APPENDIX G
SETTLEMENT EVALUATION

TECHNICAL MEMORANDUM

Project No: 3612112201

Date: December 5, 2014

To: Mark A. Peters, P.E.

From: Nicholas D. Langlais, EIT; Richard S. Egan, P.E.

Subject: **Tailings Impoundment Settlement Evaluation**
OU 3 Draft Final Design
Callahan Mine Superfund Site
Brooksville, Maine

1.0 INTRODUCTION

This Technical Memorandum summarizes a settlement evaluation performed to support the Operable Unit 3 (OU3) Draft Final Design for the Tailings Impoundment remedy at Callahan Mine Superfund Site (Site) located in Brooksville, Maine.

The remedy for the Tailings Impoundment calls for stabilization measures (e.g., dewatering and crest improvements) to improve global stability. The crest improvements require an extensive cut/fill operation. Excavated waste rock and/or dewatered tailings will be removed from the perimeter impoundment dam crest and permanently relocated, and placed as subgrade fill, within central and western portions of the Tailings Impoundment beneath a low-permeability cover system. The underlying tailings slimes and native clay will experience consolidation settlement as a result of the additional vertical load imposed by the proposed fill. The fill area encompasses approximately 5 acres.

This Technical Memorandum constitutes Appendix G of the Draft Final Basis of Design (BOD) Report. The following sections briefly summarize project information, describe subsurface conditions, review estimated settlements, and present the methodology, assumptions, results, and conclusions of this 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 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 G-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);
- Glacial Till; and
- Bedrock

The thickness of the tailings ranges from about 5 to 60 feet, and the thickness generally increases from west to east. Tailing “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 and/or constructed with clay fill/re-work and then faced extensively with waste rock.

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.

2.2 Proposed Remedy

The remedy for the Tailings Impoundment calls for stabilization measures (e.g., dewatering and crest improvements) to improve global stability. The crest improvements require an extensive cut/fill operation; up to approximately 23 feet of waste rock and/or dewatered tailings will be removed from the perimeter impoundment dam crest and permanently relocated within central and western portions of the Tailings Impoundment beneath a low-permeability cover system. As a result, up to approximately 23 feet of waste rock and/or dewatered tailings will be placed (in lifts) and compacted atop approximately 10 to 40 feet of highly compressible, saturated tailings “slimes”, which overlay up to approximately 15 feet of native clay. The fill area encompasses approximately 5 acres. Existing and proposed subgrade elevations are presented in Figure G-1.

3.0 SETTLEMENT EVALUATION

AMEC conducted a settlement evaluation to assess the magnitude and time-rate of settlement (primary and secondary consolidation) of tailings slimes and re-worked/native clay resulting from the increased soil loading associated with the remedy. Up to approximately 23 feet of waste rock and/or dewatered tailings will be placed atop existing grade in central and western portions of the Tailings Impoundment, where tailings slimes and native clay dominate the subsurface profile.

Tailings slimes and soil unit weights and consolidation parameters were assigned based on prior site-specific laboratory consolidation testing results (Mactec 2009; Credere 2012), empirical correlations to published literature values, and/or engineering judgment. For the purposes of this evaluation, the slimes are assumed to be normally consolidated (OCR=1), the re-worked and native clay are assumed to be overconsolidated (OCR>1), and existing fill (where present) and glacial till are assumed to be incompressible. A summary of unit weights and consolidation parameters utilized for each strata present is presented in Table G-1.

Table G-1 – Summary of Soil Unit Weight and Consolidation Parameters

Stratum	Unit Weight γ_t or γ_{sat} (pcf)	OCR σ'_p/σ'_{v0} [1] (-)	Modified Compression Index $C_{c\varepsilon}$ [2] (-)	Modified Recompression Index $C_{r\varepsilon}$ [3] (-)	Coefficient of Consolidation c_v (ft^2/day)	Coefficient of Secondary Consolidation c_α (ft^2/day)
Fill (existing)	120	-	-	-	-	-
Slimes (unsaturated)	110	1.0	0.15	0.05	1.00	0.005
Slimes (saturated)	115	1.0	0.15	0.05	1.00	0.005
Re-Worked Clay/Till (Fill)	125	2.0	0.15	0.02	2.00	0.005
Very Stiff Clay (native)	125	2.0	0.15	0.02	4.00	0.005
Stiff Clay (native)	125	2.0	0.15	0.02	3.00	0.005
Medium Stiff Clay (native)	120	2.0	0.15	0.02	2.00	0.005
Soft Clay (native)	120	2.0	0.15	0.02	0.50	0.005
Glacial Till	135	-	-	-	-	-

Notes: 1. OCR = σ'_p/σ'_{v0} = preconsolidation pressure / in-situ vertical effective stress.
2. $C_{c\varepsilon} = C_c / (1+e_0)$
3. $C_{r\varepsilon} = C_r / (1+e_0)$

Eighteen (18) locations within the proposed fill area were evaluated using representative/as-drilled subsurface profiles and groundwater conditions at and/or proximate to that location. Evaluation locations, shown on Figure G-1, are consistent with locations of soil borings (SB) and/or piezocones (SCPT, CPT, or CP) performed previously by Mactec (2009) and Credere (2012). Tailings slimes ranged from 10 to 40 feet in thickness, and native clay ranged from 0 to 15 feet in thickness, at the evaluation locations.

3.1 Primary Consolidation Settlement

AMEC estimated in-situ total stress, pore pressure, and effective stress at the top, middle, and bottom of each primary soil stratum based on the subsurface soil and groundwater conditions at each location. At each location, AMEC compared the proposed subgrade elevation to the existing grade in order to estimate the induced soil load resulting from the grade increase. The effective stress change was then calculated based on an assumed proposed fill (waste rock/dewatered tailings) unit weight of 120 pounds per cubic foot (pcf). Based on the stress increase, AMEC estimated primary consolidation settlement at each location, in each stratum,

using the modified compression values shown in Table G-1. A detailed settlement evaluation narrative of methods and assumptions, including a sample calculation, is included in Attachment G-1.

To summarize, primary consolidation settlement may range from less than 6 inches (where minimal grade increase is expected) to a maximum of approximately 32 inches where grade is anticipated to be approximately 23 feet above existing grade. The average settlement is anticipated to be approximately 17 inches. The majority of the settlement should occur in the tailings slimes; settlement contribution from the native clay is expected to be 1.5 inches or less. Anticipated settlement at each evaluation location is summarized in Table G-2 (Attachment G-2). Settlement calculation spreadsheets for each location are also presented in Attachment G-2. The magnitude of settlement induced by the low-permeability cover system (not considered in this evaluation) is anticipated to be on the order of 1 to 2 inches.

3.2 Time-Rate of Primary Consolidation

AMEC estimated the time required for primary consolidation (90% and 99%) to occur at each location based on the Terzaghi theory of consolidation. The coefficient of consolidation, c_v, was estimated for each of the compressible primary soil strata based on the results of site-specific one-dimensional consolidation testing data and/or empirical correlations to published values utilizing index testing data (i.e., Atterberg Limits). The c_v values utilized for each stratum are summarized in Table G-1.

The two primary strata contributing to settlement, tailings slimes and native clay, were converted into a single equivalent layer in accordance with procedures presented in NAVFAC DM-7.1 (Department of the Navy, 1982). The conversion yielded a single equivalent layer, as shown in the sample calculation in Attachment G-1. Since the slimes and clay are is underlain by low permeability glacial till and/or bedrock, single drainage was assumed for the equivalent layer.

Based on the results of the evaluation, it is anticipated that the time required to achieve 90% of primary consolidation of the slimes/clay under proposed subgrade fill ranges from approximately 1.5 months to 3.5 years; the time required to achieve 99% of primary consolidation ranges from approximately 3.5 months to 7.5 years per lift of fill. The time required to achieve a certain degree of consolidation is driven/controlled by the thickness of the slimes/clay. A summary of time required to reach 90% and 99% of primary consolidation is presented in Table G-2 (Attachment G-2).

3.3 Secondary Consolidation

Secondary consolidation of the slimes and clay soils can result in additional settlement following the completion of primary consolidation after excess pore pressures have dissipated.

AMEC estimated the secondary consolidation settlement at each evaluation location, over a 50 year design life. The coefficients of secondary consolidation (C_α) utilized are summarized in Table G-1. Secondary consolidation settlement in the proposed fill area is expected to range

from 1 to 2 inches. Secondary consolidation settlement estimates for each location are summarized in Attachment G-2.

4.0 DISCUSSION AND RECOMMENDATIONS

The results of the settlement evaluation indicate that an average of approximately 17 inches of primary consolidation settlement is likely to occur in proposed fill areas, due to increased soil loading on the slimes and clay, within central and western portions of the Tailings Impoundment. As such, the magnitude of settlement expected to occur should be considered in the cut/fill mass balance of the remedy.

It is anticipated that it will take up to approximately 3.5 years to achieve 90%, and up to 7.5 years to achieve 99%, of primary consolidation per lift of fill. To reduce consolidation time, for constructability purposes, prefabricated vertical drains (PVDs) (i.e., wick drains, EQ drains, etc.) should be installed in proposed fill areas. In general, PVDs reduce the length of the drainage path for water to be "squeezed" out of the low permeability stratum (i.e., slimes). PVDs are typically installed in a triangular grid pattern with 3 to 6-foot center to center spacing (the closer the drains, the less time required to achieve a degree of consolidation, and vice versa).

5.0 REFERENCES

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

Department of the Navy, Naval Facilities Engineering Command, 1982. "Soil Mechanics, Design Manual 7.1" (NAVFAC DM-7.1), May 1982.

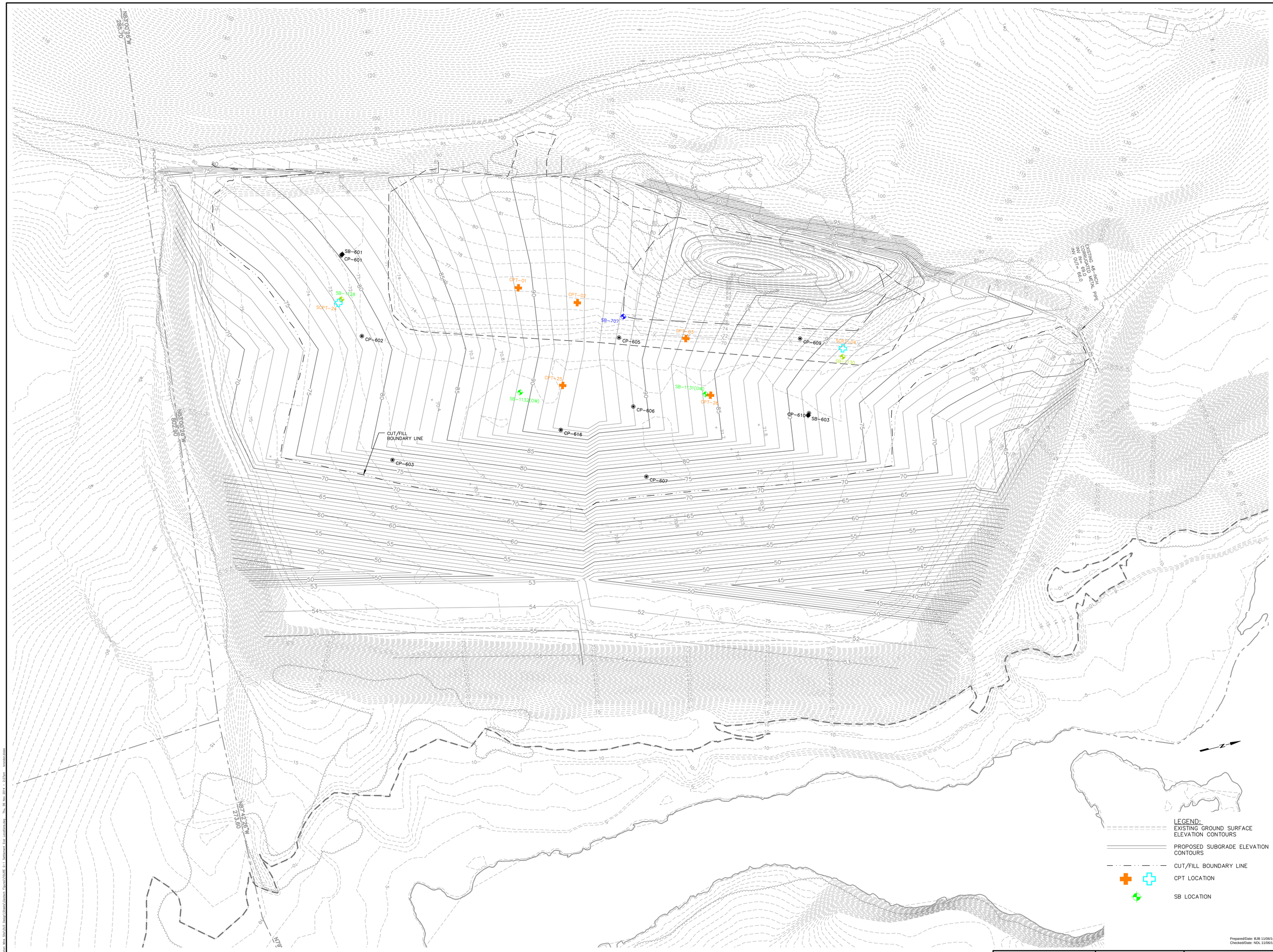
MACTEC, 2009a. "Geotechnical Evaluation Report, Callahan Mine Superfund Site, Brooksville, Maine", January 2009.

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.

FIGURES



Prepared/Date: BJB 11/06/14
Checked/Date: NDL 11/06/14

NOT FOR CONSTRUCTION

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

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SETTLEMENT
EVALUATION LOCATIONS
Project 3612-11-2201
Figure G-1

ATTACHMENTS

ATTACHMENT G-1

Narrative of Methods and Assumptions; Sample Calculation

(checked by RSE 11/14)

JOB NO. 36121122001 SHEET 1 OF 8
PHASE – TASK –
JOB NAME Callahan Mine - Tailings Impound
BY NDL DATE 10/27/14
CHECKED BY DATE

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SETTLEMENT EVALUATION

A. Objective(s):

1. Estimate the magnitudes of primary and secondary settlement expected to occur due to loading imposed on tailings Slimes and native Presumpscot Clay by excavated waste rock/dewatered tailings placed as fill to reach proposed subgrade elevations.
2. Estimate the time required to achieve 90% and 99% of primary consolidation settlement.

B. Procedure, Methods, + Assumptions

1. Select settlement evaluation locations based on proposed grades vs. existing grades (ie, fill area), extent of tailings Slimes, and the proximity of previously performed geotechnical explorations.
2. Establish subsurface profile for each evaluation location.
   a. Identify depth, thickness, and elevation of primary strata based on nearby/proximate geotechnical SBs, CPTs, and or SCPTs.
      - "Geotechnical Evaluation Report, Callahan Mine Superfund Site, Brooksville, ME" Mactec, January 2009
      - "2011 Supplemental Geotechnical Investigation, Tailings Impoundment Area - OU1 Remedial Action" Credere, February 2012.
   b. Chosen evaluation locations are coincident with previously performed geotechnical exploration locations.
3. Calculate in-situ and proposed stress vs. depth
   a. Total Stress Calculations based on the following assumed soil unit weights:

– Fill (existing)	120	pcf
– Slimes (unsat)	110	pcf
– Slimes (sat)	115	pcf
– Clay/Till Fill	125	pcf
– V. Stiff Clay	125	pcf
– Stiff Clay	125	pcf
– M. Stiff Clay	120	pcf
– Soft Clay	120	pcf
– Glacial Till	135	pcf

γ_t or γ_{sat}

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B. Procedures, Methods, + Assumptions - Cont

3. Calculate in-Situ + proposed Stress vs. depth - Cont

b. Pore pressure calculations assume hydrostatic conditions below the estimated/interpolated phreatic surface at each location. Actual site-specific groundwater data indicate a small downward vertical gradient in the tailings.

c. In-situ effective stress, σ'_{v_o} = total stress (σ_{v_o}) - pore pressure (u_o)

d. The increase in stress due to proposed subgrade elevations was based on an assumed fill (waste rock/dewatered tailings) unit weight of 120 pcf.

- $\Delta\sigma'_v$ = 120 pcf x proposed grade raise in feet

4. Estimate Primary Consolidation Settlement due to proposed grading.

- Primary Consolidation Settlement was estimated for each location.

a. Slimes were assumed to be normally consolidated (ie. OCR = 1). Primary Consolidation of the slimes assumes virgin compression. A Modified Compression Index ($C_{c\epsilon} = C_c/1+e_o$) of 0.15 was assumed based on results of site-specific laboratory testing.

b. Clay (native and reworked/fill) were assumed to be slightly overconsolidated (soft clay) to overconsolidated (ie. OCR = 1.2-2). Primary Consolidation of the clay assumes recompression (for $\sigma'_v + \Delta\sigma'_v < \sigma'_p$) or recompression + virgin compression (for $\sigma'_v + \Delta\sigma'_v > \sigma'_p$). $C_{c\epsilon}$ of 0.15 and Modified Recompression Index ($C_{r\epsilon} = C_r/1+e_o$) of 0.02 were assumed based on results of site specific laboratory testing and literature values.

c. Existing surficial fill and glacial till were assumed to be incompressible.

- $S_{pc} = C_{c\epsilon} \times H_o \times \log_{10}\left[\frac{\sigma'_{vo} + \Delta\sigma'_v}{\sigma'_{vo}}\right]$ Virgin Compression

- $S_{pc} = C_{r\epsilon} \times H_o \times \log_{10}\left[\frac{\sigma'_{vo} + \Delta\sigma'_v}{\sigma'_{vo}}\right]$ Recompression

Where: S_{pc} = Settlement due to primary consolidation
H_o = Initial thickness of stratum

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B. Procedures, Methods, + Assumptions - Cont

5. Estimate time rate of Primary Consolidation

a. Estimate time required to achieve 90% and 99% of the estimated primary Consolidation settlement.

b. Apply Terzaghi theory of Consolidation

- $t = \frac{T \times H_{dr}^2}{C_v}$ Where: t = time since application of load
  T = Time factor (Terzaghi theory)
  90% → $T = 0.848$
  99% → $T = 1.781$
  H_{dr} = Height of drainage Pathway
  C_v = Coefficient of Consolidation - from laboratory testing and/or empirical correlations.

- The Cv values utilized for this evaluation are summarized as follows:

  - Slimes → Cv = 1.0 ft²/day
  - Clay/Till/Fill → Cv = 2.0 ft²/day
  - V. Stiff Clay → Cv = 4.0
  - Stiff Clay → Cv = 3.0
  - M. Stiff Clay → Cv = 2.0
  - Soft Clay → Cv = 0.5

  - Cv values for slimes were based on site specific consolidation test results
  - Cv values for clay were based on site specific Consolidation testing results, empirical correlations (see Sheet 4), and/or engineering judgment.

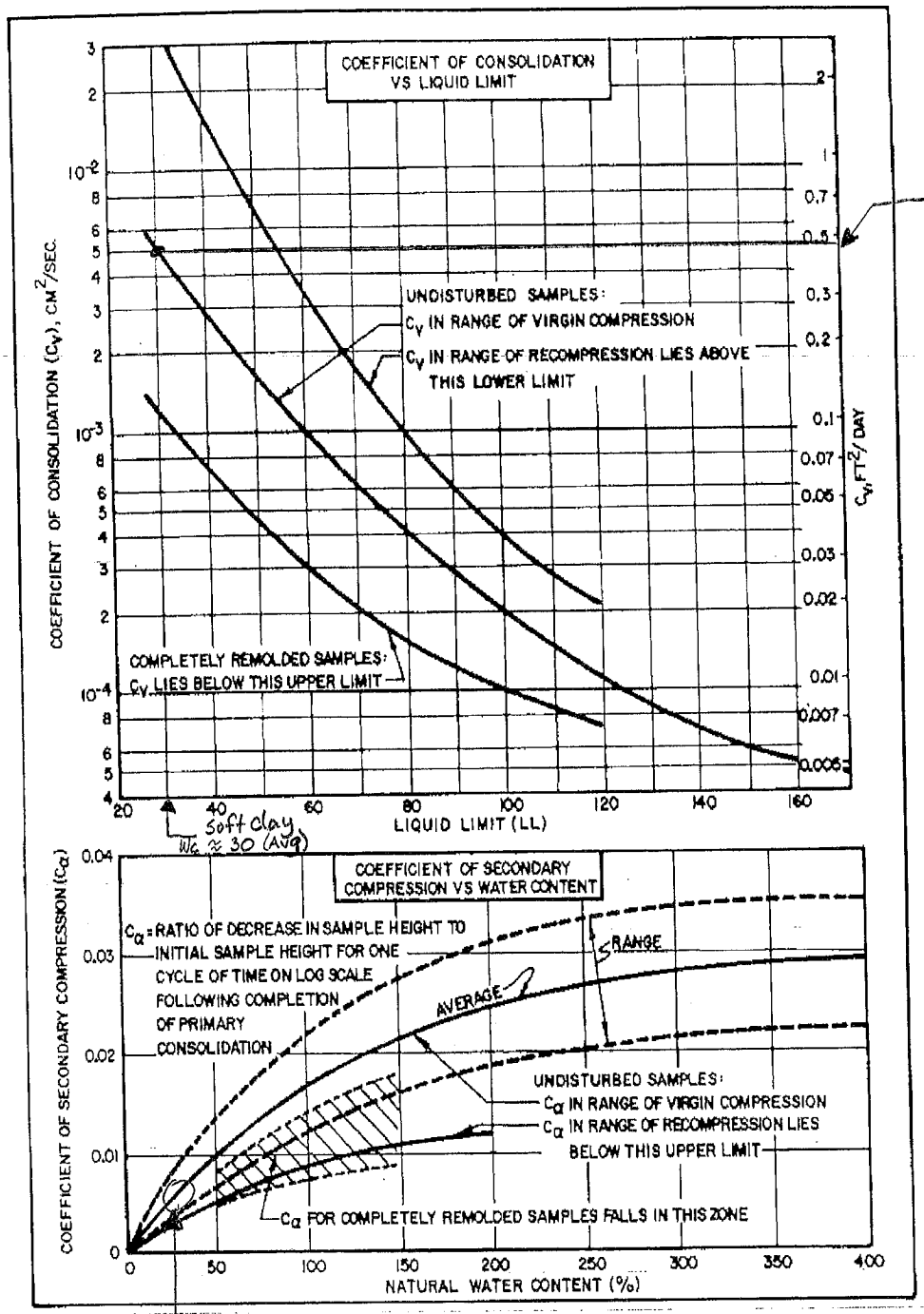

FIGURE 4
Approximate Correlations for Consolidation Characteristics of Silts and Clays

OC Clay, C_v ↑

~NC
Soft Clay $C_v \approx 0.5 \frac{ft^2}{day}$

$C_\alpha \approx 0.005$
Slimes + Clay

* From NAVFAC DM 7.1 (Dept. of the Navy, 1982)

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B. Procedures, Methods, + Assumptions - Cont

5. Estimate time-rate of primary Consolidation (cont)

C. In general, the Slimes are underlain by clay, glacial till, and/or bedrock. As such, it is reasonable to assume Single drainage of Slimes and clay, assuming that the underlying Till/Bedrock is impermeable. Water can only drain out the top of the Slimes.

Approach utilized for this evaluation:

- A multi-layer system can be converted to a single equivalent layer using procedures presented in NAVFAC DM 7.1 (pg 7.1-236), as follows:

Slimes:	H_{Slime}	$C_{v\,Slime} = 1.0$ ft²/day
Clay Till Fill:	H_{Fill}	$C_{v\,Fill} = 2.0$ ft²/day
V. Stiff Clay:	$H_{V.Stiff}$	$C_{v\,V.Stiff} = 4.0$ ft²/day
Stiff Clay:	H_{Stiff}	$C_{v\,Stiff} = 3.0$ ft²/day
M. Stiff Clay:	$H_{M.Stiff}$	$C_{v\,M.Stiff} = 2.0$ ft²/day
Soft Clay:	H_{Soft}	$C_{v\,Soft} = 0.5$ ft²/day
Till/Bedrock		

- Equivalent layer thickness $H_E = H_{Slime} + H_{Fill}\left[\frac{C_{v\,Slime}}{C_{v\,Fill}}\right]^{0.5} + H_{V.Stiff}\left[\frac{C_{v\,Slime}}{C_{v\,V.Stiff}}\right]^{0.5}$ ... and so on
- Then, assume Single drainage for the Single equivalent layer having a thickness of H_E and a C_v of 1.0 ft²/day.

6. Estimate Secondary Compression Settlement under proposed Subgrade loading

A. Estimate Secondary Consolidation Settlement as follows:

- $S_s = C_\alpha \times H_o \times \Delta \log_{10} t$, where: S_s = Secondary Compression Settlement
  C_α = Secondary Compression Ratio
  H_o = Initial layer thickness
  $\Delta \log t$ = Change in log time from end of primary to the end of the design life

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B. Procedures, Methods, + Assumptions - Cont

6. Estimate Secondary Compression - Cont

- Assume $C_\alpha = 0.005$, from empirical correlations based on index testing data. See pg 4 and pg 7.
- Assume design life of project is 50 years
- Assume end of primary occurs at t_{99}.

C. Sample Calculation

1. Use CP-607 location as example.

a. Existing Grade = 69.6 ft
b. Proposed Grade = 77.0 ft

2. Define Subsurface Profile

a. 0 - 35.5 ft bgs : Slimes
35.5 - 41.0 ft bgs : Stiff Clay
41.0 - 43.1 ft bgs : Glacial Till
43.1 ft bgs : Bedrock

b. Groundwater/phreatic surface present at ≈ 1 ft bgs (based on pore pressure dissipation test)

3. Calculate in-situ and proposed stress at the center of each Compressible Stratum.

a. In-Situ effective stress

- Center Slimes (unsat) $\Rightarrow \sigma'_{vo} = 110\ pcf \times 0.5\ ft = 55\ psf$
- Center Slimes (sat) $\Rightarrow \sigma'_{vo} = (110\ pcf)(1\ ft) + (115-62.5)(34.5/2) = 1017\ psf$
- Center Clay $\Rightarrow \sigma'_{vo} = 1017\ psf + (115-62.4)(34.5/2) + (125-62.4)(5.5/2) = 2097\ psf$

b. Stress increase due to proposed loading

- $\Delta\sigma'_v = (77-69.6)(120) = 888\ psf$

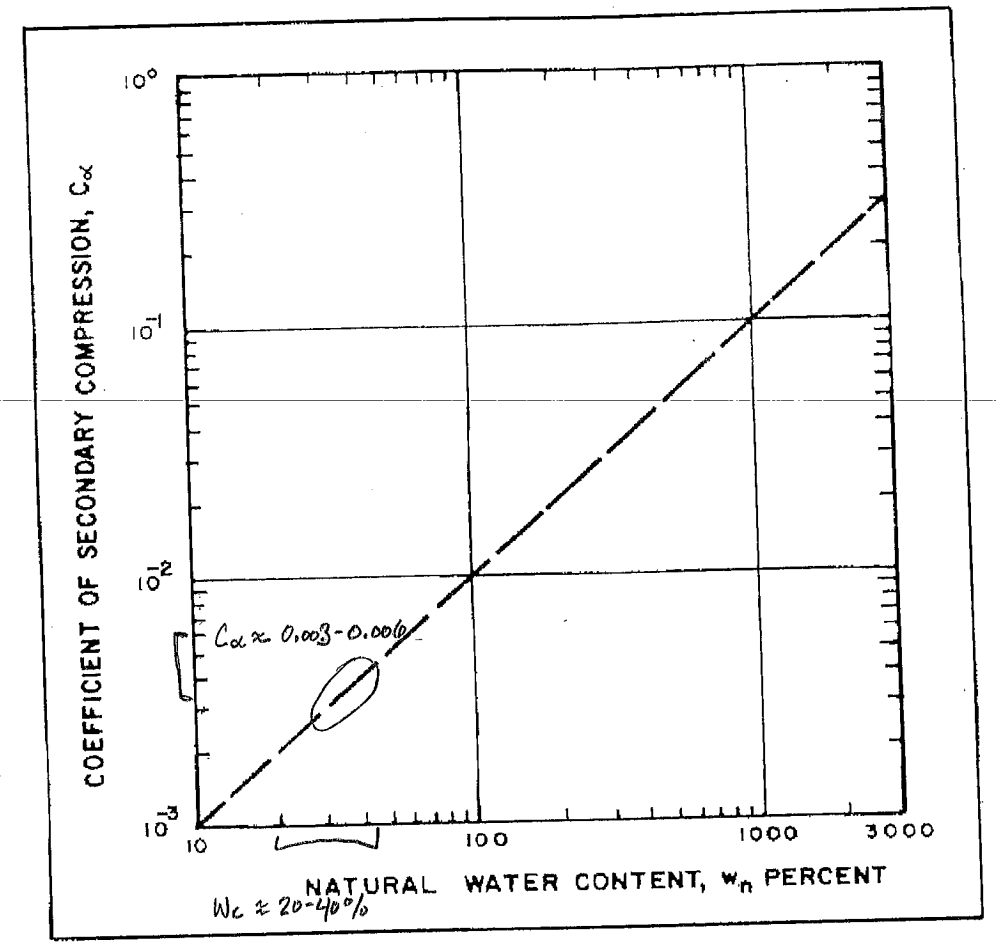

FIGURE 16
Coefficient of Secondary Compression as Related to Natural Water Content

from NAVFAC DM. 7.1 (Dept of the Navy, 1982)

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C. Sample Calculation - Cont

4. Estimate Primary Consolidation Settlement in each Stratum

a. Slimes (unsat) → $S_{pc} = (0.15)(1\text{ ft}) \log\left[\frac{55 + 888}{55}\right] = 0.185' = 2.2$ in

b. Slimes (sat) → $S_{pc} = (0.15)(34.5) \log\left[\frac{1017 + 888}{1017}\right] = 1.41' = 16.9$ in

c. Clay ($\sigma_{vo} + \Delta\sigma' < \sigma_p'$) (recompression) → $S_{pc} = (0.02)(5.5) \log\left[\frac{2097 + 888}{2097}\right] = 0.017' = 0.2$ in

