONDITIONS

ATTACHMENT N1-A

PROFILE N1 - SLOPE/W MODEL DEVELOPMENT - EXISTING CONDITIONS

- See Figure C-1 for profile location.

A. Define Overall Geometry/Topography

- Existing site-specific topography is shown on Figure C-1.
    - Define Profile Station 0+00 as the "toe" of the rock dam.
        - Positive station numbers to the west
        - Negative station numbers to the east
- See Attachment N1-B for definition of key SLOPE/W points.

B. Impoundment Dam Configuration

- The assumed/interpreted configuration of the impoundment dam is as follows:
    - Constructed via "upstream" raised embankment methods.
    - 5 total lifts (starter dam plus 4 subsequent raises).
    - Starter dam constructed with clay and glacial till from on-site (and adjacent property to the south) and face extensively with waste rock.
        - Top of starter dam at Elev. +28 ft (+/-) (~grade break).
        - Crest width of waste rock approximately 25 ft (+/-).
        - Backslope of waste rock approximately 1.3H:1V to 1.5H:1V.
        - Clay/glacial till extends 50 ft (+/-) behind the starter dam.
    - Subsequent raises/lifts constructed with waste rock and possibly lined/"chinked" with clay/till fill (limited extent/thickness).
        - Each lift/raise approximately 10 to 15 ft tall
        - Crest width of each waste rock lift/raise approximately 25 ft (+/-).
        - Backslope of each waste rock lift/raise approximately 1.3H:1V to 2.0H:1V.
- See Attachment N1-C for discussion, supporting data/evaluation, and sketches/cross-sections.

C. Define Subsurface Profile

- Geotechnical explorations along or in close proximity to Profile N1 are shown on Figure C-1.
    - RC-1145 West
    - SB-707
    - CPT-03
    - CPT-26/SB-1131
    - SB-603/CP-610
    - CP-611
    - CPT-06
    - SB-1140
    - CPT-07
    - SB-1125 Crest
    - SB-1101
    - SB-713 East
- Logs/records of these explorations are provided in prior investigation reports:
    - Credere, 2012 Supplemental Geotechnical Investigation
    - MACTEC, 2009a Geotechnical Evaluation Report
    - MACTEC, 2009b Remedial Investigation Report
- Table C-6 summarizes the primary soil strata encountered at these exploration locations.
    - Fill
    - Tailings
        - Tailings are further subdivided into "zones" of sand, mixed/stratified, or slimes based on description of sand, fines, and layering/thickness.
    - Clay/Till Fill
    - Native Estuarine
    - Presumpscot Clay
        - Native clay is further divided into layers/zones based on strength data.
    - Glacial Till
    - Other, as necessary

D. Assign Soil Unit Weight & Strength Parameters

- Assign unit weights based on soil type, in-situ conditions (e.g., density, consistency, saturation, etc.), published literature, and in conjunction with/comparison with bulk density measurements from Shelby tube samples

- Strength parameters for Tailings developed based on site-specific field and laboratory testing programs and in conjunction with applicable mine-tailings-specific references (i.e., Vick 1990)

  Note: +/- adjustments to Tailings effective stress/strength parameters have negligible impact on estimated FOS.

- Strength parameters for Clay and Estuarine deposits developed based on site-specific field and laboratory testing programs.

  - FVST data
  - CPT data
  - SPT data
  - Strength adjustments for unexplored locations (beneath the waste rock impoundment dam) are presented in Attachment N1-D.

- Strength Parameters for Glacial Till and various Fill materials developed based on site-specific field and laboratory testing programs and published values.

- Strength parameters for impoundment berm (i.e., crushed/angular waste rock) developed based on published FHWA values/data (see Sheet 6).

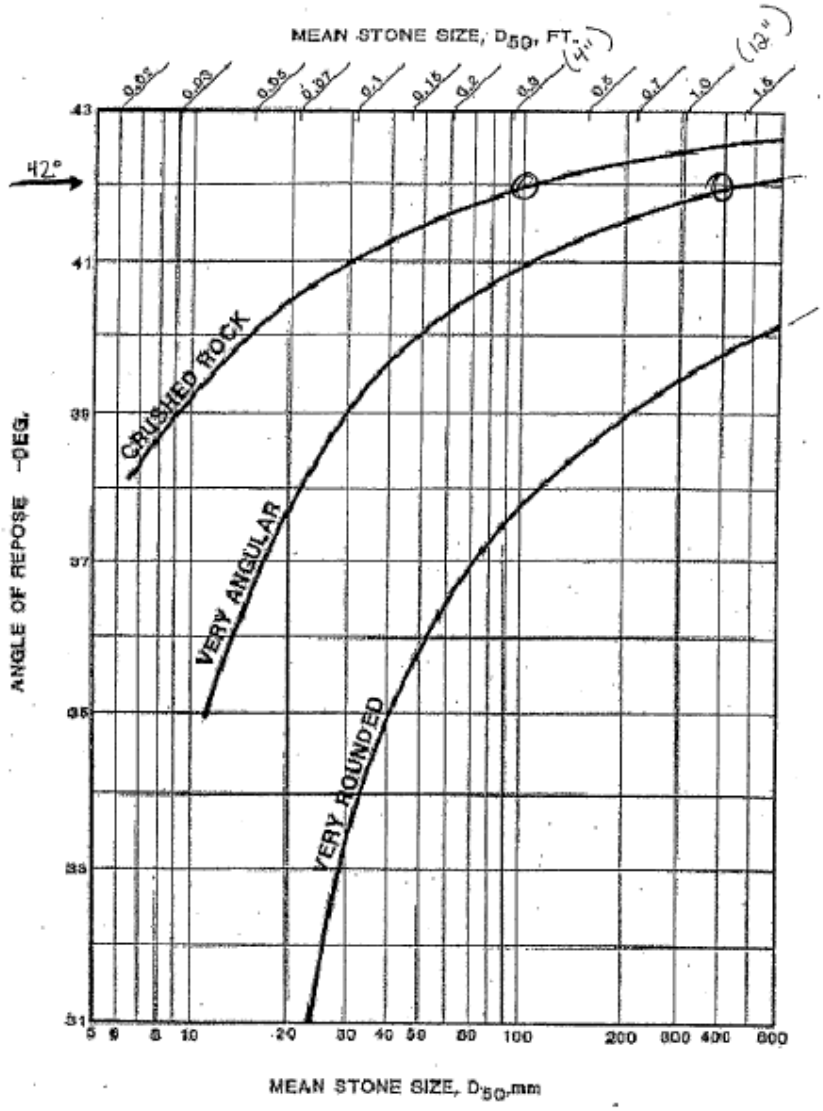
- Actual weight and strength parameters for each soil type are listed on Slope/W output files.

E. Estimate Shear Strength Increase in Clay Beneath Impoundment Dam

- Clay strengths known at crest (SB-1125) and at toe (SB-713, SB-1101). Use procedures below to provide reasonable estimates of clay strength in between the known points.
- See Attachment N1-C for sketch comparing existing conditions vs. historic (pre-mining) topography.
- Estimate gross effective stress increase - Pre-mining "cuts" approximately equal to net effective stress increase. See Attachment N1-D.
- Use Winstress software to estimate effective stress increase in clay soils at various intervals between the crest and toe. See Attachment N1-D for Winstress setup and associated output files.
- Estimate strength increase in soft/normally consolidated clay soils based on $Su/\sigma`v = 0.2$ (relationship based on site-specific lab testing and in agreement with literature values. Strength increase in medium stiff clay soils based on $Su/\sigma`v = 0.15$. Strength increase in stiff clay soils based on $Su/\sigma`v = 0.1$. No strength increase applied to very stiff clay. See Attachment N1-D.
- Apply strength increase to the "toe" conditions in segmented/zoned areas beneath the berm. See Attachment N1-D.
- See Slope/W output files for zones and strengths assigned.

F. Define Phreatic Surface/Water Table and/or Pore Pressure Grid

- Site-specific water levels measured in the installed/existing PZs, MWs, OWs, and/or VWPs provide information on impoundment water levels. This info indicates a slightly downward gradient (decreasing piezometric surface/pressure within the tailings with increasing depth bgs).
    - Water level data is available or formerly available at the following locations along or proximate to Profile N1:
        - RC-1145
        - MW-707
        - SB-1131
        - PZ-603
        - SB-1140
        - MW/PZ-713
- A pore pressure grid can be utilized in Slope/W to model decreasing pore pressure gradients with depth. This approach is applicable for existing conditions. However, the remedial design includes installtion of drainage features.
- For this evaluation, the pore pressures are modelled in Slope/W via a piezometric line and not a pore pressure grid. This is considered conservative for evaluation of existing conditions, but more reasonable/applicable for representing the long-term post-remediation impoundment water levels predicted by the groundwater model (Appendix A).
- The impoundment water levels used for existing conditions are shown in Table C-6.
    - This data is supplemented by the global assumption that the "heel" of each lift of the impoundment berm generally controls the phreatic surface. The water pressure is approximately zero near the heel of each lift.



http://www.fhwa.dot.gov/engineering/hydraulics/pubs/05114/images/hec15fig06_01.gif

ATTACHMENT N1-B

PROFILE N1
LONG-TERM STATIC SLOPE STABILITY EVALUATION

EXISTING CONDITIONS SLOPE/W POINTS (GEOMETRY)

ATTACHMENT N1-B

PROFILE N1 - SLOPE/W MODEL DEVELOPMENT - EXISTING CONDITIONS

- Define cross-section perpendicular to impoundment dam "face".
- Define STA. 0+00 at Elev. +28.0 ft MSL (~"toe"/grade break of the impoundment dam).
- Define existing topography:

Point	STA.	Ground Surface EL. (ft)	Exploration
1	7+28	80	RC−1145
2	6+88	79	
3	6+55	78	
4	6+35	78	
5	6+20	77.5	SB−707
6	5+89	77	
7	5+78	76	
8	5+67	75	
9	5+55	74	
10	5+40	73	
11	5+33	72.5	CPT−03
12	5+29	72	
13	5+23	71	
14	5+13	70	
15	4+65	71	
16	4+58	71	CPT−26 SB−1131
17	3+40	71.5	SB−603 CP−610
18	2+55	72	CP−611
19	2+14	73	
20	1+71	74	
21	1+63	74	CPT−06
22	1+25	74.5	SB−1140
23	1+10	74.5	CPT−07
24	1+07	75	
25	1+01	76	
26	0+95	77	
27	0+87	78	
28	0+74	78	SB−1125
29	0+70	78	
30	0+63	77	
31	0+60	75	
32	0+54	70	
33	0+48	65	
34	0+42	60	

Point	STA.	Ground Surface EL. (ft)	Exploration
35	$0+36$	55	
36	$0+30$	50	
37	$0+23$	45	
38	$0+17$	40	
39	$0+10$	35	
40	$0+03$	30	
41	$0+00$	28	
42	$-0+08$	27	
43	$-0+15$	26	
44	$-0+18$	25	
45	$-0+26$	20	
46	$-0+28$	19	$SB-1101$
47	$-0+35$	15	
48	$-0+52$	12	
49	$-0+56$	11	
50	$-0+75$	10	
51	$-0+88$	10	
52	$-0+95$	11	
53	$-1+11$	11	$SB-713$
54	$-1+22$	10	
55	$-1+25$	8	
56	$-1+61$	7	
57	$-1+93$	6	
58	$-2+53$	5	
59	$-2+78$	4	
60	$-3+42$	4	

ATTACHMENT N1-C

PROFILE N1
LONG-TERM STATIC SLOPE STABILITY EVALUATION

IMPOUNDMENT DAM CONFIGURATION

ATTACHMENT N1-C

PROFILE N1 - DAM IMPOUNDMENT CONFIGURATION

A. Objective:

- To assess the configuration of the existing impoundment dam, including number of lifts/raises above the starter dam and the crest width and backslope of of each lift.

