Subject:	**Southern Forebay Seismic Sensitivity Evaluation (Final Draft)**
Project feature:	Southern Forebay
Prepared for:	California Department of Water Resources (DWR) / Delta Conveyance Office (DCO)
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1. Purpose and Introduction

This technical memorandum (TM) presents the results of the sensitivity evaluation performed to support conceptual footprint development of the Southern Forebay (SF) structure, a key feature in the Delta Conveyance Project (Project). The SF would be located in Byron Tract, northwest of the Clifton Court Forebay (CCF).

The purposes of the sensitivity evaluation were as follows:

1) Assess how the steady-state static stability, seismic stability, and estimated settlement of the SF could be affected by different embankment geometries and differing supporting foundation materials.
2) Develop a recommended conceptual level Project footprint for the SF structure, including possible ground improvement layouts.

The evaluation was performed using near-site data, because site-specific data were not available. It included sensitivity analyses of anticipated subsurface layering and statistical strength parameters, and an evaluation of various conceptual ground improvement concepts.

The evaluations were performed to support the conceptual footprint development of the SF embankment structure only. This TM does not include evaluations related to selection of locations of the following structures:

- South Delta Pumping Plant
- Southern Forebay Outlet Structure
- South Delta Outlet and Control Structure
- California Aqueduct Control Structure
- Southern Forebay Emergency Spillway

1.1 Background

The SF would be an at-grade storage reservoir formed using a constructed ring embankment arrangement. As Figure 1-1 shows, the SF would be located in the Byron Tract, immediately northwest of the CCF. Note the layout shown is conceptual based upon information in early 2020.

Geotechnical conditions for the SF area consist of peaty, organic soils within the upper foundation, overlying high plasticity clays and sand. Blow counts measured in the field indicated the near-surface organics and clayey material are generally soft and the sandy material was loose to medium dense (refer

FINAL DRAFT

to Sections 2.4.1 and 2.4.2). Also of note is the SF footprint's proximity to a fault lineament immediately to the south of the SF site; likely associated with the West Tracy Fault—a fault currently thought to have a potential for surface rupture, as described in the *West Tracy Fault Preliminary Displacement Hazard Analysis* TM (DCA, 2021). The conditions at the SF site appear to have greater potential for liquefaction in upper foundation soils due to granular layers with low blow counts and the potential for large ground motions, as well as a greater settlement potential due to compressible foundation soils.

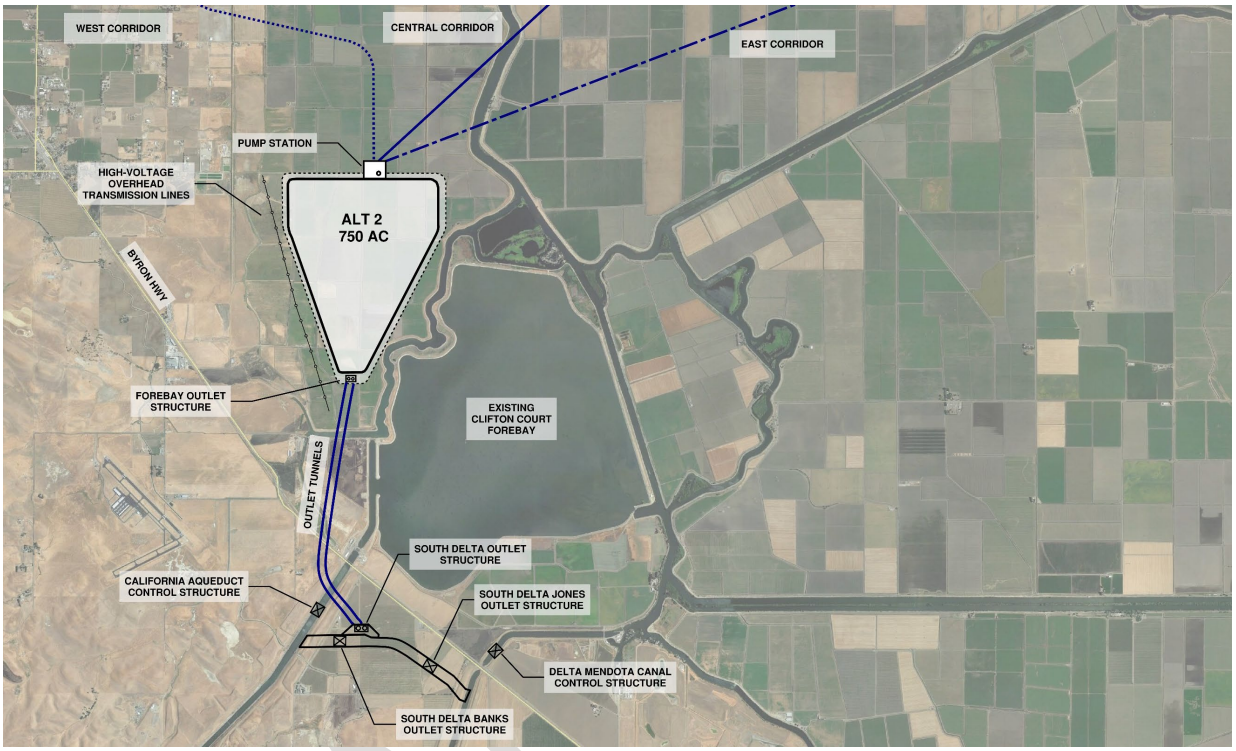

Figure 1-1. Southern Forebay Location and Related Facilities

Based on these conditions, an evaluation of the SF seismic stability and need for possible foundation improvement was necessary to further develop the footprint of the SF. The stability evaluation presented in this TM was performed using near-site subsurface conditions, with the primary assumption that the anticipated conditions are similar to those expected at the SF site. This region of the South Delta has been studied in detail for several past projects (e.g., studies by the California Department of Water Resources [DWR] for WaterFix, CCF, and various intake structures; studies by the local reclamation district for Byron Tract levee evaluation). As a result, numerous subsurface explorations have been performed relatively near to the SF location, including borings, cone penetration tests (CPTs), geophysical tests, well construction records, and other site investigation techniques (such as vane shear testing).

The Byron Tract Forebay previously analyzed under the California WaterFix project included 6 feet of foundation excavation beneath the embankment, a seepage cutoff wall, 4 horizontal (H) to 1V vertical (H:V) interior and exterior embankment slopes, and a crest width of 32 feet set at an elevation (El.) of 25 feet (North American Vertical Datum 1988 [NAVD88]). Additional foundation improvements required to mitigate settlement or embankment/foundation deformation were not previously included. Under the Project, refinements indicate the need for the embankments to be slightly taller, with the crest set at El. 28 feet to address hydraulic and dam safety requirements.

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The analyses discussed here evaluate potential modifications to the embankment slopes and/or improvements to the foundation to address the potential for poor foundation conditions and high seismicity. Embankment geometry include slopes between 3H:1V and 6H:1V. Foundation improvements include additional excavation to depths of 15 and 30 feet below grade or introducing varying amounts of cement through in situ mixing referred to as cement deep soil mixing (CDSM), also referred to more generally as deep mixing method or DMM.

This sensitivity study provides a basis for conceptual embankment and foundation configurations based on near-site data. These concept-level evaluations and recommendations should be superseded by design-level analyses using site-specific subsurface data and laboratory testing collected within the footprint of the SF to establish the ultimate Project configuration during the design phase.

1.2 Summary of Results

The following points summarize the results from this study.

- Two representative subsurface soil profiles were developed based on observed near-site data, and were considered to conservatively represent anticipated subsurface conditions for the SF. These profiles reflect soft organics, soft to medium stiff fine-grained, and loose coarse-grained layers in the upper 30 feet of the soil profiles. The profiles include stratigraphy, material properties, strength properties, and settlement properties.
- Steady-state static stability and seismic stability scenarios based on existing conditions analyses (that is, no foundation modifications beyond the initial 6-foot foundation preparation excavation) indicate the site conditions do not meet required stability criteria. The analysis results indicate some foundation remediation would be required.
- Ground improvement concepts that remove or improve the upper 30 feet of soft, organic materials and liquefiable sands produce adequate factors of safety for all analyzed embankment geometries (that is, 3H:1V, 4H:1V, and 6H:1V) and would be considered during design phase.
- Settlement estimates indicate foundation improvement would reduce settlement by about two-thirds over existing conditions by treating the upper 30 feet of foundation soils. Factors contributing to settlement would include the consolidation of near-normally consolidated organics and lean clays, liquefaction-induced settlement in the upper 30 feet, and the consolidation of deep fine-grained soil deposits.
- Though foundation improvements would result in adequate slope stability factors of safety for all considered embankment geometries; at this stage in the planning process, 4H:1V slopes are recommended for conceptual design. This recommendation is conservative based on conditions indicated by near-site data. Site-specific explorations will be necessary to update these analyses and provide a more refined and optimal SF configuration.

FINAL DRAFT

2. Methodology

This section describes the methods used to develop the concept-level recommendations for SF embankment geometry and foundation improvements. This process involved six primary phases. The data information sources, design criteria, assumptions, and approach are discussed in detail in the subsections that follow.

- Evaluate near-site data, including the extent and availability of existing subsurface data to evaluate possible range of foundation conditions. This includes the development of a ranking system to prioritize high-value historical explorations.
- Develop representative profiles and ranges of material properties using high-value historical explorations.
- Evaluate liquefaction potential and settlement potential of foundation materials.
- Develop analysis models with varying embankment geometry and foundation conditions.
- Perform high-level analyses of concept-level configurations, considering the sensitivity range of material properties.
- Develop and analyze concept-level ground improvement scenarios to mitigate against adverse stability and settlement conditions.

2.1 Data and Information Sources

Near-site data in the form of site exploration logs, construction reports, and performance observations were used to develop the subsurface model for the evaluations. Table 2-1 summarizes the data sources reviewed as part of the evaluation. This table presents a summary of the information gathered and reviewed to support the analysis profiles, material properties, and foundation improvement scenarios.

Table 2-1. Data and Information Sources

Reference Exploration Code	Reference Project[a]	Reference Data Used
ns-by-brb	Byron Road Bridge New Span (2000)	1 Boring
by-lep1	Byron Tract Levee Evaluation Phase 1 (2007-2008)	16 Borings
by-lep2	Byron Tract Levee Evaluation Phase 2 (2008)	1 Boring; 1 CPT
by-lep3	Byron Tract Levee Evaluation Phase 3 (2008)	1 Boring; 15 CPTs
byr-tra-1976	Byron Tract Levee Stability (1976)	5 Borings
ca-ccf-bt, ca-ccf-cc, ca-ccf-cca, ca-ccf-ccis, ca-ccf-eb, ca-ccf-frip, ca-ccf-is, ca-ccf-or, cca, cca-ccf-eb, cca-ccf-frip, cca-ccf-vi	California Aqueduct Clifton Court Forebay (1964-1966 & 1997)	307 Borings
DCA, DCBF, DCC, DCE, DCRA, DCT, DCW	Delta Habitat Conservation and Conveyance Program (2009-2012) and California Water Fix (2018)	24 Borings; 33 CPTs
ccf-is	Clifton Court Forebay, Italian Slough (Intake Structure) (2001)	26 Borings

FINAL DRAFT

Table 2-1. Data and Information Sources

Reference Exploration Code	Reference Project[a]	Reference Data Used
coat-co	Coney Island Aquifer Testing (1974)	6 Borings
esdm-ors	Environmental Study of Dredged Materials in Old River (1996)	4 Borings
ct	Kellogg Creek (2009)	2 Borings; 2 CPTs
ors-bd, ors-bs, ors-us, ors-vd, ors-vs	Old River Seepage Study (1997-1998)	29 Borings
pc60-pca, pc60-pt	Peripheral Canal 1960s (1966, 1968-1969)	14 Borings
ccb, cis, pc70-pc, pc70-pca, ts	Peripheral Canal 1970s (1965-1967, 1969, 1973-1975)	13 Borings
vi, vi-aip	Victoria Island Alternative Intake Project (1991, 2005-2007)	32 Borings; 13 CPTs
nsj-mcr	North San Joaquin Division - Middle River Barrier (2002)	3 CPTs
pb-gl	North San Joaquin Division - Grant Line West Permanent Barrier (2002)	4 CPTs

[a] Reference project data and boring logs compiled in DCA gINT database

2.2 Criteria

2.2.1 Slope Stability Factors of Safety

The base criteria for evaluation of the seismic stability and considered foundation improvements for the SF were to achieve the following minimum factors of safety at the sections analyzed (Table 2-2).

Table 2-2. Slope Stability Criteria

Minimum Required Factor of Safety for Considered Loading Conditions

Loading Condition[a]	Minimum Factor of Safety[a]
Steady-state: Steady-state seepage with static loading and static strengths	1.5
Post-seismic: Steady-state seepage with static loading and post-earthquake strengths	1.1

[a] According to USBR Design Standards DS13-4.
Note:
USBR = U.S. Bureau of Reclamation

As noted in Table 2-2, all stability analyses were performed under steady-state seepage conditions associated with a reservoir storage level of El. 17.5 feet corresponding to the maximum normal operating level in the reservoir. An assumed phreatic surface was used in the analyses as discussed in Section 2.3.3.

FINAL DRAFT

2.2.2 Seismic Design Criteria

The largest peak ground accelerations (PGAs) for the SF are from the West Tracy fault, which is near the southern end of the proposed SF footprint. Ground motions were calculated at the southern portion of the SF, which sits on the hanging wall of the West Tracy fault. Based on a moderate slip rate (0.4 millimeter per year [mm/yr]) and the DWR, Division of Safety of Dams guidelines, a minimum PGA of 1.0 g (84th percentile) is recommended for use for the SF (LCI, 2019). These ground motions represent free-field motions for a reference site condition of a stiff soil ($V_{S,30}$ = 1,100 feet per second [fps]; that is, Site Class D). Site responses will be required to accurately model the effects of the softer, near-surface materials.

2.3 Assumptions

The following subsections describe key assumptions for the work described in this TM.

2.3.1 Near-site Data are Representative of the Southern Forebay Site

The primary assumption made to characterize the anticipated geotechnical conditions at the SF site was that the near-site data collected by others for previous investigations were representative of the conditions at the SF. This assumption was necessary due to the lack of site-specific subsurface data. It was assumed that the following subsurface characteristics from near-site explorations (Table 2-1) were representative of the conditions at the SF site:

- Soil stratigraphy/lithology
- Soil layer thicknesses
- Material properties (including material characteristics, unit weight, compressibility, and strength)

2.3.2 Seismic Loading

A review of existing geophysical data (Table 2-1) suggests the reference site condition $V_{s,30}$ = 1,100 fps occurs at a depth of about 100 feet below ground surface. Due to lack of site-specific site response analyses, it is assumed that short-period ground motions will be de-amplified by 50 percent as they propagate up through 100 feet of alluvial or deltaic soils, or both. Therefore, a peak ground surface acceleration of 0.50 g was assumed for the seismic evaluations.

2.3.3 Stability Analysis

Several simplifying assumptions were made to perform the stability analyses presented in this TM:

- A symmetric homogenous embankment was assumed in this evaluation, though the embankment may ultimately be a zoned earthen embankment with filters and drains or some other design configuration.
- No seepage analyses were performed to develop a phreatic surface through the embankment; therefore, an assumed phreatic surface was used. The assumed phreatic surface was based on the design water surface elevation, did not consider filters and drains to be present, and assumed relatively low-permeable material to bias a higher phreatic surface. The assumed phreatic surface extends from the design water surface elevation from the interior side of the embankment through the embankment and decreases in elevation to the ground surface at the exterior embankment toe.

FINAL DRAFT

- Slip surfaces on the exterior slopes were assumed to be the critical mode for slope instability as the interior embankment slope would be buttressed by the water in the reservoir. As such, only slip surfaces on the exterior slopes were considered in the analyses.
- The post-seismic residual strength for soft to medium stiff fine-grained soils was assumed to be 80 percent of the static strength for the fine-grained soils.

2.3.4 Settlement Analysis

The primary settlement evaluation assumed the magnitude of consolidation settlement observed at CCF was representative of the consolidation characteristics of the subsurface conditions beneath the proposed SF. The stress distribution below the proposed SF embankment was assumed to be consistent with the stress distribution from a trapezoidal embankment founded on a homogeneous elastic half space (that is, a Boussinesq distribution is applicable). The settlement analyses assumed the soils below the embankment were normally consolidated.

2.3.5 Conceptual Ground Improvement

The simplifying assumptions for evaluating the conceptual ground improvements considered for the SF related to composite strength, installation configuration, constructability, and feasibility:

- Conceptual ground improvement scenarios only considered the performance improvements in terms of slope stability and settlement. They did not consider constructability or the practical implications or limitations of the proposed ground improvement concepts.
- The strengths used in evaluation of CDSM-improved strata were based on those obtained in literature and prior project experience. The actual composite soil strengths will ultimately depend on soil composition, thickness, strength, and orientation and spacing of ground improvement elements.
- The use of CDSM panels assumed no strength contribution from the soil between the shear panels. This assumption was conservative, as non-liquefied soil between the panels will contribute additional capacity and increase the composite strength of the improved ground zone.
- CDSM ground improvement was assumed to be a viable method for strengthening all materials encountered, including highly organic (peat) soils. It was also assumed that the same composite strength could be achieved in the overlying organics layer as would be achieved in the underlying soft to medium stiff fine-grained or loose sand layer. Based on review of available literature, a higher cement content or Area Replacement Ratio (ARR), or both, may be needed in areas with remnant peaty deposits in the foundation.

2.4 Approach

The approach to performing the sensitivity evaluation included five primary steps, described in the subsections that follow:

- Step 1: Develop Representative Profiles for Analyses
- Step 2: Develop Geometry for Embankment and Foundation Improvements
- Step 3: Develop Representative Material Properties
- Step 4: Perform Slope Stability Analyses
- Step 5: Perform Settlement Analyses

FINAL DRAFT

2.4.1 Step 1: Develop Representative Profiles for Analyses

Representative analysis profiles were developed based on a review of near-site data that included categorizing historical data, developing simplified lithological categories, plotting lithological profiles, and developing representative soil profiles for analysis based on the range of observed conditions. These stages are described in detail here.

2.4.1.1 Historical Data Review and Grading System

The historical boring logs, CPTs, and laboratory tests indicated in Table 2-1 were reviewed and considered to be included in the near-site dataset. This review consisted of visual interpreting the logs and qualitatively grading each log considering the exploration location, quality of data, and depth of explorations. To be considered, the historical explorations had to be located in an approximately 9-mile-wide (east-west) by 7-mile-tall (north-south) grid centered on CCF; have complete soil property descriptions (that is, fines content, blow counts, detailed descriptions); and have a depth of at least 10 feet below ground surface (bgs). Historical explorations that met these criteria were assigned grades according to the following descriptions:

- Grade A – The data are of high quality and legibility, and may be considered in developing lithological sections for analysis. The Grade A explorations included borings and CPTs located around the CCF, the Italian Slough, and locations up to about 2 miles north/northwest of CCF.
- Grade B – The data are of marginal quality, and may be useful in consideration of material properties, but are questionable for use in lithological section development.
- Grade C – The exploration data are of poor quality, and not considered for profile development or material properties.

A total of 481 borings and 71 CPTs was considered, resulting in 87 Grade A, 236 Grade B, and 158 Grade C borings, and 43 Grade A, 23 Grade B, and 5 Grade C CPTs. Grades A and B data were as deep as 320 feet and 200 feet for the borings and CPTs, respectively. The locations of historical explorations (Grades A and B only) relative to the SF are presented in Attachment 1 (Plate A1-1 and Figures A1-1 through A1-4).

2.4.1.2 Develop Lithological Categories

Once ranked, the individual Grades A and B explorations were reviewed, and the subsurface materials encountered were grouped into broad lithological categories to assist in developing representative soil profiles to model the SF foundation. The subsurface materials were first characterized as coarse-grained (sand-like) soils, fine-grained (clay-like) soils, or highly organic soils (peat). Where borings data were available, sand-like and clay-like soils were differentiated based on descriptions on the soil logs. Silts and clays were categorized as fine-grained (clay-like) and sands and gravels were classified as coarse-grained (sand-like). Where CPT data were available, a Soil Behavior Type Index (I_c) cutoff value of 2.6 was used to delineate sand-like soils ($I_c < 2.6$) and clay-like soils ($Ic \geq 2.6$) soils. Contacts between these material types were then drawn to establish the layering/thickness of these material types in each exploration.

The lithological categories and relative density consistency were assigned based on a visual and qualitative review of boring and CPT log data, in an effort to understand the overall general subsurface conditions near the SF. Section 2.4.3 discusses strength parameters developed for the representative site profiles. In developing the lithological categories, the relative density (loose, medium dense, or dense) of sand-soils and consistency (soft, medium stiff, stiff) of clay-like soils, respectively, were qualitatively assessed and assigned to each layer. Sand-like soils were first classified as loose or dense. Loose sand-like soils had very

FINAL DRAFT

low blow counts or tip resistances, which would make them susceptible to liquefaction. Dense sand-like soils had blow counts/tip resistances high enough that the potential for liquefaction could be considered negligible. A medium dense category was added to include sand-like soils that did not obviously fall into either the loose or dense category. Clay-like soils were first classified as soft or stiff. Soft clay-like soils had very low blow counts, tip resistances, or reported strengths, and were judged to be compressible. Stiff clay-like soils had blow counts/tip resistances high enough that the compressibility of the deposits could be considered negligible. A medium stiff category was added to include clay-like soils that did not obviously falling into either the soft or stiff category. The historical observations were grouped into these categories and used to develop lithological profiles (refer to Section 2.4.1.3).

2.4.1.3 Lithological Profiles

Lithological profiles were developed to evaluate the lateral and vertical spatial distribution of the lithological units, to assist in developing a representative soil profile(s) for use in the analyses. The lithologic distribution was evaluated along two lithologic profiles: (1) Lithologic Profile A-A,' located along the eastern SF boundary and (2) Lithologic Profile B-B,' located along the western/northwestern SF boundary.

Color codes were assigned to the lithological categories and color-coded stick logs were then generated for each exploration. The stick logs were projected and plotted along the two lithological profile lines to allow for a visual evaluation of the lithological distribution. Explorations presented in the lithological profiles were generally limited to explorations located within about 2,000 feet of each lithological profile. The locations of the lithological profiles are presented on Plate A1-1, with inset views provided on Figures A1-1 through A1-4. Lithological Profiles A-A' and B-B' are presented on Figures A1-5 through A1-9 and A1-10 through A1-13, respectively.

2.4.1.4 Representative Soil Profiles for Analysis

- Representative soil profiles (lithological cross sections) were developed for analysis based on a visual evaluation of the distribution of the various lithological units along the lithologic profile lines. Soil stratigraphy was visually assessed, and the contacts between interpreted soil deposits were drawn as horizontal lines. The contacts were drawn so they reasonably captured the distribution of the units across the lithological profiles as shown on Figures A1-5 through A1-13.
- Most of the SF near-site data included explorations along the eastern lithological profile (A-A'), near or along the Italian Slough. Near-site subsurface data included deposits of organic (peat) material ranging in thickness from about 5 to 20 feet, underlain by soft, compressible, fine-grained soil and liquefiable sands to total depths of about 30 feet along the eastern profile line. For analysis, a thickness of 15 feet was selected for the surficial upper organic (peat) layer and a thickness of 15 feet was selected for the soft, compressible, fine-grained soil or liquefiable sands below the upper peat layer, resulting in soft/loose material comprising the upper 30 feet of the soil profile. Two representative profiles (lithological cross sections) were developed based on this interpretation: (1) Soil Profile 1 – soft, fine-grained soil underlying the upper peat layer and (2) Soil Profile 2 – loose, coarse-grained (sand-like) soils underlying the upper peat layer. Below 30 feet, no differentiation was made between Soil Profiles 1 and 2. These underlying layers included: a medium stiff to stiff fine-grained layer from 30 to 100 feet bgs, underlain by a 50-foot-thick, dense, coarse-grained layer from 100 to 150 feet bgs, underlain by a 50-foot-thick, stiff, fine-grained layer from 150 to 195 feet bgs. These profiles are summarized in Table 2-3.

FINAL DRAFT

- Relatively limited exploration data were located along the western lithological profile line (B-B'). The dataset is composed mostly of CPTs performed along the crest of the Byron Tract levees, about a half-mile to 1 mile west/northwest of the SF. Explorations along the levee generally encountered medium stiff to stiff levee fill over medium stiff, fine-grained soils with intermittent near-surface organic soil deposits on the order of 3 to 5 feet thick. Loose sands were generally not observed in these explorations.
- In absence of site-specific data necessary to assess the differences and transition between the eastern and western lithologic profiles, only Soil Profiles 1 and 2 (Table 2-3), which were developed based on the eastern lithological profile, were considered for the analyses performed for this study. Additional analyses should be considered in future design phases to better capture the subsurface conditions along the western side of the SF.

Table 2-3. Representative Soil Profiles for Analysis

Typical Stratigraphy Layering Based on Near-Site Data

Layer	Layer Name	Applies to Soil Profile[a]	Saturated Unit Weight (pcf)	Layer Thickness (ft)	Elevation (ft, NAVD88)	
					Top	Bottom
1	Embankment	1, 2	120	33	28	-5
2	Organics	1, 2	90	15	-5	-20
3a	Soft to Medium Stiff Clay	1	110	15	-20	-35
3b	Loose Sand	2	110			
4	Medium Stiff Clay	1, 2	120	20	-35	-55
5	Stiff Clay	1, 2	125	50	-55	-105
6	Dense Sand	1, 2	125	50	-105	-155
7	Stiff Clay	1, 2	125	45	-155	-200

[a] Soil Profile 1 and Soil Profile 2 are determined by assigning Sublayer 3a/b. Soil Profile 1 is referred to as upper fine-grained while Soil Profile 2 is referred to as upper coarse-grained in reference to Layer 3

Notes:

ft = foot

pcf = pound(s) per cubic foot

2.4.2 Step 2: Develop Geometry for Embankment and Foundation Improvements

This section presents the embankment geometry and foundation improvement scenarios considered in the analyses.

2.4.2.1 Embankment Geometry

Three symmetric embankment geometries were considered in this evaluation, including embankments with side slopes of 3H:1V, 4H:1V, and 6H:1V. The embankment dimensions included a crest at El. 28 feet (NAVD88) and a crest width of 32 feet. The embankment height was assumed to be a uniform height of 33 feet (toe El. -5 feet) to capture the worst-case stability conditions and demonstrate that the

FINAL DRAFT

remediation alternatives are viable across the SF. Embankment heights will likely be less on the western/northern sides of the SF where existing grades are higher. The design water surface was set by operational requirements to be El. 17.5 feet. As Section 2.3.3 discussed, a conservative phreatic surface was assumed for the analysis and extends from the design water surface elevation through the interior portion of the embankment (that is, limited head loss) and then drops to the ground surface at the exterior toe of the embankment.

2.4.2.2 Initial Foundation Excavation Depth

A generic 6-foot foundation excavation depth was applied to both soil profiles used in the analyses to represent the minimum foundation subgrade preparation required for embankment construction.

2.4.2.3 Conceptual Foundation Improvements

2.4.2.3.1 Seepage Cutoff Wall

Cutoff walls are vertical low-permeability barriers that reduce seepage through pervious layers in the levee, blanket, and aquifer. Slurry trench cutoff walls are commonly installed by excavating a 3-foot-wide trench along the length of the embankment near the centerline and backfilling it with a fluid mixture of excavated soil and bentonite to create a soil-bentonite (SB) wall. Excavation is performed with a long-reach excavator, and the backfill materials are mixed near the trench. The trench is stabilized with bentonite slurry between excavation and backfill. The practical reach of long-reach excavators is about 70 to 80 feet below the operating platform. The anticipated depth of improvement for the seepage cutoff wall is 50 feet, but this depth will need to be confirmed with site-specific subsurface data and analysis.

2.4.2.3.2 Remove and Replace

The removal and replacement of undesirable foundation soils is the most direct method of improving foundation conditions. This method includes excavating and removing the undesirable soil and replacing it with compacted engineered fill. This method provides a high degree of confidence in the final product and requires limited specialty construction equipment, except when encountering high groundwater as anticipated, particularly along the eastern portion of the SF. If dewatering is not required, the method is typically the most economical where poor and/or liquefiable soils are shallow. The anticipated depths of improvement for the remove and replace option are 15 feet and 30 feet to remove the upper one to two subsurface layers, respectively, which will likely be significantly below existing groundwater.

2.4.2.3.3 Cement Deep Soil Mixing

For the SF, a cement deep soil mixing (CDSM) approach was considered to improve the liquefiable soil and the post-seismic factor of safety for scenarios with liquefaction-induced residual strengths (that is, strength loss). This was accomplished by using either CDSM shear walls or grids. The method results in a structural transfer of loads from the poor foundation soils to the shear walls, resulting in improved factors of safety. CDSM walls are constructed by mixing soil in-place with a cement slurry using mixing augers. For the CDSM method, the wall is constructed in panels, with no open excavations. CDSM walls can generally be constructed deeper than most conventional trench slurry walls with depths of 150 feet being attainable. CDSM is advantageous for use in in-ground shear walls as CDSM walls or grids can generally be constructed in a wide range of soil types, including soils with high fines contents.

FINAL DRAFT

CDSM is the most feasible technique to improve the engineering properties of the range of soils anticipated at the SF. An example CDSM configuration is provided on Figure 2-1. The assumed CDSM costs can be reduced by site-specific explorations and optimizing the treatment patterns and ARR below the embankment depending on the subsurface conditions (such as the presence and thickness of liquefiable sand or soft compressible materials). This optimized CDSM treatment pattern may include shear walls below the embankment slopes and isolated columns below the embankment crest (Figure 2-1) (FHWA, 2013). The ARR typically ranges between 20 percent and 40 percent for embankments (FHWA, 2013).

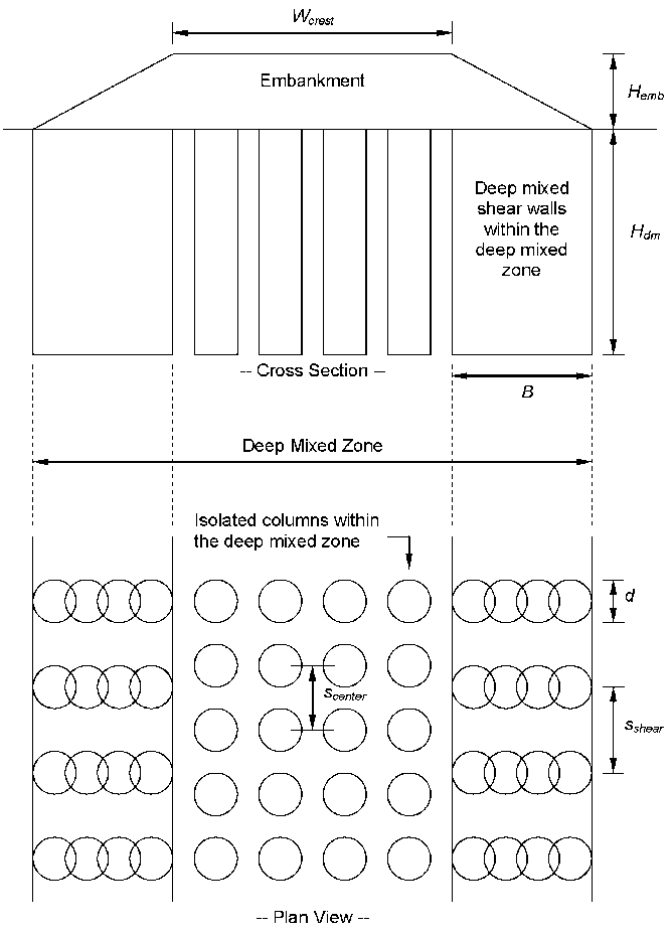

Figure 2-1. Common configuration for CDSM improvement below an embankment (FHWA, 2013)

2.4.3 Step 3: Develop Representative Material Properties

Representative material properties were developed from interpretation of near-site CPT data, as discussed here.

The DCBF, DCC, and DCE CPT data (Table 2-1) were used to develop material properties for nonorganic soils. CPT correlations were used to develop profiles of undrained shear strength (s_u, assuming cone factor N_{kt}=15; Lunne et al. 1997), stress-normalized and energy-corrected blow counts $(N_1)_{60}$ for estimating liquefied residual strength ratios, and effective friction angles (ϕ') with depth (Mayne, 2006). Undrained shear strengths were correlated for clay-like soils only (i.e., soils with $I_c \geq 2.6$). Stress-normalized and energy corrected blow count and drained friction angle were correlated for sand-like soils only (i.e., $I_c < 2.6$).

CPT-derived strengths were compiled for both fine-grained and coarse-grained deposits and used to develop depth-dependent statistical strengths. The CPT correlated strength data were combined into 5-foot-bin increments and statistically analyzed to calculate the geometric mean and standard deviation (σ) with depth for each parameter of interest. The geometric mean and 16th percentile (-1σ) strength estimates were plotted versus depth and linear relationships were visually fit to the profiles to define the representative mean and 16th percentile strength profiles.

Based on the design of the CCF, a range of undrained strength was presented for organic (peaty) soils from 200 to 900 pounds per square foot (psf) with a recommended average strength of 450 psf used for the CCF analyses (Leps, 1967a). This average value was thought to be conservative as consolidation strength gain was ignored below the embankment. These strength parameters were adopted for use in the current SF analyses.

Embankment shear strength parameters used in the SF analyses were selected to match presumptive properties for Clay Fill (effective friction angle, ϕ'- of 31 degrees & apparent cohesion, c' of 100 psf) recommended in the *Guidance Document for Geotechnical Analyses* prepared by DWR for the Urban and Non-Urban Levee Evaluations Program (DWR, 2015a). The presumptive values are reasonably consistent with drained strength parameters suggested for reusable tunnel material (RTM) (DWR, 2014), which is a potential material source for constructing the SF embankments. Suggested RTM strength parameters (DWR, 2014) varied slightly based on the foam surfactant (tunnel drilling additive) applied to the remolded soil samples but included c' values ranging from 30 to 90 psf and ϕ' values ranging from 29 to 32 degrees.

Shear strength parameters used for the conceptual ground improvement concepts described in Section 2.4.2.3 were selected based on values used in published literature (Khosravi et al., 2016; Boulanger et al., 2018) and engineering judgement. For the CDSM shear panels, a composite strength was derived using an unconfined compressive strength of 40 kilopound per square foot (ksf), peak shear strength reduction of 0.8, and a wall thickness of 2.5 feet. This results in a cohesion of 2,400 psf and 4,000 psf for the 15 percent area replacement ratio (AR) and 25 percent AR, respectively. To account for the potential limited effectiveness of CDSM techniques in organic soils, a further reduction factor of about 0.6 was applied to the above values where CDSM encountered organic soils. In addition, for the purposes of developing a composite shear strength, the shear strength of the soil between the CDSM panels was ignored. A shear strength of 300 psf was selected for the soil-bentonite wall based on past project experience.

The representative best estimate (mean) and 16th percentile (-1σ) strength parameters used in the stability analyses are provided in Tables 2-4 and 2-5, respectively.

Table 2-4. Representative Best Estimate (Mean) Strength Parameters for Stability Analyses

Details of the Assigned Analysis Strengths

Layer	Layer Name	Applies to Soil Profile[a]	Static & Pseudo-Static[b]			Post-Seismic[c]			
			ϕ'	su[d]	⍰su[d]	ϕ'	Sr/⍰'vc[e]	su[d]	⍰su[d]
			(degrees)	(psf)	(psf/ft)	(degrees)	(-)	(psf)	(psf/ft)
1	Embankment	1, 2	31	100[f]	--	31	--	100[f]	--
2	Organics	1, 2	--	450	--	--	--	360	--

FINAL DRAFT

Table 2-4. Representative Best Estimate (Mean) Strength Parameters for Stability Analyses

Details of the Assigned Analysis Strengths

Layer	Layer Name	Applies to Soil Profile[a]	Static & Pseudo-Static[b]			Post-Seismic[c]			
			ϕ′	su[d]	⍰su[d]	ϕ′	Sr/⍰'vc[e]	su[d]	⍰su[d]
			(degrees)	(psf)	(psf/ft)	(degrees)	(-)	(psf)	(psf/ft)
3a	Soft to Medium Stiff Clay	1	--	1,525	35	--	--	1,220	28
3b	Loose Sand	2	37	--	--	--	0.10	--	--
4	Medium Stiff Clay	1, 2	--	2,050	35	--	--	1,640	28
5	Stiff Clay	1, 2	--	2,750	35	--	--	2,750	35
6	Dense Sand	1, 2	39	--	--	39	--	--	--
7	Stiff Clay	1, 2	--	6,000	--	--	--	6,000	--
AR15	CDSM Area Replacement Ratio = 15% [g]	1,2	--	2,400	--	--	--	2,400	--
AR25	CDSM Area Replacement Ratio = 25% [g]	1,2	--	4,000	--	--	--	4,000	--
SB	Soil Bentonite Wall	1,2	--	300	--	--	--	300	--

[a] Soil Profile 1 and Soil Profile 2 are determined by assigning Sublayer 3a/b. Soil Profile 1 is referred to as upper fine-grained while Soil Profile 2 is referred to as upper coarse-grained in reference to Layer 3.

[b] Undrained strengths were assigned to fine-grained soil layers and drained strength parameters were assigned to coarse-grained soil layers. Strength loss due to earthquake loading was assumed to occur at completion of shaking and was not considered in pseudo-static analyses.

[c] Post-seismic undrained shear strengths for soft to medium stiff fine-grained soil layers were assigned a 20% shear strength reduction due to cyclic softening.

[d] Undrained strengths (s_u) are reported as linear parameters where s_u is strength at the top of layer and Δs_u is the incremental strength increase with depth within that layer.

[e] The undrained residual shear strength ratio was assigned following the guidance of Idriss and Boulanger (2008), assuming void redistribution effects could be significant and $(N_1)_{60cs\text{-}Sr}$=11.

[f] Equivalent to the drained cohesion based on assumed Mohr-Coulomb failure envelope for embankment fill.

[g] A reduction factor of about 0.6 is applied to CDSM composite shear panels in organic soil

FINAL DRAFT

Table 2-5. Representative 16th Percentile (-1σ) Strength Parameters for Stability Analyses

Detail of the Assigned Analysis Strengths

Layer	Layer Name	Applies to Soil Profile[a]	Static & Pseudo-Static[b]			Post-Seismic[c]			
			ϕ'	s_u[d]	Δs_u[d]	ϕ'	S_r/σ'_{vc}[e]	s_u[d]	Δs_u[d]
			(degrees)	(psf)	(psf/ft)	(degrees)	(-)	(psf)	(psf/ft)
1	Embankment	1, 2	31	100[f]	--	31	--	100[f]	--
2	Organics	1, 2	--	300	--	--	--	240	--
3a	Soft to Medium Stiff Clay	1	--	805	27	--	--	644	21.6
3b	Loose Sand	2	34	--	--	--	0.08	--	--
4	Medium Stiff Clay	1, 2	--	1210	27	--	--	968	21.6
5	Stiff Clay	1, 2	--	1750	27	--	--	1750	27
6	Dense Sand	1, 2	36	--	--	36	--	--	--
7	Stiff Clay	1, 2	--	4500	--	--	--	4500	--
AR15	CDSM Area Replacement Ratio = 15% [g]	1,2	--	2,400	--	--	--	2,400	--
AR25	CDSM Area Replacement Ratio = 25% [g]	1,2	--	4,000	--	--	--	4,000	--
SB	Soil Bentonite Wall	1,2	--	300	--	--	--	300	--

[a] Soil Profile 1 and Soil Profile 2 are determined by assigning Sublayer 3a/b. Soil Profile 1 is referred to as upper fine-grained while Soil Profile 2 is referred to as upper coarse-grained in reference to Layer 3.

[b] Undrained strengths were assigned to fine-grained soil layers and drained strength parameters were assigned to coarse-grained soil layers. Strength loss due to earthquake loading is assumed to occur at completion of shaking and is not considered in pseudo-static analyses.

[c] Post-seismic undrained shear strengths for soft to medium stiff fine-grained soil layers were assigned a 20% shear strength reduction due to cyclic softening.

[d] Undrained strengths (s_u) are reported as linear parameters where s_u is strength at the top of layer and Δs_u is the incremental strength increase with depth within that layer.

[e] The undrained residual shear strength ratio was assigned following the guidance of Idriss and Boulanger (2008), assuming void redistribution effects could be significant and $(N_1)_{60cs\text{-}Sr}$=8.

[f] Equivalent to the drained cohesion based on assumed Mohr-Coulomb failure envelope for embankment fill.

[g] A reduction factor of about 0.6 is applied to CDSM composite shear panels in organic soil

FINAL DRAFT

2.4.3.1 Liquefaction Potential

The liquefaction of loose sands and low plasticity silts is anticipated to occur at the SF site where these materials are present. The evaluation of the near-site data indicate much of the shallow sandy deposits are saturated, have low penetration resistance with interpreted $(N_1)_{60}$<15, and have factors of safety against liquefaction less than 1 under the assumed seismic loading at the ground surface of 0.50 g (that is, half of 1.0 g; Section 2.3.2). Note, prior evaluations of the Italian Slough and Intake Structure indicate significant thicknesses of sands and low plasticity silts that may extend as deep as El. 80 feet.

Due to the potential for liquefaction of these loose coarse-grained deposits, a residual strength ratio was assigned in the post-seismic analyses of Sublayer 3b. The residual strength ratio was assigned using $(N_1)_{60cs\text{-}Sr}$ according to Idriss and Boulanger (2008; that is, those with $(N_1)_{60cs\text{-}sr}$<15) and is provided in Tables 2-4 and 2-5.

2.4.4 Step 4: Perform Slope Stability Analyses

Stability analyses were performed using SLOPE/W (Geostudio, 2019R2) developed by GEO-SLOPE International, Ltd. Stability analyses were performed using the Spencer analysis method, which satisfies both moment and force equilibrium. Slip surfaces were defined using the entry-and-exit method with circular slip surfaces being used for long-term stability and pseudo-static analyses and noncircular slip surfaces for post-seismic stability where continuous weak layers (such as liquefied sand) result in critical slip surfaces that differ from traditional circular slip surfaces. Stability analyses were performed for three loading conditions: (1) long-term steady-state (static analyses), (2) post-seismic, and (3) pseudo-static stability. Each analysis case was performed assuming a long-term seepage condition at the design reservoir elevation exists. No seepage analyses were performed. These conditions will be re-evaluated along with a steady-state seepage analysis, short-term high-water stability, and rapid drawdown stability analyses, during the preliminary design stage. Section 2.3.3 provides stability analysis assumptions.

For the long-term steady-state stability case, the SF was filled to the normal high operating level (El. 17.5 feet) and the water surface elevation was assumed to remain constant long enough to establish steady-state seepage conditions through the embankment in accordance with U.S. Army Corps of Engineers (USACE) guidelines (EM 1110-2-1902). For simplicity, drained strengths were assigned to coarse-grained (sand-like) soil layers while undrained strengths were assigned to fine-grained (clay-like) soil layers.

Post-seismic stability was performed with reduced undrained strengths for clay-like soils to account for potential strength loss due to cyclic softening (Section 2.3.3). Where applicable, residual undrained strengths were applied to sand-like soils where liquefaction-induced strength loss was expected (Section 2.4.3.1).

For the pseudo-static stability analysis, the yield accelerations (k_y) were estimated for the various configurations. For these analyses, only static strengths were used with the assumption that strength loss does not occur until the end of shaking.

2.4.4.1 Analysis Cases Considered and Naming Convention

Analyses were performed considering variations in embankment geometry, soil profile considering best and 16th percentile strengths, foundation condition, and stability analyses. The analyses consisted of

FINAL DRAFT

3 types of geometries, 4 types of soil profiles, 5 types of foundation conditions, and 3 types of stability analyses, resulting in 180 slope stability scenarios.

The following naming convention was used for the analyses:

Embankment Geometry → Soil Profile → Foundation condition → Analysis.

Where embankment geometry varies from 3H:1V, 4H:1V, to 6H:1V; soil profiles vary from Soil Profile P1 to P2; soil strengths vary from best estimate (BE) to 16th percentile (e.g., P1-BE, P2-BE, P1-16th, P2-16th where P1 = Soil Profile 1, P2 = Soil Profile 2, BE = best-estimate strength and 16th = -1σ strengths); foundation conditions vary and include existing (E) conditions, Remove and Replace 15 feet (G1-RR15), Remove and Replace 30 feet (G1-RR30), 40-foot deep CDSM AR=25% (G2-AR25), 40-foot deep CDSM Mix AR=15% (G2-AR15); and analysis type includes static (S), post-seismic (PS), and pseudo-static (PSS). Note, AR is used to determine composite strengths and G1 and G2 are ground improvement schemes for "remove and replace" and "CDSM," respectively.

An example of an analysis case naming is:

- 4H1V_P1-BE_E_S = 4H:1V embankment geometry, Soil Profile 1, best estimate strengths, existing conditions, static steady-state stability.

2.4.5 Step 5: Perform Settlement Analyses

Settlement analyses were performed considering the effects of primary consolidation only. Immediate elastic settlement and secondary compression were not evaluated. Primary settlement was calculated using the approach presented in USACE EM 1110-1-1904 (USACE, 1990) for fine-grained soils:

$$S_{c,1D} = \sum_{j=1}^{\#\,Layers} \left(C_{r\varepsilon} \log\left(\frac{\sigma_{vp,j}}{\sigma'_{v0,j}}\right) + C_{c\varepsilon} \log\left(\frac{\sigma'_{vf,j}}{\sigma_{vp,j}}\right)\right) H_j$$

where $C_{r\varepsilon}$ is the modified recompression index, $C_{c\varepsilon}$ is the modified compression index, $\sigma'_{v0,j}$ is the initial vertical effective stress for sublayer j, $\sigma_{vp,j}$ is the preconsolidation stress for sublayer j, $\sigma'_{vf,j}$ is the final vertical effective stress of sublayer j considering surcharge from the embankment and H_j is the sublayer thickness.

Settlement calculations were performed considering the scenarios presented in Sections 2.4.2 and 2.4.4 for each combination of embankment geometry, soil profile, and foundation improvement configuration. The increase in stress in the foundation soils used in the analyses is discussed in Section 2.4.5.2. Due to lack of site-specific subsurface data, settlement parameters were selected through back-analysis of available data from and performance to date at the CCF.

2.4.5.1 Back-Calculated CCF Settlements

Settlement analyses require an understanding of subsurface stress history, modified compression index, and modified recompression index, none of which were documented in settlement estimates at the CCF. However, a soil profile and predicted total settlement analyzed via discreet layers with a uniform-applied stress was provided in Leps (1967b). Based on this information, coupled with an assumption of normally consolidated soils, a modified compression index was back-calculated for each material to match the predicted settlement for each layer presented in Leps (1967b). Supporting rationale for this approach

FINAL DRAFT

includes: (1) the soil profile assumed for the SF is largely based on subsurface conditions observed in exploration data from CCF resulting in very similar soil profiles, (2) the stress history at the SF and the preconstruction condition at CCF are similar, (3) using a normally consolidated assumption in back-analyses and forward analyses will inherently capture some of the stress history of the site, and (4) the predicted settlements presented in Leps (1967b) matched well with observed settlements at CCF as summarized in DWR (2015b). Additionally, the back-analyzed modified compression indices appear reasonable based on comparisons with typical consolidation parameters of soils in the Delta.

2.4.5.2 Southern Forebay Settlements

Forward predictions of settlement were performed for the scenarios considered in Sections 2.4.2 and 2.4.4. Estimated total settlements assume one-dimensional vertical consolidation occurs in the foundation only; settlement of compacted fill was considered negligible and was ignored. Settlement calculations were performed at the centerline of the proposed embankment where stress changes and potential settlements due to new embankment loads are greatest. The settlement estimates do not consider the time rate of consolidation and are based solely on differences between in situ effective stress and post-construction effective stress. Modeling settlements in this manner assumes foundation improvements and the embankment are installed instantaneously. Specific considerations and modeling approaches to estimate future settlement for each considered foundation condition are presented here.

The preconstruction subsurface profile is modeled as normally consolidated with groundwater at the ground surface. The change in subsurface stress ($\Delta\sigma$) used to analyze layer compression and surface settlement includes placement of the embankment itself, removing and replacing weaker/lighter foundation soils with heavier compacted fill, and variations in stress change with depth due to installation and interaction with CDSM shear walls.

The increase in foundation stress due to placement of the embankment was estimated using a two-dimensional trapezoidal loading configuration as presented in Das (2011). This approximation was used for foundation conditions that include the 6-foot initial excavation depth and the remove and replace foundation configurations. A separate approach for estimating stress distribution with depth was used for settlement analyses involving CDSM ground improvement as discussed further below.

Removal and replacement of foundation soils results in a net stress increase below the excavated soils due to the placement of the higher unit weight compacted fill. This change in stress is equal to the net stress difference between the two materials and dissipates with depth along lines with a slope of 0.5H:1V as presented in Das (2011).

Foundation improvement through installation of shear panels (such as CDSM panels) results in a series of parallel, relatively incompressible soil-cement panels with moderately to highly compressible soils between the panels. This improvement alternative results in dual stress transfer and settlement mechanisms, the first being transfer of overall embankment loads through the soil-cement panels to a deeper and less compressible soil stratum and the second being the bearing of local embankment loads directly on soft soils between the shear panels.

The stress transfer of the first mechanism was modeled with the CDSM panels acting as a pile group that transfers embankment stresses to a uniform stress located at a depth of two-thirds of the shear wall depth. From this depth the transferred stresses are then dissipated assuming the stress spreads out along lines with a slope of 0.5H:1V.

FINAL DRAFT

The stress transfer of the second mechanism was modeled as a reduced embankment load applied to the foundation soils between shear panels accounting for the effects of soil arching. Soil arching was modeled using a linear projection slope of 2H:1V, beginning at top of shear keys and extending into the embankment until the line intersects the projection from the adjacent shear key. Embankment soil located below this triangular projection of soil arching is assumed to act on the soft foundation soils. The change in stress was modeled using the triangular load distribution. Because the stress transfer occurs between stiff soil-cement panels, the applied stress acting between the shear panels is confined and cannot dissipate laterally. This was modeled by capping the stress reduction with depth at a depth equal to half of the in-between panel spacing. This stress was applied down to the effective transfer depth equal to two-thirds of the shear panel depth.

Consolidation settlement above the soil-cement panels is estimated using the transfer of loads mechanism only while the consolidation settlement at the midpoint between panels is estimated using both stress transfer mechanisms. The anticipated differential settlement is equal to the difference between these estimates.

3. Analysis

The analyses were performed using the methodology, assumptions and approaches presented in Section 2 for slope stability and settlement. A compilation of results from these analyses are presented in the subsections below. The detailed results are provided in Attachment 2, which includes plots showing analysis stratigraphy, embankment and foundation configurations, analysis strengths profiles, slope stability trial slip surfaces, and settlement calculations.

3.1 Slope Stability

In total, 180 analyses were performed considering variations in embankment geometry (3x), soil profile (4x), foundation condition (5x), and stability analysis (3x). An example analysis result is provided in Figure 3-1 and the results of the analyses are summarized in Tables 3-1, 3-2, and 3-3. Plots of the results are provided in Attachment 2.

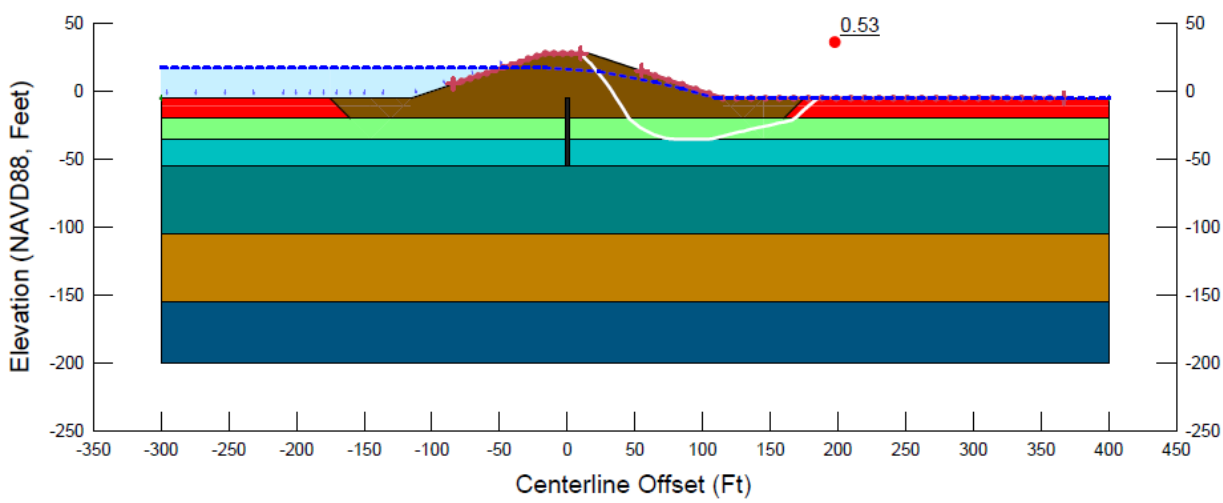

Figure 3-1. Example Slope Stability Output for a 4H:1V Embankment Overlying Liquefied Sand (post-seismic strengths)

In this example, the result of the slope stability analysis indicates a Factor of Safety of 0.53.

Table 3-1. Static Stability Analysis Results

Factor of Safety (FOS) results from Slope Stability Analyses of Existing and Improved Ground Conditions Under Static Conditions

Analysis ID[a]	FOS Using Best Estimate (Mean) Strengths[b]			FOS Using 16th Percentile (-1σ) Strengths[c]		
	3H:1V[d]	4H:1V[d]	6H:1V[d]	3H:1V[d]	4H:1V[d]	6H:1V[d]
P1_E_S	0.98	1.12	1.41	0.76	0.92	1.18
P1_G1-RR15_ S	1.68	2.05	2.91	1.47	1.71	2.13
P1_G1-RR30_ S	1.68	2.05	2.86	1.68	2.05	2.46
P1_G2-AR15_ S	1.85	2.25	3.33	1.73	2.07	2.43
P1_G2-AR25_ S	1.78	2.26	3.36	1.78	2.26	2.82
P2_E_ S	0.97	1.12	1.41	0.76	0.92	1.17
P2_G1-RR15_ S	1.68	2.05	2.91	1.68	1.94	2.37
P2_G1-RR30_ S	1.68	2.05	2.86	1.68	2.05	2.46
P2_G2-AR15_ S	1.85	2.24	3.17	1.73	2.08	2.41
P2_G2-AR25_ S	1.78	2.26	3.36	1.78	2.26	2.80

[a] Analysis identifier in the format of *SoilProfile_FoundationCondition_AnalysisType*; refer to Section 2.4.4.1 for further detail regarding the naming convention and Section 2.4.2.3 for further detail regarding the conceptual foundation improvements.

[b] Selection of best estimate (mean) strengths are described in Section 2.4.3 and Table 2-4.

[c] Selection of 16th percentile (-1σ) strengths are described in Section 2.4.3 and Table 2-5.

[d] Describes the symmetric embankment slopes; refer to Section 2.4.2 for further detail regarding embankment geometry.

FINAL DRAFT

Table 3-2. Post Seismic Stability Analysis Results

Minimum Factor of Safety (FOS) results from Slope Stability Analyses of Existing and Improved Ground Conditions Under Post Seismic Conditions

Analysis ID[a]	FOS Using Best Estimate (Mean) Strengths[b]			FOS Using 16th Percentile (-1σ) Strengths[c]		
	3H:1V[d]	4H:1V[d]	6H:1V[d]	3H:1V[d]	4H:1V[d]	6H:1V[d]
P1_E_ PS	0.85	0.97	1.30	0.62	0.79	1.06
P1_G1-RR15_ PS	1.68	2.05	2.70	1.23	1.44	1.80
P1_G1-RR30_ PS	1.68	2.05	2.86	1.58	1.77	2.14
P1_G2-AR15_ PS	1.78	2.21	2.92	1.71	1.84	2.18
P1_G2-AR25_ PS	1.78	2.26	3.36	1.78	2.26	2.67
P2_E_ PS	0.46	0.51	0.64	0.35	0.40	0.50
P2_G1-RR15_ PS	0.62	0.63	0.85	0.53	0.52	0.73
P2_G1-RR30_ PS	1.68	2.05	2.86	1.39	1.59	1.96
P2_G2-AR15_ PS	1.57	2.01	2.65	1.51	1.71	2.06
P2_G2-AR25_ PS	1.78	2.26	3.26	1.78	2.16	2.44

[a] Analysis identifier in the format of *SoilProfile_FoundationCondition_AnalysisType*; refer to Section 2.4.4.1 for further detail regarding the naming convention and Section 2.4.2.3 for further detail regarding the conceptual foundation improvements.

[b] Selection of best estimate (mean) strengths are described in Section 2.4.3 and Table 2-4.

[c] Selection of 16th percentile (-1σ) strengths are described in Section 2.4.3 and Table 2-5.

[d] Describes the symmetric embankment slopes; refer to Section 2.4.2 for further detail regarding embankment geometry.

FINAL DRAFT

Table 3-3. Pseudo-Static Stability Yield Coefficients

Yield Coefficient (k_y) results from Pseudo-Static Slope Stability Analyses of Existing and Improved Ground Conditions Under Pseudo-Static Conditions

Analysis ID[a]	k_y Using Best Estimate (Mean) Strengths[b]			k_y Using 16th Percentile (-1σ) Strengths[c]		
	3H:1V[d]	4H:1V[d]	6H:1V[d]	3H:1V[d]	4H:1V[d]	6H:1V[d]
P1_E_-PSS	Static<1	0.03	0.07	Static<1	Static<1	0.03
P1_G1-RR15_ PSS	0.18	0.23	0.28	0.10	0.12	0.15
P1_G1-RR30_ PSS	0.20	0.23	0.27	0.15	0.16	0.17
P1_G2-AR15_ PSS	0.20	0.23	0.29	0.19	0.21	0.20
P1_G2-AR25_ PSS	0.22	0.27	0.35	0.22	0.27	0.25
P2_E_ PSS	Static<1	0.03	0.07	Static<1	Static<1	0.03
P2_G1-RR15_ PSS	0.20	0.23	0.27	0.17	0.16	0.17
P2_G1-RR30_ PSS	0.20	0.23	0.26	0.16	0.17	0.18
P2_G2-AR15_ PSS	0.21	0.23	0.28	0.19	0.21	0.20
P2_G2-AR25_ PSS	0.22	0.27	0.35	0.22	0.27	0.25

[a] Analysis identifier in the format of *SoilProfile_FoundationCondition_AnalysisType*; refer to Section 2.4.4.1 for further detail regarding the naming convention and Section 2.4.2.3 for further detail regarding the conceptual foundation improvements.

[b] Selection of best estimate (mean) strengths are described in Section 2.4.3 and Table 2-4.

[c] Selection of 16th percentile (-1σ) strengths are described in Section 2.4.3 and Table 2-5.

[d] Describes the symmetric embankment slopes; refer to Section 2.4.2 for further detail regarding embankment geometry.

The yield coefficient (k_y) is the horizontal seismic coefficient required for factor of safety equal to 1.0. Yield coefficients are only calculated for static factors of safety greater than 1.0. For cases where slope stability results in FOS < 1.0, "Static<1" is shown.

3.2 Settlement

Settlement analyses were conducted for the 30 different embankment and foundation configurations described in Section 2.4.2 assuming static conditions (that is, no liquefaction). Settlement analyses were performed for each case and independently of the slope stability evaluation following the approach presented in Section 2.4.5. Results are summarized in Table 3-4 in terms of crest settlement and differential crest settlement. Differential crest settlement was calculated for shear panel ground improvement only and is equal to the difference in settlement at a point above the shear panel and the midpoint between panels. The detailed settlement calculations are provided in Attachment 2. A series of hypothetical liquefaction settlement calculations were performed on Soil Profile 2 using both best estimate and 16th percentile strengths. The calculated liquefaction induced settlement for the 15-foot-thick liquefied layer is 0.5 foot for both strength scenarios.

FINAL DRAFT

Table 3-4. Settlement Analysis Results

Results from Settlement Analysis of Proposed Scenarios

Analysis ID[a]	3H:1V Embankment Geometry[b]		4H:1V Embankment Geometry[b]		6H:1V Embankment Geometry[b]	
	Crest Settlement (ft)	Differential Crest Settlement[c] (ft)	Crest Settlement (ft)	Differential Crest Settlement[c] (ft)	Crest Settlement (ft)	Differential Crest Settlement[c] (ft)
P1_E	4.4	--	4.5	--	4.6	--
P1_G1-RR15	2.6	--	2.6	--	2.7	--
P1_G1-RR30	1.2	--	1.2	--	1.3	--
P1_G2-AR15	2.2	0.9	2.2	0.9	2.3	0.9
P1_G2-AR25	2.0	0.7	2.0	0.7	2.1	0.7
P2_E	3.1	--	3.1	--	3.2	--
P2_G1-RR15	1.2	--	1.2	--	1.3	--
P2_G1-RR30	1.2	--	1.2	--	1.3	--
P2_G2-AR15	1.7	0.6	1.7	0.6	1.8	0.6
P2_G2-AR25	1.6	0.5	1.6	0.5	1.7	0.5

[a] Analysis identifier in the format of *SoilProfile_FoundationCondition*; refer to Section 2.4.4.1 for further detail regarding the naming convention and Section 2.4.2.3 for further detail regarding the conceptual foundation improvements.

[b] Describes the symmetric embankment slopes; refer to Section 2.4.2 for further detail regarding embankment geometry.

[c] Differential crest settlement calculated for shear panel ground improvement only and is equal to the difference in settlement at a point above the shear panel and the midpoint between panels.

4. Evaluation

The approach described in this TM was used to systematically evaluate possible embankment and foundation configurations for the SF based on near-site data. The methods, assumptions, and approach used were described in Section 2. A summary of the results was presented in Section 3 and provided in Attachment 2. This section provides an interpretation of the results and this interpretation was used to support the recommended conceptual configuration for the SF embankment geometry and foundation.

4.1 Slope Stability

Slope stability results presented in Tables 3-1 and 3-2 were compared against slope stability design criteria (Table 2-2) to evaluate the ability of the considered scenarios to meet slope stability design criteria. Table 4-1 summarizes this comparison of the static stability results and indicates that for both soil profiles analyzed, none of the embankment configurations meet static stability without foundation improvement.

FINAL DRAFT

For static stability, regardless of analysis soil profile and embankment geometry, all foundation improvement scenarios result in adequate factors of safety except for the remove and replace 15-foot option for Soil Profile 1 (upper soft fine-grained).

Table 4-2 summarizes the comparison between stability results and design criteria for post seismic stability. For post seismic stability, only 6H:1V slopes for Soil Profile 1 layering (upper soft fine-grained) satisfies design criteria without foundation remediation using best estimate strengths. For Soil Profile 1, all four of the remediation alternatives options satisfy post seismic stability criteria. For Soil Profile 2 (upper loose coarse-grained) the analyses indicate the removal or improvement of the upper 30 feet to remove the loose, liquefiable sand (located 15 to 30 feet bgs) is required to achieve adequate factors of safety. Analysis scenario P2_G1-RR15 does not meet design criteria because it does not improve the upper liquefiable sand layer, which is below a depth of 15 feet.

Table 4-1. Evaluation of Static Stability Analysis Results

Comparison of Static Slope Stability Analyses Factors of Safety with Design Criteria Factors of Safety for Existing and Improved Ground Conditions Under Static Conditions

Analysis ID[a]	Best Estimate (Mean) Strengths[b]			16th Percentile (-1σ) Strengths[c]		
	3H:1V[d]	4H:1V[d]	6H:1V[d]	3H:1V[d]	4H:1V[d]	6H:1V[d]
P1_E_A1-S	Does Not Meet	Does Not Meet	Does Not Meet	Does Not Meet	Does Not Meet	Does Not Meet
P1_G1-RR15_A1-S	Meets	Meets	Meets	Does Not Meet	Meets	Meets
P1_G1-RR30_A1-S	Meets	Meets	Meets	Meets	Meets	Meets
P1_G2-AR15_A1-S	Meets	Meets	Meets	Meets	Meets	Meets
P1_G2-AR25_A1-S	Meets	Meets	Meets	Meets	Meets	Meets
P2_E_A1-S	Does Not Meet	Does Not Meet	Does Not Meet	Does Not Meet	Does Not Meet	Does Not Meet
P2_G1-RR15_A1-S	Meets	Meets	Meets	Meets	Meets	Meets
P2_G1-RR30_A1-S	Meets	Meets	Meets	Meets	Meets	Meets
P2_G2-AR15_A1-S	Meets	Meets	Meets	Meets	Meets	Meets
P2_G2-AR25_A1-S	Meets	Meets	Meets	Meets	Meets	Meets

[a] Analysis identifier in the format of *SoilProfile_FoundationCondition_AnalysisType*; refer to Section 2.4.4.1 for further detail regarding the naming convention and Section 2.4.2.3 for further detail regarding the conceptual foundation improvements.

[b] Selection of best estimate (mean) strengths are described in Section 2.4.3 and Table 2-4.

[c] Selection of 16th percentile (-1σ) strengths are described in Section 2.4.3 and Table 2-5.

[d] Describes the symmetric embankment slopes; refer to Section 2.4.2 for further detail regarding embankment geometry.

FINAL DRAFT

Table 4-2. Evaluation of Post-seismic Stability Analysis Results

Comparison of Static Slope Stability Analyses Factors of Safety with Design Criteria Factors of Safety for Existing and Improved Ground Conditions Under Post Seismic Conditions

Analysis ID[a]	Best Estimate (Mean) Strengths[b]			16th Percentile (-1σ) Strengths[c]		
	3H:1V[d]	4H:1V[d]	6H:1V[d]	3H:1V[d]	4H:1V[d]	6H:1V[d]
P1_E_A2-PS	Does Not Meet	Does Not Meet	Meets	Does Not Meet	Does Not Meet	Does Not Meet
P1_G1-RR15_A2-PS	Meets	Meets	Meets	Meets	Meets	Meets
P1_G1-RR30_A2-PS	Meets	Meets	Meets	Meets	Meets	Meets
P1_G2-AR15_A2-PS	Meets	Meets	Meets	Meets	Meets	Meets
P1_G2-AR25_A2-PS	Meets	Meets	Meets	Meets	Meets	Meets
P2_E_A2-PS	Does Not Meet	Does Not Meet	Does Not Meet	Does Not Meet	Does Not Meet	Does Not Meet
P2_G1-RR15_A2-PS	Does Not Meet	Does Not Meet	Does Not Meet	Does Not Meet	Does Not Meet	Does Not Meet
Analysis ID[a]	Best Estimate (Mean) Strengths[b]			16th Percentile (-1σ) Strengths[c]		
	3H:1V[d]	4H:1V[d]	6H:1V[d]	3H:1V[d]	4H:1V[d]	6H:1V[d]
P2_G1-RR30_A2-PS	Meets	Meets	Meets	Meets	Meets	Meets
P2_G2-AR15_A2-PS	Meets	Meets	Meets	Meets	Meets	Meets
P2_G2-AR25_A2-PS	Meets	Meets	Meets	Meets	Meets	Meets

[a] Analysis identifier in the format of *SoiProfile_FoundationCondition_AnalysisType*; refer to Section 2.4.4.1 for further detail regarding the naming convention and Section 2.4.2.3 for further detail regarding the conceptual foundation improvements.

[b] Selection of best estimate (mean) strengths are described in Section 2.4.3 and Table 2-4.

[c] Selection of 16th percentile (-1σ) strengths are described in Section 2.4.3 and Table 2-5.

[d] Describes the symmetric embankment slopes; refer to Section 2.4.2 for further detail regarding embankment geometry.

As observed at the CCF, the remove and replace method can be challenging to implement in soft, saturated soils. Therefore, using the remove and replace method to achieve target excavation depths of 15 and 30 feet may be difficult to implement. Considering these construction challenges, particularly for the Profile 2 scenario (upper loose coarse-grained), the CDSM approach may be more viable.

4.2 Settlement

Based on the results of the settlement analyses presented in Section 3.2, the settlements estimated at the proposed SF location range from 1.2 to 4.6 feet at the crest for the existing and improved foundation conditions, with foundation improvement resulting in reduced settlement. Differential settlement, measured as the difference between crest settlement above a CDSM panel and crest settlement at the

FINAL DRAFT

midpoint between CDSM panels, ranged from 0.5 to 0.9 foot for the considered scenarios and assumptions (note that these settlements are calculated over the entire soil profile thickness of 195 feet). The selected soil profiles assumed the foundation soils were normally consolidated. These settlement estimates were intended to be conservative. The subsurface conditions below the SF may have thinner deposits of highly compressible soils, particularly along the western edge of the SF where organic deposits are anticipated to thin out. Additionally, the SF embankment heights will be lower than what was assumed for the current study on the northern/northwestern side of the SF where topography is higher, which would reduce the estimated crest and differential settlements. The estimated settlements compared reasonably well with actual post-construction settlements observed at CCF, which were on the order of 1 foot (though CCF was constructed in stages to account for soil strength gain and to limit post construction settlement). The taller SF embankment (about 65 percent taller [13 feet taller]) and the assumed normally consolidated foundation soils account for most of the observed differences. The use of ground improvement techniques reduces the estimated settlement when compared against existing conditions, with settlements down to a minimum of 1.2 feet for the remove and replace scenarios.

These settlement estimates neglect liquefaction-induced settlement. The magnitude and potential for liquefaction-induced settlement to occur will depend on the selected foundation improvement method. For example, the installation and spacing of CDSM panels will affect the liquefaction potential of the loose sand between the panels.

5. Observations and Conclusions

This TM presented the concept-level analysis of the SF. The analysis included a review of near-site data, steady-state static, post-seismic, and pseudo-static slope stability analyses, and settlement analyses. This section summarizes key observations and conclusions from the slope stability and settlement analyses presented in Section 3 and evaluated in Section 4.

- Existing near-site data are concentrated along the eastern side of the SF and indicate the upper 30 feet of the foundation material consists of organic to highly organic, soft to medium stiff, fine-grained deposits, and loose coarse-grained deposits. Understanding the presence, extent, material properties, and thicknesses of these deposits using site-specific data will be key to refining the conceptual designs presented in this TM.
- This analysis is entirely dependent on interpretation of near-site data concentrated near the eastern edge of the SF and the assumption that near-site conditions are representative of conditions at the SF. Site-specific subsurface information obtained following the distribution of this TM will likely change the results and conclusions provided herein.
- Limited site data are currently available near the western/northern extent of the SF. Available data located about a half-mile to 1 mile west/northwest of the site suggest organic deposits and liquefiable coarse-grained materials thin from east to west across the SF. Additionally, existing grades within the SF increase in elevation from east to west and from south to north, which in turn results in shorter embankment heights. Subsurface conditions along the western portion of the SF should be further evaluated and analyzed based on site-specific information to determine whether ground improvement beyond the 6-foot embankment foundation excavation and replacement is needed beneath this portion of the proposed embankment.
- Some form of foundation improvement would be required to satisfy static stability and post-seismic stability and reduce settlement to acceptable levels along the eastern portion of the SF embankment.

FINAL DRAFT

- Based on the information presented in this TM, the conservative recommended embankment configuration would have interior and exterior slopes no steeper than 4H:1V.
- Site-specific investigations and geotechnical data are necessary to determine the best location for ground improvements and to optimize ground improvement treatment patterns, including the recommended seepage cutoff wall. Site-specific geotechnical data would also help refine the strengths used in analysis.

5.1 Risk and Accuracy

This analysis was performed assuming conditions at nearby site locations are representative of the conditions at the SF. There is a great amount of uncertainty and risk associated with this approach as minimal site-specific subsurface information was available at the time this TM was prepared.

Designing CDSM for strength gain in organic (peaty) soils is not a common practice due to the strength gain results being highly variable. The quantity of cement required to meet a specific design strength in organic material would likely be significantly higher relative to nonorganic soils and would require a robust quality assurance and quality control testing program to verify performance. Improving organic soils with CDSM would not be recommended. If feasible, removing and replacing soft organic soils with compacted fill is the preferred approach to mitigating this material.

Source material to construct the SF could include reusing onsite soils generated from excavations, RTM, or other import sources. The embankment material parameters used for analyses presented in this TM are assumed. Once a fill source is identified, a rigorous testing program must be implemented to develop suitable seepage and shear strength parameters for design.

To develop the conclusions presented in this report, subsurface data collected by others during previous investigations near the project site was used. Much of the subsurface data represent locations within a half-mile of the SF, but some of the data used for the evaluations were located as much as 1 to 2 miles from the SF site. The evaluations presented in this TM assume foundation conditions below the SF do not deviate appreciably from those presented in the subsurface investigations reviewed for this study. The results in this TM are preliminary in nature and should not be used for detailed design.

5.2 Recommendations and Next Steps

5.2.1 Recommendations

The recommended embankment configuration would include 4H:1V slopes (both interior and exterior) with foundation improvement. Provided the highly compressible, soft organics are located at shallow depths, removal and replacement with compacted fill is the most optimal and reliable improvement method. For cases where liquefiable deposits are present at greater depths, CDSM shear panels would be recommended for foundation improvement along the SF embankment. Given the anticipated stratigraphic variability, it is likely that a combination of these methods would be used across the project site.

Given the uncertainties in using near-site data, the recommended 4H:1V slopes provide a reasonable level of conservativism until the embankment design could be updated with site-specific data. Given the size of the embankment and the depositional environment present at the SF location, it is likely that variability

FINAL DRAFT

in the foundation condition exist and the foundation improvement method would be adjusted/optimized based on actual conditions.

5.2.2 Next Steps

- Step 1: Perform site-specific subsurface explorations and laboratory testing to capture the range of subsurface conditions for the SF
- Step 2: Update the subsurface interpretation and analyses performed herein to develop individual reaches so that foundation improvement plans can be designed on a reach-by-reach basis. This includes performing additional analyses that include but are not limited to site-specific site response; and liquefaction, seepage, stability, and settlement analyses.

6. References

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7. Document History and Quality Assurance

Reviewers listed have completed an internal quality review check and approval process for deliverable documents that is consistent with procedures and directives identified by the Engineering Design Manager (EDM) and the DCA.

Approval Names and Roles			
Prepared by	**Internal Quality Control review by**	**Consistency review by**	**Approved for submission by**
Chris Krage, Elliott Ticen, Annmarie Behan / Project Engineers	Graham Bradner / DCA Executive Director Craig Hall/ EDM Geotechnical Engineer	Gwen Buchholz / DCA Environmental Consultant	Terry Krause / EDM Project Manager

This interim document is considered preliminary and was prepared under the responsible charge of Chris Krage, California Professional Engineering License C90899.

Note to Reader

This is an early foundational technical document. Contents therefore reflect the timeframe associated with submission of the initial and final drafts. Only minor editorial and document date revisions have been made to the current Conformed Final Draft for Administrative Draft Engineering Project Report version.

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Attachment 1
Interpretation of Near-site Data

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Attachment 1. Interpretation of Near-site Data

- Presentation of the detailed historical evaluation of near-site data, including plan view, lithologic profiles, interpreted analysis profiles, and observed and interpreted strengths.

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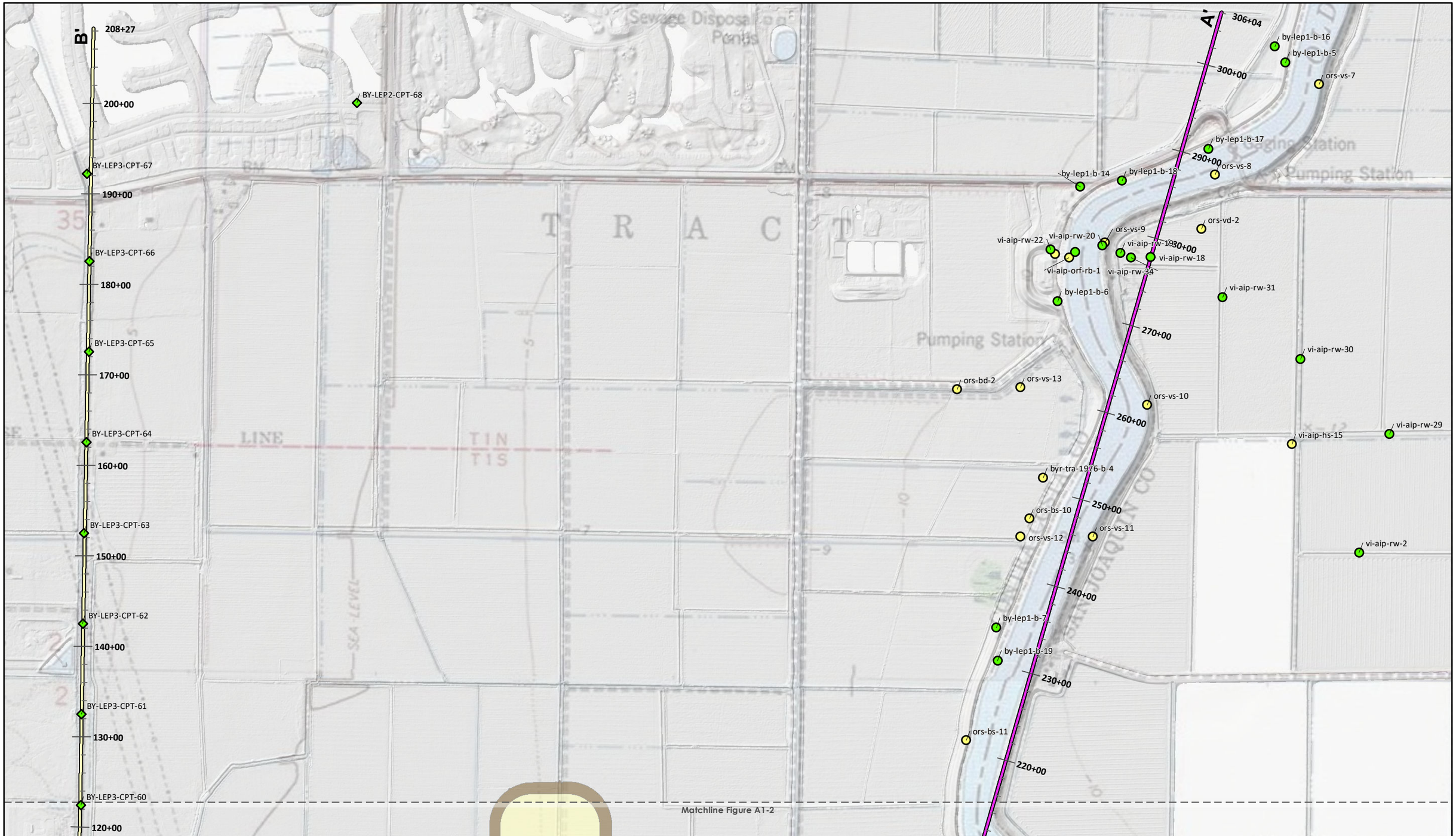

GEI Grade (CPTs)
- A
- B

GEI Grade (Borings)
- A
- B

Lithologic Profile ID
- A-A'
- B-B'

Note: See Plate A1-1 for figure inset locations

N

0 500 1,000 2,000 Feet

Projection: CA State Plane III NAD83 (ft)
Background: USGS 7.5' Topo/DWR CVFED LiDAR 2006

Southern Forebay
Seismic Stability Sensitivity

Delta Conveyance Design and Construction Authority

DCA DELTA CONVEYANCE DESIGN & CONSTRUCTION AUTHORITY

PLAN VIEW OF GRADED HISTORICAL EXPLORATIONS - INSET 1

MARCH 2020

FIGURE A1-1

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GEI Grade (CPTs)

- A
- B

GEI Grade (Borings)

- A
- B

Lithologic Profile ID

- A-A'
- B-B'

Note: See Plate A1-1 for figure inset locations

0 500 1,000 2,000 Feet

N

Projection: CA State Plane III NAD83 (ft)
Background: USGS 7.5' Topo/DWR CVFED LiDAR 2006

Southern Forebay
Seismic Stability Sensitivity

Delta Conveyance Design and Construction Authority

DCA
DELTA CONVEYANCE DESIGN & CONSTRUCTION AUTHORITY

PLAN VIEW OF GRADED HISTORICAL EXPLORATIONS - INSET 2

MARCH 2020

FIGURE A1-2

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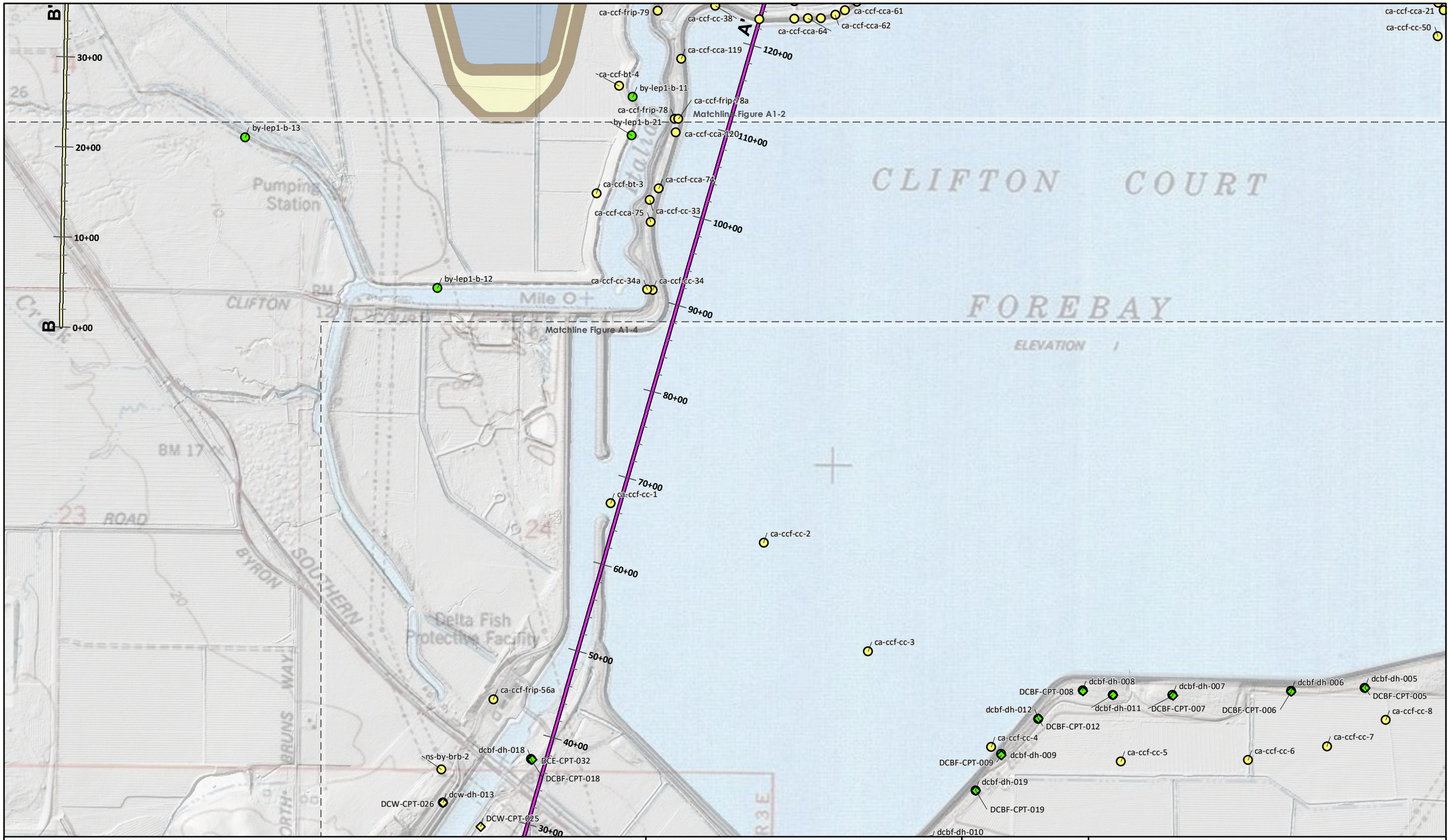
110+00



GEI Grade (CPTs)
- A
- B

GEI Grade (Borings)
- A
- B

Lithologic Profile ID
- A-A'
- B-B'

Note: See Plate A1-1 for figure inset locations

N

0 500 1,000 2,000 Feet

Projection: CA State Plane III NAD83 (ft)
Background: USGS 7.5' Topo/DWR CVFED LiDAR 2006

Southern Forebay
Seismic Stability Sensitivity

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PLAN VIEW OF GRADED HISTORICAL EXPLORATIONS - INSET 3

MARCH 2020

FIGURE A1-3

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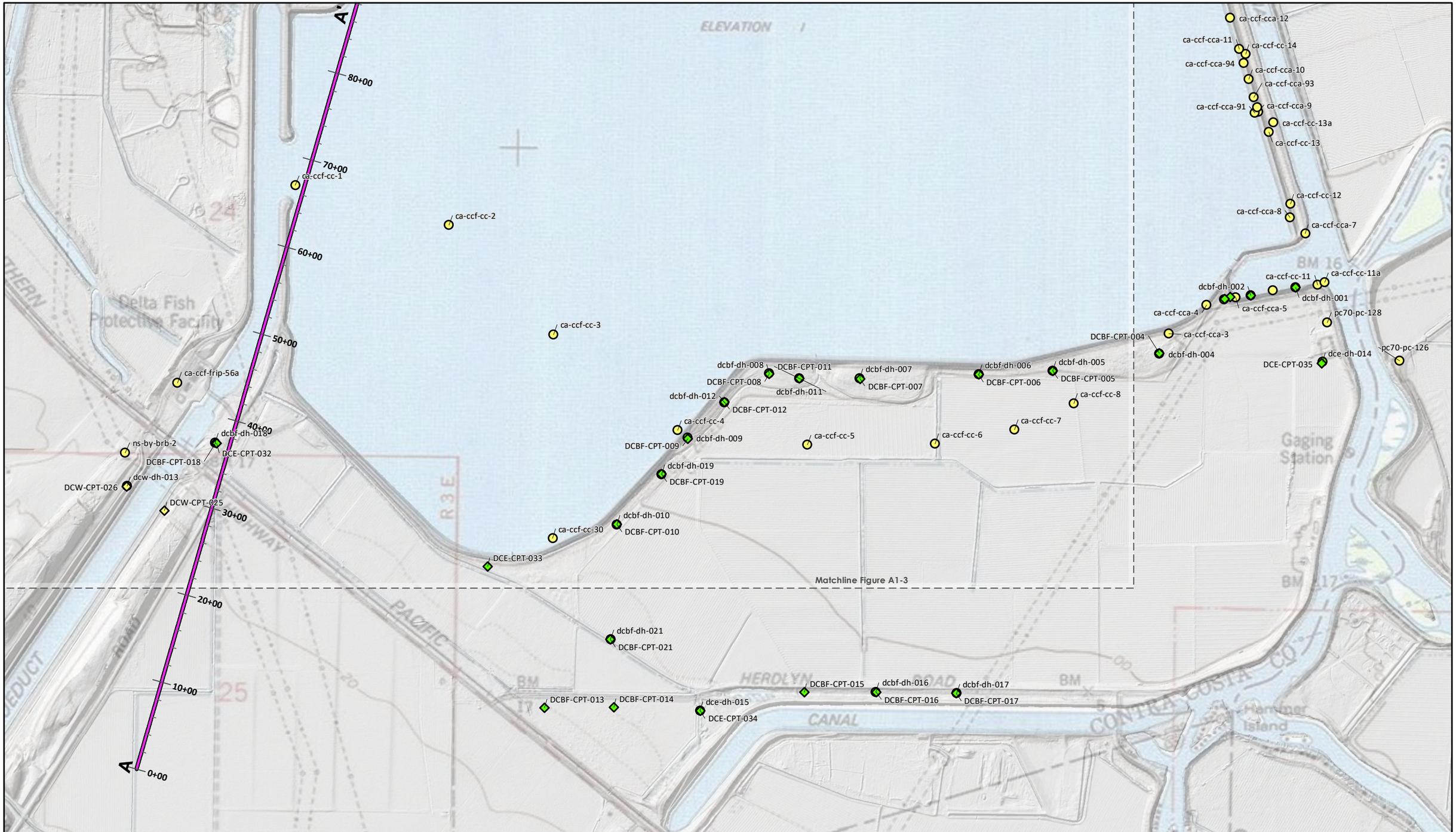

GEI Grade (CPTs)
- A
- B

GEI Grade (Borings)
- A
- B

Lithologic Profile ID
- A-A'
- B-B'

Note: See Plate A1-1 for figure inset locations

N

0 500 1,000 2,000 Feet

Projection: CA State Plane III NAD83 (ft)
Background: USGS 7.5' Topo/DWR CVFED LiDAR 2006

Southern Forebay
Seismic Stability Sensitivity

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PLAN VIEW OF GRADED HISTORICAL EXPLORATIONS - INSET 4

MARCH 2020

FIGURE A1-4

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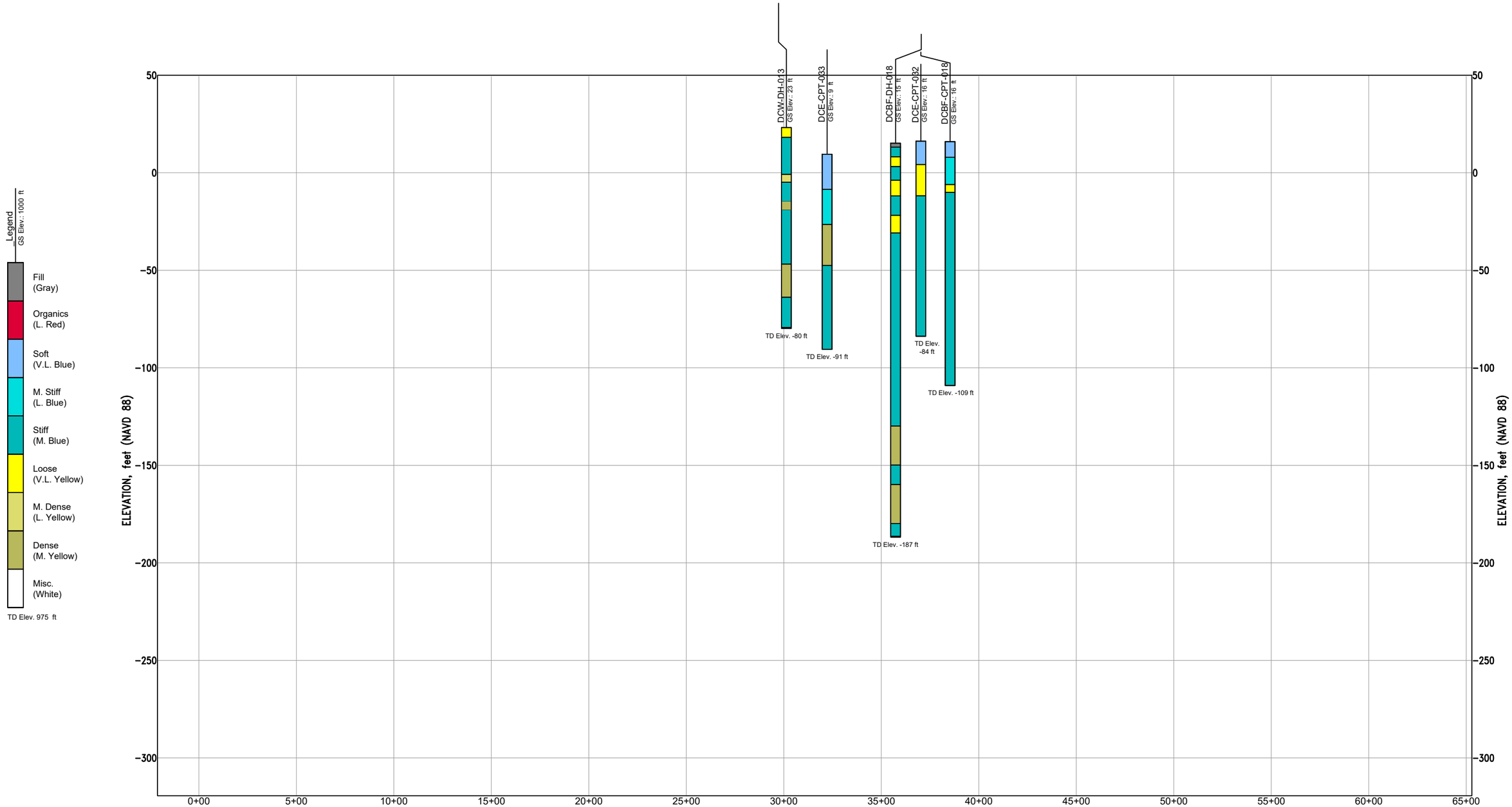

Vertical (10x)

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SCALE: 1" = 50'

Horizontal

0 500 1000

SCALE: 1" = 500'

Southern Forebay Seismic Stability Sensitivity

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LITHOLOGIC PROFILE A-A'
0+00 TO 60+00

March 2020

Figure A1-5

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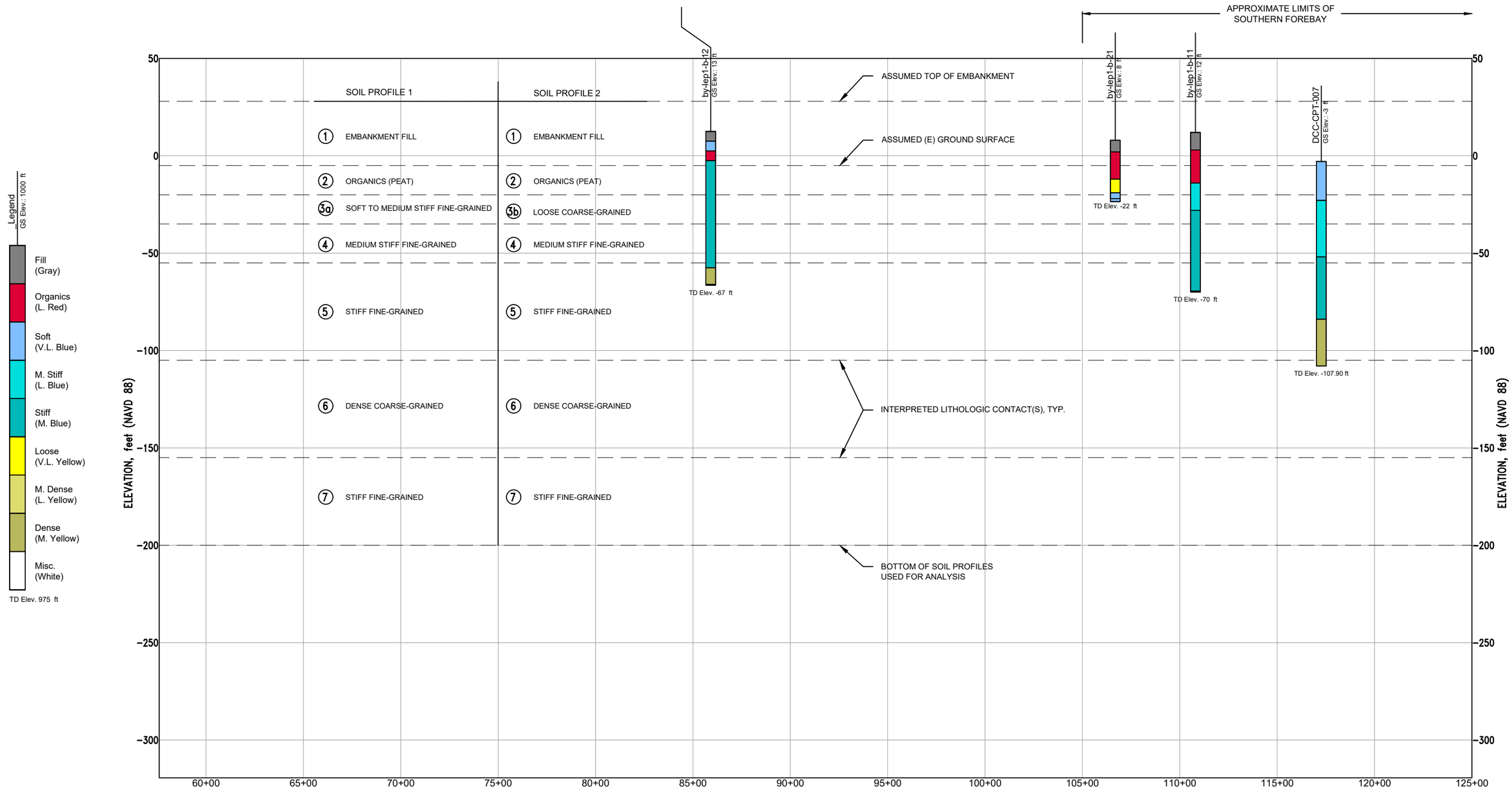

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SCALE: 1" = 500'

Southern Forebay Seismic Stability Sensitivity	DCA DELTA CONVEYANCE DESIGN & CONSTRUCTION AUTHORITY	LITHOLOGIC PROFILE A-A' 60+00 TO 120+00
Delta Conveyance Design and Construction Authority		March 2020 Figure A1-6

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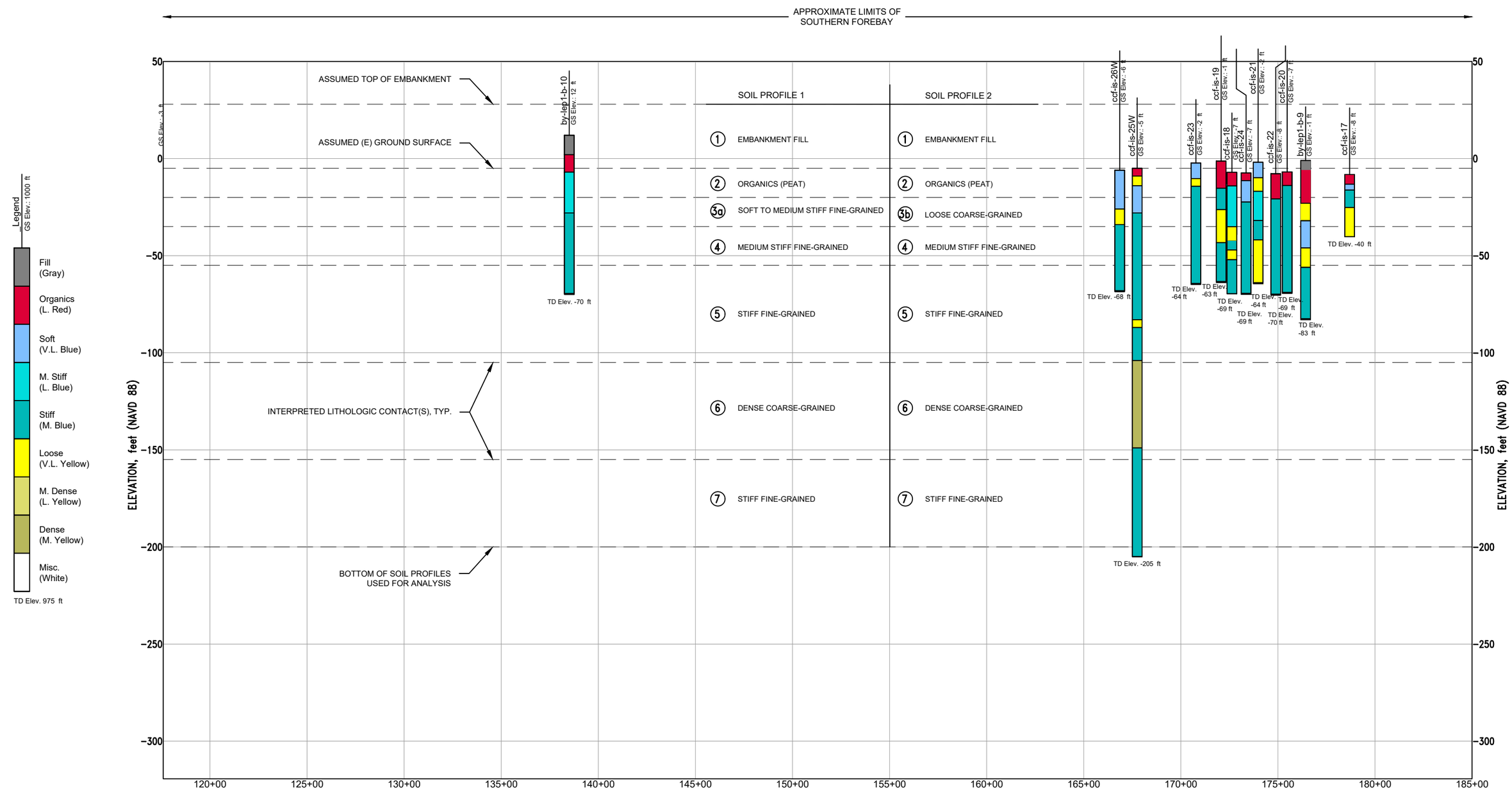

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Horizontal

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SCALE: 1" = 500'

Southern Forebay Seismic Stability Sensitivity	DCA DELTA CONVEYANCE DESIGN & CONSTRUCTION AUTHORITY	LITHOLOGIC PROFILE A-A' 120+00 TO 180+00
Delta Conveyance Design and Construction Authority		March 2020 Figure A1-7

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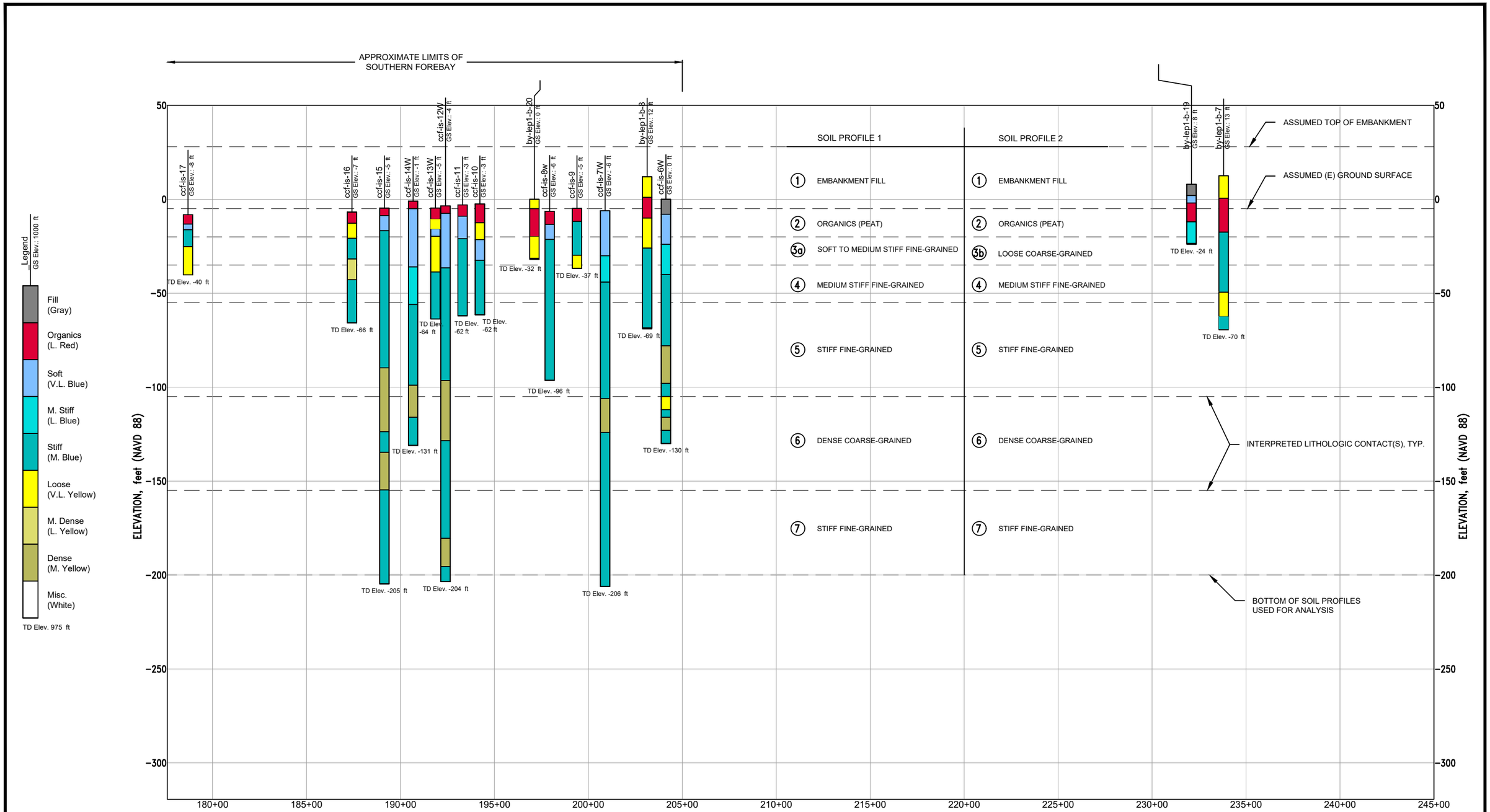

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Horizontal

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SCALE: 1" = 500'

Southern Forebay Seismic Stability Sensitivity	DCA DELTA CONVEYANCE DESIGN & CONSTRUCTION AUTHORITY	LITHOLOGIC PROFILE A-A' 180+00 TO 240+00
Delta Conveyance Design and Construction Authority		March 2020 Figure A1-8

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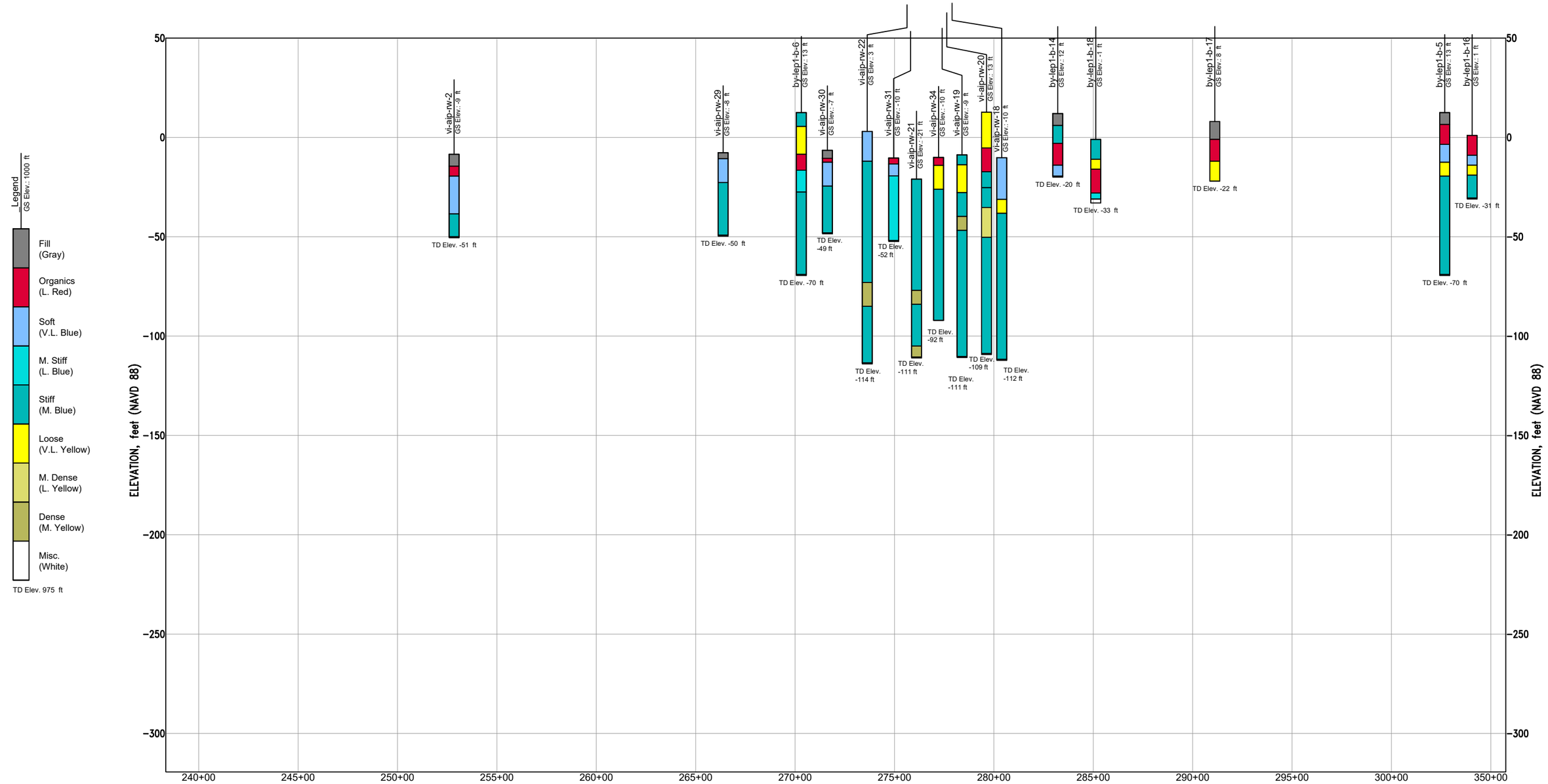