Σ 19.3 in

5. Estimate time-rate of primary Consolidation

a. Convert Slimes + Clay into an equivalent single layer with height H_E

- $H_E = 35.5\text{ ft} + 5.5\text{ ft}\left[\frac{1.0\text{ ft}^2/\text{day}}{3.0\text{ ft}^2/\text{day}}\right]^{1/2} = 38.68$ ft

b. Assume Single drainage

- $t_{90} = \frac{(0.848)(38.68')^2}{1.0\text{ ft}^2/\text{day}} = 1268$ days $= 3.5$ years
- $t_{99} = \frac{(1.781)(38.68)^2}{1.0} = 26604$ days $= 7.3$ years

6. Estimate Secondary Compression Settlement

a. Slimes : $S_s = (0.005)(35.5) \log\left[\frac{50\text{ yrs}}{7.3\text{ yrs}}\right] = 1.8$ in

b. Clay : $S_s = (0.005)(5.5) \log\left[\frac{50\text{ yrs}}{7.3\text{ yrs}}\right] = 0.3$ in

ATTACHMENT G-2

Evaluation Results Summary; Spreadsheet Calculations

TAILINGSIMPOUNDMENT SETTLEMENT EVALUATION SUMMARY

LOCATION WITHIN IMPOUNDMENT	ANALYSIS POINT (Exploration Location)	ELEVATION DATA (At and/or Proximate to Analysis Point)			ESTIMATED SETTLEMENT DUE TO PROPOSED SUBGRADE (Primary Consolidation)			ESTIMATED TIME REQUIRED TO ACHIEVE 90% CONSOLIDATION (Single Drainage)	ESTIMATED TIME REQUIRED TO ACHIEVE 99% CONSOLIDATION (Single Drainage)	ESTIMATED SETTLEMENT DUE TO PROPOSED SUBGRADE ELEVATION (Secondary Compression)		
		Existing Grade	Proposed Subgrade	Proposed Fill Thickness	Stratum		Total	Time	Time	Stratum		Total
					Tailings Slimes	Clay				Tailings Slimes	Clay	
		(feet)	(feet)	(feet)	(inches)	(inches)	(inches)	(years)	(years)	(inches)	(inches)	(inches)
WESTERN EXTENT OF SLIMES (South to North)	SB-601/CP-601	71.4	80.3	8.8	13.1	3.6	**16.7**	1.9	4.0	0.8	1.1	**1.9**
	SB-1128/SCPT-24	72.5	78.5	6.0	9.8	1.0	**10.8**	2.4	5.1	1.1	0.9	**2.0**
	CPT-01	76.3	89.3	13.0	5.1	0.2	**5.3**	0.1	0.3	0.9	0.1	**1.1**
	CPT-02	75.5	92.5	17.0	8.6	0.0	**8.6**	0.2	0.5	1.2	0.0	**1.2**
	SB-707	74.5	91.5	17.0	6.8	0.0	**6.8**	0.1	0.3	1.0	0.0	**1.0**
	CP-609	73.0	81.5	8.5	9.4	0.0	**9.4**	0.4	0.8	1.4	0.0	**1.4**
	SB-1130/SCPT-04	71.0	78.5	7.5	10.8	0.0	**10.8**	0.6	1.2	1.5	0.0	**1.5**
CENTRAL SLIMES AREA (South to North)	CP-602	71.5	78.5	7.0	13.0	0.7	**13.7**	2.2	4.7	1.4	0.5	**1.9**
	SB-1132	69.7	89.3	19.6	24.4	0.6	**25.0**	1.0	2.2	1.6	0.1	**1.8**
	CPT-25	69.3	92.0	22.7	22.1	0.0	**22.1**	0.8	1.8	1.7	0.0	**1.7**
	CP-616	69.1	92.0	22.9	31.7	0.0	**31.7**	1.6	3.4	1.9	0.0	**1.9**
	CP-605	69.8	91.8	22.0	19.5	0.0	**19.5**	0.4	0.8	1.4	0.0	**1.4**
	CP-606	69.4	91.0	21.6	30.4	0.0	**30.4**	1.5	3.2	1.8	0.0	**1.8**
	CPT-03	71.0	87.5	16.5	16.8	0.4	**17.2**	0.5	1.0	1.4	0.1	**1.5**
	SB-1131/CPT-26	69.3	85.5	16.2	28.0	0.1	**28.1**	2.1	4.4	1.9	0.1	**1.9**
	SB-603/CP-610	70.0	78.5	8.5	17.0	0.7	**17.7**	3.6	7.6	1.3	0.7	**2.0**
EASTERN EXTENT OF SLIMES (South to North)	CP-603	70.8	78.0	7.2	14.8	0.1	**14.9**	3.4	7.2	1.8	0.2	**2.0**
	CP-607	69.6	77.0	7.4	19.1	0.2	**19.3**	3.5	7.3	1.8	0.3	**2.1**
					AVERAGE		**17.1**			AVERAGE		**1.7**

By/Date: JC/10-21-14

Chk/Date: NDL/10-23-14

DATA INPUT AND OUTPUT SUMMARY

KEY

Data Input Cells:	Input Data Here	Input location-specific information for this Analysis Point
Data Output Cells:	Calculation/Output	Calculated value. Read output cell for result.

EXISTING CONDITIONS, PROPOSED GRADING, & PRIMARY CONSOLIDATION

Analyis Point No.:	**SB-601/CP-601**	Input analysis point no./exploration location.
Existing Grade (ft):	**71.4**	Input existing ground surface elev. (to nearest 0.25') at analysis point location.
Groundwater Depth (ft bgs):	**1.4**	Input existing groundwater depth (to nearest 0.25') at analysis point location.
Proposed Grade (ft):	**80.3**	Input proposed grade (to nearest 0.25') at analysis point location.
Unit Weight of Prop. Fill (pcf):	**120.0**	Input unit weight of grade change fill/materials.
Est. Primary Consol. Settlement:	**16.7**	Estimated primary consol. settlement (in inches) due to proposed grade change.
Est. Primary Consol. Settlement:	**15.0**	Estimated primary consol. settlement (in inches) at 90% consolidation.
Est. Time to 90% Primary Conol (single drain).:	**1.9**	Estimated time (in years) to achieve 90% of the est. primary consol. settlement.
Est. Time to 99% Primary Consol. (single drain):	**4.0**	Estimated time (in years) to achieve 99% of the est. primary consol. settlement.
Est. Time to 90% Primary Conol (double drain).:	**0.5**	Estimated time (in years) to achieve 90% of the est. primary consol. settlement.
Est. Time to 99% Primary Consol. (double drain):	**1.0**	Estimated time (in years) to achieve 99% of the est. primary consol. settlement.

SECONDARY CONSOLIDATION

Analysis Point No:	**SB-601/CP-601**	-	
Surcharge Area/Point No:	**0**	-	
Coefficient of Secondary Compression, $C_{\acute{\alpha}}$	**0.005**	Clay	(Cά expressed by change in strain per log cycle of time)
Coefficient of Secondary Compression, $C_{\acute{\alpha}}$	**0.005**	Slimes	(Cά expressed by change in strain per log cycle of time)
Est. Time to End of Primary Consolidation, t_p	**4.0**	Years	
Est. Design Life Time, t_{sec}	**50**	Years	

Method from NAVFAC DM 7.1-231: $H_{sec} = C\acute{\alpha} * H_t * \log (t_{sec}/t_p)$

Where: H_{sec} = Secondary compression; H_t = Thickness of soil stratum

Est. Secondary Compression (inches):	**0.8**	Slimes
Est. Secondary Compression (inches):	**1.1**	Clay

SUMMARY OF EXISTING CONDITIONS AND PROPOSED GRADING

Analysis Point/Location: SB-601/CP-601
Existing Grade: 71.4 feet
Assumed Bedrock Depth: 30.0 feet bgs
Groundwater Depth: 1.4 feet bgs
Tot./Eff. Stress @ GWT = 154.0 psf

Analysis Point/Location: SB-601/CP-601
Proposed Grade: 80.25 feet
Grade Change: 8.8 feet
Fill Unit Weight: 120.00 pcf
Δ Stress: 1062.0 psf

Input assumed or known depth (ft bgs) to bedrock above. Then input the bottom depth (ft bgs) and unit weight (pcf) for each primary stratum below.

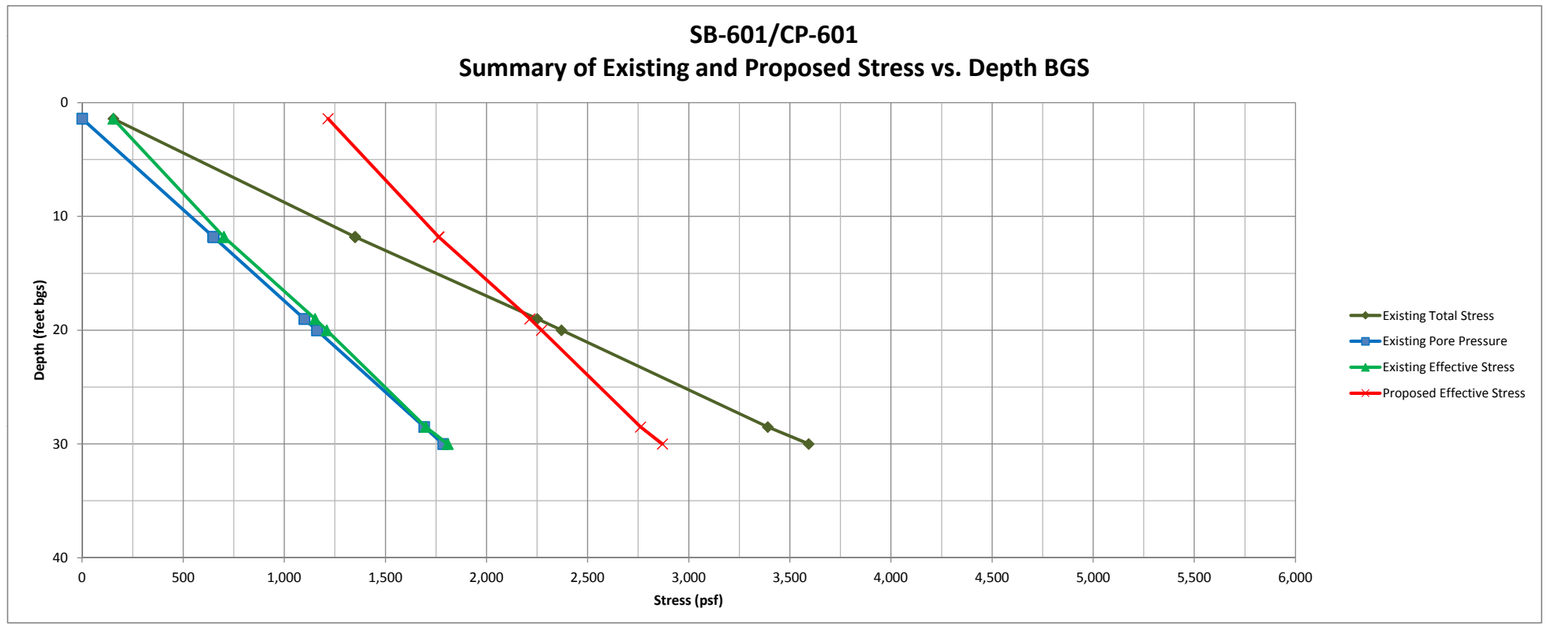
Subsurface Conditions					Existing Grade Conditions									Proposed Grade Conditions		
Primary Stratum	Depth		Thickness	Unit Weight γ_t or γ_{sat}	Total Stress			Pore Pressure			Effective Stress			Effective Stress		
	Top (ft bgs)	Bottom (ft bgs)	(ft)	(pcf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)
Slimes (unsat)	0.0	1.4	1.4	110	0.0	154.0	77.0	0.0	0.0	0.0	0.0	154.0	77.0	1062.0	1216.0	1139.0
Slimes (sat)	1.4	11.8	10.4	115	154.0	1350.0	752.0	0.0	649.0	324.5	154.0	701.0	427.5	1216.0	1763.0	1489.5
Clay/Till Fill	11.8	11.8	0.0	125	1350.0	1350.0	1350.0	649.0	649.0	649.0	701.0	701.0	701.0	1763.0	1763.0	1763.0
V. Stiff Clay	11.8	11.8	0.0	125	1350.0	1350.0	1350.0	649.0	649.0	649.0	701.0	701.0	701.0	1763.0	1763.0	1763.0
Stiff Clay	11.8	19.0	7.2	125	1350.0	2250.0	1800.0	649.0	1098.2	873.6	701.0	1151.8	926.4	1763.0	2213.8	1988.4
M. Stiff Clay	19.0	20.0	1.0	120	2250.0	2370.0	2310.0	1098.2	1160.6	1129.4	1151.8	1209.4	1180.6	2213.8	2271.4	2242.6
Soft Clay	20.0	28.5	8.5	120	2370.0	3390.0	2880.0	1160.6	1691.0	1425.8	1209.4	1699.0	1454.2	2271.4	2761.0	2516.2
Till	28.5	30.0	1.5	135	3390.0	3592.5	3491.3	1691.0	1784.6	1737.8	1699.0	1807.9	1753.4	2761.0	2869.9	2815.4

Notes, Comments, and/or Adjustments Made to Subsurface Conditions

1. n/a
2. n/a
3. n/a

Prepared By/Date: JC/10-21-14

Checked By/Date: NDL/10-23-14



SUMMARY OF COMPRESSIBILITY PARAMETERS, ESTIMATED PRIMARY CONSOLIDATION SETTLEMENT, & TIME-RATE OF CONSOLIDATION

Analysis Point/Location: **SB-601/CP-601**
Proposed Grade: 80.3 feet
Grade Change: 8.8 feet
Fill Unit Weight: 120.0 pcf
Δ Stress: 1062.0 psf

Input assumed over-consolidation ratio, compression index (= $C_c/1+e_0$), recompression index (= $C_r/1+e_0$), and coefficient of consolidation (ft^2/day) for each primary stratum below.

Assumed Compressibility Parameters					Primary Consolidation Settlement (Due to Proposed Grade Change)	Time-Rate of Consolidation (to 90% Consolidation)		
Primary Stratum	OCR	Comp. Index $C_{cε}$	Recomp. Index $C_{rε}$	Coef. of Consol. c_v (ft^2/day)	(inches)	Drainage Height H_{dr} (feet)	Time Factor T	Time t (days)
Slimes (unsat)	1.0	0.15	0.05	1.00	2.95	0.7	0.848	0.4
Slimes (sat)	1.0	0.15	0.05	1.00	10.15	5.2	0.848	22.9
Clay/Till Fill	2.0	0.15	0.02	2.00	0.00	0.0	0.848	0.0
V. Stiff Clay	2.0	0.15	0.02	4.00	0.00	0.0	0.848	0.0
Stiff Clay	2.0	0.15	0.02	3.00	0.92	3.6	0.848	3.7
M. Stiff Clay	2.0	0.15	0.02	2.00	0.07	0.5	0.848	0.1
Soft Clay	1.2	0.15	0.02	0.50	2.59	4.3	0.848	30.6
Till	-	-	-	-	-	-	-	-
					16.67			

Estimated Settlement @ 90% Consolidation
(inches)
15.01

Days	30.6
Months	1.0
Years	0.1

Above Time-Rate calcs assume double drainage of each stratum. However, this is not valid. In this case, convert to a composite stratum as per below.

Double drainage of each Stratum? **NO**

If answer to double drainage question = "YES", refer to the values above for the estimated time to 90% consolidation. If the answer to the question = "NO", refer to the composite Stratum calculation below for the estimated time to 90% consolidation.

COMPOSITE STRATUM (Slimes & Clay)
Convert to One "Composite" Layer (NAVFAC DM 7.1-235)
(w/ C_v properties of Slimes)

$$H_{comp} = H_d + H_o(Cv_d / Cv_o)^{1/2}$$

H_{comp} = 28.7 ft

H_{dr} = 28.7 ft - Single Drainage
H_{dr} = 14.3 ft - Double Drainage
T = 0.848 90% consolidation

Calculate Time, t, in days to 90% Consolidation

$$t = (T * H_{dr}^2) / Cv_d$$

	Single Drainage	Double Drainage
Days	697.8	174.4
Months	22.9	5.7
Years	1.9	0.5

DATA INPUT AND OUTPUT SUMMARY

KEY

Data Input Cells:	Input Data Here	Input location-specific information for this Analysis Point
Data Output Cells:	Calculation/Output	Calculated value. Read output cell for result.

EXISTING CONDITIONS, PROPOSED GRADING, & PRIMARY CONSOLIDATION

Analyis Point No.:	SB-1128/SCPT-24	Input analysis point no./exploration location.
Existing Grade (ft):	72.5	Input existing ground surface elev. (to nearest 0.25') at analysis point location.
Groundwater Depth (ft bgs):	4.1	Input existing groundwater depth (to nearest 0.25') at analysis point location.
Proposed Grade (ft):	78.5	Input proposed grade (to nearest 0.25') at analysis point location.
Unit Weight of Prop. Fill (pcf):	120.0	Input unit weight of grade change fill/materials.
Est. Primary Consol. Settlement:	10.8	Estimated primary consol. settlement (in inches) due to proposed grade change.
Est. Primary Consol. Settlement:	9.7	Estimated primary consol. settlement (in inches) at 90% consolidation.
Est. Time to 90% Primary Conol (single drain).:	2.4	Estimated time (in years) to achieve 90% of the est. primary consol. settlement.
Est. Time to 99% Primary Consol. (single drain):	5.1	Estimated time (in years) to achieve 99% of the est. primary consol. settlement.
Est. Time to 90% Primary Conol (double drain).:	0.6	Estimated time (in years) to achieve 90% of the est. primary consol. settlement.
Est. Time to 99% Primary Consol. (double drain):	1.3	Estimated time (in years) to achieve 99% of the est. primary consol. settlement.

SECONDARY CONSOLIDATION

Analysis Point No:	SB-1128/SCPT-24	-	
Surcharge Area/Point No:	0	-	
Coefficient of Secondary Compression, $C_{\acute{\alpha}}$	0.005	Clay	(Cά expressed by change in strain per log cycle of time)
Coefficient of Secondary Compression, $C_{\acute{\alpha}}$	0.005	Slimes	(Cά expressed by change in strain per log cycle of time)
Est. Time to End of Primary Consolidation, t_p	5.1	Years	
Est. Design Life Time, t_{sec}	50	Years	

Method from NAVFAC DM 7.1-231: $H_{sec} = C\acute{\alpha} * H_t * \log (t_{sec}/t_p)$

Where: H_{sec} = Secondary compression; H_t = Thickness of soil stratum

Est. Secondary Compression (inches):	1.1	Slimes
Est. Secondary Compression (inches):	0.9	Clay

SUMMARY OF EXISTING CONDITIONS AND PROPOSED GRADING

Analysis Point/Location: B-1128/SCPT-24

Existing Grade:	72.5	feet
Assumed Bedrock Depth:	36.8	feet bgs
Groundwater Depth:	4.1	feet bgs
Tot./Eff. Stress @ GWT =	451.0	psf

Analysis Point/Location: B-1128/SCPT-24

Proposed Grade:	78.50	feet
Grade Change:	6.0	feet
Fill Unit Weight:	120.00	pcf
Δ Stress:	720.0	psf

Input assumed or known depth (ft bgs) to bedrock above. Then input the bottom depth (ft bgs) and unit weight (pcf) for each primary stratum below.

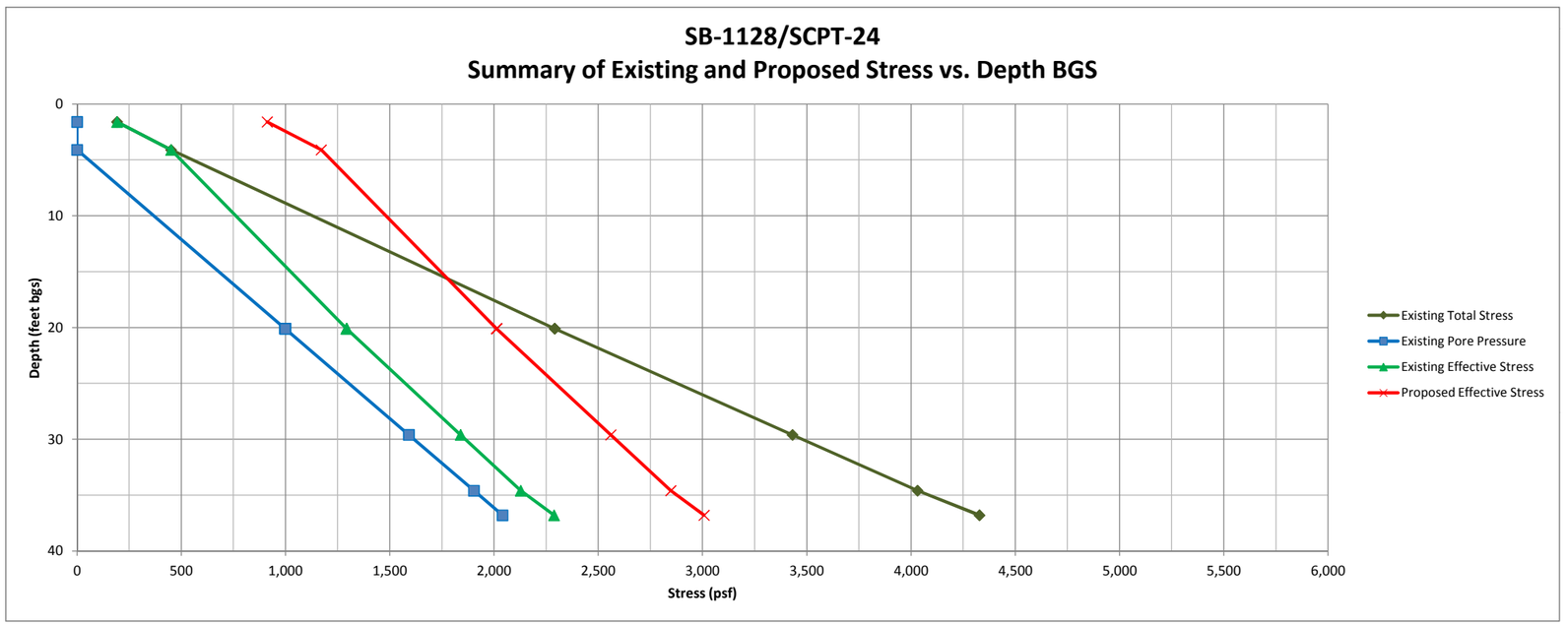
Subsurface Conditions					Existing Grade Conditions									Proposed Grade Conditions		
Primary Stratum	Depth		Thickness	Unit Weight	Total Stress			Pore Pressure			Effective Stress			Effective Stress		
	Top (ft bgs)	Bottom (ft bgs)	(ft)	γ_t or γ_{sat} (pcf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)
Fill	0	1.6	1.6	120	0	192.0	96.0	0	0.0	0	0	192.0	96.0	720.0	912.0	816.0
Slimes (unsat)	1.6	4.1	2.5	110	192.0	451.0	321.5	0.0	0.0	0.0	192.0	451.0	321.5	912.0	1171.0	1041.5
Slimes (sat)	4.1	20.1	16.0	115	451.0	2291.0	1371.0	0.0	998.4	499.2	451.0	1292.6	871.8	1171.0	2012.6	1591.8
Clay/Till Fill	20.1	20.1	0.0	125	2291.0	2291.0	2291.0	998.4	998.4	998.4	1292.6	1292.6	1292.6	2012.6	2012.6	2012.6
V. Stiff Clay	20.1	20.1	0.0	125	2291.0	2291.0	2291.0	998.4	998.4	998.4	1292.6	1292.6	1292.6	2012.6	2012.6	2012.6
Stiff Clay	20.1	20.1	0.0	125	2291.0	2291.0	2291.0	998.4	998.4	998.4	1292.6	1292.6	1292.6	2012.6	2012.6	2012.6
M. Stiff Clay	20.1	29.6	9.5	120	2291.0	3431.0	2861.0	998.4	1591.2	1294.8	1292.6	1839.8	1566.2	2012.6	2559.8	2286.2
Soft Clay	29.6	34.6	5.0	120	3431.0	4031.0	3731.0	1591.2	1903.2	1747.2	1839.8	2127.8	1983.8	2559.8	2847.8	2703.8
Till	34.6	36.8	2.2	135	4031.0	4328.0	4179.5	1903.2	2040.5	1971.8	2127.8	2287.5	2207.7	2847.8	3007.5	2927.7

Notes, Comments, and/or Adjustments Made to Subsurface Conditions

1. n/a
2. n/a
3. n/a

Prepared By/Date: JC/10-21-14

Checked By/Date: NDL/10-23-14



SUMMARY OF COMPRESSIBILITY PARAMETERS, ESTIMATED PRIMARY CONSOLIDATION SETTLEMENT, & TIME-RATE OF CONSOLIDATION

Analysis Point/Location: **SB-1128/SCPT-24**
Proposed Grade: 78.5 feet
Grade Change: 6.0 feet
Fill Unit Weight: 120.0 pcf
Δ Stress: 720.0 psf

Input assumed over-consolidation ratio, compression index (= $C_c/1+e_o$), recompression index (= $C_r/1+e_o$), and coefficient of consolidation (ft^2/day) for each primary stratum below.

Assumed Compressibility Parameters					Primary Consolidation Settlement (Due to Proposed Grade Change)	Time-Rate of Consolidation (to 90% Consolidation)		
Primary Stratum	OCR	Comp. Index $C_{c\varepsilon}$	Recomp. Index $C_{r\varepsilon}$	Coef. of Consol. c_v (ft^2/day)	(inches)	Drainage Height H_{dr} (feet)	Time Factor T	Time t (days)
Fill	-	-	-	-	-	-	-	-
Slimes (unsat)	1.0	0.15	0.05	1.00	2.30	1.25	0.848	1.3
Slimes (sat)	1.0	0.15	0.05	1.00	7.53	8	0.848	54.3
Clay/Till Fill	2.0	0.15	0.02	2.00	0.00	0.0	0.848	0.0
V. Stiff Clay	2.0	0.15	0.02	4.00	0.00	0.0	0.848	0.0
Stiff Clay	2.0	0.15	0.02	3.00	0.00	0.0	0.848	0.0
M. Stiff Clay	2.0	0.15	0.02	2.00	0.37	4.8	0.848	9.6
Soft Clay	1.2	0.15	0.02	0.50	0.59	2.5	0.848	10.6
Till	-	-	-	-	-	-	-	-
					10.79			

Estimated Settlement @ 90% Consolidation
(inches)
9.72

Days	**54.3**
Months	**1.8**
Years	**0.1**

Above Time-Rate calcs assume double drainage of each stratum. However, this is not valid. In this case, convert to a composite stratum as per below.

Double drainage of each Stratum? **NO**

If answer to double drainage question = "YES", refer to the values above for the estimated time to 90% consolidation. If the answer to the question = "NO", refer to the composite Stratum calculation below for the estimated time to 90% consolidation.

COMPOSITE STRATUM (Slimes & Clay)
Convert to One "Composite" Layer (NAVFAC DM 7.1-235)
(w/ C_v properties of Slimes)

$$H_{comp} = H_d + H_o(Cv_d / Cv_o)^{1/2}$$

H_{comp} = 32.3 ft

H_{dr} = 32.3 ft - Single Drainage
H_{dr} = 16.1 ft - Double Drainage
T = 0.848 90% consolidation

Calculate Time, t, in days to 90% Consolidation

$$t = (T * H_{dr}^2) / Cv_d$$

	Single Drainage	Double Drainage
Days	**884.1**	**221.0**
Months	**29.0**	**7.2**
Years	**2.4**	**0.6**

DATA INPUT AND OUTPUT SUMMARY

KEY

Data Input Cells:	Input Data Here	Input location-specific information for this Analysis Point
Data Output Cells:	Calculation/Output	Calculated value. Read output cell for result.

EXISTING CONDITIONS, PROPOSED GRADING, & PRIMARY CONSOLIDATION

Analyis Point No.:	**CPT-01**	Input analysis point no./exploration location.
Existing Grade (ft):	**76.3**	Input existing ground surface elev. (to nearest 0.25') at analysis point location.
Groundwater Depth (ft bgs):	**7.3**	Input existing groundwater depth (to nearest 0.25') at analysis point location.
Proposed Grade (ft):	**89.3**	Input proposed grade (to nearest 0.25') at analysis point location.
Unit Weight of Prop. Fill (pcf):	**120.0**	Input unit weight of grade change fill/materials.
Est. Primary Consol. Settlement:	**5.3**	Estimated primary consol. settlement (in inches) due to proposed grade change.
Est. Primary Consol. Settlement:	**4.7**	Estimated primary consol. settlement (in inches) at 90% consolidation.
Est. Time to 90% Primary Conol (single drain).:	**0.1**	Estimated time (in years) to achieve 90% of the est. primary consol. settlement.
Est. Time to 99% Primary Consol. (single drain):	**0.3**	Estimated time (in years) to achieve 99% of the est. primary consol. settlement.
Est. Time to 90% Primary Conol (double drain).:	**0.0**	Estimated time (in years) to achieve 90% of the est. primary consol. settlement.
Est. Time to 99% Primary Consol. (double drain):	**0.1**	Estimated time (in years) to achieve 99% of the est. primary consol. settlement.