B. Discussion:

- Anecdotal information, historic photographs, and subsurface exploration data indicate that the impoundment dam was constructed via upstream raised embankment methods. Tailings were discharged via spigots placed peripherally along the crest of the starter dam (and each subsequent "lift" of the dam/embankment raise).

- Borings/wells drilled near the crest of the dam typically identify clay/glacial till fill "at depth" beneath the tailings.

C. Data Evaluation:

- MW-604R

  - Location: Northeastern corner of impoundment
  - Crest EL.: +75 to +77 ft (including surface gravel)
  - Toe EL.: +10 ft
  - Existing GS EL.: +77 ft
  - Horiz. Distance from Crest Grade Break (northern): 37 ft
  - Horiz. Distance from Crest Grade Break (eastern): 46 ft

  - Data Summary:

    - 0.0-1.5 ft bgs: Road base gravel;
    - 1.5-5.0 ft bgs: Gravel and cobbles;
    - 5.0-15.0 ft bgs: Poor recovery/limited soil description/stratigraphy due to sonic drilling method. In general, Waste Rock over Sand tailings, over Slime tailings @ ~12-15 ft bgs; and
    - 62.0-65.0 ft bgs: Possible reworked clay/glacial till.

  - Conclusions:

    - Gravel and cobbles at shallow depth may not be associated with the impoundment dam. Rather, used for support of present-day roadway.
    - Impoundment dam may not have been encountered at this boring. This suggests max crest width of uppermost dam ~25 ft for northern side, assuming ~10 ft tall lift (25+10*1.3=38 ft) OR ~20 ft for northern side, assuming a ~15 ft tall lift. Using the same criteria, a 25 to 30 ft wide crest is possible for the eastern side.
    - Slimes @ ~12-15 ft bgs suggest bottom of uppermost lift at ~EL. +65 ft, OR no spigot in the corner.
    - Clay/till fill at depth likely part of starter dam.

C. Data Evaluation - continued:

- MW-722R

  - Location: Southeastern corner of impoundment
  - Crest EL.: +75 to +77 ft
  - Toe EL.: +20 ft
  - Existing GS EL.: +77 ft
  - Horiz. Distance from Crest Grade Break (eastern): 37 ft
  - Horiz. Distance from Crest Grade Break (southern): 37 ft

  - Data Summary:

    - 0.0-1.0 ft bgs: Road base gravel;
    - 1.0- 10-15 ft bgs: Gravel, cobbles, and boulders;
    - >10-15 ft bgs: Sand/silt;
    - Limited soil description/stratigraphy at depth due to sonic drilling methods.

  - Conclusions:

    - Impoundment dam encountered at this location.
    - Some of the shallow gravel, cobbles, and boulders may be associated with support of present-day roadway.
    - Suggests crest width of 25 to 30 ft, assuming 10 to 15 ft lift.
    - Suggests 10 to 15 ft height for uppermost lift.
    - Suggests bottom of uppermost lift at ~EL. +62 to +67 ft.

- SB-1124 & SB-1119

  - Location: Eastern side (~E2 profile)
  - Crest EL.: +75 to +77 ft
  - Toe EL.: +15 ft
  - Existing GS EL.: +76.5 ft (SB-1124); +75.5 ft (SB-1119)
  - Horiz. Distance from Crest Grade Break: 22 ft (SB-1124); 32 ft (SB-1119)

  - Data Summary:

SB-1124		SB-1119	
0-1 ft bgs:	Roadway gravel	0-1 ft bgs:	Roadway gravel
1-25 ft bgs:	Waste rock	1-11 ft bgs:	Waste rock
25-43 ft bgs:	Sand tailings	11-28.5 ft bgs:	Sand tailings
- Obstruction ~33 ft bgs		- Boney ~19 ft bgs	
43-48.5 ft bgs:	Waste rock/tailings	28.5-56 ft bgs:	Mixed tailings
48.5-53 ft bgs:	Sand tailings	- Gravelly ~33 ft bgs	
53-61 ft bgs:	Reworked clay	56-61 ft bgs:	Clay, possible rework
61-68 ft bgs:	Native clay	61-67 ft bgs:	Native clay

C. Data Evaluation - continued:

- SB-1124 & SB-1119 - continued

  - Conclusions:

    - Empoundment dam encountered at these locations.
    - Suggests bottom of the uppermost lift at ~EL. +65.
    - Suggests 10-11 ft lift height for uppermost lift.
    - Suggests 25-30 ft wide crest width for uppermost lift.
    - SB-1119, SCPT-16 (refusal at 6.5 ft bgs, 14 ft from SB-1119), and SCPT-16A (No refusal, 23 ft from SB-1119) suggest ~2H:1V backslope on uppermost lift.
    - SB-1124 suggests 25-30 ft wide crest for 2nd uppermost lift.
    - SB-1124 sugests bottom of the 2nd uppermost lift at ~EL. +50 to +55 ft.
    - SB-1124 & SB-1119 indicate reworked clay fill at 53 ft and 56 ft bgs, respectively. Suggests clay fill with 2.5H:1V backslope. Indicates clay fill behind starter dam.

- SB-1123 & SB-1122

  - Location: Eastern side (~E3 profile)
  - Crest EL.: +75 to +78 ft
  - Toe EL.: +12 ft
  - Existing GS EL.: +77ft (SB-1123); +75.5 ft (SB-1122)
  - Horiz. Distance from Crest Grade Break: 20 ft (SB-1123); 29 ft (SB-1129)

  - Data Summary:

SB-1123		SB-1122
0-1.5 ft bgs:	Roadway gravel	0-8 ft bgs (+/-): Roadway gravel
1.5-23 ft bgs:	Waste rock	8-17 ft bgs (+/-): Waste rock
23-33.5 ft bgs:	Waste rock/tailings	17-33.5 ft bgs: Sand tailings
33.5-39.5 ft bgs:	Sand/mixed tailings	- Gravel/obstruction at 32.5 ft bgs
39.5-55.5 ft bgs:	Mixed tailings	33.5-56 ft bgs: Mixed tailings
55.5-66 ft bgs:	Reworked clay	56-63.5 ft bgs: Reworked clay
66-68.5 ft bgs:	Native clay	- "Boney" material at 59' bgs
68.5 ft bgs:	Till/bedrock	63.5-65.5 ft bgs: Native clay
		65.5 ft bgs: Till/bedrock

C. Data Evaluation - continued:

- SB-1123 & SB-1122 - continued
  - Conclusions:
    - Empoundment dam encountered at these locations.
    - Suggests bottom of the uppermost lift at ~EL. +65.
    - Suggests 10 ft lift height for uppermost lift.
    - Suggests 25-30 ft wide crest width for uppermost lift.
    - SB-1122, SCPT-14 (refusal at 6.5 ft bgs, 10 ft from SB-1122), and SCPT-14A (No refusal, 25 ft from SB-1122) suggest ~1.3H:1V backslope on uppermost lift.
    - SB-1123 suggests 25-30 ft wide crest for 2nd uppermost lift.
    - SB-1123 sugests bottom of the 2nd uppermost lift at ~EL. +50 to +55 ft.
    - SB-1123 & SB-1122 indicate reworked clay fill at 55 ft and 56 ft bgs, respectively. Suggests clay fill with 3H:1V backslope. Indicates clay fill behind starter dam.

- SB-1125
  - Location: Northern side
  - Crest EL: +75 to +78 ft
  - Toe EL.: +28 ft
  - Existing GS EL.: +78 ft
  - Horiz. Distance from Crest Grade Break: 14 ft
  - Data Summary:
    - 0-36 ft bgs: Waste Rock
    - 36-51 ft bgs: Waste rock/tailings mix
    - 51-63.5 ft bgs: Clay/till fill
    - 63.5-66 ft bgs: Native organic silt
    - 66-73.5 ft bgs: Native clay
    - 73.5-77 ft bgs: Glacial till
  - Conclusions:
    - Impoundment dam encountered at this location.
    - Suggests bottom of 3rd uppermost lift at ~EL. +40 to +45 ft.
    - Indicates 25 ft wide crest for the 2nd uppermost lift.
    - Indicates clay/till fill behind the starter dam. Thickness of fill (and top elevation of fill) appears to increase as distance from crest/toe/starter dam decreases.