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SCALE: 1" = 500'

Southern Forebay Seismic Stability Sensitivity

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LITHOLOGIC PROFILE A-A'
240+00 TO 300+00

March 2020

Figure A1-9

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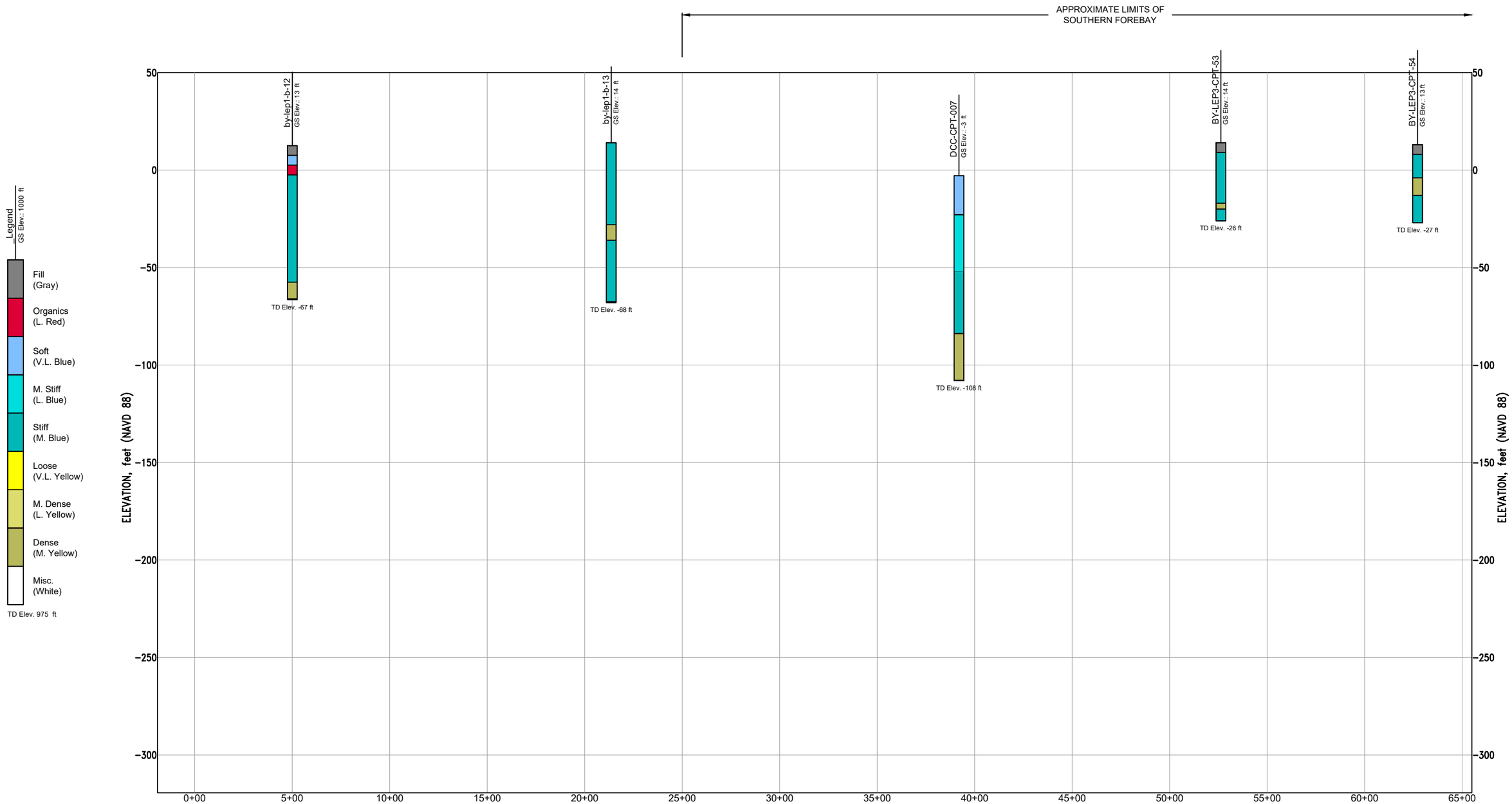

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Horizontal

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SCALE: 1" = 500'

Southern Forebay Seismic Stability Sensitivity

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DCA DELTA CONVEYANCE DESIGN & CONSTRUCTION AUTHORITY

LITHOLOGIC PROFILE B-B'
0+00 TO 60+00

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Figure A1-10

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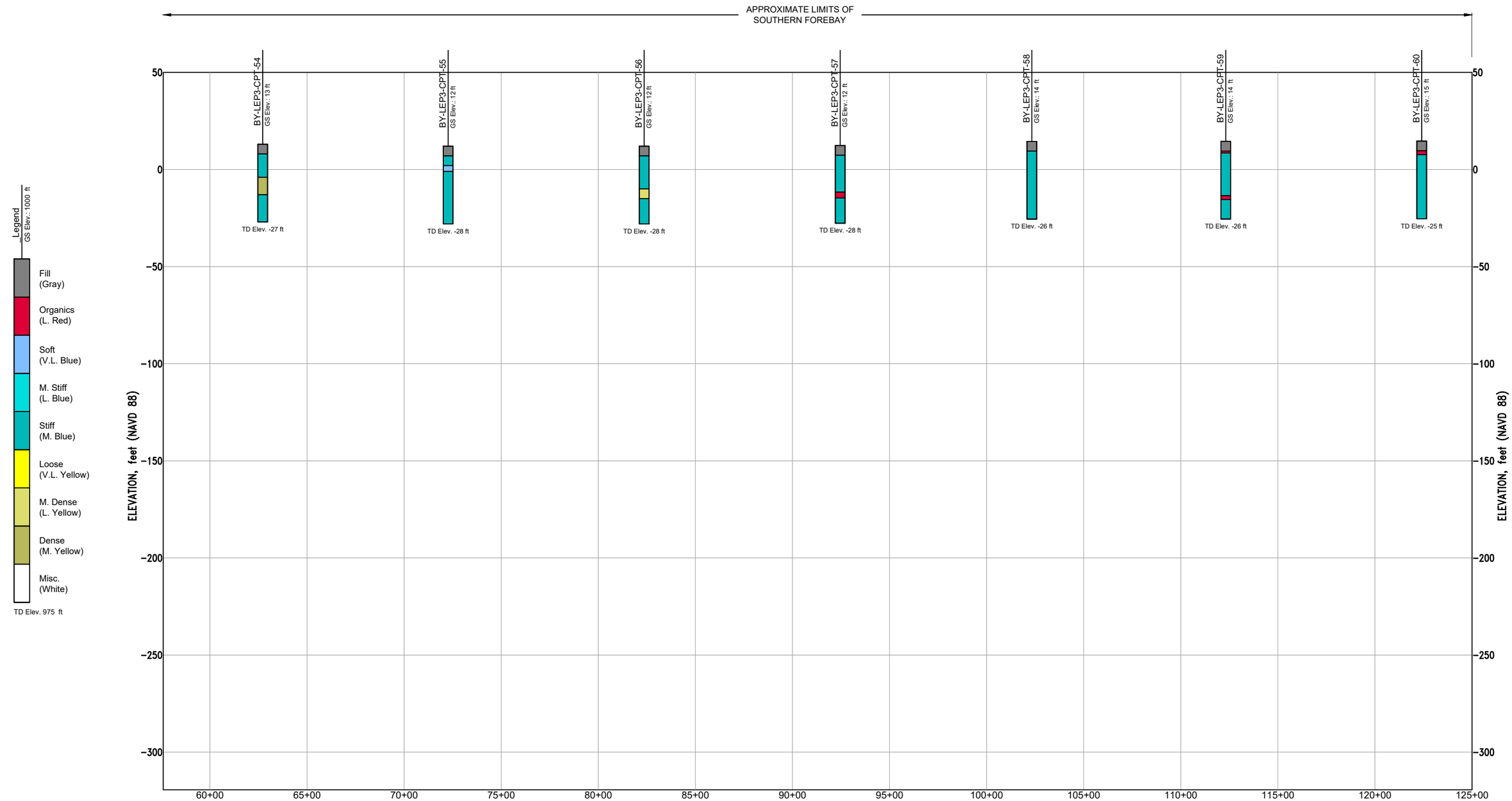

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SCALE: 1" = 50'

Horizontal

0 500 1000

SCALE: 1" = 500'

Southern Forebay Seismic Stability Sensitivity

Delta Conveyance Design and Construction Authority

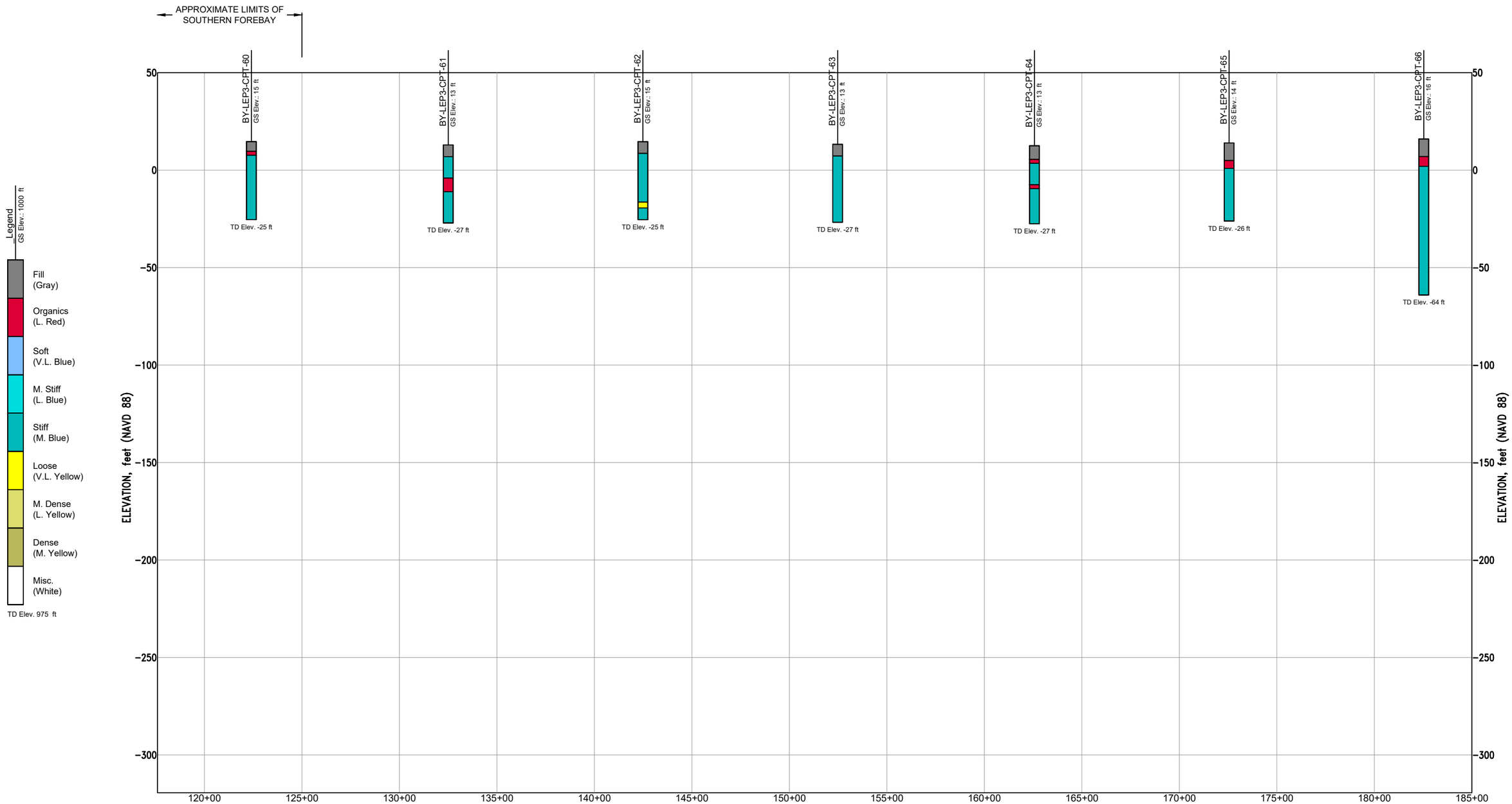
DCA DELTA CONVEYANCE DESIGN & CONSTRUCTION AUTHORITY

LITHOLOGIC PROFILE B-B'
60+00 TO 120+00

March 2020

Figure A1-11

\\sac1v-fs01\ \\sac1v-fs01\Data\WR\CA WaterFix DCA\Projects\1900832 CWF EDM\Analysis\Tech Memos\Southern Forebay Seismic Eval\02_Data Gathering\binning-digitization\AutoCAD\DCA_Alignments_v2.dwg - 3/9/2020



Vertical (10x)

0 50 100

SCALE: 1" = 50'

Horizontal

0 500 1000

SCALE: 1" = 500'

Southern Forebay Seismic Stability Sensitivity

Delta Conveyance Design and Construction Authority

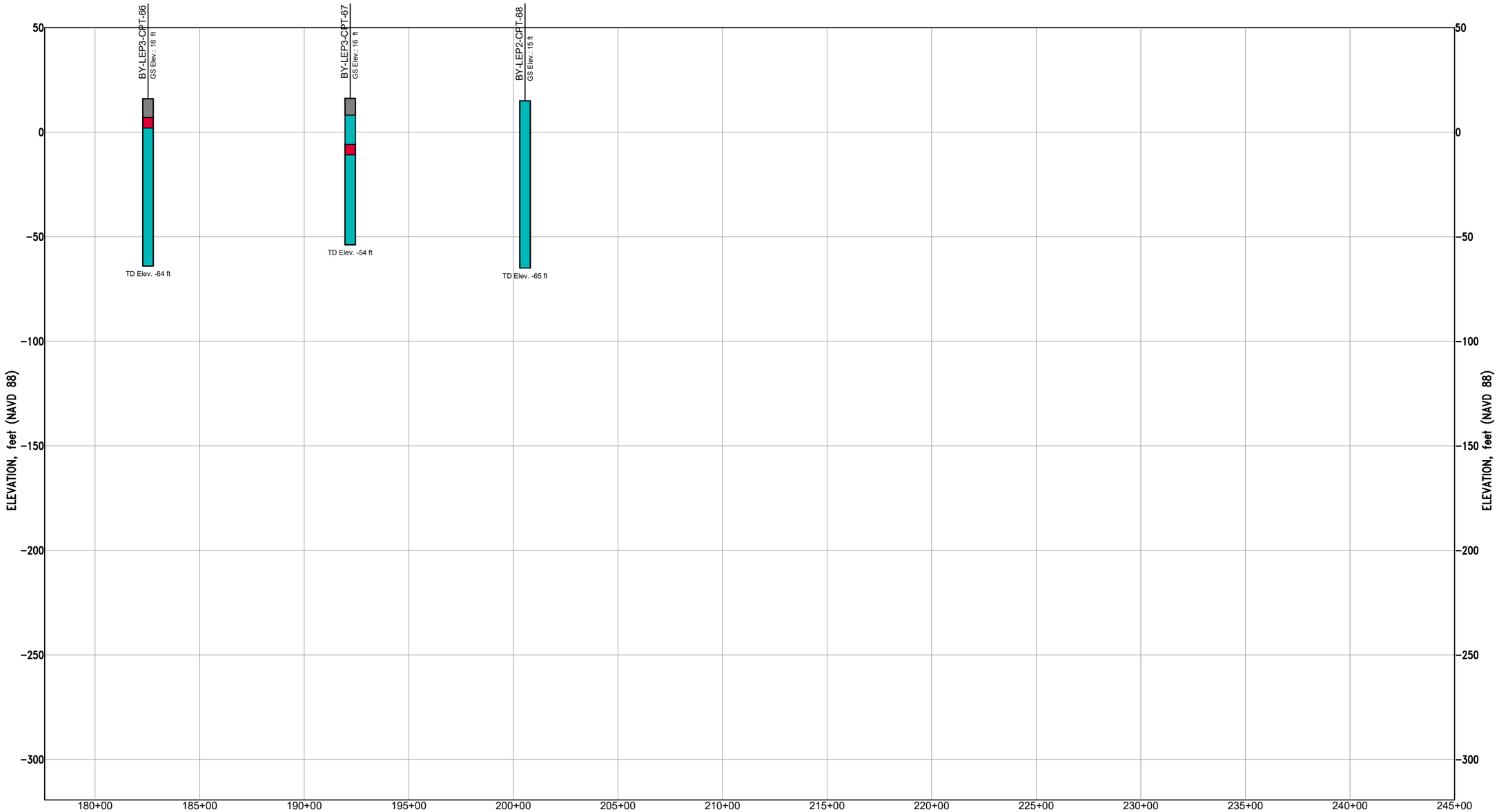
DCA DELTA CONVEYANCE DESIGN & CONSTRUCTION AUTHORITY

LITHOLOGIC PROFILE B-B'
120+00 TO 180+00

March 2020

Figure A1-12

\\sac1v-fs01\ \\sac1v-fs01\Data\WR\CA WaterFix DCA\Projects\1900832 CWF EDM\Analysis\Tech Memos\Southern Forebay Seismic Eval\02_Data Gathering\binning-digitization\AutoCAD\DCA_Alignments_v2.dwg - 3/9/2020



Legend
GS Elev.: 1000 ft

- Fill (Gray)
- Organics (L. Red)
- Soft (V.L. Blue)
- M. Stiff (L. Blue)
- Stiff (M. Blue)
- Loose (V.L. Yellow)
- M. Dense (L. Yellow)
- Dense (M. Yellow)
- Misc. (White)

TD Elev. 975 ft

Vertical (10x)
0 50 100
SCALE: 1" = 50'

Horizontal
0 500 1000
SCALE: 1" = 500'

Southern Forebay Seismic Stability Sensitivity

Delta Conveyance Design and Construction Authority

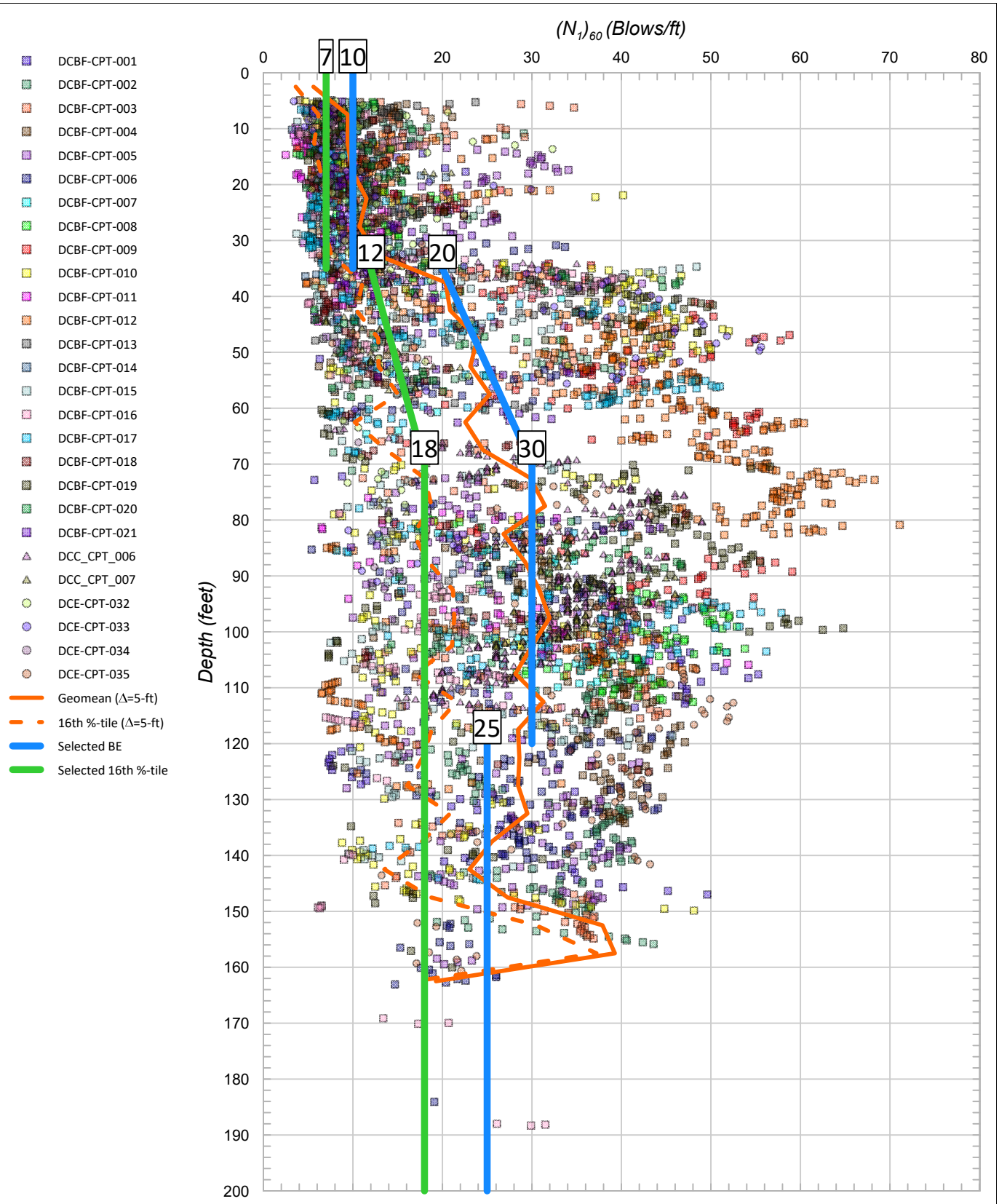
DCA DELTA CONVEYANCE DESIGN & CONSTRUCTION AUTHORITY

LITHOLOGIC PROFILE B-B'
180+00 TO 240+00

March 2020

Figure A1-13

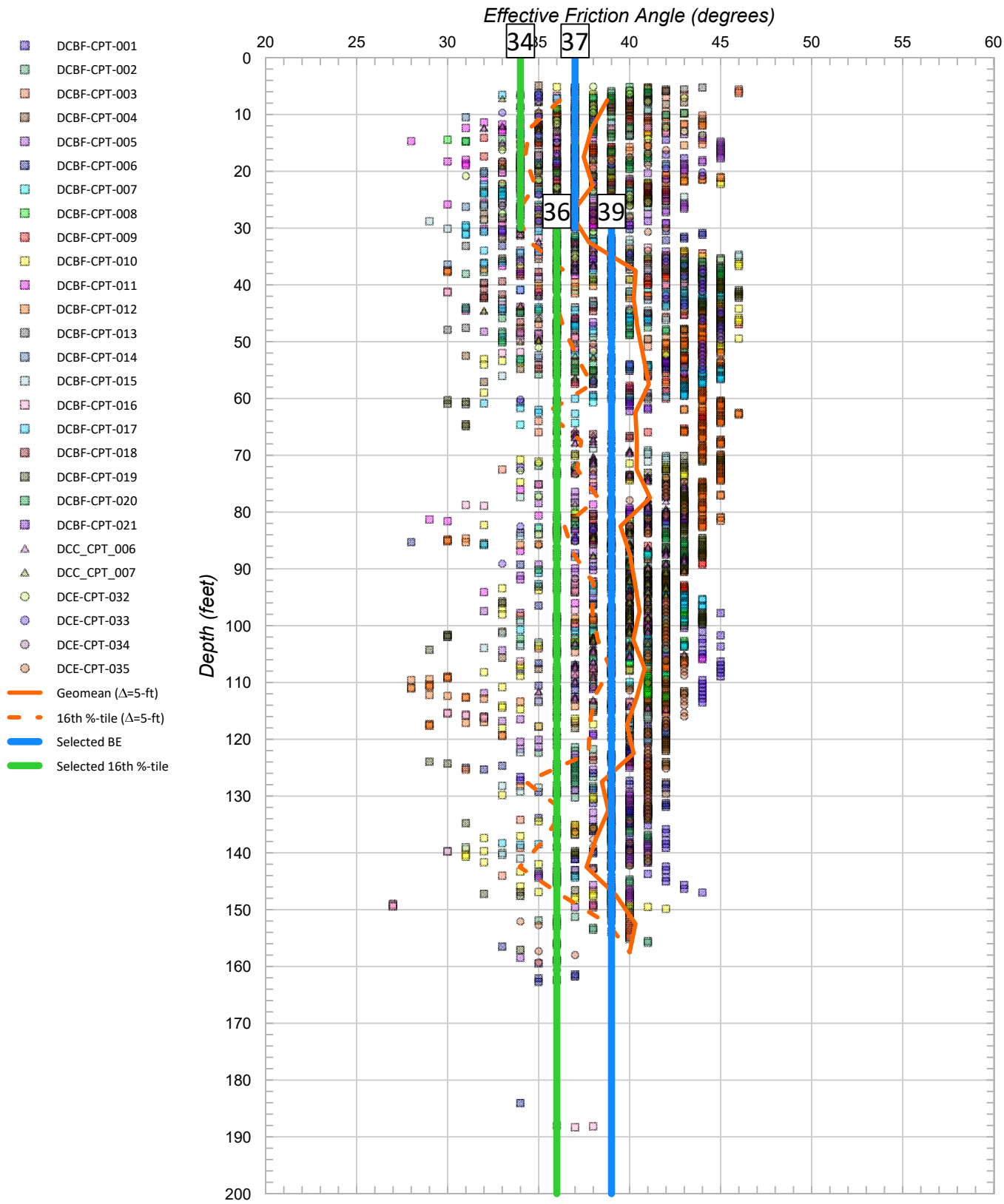
\\sac1v-fs01\ \\sac1v-fs01\Data\WR\CA WaterFix DCA\Projects\1900832 CWF EDM\Analysis\Tech Memos\Southern Forebay Seismic Eval\02_Data Gathering\binning-digitization\AutoCAD\DCA_Alignments_v2.dwg - 3/9/2020



Note: $(N_1)_{60}$ values are plotted for soils with Ic≤2.6

Southern Forebay Seismic Stability Sensitivity	DCA DELTA CONVEYANCE DESIGN & CONSTRUCTION AUTHORITY	$(N_1)_{60}$ INTERPRETED BY CPT (DCBF, DCC, AND DCE CPTS ONLY)
Delta Conveyance Design and Construction Authority		March 2020 Figure A1-14

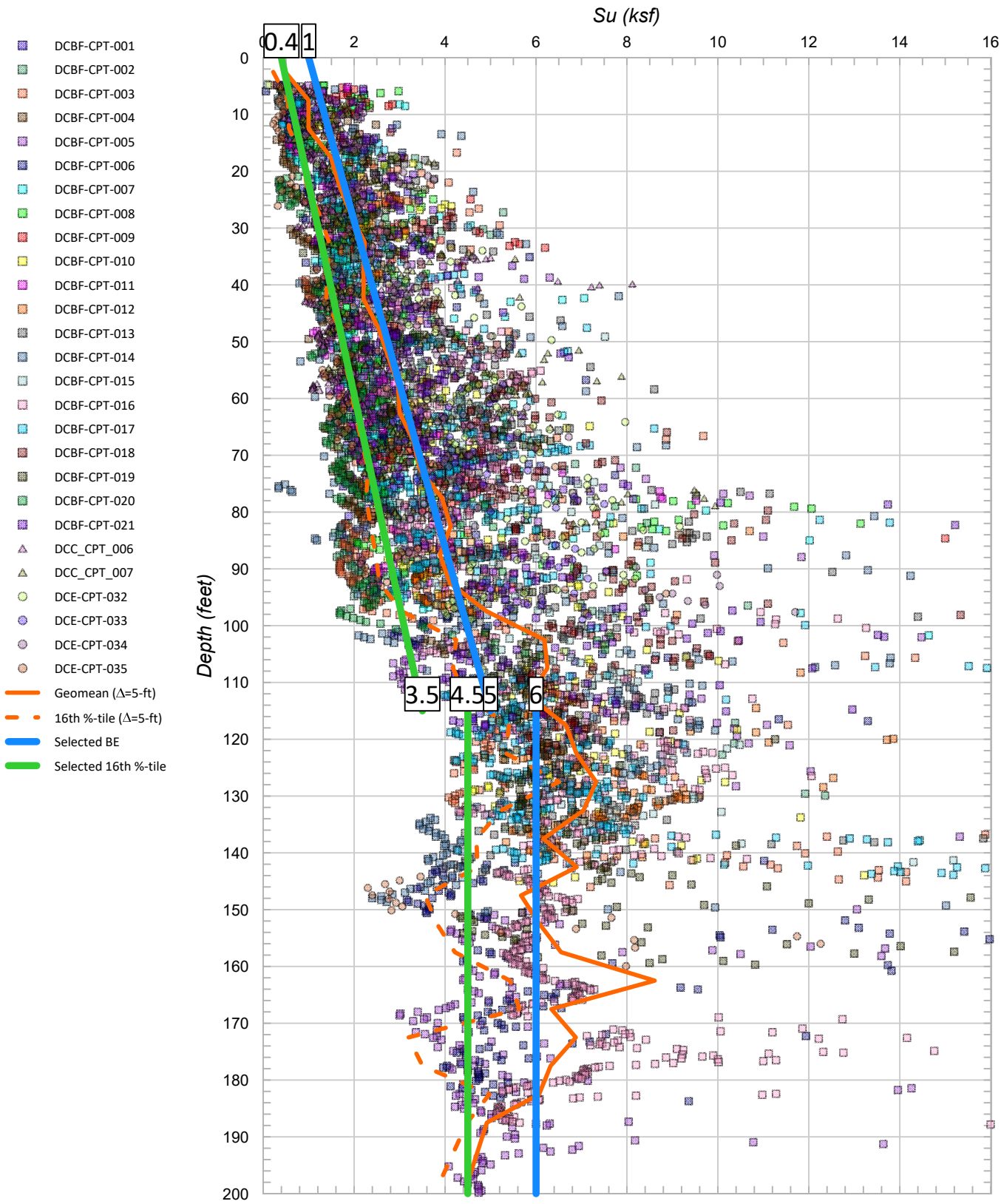
\\sac1v-fs01\Data\WR\CA WaterFix DCA\Projects\1900832 CWF EDM\Analysis\Tech Memos\Southern Forebay Seismic Eval\05 Analysis\Strength CPT



Note: Friction angles are plotted for soils with Ic≤2.6

Southern Forebay Seismic Stability Sensitivity	DCA DELTA CONVEYANCE DESIGN & CONSTRUCTION AUTHORITY	EFFECTIVE FRICTION ANGLE INTERPRETED BY CPT (DCBF, DCC, AND DCE CPTS ONLY)
Delta Conveyance Design and Construction Authority		March 2020 Figure A1-15

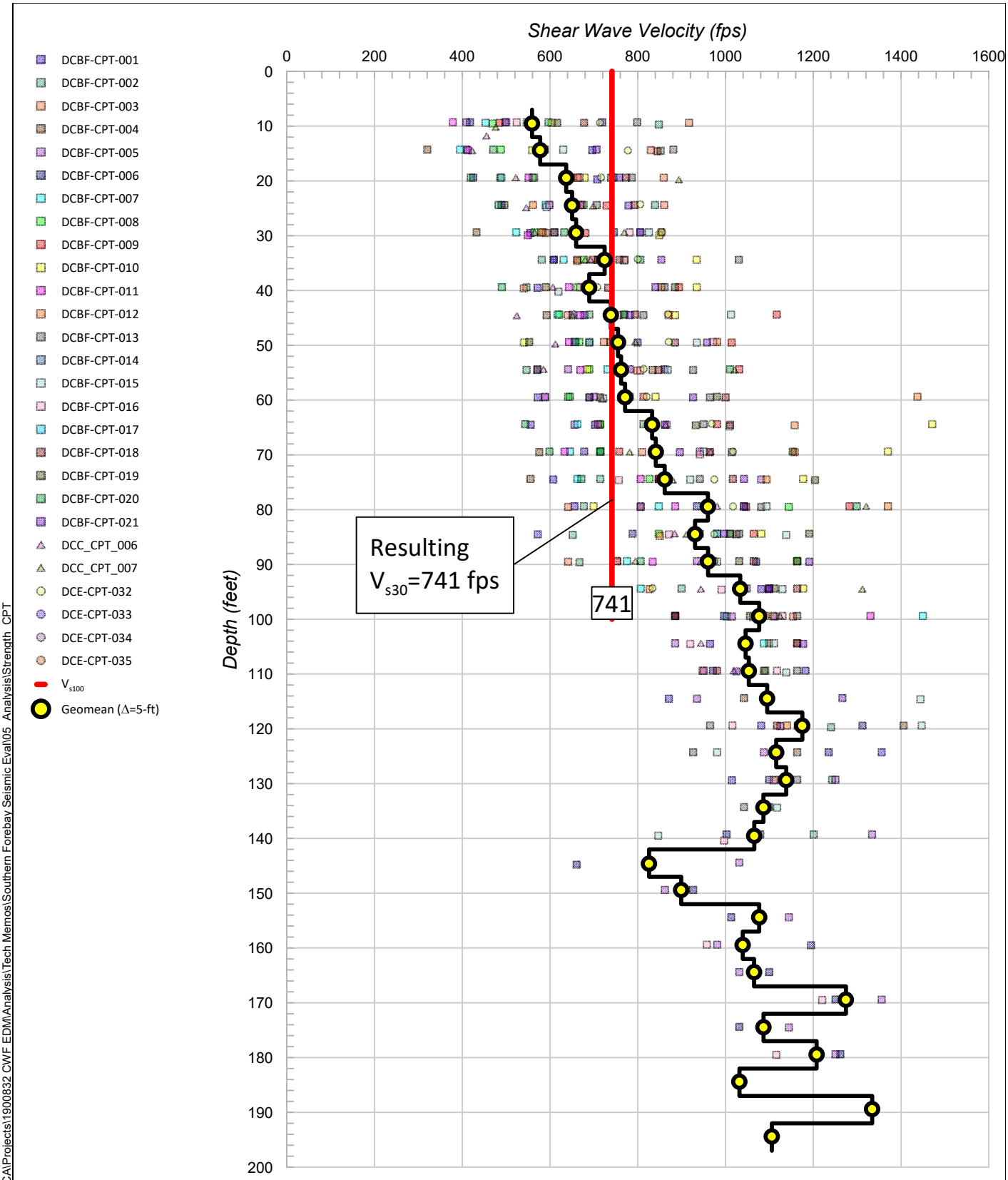
\\sac1v-fs01\Data\WR\CA WaterFix DCA\Projects\1900832 CWF EDM\Analysis\Tech Memos\Southern Forebay Seismic Eval\05 Analysis\Strength CPT



Note: Su values are plotted for soils with Ic>2.6

Southern Forebay Seismic Stability Sensitivity	DCA DELTA CONVEYANCE DESIGN & CONSTRUCTION AUTHORITY	UNDRAINED SHEAR STRENGTH INTERPRETED BY CPT (DCBF, DCC, AND DCE CPTS ONLY)
Delta Conveyance Design and Construction Authority		March 2020 Figure A1-16

\\sac1v-fs01\Data\WR\CA WaterFix DCA\Projects\1900832 CWF EDM\Analysis\Tech Memos\Southern Forebay Seismic Eval\05 Analysis\Strength CPT



Note: LCI V_{s30} used for ground motion development = 1,100 fps

Southern Forebay Seismic Stability Sensitivity	DCA DELTA CONVEYANCE DESIGN & CONSTRUCTION AUTHORITY	SHEAR WAVE VELOCITY FROM SCPT
Delta Conveyance Design and Construction Authority		March 2020 Figure A1-17

\\sac1v-fs01\Data\WR\CA WaterFix DCA\Projects\1900832 CWF EDM\Analysis\Tech Memos\Southern Forebay Seismic Eval\05 Analysis\Strength CPT

Attachment 2
Analysis Results

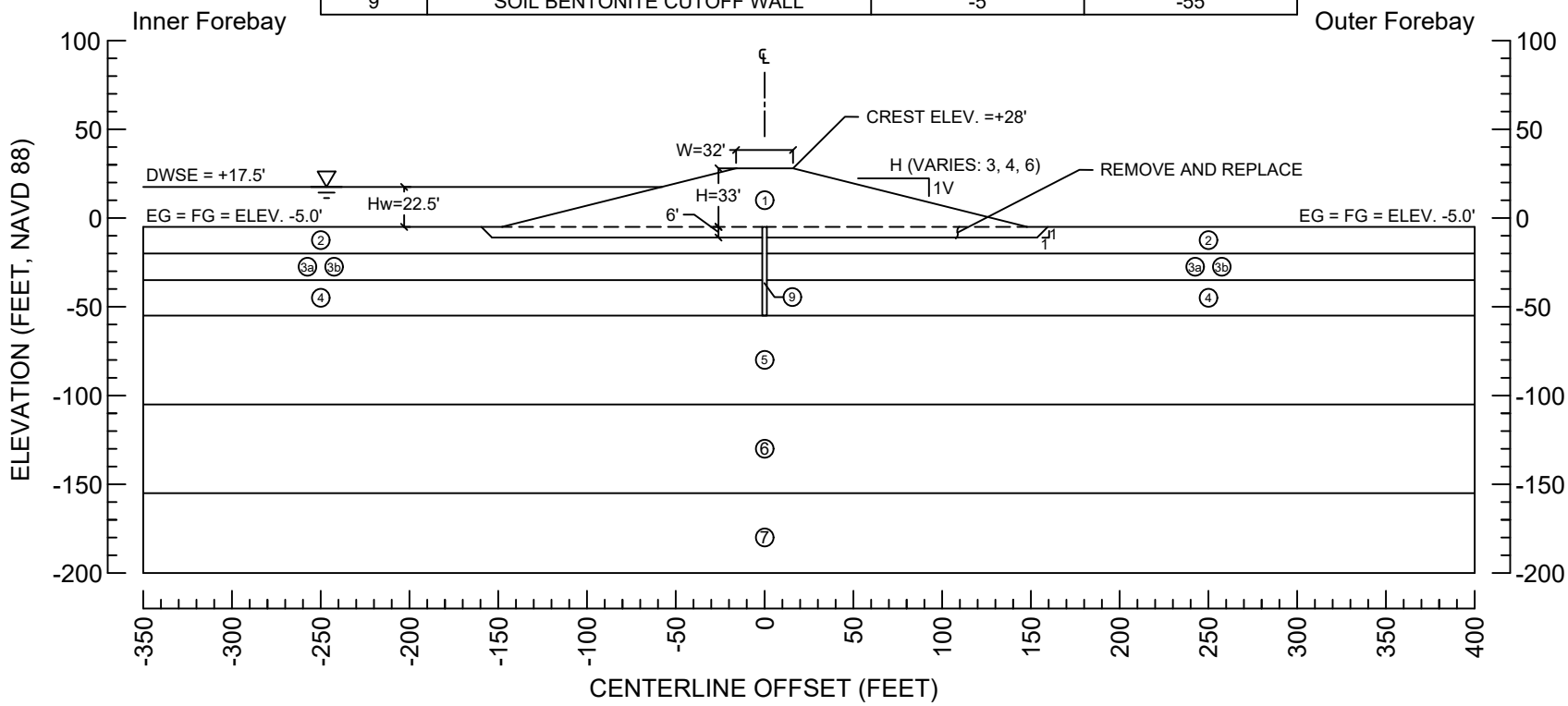
FINAL DRAFT

Attachment 2. Analysis Results

- Presentation of the analysis profiles, strength distributions, slope stability, settlement, and foundation improvement results

FINAL DRAFT

ANALYSIS STRATIGRAPHY AT EMBANKMENT CREST			
LAYER NO.	LAYER NAME	TOP ELEVATION (FEET)	BOTTOM ELEVATION (FEET)
1	EMBANKMENT FILL	28	-11
2	ORGANICS (PEAT)	-11	-20
3a	SOFT TO MEDIUM STIFF FINE-GRAINED	-20	-35
3b	LOOSE COARSE-GRAINED	-20	-35
4	MEDIUM STIFF FINE-GRAINED	-35	-55
5	STIFF FINE-GRAINED	-55	-105
6	DENSE COARSE-GRAINED	-105	-155
7	STIFF FINE-GRAINED	-155	-200
9	SOIL BENTONITE CUTOFF WALL	-5	-55



0 100 200

SCALE: 1" = 100'

Southern Forebay Seismic Stability Sensitivity

Delta Conveyance Design and Construction Authority

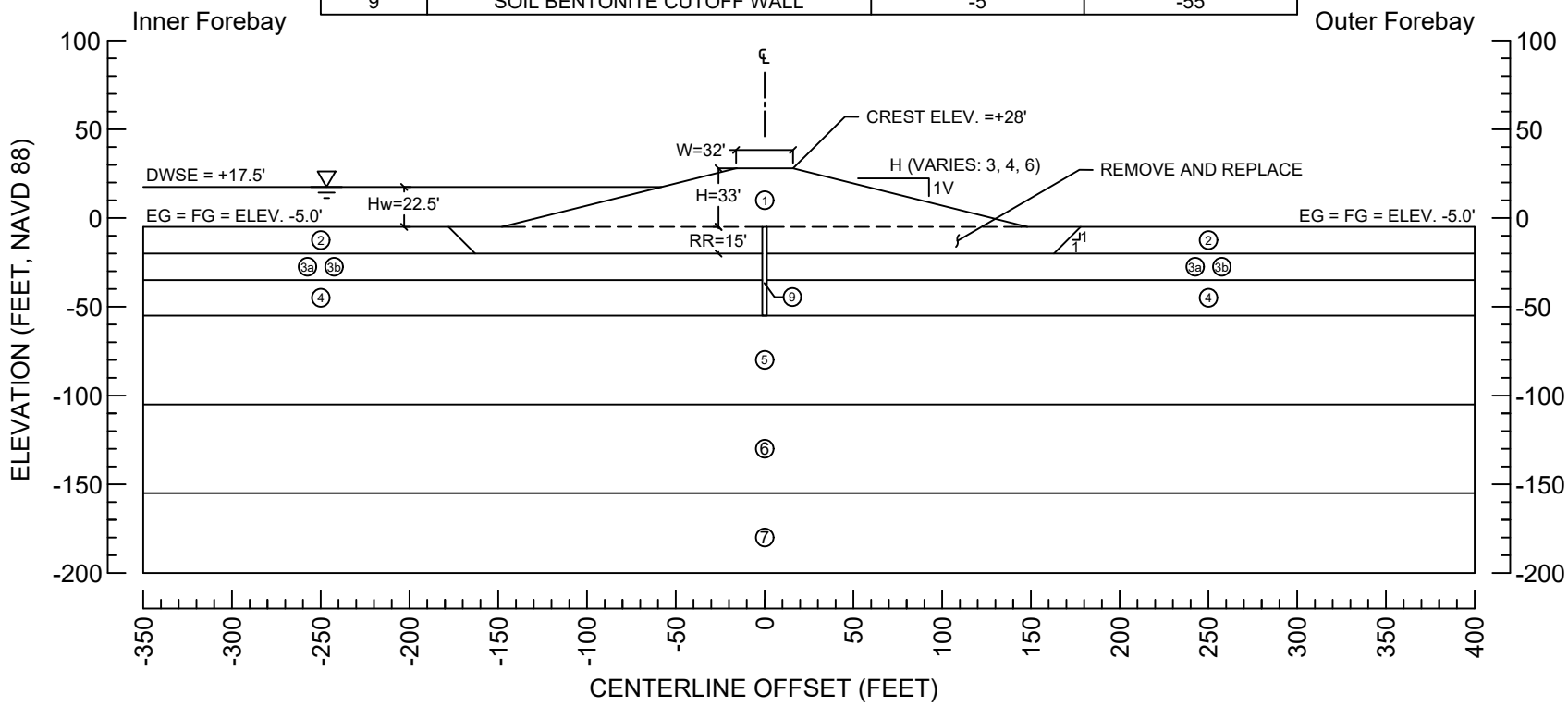
DCA DELTA CONVEYANCE DESIGN & CONSTRUCTION AUTHORITY

ANALYSIS SECTION
PROFILE P1 & P2
EXISTING CONDITION

March 2020 Figure A2-1

\\OAK2L-ETICE \\sac1v-fs01\Data\WR\CA WaterFix DCA\Projects\1900832 CWF EDM\Analysis\Tech Memos\Southern Forebay Seismic Eval\02_Data Gathering\binning-digitization\AutoCAD\DCA_SF_Geometry_Sections.dwg - 2/27/2020

ANALYSIS STRATIGRAPHY AT EMBANKMENT CREST			
LAYER NO.	LAYER NAME	TOP ELEVATION (FEET)	BOTTOM ELEVATION (FEET)
1	EMBANKMENT FILL	28	-20
2	ORGANICS (PEAT)	NA	NA
3a	SOFT TO MEDIUM STIFF FINE-GRAINED	-20	-35
3b	LOOSE COARSE-GRAINED	-20	-35
4	MEDIUM STIFF FINE-GRAINED	-35	-55
5	STIFF FINE-GRAINED	-55	-105
6	DENSE COARSE-GRAINED	-105	-155
7	STIFF FINE-GRAINED	-155	-200
9	SOIL BENTONITE CUTOFF WALL	-5	-55



0 100 200

SCALE: 1" = 100'

Southern Forebay Seismic Stability Sensitivity

Delta Conveyance Design and Construction Authority

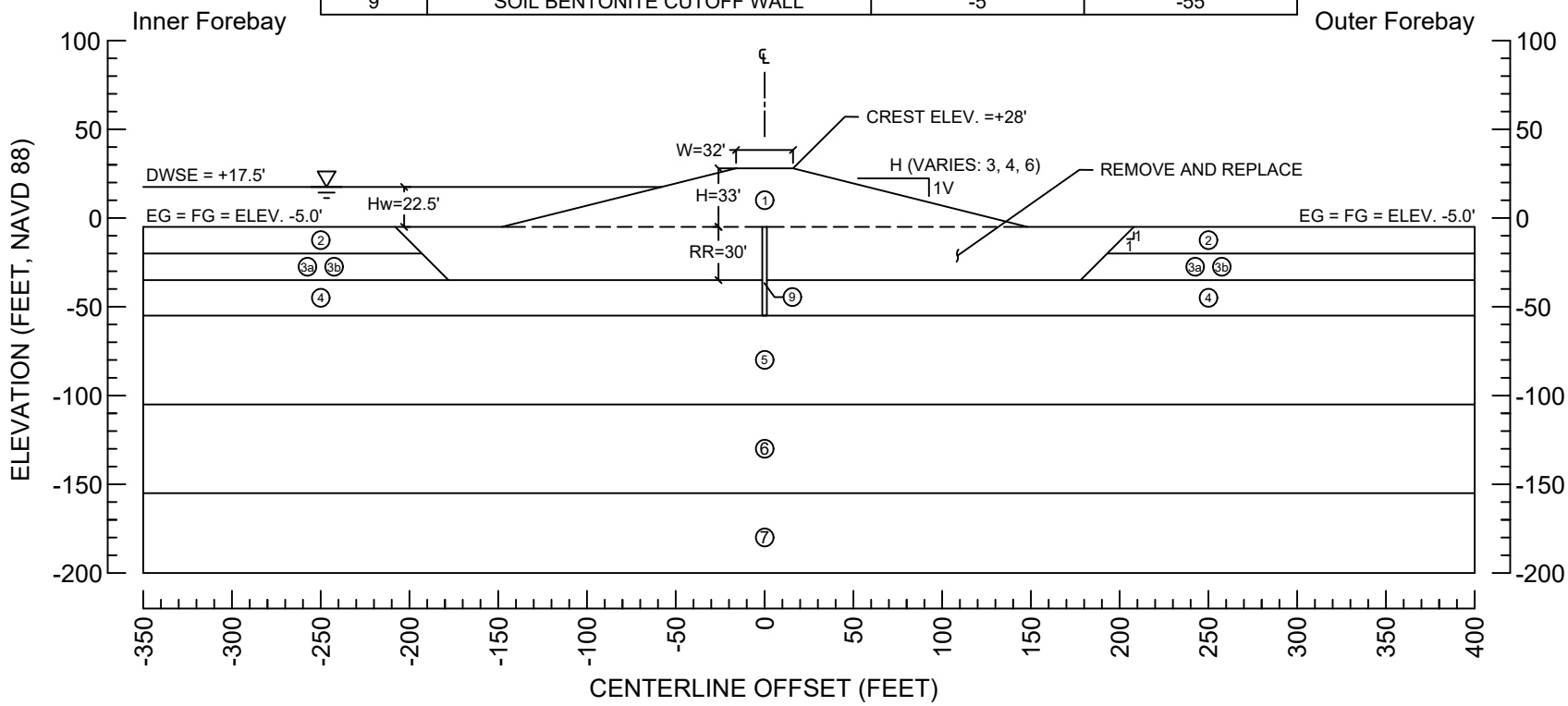
DCA DELTA CONVEYANCE DESIGN & CONSTRUCTION AUTHORITY

ANALYSIS SECTION
PROFILE P1 & P2
IMPROVED CONDITION
G1-RR15

March 2020 Figure A2-2

\\OAK2L-ETICE \\sac1v-fs01\Data\WR\CA WaterFix DCA\Projects\1900832 CWF EDM\Analysis\Tech Memos\Southern Forebay Seismic Eval\02_Data Gathering\binning-digitization\AutoCAD\DCA_SF_Geometry_Sections.dwg - 2/27/2020

ANALYSIS STRATIGRAPHY AT EMBANKMENT CREST			
LAYER NO.	LAYER NAME	TOP ELEVATION (FEET)	BOTTOM ELEVATION (FEET)
1	EMBANKMENT FILL	28	-35
2	ORGANICS (PEAT)	NA	NA
3a	SOFT TO MEDIUM STIFF FINE-GRAINED	NA	NA
3b	LOOSE COARSE-GRAINED	NA	NA
4	MEDIUM STIFF FINE-GRAINED	-35	-55
5	STIFF FINE-GRAINED	-55	-105
6	DENSE COARSE-GRAINED	-105	-155
7	STIFF FINE-GRAINED	-155	-200
9	SOIL BENTONITE CUTOFF WALL	-5	-55



0 100 200

SCALE: 1" = 100'

Southern Forebay Seismic Stability Sensitivity

Delta Conveyance Design and Construction Authority

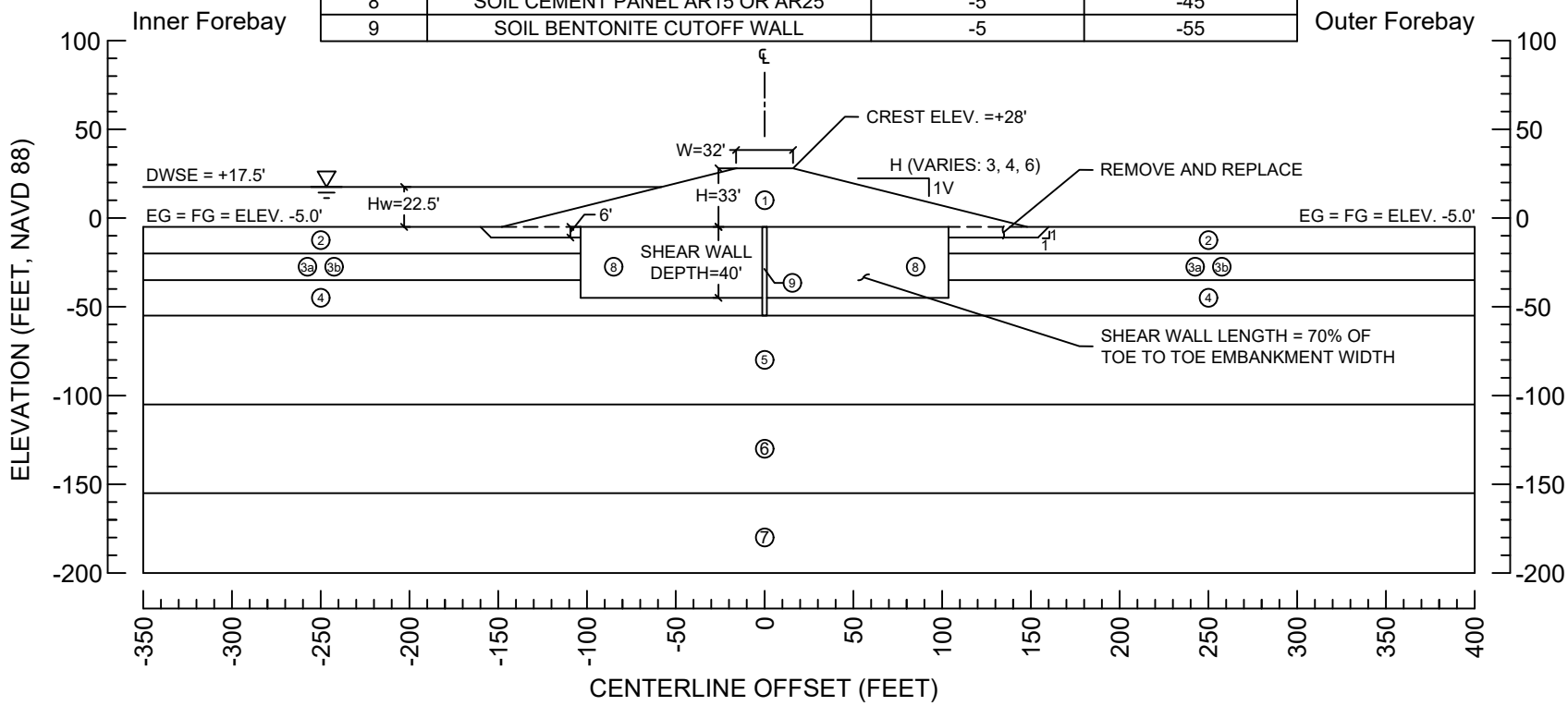
DCA DELTA CONVEYANCE DESIGN & CONSTRUCTION AUTHORITY

ANALYSIS SECTION
PROFILE P1 & P2
IMPROVED CONDITION
G1-RR30

March 2020 Figure A2-3

\\OAK2L-ETICE \\sac1v-fs01\Data\WR\CA WaterFix DCA\Projects\1900832 CWF EDM\Analysis\Tech Memos\Southern Forebay Seismic Eval\02_Data Gathering\binning-digitization\AutoCAD\DCA_SF_Geometry_Sections.dwg - 2/27/2020

ANALYSIS STRATIGRAPHY AT EMBANKMENT CREST			
LAYER NO.	LAYER NAME	TOP ELEVATION (FEET)	BOTTOM ELEVATION (FEET)
1	EMBANKMENT FILL	28	-11
2	ORGANICS (PEAT)	NA	NA
3a	SOFT TO MEDIUM STIFF FINE-GRAINED	NA	NA
3b	LOOSE COARSE-GRAINED	NA	NA
4	MEDIUM STIFF FINE-GRAINED	-45	-55
5	STIFF FINE-GRAINED	-55	-105
6	DENSE COARSE-GRAINED	-105	-155
7	STIFF FINE-GRAINED	-155	-200
8	SOIL CEMENT PANEL AR15 OR AR25	-5	-45
9	SOIL BENTONITE CUTOFF WALL	-5	-55



0 100 200

SCALE: 1" = 100'

Southern Forebay Seismic Stability Sensitivity

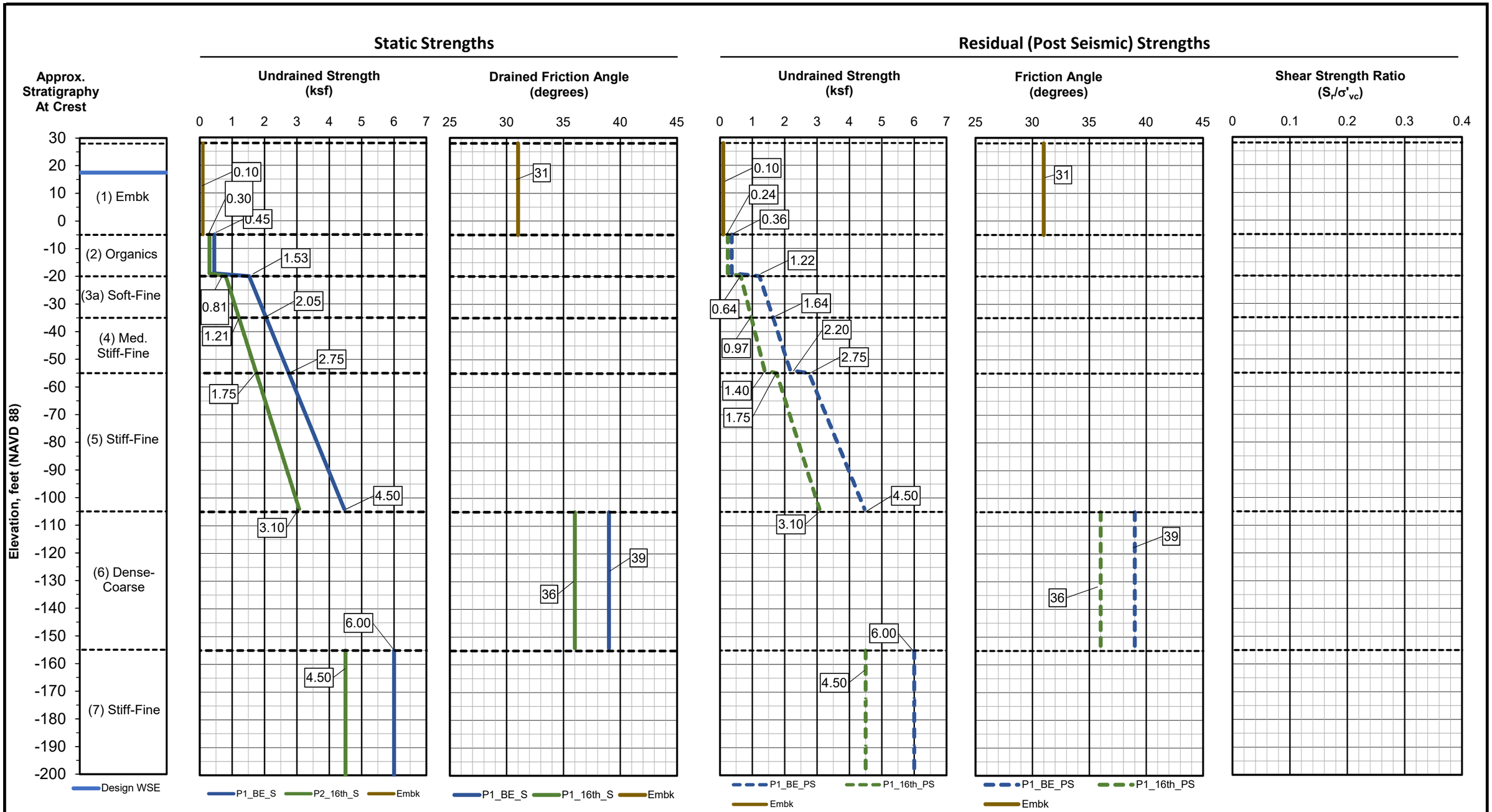
Delta Conveyance Design and Construction Authority

DCA DELTA CONVEYANCE DESIGN & CONSTRUCTION AUTHORITY

ANALYSIS SECTION
PROFILE P1 & P2
IMPROVED CONDITION
G2-AR15 & G2-AR25

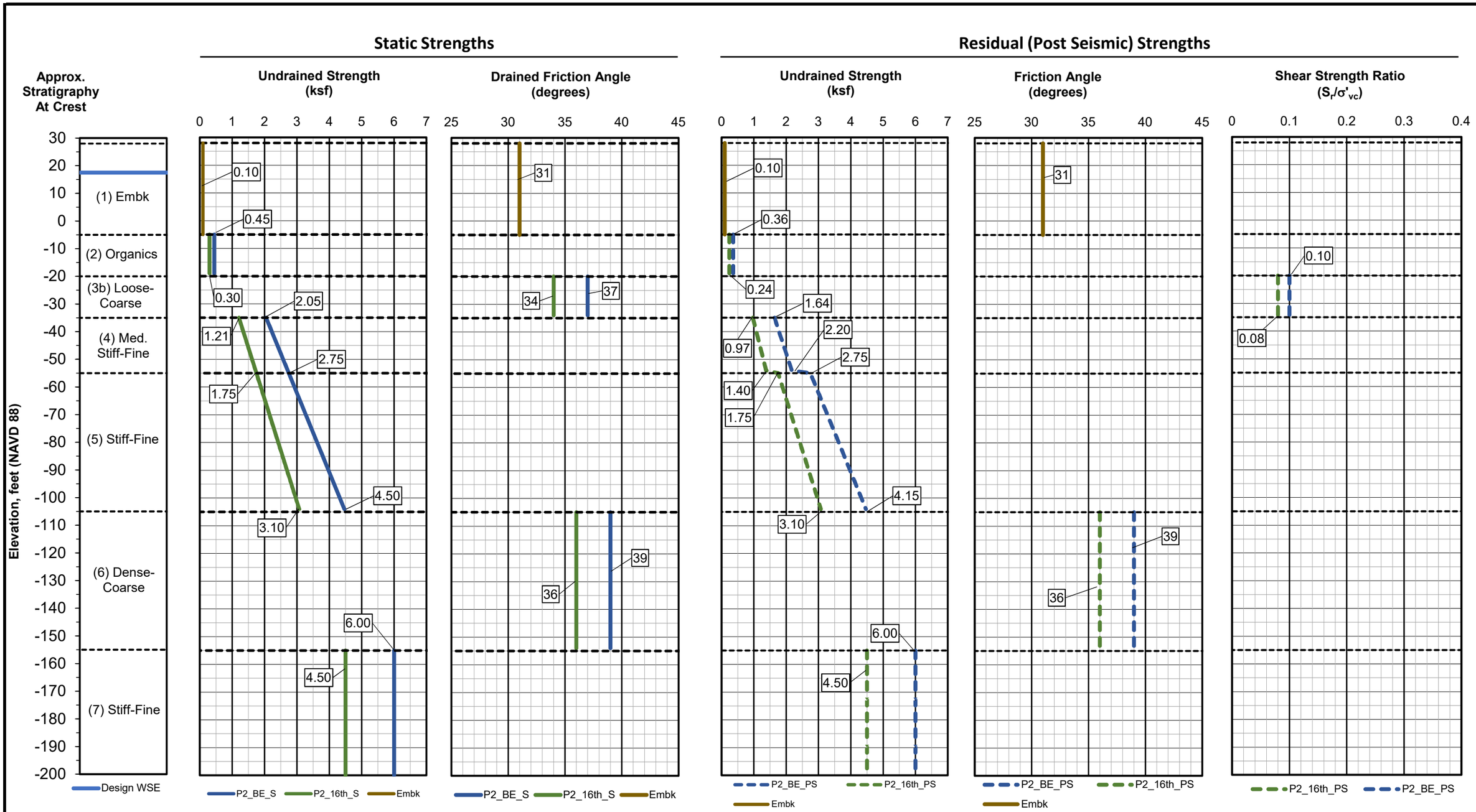
March 2020 Figure A2-4

\\OAK2L-ETICE \\sac1v-fs01\Data\WR\CA WaterFix DCA\Projects\1900832 CWF EDM\Analysis\Tech Memos\Southern Forebay Seismic Eval\02_Data Gathering\binning-digitization\AutoCAD\DCA_SF_Geometry_Sections.dwg - 2/27/2020



Note: Embankment fill undrained strength is equivalent to the drained cohesion based on assumed mohr-coulomb failure envelope for embankment fill.

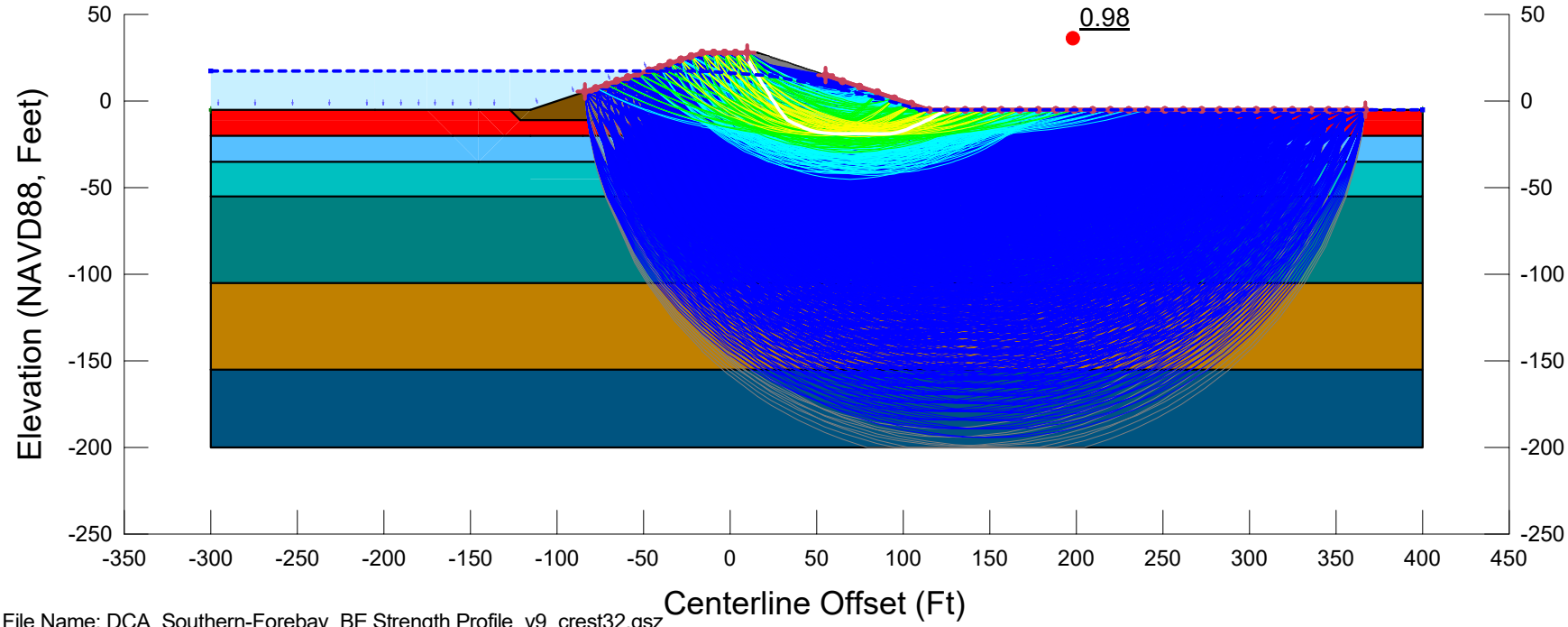
Southern Forebay Seisimc Sensitivity	DCA DELTA CONVEYANCE DESIGN & CONSTRUCTION AUTHORITY	Strength Parameters Profile P1
Delta Conveyance Design and Construction Authority		March 2020 Figure A2-5



Note: Embankment fill undrained strength is equivalent to the drained cohesion based on assumed mohr-coulomb failure envelope for embankment fill.

Southern Forebay Seisimc Sensitivity	DCA DELTA CONVEYANCE DESIGN & CONSTRUCTION AUTHORITY	Strength Parameters Profile P2
Delta Conveyance Design and Construction Authority		March 2020 Figure A2-6

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_BE	phi'_P1_BE		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_BE	phi'_P1_BE		
	04_Med. Stiff_Fine_P1	120	c_P1_BE	phi'_P1_BE		
	05_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	06_Dense_Coarse_P1	125	c_P1_BE	phi'_P1_BE		
	07_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		



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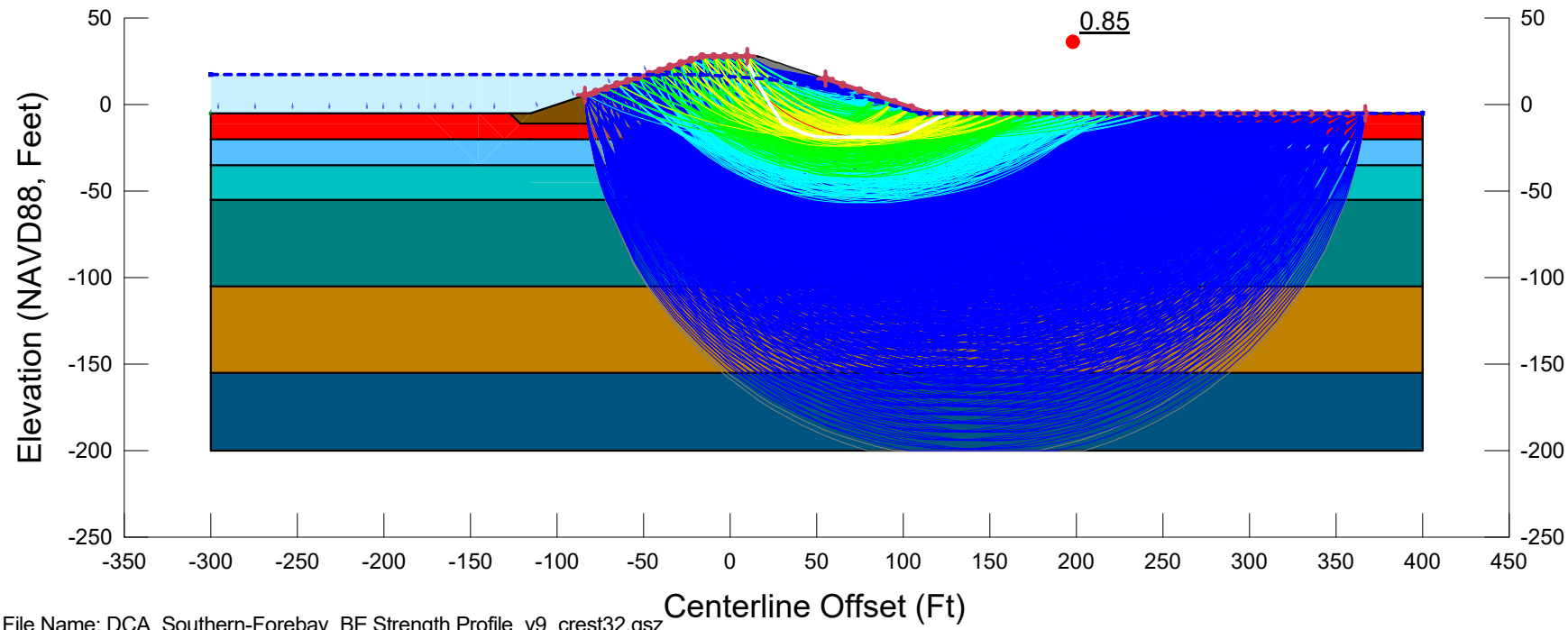
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Constant
Horz Seismic Coef.:

3H1V_P1_E_A1-S

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1.PS	90	c_P1_BE.PS	phi'_P1_BE.PS		
	03A_Soft-Med. Stiff_Fine_P1.PS	110	c_P1_BE.PS	phi'_P1_BE.PS		
	04_Med. Stiff_Fine_P1.PS	120	c_P1_BE.PS	phi'_P1_BE.PS		
	05_Stiff_Fine_P1.PS	125	c_P1_BE.PS	phi'_P1_BE.PS		
	06_Dense_Coarse_P1.PS	125	c_P1_BE.PS	phi'_P1_BE.PS		
	07_Stiff_Fine_P1.PS	125	c_P1_BE.PS	phi'_P1_BE.PS		



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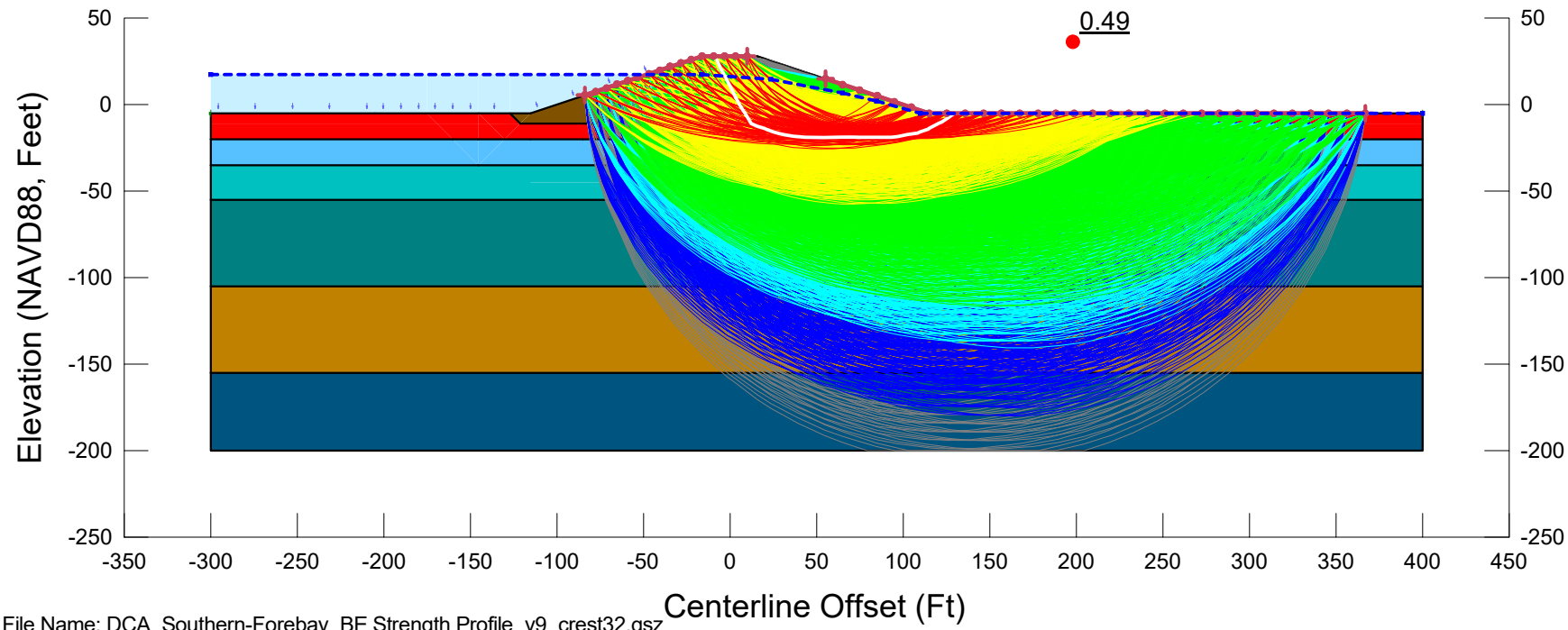
F of S Calculation Option: Constant
Horz Seismic Coef.:

3H1V_P1_E_A2-PS	
DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz	
02/27/2020	1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_BE	phi'_P1_BE		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_BE	phi'_P1_BE		
	04_Med. Stiff_Fine_P1	120	c_P1_BE	phi'_P1_BE		
	05_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	06_Dense_Coarse_P1	125	c_P1_BE	phi'_P1_BE		
	07_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		



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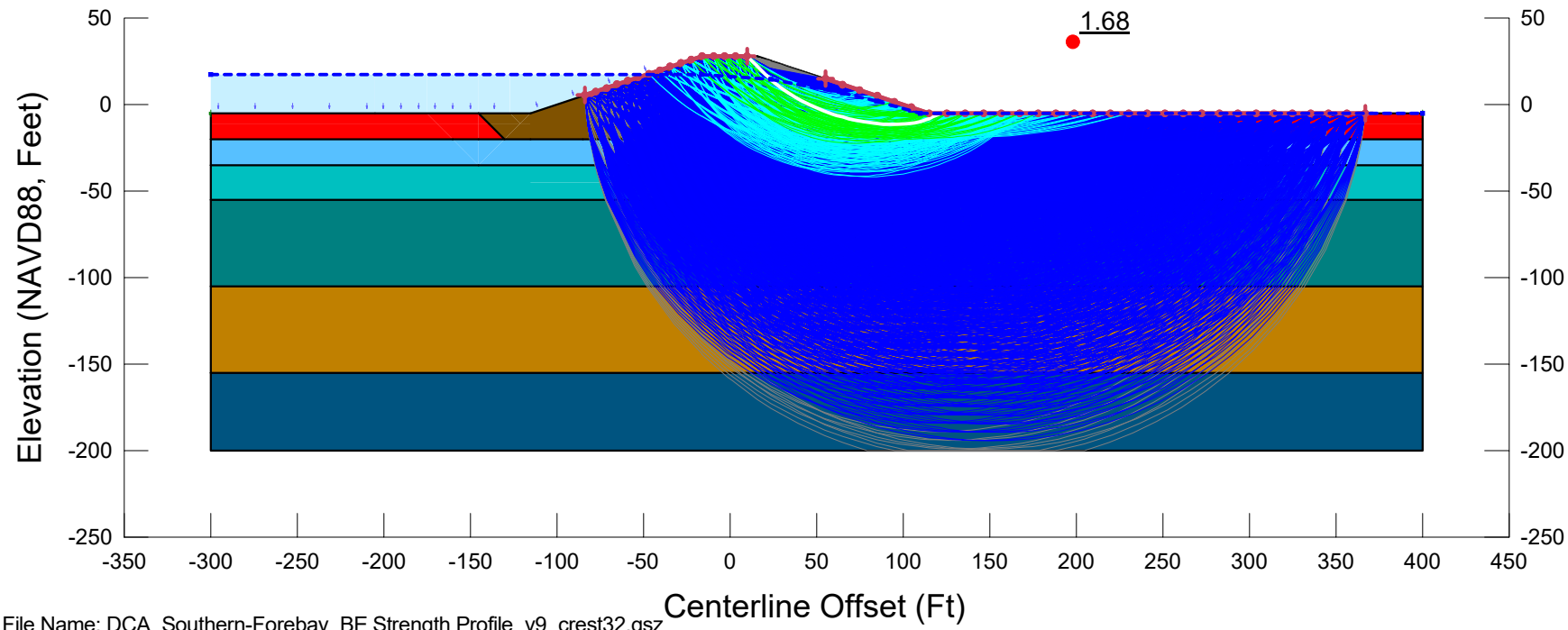
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

3H1V_P1_E_A3-PSS	
DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz	
02/27/2020	1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_BE	phi'_P1_BE		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_BE	phi'_P1_BE		
	04_Med. Stiff_Fine_P1	120	c_P1_BE	phi'_P1_BE		
	05_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	06_Dense_Coarse_P1	125	c_P1_BE	phi'_P1_BE		
	07_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	09_Soil Bentonite Wall	100			300	0



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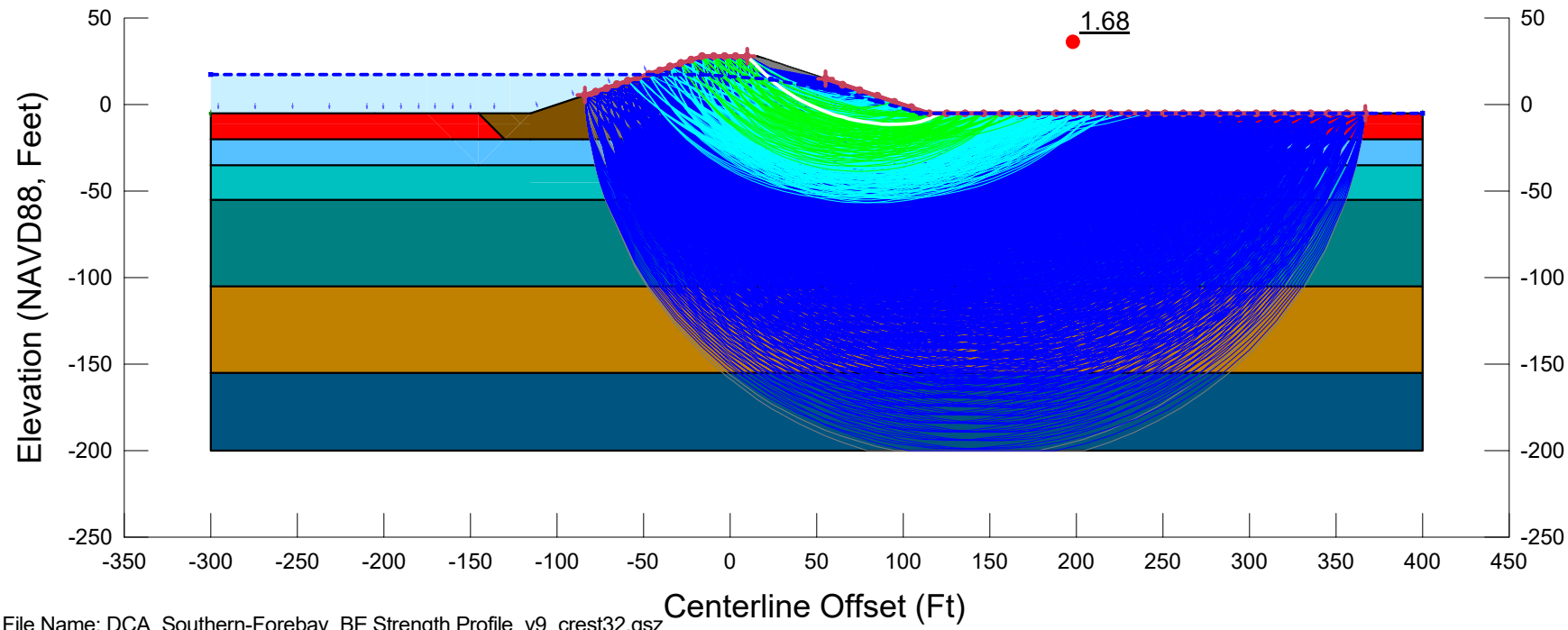
F of S Calculation Option: Constant
Horz Seismic Coef.:

3H1V_P1_G1-RR15_A1-S

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1.PS	90	c_P1_BE.PS	phi'_P1_BE.PS		
	03A_Soft-Med. Stiff_Fine_P1.PS	110	c_P1_BE.PS	phi'_P1_BE.PS		
	04_Med. Stiff_Fine_P1.PS	120	c_P1_BE.PS	phi'_P1_BE.PS		
	05_Stiff_Fine_P1.PS	125	c_P1_BE.PS	phi'_P1_BE.PS		
	06_Dense_Coarse_P1.PS	125	c_P1_BE.PS	phi'_P1_BE.PS		
	07_Stiff_Fine_P1.PS	125	c_P1_BE.PS	phi'_P1_BE.PS		
	09_Soil Bentonite Wall	100			300	0



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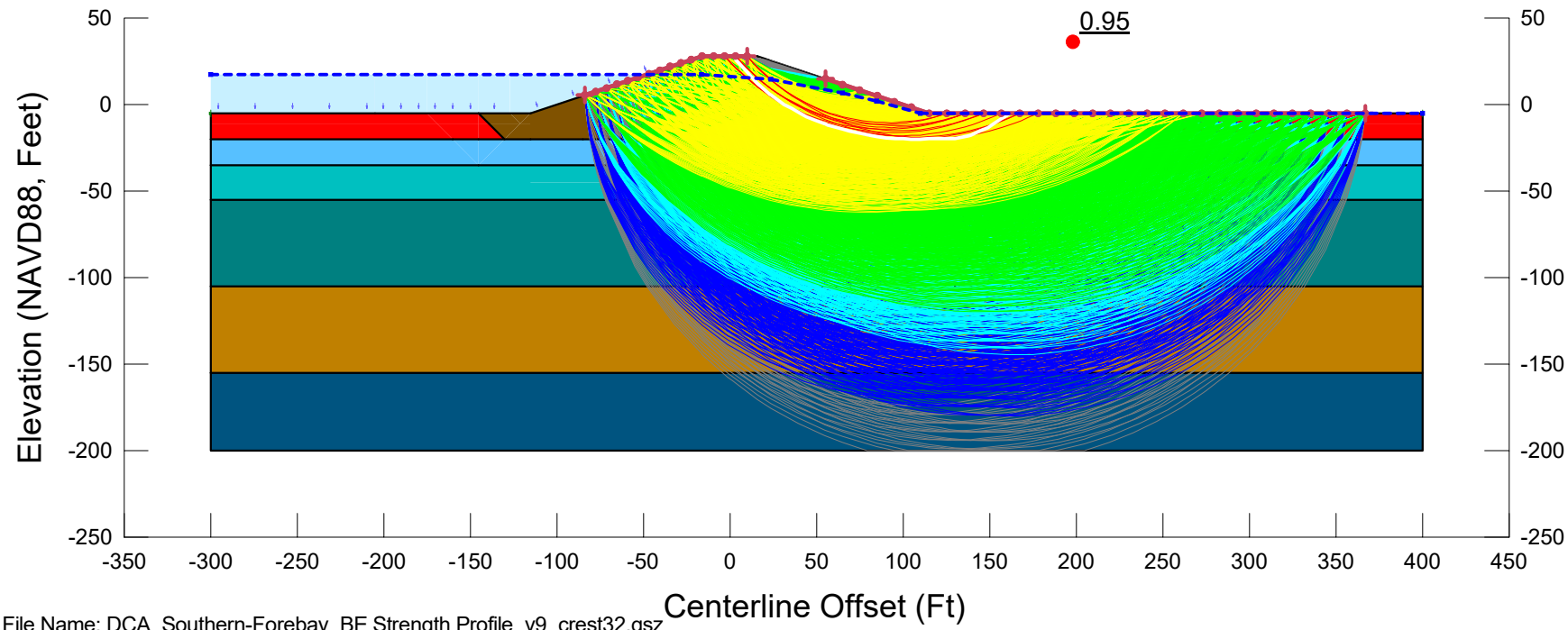
F of S Calculation Option: Constant
Horz Seismic Coef.:

3H1V_P1_G1-RR15_A2-PS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_BE	phi'_P1_BE		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_BE	phi'_P1_BE		
	04_Med. Stiff_Fine_P1	120	c_P1_BE	phi'_P1_BE		
	05_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	06_Dense_Coarse_P1	125	c_P1_BE	phi'_P1_BE		
	07_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	09_Soil Bentonite Wall	100			300	0



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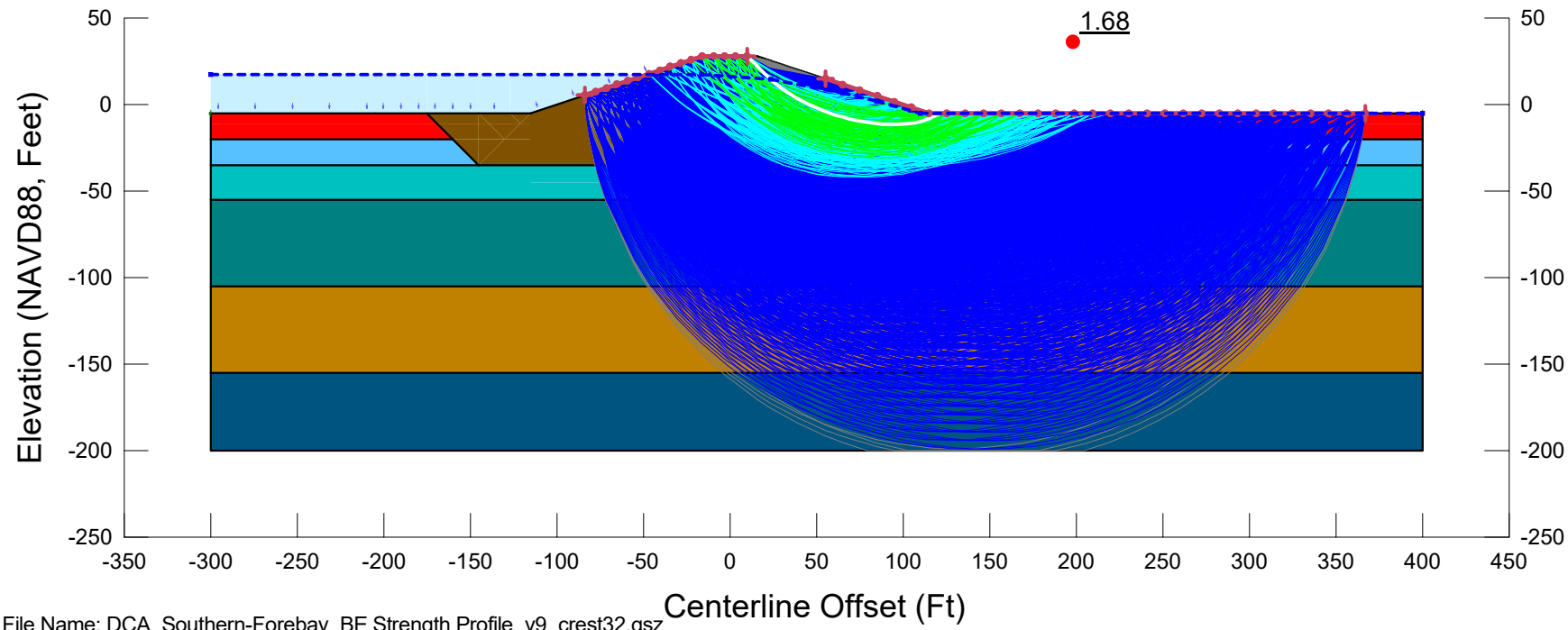
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

3H1V_P1_G1-RR15_A3-PSS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_BE	phi'_P1_BE		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_BE	phi'_P1_BE		
	04_Med. Stiff_Fine_P1	120	c_P1_BE	phi'_P1_BE		
	05_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	06_Dense_Coarse_P1	125	c_P1_BE	phi'_P1_BE		
	07_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	09_Soil Bentonite Wall	100			300	0



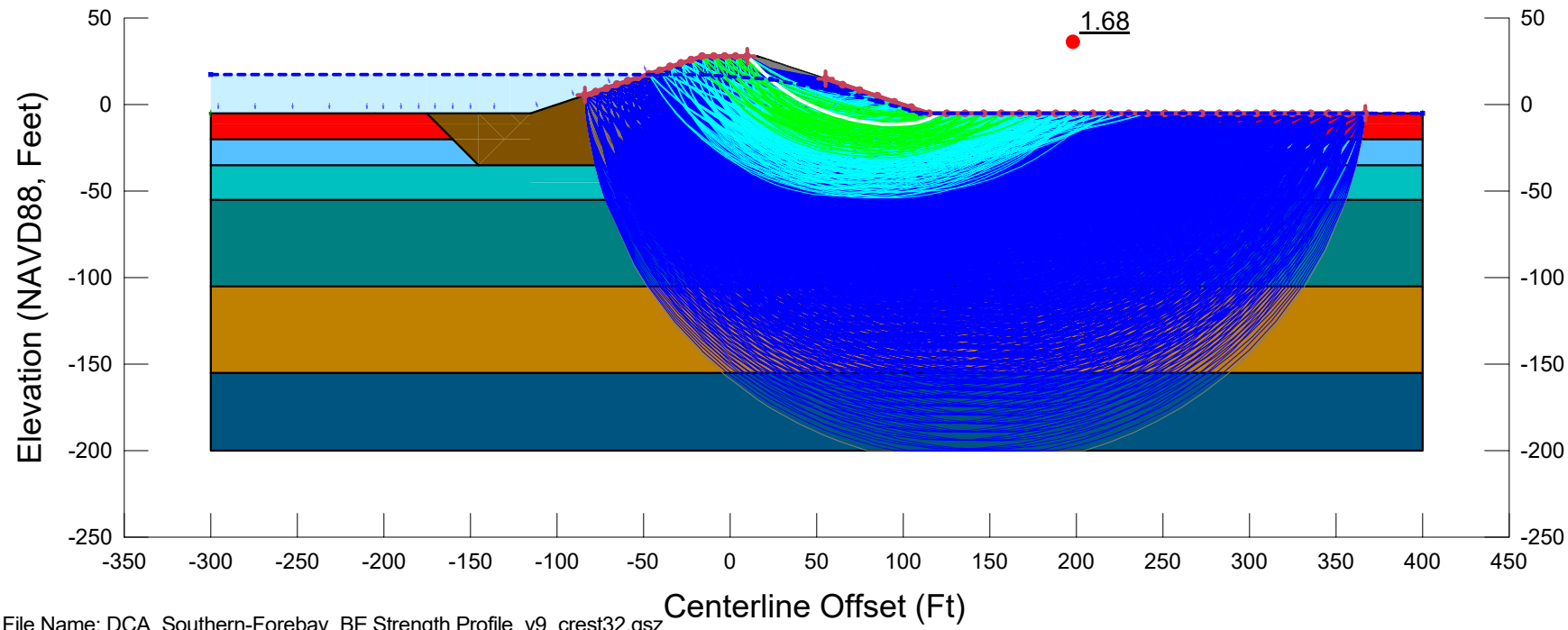
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Constant
Horz Seismic Coef.:

3H1V_P1_G1-RR30_A1-S

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1.PS	90	c_P1_BE.PS	phi'_P1_BE.PS		
	03A_Soft-Med. Stiff_Fine_P1.PS	110	c_P1_BE.PS	phi'_P1_BE.PS		
	04_Med. Stiff_Fine_P1.PS	120	c_P1_BE.PS	phi'_P1_BE.PS		
	05_Stiff_Fine_P1.PS	125	c_P1_BE.PS	phi'_P1_BE.PS		
	06_Dense_Coarse_P1.PS	125	c_P1_BE.PS	phi'_P1_BE.PS		
	07_Stiff_Fine_P1.PS	125	c_P1_BE.PS	phi'_P1_BE.PS		
	09_Soil Bentonite Wall	100			300	0



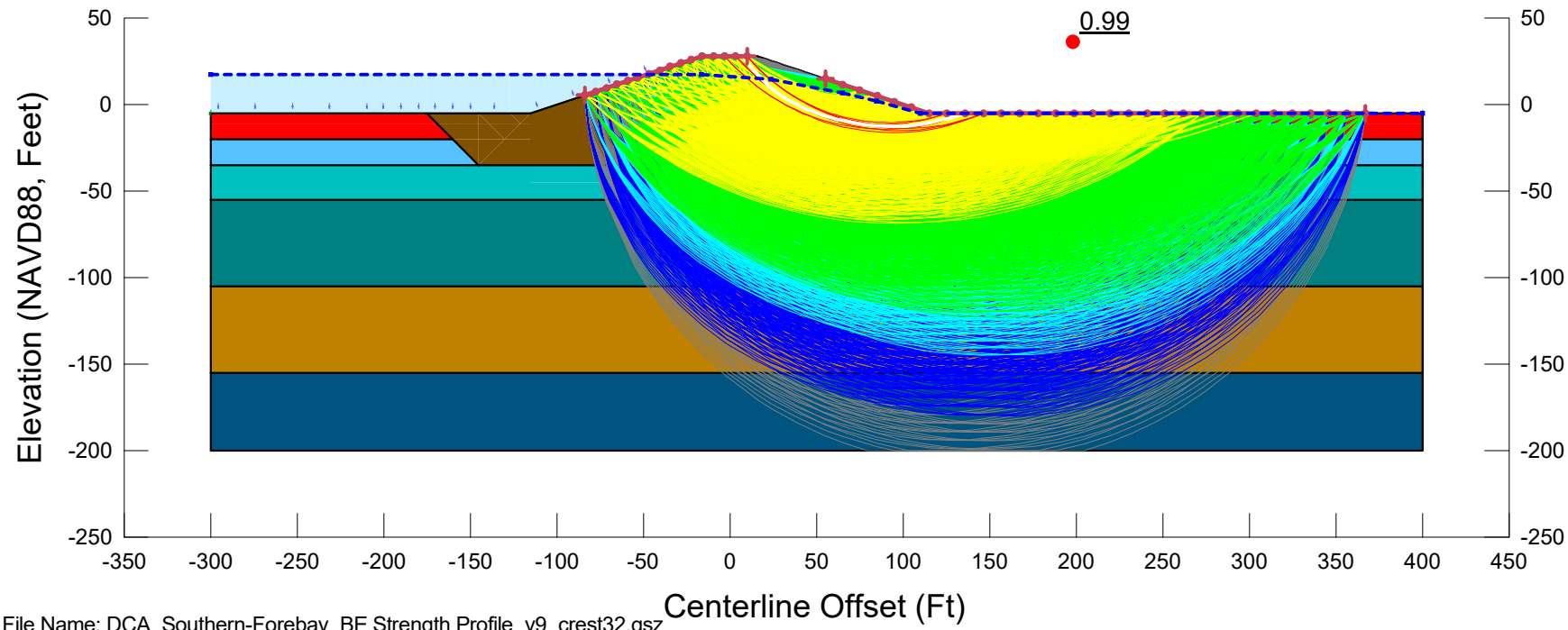
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Constant
Horz Seismic Coef.:

3H1V_P1_G1-RR30_A2-PS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_BE	phi'_P1_BE		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_BE	phi'_P1_BE		
	04_Med. Stiff_Fine_P1	120	c_P1_BE	phi'_P1_BE		
	05_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	06_Dense_Coarse_P1	125	c_P1_BE	phi'_P1_BE		
	07_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	09_Soil Bentonite Wall	100			300	0



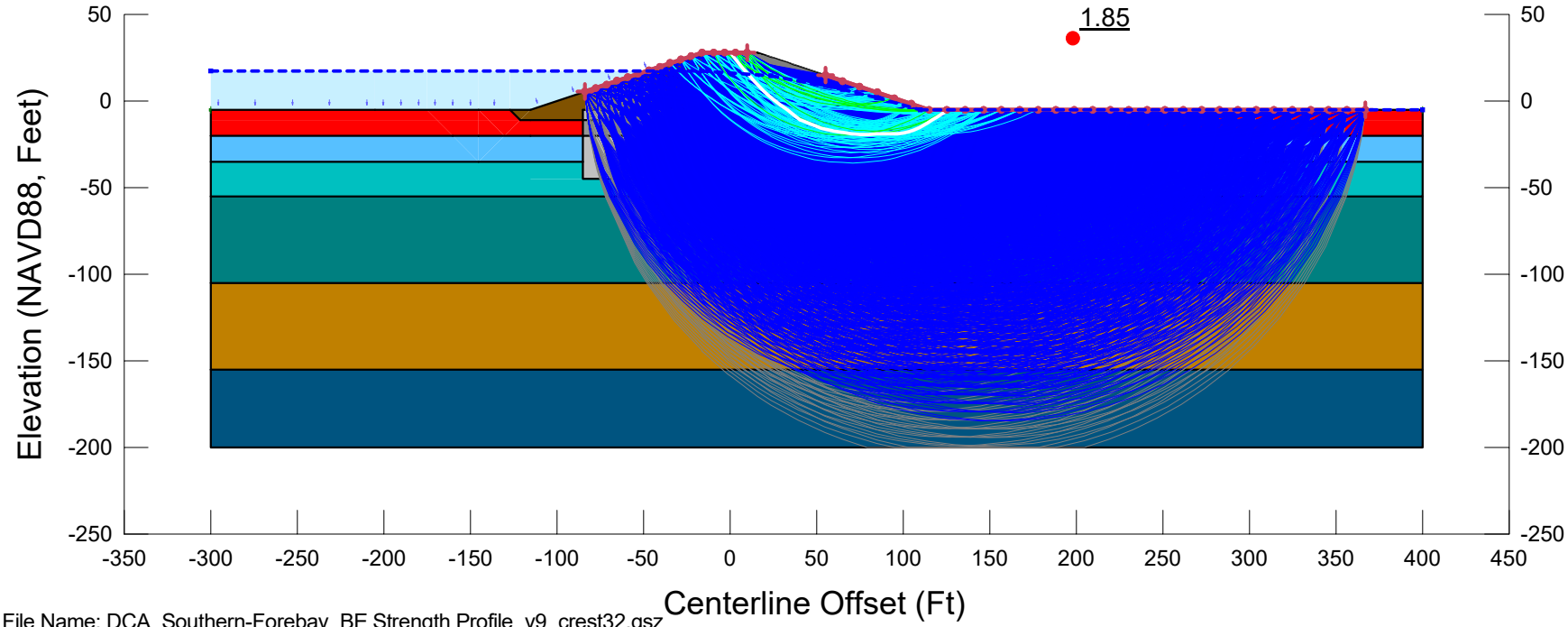
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

3H1V_P1_G1-RR30_A3-PSS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_BE	phi'_P1_BE		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_BE	phi'_P1_BE		
	04_Med. Stiff_Fine_P1	120	c_P1_BE	phi'_P1_BE		
	05_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	06_Dense_Coarse_P1	125	c_P1_BE	phi'_P1_BE		
	07_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	08_Soil Cement AR=0.15	125			2,400	0
	08_Soil Cement Organics AR=0.15	125			1,425	0
	09_Soil Bentonite Wall	100			300	0



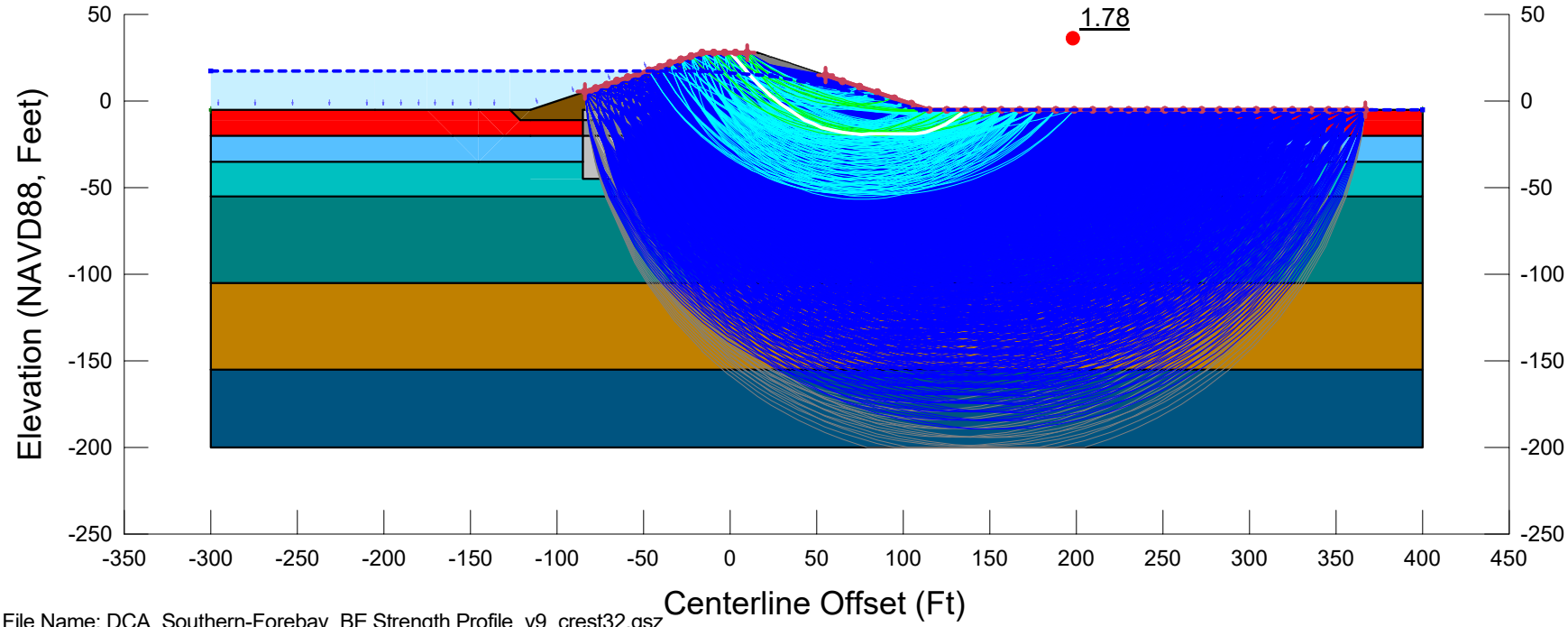
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.:

3H1V_P1_G2-AR15_A1-S

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1.PS	90	c_P1_BE.PS	phi'_P1_BE.PS		
	03A_Soft-Med. Stiff_Fine_P1.PS	110	c_P1_BE.PS	phi'_P1_BE.PS		
	04_Med. Stiff_Fine_P1.PS	120	c_P1_BE.PS	phi'_P1_BE.PS		
	05_Stiff_Fine_P1.PS	125	c_P1_BE.PS	phi'_P1_BE.PS		
	06_Dense_Coarse_P1.PS	125	c_P1_BE.PS	phi'_P1_BE.PS		
	07_Stiff_Fine_P1.PS	125	c_P1_BE.PS	phi'_P1_BE.PS		
	08_Soil Cement AR=0.15	125			2,400	0
	08_Soil Cement Organics AR=0.15	125			1,425	0
	09_Soil Bentonite Wall	100			300	0



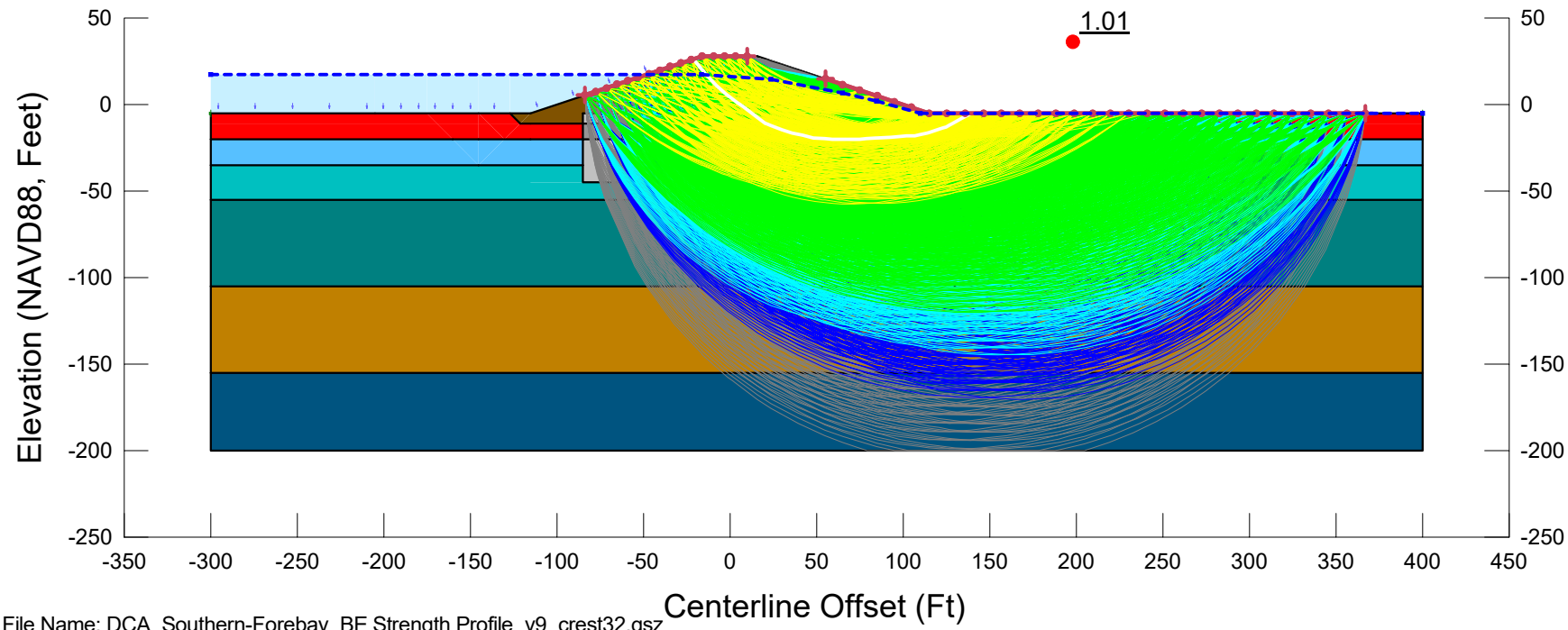
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.:

3H1V_P1_G2-AR15_A2-PS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_BE	phi'_P1_BE		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_BE	phi'_P1_BE		
	04_Med. Stiff_Fine_P1	120	c_P1_BE	phi'_P1_BE		
	05_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	06_Dense_Coarse_P1	125	c_P1_BE	phi'_P1_BE		
	07_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	08_Soil Cement AR=0.15	125			2,400	0
	08_Soil Cement Organics AR=0.15	125			1,425	0
	09_Soil Bentonite Wall	100			300	0