SECONDARY CONSOLIDATION

Analysis Point No:	**CPT-01**	-	
Surcharge Area/Point No:	**0**	-	
Coefficient of Secondary Compression, $C_{\acute{\alpha}}$	**0.005**	Clay	(Cά expressed by change in strain per log cycle of time)
Coefficient of Secondary Compression, $C_{\acute{\alpha}}$	**0.005**	Slimes	(Cά expressed by change in strain per log cycle of time)
Est. Time to End of Primary Consolidation, t_p	**0.3**	Years	
Est. Design Life Time, t_{sec}	**50**	Years	

Method from NAVFAC DM 7.1-231: $H_{sec} = C\acute{\alpha} * H_t * \log (t_{sec}/t_p)$

Where: H_{sec} = Secondary compression
H_t = Thickness of soil stratum

Est. Secondary Compression (inches):	**0.9**	Slimes
Est. Secondary Compression (inches):	**0.1**	Clay

SUMMARY OF EXISTING CONDITIONS AND PROPOSED GRADING

Analysis Point/Location:	**CPT-01**	
Existing Grade:	76.3	feet
Assumed Bedrock Depth:	16.7	feet bgs
Groundwater Depth:	7.3	feet bgs
Tot./Eff. Stress @ GWT =	797.5	psf

Analysis Point/Location:	**CPT-01**	
Proposed Grade:	89.25	feet
Grade Change:	13.0	feet
Fill Unit Weight:	120.00	pcf
Δ Stress:	1560.0	psf

Input assumed or known depth (ft bgs) to bedrock above. Then input the bottom depth (ft bgs) and unit weight (pcf) for each primary stratum below.

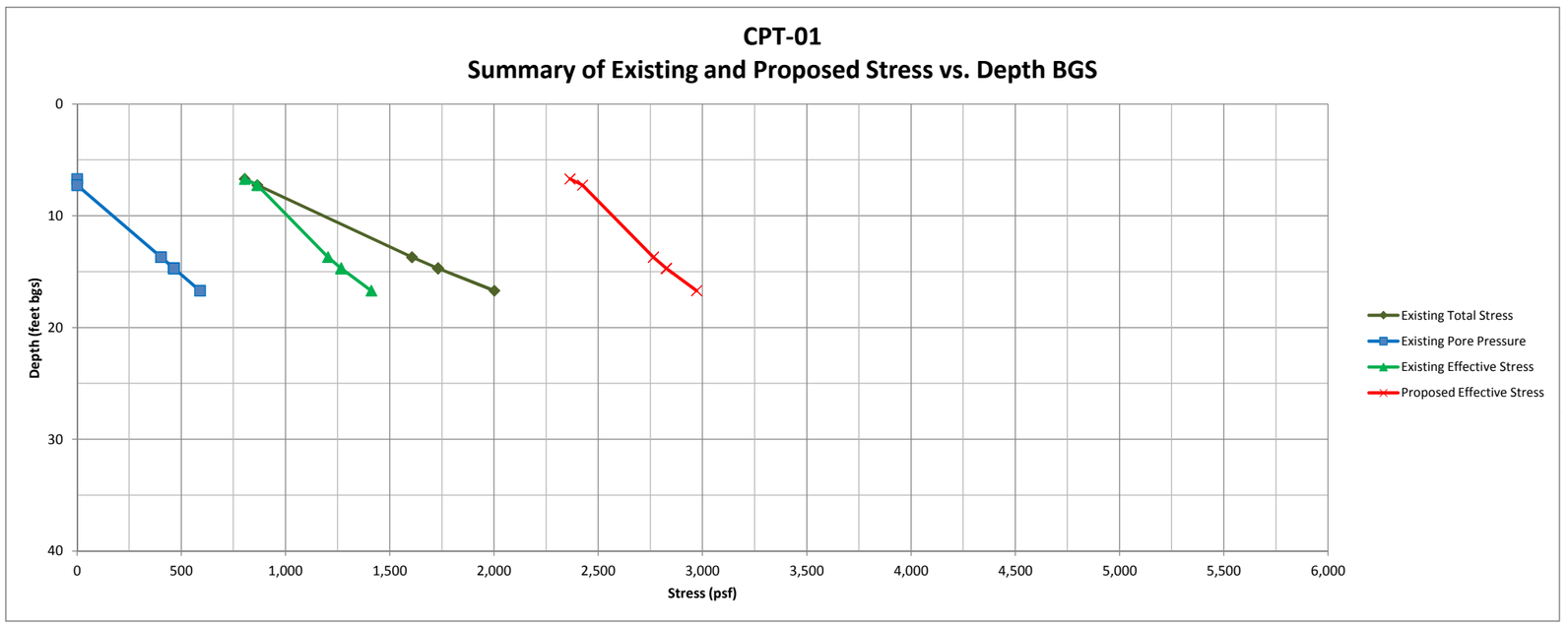
Subsurface Conditions					Existing Grade Conditions									Proposed Grade Conditions		
Primary Stratum	Depth		Thickness	Unit Weight	Total Stress			Pore Pressure			Effective Stress			Effective Stress		
	Top (ft bgs)	Bottom (ft bgs)	(ft)	γ_t or γ_{sat} (pcf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)
Fill	0	6.7	6.7	120	0.0	804.0	402.0	0	0.0	0	0	804.0	402.0	1560.0	2364.0	1962.0
Slimes (unsat)	6.7	7.3	0.6	110	804.0	864.5	834.3	0.0	0.0	0.0	804.0	864.5	834.3	2364.0	2424.5	2394.3
Slimes (sat)	7.3	13.7	6.5	115	864.5	1606.3	1235.4	0.0	402.5	201.2	864.5	1203.8	1034.1	2424.5	2763.8	2594.1
Clay/Till Fill	13.7	13.7	0.0	125	1606.3	1606.3	1606.3	402.5	402.5	402.5	1203.8	1203.8	1203.8	2763.8	2763.8	2763.8
V. Stiff Clay	13.7	14.7	1.0	125	1606.3	1731.3	1668.8	402.5	464.9	433.7	1203.8	1266.4	1235.1	2763.8	2826.4	2795.1
Stiff Clay	14.7	14.7	0.0	125	1731.3	1731.3	1731.3	464.9	464.9	464.9	1266.4	1266.4	1266.4	2826.4	2826.4	2826.4
M. Stiff Clay	14.7	14.7	0.0	120	1731.3	1731.3	1731.3	464.9	464.9	464.9	1266.4	1266.4	1266.4	2826.4	2826.4	2826.4
Soft Clay	14.7	14.7	0.0	120	1731.3	1731.3	1731.3	464.9	464.9	464.9	1266.4	1266.4	1266.4	2826.4	2826.4	2826.4
Till	14.7	16.7	2.0	135	1731.3	2001.3	1866.3	464.9	589.7	527.3	1266.4	1411.6	1339.0	2826.4	2971.6	2899.0

Notes, Comments, and/or Adjustments Made to Subsurface Conditions

1. n/a
2. n/a
3. n/a

Prepared By/Date: JC/10-21-14

Checked By/Date: NDL/10-23-14



SUMMARY OF COMPRESSIBILITY PARAMETERS, ESTIMATED PRIMARY CONSOLIDATION SETTLEMENT, & TIME-RATE OF CONSOLIDATION

Analysis Point/Location:	**CPT-01**	
Proposed Grade:	89.3	feet
Grade Change:	13.0	feet
Fill Unit Weight:	120.0	pcf
Δ Stress:	1560.0	psf

Input assumed over-consolidation ratio, compression index (= $C_c/1+e_0$), recompression index (= $C_r/1+e_0$), and coefficient of consolidation (ft^2/day) for each primary stratum below.

Assumed Compressibility Parameters					Primary Consolidation Settlement (Due to Proposed Grade Change)	Time-Rate of Consolidation (to 90% Consolidation)		
Primary Stratum	OCR	Comp. Index $C_{c\varepsilon}$	Recomp. Index $C_{r\varepsilon}$	Coef. of Consol. c_v (ft^2/day)	(inches)	Drainage Height H_{dr} (feet)	Time Factor T	Time t (days)
Fill	-	-	-	-	-	-	-	-
Slimes (unsat)	1.0	0.15	0.05	1.00	0.45	0.275	0.848	0.1
Slimes (sat)	1.0	0.15	0.05	1.00	4.64	3.225	0.848	8.8
Clay/Till Fill	2.0	0.15	0.02	2.00	0.00	0.0	0.848	0.0
V. Stiff Clay	2.0	0.15	0.02	4.00	0.17	0.5	0.848	0.1
Stiff Clay	2.0	0.15	0.02	3.00	0.00	0.0	0.848	0.0
M. Stiff Clay	2.0	0.15	0.02	2.00	0.00	0.0	0.848	0.0
Soft Clay	1.2	0.15	0.02	0.50	0.00	0.0	0.848	0.0
Till	-	-	-	-	-	-	-	-
					5.26			

Estimated Settlement @ 90% Consolidation
(inches)
4.73

Days	**8.8**
Months	**0.3**
Years	**0.0**

Above Time-Rate calcs assume double drainage of each stratum. However, this is not valid. In this case, convert to a composite stratum as per below.

Double drainage of each Stratum? **NO**

If answer to double drainage question = "YES", refer to the values above for the estimated time to 90% consolidation. If the answer to the question = "NO", refer to the composite Stratum calculation below for the estimated time to 90% consolidation.

COMPOSITE STRATUM (Slimes & Clay)

Convert to One "Composite" Layer (NAVFAC DM 7.1-235)
(w/ C_v properties of Slimes)

$$H_{comp} = H_d + H_o(Cv_d / Cv_o)^{1/2}$$

H_{comp} = 7.5 ft

H_{dr} = 7.5 ft - Single Drainage
H_{dr} = 3.8 ft - Double Drainage
T = 0.848 90% consolidation

Calculate Time, t, in days to 90% Consolidation

$$t = (T * H_{dr}^2) / Cv_d$$

	Single Drainage	Double Drainage
Days	**47.7**	**11.9**
Months	**1.6**	**0.4**
Years	**0.1**	**0.0**

DATA INPUT AND OUTPUT SUMMARY

KEY

Data Input Cells:	Input Data Here	Input location-specific information for this Analysis Point
Data Output Cells:	Calculation/Output	Calculated value. Read output cell for result.

EXISTING CONDITIONS, PROPOSED GRADING, & PRIMARY CONSOLIDATION

Analyis Point No.:	**CPT-02**	Input analysis point no./exploration location.
Existing Grade (ft):	**75.5**	Input existing ground surface elev. (to nearest 0.25') at analysis point location.
Groundwater Depth (ft bgs):	**6.5**	Input existing groundwater depth (to nearest 0.25') at analysis point location.
Proposed Grade (ft):	**92.5**	Input proposed grade (to nearest 0.25') at analysis point location.
Unit Weight of Prop. Fill (pcf):	**120.0**	Input unit weight of grade change fill/materials.
Est. Primary Consol. Settlement:	**8.6**	Estimated primary consol. settlement (in inches) due to proposed grade change.
Est. Primary Consol. Settlement:	**7.8**	Estimated primary consol. settlement (in inches) at 90% consolidation.
Est. Time to 90% Primary Conol (single drain).:	**0.2**	Estimated time (in years) to achieve 90% of the est. primary consol. settlement.
Est. Time to 99% Primary Consol. (single drain):	**0.5**	Estimated time (in years) to achieve 99% of the est. primary consol. settlement.
Est. Time to 90% Primary Conol (double drain).:	**0.1**	Estimated time (in years) to achieve 90% of the est. primary consol. settlement.
Est. Time to 99% Primary Consol. (double drain):	**0.1**	Estimated time (in years) to achieve 99% of the est. primary consol. settlement.

SECONDARY CONSOLIDATION

Analysis Point No:	**CPT-02**	-	
Surcharge Area/Point No:	**0**	-	
Coefficient of Secondary Compression, $C_{\acute{\alpha}}$	**0.005**	Clay	(Cά expressed by change in strain per log cycle of time)
Coefficient of Secondary Compression, $C_{\acute{\alpha}}$	**0.005**	Slimes	(Cά expressed by change in strain per log cycle of time)
Est. Time to End of Primary Consolidation, t_p	**0.5**	Years	
Est. Design Life Time, t_{sec}	**50**	Years	

Method from NAVFAC DM 7.1-231: $H_{sec} = C\acute{\alpha} * H_t * \log (t_{sec}/t_p)$

Where: H_{sec} = Secondary compression; H_t = Thickness of soil stratum

Est. Secondary Compression (inches):	**1.2**	Slimes
Est. Secondary Compression (inches):	**0.0**	Clay

SUMMARY OF EXISTING CONDITIONS AND PROPOSED GRADING

Analysis Point/Location:	**CPT-02**	
Existing Grade:	75.5	feet
Assumed Bedrock Depth:	17.5	feet bgs
Groundwater Depth:	6.5	feet bgs
Tot./Eff. Stress @ GWT =	715.0	psf

Analysis Point/Location:	**CPT-02**	
Proposed Grade:	92.50	feet
Grade Change:	17.0	feet
Fill Unit Weight:	120.00	pcf
Δ Stress:	2040.0	psf

Input assumed or known depth (ft bgs) to bedrock above. Then input the bottom depth (ft bgs) and unit weight (pcf) for each primary stratum below.

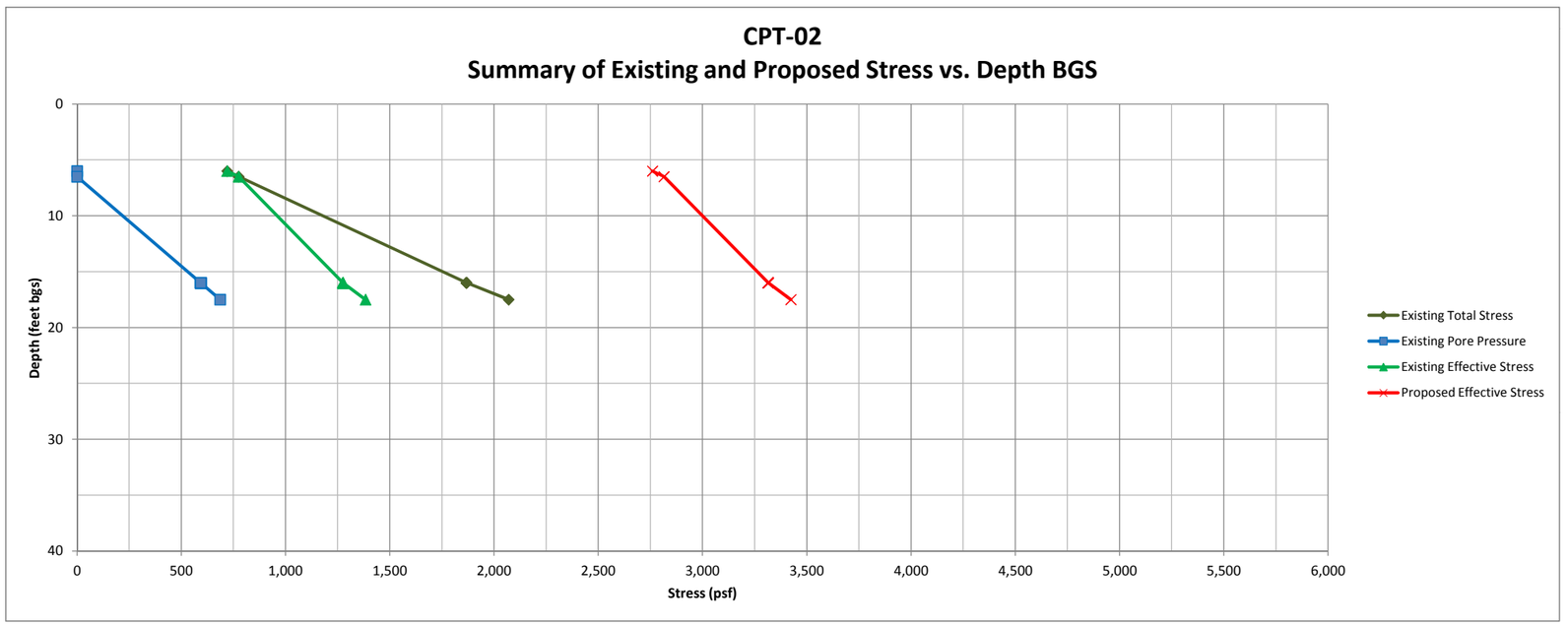
Subsurface Conditions					Existing Grade Conditions									Proposed Grade Conditions		
Primary Stratum	Depth		Thickness	Unit Weight	Total Stress			Pore Pressure			Effective Stress			Effective Stress		
	Top (ft bgs)	Bottom (ft bgs)	(ft)	γ_t or γ_{sat} (pcf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)
Fill	0	6.0	6.0	120	0.0	720.0	360.0	0	0.0	0	0	720.0	360.0	2040.0	2760.0	2400.0
Slimes (unsat)	6.0	6.5	0.5	110	720.0	775.0	747.5	0.0	0.0	0.0	720.0	775.0	747.5	2760.0	2815.0	2787.5
Slimes (sat)	6.5	16.0	9.5	115	775.0	1867.5	1321.3	0.0	592.8	296.4	775.0	1274.7	1024.9	2815.0	3314.7	3064.9
Clay/Till Fill	16.0	16.0	0.0	125	1867.5	1867.5	1867.5	592.8	592.8	592.8	1274.7	1274.7	1274.7	3314.7	3314.7	3314.7
V. Stiff Clay	16.0	16.0	0.0	125	1867.5	1867.5	1867.5	592.8	592.8	592.8	1274.7	1274.7	1274.7	3314.7	3314.7	3314.7
Stiff Clay	16.0	16.0	0.0	125	1867.5	1867.5	1867.5	592.8	592.8	592.8	1274.7	1274.7	1274.7	3314.7	3314.7	3314.7
M. Stiff Clay	16.0	16.0	0.0	120	1867.5	1867.5	1867.5	592.8	592.8	592.8	1274.7	1274.7	1274.7	3314.7	3314.7	3314.7
Soft Clay	16.0	16.0	0.0	120	1867.5	1867.5	1867.5	592.8	592.8	592.8	1274.7	1274.7	1274.7	3314.7	3314.7	3314.7
Till	16.0	17.5	1.5	135	1867.5	2070.0	1968.8	592.8	686.4	639.6	1274.7	1383.6	1329.2	3314.7	3423.6	3369.2

Notes, Comments, and/or Adjustments Made to Subsurface Conditions

1. n/a
2. n/a
3. n/a

Prepared By/Date: JC/10-21-14

Checked By/Date: NDL/10-23-14



SUMMARY OF COMPRESSIBILITY PARAMETERS, ESTIMATED PRIMARY CONSOLIDATION SETTLEMENT, & TIME-RATE OF CONSOLIDATION

Analysis Point/Location:	**CPT-02**	
Proposed Grade:	92.5	feet
Grade Change:	17.0	feet
Fill Unit Weight:	120.0	pcf
Δ Stress:	2040.0	psf

Input assumed over-consolidation ratio, compression index (= $C_c/1+e_0$), recompression index (= $C_r/1+e_0$), and coefficient of consolidation (ft^2/day) for each primary stratum below.

Assumed Compressibility Parameters					Primary Consolidation Settlement (Due to Proposed Grade Change)	Time-Rate of Consolidation (to 90% Consolidation)		
Primary Stratum	OCR	Comp. Index $C_{c\varepsilon}$	Recomp. Index $C_{r\varepsilon}$	Coef. of Consol. c_v (ft^2/day)	(inches)	Drainage Height H_{dr} (feet)	Time Factor T	Time t (days)
Fill	-	-	-	-	-	-	-	-
Slimes (unsat)	1.0	0.15	0.05	1.00	0.51	0.25	0.848	0.1
Slimes (sat)	1.0	0.15	0.05	1.00	8.14	4.75	0.848	19.1
Clay/Till Fill	2.0	0.15	0.02	2.00	0.00	0.0	0.848	0.0
V. Stiff Clay	2.0	0.15	0.02	4.00	0.00	0.0	0.848	0.0
Stiff Clay	2.0	0.15	0.02	3.00	0.00	0.0	0.848	0.0
M. Stiff Clay	2.0	0.15	0.02	2.00	0.00	0.0	0.848	0.0
Soft Clay	1.2	0.15	0.02	0.50	0.00	0.0	0.848	0.0
Till	-	-	-	-	-	-	-	-
					8.65			

Estimated Settlement @ 90% Consolidation
(inches)
7.78

Days	**19.1**
Months	**0.6**
Years	**0.1**

Above Time-Rate calcs assume double drainage of each stratum. However, this is not valid. In this case, convert to a composite stratum as per below.

Double drainage of each Stratum? **NO**

If answer to double drainage question = "YES", refer to the values above for the estimated time to 90% consolidation. If the answer to the question = "NO", refer to the composite Stratum calculation below for the estimated time to 90% consolidation.

COMPOSITE STRATUM (Slimes & Clay)

Convert to One "Composite" Layer (NAVFAC DM 7.1-235)
(w/ C_v properties of Slimes)

$$H_{comp} = H_d + H_o(Cv_d / Cv_o)^{1/2}$$

H_{comp} = 10.0 ft

H_{dr} = 10.0 ft - Single Drainage
H_{dr} = 5.0 ft - Double Drainage
T = 0.848 90% consolidation

Calculate Time, t, in days to 90% Consolidation

$$t = (T * H_{dr}^2) / Cv_d$$

	Single Drainage	Double Drainage
Days	**84.8**	**21.2**
Months	**2.8**	**0.7**
Years	**0.2**	**0.1**

DATA INPUT AND OUTPUT SUMMARY

KEY

Data Input Cells:	Input Data Here	Input location-specific information for this Analysis Point
Data Output Cells:	Calculation/Output	Calculated value. Read output cell for result.

EXISTING CONDITIONS, PROPOSED GRADING, & PRIMARY CONSOLIDATION

Analyis Point No.:	**CP-605**	Input analysis point no./exploration location.
Existing Grade (ft):	**69.8**	Input existing ground surface elev. (to nearest 0.25') at analysis point location.
Groundwater Depth (ft bgs):	**2.8**	Input existing groundwater depth (to nearest 0.25') at analysis point location.
Proposed Grade (ft):	**91.8**	Input proposed grade (to nearest 0.25') at analysis point location.
Unit Weight of Prop. Fill (pcf):	**120.0**	Input unit weight of grade change fill/materials.
Est. Primary Consol. Settlement:	**19.5**	Estimated primary consol. settlement (in inches) due to proposed grade change.
Est. Primary Consol. Settlement:	**17.6**	Estimated primary consol. settlement (in inches) at 90% consolidation.
Est. Time to 90% Primary Conol (single drain).:	**0.4**	Estimated time (in years) to achieve 90% of the est. primary consol. settlement.
Est. Time to 99% Primary Consol. (single drain):	**0.8**	Estimated time (in years) to achieve 99% of the est. primary consol. settlement.
Est. Time to 90% Primary Conol (double drain).:	**0.1**	Estimated time (in years) to achieve 90% of the est. primary consol. settlement.
Est. Time to 99% Primary Consol. (double drain):	**0.2**	Estimated time (in years) to achieve 99% of the est. primary consol. settlement.

SECONDARY CONSOLIDATION

Analysis Point No:	**CP-605**	-	
Surcharge Area/Point No:	**0**	-	
Coefficient of Secondary Compression, $C_{\acute{\alpha}}$	**0.005**	Clay	(Cά expressed by change in strain per log cycle of time)
Coefficient of Secondary Compression, $C_{\acute{\alpha}}$	**0.005**	Slimes	(Cά expressed by change in strain per log cycle of time)
Est. Time to End of Primary Consolidation, t_p	**0.8**	Years	
Est. Design Life Time, t_{sec}	**50**	Years	

Method from NAVFAC DM 7.1-231: $H_{sec} = C\acute{\alpha} * H_t * \log (t_{sec}/t_p)$

Where: H_{sec} = Secondary compression
H_t = Thickness of soil stratum

Est. Secondary Compression (inches):	**1.4**	Slimes
Est. Secondary Compression (inches):	**0.0**	Clay

SUMMARY OF EXISTING CONDITIONS AND PROPOSED GRADING

Analysis Point/Location:	**CP-605**	
Existing Grade:	69.8	feet
Assumed Bedrock Depth:	15.3	feet bgs
Groundwater Depth:	2.8	feet bgs
Tot./Eff. Stress @ GWT =	308.0	psf

Analysis Point/Location:	**CP-605**	
Proposed Grade:	91.75	feet
Grade Change:	22.0	feet
Fill Unit Weight:	120.00	pcf
Δ Stress:	2634.0	psf

Input assumed or known depth (ft bgs) to bedrock above. Then input the bottom depth (ft bgs) and unit weight (pcf) for each primary stratum below.

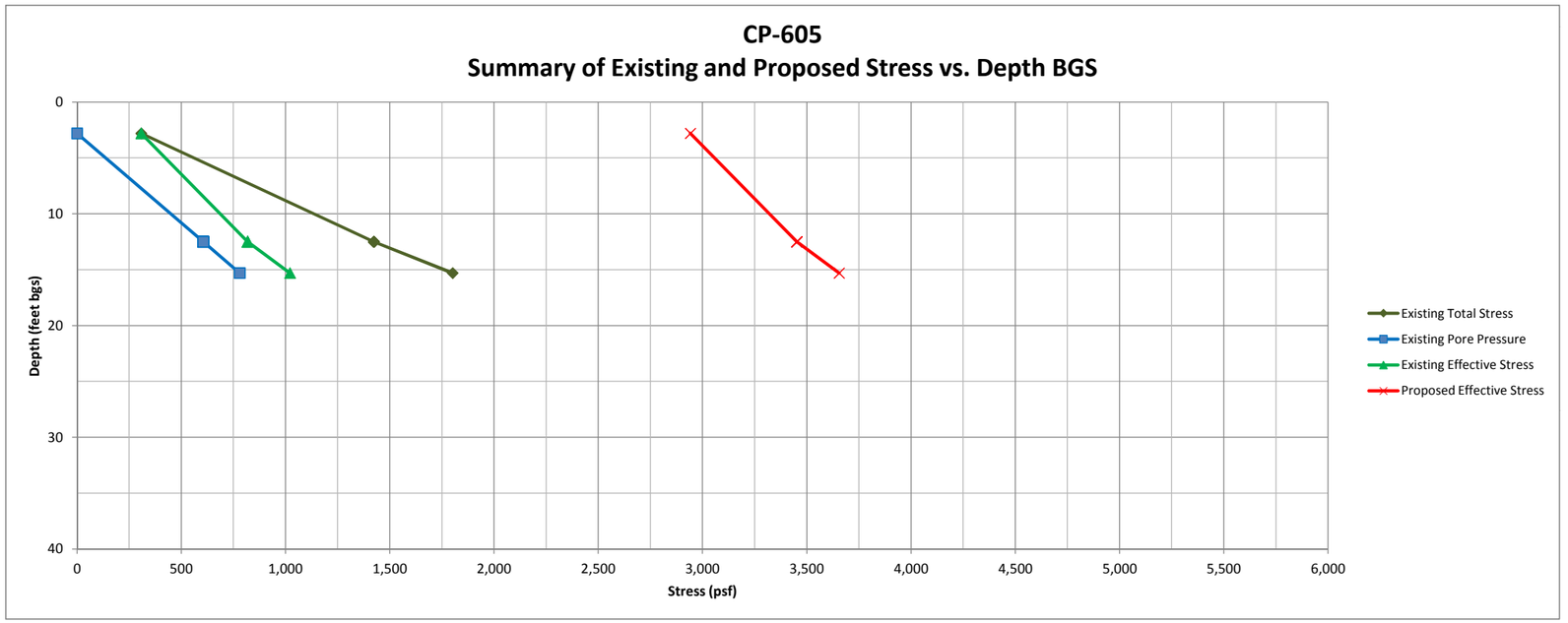
Subsurface Conditions					Existing Grade Conditions									Proposed Grade Conditions		
Primary Stratum	Depth		Thickness	Unit Weight	Total Stress			Pore Pressure			Effective Stress			Effective Stress		
	Top (ft bgs)	Bottom (ft bgs)	(ft)	γ_t or γ_{sat} (pcf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)
Slimes (unsat)	0.0	2.8	2.8	110	0.0	308.0	154.0	0.0	0.0	0.0	0.0	308.0	154.0	2634.0	2942.0	2788.0
Slimes (sat)	2.8	12.5	9.7	115	308.0	1423.5	865.8	0.0	605.3	302.6	308.0	818.2	563.1	2942.0	3452.2	3197.1
Clay/Till Fill	12.5	12.5	0.0	125	1423.5	1423.5	1423.5	605.3	605.3	605.3	818.2	818.2	818.2	3452.2	3452.2	3452.2
V. Stiff Clay	12.5	12.5	0.0	125	1423.5	1423.5	1423.5	605.3	605.3	605.3	818.2	818.2	818.2	3452.2	3452.2	3452.2
Stiff Clay	12.5	12.5	0.0	125	1423.5	1423.5	1423.5	605.3	605.3	605.3	818.2	818.2	818.2	3452.2	3452.2	3452.2
M. Stiff Clay	12.5	12.5	0.0	120	1423.5	1423.5	1423.5	605.3	605.3	605.3	818.2	818.2	818.2	3452.2	3452.2	3452.2
Soft Clay	12.5	12.5	0.0	120	1423.5	1423.5	1423.5	605.3	605.3	605.3	818.2	818.2	818.2	3452.2	3452.2	3452.2
Till	12.5	15.3	2.8	135	1423.5	1801.5	1612.5	605.3	780.0	692.6	818.2	1021.5	919.9	3452.2	3655.5	3553.9

Notes, Comments, and/or Adjustments Made to Subsurface Conditions

1. n/a
2. n/a
3. n/a

Prepared By/Date: JC/10-21-14

Checked By/Date: NDL/10-23-14



SUMMARY OF COMPRESSIBILITY PARAMETERS, ESTIMATED PRIMARY CONSOLIDATION SETTLEMENT, & TIME-RATE OF CONSOLIDATION

Analysis Point/Location:	**CP-605**	
Proposed Grade:	91.8	feet
Grade Change:	22.0	feet
Fill Unit Weight:	120.0	pcf
Δ Stress:	2634.0	psf

Input assumed over-consolidation ratio, compression index (= $C_c/1+e_0$), recompression index (= $C_r/1+e_0$), and coefficient of consolidation (ft^2/day) for each primary stratum below.