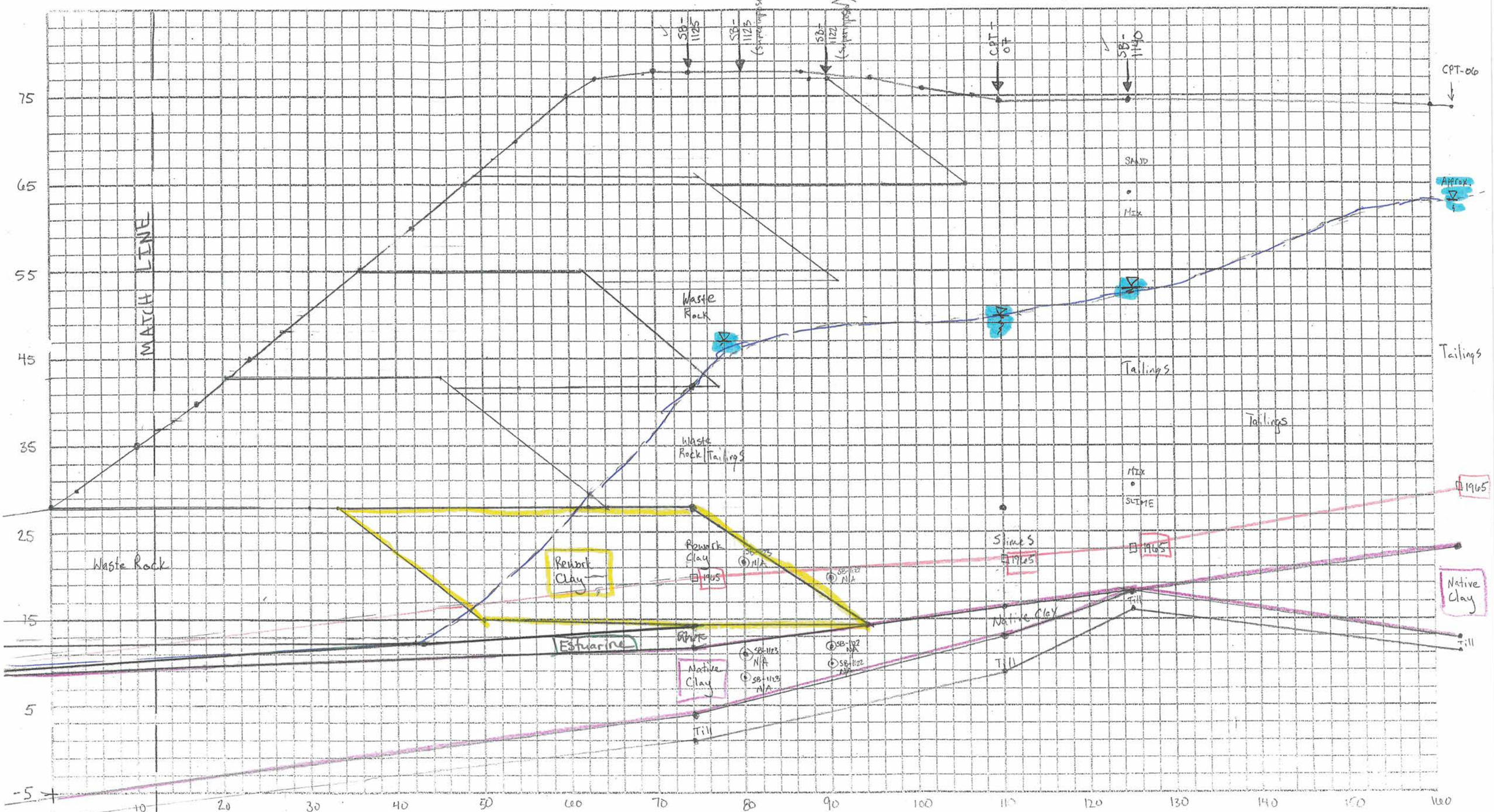
C. Data Evaluation - continued:

- SB-1126
  - Location: Southern side
  - Crest EL.: +75 to +77 ft
  - Existing GS EL.: +77 ft
  - Horiz. Distance from Grade Break: 20 ft
  - Data Summary:
    - Advanced 0-45 ft bgs via air hammer drilling methods:
      - Waste rock;
      - Waste rock/Dense tailings mix; and/or
      - Very stiff/stiff clay/till fill
    - 48 ft bgs: Bottom of clay/till fill
    - 48-64 ft bgs: Native clay
    - 64-77 ft bgs: Glacial till
    - 77 ft bgs: Probable bedrock

- A sketch of the interpreted impoundment dam configuration is shown on Sheet 6.

y = Elevation (ft) : 1" = 10'
x = Distance from Toe (ft) : 1" = 10'

Profile N1	PROJECT Callahan Mine Tailings Impoundment Slope Stability Evaluation	COMP BY NDL	JOB NO. 3612112201
Interpreted Rock Dam		CHK BY TCC	DATE 7/2014



Y = Elevation (ft) : 1" = 10'
x = Distance from Toe (ft) : 1" = 10'

Profile N1
Interpreted Rock Dam

PROJEC

ATTACHMENT N1-D

PROFILE N1
LONG-TERM STATIC SLOPE STABILITY EVALUATION

ESTIMATES OF CLAY SHEAR STRENGTH VIA SHANSEP METHOD

ATTACHMENT N1-D

PROFILE N1 - ESTIMATE CLAY SHEAR STRENGTH BENEATH IMPOUNDMENT DAM

- Clay thickness and shear strength profile are "known" near the toe of the impoundment dam.
  - SB-713 ~10 ft thick
    - 0-3 ft (below top of clay): 2000 psf
    - 3-5 ft: 1500 psf
    - 5-7 ft: 750 psf
    - 7-9 ft: 550 psf
    - 9-10 ft: 475 psf
  - SB-1101 ~14 ft thick
    - 0-7 ft (below top of clay): 2500 psf
    - 7-9 ft: 1750 psf
    - 9-12 ft: 1250 psf
    - 12-14 ft: 750 psf
- Clay thickness and shear strength profile are "known" at/near the crest of the impoundment dam.
  - SB-1125 ~7.5 ft thick
    - 0-2.5 ft (below top of clay): 2750 psf
    - 2.5-5 ft: 2250 psf
    - 5-7.5 ft: 1750 psf
- Clay thickness will be interpolated between these points:
  - Distance ~= 102 ft
- Clay strength profile will be interpolated between these points using $Su/\sigma'v$ (also called c/p) ratios, based on site specific laboratory test results and literature values:
  - Soft: $\Delta Su/\Delta\sigma'v = 0.20$
  - Medium stiff: $\Delta Su/\Delta\sigma'v = 0.15$
  - Stiff (<1500 psf): $\Delta Su/\Delta\sigma'v = 0.10$
    - Apply strength increase (ΔSu) to clay strength profile at toe based on effective stress increase ($\Delta\sigma'v$) imposed by the impoundment dam.
    - See Attachment N1-C for a sketch of existing conditions/topo, 1965 topo, and soil boring locations relative to the toe of the dam.
    - Use Winstress software to estimate $\Delta\sigma'v$ applied to clay soils at various stations/zones beneath the impoundment dam.

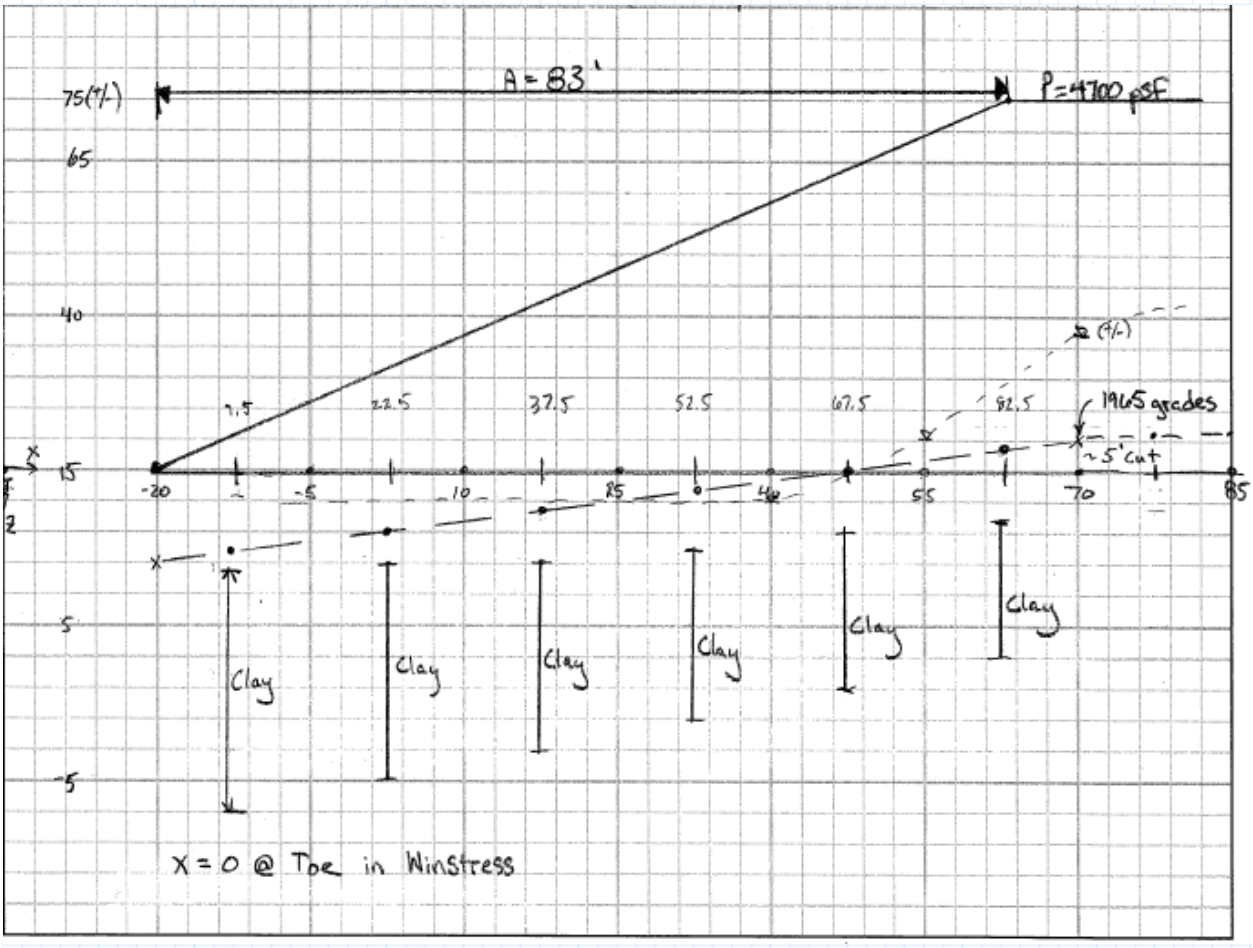
- Estimate embankment load imposed by the impoundment:
  - Beneath crest point:
    - 57 ft tall dam/impoundment (relative to 1965 grade of ~+20 ft)
      - σ'v = 49 ft unsaturated waste rock/tailings = 49' x 105 pcf = 5,145 psf
      - σ'v = 8 ft saturated rework clay/till = 8' x 125 pcf = 1,000 psf
      - u = 8 ft water = -8' x 62.4 pcf = -499 psf
      - Assume 3 ft rise in pore pressure in clay = -3' x 62.4 pcf = -187 psf
        - Load imposed beneath crest ~= 5,459 psf
  - Beneath SB-1140:
    - 52 ft tall dam (relative to 1965 grade of ~+23)
      - σ'v = 22 ft unsaturated tailings = 22' x 110 pcf = 2,420 psf
      - σ'v = 30 ft saturated tailings = 30' x 120 pcf = 3,600 psf
      - u = 30 ft of water = -30' x 62.4 pcf = -1,872 psf
      - Assume 3 ft rise in pore pressure in clay = -3' x 62.4 pcf = -187 psf
        - Load imposed beneath SB-1140 ~= 3,961 psf
  - Average embankment/terrace load = 4,700 psf

- Use Winstress software with the following inputs:
  - Load at crest = 4,700 psf
  - A=Distance toe to crest = 83 ft
  - B=Distance to to end of load = 180 ft
  - x = 0 @ toe of "new" embankment load (Winstress coordinates)

- Vary x to estimate Ds'v with depth (z) below the embankment.