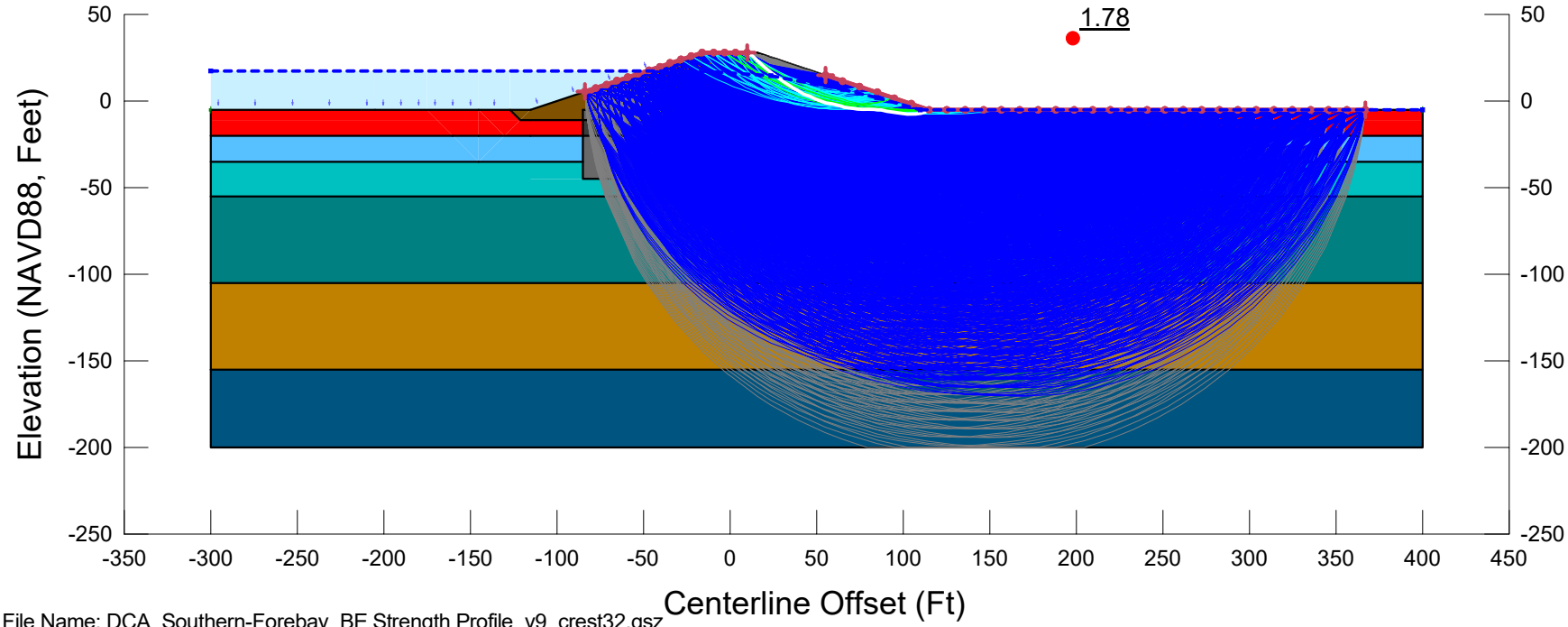
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

3H1V_P1_G2-AR15_A3-PSS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_BE	phi'_P1_BE		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_BE	phi'_P1_BE		
	04_Med. Stiff_Fine_P1	120	c_P1_BE	phi'_P1_BE		
	05_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	06_Dense_Coarse_P1	125	c_P1_BE	phi'_P1_BE		
	07_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	08_Soil Cement AR=0.25	125			4,000	0
	08_Soil Cement Organics AR=0.25	125			2,225	0
	09_Soil Bentonite Wall	100			300	0



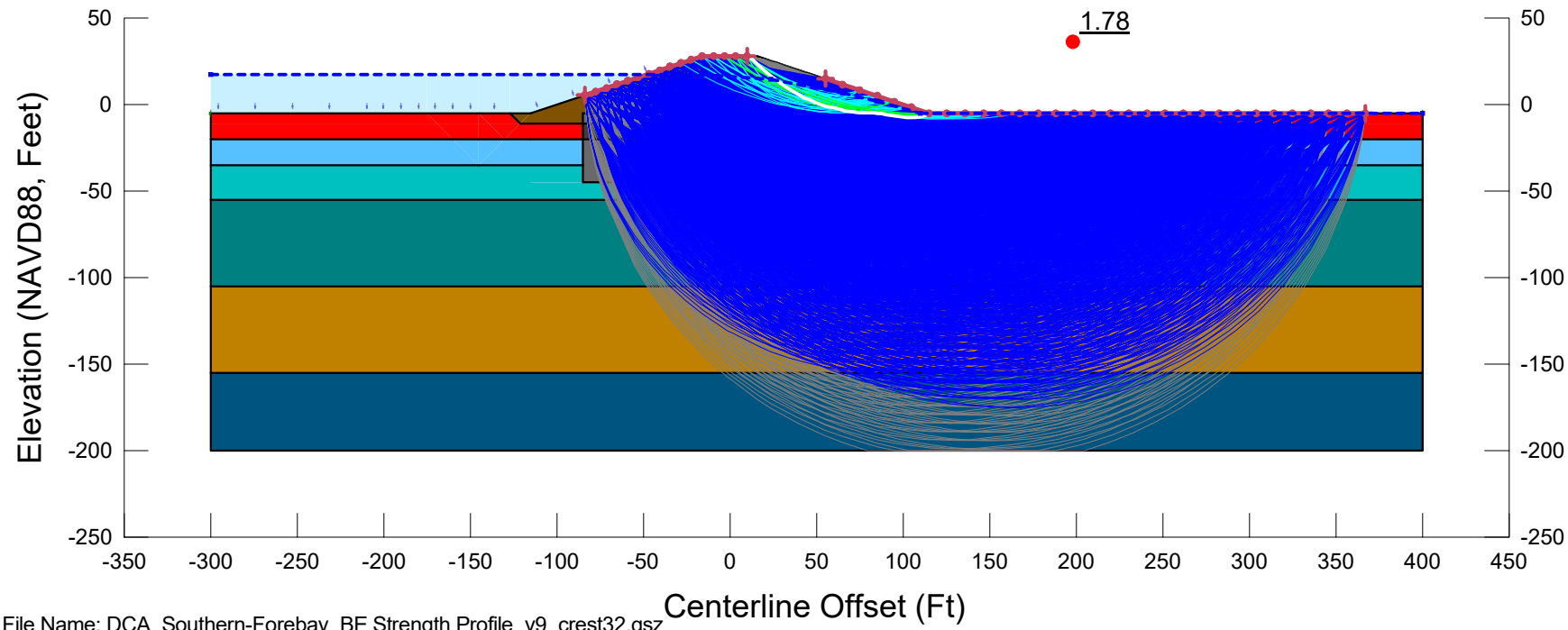
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.:

3H1V_P1_G2-AR25_A1-S

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1.PS	90	c_P1_BE.PS	phi'_P1_BE.PS		
	03A_Soft-Med. Stiff_Fine_P1.PS	110	c_P1_BE.PS	phi'_P1_BE.PS		
	04_Med. Stiff_Fine_P1.PS	120	c_P1_BE.PS	phi'_P1_BE.PS		
	05_Stiff_Fine_P1.PS	125	c_P1_BE.PS	phi'_P1_BE.PS		
	06_Dense_Coarse_P1.PS	125	c_P1_BE.PS	phi'_P1_BE.PS		
	07_Stiff_Fine_P1.PS	125	c_P1_BE.PS	phi'_P1_BE.PS		
	08_Soil Cement AR=0.25	125			4,000	0
	08_Soil Cement Organics AR=0.25	125			2,225	0
	09_Soil Bentonite Wall	100			300	0



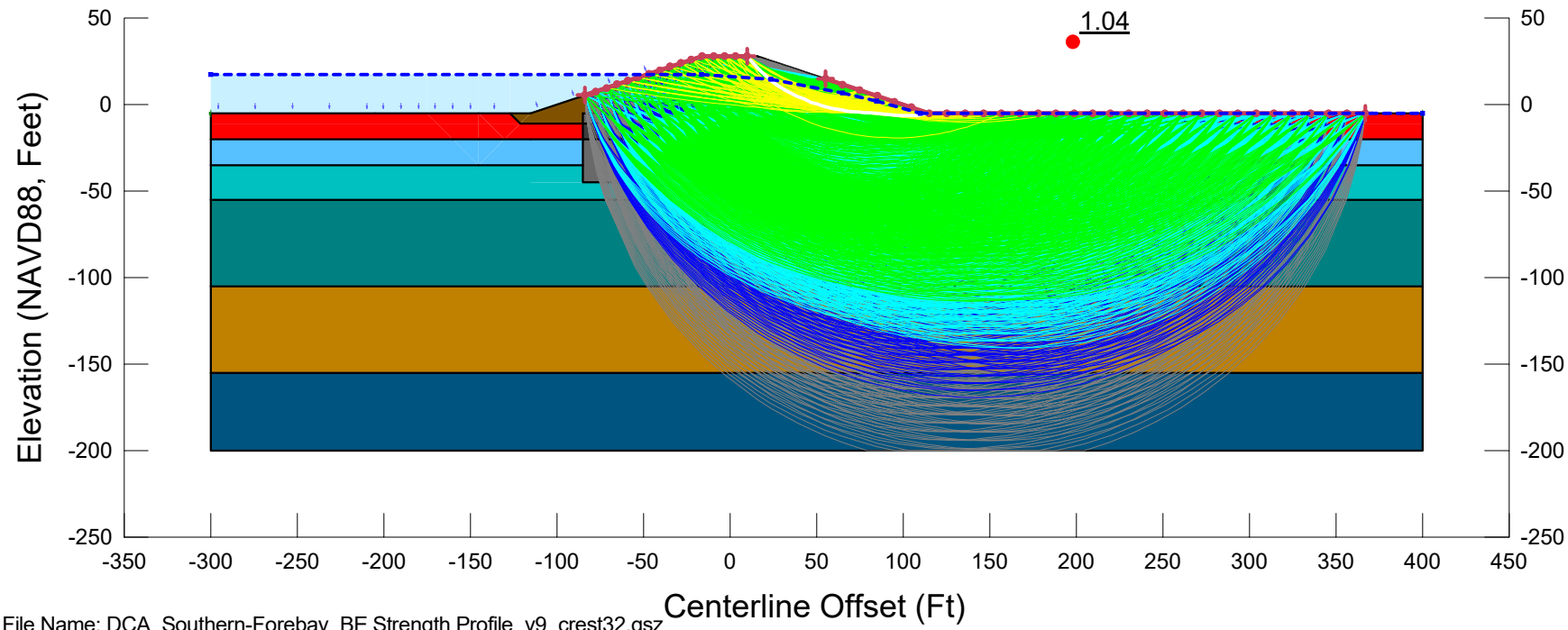
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.:

3H1V_P1_G2-AR25_A2-PS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_BE	phi'_P1_BE		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_BE	phi'_P1_BE		
	04_Med. Stiff_Fine_P1	120	c_P1_BE	phi'_P1_BE		
	05_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	06_Dense_Coarse_P1	125	c_P1_BE	phi'_P1_BE		
	07_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	08_Soil Cement AR=0.25	125			4,000	0
	08_Soil Cement Organics AR=0.25	125			2,225	0
	09_Soil Bentonite Wall	100			300	0



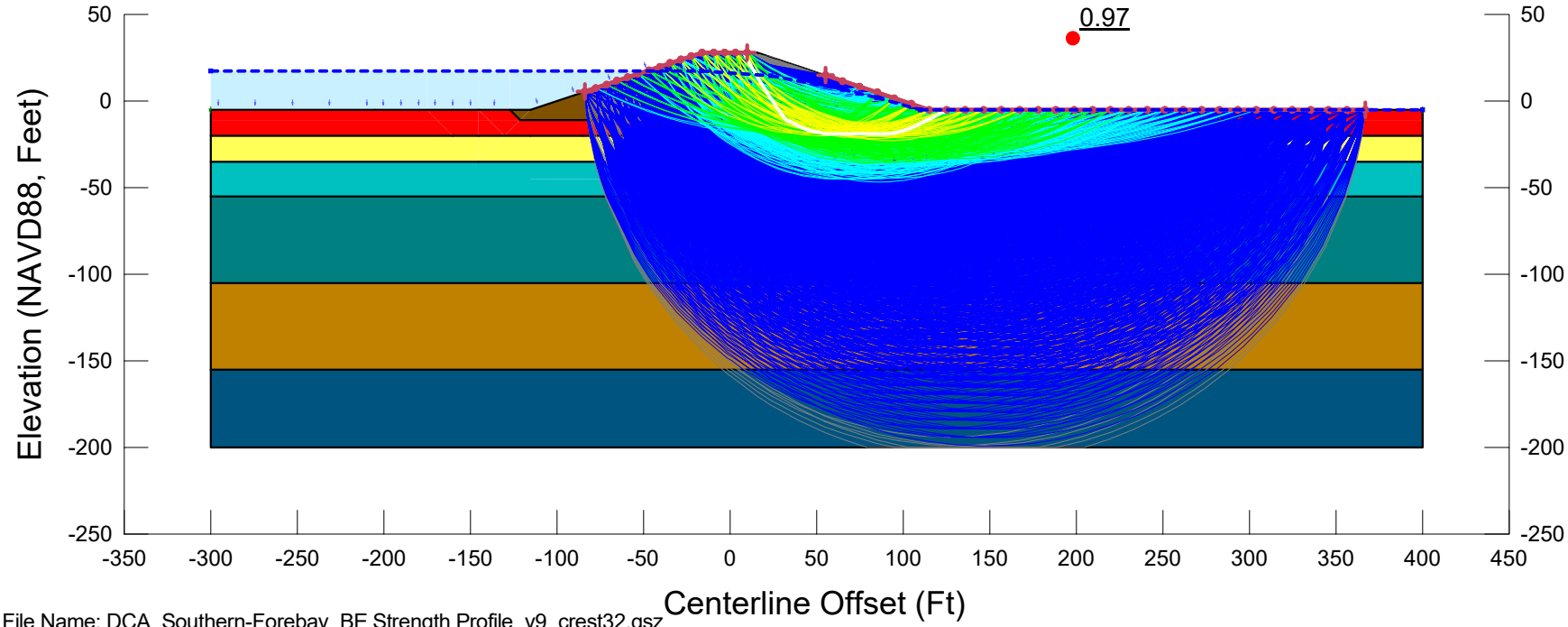
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

3H1V_P1_G2-AR25_A3-PSS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_BE	phi'_P2_BE		
	03B_Loose_Coarse_P2	110	c_P2_BE	phi'_P2_BE		
	04_Med. Stiff_Fine_P2	120	c_P2_BE	phi'_P2_BE		
	05_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	06_Dense_Coarse_P2	125	c_P2_BE	phi'_P2_BE		
	07_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		



File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
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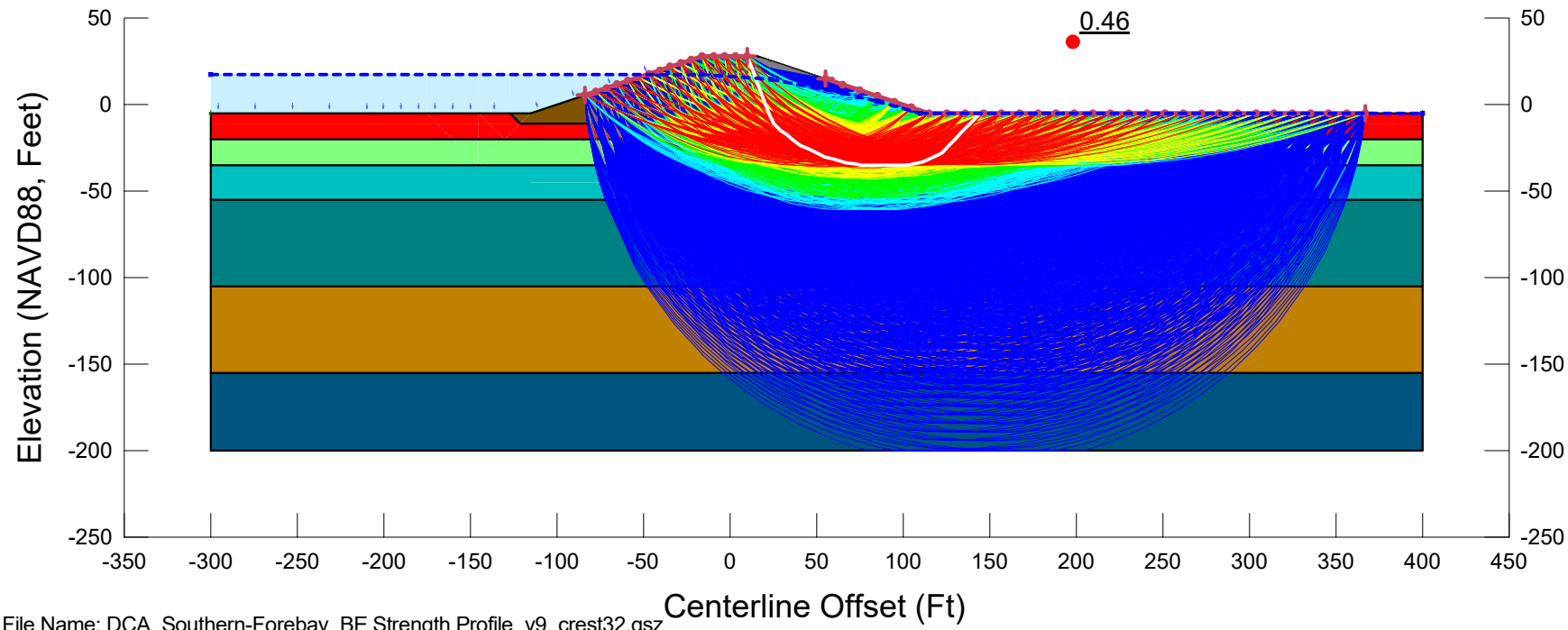
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Constant
Horz Seismic Coef.:

3H1V_P2_E_A1-S

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Tau/Sigma Ratio	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120				100	31
	02_Organics_P2.PS	90		c_P2_BE.PS	phi'_P2_BE.PS		
	03B_Loose_Coarse-0.1	110	0.1				
	04_Med. Stiff_Fine_P2.PS	120		c_P2_BE.PS	phi'_P2_BE.PS		
	05_Stiff_Fine_P2.PS	125		c_P2_BE.PS	phi'_P2_BE.PS		
	06_Dense_Coarse_P2.PS	125		c_P2_BE.PS	phi'_P2_BE.PS		
	07_Stiff_Fine_P2.PS	125		c_P2_BE.PS	phi'_P2_BE.PS		



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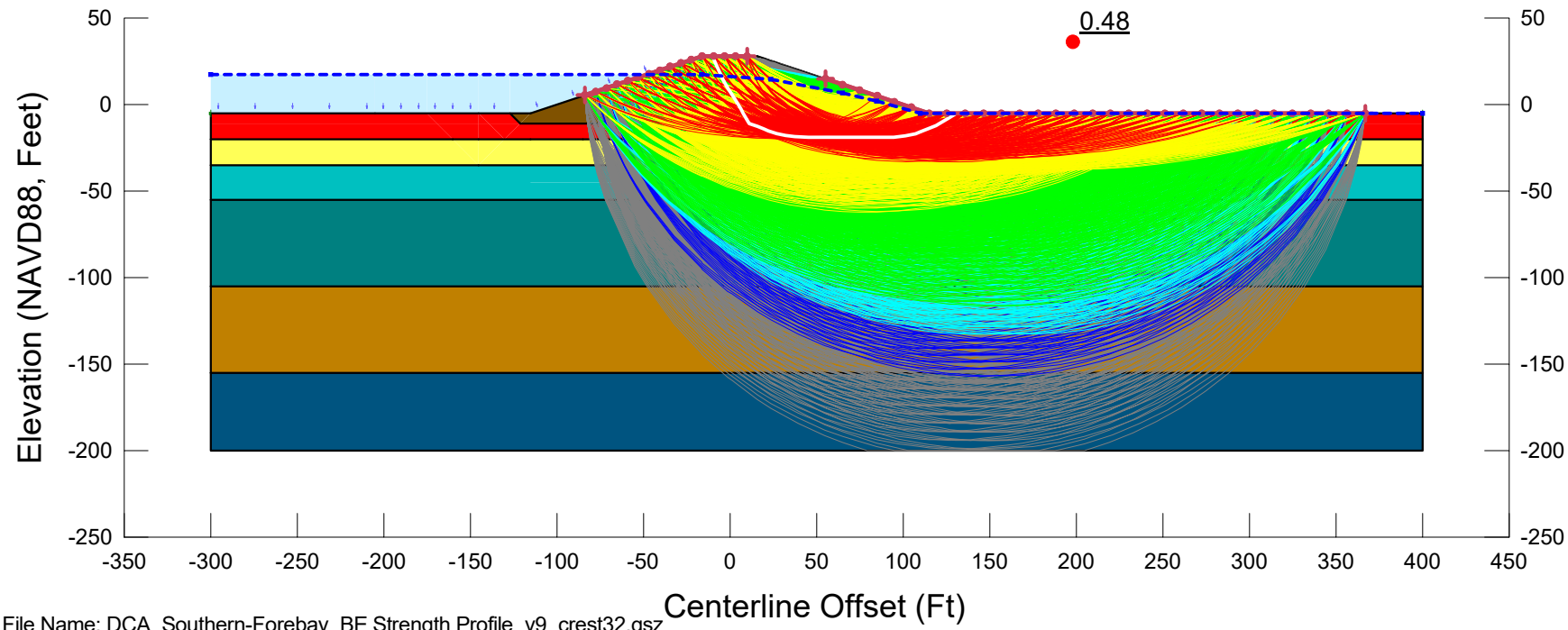
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Constant
Horz Seismic Coef.:

3H1V_P2_E_A2-PS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_BE	phi'_P2_BE		
	03B_Loose_Coarse_P2	110	c_P2_BE	phi'_P2_BE		
	04_Med. Stiff_Fine_P2	120	c_P2_BE	phi'_P2_BE		
	05_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	06_Dense_Coarse_P2	125	c_P2_BE	phi'_P2_BE		
	07_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		



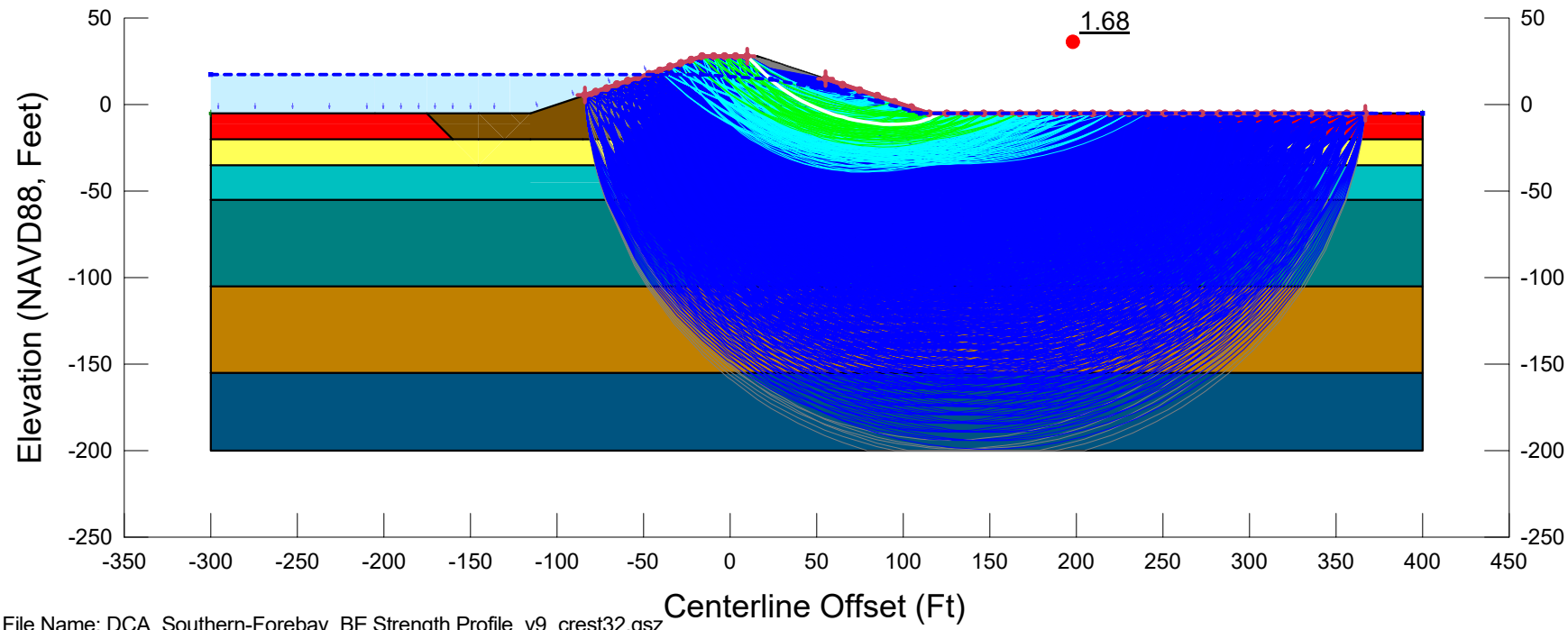
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

3H1V_P2_E_A3-PSS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_BE	phi'_P2_BE		
	03B_Loose_Coarse_P2	110	c_P2_BE	phi'_P2_BE		
	04_Med. Stiff_Fine_P2	120	c_P2_BE	phi'_P2_BE		
	05_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	06_Dense_Coarse_P2	125	c_P2_BE	phi'_P2_BE		
	07_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	09_Soil Bentonite Wall	100			300	0



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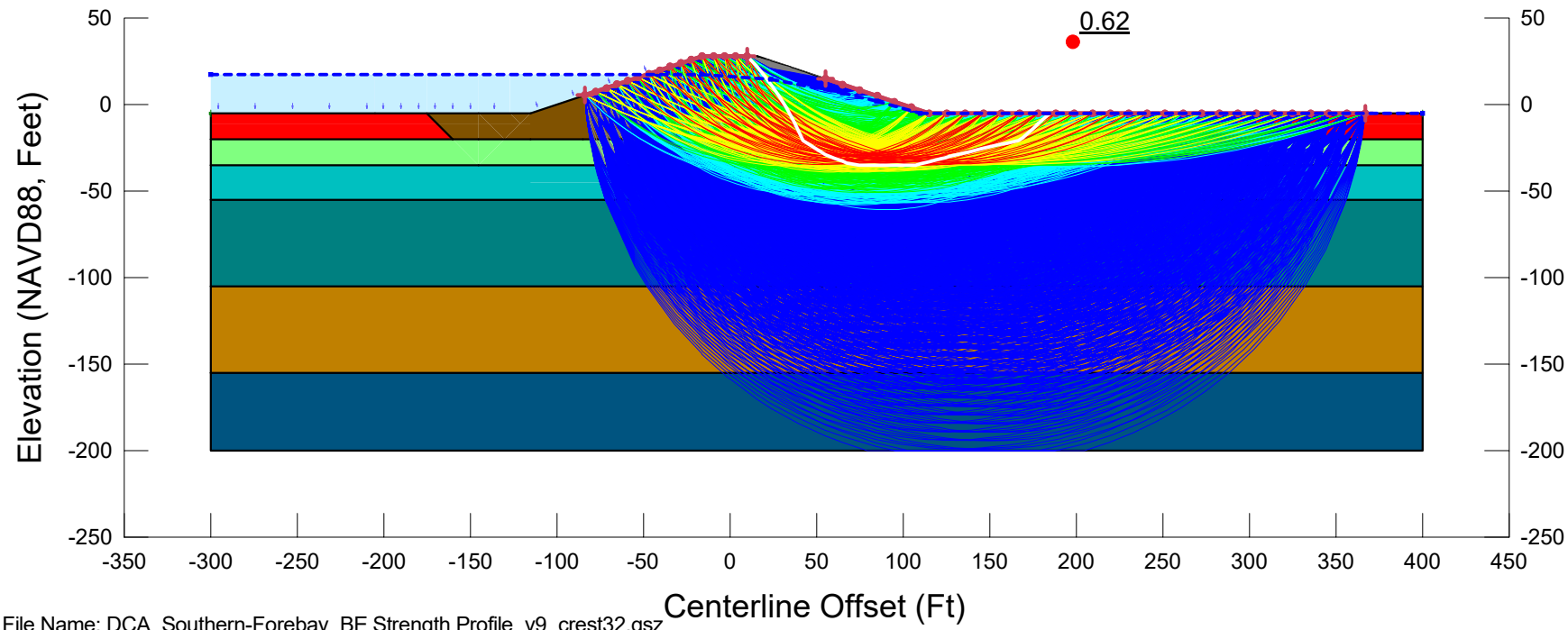
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Constant
Horz Seismic Coef.:

3H1V_P2_G1-RR15_A1-S

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Tau/Sigma Ratio	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120				100	31
	02_Organics_P2.PS	90		c_P2_BE.PS	phi'_P2_BE.PS		
	03B_Loose_Coarse-0.1	110	0.1				
	04_Med. Stiff_Fine_P2.PS	120		c_P2_BE.PS	phi'_P2_BE.PS		
	05_Stiff_Fine_P2.PS	125		c_P2_BE.PS	phi'_P2_BE.PS		
	06_Dense_Coarse_P2.PS	125		c_P2_BE.PS	phi'_P2_BE.PS		
	07_Stiff_Fine_P2.PS	125		c_P2_BE.PS	phi'_P2_BE.PS		
	09_Soil Bentonite Wall	100				300	0



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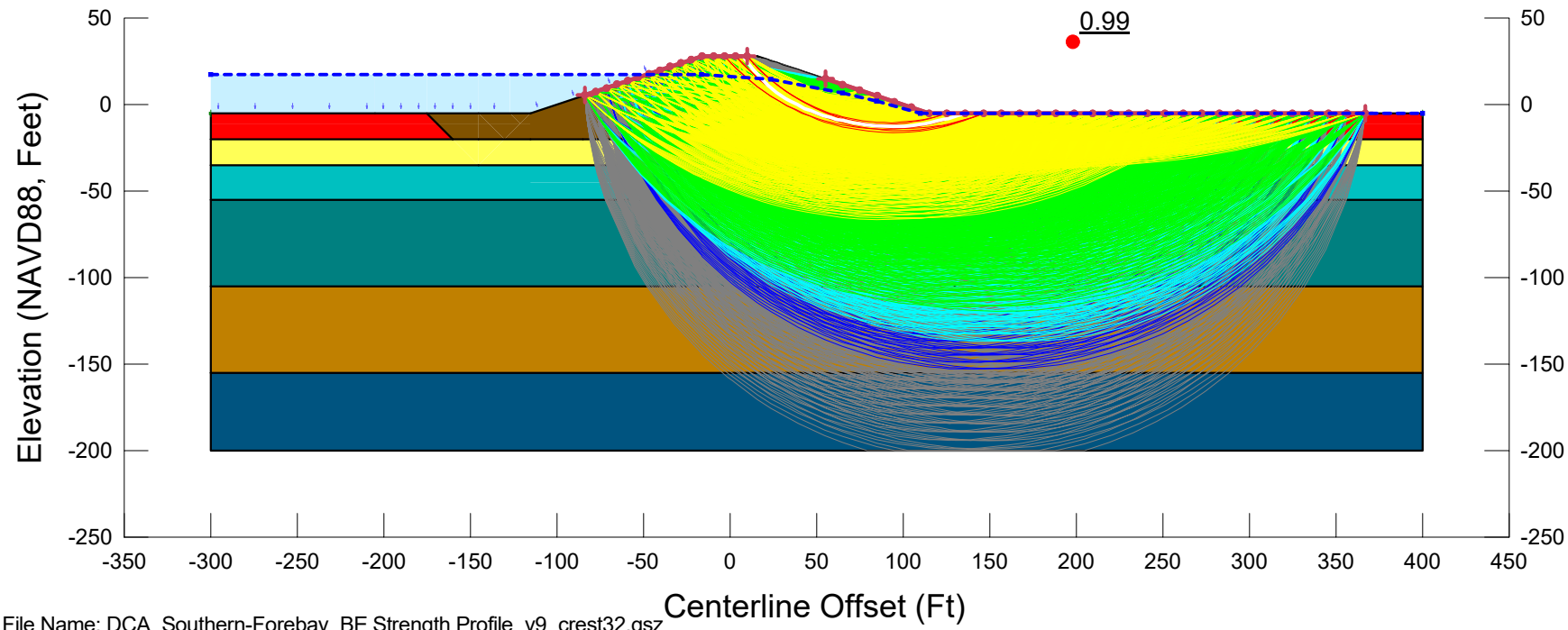
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Constant
Horz Seismic Coef.:

3H1V_P2_G1-RR15_A2-PS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_BE	phi'_P2_BE		
	03B_Loose_Coarse_P2	110	c_P2_BE	phi'_P2_BE		
	04_Med. Stiff_Fine_P2	120	c_P2_BE	phi'_P2_BE		
	05_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	06_Dense_Coarse_P2	125	c_P2_BE	phi'_P2_BE		
	07_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	09_Soil Bentonite Wall	100			300	0



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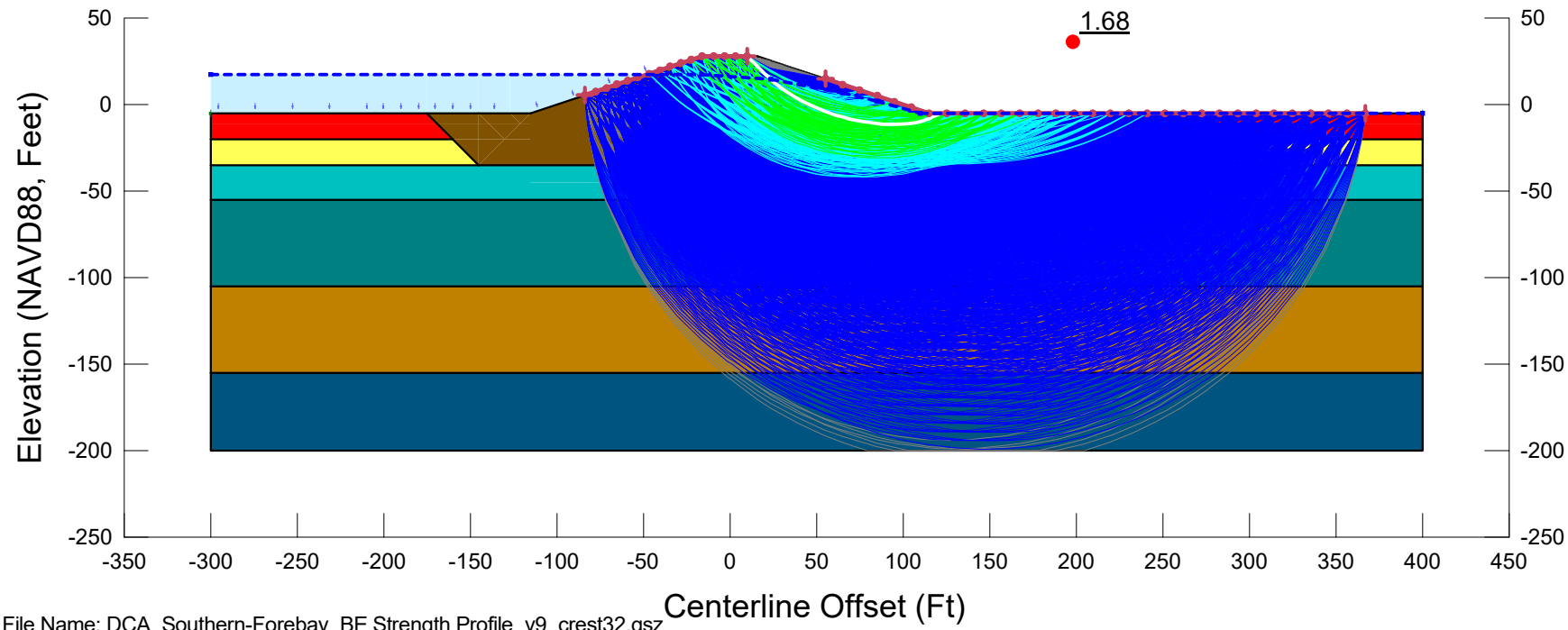
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

3H1V_P2_G1-RR15_A3-PSS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_BE	phi'_P2_BE		
	03B_Loose_Coarse_P2	110	c_P2_BE	phi'_P2_BE		
	04_Med. Stiff_Fine_P2	120	c_P2_BE	phi'_P2_BE		
	05_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	06_Dense_Coarse_P2	125	c_P2_BE	phi'_P2_BE		
	07_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	09_Soil Bentonite Wall	100			300	0



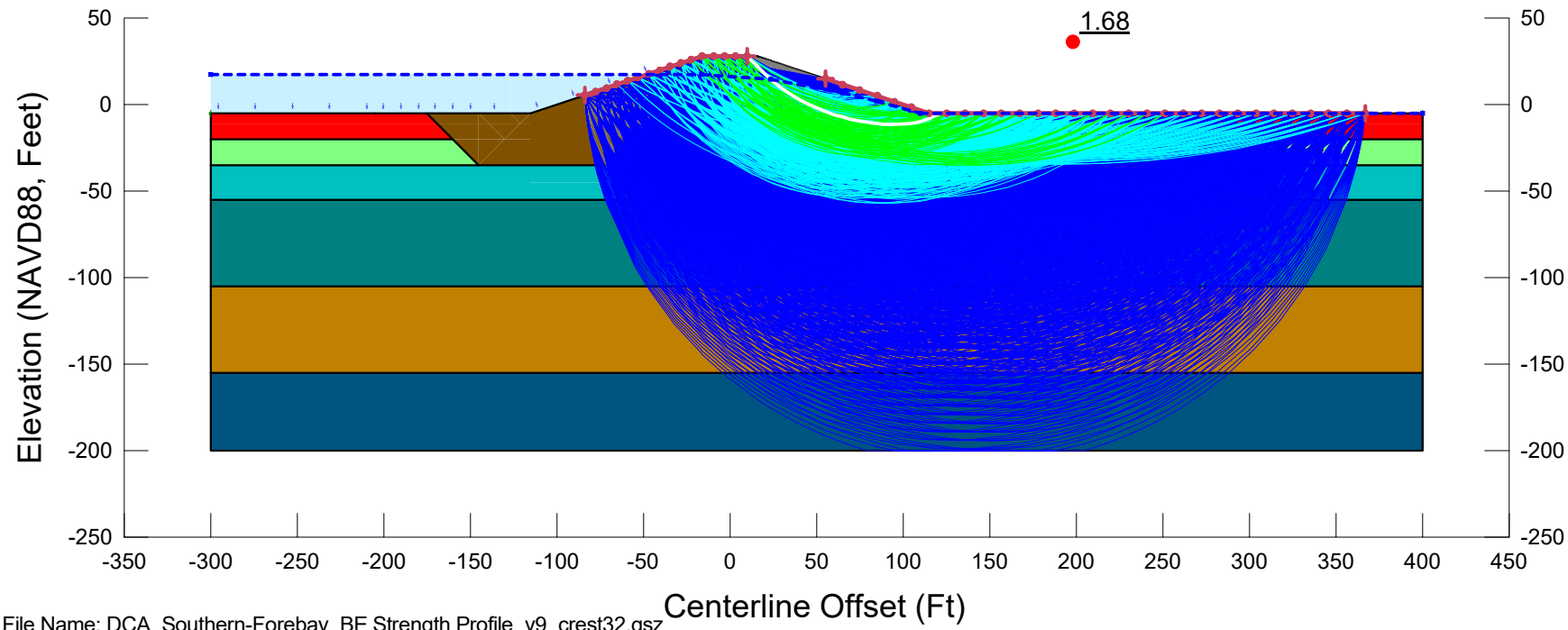
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Constant
Horz Seismic Coef.:

3H1V_P2_G1-RR30_A1-S

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Tau/Sigma Ratio	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120				100	31
	02_Organics_P2.PS	90		c_P2_BE.PS	phi'_P2_BE.PS		
	03B_Loose_Coarse-0.1	110	0.1				
	04_Med. Stiff_Fine_P2.PS	120		c_P2_BE.PS	phi'_P2_BE.PS		
	05_Stiff_Fine_P2.PS	125		c_P2_BE.PS	phi'_P2_BE.PS		
	06_Dense_Coarse_P2.PS	125		c_P2_BE.PS	phi'_P2_BE.PS		
	07_Stiff_Fine_P2.PS	125		c_P2_BE.PS	phi'_P2_BE.PS		
	09_Soil Bentonite Wall	100				300	0



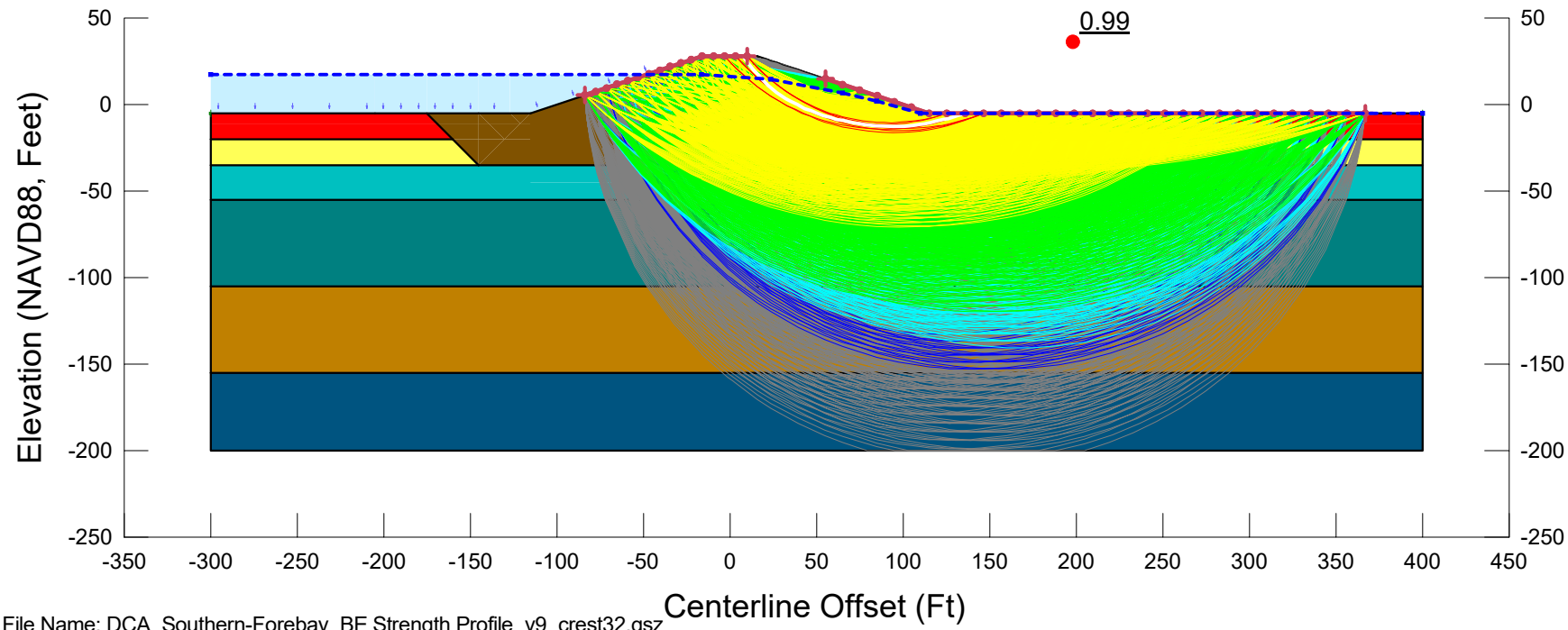
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Constant
Horz Seismic Coef.:

3H1V_P2_G1-RR30_A2-PS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_BE	phi'_P2_BE		
	03B_Loose_Coarse_P2	110	c_P2_BE	phi'_P2_BE		
	04_Med. Stiff_Fine_P2	120	c_P2_BE	phi'_P2_BE		
	05_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	06_Dense_Coarse_P2	125	c_P2_BE	phi'_P2_BE		
	07_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	09_Soil Bentonite Wall	100			300	0



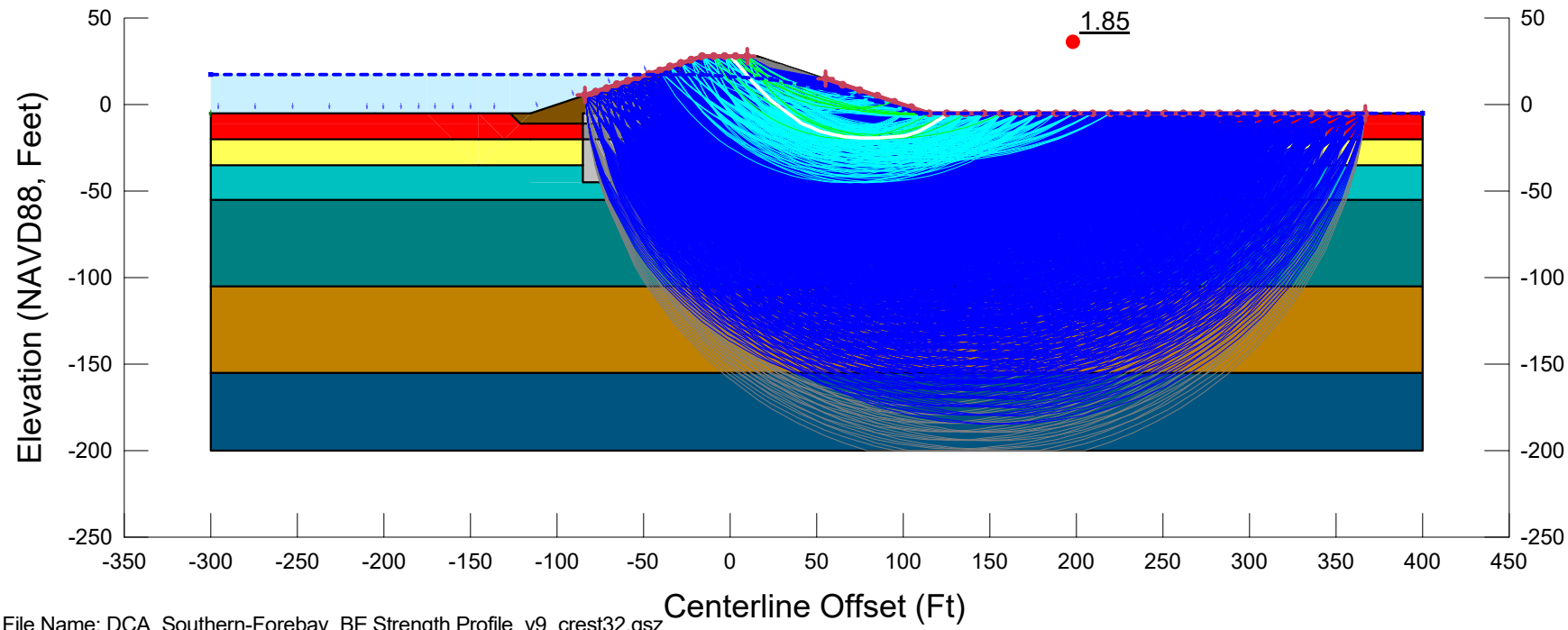
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

3H1V_P2_G1-RR30_A3-PSS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_BE	phi'_P2_BE		
	03B_Loose_Coarse_P2	110	c_P2_BE	phi'_P2_BE		
	04_Med. Stiff_Fine_P2	120	c_P2_BE	phi'_P2_BE		
	05_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	06_Dense_Coarse_P2	125	c_P2_BE	phi'_P2_BE		
	07_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	08_Soil Cement AR=0.15	125			2,400	0
	08_Soil Cement Organics AR=0.15	125			1,425	0
	09_Soil Bentonite Wall	100			300	0



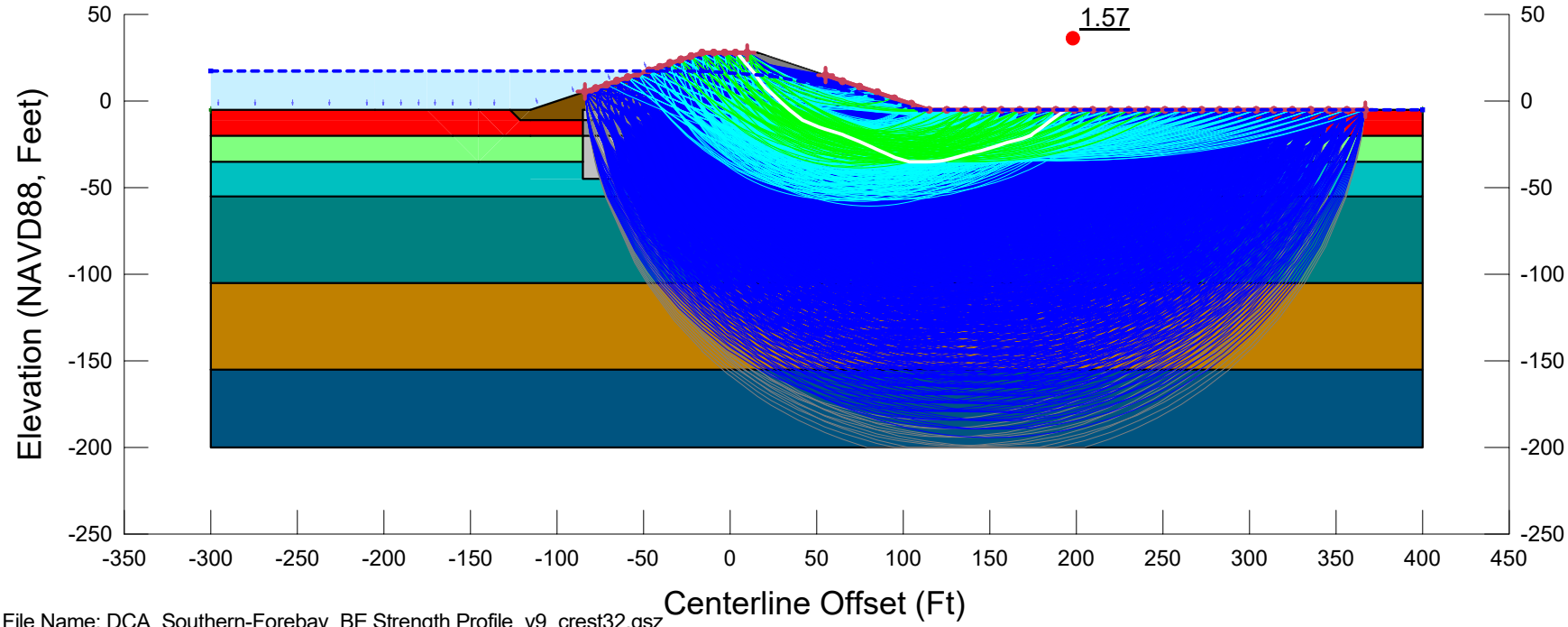
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.:

3H1V_P2_G2-AR15_A1-S

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Tau/Sigma Ratio	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120				100	31
	02_Organics_P2.PS	90		c_P2_BE.PS	phi'_P2_BE.PS		
	03B_Loose_Coarse-0.1	110	0.1				
	04_Med. Stiff_Fine_P2.PS	120		c_P2_BE.PS	phi'_P2_BE.PS		
	05_Stiff_Fine_P2.PS	125		c_P2_BE.PS	phi'_P2_BE.PS		
	06_Dense_Coarse_P2.PS	125		c_P2_BE.PS	phi'_P2_BE.PS		
	07_Stiff_Fine_P2.PS	125		c_P2_BE.PS	phi'_P2_BE.PS		
	08_Soil Cement AR=0.15	125				2,400	0
	08_Soil Cement Organics AR=0.15	125				1,425	0
	09_Soil Bentonite Wall	100				300	0



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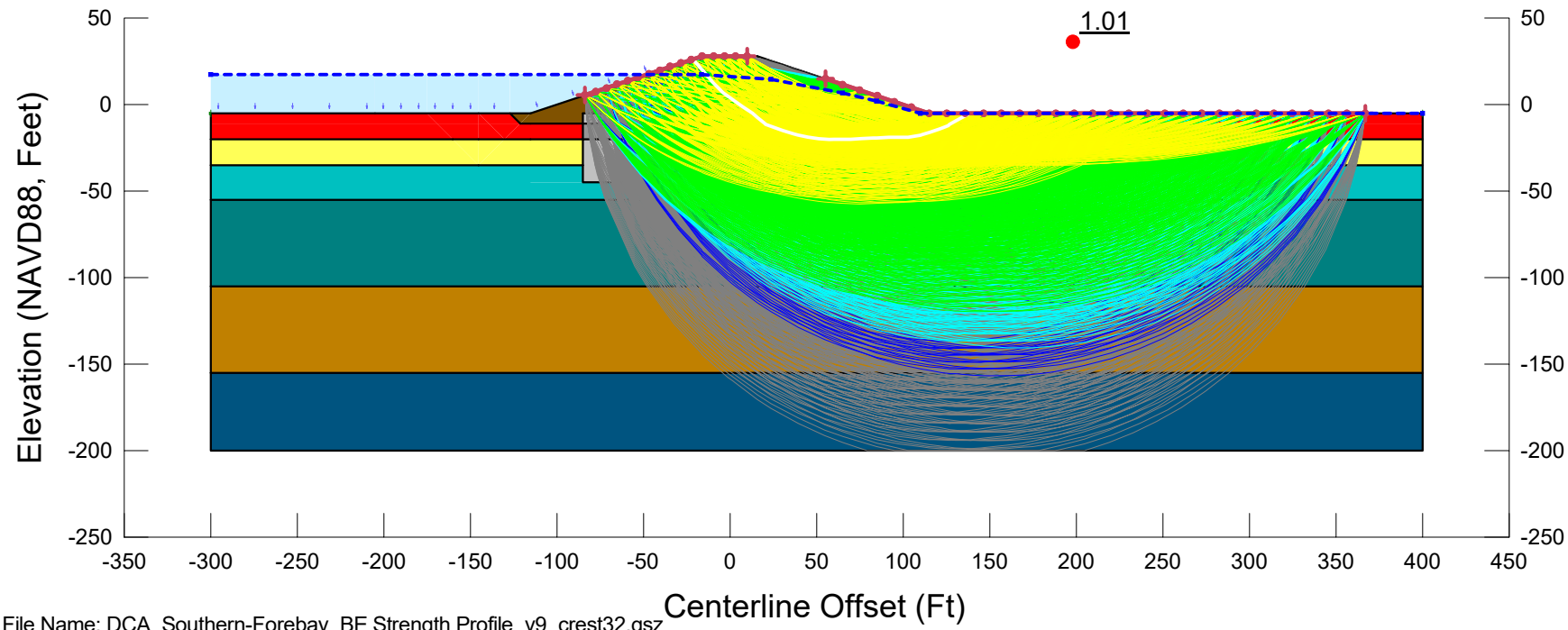
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.:

3H1V_P2_G2-AR15_A2-PS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_BE	phi'_P2_BE		
	03B_Loose_Coarse_P2	110	c_P2_BE	phi'_P2_BE		
	04_Med. Stiff_Fine_P2	120	c_P2_BE	phi'_P2_BE		
	05_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	06_Dense_Coarse_P2	125	c_P2_BE	phi'_P2_BE		
	07_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	08_Soil Cement AR=0.15	125			2,400	0
	08_Soil Cement Organics AR=0.15	125			1,425	0
	09_Soil Bentonite Wall	100			300	0



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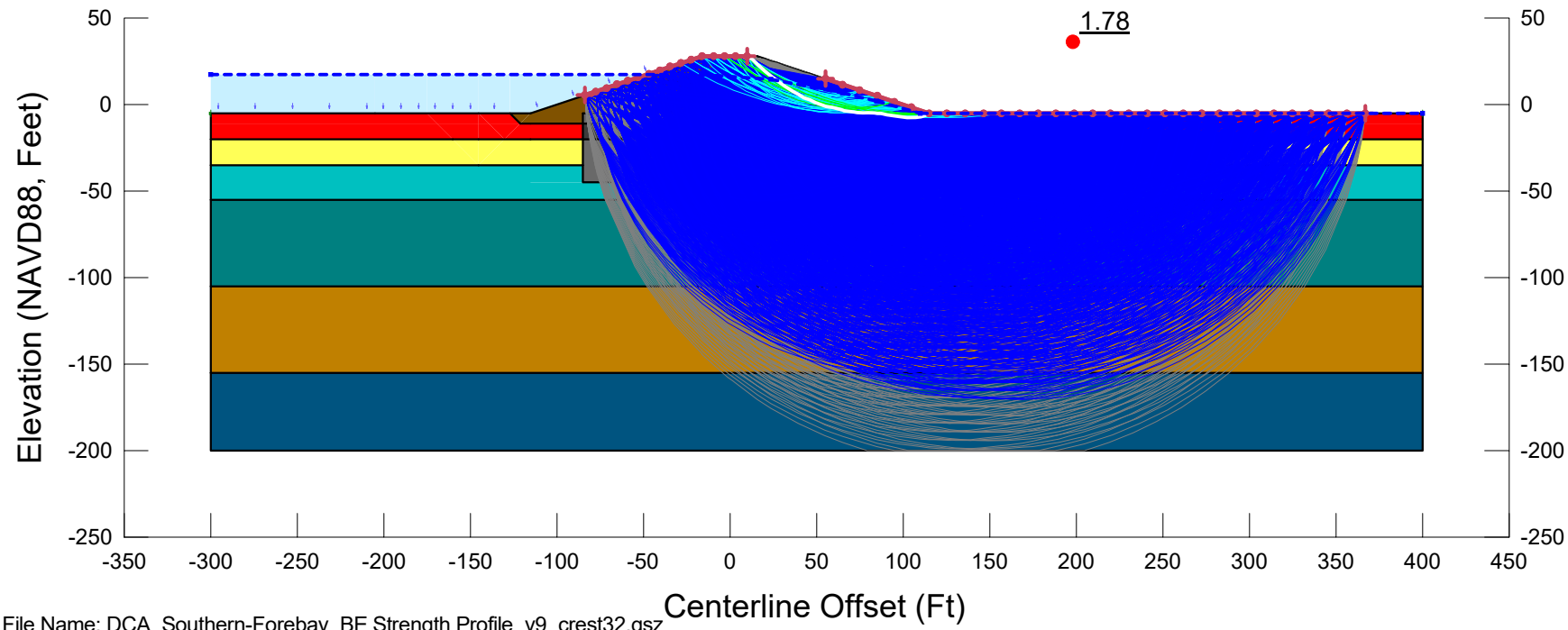
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

3H1V_P2_G2-AR15_A3-PSS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_BE	phi'_P2_BE		
	03B_Loose_Coarse_P2	110	c_P2_BE	phi'_P2_BE		
	04_Med. Stiff_Fine_P2	120	c_P2_BE	phi'_P2_BE		
	05_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	06_Dense_Coarse_P2	125	c_P2_BE	phi'_P2_BE		
	07_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	08_Soil Cement AR=0.25	125			4,000	0
	08_Soil Cement Organics AR=0.25	125			2,225	0
	09_Soil Bentonite Wall	100			300	0



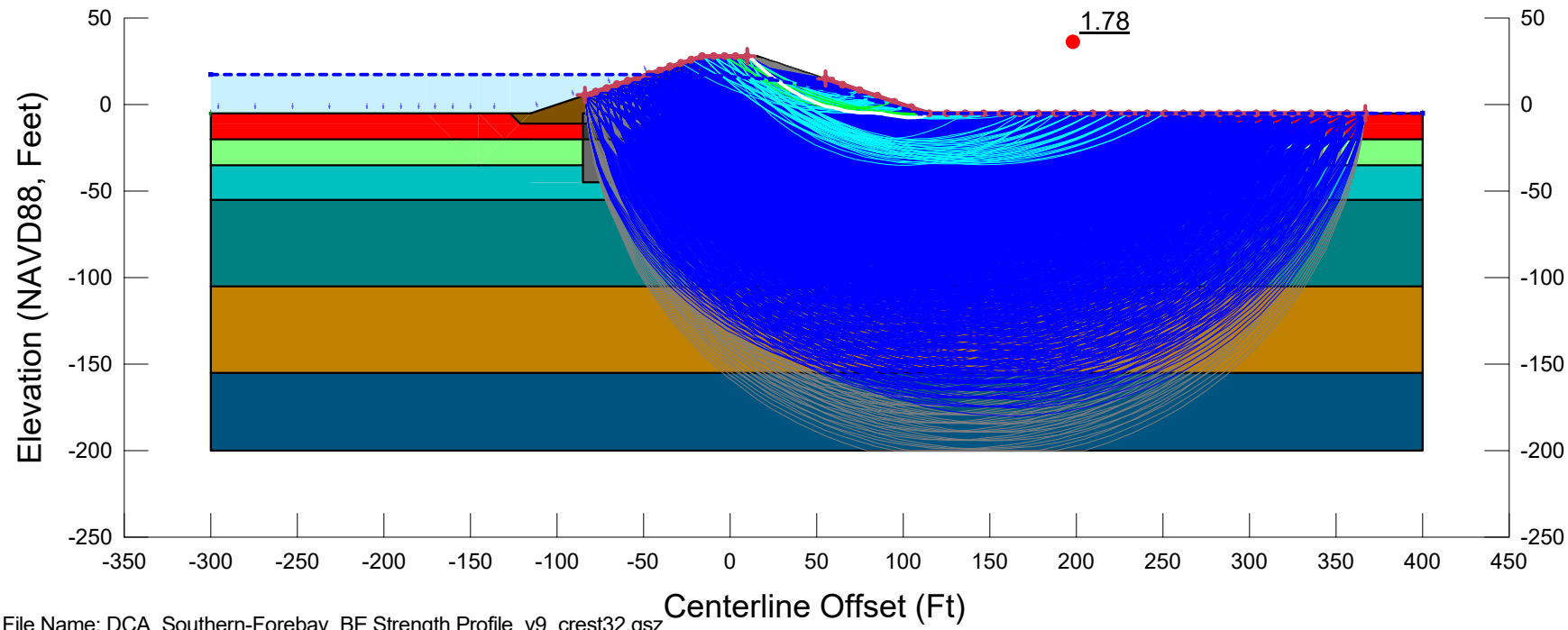
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.:

3H1V_P2_G2-AR25_A1-S

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Tau/Sigma Ratio	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120				100	31
	02_Organics_P2.PS	90		c_P2_BE.PS	phi'_P2_BE.PS		
	03B_Loose_Coarse-0.1	110	0.1				
	04_Med. Stiff_Fine_P2.PS	120		c_P2_BE.PS	phi'_P2_BE.PS		
	05_Stiff_Fine_P2.PS	125		c_P2_BE.PS	phi'_P2_BE.PS		
	06_Dense_Coarse_P2.PS	125		c_P2_BE.PS	phi'_P2_BE.PS		
	07_Stiff_Fine_P2.PS	125		c_P2_BE.PS	phi'_P2_BE.PS		
	08_Soil Cement AR=0.25	125				4,000	0
	08_Soil Cement Organics AR=0.25	125				2,225	0
	09_Soil Bentonite Wall	100				300	0



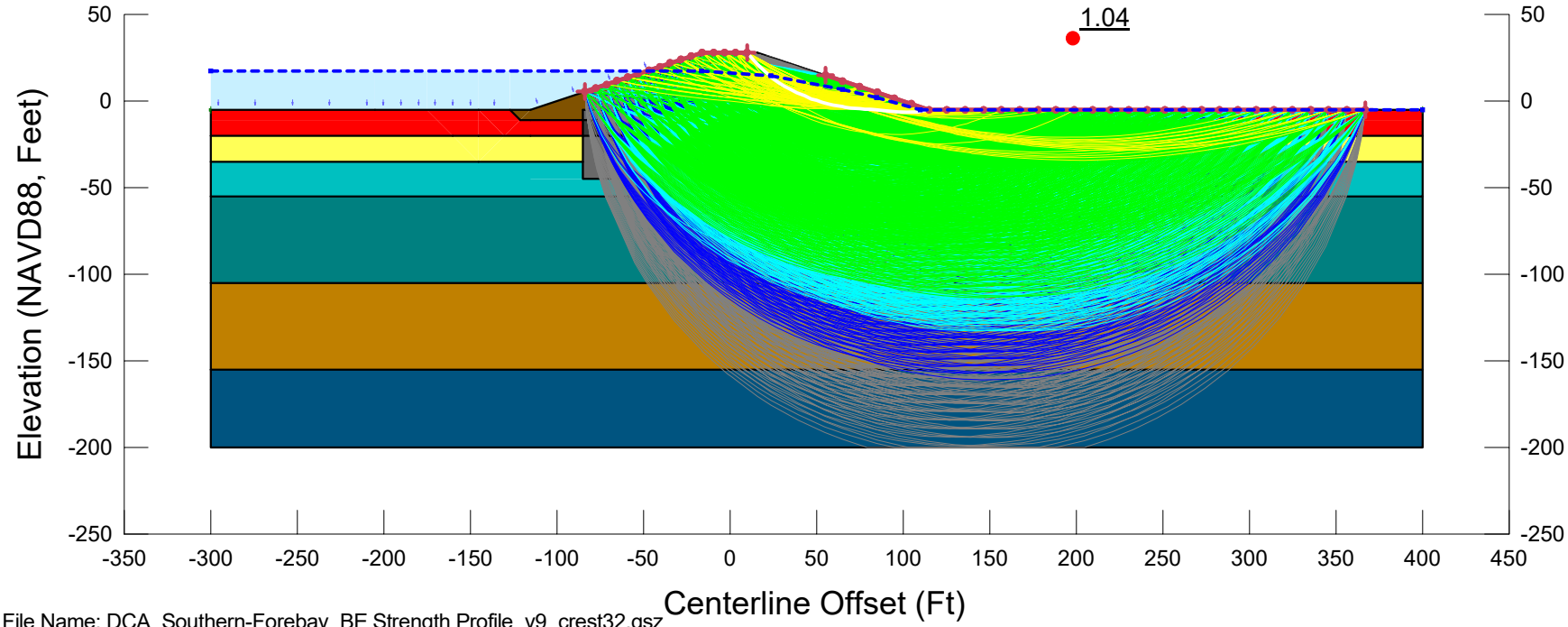
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.:

3H1V_P2_G2-AR25_A2-PS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_BE	phi'_P2_BE		
	03B_Loose_Coarse_P2	110	c_P2_BE	phi'_P2_BE		
	04_Med. Stiff_Fine_P2	120	c_P2_BE	phi'_P2_BE		
	05_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	06_Dense_Coarse_P2	125	c_P2_BE	phi'_P2_BE		
	07_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	08_Soil Cement AR=0.25	125			4,000	0
	08_Soil Cement Organics AR=0.25	125			2,225	0
	09_Soil Bentonite Wall	100			300	0



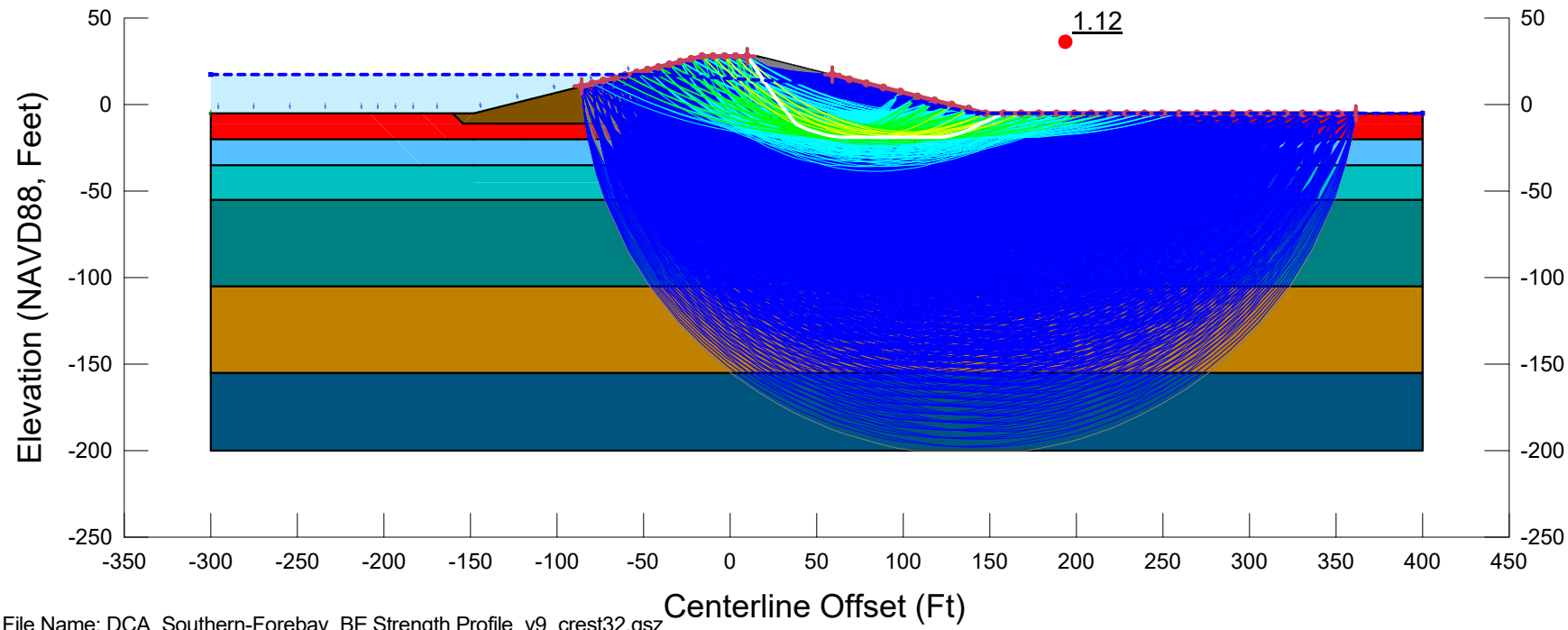
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

3H1V_P2_G2-AR25_A3-PSS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

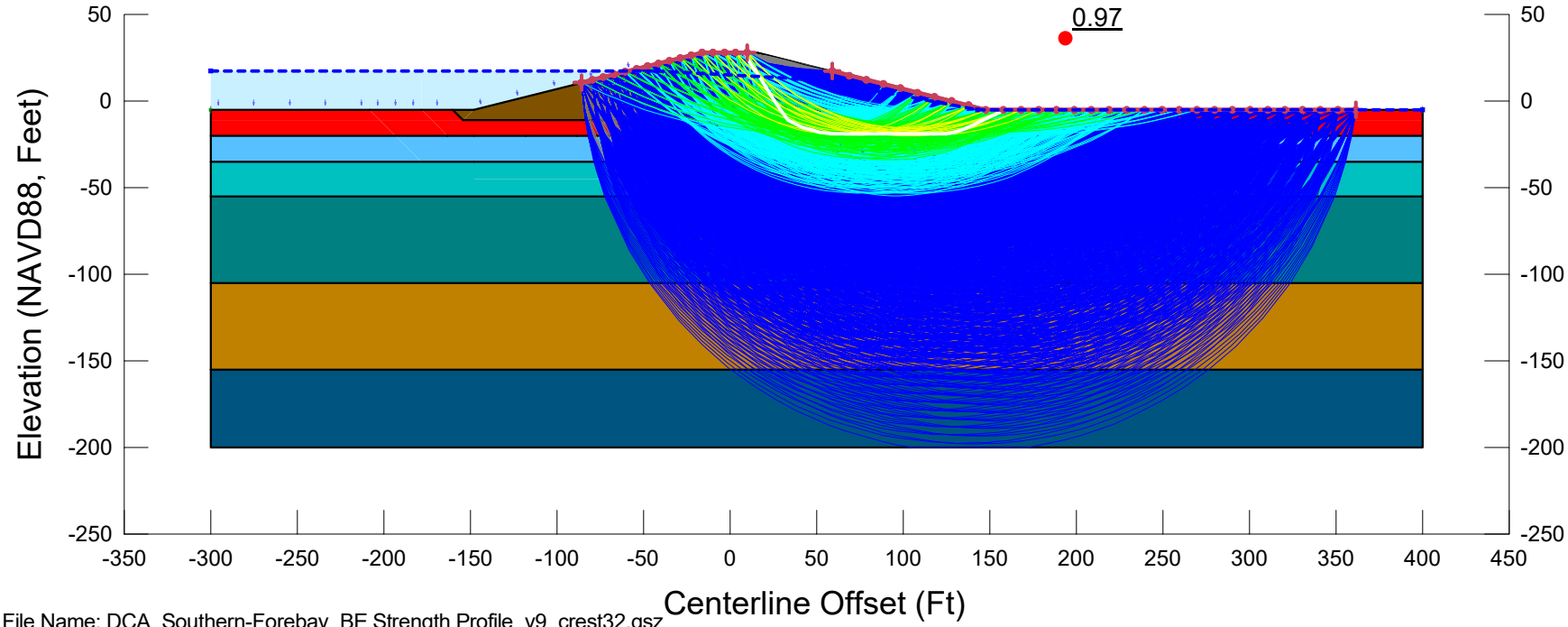
Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_BE	phi'_P1_BE		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_BE	phi'_P1_BE		
	04_Med. Stiff_Fine_P1	120	c_P1_BE	phi'_P1_BE		
	05_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	06_Dense_Coarse_P1	125	c_P1_BE	phi'_P1_BE		
	07_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		



File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Constant
Horz Seismic Coef.:

4H1V_P1_E_A1-S	
DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz	
02/27/2020	1:1,200

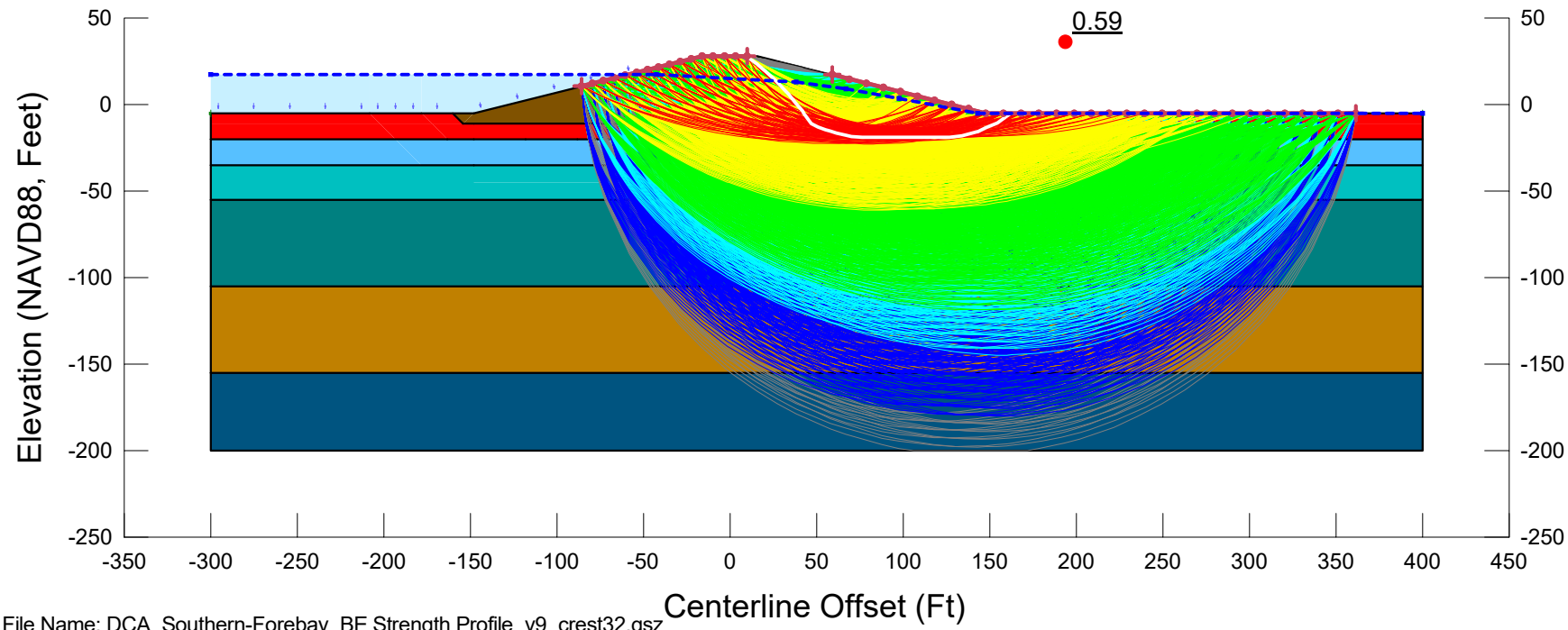
Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1.PS	90	c_P1_BE.PS	phi'_P1_BE.PS		
	03A_Soft-Med. Stiff_Fine_P1.PS	110	c_P1_BE.PS	phi'_P1_BE.PS		
	04_Med. Stiff_Fine_P1.PS	120	c_P1_BE.PS	phi'_P1_BE.PS		
	05_Stiff_Fine_P1.PS	125	c_P1_BE.PS	phi'_P1_BE.PS		
	06_Dense_Coarse_P1.PS	125	c_P1_BE.PS	phi'_P1_BE.PS		
	07_Stiff_Fine_P1.PS	125	c_P1_BE.PS	phi'_P1_BE.PS		



File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Constant
Horz Seismic Coef.:

4H1V_P1_E_A2-PS	
DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz	
02/27/2020	1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_BE	phi'_P1_BE		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_BE	phi'_P1_BE		
	04_Med. Stiff_Fine_P1	120	c_P1_BE	phi'_P1_BE		
	05_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	06_Dense_Coarse_P1	125	c_P1_BE	phi'_P1_BE		
	07_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		



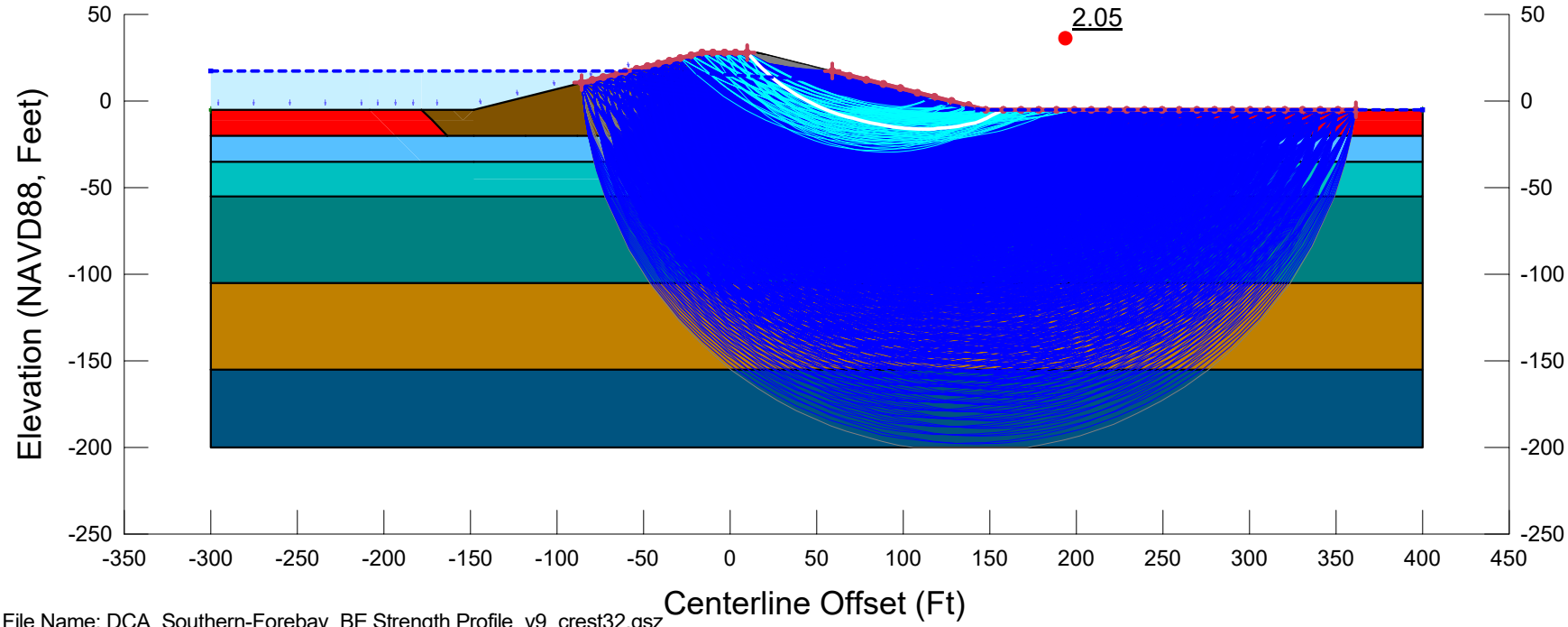
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

4H1V_P1_E_A3-PSS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_BE	phi'_P1_BE		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_BE	phi'_P1_BE		
	04_Med. Stiff_Fine_P1	120	c_P1_BE	phi'_P1_BE		
	05_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	06_Dense_Coarse_P1	125	c_P1_BE	phi'_P1_BE		
	07_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	09_Soil Bentonite Wall	100			300	0



File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
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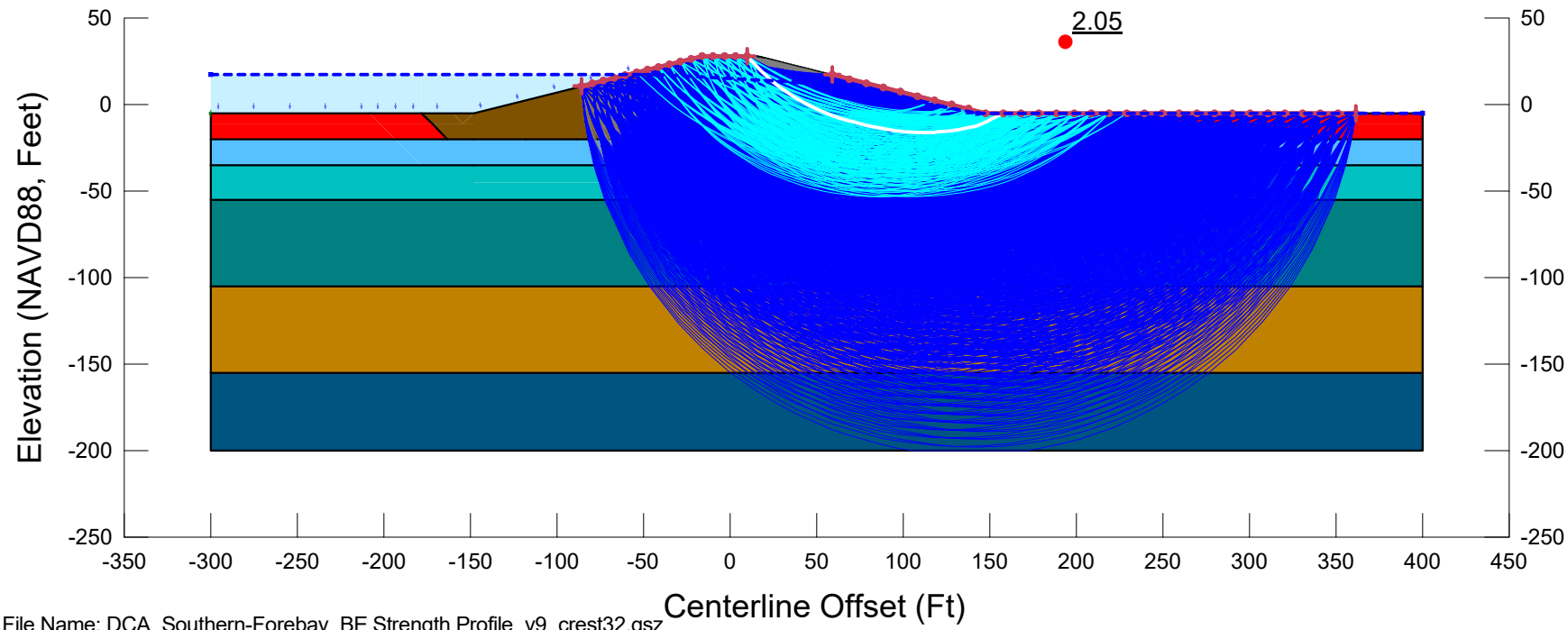
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Constant
Horz Seismic Coef.:

4H1V_P1_G1-RR15_A1-S

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1.PS	90	c_P1_BE.PS	phi'_P1_BE.PS		
	03A_Soft-Med. Stiff_Fine_P1.PS	110	c_P1_BE.PS	phi'_P1_BE.PS		
	04_Med. Stiff_Fine_P1.PS	120	c_P1_BE.PS	phi'_P1_BE.PS		
	05_Stiff_Fine_P1.PS	125	c_P1_BE.PS	phi'_P1_BE.PS		
	06_Dense_Coarse_P1.PS	125	c_P1_BE.PS	phi'_P1_BE.PS		
	07_Stiff_Fine_P1.PS	125	c_P1_BE.PS	phi'_P1_BE.PS		
	09_Soil Bentonite Wall	100			300	0



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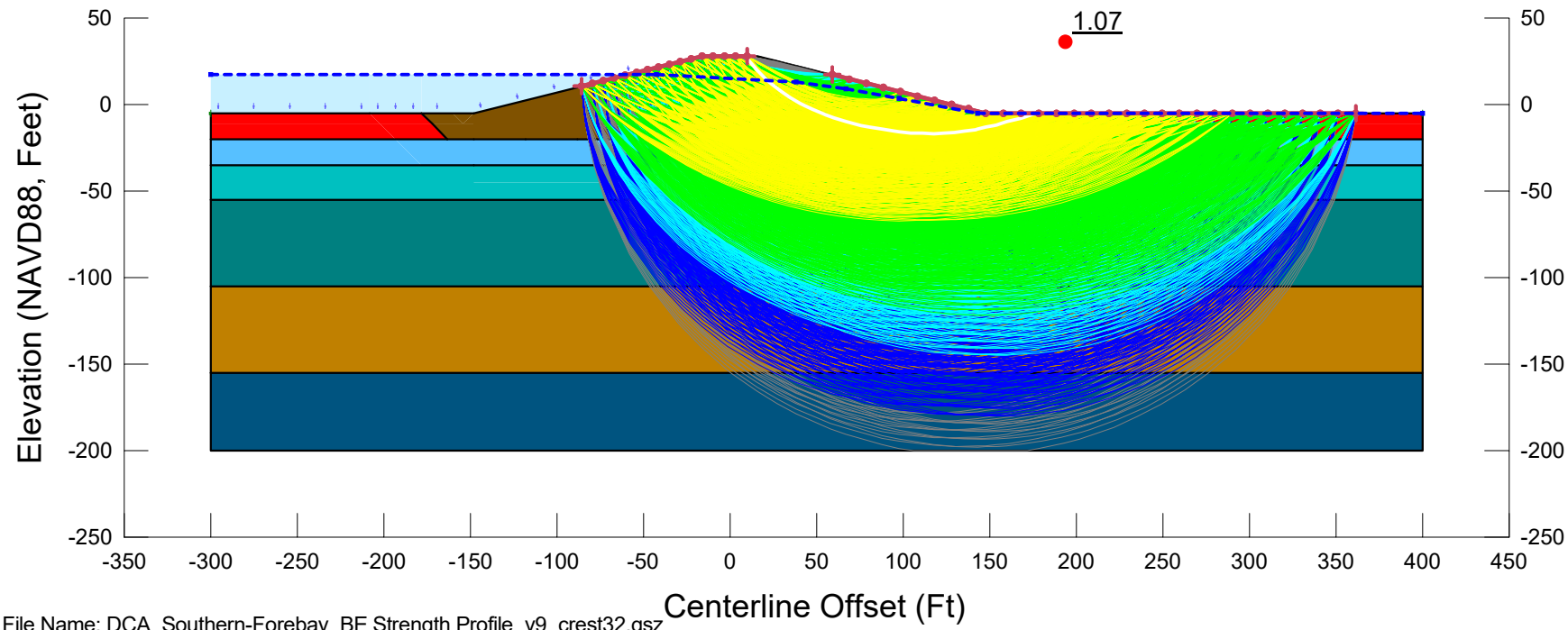
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Constant
Horz Seismic Coef.:

4H1V_P1_G1-RR15_A2-PS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_BE	phi'_P1_BE		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_BE	phi'_P1_BE		
	04_Med. Stiff_Fine_P1	120	c_P1_BE	phi'_P1_BE		
	05_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	06_Dense_Coarse_P1	125	c_P1_BE	phi'_P1_BE		
	07_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	09_Soil Bentonite Wall	100			300	0



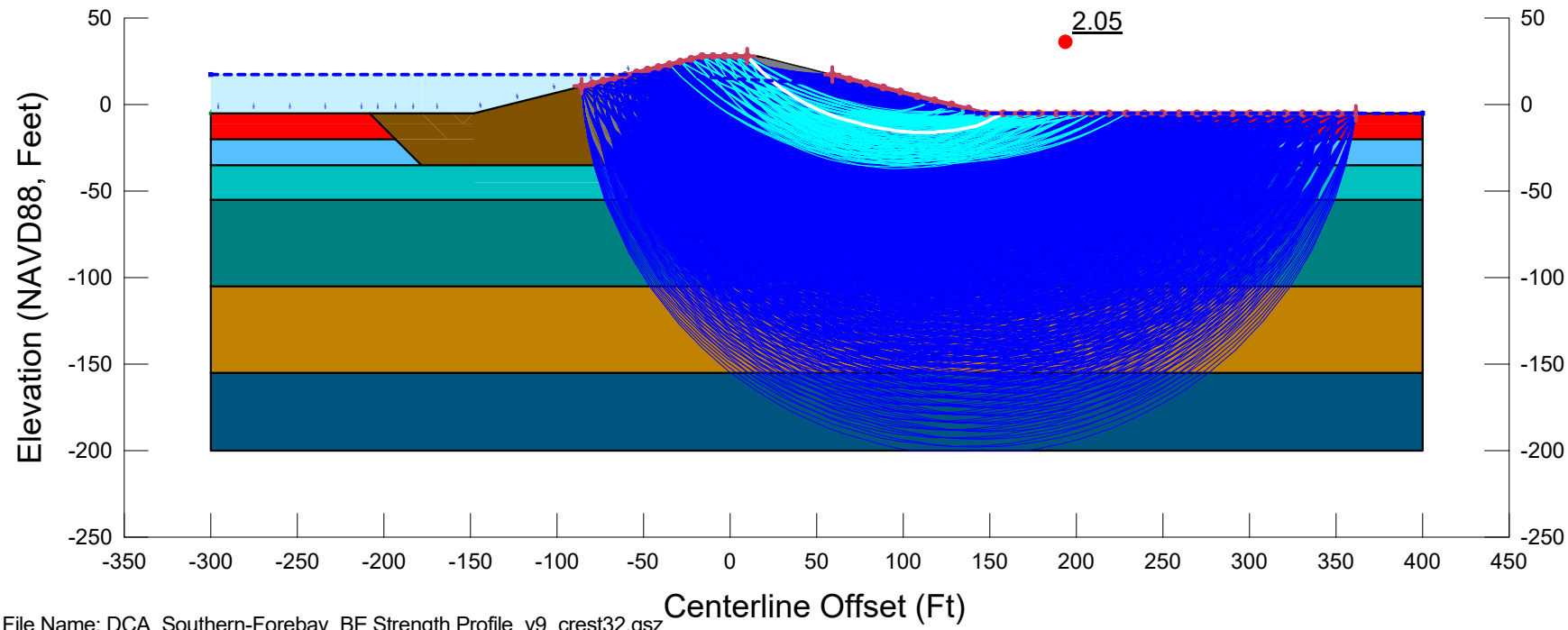
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

4H1V_P1_G1-RR15_A3-PSS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_BE	phi'_P1_BE		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_BE	phi'_P1_BE		
	04_Med. Stiff_Fine_P1	120	c_P1_BE	phi'_P1_BE		
	05_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	06_Dense_Coarse_P1	125	c_P1_BE	phi'_P1_BE		
	07_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	09_Soil Bentonite Wall	100			300	0



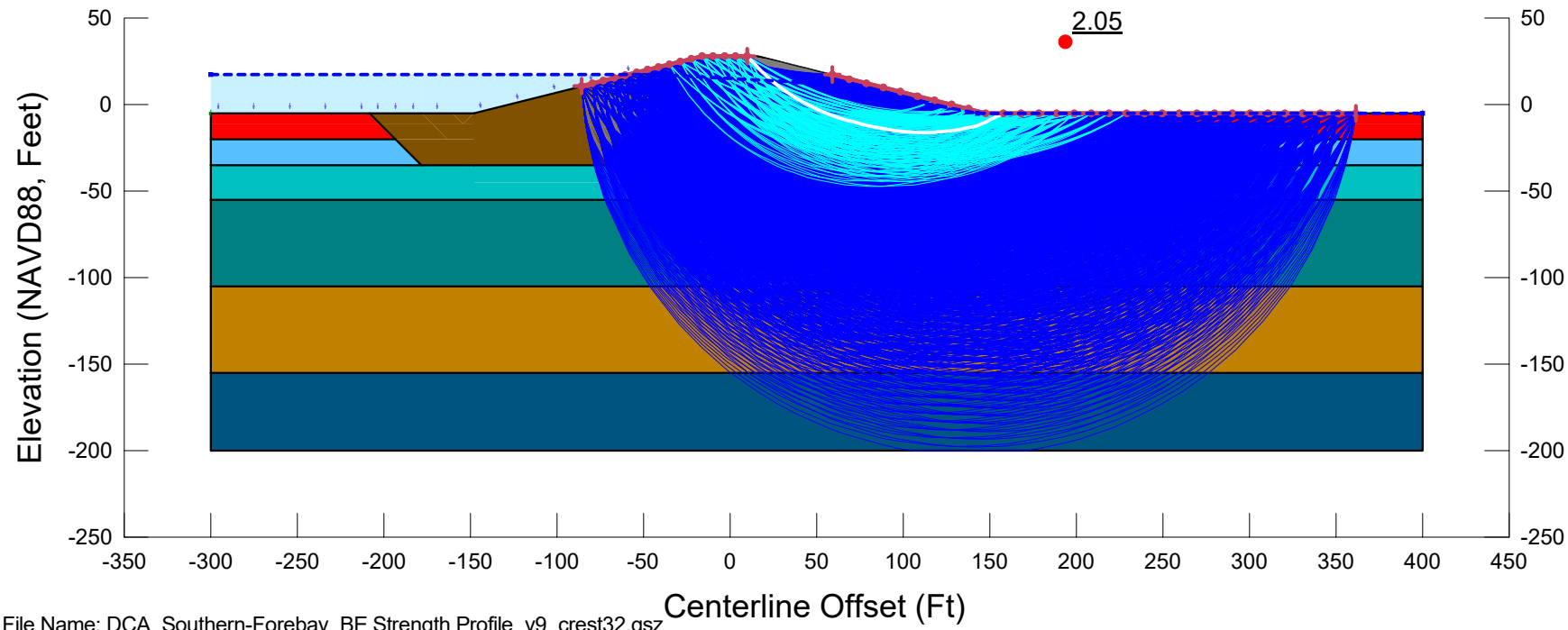
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Constant
Horz Seismic Coef.:

4H1V_P1_G1-RR30_A1-S

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1.PS	90	c_P1_BE.PS	phi'_P1_BE.PS		
	03A_Soft-Med. Stiff_Fine_P1.PS	110	c_P1_BE.PS	phi'_P1_BE.PS		
	04_Med. Stiff_Fine_P1.PS	120	c_P1_BE.PS	phi'_P1_BE.PS		
	05_Stiff_Fine_P1.PS	125	c_P1_BE.PS	phi'_P1_BE.PS		
	06_Dense_Coarse_P1.PS	125	c_P1_BE.PS	phi'_P1_BE.PS		
	07_Stiff_Fine_P1.PS	125	c_P1_BE.PS	phi'_P1_BE.PS		
	09_Soil Bentonite Wall	100			300	0



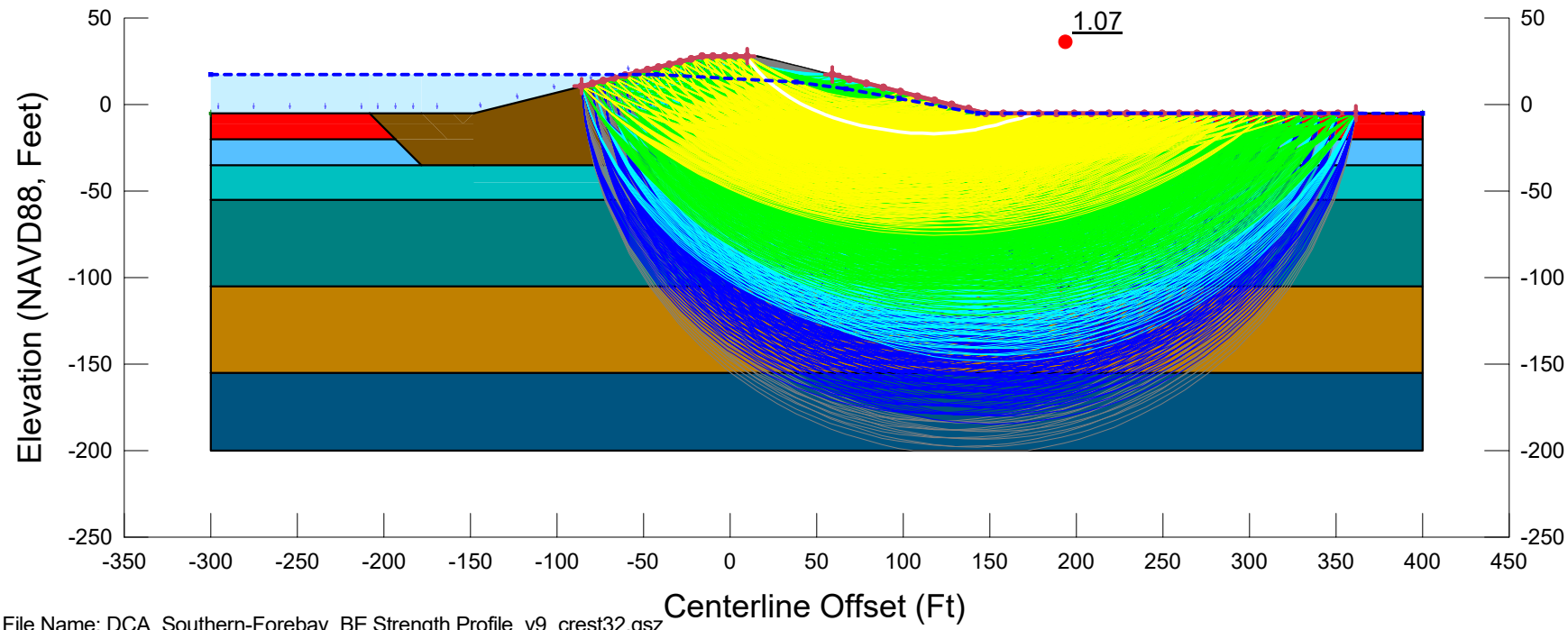
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Constant
Horz Seismic Coef.:

4H1V_P1_G1-RR30_A2-PS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_BE	phi'_P1_BE		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_BE	phi'_P1_BE		
	04_Med. Stiff_Fine_P1	120	c_P1_BE	phi'_P1_BE		
	05_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	06_Dense_Coarse_P1	125	c_P1_BE	phi'_P1_BE		
	07_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	09_Soil Bentonite Wall	100			300	0



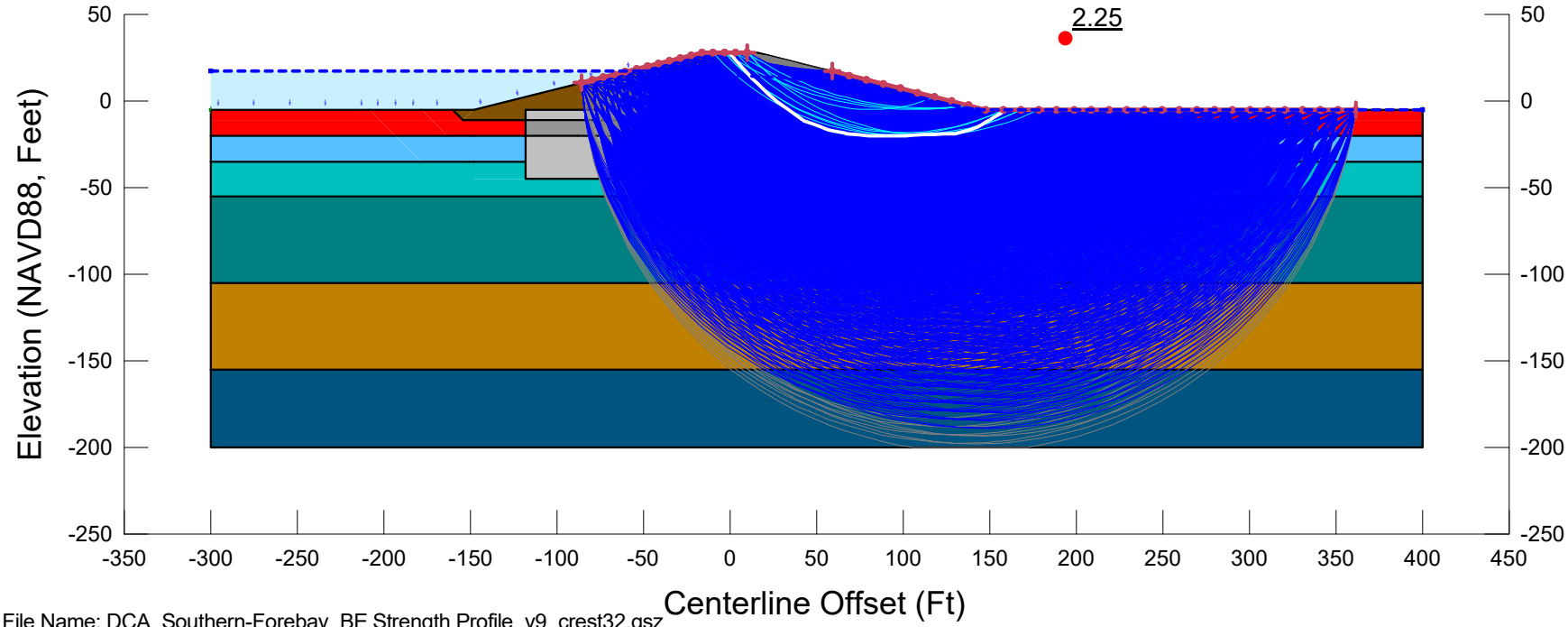
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

4H1V_P1_G1-RR30_A3-PSS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_BE	phi'_P1_BE		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_BE	phi'_P1_BE		
	04_Med. Stiff_Fine_P1	120	c_P1_BE	phi'_P1_BE		
	05_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	06_Dense_Coarse_P1	125	c_P1_BE	phi'_P1_BE		
	07_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	08_Soil Cement AR=0.15	125			2,400	0
	08_Soil Cement Organics AR=0.15	125			1,425	0
	09_Soil Bentonite Wall	100			300	0



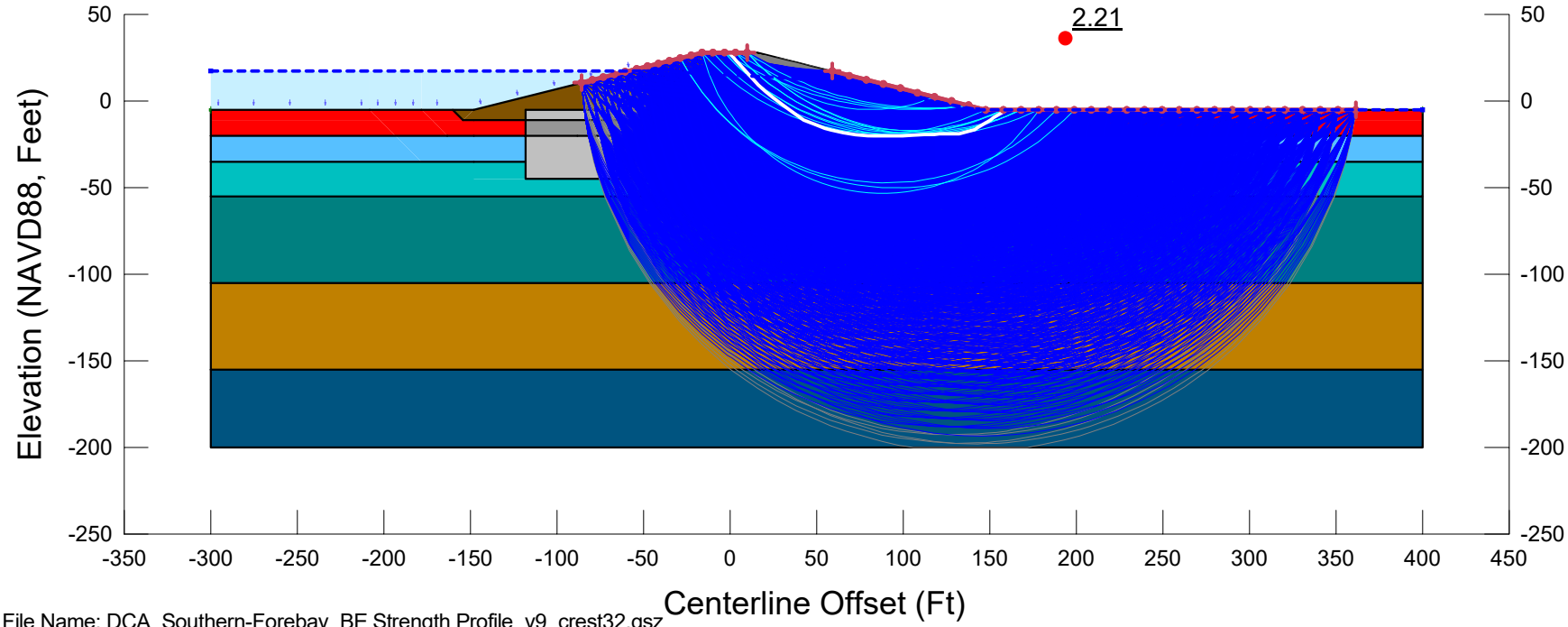
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.:

4H1V_P1_G2-AR15_A1-S

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1.PS	90	c_P1_BE.PS	phi'_P1_BE.PS		
	03A_Soft-Med. Stiff_Fine_P1.PS	110	c_P1_BE.PS	phi'_P1_BE.PS		
	04_Med. Stiff_Fine_P1.PS	120	c_P1_BE.PS	phi'_P1_BE.PS		
	05_Stiff_Fine_P1.PS	125	c_P1_BE.PS	phi'_P1_BE.PS		
	06_Dense_Coarse_P1.PS	125	c_P1_BE.PS	phi'_P1_BE.PS		
	07_Stiff_Fine_P1.PS	125	c_P1_BE.PS	phi'_P1_BE.PS		
	08_Soil Cement AR=0.15	125			2,400	0
	08_Soil Cement Organics AR=0.15	125			1,425	0
	09_Soil Bentonite Wall	100			300	0



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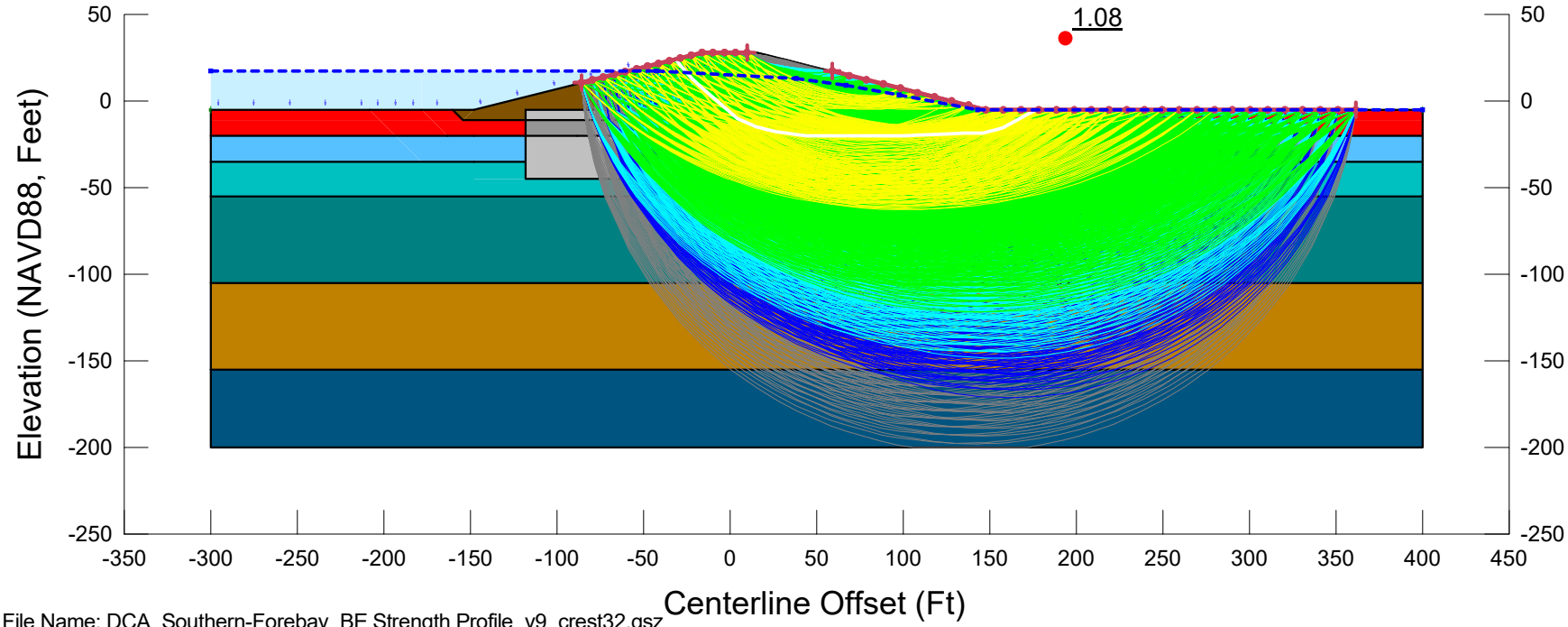
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.:

4H1V_P1_G2-AR15_A2-PS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_BE	phi'_P1_BE		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_BE	phi'_P1_BE		
	04_Med. Stiff_Fine_P1	120	c_P1_BE	phi'_P1_BE		
	05_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	06_Dense_Coarse_P1	125	c_P1_BE	phi'_P1_BE		
	07_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	08_Soil Cement AR=0.15	125			2,400	0
	08_Soil Cement Organics AR=0.15	125			1,425	0
	09_Soil Bentonite Wall	100			300	0



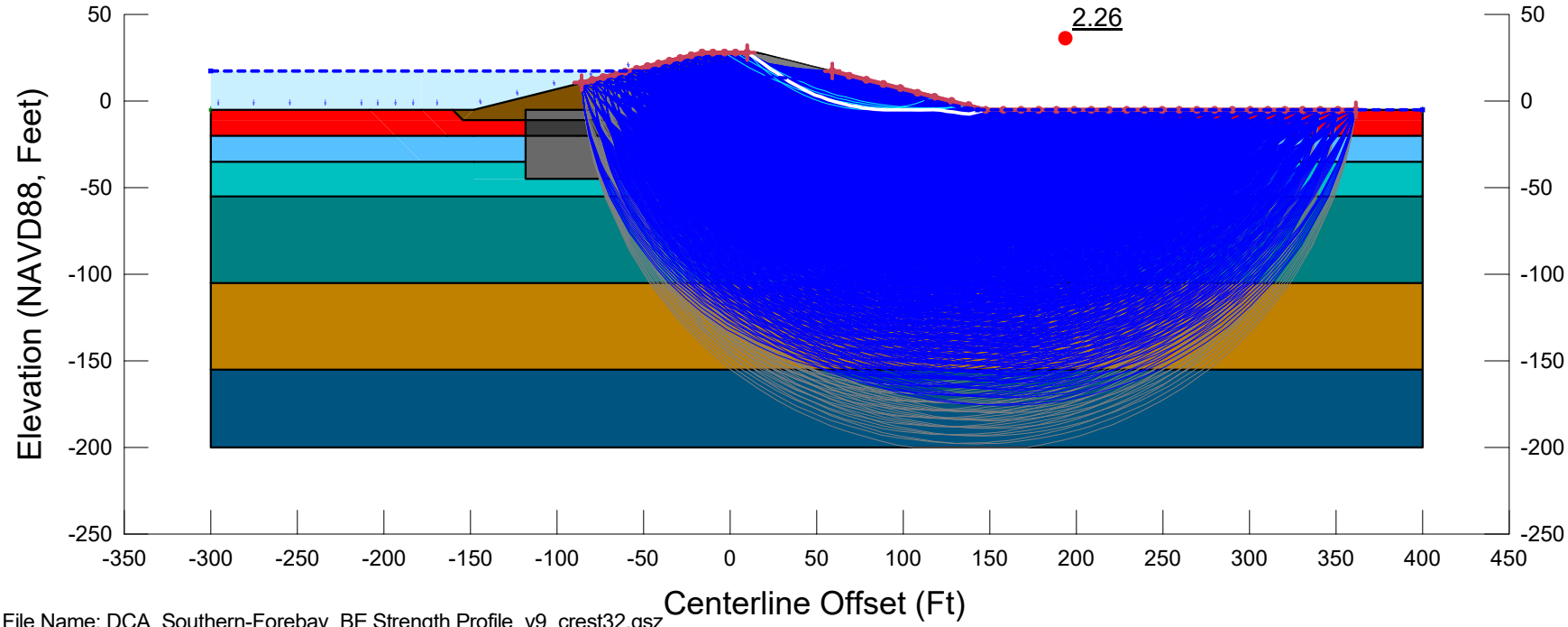
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

4H1V_P1_G2-AR15_A3-PSS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_BE	phi'_P1_BE		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_BE	phi'_P1_BE		
	04_Med. Stiff_Fine_P1	120	c_P1_BE	phi'_P1_BE		
	05_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	06_Dense_Coarse_P1	125	c_P1_BE	phi'_P1_BE		
	07_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	08_Soil Cement AR=0.25	125			4,000	0
	08_Soil Cement Organics AR=0.25	125			2,225	0
	09_Soil Bentonite Wall	100			300	0



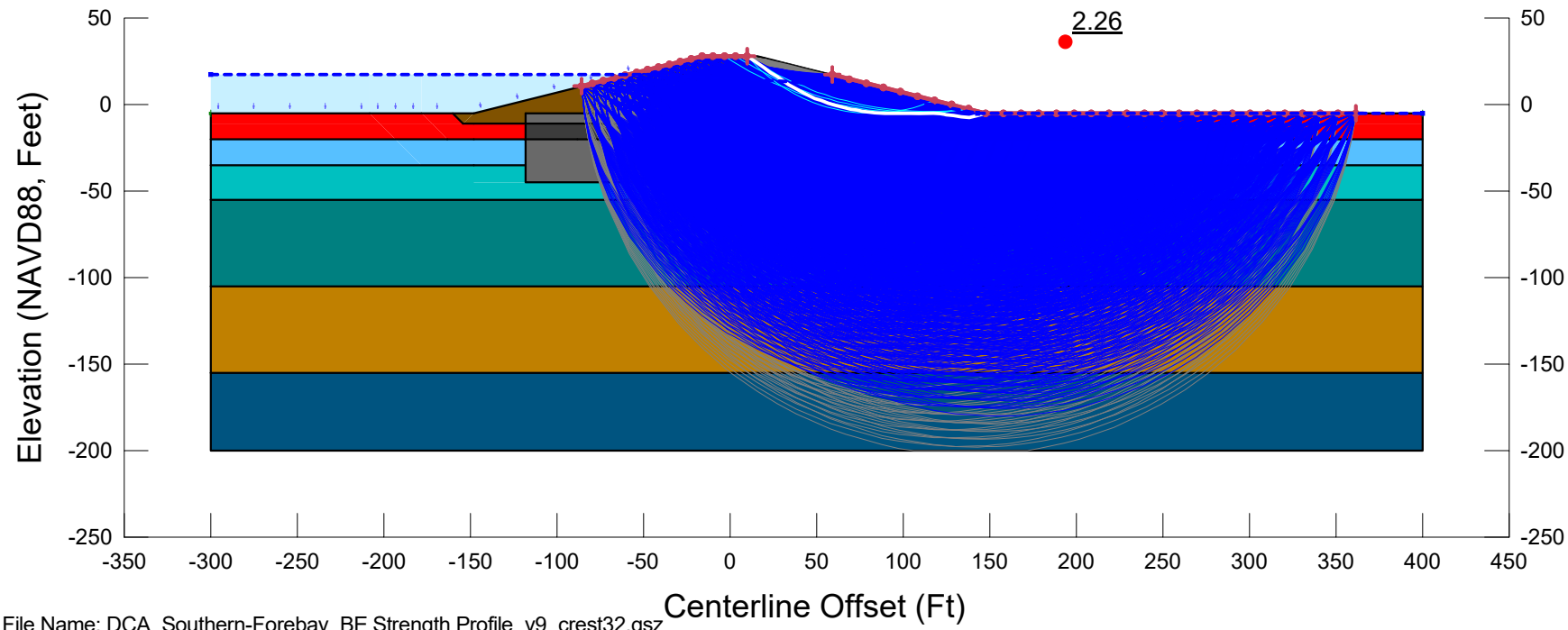
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.:

4H1V_P1_G2-AR25_A1-S

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1.PS	90	c_P1_BE.PS	phi'_P1_BE.PS		
	03A_Soft-Med. Stiff_Fine_P1.PS	110	c_P1_BE.PS	phi'_P1_BE.PS		
	04_Med. Stiff_Fine_P1.PS	120	c_P1_BE.PS	phi'_P1_BE.PS		
	05_Stiff_Fine_P1.PS	125	c_P1_BE.PS	phi'_P1_BE.PS		
	06_Dense_Coarse_P1.PS	125	c_P1_BE.PS	phi'_P1_BE.PS		
	07_Stiff_Fine_P1.PS	125	c_P1_BE.PS	phi'_P1_BE.PS		
	08_Soil Cement AR=0.25	125			4,000	0
	08_Soil Cement Organics AR=0.25	125			2,225	0
	09_Soil Bentonite Wall	100			300	0



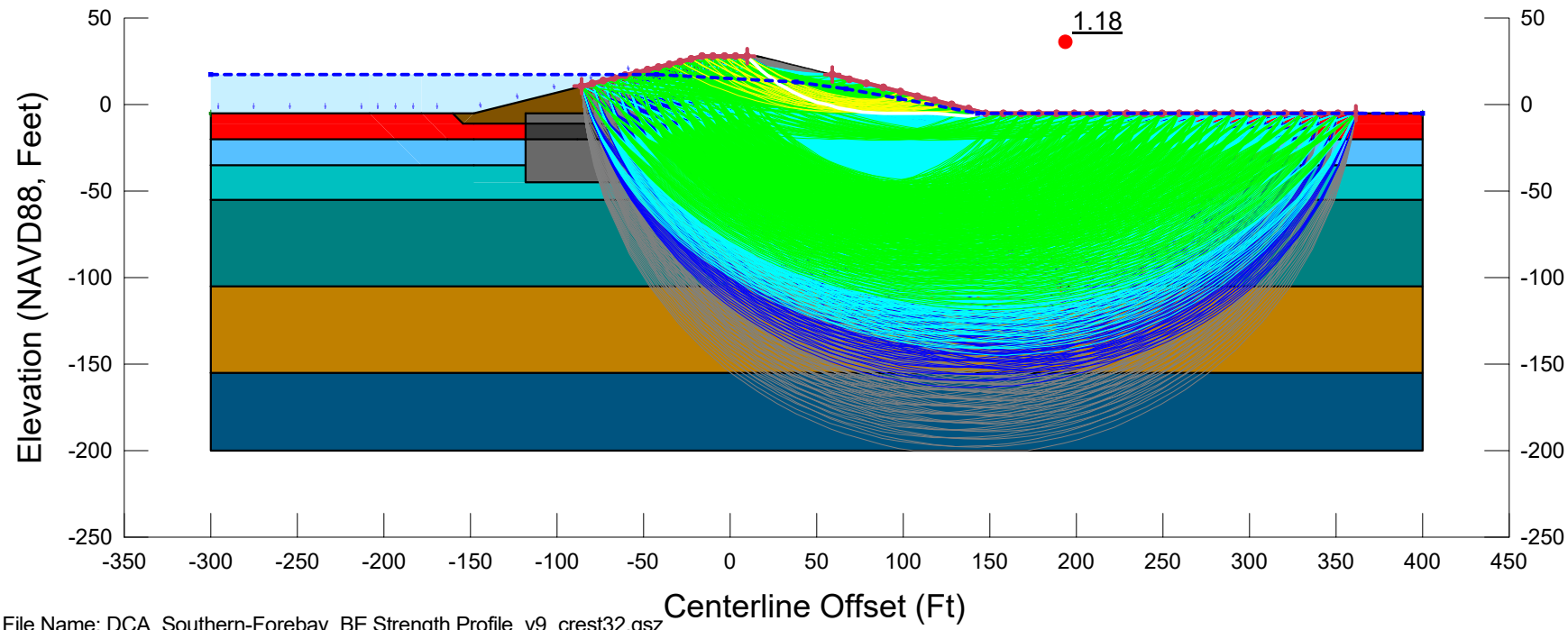
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.:

4H1V_P1_G2-AR25_A2-PS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_BE	phi'_P1_BE		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_BE	phi'_P1_BE		
	04_Med. Stiff_Fine_P1	120	c_P1_BE	phi'_P1_BE		
	05_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	06_Dense_Coarse_P1	125	c_P1_BE	phi'_P1_BE		
	07_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	08_Soil Cement AR=0.25	125			4,000	0
	08_Soil Cement Organics AR=0.25	125			2,225	0
	09_Soil Bentonite Wall	100			300	0



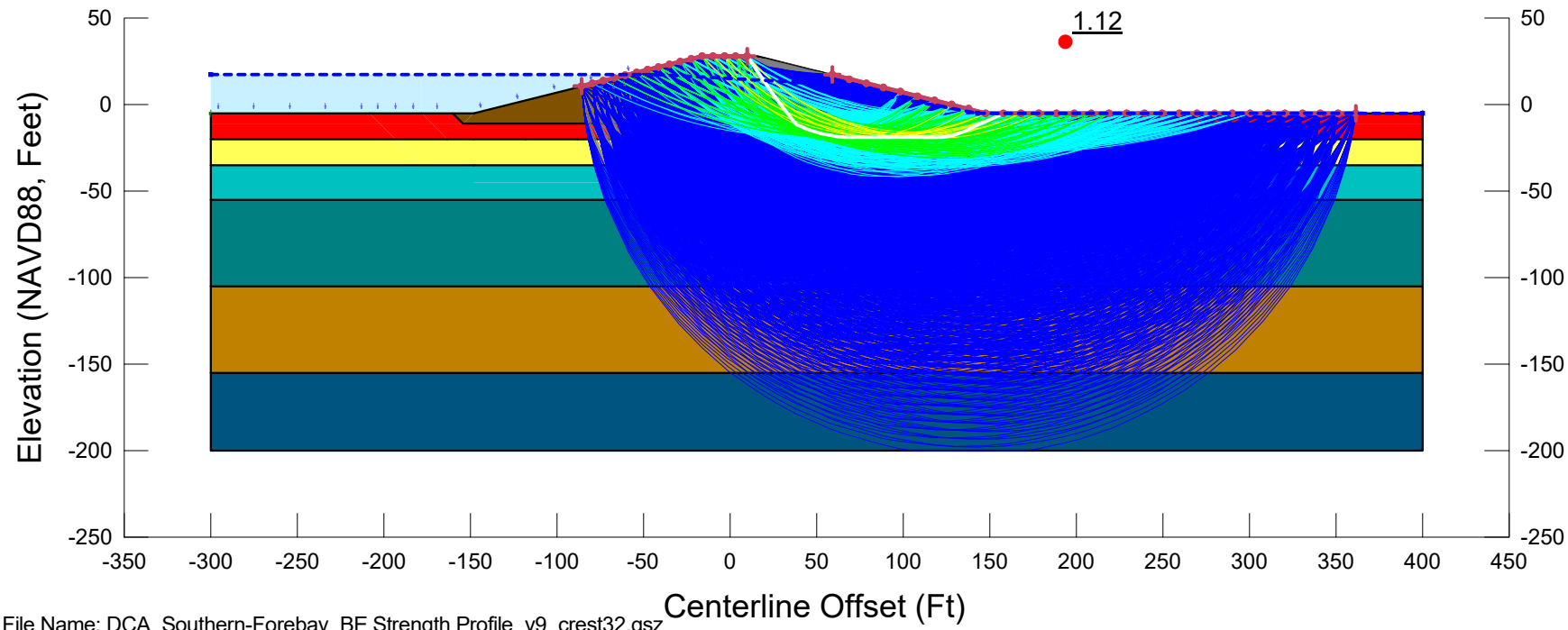
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

4H1V_P1_G2-AR25_A3-PSS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_BE	phi'_P2_BE		
	03B_Loose_Coarse_P2	110	c_P2_BE	phi'_P2_BE		
	04_Med. Stiff_Fine_P2	120	c_P2_BE	phi'_P2_BE		
	05_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	06_Dense_Coarse_P2	125	c_P2_BE	phi'_P2_BE		
	07_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		



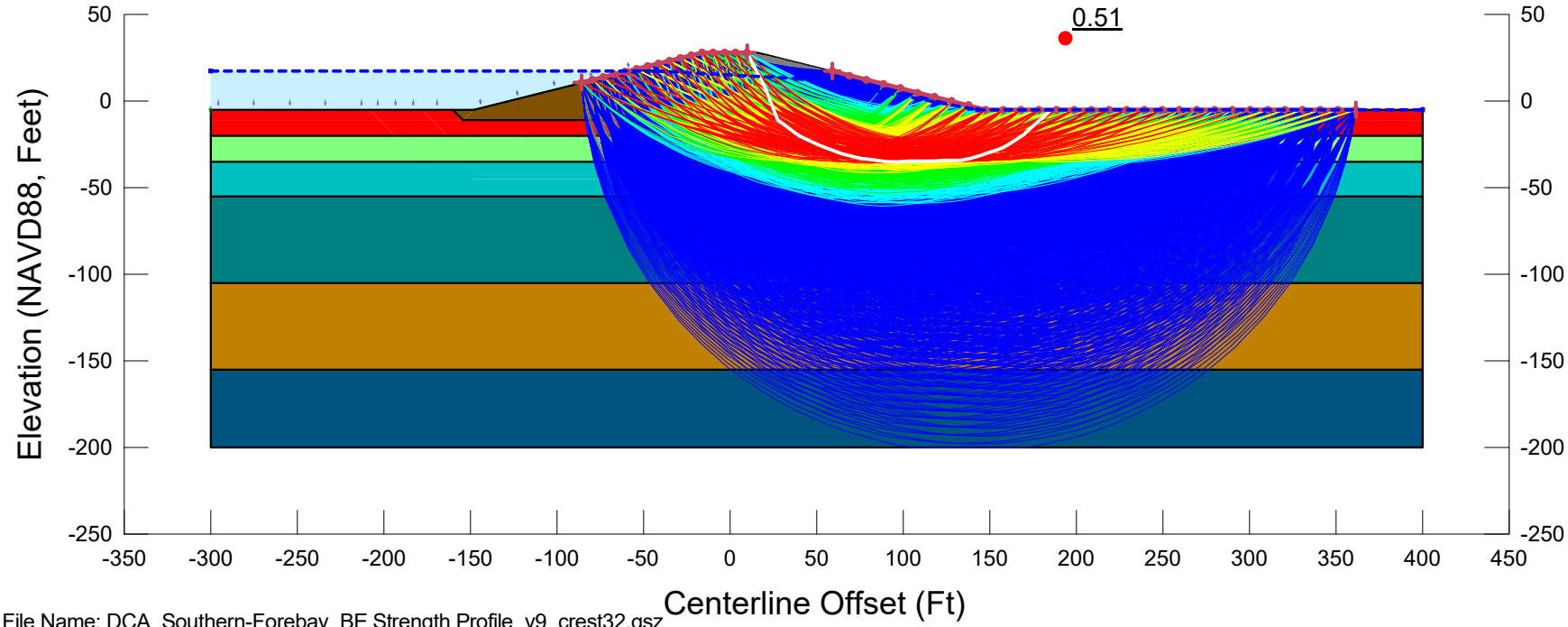
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Constant
Horz Seismic Coef.:

4H1V_P2_E_A1-S

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Tau/Sigma Ratio	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120				100	31
	02_Organics_P2.PS	90		c_P2_BE.PS	phi'_P2_BE.PS		
	03B_Loose_Coarse-0.1	110	0.1				
	04_Med. Stiff_Fine_P2.PS	120		c_P2_BE.PS	phi'_P2_BE.PS		
	05_Stiff_Fine_P2.PS	125		c_P2_BE.PS	phi'_P2_BE.PS		
	06_Dense_Coarse_P2.PS	125		c_P2_BE.PS	phi'_P2_BE.PS		
	07_Stiff_Fine_P2.PS	125		c_P2_BE.PS	phi'_P2_BE.PS		



File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
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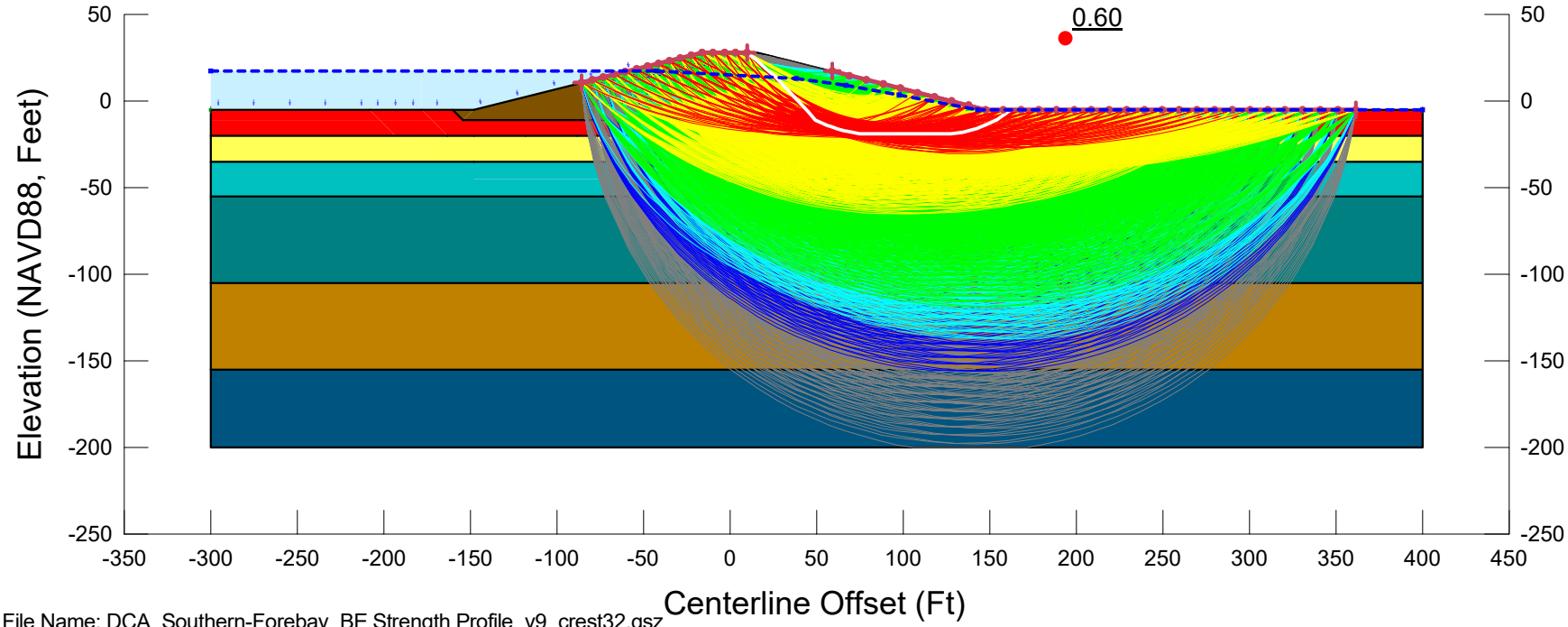
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Constant
Horz Seismic Coef.:

4H1V_P2_E_A2-PS	
DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz	
02/27/2020	1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_BE	phi'_P2_BE		
	03B_Loose_Coarse_P2	110	c_P2_BE	phi'_P2_BE		
	04_Med. Stiff_Fine_P2	120	c_P2_BE	phi'_P2_BE		
	05_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	06_Dense_Coarse_P2	125	c_P2_BE	phi'_P2_BE		
	07_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		



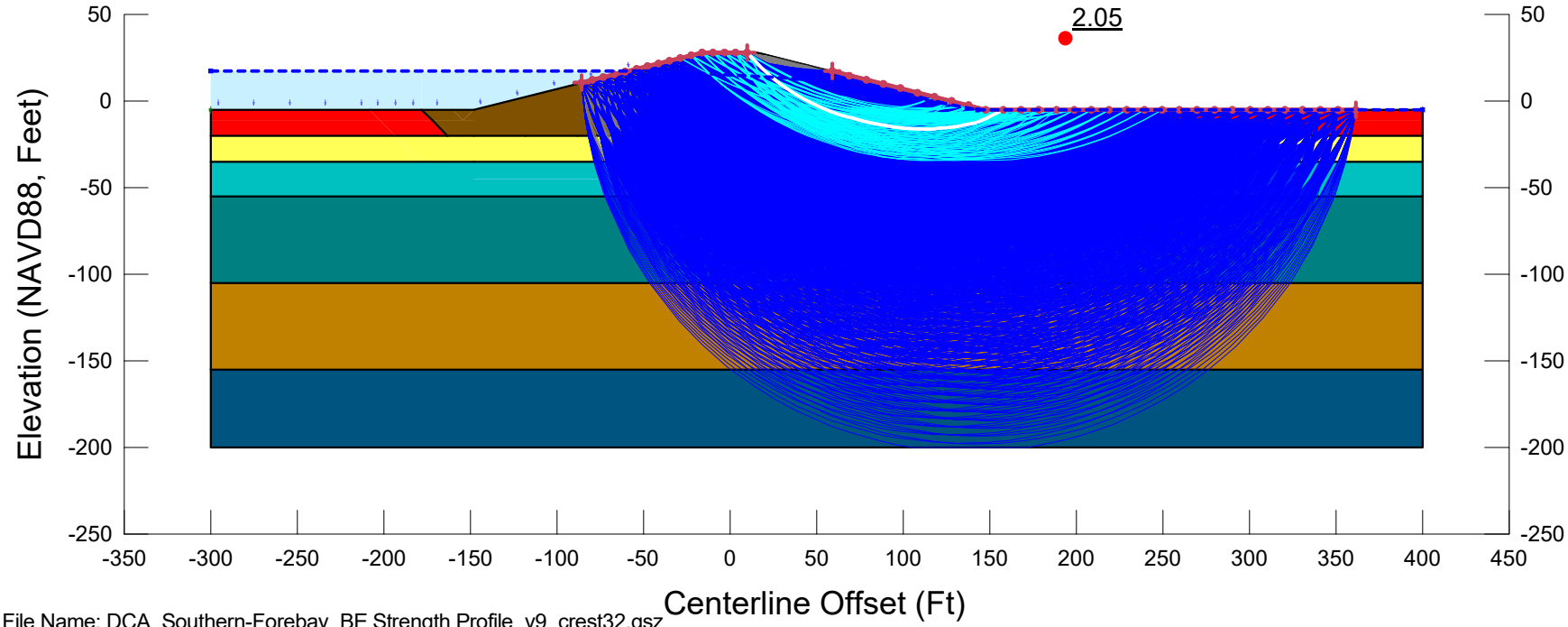
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

4H1V_P2_E_A3-PSS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_BE	phi'_P2_BE		
	03B_Loose_Coarse_P2	110	c_P2_BE	phi'_P2_BE		
	04_Med. Stiff_Fine_P2	120	c_P2_BE	phi'_P2_BE		
	05_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	06_Dense_Coarse_P2	125	c_P2_BE	phi'_P2_BE		
	07_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	09_Soil Bentonite Wall	100			300	0



File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
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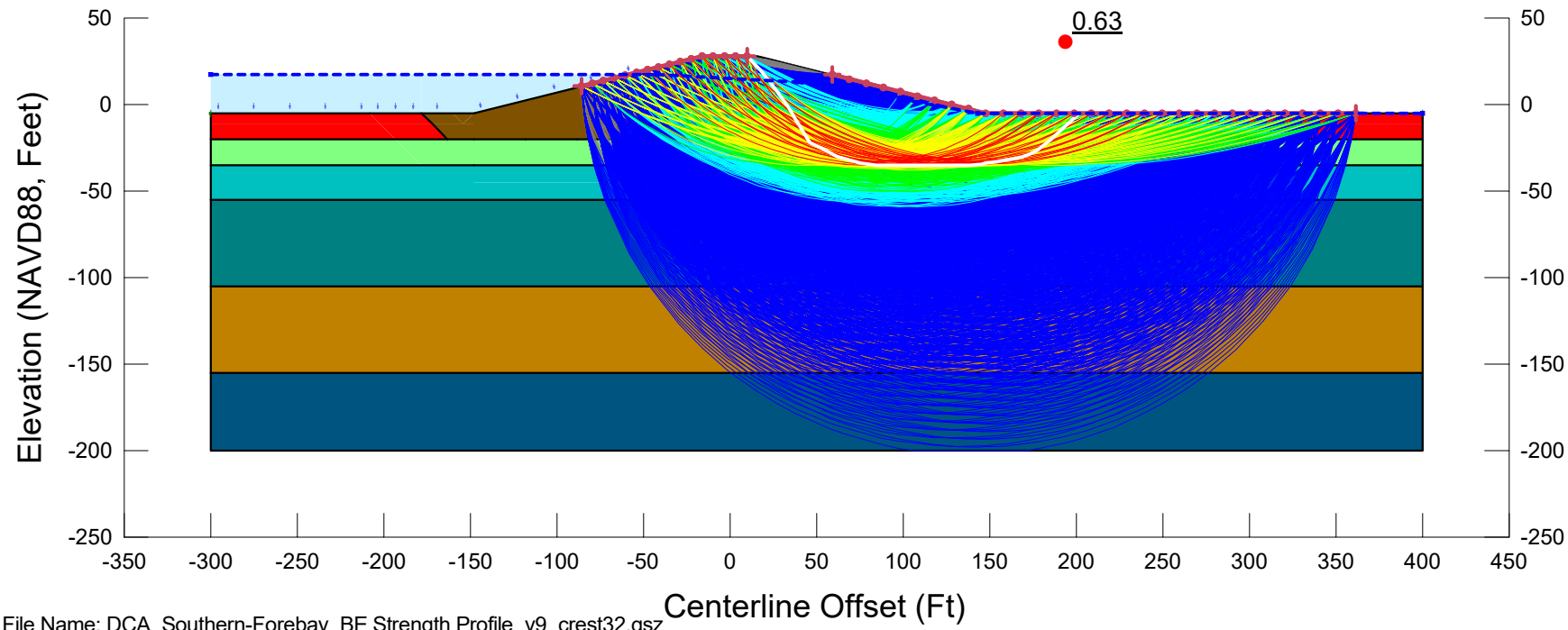
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Constant
Horz Seismic Coef.:

4H1V_P2_G1-RR15_A1-S

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Tau/Sigma Ratio	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120				100	31
	02_Organics_P2.PS	90		c_P2_BE.PS	phi'_P2_BE.PS		
	03B_Loose_Coarse-0.1	110	0.1				
	04_Med. Stiff_Fine_P2.PS	120		c_P2_BE.PS	phi'_P2_BE.PS		
	05_Stiff_Fine_P2.PS	125		c_P2_BE.PS	phi'_P2_BE.PS		
	06_Dense_Coarse_P2.PS	125		c_P2_BE.PS	phi'_P2_BE.PS		
	07_Stiff_Fine_P2.PS	125		c_P2_BE.PS	phi'_P2_BE.PS		
	09_Soil Bentonite Wall	100				300	0



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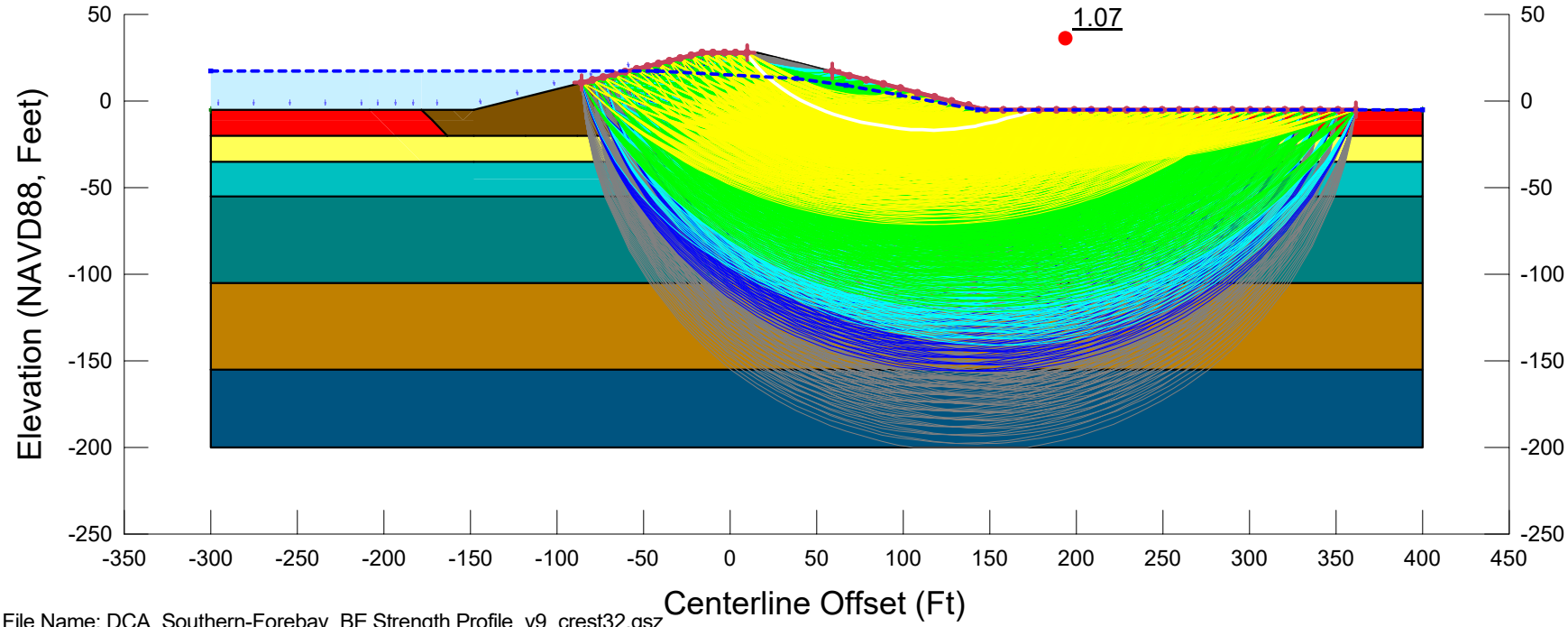
F of S Calculation Option: Constant
Horz Seismic Coef.:

4H1V_P2_G1-RR15_A2-PS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_BE	phi'_P2_BE		
	03B_Loose_Coarse_P2	110	c_P2_BE	phi'_P2_BE		
	04_Med. Stiff_Fine_P2	120	c_P2_BE	phi'_P2_BE		
	05_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	06_Dense_Coarse_P2	125	c_P2_BE	phi'_P2_BE		
	07_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	09_Soil Bentonite Wall	100			300	0



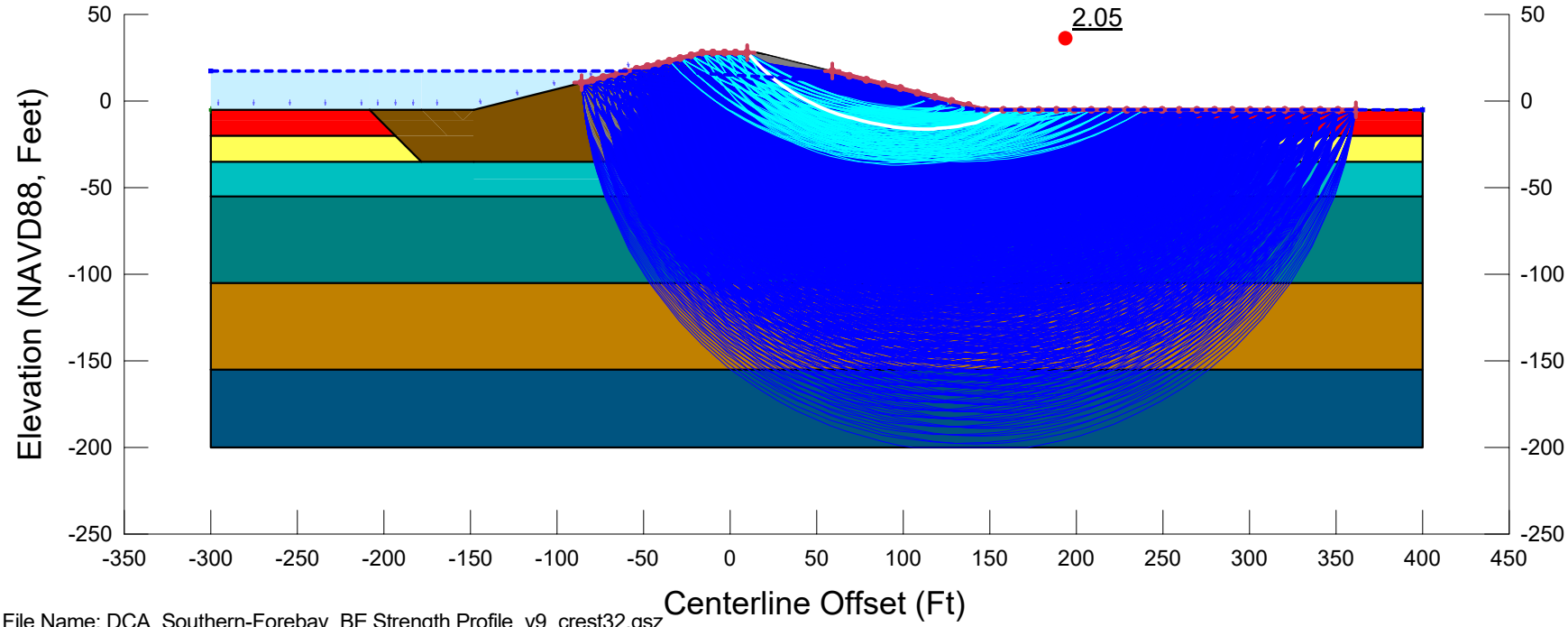
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

4H1V_P2_G1-RR15_A3-PSS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_BE	phi'_P2_BE		
	03B_Loose_Coarse_P2	110	c_P2_BE	phi'_P2_BE		
	04_Med. Stiff_Fine_P2	120	c_P2_BE	phi'_P2_BE		
	05_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	06_Dense_Coarse_P2	125	c_P2_BE	phi'_P2_BE		
	07_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	09_Soil Bentonite Wall	100			300	0



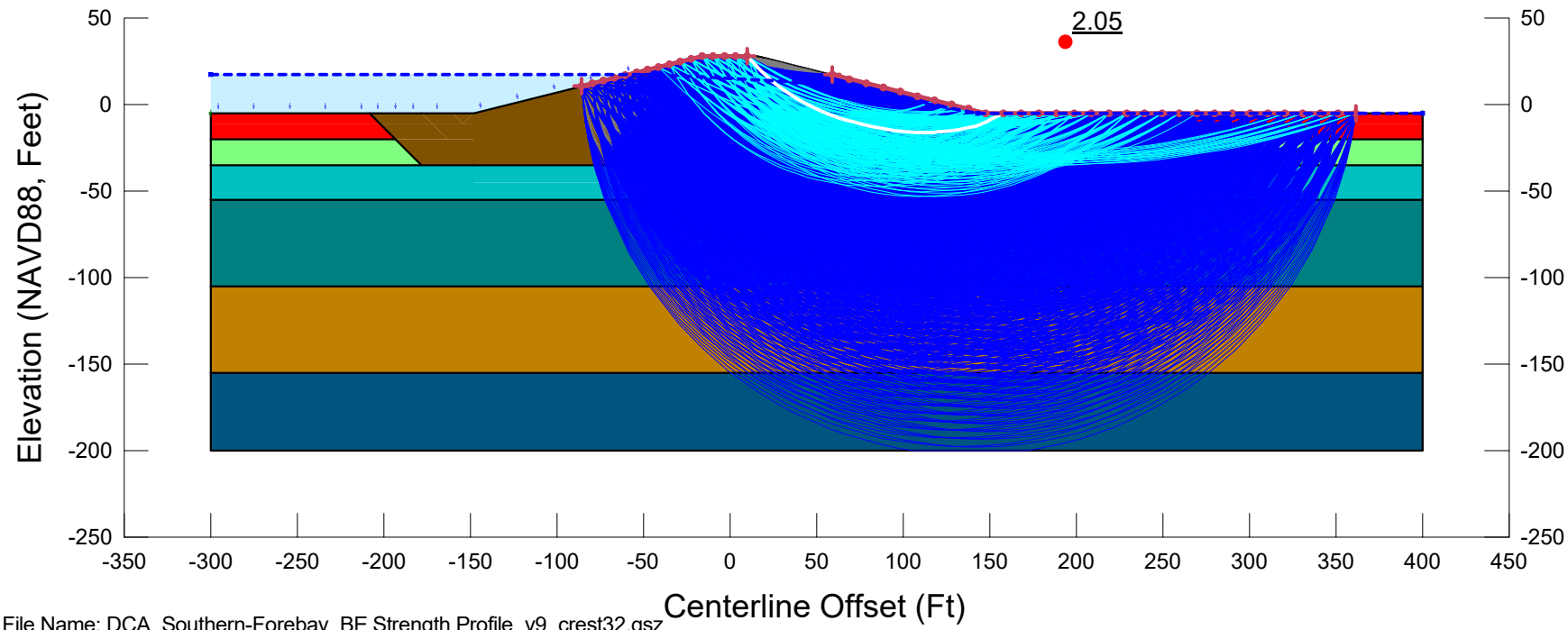
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Constant
Horz Seismic Coef.:

4H1V_P2_G1-RR30_A1-S

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

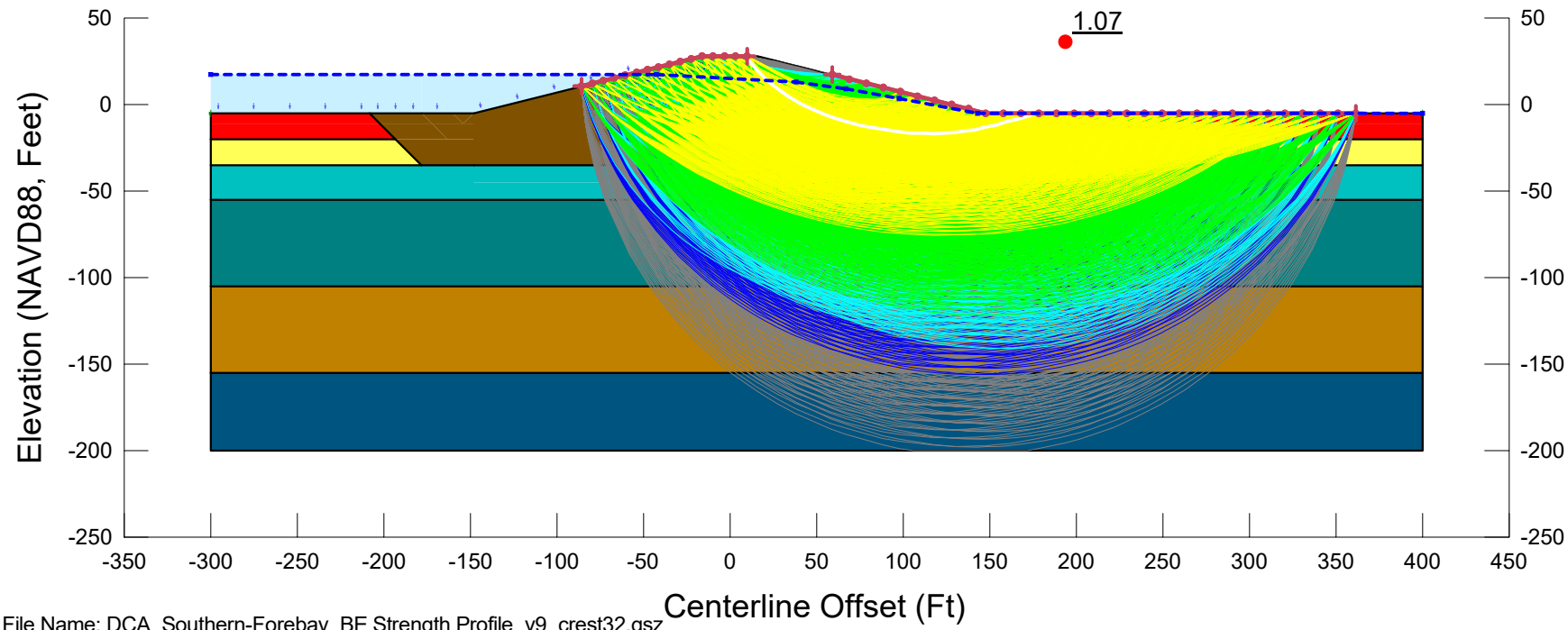
Color	Name	Unit Weight (pcf)	Tau/Sigma Ratio	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120				100	31
	02_Organics_P2.PS	90		c_P2_BE.PS	phi'_P2_BE.PS		
	03B_Loose_Coarse-0.1	110	0.1				
	04_Med. Stiff_Fine_P2.PS	120		c_P2_BE.PS	phi'_P2_BE.PS		
	05_Stiff_Fine_P2.PS	125		c_P2_BE.PS	phi'_P2_BE.PS		
	06_Dense_Coarse_P2.PS	125		c_P2_BE.PS	phi'_P2_BE.PS		
	07_Stiff_Fine_P2.PS	125		c_P2_BE.PS	phi'_P2_BE.PS		
	09_Soil Bentonite Wall	100				300	0



File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Constant
Horz Seismic Coef.:

4H1V_P2_G1-RR30_A2-PS	
DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz	
02/27/2020	1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_BE	phi'_P2_BE		
	03B_Loose_Coarse_P2	110	c_P2_BE	phi'_P2_BE		
	04_Med. Stiff_Fine_P2	120	c_P2_BE	phi'_P2_BE		
	05_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	06_Dense_Coarse_P2	125	c_P2_BE	phi'_P2_BE		
	07_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	09_Soil Bentonite Wall	100			300	0



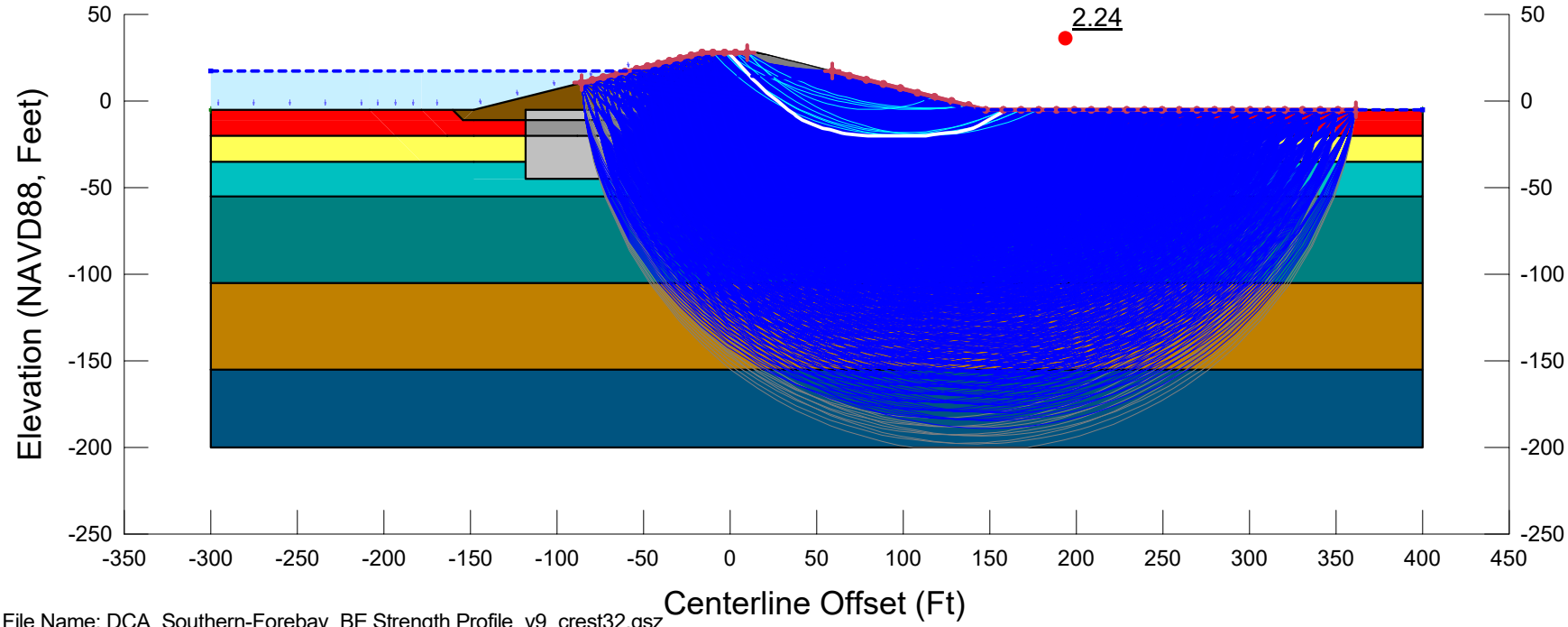
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

4H1V_P2_G1-RR30_A3-PSS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_BE	phi'_P2_BE		
	03B_Loose_Coarse_P2	110	c_P2_BE	phi'_P2_BE		
	04_Med. Stiff_Fine_P2	120	c_P2_BE	phi'_P2_BE		
	05_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	06_Dense_Coarse_P2	125	c_P2_BE	phi'_P2_BE		
	07_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	08_Soil Cement AR=0.15	125			2,400	0
	08_Soil Cement Organics AR=0.15	125			1,425	0
	09_Soil Bentonite Wall	100			300	0



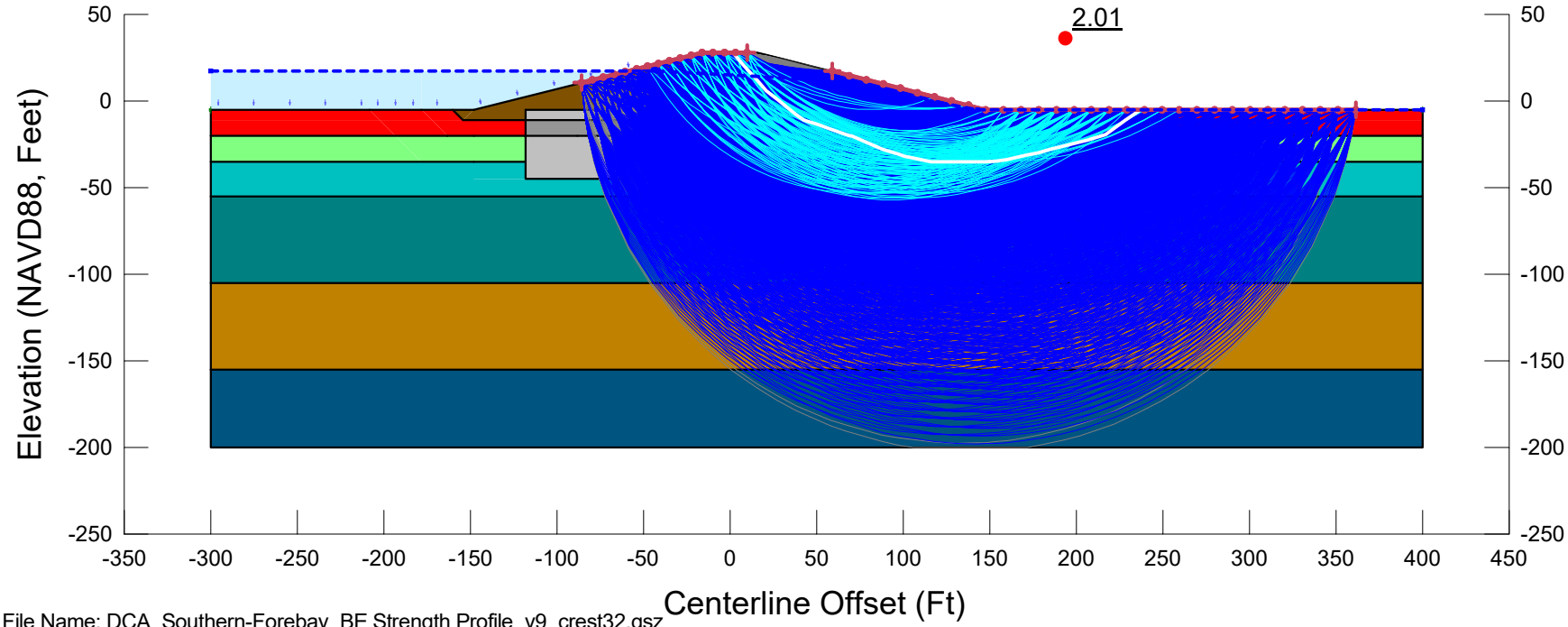
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.:

4H1V_P2_G2-AR15_A1-S

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Tau/Sigma Ratio	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120				100	31
	02_Organics_P2.PS	90		c_P2_BE.PS	phi'_P2_BE.PS		
	03B_Loose_Coarse-0.1	110	0.1				
	04_Med. Stiff_Fine_P2.PS	120		c_P2_BE.PS	phi'_P2_BE.PS		
	05_Stiff_Fine_P2.PS	125		c_P2_BE.PS	phi'_P2_BE.PS		
	06_Dense_Coarse_P2.PS	125		c_P2_BE.PS	phi'_P2_BE.PS		
	07_Stiff_Fine_P2.PS	125		c_P2_BE.PS	phi'_P2_BE.PS		
	08_Soil Cement AR=0.15	125				2,400	0
	08_Soil Cement Organics AR=0.15	125				1,425	0
	09_Soil Bentonite Wall	100				300	0



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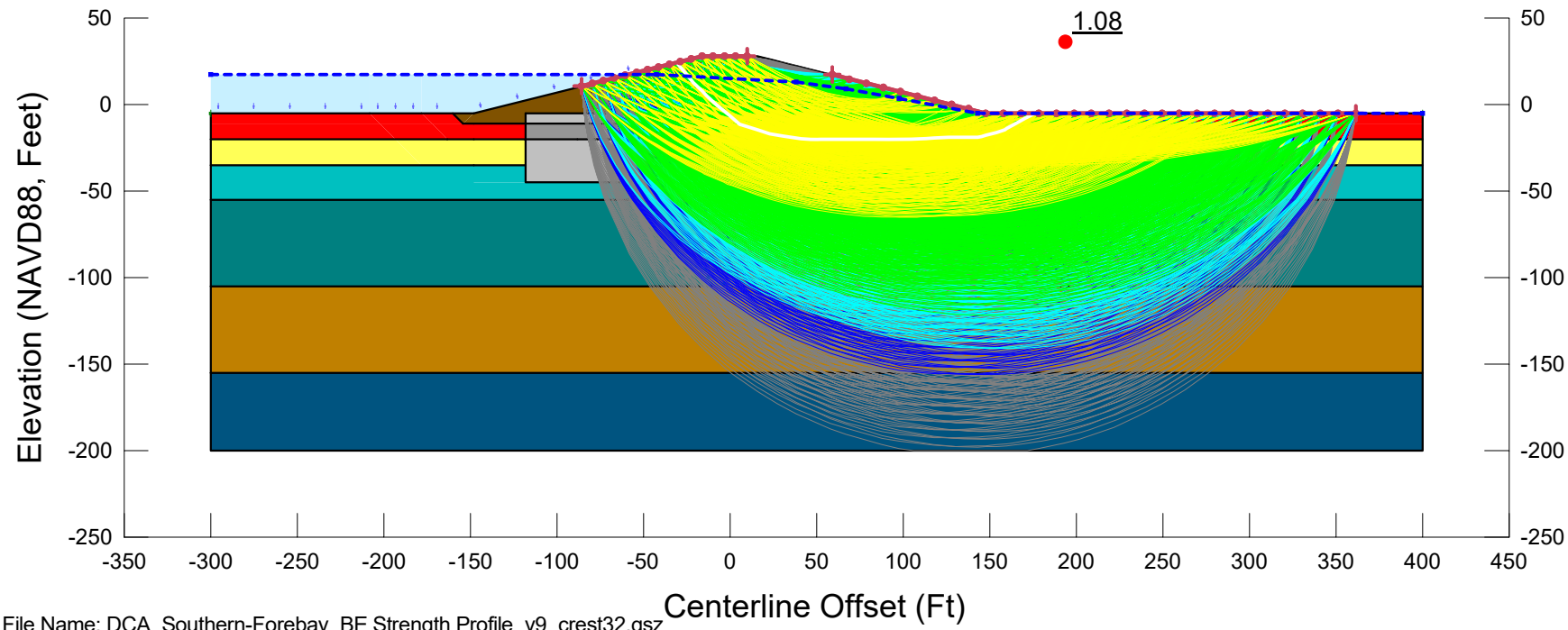
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.:

4H1V_P2_G2-AR15_A2-PS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_BE	phi'_P2_BE		
	03B_Loose_Coarse_P2	110	c_P2_BE	phi'_P2_BE		
	04_Med. Stiff_Fine_P2	120	c_P2_BE	phi'_P2_BE		
	05_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	06_Dense_Coarse_P2	125	c_P2_BE	phi'_P2_BE		
	07_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	08_Soil Cement AR=0.15	125			2,400	0
	08_Soil Cement Organics AR=0.15	125			1,425	0
	09_Soil Bentonite Wall	100			300	0



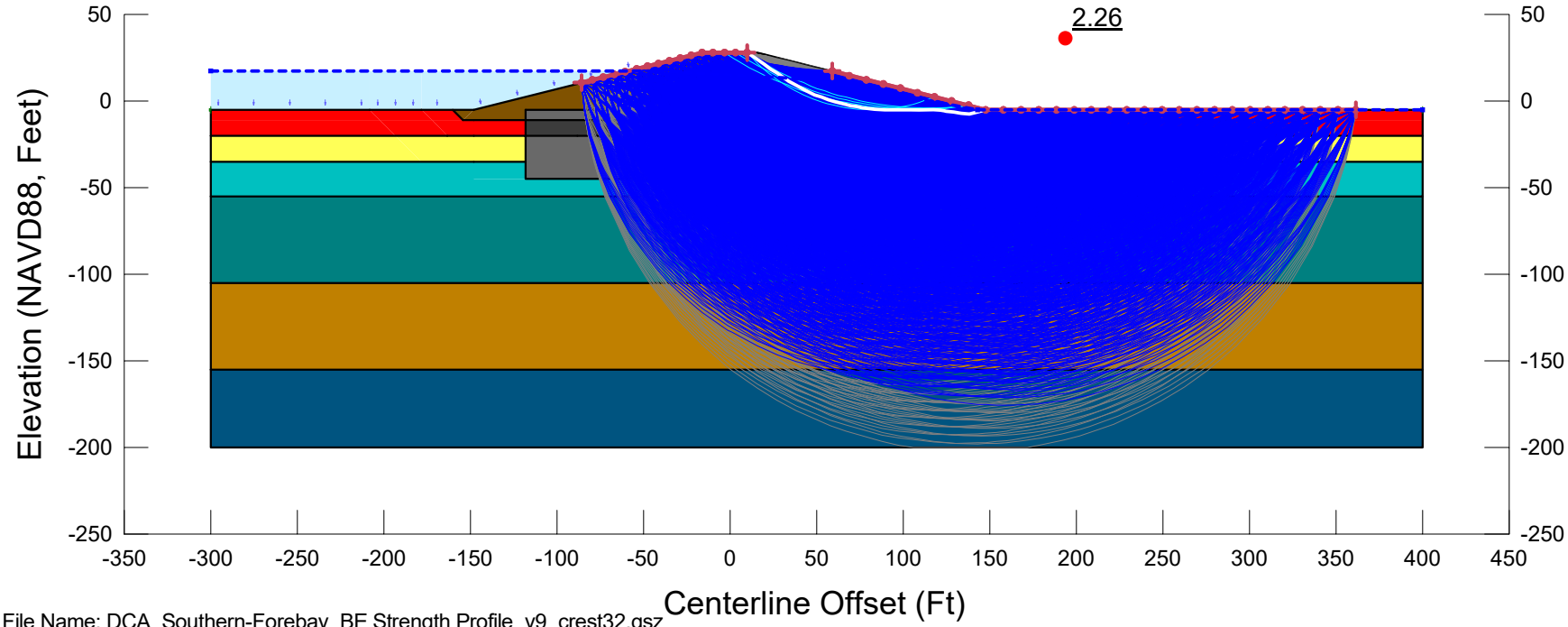
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

4H1V_P2_G2-AR15_A3-PSS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_BE	phi'_P2_BE		
	03B_Loose_Coarse_P2	110	c_P2_BE	phi'_P2_BE		
	04_Med. Stiff_Fine_P2	120	c_P2_BE	phi'_P2_BE		
	05_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	06_Dense_Coarse_P2	125	c_P2_BE	phi'_P2_BE		
	07_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	08_Soil Cement AR=0.25	125			4,000	0
	08_Soil Cement Organics AR=0.25	125			2,225	0
	09_Soil Bentonite Wall	100			300	0



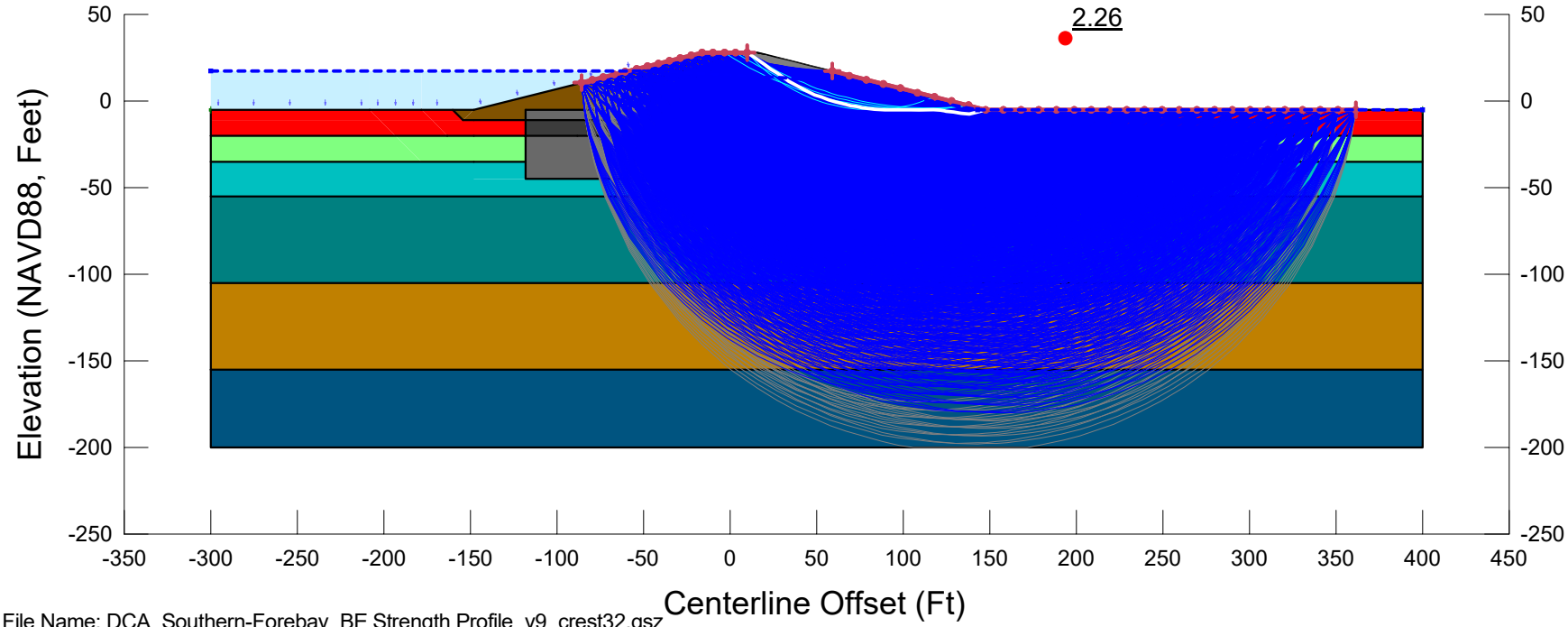
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.:

4H1V_P2_G2-AR25_A1-S

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Tau/Sigma Ratio	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120				100	31
	02_Organics_P2.PS	90		c_P2_BE.PS	phi'_P2_BE.PS		
	03B_Loose_Coarse-0.1	110	0.1				
	04_Med. Stiff_Fine_P2.PS	120		c_P2_BE.PS	phi'_P2_BE.PS		
	05_Stiff_Fine_P2.PS	125		c_P2_BE.PS	phi'_P2_BE.PS		
	06_Dense_Coarse_P2.PS	125		c_P2_BE.PS	phi'_P2_BE.PS		
	07_Stiff_Fine_P2.PS	125		c_P2_BE.PS	phi'_P2_BE.PS		
	08_Soil Cement AR=0.25	125				4,000	0
	08_Soil Cement Organics AR=0.25	125				2,225	0
	09_Soil Bentonite Wall	100				300	0



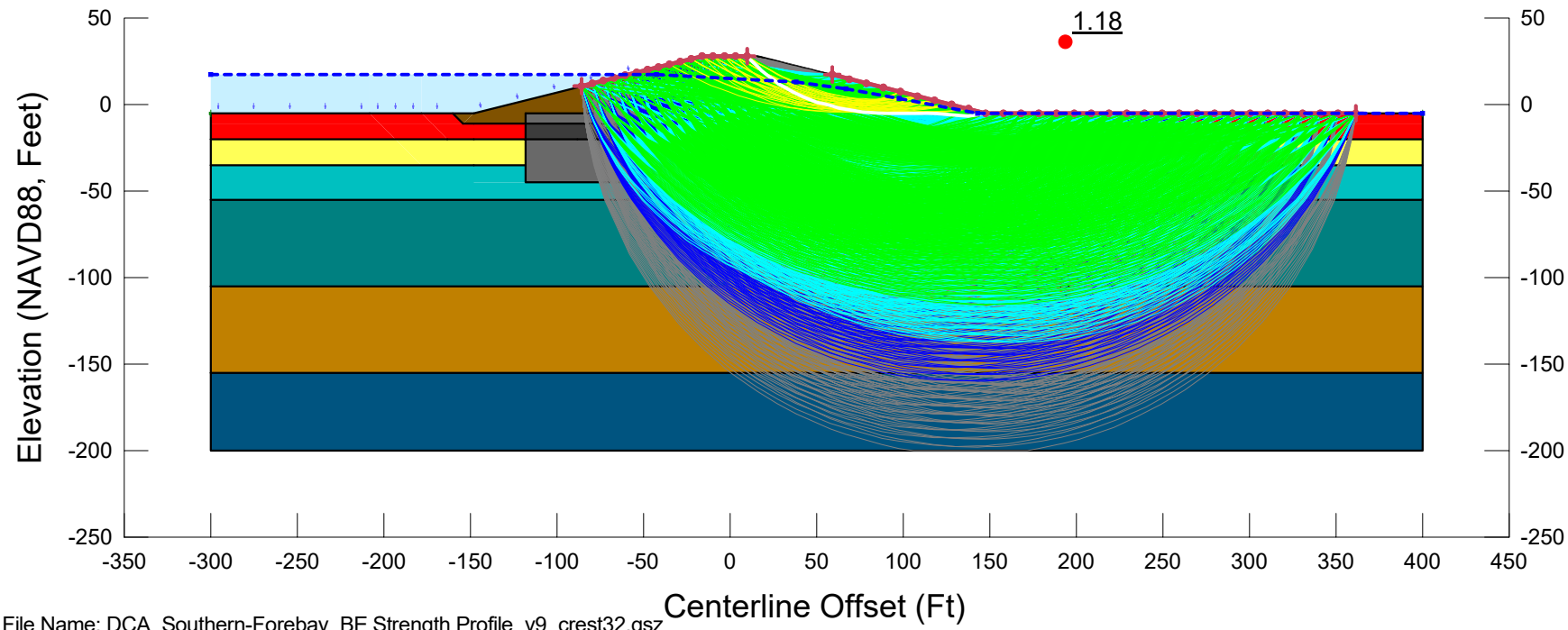
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.:

4H1V_P2_G2-AR25_A2-PS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_BE	phi'_P2_BE		
	03B_Loose_Coarse_P2	110	c_P2_BE	phi'_P2_BE		
	04_Med. Stiff_Fine_P2	120	c_P2_BE	phi'_P2_BE		
	05_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	06_Dense_Coarse_P2	125	c_P2_BE	phi'_P2_BE		
	07_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	08_Soil Cement AR=0.25	125			4,000	0
	08_Soil Cement Organics AR=0.25	125			2,225	0
	09_Soil Bentonite Wall	100			300	0



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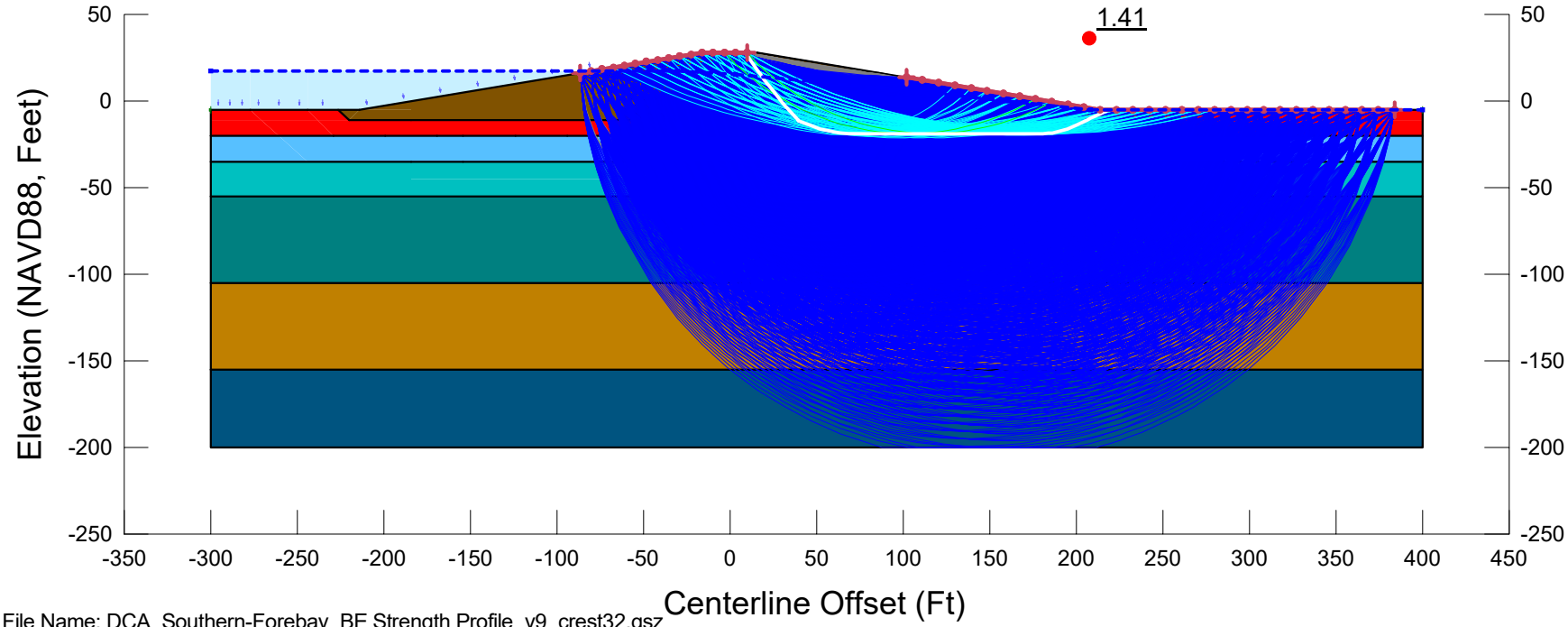
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

4H1V_P2_G2-AR25_A3-PSS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

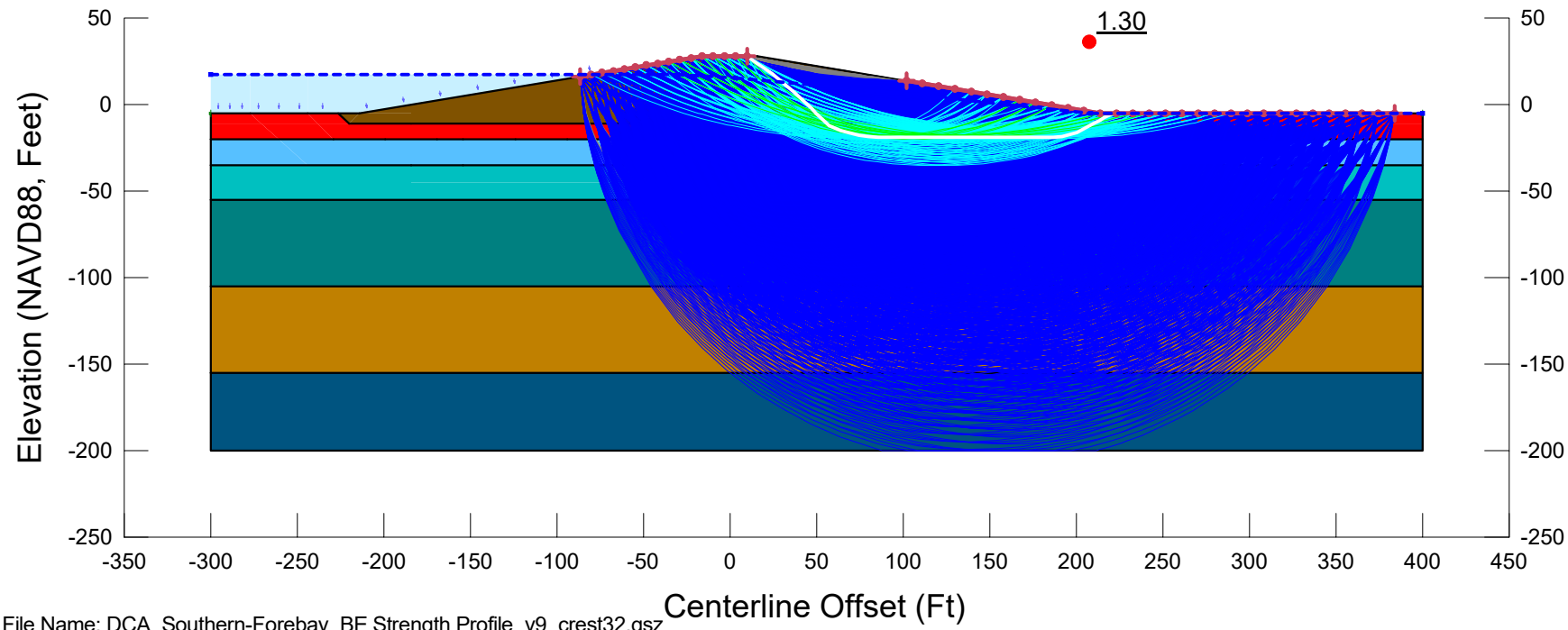
Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_BE	phi'_P1_BE		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_BE	phi'_P1_BE		
	04_Med. Stiff_Fine_P1	120	c_P1_BE	phi'_P1_BE		
	05_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	06_Dense_Coarse_P1	125	c_P1_BE	phi'_P1_BE		
	07_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		



File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Constant
Horz Seismic Coef.:

6H1V_P1_E_A1-S	
DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz	
02/27/2020	1:1,200

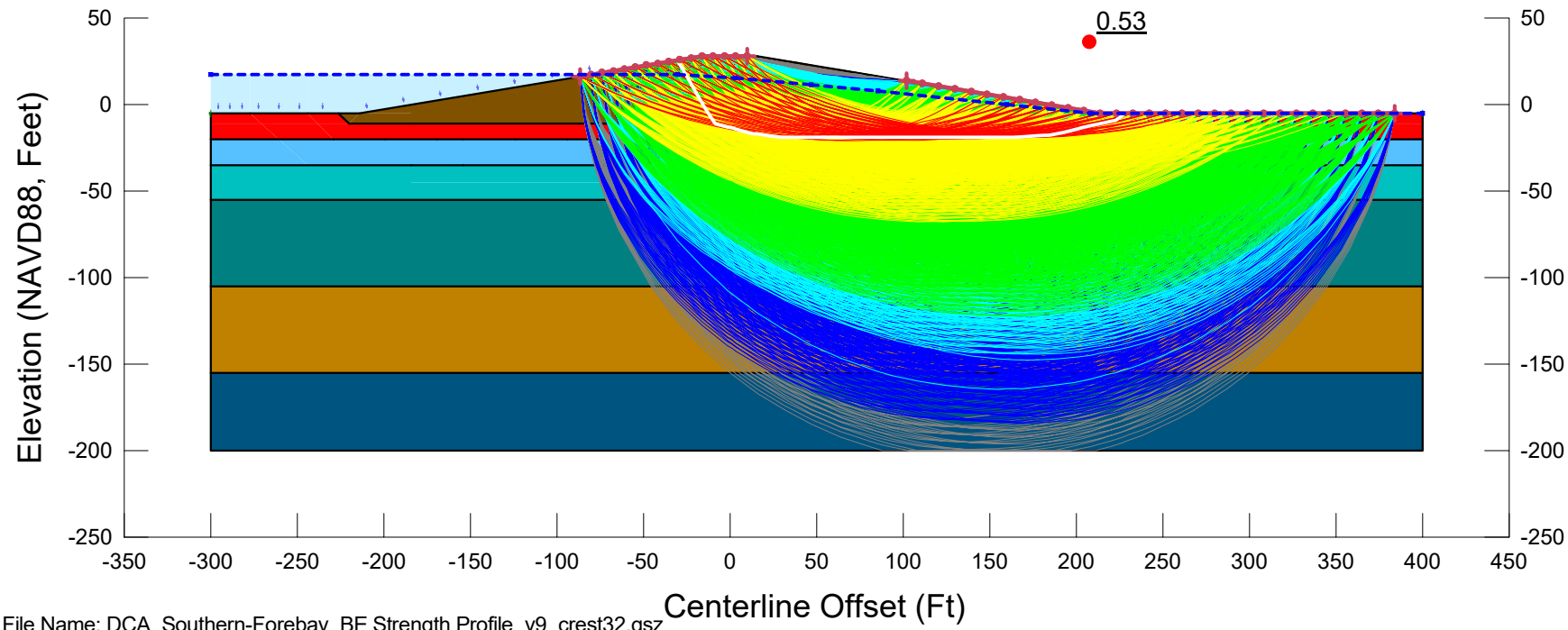
Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1.PS	90	c_P1_BE.PS	phi'_P1_BE.PS		
	03A_Soft-Med. Stiff_Fine_P1.PS	110	c_P1_BE.PS	phi'_P1_BE.PS		
	04_Med. Stiff_Fine_P1.PS	120	c_P1_BE.PS	phi'_P1_BE.PS		
	05_Stiff_Fine_P1.PS	125	c_P1_BE.PS	phi'_P1_BE.PS		
	06_Dense_Coarse_P1.PS	125	c_P1_BE.PS	phi'_P1_BE.PS		
	07_Stiff_Fine_P1.PS	125	c_P1_BE.PS	phi'_P1_BE.PS		



File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Constant
Horz Seismic Coef.:

6H1V_P1_E_A2-PS	
DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz	
02/27/2020	1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_BE	phi'_P1_BE		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_BE	phi'_P1_BE		
	04_Med. Stiff_Fine_P1	120	c_P1_BE	phi'_P1_BE		
	05_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	06_Dense_Coarse_P1	125	c_P1_BE	phi'_P1_BE		
	07_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		



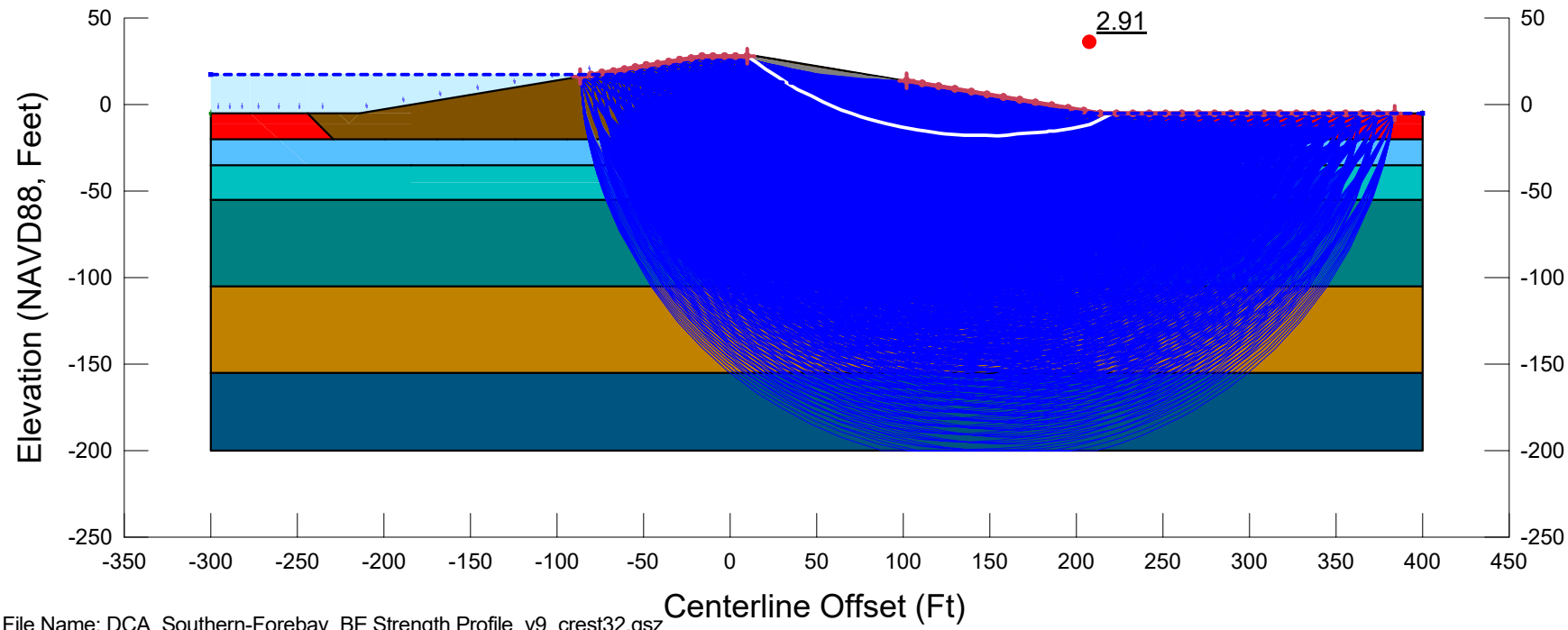
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

6H1V_P1_E_A3-PSS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_BE	phi'_P1_BE		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_BE	phi'_P1_BE		
	04_Med. Stiff_Fine_P1	120	c_P1_BE	phi'_P1_BE		
	05_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	06_Dense_Coarse_P1	125	c_P1_BE	phi'_P1_BE		
	07_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	09_Soil Bentonite Wall	100			300	0



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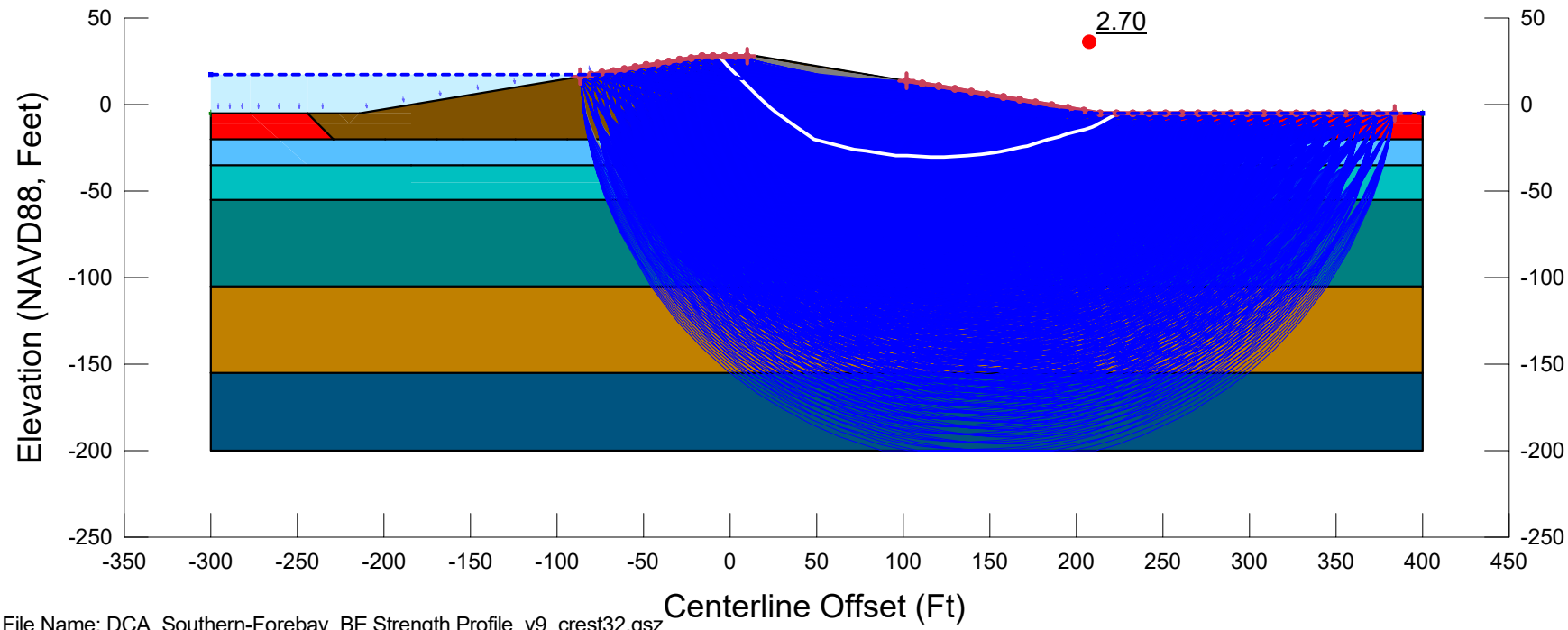
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Constant
Horz Seismic Coef.:

6H1V_P1_G1-RR15_A1-S	
DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz	
02/27/2020	1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1.PS	90	c_P1_BE.PS	phi'_P1_BE.PS		
	03A_Soft-Med. Stiff_Fine_P1.PS	110	c_P1_BE.PS	phi'_P1_BE.PS		
	04_Med. Stiff_Fine_P1.PS	120	c_P1_BE.PS	phi'_P1_BE.PS		
	05_Stiff_Fine_P1.PS	125	c_P1_BE.PS	phi'_P1_BE.PS		
	06_Dense_Coarse_P1.PS	125	c_P1_BE.PS	phi'_P1_BE.PS		
	07_Stiff_Fine_P1.PS	125	c_P1_BE.PS	phi'_P1_BE.PS		
	09_Soil Bentonite Wall	100			300	0



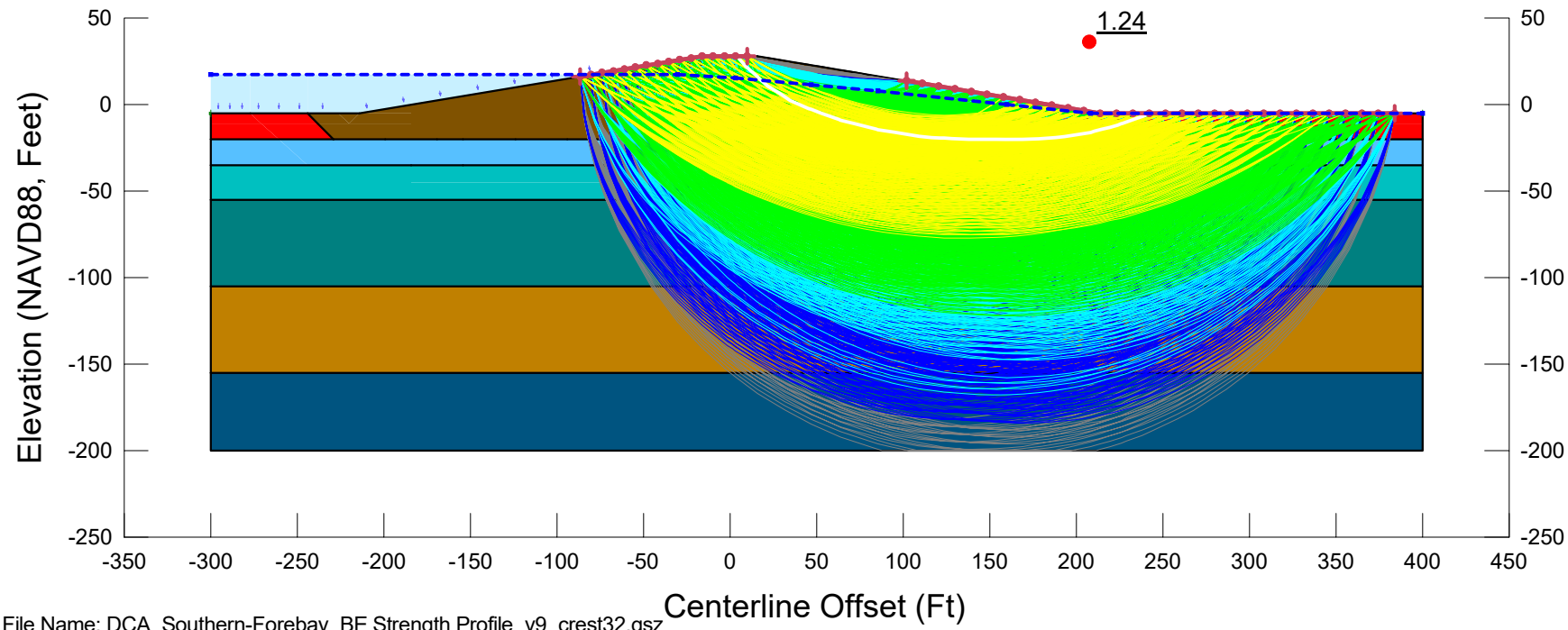
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Constant
Horz Seismic Coef.:

6H1V_P1_G1-RR15_A2-PS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_BE	phi'_P1_BE		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_BE	phi'_P1_BE		
	04_Med. Stiff_Fine_P1	120	c_P1_BE	phi'_P1_BE		
	05_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	06_Dense_Coarse_P1	125	c_P1_BE	phi'_P1_BE		
	07_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	09_Soil Bentonite Wall	100			300	0



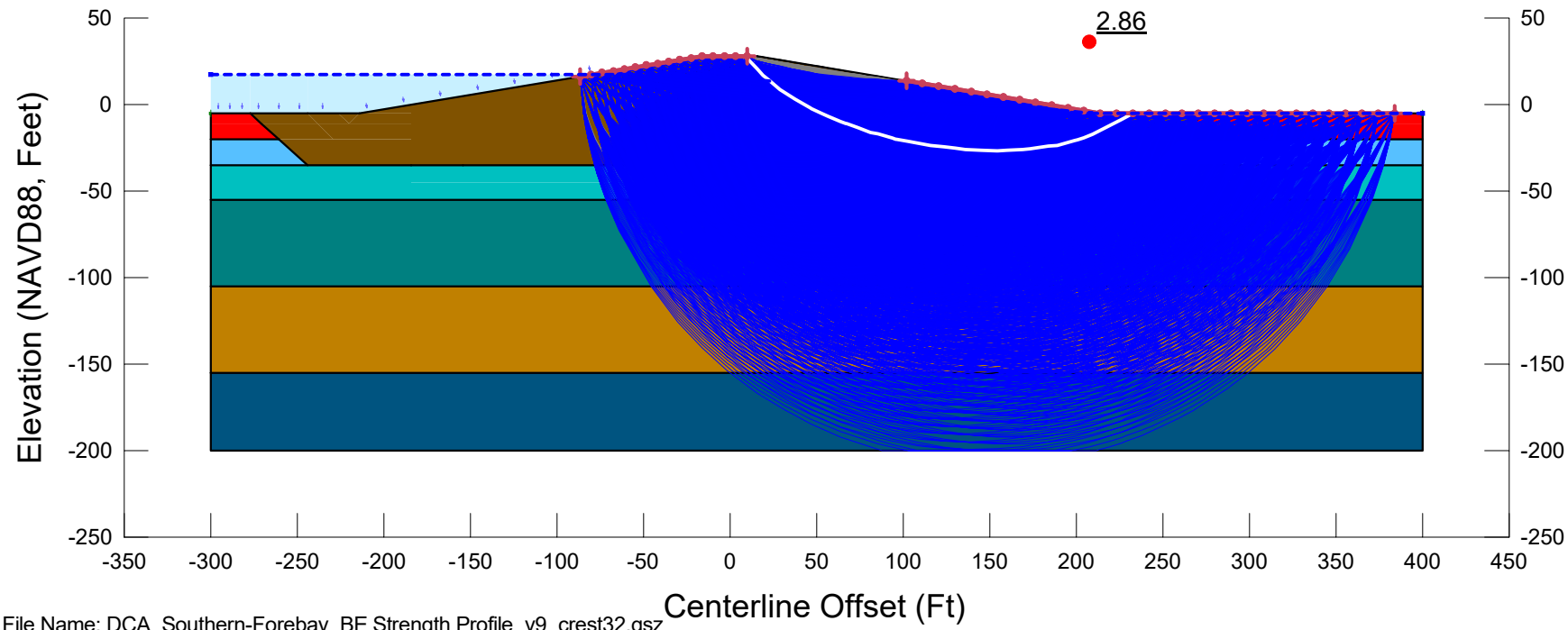
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

6H1V_P1_G1-RR15_A3-PSS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_BE	phi'_P1_BE		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_BE	phi'_P1_BE		
	04_Med. Stiff_Fine_P1	120	c_P1_BE	phi'_P1_BE		
	05_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	06_Dense_Coarse_P1	125	c_P1_BE	phi'_P1_BE		
	07_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	09_Soil Bentonite Wall	100			300	0



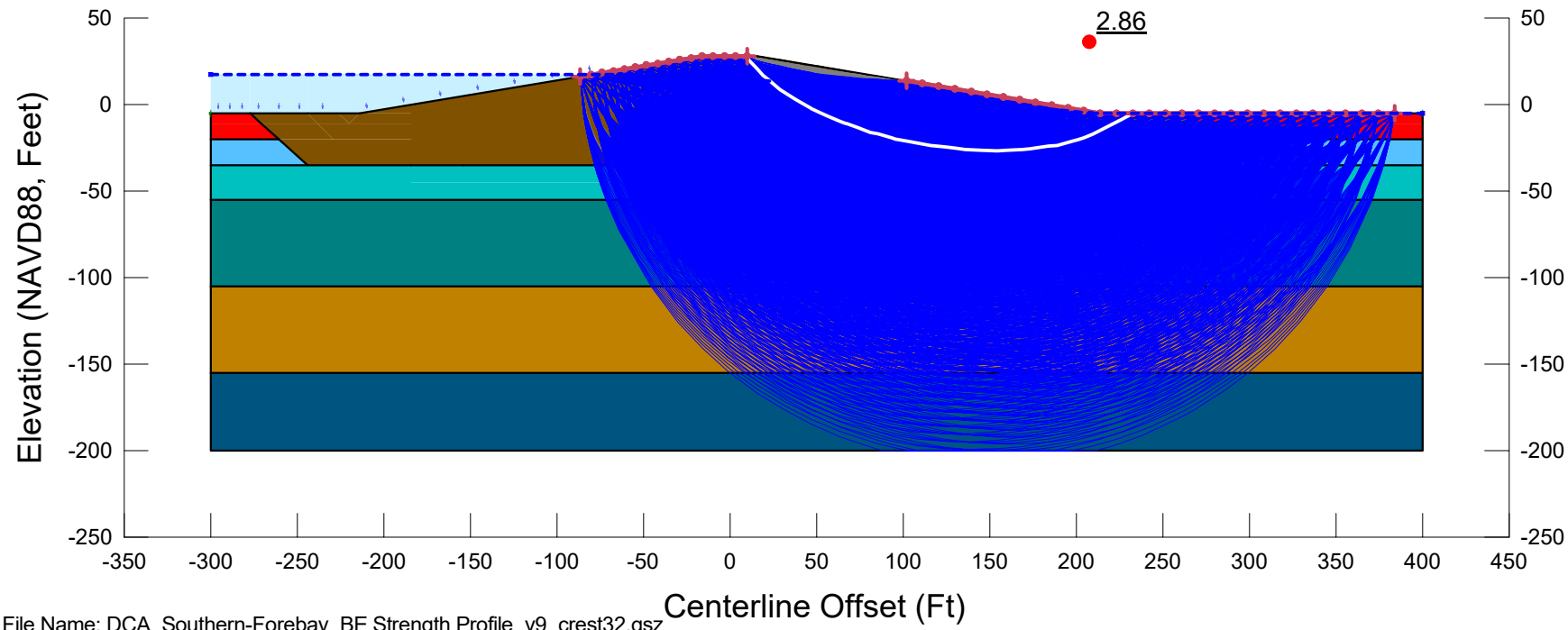
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Constant
Horz Seismic Coef.:

6H1V_P1_G1-RR30_A1-S

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1.PS	90	c_P1_BE.PS	phi'_P1_BE.PS		
	03A_Soft-Med. Stiff_Fine_P1.PS	110	c_P1_BE.PS	phi'_P1_BE.PS		
	04_Med. Stiff_Fine_P1.PS	120	c_P1_BE.PS	phi'_P1_BE.PS		
	05_Stiff_Fine_P1.PS	125	c_P1_BE.PS	phi'_P1_BE.PS		
	06_Dense_Coarse_P1.PS	125	c_P1_BE.PS	phi'_P1_BE.PS		
	07_Stiff_Fine_P1.PS	125	c_P1_BE.PS	phi'_P1_BE.PS		
	09_Soil Bentonite Wall	100			300	0



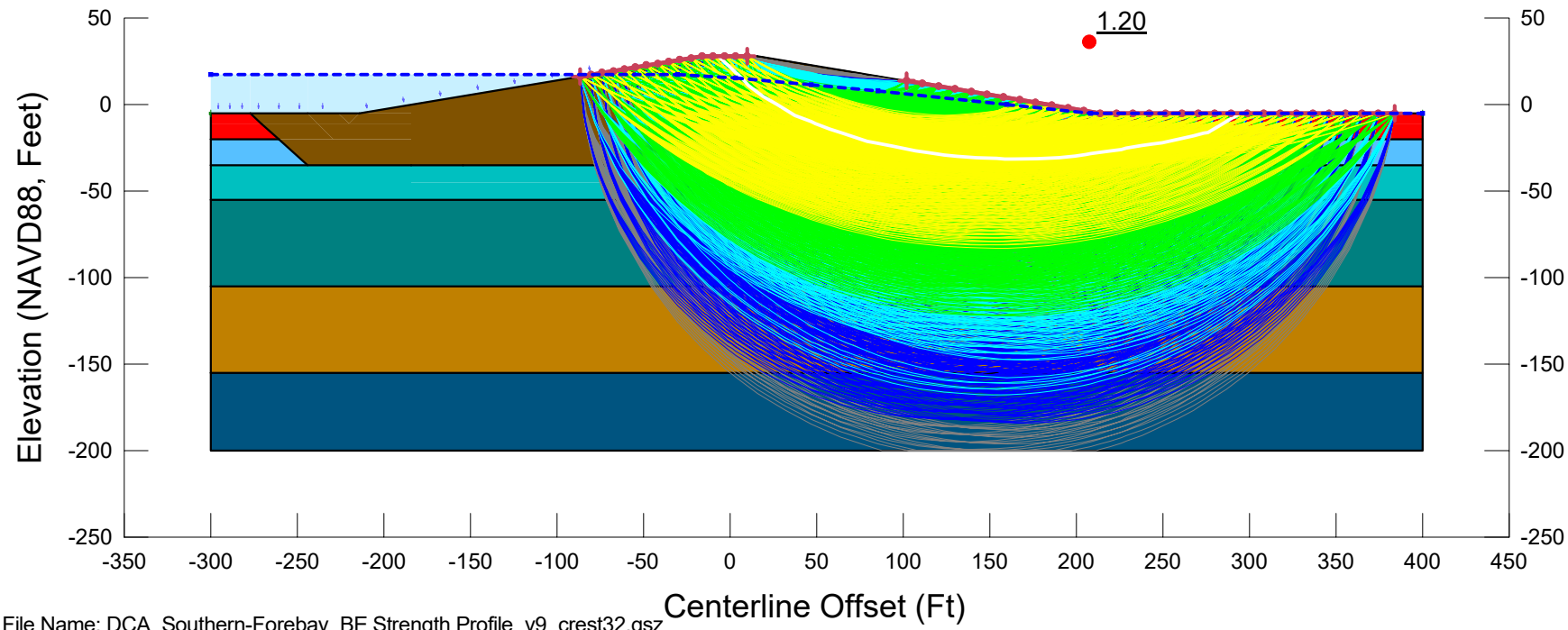
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Constant
Horz Seismic Coef.:

6H1V_P1_G1-RR30_A2-PS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_BE	phi'_P1_BE		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_BE	phi'_P1_BE		
	04_Med. Stiff_Fine_P1	120	c_P1_BE	phi'_P1_BE		
	05_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	06_Dense_Coarse_P1	125	c_P1_BE	phi'_P1_BE		
	07_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	09_Soil Bentonite Wall	100			300	0



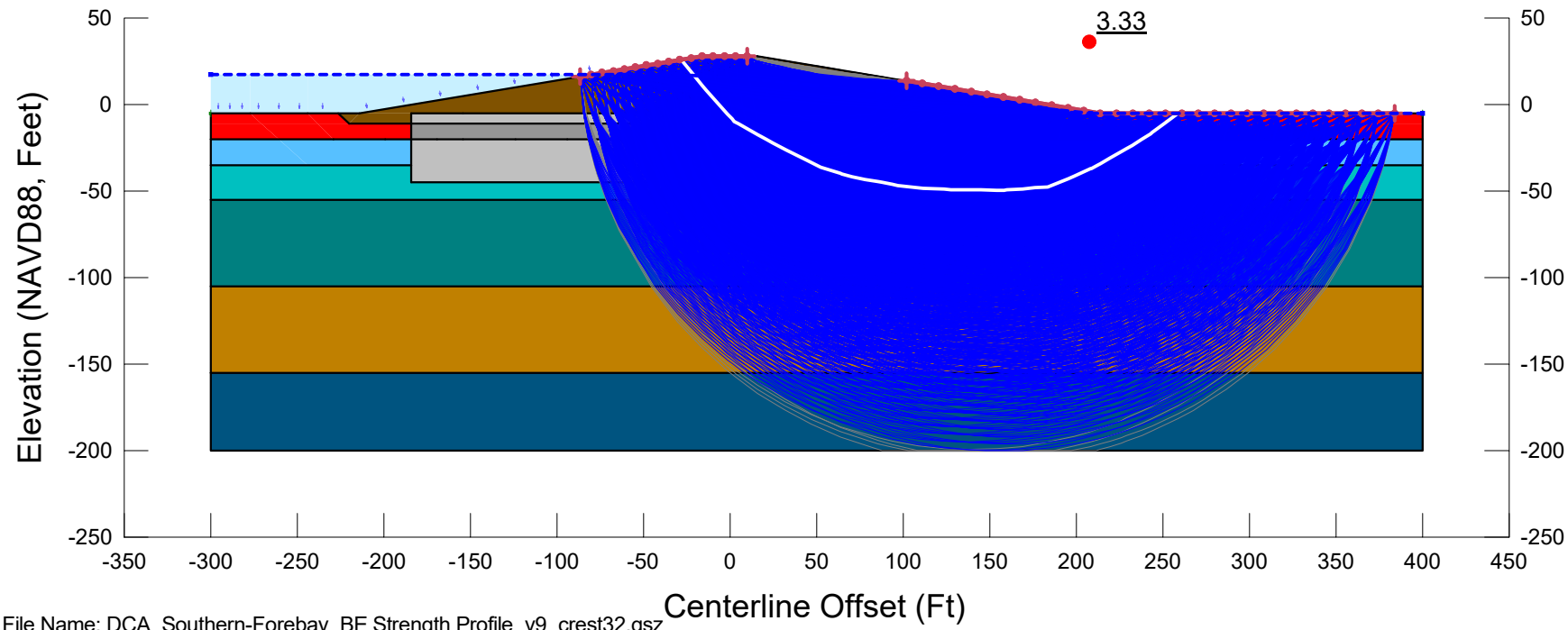
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

6H1V_P1_G1-RR30_A3-PSS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_BE	phi'_P1_BE		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_BE	phi'_P1_BE		
	04_Med. Stiff_Fine_P1	120	c_P1_BE	phi'_P1_BE		
	05_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	06_Dense_Coarse_P1	125	c_P1_BE	phi'_P1_BE		
	07_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	08_Soil Cement AR=0.15	125			2,400	0
	08_Soil Cement Organics AR=0.15	125			1,425	0
	09_Soil Bentonite Wall	100			300	0



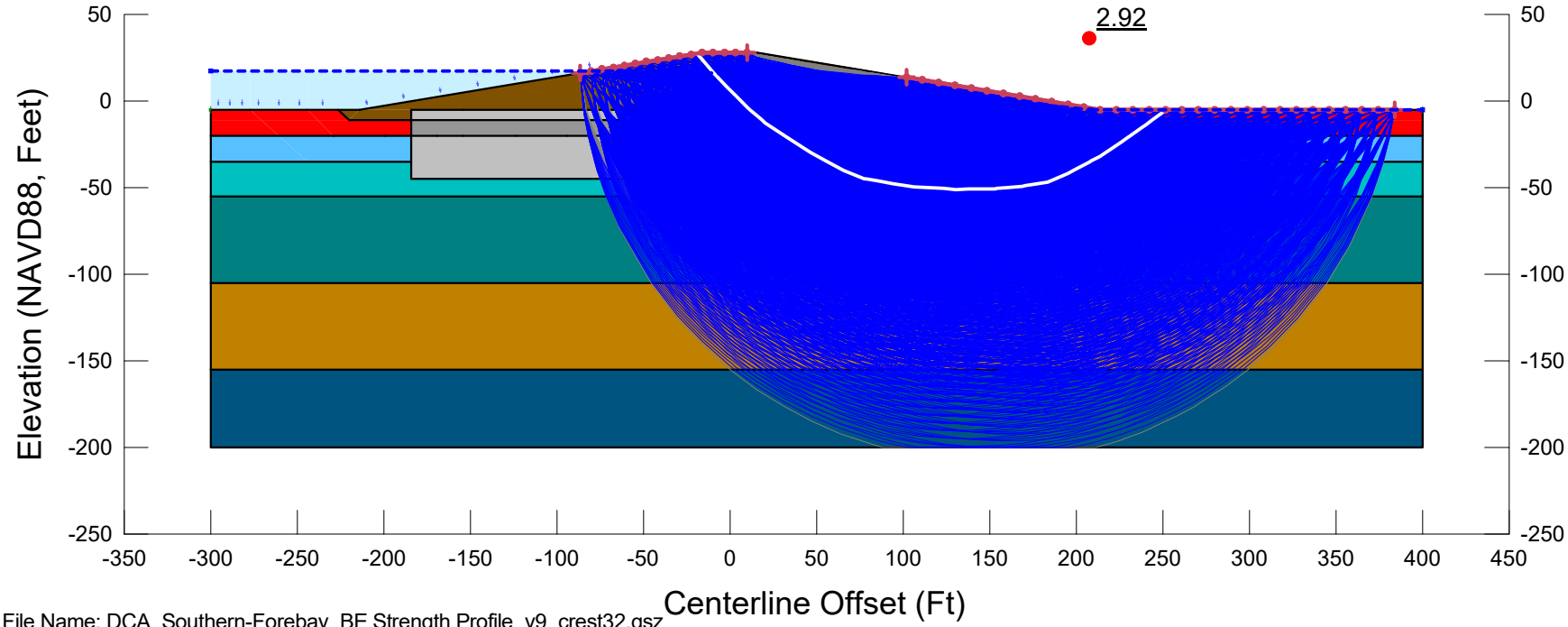
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.:

6H1V_P1_G2-AR15_A1-S

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1.PS	90	c_P1_BE.PS	phi'_P1_BE.PS		
	03A_Soft-Med. Stiff_Fine_P1.PS	110	c_P1_BE.PS	phi'_P1_BE.PS		
	04_Med. Stiff_Fine_P1.PS	120	c_P1_BE.PS	phi'_P1_BE.PS		
	05_Stiff_Fine_P1.PS	125	c_P1_BE.PS	phi'_P1_BE.PS		
	06_Dense_Coarse_P1.PS	125	c_P1_BE.PS	phi'_P1_BE.PS		
	07_Stiff_Fine_P1.PS	125	c_P1_BE.PS	phi'_P1_BE.PS		
	08_Soil Cement AR=0.15	125			2,400	0
	08_Soil Cement Organics AR=0.15	125			1,425	0
	09_Soil Bentonite Wall	100			300	0