Assumed Compressibility Parameters					Primary Consolidation Settlement (Due to Proposed Grade Change)	Time-Rate of Consolidation (to 90% Consolidation)		
Primary Stratum	OCR	Comp. Index $C_{c\varepsilon}$	Recomp. Index $C_{r\varepsilon}$	Coef. of Consol. c_v (ft^2/day)	(inches)	Drainage Height H_{dr} (feet)	Time Factor T	Time t (days)
Slimes (unsat)	1.0	0.15	0.05	1.00	6.34	1.4	0.848	1.7
Slimes (sat)	1.0	0.15	0.05	1.00	13.17	4.85	0.848	19.9
Clay/Till Fill	2.0	0.15	0.02	2.00	0.00	0.0	0.848	0.0
V. Stiff Clay	2.0	0.15	0.02	4.00	0.00	0.0	0.848	0.0
Stiff Clay	2.0	0.15	0.02	3.00	0.00	0.0	0.848	0.0
M. Stiff Clay	2.0	0.15	0.02	2.00	0.00	0.0	0.848	0.0
Soft Clay	1.2	0.15	0.02	0.50	0.00	0.0	0.848	0.0
Till	-	-	-	-	-	-	-	-
					19.51			

Estimated Settlement @ 90% Consolidation

(inches)

17.56

Days	**19.9**
Months	**0.7**
Years	**0.1**

Above Time-Rate calcs assume double drainage of each stratum. However, this is not valid. In this case, convert to a composite stratum as per below.

Double drainage of each Stratum? **NO**

If answer to double drainage question = "YES", refer to the values above for the estimated time to 90% consolidation. If the answer to the question = "NO", refer to the composite Stratum calculation below for the estimated time to 90% consolidation.

COMPOSITE STRATUM (Slimes & Clay)

Convert to One "Composite" Layer (NAVFAC DM 7.1-235)

(w/ C_v properties of Slimes)

$$H_{comp} = H_d + H_o(Cv_d / Cv_o)^{1/2}$$

H_{comp} = 12.5 ft

H_{dr} = 12.5 ft - Single Drainage

H_{dr} = 6.3 ft - Double Drainage

T = 0.848 90% consolidation

Calculate Time, t, in days to 90% Consolidation

$$t = (T * H_{dr}^2) / Cv_d$$

	Single Drainage	Double Drainage
Days	**132.5**	**33.1**
Months	**4.3**	**1.1**
Years	**0.4**	**0.1**

DATA INPUT AND OUTPUT SUMMARY

KEY

Data Input Cells:	Input Data Here	Input location-specific information for this Analysis Point
Data Output Cells:	Calculation/Output	Calculated value. Read output cell for result.

EXISTING CONDITIONS, PROPOSED GRADING, & PRIMARY CONSOLIDATION

Analyis Point No.:	**SB-707**	Input analysis point no./exploration location.
Existing Grade (ft):	**74.5**	Input existing ground surface elev. (to nearest 0.25') at analysis point location.
Groundwater Depth (ft bgs):	**10.3**	Input existing groundwater depth (to nearest 0.25') at analysis point location.
Proposed Grade (ft):	**91.5**	Input proposed grade (to nearest 0.25') at analysis point location.
Unit Weight of Prop. Fill (pcf):	**120.0**	Input unit weight of grade change fill/materials.
Est. Primary Consol. Settlement:	**6.8**	Estimated primary consol. settlement (in inches) due to proposed grade change.
Est. Primary Consol. Settlement:	**6.2**	Estimated primary consol. settlement (in inches) at 90% consolidation.
Est. Time to 90% Primary Conol (single drain).:	**0.1**	Estimated time (in years) to achieve 90% of the est. primary consol. settlement.
Est. Time to 99% Primary Consol. (single drain):	**0.3**	Estimated time (in years) to achieve 99% of the est. primary consol. settlement.
Est. Time to 90% Primary Conol (double drain).:	**0.0**	Estimated time (in years) to achieve 90% of the est. primary consol. settlement.
Est. Time to 99% Primary Consol. (double drain):	**0.1**	Estimated time (in years) to achieve 99% of the est. primary consol. settlement.

SECONDARY CONSOLIDATION

Analysis Point No:	**SB-707**	-	
Surcharge Area/Point No:	**0**	-	
Coefficient of Secondary Compression, $C_{\acute{\alpha}}$	**0.005**	Clay	(Cά expressed by change in strain per log cycle of time)
Coefficient of Secondary Compression, $C_{\acute{\alpha}}$	**0.005**	Slimes	(Cά expressed by change in strain per log cycle of time)
Est. Time to End of Primary Consolidation, t_p	**0.3**	Years	
Est. Design Life Time, t_{sec}	**50**	Years	

Method from NAVFAC DM 7.1-231: $H_{sec} = C\acute{\alpha} * H_t * \log (t_{sec}/t_p)$

Where: H_{sec} = Secondary compression
H_t = Thickness of soil stratum

Est. Secondary Compression (inches):	**1.0**	Slimes
Est. Secondary Compression (inches):	**0.0**	Clay

SUMMARY OF EXISTING CONDITIONS AND PROPOSED GRADING

Analysis Point/Location:	**SB-707**	
Existing Grade:	74.5	feet
Assumed Bedrock Depth:	13.8	feet bgs
Groundwater Depth:	10.3	feet bgs
Tot./Eff. Stress @ GWT =	1133.0	psf

Analysis Point/Location:	**SB-707**	
Proposed Grade:	91.50	feet
Grade Change:	17.0	feet
Fill Unit Weight:	120.00	pcf
Δ Stress:	2040.0	psf

Input assumed or known depth (ft bgs) to bedrock above. Then input the bottom depth (ft bgs) and unit weight (pcf) for each primary stratum below.

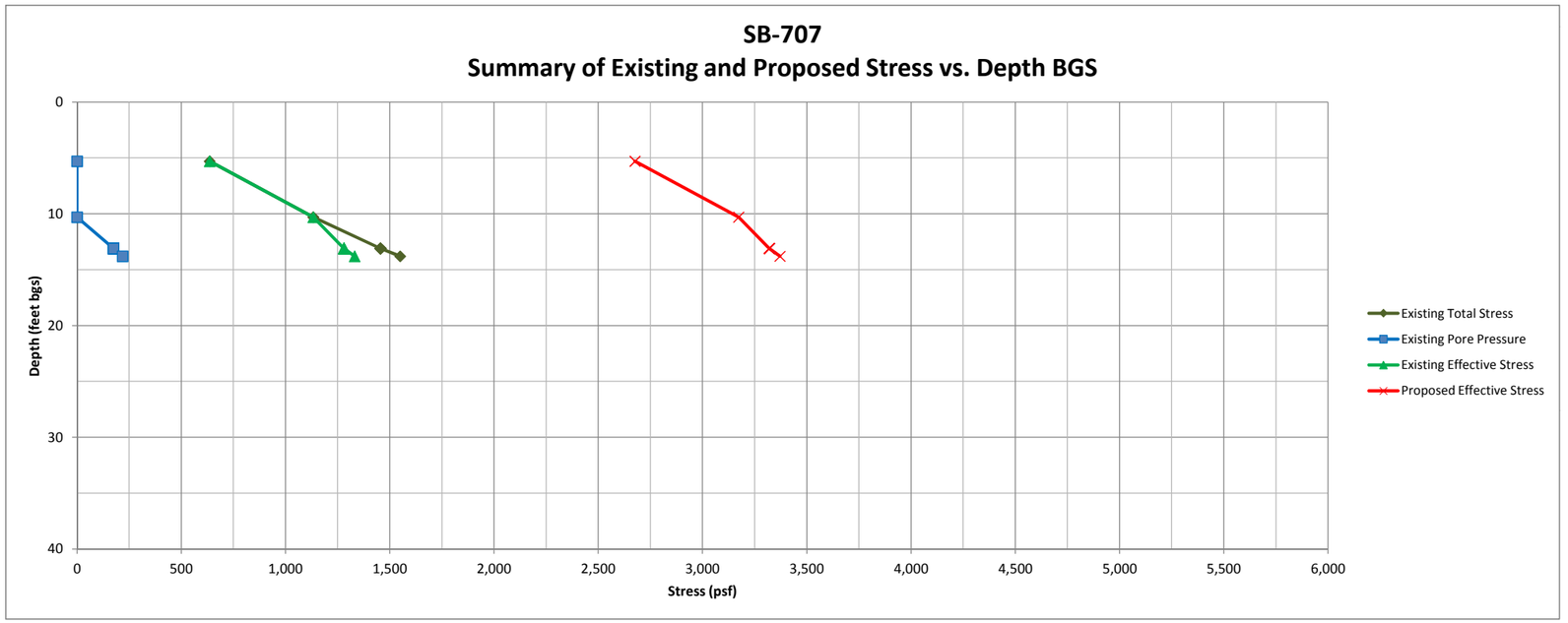
Subsurface Conditions					Existing Grade Conditions									Proposed Grade Conditions		
Primary Stratum	Depth		Thickness	Unit Weight	Total Stress			Pore Pressure			Effective Stress			Effective Stress		
	Top (ft bgs)	Bottom (ft bgs)	(ft)	γ_t or γ_{sat} (pcf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)
Fill	0	5.3	5.3	120	0	636.0	318.0	0	0.0	0	0	636.0	318.0	2040.0	2676.0	2358.0
Slimes (unsat)	5.3	10.3	5.0	110	636.0	1133.0	884.5	0.0	0.0	0.0	636.0	1133.0	884.5	2676.0	3173.0	2924.5
Slimes (sat)	10.3	13.1	2.8	115	1133.0	1455.0	1294.0	0.0	174.7	87.4	1133.0	1280.3	1206.6	3173.0	3320.3	3246.6
Clay/Till Fill	13.1	13.1	0.0	125	1455.0	1455.0	1455.0	174.7	174.7	174.7	1280.3	1280.3	1280.3	3320.3	3320.3	3320.3
V. Stiff Clay	13.1	13.1	0.0	125	1455.0	1455.0	1455.0	174.7	174.7	174.7	1280.3	1280.3	1280.3	3320.3	3320.3	3320.3
Stiff Clay	13.1	13.1	0.0	125	1455.0	1455.0	1455.0	174.7	174.7	174.7	1280.3	1280.3	1280.3	3320.3	3320.3	3320.3
M. Stiff Clay	13.1	13.1	0.0	120	1455.0	1455.0	1455.0	174.7	174.7	174.7	1280.3	1280.3	1280.3	3320.3	3320.3	3320.3
Soft Clay	13.1	13.1	0.0	120	1455.0	1455.0	1455.0	174.7	174.7	174.7	1280.3	1280.3	1280.3	3320.3	3320.3	3320.3
Till	13.1	13.8	0.7	135	1455.0	1549.5	1502.3	174.7	218.4	196.6	1280.3	1331.1	1305.7	3320.3	3371.1	3345.7

Notes, Comments, and/or Adjustments Made to Subsurface Conditions

1. n/a
2. n/a
3. n/a

Prepared By/Date: JC/10-21-14

Checked By/Date: NDL/10-23-14



SUMMARY OF COMPRESSIBILITY PARAMETERS, ESTIMATED PRIMARY CONSOLIDATION SETTLEMENT, & TIME-RATE OF CONSOLIDATION

Analysis Point/Location:	**SB-707**	
Proposed Grade:	91.5	feet
Grade Change:	17.0	feet
Fill Unit Weight:	120.0	pcf
Δ Stress:	2040.0	psf

Input assumed over-consolidation ratio, compression index (= $C_c/1+e_o$), recompression index (= $C_r/1+e_o$), and coefficient of consolidation (ft^2/day) for each primary stratum below.

Assumed Compressibility Parameters					Primary Consolidation Settlement (Due to Proposed Grade Change)	Time-Rate of Consolidation (to 90% Consolidation)		
Primary Stratum	OCR	Comp. Index $C_{c\varepsilon}$	Recomp. Index $C_{r\varepsilon}$	Coef. of Consol. c_v (ft^2/day)	(inches)	Drainage Height H_{dr} (feet)	Time Factor T	Time t (days)
Fill	-	-	-	-	-	-	-	-
Slimes (unsat)	1.0	0.15	0.05	1.00	4.67	2.5	0.848	5.3
Slimes (sat)	1.0	0.15	0.05	1.00	2.17	1.4	0.848	1.7
Clay/Till Fill	2.0	0.15	0.02	2.00	0.00	0.0	0.848	0.0
V. Stiff Clay	2.0	0.15	0.02	4.00	0.00	0.0	0.848	0.0
Stiff Clay	2.0	0.15	0.02	3.00	0.00	0.0	0.848	0.0
M. Stiff Clay	2.0	0.15	0.02	2.00	0.00	0.0	0.848	0.0
Soft Clay	1.2	0.15	0.02	0.50	0.00	0.0	0.848	0.0
Till	-	-	-	-	-	-	-	-
					6.84			

Estimated Settlement @ 90% Consolidation
(inches)
6.16

Days	**5.3**
Months	**0.2**
Years	**0.0**

Above Time-Rate calcs assume double drainage of each stratum. However, this is not valid. In this case, convert to a composite stratum as per below.

Double drainage of each Stratum? **NO**

If answer to double drainage question = "YES", refer to the values above for the estimated time to 90% consolidation. If the answer to the question = "NO", refer to the composite Stratum calculation below for the estimated time to 90% consolidation.

COMPOSITE STRATUM (Slimes & Clay)

Convert to One "Composite" Layer (NAVFAC DM 7.1-235)
(w/ C_v properties of Slimes)

$$H_{comp} = H_d + H_o(Cv_d / Cv_o)^{1/2}$$

H_{comp} = 7.8 ft

H_{dr} = 7.8 ft - Single Drainage
H_{dr} = 3.9 ft - Double Drainage
T = 0.848 90% consolidation

Calculate Time, t, in days to 90% Consolidation

$$t = (T * H_{dr}^2) / Cv_d$$

	Single Drainage	Double Drainage
Days	**51.6**	**12.9**
Months	**1.7**	**0.4**
Years	**0.1**	**0.0**

DATA INPUT AND OUTPUT SUMMARY

KEY

Data Input Cells:	Input Data Here	Input location-specific information for this Analysis Point
Data Output Cells:	Calculation/Output	Calculated value. Read output cell for result.

EXISTING CONDITIONS, PROPOSED GRADING, & PRIMARY CONSOLIDATION

Analyis Point No.:	**CPT-03**	Input analysis point no./exploration location.
Existing Grade (ft):	**71.0**	Input existing ground surface elev. (to nearest 0.25') at analysis point location.
Groundwater Depth (ft bgs):	**2.0**	Input existing groundwater depth (to nearest 0.25') at analysis point location.
Proposed Grade (ft):	**87.5**	Input proposed grade (to nearest 0.25') at analysis point location.
Unit Weight of Prop. Fill (pcf):	**120.0**	Input unit weight of grade change fill/materials.
Est. Primary Consol. Settlement:	**17.2**	Estimated primary consol. settlement (in inches) due to proposed grade change.
Est. Primary Consol. Settlement:	**15.5**	Estimated primary consol. settlement (in inches) at 90% consolidation.
Est. Time to 90% Primary Conol (single drain).:	**0.5**	Estimated time (in years) to achieve 90% of the est. primary consol. settlement.
Est. Time to 99% Primary Consol. (single drain):	**1.0**	Estimated time (in years) to achieve 99% of the est. primary consol. settlement.
Est. Time to 90% Primary Conol (double drain).:	**0.1**	Estimated time (in years) to achieve 90% of the est. primary consol. settlement.
Est. Time to 99% Primary Consol. (double drain):	**0.3**	Estimated time (in years) to achieve 99% of the est. primary consol. settlement.

SECONDARY CONSOLIDATION

Analysis Point No:	**CPT-03**	-	
Surcharge Area/Point No:	**0**	-	
Coefficient of Secondary Compression, $C_{\acute{\alpha}}$	**0.005**	Clay	(Cά expressed by change in strain per log cycle of time)
Coefficient of Secondary Compression, $C_{\acute{\alpha}}$	**0.005**	Slimes	(Cά expressed by change in strain per log cycle of time)
Est. Time to End of Primary Consolidation, t_p	**1.0**	Years	
Est. Design Life Time, t_{sec}	**50**	Years	

Method from NAVFAC DM 7.1-231: $H_{sec} = C\acute{\alpha} * H_t * \log (t_{sec}/t_p)$

Where: H_{sec} = Secondary compression
H_t = Thickness of soil stratum

Est. Secondary Compression (inches):	**1.4**	Slimes
Est. Secondary Compression (inches):	**0.1**	Clay

SUMMARY OF EXISTING CONDITIONS AND PROPOSED GRADING

Analysis Point/Location:	**CPT-03**	
Existing Grade:	71.0	feet
Assumed Bedrock Depth:	16.8	feet bgs
Groundwater Depth:	2.0	feet bgs
Tot./Eff. Stress @ GWT =	220.0	psf

Analysis Point/Location:	**CPT-03**	
Proposed Grade:	87.50	feet
Grade Change:	16.5	feet
Fill Unit Weight:	120.00	pcf
Δ Stress:	1980.0	psf

Input assumed or known depth (ft bgs) to bedrock above. Then input the bottom depth (ft bgs) and unit weight (pcf) for each primary stratum below.

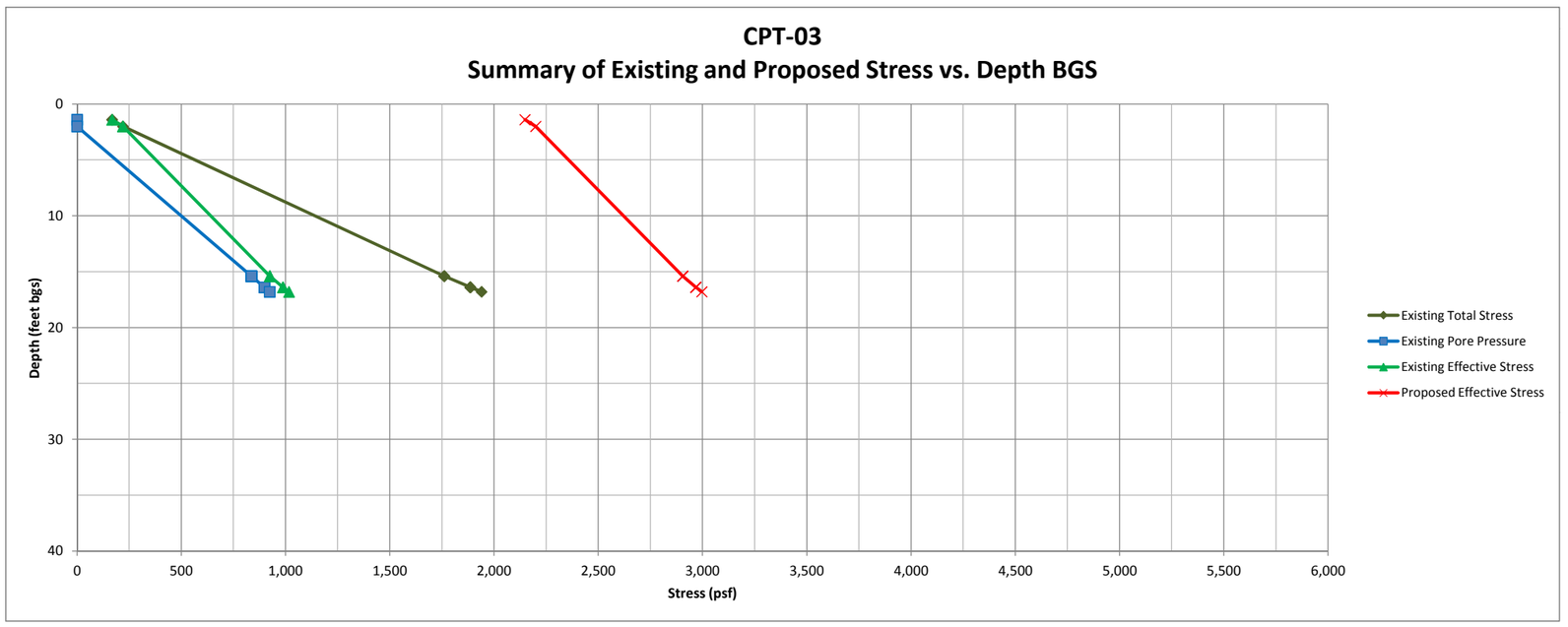
Subsurface Conditions					Existing Grade Conditions									Proposed Grade Conditions		
Primary Stratum	Depth		Thickness	Unit Weight	Total Stress			Pore Pressure			Effective Stress			Effective Stress		
	Top (ft bgs)	Bottom (ft bgs)	(ft)	γ_t or γ_{sat} (pcf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)
Fill	0	1.4	1.4	120	0	168.0	84.0	0	0.0	0	0	168.0	84.0	1980.0	2148.0	2064.0
Slimes (unsat)	1.4	2.0	0.6	110	168.0	220.0	194.0	0.0	0.0	0.0	168.0	220.0	194.0	2148.0	2200.0	2174.0
Slimes (sat)	2.0	15.4	13.4	115	220.0	1761.0	990.5	0.0	836.2	418.1	220.0	924.8	572.4	2200.0	2904.8	2552.4
Clay/Till Fill	15.4	15.4	0.0	125	1761.0	1761.0	1761.0	836.2	836.2	836.2	924.8	924.8	924.8	2904.8	2904.8	2904.8
V. Stiff Clay	15.4	15.4	0.0	125	1761.0	1761.0	1761.0	836.2	836.2	836.2	924.8	924.8	924.8	2904.8	2904.8	2904.8
Stiff Clay	15.4	16.4	1.0	125	1761.0	1886.0	1823.5	836.2	898.6	867.4	924.8	987.4	956.1	2904.8	2967.4	2936.1
M. Stiff Clay	16.4	16.4	0.0	120	1886.0	1886.0	1886.0	898.6	898.6	898.6	987.4	987.4	987.4	2967.4	2967.4	2967.4
Soft Clay	16.4	16.4	0.0	120	1886.0	1886.0	1886.0	898.6	898.6	898.6	987.4	987.4	987.4	2967.4	2967.4	2967.4
Till	16.4	16.8	0.4	135	1886.0	1940.0	1913.0	898.6	923.5	911.0	987.4	1016.5	1002.0	2967.4	2996.5	2982.0

Notes, Comments, and/or Adjustments Made to Subsurface Conditions

1. n/a
2. n/a
3. n/a

Prepared By/Date: JC/10-21-14

Checked By/Date: NDL/10-23-14



SUMMARY OF COMPRESSIBILITY PARAMETERS, ESTIMATED PRIMARY CONSOLIDATION SETTLEMENT, & TIME-RATE OF CONSOLIDATION

Analysis Point/Location:	**CPT-03**	
Proposed Grade:	87.5	feet
Grade Change:	16.5	feet
Fill Unit Weight:	120.0	pcf
Δ Stress:	1980.0	psf

Input assumed over-consolidation ratio, compression index (= $C_c/1+e_o$), recompression index (= $C_r/1+e_o$), and coefficient of consolidation (ft^2/day) for each primary stratum below.

Assumed Compressibility Parameters					Primary Consolidation Settlement (Due to Proposed Grade Change)	Time-Rate of Consolidation (to 90% Consolidation)		
Primary Stratum	OCR	Comp. Index $C_{c\varepsilon}$	Recomp. Index $C_{r\varepsilon}$	Coef. of Consol. c_v (ft^2/day)	(inches)	Drainage Height H_{dr} (feet)	Time Factor T	Time t (days)
-	-	-	-	-	-	-	-	-
Slimes (unsat)	1.0	0.15	0.05	1.00	1.13	0.3	0.848	0.1
Slimes (sat)	1.0	0.15	0.05	1.00	15.66	6.7	0.848	38.1
Clay/Till Fill	2.0	0.15	0.02	2.00	0.00	0.0	0.848	0.0
V. Stiff Clay	2.0	0.15	0.02	4.00	0.00	0.0	0.848	0.0
Stiff Clay	2.0	0.15	0.02	3.00	0.41	0.5	0.848	0.1
M. Stiff Clay	2.0	0.15	0.02	2.00	0.00	0.0	0.848	0.0
Soft Clay	1.2	0.15	0.02	0.50	0.00	0.0	0.848	0.0
Till	-	-	-	-	-	-	-	-
					17.20			

Estimated Settlement @ 90% Consolidation
(inches)
15.48

Days	**38.1**
Months	**1.3**
Years	**0.1**

Above Time-Rate calcs assume double drainage of each stratum. However, this is not valid. In this case, convert to a composite stratum as per below.

Double drainage of each Stratum? **NO**

If answer to double drainage question = "YES", refer to the values above for the estimated time to 90% consolidation. If the answer to the question = "NO", refer to the composite Stratum calculation below for the estimated time to 90% consolidation.

COMPOSITE STRATUM (Slimes & Clay)

Convert to One "Composite" Layer (NAVFAC DM 7.1-235)
(w/ C_v properties of Slimes)

$$H_{comp} = H_d + H_o(Cv_d / Cv_o)^{1/2}$$

H_{comp} = 14.6 ft

H_{dr} = 14.6 ft - Single Drainage
H_{dr} = 7.3 ft - Double Drainage
T = 0.848 90% consolidation

Calculate Time, t, in days to 90% Consolidation

$$t = (T * H_{dr}^2) / Cv_d$$

	Single Drainage	Double Drainage
Days	**180.2**	**45.0**
Months	**5.9**	**1.5**
Years	**0.5**	**0.1**

DATA INPUT AND OUTPUT SUMMARY

KEY

Data Input Cells:	Input Data Here	Input location-specific information for this Analysis Point
Data Output Cells:	Calculation/Output	Calculated value. Read output cell for result.

EXISTING CONDITIONS, PROPOSED GRADING, & PRIMARY CONSOLIDATION

Analyis Point No.:	**CP-609**	Input analysis point no./exploration location.
Existing Grade (ft):	**73.0**	Input existing ground surface elev. (to nearest 0.25') at analysis point location.
Groundwater Depth (ft bgs):	**4.2**	Input existing groundwater depth (to nearest 0.25') at analysis point location.
Proposed Grade (ft):	**81.5**	Input proposed grade (to nearest 0.25') at analysis point location.
Unit Weight of Prop. Fill (pcf):	**120.0**	Input unit weight of grade change fill/materials.
Est. Primary Consol. Settlement:	**9.4**	Estimated primary consol. settlement (in inches) due to proposed grade change.
Est. Primary Consol. Settlement:	**8.4**	Estimated primary consol. settlement (in inches) at 90% consolidation.
Est. Time to 90% Primary Conol (single drain).:	**0.4**	Estimated time (in years) to achieve 90% of the est. primary consol. settlement.
Est. Time to 99% Primary Consol. (single drain):	**0.8**	Estimated time (in years) to achieve 99% of the est. primary consol. settlement.
Est. Time to 90% Primary Conol (double drain).:	**0.1**	Estimated time (in years) to achieve 90% of the est. primary consol. settlement.
Est. Time to 99% Primary Consol. (double drain):	**0.2**	Estimated time (in years) to achieve 99% of the est. primary consol. settlement.

SECONDARY CONSOLIDATION

Analysis Point No:	**CP-609**	-	
Surcharge Area/Point No:	**0**	-	
Coefficient of Secondary Compression, $C_{\acute{\alpha}}$	**0.005**	Clay	(Cά expressed by change in strain per log cycle of time)
Coefficient of Secondary Compression, $C_{\acute{\alpha}}$	**0.005**	Slimes	(Cά expressed by change in strain per log cycle of time)
Est. Time to End of Primary Consolidation, t_p	**0.8**	Years	
Est. Design Life Time, t_{sec}	**50**	Years	

Method from NAVFAC DM 7.1-231: $H_{sec} = C\acute{\alpha} * H_t * \log (t_{sec}/t_p)$

Where: H_{sec} = Secondary compression
H_t = Thickness of soil stratum

Est. Secondary Compression (inches):	**1.4**	Slimes
Est. Secondary Compression (inches):	**0.0**	Clay

SUMMARY OF EXISTING CONDITIONS AND PROPOSED GRADING

Analysis Point/Location:	**CP-609**	
Existing Grade:	73.0	feet
Assumed Bedrock Depth:	20.9	feet bgs
Groundwater Depth:	4.2	feet bgs
Tot./Eff. Stress @ GWT =	462.0	psf

Analysis Point/Location:	**CP-609**	
Proposed Grade:	81.50	feet
Grade Change:	8.5	feet
Fill Unit Weight:	120.00	pcf
Δ Stress:	1020.0	psf

Input assumed or known depth (ft bgs) to bedrock above. Then input the bottom depth (ft bgs) and unit weight (pcf) for each primary stratum below.