- Winstress software input/analysis definitions:

X-Range (Slope/W coords.)	Analysis Point (Winstress)	Discussion
-20 to -5	x = 7.5	Toe @ -20 in Slope/W;
-5 to +10	x = 22.5	See attached output files;
+10 to +25	x = 37.5	Soft: c/p = 0.20
+25 to +40	x = 52.5	M. Stiff: c/p = 0.15
+40 to +55	x = 67.5	Stiff: c/p = 0.10
+55 to +70	x = 82.5	V. Stiff: N/A


A = 83'
P = 4700 psf
75(?)
65
40
15
5
-5
7.5
22.5
37.5
52.5
67.5
82.5
1965 grades
~5' cut
-20
-5
10
25
40
55
70
85
Clay
Clay
Clay
Clay
Clay
Clay
X = 0 @ Toe in WinStress

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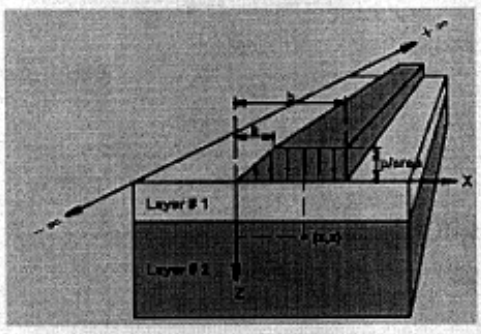
Increment of stress calculation = vertical $\Delta\sigma z$

STRIP FOOTING

Width of strip A = 83.00
Width of strip B = 180.00
p load/unit area = 4700.000



POINTS FOR COMPUTATION OF INCREMENT OF STRESS

x1 coordinate = 7.50
z1 coordinate = 0.00
z2 coordinate = 25.00
delta z = 1.00

calculate in = z direction

Ok | Cancel | Print Screen | Save Screen

@ x = 7.5

Clay Estuarine EL	Relative to Elev. +10 (1965 grade)
+9.5	0.5' bgs
to	to
-7.0	17.0' bgs

LOADING ON AN INFINITE STRIP
VERTICAL EMBANKMENT LOADING

Project Name: Callahan Mine - Tailings Project Number : 3612112201
Client : MDOT Project Manager: PSB
Date : 7/1/2014 Computed by : NDL

Embank. slope a = 83.00 (ft)
Embank. width b = 180.00 (ft)
p load/unit area = 4700.000(psf)

INCREMENT OF STRESSES FOR Z-DIRECTION
X = 7.50(ft)

Z (ft)	Vert. Dsz (psf)	
0.00	424.70	M. Stiff Estuarine x 0.15 ≅ 63 psf ≅ ΔSu
1.00	424.80	
2.00	425.51	
3.00	427.30	
4.00	430.48	
5.00	435.18	
6.00	441.36	
7.00	448.93	
8.00	457.73	Stiff x 0.1 ≅ 50 psf ≅ ΔSu
9.00	467.59	
10.00	478.35	
11.00	489.88	
12.00	502.03	
13.00	514.71	
14.00	527.82	
15.00	541.27	M. Stiff x 0.15 ≅ 83 psf ≅ ΔSu
16.00	555.01	
17.00	568.97	
18.00	583.10	
19.00	597.36	
20.00	611.72	
21.00	626.14	
22.00	640.60	
23.00	655.06	
24.00	669.52	
25.00	683.94	

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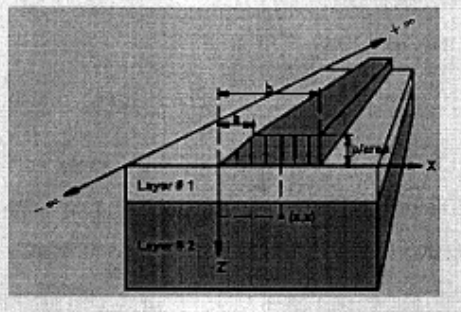
Increment of stress calculation = vertical $\Delta\sigma z$

STRIP FOOTING

Width of strip A = 83.00
Width of strip B = 180.00
p load/unit area = 4700.000



POINTS FOR COMPUTATION OF INCREMENT OF STRESS

calculate in = z direction

x1 coordinate = 22.50
z1 coordinate = 0.00
z2 coordinate = 20.00
delta z = 1.00

Ok | Cancel | Print Screen | Save Screen

@ X = 22.5

Clay Estuarine EL	Relative to EL. +11.0' (~1965 grade)
+10.5'	0.5' bgs
to	to
-5.0'	16.0' bgs

LOADING ON AN INFINITE STRIP
VERTICAL EMBANKMENT LOADING

Project Name: Callahan Mine - Tailings Project Number : 3612112201
Client : MDOT Project Manager: PSB
Date : 7/1/2014 Computed by : NDL

Embank. slope a = 83.00 (ft)
Embank. width b = 180.00 (ft)
p load/unit area = 4700.000(psf)

INCREMENT OF STRESSES FOR Z-DIRECTION
X = 22.50(ft)

Z (ft)	Vert. Dsz (psf)	
0.00		
1.00	1274.10	M.stiff
2.00	1274.11	x 0.15 ≅ 190 psf ≅ ΔSu
3.00	1274.18	
4.00	1274.36	
5.00	1274.72	
6.00	1275.30	
7.00	1276.15	
8.00	1277.30	
9.00	1278.79	
10.00	1280.64	
11.00	1282.86	Stiff x 0.1 ≅ 125 psf ≅ ΔSu
12.00	1285.47	
13.00	1288.48	
14.00	1291.87	
15.00	1295.65	M.stiff x 0.15 ≅ 195 psf ≅ ΔSu
16.00	1299.80	
17.00	1304.31	
18.00	1309.16	
19.00	1314.34	
20.00	1319.81	
	1325.56	

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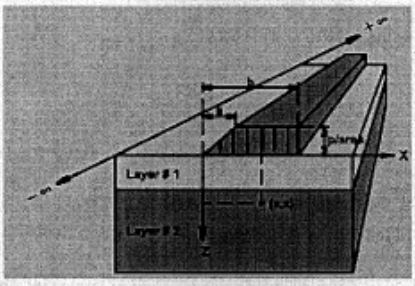
Increment of stress calculation = vertical Δσz

STRIP FOOTING

Width of strip A = 83.00
Width of strip B = 180.00
p load/unit area = 4700.000



POINTS FOR COMPUTATION OF INCREMENT OF STRESS

calculate in = z direction

x1 coordinate = 37.50
z1 coordinate = 0.00
z2 coordinate = 20.00
delta z = 1.00

Ok | Cancel | Print Screen | Save Screen

@ x = 37.5

Clay EL.	Relative to EL. +12.5' (~1965 grade)
+11.0'	1.5' bgs
to	to
-3.0'	15.5' bgs

LOADING ON AN INFINITE STRIP
VERTICAL EMBANKMENT LOADING

Project Name: Callahan Mine - Tailings Project Number : 3612112201
Client : MDOT Project Manager: PSB
Date : 7/1/2014 Computed by : NDL

Embank. slope a = 83.00 (ft)
Embank. width b = 180.00 (ft)
p load/unit area = 4700.000(psf)

INCREMENT OF STRESSES FOR Z-DIRECTION
X = 37.50(ft)

Z (ft)	Vert. Dsz (psf)	
0.00	2123.49	
1.00	2123.50	
2.00	2123.50	Stiff x 0.1 ≅ 212 psf ≅ ΔSu
3.00	2123.52	
4.00	2123.56	
5.00	2123.62	
6.00	2123.71	
7.00	2123.83	
8.00	2123.99	
9.00	2124.19	
10.00	2124.43	stiff x 0.1 ≅ 212 psf ≅ ΔSu
11.00	2124.72	
12.00	2125.05	
13.00	2125.43	
14.00	2125.85	
15.00	2126.32	M.stiff 0.15 ≅ 318 psf ≅ ΔSu
16.00	2126.83	
17.00	2127.39	
18.00	2127.98	
19.00	2128.61	
20.00	2129.27	

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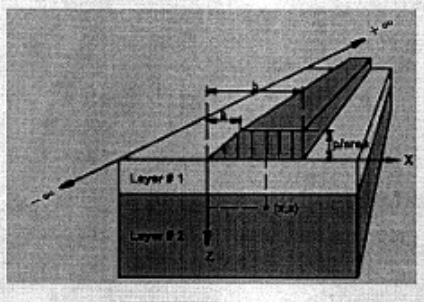
Increment of stress calculation = vertical Δσz

STRIP FOOTING

Width of strip A = 83.00
Width of strip B = 180.00
p load/unit area = 4700.000



POINTS FOR COMPUTATION OF INCREMENT OF STRESS

calculate in = z direction

x1 coordinate = 52.50

z1 coordinate = 0.00
z2 coordinate = 20.00
delta z = 1.00

Ok | Cancel | Print Screen | Save Screen

@ x = 52.5

Clay EL.	Relative to EL. +14.0' (~1965 grade)
+11.5'	2.5' bgs
to	to
-1.0'	15.0' bgs

LOADING ON AN INFINITE STRIP
VERTICAL EMBANKMENT LOADING

Project Name: Callahan Mine - Tailings
Client : MDOT
Date : 7/1/2014

Project Number : 3612112201
Project Manager: PSB
Computed by : NDL

Embank. slope a = 83.00 (ft)
Embank. width b = 180.00 (ft)
p load/unit area = 4700.000(psf)

INCREMENT OF STRESSES FOR Z-DIRECTION
X = 52.50(ft)