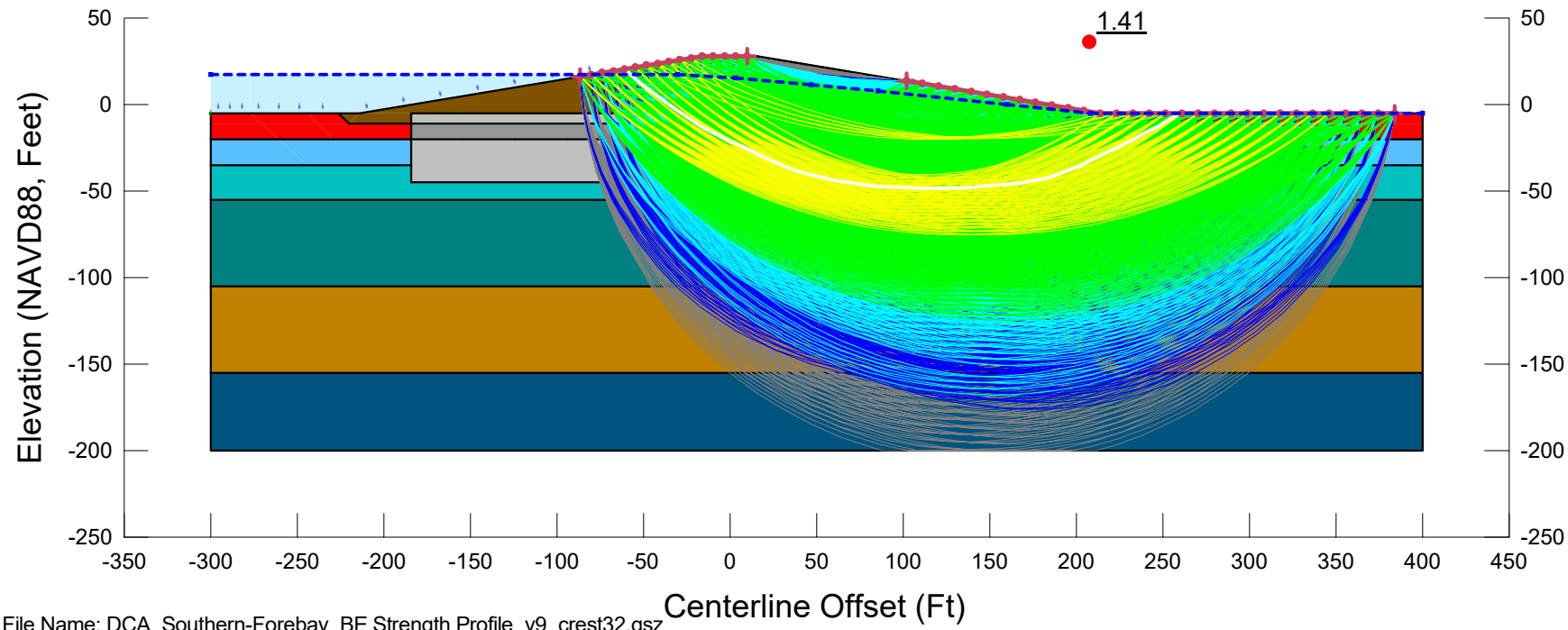
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.:

6H1V_P1_G2-AR15_A2-PS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_BE	phi'_P1_BE		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_BE	phi'_P1_BE		
	04_Med. Stiff_Fine_P1	120	c_P1_BE	phi'_P1_BE		
	05_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	06_Dense_Coarse_P1	125	c_P1_BE	phi'_P1_BE		
	07_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	08_Soil Cement AR=0.15	125			2,400	0
	08_Soil Cement Organics AR=0.15	125			1,425	0
	09_Soil Bentonite Wall	100			300	0



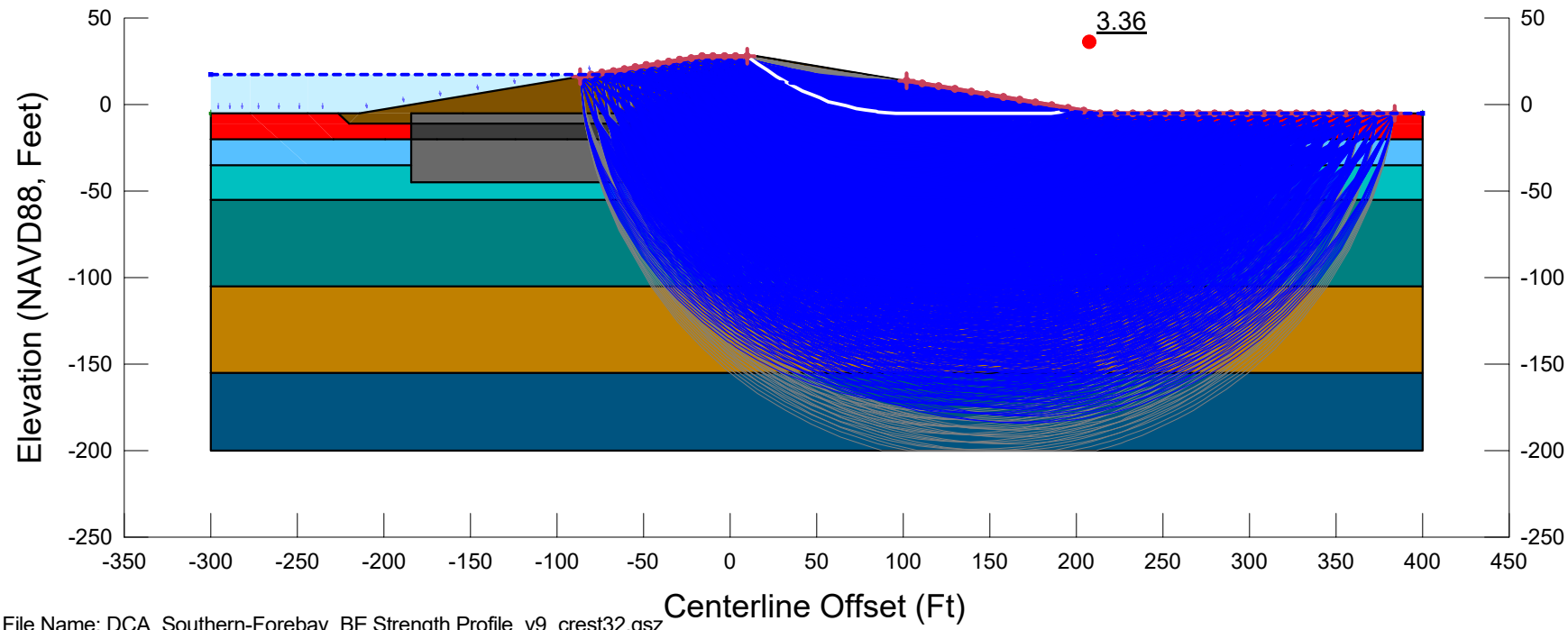
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

6H1V_P1_G2-AR15_A3-PSS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_BE	phi'_P1_BE		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_BE	phi'_P1_BE		
	04_Med. Stiff_Fine_P1	120	c_P1_BE	phi'_P1_BE		
	05_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	06_Dense_Coarse_P1	125	c_P1_BE	phi'_P1_BE		
	07_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	08_Soil Cement AR=0.25	125			4,000	0
	08_Soil Cement Organics AR=0.25	125			2,225	0
	09_Soil Bentonite Wall	100			300	0



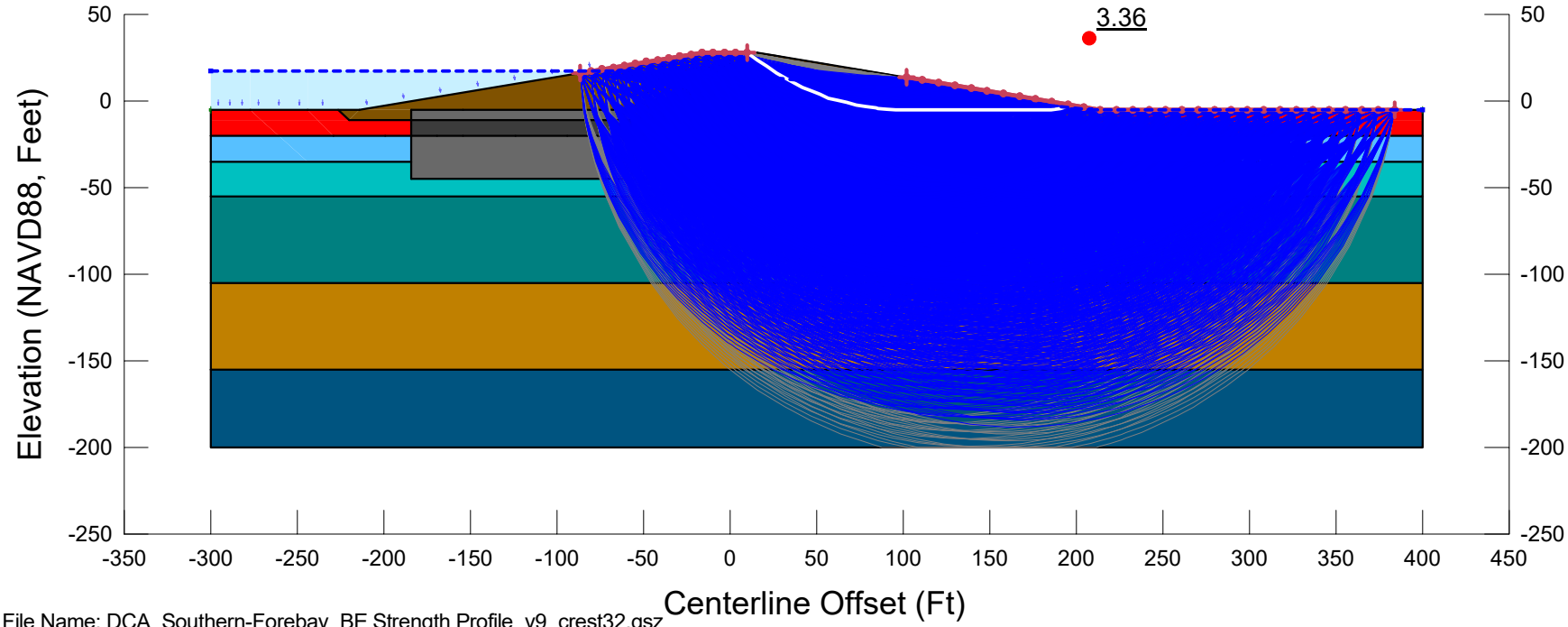
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Constant
Horz Seismic Coef.:

6H1V_P1_G2-AR25_A1-S

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1.PS	90	c_P1_BE.PS	phi'_P1_BE.PS		
	03A_Soft-Med. Stiff_Fine_P1.PS	110	c_P1_BE.PS	phi'_P1_BE.PS		
	04_Med. Stiff_Fine_P1.PS	120	c_P1_BE.PS	phi'_P1_BE.PS		
	05_Stiff_Fine_P1.PS	125	c_P1_BE.PS	phi'_P1_BE.PS		
	06_Dense_Coarse_P1.PS	125	c_P1_BE.PS	phi'_P1_BE.PS		
	07_Stiff_Fine_P1.PS	125	c_P1_BE.PS	phi'_P1_BE.PS		
	08_Soil Cement AR=0.25	125			4,000	0
	08_Soil Cement Organics AR=0.25	125			2,225	0
	09_Soil Bentonite Wall	100			300	0



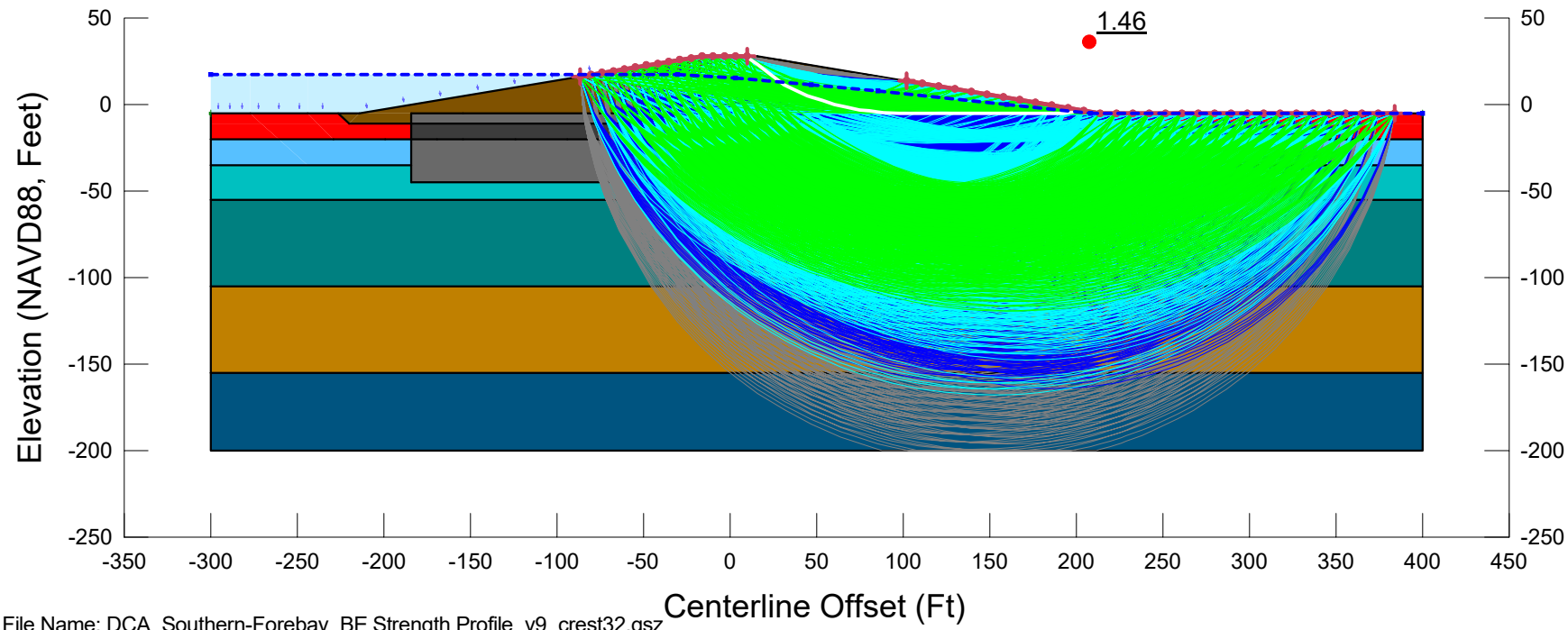
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Constant
Horz Seismic Coef.:

6H1V_P1_G2-AR25_A2-PS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_BE	phi'_P1_BE		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_BE	phi'_P1_BE		
	04_Med. Stiff_Fine_P1	120	c_P1_BE	phi'_P1_BE		
	05_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	06_Dense_Coarse_P1	125	c_P1_BE	phi'_P1_BE		
	07_Stiff_Fine_P1	125	c_P1_BE	phi'_P1_BE		
	08_Soil Cement AR=0.25	125			4,000	0
	08_Soil Cement Organics AR=0.25	125			2,225	0
	09_Soil Bentonite Wall	100			300	0



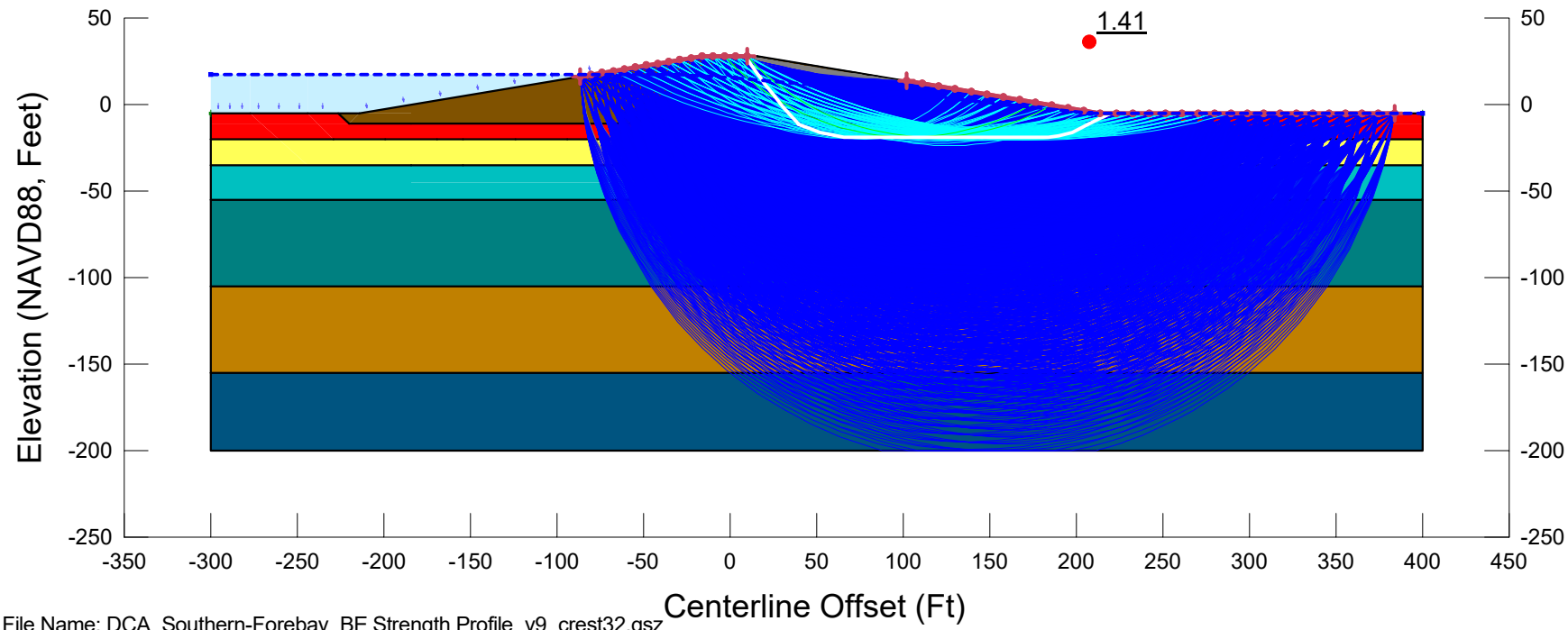
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

6H1V_P1_G2-AR25_A3-PSS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_BE	phi'_P2_BE		
	03B_Loose_Coarse_P2	110	c_P2_BE	phi'_P2_BE		
	04_Med. Stiff_Fine_P2	120	c_P2_BE	phi'_P2_BE		
	05_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	06_Dense_Coarse_P2	125	c_P2_BE	phi'_P2_BE		
	07_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		



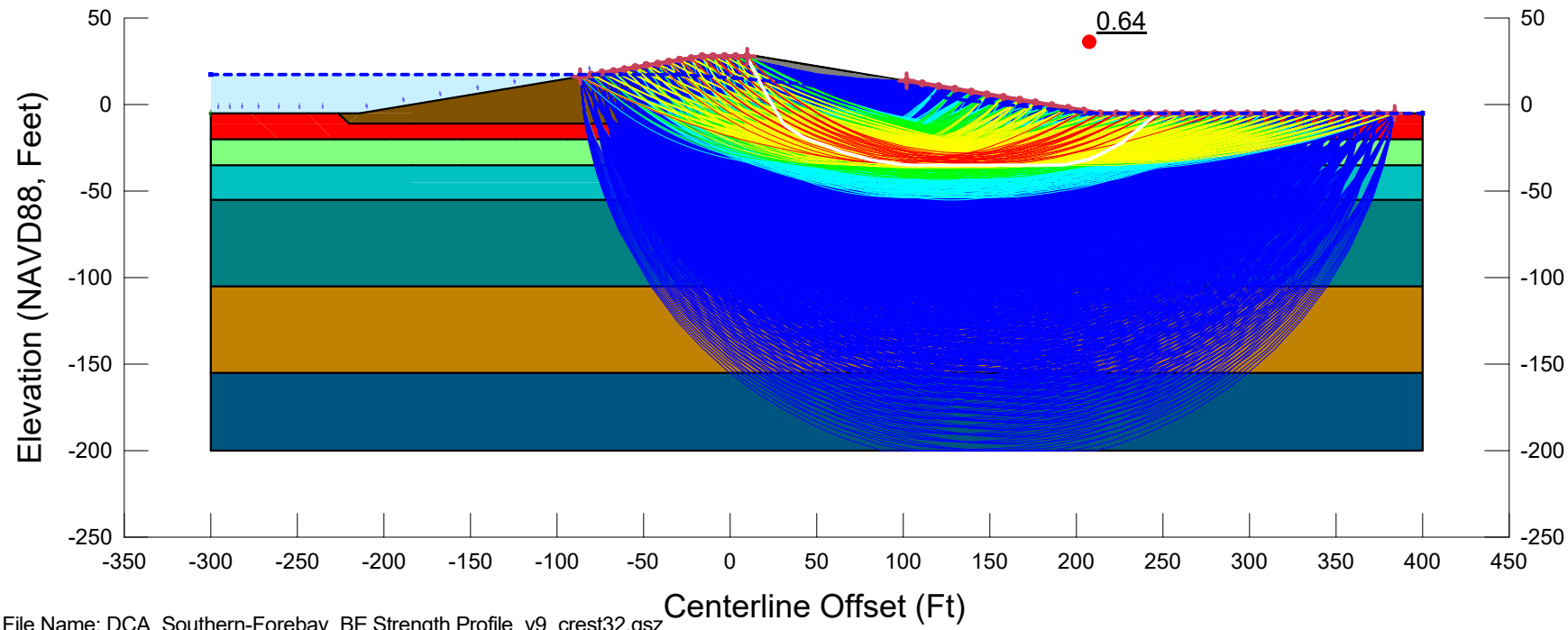
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Constant
Horz Seismic Coef.:

6H1V_P2_E_A1-S

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

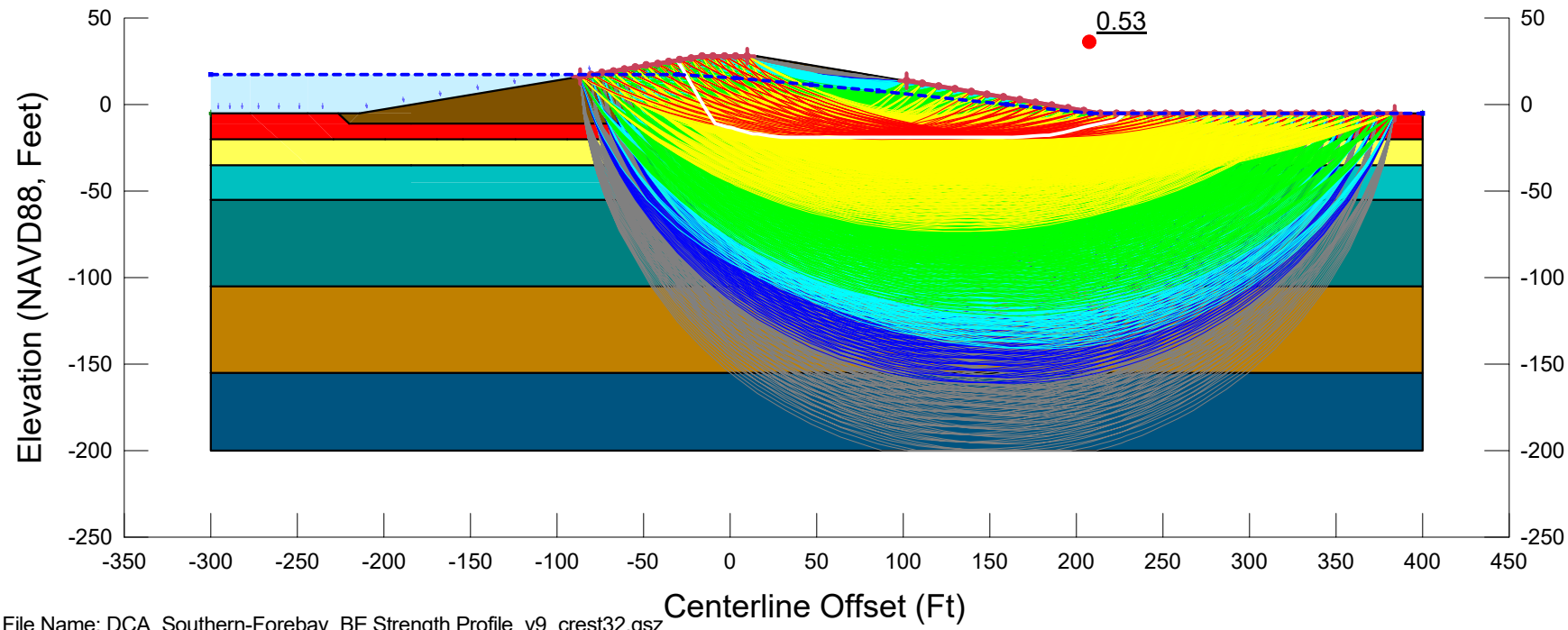
Color	Name	Unit Weight (pcf)	Tau/Sigma Ratio	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120				100	31
	02_Organics_P2.PS	90		c_P2_BE.PS	phi'_P2_BE.PS		
	03B_Loose_Coarse-0.1	110	0.1				
	04_Med. Stiff_Fine_P2.PS	120		c_P2_BE.PS	phi'_P2_BE.PS		
	05_Stiff_Fine_P2.PS	125		c_P2_BE.PS	phi'_P2_BE.PS		
	06_Dense_Coarse_P2.PS	125		c_P2_BE.PS	phi'_P2_BE.PS		
	07_Stiff_Fine_P2.PS	125		c_P2_BE.PS	phi'_P2_BE.PS		



File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Constant
Horz Seismic Coef.:

6H1V_P2_E_A2-PS	
DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz	
02/27/2020	1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_BE	phi'_P2_BE		
	03B_Loose_Coarse_P2	110	c_P2_BE	phi'_P2_BE		
	04_Med. Stiff_Fine_P2	120	c_P2_BE	phi'_P2_BE		
	05_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	06_Dense_Coarse_P2	125	c_P2_BE	phi'_P2_BE		
	07_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		



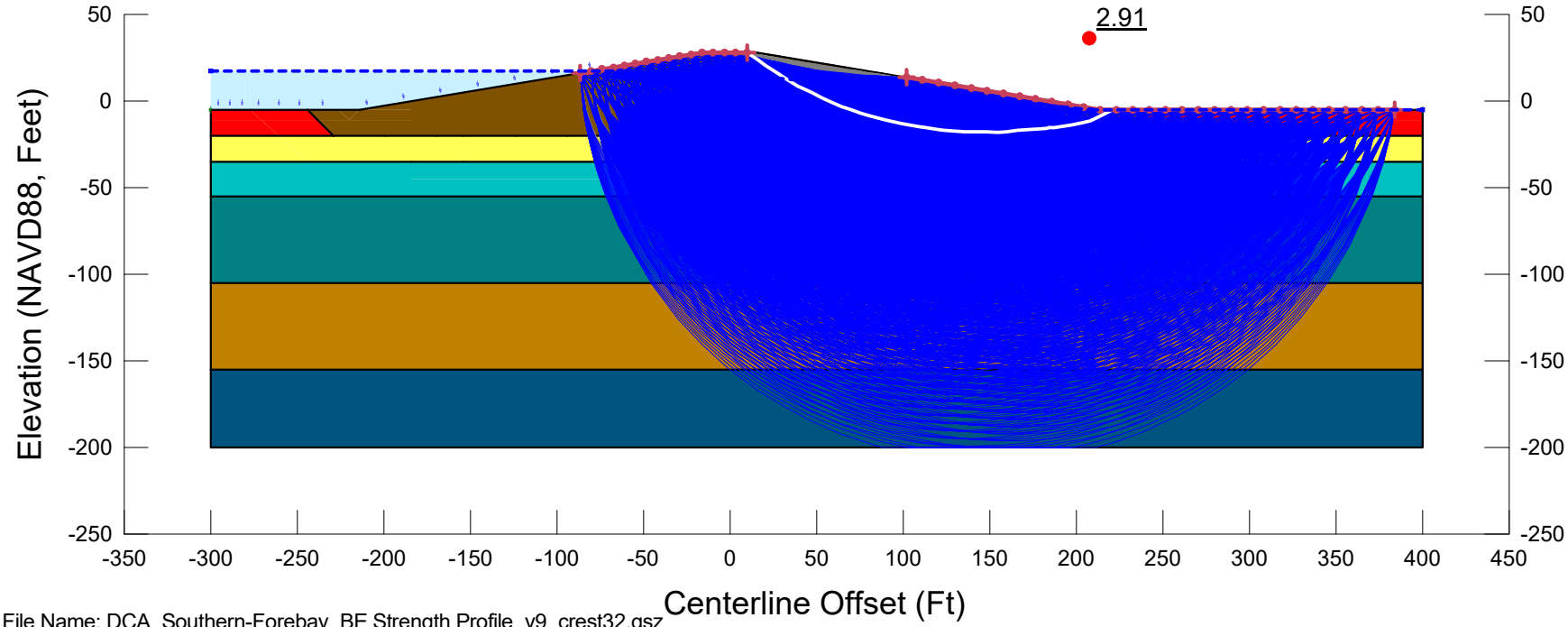
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

6H1V_P2_E_A3-PSS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

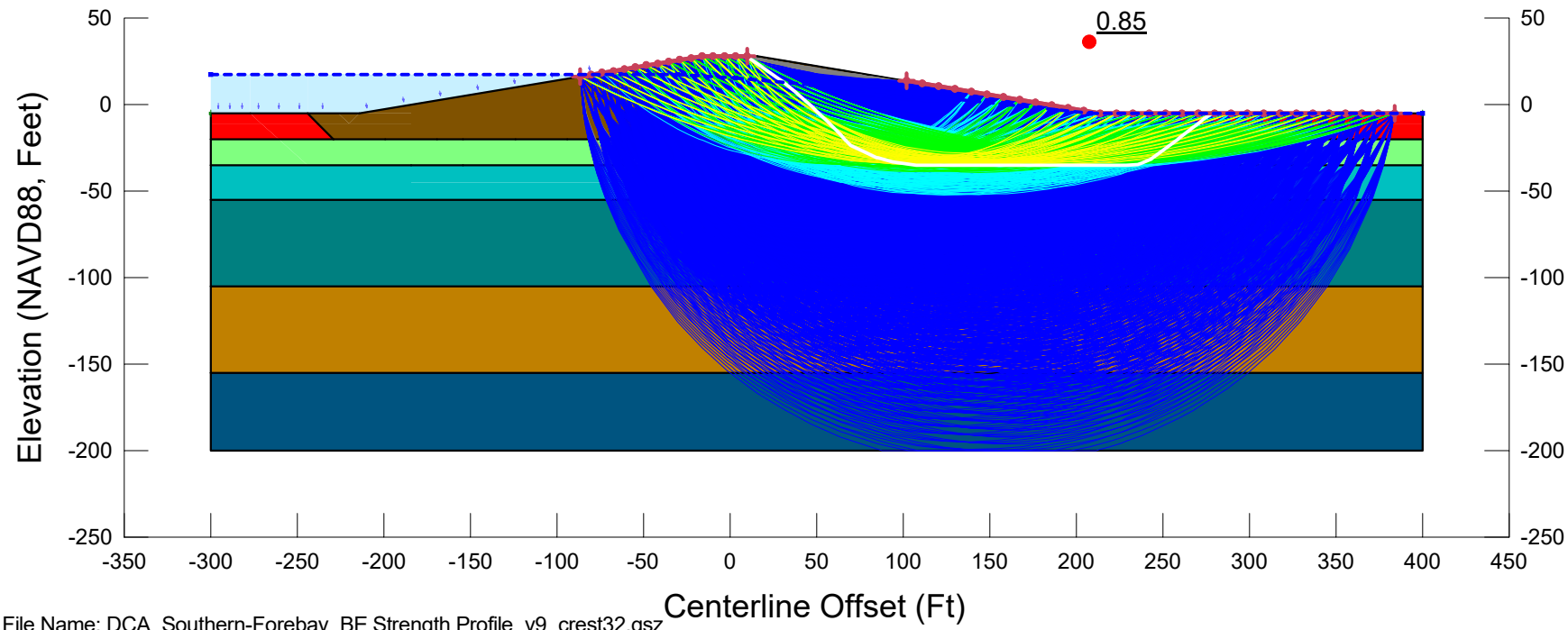
Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_BE	phi'_P2_BE		
	03B_Loose_Coarse_P2	110	c_P2_BE	phi'_P2_BE		
	04_Med. Stiff_Fine_P2	120	c_P2_BE	phi'_P2_BE		
	05_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	06_Dense_Coarse_P2	125	c_P2_BE	phi'_P2_BE		
	07_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	09_Soil Bentonite Wall	100			300	0



File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Constant
Horz Seismic Coef.:

6H1V_P2_G1-RR15_A1-S	
DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz	
02/27/2020	1:1,200

Color	Name	Unit Weight (pcf)	Tau/Sigma Ratio	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120				100	31
	02_Organics_P2.PS	90		c_P2_BE.PS	phi'_P2_BE.PS		
	03B_Loose_Coarse-0.1	110	0.1				
	04_Med. Stiff_Fine_P2.PS	120		c_P2_BE.PS	phi'_P2_BE.PS		
	05_Stiff_Fine_P2.PS	125		c_P2_BE.PS	phi'_P2_BE.PS		
	06_Dense_Coarse_P2.PS	125		c_P2_BE.PS	phi'_P2_BE.PS		
	07_Stiff_Fine_P2.PS	125		c_P2_BE.PS	phi'_P2_BE.PS		
	09_Soil Bentonite Wall	100				300	0



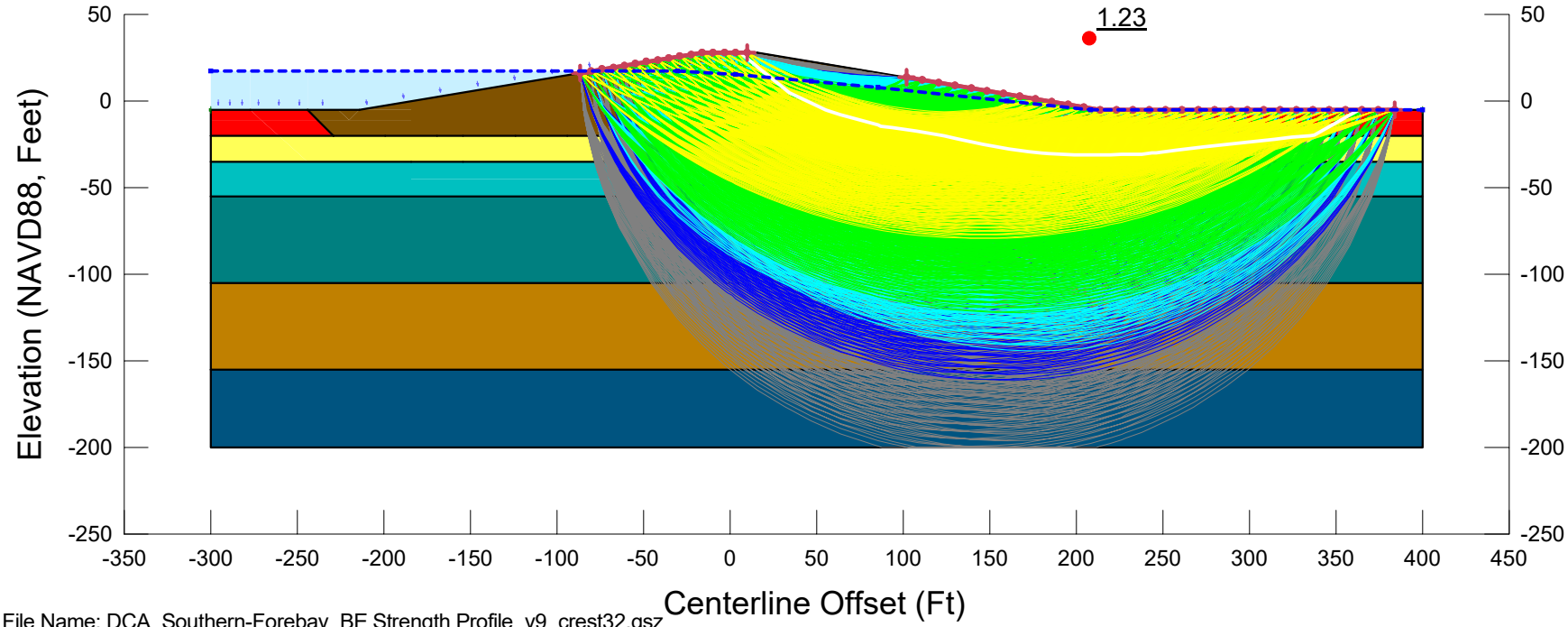
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Constant
Horz Seismic Coef.:

6H1V_P2_G1-RR15_A2-PS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_BE	phi'_P2_BE		
	03B_Loose_Coarse_P2	110	c_P2_BE	phi'_P2_BE		
	04_Med. Stiff_Fine_P2	120	c_P2_BE	phi'_P2_BE		
	05_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	06_Dense_Coarse_P2	125	c_P2_BE	phi'_P2_BE		
	07_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	09_Soil Bentonite Wall	100			300	0



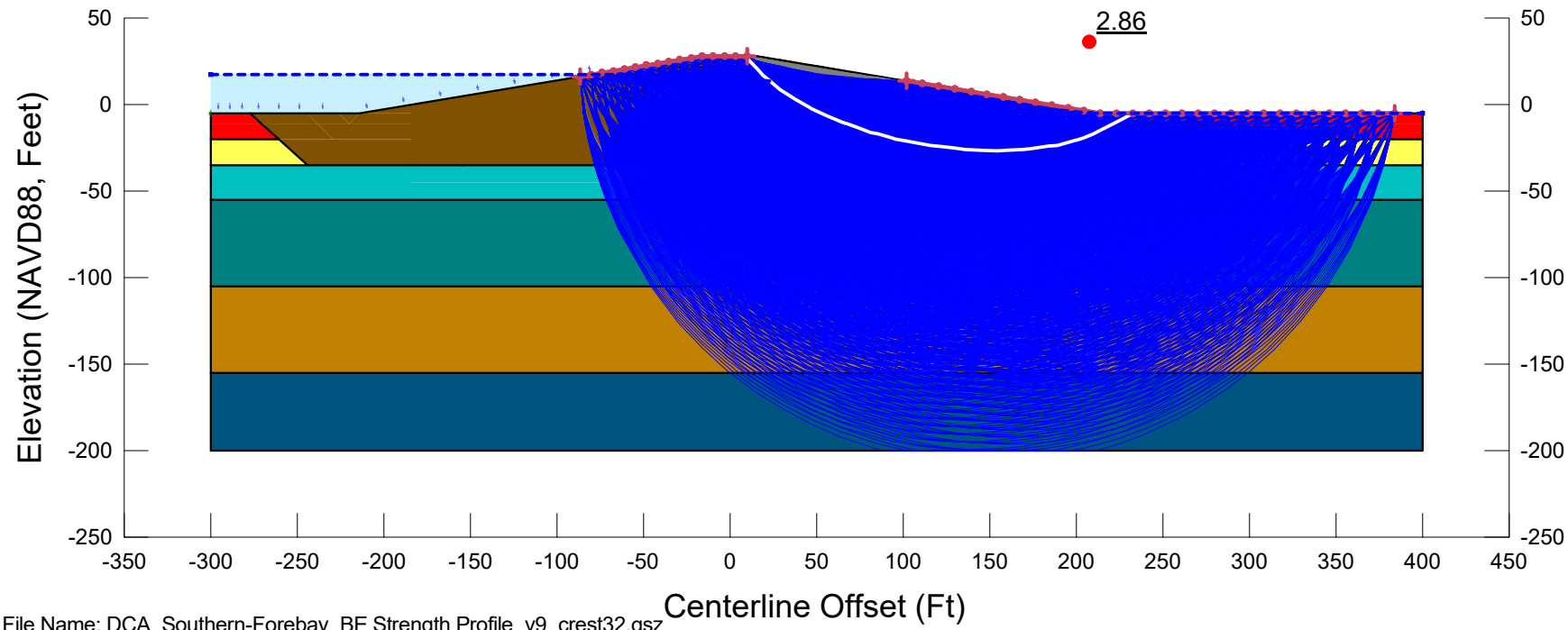
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

6H1V_P2_G1-RR15_A3-PSS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

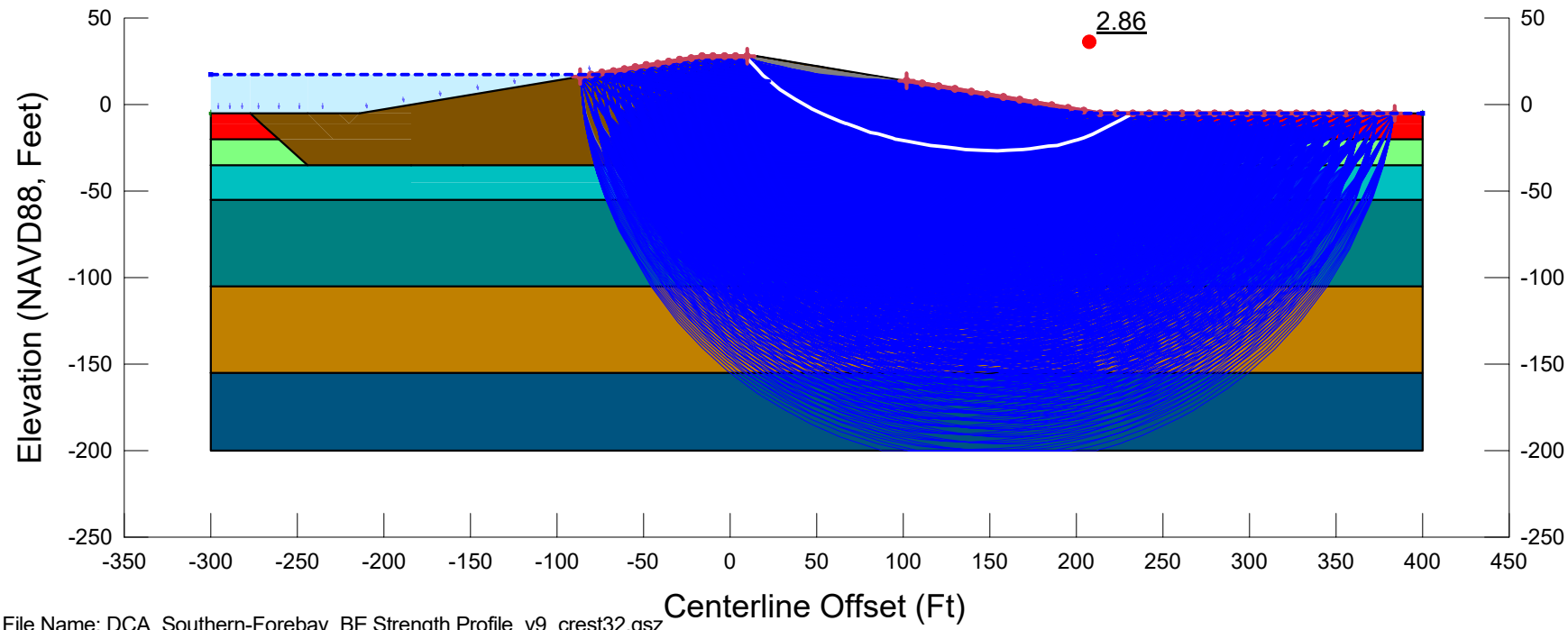
Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_BE	phi'_P2_BE		
	03B_Loose_Coarse_P2	110	c_P2_BE	phi'_P2_BE		
	04_Med. Stiff_Fine_P2	120	c_P2_BE	phi'_P2_BE		
	05_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	06_Dense_Coarse_P2	125	c_P2_BE	phi'_P2_BE		
	07_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	09_Soil Bentonite Wall	100			300	0



File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Constant
Horz Seismic Coef.:

6H1V_P2_G1-RR30_A1-S	
DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz	
02/27/2020	1:1,200

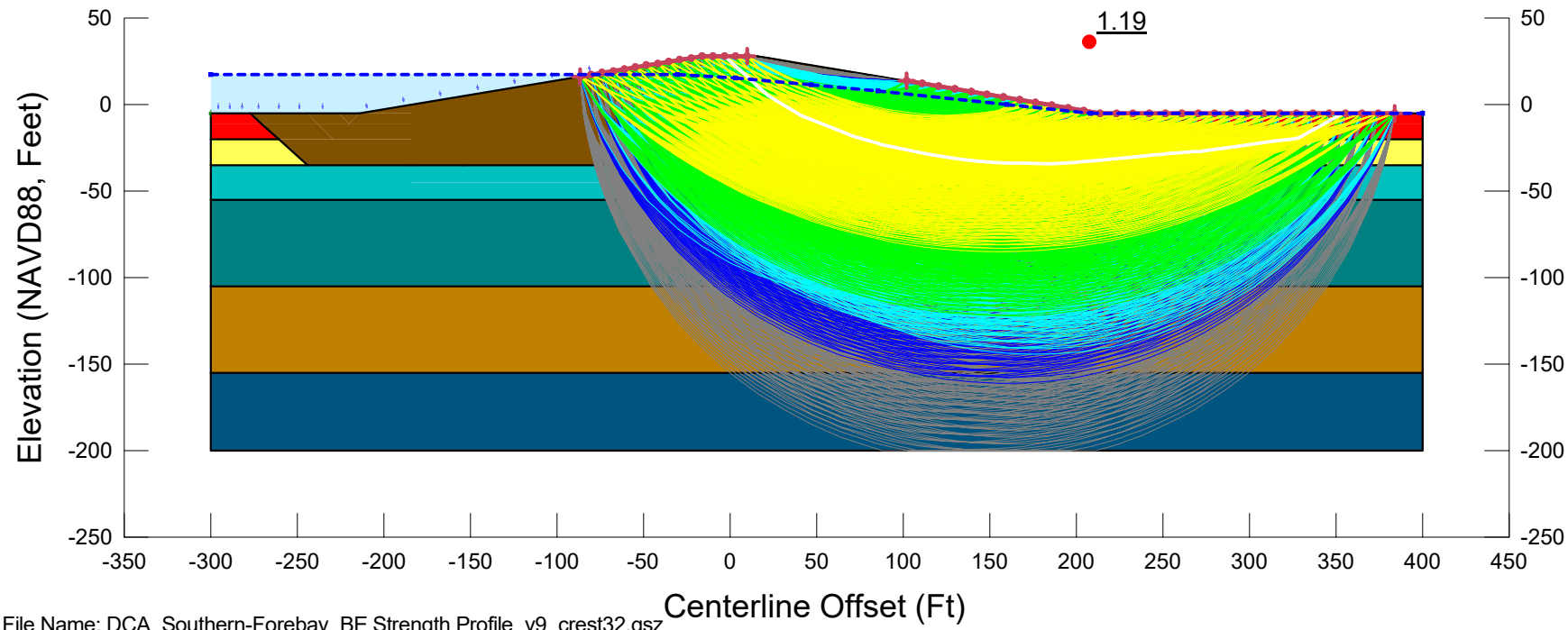
Color	Name	Unit Weight (pcf)	Tau/Sigma Ratio	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120				100	31
	02_Organics_P2.PS	90		c_P2_BE.PS	phi'_P2_BE.PS		
	03B_Loose_Coarse-0.1	110	0.1				
	04_Med. Stiff_Fine_P2.PS	120		c_P2_BE.PS	phi'_P2_BE.PS		
	05_Stiff_Fine_P2.PS	125		c_P2_BE.PS	phi'_P2_BE.PS		
	06_Dense_Coarse_P2.PS	125		c_P2_BE.PS	phi'_P2_BE.PS		
	07_Stiff_Fine_P2.PS	125		c_P2_BE.PS	phi'_P2_BE.PS		
	09_Soil Bentonite Wall	100				300	0



File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Constant
Horz Seismic Coef.:

6H1V_P2_G1-RR30_A2-PS	
DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz	
02/27/2020	1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_BE	phi'_P2_BE		
	03B_Loose_Coarse_P2	110	c_P2_BE	phi'_P2_BE		
	04_Med. Stiff_Fine_P2	120	c_P2_BE	phi'_P2_BE		
	05_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	06_Dense_Coarse_P2	125	c_P2_BE	phi'_P2_BE		
	07_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	09_Soil Bentonite Wall	100			300	0



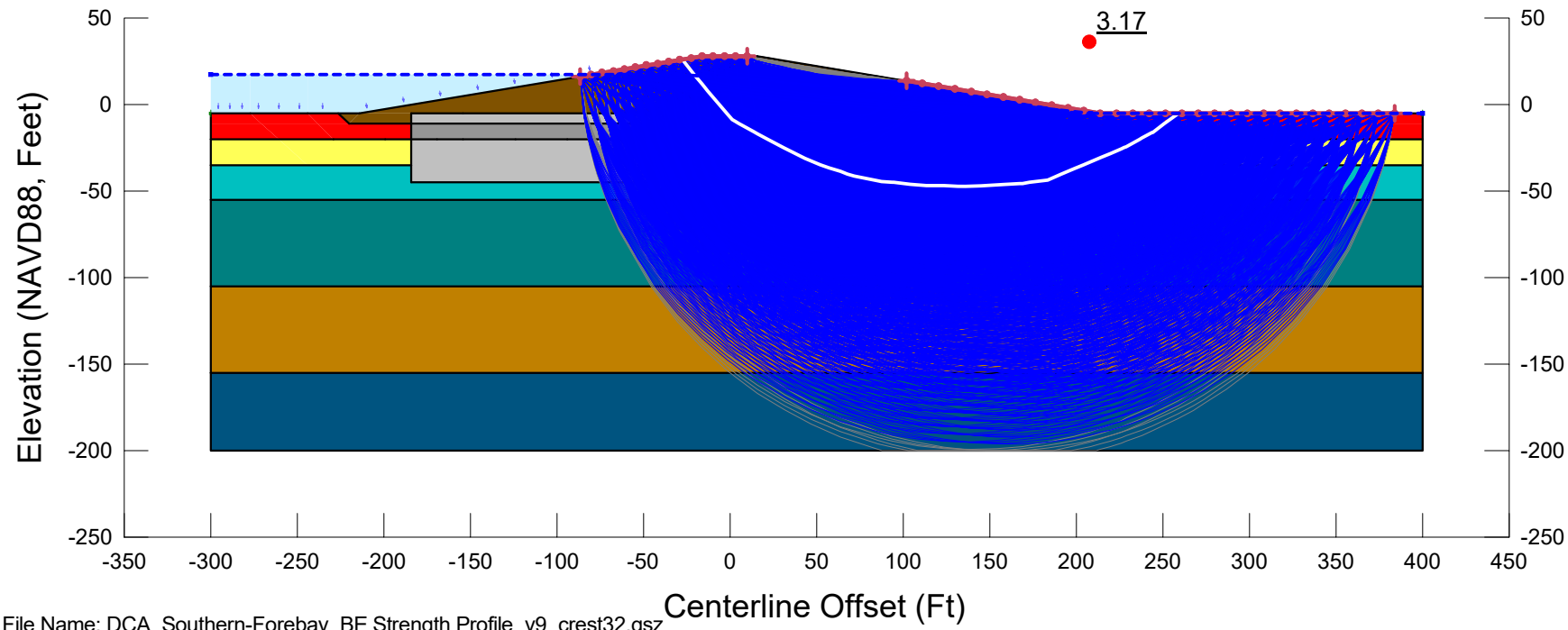
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

6H1V_P2_G1-RR30_A3-PSS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_BE	phi'_P2_BE		
	03B_Loose_Coarse_P2	110	c_P2_BE	phi'_P2_BE		
	04_Med. Stiff_Fine_P2	120	c_P2_BE	phi'_P2_BE		
	05_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	06_Dense_Coarse_P2	125	c_P2_BE	phi'_P2_BE		
	07_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	08_Soil Cement AR=0.15	125			2,400	0
	08_Soil Cement Organics AR=0.15	125			1,425	0
	09_Soil Bentonite Wall	100			300	0



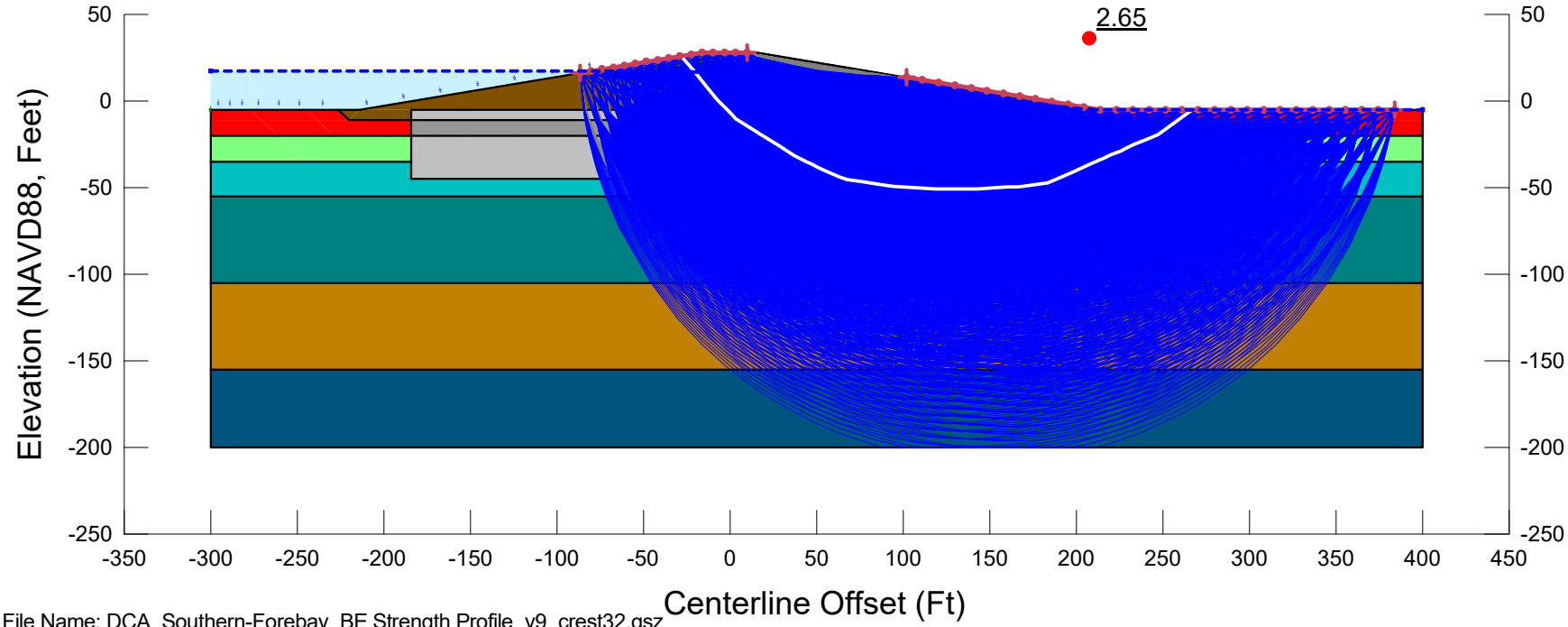
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.:

6H1V_P2_G2-AR15_A1-S

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Tau/Sigma Ratio	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120				100	31
	02_Organics_P2.PS	90		c_P2_BE.PS	phi'_P2_BE.PS		
	03B_Loose_Coarse-0.1	110	0.1				
	04_Med. Stiff_Fine_P2.PS	120		c_P2_BE.PS	phi'_P2_BE.PS		
	05_Stiff_Fine_P2.PS	125		c_P2_BE.PS	phi'_P2_BE.PS		
	06_Dense_Coarse_P2.PS	125		c_P2_BE.PS	phi'_P2_BE.PS		
	07_Stiff_Fine_P2.PS	125		c_P2_BE.PS	phi'_P2_BE.PS		
	08_Soil Cement AR=0.15	125				2,400	0
	08_Soil Cement Organics AR=0.15	125				1,425	0
	09_Soil Bentonite Wall	100				300	0



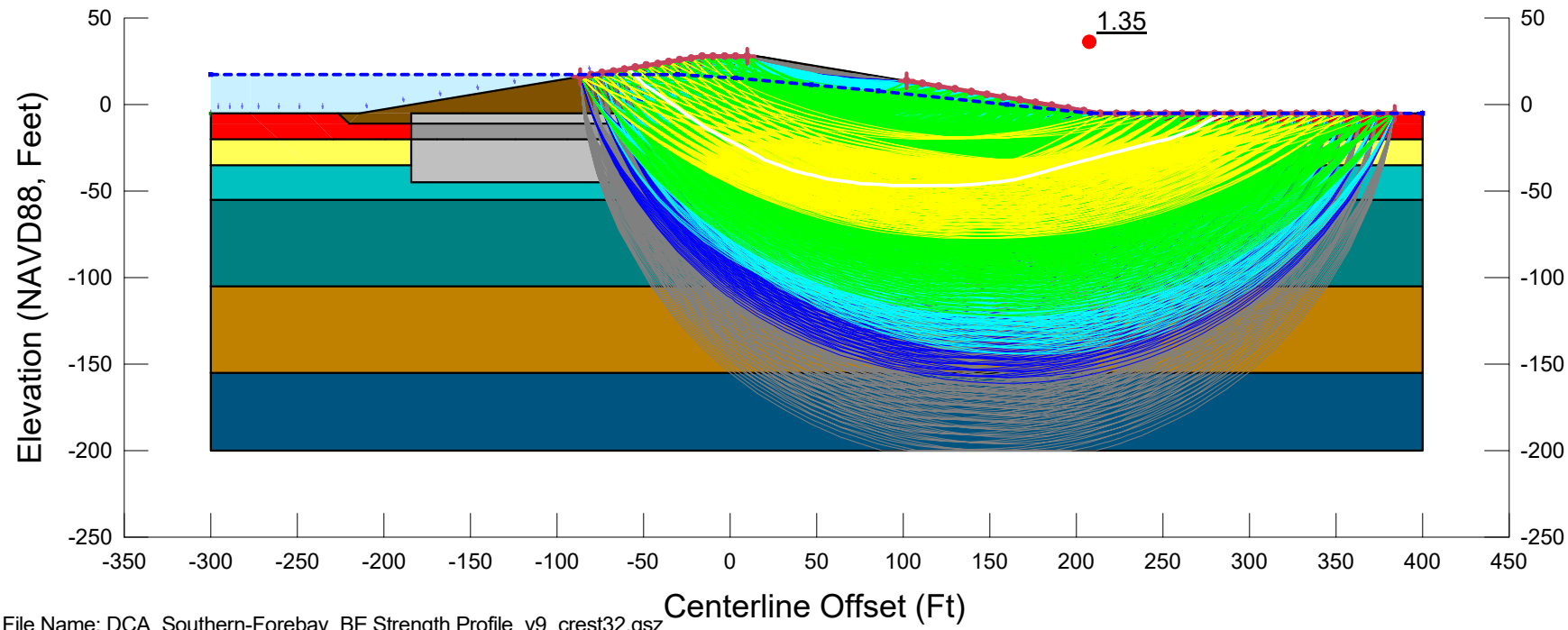
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.:

6H1V_P2_G2-AR15_A2-PS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_BE	phi'_P2_BE		
	03B_Loose_Coarse_P2	110	c_P2_BE	phi'_P2_BE		
	04_Med. Stiff_Fine_P2	120	c_P2_BE	phi'_P2_BE		
	05_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	06_Dense_Coarse_P2	125	c_P2_BE	phi'_P2_BE		
	07_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	08_Soil Cement AR=0.15	125			2,400	0
	08_Soil Cement Organics AR=0.15	125			1,425	0
	09_Soil Bentonite Wall	100			300	0



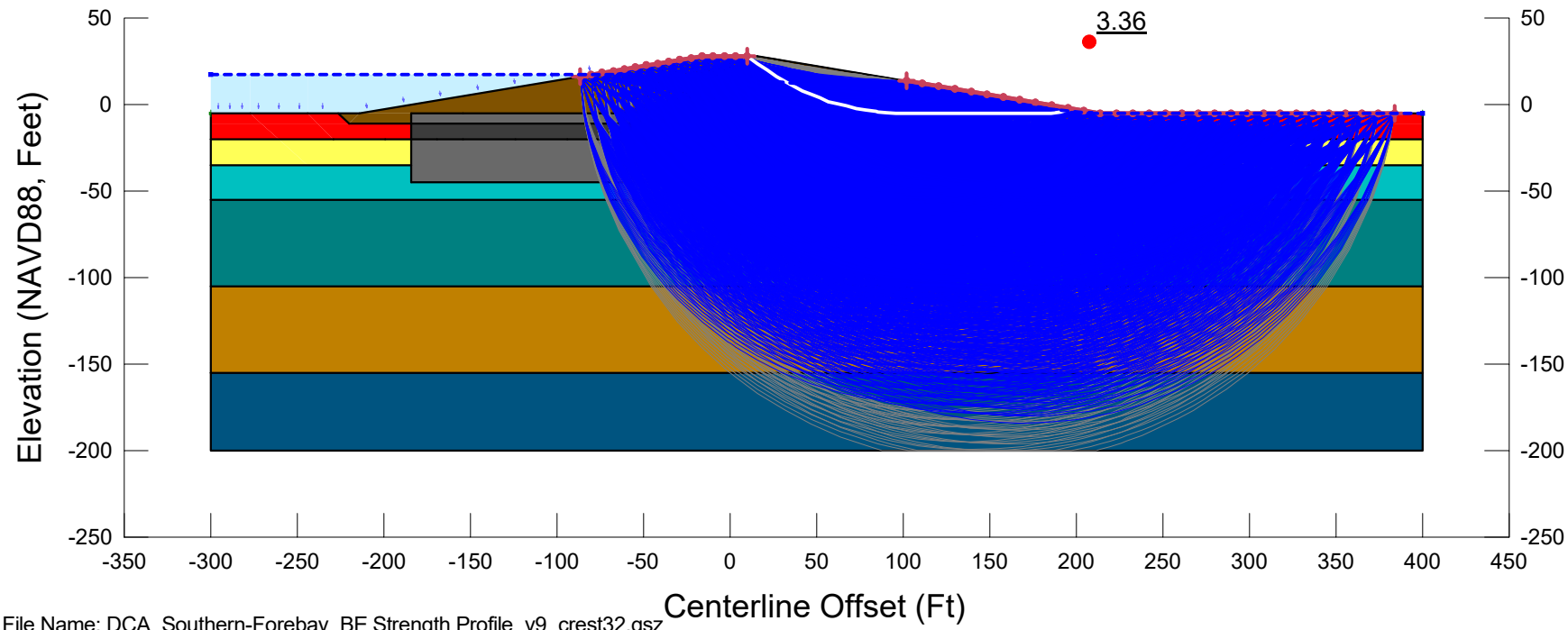
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

6H1V_P2_G2-AR15_A3-PSS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_BE	phi'_P2_BE		
	03B_Loose_Coarse_P2	110	c_P2_BE	phi'_P2_BE		
	04_Med. Stiff_Fine_P2	120	c_P2_BE	phi'_P2_BE		
	05_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	06_Dense_Coarse_P2	125	c_P2_BE	phi'_P2_BE		
	07_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	08_Soil Cement AR=0.25	125			4,000	0
	08_Soil Cement Organics AR=0.25	125			2,225	0
	09_Soil Bentonite Wall	100			300	0



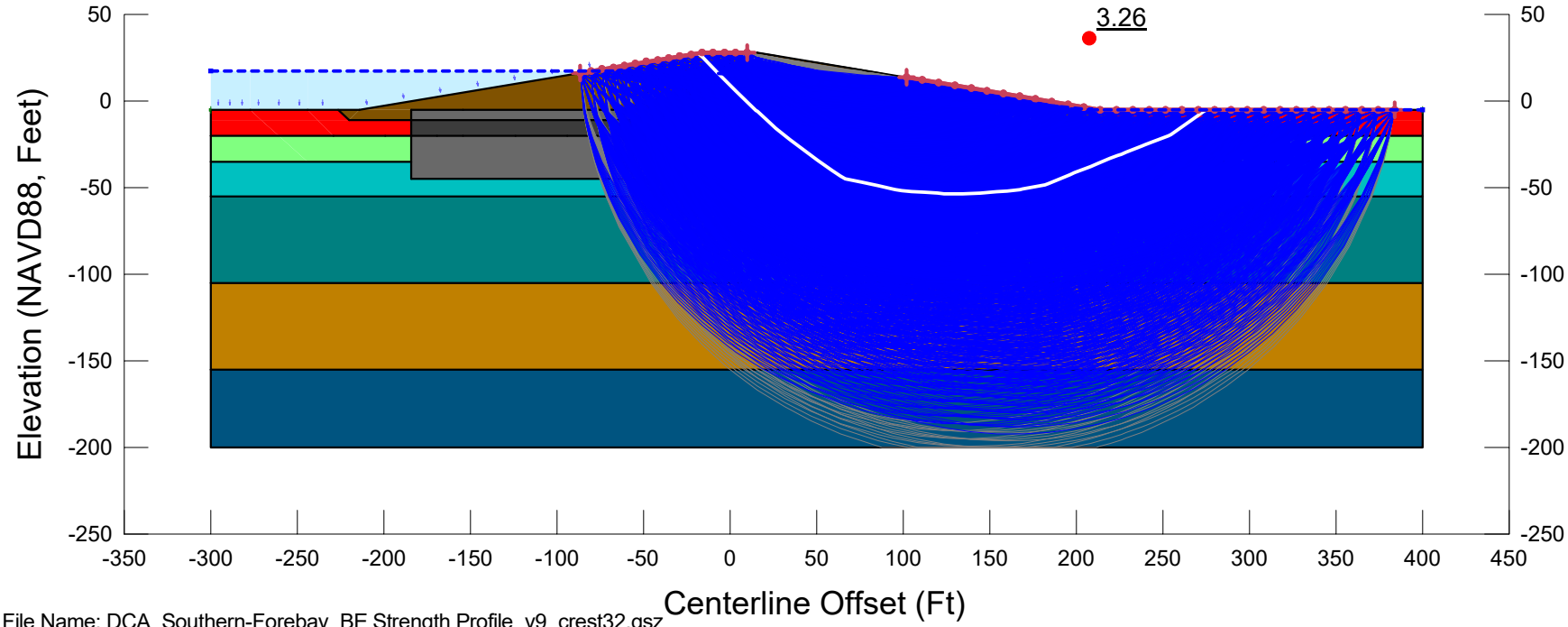
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.:

6H1V_P2_G2-AR25_A1-S

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Tau/Sigma Ratio	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120				100	31
	02_Organics_P2.PS	90		c_P2_BE.PS	phi'_P2_BE.PS		
	03B_Loose_Coarse-0.1	110	0.1				
	04_Med. Stiff_Fine_P2.PS	120		c_P2_BE.PS	phi'_P2_BE.PS		
	05_Stiff_Fine_P2.PS	125		c_P2_BE.PS	phi'_P2_BE.PS		
	06_Dense_Coarse_P2.PS	125		c_P2_BE.PS	phi'_P2_BE.PS		
	07_Stiff_Fine_P2.PS	125		c_P2_BE.PS	phi'_P2_BE.PS		
	08_Soil Cement AR=0.25	125				4,000	0
	08_Soil Cement Organics AR=0.25	125				2,225	0
	09_Soil Bentonite Wall	100				300	0



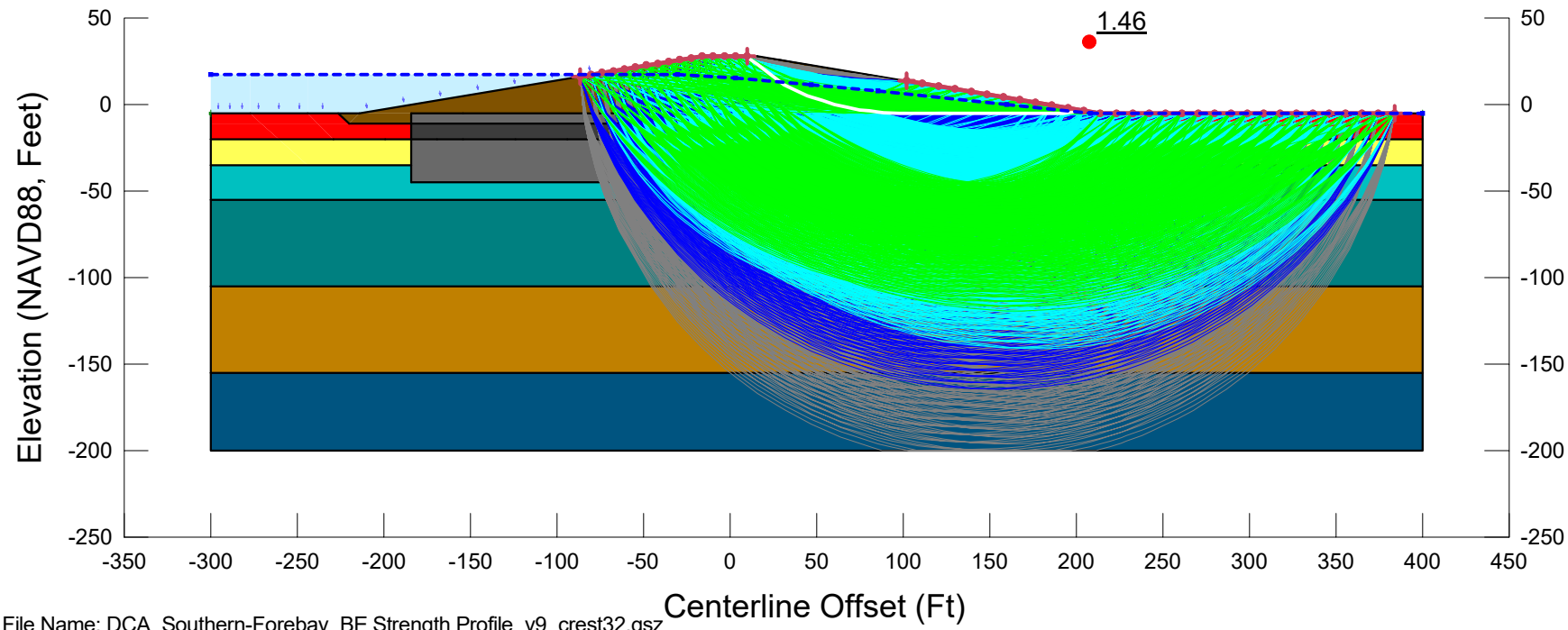
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.:

6H1V_P2_G2-AR25_A2-PS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_BE	phi'_P2_BE		
	03B_Loose_Coarse_P2	110	c_P2_BE	phi'_P2_BE		
	04_Med. Stiff_Fine_P2	120	c_P2_BE	phi'_P2_BE		
	05_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	06_Dense_Coarse_P2	125	c_P2_BE	phi'_P2_BE		
	07_Stiff_Fine_P2	125	c_P2_BE	phi'_P2_BE		
	08_Soil Cement AR=0.25	125			4,000	0
	08_Soil Cement Organics AR=0.25	125			2,225	0
	09_Soil Bentonite Wall	100			300	0



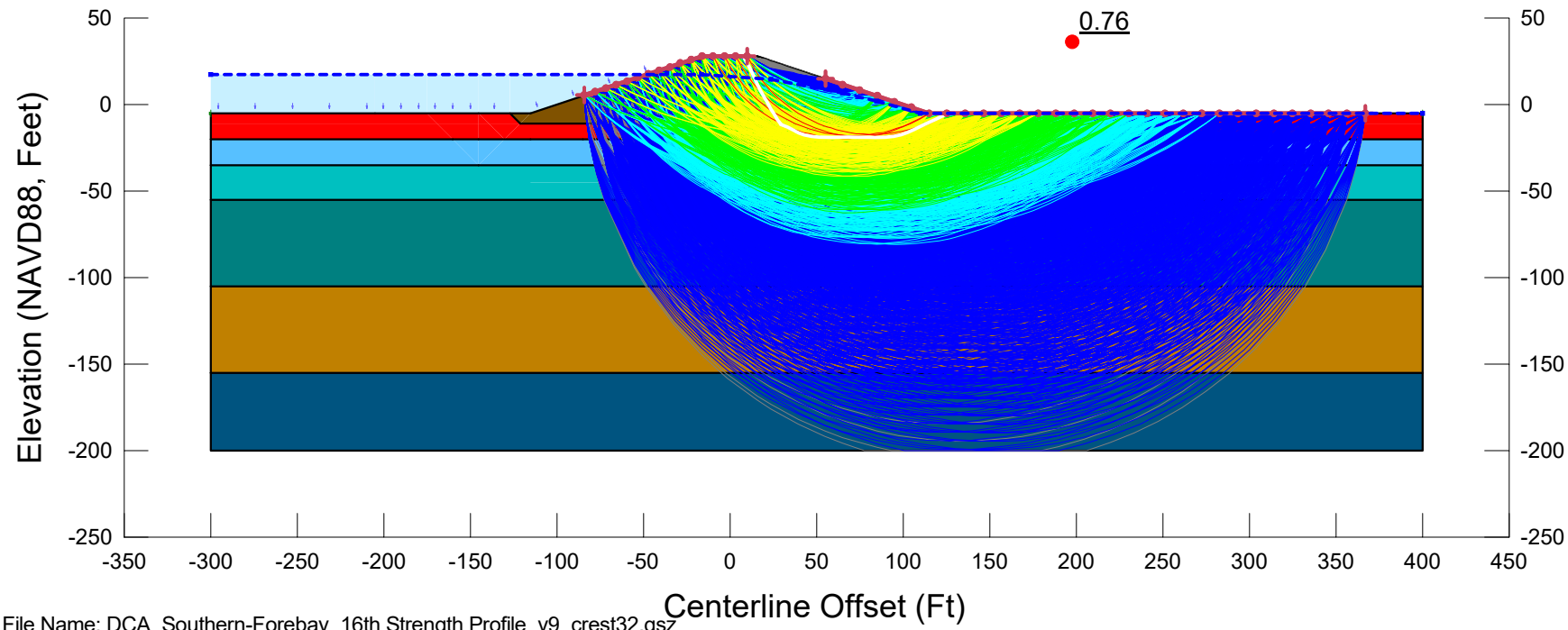
File Name: DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:20:38 AM Rev. No.: 150
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

6H1V_P2_G2-AR25_A3-PSS

DCA_Southern-Forebay_BE Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_16th	phi'_P1_16th		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_16th	phi'_P1_16th		
	04_Med. Stiff_Fine_P1	120	c_P1_16th	phi'_P1_16th		
	05_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	06_Dense_Coarse_P1	125	c_P1_16th	phi'_P1_16th		
	07_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		



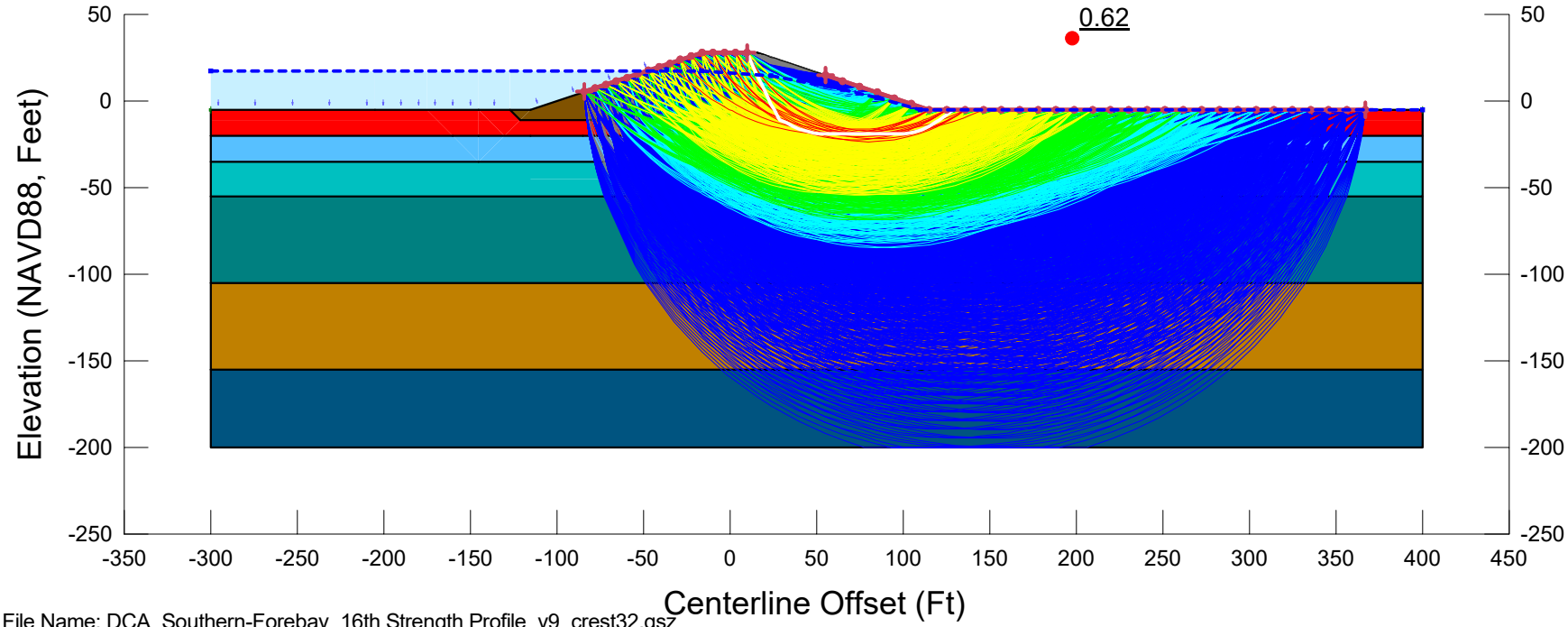
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Constant
Horz Seismic Coef.:

3H1V_P1_E_A1-S

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1.PS	90	c_P1_16th.PS	phi'_P1_16th.PS		
	03A_Soft-Med. Stiff_Fine_P1.PS	110	c_P1_16th.PS	phi'_P1_16th.PS		
	04_Med. Stiff_Fine_P1.PS	120	c_P1_16th.PS	phi'_P1_16th.PS		
	05_Stiff_Fine_P1.PS	125	c_P1_16th.PS	phi'_P1_16th.PS		
	06_Dense_Coarse_P1.PS	125	c_P1_16th.PS	phi'_P1_16th.PS		
	07_Stiff_Fine_P1.PS	125	c_P1_16th.PS	phi'_P1_16th.PS		



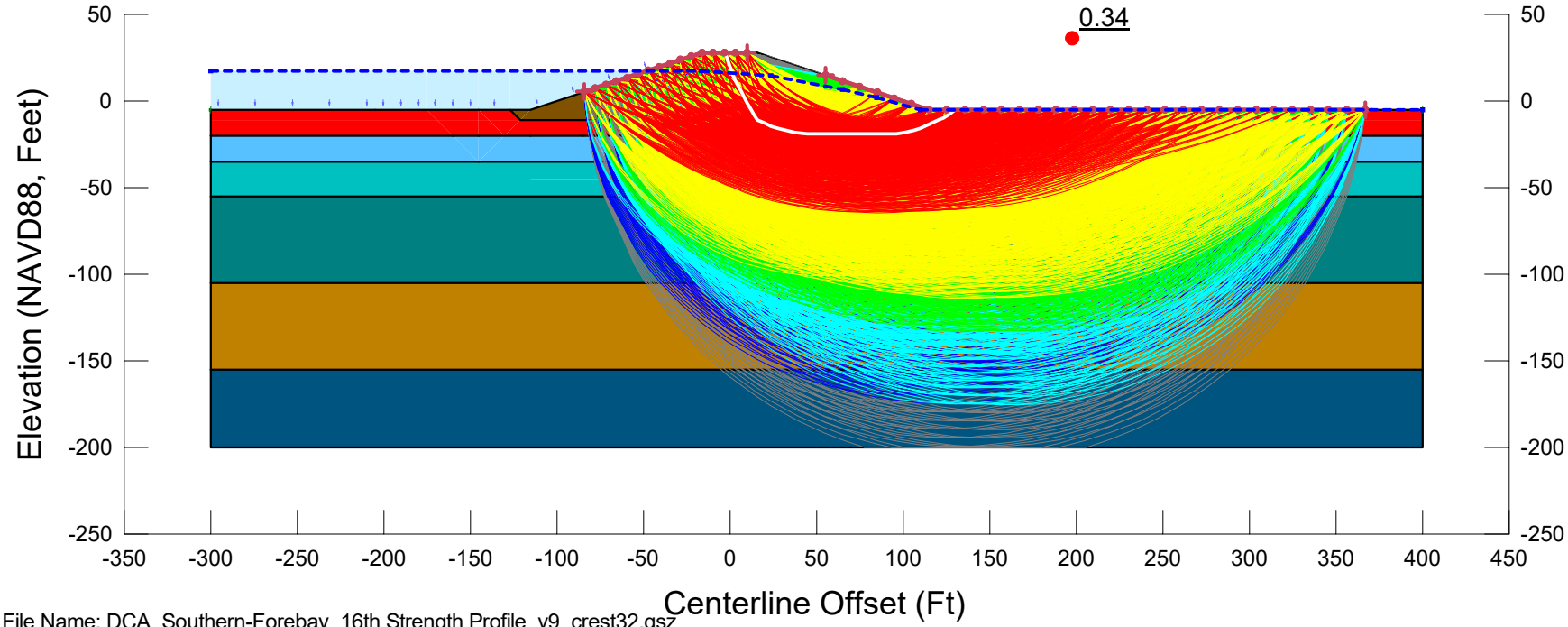
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Constant
Horz Seismic Coef.:

3H1V_P1_E_A2-PS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_16th	phi'_P1_16th		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_16th	phi'_P1_16th		
	04_Med. Stiff_Fine_P1	120	c_P1_16th	phi'_P1_16th		
	05_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	06_Dense_Coarse_P1	125	c_P1_16th	phi'_P1_16th		
	07_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		



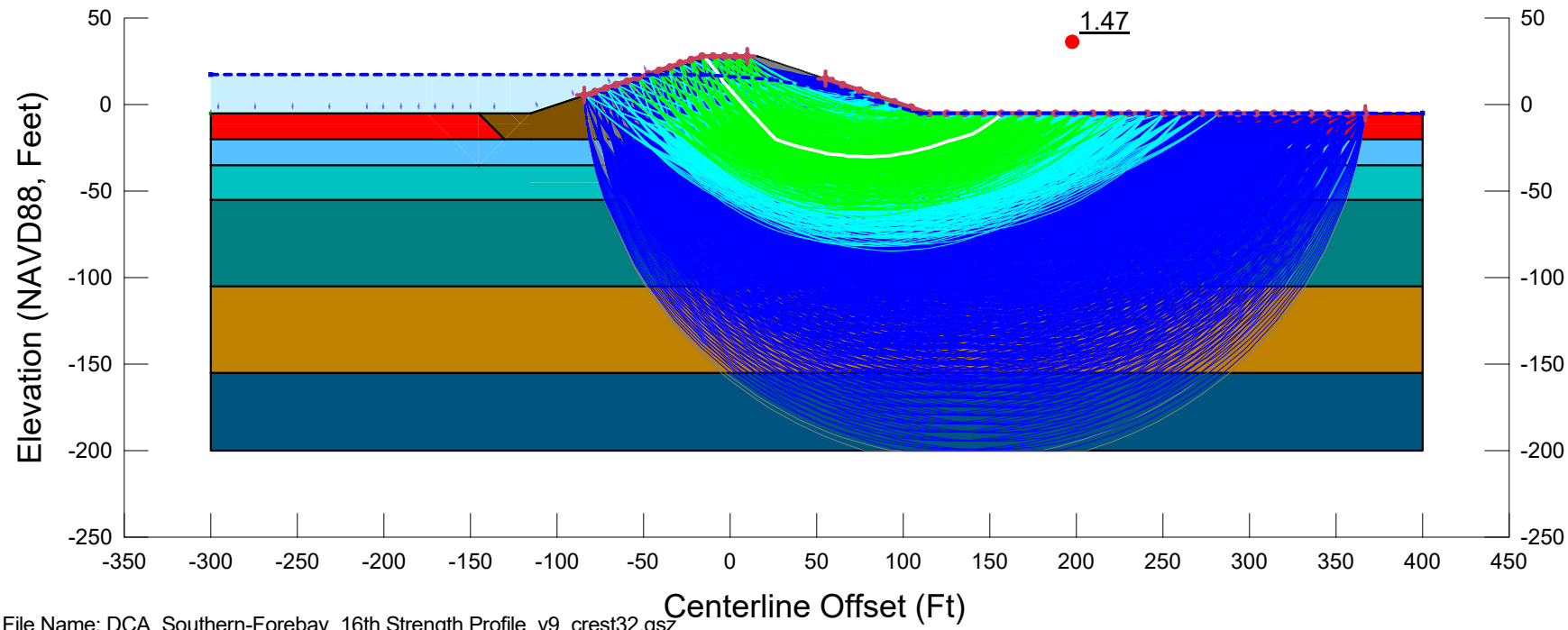
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

3H1V_P1_E_A3-PSS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_16th	phi'_P1_16th		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_16th	phi'_P1_16th		
	04_Med. Stiff_Fine_P1	120	c_P1_16th	phi'_P1_16th		
	05_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	06_Dense_Coarse_P1	125	c_P1_16th	phi'_P1_16th		
	07_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	09_Soil Bentonite Wall	100			300	0



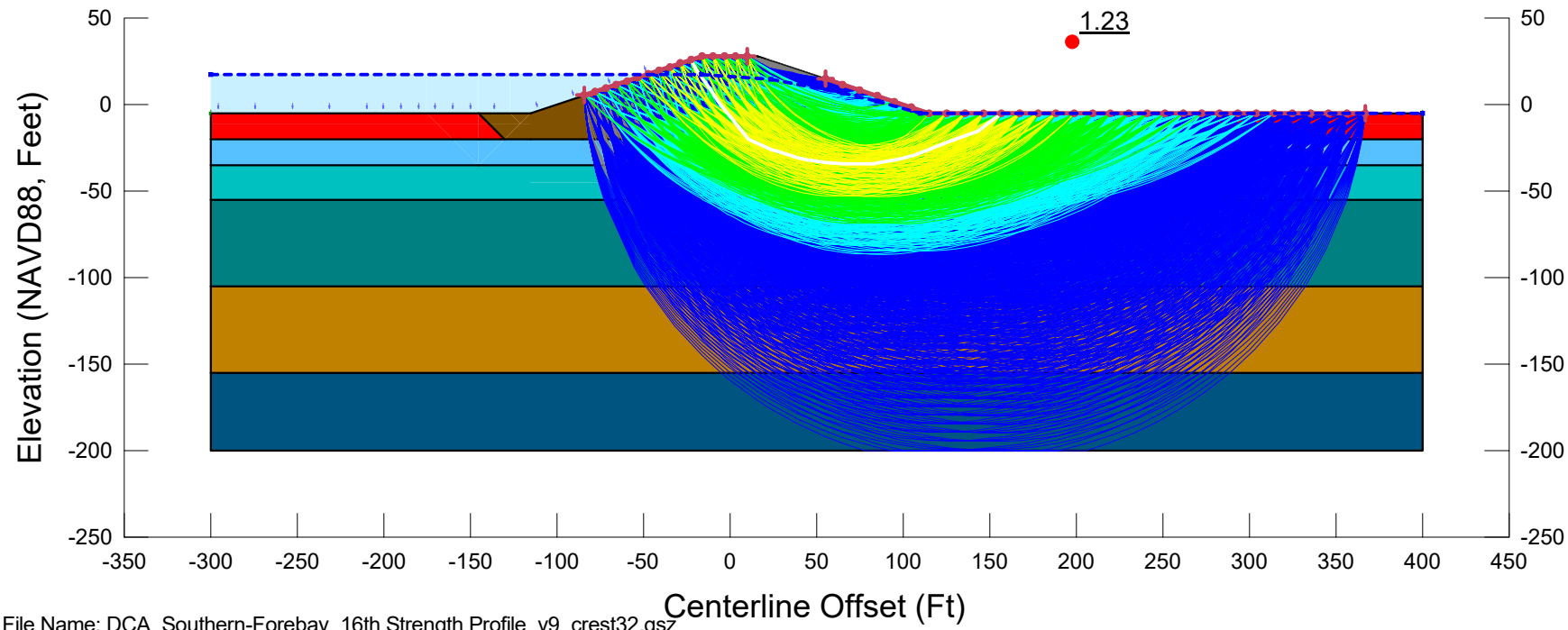
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Constant
Horz Seismic Coef.:

3H1V_P1_G1-RR15_A1-S

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1.PS	90	c_P1_16th.PS	phi'_P1_16th.PS		
	03A_Soft-Med. Stiff_Fine_P1.PS	110	c_P1_16th.PS	phi'_P1_16th.PS		
	04_Med. Stiff_Fine_P1.PS	120	c_P1_16th.PS	phi'_P1_16th.PS		
	05_Stiff_Fine_P1.PS	125	c_P1_16th.PS	phi'_P1_16th.PS		
	06_Dense_Coarse_P1.PS	125	c_P1_16th.PS	phi'_P1_16th.PS		
	07_Stiff_Fine_P1.PS	125	c_P1_16th.PS	phi'_P1_16th.PS		
	09_Soil Bentonite Wall	100			300	0



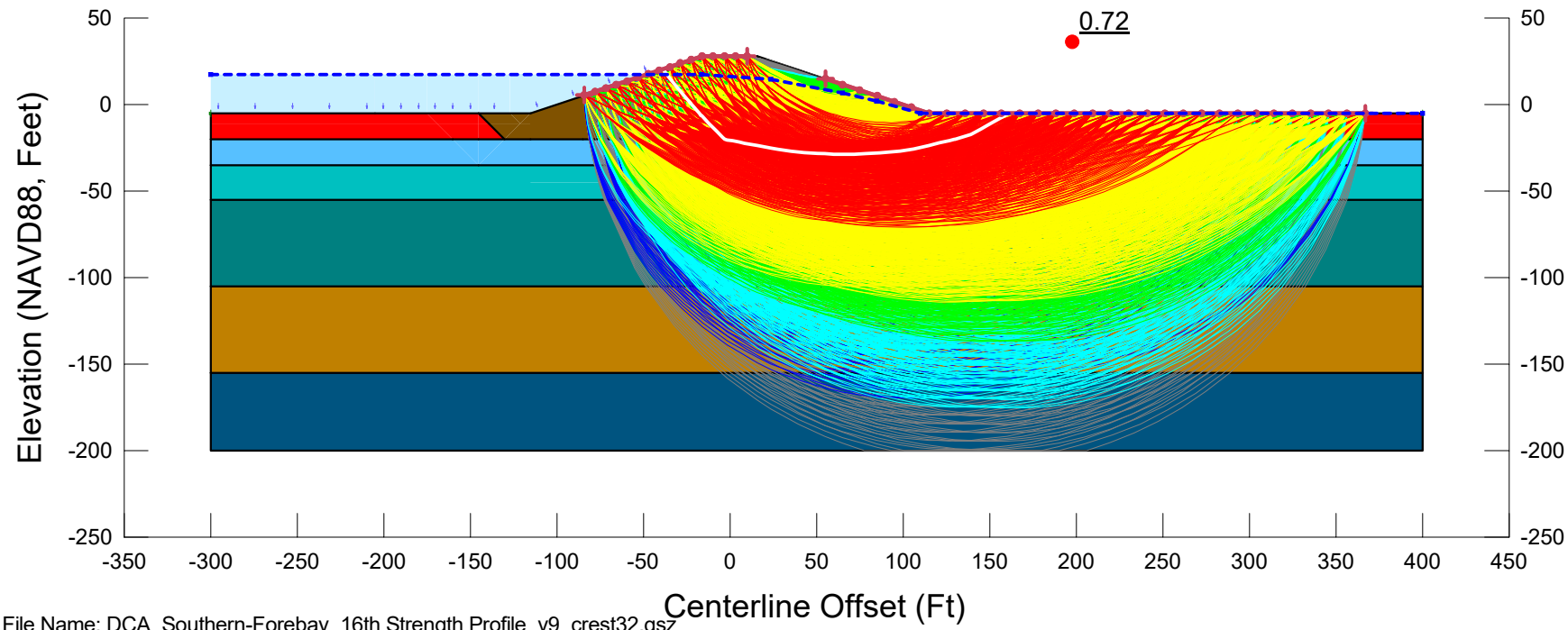
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Constant
Horz Seismic Coef.:

3H1V_P1_G1-RR15_A2-PS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_16th	phi'_P1_16th		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_16th	phi'_P1_16th		
	04_Med. Stiff_Fine_P1	120	c_P1_16th	phi'_P1_16th		
	05_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	06_Dense_Coarse_P1	125	c_P1_16th	phi'_P1_16th		
	07_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	09_Soil Bentonite Wall	100			300	0



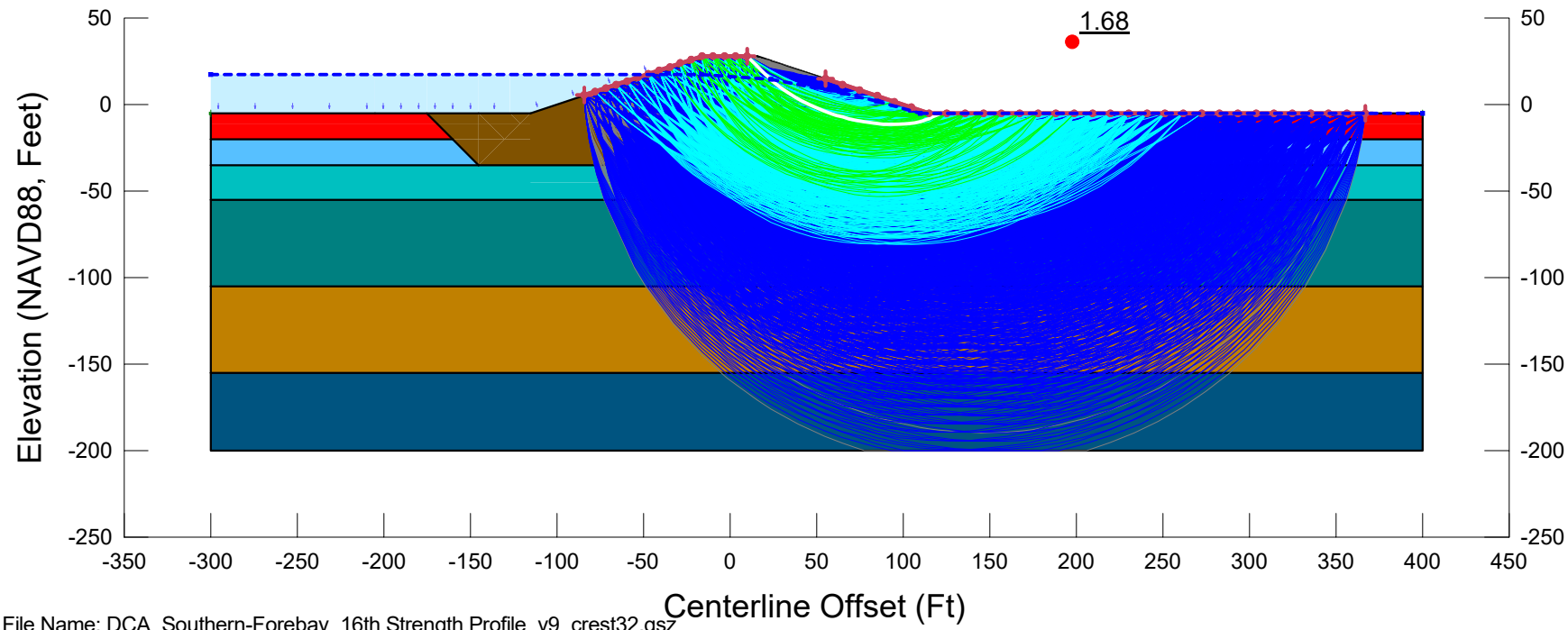
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

3H1V_P1_G1-RR15_A3-PSS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_16th	phi'_P1_16th		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_16th	phi'_P1_16th		
	04_Med. Stiff_Fine_P1	120	c_P1_16th	phi'_P1_16th		
	05_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	06_Dense_Coarse_P1	125	c_P1_16th	phi'_P1_16th		
	07_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	09_Soil Bentonite Wall	100			300	0



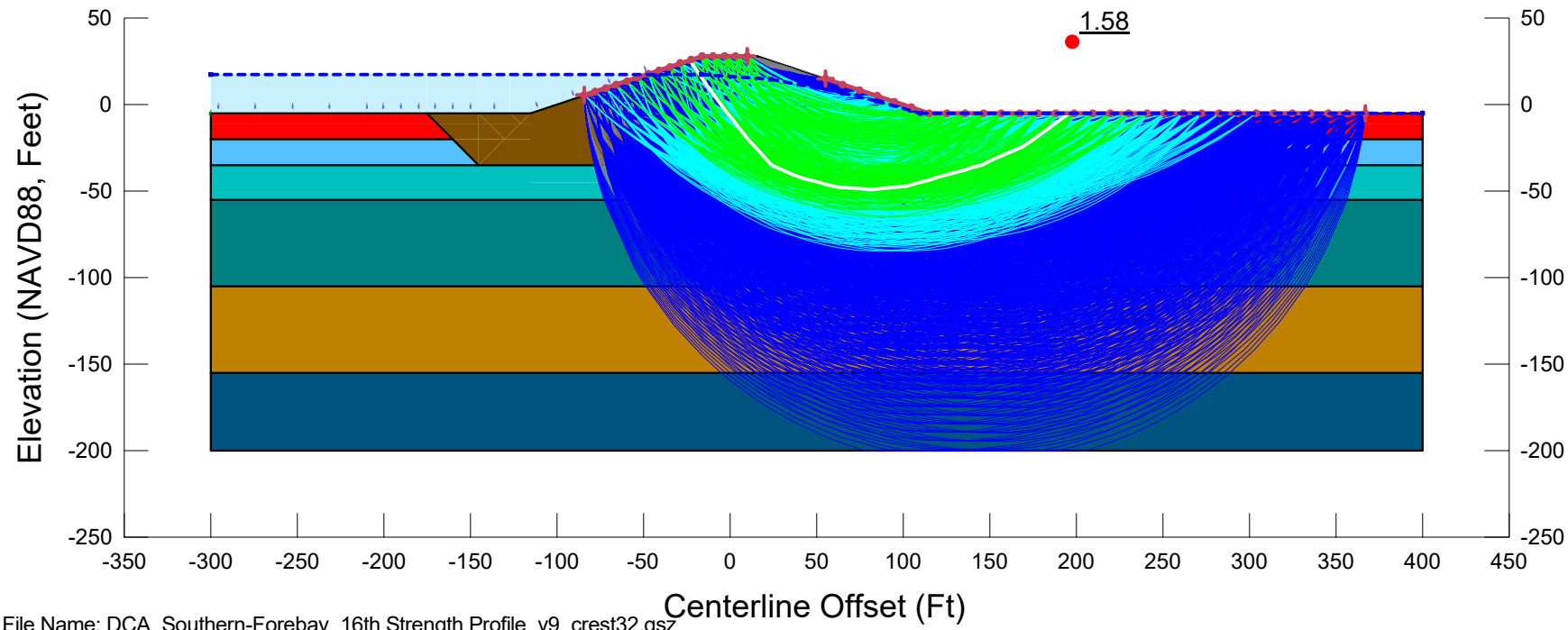
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Constant
Horz Seismic Coef.:

3H1V_P1_G1-RR30_A1-S

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1.PS	90	c_P1_16th.PS	phi'_P1_16th.PS		
	03A_Soft-Med. Stiff_Fine_P1.PS	110	c_P1_16th.PS	phi'_P1_16th.PS		
	04_Med. Stiff_Fine_P1.PS	120	c_P1_16th.PS	phi'_P1_16th.PS		
	05_Stiff_Fine_P1.PS	125	c_P1_16th.PS	phi'_P1_16th.PS		
	06_Dense_Coarse_P1.PS	125	c_P1_16th.PS	phi'_P1_16th.PS		
	07_Stiff_Fine_P1.PS	125	c_P1_16th.PS	phi'_P1_16th.PS		
	09_Soil Bentonite Wall	100			300	0



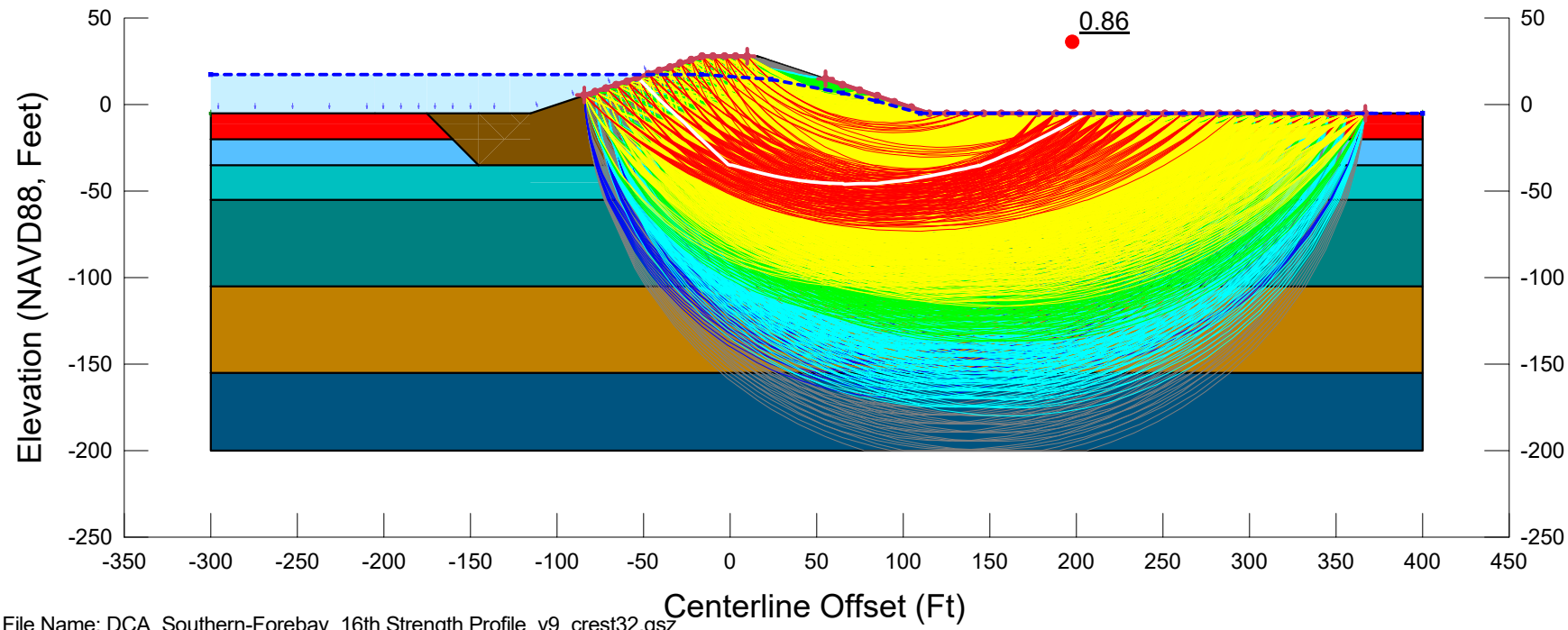
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Constant
Horz Seismic Coef.:

3H1V_P1_G1-RR30_A2-PS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_16th	phi'_P1_16th		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_16th	phi'_P1_16th		
	04_Med. Stiff_Fine_P1	120	c_P1_16th	phi'_P1_16th		
	05_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	06_Dense_Coarse_P1	125	c_P1_16th	phi'_P1_16th		
	07_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	09_Soil Bentonite Wall	100			300	0



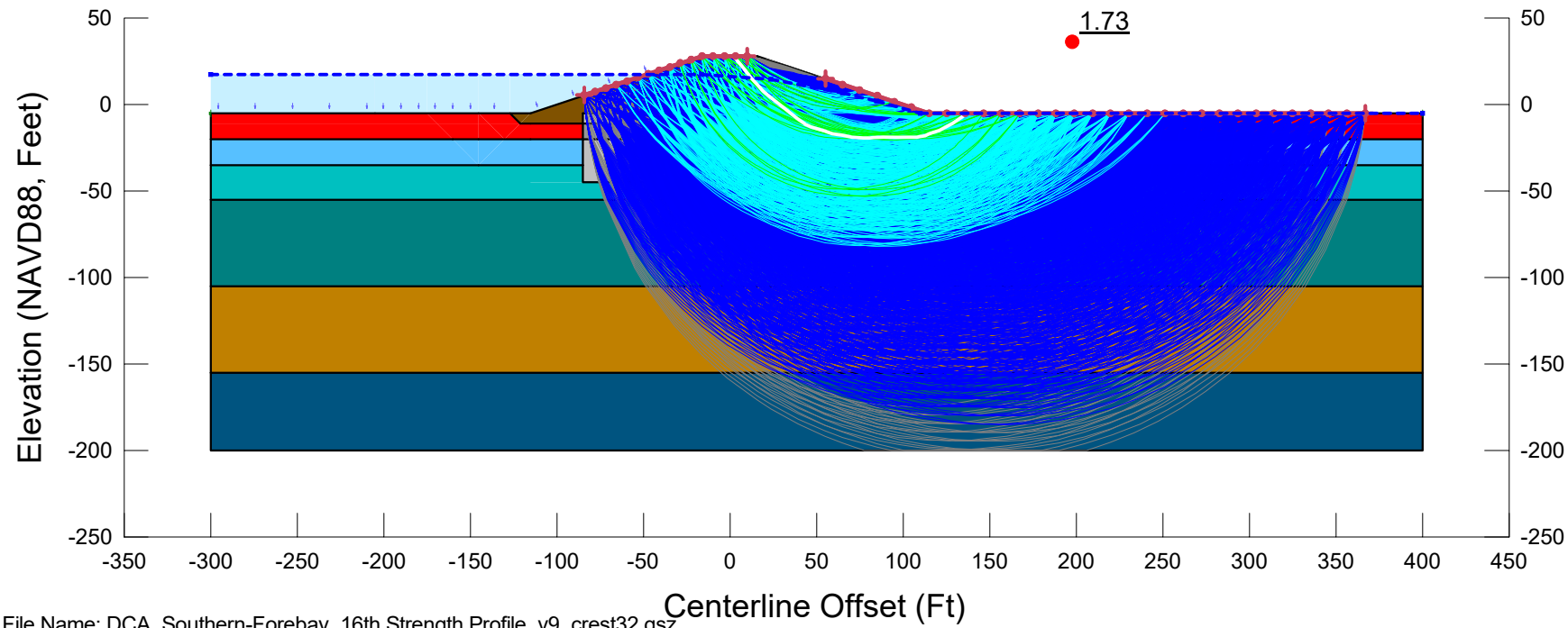
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

3H1V_P1_G1-RR30_A3-PSS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_16th	phi'_P1_16th		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_16th	phi'_P1_16th		
	04_Med. Stiff_Fine_P1	120	c_P1_16th	phi'_P1_16th		
	05_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	06_Dense_Coarse_P1	125	c_P1_16th	phi'_P1_16th		
	07_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	08_Soil Cement AR=0.15	125			2,400	0
	08_Soil Cement Organics AR=0.15	125			1,425	0
	09_Soil Bentonite Wall	100			300	0



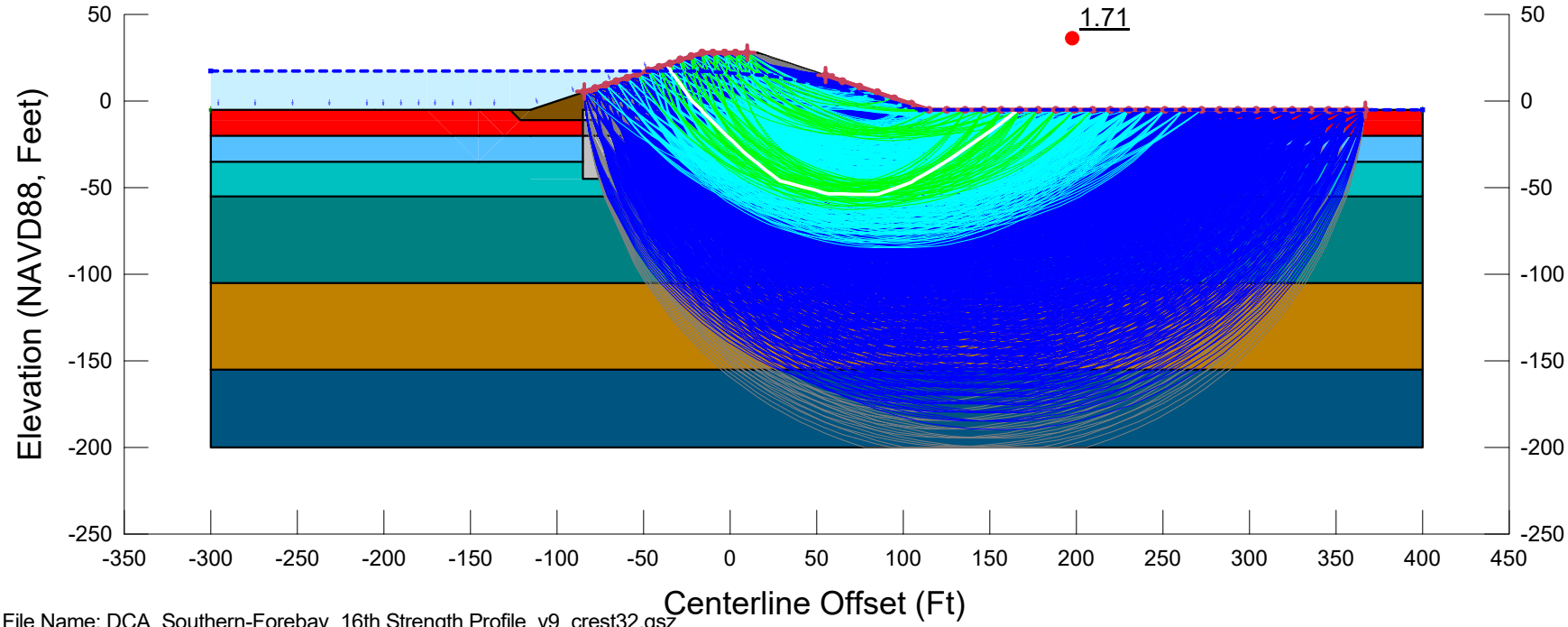
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.:

3H1V_P1_G2-AR15_A1-S

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1.PS	90	c_P1_16th.PS	phi'_P1_16th.PS		
	03A_Soft-Med. Stiff_Fine_P1.PS	110	c_P1_16th.PS	phi'_P1_16th.PS		
	04_Med. Stiff_Fine_P1.PS	120	c_P1_16th.PS	phi'_P1_16th.PS		
	05_Stiff_Fine_P1.PS	125	c_P1_16th.PS	phi'_P1_16th.PS		
	06_Dense_Coarse_P1.PS	125	c_P1_16th.PS	phi'_P1_16th.PS		
	07_Stiff_Fine_P1.PS	125	c_P1_16th.PS	phi'_P1_16th.PS		
	08_Soil Cement AR=0.15	125			2,400	0
	08_Soil Cement Organics AR=0.15	125			1,425	0
	09_Soil Bentonite Wall	100			300	0



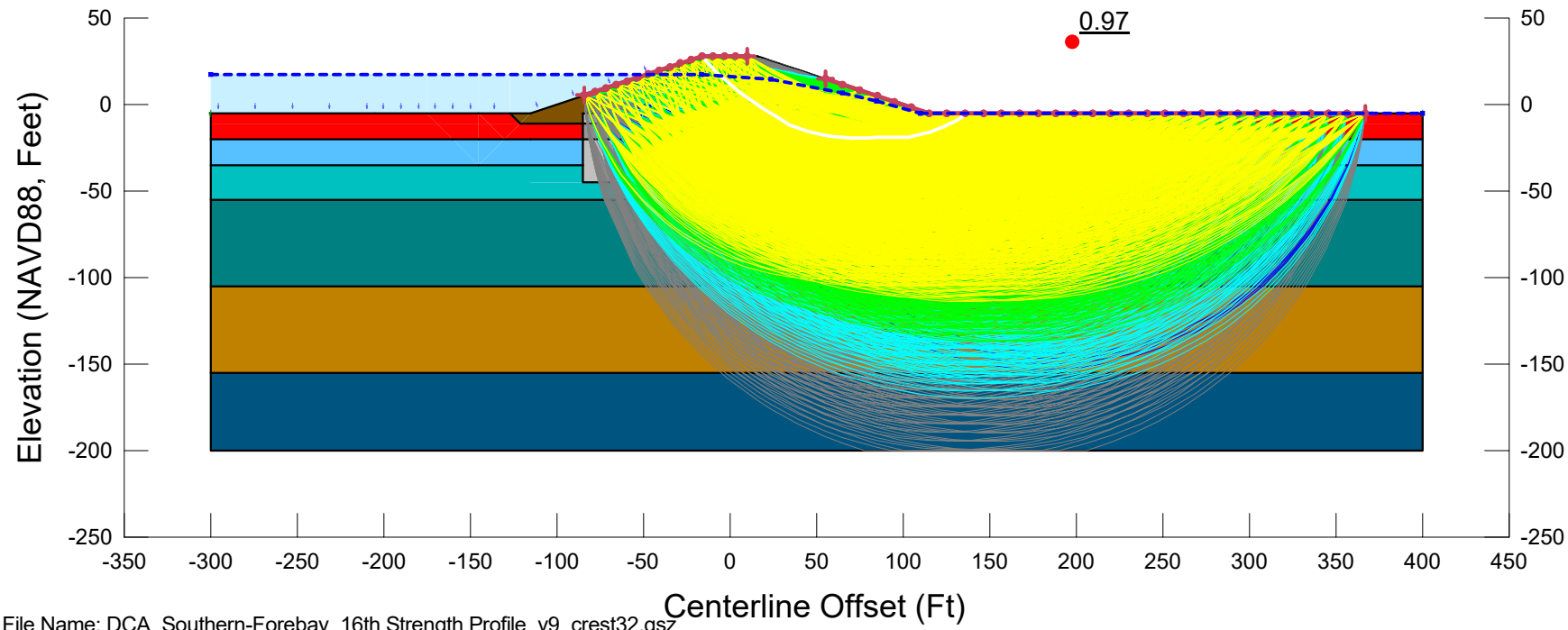
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.:

3H1V_P1_G2-AR15_A2-PS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_16th	phi'_P1_16th		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_16th	phi'_P1_16th		
	04_Med. Stiff_Fine_P1	120	c_P1_16th	phi'_P1_16th		
	05_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	06_Dense_Coarse_P1	125	c_P1_16th	phi'_P1_16th		
	07_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	08_Soil Cement AR=0.15	125			2,400	0
	08_Soil Cement Organics AR=0.15	125			1,425	0
	09_Soil Bentonite Wall	100			300	0



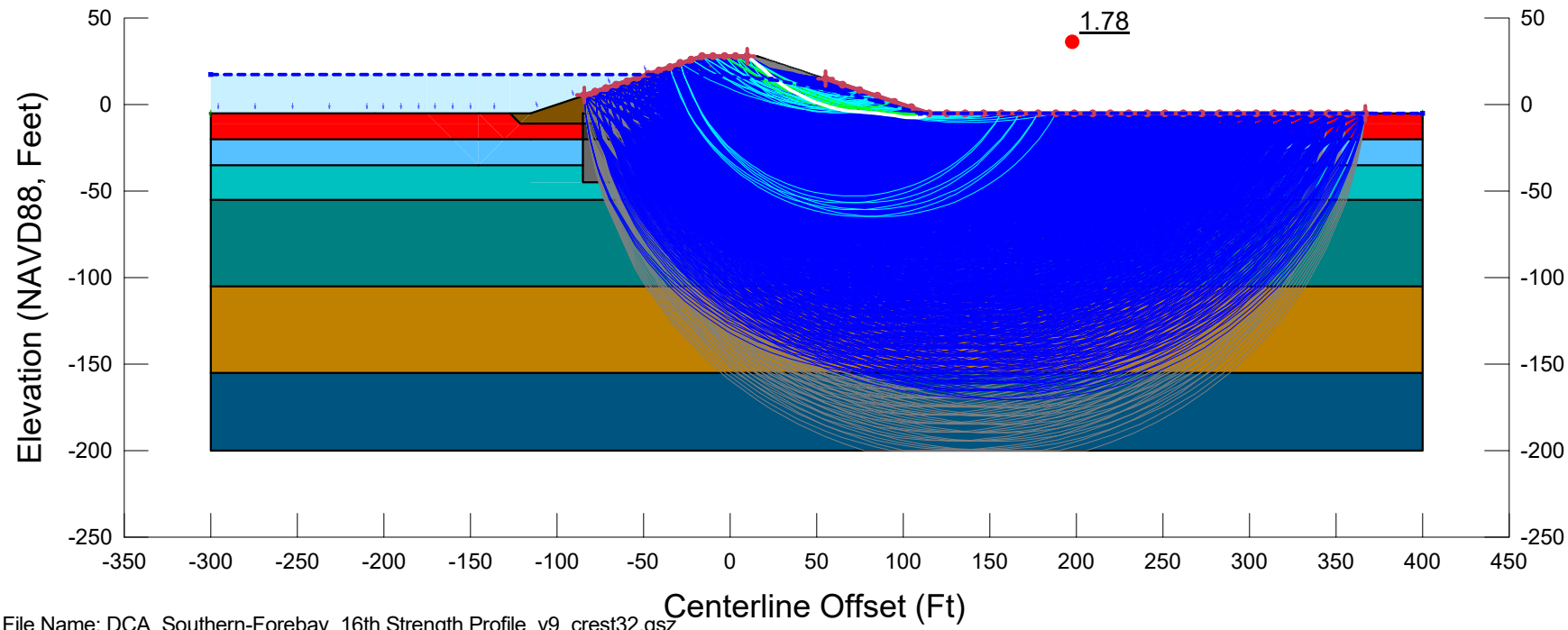
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

3H1V_P1_G2-AR15_A3-PSS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_16th	phi'_P1_16th		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_16th	phi'_P1_16th		
	04_Med. Stiff_Fine_P1	120	c_P1_16th	phi'_P1_16th		
	05_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	06_Dense_Coarse_P1	125	c_P1_16th	phi'_P1_16th		
	07_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	08_Soil Cement AR=0.25	125			4,000	0
	08_Soil Cement Organics AR=0.25	125			2,225	0
	09_Soil Bentonite Wall	100			300	0



File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
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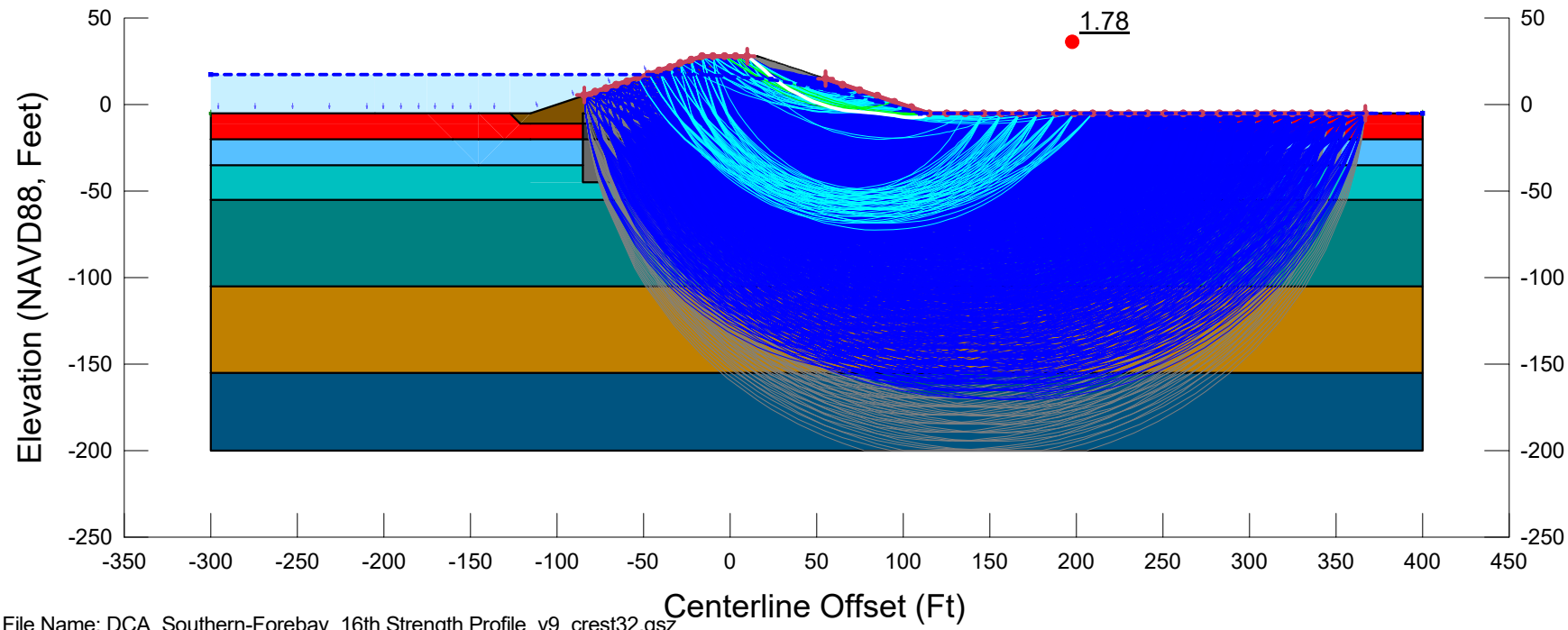
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.:

3H1V_P1_G2-AR25_A1-S

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1.PS	90	c_P1_16th.PS	phi'_P1_16th.PS		
	03A_Soft-Med. Stiff_Fine_P1.PS	110	c_P1_16th.PS	phi'_P1_16th.PS		
	04_Med. Stiff_Fine_P1.PS	120	c_P1_16th.PS	phi'_P1_16th.PS		
	05_Stiff_Fine_P1.PS	125	c_P1_16th.PS	phi'_P1_16th.PS		
	06_Dense_Coarse_P1.PS	125	c_P1_16th.PS	phi'_P1_16th.PS		
	07_Stiff_Fine_P1.PS	125	c_P1_16th.PS	phi'_P1_16th.PS		
	08_Soil Cement AR=0.25	125			4,000	0
	08_Soil Cement Organics AR=0.25	125			2,225	0
	09_Soil Bentonite Wall	100			300	0



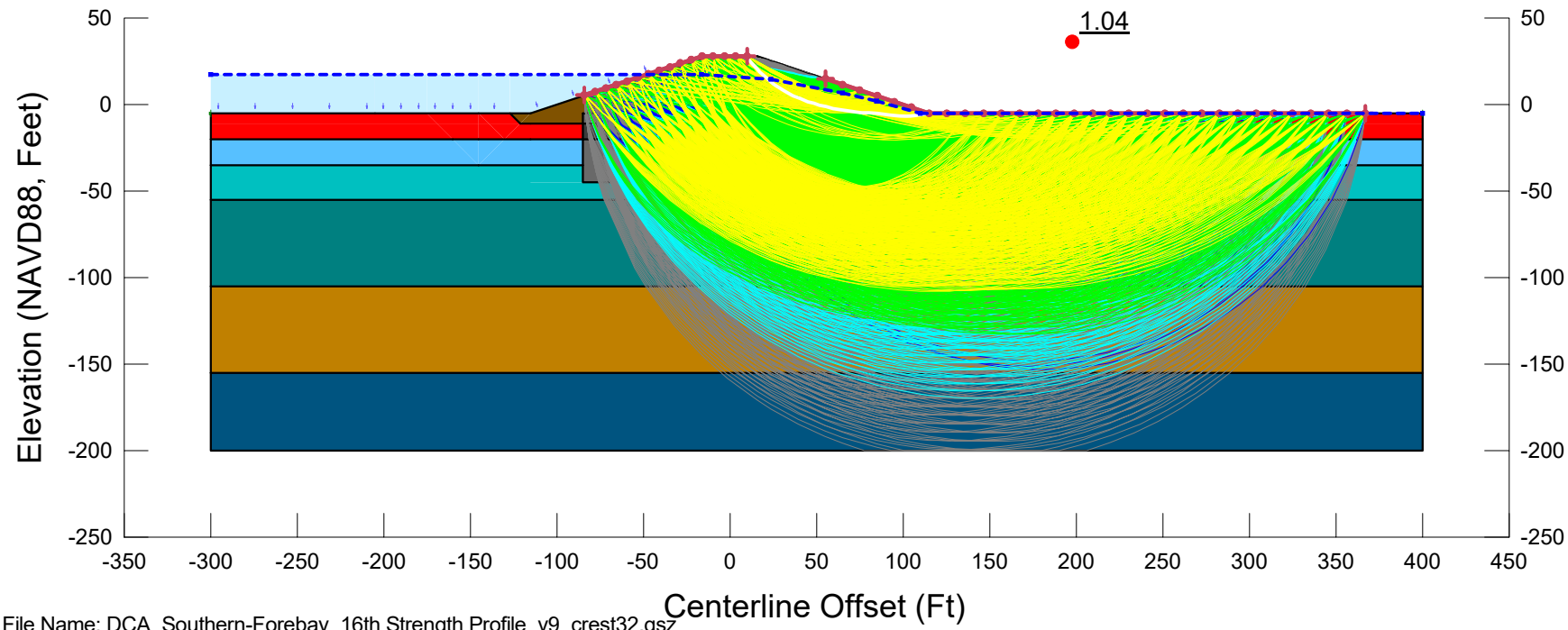
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.:

3H1V_P1_G2-AR25_A2-PS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_16th	phi'_P1_16th		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_16th	phi'_P1_16th		
	04_Med. Stiff_Fine_P1	120	c_P1_16th	phi'_P1_16th		
	05_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	06_Dense_Coarse_P1	125	c_P1_16th	phi'_P1_16th		
	07_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	08_Soil Cement AR=0.25	125			4,000	0
	08_Soil Cement Organics AR=0.25	125			2,225	0
	09_Soil Bentonite Wall	100			300	0



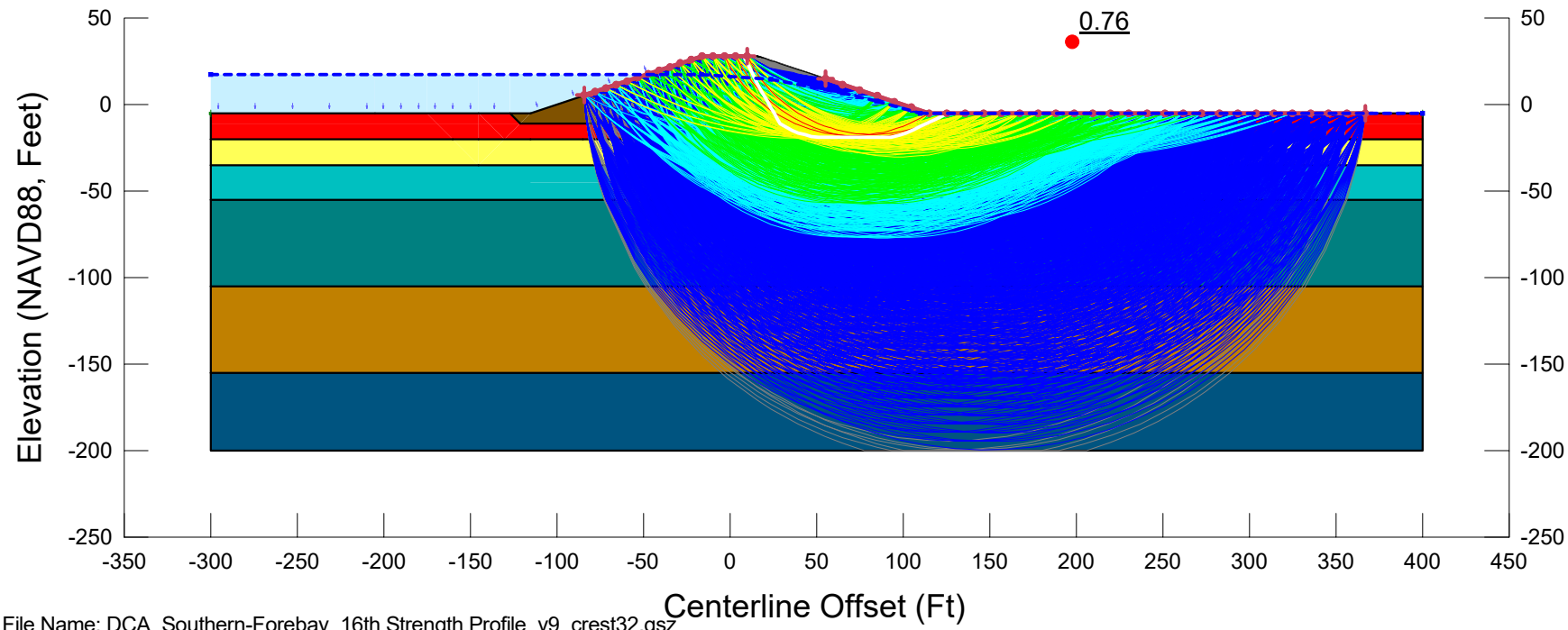
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

3H1V_P1_G2-AR25_A3-PSS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_16th	phi'_P2_16th		
	03B_Loose_Coarse_P2	110	c_P2_16th	phi'_P2_16th		
	04_Med. Stiff_Fine_P2	120	c_P2_16th	phi'_P2_16th		
	05_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	06_Dense_Coarse_P2	125	c_P2_16th	phi'_P2_16th		
	07_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		



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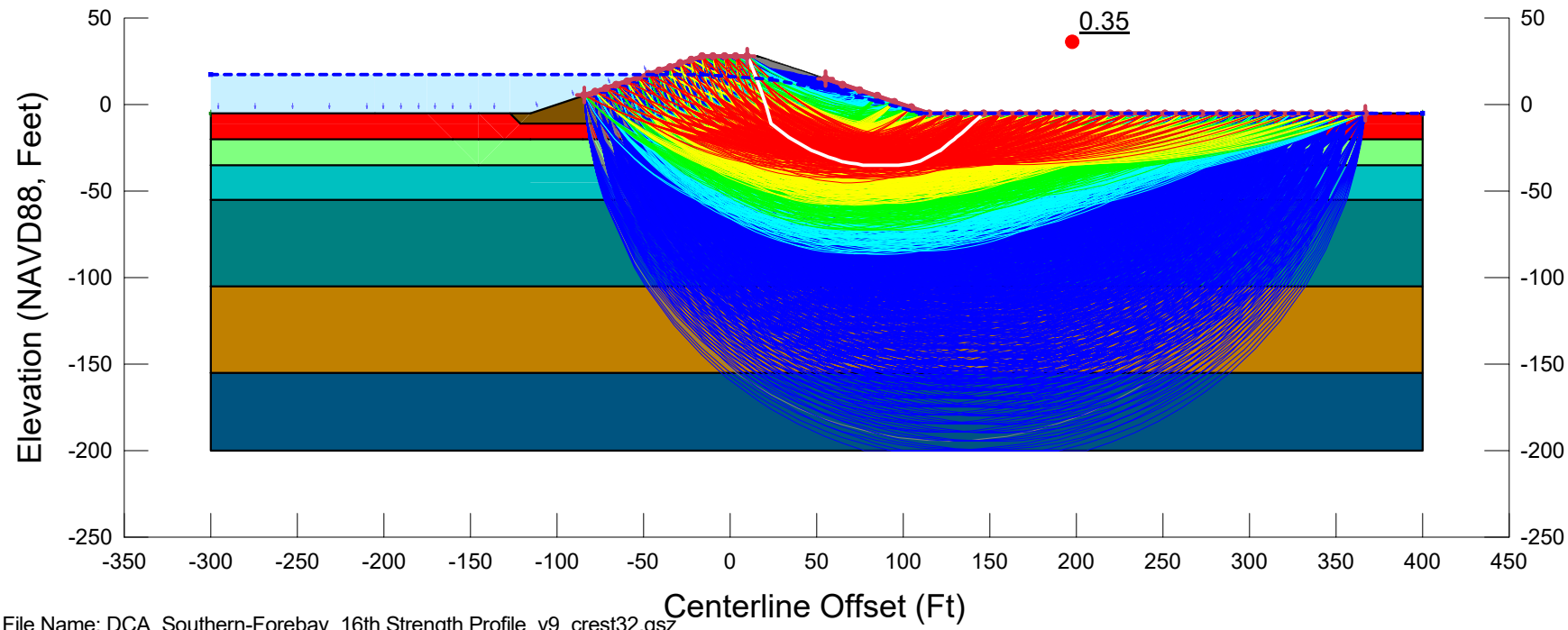
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Constant
Horz Seismic Coef.:

3H1V_P2_E_A1-S

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Tau/Sigma Ratio	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120				100	31
	02_Organics_P2.PS	90		c_P2_16th.PS	phi'_P2_16th.PS		
	03B_Loose_Coarse-0.08	110	0.08				
	04_Med. Stiff_Fine_P2.PS	120		c_P2_16th.PS	phi'_P2_16th.PS		
	05_Stiff_Fine_P2.PS	125		c_P2_16th.PS	phi'_P2_16th.PS		
	06_Dense_Coarse_P2.PS	125		c_P2_16th.PS	phi'_P2_16th.PS		
	07_Stiff_Fine_P2.PS	125		c_P2_16th.PS	phi'_P2_16th.PS		



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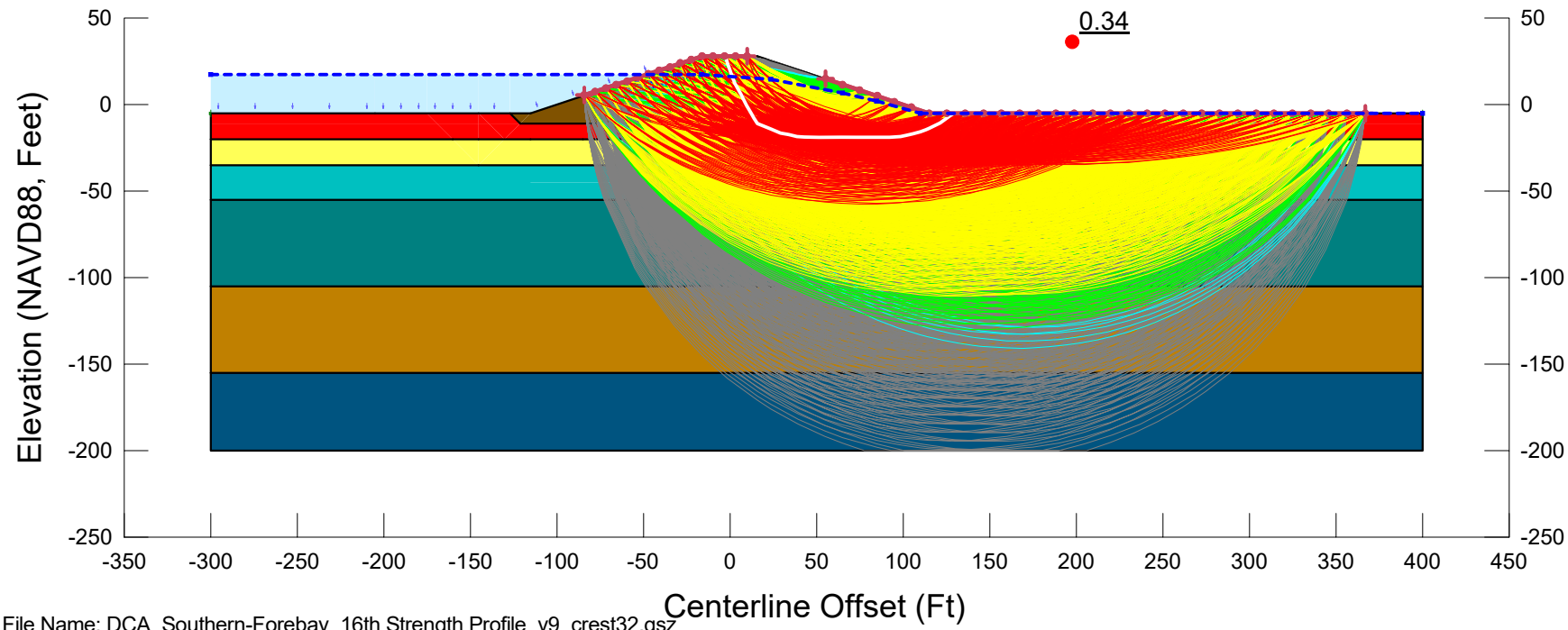
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Constant
Horz Seismic Coef.:

3H1V_P2_E_A2-PS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_16th	phi'_P2_16th		
	03B_Loose_Coarse_P2	110	c_P2_16th	phi'_P2_16th		
	04_Med. Stiff_Fine_P2	120	c_P2_16th	phi'_P2_16th		
	05_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	06_Dense_Coarse_P2	125	c_P2_16th	phi'_P2_16th		
	07_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		



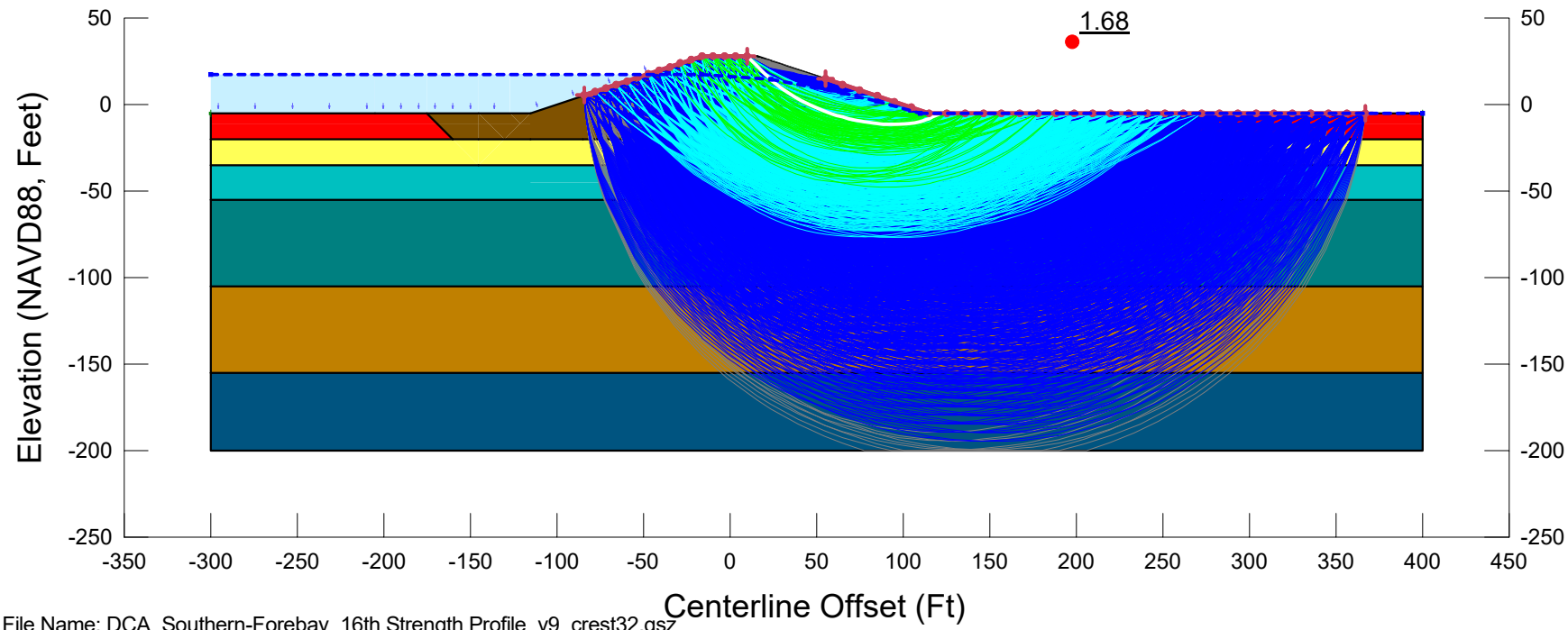
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

3H1V_P2_E_A3-PSS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_16th	phi'_P2_16th		
	03B_Loose_Coarse_P2	110	c_P2_16th	phi'_P2_16th		
	04_Med. Stiff_Fine_P2	120	c_P2_16th	phi'_P2_16th		
	05_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	06_Dense_Coarse_P2	125	c_P2_16th	phi'_P2_16th		
	07_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	09_Soil Bentonite Wall	100			300	0



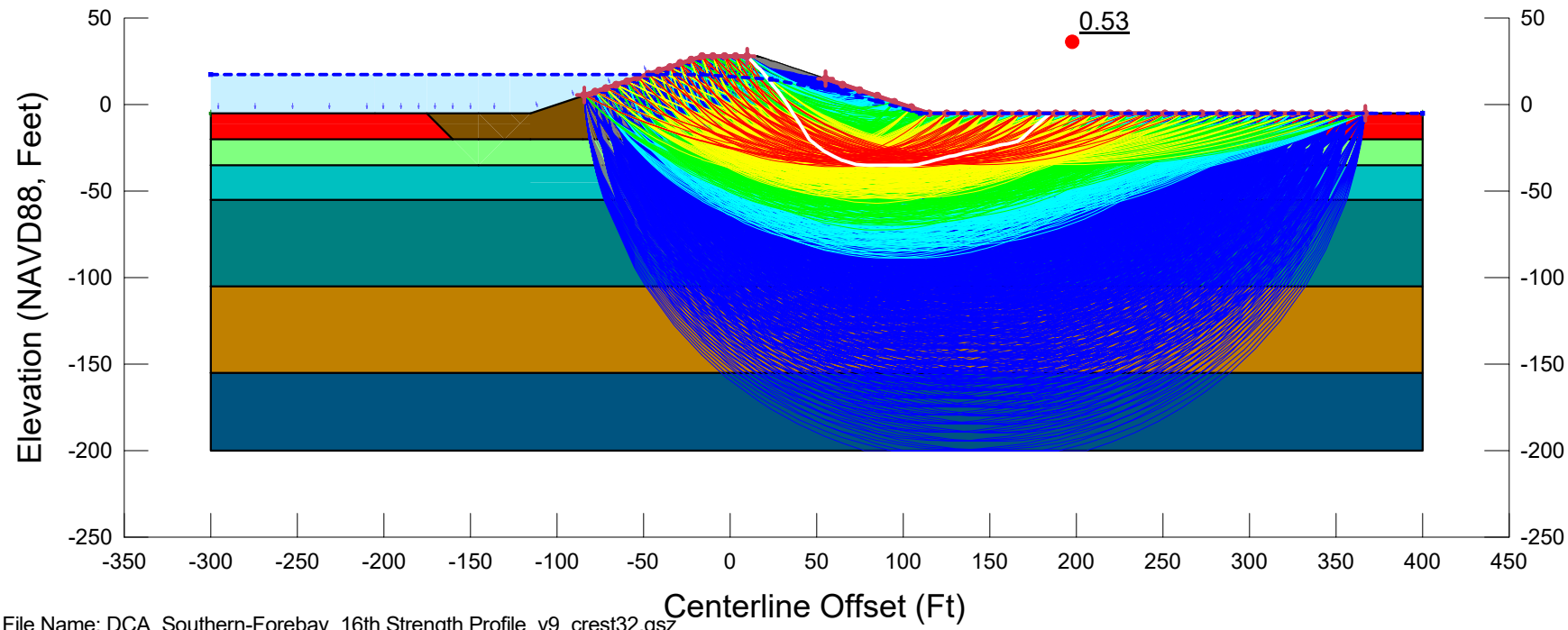
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Constant
Horz Seismic Coef.:

3H1V_P2_G1-RR15_A1-S

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Tau/Sigma Ratio	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120				100	31
	02_Organics_P2.PS	90		c_P2_16th.PS	phi'_P2_16th.PS		
	03B_Loose_Coarse-0.08	110	0.08				
	04_Med. Stiff_Fine_P2.PS	120		c_P2_16th.PS	phi'_P2_16th.PS		
	05_Stiff_Fine_P2.PS	125		c_P2_16th.PS	phi'_P2_16th.PS		
	06_Dense_Coarse_P2.PS	125		c_P2_16th.PS	phi'_P2_16th.PS		
	07_Stiff_Fine_P2.PS	125		c_P2_16th.PS	phi'_P2_16th.PS		
	09_Soil Bentonite Wall	100				300	0



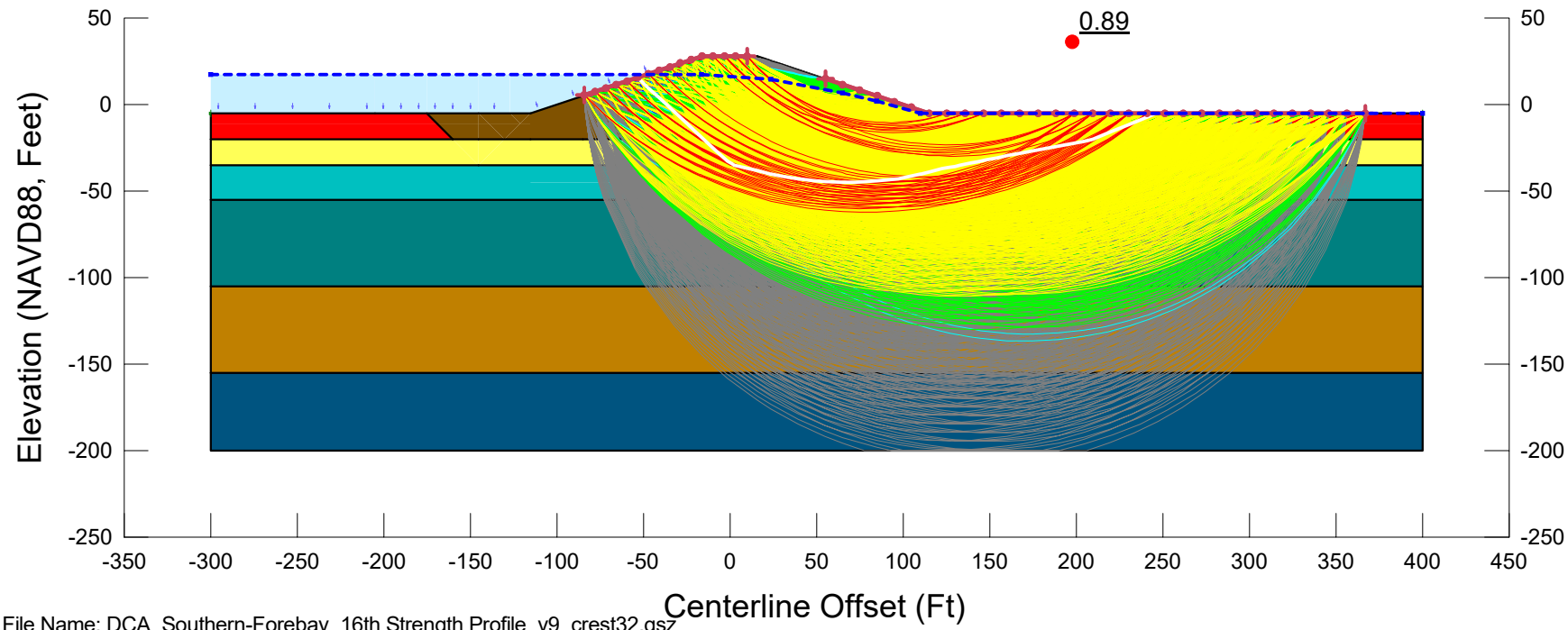
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Constant
Horz Seismic Coef.:

3H1V_P2_G1-RR15_A2-PS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_16th	phi'_P2_16th		
	03B_Loose_Coarse_P2	110	c_P2_16th	phi'_P2_16th		
	04_Med. Stiff_Fine_P2	120	c_P2_16th	phi'_P2_16th		
	05_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	06_Dense_Coarse_P2	125	c_P2_16th	phi'_P2_16th		
	07_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	09_Soil Bentonite Wall	100			300	0



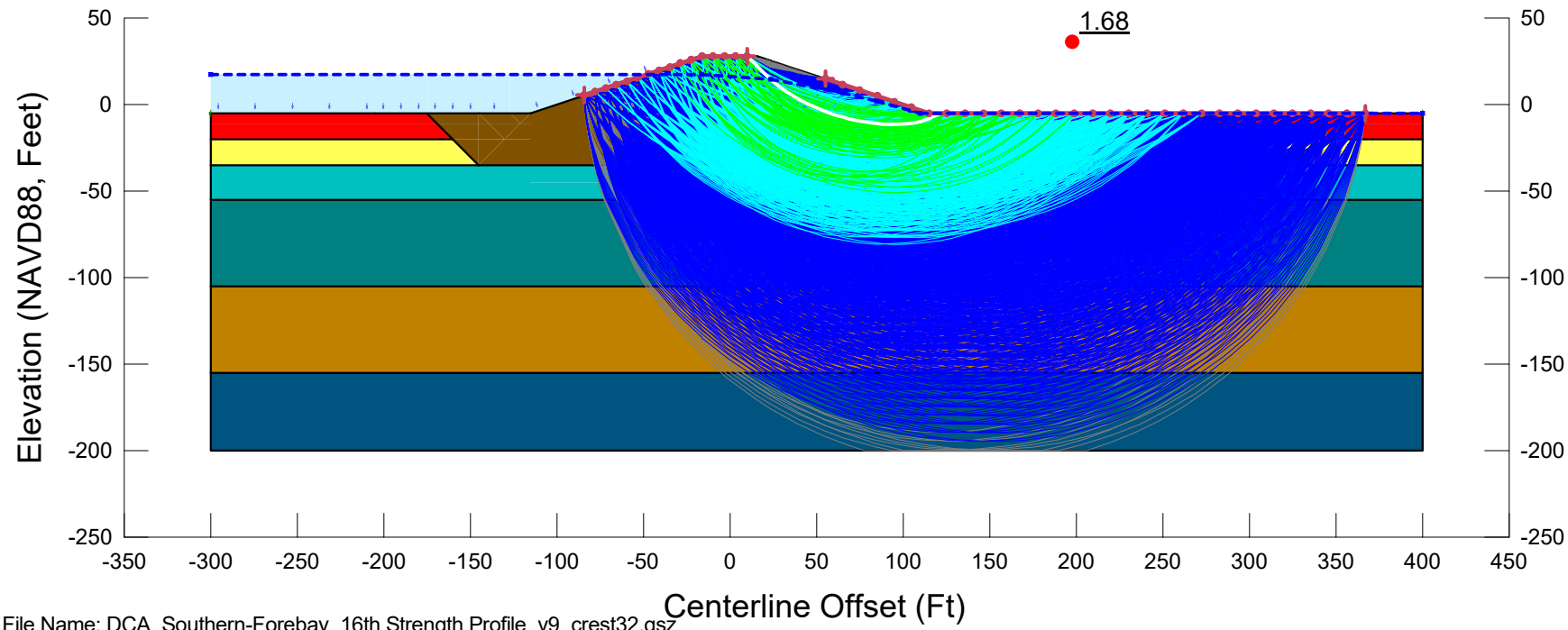
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

3H1V_P2_G1-RR15_A3-PSS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_16th	phi'_P2_16th		
	03B_Loose_Coarse_P2	110	c_P2_16th	phi'_P2_16th		
	04_Med. Stiff_Fine_P2	120	c_P2_16th	phi'_P2_16th		
	05_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	06_Dense_Coarse_P2	125	c_P2_16th	phi'_P2_16th		
	07_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	09_Soil Bentonite Wall	100			300	0



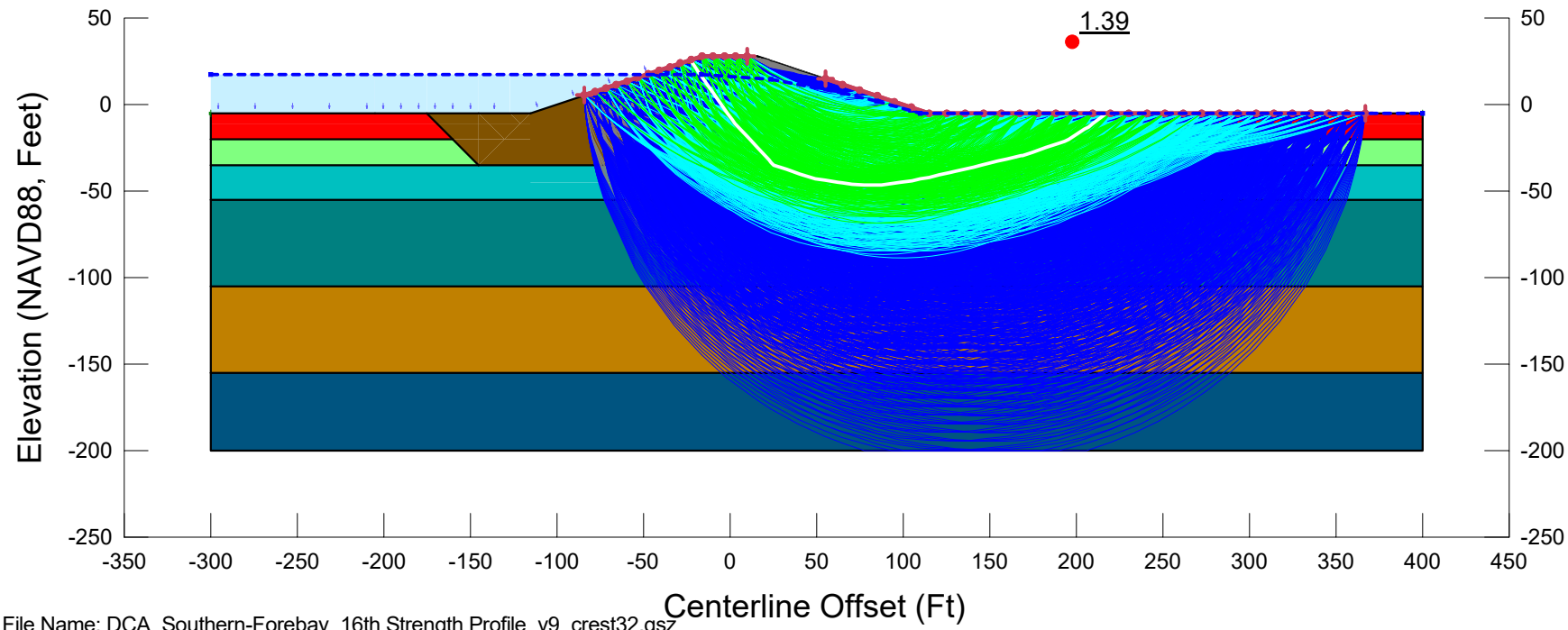
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Constant
Horz Seismic Coef.:

3H1V_P2_G1-RR30_A1-S

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Tau/Sigma Ratio	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120				100	31
	02_Organics_P2.PS	90		c_P2_16th.PS	phi'_P2_16th.PS		
	03B_Loose_Coarse-0.08	110	0.08				
	04_Med. Stiff_Fine_P2.PS	120		c_P2_16th.PS	phi'_P2_16th.PS		
	05_Stiff_Fine_P2.PS	125		c_P2_16th.PS	phi'_P2_16th.PS		
	06_Dense_Coarse_P2.PS	125		c_P2_16th.PS	phi'_P2_16th.PS		
	07_Stiff_Fine_P2.PS	125		c_P2_16th.PS	phi'_P2_16th.PS		
	09_Soil Bentonite Wall	100				300	0



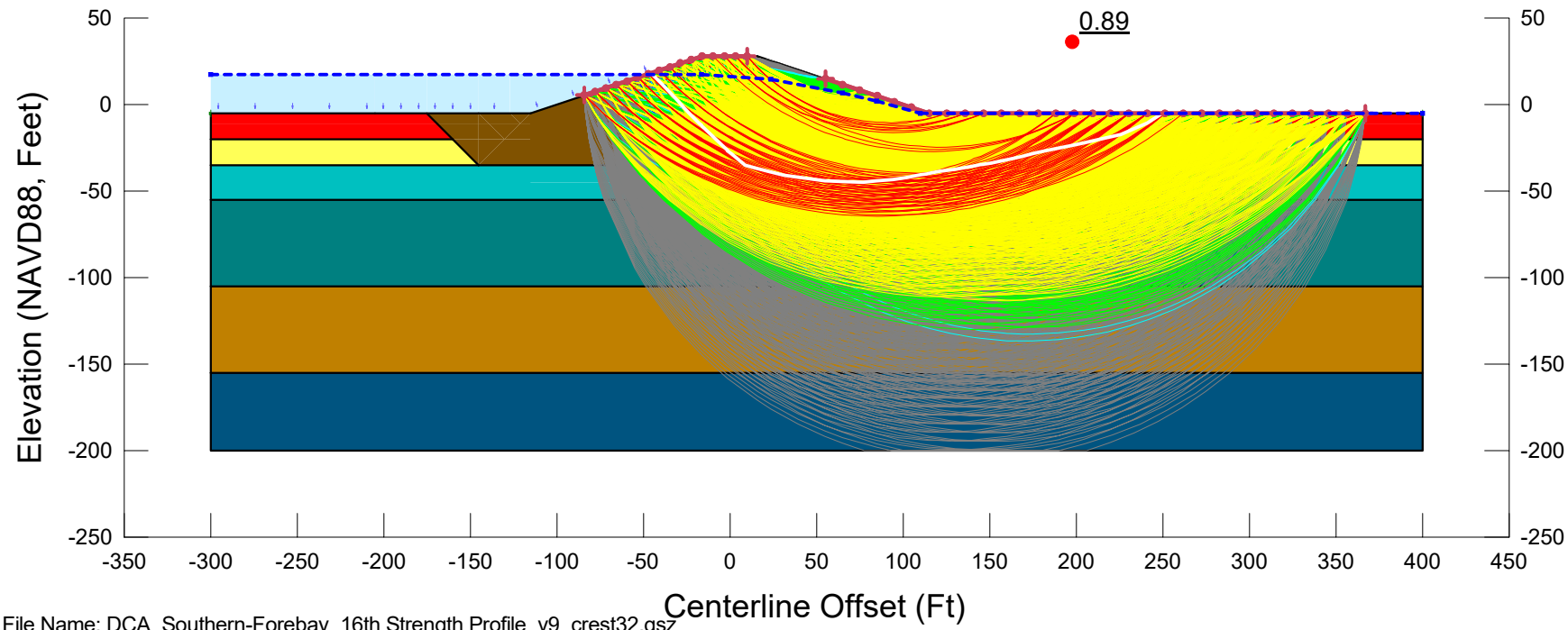
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Constant
Horz Seismic Coef.:

3H1V_P2_G1-RR30_A2-PS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_16th	phi'_P2_16th		
	03B_Loose_Coarse_P2	110	c_P2_16th	phi'_P2_16th		
	04_Med. Stiff_Fine_P2	120	c_P2_16th	phi'_P2_16th		
	05_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	06_Dense_Coarse_P2	125	c_P2_16th	phi'_P2_16th		
	07_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	09_Soil Bentonite Wall	100			300	0



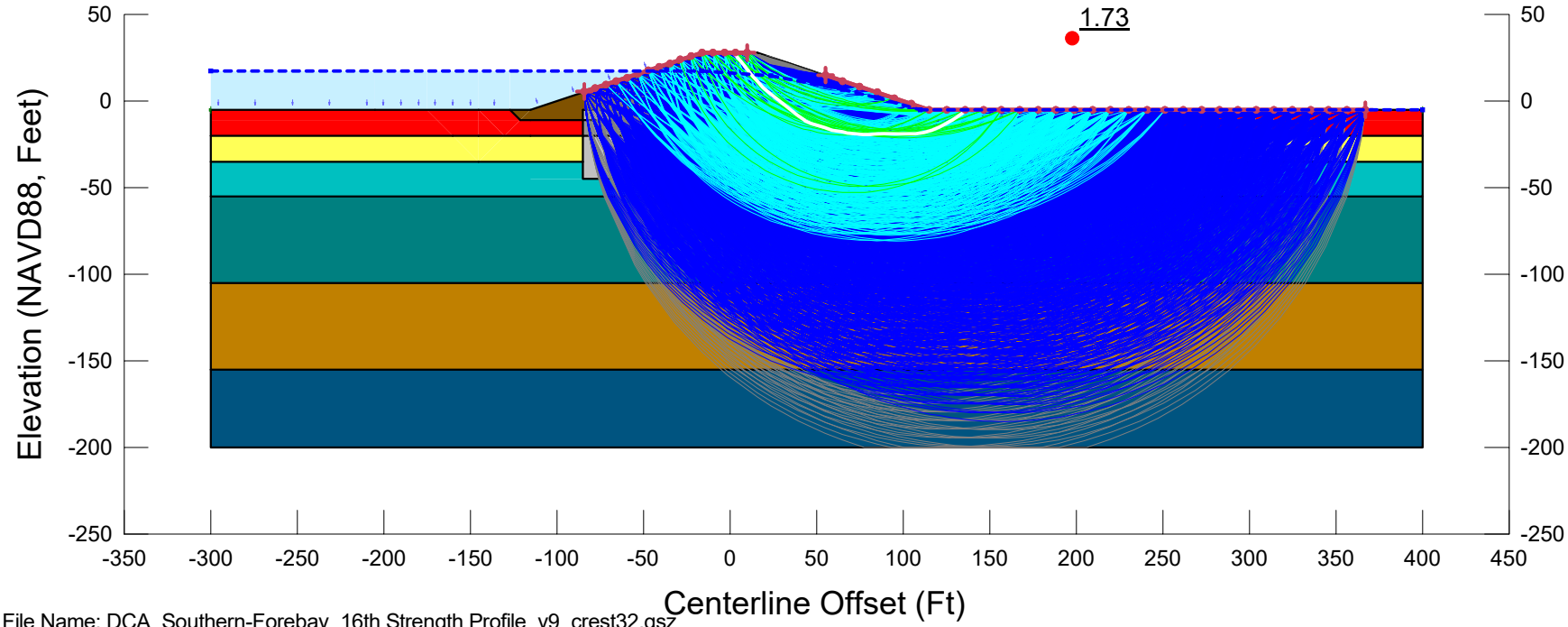
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

3H1V_P2_G1-RR30_A3-PSS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_16th	phi'_P2_16th		
	03B_Loose_Coarse_P2	110	c_P2_16th	phi'_P2_16th		
	04_Med. Stiff_Fine_P2	120	c_P2_16th	phi'_P2_16th		
	05_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	06_Dense_Coarse_P2	125	c_P2_16th	phi'_P2_16th		
	07_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	08_Soil Cement AR=0.15	125			2,400	0
	08_Soil Cement Organics AR=0.15	125			1,425	0
	09_Soil Bentonite Wall	100			300	0



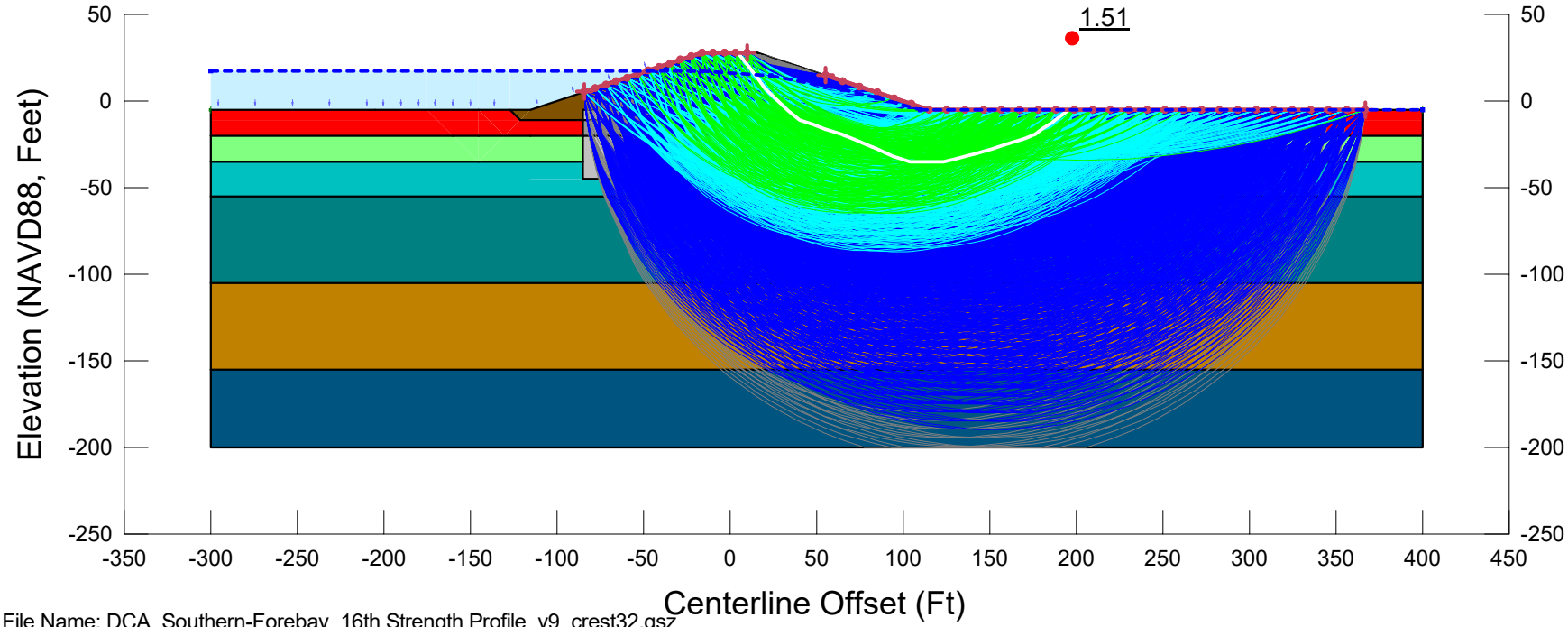
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.:

3H1V_P2_G2-AR15_A1-S

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Tau/Sigma Ratio	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120				100	31
	02_Organics_P2.PS	90		c_P2_16th.PS	phi'_P2_16th.PS		
	03B_Loose_Coarse-0.08	110	0.08				
	04_Med. Stiff_Fine_P2.PS	120		c_P2_16th.PS	phi'_P2_16th.PS		
	05_Stiff_Fine_P2.PS	125		c_P2_16th.PS	phi'_P2_16th.PS		
	06_Dense_Coarse_P2.PS	125		c_P2_16th.PS	phi'_P2_16th.PS		
	07_Stiff_Fine_P2.PS	125		c_P2_16th.PS	phi'_P2_16th.PS		
	08_Soil Cement AR=0.15	125				2,400	0
	08_Soil Cement Organics AR=0.15	125				1,425	0
	09_Soil Bentonite Wall	100				300	0



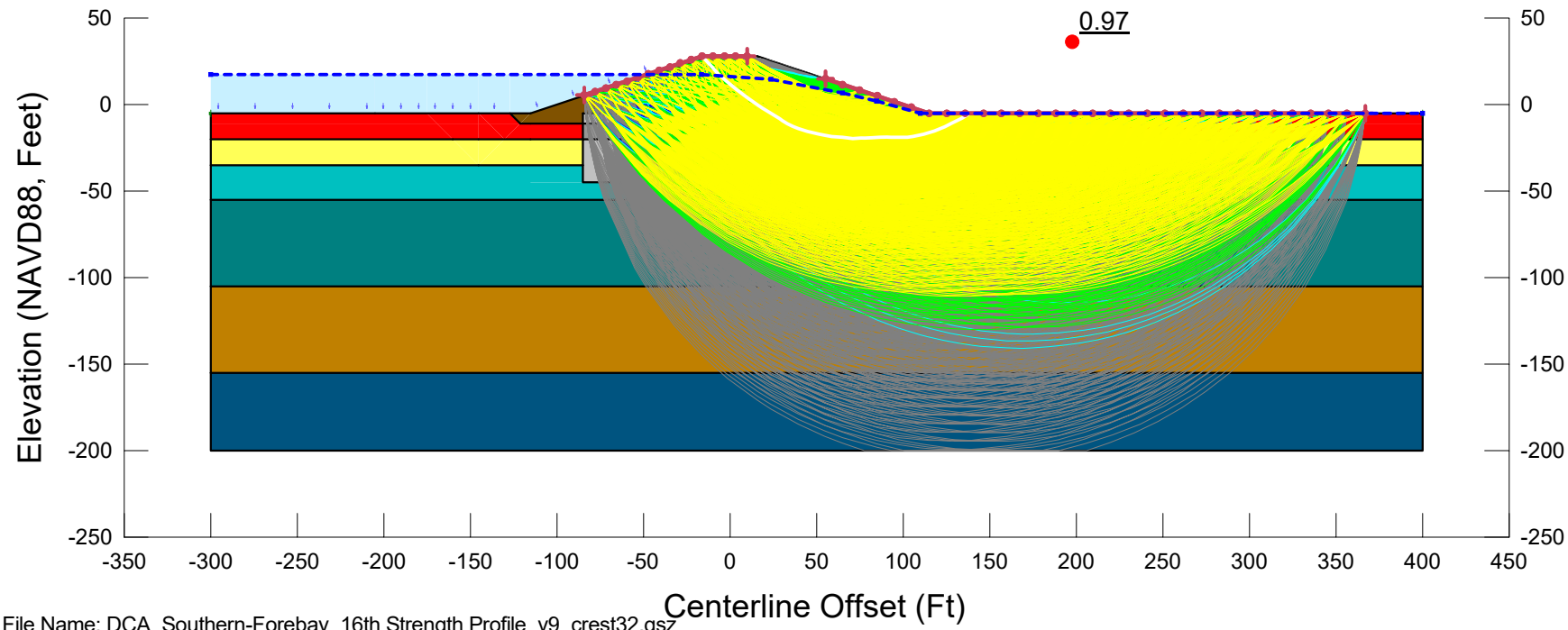
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.:

3H1V_P2_G2-AR15_A2-PS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_16th	phi'_P2_16th		
	03B_Loose_Coarse_P2	110	c_P2_16th	phi'_P2_16th		
	04_Med. Stiff_Fine_P2	120	c_P2_16th	phi'_P2_16th		
	05_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	06_Dense_Coarse_P2	125	c_P2_16th	phi'_P2_16th		
	07_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	08_Soil Cement AR=0.15	125			2,400	0
	08_Soil Cement Organics AR=0.15	125			1,425	0
	09_Soil Bentonite Wall	100			300	0



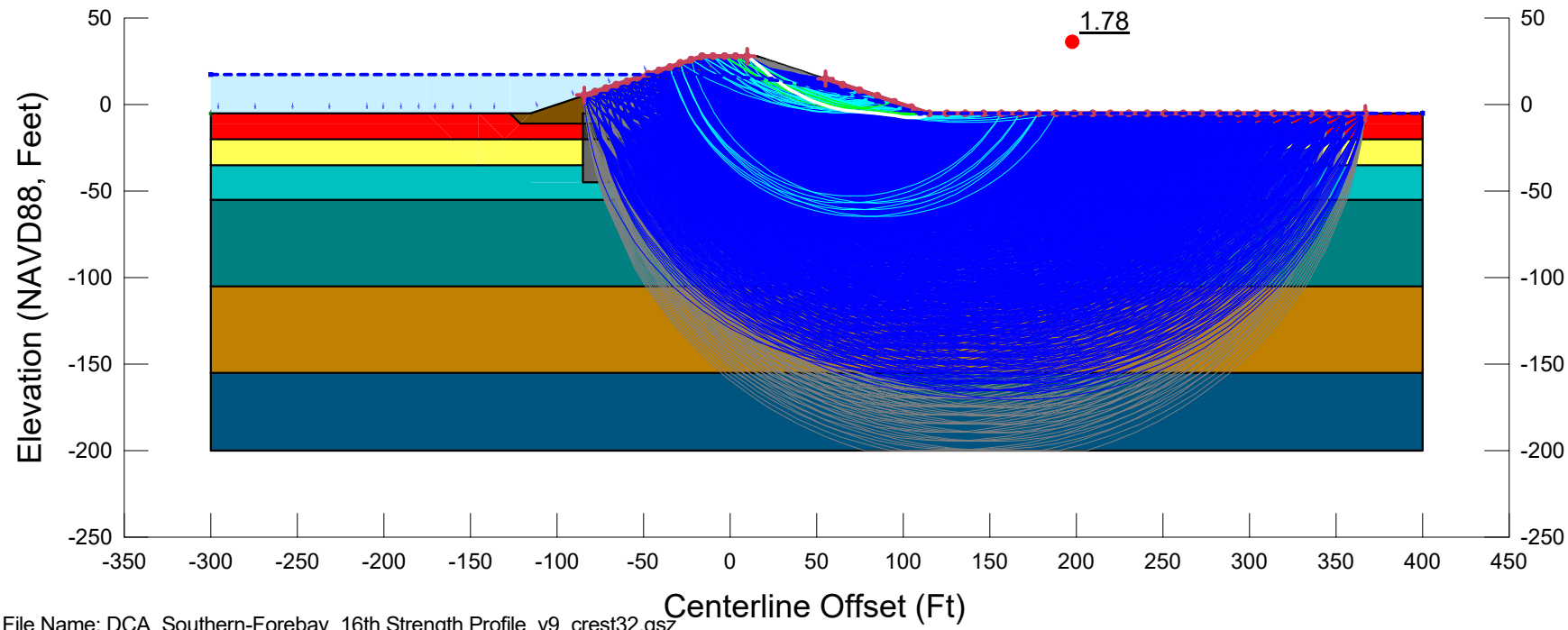
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

3H1V_P2_G2-AR15_A3-PSS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_16th	phi'_P2_16th		
	03B_Loose_Coarse_P2	110	c_P2_16th	phi'_P2_16th		
	04_Med. Stiff_Fine_P2	120	c_P2_16th	phi'_P2_16th		
	05_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	06_Dense_Coarse_P2	125	c_P2_16th	phi'_P2_16th		
	07_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	08_Soil Cement AR=0.25	125			4,000	0
	08_Soil Cement Organics AR=0.25	125			2,225	0
	09_Soil Bentonite Wall	100			300	0



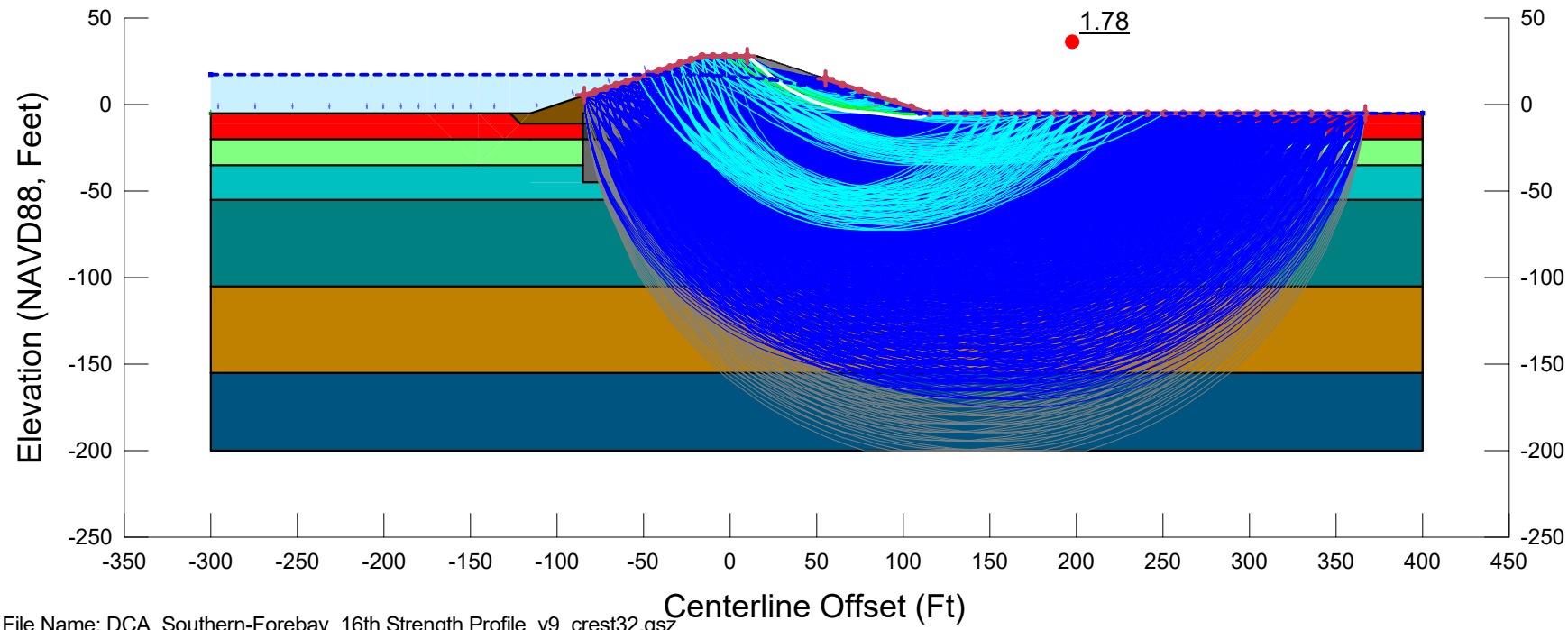
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.:

3H1V_P2_G2-AR25_A1-S

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Tau/Sigma Ratio	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120				100	31
	02_Organics_P2.PS	90		c_P2_16th.PS	phi'_P2_16th.PS		
	03B_Loose_Coarse-0.08	110	0.08				
	04_Med. Stiff_Fine_P2.PS	120		c_P2_16th.PS	phi'_P2_16th.PS		
	05_Stiff_Fine_P2.PS	125		c_P2_16th.PS	phi'_P2_16th.PS		
	06_Dense_Coarse_P2.PS	125		c_P2_16th.PS	phi'_P2_16th.PS		
	07_Stiff_Fine_P2.PS	125		c_P2_16th.PS	phi'_P2_16th.PS		
	08_Soil Cement AR=0.25	125				4,000	0
	08_Soil Cement Organics AR=0.25	125				2,225	0
	09_Soil Bentonite Wall	100				300	0



File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
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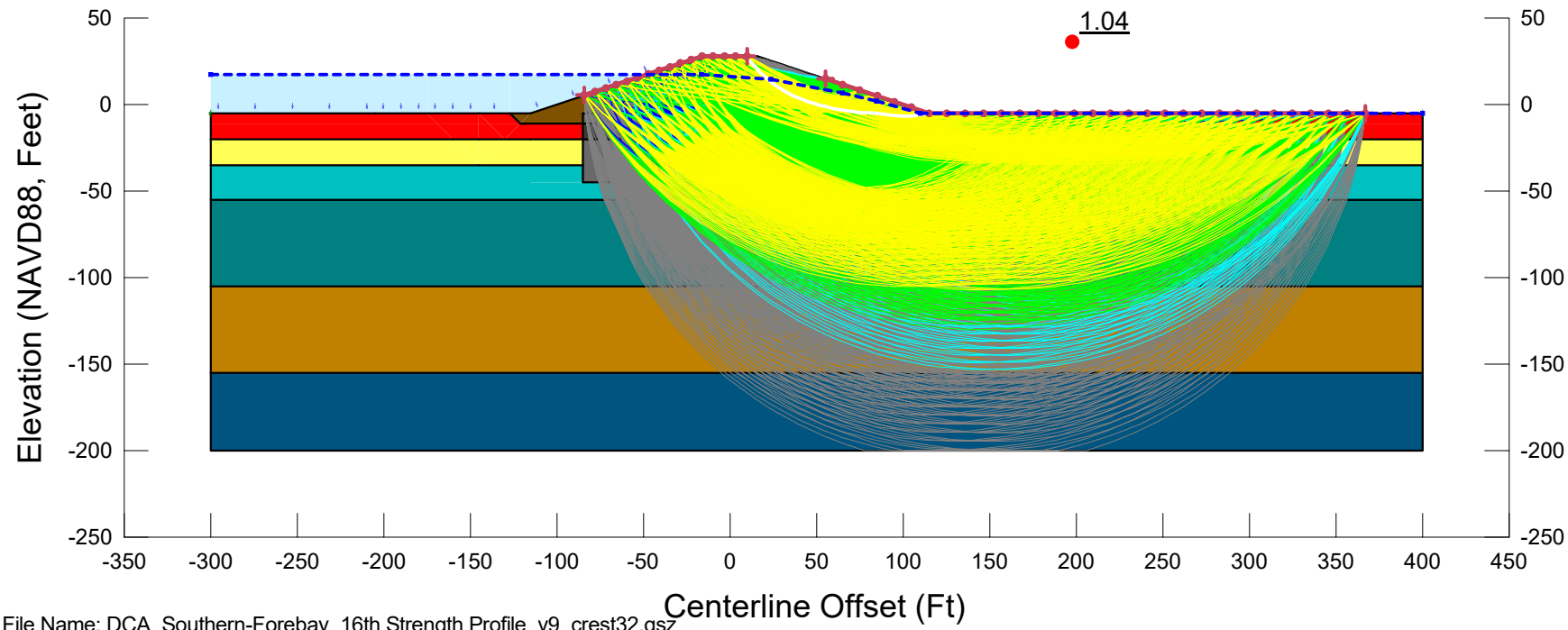
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.:

3H1V_P2_G2-AR25_A2-PS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_16th	phi'_P2_16th		
	03B_Loose_Coarse_P2	110	c_P2_16th	phi'_P2_16th		
	04_Med. Stiff_Fine_P2	120	c_P2_16th	phi'_P2_16th		
	05_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	06_Dense_Coarse_P2	125	c_P2_16th	phi'_P2_16th		
	07_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	08_Soil Cement AR=0.25	125			4,000	0
	08_Soil Cement Organics AR=0.25	125			2,225	0
	09_Soil Bentonite Wall	100			300	0



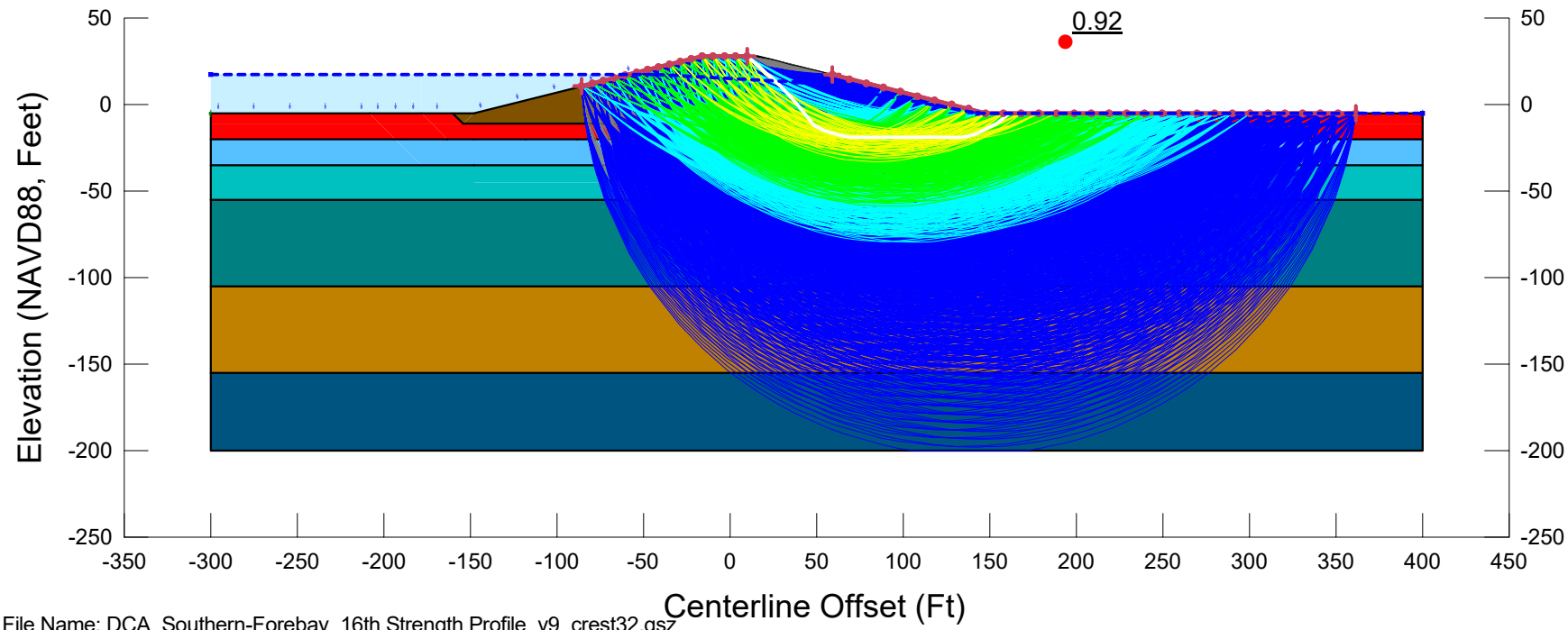
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

3H1V_P2_G2-AR25_A3-PSS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_16th	phi'_P1_16th		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_16th	phi'_P1_16th		
	04_Med. Stiff_Fine_P1	120	c_P1_16th	phi'_P1_16th		
	05_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	06_Dense_Coarse_P1	125	c_P1_16th	phi'_P1_16th		
	07_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		



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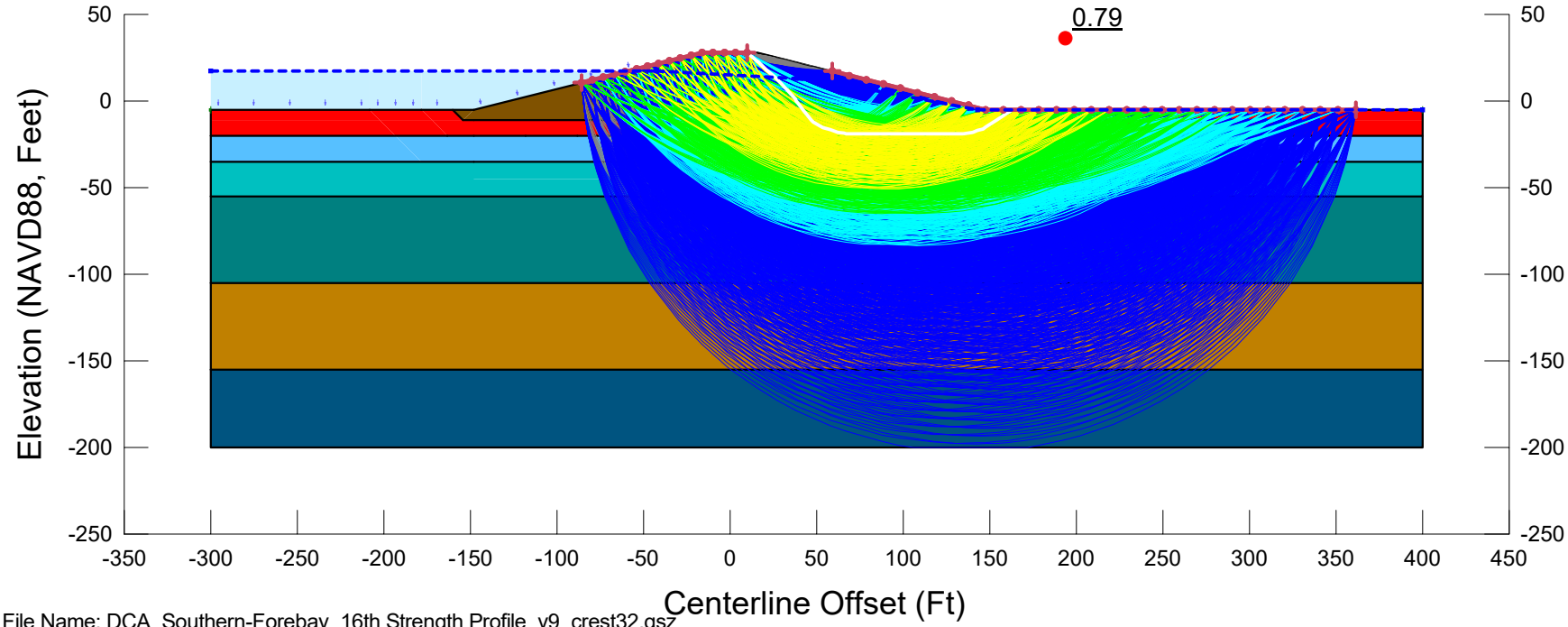
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Constant
Horz Seismic Coef.:

4H1V_P1_E_A1-S

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1.PS	90	c_P1_16th.PS	phi'_P1_16th.PS		
	03A_Soft-Med. Stiff_Fine_P1.PS	110	c_P1_16th.PS	phi'_P1_16th.PS		
	04_Med. Stiff_Fine_P1.PS	120	c_P1_16th.PS	phi'_P1_16th.PS		
	05_Stiff_Fine_P1.PS	125	c_P1_16th.PS	phi'_P1_16th.PS		
	06_Dense_Coarse_P1.PS	125	c_P1_16th.PS	phi'_P1_16th.PS		
	07_Stiff_Fine_P1.PS	125	c_P1_16th.PS	phi'_P1_16th.PS		



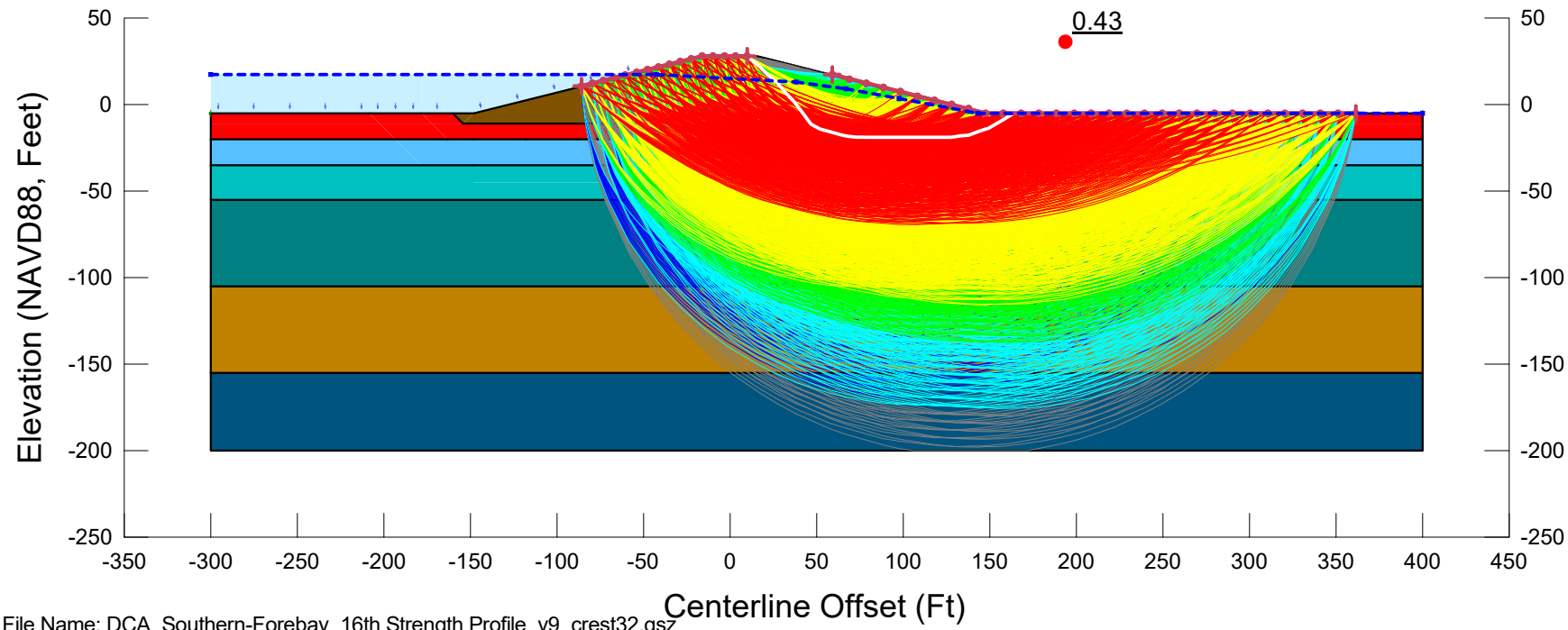
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Constant
Horz Seismic Coef.:

4H1V_P1_E_A2-PS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

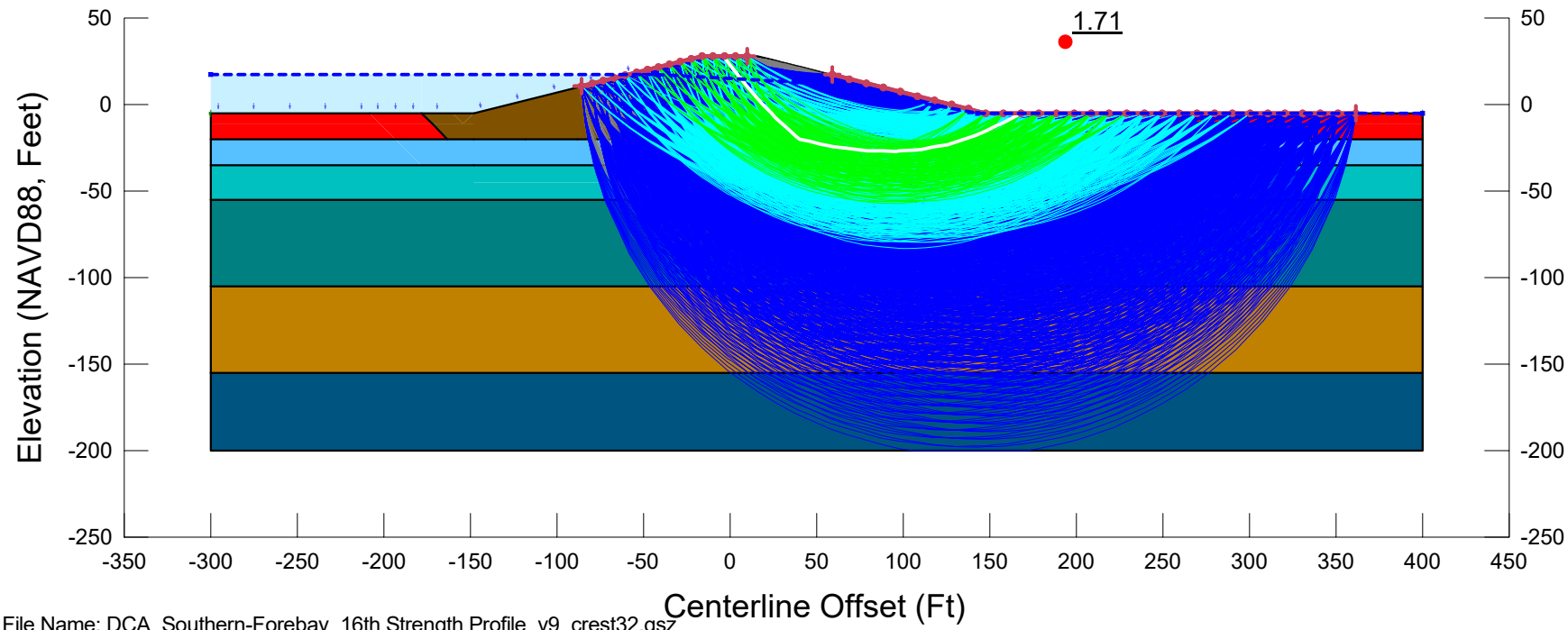
Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_16th	phi'_P1_16th		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_16th	phi'_P1_16th		
	04_Med. Stiff_Fine_P1	120	c_P1_16th	phi'_P1_16th		
	05_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	06_Dense_Coarse_P1	125	c_P1_16th	phi'_P1_16th		
	07_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		



File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

4H1V_P1_E_A3-PSS	
DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz	
02/27/2020	1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_16th	phi'_P1_16th		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_16th	phi'_P1_16th		
	04_Med. Stiff_Fine_P1	120	c_P1_16th	phi'_P1_16th		
	05_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	06_Dense_Coarse_P1	125	c_P1_16th	phi'_P1_16th		
	07_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	09_Soil Bentonite Wall	100			300	0



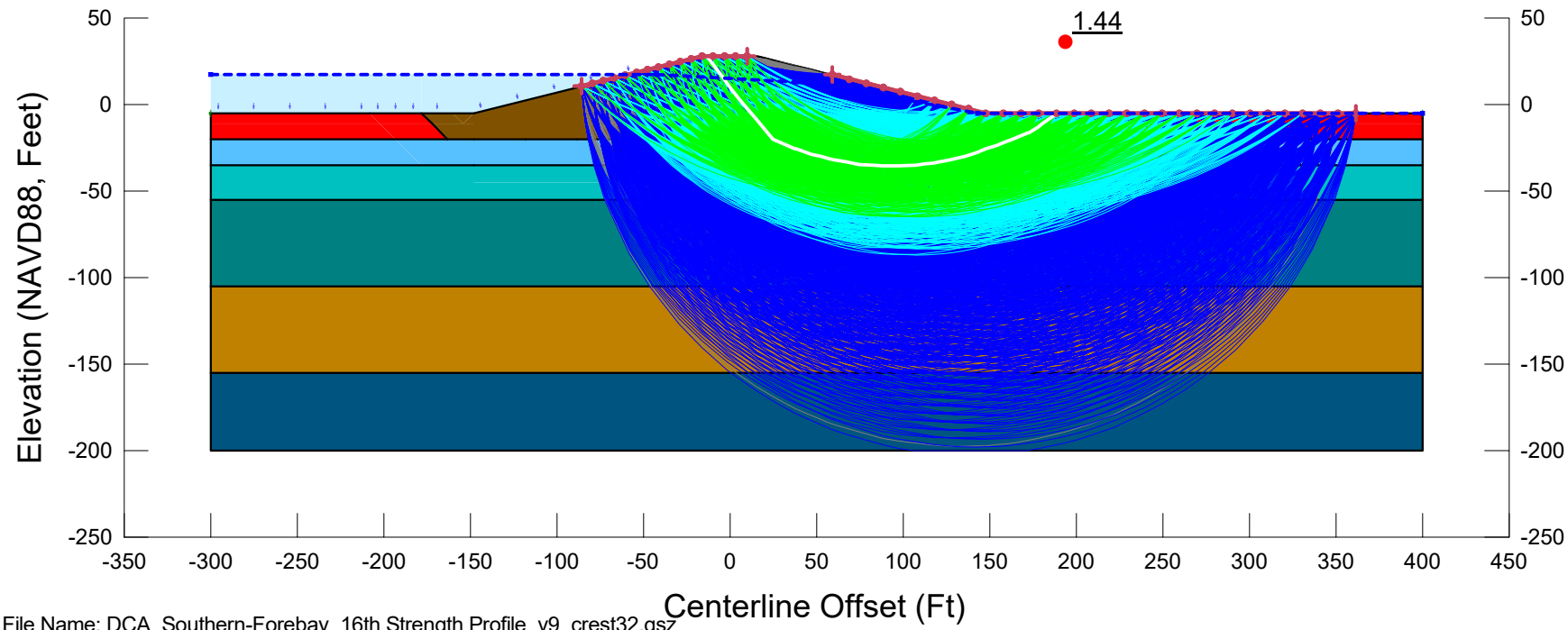
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Constant
Horz Seismic Coef.:

4H1V_P1_G1-RR15_A1-S

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1.PS	90	c_P1_16th.PS	phi'_P1_16th.PS		
	03A_Soft-Med. Stiff_Fine_P1.PS	110	c_P1_16th.PS	phi'_P1_16th.PS		
	04_Med. Stiff_Fine_P1.PS	120	c_P1_16th.PS	phi'_P1_16th.PS		
	05_Stiff_Fine_P1.PS	125	c_P1_16th.PS	phi'_P1_16th.PS		
	06_Dense_Coarse_P1.PS	125	c_P1_16th.PS	phi'_P1_16th.PS		
	07_Stiff_Fine_P1.PS	125	c_P1_16th.PS	phi'_P1_16th.PS		
	09_Soil Bentonite Wall	100			300	0



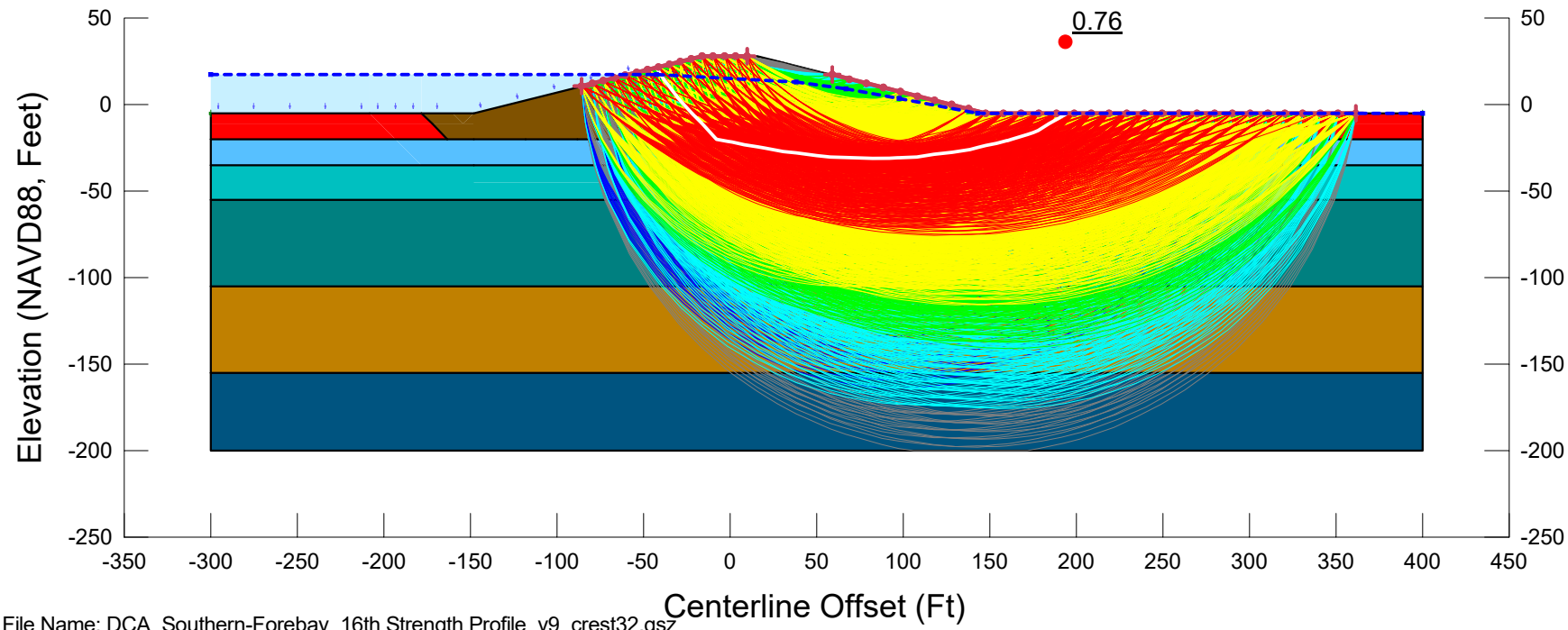
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Constant
Horz Seismic Coef.:

4H1V_P1_G1-RR15_A2-PS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_16th	phi'_P1_16th		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_16th	phi'_P1_16th		
	04_Med. Stiff_Fine_P1	120	c_P1_16th	phi'_P1_16th		
	05_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	06_Dense_Coarse_P1	125	c_P1_16th	phi'_P1_16th		
	07_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	09_Soil Bentonite Wall	100			300	0



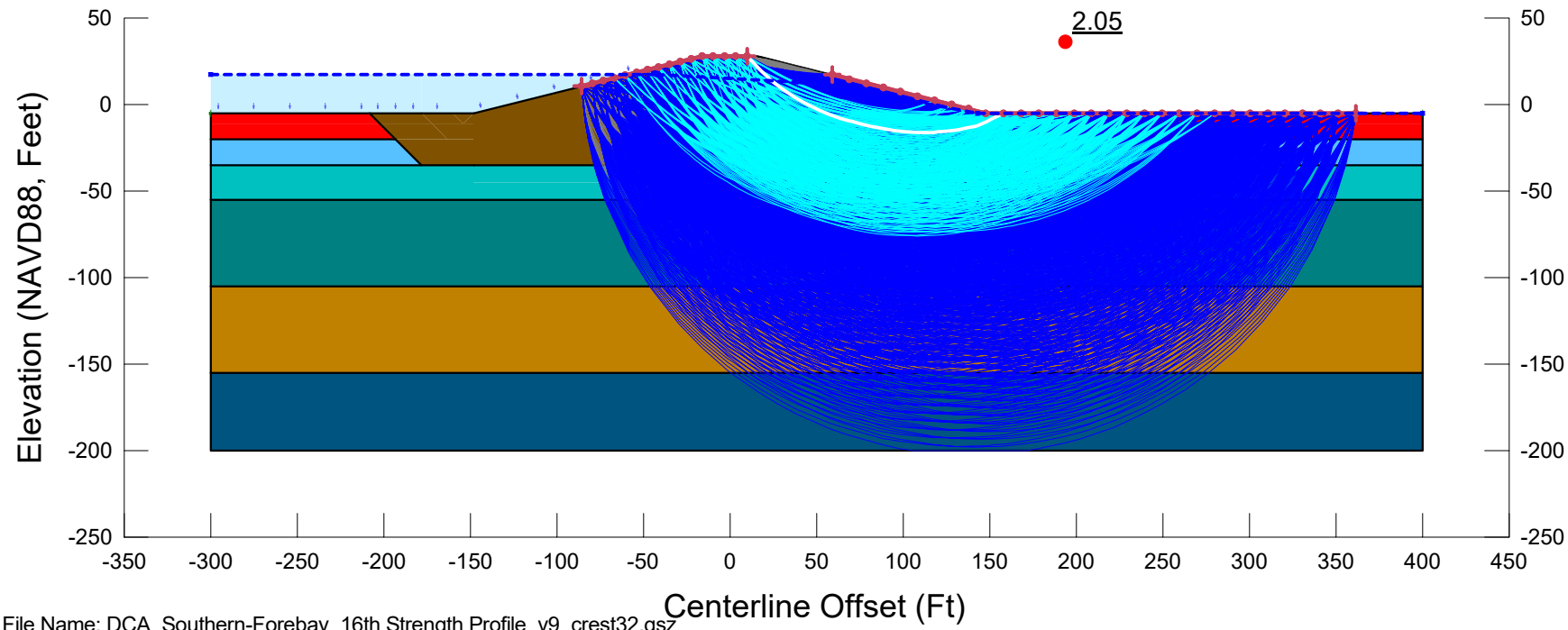
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

4H1V_P1_G1-RR15_A3-PSS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_16th	phi'_P1_16th		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_16th	phi'_P1_16th		
	04_Med. Stiff_Fine_P1	120	c_P1_16th	phi'_P1_16th		
	05_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	06_Dense_Coarse_P1	125	c_P1_16th	phi'_P1_16th		
	07_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	09_Soil Bentonite Wall	100			300	0



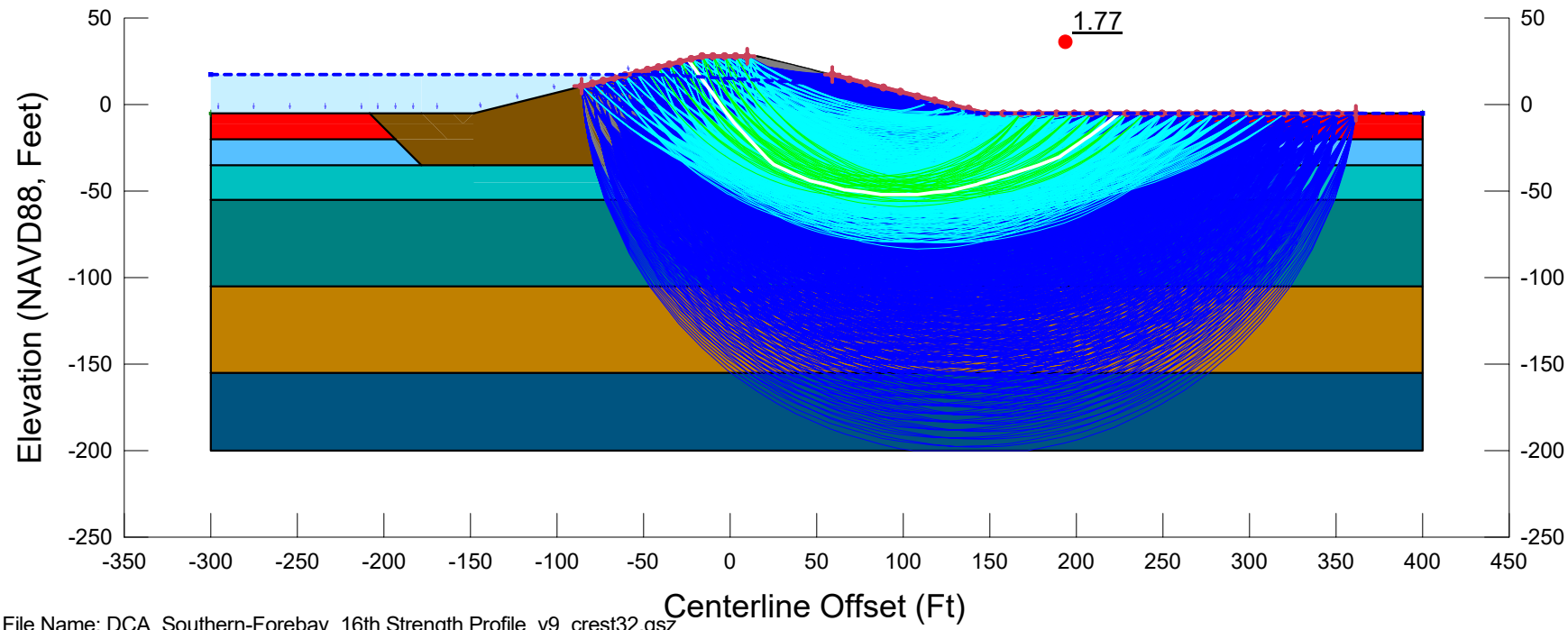
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Constant
Horz Seismic Coef.:

4H1V_P1_G1-RR30_A1-S

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1.PS	90	c_P1_16th.PS	phi'_P1_16th.PS		
	03A_Soft-Med. Stiff_Fine_P1.PS	110	c_P1_16th.PS	phi'_P1_16th.PS		
	04_Med. Stiff_Fine_P1.PS	120	c_P1_16th.PS	phi'_P1_16th.PS		
	05_Stiff_Fine_P1.PS	125	c_P1_16th.PS	phi'_P1_16th.PS		
	06_Dense_Coarse_P1.PS	125	c_P1_16th.PS	phi'_P1_16th.PS		
	07_Stiff_Fine_P1.PS	125	c_P1_16th.PS	phi'_P1_16th.PS		
	09_Soil Bentonite Wall	100			300	0



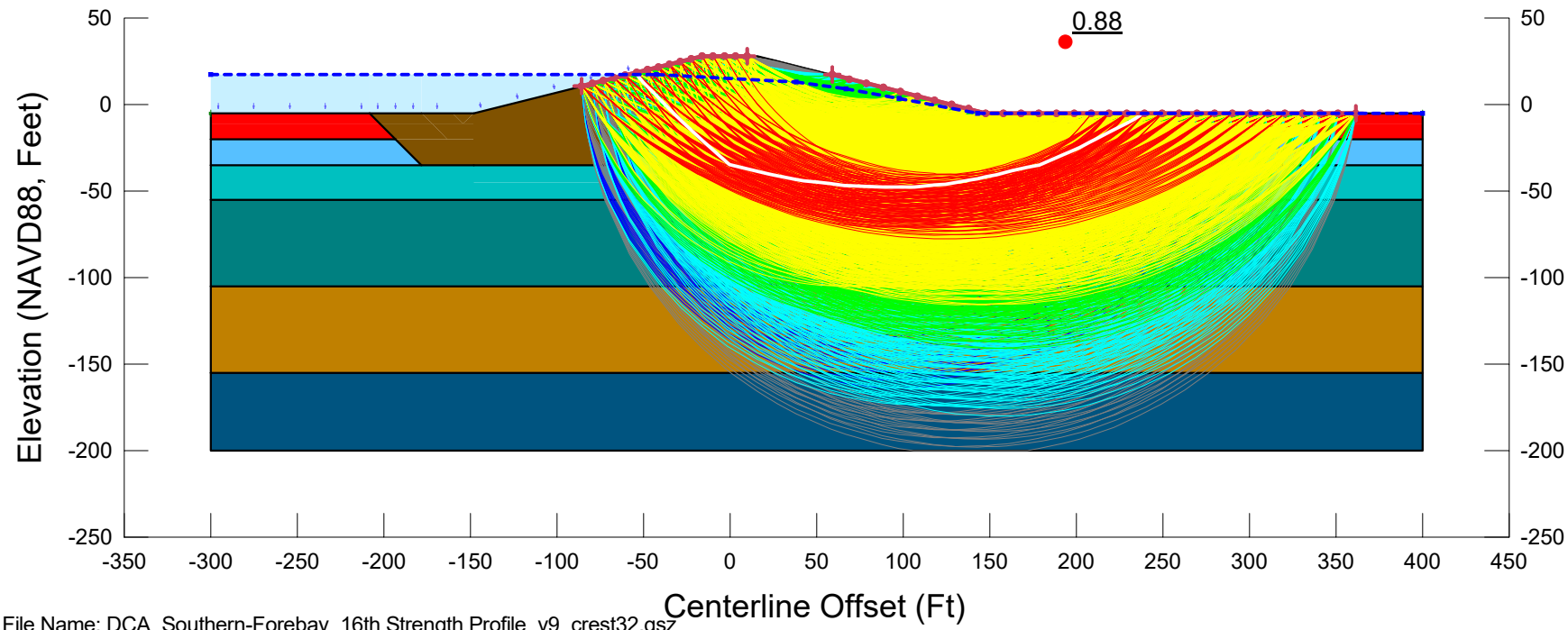
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Constant
Horz Seismic Coef.:

4H1V_P1_G1-RR30_A2-PS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_16th	phi'_P1_16th		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_16th	phi'_P1_16th		
	04_Med. Stiff_Fine_P1	120	c_P1_16th	phi'_P1_16th		
	05_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	06_Dense_Coarse_P1	125	c_P1_16th	phi'_P1_16th		
	07_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	09_Soil Bentonite Wall	100			300	0



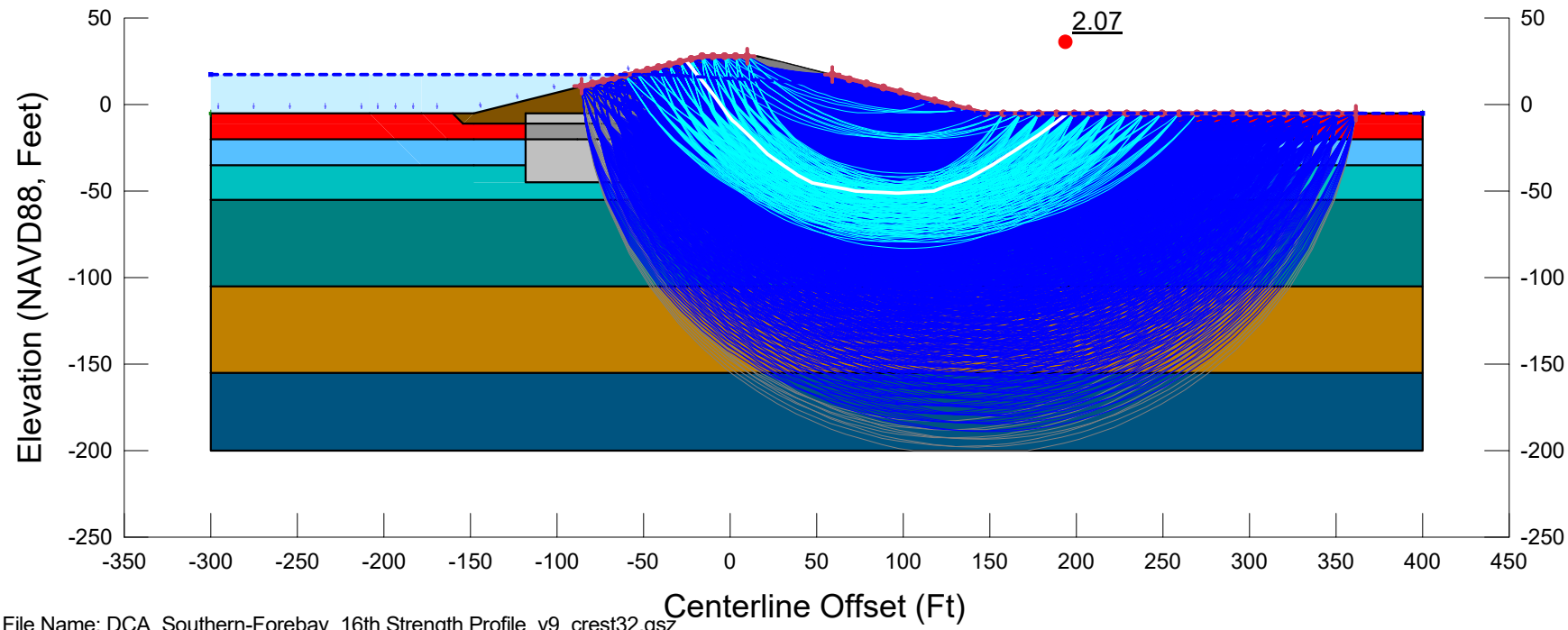
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

4H1V_P1_G1-RR30_A3-PSS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_16th	phi'_P1_16th		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_16th	phi'_P1_16th		
	04_Med. Stiff_Fine_P1	120	c_P1_16th	phi'_P1_16th		
	05_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	06_Dense_Coarse_P1	125	c_P1_16th	phi'_P1_16th		
	07_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	08_Soil Cement AR=0.15	125			2,400	0
	08_Soil Cement Organics AR=0.15	125			1,425	0
	09_Soil Bentonite Wall	100			300	0



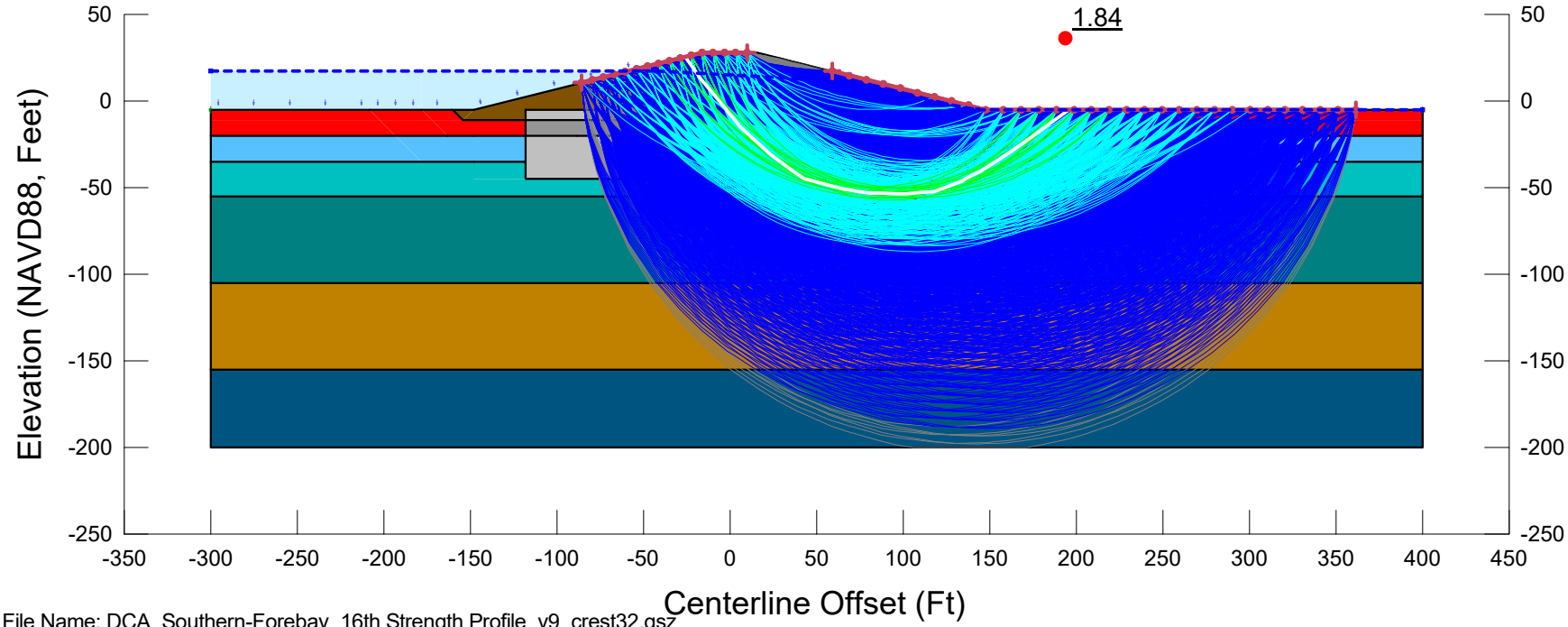
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.:

4H1V_P1_G2-AR15_A1-S

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1.PS	90	c_P1_16th.PS	phi'_P1_16th.PS		
	03A_Soft-Med. Stiff_Fine_P1.PS	110	c_P1_16th.PS	phi'_P1_16th.PS		
	04_Med. Stiff_Fine_P1.PS	120	c_P1_16th.PS	phi'_P1_16th.PS		
	05_Stiff_Fine_P1.PS	125	c_P1_16th.PS	phi'_P1_16th.PS		
	06_Dense_Coarse_P1.PS	125	c_P1_16th.PS	phi'_P1_16th.PS		
	07_Stiff_Fine_P1.PS	125	c_P1_16th.PS	phi'_P1_16th.PS		
	08_Soil Cement AR=0.15	125			2,400	0
	08_Soil Cement Organics AR=0.15	125			1,425	0
	09_Soil Bentonite Wall	100			300	0



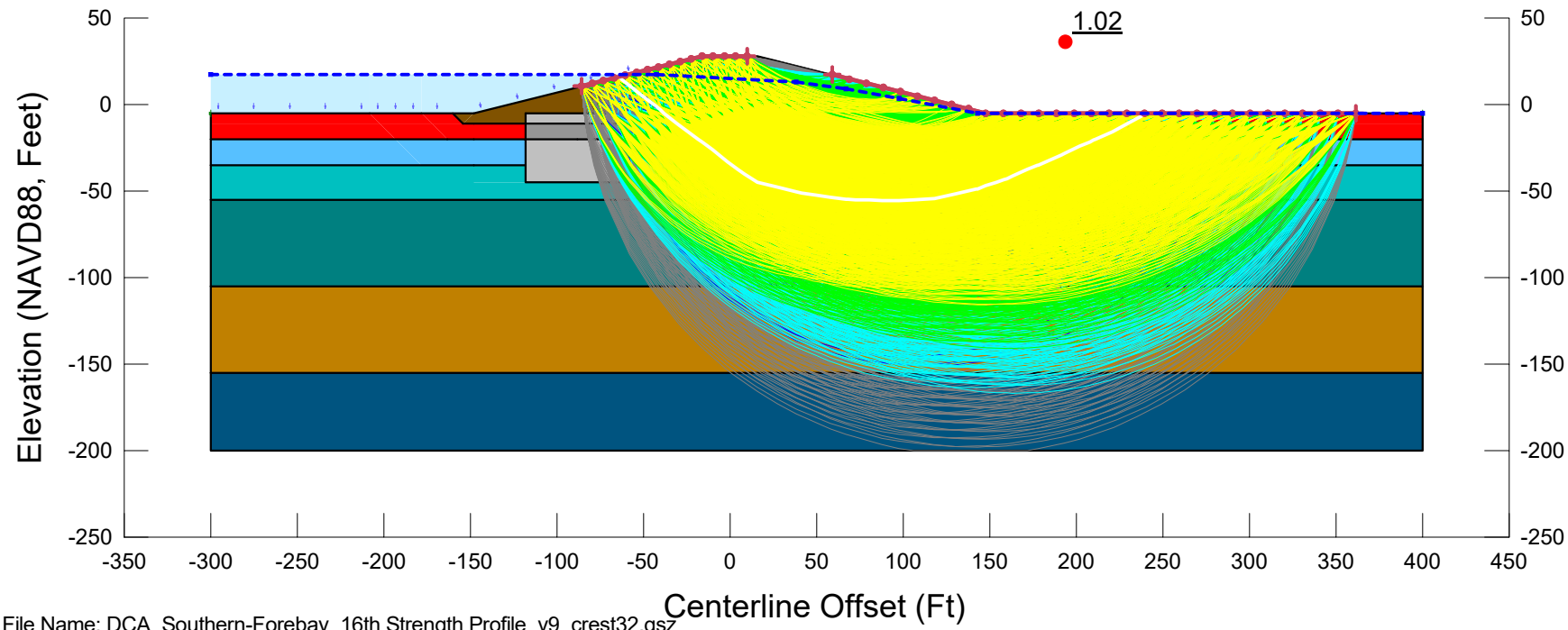
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.:

4H1V_P1_G2-AR15_A2-PS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_16th	phi'_P1_16th		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_16th	phi'_P1_16th		
	04_Med. Stiff_Fine_P1	120	c_P1_16th	phi'_P1_16th		
	05_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	06_Dense_Coarse_P1	125	c_P1_16th	phi'_P1_16th		
	07_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	08_Soil Cement AR=0.15	125			2,400	0
	08_Soil Cement Organics AR=0.15	125			1,425	0
	09_Soil Bentonite Wall	100			300	0



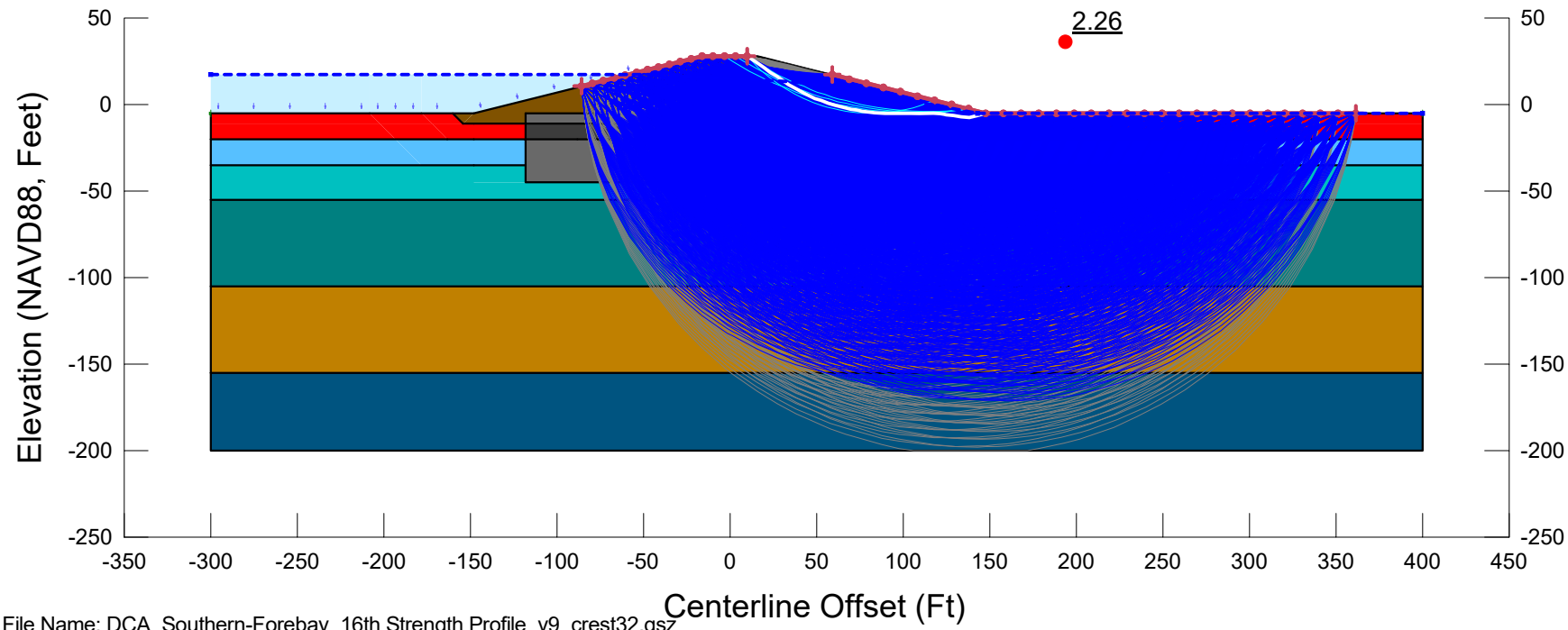
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

4H1V_P1_G2-AR15_A3-PSS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_16th	phi'_P1_16th		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_16th	phi'_P1_16th		
	04_Med. Stiff_Fine_P1	120	c_P1_16th	phi'_P1_16th		
	05_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	06_Dense_Coarse_P1	125	c_P1_16th	phi'_P1_16th		
	07_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	08_Soil Cement AR=0.25	125			4,000	0
	08_Soil Cement Organics AR=0.25	125			2,225	0
	09_Soil Bentonite Wall	100			300	0



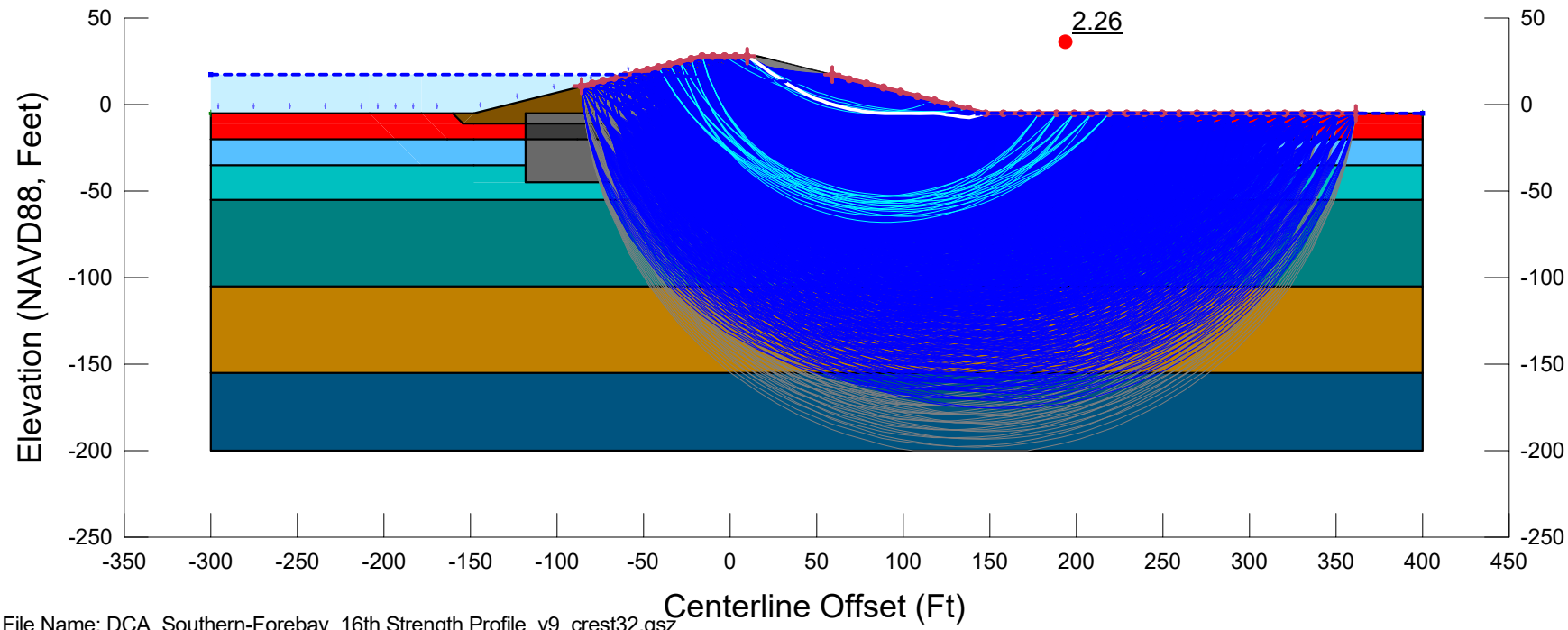
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.:

4H1V_P1_G2-AR25_A1-S

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1.PS	90	c_P1_16th.PS	phi'_P1_16th.PS		
	03A_Soft-Med. Stiff_Fine_P1.PS	110	c_P1_16th.PS	phi'_P1_16th.PS		
	04_Med. Stiff_Fine_P1.PS	120	c_P1_16th.PS	phi'_P1_16th.PS		
	05_Stiff_Fine_P1.PS	125	c_P1_16th.PS	phi'_P1_16th.PS		
	06_Dense_Coarse_P1.PS	125	c_P1_16th.PS	phi'_P1_16th.PS		
	07_Stiff_Fine_P1.PS	125	c_P1_16th.PS	phi'_P1_16th.PS		
	08_Soil Cement AR=0.25	125			4,000	0
	08_Soil Cement Organics AR=0.25	125			2,225	0
	09_Soil Bentonite Wall	100			300	0



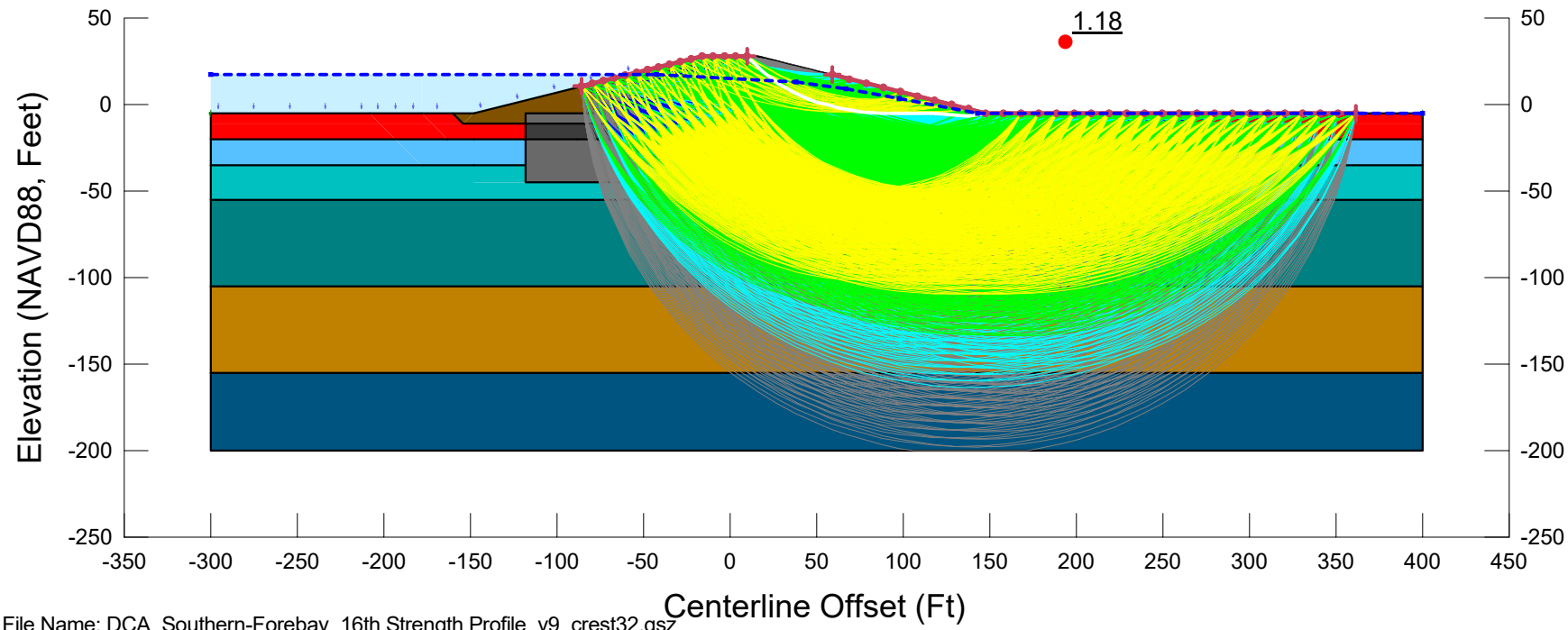
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.:

4H1V_P1_G2-AR25_A2-PS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_16th	phi'_P1_16th		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_16th	phi'_P1_16th		
	04_Med. Stiff_Fine_P1	120	c_P1_16th	phi'_P1_16th		
	05_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	06_Dense_Coarse_P1	125	c_P1_16th	phi'_P1_16th		
	07_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	08_Soil Cement AR=0.25	125			4,000	0
	08_Soil Cement Organics AR=0.25	125			2,225	0
	09_Soil Bentonite Wall	100			300	0



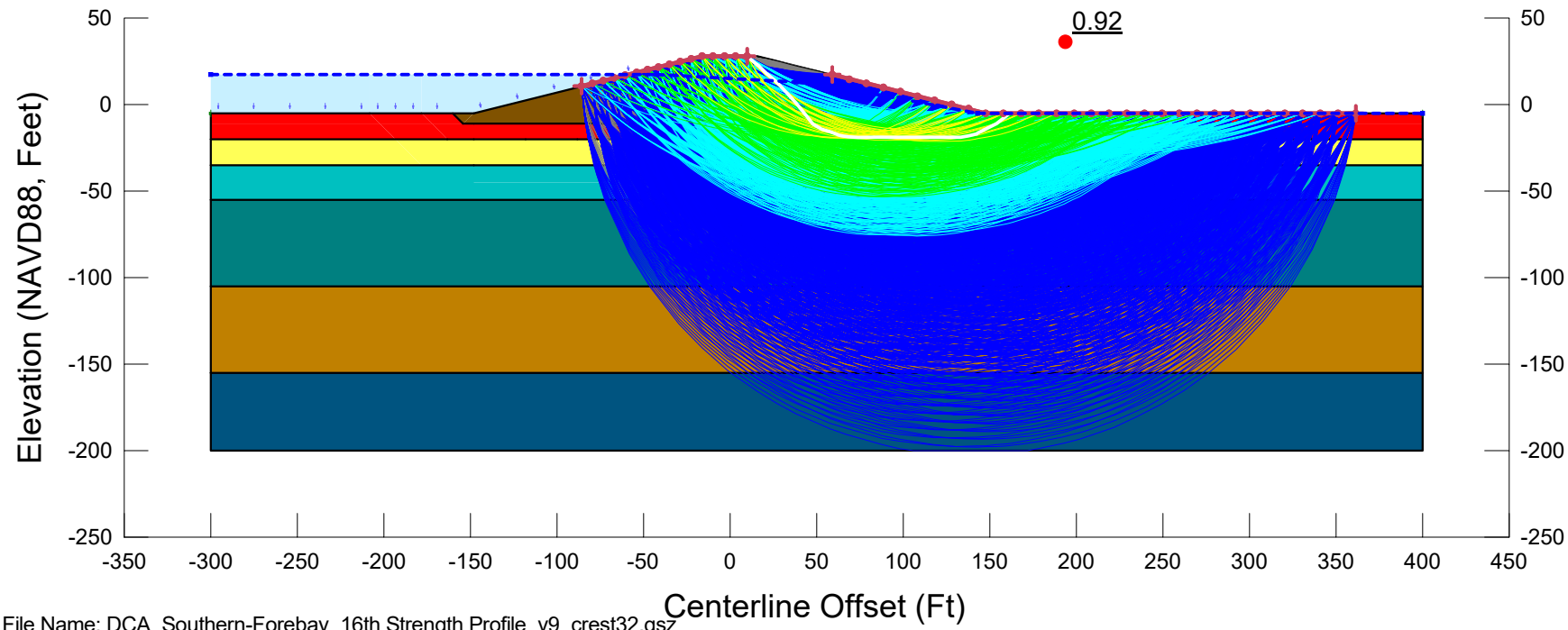
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

4H1V_P1_G2-AR25_A3-PSS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_16th	phi'_P2_16th		
	03B_Loose_Coarse_P2	110	c_P2_16th	phi'_P2_16th		
	04_Med. Stiff_Fine_P2	120	c_P2_16th	phi'_P2_16th		
	05_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	06_Dense_Coarse_P2	125	c_P2_16th	phi'_P2_16th		
	07_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		



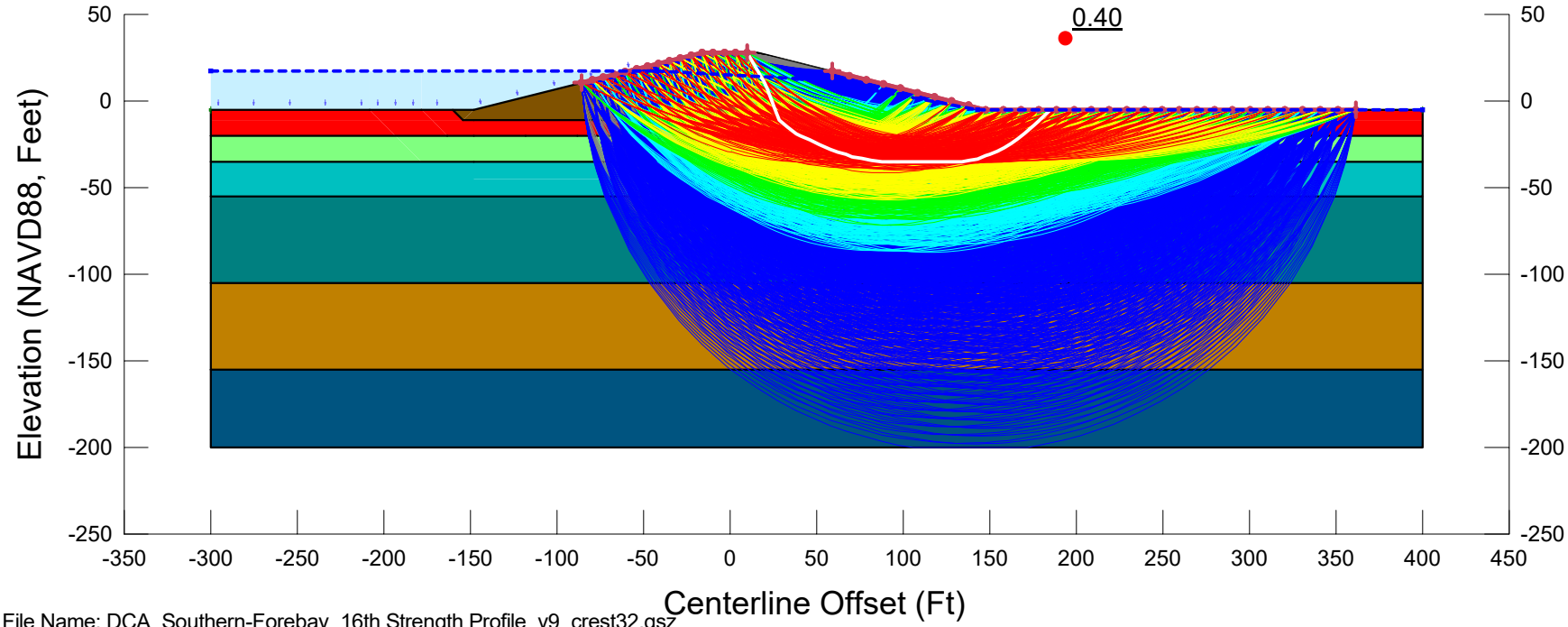
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Constant
Horz Seismic Coef.:

4H1V_P2_E_A1-S

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Tau/Sigma Ratio	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120				100	31
	02_Organics_P2.PS	90		c_P2_16th.PS	phi'_P2_16th.PS		
	03B_Loose_Coarse-0.08	110	0.08				
	04_Med. Stiff_Fine_P2.PS	120		c_P2_16th.PS	phi'_P2_16th.PS		
	05_Stiff_Fine_P2.PS	125		c_P2_16th.PS	phi'_P2_16th.PS		
	06_Dense_Coarse_P2.PS	125		c_P2_16th.PS	phi'_P2_16th.PS		
	07_Stiff_Fine_P2.PS	125		c_P2_16th.PS	phi'_P2_16th.PS		



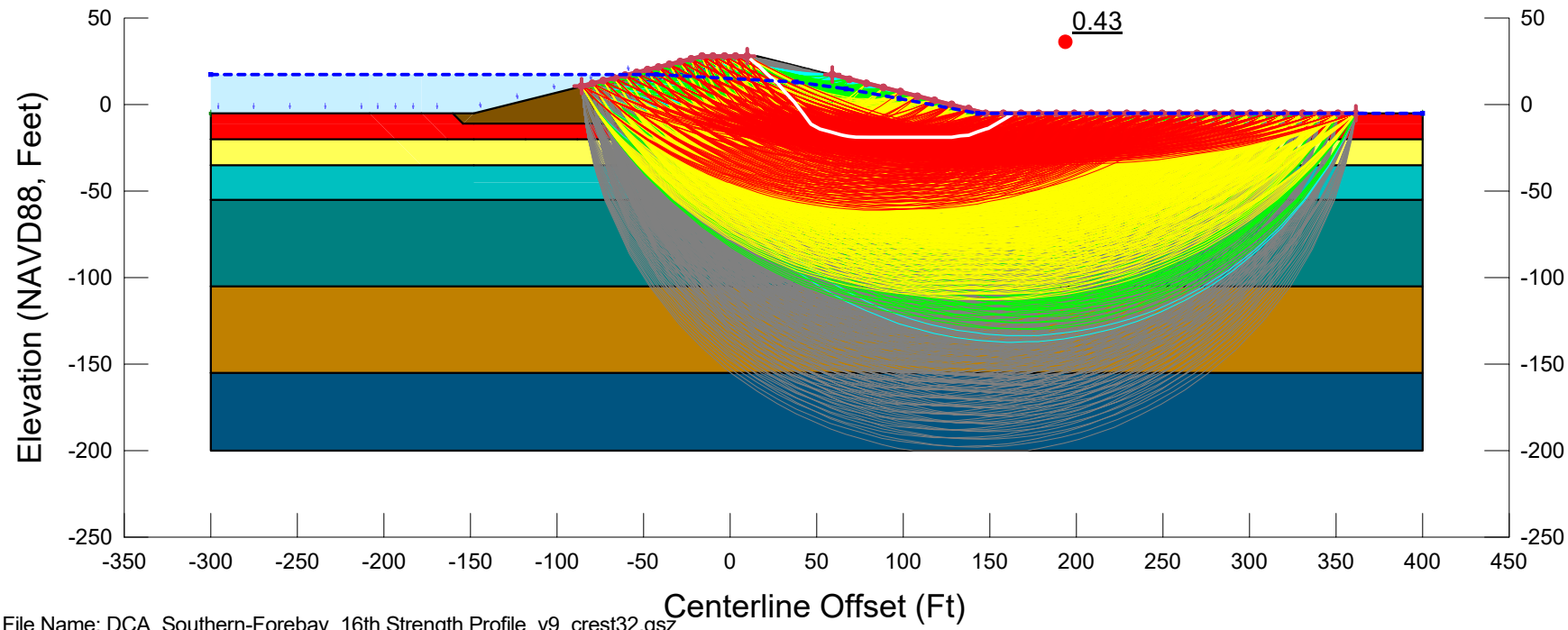
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Constant
Horz Seismic Coef.:

4H1V_P2_E_A2-PS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_16th	phi'_P2_16th		
	03B_Loose_Coarse_P2	110	c_P2_16th	phi'_P2_16th		
	04_Med. Stiff_Fine_P2	120	c_P2_16th	phi'_P2_16th		
	05_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	06_Dense_Coarse_P2	125	c_P2_16th	phi'_P2_16th		
	07_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		



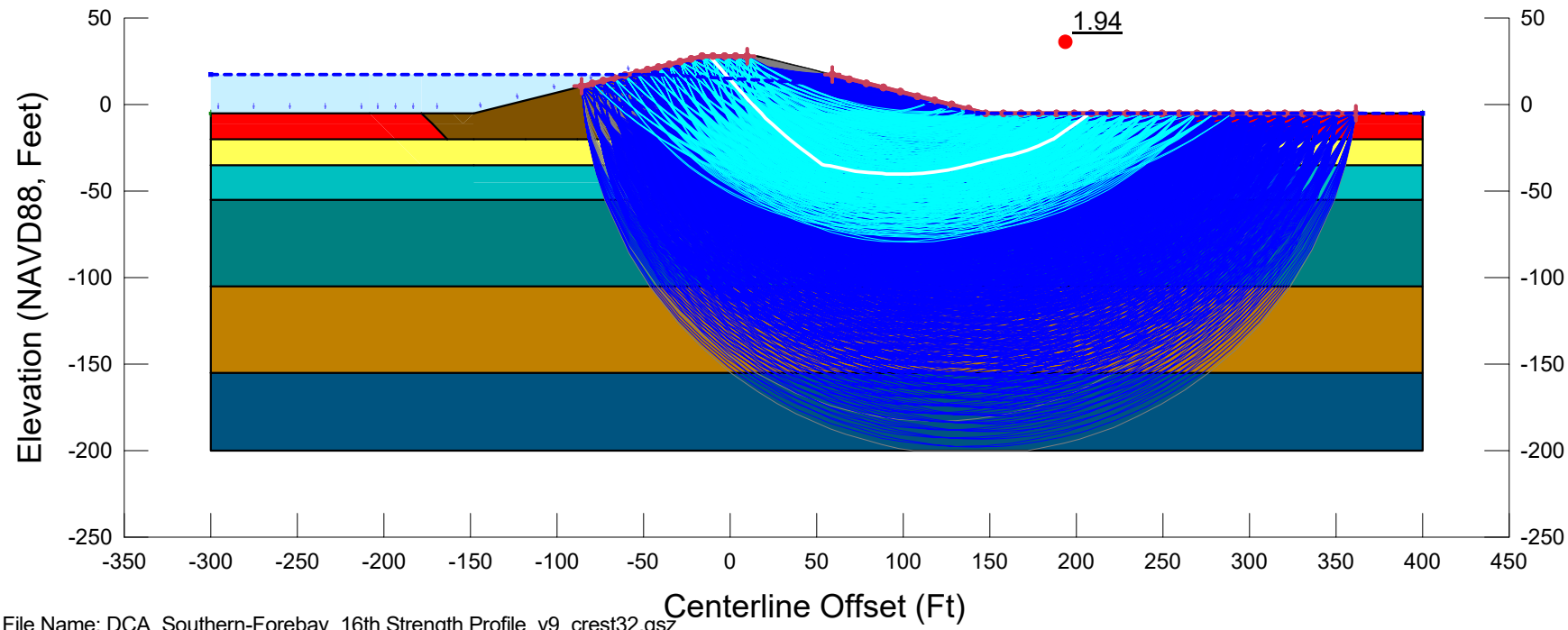
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

4H1V_P2_E_A3-PSS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_16th	phi'_P2_16th		
	03B_Loose_Coarse_P2	110	c_P2_16th	phi'_P2_16th		
	04_Med. Stiff_Fine_P2	120	c_P2_16th	phi'_P2_16th		
	05_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	06_Dense_Coarse_P2	125	c_P2_16th	phi'_P2_16th		
	07_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	09_Soil Bentonite Wall	100			300	0



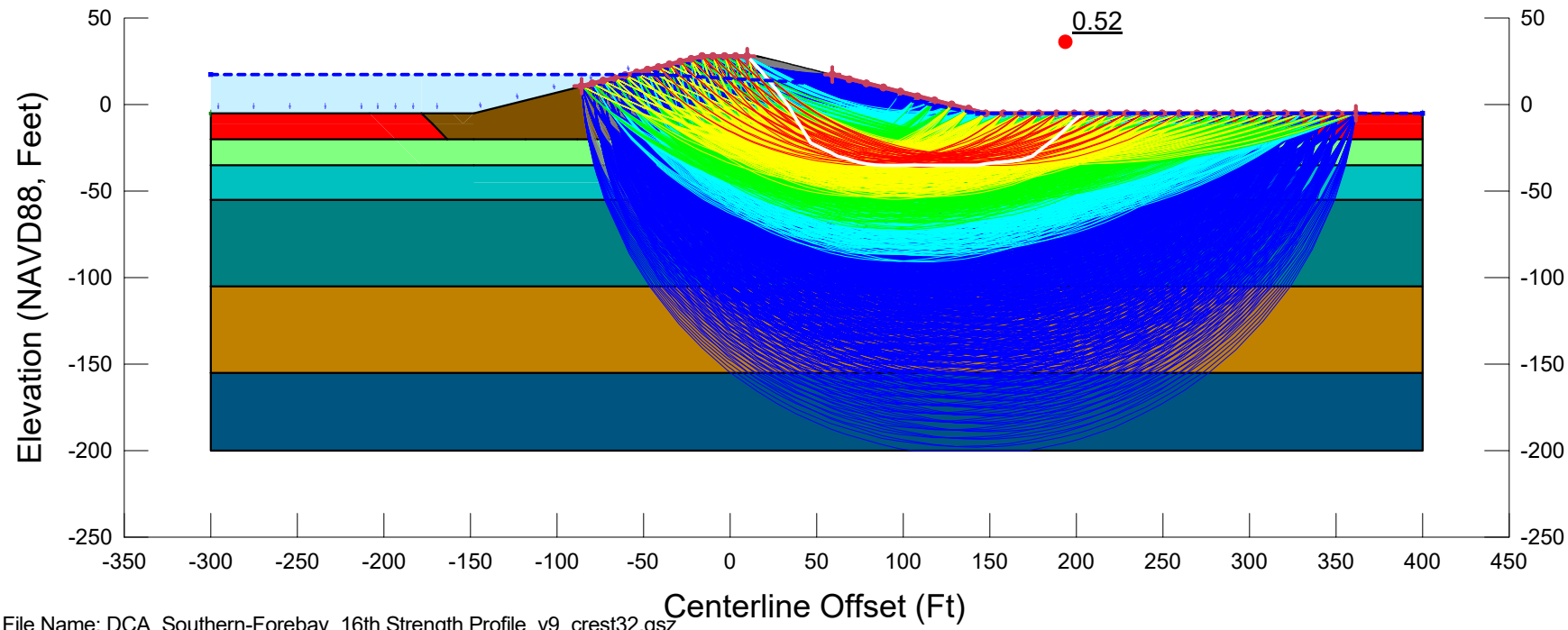
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Constant
Horz Seismic Coef.:

4H1V_P2_G1-RR15_A1-S

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Tau/Sigma Ratio	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120				100	31
	02_Organics_P2.PS	90		c_P2_16th.PS	phi'_P2_16th.PS		
	03B_Loose_Coarse-0.08	110	0.08				
	04_Med. Stiff_Fine_P2.PS	120		c_P2_16th.PS	phi'_P2_16th.PS		
	05_Stiff_Fine_P2.PS	125		c_P2_16th.PS	phi'_P2_16th.PS		
	06_Dense_Coarse_P2.PS	125		c_P2_16th.PS	phi'_P2_16th.PS		
	07_Stiff_Fine_P2.PS	125		c_P2_16th.PS	phi'_P2_16th.PS		
	09_Soil Bentonite Wall	100				300	0



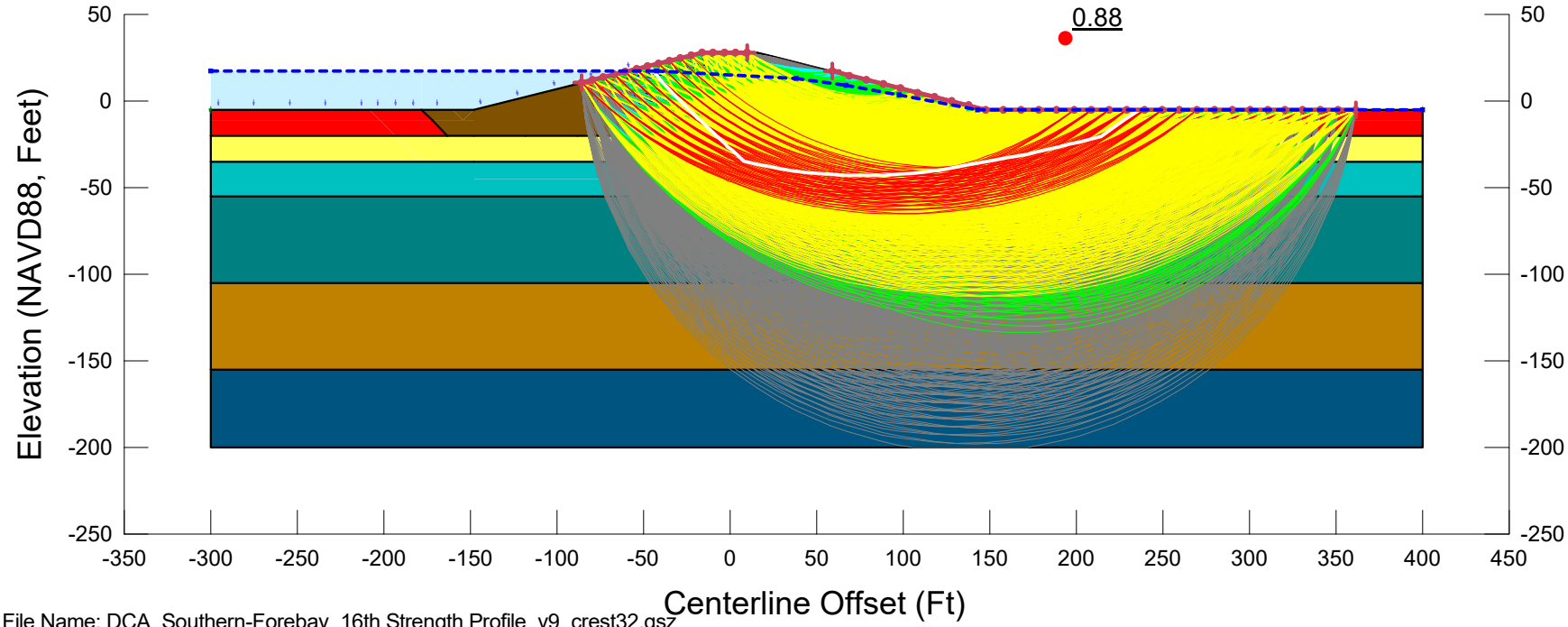
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Constant
Horz Seismic Coef.:

4H1V_P2_G1-RR15_A2-PS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_16th	phi'_P2_16th		
	03B_Loose_Coarse_P2	110	c_P2_16th	phi'_P2_16th		
	04_Med. Stiff_Fine_P2	120	c_P2_16th	phi'_P2_16th		
	05_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	06_Dense_Coarse_P2	125	c_P2_16th	phi'_P2_16th		
	07_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	09_Soil Bentonite Wall	100			300	0



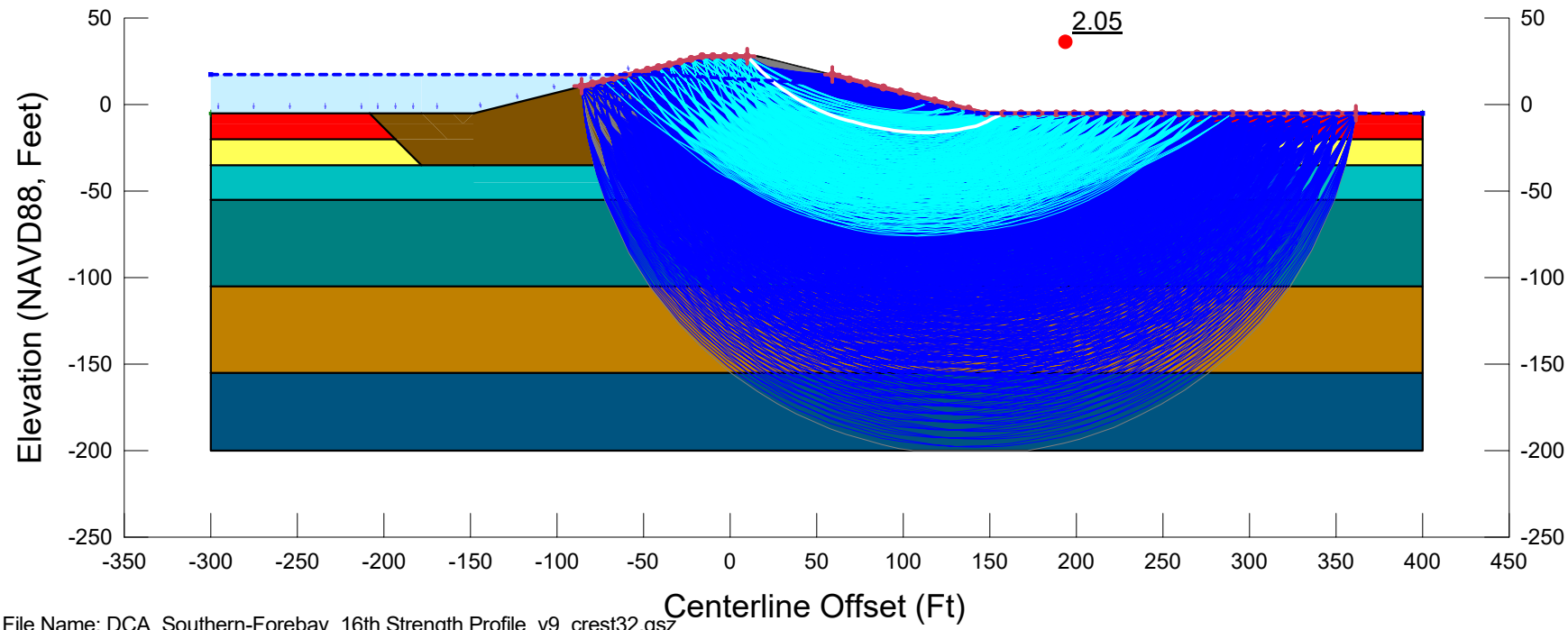
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

4H1V_P2_G1-RR15_A3-PSS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_16th	phi'_P2_16th		
	03B_Loose_Coarse_P2	110	c_P2_16th	phi'_P2_16th		
	04_Med. Stiff_Fine_P2	120	c_P2_16th	phi'_P2_16th		
	05_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	06_Dense_Coarse_P2	125	c_P2_16th	phi'_P2_16th		
	07_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	09_Soil Bentonite Wall	100			300	0



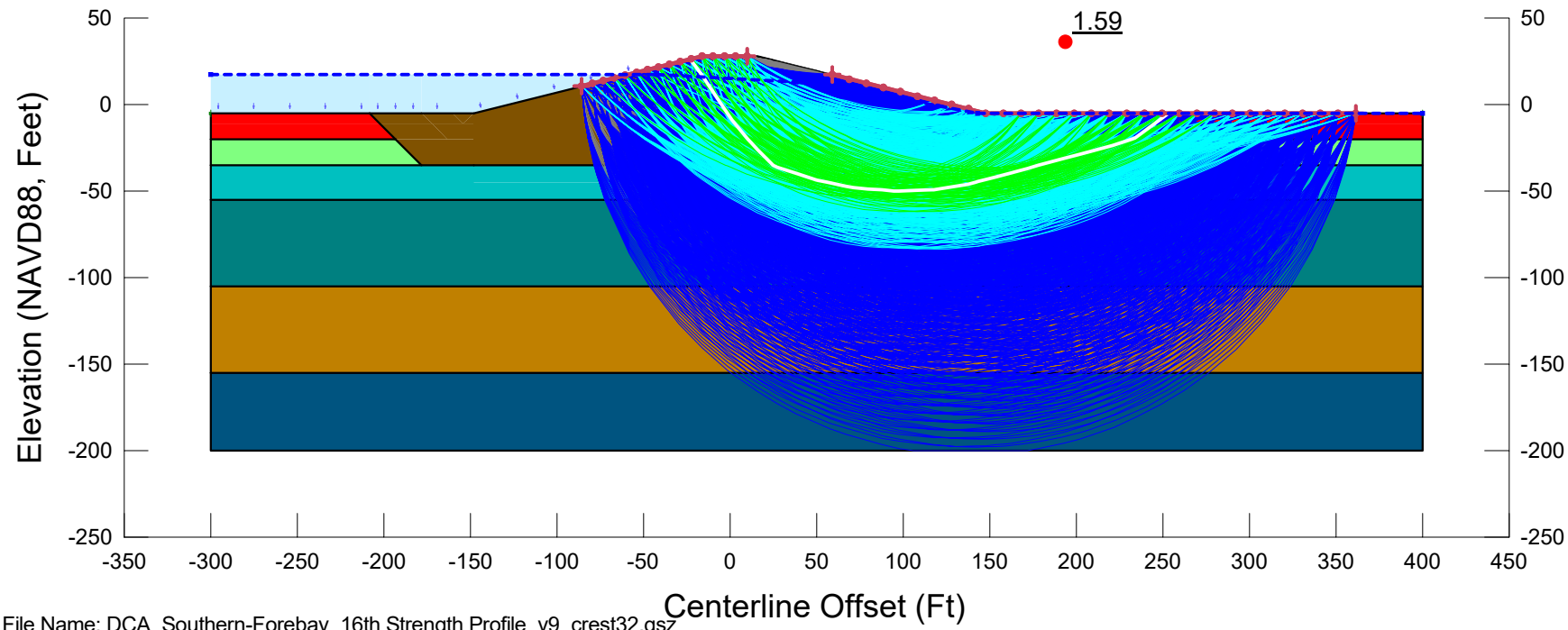
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Constant
Horz Seismic Coef.:

4H1V_P2_G1-RR30_A1-S

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Tau/Sigma Ratio	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120				100	31
	02_Organics_P2.PS	90		c_P2_16th.PS	phi'_P2_16th.PS		
	03B_Loose_Coarse-0.08	110	0.08				
	04_Med. Stiff_Fine_P2.PS	120		c_P2_16th.PS	phi'_P2_16th.PS		
	05_Stiff_Fine_P2.PS	125		c_P2_16th.PS	phi'_P2_16th.PS		
	06_Dense_Coarse_P2.PS	125		c_P2_16th.PS	phi'_P2_16th.PS		
	07_Stiff_Fine_P2.PS	125		c_P2_16th.PS	phi'_P2_16th.PS		
	09_Soil Bentonite Wall	100				300	0



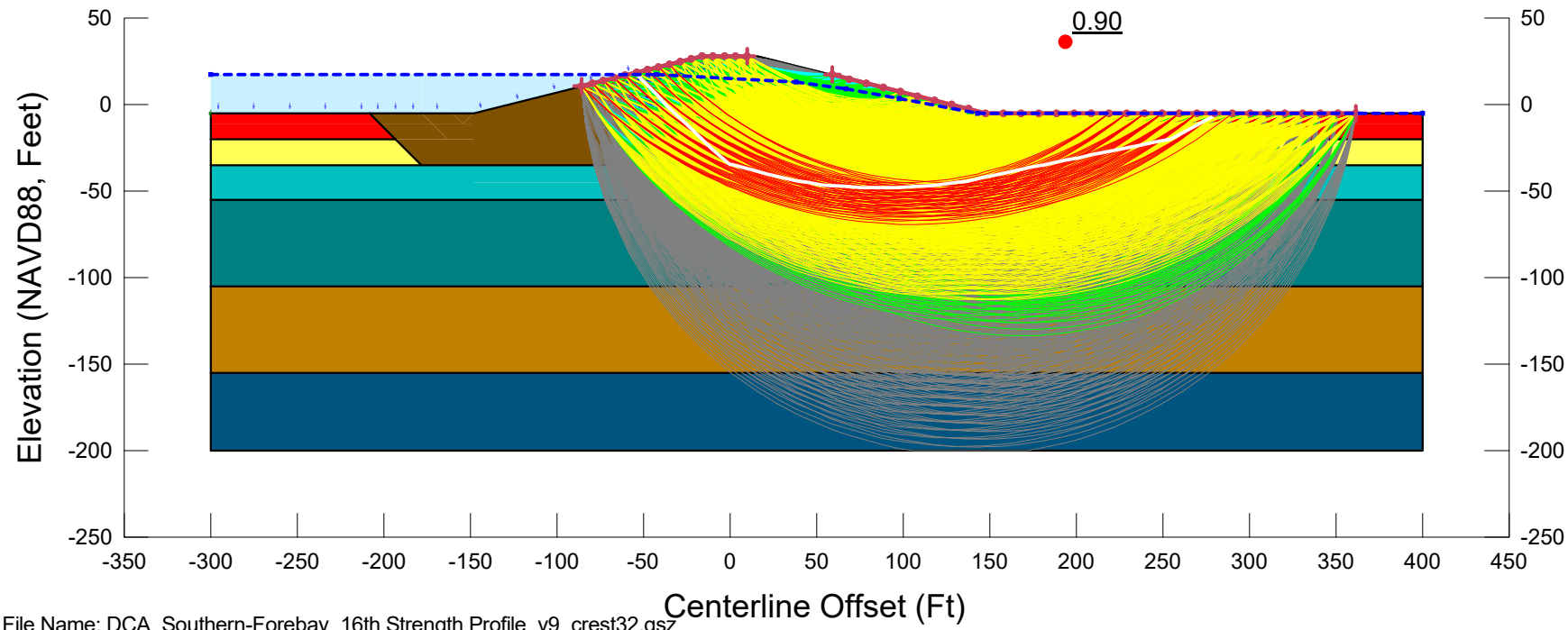
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Constant
Horz Seismic Coef.:

4H1V_P2_G1-RR30_A2-PS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_16th	phi'_P2_16th		
	03B_Loose_Coarse_P2	110	c_P2_16th	phi'_P2_16th		
	04_Med. Stiff_Fine_P2	120	c_P2_16th	phi'_P2_16th		
	05_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	06_Dense_Coarse_P2	125	c_P2_16th	phi'_P2_16th		
	07_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	09_Soil Bentonite Wall	100			300	0



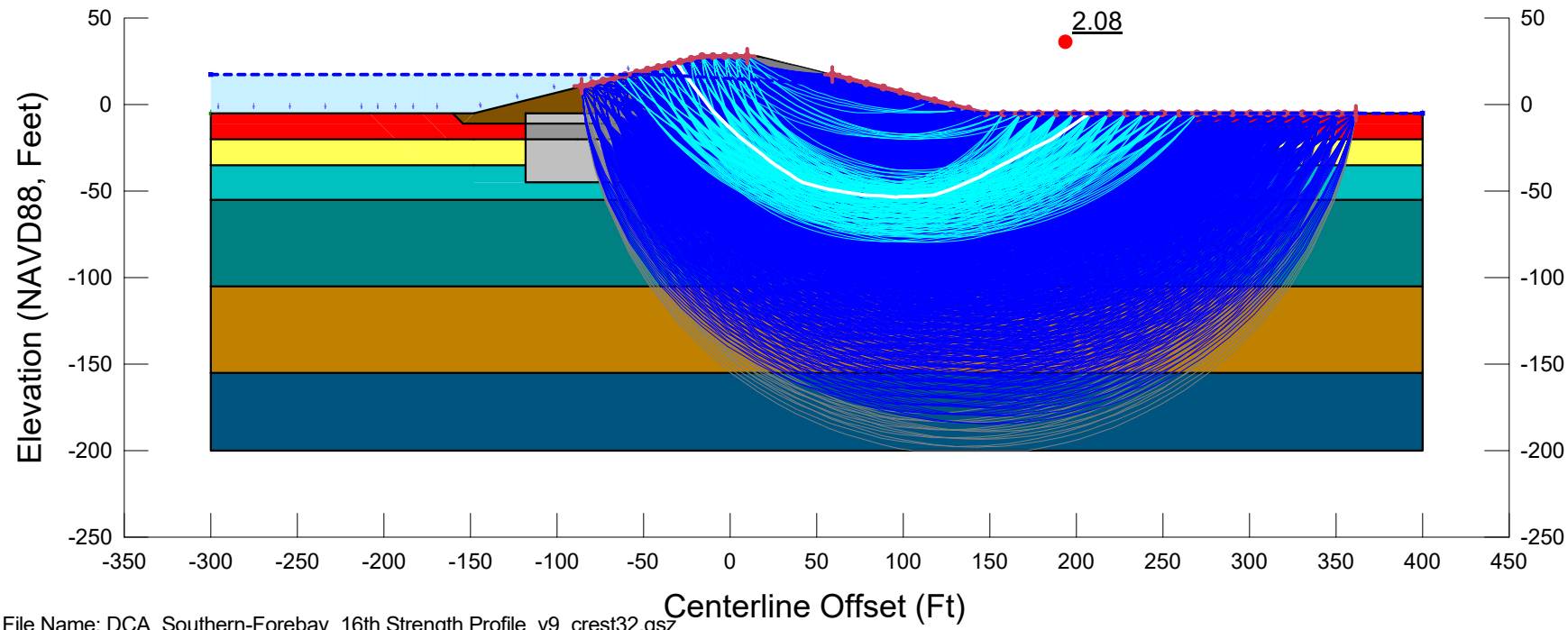
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

4H1V_P2_G1-RR30_A3-PSS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_16th	phi'_P2_16th		
	03B_Loose_Coarse_P2	110	c_P2_16th	phi'_P2_16th		
	04_Med. Stiff_Fine_P2	120	c_P2_16th	phi'_P2_16th		
	05_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	06_Dense_Coarse_P2	125	c_P2_16th	phi'_P2_16th		
	07_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	08_Soil Cement AR=0.15	125			2,400	0
	08_Soil Cement Organics AR=0.15	125			1,425	0
	09_Soil Bentonite Wall	100			300	0



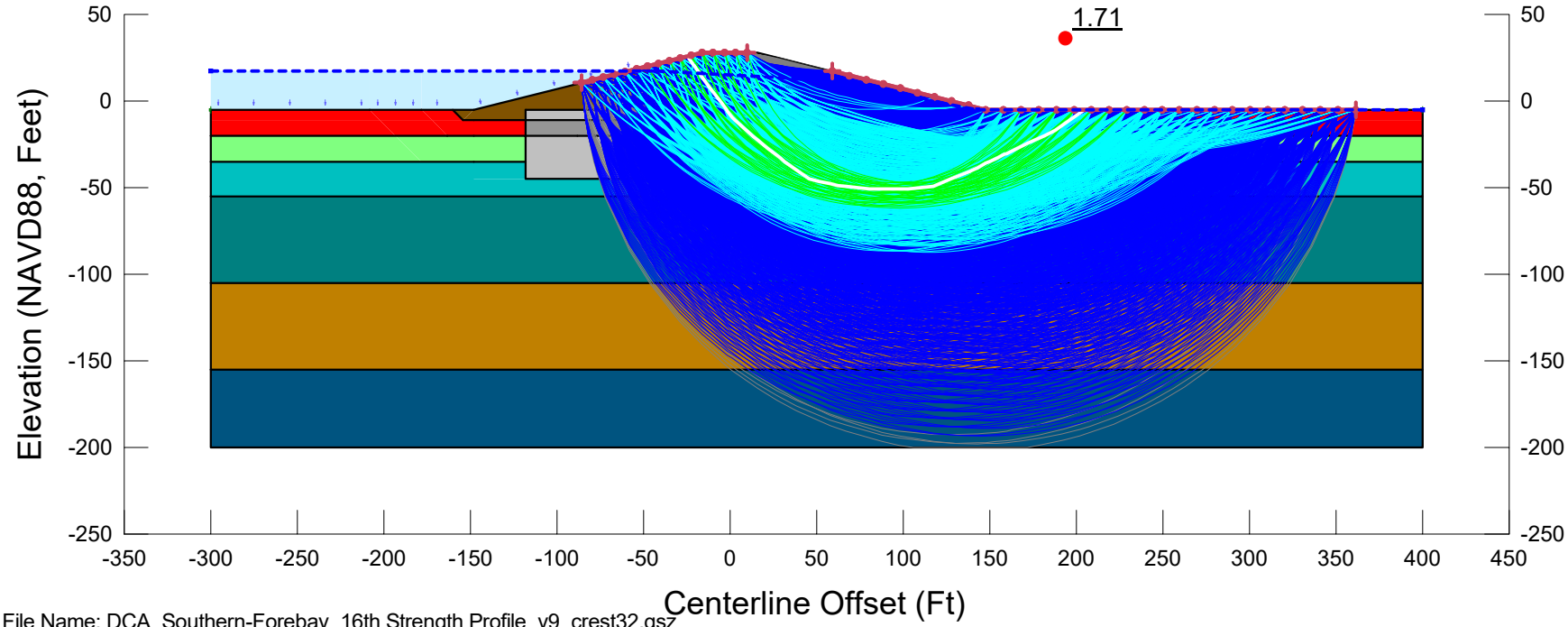
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.:

4H1V_P2_G2-AR15_A1-S

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Tau/Sigma Ratio	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120				100	31
	02_Organics_P2.PS	90		c_P2_16th.PS	phi'_P2_16th.PS		
	03B_Loose_Coarse-0.08	110	0.08				
	04_Med. Stiff_Fine_P2.PS	120		c_P2_16th.PS	phi'_P2_16th.PS		
	05_Stiff_Fine_P2.PS	125		c_P2_16th.PS	phi'_P2_16th.PS		
	06_Dense_Coarse_P2.PS	125		c_P2_16th.PS	phi'_P2_16th.PS		
	07_Stiff_Fine_P2.PS	125		c_P2_16th.PS	phi'_P2_16th.PS		
	08_Soil Cement AR=0.15	125				2,400	0
	08_Soil Cement Organics AR=0.15	125				1,425	0
	09_Soil Bentonite Wall	100				300	0



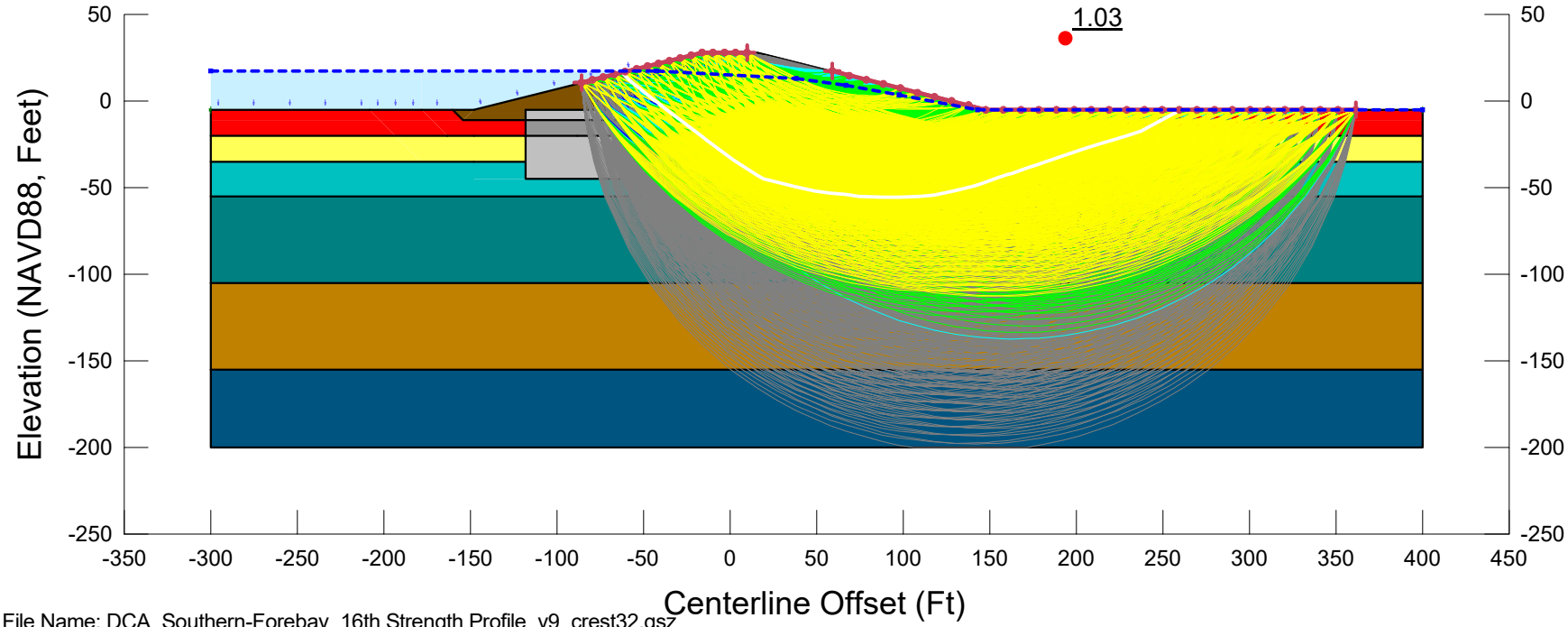
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.:

4H1V_P2_G2-AR15_A2-PS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_16th	phi'_P2_16th		
	03B_Loose_Coarse_P2	110	c_P2_16th	phi'_P2_16th		
	04_Med. Stiff_Fine_P2	120	c_P2_16th	phi'_P2_16th		
	05_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	06_Dense_Coarse_P2	125	c_P2_16th	phi'_P2_16th		
	07_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	08_Soil Cement AR=0.15	125			2,400	0
	08_Soil Cement Organics AR=0.15	125			1,425	0
	09_Soil Bentonite Wall	100			300	0



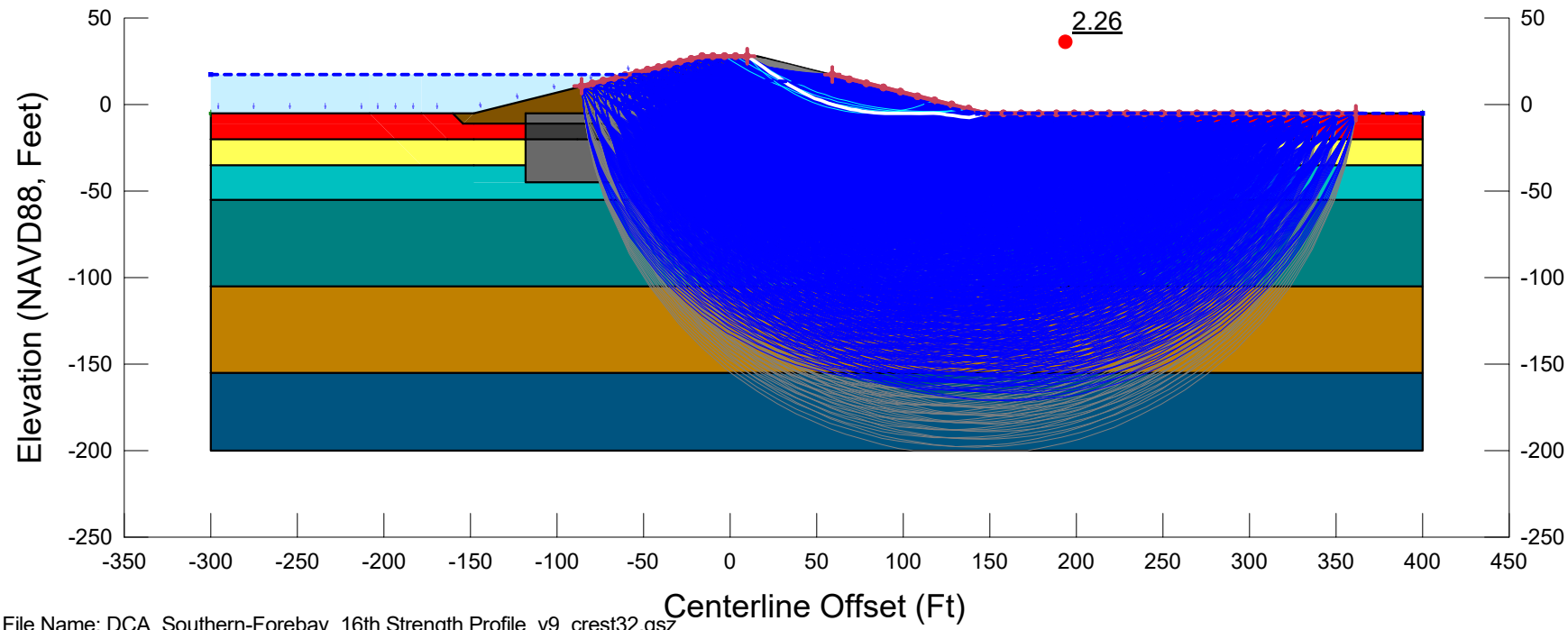
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

4H1V_P2_G2-AR15_A3-PSS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_16th	phi'_P2_16th		
	03B_Loose_Coarse_P2	110	c_P2_16th	phi'_P2_16th		
	04_Med. Stiff_Fine_P2	120	c_P2_16th	phi'_P2_16th		
	05_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	06_Dense_Coarse_P2	125	c_P2_16th	phi'_P2_16th		
	07_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	08_Soil Cement AR=0.25	125			4,000	0
	08_Soil Cement Organics AR=0.25	125			2,225	0
	09_Soil Bentonite Wall	100			300	0



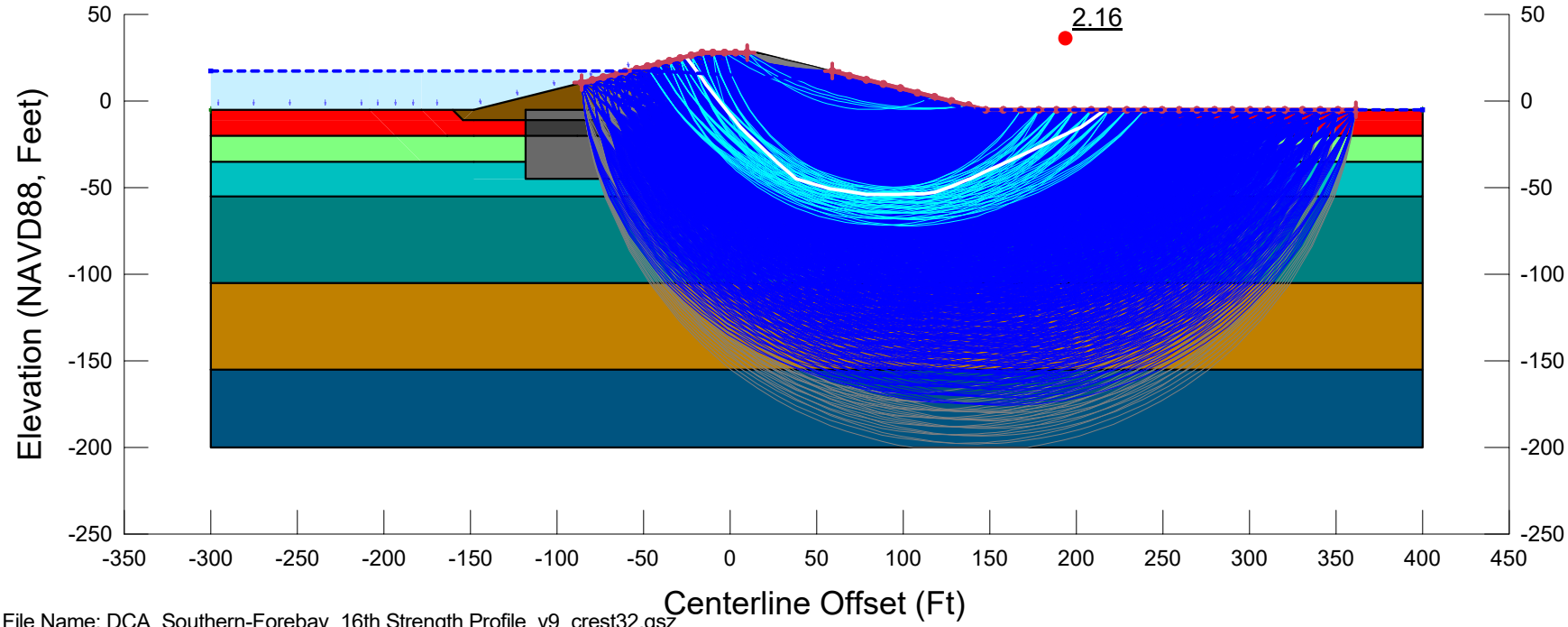
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.:

4H1V_P2_G2-AR25_A1-S

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Tau/Sigma Ratio	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120				100	31
	02_Organics_P2.PS	90		c_P2_16th.PS	phi'_P2_16th.PS		
	03B_Loose_Coarse-0.08	110	0.08				
	04_Med. Stiff_Fine_P2.PS	120		c_P2_16th.PS	phi'_P2_16th.PS		
	05_Stiff_Fine_P2.PS	125		c_P2_16th.PS	phi'_P2_16th.PS		
	06_Dense_Coarse_P2.PS	125		c_P2_16th.PS	phi'_P2_16th.PS		
	07_Stiff_Fine_P2.PS	125		c_P2_16th.PS	phi'_P2_16th.PS		
	08_Soil Cement AR=0.25	125				4,000	0
	08_Soil Cement Organics AR=0.25	125				2,225	0
	09_Soil Bentonite Wall	100				300	0



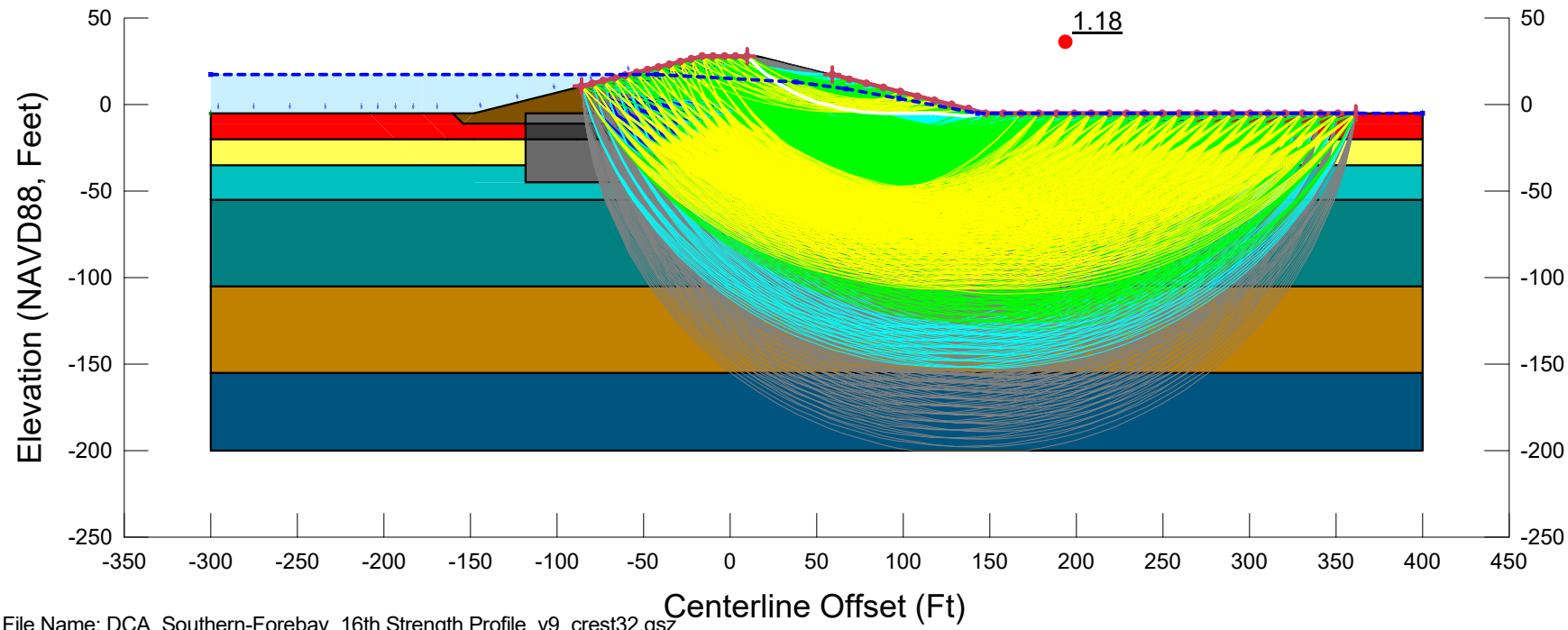
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.:

4H1V_P2_G2-AR25_A2-PS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_16th	phi'_P2_16th		
	03B_Loose_Coarse_P2	110	c_P2_16th	phi'_P2_16th		
	04_Med. Stiff_Fine_P2	120	c_P2_16th	phi'_P2_16th		
	05_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	06_Dense_Coarse_P2	125	c_P2_16th	phi'_P2_16th		
	07_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	08_Soil Cement AR=0.25	125			4,000	0
	08_Soil Cement Organics AR=0.25	125			2,225	0
	09_Soil Bentonite Wall	100			300	0



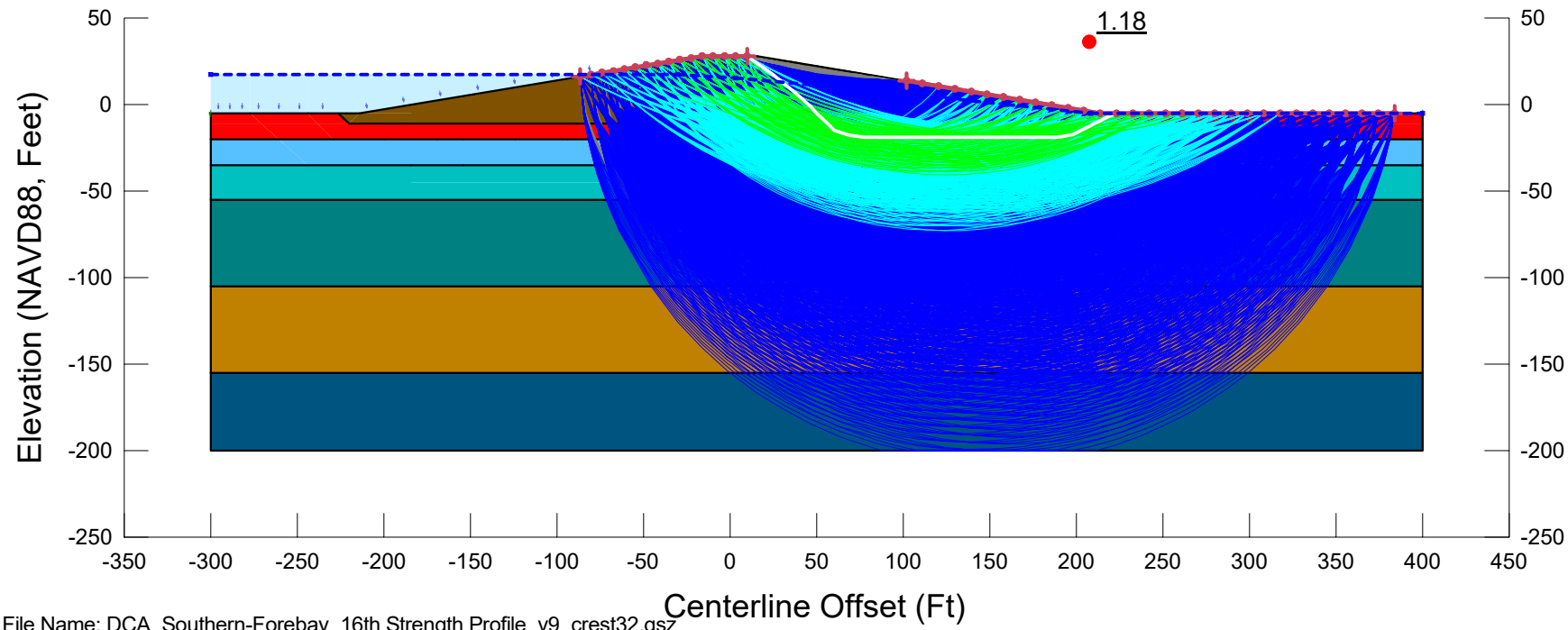
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

4H1V_P2_G2-AR25_A3-PSS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_16th	phi'_P1_16th		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_16th	phi'_P1_16th		
	04_Med. Stiff_Fine_P1	120	c_P1_16th	phi'_P1_16th		
	05_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	06_Dense_Coarse_P1	125	c_P1_16th	phi'_P1_16th		
	07_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		



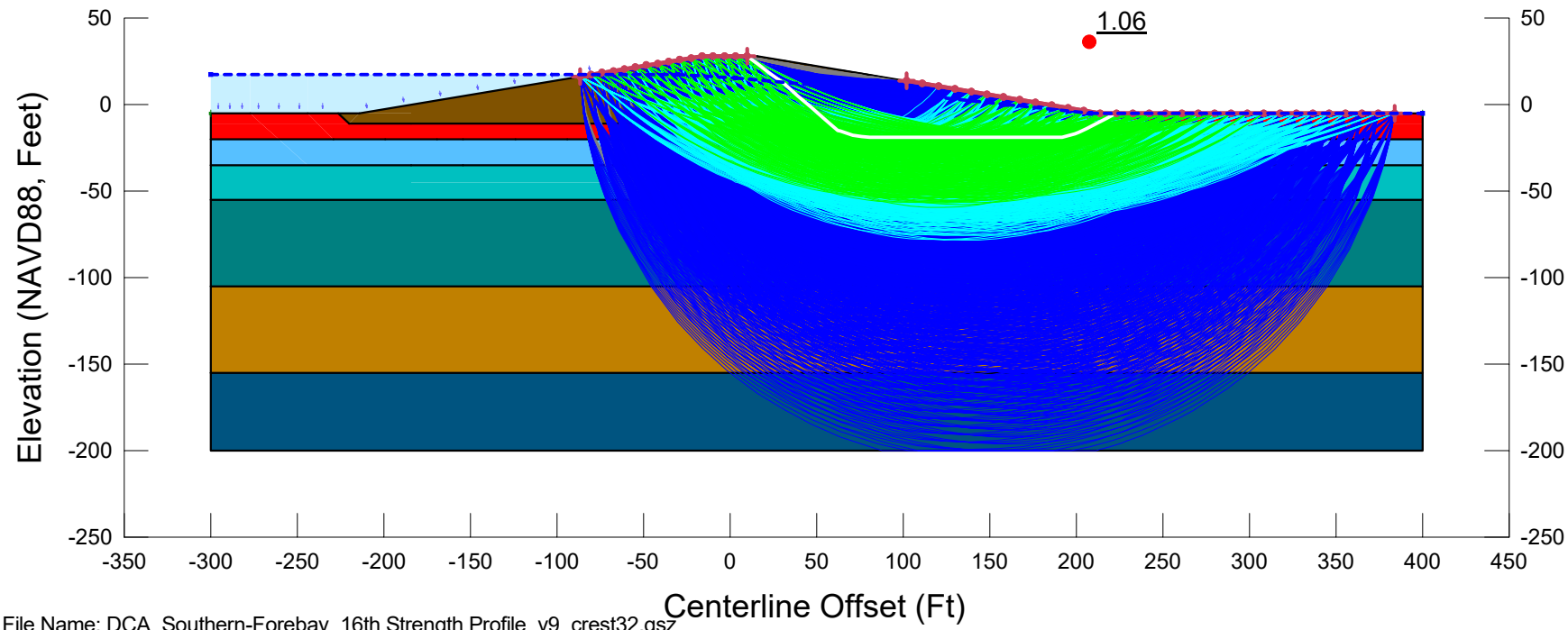
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Constant
Horz Seismic Coef.:

6H1V_P1_E_A1-S

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1.PS	90	c_P1_16th.PS	phi'_P1_16th.PS		
	03A_Soft-Med. Stiff_Fine_P1.PS	110	c_P1_16th.PS	phi'_P1_16th.PS		
	04_Med. Stiff_Fine_P1.PS	120	c_P1_16th.PS	phi'_P1_16th.PS		
	05_Stiff_Fine_P1.PS	125	c_P1_16th.PS	phi'_P1_16th.PS		
	06_Dense_Coarse_P1.PS	125	c_P1_16th.PS	phi'_P1_16th.PS		
	07_Stiff_Fine_P1.PS	125	c_P1_16th.PS	phi'_P1_16th.PS		



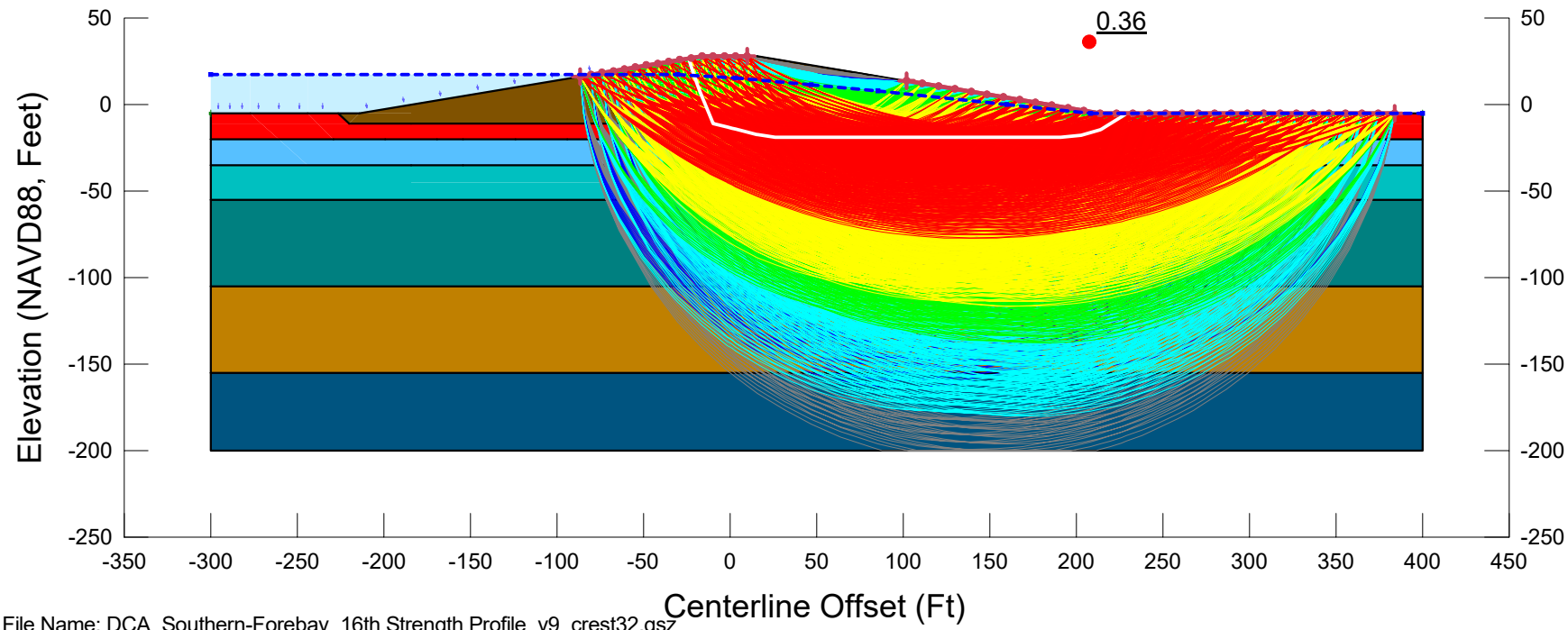
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Constant
Horz Seismic Coef.:

6H1V_P1_E_A2-PS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_16th	phi'_P1_16th		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_16th	phi'_P1_16th		
	04_Med. Stiff_Fine_P1	120	c_P1_16th	phi'_P1_16th		
	05_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	06_Dense_Coarse_P1	125	c_P1_16th	phi'_P1_16th		
	07_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		



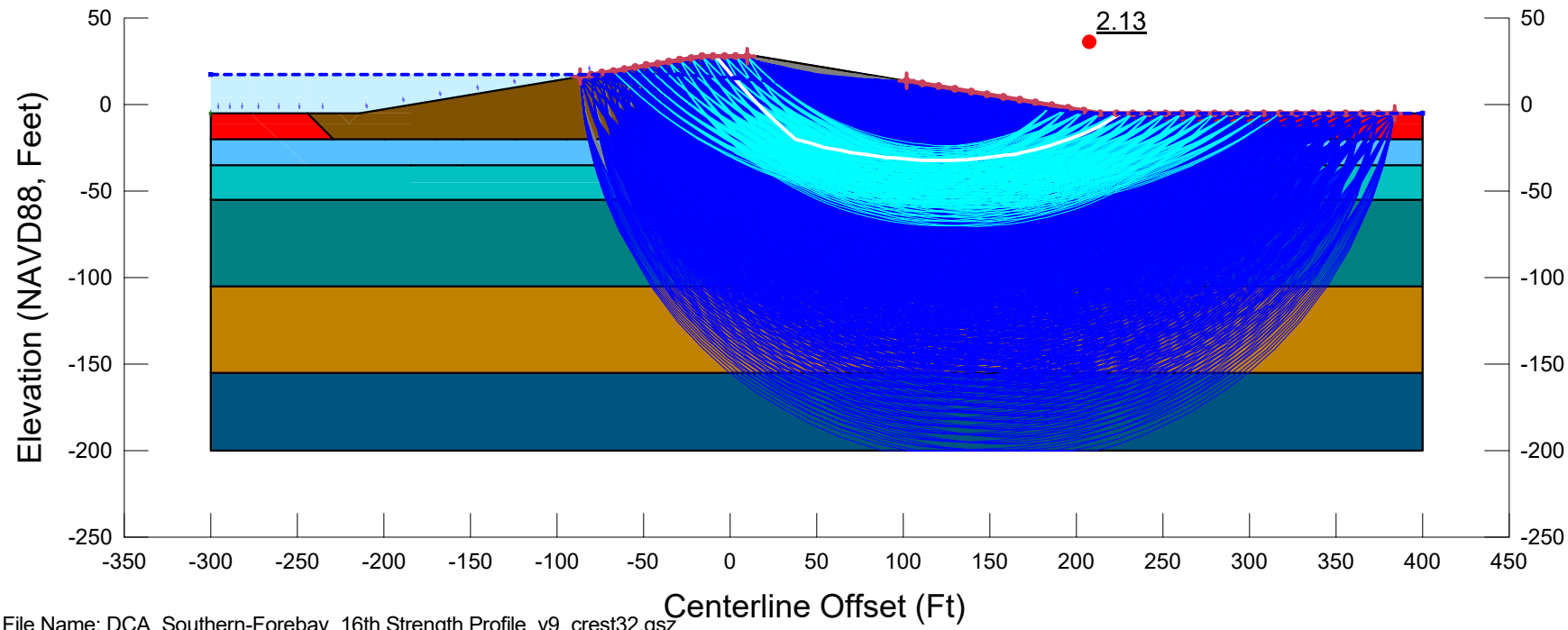
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

6H1V_P1_E_A3-PSS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_16th	phi'_P1_16th		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_16th	phi'_P1_16th		
	04_Med. Stiff_Fine_P1	120	c_P1_16th	phi'_P1_16th		
	05_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	06_Dense_Coarse_P1	125	c_P1_16th	phi'_P1_16th		
	07_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	09_Soil Bentonite Wall	100			300	0



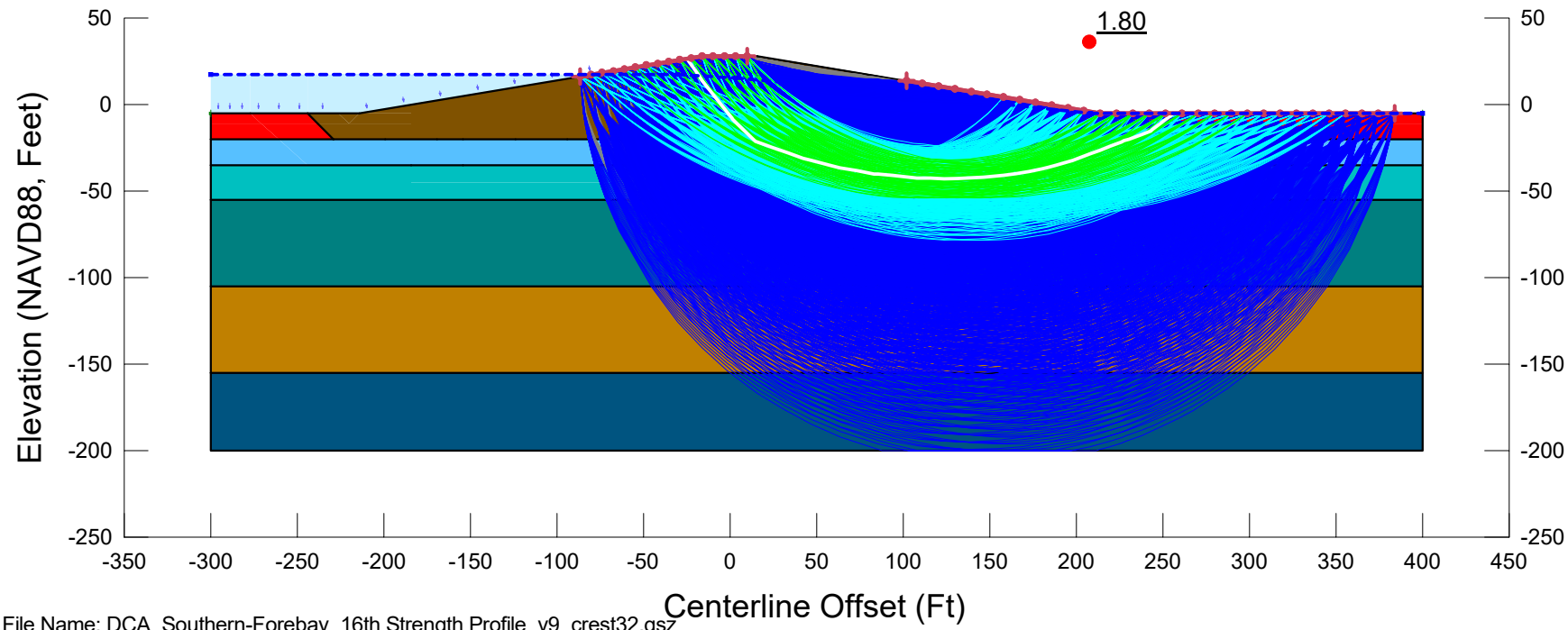
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Constant
Horz Seismic Coef.:

6H1V_P1_G1-RR15_A1-S

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1.PS	90	c_P1_16th.PS	phi'_P1_16th.PS		
	03A_Soft-Med. Stiff_Fine_P1.PS	110	c_P1_16th.PS	phi'_P1_16th.PS		
	04_Med. Stiff_Fine_P1.PS	120	c_P1_16th.PS	phi'_P1_16th.PS		
	05_Stiff_Fine_P1.PS	125	c_P1_16th.PS	phi'_P1_16th.PS		
	06_Dense_Coarse_P1.PS	125	c_P1_16th.PS	phi'_P1_16th.PS		
	07_Stiff_Fine_P1.PS	125	c_P1_16th.PS	phi'_P1_16th.PS		
	09_Soil Bentonite Wall	100			300	0



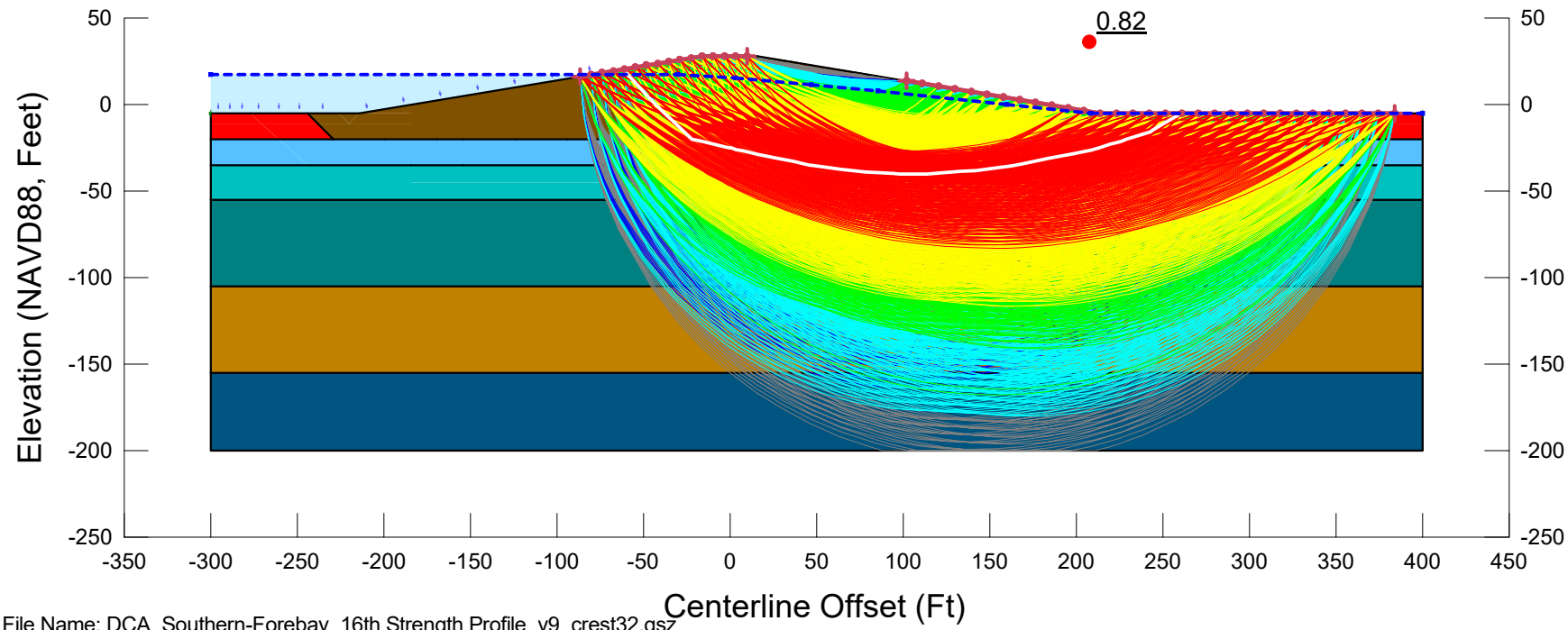
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Constant
Horz Seismic Coef.:

6H1V_P1_G1-RR15_A2-PS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_16th	phi'_P1_16th		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_16th	phi'_P1_16th		
	04_Med. Stiff_Fine_P1	120	c_P1_16th	phi'_P1_16th		
	05_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	06_Dense_Coarse_P1	125	c_P1_16th	phi'_P1_16th		
	07_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	09_Soil Bentonite Wall	100			300	0



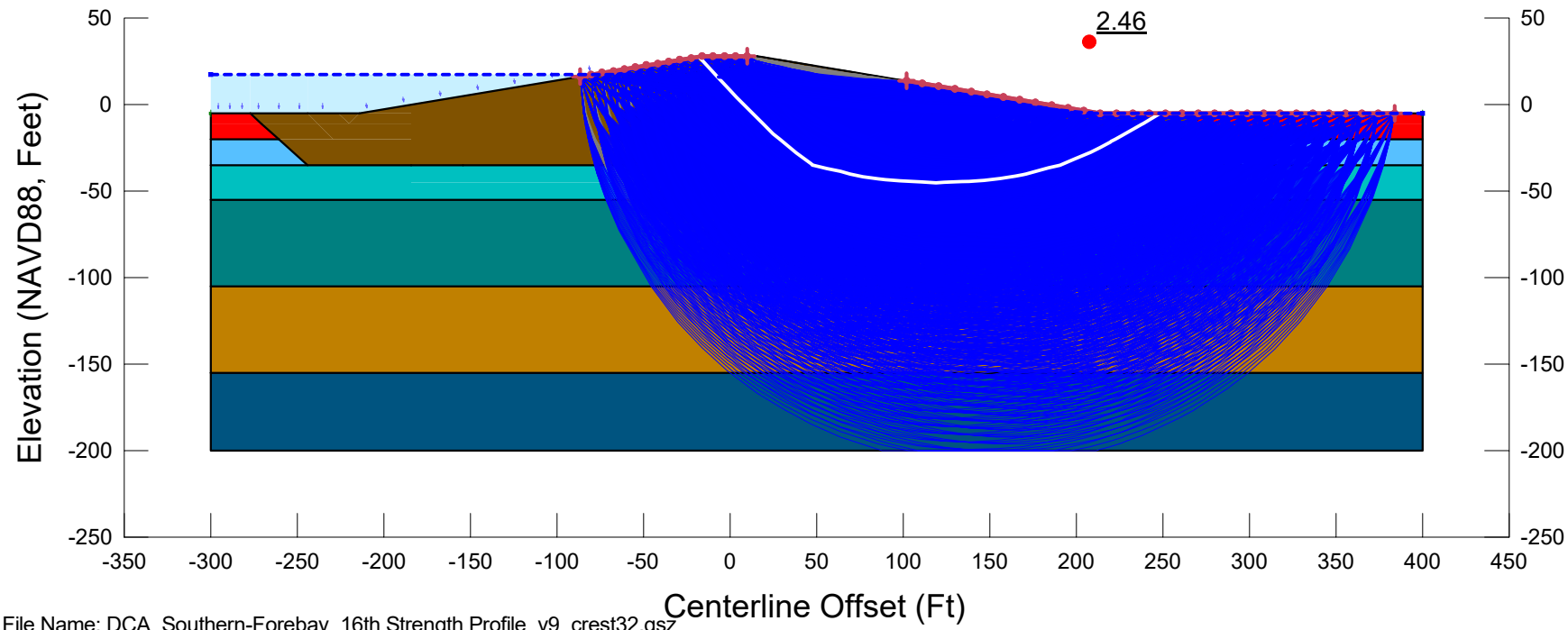
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

6H1V_P1_G1-RR15_A3-PSS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_16th	phi'_P1_16th		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_16th	phi'_P1_16th		
	04_Med. Stiff_Fine_P1	120	c_P1_16th	phi'_P1_16th		
	05_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	06_Dense_Coarse_P1	125	c_P1_16th	phi'_P1_16th		
	07_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	09_Soil Bentonite Wall	100			300	0



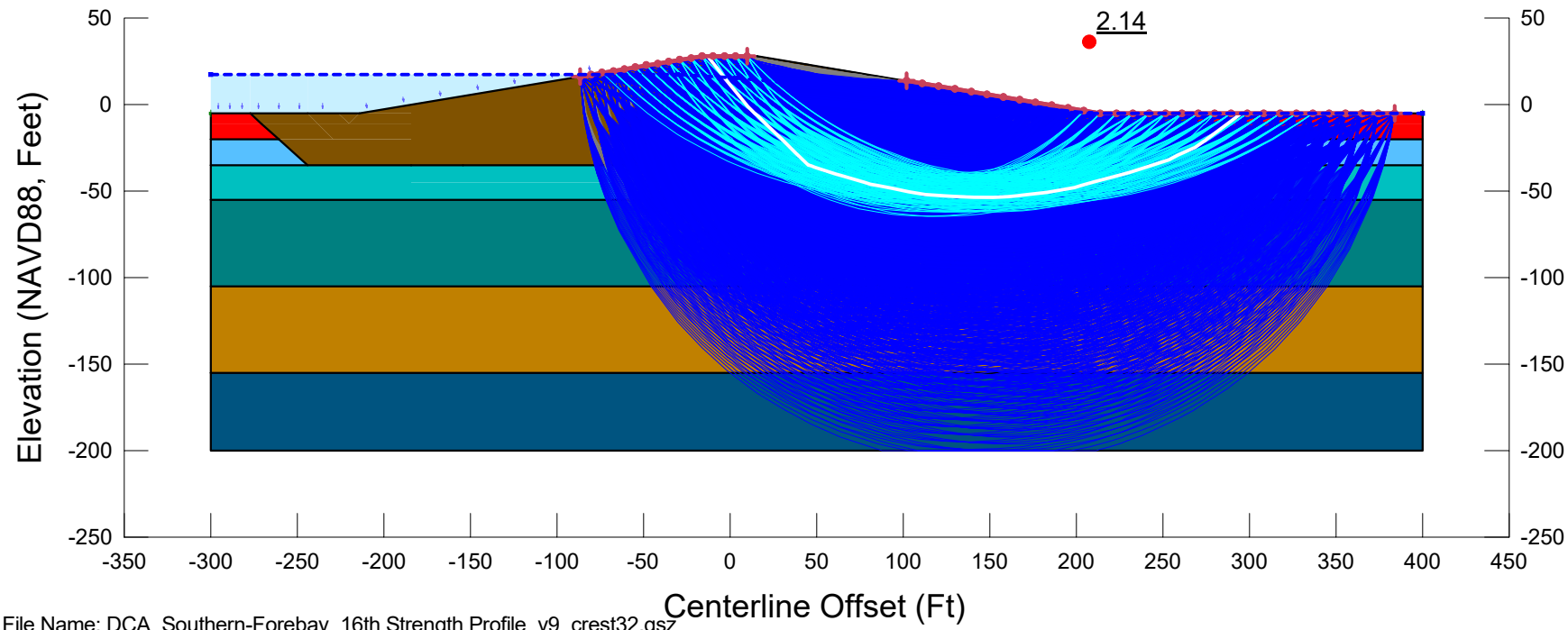
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Constant
Horz Seismic Coef.:

6H1V_P1_G1-RR30_A1-S

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1.PS	90	c_P1_16th.PS	phi'_P1_16th.PS		
	03A_Soft-Med. Stiff_Fine_P1.PS	110	c_P1_16th.PS	phi'_P1_16th.PS		
	04_Med. Stiff_Fine_P1.PS	120	c_P1_16th.PS	phi'_P1_16th.PS		
	05_Stiff_Fine_P1.PS	125	c_P1_16th.PS	phi'_P1_16th.PS		
	06_Dense_Coarse_P1.PS	125	c_P1_16th.PS	phi'_P1_16th.PS		
	07_Stiff_Fine_P1.PS	125	c_P1_16th.PS	phi'_P1_16th.PS		
	09_Soil Bentonite Wall	100			300	0



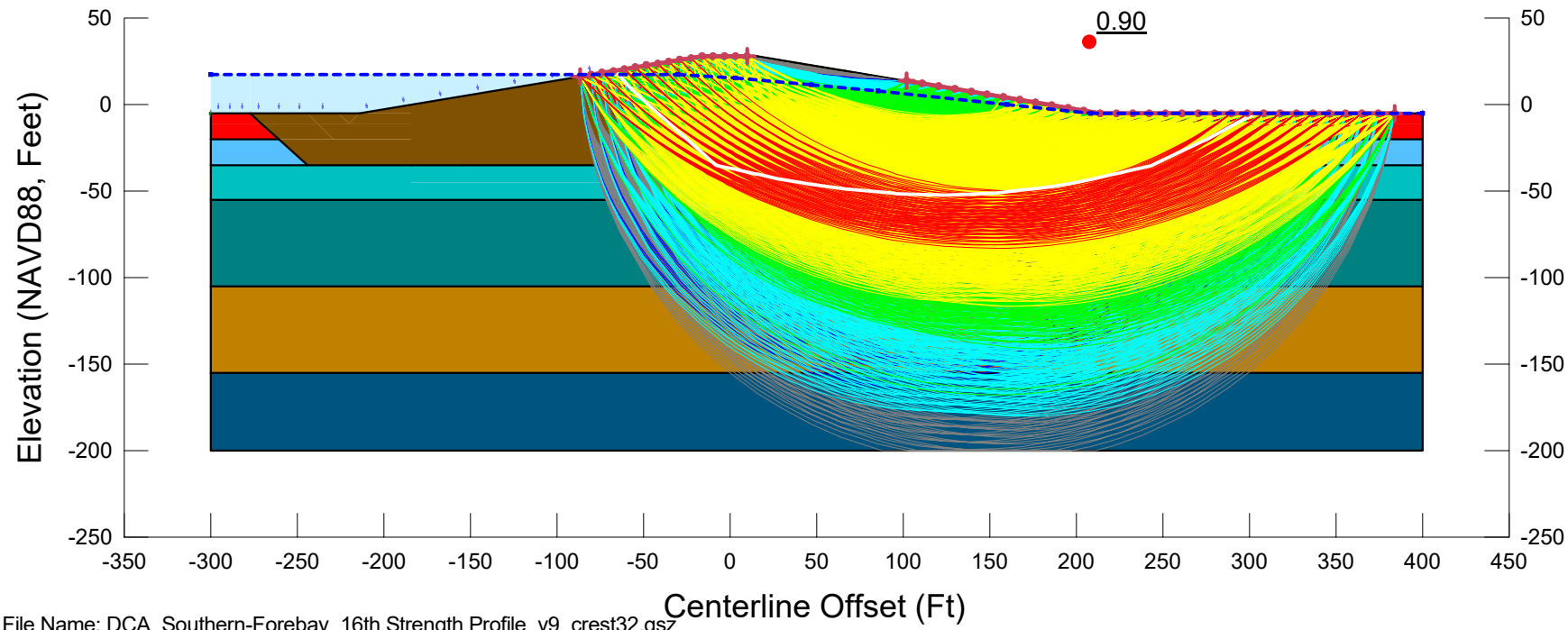
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Constant
Horz Seismic Coef.:

6H1V_P1_G1-RR30_A2-PS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_16th	phi'_P1_16th		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_16th	phi'_P1_16th		
	04_Med. Stiff_Fine_P1	120	c_P1_16th	phi'_P1_16th		
	05_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	06_Dense_Coarse_P1	125	c_P1_16th	phi'_P1_16th		
	07_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	09_Soil Bentonite Wall	100			300	0



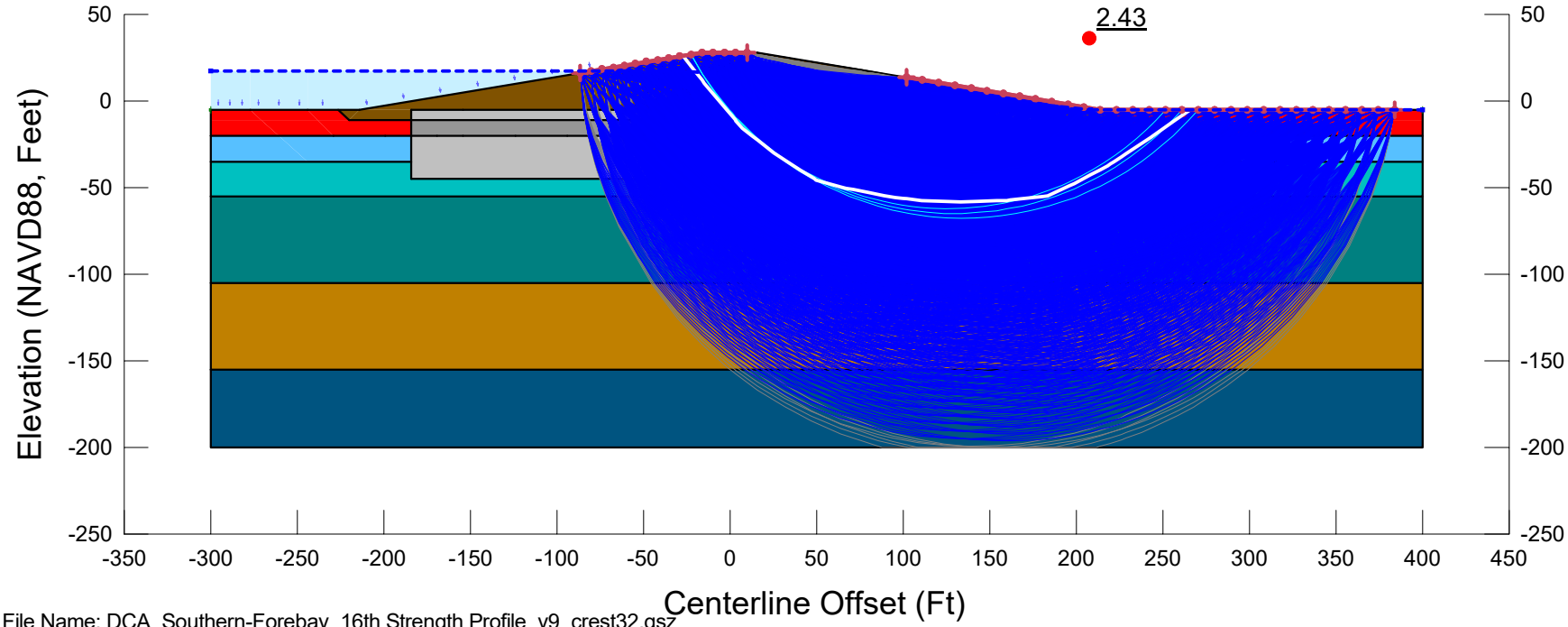
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

6H1V_P1_G1-RR30_A3-PSS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_16th	phi'_P1_16th		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_16th	phi'_P1_16th		
	04_Med. Stiff_Fine_P1	120	c_P1_16th	phi'_P1_16th		
	05_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	06_Dense_Coarse_P1	125	c_P1_16th	phi'_P1_16th		
	07_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	08_Soil Cement AR=0.15	125			2,400	0
	08_Soil Cement Organics AR=0.15	125			1,425	0
	09_Soil Bentonite Wall	100			300	0