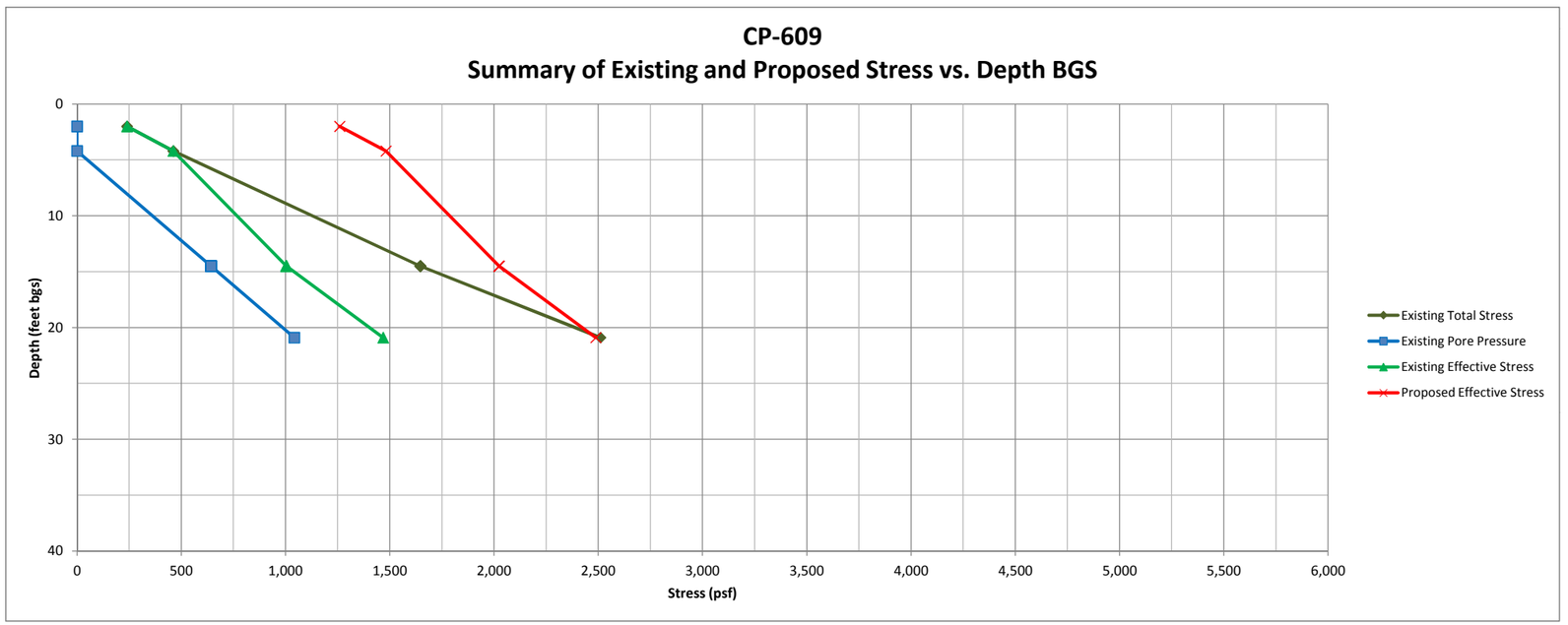
Subsurface Conditions					Existing Grade Conditions									Proposed Grade Conditions		
Primary Stratum	Depth		Thickness	Unit Weight	Total Stress			Pore Pressure			Effective Stress			Effective Stress		
	Top (ft bgs)	Bottom (ft bgs)	(ft)	γ_t or γ_{sat} (pcf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)
Fill	0	2.0	2.0	120	0	240.0	120.0	0	0.0	0	0	240.0	120.0	1020.0	1260.0	1140.0
Slimes (unsat)	2.0	4.2	2.2	110	240.0	462.0	351.0	0.0	0.0	0.0	240.0	462.0	351.0	1260.0	1482.0	1371.0
Slimes (sat)	4.2	14.5	10.3	115	462.0	1646.5	1054.3	0.0	642.7	321.4	462.0	1003.8	732.9	1482.0	2023.8	1752.9
Clay/Till Fill	14.5	14.5	0.0	125	1646.5	1646.5	1646.5	642.7	642.7	642.7	1003.8	1003.8	1003.8	2023.8	2023.8	2023.8
V. Stiff Clay	14.5	14.5	0.0	125	1646.5	1646.5	1646.5	642.7	642.7	642.7	1003.8	1003.8	1003.8	2023.8	2023.8	2023.8
Stiff Clay	14.5	14.5	0.0	125	1646.5	1646.5	1646.5	642.7	642.7	642.7	1003.8	1003.8	1003.8	2023.8	2023.8	2023.8
M. Stiff Clay	14.5	14.5	0.0	120	1646.5	1646.5	1646.5	642.7	642.7	642.7	1003.8	1003.8	1003.8	2023.8	2023.8	2023.8
Soft Clay	14.5	14.5	0.0	120	1646.5	1646.5	1646.5	642.7	642.7	642.7	1003.8	1003.8	1003.8	2023.8	2023.8	2023.8
Till	14.5	20.9	6.4	135	1646.5	2510.5	2078.5	642.7	1042.1	842.4	1003.8	1468.4	1236.1	2023.8	2488.4	2256.1

Notes, Comments, and/or Adjustments Made to Subsurface Conditions

1. n/a
2. n/a
3. n/a

Prepared By/Date: JC/10-21-14

Checked By/Date: NDL/10-23-14



SUMMARY OF COMPRESSIBILITY PARAMETERS, ESTIMATED PRIMARY CONSOLIDATION SETTLEMENT, & TIME-RATE OF CONSOLIDATION

Analysis Point/Location:	**CP-609**	
Proposed Grade:	81.5	feet
Grade Change:	8.5	feet
Fill Unit Weight:	120.0	pcf
Δ Stress:	1020.0	psf

Input assumed over-consolidation ratio, compression index (= $C_c/1+e_0$), recompression index (= $C_r/1+e_0$), and coefficient of consolidation (ft^2/day) for each primary stratum below.

Assumed Compressibility Parameters					Primary Consolidation Settlement (Due to Proposed Grade Change)	Time-Rate of Consolidation (to 90% Consolidation)		
Primary Stratum	OCR	Comp. Index $C_{c\varepsilon}$	Recomp. Index $C_{r\varepsilon}$	Coef. of Consol. c_v (ft^2/day)	(inches)	Drainage Height H_{dr} (feet)	Time Factor T	Time t (days)
Fill	-	-	-	-	-	-	-	-
Slimes (unsat)	1.0	0.15	0.05	1.00	2.34	1.1	0.848	1.0
Slimes (sat)	1.0	0.15	0.05	1.00	7.02	5.15	0.848	22.5
Clay/Till Fill	2.0	0.15	0.02	2.00	0.00	0.0	0.848	0.0
V. Stiff Clay	2.0	0.15	0.02	4.00	0.00	0.0	0.848	0.0
Stiff Clay	2.0	0.15	0.02	3.00	0.00	0.0	0.848	0.0
M. Stiff Clay	2.0	0.15	0.02	2.00	0.00	0.0	0.848	0.0
Soft Clay	1.2	0.15	0.02	0.50	0.00	0.0	0.848	0.0
Till	-	-	-	-	-	-	-	-
					9.36			

Estimated Settlement @ 90% Consolidation
(inches)
8.43

Days	**22.5**
Months	**0.7**
Years	**0.1**

Above Time-Rate calcs assume double drainage of each stratum. However, this is not valid. In this case, convert to a composite stratum as per below.

Double drainage of each Stratum? **NO**

If answer to double drainage question = "YES", refer to the values above for the estimated time to 90% consolidation. If the answer to the question = "NO", refer to the composite Stratum calculation below for the estimated time to 90% consolidation.

COMPOSITE STRATUM (Slimes & Clay)

Convert to One "Composite" Layer (NAVFAC DM 7.1-235)
(w/ C_v properties of Slimes)

$$H_{comp} = H_d + H_o(Cv_d / Cv_o)^{1/2}$$

H_{comp} = 12.5 ft

H_{dr} = 12.5 ft - Single Drainage
H_{dr} = 6.3 ft - Double Drainage
T = 0.848 90% consolidation

Calculate Time, t, in days to 90% Consolidation

$$t = (T * H_{dr}^2) / Cv_d$$

	Single Drainage	Double Drainage
Days	**132.5**	**33.1**
Months	**4.3**	**1.1**
Years	**0.4**	**0.1**

DATA INPUT AND OUTPUT SUMMARY

KEY

Data Input Cells:	Input Data Here	Input location-specific information for this Analysis Point
Data Output Cells:	Calculation/Output	Calculated value. Read output cell for result.

EXISTING CONDITIONS, PROPOSED GRADING, & PRIMARY CONSOLIDATION

Analyis Point No.:	SB-1130/SCPT-04	Input analysis point no./exploration location.
Existing Grade (ft):	71.0	Input existing ground surface elev. (to nearest 0.25') at analysis point location.
Groundwater Depth (ft bgs):	5.0	Input existing groundwater depth (to nearest 0.25') at analysis point location.
Proposed Grade (ft):	78.5	Input proposed grade (to nearest 0.25') at analysis point location.
Unit Weight of Prop. Fill (pcf):	120.0	Input unit weight of grade change fill/materials.
Est. Primary Consol. Settlement:	10.8	Estimated primary consol. settlement (in inches) due to proposed grade change.
Est. Primary Consol. Settlement:	9.7	Estimated primary consol. settlement (in inches) at 90% consolidation.
Est. Time to 90% Primary Conol (single drain).:	0.6	Estimated time (in years) to achieve 90% of the est. primary consol. settlement.
Est. Time to 99% Primary Consol. (single drain):	1.2	Estimated time (in years) to achieve 99% of the est. primary consol. settlement.
Est. Time to 90% Primary Conol (double drain).:	0.1	Estimated time (in years) to achieve 90% of the est. primary consol. settlement.
Est. Time to 99% Primary Consol. (double drain):	0.3	Estimated time (in years) to achieve 99% of the est. primary consol. settlement.

SECONDARY CONSOLIDATION

Analysis Point No:	SB-1130/SCPT-04	-	
Surcharge Area/Point No:	0	-	
Coefficient of Secondary Compression, $C_{\acute{\alpha}}$	0.005	Clay	(Cά expressed by change in strain per log cycle of time)
Coefficient of Secondary Compression, $C_{\acute{\alpha}}$	0.005	Slimes	(Cά expressed by change in strain per log cycle of time)
Est. Time to End of Primary Consolidation, t_p	1.2	Years	
Est. Design Life Time, t_{sec}	50	Years	

Method from NAVFAC DM 7.1-231: $H_{sec} = C\acute{\alpha} * H_t * \log (t_{sec}/t_p)$

Where: H_{sec} = Secondary compression; H_t = Thickness of soil stratum

Est. Secondary Compression (inches):	1.5	Slimes
Est. Secondary Compression (inches):	0.0	Clay

SUMMARY OF EXISTING CONDITIONS AND PROPOSED GRADING

Analysis Point/Location: B-1130/SCPT-04

Existing Grade:	71.0	feet
Assumed Bedrock Depth:	19.5	feet bgs
Groundwater Depth:	5.0	feet bgs
Tot./Eff. Stress @ GWT =	550.0	psf

Analysis Point/Location: B-1130/SCPT-04

Proposed Grade:	78.50	feet
Grade Change:	7.5	feet
Fill Unit Weight:	120.00	pcf
Δ Stress:	900.0	psf

Input assumed or known depth (ft bgs) to bedrock above. Then input the bottom depth (ft bgs) and unit weight (pcf) for each primary stratum below.

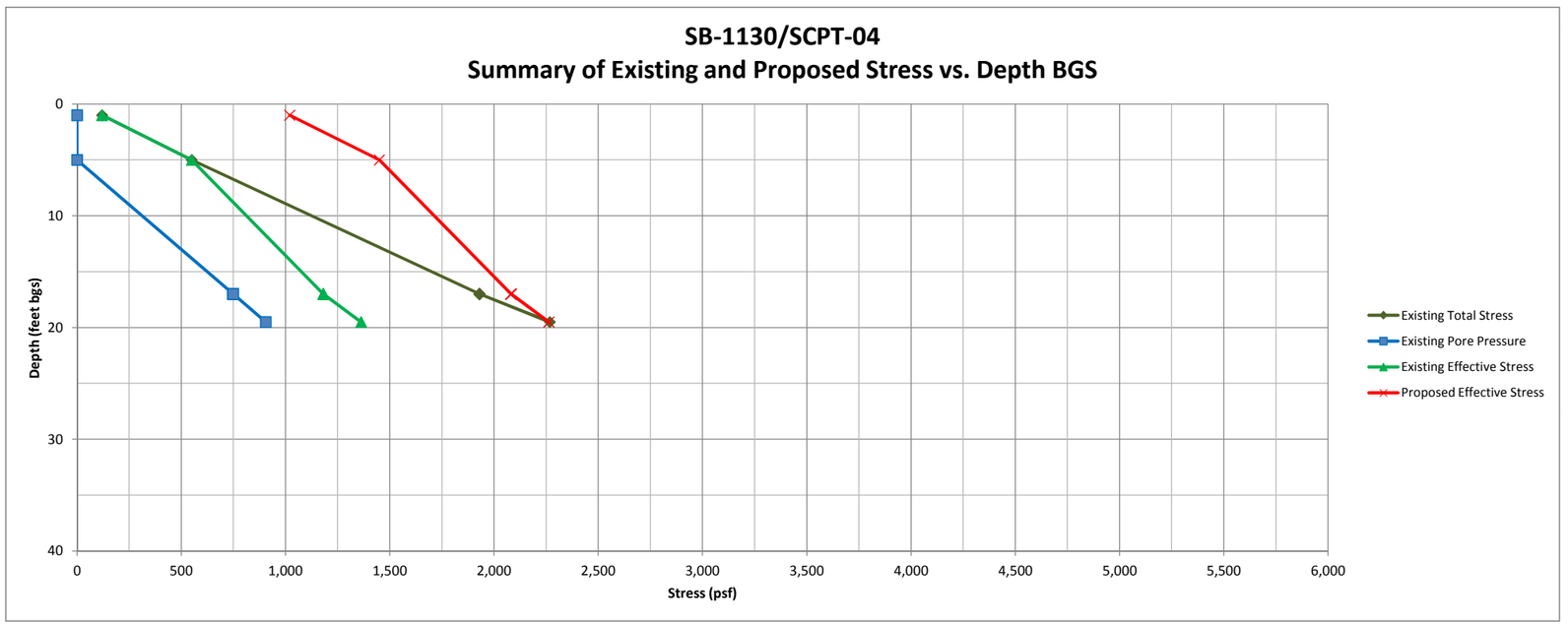
Subsurface Conditions					Existing Grade Conditions									Proposed Grade Conditions		
Primary Stratum	Depth		Thickness	Unit Weight	Total Stress			Pore Pressure			Effective Stress			Effective Stress		
	Top (ft bgs)	Bottom (ft bgs)	(ft)	γ_t or γ_{sat} (pcf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)
Fill	0	1.0	1.0	120	0	120.0	60.0	0	0.0	0	0	120.0	60.0	900.0	1020.0	960.0
Slimes (unsat)	1.0	5.0	4.0	110	120.0	550.0	335.0	0.0	0.0	0.0	120.0	550.0	335.0	1020.0	1450.0	1235.0
Slimes (sat)	5.0	17.0	12.0	115	550.0	1930.0	1240.0	0.0	748.8	374.4	550.0	1181.2	865.6	1450.0	2081.2	1765.6
Clay/Till Fill	17.0	17.0	0.0	125	1930.0	1930.0	1930.0	748.8	748.8	748.8	1181.2	1181.2	1181.2	2081.2	2081.2	2081.2
V. Stiff Clay	17.0	17.0	0.0	125	1930.0	1930.0	1930.0	748.8	748.8	748.8	1181.2	1181.2	1181.2	2081.2	2081.2	2081.2
Stiff Clay	17.0	17.0	0.0	125	1930.0	1930.0	1930.0	748.8	748.8	748.8	1181.2	1181.2	1181.2	2081.2	2081.2	2081.2
M. Stiff Clay	17.0	17.0	0.0	120	1930.0	1930.0	1930.0	748.8	748.8	748.8	1181.2	1181.2	1181.2	2081.2	2081.2	2081.2
Soft Clay	17.0	17.0	0.0	120	1930.0	1930.0	1930.0	748.8	748.8	748.8	1181.2	1181.2	1181.2	2081.2	2081.2	2081.2
Till	17.0	19.5	2.5	135	1930.0	2267.5	2098.8	748.8	904.8	826.8	1181.2	1362.7	1272.0	2081.2	2262.7	2172.0

Notes, Comments, and/or Adjustments Made to Subsurface Conditions

1. n/a
2. n/a
3. n/a

Prepared By/Date: JC/10-21-14

Checked By/Date: NDL/10-23-14



SUMMARY OF COMPRESSIBILITY PARAMETERS, ESTIMATED PRIMARY CONSOLIDATION SETTLEMENT, & TIME-RATE OF CONSOLIDATION

Analysis Point/Location: **SB-1130/SCPT-04**

Proposed Grade:	78.5	feet
Grade Change:	7.5	feet
Fill Unit Weight:	120.0	pcf
Δ Stress:	900.0	psf

Input assumed over-consolidation ratio, compression index (= $C_c/1+e_0$), recompression index (= $C_r/1+e_0$), and coefficient of consolidation (ft^2/day) for each primary stratum below.

Assumed Compressibility Parameters					Primary Consolidation Settlement (Due to Proposed Grade Change)	Time-Rate of Consolidation (to 90% Consolidation)		
Primary Stratum	OCR	Comp. Index $C_{c\varepsilon}$	Recomp. Index $C_{r\varepsilon}$	Coef. of Consol. c_v (ft^2/day)	(inches)	Drainage Height H_{dr} (feet)	Time Factor T	Time t (days)
-	-	-	-	-	-	-	-	-
Slimes (unsat)	1.0	0.15	0.05	1.00	4.08	2	0.848	3.4
Slimes (sat)	1.0	0.15	0.05	1.00	6.69	6	0.848	30.5
Clay/Till Fill	2.0	0.15	0.02	2.00	0.00	0.0	0.848	0.0
V. Stiff Clay	2.0	0.15	0.02	4.00	0.00	0.0	0.848	0.0
Stiff Clay	2.0	0.15	0.02	3.00	0.00	0.0	0.848	0.0
M. Stiff Clay	2.0	0.15	0.02	2.00	0.00	0.0	0.848	0.0
Soft Clay	1.2	0.15	0.02	0.50	0.00	0.0	0.848	0.0
Till	-	-	-	-	-	-	-	-
					10.77			

Estimated Settlement @ 90% Consolidation
(inches)
9.69

Days	**30.5**
Months	**1.0**
Years	**0.1**

Above Time-Rate calcs assume double drainage of each stratum. However, this is not valid. In this case, convert to a composite stratum as per below.

Double drainage of each Stratum? **NO**

If answer to double drainage question = "YES", refer to the values above for the estimated time to 90% consolidation. If the answer to the question = "NO", refer to the composite Stratum calculation below for the estimated time to 90% consolidation.

COMPOSITE STRATUM (Slimes & Clay)

Convert to One "Composite" Layer (NAVFAC DM 7.1-235)
(w/ C_v properties of Slimes)

$$H_{comp} = H_d + H_o(Cv_d / Cv_o)^{1/2}$$

H_{comp} = 16.0 ft

H_{dr} = 16.0 ft - Single Drainage
H_{dr} = 8.0 ft - Double Drainage
T = 0.848 90% consolidation

Calculate Time, t, in days to 90% Consolidation

$$t = (T * H_{dr}^2) / Cv_d$$

	Single Drainage	Double Drainage
Days	**217.1**	**54.3**
Months	**7.1**	**1.8**
Years	**0.6**	**0.1**

DATA INPUT AND OUTPUT SUMMARY

KEY

Data Input Cells:	Input Data Here	Input location-specific information for this Analysis Point
Data Output Cells:	Calculation/Output	Calculated value. Read output cell for result.

EXISTING CONDITIONS, PROPOSED GRADING, & PRIMARY CONSOLIDATION

Analyis Point No.:	**CP-602**	Input analysis point no./exploration location.
Existing Grade (ft):	**71.5**	Input existing ground surface elev. (to nearest 0.25') at analysis point location.
Groundwater Depth (ft bgs):	**4.3**	Input existing groundwater depth (to nearest 0.25') at analysis point location.
Proposed Grade (ft):	**78.5**	Input proposed grade (to nearest 0.25') at analysis point location.
Unit Weight of Prop. Fill (pcf):	**120.0**	Input unit weight of grade change fill/materials.
Est. Primary Consol. Settlement:	**13.7**	Estimated primary consol. settlement (in inches) due to proposed grade change.
Est. Primary Consol. Settlement:	**12.3**	Estimated primary consol. settlement (in inches) at 90% consolidation.
Est. Time to 90% Primary Conol (single drain).:	**2.2**	Estimated time (in years) to achieve 90% of the est. primary consol. settlement.
Est. Time to 99% Primary Consol. (single drain):	**4.7**	Estimated time (in years) to achieve 99% of the est. primary consol. settlement.
Est. Time to 90% Primary Conol (double drain).:	**0.6**	Estimated time (in years) to achieve 90% of the est. primary consol. settlement.
Est. Time to 99% Primary Consol. (double drain):	**1.2**	Estimated time (in years) to achieve 99% of the est. primary consol. settlement.

SECONDARY CONSOLIDATION

Analysis Point No:	**CP-602**	-	
Surcharge Area/Point No:	**0**	-	
Coefficient of Secondary Compression, $C_{\acute{\alpha}}$	**0.005**	Clay	(Cά expressed by change in strain per log cycle of time)
Coefficient of Secondary Compression, $C_{\acute{\alpha}}$	**0.005**	Slimes	(Cά expressed by change in strain per log cycle of time)
Est. Time to End of Primary Consolidation, t_p	**4.7**	Years	
Est. Design Life Time, t_{sec}	**50**	Years	

Method from NAVFAC DM 7.1-231: $H_{sec} = C\acute{\alpha} * H_t * \log (t_{sec}/t_p)$

Where: H_{sec} = Secondary compression; H_t = Thickness of soil stratum

Est. Secondary Compression (inches):	**1.4**	Slimes
Est. Secondary Compression (inches):	**0.5**	Clay

SUMMARY OF EXISTING CONDITIONS AND PROPOSED GRADING

Analysis Point/Location:	**CP-602**	
Existing Grade:	71.5	feet
Assumed Bedrock Depth:	38.3	feet bgs
Groundwater Depth:	4.3	feet bgs
Tot./Eff. Stress @ GWT =	473.0	psf

Analysis Point/Location:	**CP-602**	
Proposed Grade:	78.45	feet
Grade Change:	7.0	feet
Fill Unit Weight:	120.00	pcf
Δ Stress:	834.0	psf

Input assumed or known depth (ft bgs) to bedrock above. Then input the bottom depth (ft bgs) and unit weight (pcf) for each primary stratum below.

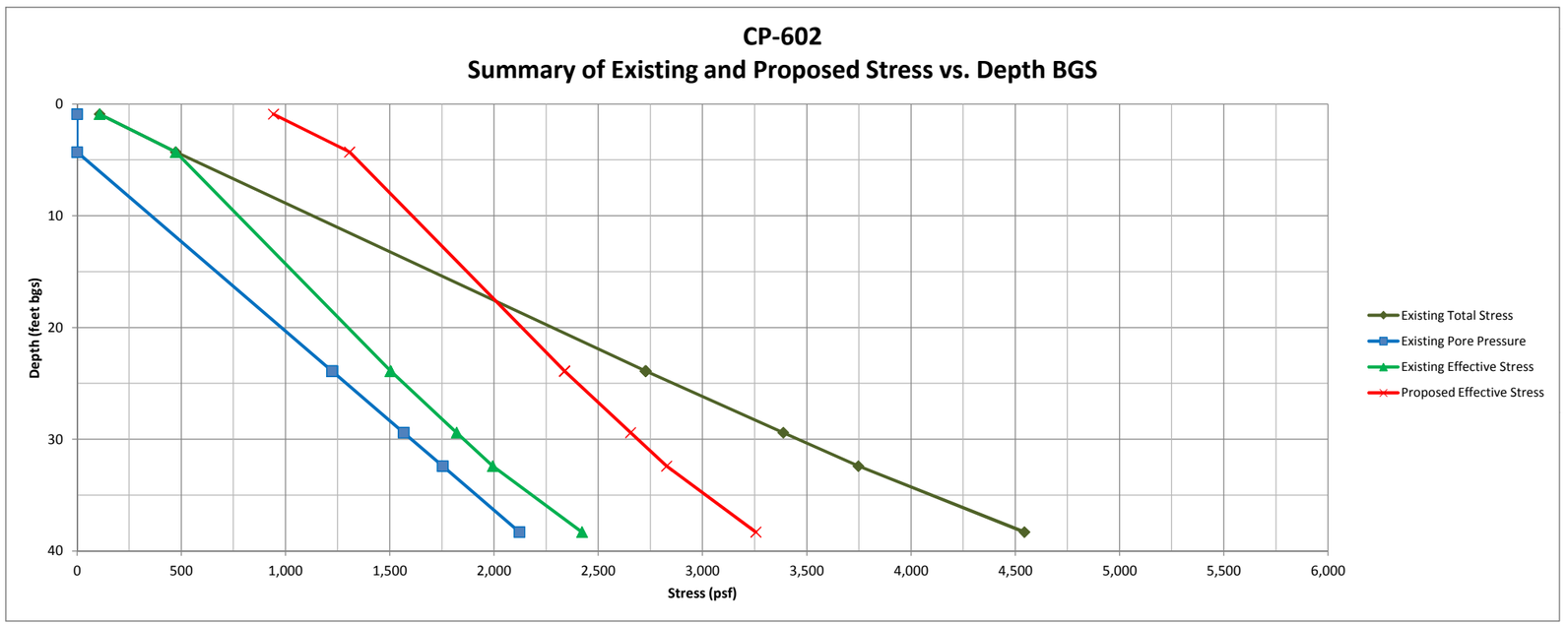
Subsurface Conditions					Existing Grade Conditions									Proposed Grade Conditions		
Primary Stratum	Depth		Thickness	Unit Weight	Total Stress			Pore Pressure			Effective Stress			Effective Stress		
	Top (ft bgs)	Bottom (ft bgs)	(ft)	γ_t or γ_{sat} (pcf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)
Fill	0	0.9	0.9	120	0	108.0	54.0	0	0.0	0	0	108.0	54.0	834.0	942.0	888.0
Slimes (unsat)	0.9	4.3	3.4	110	108.0	473.0	290.5	0.0	0.0	0.0	108.0	473.0	290.5	942.0	1307.0	1124.5
Slimes (sat)	4.3	23.9	19.6	115	473.0	2727.0	1600.0	0.0	1223.0	611.5	473.0	1504.0	988.5	1307.0	2338.0	1822.5
Clay/Till Fill	23.9	23.9	0.0	125	2727.0	2727.0	2727.0	1223.0	1223.0	1223.0	1504.0	1504.0	1504.0	2338.0	2338.0	2338.0
V. Stiff Clay	23.9	23.9	0.0	125	2727.0	2727.0	2727.0	1223.0	1223.0	1223.0	1504.0	1504.0	1504.0	2338.0	2338.0	2338.0
Stiff Clay	23.9	23.9	0.0	125	2727.0	2727.0	2727.0	1223.0	1223.0	1223.0	1504.0	1504.0	1504.0	2338.0	2338.0	2338.0
M. Stiff Clay	23.9	29.4	5.5	120	2727.0	3387.0	3057.0	1223.0	1566.2	1394.6	1504.0	1820.8	1662.4	2338.0	2654.8	2496.4
Soft Clay	29.4	32.4	3.0	120	3387.0	3747.0	3567.0	1566.2	1753.4	1659.8	1820.8	1993.6	1907.2	2654.8	2827.6	2741.2
Till	32.4	38.3	5.9	135	3747.0	4543.5	4145.3	1753.4	2121.6	1937.5	1993.6	2421.9	2207.7	2827.6	3255.9	3041.7

Notes, Comments, and/or Adjustments Made to Subsurface Conditions

1. n/a
2. n/a
3. n/a

Prepared By/Date: JC/10-21-14

Checked By/Date: NDL/10-23-14



SUMMARY OF COMPRESSIBILITY PARAMETERS, ESTIMATED PRIMARY CONSOLIDATION SETTLEMENT, & TIME-RATE OF CONSOLIDATION

Analysis Point/Location:	**CP-602**	
Proposed Grade:	78.5	feet
Grade Change:	7.0	feet
Fill Unit Weight:	120.0	pcf
Δ Stress:	834.0	psf

Input assumed over-consolidation ratio, compression index (= $C_c/1+e_0$), recompression index (= $C_r/1+e_0$), and coefficient of consolidation (ft^2/day) for each primary stratum below.

Assumed Compressibility Parameters					Primary Consolidation Settlement (Due to Proposed Grade Change)	Time-Rate of Consolidation (to 90% Consolidation)		
Primary Stratum	OCR	Comp. Index $C_{c\varepsilon}$	Recomp. Index $C_{r\varepsilon}$	Coef. of Consol. c_v (ft^2/day)	(inches)	Drainage Height H_{dr} (feet)	Time Factor T	Time t (days)
Fill	-	-	-	-	-	-	-	-
Slimes (unsat)	1.0	0.15	0.05	1.00	3.60	1.7	0.848	2.5
Slimes (sat)	1.0	0.15	0.05	1.00	9.37	9.8	0.848	81.4
Clay/Till Fill	2.0	0.15	0.02	2.00	0.00	0.0	0.848	0.0
V. Stiff Clay	2.0	0.15	0.02	4.00	0.00	0.0	0.848	0.0
Stiff Clay	2.0	0.15	0.02	3.00	0.00	0.0	0.848	0.0
M. Stiff Clay	2.0	0.15	0.02	2.00	0.23	2.8	0.848	3.2
Soft Clay	1.2	0.15	0.02	0.50	0.48	1.5	0.848	3.8
Till	-	-	-	-	-	-	-	-
					13.68			

Estimated Settlement @ 90% Consolidation

(inches)

12.32

Days	**81.4**
Months	**2.7**
Years	**0.2**

Above Time-Rate calcs assume double drainage of each stratum. However, this is not valid. In this case, convert to a composite stratum as per below.

Double drainage of each Stratum? **NO**

If answer to double drainage question = "YES", refer to the values above for the estimated time to 90% consolidation. If the answer to the question = "NO", refer to the composite Stratum calculation below for the estimated time to 90% consolidation.

COMPOSITE STRATUM (Slimes & Clay)

Convert to One "Composite" Layer (NAVFAC DM 7.1-235)

(w/ C_v properties of Slimes)

$$H_{comp} = H_d + H_o(Cv_d / Cv_o)^{1/2}$$

H_{comp} = 31.1 ft

H_{dr} = 31.1 ft - Single Drainage

H_{dr} = 15.6 ft - Double Drainage

T = 0.848 90% consolidation

Calculate Time, t, in days to 90% Consolidation

$$t = (T * H_{dr}^2) / Cv_d$$

	Single Drainage	Double Drainage
Days	**821.9**	**205.5**
Months	**26.9**	**6.7**
Years	**2.2**	**0.6**

DATA INPUT AND OUTPUT SUMMARY

KEY

Data Input Cells:	Input Data Here	Input location-specific information for this Analysis Point
Data Output Cells:	Calculation/Output	Calculated value. Read output cell for result.