Z (ft)	Vert. Dsz (psf)	
0.00	2972.89	
1.00	2972.89	
2.00	2972.85	stiff × 0.1 ≅ 297 psf ≅ ΔSu
3.00	2972.76	
4.00	2972.59	
5.00	2972.31	
6.00	2971.89	
7.00	2971.32	
8.00	2970.57	
9.00	2969.63	stiff × 0.1 ≅ 297 psf ≅ ΔSu
10.00	2968.48	
11.00	2967.10	
12.00	2965.50	
13.00	2963.65	M. Stiff × 0.15 ≅ 444 psf ≅ ΔSu
14.00	2961.56	
15.00	2959.22	
16.00	2956.62	
17.00	2953.78	
18.00	2950.70	
19.00	2947.37	
20.00	2943.80	

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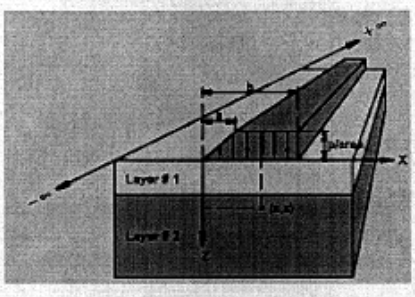
Increment of stress calculation = vertical Δσz

STRIP FOOTING

Width of strip A = 83.00
Width of strip B = 180.00
p load/unit area = 4700.000



POINTS FOR COMPUTATION OF INCREMENT OF STRESS

x1 coordinate = 67.50
z1 coordinate = 0.00
z2 coordinate = 20.00
delta z = 1.00

calculate in = z direction

Ok | Cancel | Print Screen | Save Screen

@ x = 67.5

Clay EL	Relative to EL. +15.0 (~1965 grade)
+ 12.0'	3.0' bgs
to	to
+ 1.0'	14.0' bgs

LOADING ON AN INFINITE STRIP
VERTICAL EMBANKMENT LOADING

Project Name: Callahan Mine - Tailings Project Number : 3612112201
Client : MDOT Project Manager: PSB
Date : 7/1/2014 Computed by : NDL

Embank. slope a = 83.00 (ft)
Embank. width b = 180.00 (ft)
p load/unit area = 4700.000(psf)

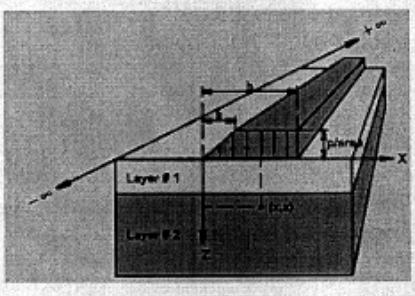
INCREMENT OF STRESSES FOR Z-DIRECTION
X = 67.50(ft)

Z (ft)	Vert. Dsz (psf)	
0.00	3822.29	
1.00	3822.26	
2.00	3822.10	
3.00	3821.65	Stiff x0.1 ≅ 382 psf ≅ ΔSu
4.00	3820.79	
5.00	3819.42	
6.00	3817.46	
7.00	3814.84	
8.00	3811.52	
9.00	3807.49	
10.00	3802.73	
11.00	3797.26	Stiff x.10 ≅ 375psf ≅ ΔSu
12.00	3791.09	
13.00	3784.27	
14.00	3776.82	
15.00	3768.77	
16.00	3760.18	
17.00	3751.07	
18.00	3741.50	
19.00	3731.49	
20.00	3721.08	

Increment of stress calculation = vertical $\Delta\sigma z$

STRIP FOOTING

Width of strip A = 83.00
Width of strip B = 180.00
p load/unit area = 4700.000



POINTS FOR COMPUTATION OF INCREMENT OF STRESS

calculate in = z direction

x1 coordinate = 82.50

z1 coordinate = 0.00
z2 coordinate = 20.00
delta z = 1.00

Ok | Cancel | Print Screen | Save Screen

@ X = 82.5

Clay EL.	Relative to + 16.0' (~1965 grade)
+ 13.0'	3.0' bgs
to	to
+ 3.0'	13' bgs

LOADING ON AN INFINITE STRIP
VERTICAL EMBANKMENT LOADING

Project Name: Callahan Mine - Tailings Project Number : 3612112201
Client : MDOT Project Manager: PSB
Date : 7/1/2014 Computed by : NDL

Embank. slope a = 83.00 (ft)
Embank. width b = 180.00 (ft)
p load/unit area = 4700.000(psf)

INCREMENT OF STRESSES FOR Z-DIRECTION
X = 82.50(ft)

Z (ft)	Vert. Dsz (psf)	
0.00	4671.69	
1.00	4663.64	
2.00	4647.58	
3.00	4630.28	
4.00	4612.61	
5.00	4594.80	Stiff x0.10 ≅ 460 psf ≅ ΔSu
6.00	4576.90	
7.00	4558.96	
8.00	4540.99	
9.00	4522.98	
10.00	4504.96	
11.00	4486.91	M.Stiff x0.1 ≅ 450 psf ≅ ΔSu
12.00	4468.85	
13.00	4450.77	
14.00	4432.67	
15.00	4414.56	
16.00	4396.43	
17.00	4378.29	
18.00	4360.13	
19.00	4341.95	
20.00	4323.75	

ATTACHMENT N1-E

PROFILE N1
LONG-TERM STATIC SLOPE STABILITY EVALUATION

SLOPE/W OUTPUT: EXISTING CONDITIONS

Title: Callahan Mine OU3 - Profile N1
Date: 10/15/2014
File Name: Tailings_Profile N1_Existing-Cond-90%.gsz

Name: Profile N1b - Existing - Ent/Exit - Till Imp
Method: Spencer

Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 117 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Gravel Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38 ° Constant Unit Wt. Above Water Table: 125 pcf Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 120 pcf Piezometric Li
Name: Fill - Sand/Fines/Org. Mix Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 25 psf Phi': 32 ° Constant Unit Wt. Above Water Table: 115 pcf Piezometric Li
Name: SM-Clay/Org. - 750 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 750 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 2750 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,750 psf Piezometric Line: 1
Name: Clay - 2250 Model: Undrained (Phi=0) Unit Weight: 124 pcf Cohesion': 2,250 psf Piezometric Line: 1
Name: Clay - 1750 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,750 psf Piezometric Line: 1
Name: Clay - 1250 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,250 psf Piezometric Line: 1
Name: Clay - 475 Model: Undrained (Phi=0) Unit Weight: 119 pcf Cohesion': 475 psf Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Reworked Clay/Till - Su Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Clay - 1075 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,075 psf Piezometric Line: 1
Name: SM-Clay - 1000 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 1,000 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 750 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 750 psf Piezometric Line: 1
Name: Glacial Till - Impenetrable Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Clay - 1375 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,375 psf Piezometric Line: 1
Name: Clay - 950 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 950 psf Piezometric Line: 1
Name: Clay - 1200 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,200 psf Piezometric Line: 1
Name: Clay - 550 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 550 psf Piezometric Line: 1
Name: Clay - 1800 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,800 psf Piezometric Line: 1
Name: Clay - 825 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 825 psf Piezometric Line: 1
Name: Clay - 1875 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,875 psf Piezometric Line: 1
Name: Clay - 2050 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 2,050 psf Piezometric Line: 1
Name: Clay - 1550 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,550 psf Piezometric Line: 1
Name: Clay - 2150 Model: Undrained (Phi=0) Unit Weight: 124 pcf Cohesion': 2,150 psf Piezometric Line: 1
Name: Clay - 2200 Model: Undrained (Phi=0) Unit Weight: 124 pcf Cohesion': 2,200 psf Piezometric Line: 1
Name: Clay - 1700 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,700 psf Piezometric Line: 1
Name: Clay - 1450 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,450 psf Piezometric Line: 1
Name: Clay - 2000 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 2,000 psf Piezometric Line: 1
Name: Clay - 1500 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,500 psf Piezometric Line: 1
Name: Clay - 2500 Model: Undrained (Phi=0) Unit Weight: 124 pcf Cohesion': 2,500 psf Piezometric Line: 1
Name: SM-Clay/Org. - 1500 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,500 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 1050 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,050 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 1175 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,175 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 1200 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,200 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 1300 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,300 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 1375 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,375 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 1450 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,450 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 1300 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,300 psf Piezometric Line: 1
Name: Clay - 1950 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,950 psf Piezometric Line: 1
Name: Clay - 2125 Model: Undrained (Phi=0) Unit Weight: 124 pcf Cohesion': 2,125 psf Piezometric Line: 1
Name: Clay - 1625 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,625 psf Piezometric Line: 1

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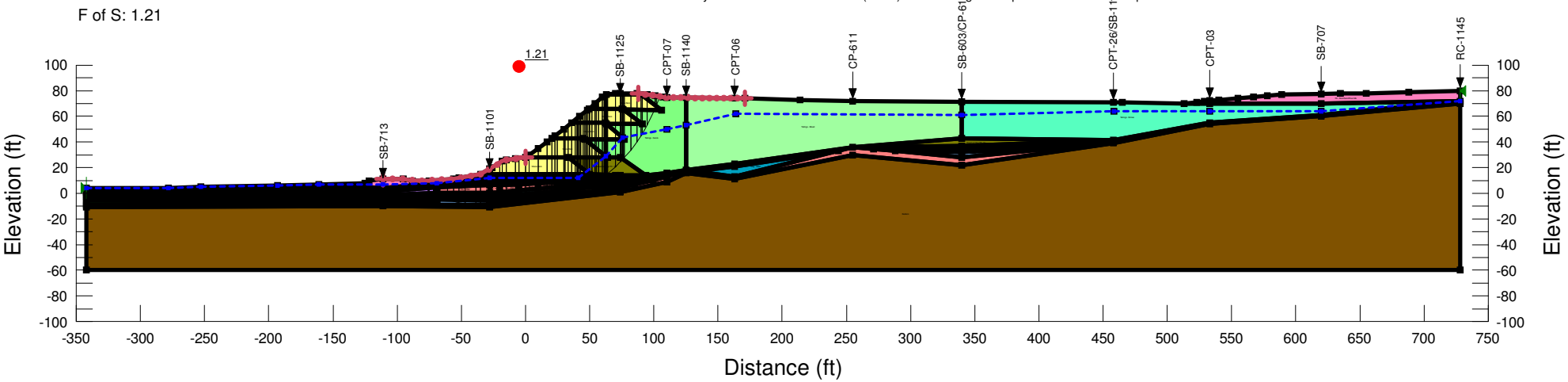

Title: Callahan Mine OU3 - Profile N1
Date: 10/15/2014
File Name: Tailings_Profile N1_Existing-Cond-90%.gsz

Name: Profile N1a - Existing - Ent/Exit - Till Reg
Method: Spencer

Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 117 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Glacial Till - Reg Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 50 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 130 pcf Piezometric Line: 1
Name: Gravel Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38 ° Constant Unit Wt. Above Water Table: 125 pcf Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 120 pcf Piezometric Lir
Name: Fill - Sand/Fines/Org. Mix Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 25 psf Phi': 32 ° Constant Unit Wt. Above Water Table: 115 pcf Piezometric Lin
Name: SM-Clay/Org. - 750 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 750 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 2750 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,750 psf Piezometric Line: 1
Name: Clay - 2250 Model: Undrained (Phi=0) Unit Weight: 124 pcf Cohesion': 2,250 psf Piezometric Line: 1
Name: Clay - 1750 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,750 psf Piezometric Line: 1
Name: Clay - 1250 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,250 psf Piezometric Line: 1
Name: Clay - 475 Model: Undrained (Phi=0) Unit Weight: 119 pcf Cohesion': 475 psf Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Reworked Clay/Till - Su Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Clay - 1075 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,075 psf Piezometric Line: 1
Name: SM-Clay - 1000 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 1,000 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 750 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 750 psf Piezometric Line: 1
Name: Clay - 1375 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,375 psf Piezometric Line: 1
Name: Clay - 950 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 950 psf Piezometric Line: 1
Name: Clay - 1200 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,200 psf Piezometric Line: 1
Name: Clay - 550 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 550 psf Piezometric Line: 1
Name: Clay - 1800 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,800 psf Piezometric Line: 1
Name: Clay - 825 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 825 psf Piezometric Line: 1
Name: Clay - 1875 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,875 psf Piezometric Line: 1
Name: Clay - 2050 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 2,050 psf Piezometric Line: 1
Name: Clay - 1550 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,550 psf Piezometric Line: 1
Name: Clay - 2150 Model: Undrained (Phi=0) Unit Weight: 124 pcf Cohesion': 2,150 psf Piezometric Line: 1
Name: Clay - 2200 Model: Undrained (Phi=0) Unit Weight: 124 pcf Cohesion': 2,200 psf Piezometric Line: 1
Name: Clay - 1700 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,700 psf Piezometric Line: 1
Name: Clay - 1450 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,450 psf Piezometric Line: 1
Name: Clay - 2000 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 2,000 psf Piezometric Line: 1
Name: Clay - 1500 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,500 psf Piezometric Line: 1
Name: Clay - 2500 Model: Undrained (Phi=0) Unit Weight: 124 pcf Cohesion': 2,500 psf Piezometric Line: 1
Name: SM-Clay/Org. - 1500 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,500 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 1050 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,050 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 1175 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,175 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 1200 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,200 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 1300 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,300 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 1375 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,375 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 1450 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,450 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 1300 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,300 psf Piezometric Line: 1
Name: Clay - 1950 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,950 psf Piezometric Line: 1
Name: Clay - 2125 Model: Undrained (Phi=0) Unit Weight: 124 pcf Cohesion': 2,125 psf Piezometric Line: 1
Name: Clay - 1625 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,625 psf Piezometric Line: 1

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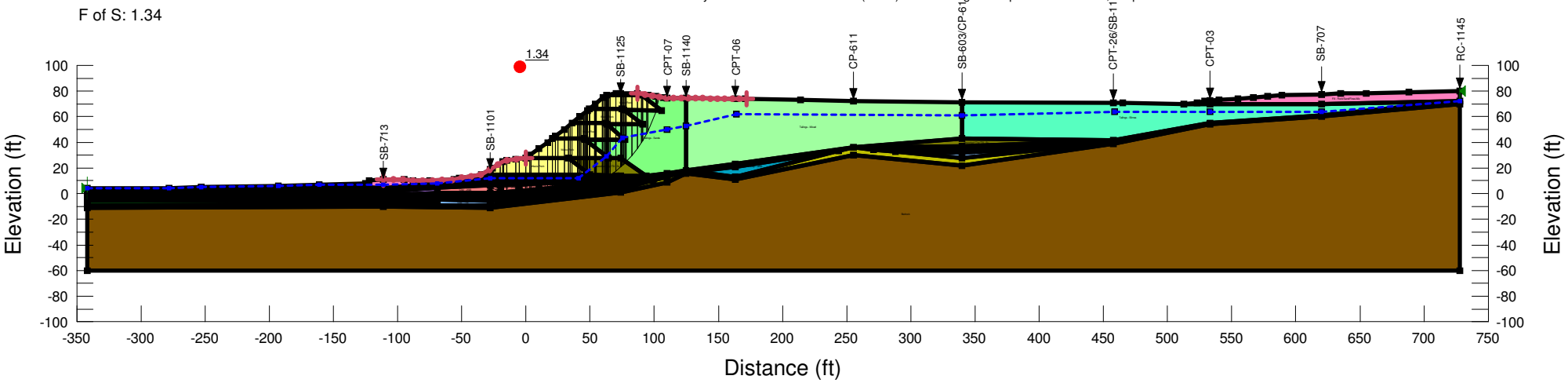


ATTACHMENT N1-F

PROFILE N1
LONG-TERM STATIC SLOPE STABILITY EVALUATION

SLOPE/W MODEL DEVELOPMENT: POST-REMEDIATION CONDITIONS

ATTACHMENT N1-F

PROFILE N1 - SLOPE/W MODEL DEVELOPMENT - PROPOSED CONDITIONS

- See Figure C-1 for profile location.

A. Define Proposed Subgrade/Final Grade Topography

- Proposed subgrade topography is shown on Figure C-1.
- A profile section view is shown on Figure C-3.
- Define long-term post-remediation topography:

Point	STA.	Subgrade EL. (ft)	Final Grade EL. (ft)*
1	7+28	93	94.5
2	6+81	93	94.5
3	6+42	92	93.5
4	6+17	91	92.5
5	5+90	90	91.5
6	5+65	89	90.5
7	5+41	88	89.5
8	4+80	85	86.5
9	2+46	75	76.5
10	2+21	74	75.5
11	0+30	51	52.5
12	0+06	32	32
13	0+00	27	27
14	−0+06	26	26
15	−0+19	25	25
16	−0+39	18	18

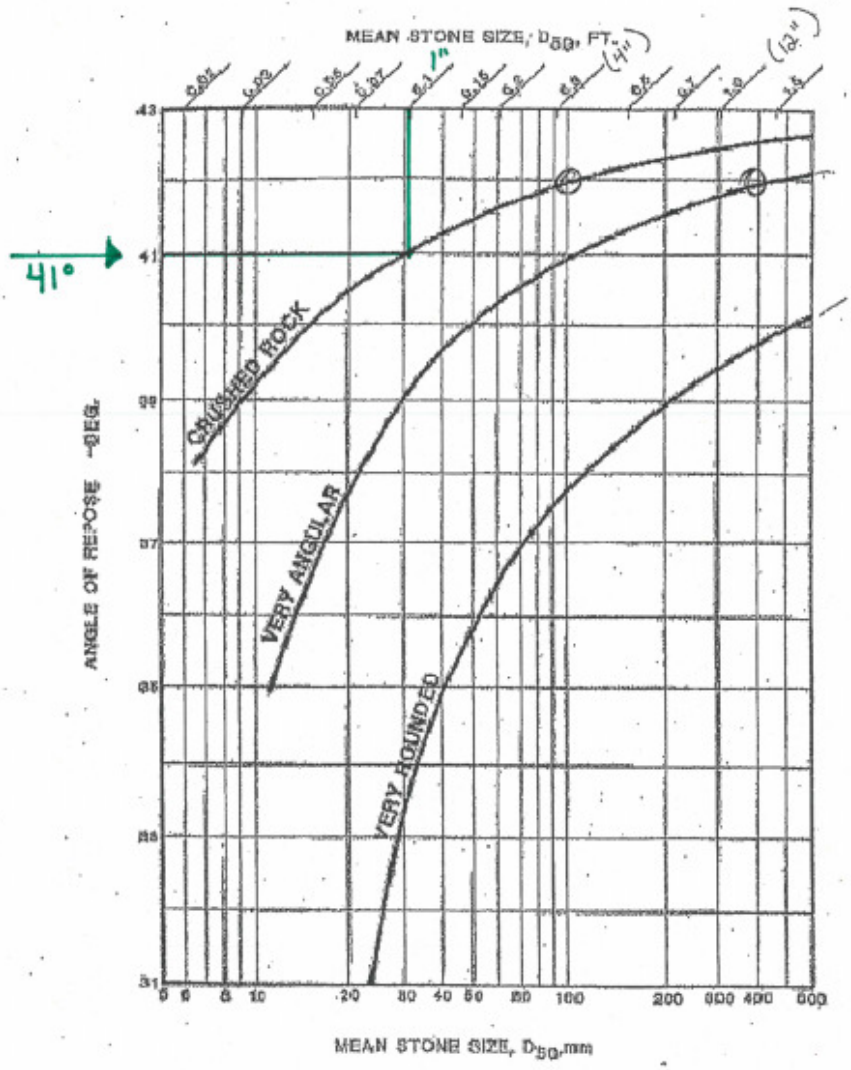
*Notes: Final grade assumes 1.5 ft of agrregate cover over subgrade. Final cap not applicable to points 12-16.

B. Low-Permeability Cover

- The proposed low perm cover system consists of approximately 15 inches of crushed gravel/aggregate over a GDL, FML, and a GCL.
- The crushed gravel (1" < D_{50} < 6") is modeled in Slope/W with the following parameters:
  - Unit Weight = 100 pcf (assume loosely placed, 40% porosity).
  - Friction Angle = 41° (see Sheet 3 - conservatively assume D_{50} = 1").
- The unit weight and strength of the GDL, FML, and GCL are considered insignificant, and these materials were not included in the Slope/W model.