EXISTING CONDITIONS, PROPOSED GRADING, & PRIMARY CONSOLIDATION

Analyis Point No.:	**SB-1132**	Input analysis point no./exploration location.
Existing Grade (ft):	**69.7**	Input existing ground surface elev. (to nearest 0.25') at analysis point location.
Groundwater Depth (ft bgs):	**3.5**	Input existing groundwater depth (to nearest 0.25') at analysis point location.
Proposed Grade (ft):	**89.3**	Input proposed grade (to nearest 0.25') at analysis point location.
Unit Weight of Prop. Fill (pcf):	**120.0**	Input unit weight of grade change fill/materials.
Est. Primary Consol. Settlement:	**25.0**	Estimated primary consol. settlement (in inches) due to proposed grade change.
Est. Primary Consol. Settlement:	**22.5**	Estimated primary consol. settlement (in inches) at 90% consolidation.
Est. Time to 90% Primary Conol (single drain).:	**1.0**	Estimated time (in years) to achieve 90% of the est. primary consol. settlement.
Est. Time to 99% Primary Consol. (single drain):	**2.2**	Estimated time (in years) to achieve 99% of the est. primary consol. settlement.
Est. Time to 90% Primary Conol (double drain).:	**0.3**	Estimated time (in years) to achieve 90% of the est. primary consol. settlement.
Est. Time to 99% Primary Consol. (double drain):	**0.5**	Estimated time (in years) to achieve 99% of the est. primary consol. settlement.

SECONDARY CONSOLIDATION

Analysis Point No:	**SB-1132**	-	
Surcharge Area/Point No:	**0**	-	
Coefficient of Secondary Compression, $C_{\acute{\alpha}}$	**0.005**	Clay	(Cά expressed by change in strain per log cycle of time)
Coefficient of Secondary Compression, $C_{\acute{\alpha}}$	**0.005**	Slimes	(Cά expressed by change in strain per log cycle of time)
Est. Time to End of Primary Consolidation, t_p	**2.2**	Years	
Est. Design Life Time, t_{sec}	**50**	Years	

Method from NAVFAC DM 7.1-231: $H_{sec} = C\acute{\alpha} * H_t * \log (t_{sec}/t_p)$

Where: H_{sec} = Secondary compression; H_t = Thickness of soil stratum

Est. Secondary Compression (inches):	**1.6**	Slimes
Est. Secondary Compression (inches):	**0.1**	Clay

SUMMARY OF EXISTING CONDITIONS AND PROPOSED GRADING

Analysis Point/Location:	**SB-1132**	
Existing Grade:	69.7	feet
Assumed Bedrock Depth:	21.6	feet bgs
Groundwater Depth:	3.5	feet bgs
Tot./Eff. Stress @ GWT =	385.0	psf

Analysis Point/Location:	**SB-1132**	
Proposed Grade:	89.33	feet
Grade Change:	19.6	feet
Fill Unit Weight:	120.00	pcf
Δ Stress:	2355.6	psf

Input assumed or known depth (ft bgs) to bedrock above. Then input the bottom depth (ft bgs) and unit weight (pcf) for each primary stratum below.

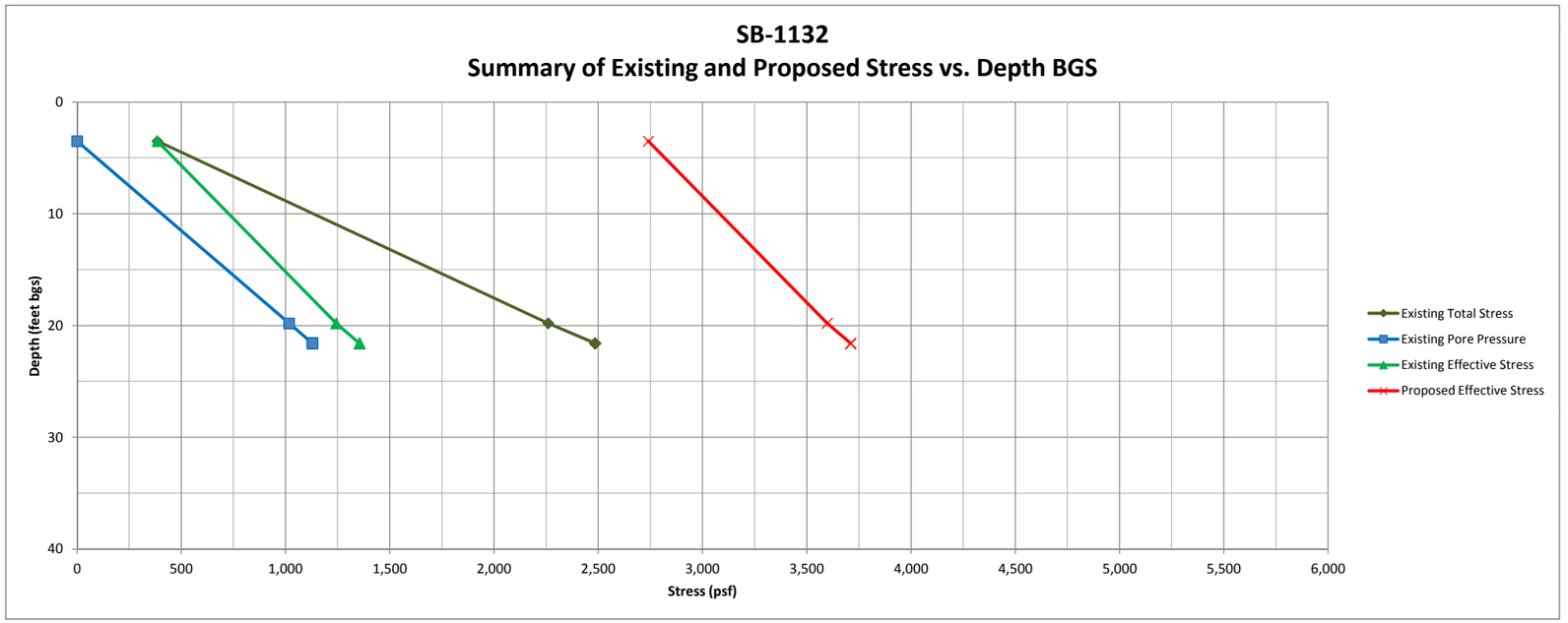
Subsurface Conditions					Existing Grade Conditions									Proposed Grade Conditions		
Primary Stratum	Depth		Thickness	Unit Weight	Total Stress			Pore Pressure			Effective Stress			Effective Stress		
	Top (ft bgs)	Bottom (ft bgs)	(ft)	γ_t or γ_{sat} (pcf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)
Slimes (unsat)	0.0	3.5	3.5	110	0.0	385.0	192.5	0.0	0.0	0.0	0.0	385.0	192.5	2355.6	2740.6	2548.1
Slimes (sat)	3.5	19.8	16.3	115	385.0	2259.5	1322.3	0.0	1017.1	508.6	385.0	1242.4	813.7	2740.6	3598.0	3169.3
Clay/Till Fill	19.8	21.6	1.8	125	2259.5	2484.5	2372.0	1017.1	1129.4	1073.3	1242.4	1355.1	1298.7	3598.0	3710.7	3654.3
V. Stiff Clay	21.6	21.6	0.0	125	2484.5	2484.5	2484.5	1129.4	1129.4	1129.4	1355.1	1355.1	1355.1	3710.7	3710.7	3710.7
Stiff Clay	21.6	21.6	0.0	125	2484.5	2484.5	2484.5	1129.4	1129.4	1129.4	1355.1	1355.1	1355.1	3710.7	3710.7	3710.7
M. Stiff Clay	21.6	21.6	0.0	120	2484.5	2484.5	2484.5	1129.4	1129.4	1129.4	1355.1	1355.1	1355.1	3710.7	3710.7	3710.7
Soft Clay	21.6	21.6	0.0	120	2484.5	2484.5	2484.5	1129.4	1129.4	1129.4	1355.1	1355.1	1355.1	3710.7	3710.7	3710.7
Till	21.6	21.6	0.0	135	2484.5	2484.5	2484.5	1129.4	1129.4	1129.4	1355.1	1355.1	1355.1	3710.7	3710.7	3710.7

Notes, Comments, and/or Adjustments Made to Subsurface Conditions

1. n/a
2. n/a
3. n/a

Prepared By/Date: JC/10-21-14

Checked By/Date: NDL/10-23-14



SUMMARY OF COMPRESSIBILITY PARAMETERS, ESTIMATED PRIMARY CONSOLIDATION SETTLEMENT, & TIME-RATE OF CONSOLIDATION

Analysis Point/Location:	**SB-1132**	
Proposed Grade:	89.3	feet
Grade Change:	19.6	feet
Fill Unit Weight:	120.0	pcf
Δ Stress:	2355.6	psf

Input assumed over-consolidation ratio, compression index (= $C_c/1+e_0$), recompression index (= $C_r/1+e_0$), and coefficient of consolidation (ft^2/day) for each primary stratum below.

Assumed Compressibility Parameters					Primary Consolidation Settlement (Due to Proposed Grade Change)	Time-Rate of Consolidation (to 90% Consolidation)		
Primary Stratum	OCR	Comp. Index $C_{c\varepsilon}$	Recomp. Index $C_{r\varepsilon}$	Coef. of Consol. c_v (ft^2/day)	(inches)	Drainage Height H_{dr} (feet)	Time Factor T	Time t (days)
Slimes (unsat)	1.0	0.15	0.05	1.00	7.07	1.75	0.848	2.6
Slimes (sat)	1.0	0.15	0.05	1.00	17.33	8.15	0.848	56.3
Clay/Till Fill	2.0	0.15	0.02	2.00	0.61	0.9	0.848	0.3
V. Stiff Clay	2.0	0.15	0.02	4.00	0.00	0.0	0.848	0.0
Stiff Clay	2.0	0.15	0.02	3.00	0.00	0.0	0.848	0.0
M. Stiff Clay	2.0	0.15	0.02	2.00	0.00	0.0	0.848	0.0
Soft Clay	1.2	0.15	0.02	0.50	0.00	0.0	0.848	0.0
Till	-	-	-	-	-	-	-	-
					25.00			

Estimated Settlement @ 90% Consolidation
(inches)
22.50

Days	**56.3**
Months	**1.9**
Years	**0.2**

Above Time-Rate calcs assume double drainage of each stratum. However, this is not valid. In this case, convert to a composite stratum as per below.

Double drainage of each Stratum? **NO**

If answer to double drainage question = "YES", refer to the values above for the estimated time to 90% consolidation. If the answer to the question = "NO", refer to the composite Stratum calculation below for the estimated time to 90% consolidation.

COMPOSITE STRATUM (Slimes & Clay)

Convert to One "Composite" Layer (NAVFAC DM 7.1-235)
(w/ C_v properties of Slimes)

$$H_{comp} = H_d + H_o(Cv_d / Cv_o)^{1/2}$$

H_{comp} = 21.1 ft

H_{dr} = 21.1 ft - Single Drainage
H_{dr} = 10.5 ft - Double Drainage
T = 0.848 90% consolidation

Calculate Time, t, in days to 90% Consolidation

$$t = (T * H_{dr}^2) / Cv_d$$

	Single Drainage	Double Drainage
Days	**376.6**	**94.1**
Months	**12.3**	**3.1**
Years	**1.0**	**0.3**

DATA INPUT AND OUTPUT SUMMARY

KEY

Data Input Cells:	Input Data Here	Input location-specific information for this Analysis Point
Data Output Cells:	Calculation/Output	Calculated value. Read output cell for result.

EXISTING CONDITIONS, PROPOSED GRADING, & PRIMARY CONSOLIDATION

Analyis Point No.:	**CPT-25**	Input analysis point no./exploration location.
Existing Grade (ft):	**69.3**	Input existing ground surface elev. (to nearest 0.25') at analysis point location.
Groundwater Depth (ft bgs):	**9.3**	Input existing groundwater depth (to nearest 0.25') at analysis point location.
Proposed Grade (ft):	**92.0**	Input proposed grade (to nearest 0.25') at analysis point location.
Unit Weight of Prop. Fill (pcf):	**120.0**	Input unit weight of grade change fill/materials.
Est. Primary Consol. Settlement:	**22.1**	Estimated primary consol. settlement (in inches) due to proposed grade change.
Est. Primary Consol. Settlement:	**19.9**	Estimated primary consol. settlement (in inches) at 90% consolidation.
Est. Time to 90% Primary Conol (single drain).:	**0.8**	Estimated time (in years) to achieve 90% of the est. primary consol. settlement.
Est. Time to 99% Primary Consol. (single drain):	**1.8**	Estimated time (in years) to achieve 99% of the est. primary consol. settlement.
Est. Time to 90% Primary Conol (double drain).:	**0.2**	Estimated time (in years) to achieve 90% of the est. primary consol. settlement.
Est. Time to 99% Primary Consol. (double drain):	**0.4**	Estimated time (in years) to achieve 99% of the est. primary consol. settlement.

SECONDARY CONSOLIDATION

Analysis Point No:	**CPT-25**	-	
Surcharge Area/Point No:	**0**	-	
Coefficient of Secondary Compression, $C_{\acute{\alpha}}$	**0.005**	Clay	(Cά expressed by change in strain per log cycle of time)
Coefficient of Secondary Compression, $C_{\acute{\alpha}}$	**0.005**	Slimes	(Cά expressed by change in strain per log cycle of time)
Est. Time to End of Primary Consolidation, t_p	**1.8**	Years	
Est. Design Life Time, t_{sec}	**50**	Years	

Method from NAVFAC DM 7.1-231: $H_{sec} = C\acute{\alpha} * H_t * \log (t_{sec}/t_p)$

Where: H_{sec} = Secondary compression
H_t = Thickness of soil stratum

Est. Secondary Compression (inches):	**1.7**	Slimes
Est. Secondary Compression (inches):	**0.0**	Clay

SUMMARY OF EXISTING CONDITIONS AND PROPOSED GRADING

Analysis Point/Location:	**CPT-25**	
Existing Grade:	69.3	feet
Assumed Bedrock Depth:	22.6	feet bgs
Groundwater Depth:	9.3	feet bgs
Tot./Eff. Stress @ GWT =	1023.0	psf

Analysis Point/Location:	**CPT-25**	
Proposed Grade:	92.00	feet
Grade Change:	22.7	feet
Fill Unit Weight:	120.00	pcf
Δ Stress:	2724.0	psf

Input assumed or known depth (ft bgs) to bedrock above. Then input the bottom depth (ft bgs) and unit weight (pcf) for each primary stratum below.

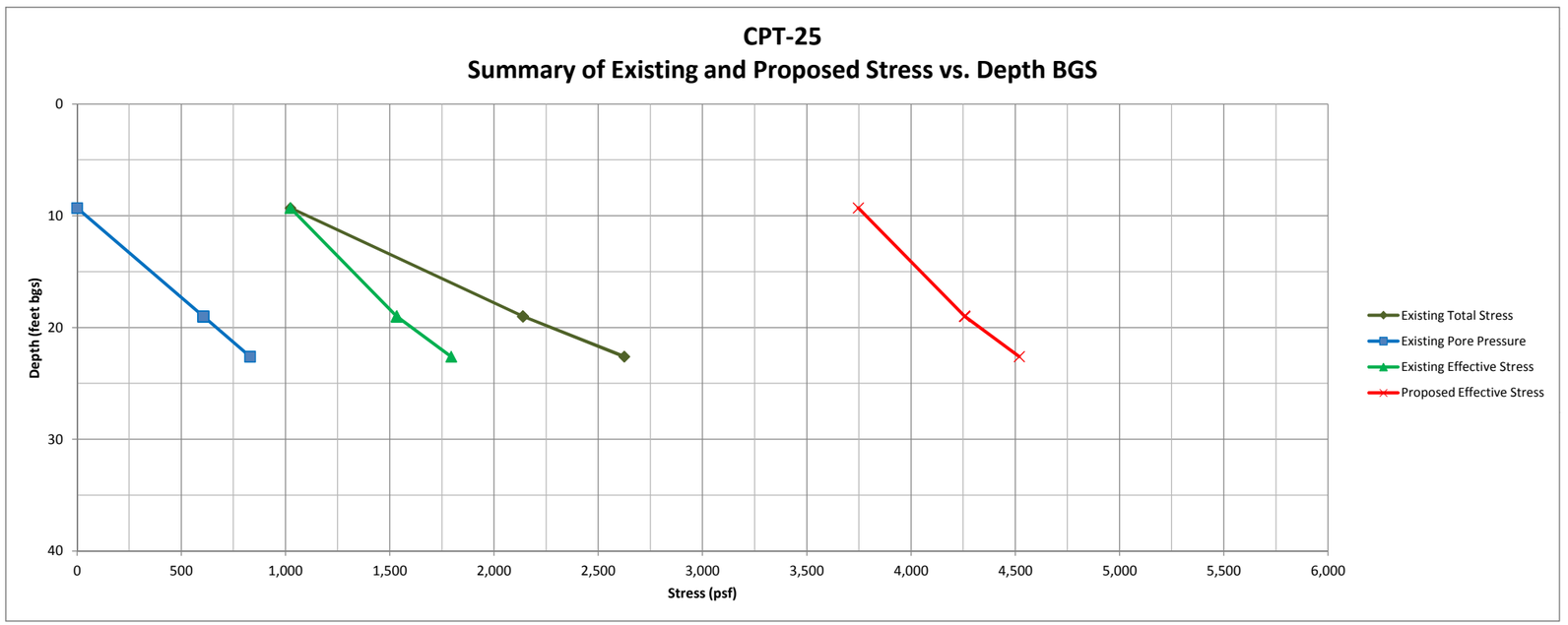
Subsurface Conditions					Existing Grade Conditions									Proposed Grade Conditions		
Primary Stratum	Depth		Thickness	Unit Weight	Total Stress			Pore Pressure			Effective Stress			Effective Stress		
	Top (ft bgs)	Bottom (ft bgs)	(ft)	γ_t or γ_{sat} (pcf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)
						0.0										
Slimes (unsat)	0.0	9.3	9.3	110	0.0	1023.0	511.5	0.0	0.0	0.0	0.0	1023.0	511.5	2724.0	3747.0	3235.5
Slimes (sat)	9.3	19.0	9.7	115	1023.0	2138.5	1580.8	0.0	605.3	302.6	1023.0	1533.2	1278.1	3747.0	4257.2	4002.1
Clay/Till Fill	19.0	19.0	0.0	125	2138.5	2138.5	2138.5	605.3	605.3	605.3	1533.2	1533.2	1533.2	4257.2	4257.2	4257.2
V. Stiff Clay	19.0	19.0	0.0	125	2138.5	2138.5	2138.5	605.3	605.3	605.3	1533.2	1533.2	1533.2	4257.2	4257.2	4257.2
Stiff Clay	19.0	19.0	0.0	125	2138.5	2138.5	2138.5	605.3	605.3	605.3	1533.2	1533.2	1533.2	4257.2	4257.2	4257.2
M. Stiff Clay	19.0	19.0	0.0	120	2138.5	2138.5	2138.5	605.3	605.3	605.3	1533.2	1533.2	1533.2	4257.2	4257.2	4257.2
Soft Clay	19.0	19.0	0.0	120	2138.5	2138.5	2138.5	605.3	605.3	605.3	1533.2	1533.2	1533.2	4257.2	4257.2	4257.2
Till	19.0	22.6	3.6	135	2138.5	2624.5	2381.5	605.3	829.9	717.6	1533.2	1794.6	1663.9	4257.2	4518.6	4387.9

Notes, Comments, and/or Adjustments Made to Subsurface Conditions

1. n/a
2. n/a
3. n/a

Prepared By/Date: JC/10-21-14

Checked By/Date: NDL/10-23-14



SUMMARY OF COMPRESSIBILITY PARAMETERS, ESTIMATED PRIMARY CONSOLIDATION SETTLEMENT, & TIME-RATE OF CONSOLIDATION

Analysis Point/Location:	**CPT-25**	
Proposed Grade:	92.0	feet
Grade Change:	22.7	feet
Fill Unit Weight:	120.0	pcf
Δ Stress:	2724.0	psf

Input assumed over-consolidation ratio, compression index (= $C_c/1+e_0$), recompression index (= $C_r/1+e_0$), and coefficient of consolidation (ft^2/day) for each primary stratum below.

Assumed Compressibility Parameters					Primary Consolidation Settlement (Due to Proposed Grade Change)	Time-Rate of Consolidation (to 90% Consolidation)		
Primary Stratum	OCR	Comp. Index $C_{c\varepsilon}$	Recomp. Index $C_{r\varepsilon}$	Coef. of Consol. c_v (ft^2/day)	(inches)	Drainage Height H_{dr} (feet)	Time Factor T	Time t (days)
Slimes (unsat)	1.0	0.15	0.05	1.00	13.41	4.65	0.848	18.3
Slimes (sat)	1.0	0.15	0.05	1.00	8.66	4.85	0.848	19.9
Clay/Till Fill	2.0	0.15	0.02	2.00	0.00	0.0	0.848	0.0
V. Stiff Clay	2.0	0.15	0.02	4.00	0.00	0.0	0.848	0.0
Stiff Clay	2.0	0.15	0.02	3.00	0.00	0.0	0.848	0.0
M. Stiff Clay	2.0	0.15	0.02	2.00	0.00	0.0	0.848	0.0
Soft Clay	1.2	0.15	0.02	0.50	0.00	0.0	0.848	0.0
Till	-	-	-	-	-	-	-	-
					22.07			

Estimated Settlement @ 90% Consolidation
(inches)
19.86

Days	**19.9**
Months	**0.7**
Years	**0.1**

Above Time-Rate calcs assume double drainage of each stratum. However, this is not valid. In this case, convert to a composite stratum as per below.

Double drainage of each Stratum? **NO**

If answer to double drainage question = "YES", refer to the values above for the estimated time to 90% consolidation. If the answer to the question = "NO", refer to the composite Stratum calculation below for the estimated time to 90% consolidation.

COMPOSITE STRATUM (Slimes & Clay)

Convert to One "Composite" Layer (NAVFAC DM 7.1-235)
(w/ C_v properties of Slimes)

$$H_{comp} = H_d + H_o(Cv_d / Cv_o)^{1/2}$$

H_{comp} = 19.0 ft

H_{dr} = 19.0 ft - Single Drainage
H_{dr} = 9.5 ft - Double Drainage
T = 0.848 90% consolidation

Calculate Time, t, in days to 90% Consolidation

$$t = (T * H_{dr}^2) / Cv_d$$

	Single Drainage	Double Drainage
Days	**306.1**	**76.5**
Months	**10.0**	**2.5**
Years	**0.8**	**0.2**

DATA INPUT AND OUTPUT SUMMARY

KEY

Data Input Cells:	Input Data Here	Input location-specific information for this Analysis Point
Data Output Cells:	Calculation/Output	Calculated value. Read output cell for result.

EXISTING CONDITIONS, PROPOSED GRADING, & PRIMARY CONSOLIDATION

Analyis Point No.:	**CP-616**	Input analysis point no./exploration location.
Existing Grade (ft):	**69.1**	Input existing ground surface elev. (to nearest 0.25') at analysis point location.
Groundwater Depth (ft bgs):	**3.0**	Input existing groundwater depth (to nearest 0.25') at analysis point location.
Proposed Grade (ft):	**92.0**	Input proposed grade (to nearest 0.25') at analysis point location.
Unit Weight of Prop. Fill (pcf):	**120.0**	Input unit weight of grade change fill/materials.
Est. Primary Consol. Settlement:	**31.7**	Estimated primary consol. settlement (in inches) due to proposed grade change.
Est. Primary Consol. Settlement:	**28.6**	Estimated primary consol. settlement (in inches) at 90% consolidation.
Est. Time to 90% Primary Conol (single drain).:	**1.6**	Estimated time (in years) to achieve 90% of the est. primary consol. settlement.
Est. Time to 99% Primary Consol. (single drain):	**3.4**	Estimated time (in years) to achieve 99% of the est. primary consol. settlement.
Est. Time to 90% Primary Conol (double drain).:	**0.4**	Estimated time (in years) to achieve 90% of the est. primary consol. settlement.
Est. Time to 99% Primary Consol. (double drain):	**0.9**	Estimated time (in years) to achieve 99% of the est. primary consol. settlement.

SECONDARY CONSOLIDATION

Analysis Point No:	**CP-616**	-	
Surcharge Area/Point No:	**0**	-	
Coefficient of Secondary Compression, $C_{\acute{\alpha}}$	**0.005**	Clay	(Cά expressed by change in strain per log cycle of time)
Coefficient of Secondary Compression, $C_{\acute{\alpha}}$	**0.005**	Slimes	(Cά expressed by change in strain per log cycle of time)
Est. Time to End of Primary Consolidation, t_p	**3.4**	Years	
Est. Design Life Time, t_{sec}	**50**	Years	

Method from NAVFAC DM 7.1-231: $H_{sec} = C\acute{\alpha} * H_t * \log (t_{sec}/t_p)$

Where: H_{sec} = Secondary compression
H_t = Thickness of soil stratum

Est. Secondary Compression (inches):	**1.9**	Slimes
Est. Secondary Compression (inches):	**0.0**	Clay

SUMMARY OF EXISTING CONDITIONS AND PROPOSED GRADING

Analysis Point/Location:	**CP-616**	
Existing Grade:	69.1	feet
Assumed Bedrock Depth:	31.3	feet bgs
Groundwater Depth:	3.0	feet bgs
Tot./Eff. Stress @ GWT =	330.0	psf

Analysis Point/Location:	**CP-616**	
Proposed Grade:	92.00	feet
Grade Change:	22.9	feet
Fill Unit Weight:	120.00	pcf
Δ Stress:	2748.0	psf

Input assumed or known depth (ft bgs) to bedrock above. Then input the bottom depth (ft bgs) and unit weight (pcf) for each primary stratum below.

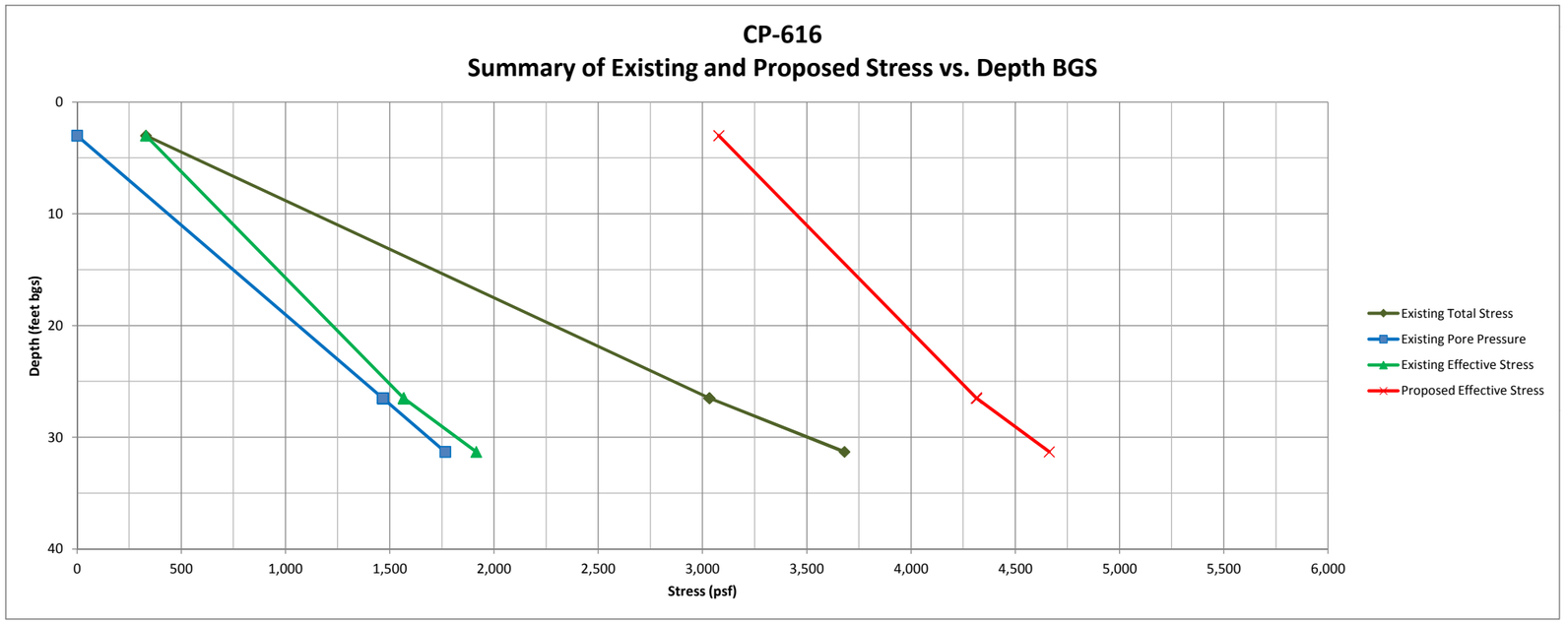
Subsurface Conditions					Existing Grade Conditions									Proposed Grade Conditions		
Primary Stratum	Depth		Thickness	Unit Weight	Total Stress			Pore Pressure			Effective Stress			Effective Stress		
	Top (ft bgs)	Bottom (ft bgs)	(ft)	γ_t or γ_{sat} (pcf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)
Slimes (unsat)	0.0	3.0	3.0	110	0.0	330.0	165.0	0.0	0.0	0.0	0.0	330.0	165.0	2748.0	3078.0	2913.0
Slimes (sat)	3.0	26.5	23.5	115	330.0	3032.5	1681.3	0.0	1466.4	733.2	330.0	1566.1	948.1	3078.0	4314.1	3696.1
Clay/Till Fill	26.5	26.5	0.0	125	3032.5	3032.5	3032.5	1466.4	1466.4	1466.4	1566.1	1566.1	1566.1	4314.1	4314.1	4314.1
V. Stiff Clay	26.5	26.5	0.0	125	3032.5	3032.5	3032.5	1466.4	1466.4	1466.4	1566.1	1566.1	1566.1	4314.1	4314.1	4314.1
Stiff Clay	26.5	26.5	0.0	125	3032.5	3032.5	3032.5	1466.4	1466.4	1466.4	1566.1	1566.1	1566.1	4314.1	4314.1	4314.1
M. Stiff Clay	26.5	26.5	0.0	120	3032.5	3032.5	3032.5	1466.4	1466.4	1466.4	1566.1	1566.1	1566.1	4314.1	4314.1	4314.1
Soft Clay	26.5	26.5	0.0	120	3032.5	3032.5	3032.5	1466.4	1466.4	1466.4	1566.1	1566.1	1566.1	4314.1	4314.1	4314.1
Till	26.5	31.3	4.8	135	3032.5	3680.5	3356.5	1466.4	1765.9	1616.2	1566.1	1914.6	1740.3	4314.1	4662.6	4488.3

Notes, Comments, and/or Adjustments Made to Subsurface Conditions

1. n/a
2. n/a
3. n/a

Prepared By/Date: JC/10-21-14

Checked By/Date: NDL/10-23-14



SUMMARY OF COMPRESSIBILITY PARAMETERS, ESTIMATED PRIMARY CONSOLIDATION SETTLEMENT, & TIME-RATE OF CONSOLIDATION

Analysis Point/Location:	**CP-616**	
Proposed Grade:	92.0	feet
Grade Change:	22.9	feet
Fill Unit Weight:	120.0	pcf
Δ Stress:	2748.0	psf

Input assumed over-consolidation ratio, compression index (= $C_c/1+e_0$), recompression index (= $C_r/1+e_0$), and coefficient of consolidation (ft^2/day) for each primary stratum below.

Assumed Compressibility Parameters					Primary Consolidation Settlement (Due to Proposed Grade Change)	Time-Rate of Consolidation (to 90% Consolidation)		
Primary Stratum	OCR	Comp. Index $C_{c\varepsilon}$	Recomp. Index $C_{r\varepsilon}$	Coef. of Consol. c_v (ft^2/day)	(inches)	Drainage Height H_{dr} (feet)	Time Factor T	Time t (days)
Slimes (unsat)	1.0	0.15	0.05	1.00	6.73	1.5	0.848	1.9
Slimes (sat)	1.0	0.15	0.05	1.00	25.00	11.75	0.848	117.1
Clay/Till Fill	2.0	0.15	0.02	2.00	0.00	0.0	0.848	0.0
V. Stiff Clay	2.0	0.15	0.02	4.00	0.00	0.0	0.848	0.0
Stiff Clay	2.0	0.15	0.02	3.00	0.00	0.0	0.848	0.0
M. Stiff Clay	2.0	0.15	0.02	2.00	0.00	0.0	0.848	0.0
Soft Clay	1.2	0.15	0.02	0.50	0.00	0.0	0.848	0.0
Till	-	-	-	-	-	-	-	-
					31.73			

Estimated Settlement @ 90% Consolidation
(inches)
28.56

Days	**117.1**
Months	**3.8**
Years	**0.3**

Above Time-Rate calcs assume double drainage of each stratum. However, this is not valid. In this case, convert to a composite stratum as per below.

Double drainage of each Stratum? **NO**

If answer to double drainage question = "YES", refer to the values above for the estimated time to 90% consolidation. If the answer to the question = "NO", refer to the composite Stratum calculation below for the estimated time to 90% consolidation.

COMPOSITE STRATUM (Slimes & Clay)

Convert to One "Composite" Layer (NAVFAC DM 7.1-235)
(w/ C_v properties of Slimes)

$$H_{comp} = H_d + H_o(Cv_d / Cv_o)^{1/2}$$

H_{comp} = 26.5 ft

H_{dr} = 26.5 ft - Single Drainage
H_{dr} = 13.3 ft - Double Drainage
T = 0.848 90% consolidation

Calculate Time, t, in days to 90% Consolidation

$$t = (T * H_{dr}^2) / Cv_d$$

	Single Drainage	Double Drainage
Days	**595.5**	**148.9**
Months	**19.5**	**4.9**
Years	**1.6**	**0.4**

DATA INPUT AND OUTPUT SUMMARY

KEY

Data Input Cells:	Input Data Here	Input location-specific information for this Analysis Point
Data Output Cells:	Calculation/Output	Calculated value. Read output cell for result.

EXISTING CONDITIONS, PROPOSED GRADING, & PRIMARY CONSOLIDATION

Analyis Point No.:	**CP-606**	Input analysis point no./exploration location.
Existing Grade (ft):	**69.4**	Input existing ground surface elev. (to nearest 0.25') at analysis point location.
Groundwater Depth (ft bgs):	**2.6**	Input existing groundwater depth (to nearest 0.25') at analysis point location.
Proposed Grade (ft):	**91.0**	Input proposed grade (to nearest 0.25') at analysis point location.
Unit Weight of Prop. Fill (pcf):	**120.0**	Input unit weight of grade change fill/materials.
Est. Primary Consol. Settlement:	**30.4**	Estimated primary consol. settlement (in inches) due to proposed grade change.
Est. Primary Consol. Settlement:	**27.4**	Estimated primary consol. settlement (in inches) at 90% consolidation.
Est. Time to 90% Primary Conol (single drain).:	**1.5**	Estimated time (in years) to achieve 90% of the est. primary consol. settlement.
Est. Time to 99% Primary Consol. (single drain):	**3.2**	Estimated time (in years) to achieve 99% of the est. primary consol. settlement.
Est. Time to 90% Primary Conol (double drain).:	**0.4**	Estimated time (in years) to achieve 90% of the est. primary consol. settlement.
Est. Time to 99% Primary Consol. (double drain):	**0.8**	Estimated time (in years) to achieve 99% of the est. primary consol. settlement.

SECONDARY CONSOLIDATION

Analysis Point No:	**CP-606**	-	
Surcharge Area/Point No:	**0**	-	
Coefficient of Secondary Compression, $C_{\acute{\alpha}}$	**0.005**	Clay	(Cά expressed by change in strain per log cycle of time)
Coefficient of Secondary Compression, $C_{\acute{\alpha}}$	**0.005**	Slimes	(Cά expressed by change in strain per log cycle of time)
Est. Time to End of Primary Consolidation, t_p	**3.2**	Years	
Est. Design Life Time, t_{sec}	**50**	Years	

Method from NAVFAC DM 7.1-231: $H_{sec} = C\acute{\alpha} * H_t * \log (t_{sec}/t_p)$

Where: H_{sec} = Secondary compression; H_t = Thickness of soil stratum

Est. Secondary Compression (inches):	**1.8**	Slimes
Est. Secondary Compression (inches):	**0.0**	Clay

SUMMARY OF EXISTING CONDITIONS AND PROPOSED GRADING

Analysis Point/Location:	**CP-606**	
Existing Grade:	69.4	feet
Assumed Bedrock Depth:	29.7	feet bgs
Groundwater Depth:	2.6	feet bgs
Tot./Eff. Stress @ GWT =	286.0	psf

Analysis Point/Location:	**CP-606**	
Proposed Grade:	91.00	feet
Grade Change:	21.6	feet
Fill Unit Weight:	120.00	pcf
Δ Stress:	2592.0	psf

Input assumed or known depth (ft bgs) to bedrock above. Then input the bottom depth (ft bgs) and unit weight (pcf) for each primary stratum below.

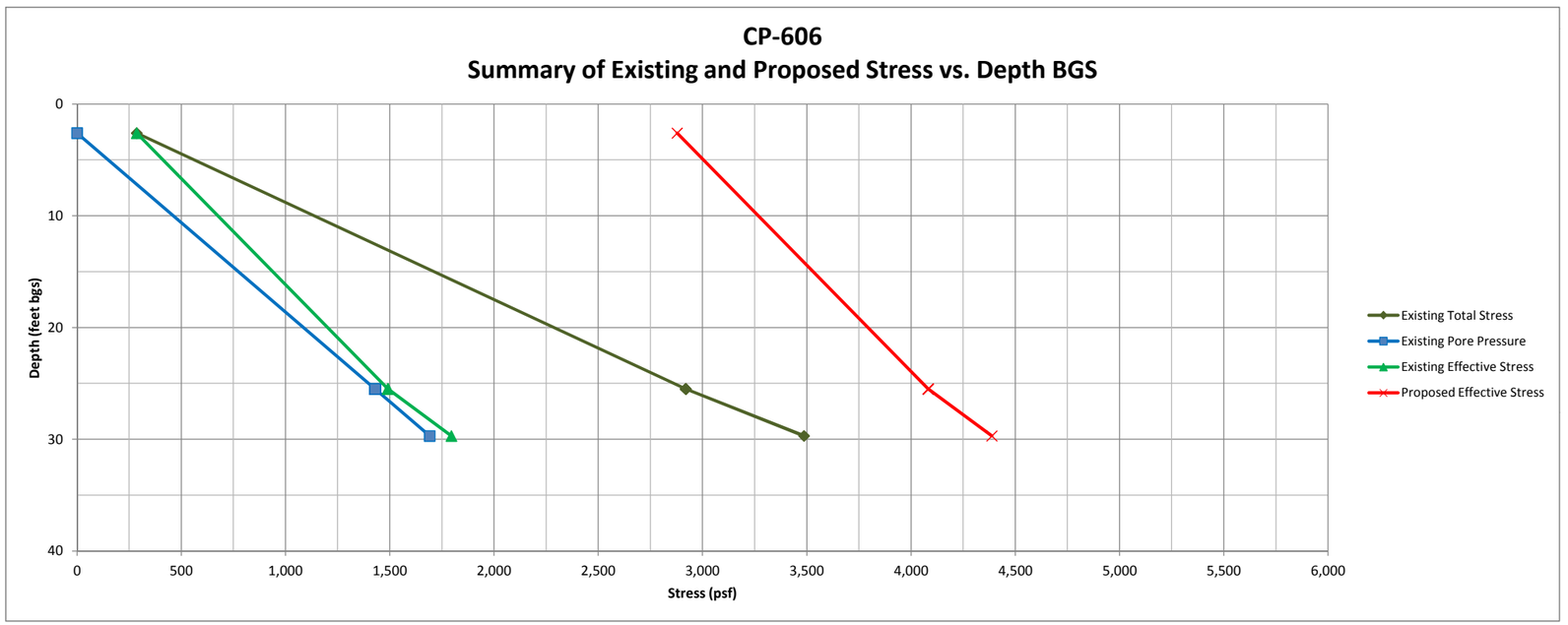
Subsurface Conditions					Existing Grade Conditions									Proposed Grade Conditions		
Primary Stratum	Depth		Thickness	Unit Weight	Total Stress			Pore Pressure			Effective Stress			Effective Stress		
	Top (ft bgs)	Bottom (ft bgs)	(ft)	γ_t or γ_{sat} (pcf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)
Slimes (unsat)	0.0	2.6	2.6	110	0.0	286.0	143.0	0.0	0.0	0.0	0.0	286.0	143.0	2592.0	2878.0	2735.0
Slimes (sat)	2.6	25.5	22.9	115	286.0	2919.5	1602.8	0.0	1429.0	714.5	286.0	1490.5	888.3	2878.0	4082.5	3480.3
Clay/Till Fill	25.5	25.5	0.0	125	2919.5	2919.5	2919.5	1429.0	1429.0	1429.0	1490.5	1490.5	1490.5	4082.5	4082.5	4082.5
V. Stiff Clay	25.5	25.5	0.0	125	2919.5	2919.5	2919.5	1429.0	1429.0	1429.0	1490.5	1490.5	1490.5	4082.5	4082.5	4082.5
Stiff Clay	25.5	25.5	0.0	125	2919.5	2919.5	2919.5	1429.0	1429.0	1429.0	1490.5	1490.5	1490.5	4082.5	4082.5	4082.5
M. Stiff Clay	25.5	25.5	0.0	120	2919.5	2919.5	2919.5	1429.0	1429.0	1429.0	1490.5	1490.5	1490.5	4082.5	4082.5	4082.5
Soft Clay	25.5	25.5	0.0	120	2919.5	2919.5	2919.5	1429.0	1429.0	1429.0	1490.5	1490.5	1490.5	4082.5	4082.5	4082.5
Till	25.5	29.7	4.2	135	2919.5	3486.5	3203.0	1429.0	1691.0	1560.0	1490.5	1795.5	1643.0	4082.5	4387.5	4235.0

Notes, Comments, and/or Adjustments Made to Subsurface Conditions

1. n/a
2. n/a
3. n/a

Prepared By/Date: JC/10-21-14

Checked By/Date: NDL/10-23-14



SUMMARY OF COMPRESSIBILITY PARAMETERS, ESTIMATED PRIMARY CONSOLIDATION SETTLEMENT, & TIME-RATE OF CONSOLIDATION

Analysis Point/Location:	**CP-606**	
Proposed Grade:	91.0	feet
Grade Change:	21.6	feet
Fill Unit Weight:	120.0	pcf
Δ Stress:	2592.0	psf

Input assumed over-consolidation ratio, compression index (= $C_c/1+e_0$), recompression index (= $C_r/1+e_0$), and coefficient of consolidation (ft^2/day) for each primary stratum below.

Assumed Compressibility Parameters					Primary Consolidation Settlement (Due to Proposed Grade Change)	Time-Rate of Consolidation (to 90% Consolidation)		
Primary Stratum	OCR	Comp. Index $C_{c\varepsilon}$	Recomp. Index $C_{r\varepsilon}$	Coef. of Consol. c_v (ft^2/day)	(inches)	Drainage Height H_{dr} (feet)	Time Factor T	Time t (days)
Slimes (unsat)	1.0	0.15	0.05	1.00	6.00	1.3	0.848	1.4
Slimes (sat)	1.0	0.15	0.05	1.00	24.45	11.45	0.848	111.2
Clay/Till Fill	2.0	0.15	0.02	2.00	0.00	0.0	0.848	0.0
V. Stiff Clay	2.0	0.15	0.02	4.00	0.00	0.0	0.848	0.0
Stiff Clay	2.0	0.15	0.02	3.00	0.00	0.0	0.848	0.0
M. Stiff Clay	2.0	0.15	0.02	2.00	0.00	0.0	0.848	0.0
Soft Clay	1.2	0.15	0.02	0.50	0.00	0.0	0.848	0.0
Till	-	-	-	-	-	-	-	-
					30.44			

Estimated Settlement @ 90% Consolidation
(inches)
27.40

Days	**111.2**
Months	**3.7**
Years	**0.3**

Above Time-Rate calcs assume double drainage of each stratum. However, this is not valid. In this case, convert to a composite stratum as per below.

Double drainage of each Stratum? **NO**

If answer to double drainage question = "YES", refer to the values above for the estimated time to 90% consolidation. If the answer to the question = "NO", refer to the composite Stratum calculation below for the estimated time to 90% consolidation.

COMPOSITE STRATUM (Slimes & Clay)

Convert to One "Composite" Layer (NAVFAC DM 7.1-235)
(w/ C_v properties of Slimes)

$$H_{comp} = H_d + H_o(Cv_d / Cv_o)^{1/2}$$

H_{comp} = 25.5 ft

H_{dr} = 25.5 ft - Single Drainage
H_{dr} = 12.8 ft - Double Drainage
T = 0.848 90% consolidation

Calculate Time, t, in days to 90% Consolidation

$$t = (T * H_{dr}^2) / Cv_d$$

	Single Drainage	Double Drainage
Days	**551.4**	**137.9**
Months	**18.1**	**4.5**
Years	**1.5**	**0.4**

DATA INPUT AND OUTPUT SUMMARY

KEY

Data Input Cells:	Input Data Here	Input location-specific information for this Analysis Point
Data Output Cells:	Calculation/Output	Calculated value. Read output cell for result.

EXISTING CONDITIONS, PROPOSED GRADING, & PRIMARY CONSOLIDATION

Analyis Point No.:	SB-1131/CPT-26	Input analysis point no./exploration location.
Existing Grade (ft):	69.3	Input existing ground surface elev. (to nearest 0.25') at analysis point location.
Groundwater Depth (ft bgs):	3.0	Input existing groundwater depth (to nearest 0.25') at analysis point location.
Proposed Grade (ft):	85.5	Input proposed grade (to nearest 0.25') at analysis point location.
Unit Weight of Prop. Fill (pcf):	120.0	Input unit weight of grade change fill/materials.
Est. Primary Consol. Settlement:	28.1	Estimated primary consol. settlement (in inches) due to proposed grade change.
Est. Primary Consol. Settlement:	25.3	Estimated primary consol. settlement (in inches) at 90% consolidation.
Est. Time to 90% Primary Consol (single drain).:	2.1	Estimated time (in years) to achieve 90% of the est. primary consol. settlement.
Est. Time to 99% Primary Consol. (single drain):	4.4	Estimated time (in years) to achieve 99% of the est. primary consol. settlement.
Est. Time to 90% Primary Consol (double drain).:	0.5	Estimated time (in years) to achieve 90% of the est. primary consol. settlement.
Est. Time to 99% Primary Consol. (double drain):	1.1	Estimated time (in years) to achieve 99% of the est. primary consol. settlement.

SECONDARY CONSOLIDATION

Analysis Point No:	SB-1131/CPT-26	-	
Surcharge Area/Point No:	0	-	
Coefficient of Secondary Compression, $C_{\acute{\alpha}}$	0.005	Clay	(Cά expressed by change in strain per log cycle of time)
Coefficient of Secondary Compression, $C_{\acute{\alpha}}$	0.005	Slimes	(Cά expressed by change in strain per log cycle of time)
Est. Time to End of Primary Consolidation, t_p	4.4	Years	
Est. Design Life Time, t_{sec}	50	Years	

Method from NAVFAC DM 7.1-231: $H_{sec} = C\acute{\alpha} * H_t * \log (t_{sec}/t_p)$

Where: H_{sec} = Secondary compression; H_t = Thickness of soil stratum

Est. Secondary Compression (inches):	1.9	Slimes
Est. Secondary Compression (inches):	0.1	Clay

SUMMARY OF EXISTING CONDITIONS AND PROPOSED GRADING

Analysis Point/Location:	SB-1131/CPT-26	
Existing Grade:	69.3	feet
Assumed Bedrock Depth:	30.5	feet bgs
Groundwater Depth:	3.0	feet bgs
Tot./Eff. Stress @ GWT =	330.0	psf

Analysis Point/Location:	SB-1131/CPT-26	
Proposed Grade:	85.50	feet
Grade Change:	16.2	feet
Fill Unit Weight:	120.00	pcf
Δ Stress:	1944.0	psf

Input assumed or known depth (ft bgs) to bedrock above. Then input the bottom depth (ft bgs) and unit weight (pcf) for each primary stratum below.

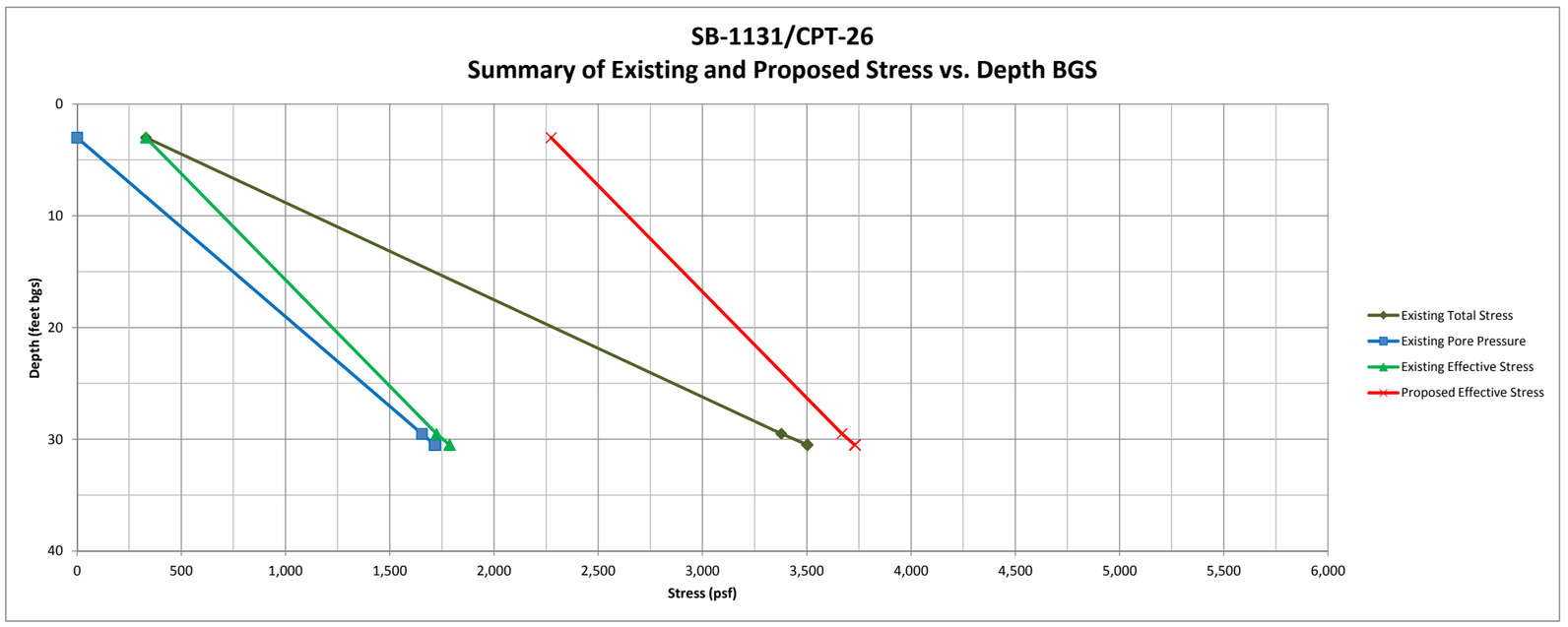
Subsurface Conditions					Existing Grade Conditions									Proposed Grade Conditions		
Primary Stratum	Depth		Thickness	Unit Weight	Total Stress			Pore Pressure			Effective Stress			Effective Stress		
	Top (ft bgs)	Bottom (ft bgs)	(ft)	γ_t or γ_{sat} (pcf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)
Slimes (unsat)	0.0	3.0	3.0	110	0.0	330.0	165.0	0.0	0.0	0.0	0.0	330.0	165.0	1944.0	2274.0	2109.0
Slimes (sat)	3.0	29.5	26.5	115	330.0	3377.5	1853.8	0.0	1653.6	826.8	330.0	1723.9	1027.0	2274.0	3667.9	2971.0
Clay/Till Fill	29.5	30.5	1.0	125	3377.5	3502.5	3440.0	1653.6	1716.0	1684.8	1723.9	1786.5	1755.2	3667.9	3730.5	3699.2
V. Stiff Clay	30.5	30.5	0.0	125	3502.5	3502.5	3502.5	1716.0	1716.0	1716.0	1786.5	1786.5	1786.5	3730.5	3730.5	3730.5
Stiff Clay	30.5	30.5	0.0	125	3502.5	3502.5	3502.5	1716.0	1716.0	1716.0	1786.5	1786.5	1786.5	3730.5	3730.5	3730.5
M. Stiff Clay	30.5	30.5	0.0	120	3502.5	3502.5	3502.5	1716.0	1716.0	1716.0	1786.5	1786.5	1786.5	3730.5	3730.5	3730.5
Soft Clay	30.5	30.5	0.0	120	3502.5	3502.5	3502.5	1716.0	1716.0	1716.0	1786.5	1786.5	1786.5	3730.5	3730.5	3730.5
Till	30.5	30.5	0.0	135	3502.5	3502.5	3502.5	1716.0	1716.0	1716.0	1786.5	1786.5	1786.5	3730.5	3730.5	3730.5

Notes, Comments, and/or Adjustments Made to Subsurface Conditions

1. n/a
2. n/a
3. n/a

Prepared By/Date: JC/10-21-14

Checked By/Date: NDL/10-23-14



SUMMARY OF COMPRESSIBILITY PARAMETERS, ESTIMATED PRIMARY CONSOLIDATION SETTLEMENT, & TIME-RATE OF CONSOLIDATION

Analysis Point/Location: **SB-1131/CPT-26**
Proposed Grade: 85.5 feet
Grade Change: 16.2 feet
Fill Unit Weight: 120.0 pcf
Δ Stress: 1944.0 psf

Input assumed over-consolidation ratio, compression index (= $C_c/1+e_0$), recompression index (= $C_r/1+e_0$), and coefficient of consolidation (ft^2/day) for each primary stratum below.

Assumed Compressibility Parameters					Primary Consolidation Settlement (Due to Proposed Grade Change)	Time-Rate of Consolidation (to 90% Consolidation)		
Primary Stratum	OCR	Comp. Index $C_{c\varepsilon}$	Recomp. Index $C_{r\varepsilon}$	Coef. of Consol. c_v (ft^2/day)	(inches)	Drainage Height H_{dr} (feet)	Time Factor T	Time t (days)
Slimes (unsat)	1.0	0.15	0.05	1.00	5.98	1.5	0.848	1.9
Slimes (sat)	1.0	0.15	0.05	1.00	22.01	13.25	0.848	148.9
Clay/Till Fill	2.0	0.15	0.02	2.00	0.11	0.5	0.848	0.1
V. Stiff Clay	2.0	0.15	0.02	4.00	0.00	0.0	0.848	0.0
Stiff Clay	2.0	0.15	0.02	3.00	0.00	0.0	0.848	0.0
M. Stiff Clay	2.0	0.15	0.02	2.00	0.00	0.0	0.848	0.0
Soft Clay	1.2	0.15	0.02	0.50	0.00	0.0	0.848	0.0
Till	-	-	-	-	-	-	-	-
					28.10			

Estimated Settlement @ 90% Consolidation
(inches)
25.29

Days	**148.9**
Months	**4.9**
Years	**0.4**

Above Time-Rate calcs assume double drainage of each stratum. However, this is not valid. In this case, convert to a composite stratum as per below.

Double drainage of each Stratum? **NO**

If answer to double drainage question = "YES", refer to the values above for the estimated time to 90% consolidation. If the answer to the question = "NO", refer to the composite Stratum calculation below for the estimated time to 90% consolidation.

COMPOSITE STRATUM (Slimes & Clay)
Convert to One "Composite" Layer (NAVFAC DM 7.1-235)
(w/ C_v properties of Slimes)

$$H_{comp} = H_d + H_o(Cv_d / Cv_o)^{1/2}$$

H_{comp} = 30.2 ft

H_{dr} = 30.2 ft - Single Drainage
H_{dr} = 15.1 ft - Double Drainage
T = 0.848 90% consolidation

Calculate Time, t, in days to 90% Consolidation

$$t = (T * H_{dr}^2) / Cv_d$$

	Single Drainage	Double Drainage
Days	**773.8**	**193.4**
Months	**25.4**	**6.3**
Years	**2.1**	**0.5**

DATA INPUT AND OUTPUT SUMMARY

KEY

Data Input Cells:	Input Data Here	Input location-specific information for this Analysis Point
Data Output Cells:	Calculation/Output	Calculated value. Read output cell for result.

EXISTING CONDITIONS, PROPOSED GRADING, & PRIMARY CONSOLIDATION

Analyis Point No.:	**SB-603/CP-610**	Input analysis point no./exploration location.
Existing Grade (ft):	**70.0**	Input existing ground surface elev. (to nearest 0.25') at analysis point location.
Groundwater Depth (ft bgs):	**5.5**	Input existing groundwater depth (to nearest 0.25') at analysis point location.
Proposed Grade (ft):	**78.5**	Input proposed grade (to nearest 0.25') at analysis point location.
Unit Weight of Prop. Fill (pcf):	**120.0**	Input unit weight of grade change fill/materials.
Est. Primary Consol. Settlement:	**17.7**	Estimated primary consol. settlement (in inches) due to proposed grade change.
Est. Primary Consol. Settlement:	**16.0**	Estimated primary consol. settlement (in inches) at 90% consolidation.
Est. Time to 90% Primary Conol (single drain).:	**3.6**	Estimated time (in years) to achieve 90% of the est. primary consol. settlement.
Est. Time to 99% Primary Consol. (single drain):	**7.6**	Estimated time (in years) to achieve 99% of the est. primary consol. settlement.
Est. Time to 90% Primary Conol (double drain).:	**0.9**	Estimated time (in years) to achieve 90% of the est. primary consol. settlement.
Est. Time to 99% Primary Consol. (double drain):	**1.9**	Estimated time (in years) to achieve 99% of the est. primary consol. settlement.

SECONDARY CONSOLIDATION

Analysis Point No:	**SB-603/CP-610**	-	
Surcharge Area/Point No:	**0**	-	
Coefficient of Secondary Compression, $C_{\acute{\alpha}}$	**0.005**	Clay	(Cά expressed by change in strain per log cycle of time)
Coefficient of Secondary Compression, $C_{\acute{\alpha}}$	**0.005**	Slimes	(Cά expressed by change in strain per log cycle of time)
Est. Time to End of Primary Consolidation, t_p	**7.6**	Years	
Est. Design Life Time, t_{sec}	**50**	Years	

Method from NAVFAC DM 7.1-231: $H_{sec} = C\acute{\alpha} * H_t * \log (t_{sec}/t_p)$

Where: H_{sec} = Secondary compression; H_t = Thickness of soil stratum

Est. Secondary Compression (inches):	**1.3**	Slimes
Est. Secondary Compression (inches):	**0.7**	Clay

SUMMARY OF EXISTING CONDITIONS AND PROPOSED GRADING

Analysis Point/Location: SB-603/CP-610

Existing Grade:	70.0	feet
Assumed Bedrock Depth:	48.5	feet bgs
Groundwater Depth:	5.5	feet bgs
Tot./Eff. Stress @ GWT =	605.0	psf

Analysis Point/Location: SB-603/CP-610

Proposed Grade:	78.50	feet
Grade Change:	8.5	feet
Fill Unit Weight:	120.00	pcf
Δ Stress:	1020.0	psf

Input assumed or known depth (ft bgs) to bedrock above. Then input the bottom depth (ft bgs) and unit weight (pcf) for each primary stratum below.