C. Long-Term Groundwater Levels

- Proposed horizontal drain locations are shown on Figure C-1.
- The water levels used for long-term post-remediation conditions are based on the current groundwater model for horizontal drain(s) located at/near the bottom of the tailings, approximately elevation +24 feet (+/-) and approximately 100 feet back from the existing crest, and a low perm cover system.
  - The long-term post-remediation groundwater levels used in the Slope/W models is assumed based on the drain location(s) and as per the groundwater model (Appendix A).



http://www.fhwa.dot.gov/engineering/hydraulics/pubs/05114/images/hec15fig06_01.gif

ATTACHMENT N1-G

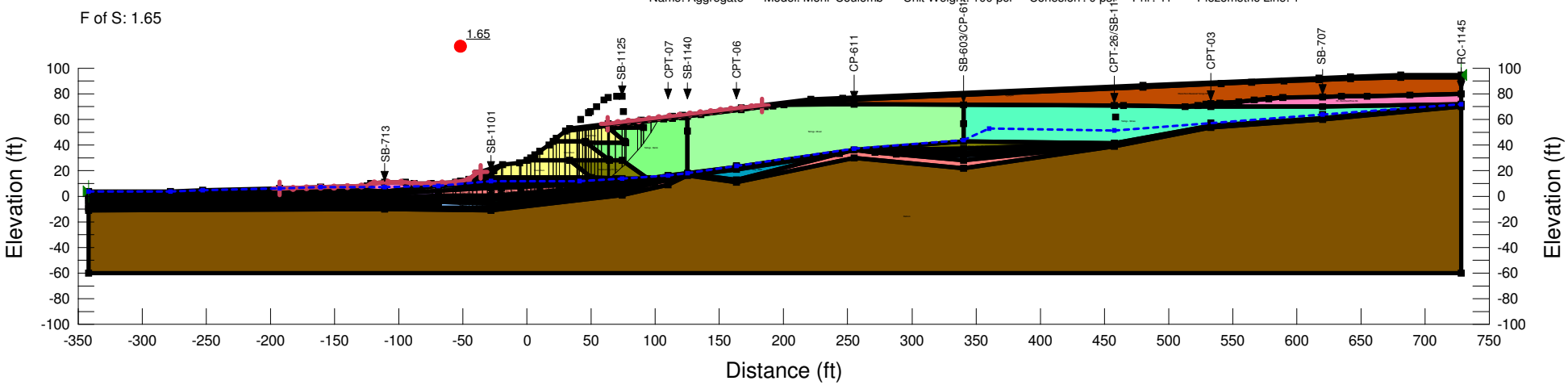
PROFILE N1
LONG-TERM STATIC SLOPE STABILITY EVALUATION

SLOPE/W OUTPUT: POST-REMEDIATION CONDITIONS

Title: Callahan Mine OU3 - Profile N1
Date: 10/16/2014
File Name: Tailings_Profile N1_Proposed-Cond_90%.gsz

Name: Profile N1; a2 - Proposed - Static - Crest/Toe - Till Imp
Method: Spencer

Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 117 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Fill - Sand/Fines/Org. Mix Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 25 psf Phi': 32 ° Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 750 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 750 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 2750 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,750 psf Piezometric Line: 1
Name: Clay - 2250 Model: Undrained (Phi=0) Unit Weight: 124 pcf Cohesion': 2,250 psf Piezometric Line: 1
Name: Clay - 1750 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,750 psf Piezometric Line: 1
Name: Clay - 1250 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,250 psf Piezometric Line: 1
Name: Clay - 475 Model: Undrained (Phi=0) Unit Weight: 119 pcf Cohesion': 475 psf Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Reworked Clay/Till - Su Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Clay - 1075 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,075 psf Piezometric Line: 1
Name: SM-Clay - 1000 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 1,000 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 750 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 750 psf Piezometric Line: 1
Name: Waste Rock/Dewatered Tailings Mix Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 38 ° Constant Unit Wt. Above Water Table: 115 pcf Piezometric
Name: Glacial Till - Impenetrable Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Clay - 1375 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,375 psf Piezometric Line: 1
Name: Clay - 950 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 950 psf Piezometric Line: 1
Name: Clay - 1200 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,200 psf Piezometric Line: 1
Name: Clay - 550 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 550 psf Piezometric Line: 1
Name: Clay - 1800 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,800 psf Piezometric Line: 1
Name: Clay - 825 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 825 psf Piezometric Line: 1
Name: Clay - 1875 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,875 psf Piezometric Line: 1
Name: Clay - 2050 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 2,050 psf Piezometric Line: 1
Name: Clay - 1550 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,550 psf Piezometric Line: 1
Name: Clay - 2150 Model: Undrained (Phi=0) Unit Weight: 124 pcf Cohesion': 2,150 psf Piezometric Line: 1
Name: Clay - 2200 Model: Undrained (Phi=0) Unit Weight: 124 pcf Cohesion': 2,200 psf Piezometric Line: 1
Name: Clay - 1700 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,700 psf Piezometric Line: 1
Name: Clay - 1450 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,450 psf Piezometric Line: 1
Name: Clay - 2000 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 2,000 psf Piezometric Line: 1
Name: Clay - 1500 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,500 psf Piezometric Line: 1
Name: Clay - 2500 Model: Undrained (Phi=0) Unit Weight: 124 pcf Cohesion': 2,500 psf Piezometric Line: 1
Name: SM-Clay/Org. - 1500 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,500 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 1050 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,050 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 1175 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,175 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 1200 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,200 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 1300 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,300 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 1375 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,375 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 1450 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,450 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 1300 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,300 psf Piezometric Line: 1
Name: Clay - 1950 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,950 psf Piezometric Line: 1
Name: Clay - 2125 Model: Undrained (Phi=0) Unit Weight: 124 pcf Cohesion': 2,125 psf Piezometric Line: 1
Name: Clay - 1625 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,625 psf Piezometric Line: 1
Name: Aggregate Model: Mohr-Coulomb Unit Weight: 100 pcf Cohesion': 0 psf Phi': 41 ° Piezometric Line: 1

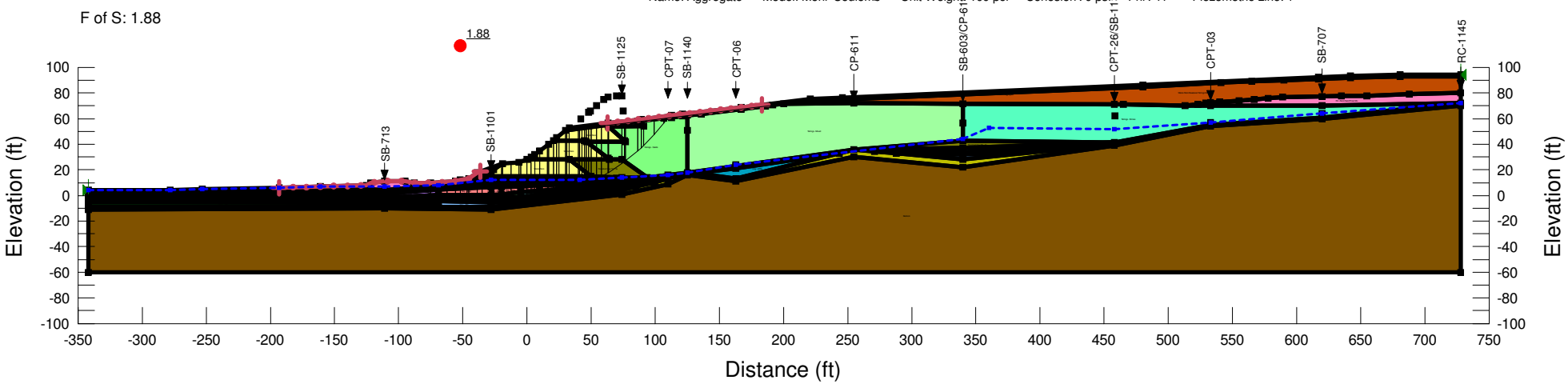


Title: Callahan Mine OU3 - Profile N1
Date: 10/16/2014
File Name: Tailings_Profile N1_Proposed-Cond_90%.gsz

Name: Profile N1; a1 - Proposed - Static - Crest/Toe - Till Reg
Method: Spencer

Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 117 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Glacial Till - Reg Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 50 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 130 pcf Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Fill - Sand/Fines/Org. Mix Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 25 psf Phi': 32 ° Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 750 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 750 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 2750 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,750 psf Piezometric Line: 1
Name: Clay - 2250 Model: Undrained (Phi=0) Unit Weight: 124 pcf Cohesion': 2,250 psf Piezometric Line: 1
Name: Clay - 1750 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,750 psf Piezometric Line: 1
Name: Clay - 1250 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,250 psf Piezometric Line: 1
Name: Clay - 475 Model: Undrained (Phi=0) Unit Weight: 119 pcf Cohesion': 475 psf Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Reworked Clay/Till - Su Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Clay - 1075 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,075 psf Piezometric Line: 1
Name: SM-Clay - 1000 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 1,000 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 750 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 750 psf Piezometric Line: 1
Name: Waste Rock/Dewatered Tailings Mix Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 38 ° Constant Unit Wt. Above Water Table: 115 pcf Piezometric
Name: Clay - 1375 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,375 psf Piezometric Line: 1
Name: Clay - 950 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 950 psf Piezometric Line: 1
Name: Clay - 1200 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,200 psf Piezometric Line: 1
Name: Clay - 550 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 550 psf Piezometric Line: 1
Name: Clay - 1800 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,800 psf Piezometric Line: 1
Name: Clay - 825 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 825 psf Piezometric Line: 1
Name: Clay - 1875 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,875 psf Piezometric Line: 1
Name: Clay - 2050 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 2,050 psf Piezometric Line: 1
Name: Clay - 1550 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,550 psf Piezometric Line: 1
Name: Clay - 2150 Model: Undrained (Phi=0) Unit Weight: 124 pcf Cohesion': 2,150 psf Piezometric Line: 1
Name: Clay - 2200 Model: Undrained (Phi=0) Unit Weight: 124 pcf Cohesion': 2,200 psf Piezometric Line: 1
Name: Clay - 1700 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,700 psf Piezometric Line: 1
Name: Clay - 1450 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,450 psf Piezometric Line: 1
Name: Clay - 2000 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 2,000 psf Piezometric Line: 1
Name: Clay - 1500 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,500 psf Piezometric Line: 1
Name: Clay - 2500 Model: Undrained (Phi=0) Unit Weight: 124 pcf Cohesion': 2,500 psf Piezometric Line: 1
Name: SM-Clay/Org. - 1500 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,500 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 1050 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,050 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 1175 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,175 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 1200 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,200 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 1300 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,300 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 1375 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,375 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 1450 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,450 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 1300 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,300 psf Piezometric Line: 1
Name: Clay - 1950 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,950 psf Piezometric Line: 1
Name: Clay - 2125 Model: Undrained (Phi=0) Unit Weight: 124 pcf Cohesion': 2,125 psf Piezometric Line: 1
Name: Clay - 1625 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,625 psf Piezometric Line: 1
Name: Aggregate Model: Mohr-Coulomb Unit Weight: 100 pcf Cohesion': 0 psf Phi': 41 ° Piezometric Line: 1

F of S: 1.88



Title: Callahan Mine OU3 - Profile N1
Date: 10/16/2014
File Name: Tailings_Profile N1_Proposed-Cond_90%.gsz

Name: Profile N1; b2 - Proposed - Static - Fill/Toe - Till Imp
Method: Spencer

Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 117 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Fill - Sand/Fines/Org. Mix Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 25 psf Phi': 32 ° Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 750 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 750 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 2750 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,750 psf Piezometric Line: 1
Name: Clay - 2250 Model: Undrained (Phi=0) Unit Weight: 124 pcf Cohesion': 2,250 psf Piezometric Line: 1
Name: Clay - 1750 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,750 psf Piezometric Line: 1
Name: Clay - 1250 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,250 psf Piezometric Line: 1
Name: Clay - 475 Model: Undrained (Phi=0) Unit Weight: 119 pcf Cohesion': 475 psf Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Reworked Clay/Till - Su Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Clay - 1075 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,075 psf Piezometric Line: 1
Name: SM-Clay - 1000 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 1,000 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 750 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 750 psf Piezometric Line: 1
Name: Waste Rock/Dewatered Tailings Mix Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 38 ° Constant Unit Wt. Above Water Table: 115 pcf Piezometr
Name: Glacial Till - Impenetrable Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Clay - 1375 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,375 psf Piezometric Line: 1
Name: Clay - 950 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 950 psf Piezometric Line: 1
Name: Clay - 1200 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,200 psf Piezometric Line: 1
Name: Clay - 550 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 550 psf Piezometric Line: 1
Name: Clay - 1800 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,800 psf Piezometric Line: 1
Name: Clay - 825 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 825 psf Piezometric Line: 1
Name: Clay - 1875 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,875 psf Piezometric Line: 1
Name: Clay - 2050 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 2,050 psf Piezometric Line: 1
Name: Clay - 1550 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,550 psf Piezometric Line: 1
Name: Clay - 2150 Model: Undrained (Phi=0) Unit Weight: 124 pcf Cohesion': 2,150 psf Piezometric Line: 1
Name: Clay - 2200 Model: Undrained (Phi=0) Unit Weight: 124 pcf Cohesion': 2,200 psf Piezometric Line: 1
Name: Clay - 1700 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,700 psf Piezometric Line: 1
Name: Clay - 1450 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,450 psf Piezometric Line: 1
Name: Clay - 2000 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 2,000 psf Piezometric Line: 1
Name: Clay - 1500 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,500 psf Piezometric Line: 1
Name: Clay - 2500 Model: Undrained (Phi=0) Unit Weight: 124 pcf Cohesion': 2,500 psf Piezometric Line: 1
Name: SM-Clay/Org. - 1500 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,500 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 1050 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,050 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 1175 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,175 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 1200 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,200 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 1300 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,300 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 1375 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,375 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 1450 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,450 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 1300 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,300 psf Piezometric Line: 1
Name: Clay - 1950 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,950 psf Piezometric Line: 1
Name: Clay - 2125 Model: Undrained (Phi=0) Unit Weight: 124 pcf Cohesion': 2,125 psf Piezometric Line: 1
Name: Clay - 1625 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,625 psf Piezometric Line: 1
Name: Aggregate Model: Mohr-Coulomb Unit Weight: 100 pcf Cohesion': 0 psf Phi': 41 ° Piezometric Line: 1

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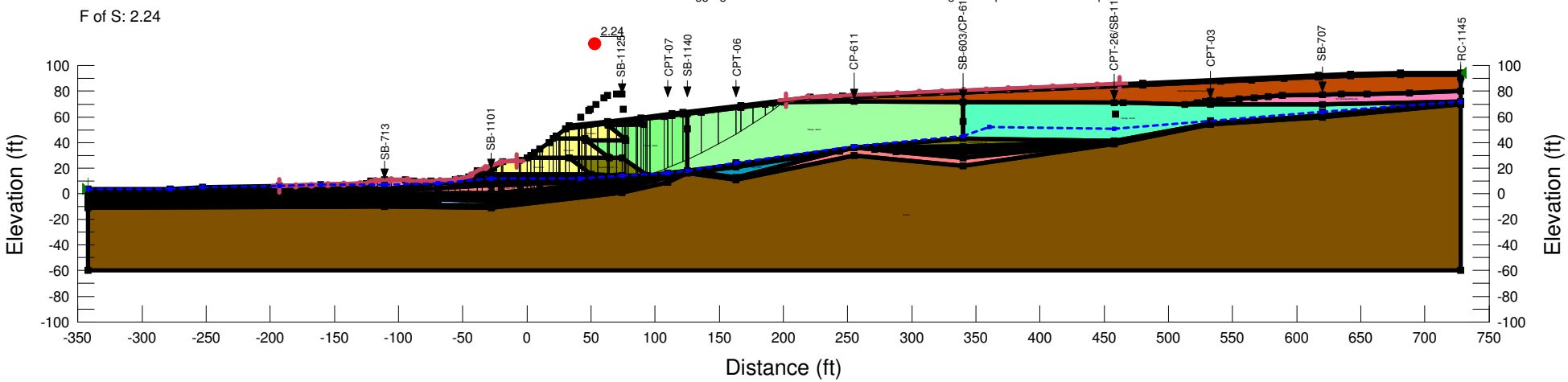
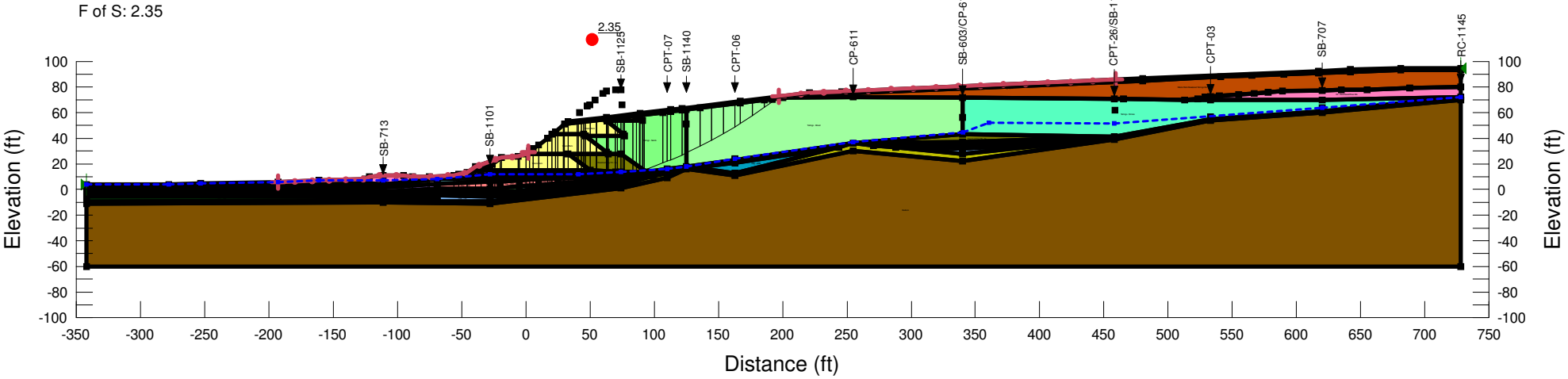


Title: Callahan Mine OU3 - Profile N1
Date: 10/16/2014
File Name: Tailings_Profile N1_Proposed-Cond_90%.gsz

Name: Profile N1; b1 - Proposed - Static - Fill/Toe - Till Reg
Method: Spencer

Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 117 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Glacial Till - Reg Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 50 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 130 pcf Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Fill - Sand/Fines/Org. Mix Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 25 psf Phi': 32 ° Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 750 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 750 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 2750 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,750 psf Piezometric Line: 1
Name: Clay - 2250 Model: Undrained (Phi=0) Unit Weight: 124 pcf Cohesion': 2,250 psf Piezometric Line: 1
Name: Clay - 1750 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,750 psf Piezometric Line: 1
Name: Clay - 1250 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,250 psf Piezometric Line: 1
Name: Clay - 475 Model: Undrained (Phi=0) Unit Weight: 119 pcf Cohesion': 475 psf Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Reworked Clay/Till - Su Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Clay - 1075 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,075 psf Piezometric Line: 1
Name: SM-Clay - 1000 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 1,000 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 750 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 750 psf Piezometric Line: 1
Name: Waste Rock/Dewatered Tailings Mix Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 38 ° Constant Unit Wt. Above Water Table: 115 pcf Piezometric L
Name: Clay - 1375 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,375 psf Piezometric Line: 1
Name: Clay - 950 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 950 psf Piezometric Line: 1
Name: Clay - 1200 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,200 psf Piezometric Line: 1
Name: Clay - 550 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 550 psf Piezometric Line: 1
Name: Clay - 1800 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,800 psf Piezometric Line: 1
Name: Clay - 825 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 825 psf Piezometric Line: 1
Name: Clay - 1875 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,875 psf Piezometric Line: 1
Name: Clay - 2050 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 2,050 psf Piezometric Line: 1
Name: Clay - 1550 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,550 psf Piezometric Line: 1
Name: Clay - 2150 Model: Undrained (Phi=0) Unit Weight: 124 pcf Cohesion': 2,150 psf Piezometric Line: 1
Name: Clay - 2200 Model: Undrained (Phi=0) Unit Weight: 124 pcf Cohesion': 2,200 psf Piezometric Line: 1
Name: Clay - 1700 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,700 psf Piezometric Line: 1
Name: Clay - 1450 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,450 psf Piezometric Line: 1
Name: Clay - 2000 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 2,000 psf Piezometric Line: 1
Name: Clay - 1500 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,500 psf Piezometric Line: 1
Name: Clay - 2500 Model: Undrained (Phi=0) Unit Weight: 124 pcf Cohesion': 2,500 psf Piezometric Line: 1
Name: SM-Clay/Org. - 1500 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,500 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 1050 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,050 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 1175 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,175 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 1200 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,200 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 1300 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,300 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 1375 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,375 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 1450 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,450 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 1300 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,300 psf Piezometric Line: 1
Name: Clay - 1950 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,950 psf Piezometric Line: 1
Name: Clay - 2125 Model: Undrained (Phi=0) Unit Weight: 124 pcf Cohesion': 2,125 psf Piezometric Line: 1
Name: Clay - 1625 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,625 psf Piezometric Line: 1
Name: Aggregate Model: Mohr-Coulomb Unit Weight: 100 pcf Cohesion': 0 psf Phi': 41 ° Piezometric Line: 1

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