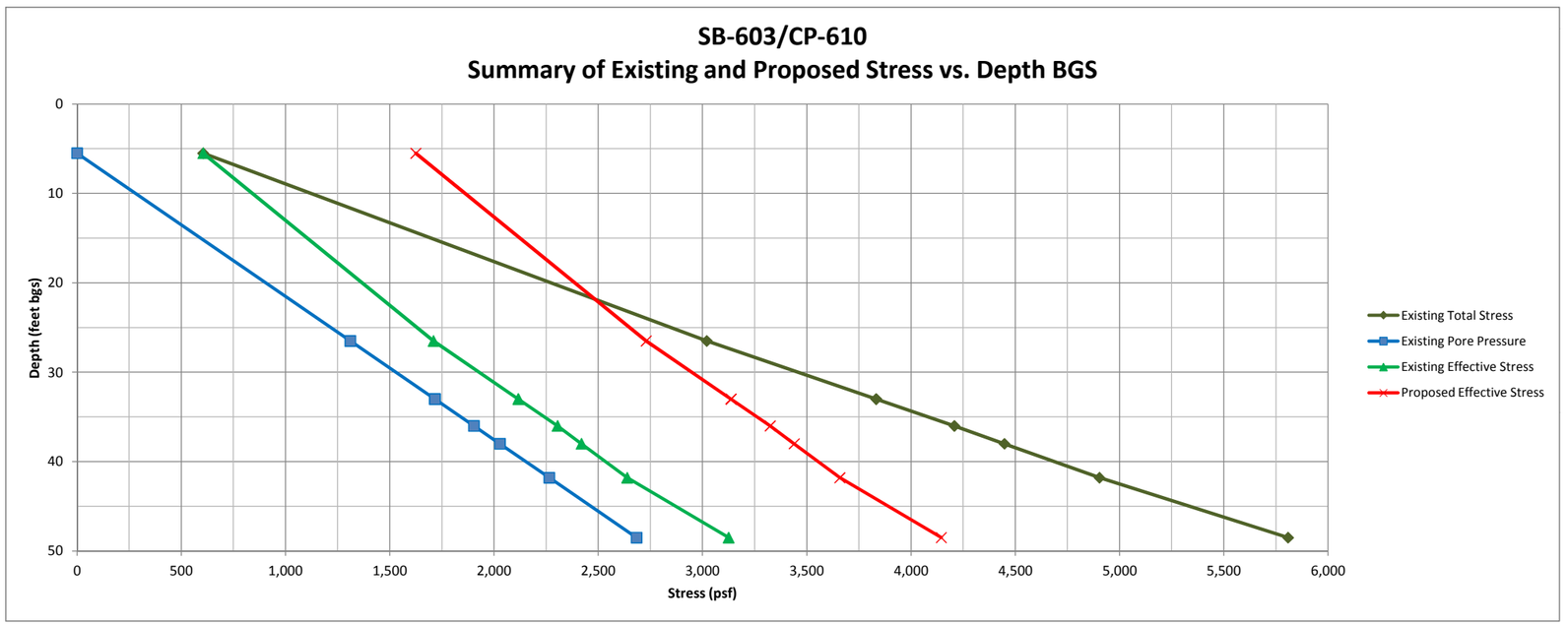
Subsurface Conditions					Existing Grade Conditions									Proposed Grade Conditions		
Primary Stratum	Depth		Thickness	Unit Weight	Total Stress			Pore Pressure			Effective Stress			Effective Stress		
	Top (ft bgs)	Bottom (ft bgs)	(ft)	γ_t or γ_{sat} (pcf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)
Slimes (unsat)	0.0	5.5	5.5	110	0.0	605.0	302.5	0.0	0.0	0.0	0.0	605.0	302.5	1020.0	1625.0	1322.5
Slimes (sat)	5.5	26.5	21.0	115	605.0	3020.0	1812.5	0.0	1310.4	655.2	605.0	1709.6	1157.3	1625.0	2729.6	2177.3
Clay/Till Fill	26.5	33.0	6.5	125	3020.0	3832.5	3426.3	1310.4	1716.0	1513.2	1709.6	2116.5	1913.1	2729.6	3136.5	2933.1
V. Stiff Clay	33.0	33.0	0.0	125	3832.5	3832.5	3832.5	1716.0	1716.0	1716.0	2116.5	2116.5	2116.5	3136.5	3136.5	3136.5
Stiff Clay	33.0	36.0	3.0	125	3832.5	4207.5	4020.0	1716.0	1903.2	1809.6	2116.5	2304.3	2210.4	3136.5	3324.3	3230.4
M. Stiff Clay	36.0	38.0	2.0	120	4207.5	4447.5	4327.5	1903.2	2028.0	1965.6	2304.3	2419.5	2361.9	3324.3	3439.5	3381.9
Soft Clay	38.0	41.8	3.8	120	4447.5	4903.5	4675.5	2028.0	2265.1	2146.6	2419.5	2638.4	2528.9	3439.5	3658.4	3548.9
Till	41.8	48.5	6.7	135	4903.5	5808.0	5355.8	2265.1	2683.2	2474.2	2638.4	3124.8	2881.6	3658.4	4144.8	3901.6

Notes, Comments, and/or Adjustments Made to Subsurface Conditions

1. n/a
2. n/a
3. n/a

Prepared By/Date: JC/10-21-14

Checked By/Date: NDL/10-23-14



SUMMARY OF COMPRESSIBILITY PARAMETERS, ESTIMATED PRIMARY CONSOLIDATION SETTLEMENT, & TIME-RATE OF CONSOLIDATION

Analysis Point/Location:	**SB-603/CP-610**	
Proposed Grade:	78.5	feet
Grade Change:	8.5	feet
Fill Unit Weight:	120.0	pcf
Δ Stress:	1020.0	psf

Input assumed over-consolidation ratio, compression index (= $C_c/1+e_0$), recompression index (= $C_r/1+e_0$), and coefficient of consolidation (ft^2/day) for each primary stratum below.

Assumed Compressibility Parameters					Primary Consolidation Settlement (Due to Proposed Grade Change)	Time-Rate of Consolidation (to 90% Consolidation)		
Primary Stratum	OCR	Comp. Index $C_{c\varepsilon}$	Recomp. Index $C_{r\varepsilon}$	Coef. of Consol. c_v (ft^2/day)	(inches)	Drainage Height H_{dr} (feet)	Time Factor T	Time t (days)
Slimes (unsat)	1.0	0.15	0.05	1.00	6.34	2.75	0.848	6.4
Slimes (sat)	1.0	0.15	0.05	1.00	10.38	10.5	0.848	93.5
Clay/Till Fill	2.0	0.15	0.02	2.00	0.29	3.3	0.848	4.5
V. Stiff Clay	2.0	0.15	0.02	4.00	0.00	0.0	0.848	0.0
Stiff Clay	2.0	0.15	0.02	3.00	0.12	1.5	0.848	0.6
M. Stiff Clay	2.0	0.15	0.02	2.00	0.07	1.0	0.848	0.4
Soft Clay	1.2	0.15	0.02	0.50	0.54	1.9	0.848	6.1
Till	-	-	-	-	-	-	-	-
					17.74			

Estimated Settlement @ 90% Consolidation
(inches)
15.96

Days	**93.5**
Months	**3.1**
Years	**0.3**

Above Time-Rate calcs assume double drainage of each stratum. However, this is not valid. In this case, convert to a composite stratum as per below.

Double drainage of each Stratum? **NO**

If answer to double drainage question = "YES", refer to the values above for the estimated time to 90% consolidation. If the answer to the question = "NO", refer to the composite Stratum calculation below for the estimated time to 90% consolidation.

COMPOSITE STRATUM (Slimes & Clay)

Convert to One "Composite" Layer (NAVFAC DM 7.1-235)
(w/ C_v properties of Slimes)

$$H_{comp} = H_d + H_o(Cv_d / Cv_o)^{1/2}$$

H_{comp} =	39.6	ft
H_{dr} =	39.6	ft - Single Drainage
H_{dr} =	19.8	ft - Double Drainage
T =	0.848	90% consolidation

Calculate Time, t, in days to 90% Consolidation

$$t = (T * H_{dr}^2) / Cv_d$$

	Single Drainage	Double Drainage
Days	**1330.9**	**332.7**
Months	**43.6**	**10.9**
Years	**3.6**	**0.9**

DATA INPUT AND OUTPUT SUMMARY

KEY

Data Input Cells:	Input Data Here	Input location-specific information for this Analysis Point
Data Output Cells:	Calculation/Output	Calculated value. Read output cell for result.

EXISTING CONDITIONS, PROPOSED GRADING, & PRIMARY CONSOLIDATION

Analyis Point No.:	**CP-603**	Input analysis point no./exploration location.
Existing Grade (ft):	**70.8**	Input existing ground surface elev. (to nearest 0.25') at analysis point location.
Groundwater Depth (ft bgs):	**11.8**	Input existing groundwater depth (to nearest 0.25') at analysis point location.
Proposed Grade (ft):	**78.0**	Input proposed grade (to nearest 0.25') at analysis point location.
Unit Weight of Prop. Fill (pcf):	**120.0**	Input unit weight of grade change fill/materials.
Est. Primary Consol. Settlement:	**14.9**	Estimated primary consol. settlement (in inches) due to proposed grade change.
Est. Primary Consol. Settlement:	**13.4**	Estimated primary consol. settlement (in inches) at 90% consolidation.
Est. Time to 90% Primary Conol (single drain).:	**3.4**	Estimated time (in years) to achieve 90% of the est. primary consol. settlement.
Est. Time to 99% Primary Consol. (single drain):	**7.2**	Estimated time (in years) to achieve 99% of the est. primary consol. settlement.
Est. Time to 90% Primary Conol (double drain).:	**0.9**	Estimated time (in years) to achieve 90% of the est. primary consol. settlement.
Est. Time to 99% Primary Consol. (double drain):	**1.8**	Estimated time (in years) to achieve 99% of the est. primary consol. settlement.

SECONDARY CONSOLIDATION

Analysis Point No:	**CP-603**	-	
Surcharge Area/Point No:	**0**	-	
Coefficient of Secondary Compression, $C_{\acute{\alpha}}$	**0.005**	Clay	(Cά expressed by change in strain per log cycle of time)
Coefficient of Secondary Compression, $C_{\acute{\alpha}}$	**0.005**	Slimes	(Cά expressed by change in strain per log cycle of time)
Est. Time to End of Primary Consolidation, t_p	**7.2**	Years	
Est. Design Life Time, t_{sec}	**50**	Years	

Method from NAVFAC DM 7.1-231: $H_{sec} = C\acute{\alpha} * H_t * \log (t_{sec}/t_p)$

Where: H_{sec} = Secondary compression; H_t = Thickness of soil stratum

Est. Secondary Compression (inches):	**1.8**	Slimes
Est. Secondary Compression (inches):	**0.2**	Clay

SUMMARY OF EXISTING CONDITIONS AND PROPOSED GRADING

Analysis Point/Location:	**CP-603**	
Existing Grade:	70.8	feet
Assumed Bedrock Depth:	41.3	feet bgs
Groundwater Depth:	11.8	feet bgs
Tot./Eff. Stress @ GWT =	1298.0	psf

Analysis Point/Location:	**CP-603**	
Proposed Grade:	77.98	feet
Grade Change:	7.2	feet
Fill Unit Weight:	120.00	pcf
Δ Stress:	861.6	psf

Input assumed or known depth (ft bgs) to bedrock above. Then input the bottom depth (ft bgs) and unit weight (pcf) for each primary stratum below.

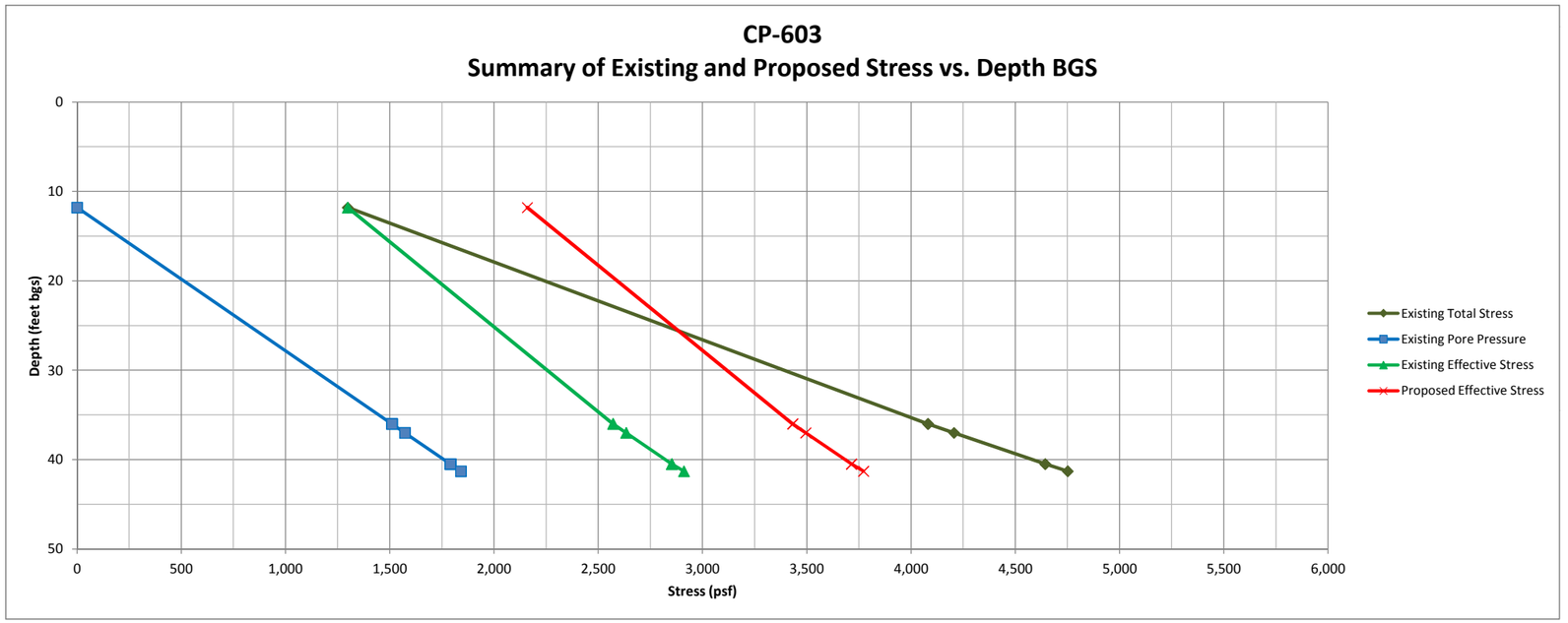
Subsurface Conditions					Existing Grade Conditions									Proposed Grade Conditions		
Primary Stratum	Depth		Thickness	Unit Weight	Total Stress			Pore Pressure			Effective Stress			Effective Stress		
	Top (ft bgs)	Bottom (ft bgs)	(ft)	γ_t or γ_{sat} (pcf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)
Slimes (unsat)	0.0	11.8	11.8	110	0.0	1298.0	649.0	0.0	0.0	0.0	1298.0	2570.9	1934.5	2159.6	3432.5	2796.1
Slimes (sat)	11.8	36.0	24.2	115	1298.0	4081.0	2689.5	0.0	1510.1	755.0	1298.0	2570.9	1934.5	2159.6	3432.5	2796.1
Clay/Till Fill	36.0	36.0	0.0	125	4081.0	4081.0	4081.0	1510.1	1510.1	1510.1	2570.9	2570.9	2570.9	3432.5	3432.5	3432.5
V. Stiff Clay	36.0	37.0	1.0	125	4081.0	4206.0	4143.5	1510.1	1572.5	1541.3	2570.9	2633.5	2602.2	3432.5	3495.1	3463.8
Stiff Clay	37.0	40.5	3.5	125	4206.0	4643.5	4424.8	1572.5	1790.9	1681.7	2633.5	2852.6	2743.1	3495.1	3714.2	3604.7
M. Stiff Clay	40.5	40.5	0.0	120	4643.5	4643.5	4643.5	1790.9	1790.9	1790.9	2852.6	2852.6	2852.6	3714.2	3714.2	3714.2
Soft Clay	40.5	40.5	0.0	120	4643.5	4643.5	4643.5	1790.9	1790.9	1790.9	2852.6	2852.6	2852.6	3714.2	3714.2	3714.2
Till	40.5	41.3	0.8	135	4643.5	4751.5	4697.5	1790.9	1840.8	1815.8	2852.6	2910.7	2881.7	3714.2	3772.3	3743.3

Notes, Comments, and/or Adjustments Made to Subsurface Conditions

1. n/a
2. n/a
3. n/a

Prepared By/Date: JC/10-21-14

Checked By/Date: NDL/10-23-14



SUMMARY OF COMPRESSIBILITY PARAMETERS, ESTIMATED PRIMARY CONSOLIDATION SETTLEMENT, & TIME-RATE OF CONSOLIDATION

Analysis Point/Location:	**CP-603**	
Proposed Grade:	78.0	feet
Grade Change:	7.2	feet
Fill Unit Weight:	120.0	pcf
Δ Stress:	861.6	psf

Input assumed over-consolidation ratio, compression index (= $C_c/1+e_0$), recompression index (= $C_r/1+e_0$), and coefficient of consolidation (ft^2/day) for each primary stratum below.

Assumed Compressibility Parameters					Primary Consolidation Settlement (Due to Proposed Grade Change)	Time-Rate of Consolidation (to 90% Consolidation)		
Primary Stratum	OCR	Comp. Index $C_{c\varepsilon}$	Recomp. Index $C_{r\varepsilon}$	Coef. of Consol. c_v (ft^2/day)	(inches)	Drainage Height H_{dr} (feet)	Time Factor T	Time t (days)
Slimes (unsat)	1.0	0.15	0.05	1.00	7.79	5.9	0.848	29.5
Slimes (sat)	1.0	0.15	0.05	1.00	6.97	12.1	0.848	124.2
Clay/Till Fill	2.0	0.15	0.02	2.00	0.00	0.0	0.848	0.0
V. Stiff Clay	2.0	0.15	0.02	4.00	0.03	0.5	0.848	0.1
Stiff Clay	2.0	0.15	0.02	3.00	0.10	1.8	0.848	0.9
M. Stiff Clay	2.0	0.15	0.02	2.00	0.00	0.0	0.848	0.0
Soft Clay	1.2	0.15	0.02	0.50	0.00	0.0	0.848	0.0
Till	-	-	-	-	-	-	-	-
					14.89			

Estimated Settlement @ 90% Consolidation
(inches)
13.40

Days	**124.2**
Months	**4.1**
Years	**0.3**

Above Time-Rate calcs assume double drainage of each stratum. However, this is not valid. In this case, convert to a composite stratum as per below.

Double drainage of each Stratum? **NO**

If answer to double drainage question = "YES", refer to the values above for the estimated time to 90% consolidation. If the answer to the question = "NO", refer to the composite Stratum calculation below for the estimated time to 90% consolidation.

COMPOSITE STRATUM (Slimes & Clay)

Convert to One "Composite" Layer (NAVFAC DM 7.1-235)
(w/ C_v properties of Slimes)

$$H_{comp} = H_d + H_o(Cv_d / Cv_o)^{1/2}$$

H_{comp} = 38.5 ft

H_{dr} = 38.5 ft - Single Drainage
H_{dr} = 19.3 ft - Double Drainage
T = 0.848 90% consolidation

Calculate Time, t, in days to 90% Consolidation

$$t = (T * H_{dr}^2) / Cv_d$$

	Single Drainage	Double Drainage
Days	**1258.3**	**314.6**
Months	**41.3**	**10.3**
Years	**3.4**	**0.9**

DATA INPUT AND OUTPUT SUMMARY

KEY

Data Input Cells:	Input Data Here	Input location-specific information for this Analysis Point
Data Output Cells:	Calculation/Output	Calculated value. Read output cell for result.

EXISTING CONDITIONS, PROPOSED GRADING, & PRIMARY CONSOLIDATION

Analyis Point No.:	**CP-607**	Input analysis point no./exploration location.
Existing Grade (ft):	**69.6**	Input existing ground surface elev. (to nearest 0.25') at analysis point location.
Groundwater Depth (ft bgs):	**1.0**	Input existing groundwater depth (to nearest 0.25') at analysis point location.
Proposed Grade (ft):	**77.0**	Input proposed grade (to nearest 0.25') at analysis point location.
Unit Weight of Prop. Fill (pcf):	**120.0**	Input unit weight of grade change fill/materials.
Est. Primary Consol. Settlement:	**19.3**	Estimated primary consol. settlement (in inches) due to proposed grade change.
Est. Primary Consol. Settlement:	**17.4**	Estimated primary consol. settlement (in inches) at 90% consolidation.
Est. Time to 90% Primary Conol (single drain).:	**3.5**	Estimated time (in years) to achieve 90% of the est. primary consol. settlement.
Est. Time to 99% Primary Consol. (single drain):	**7.3**	Estimated time (in years) to achieve 99% of the est. primary consol. settlement.
Est. Time to 90% Primary Conol (double drain).:	**0.9**	Estimated time (in years) to achieve 90% of the est. primary consol. settlement.
Est. Time to 99% Primary Consol. (double drain):	**1.8**	Estimated time (in years) to achieve 99% of the est. primary consol. settlement.

SECONDARY CONSOLIDATION

Analysis Point No:	**CP-607**	-	
Surcharge Area/Point No:	**0**	-	
Coefficient of Secondary Compression, $C_{\acute{\alpha}}$	**0.005**	Clay	(Cά expressed by change in strain per log cycle of time)
Coefficient of Secondary Compression, $C_{\acute{\alpha}}$	**0.005**	Slimes	(Cά expressed by change in strain per log cycle of time)
Est. Time to End of Primary Consolidation, t_p	**7.3**	Years	
Est. Design Life Time, t_{sec}	**50**	Years	

Method from NAVFAC DM 7.1-231: $H_{sec} = C\acute{\alpha} * H_t * \log (t_{sec}/t_p)$

Where: H_{sec} = Secondary compression
H_t = Thickness of soil stratum

Est. Secondary Compression (inches):	**1.8**	Slimes
Est. Secondary Compression (inches):	**0.3**	Clay

SUMMARY OF EXISTING CONDITIONS AND PROPOSED GRADING

Analysis Point/Location:	**CP-607**	
Existing Grade:	69.6	feet
Assumed Bedrock Depth:	43.1	feet bgs
Groundwater Depth:	1.0	feet bgs
Tot./Eff. Stress @ GWT =	110.0	psf

Analysis Point/Location:	**CP-607**	
Proposed Grade:	77.00	feet
Grade Change:	7.4	feet
Fill Unit Weight:	120.00	pcf
Δ Stress:	888.0	psf

Input assumed or known depth (ft bgs) to bedrock above. Then input the bottom depth (ft bgs) and unit weight (pcf) for each primary stratum below.

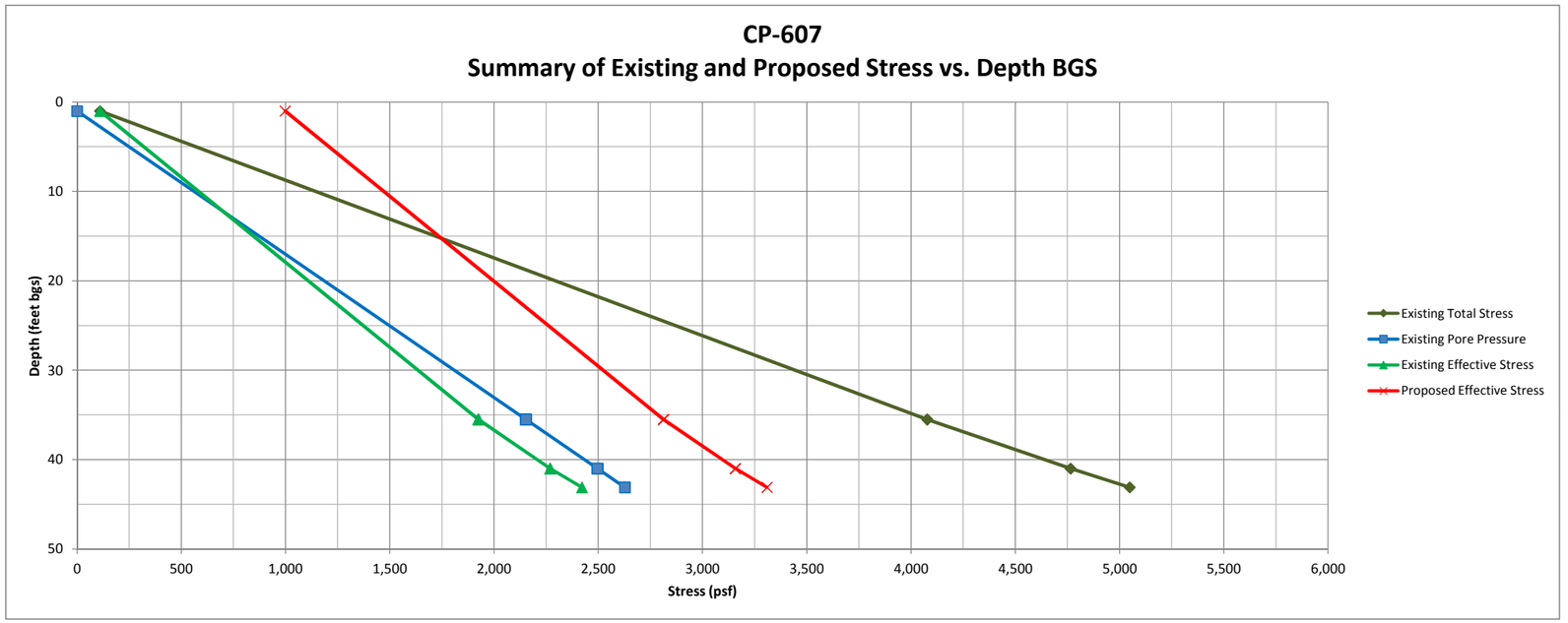
Subsurface Conditions					Existing Grade Conditions									Proposed Grade Conditions		
Primary Stratum	Depth		Thickness	Unit Weight	Total Stress			Pore Pressure			Effective Stress			Effective Stress		
	Top (ft bgs)	Bottom (ft bgs)	(ft)	γ_t or γ_{sat} (pcf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)	Top (psf)	Bottom (psf)	Middle (psf)
Slimes (unsat)	0.0	1.0	1.0	110	0.0	110.0	55.0	0.0	0.0	0.0	110.0	110.0	55.0	888.0	998.0	943.0
Slimes (sat)	1.0	35.5	34.5	115	110.0	4077.5	2093.8	0.0	2152.8	1076.4	110.0	1924.7	1017.4	998.0	2812.7	1905.4
Clay/Till Fill	35.5	35.5	0.0	125	4077.5	4077.5	4077.5	2152.8	2152.8	2152.8	1924.7	1924.7	1924.7	2812.7	2812.7	2812.7
V. Stiff Clay	35.5	35.5	0.0	125	4077.5	4077.5	4077.5	2152.8	2152.8	2152.8	1924.7	1924.7	1924.7	2812.7	2812.7	2812.7
Stiff Clay	35.5	41.0	5.5	125	4077.5	4765.0	4421.3	2152.8	2496.0	2324.4	1924.7	2269.0	2096.9	2812.7	3157.0	2984.9
M. Stiff Clay	41.0	41.0	0.0	120	4765.0	4765.0	4765.0	2496.0	2496.0	2496.0	2269.0	2269.0	2269.0	3157.0	3157.0	3157.0
Soft Clay	41.0	41.0	0.0	120	4765.0	4765.0	4765.0	2496.0	2496.0	2496.0	2269.0	2269.0	2269.0	3157.0	3157.0	3157.0
Till	41.0	43.1	2.1	135	4765.0	5048.5	4906.8	2496.0	2627.0	2561.5	2269.0	2421.5	2345.2	3157.0	3309.5	3233.2

Notes, Comments, and/or Adjustments Made to Subsurface Conditions

1. n/a
2. n/a
3. n/a

Prepared By/Date: JC/10-21-14

Checked By/Date: NDL/10-23-14



SUMMARY OF COMPRESSIBILITY PARAMETERS, ESTIMATED PRIMARY CONSOLIDATION SETTLEMENT, & TIME-RATE OF CONSOLIDATION

Analysis Point/Location:	**CP-607**	
Proposed Grade:	77.0	feet
Grade Change:	7.4	feet
Fill Unit Weight:	120.0	pcf
Δ Stress:	888.0	psf

Input assumed over-consolidation ratio, compression index (= $C_c/1+e_0$), recompression index (= $C_r/1+e_0$), and coefficient of consolidation (ft^2/day) for each primary stratum below.

Assumed Compressibility Parameters					Primary Consolidation Settlement (Due to Proposed Grade Change)	Time-Rate of Consolidation (to 90% Consolidation)		
Primary Stratum	OCR	Comp. Index $C_{c\varepsilon}$	Recomp. Index $C_{r\varepsilon}$	Coef. of Consol. c_v (ft^2/day)	(inches)	Drainage Height H_{dr} (feet)	Time Factor T	Time t (days)
Slimes (unsat)	1.0	0.15	0.05	1.00	2.22	0.5	0.848	0.2
Slimes (sat)	1.0	0.15	0.05	1.00	16.92	17.25	0.848	252.3
Clay/Till Fill	2.0	0.15	0.02	2.00	0.00	0.0	0.848	0.0
V. Stiff Clay	2.0	0.15	0.02	4.00	0.00	0.0	0.848	0.0
Stiff Clay	2.0	0.15	0.02	3.00	0.20	2.8	0.848	2.1
M. Stiff Clay	2.0	0.15	0.02	2.00	0.00	0.0	0.848	0.0
Soft Clay	1.2	0.15	0.02	0.50	0.00	0.0	0.848	0.0
Till	-	-	-	-	-	-	-	-
					19.35			

Estimated Settlement @ 90% Consolidation

(inches)
17.41

Days	**252.3**
Months	**8.3**
Years	**0.7**

Above Time-Rate calcs assume double drainage of each stratum. However, this is not valid. In this case, convert to a composite stratum as per below.

Double drainage of each Stratum? **NO**

If answer to double drainage question = "YES", refer to the values above for the estimated time to 90% consolidation. If the answer to the question = "NO", refer to the composite Stratum calculation below for the estimated time to 90% consolidation.

COMPOSITE STRATUM (Slimes & Clay)

Convert to One "Composite" Layer (NAVFAC DM 7.1-235)

(w/ C_v properties of Slimes)

$$H_{comp} = H_d + H_o(Cv_d / Cv_o)^{1/2}$$

H_{comp} = 38.7 ft

H_{dr} = 38.7 ft - Single Drainage

H_{dr} = 19.3 ft - Double Drainage

T = 0.848 90% consolidation

Calculate Time, t, in days to 90% Consolidation

$$t = (T * H_{dr}^2) / Cv_d$$

	Single Drainage	Double Drainage
Days	**1268.4**	**317.1**
Months	**41.6**	**10.4**
Years	**3.5**	**0.9**