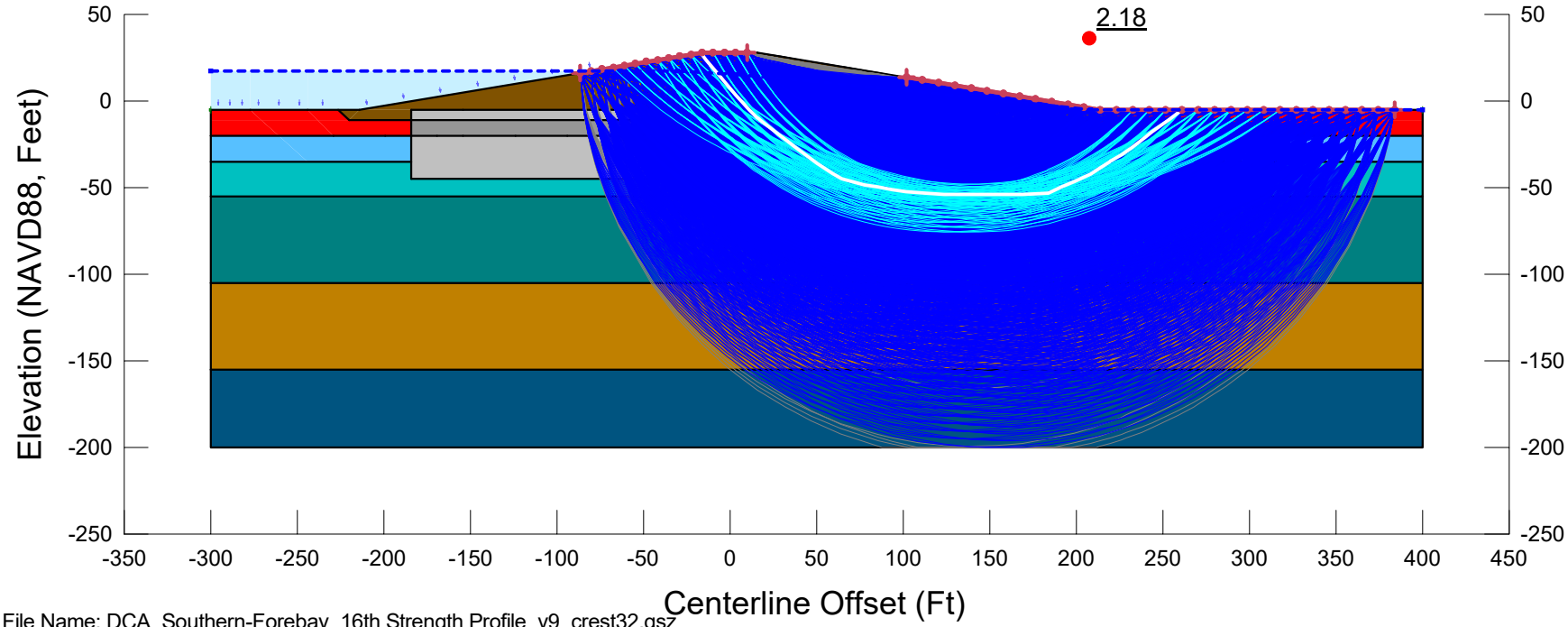
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.:

6H1V_P1_G2-AR15_A1-S

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1.PS	90	c_P1_16th.PS	phi'_P1_16th.PS		
	03A_Soft-Med. Stiff_Fine_P1.PS	110	c_P1_16th.PS	phi'_P1_16th.PS		
	04_Med. Stiff_Fine_P1.PS	120	c_P1_16th.PS	phi'_P1_16th.PS		
	05_Stiff_Fine_P1.PS	125	c_P1_16th.PS	phi'_P1_16th.PS		
	06_Dense_Coarse_P1.PS	125	c_P1_16th.PS	phi'_P1_16th.PS		
	07_Stiff_Fine_P1.PS	125	c_P1_16th.PS	phi'_P1_16th.PS		
	08_Soil Cement AR=0.15	125			2,400	0
	08_Soil Cement Organics AR=0.15	125			1,425	0
	09_Soil Bentonite Wall	100			300	0



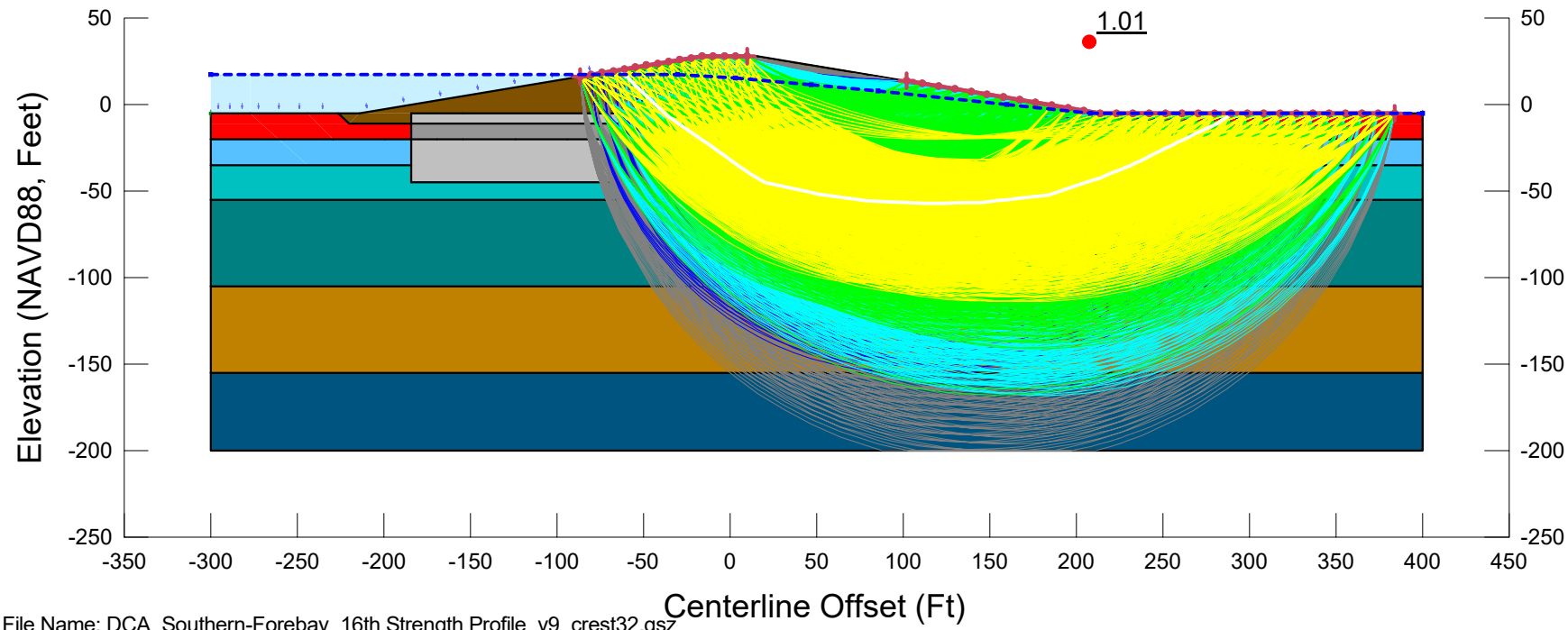
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.:

6H1V_P1_G2-AR15_A2-PS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

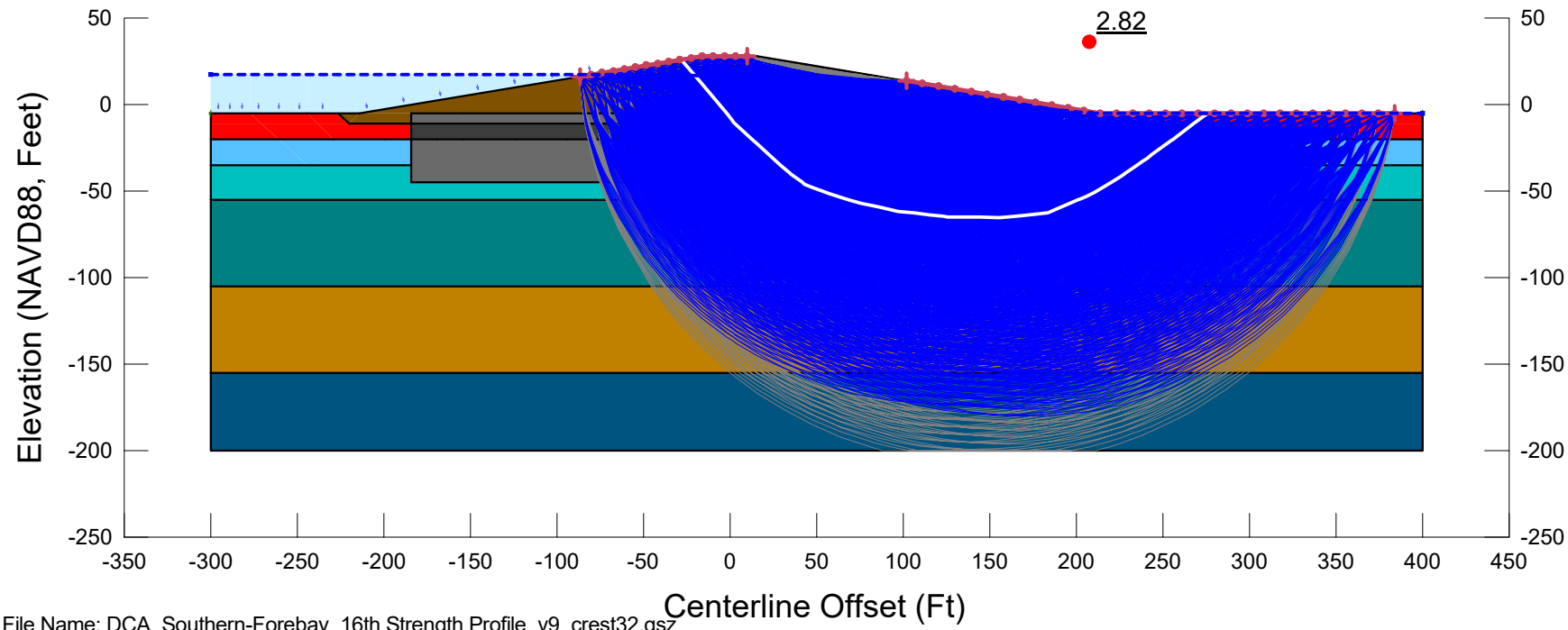
Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_16th	phi'_P1_16th		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_16th	phi'_P1_16th		
	04_Med. Stiff_Fine_P1	120	c_P1_16th	phi'_P1_16th		
	05_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	06_Dense_Coarse_P1	125	c_P1_16th	phi'_P1_16th		
	07_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	08_Soil Cement AR=0.15	125			2,400	0
	08_Soil Cement Organics AR=0.15	125			1,425	0
	09_Soil Bentonite Wall	100			300	0



File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

6H1V_P1_G2-AR15_A3-PSS	
DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz	
02/27/2020	1:1,200

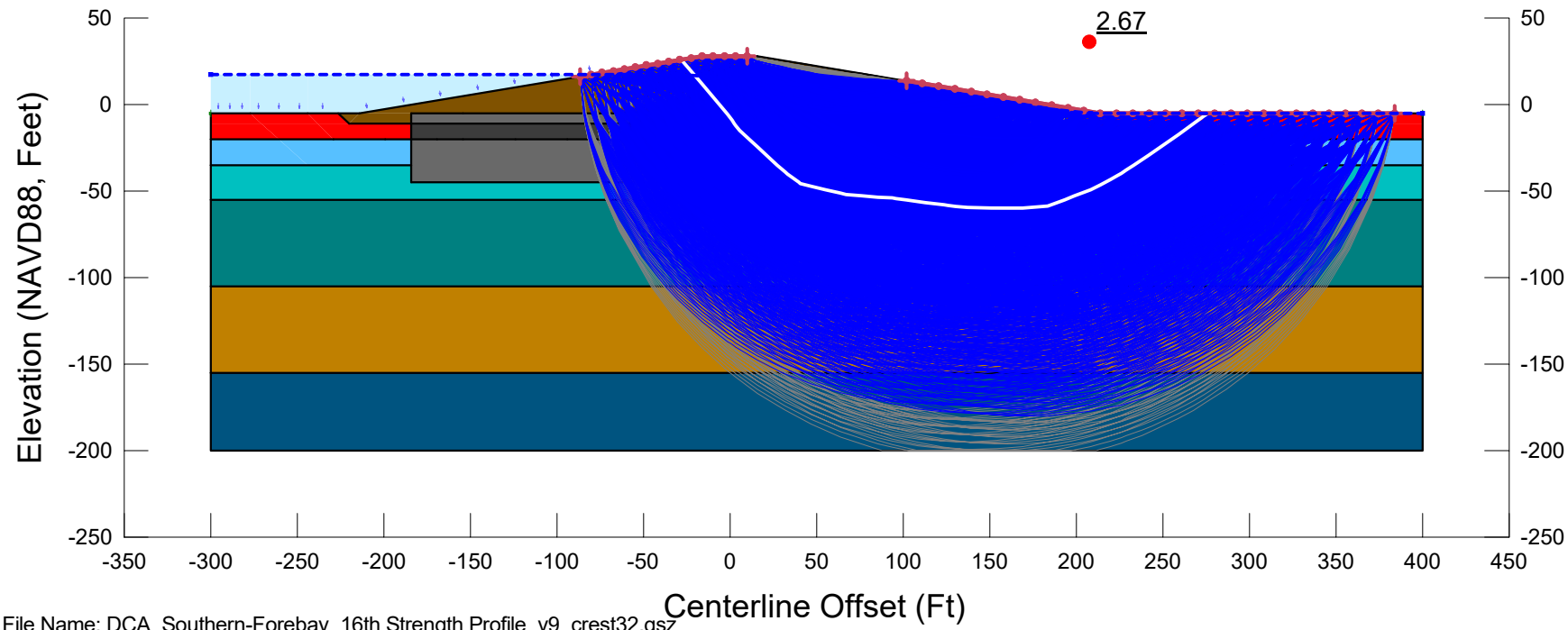
Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_16th	phi'_P1_16th		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_16th	phi'_P1_16th		
	04_Med. Stiff_Fine_P1	120	c_P1_16th	phi'_P1_16th		
	05_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	06_Dense_Coarse_P1	125	c_P1_16th	phi'_P1_16th		
	07_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	08_Soil Cement AR=0.25	125			4,000	0
	08_Soil Cement Organics AR=0.25	125			2,225	0
	09_Soil Bentonite Wall	100			300	0



File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Constant
Horz Seismic Coef.:

6H1V_P1_G2-AR25_A1-S	
DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz	
02/27/2020	1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1.PS	90	c_P1_16th.PS	phi'_P1_16th.PS		
	03A_Soft-Med. Stiff_Fine_P1.PS	110	c_P1_16th.PS	phi'_P1_16th.PS		
	04_Med. Stiff_Fine_P1.PS	120	c_P1_16th.PS	phi'_P1_16th.PS		
	05_Stiff_Fine_P1.PS	125	c_P1_16th.PS	phi'_P1_16th.PS		
	06_Dense_Coarse_P1.PS	125	c_P1_16th.PS	phi'_P1_16th.PS		
	07_Stiff_Fine_P1.PS	125	c_P1_16th.PS	phi'_P1_16th.PS		
	08_Soil Cement AR=0.25	125			4,000	0
	08_Soil Cement Organics AR=0.25	125			2,225	0
	09_Soil Bentonite Wall	100			300	0



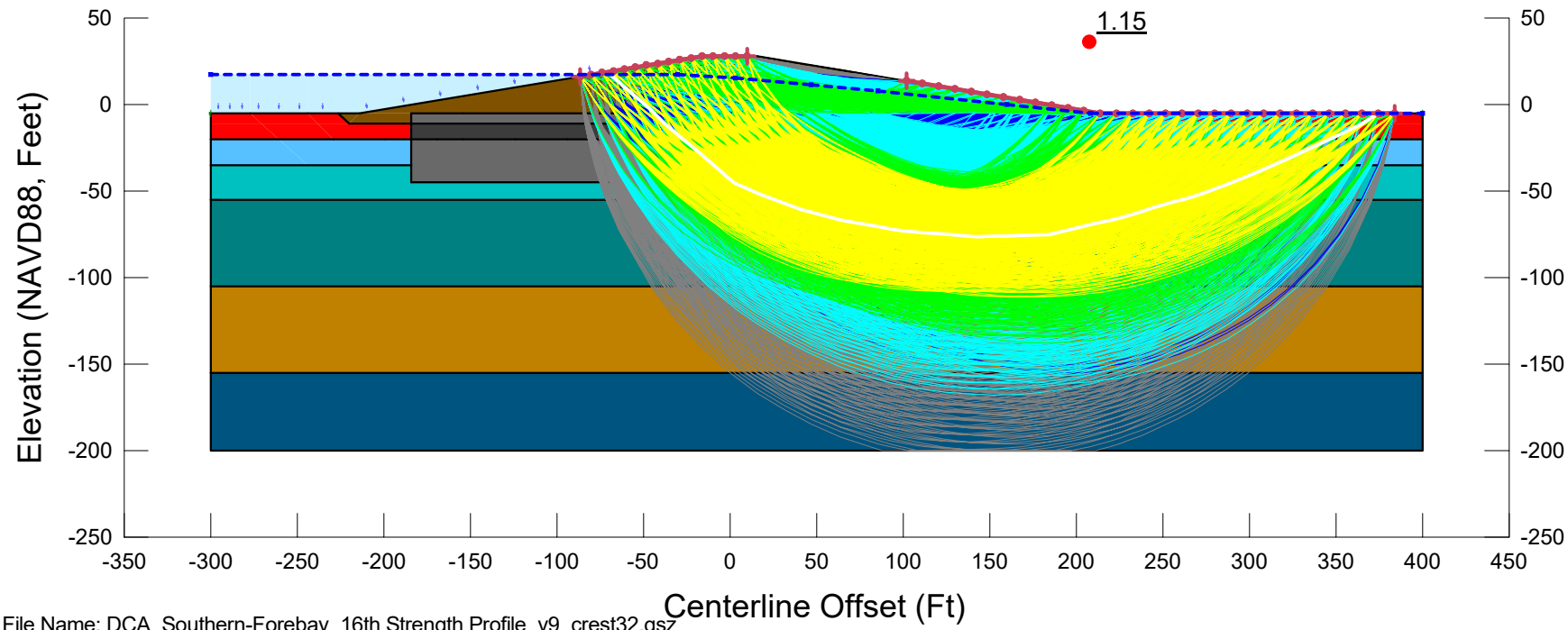
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Constant
Horz Seismic Coef.:

6H1V_P1_G2-AR25_A2-PS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P1	90	c_P1_16th	phi'_P1_16th		
	03A_Soft-Med. Stiff_Fine_P1	110	c_P1_16th	phi'_P1_16th		
	04_Med. Stiff_Fine_P1	120	c_P1_16th	phi'_P1_16th		
	05_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	06_Dense_Coarse_P1	125	c_P1_16th	phi'_P1_16th		
	07_Stiff_Fine_P1	125	c_P1_16th	phi'_P1_16th		
	08_Soil Cement AR=0.25	125			4,000	0
	08_Soil Cement Organics AR=0.25	125			2,225	0
	09_Soil Bentonite Wall	100			300	0



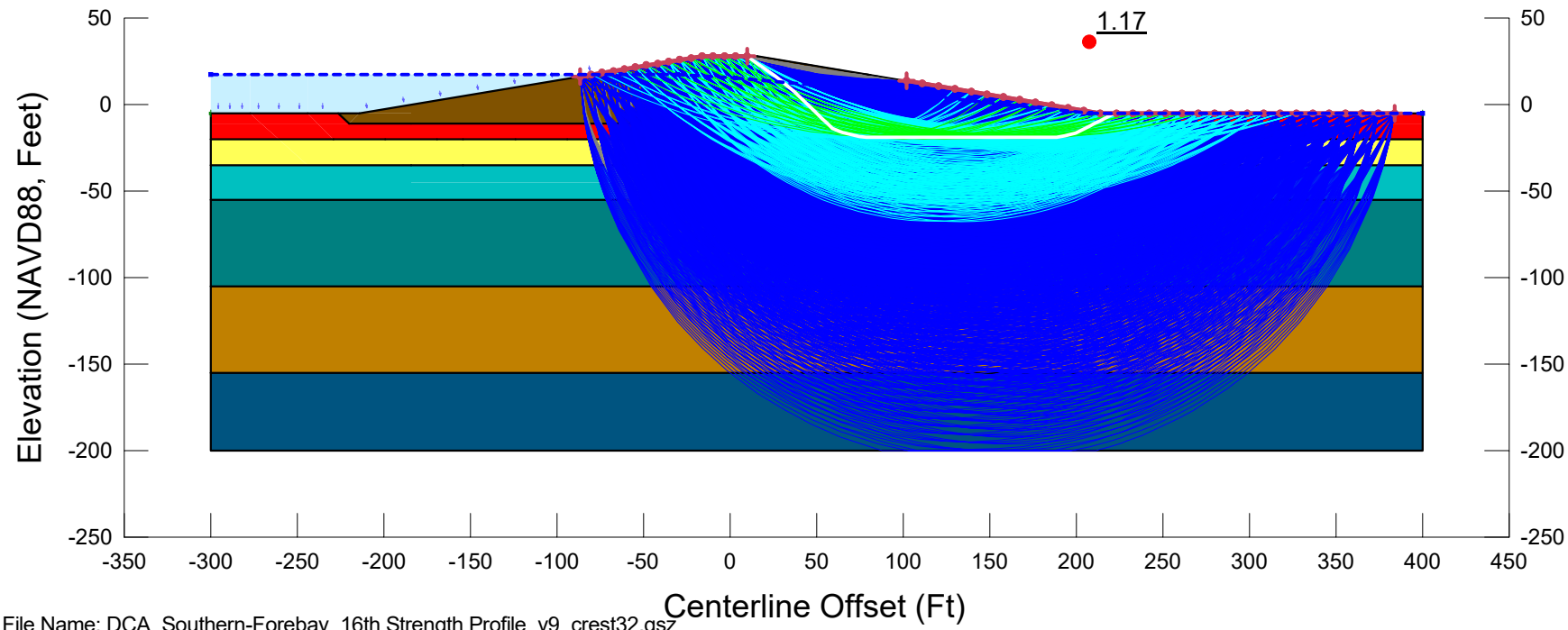
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

6H1V_P1_G2-AR25_A3-PSS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_16th	phi'_P2_16th		
	03B_Loose_Coarse_P2	110	c_P2_16th	phi'_P2_16th		
	04_Med. Stiff_Fine_P2	120	c_P2_16th	phi'_P2_16th		
	05_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	06_Dense_Coarse_P2	125	c_P2_16th	phi'_P2_16th		
	07_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		



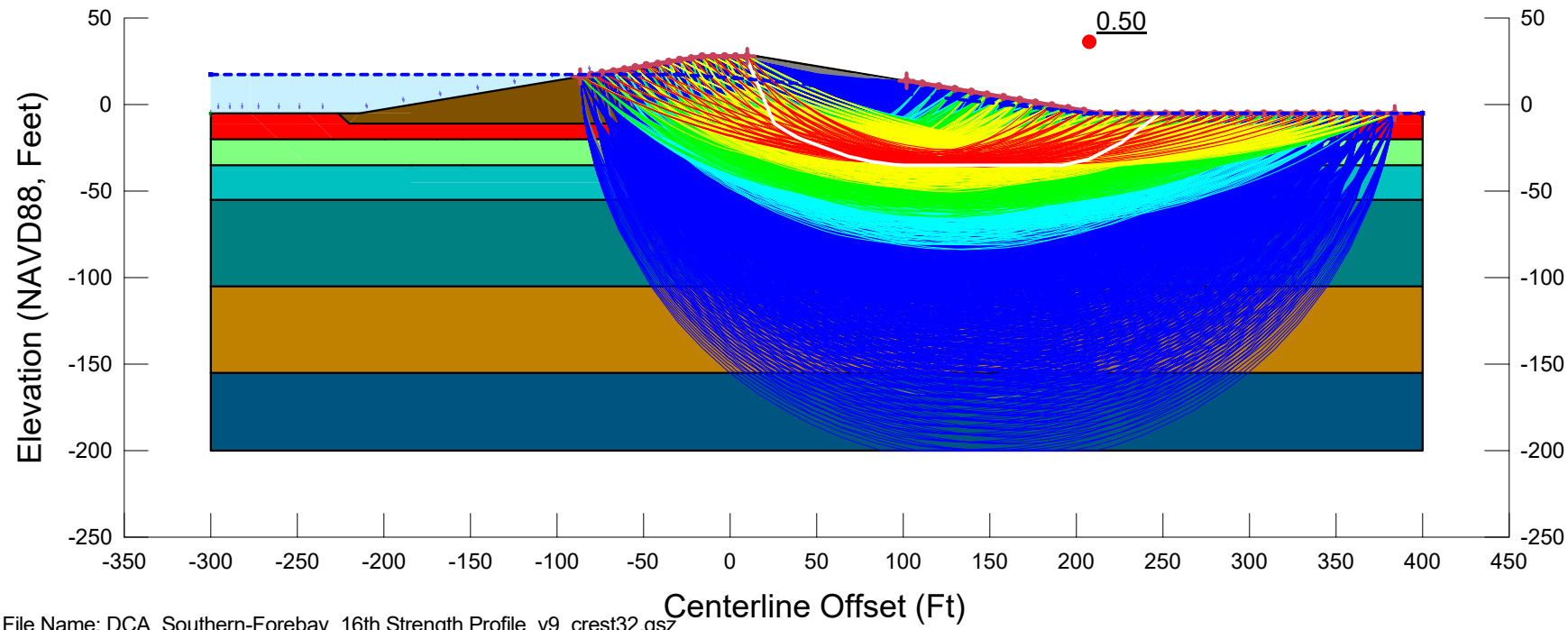
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Constant
Horz Seismic Coef.:

6H1V_P2_E_A1-S

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Tau/Sigma Ratio	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120				100	31
	02_Organics_P2.PS	90		c_P2_16th.PS	phi'_P2_16th.PS		
	03B_Loose_Coarse-0.08	110	0.08				
	04_Med. Stiff_Fine_P2.PS	120		c_P2_16th.PS	phi'_P2_16th.PS		
	05_Stiff_Fine_P2.PS	125		c_P2_16th.PS	phi'_P2_16th.PS		
	06_Dense_Coarse_P2.PS	125		c_P2_16th.PS	phi'_P2_16th.PS		
	07_Stiff_Fine_P2.PS	125		c_P2_16th.PS	phi'_P2_16th.PS		



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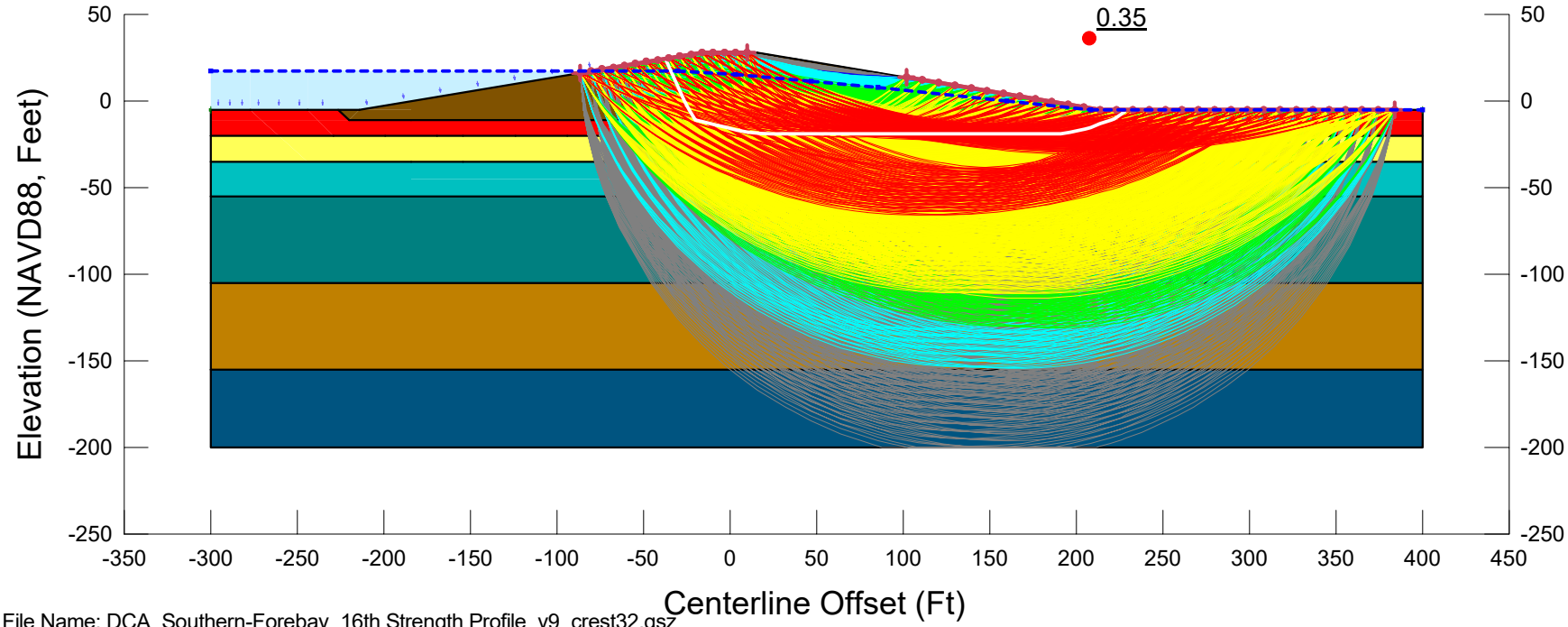
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Constant
Horz Seismic Coef.:

6H1V_P2_E_A2-PS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_16th	phi'_P2_16th		
	03B_Loose_Coarse_P2	110	c_P2_16th	phi'_P2_16th		
	04_Med. Stiff_Fine_P2	120	c_P2_16th	phi'_P2_16th		
	05_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	06_Dense_Coarse_P2	125	c_P2_16th	phi'_P2_16th		
	07_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		



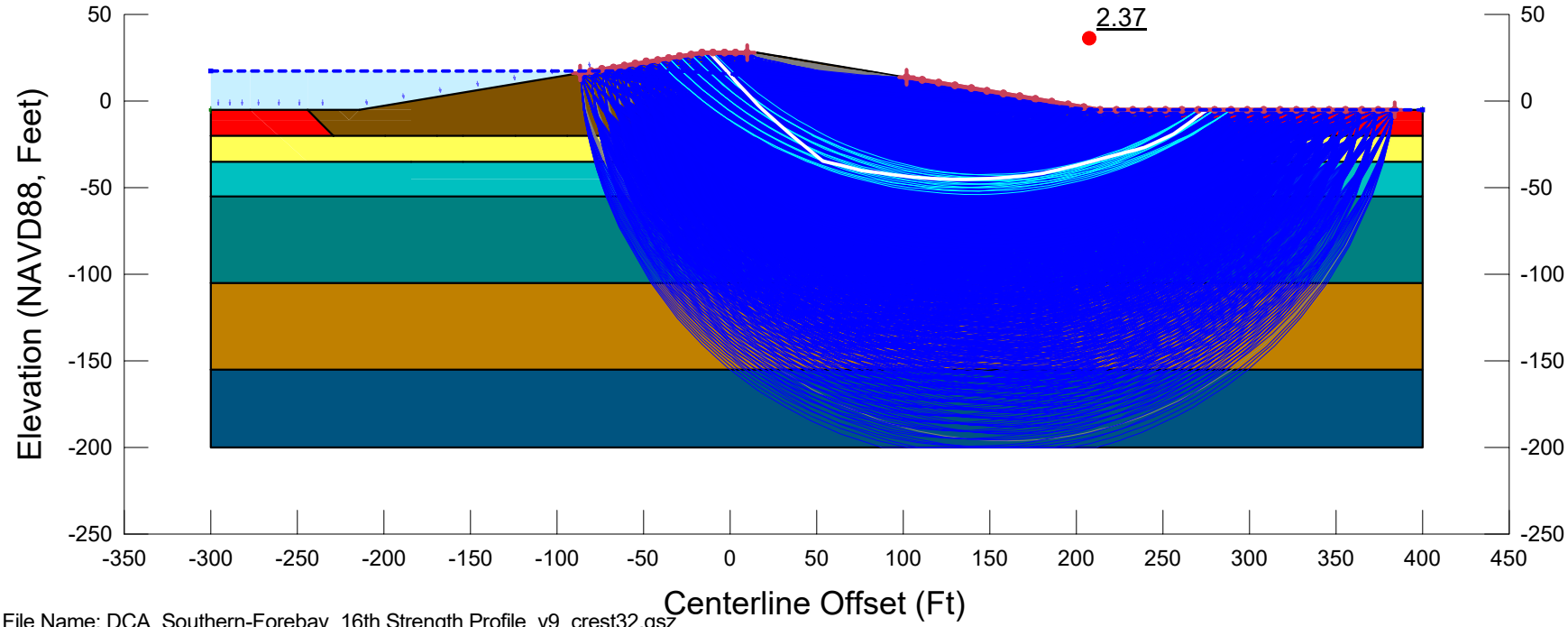
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

6H1V_P2_E_A3-PSS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_16th	phi'_P2_16th		
	03B_Loose_Coarse_P2	110	c_P2_16th	phi'_P2_16th		
	04_Med. Stiff_Fine_P2	120	c_P2_16th	phi'_P2_16th		
	05_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	06_Dense_Coarse_P2	125	c_P2_16th	phi'_P2_16th		
	07_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	09_Soil Bentonite Wall	100			300	0



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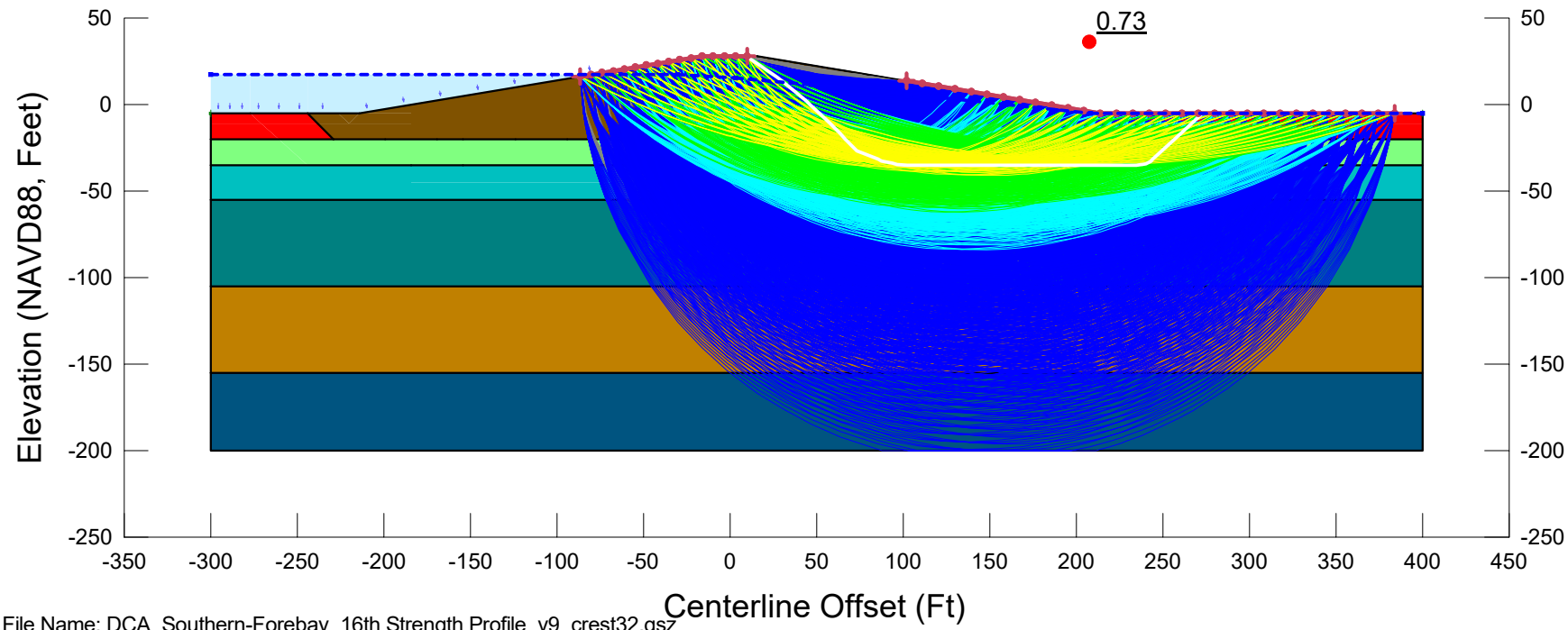
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Constant
Horz Seismic Coef.:

6H1V_P2_G1-RR15_A1-S

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Tau/Sigma Ratio	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120				100	31
	02_Organics_P2.PS	90		c_P2_16th.PS	phi'_P2_16th.PS		
	03B_Loose_Coarse-0.08	110	0.08				
	04_Med. Stiff_Fine_P2.PS	120		c_P2_16th.PS	phi'_P2_16th.PS		
	05_Stiff_Fine_P2.PS	125		c_P2_16th.PS	phi'_P2_16th.PS		
	06_Dense_Coarse_P2.PS	125		c_P2_16th.PS	phi'_P2_16th.PS		
	07_Stiff_Fine_P2.PS	125		c_P2_16th.PS	phi'_P2_16th.PS		
	09_Soil Bentonite Wall	100				300	0



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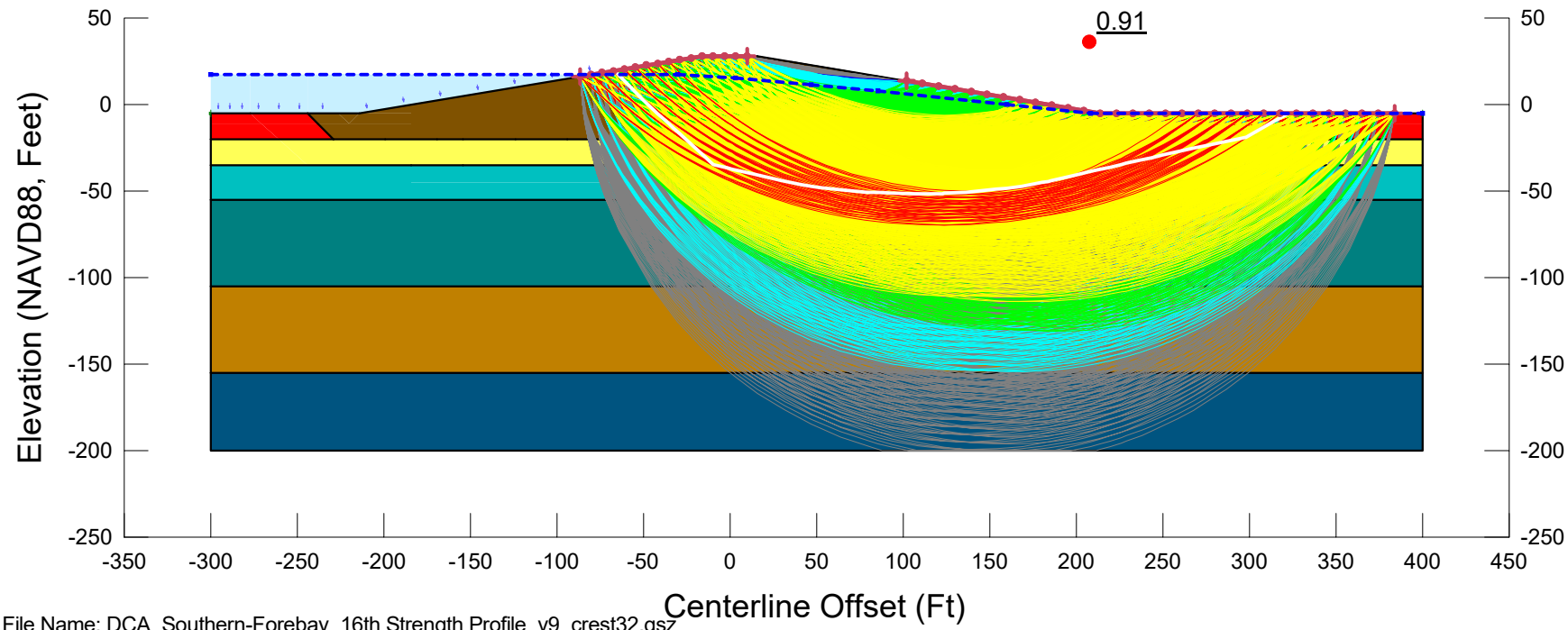
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Constant
Horz Seismic Coef.:

6H1V_P2_G1-RR15_A2-PS	
DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz	
02/27/2020	1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_16th	phi'_P2_16th		
	03B_Loose_Coarse_P2	110	c_P2_16th	phi'_P2_16th		
	04_Med. Stiff_Fine_P2	120	c_P2_16th	phi'_P2_16th		
	05_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	06_Dense_Coarse_P2	125	c_P2_16th	phi'_P2_16th		
	07_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	09_Soil Bentonite Wall	100			300	0



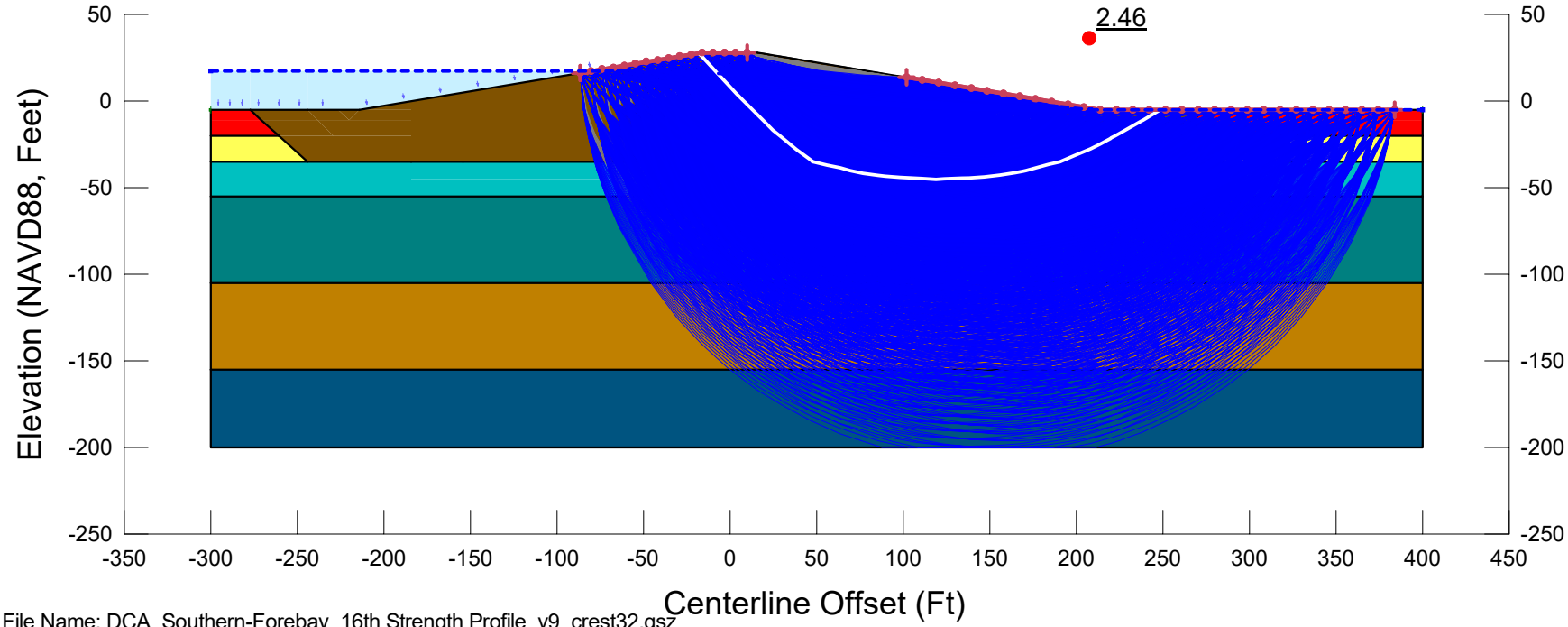
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

6H1V_P2_G1-RR15_A3-PSS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_16th	phi'_P2_16th		
	03B_Loose_Coarse_P2	110	c_P2_16th	phi'_P2_16th		
	04_Med. Stiff_Fine_P2	120	c_P2_16th	phi'_P2_16th		
	05_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	06_Dense_Coarse_P2	125	c_P2_16th	phi'_P2_16th		
	07_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	09_Soil Bentonite Wall	100			300	0



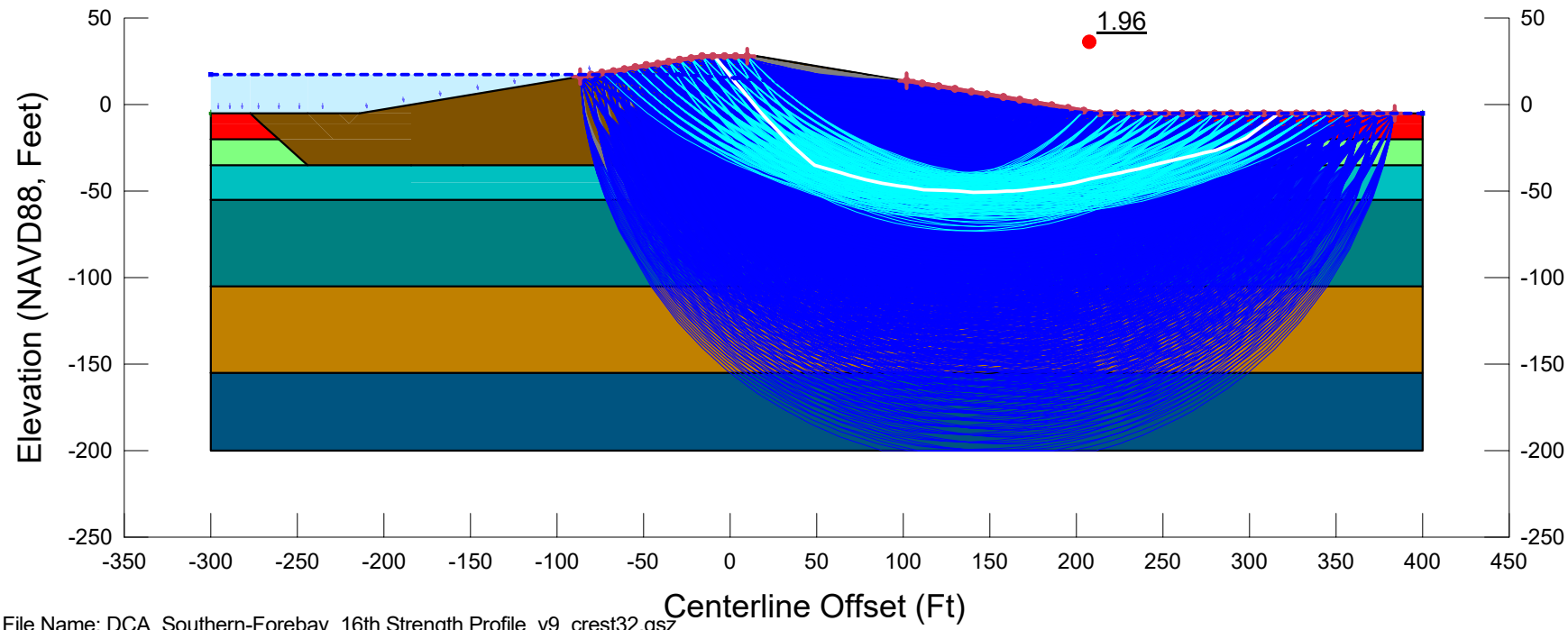
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Constant
Horz Seismic Coef.:

6H1V_P2_G1-RR30_A1-S

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Tau/Sigma Ratio	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120				100	31
	02_Organics_P2.PS	90		c_P2_16th.PS	phi'_P2_16th.PS		
	03B_Loose_Coarse-0.08	110	0.08				
	04_Med. Stiff_Fine_P2.PS	120		c_P2_16th.PS	phi'_P2_16th.PS		
	05_Stiff_Fine_P2.PS	125		c_P2_16th.PS	phi'_P2_16th.PS		
	06_Dense_Coarse_P2.PS	125		c_P2_16th.PS	phi'_P2_16th.PS		
	07_Stiff_Fine_P2.PS	125		c_P2_16th.PS	phi'_P2_16th.PS		
	09_Soil Bentonite Wall	100				300	0



File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
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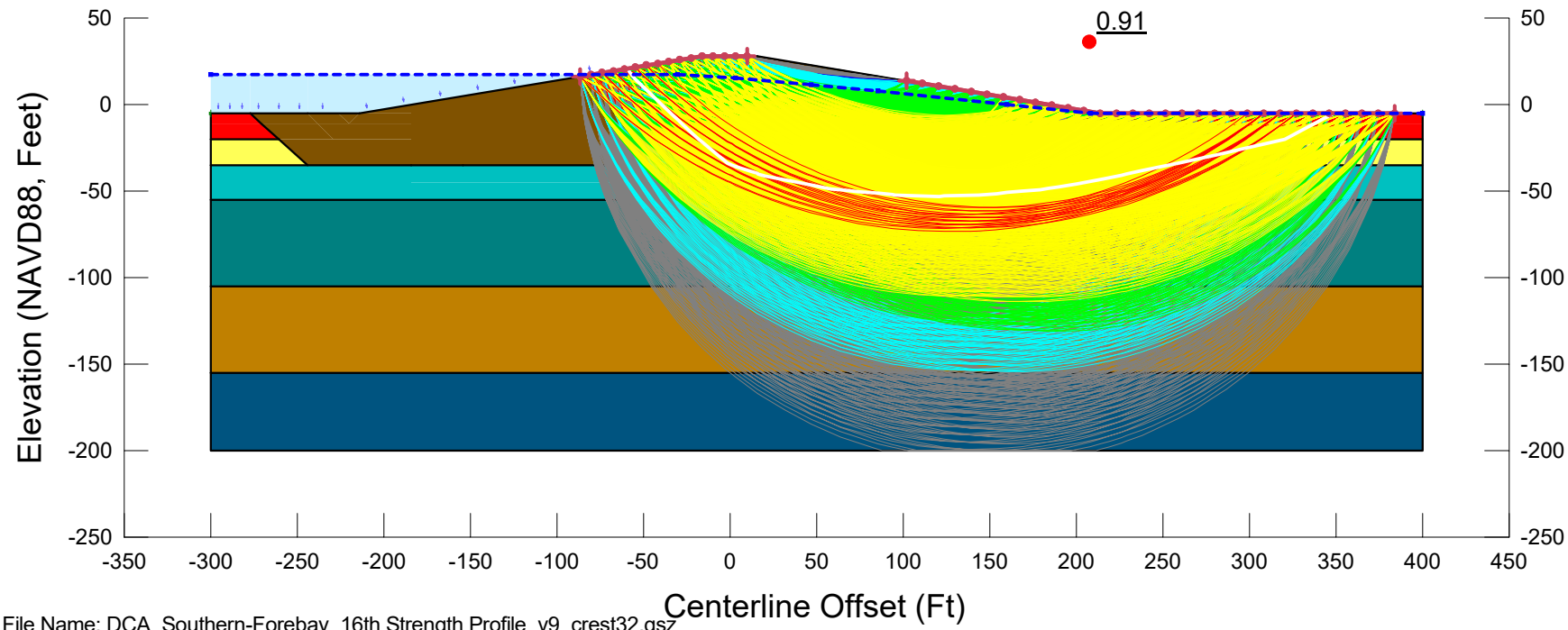
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Constant
Horz Seismic Coef.:

6H1V_P2_G1-RR30_A2-PS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_16th	phi'_P2_16th		
	03B_Loose_Coarse_P2	110	c_P2_16th	phi'_P2_16th		
	04_Med. Stiff_Fine_P2	120	c_P2_16th	phi'_P2_16th		
	05_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	06_Dense_Coarse_P2	125	c_P2_16th	phi'_P2_16th		
	07_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	09_Soil Bentonite Wall	100			300	0



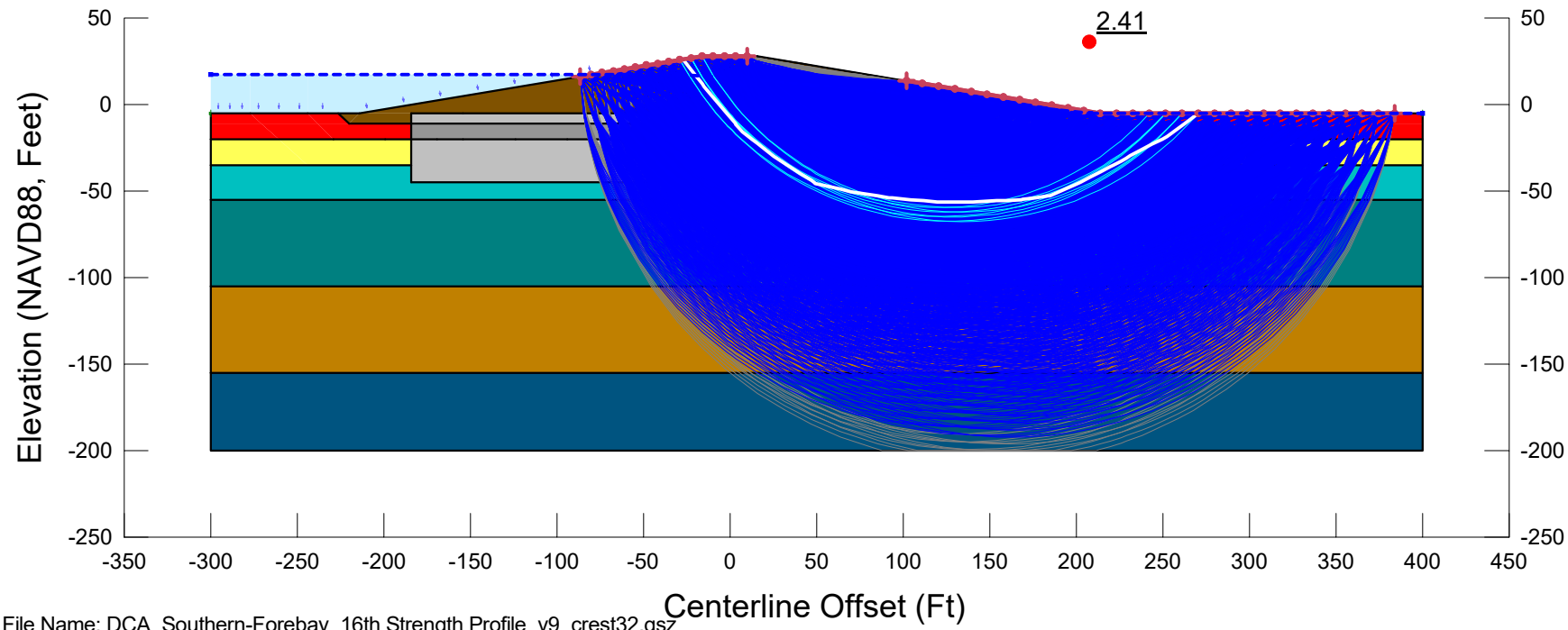
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

6H1V_P2_G1-RR30_A3-PSS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_16th	phi'_P2_16th		
	03B_Loose_Coarse_P2	110	c_P2_16th	phi'_P2_16th		
	04_Med. Stiff_Fine_P2	120	c_P2_16th	phi'_P2_16th		
	05_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	06_Dense_Coarse_P2	125	c_P2_16th	phi'_P2_16th		
	07_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	08_Soil Cement AR=0.15	125			2,400	0
	08_Soil Cement Organics AR=0.15	125			1,425	0
	09_Soil Bentonite Wall	100			300	0



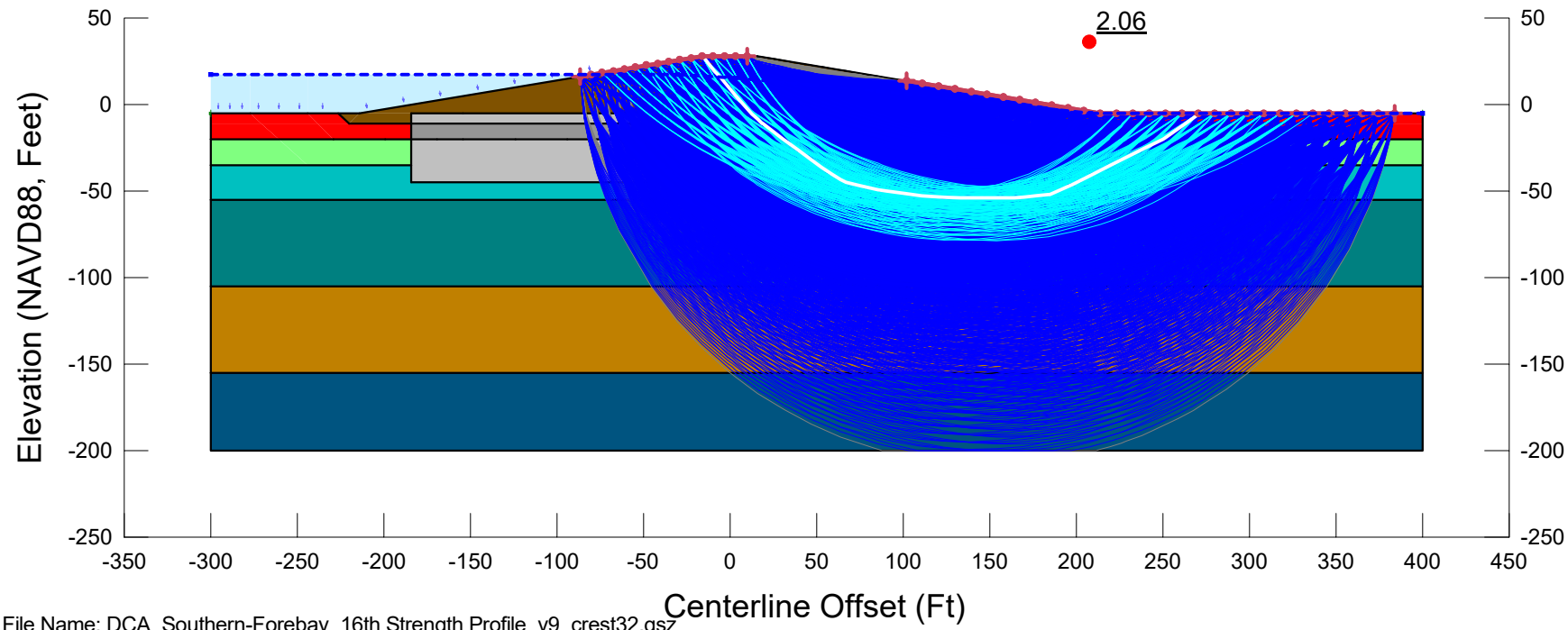
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.:

6H1V_P2_G2-AR15_A1-S

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Tau/Sigma Ratio	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120				100	31
	02_Organics_P2.PS	90		c_P2_16th.PS	phi'_P2_16th.PS		
	03B_Loose_Coarse-0.08	110	0.08				
	04_Med. Stiff_Fine_P2.PS	120		c_P2_16th.PS	phi'_P2_16th.PS		
	05_Stiff_Fine_P2.PS	125		c_P2_16th.PS	phi'_P2_16th.PS		
	06_Dense_Coarse_P2.PS	125		c_P2_16th.PS	phi'_P2_16th.PS		
	07_Stiff_Fine_P2.PS	125		c_P2_16th.PS	phi'_P2_16th.PS		
	08_Soil Cement AR=0.15	125				2,400	0
	08_Soil Cement Organics AR=0.15	125				1,425	0
	09_Soil Bentonite Wall	100				300	0



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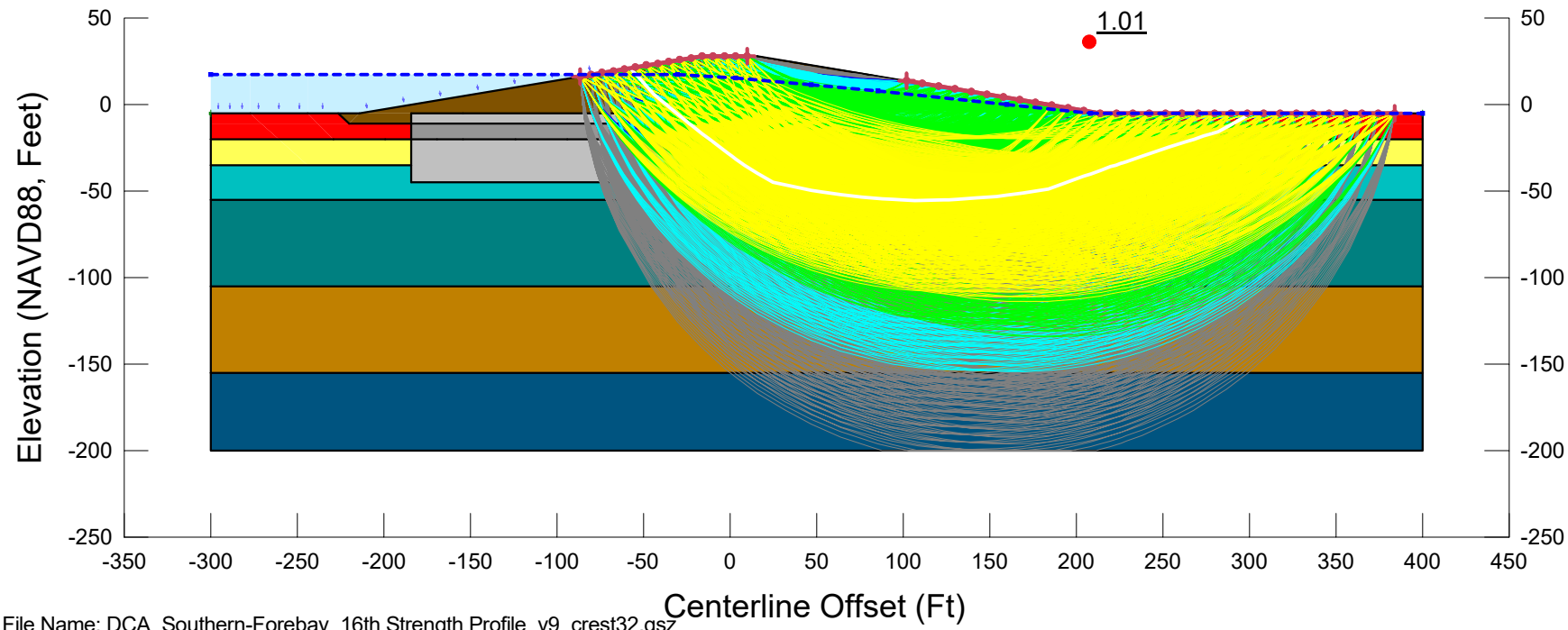
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.:

6H1V_P2_G2-AR15_A2-PS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_16th	phi'_P2_16th		
	03B_Loose_Coarse_P2	110	c_P2_16th	phi'_P2_16th		
	04_Med. Stiff_Fine_P2	120	c_P2_16th	phi'_P2_16th		
	05_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	06_Dense_Coarse_P2	125	c_P2_16th	phi'_P2_16th		
	07_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	08_Soil Cement AR=0.15	125			2,400	0
	08_Soil Cement Organics AR=0.15	125			1,425	0
	09_Soil Bentonite Wall	100			300	0



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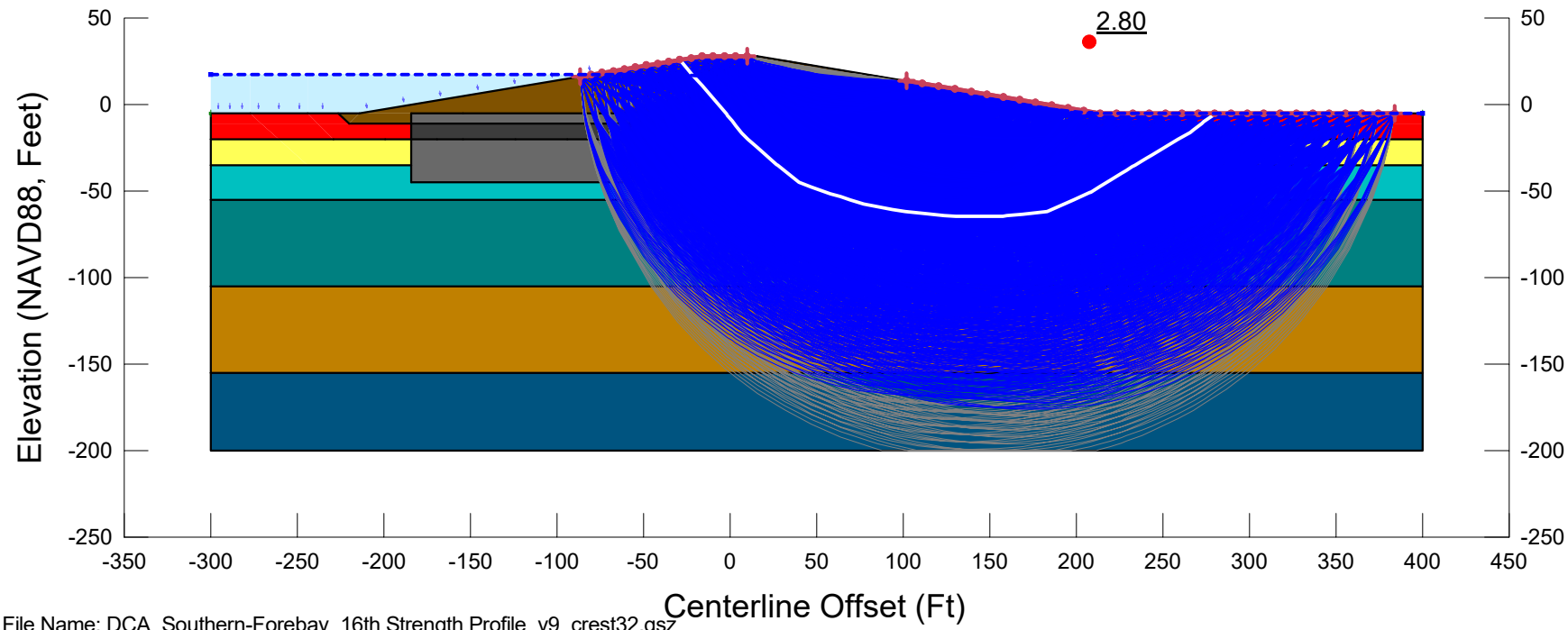
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

6H1V_P2_G2-AR15_A3-PSS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_16th	phi'_P2_16th		
	03B_Loose_Coarse_P2	110	c_P2_16th	phi'_P2_16th		
	04_Med. Stiff_Fine_P2	120	c_P2_16th	phi'_P2_16th		
	05_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	06_Dense_Coarse_P2	125	c_P2_16th	phi'_P2_16th		
	07_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	08_Soil Cement AR=0.25	125			4,000	0
	08_Soil Cement Organics AR=0.25	125			2,225	0
	09_Soil Bentonite Wall	100			300	0



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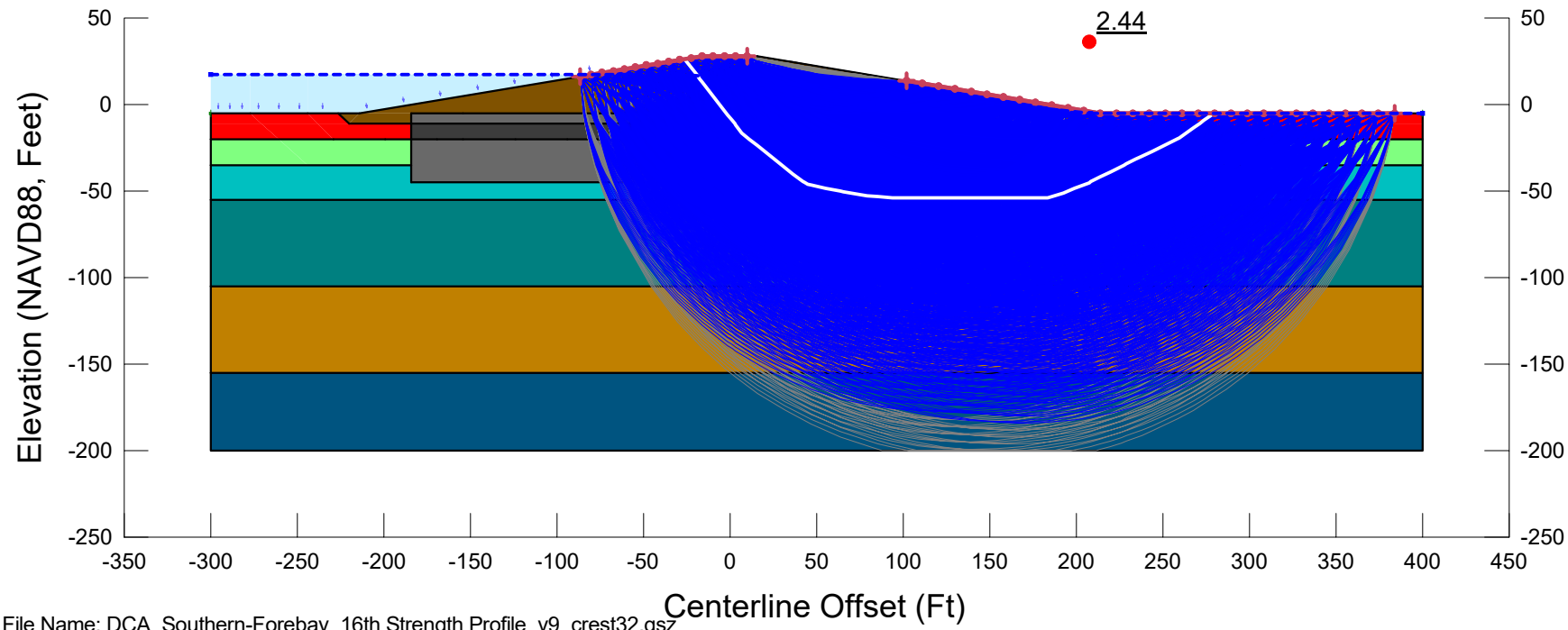
F of S Calculation Option: Sensitivity
Horz Seismic Coef.:

6H1V_P2_G2-AR25_A1-S

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Tau/Sigma Ratio	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120				100	31
	02_Organics_P2.PS	90		c_P2_16th.PS	phi'_P2_16th.PS		
	03B_Loose_Coarse-0.08	110	0.08				
	04_Med. Stiff_Fine_P2.PS	120		c_P2_16th.PS	phi'_P2_16th.PS		
	05_Stiff_Fine_P2.PS	125		c_P2_16th.PS	phi'_P2_16th.PS		
	06_Dense_Coarse_P2.PS	125		c_P2_16th.PS	phi'_P2_16th.PS		
	07_Stiff_Fine_P2.PS	125		c_P2_16th.PS	phi'_P2_16th.PS		
	08_Soil Cement AR=0.25	125				4,000	0
	08_Soil Cement Organics AR=0.25	125				2,225	0
	09_Soil Bentonite Wall	100				300	0



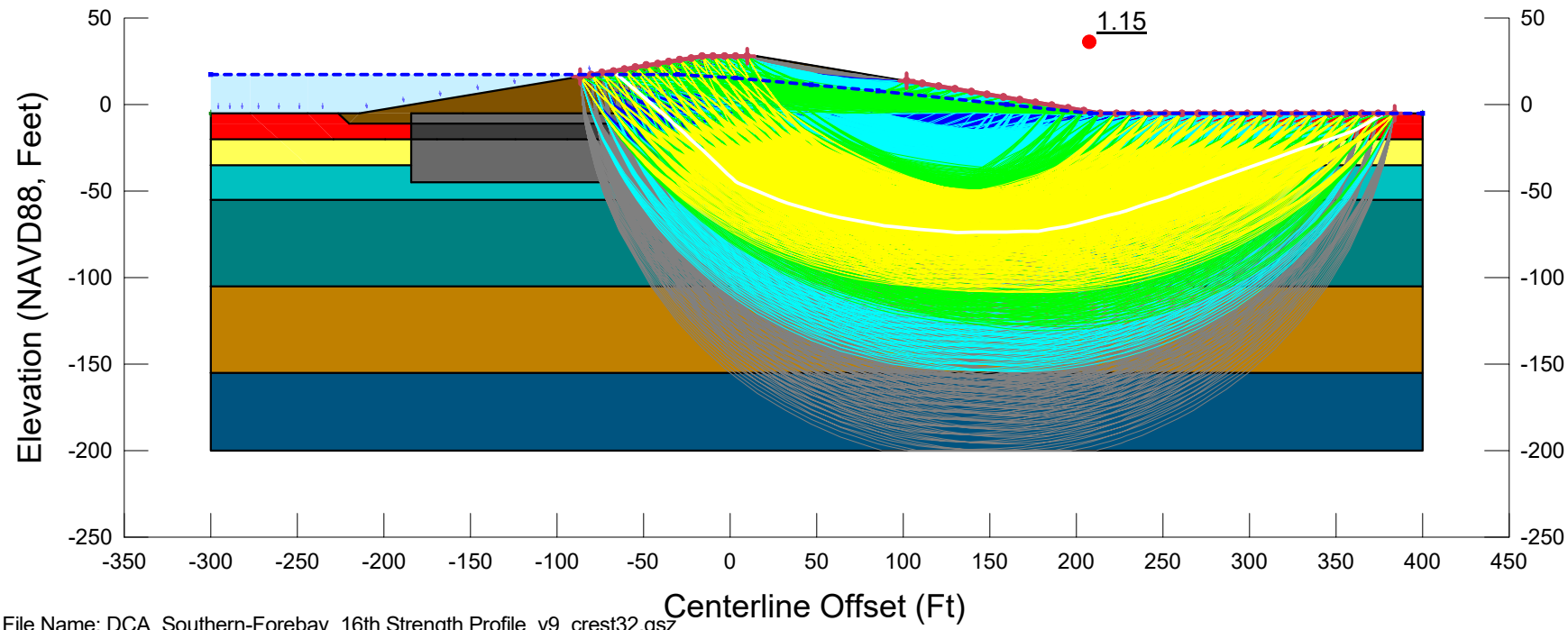
File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.:

6H1V_P2_G2-AR25_A2-PS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Color	Name	Unit Weight (pcf)	Cohesion Fn	Phi Fn	Cohesion' (psf)	Phi' (°)
	01_Embk	120			100	31
	02_Organics_P2	90	c_P2_16th	phi'_P2_16th		
	03B_Loose_Coarse_P2	110	c_P2_16th	phi'_P2_16th		
	04_Med. Stiff_Fine_P2	120	c_P2_16th	phi'_P2_16th		
	05_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	06_Dense_Coarse_P2	125	c_P2_16th	phi'_P2_16th		
	07_Stiff_Fine_P2	125	c_P2_16th	phi'_P2_16th		
	08_Soil Cement AR=0.25	125			4,000	0
	08_Soil Cement Organics AR=0.25	125			2,225	0
	09_Soil Bentonite Wall	100			300	0



File Name: DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz
Created By: Ticen, Elliott Last Edited By: Ticen, Elliott
Date: 02/27/2020 Time: 10:41:45 AM Rev. No.: 153
F of S Calculation Option: Sensitivity
Horz Seismic Coef.: 0.2

6H1V_P2_G2-AR25_A3-PSS

DCA_Southern-Forebay_16th Strength Profile_v9_crest32.gsz

02/27/2020 1:1,200

Forward Analysis Settlement Parameters

by: E. Ticen
Date: February 2020
Checked by: C. Krage
Checked date: 2/12/2020

Layer	Layer Name	Unit Weight (pcf)		Settlement Parameters		
		Moist	Saturated	$C_{c\varepsilon}$	$C_{r\varepsilon}=0.2*C_{c\varepsilon}$	OCR
1	Embankment Fill	115	120	0.010	0.002	5
2	Organics	85	90	0.180	0.036	1
3a	Soft to Medium Stiff Fine-Grained	105	110	0.120	0.024	1
3b	Loose - Coarse Grained	105	110	0.005	0.001	1
4	Medium Stiff Fine-Grained	115	120	0.070	0.014	1
5	Stiff Fine-Grained	120	125	0.017	0.003	1
6	Dense Coarse-Grained	120	125	0.017	0.003	1
7	Stiff Fine-Grained	120	125	0.017	0.003	1

Organics $C_{c\varepsilon}$ weighting

Moderately Organic Ccε	0.058
Highly Organic Ccε	0.300
% Highly Organic Composition (1)	50%
Weighted Ccε For Organic Layer	0.179

(1) Weighting Factor to account for percentage of highly compressible (peat) organics.

Configuration **3H1V_P1_E**

by: E. Ticen
Last Updated: February 2020

Geometry	Embankment Height, H	33	ft
	Embankment Side Slopes	3	xH:1V
	Crown Width	32	ft
	Half Crown Width, B1	16	ft
	Side Slope Width, B2	99	ft
	Unit Weight of Embankment, γ	120	pcf
	Depth to Ground Water	0	ft
	Maximum Stress Increase	3960	psf
	Water Surface Elevation	-5	ft
	Ground Surface Elevation	-5	ft
Foundation Improvements	Remove & Replace Depth [1]	6	ft
	Area Replacement Ratio	0	-
	Shear Key Thickness	0	ft
	Shear Key Depth	0	ft
	Shear Key Raft Foundation Depth	0.0	ft
	Shear key Spacing	--	ft
	Soil Arching b/w Shear Key	0	xV:1H
	Arching Stress Height	--	ft
	Arching Side Slope Width, B2	--	ft
	σmax Arching	0	psf

Notes:
1) Compacted fill where settlement of the material is considered to be negligible.
2)
3)
4)
5)
6)
7)

Total Settlement at Midpoint Between Shear Keys=	--	inches
Total Settlement at Shear Keys=	--	inches
Differential Settlement=	--	inches

		Depth (GS=0-ft)		Elevation (ft)		Unit Weight		Settlement					Staged Construction		
		Top	Bottom	Top	Bottom	Moist	Saturated	$C_{c\varepsilon} = C_c/(1+e_o)$	$C_{r\varepsilon} = C_{cε}/5$	OCR	Total Layer Settlement		Reduction	Total Layer Settlement	
Layer	Description	(ft)	(ft)	(ft)	(ft)	(pcf)	(pcf)	(-)	(-)	(-)	(in)	(ft)	(%)	(in)	(ft)
1	Embankment Fill	-33	0	28	-5	115	120	0.01	0.002	5	0	0.00	100%	0	0.00
2	Organics	0	15	-5	-20	85	90	0.180	0.036	1	23.2	1.93	0%	23	1.93
3a	Soft to Medium Stiff Fine-Grained	15	30	-20	-35	105	110	0.120	0.024	1	17.2	1.43	0%	17	1.43
4	Medium Stiff Fine-Grained	30	50	-35	-55	115	120	0.070	0.014	1	8.4	0.70	0%	8	0.70
5	Stiff Fine-Grained	50	100	-55	-105	120	125	0.017	0.0034	1	2.6	0.22	0%	3	0.22
6	Dense Coarse-Grained	100	150	-105	-155	120	125	0.017	0.0034	1	1.2	0.10	0%	1	0.10
7	Stiff Fine-Grained	150	200	-155	-205	120	125	0.017	0.0034	1	0.7	0.05	0%	1	0.05
										Σ=	53.2	4.4	Σ=	53.2	4.4

							Pre Construction					Δσ due to Embankment Load (Das - 5.6)				Δσ due to Foundation R&R (2:1)			Δσ With Arching for Shear Keys (Das - 5.6)									
Top of Layer	Bottom of Layer	Depth (ft)	Layer (-)	Elevation (ft)	Moist Unit Weight (pcf)	Saturated Unit Weight (pcf)	Total Stress (psf)	Pore Pressure (psf)	Effective stress (psf)	OCR (-)	Pre- Consolidation Pressure (psf)	α_1 (rad)	α_2 (rad)	Influence Value I'	Δσ below Embankment middle (psf)	Foundation Removal (psf)	Foundation Replacement (psf)	Net Stress Change in Layer (psf)	α1 (rad)	α2 (rad)	Influence Value I'	Δσ between shear keys above shear key raft foundation (psf)	Δσ below shear key raft foundation	Final Stress (psf)	$C_{c\varepsilon}$ (-)	$C_{r\varepsilon}$ (-)	Vertical Strain $\varepsilon_{v,i}$ (%)	Change in Layer Thickness Δh_i (in)
0	1	0.5	Organics	-5.5	85	90	45	31	14	1.0	14	0.03	1.54	0.50	3960	-45	60	15	0.00	0.00	0.0	0	0	3989	0.18	0.036	0.0	0.00
1	2	1.5	Organics	-6.5	85	90	135	94	41	1.0	41	0.08	1.48	0.50	3960	-135	180	45	0.00	0.00	0.0	0	0	4046	0.18	0.036	0.0	0.00
2	3	2.5	Organics	-7.5	85	90	225	156	69	1.0	69	0.13	1.42	0.50	3959	-225	300	75	0.00	0.00	0.0	0	0	4103	0.18	0.036	0.0	0.00
3	4	3.5	Organics	-8.5	85	90	315	218	97	1.0	97	0.18	1.36	0.50	3959	-315	420	105	0.00	0.00	0.0	0	0	4160	0.18	0.036	0.0	0.00
4	5	4.5	Organics	-9.5	85	90	405	281	124	1.0	124	0.24	1.30	0.50	3957	-405	540	135	0.00	0.00	0.0	0	0	4216	0.18	0.036	0.0	0.00
5	6	5.5	Organics	-10.5	85	90	495	343	152	1.0	152	0.28	1.24	0.50	3955	-495	660	165	0.00	0.00	0.0	0	0	4272	0.18	0.036	0.0	0.00
6	7	6.5	Organics	-11.5	85	90	585	406	179	1.0	179	0.33	1.18	0.50	3952	-493	657	164	0.00	0.00	0.0	0	0	4296	0.18	0.036	0.2	2.98
7	8	7.5	Organics	-12.5	85	90	675	468	207	1.0	207	0.37	1.13	0.50	3948	-489	652	163	0.00	0.00	0.0	0	0	4318	0.18	0.036	0.2	2.85
8	9	8.5	Organics	-13.5	85	90	765	530	235	1.0	235	0.41	1.08	0.50	3943	-485	647	162	0.00	0.00	0.0	0	0	4339	0.18	0.036	0.2	2.74
9	10	9.5	Organics	-14.5	85	90	855	593	262	1.0	262	0.45	1.03	0.50	3937	-481	641	160	0.00	0.00	0.0	0	0	4359	0.18	0.036	0.2	2.64
10	11	10.5	Organics	-15.5	85	90	945	655	290	1.0	290	0.49	0.99	0.50	3930	-477	636	159	0.00	0.00	0.0	0	0	4379	0.18	0.036	0.2	2.55
11	12	11.5	Organics	-16.5	85	90	1035	718	317	1.0	317	0.52	0.95	0.50	3922	-473	631	158	0.00	0.00	0.0	0	0	4397	0.18	0.036	0.2	2.47
12	13	12.5	Organics	-17.5	85	90	1125	780	345	1.0	345	0.55	0.91	0.49	3913	-469	626	156	0.00	0.00	0.0	0	0	4415	0.18	0.036	0.2	2.39
13	14	13.5	Organics	-18.5	85	90	1215	842	373	1.0	373	0.58	0.87	0.49	3903	-466	621	155	0.00	0.00	0.0	0	0	4431	0.18	0.036	0.2	2.32
14	15	14.5	Organics	-19.5	85	90	1305	905	400	1.0	400	0.61	0.83	0.49	3893	-462	616	154	0.00	0.00	0.0	0	0	4447	0.18	0.036	0.2	2.26
15	16	15.5	Soft to Medium Stiff Fine-Grained	-20.5	105	110	1415	967	448	1.0	448	0.64	0.80	0.49	3881	-458	611	153	0.00	0.00	0.0	0	0	4482	0.12	0.024	0.1	1.44
16	17	16.5	Soft to Medium Stiff Fine-Grained	-21.5	105	110	1525	1030	495	1.0	495	0.66	0.77	0.49	3869	-455	606	152	0.00	0.00	0.0	0	0	4516	0.12	0.024	0.1	1.38
17	18	17.5	Soft to Medium Stiff Fine-Grained	-22.5	105	110	1635	1092	543	1.0	543	0.68	0.74	0.49	3856	-451	601	150	0.00	0.00	0.0	0	0	4549	0.12	0.024	0.1	1.33
18	19	18.5	Soft to Medium Stiff Fine-Grained	-23.5	105	110	1745	1154	591	1.0	591	0.70	0.71	0.49	3842	-448	597	149	0.00	0.00	0.0	0	0	4582	0.12	0.024	0.1	1.28
19	20	19.5	Soft to Medium Stiff Fine-Grained	-24.5	105	110	1855	1217	638	1.0	638	0.72	0.69	0.48	3828	-444	592	148	0.00	0.00	0.0	0	0	4614	0.12	0.024	0.1	1.24
20	21	20.5	Soft to Medium Stiff Fine-Grained	-25.5	105	110	1965	1279	686	1.0	686	0.73	0.66	0.48	3813	-441	587	147	0.00	0.00	0.0	0	0	4646	0.12	0.024	0.1	1.20
21	22	21.5	Soft to Medium Stiff Fine-Grained	-26.5	105	110	2075	1342	733	1.0	733	0.75	0.64	0.48	3798	-437	583	146	0.00	0.00	0.0	0	0	4677	0.12	0.024	0.1	1.16
22	23	22.5	Soft to Medium Stiff Fine-Grained	-27.5	105	110	2185	1404	781	1.0	781	0.76	0.62	0.48	3782	-434	578	145	0.00	0.00	0.0	0	0	4708	0.12	0.024	0.1	1.12
23	24	23.5	Soft to Medium Stiff Fine-Grained	-28.5	105	110	2295	1466	829	1.0	829	0.77	0.60	0.48	3766	-430	574	143	0.00	0.00	0.0	0	0	4738	0.12	0.024	0.1	1.09
24	25	24.5	Soft to Medium Stiff Fine-Grained	-29.5	105	110	2405	1529	876	1.0	876	0.78	0.58	0.47	3750	-427	570	142	0.00	0.00	0.0	0	0	4768	0.12	0.024	0.1	1.06
25	26	25.5	Soft to Medium Stiff Fine-Grained	-30.5	105	110	2515	1591	924	1.0	924	0.79	0.56	0.47	3733	-424	565	141	0.00	0.00	0.0	0	0	4798	0.12	0.024	0.1	1.03
26	27	26.5	Soft to Medium Stiff Fine-Grained	-31.5	105	110	2625	1654	971	1.0	971	0.80	0.54	0.47	3715	-421	561	140	0.00	0.00	0.0	0	0	4827	0.12	0.024	0.1	1.00
27	28	27.5	Soft to Medium Stiff Fine-Grained	-32.5	105	110	2735	1716	1019	1.0	1019	0.81	0.53	0.47	3698	-418	557	139	0.00	0.00	0.0	0	0	4856	0.12	0.024	0.1	0.98
28	29	28.5	Soft to Medium Stiff Fine-Grained	-33.5	105	110	2845	1778	1067	1.0	1067	0.82	0.51	0.46	3680	-414	552	138	0.00	0.00	0.0	0	0	4885	0.12	0.024	0.1	0.95
29	30	29.5	Soft to Medium Stiff Fine-Grained	-34.5	105	110	2955	1841	1114	1.0	1114	0.82	0.50	0.46	3662	-411	548	137	0.00	0.00	0.0	0	0	4913	0.12	0.024	0.1	0.93
30	31	30.5	Medium Stiff Fine-Grained	-35.5	115	120	3075	1903	1172	1.0	1172	0.83	0.48	0.46	3644	-408	544	136	0.00	0.00	0.0	0	0	4952	0.07	0.014	0.0	0.53
31	32	31.5	Medium Stiff Fine-Grained	-36.5	115	120	3195	1966	1229	1.0	1229	0.83	0.47	0.46	3626	-405	540	135	0.00	0.00	0.0	0	0	4990	0.07	0.014	0.0	0.51
32	33	32.5	Medium Stiff Fine-Grained	-37.5	115	120	3315	2028	1287	1.0	1287	0.84	0.46	0.46	3607	-402	536	134	0.00	0.00	0.0	0	0	5028	0.07	0.014	0.0	0.50
33	34	33.5	Medium Stiff Fine-Grained	-38.5	115	120	3435	2090	1345	1.0	1345	0.84	0.45	0.45	3588	-399	532	133	0.00	0.00	0.0	0	0	5066	0.07	0.014	0.0	0.48
34	35	34.5	Medium Stiff Fine-Grained	-39.5	115	120	3555	2153	1402	1.0	1402	0.85	0.43	0.45	3570	-396	528	132	0.00	0.00	0.0	0	0	5104	0.07	0.014	0.0	0.47
35	36	35.5	Medium Stiff Fine-Grained	-40.5	115	120	3675	2215	1460	1.0	1460	0.85	0.42	0.45	3551	-393	524	131	0.00	0.00	0.0	0	0	5142	0.07	0.014	0.0	0.46
36	37	36.5	Medium Stiff Fine-Grained	-41.5	115	120	3795	2278	1517	1.0	1517	0.85	0.41	0.45	3532	-390	521	130	0.00	0.00	0.0	0	0	5179	0.07	0.014	0.0	0.45
37	38	37.5	Medium Stiff Fine-Grained	-42.5	115	120	3915	2340	1575	1.0	1575	0.85	0.40	0.44	3513	-388	517	129	0.00	0.00	0.0	0	0	5217	0.07	0.014	0.0	0.44
38	39	38.5	Medium Stiff Fine-Grained	-43.5	115	120	4035	2402	1633	1.0	1633	0.85	0.39	0.44	3493	-385	513	128	0.00	0.00	0.0	0	0	5254	0.07	0.014	0.0	0.43
39	40	39.5	Medium Stiff Fine-Grained	-44.5	115	120	4155	2465	1690	1.0	1690	0.86	0.38	0.44	3474	-382	509	127	0.00	0.00	0.0	0	0	5292	0.07	0.014	0.0	0.42
40	41	40.5	Medium Stiff Fine-Grained	-45.5	115	120	4275	2527	1748	1.0	1748	0.86	0.38	0.44	3455	-379	506	126	0.00	0.00	0.0	0	0	5329	0.07	0.014	0.0	0.41
41	42	41.5	Medium Stiff Fine-Grained	-46.5	115	120	4395	2590	1805	1.0	1805	0.86	0.37	0.43	3436	-376	502	125	0.00	0.00	0.0	0	0	5367	0.07	0.014	0.0	0.40
42	43	42.5	Medium Stiff Fine-Grained	-47.5	115	120	4515	2652	1863	1.0	1863	0.86	0.36	0.43	3417	-374	498	125	0.00	0.00	0.0	0	0	5404	0.07	0.014	0.0	0.39
43	44	43.5	Medium Stiff Fine-Grained	-48.5	115	120	4635	2714	1921	1.0	1921	0.86	0.35	0.43	3397	-371	495	124	0.00	0.00	0.0	0	0	5442	0.07	0.014	0.0	0.38
44	45	44.5	Medium Stiff Fine-Grained	-49.5	115	120	4755	2777	1978	1.0	1978	0.86	0.35	0.43	3378	-368	491	123	0.00	0.00	0.0	0	0	5479	0.07	0.014	0.0	0.37
45	46	45.5	Medium Stiff Fine-Grained	-50.5	115	120	4875	2839	2036	1.0	2036	0.86	0.34	0.42	3359	-366	488	122	0.00	0.00	0.0	0	0	5517	0.07	0.014	0.0	0.36
46	47	46.5	Medium Stiff Fine-Grained	-51.5	115	120	4995	2902	2093	1.0	2093	0.86	0.33	0.42	3340	-363	484	121	0.00	0.00	0.0	0	0	5554	0.07	0.014	0.0	0.36
47	48	47.5	Medium Stiff Fine-Grained	-52.5	115	120	5115	2964	2151	1.0	2151	0.85	0.32	0.42	3321	-361	481	120	0.00	0.00	0.0	0	0	5592	0.07	0.014	0.0	0.35
48	49	48.5	Medium Stiff Fine-Grained	-53.5	115	120	5235	3026	2209	1.0	2209	0.85	0.32	0.42	3301	-358	478	119	0.00	0.00	0.0	0	0	5629	0.07	0.014	0.0	0.34

Configuration **3H1V_P1_G1-RR15**

by: E. Ticen
Last Updated: February 2020

Geometry	Embankment Height, H	33	ft
	Embankment Side Slopes	3	xH:1V
	Crown Width	32	ft
	Half Crown Width, B1	16	ft
	Side Slope Width, B2	99	ft
	Unit Weight of Embankment, γ	120	pcf
	Depth to Ground Water	0	ft
	Maximum Stress Increase	3960	psf
	Water Surface Elevation	-5	ft
	Ground Surface Elevation	-5	ft
Foundation Improvements	Remove & Replace Depth [1]	15	ft
	Area Replacement Ratio	0	-
	Shear Key Thickness	0	ft
	Shear Key Depth	0	ft
	Shear Key Raft Foundation Depth	0.0	ft
	Shear key Spacing	--	ft
	Soil Arching b/w Shear Key	0	xV:1H
	Arching Stress Height	--	ft
	Arching Side Slope Width, B2	--	ft
	σmax Arching	0	psf

Notes:
1) Compacted fill where settlement of the material is considered to be negligible.
2)
3)
4)
5)
6)
7)

Total Settlement at Midpoint Between Shear Keys=	--	inches
Total Settlement at Shear Keys=	--	inches
Differential Settlement=	--	inches

		Depth (GS=0-ft)		Elevation (ft)		Unit Weight		Settlement					Staged Construction		
		Top	Bottom	Top	Bottom	Moist	Saturated	$C_{c\varepsilon} = C_c/(1+e_o)$	$C_{r\varepsilon} = C_{c\varepsilon}/5$	OCR	Total Layer Settlement		Reduction	Total Layer Settlement	
Layer	Description	(ft)	(ft)	(ft)	(ft)	(pcf)	(pcf)	(-)	(-)	(-)	(in)	(ft)	(%)	(in)	(ft)
1	Embankment Fill	-33	0	28	-5	115	120	0.01	0.002	5	0	0.00	100%	0	0.00
2	Organics	0	15	-5	-20	85	90	0.180	0.036	1	0.0	0.00	0%	0	0.00
3a	Soft to Medium Stiff Fine-Grained	15	30	-20	-35	105	110	0.120	0.024	1	17.7	1.48	0%	18	1.48
4	Medium Stiff Fine-Grained	30	50	-35	-55	115	120	0.070	0.014	1	8.7	0.72	0%	9	0.72
5	Stiff Fine-Grained	50	100	-55	-105	120	125	0.017	0.0034	1	2.7	0.23	0%	3	0.23
6	Dense Coarse-Grained	100	150	-105	-155	120	125	0.017	0.0034	1	1.3	0.11	0%	1	0.11
7	Stiff Fine-Grained	150	200	-155	-205	120	125	0.017	0.0034	1	0.7	0.06	0%	1	0.06
										Σ=	31.1	2.6	Σ=	31.1	2.6

							Pre Construction							Δσ due to Embankment Load (Das - 5.6)			Δσ due to Foundation R&R (2:1)			Δσ With Arching for Shear Keys (Das - 5.6)									
Top of Layer	Bottom of Layer	Depth (ft)	Layer (-)	Elevation (ft)	Moist Unit Weight (pcf)	Saturated Unit Weight (pcf)	Total Stress (psf)	Pore Pressure (psf)	Effective stress (psf)	OCR (-)	Pre- Consolidation Pressure (psf)	α_1 (rad)	α_2 (rad)	Influence Value I'	Δσ below Embankment middle (psf)	Foundation Removal (psf)	Foundation Replacement (psf)	Net Stress Change in Layer (psf)	α1 (rad)	α2 (rad)	Influence Value I'	Δσ between shear keys above shear key raft foundation (psf)	Δσ below shear key raft foundation	Final Stress (psf)	$C_{c\varepsilon}$ (-)	$C_{r\varepsilon}$ (-)	Vertical Strain $\varepsilon_{v,i}$ (%)	Change in Layer Thickness Δh_i (in)
0	1	0.5	Organics	-5.5	85	90	45	31	14	1.0	14	0.03	1.54	0.50	3960	-45	60	15	0.00	0.00	0.0	0	0	3989	0.18	0.036	0.0	0.00
1	2	1.5	Organics	-6.5	85	90	135	94	41	1.0	41	0.08	1.48	0.50	3960	-135	180	45	0.00	0.00	0.0	0	0	4046	0.18	0.036	0.0	0.00
2	3	2.5	Organics	-7.5	85	90	225	156	69	1.0	69	0.13	1.42	0.50	3959	-225	300	75	0.00	0.00	0.0	0	0	4103	0.18	0.036	0.0	0.00
3	4	3.5	Organics	-8.5	85	90	315	218	97	1.0	97	0.18	1.36	0.50	3959	-315	420	105	0.00	0.00	0.0	0	0	4160	0.18	0.036	0.0	0.00
4	5	4.5	Organics	-9.5	85	90	405	281	124	1.0	124	0.24	1.30	0.50	3957	-405	540	135	0.00	0.00	0.0	0	0	4216	0.18	0.036	0.0	0.00
5	6	5.5	Organics	-10.5	85	90	495	343	152	1.0	152	0.28	1.24	0.50	3955	-495	660	165	0.00	0.00	0.0	0	0	4272	0.18	0.036	0.0	0.00
6	7	6.5	Organics	-11.5	85	90	585	406	179	1.0	179	0.33	1.18	0.50	3952	-585	780	195	0.00	0.00	0.0	0	0	4326	0.18	0.036	0.0	0.00
7	8	7.5	Organics	-12.5	85	90	675	468	207	1.0	207	0.37	1.13	0.50	3948	-675	900	225	0.00	0.00	0.0	0	0	4380	0.18	0.036	0.0	0.00
8	9	8.5	Organics	-13.5	85	90	765	530	235	1.0	235	0.41	1.08	0.50	3943	-765	1020	255	0.00	0.00	0.0	0	0	4433	0.18	0.036	0.0	0.00
9	10	9.5	Organics	-14.5	85	90	855	593	262	1.0	262	0.45	1.03	0.50	3937	-855	1140	285	0.00	0.00	0.0	0	0	4484	0.18	0.036	0.0	0.00
10	11	10.5	Organics	-15.5	85	90	945	655	290	1.0	290	0.49	0.99	0.50	3930	-945	1260	315	0.00	0.00	0.0	0	0	4535	0.18	0.036	0.0	0.00
11	12	11.5	Organics	-16.5	85	90	1035	718	317	1.0	317	0.52	0.95	0.50	3922	-1035	1380	345	0.00	0.00	0.0	0	0	4584	0.18	0.036	0.0	0.00
12	13	12.5	Organics	-17.5	85	90	1125	780	345	1.0	345	0.55	0.91	0.49	3913	-1125	1500	375	0.00	0.00	0.0	0	0	4633	0.18	0.036	0.0	0.00
13	14	13.5	Organics	-18.5	85	90	1215	842	373	1.0	373	0.58	0.87	0.49	3903	-1215	1620	405	0.00	0.00	0.0	0	0	4681	0.18	0.036	0.0	0.00
14	15	14.5	Organics	-19.5	85	90	1305	905	400	1.0	400	0.61	0.83	0.49	3893	-1305	1740	435	0.00	0.00	0.0	0	0	4728	0.18	0.036	0.0	0.00
15	16	15.5	Soft to Medium Stiff Fine-Grained	-20.5	105	110	1415	967	448	1.0	448	0.64	0.80	0.49	3881	-1300	1733	433	0.00	0.00	0.0	0	0	4762	0.12	0.024	0.1	1.48
16	17	16.5	Soft to Medium Stiff Fine-Grained	-21.5	105	110	1525	1030	495	1.0	495	0.66	0.77	0.49	3869	-1290	1720	430	0.00	0.00	0.0	0	0	4794	0.12	0.024	0.1	1.42
17	18	17.5	Soft to Medium Stiff Fine-Grained	-22.5	105	110	1635	1092	543	1.0	543	0.68	0.74	0.49	3856	-1280	1707	427	0.00	0.00	0.0	0	0	4826	0.12	0.024	0.1	1.37
18	19	18.5	Soft to Medium Stiff Fine-Grained	-23.5	105	110	1745	1154	591	1.0	591	0.70	0.71	0.49	3842	-1271	1694	424	0.00	0.00	0.0	0	0	4856	0.12	0.024	0.1	1.32
19	20	19.5	Soft to Medium Stiff Fine-Grained	-24.5	105	110	1855	1217	638	1.0	638	0.72	0.69	0.48	3828	-1261	1681	420	0.00	0.00	0.0	0	0	4887	0.12	0.024	0.1	1.27
20	21	20.5	Soft to Medium Stiff Fine-Grained	-25.5	105	110	1965	1279	686	1.0	686	0.73	0.66	0.48	3813	-1251	1669	417	0.00	0.00	0.0	0	0	4916	0.12	0.024	0.1	1.23
21	22	21.5	Soft to Medium Stiff Fine-Grained	-26.5	105	110	2075	1342	733	1.0	733	0.75	0.64	0.48	3798	-1242	1656	414	0.00	0.00	0.0	0	0	4946	0.12	0.024	0.1	1.19
22	23	22.5	Soft to Medium Stiff Fine-Grained	-27.5	105	110	2185	1404	781	1.0	781	0.76	0.62	0.48	3782	-1233	1644	411	0.00	0.00	0.0	0	0	4974	0.12	0.024	0.1	1.16
23	24	23.5	Soft to Medium Stiff Fine-Grained	-28.5	105	110	2295	1466	829	1.0	829	0.77	0.60	0.48	3766	-1224	1632	408	0.00	0.00	0.0	0	0	5003	0.12	0.024	0.1	1.12
24	25	24.5	Soft to Medium Stiff Fine-Grained	-29.5	105	110	2405	1529	876	1.0	876	0.78	0.58	0.47	3750	-1215	1619	405	0.00	0.00	0.0	0	0	5031	0.12	0.024	0.1	1.09
25	26	25.5	Soft to Medium Stiff Fine-Grained	-30.5	105	110	2515	1591	924	1.0	924	0.79	0.56	0.47	3733	-1206	1608	402	0.00	0.00	0.0	0	0	5058	0.12	0.024	0.1	1.06
26	27	26.5	Soft to Medium Stiff Fine-Grained	-31.5	105	110	2625	1654	971	1.0	971	0.80	0.54	0.47	3715	-1197	1596	399	0.00	0.00	0.0	0	0	5086	0.12	0.024	0.1	1.04
27	28	27.5	Soft to Medium Stiff Fine-Grained	-32.5	105	110	2735	1716	1019	1.0	1019	0.81	0.53	0.47	3698	-1188	1584	396	0.00	0.00	0.0	0	0	5113	0.12	0.024	0.1	1.01
28	29	28.5	Soft to Medium Stiff Fine-Grained	-33.5	105	110	2845	1778	1067	1.0	1067	0.82	0.51	0.46	3680	-1179	1572	393	0.00	0.00	0.0	0	0	5140	0.12	0.024	0.1	0.98
29	30	29.5	Soft to Medium Stiff Fine-Grained	-34.5	105	110	2955	1841	1114	1.0	1114	0.82	0.50	0.46	3662	-1171	1561	390	0.00	0.00	0.0	0	0	5167	0.12	0.024	0.1	0.96
30	31	30.5	Medium Stiff Fine-Grained	-35.5	115	120	3075	1903	1172	1.0	1172	0.83	0.48	0.46	3644	-1162	1550	387	0.00	0.00	0.0	0	0	5203	0.07	0.014	0.0	0.54
31	32	31.5	Medium Stiff Fine-Grained	-36.5	115	120	3195	1966	1229	1.0	1229	0.83	0.47	0.46	3626	-1154	1539	385	0.00	0.00	0.0	0	0	5240	0.07	0.014	0.0	0.53
32	33	32.5	Medium Stiff Fine-Grained	-37.5	115	120	3315	2028	1287	1.0	1287	0.84	0.46	0.46	3607	-1146	1527	382	0.00	0.00	0.0	0	0	5276	0.07	0.014	0.0	0.51
33	34	33.5	Medium Stiff Fine-Grained	-38.5	115	120	3435	2090	1345	1.0	1345	0.84	0.45	0.45	3588	-1137	1517	379	0.00	0.00	0.0	0	0	5312	0.07	0.014	0.0	0.50
34	35	34.5	Medium Stiff Fine-Grained	-39.5	115	120	3555	2153	1402	1.0	1402	0.85	0.43	0.45	3570	-1129	1506	376	0.00	0.00	0.0	0	0	5348	0.07	0.014	0.0	0.49
35	36	35.5	Medium Stiff Fine-Grained	-40.5	115	120	3675	2215	1460	1.0	1460	0.85	0.42	0.45	3551	-1121	1495	374	0.00	0.00	0.0	0	0	5384	0.07	0.014	0.0	0.48
36	37	36.5	Medium Stiff Fine-Grained	-41.5	115	120	3795	2278	1517	1.0	1517	0.85	0.41	0.45	3532	-1113	1484	371	0.00	0.00	0.0	0	0	5420	0.07	0.014	0.0	0.46
37	38	37.5	Medium Stiff Fine-Grained	-42.5	115	120	3915	2340	1575	1.0	1575	0.85	0.40	0.44	3513	-1105	1474	368	0.00	0.00	0.0	0	0	5456	0.07	0.014	0.0	0.45
38	39	38.5	Medium Stiff Fine-Grained	-43.5	115	120	4035	2402	1633	1.0	1633	0.85	0.39	0.44	3493	-1098	1463	366	0.00	0.00	0.0	0	0	5492	0.07	0.014	0.0	0.44
39	40	39.5	Medium Stiff Fine-Grained	-44.5	115	120	4155	2465	1690	1.0	1690	0.86	0.38	0.44	3474	-1090	1453	363	0.00	0.00	0.0	0	0	5528	0.07	0.014	0.0	0.43
40	41	40.5	Medium Stiff Fine-Grained	-45.5	115	120	4275	2527	1748	1.0	1748	0.86	0.38	0.44	3455	-1082	1443	361	0.00	0.00	0.0	0	0	5564	0.07	0.014	0.0	0.42
41	42	41.5	Medium Stiff Fine-Grained	-46.5	115	120	4395	2590	1805	1.0	1805	0.86	0.37	0.43	3436	-1075	1433	358	0.00	0.00	0.0	0	0	5600	0.07	0.014	0.0	0.41
42	43	42.5	Medium Stiff Fine-Grained	-47.5	115	120	4515	2652	1863	1.0	1863	0.86	0.36	0.43	3417	-1067	1423	356	0.00	0.00	0.0	0	0	5635	0.07	0.014	0.0	0.40
43	44	43.5	Medium Stiff Fine-Grained	-48.5	115	120	4635	2714	1921	1.0	1921	0.86	0.35	0.43	3397	-1060	1413	353	0.00	0.00	0.0	0	0	5671	0.07	0.014	0.0	0.40
44	45	44.5	Medium Stiff Fine-Grained	-49.5	115	120	4755	2777	1978	1.0	1978	0.86	0.35	0.43	3378	-1053	1403	351	0.00	0.00	0.0	0	0	5707	0.07	0.014	0.0	0.39
45	46	45.5	Medium Stiff Fine-Grained	-50.5	115	120	4875	2839	2036	1.0	2036	0.86	0.34	0.42	3359	-1045	1394	348	0.00	0.00	0.0	0	0	5743	0.07	0.014	0.0	0.38
46	47	46.5	Medium Stiff Fine-Grained	-51.5	115	120	4995	2902	2093	1.0	2093	0.86	0.33	0.42	3340	-1038	1384	346	0.00	0.00	0.0	0	0	5779	0.07	0.014	0.0	0.37
47	48	47.5	Medium Stiff Fine-Grained	-52.5	115	120	5115	2964	2151	1.0	2151	0.85	0.32	0.42	3321	-1031	1375	344	0.00	0.00	0.0	0	0	5815	0.07	0.014	0.0	0.36
48	49	48.5	Medium Stiff Fine-Grained	-53.5	115	120	5235	3026	2209	1.0	2209	0.85	0.32	0.42	3301	-1024	1365	341	0.00	0.00	0.0	0	0	5851	0.07	0.014	0.0	0.36

Configuration **3H1V_P1_G1-RR30**

by: E. Ticen
Last Updated: February 2020

Geometry	Embankment Height, H	33	ft
	Embankment Side Slopes	3	xH:1V
	Crown Width	32	ft
	Half Crown Width, B1	16	ft
	Side Slope Width, B2	99	ft
	Unit Weight of Embankment, γ	120	pcf
	Depth to Ground Water	0	ft
	Maximum Stress Increase	3960	psf
	Water Surface Elevation	-5	ft
	Ground Surface Elevation	-5	ft
Foundation Improvements	Remove & Replace Depth [1]	30	ft
	Area Replacement Ratio	0	-
	Shear Key Thickness	0	ft
	Shear Key Depth	0	ft
	Shear Key Raft Foundation Depth	0.0	ft
	Shear key Spacing	--	ft
	Soil Arching b/w Shear Key	0	xV:1H
	Arching Stress Height	--	ft
	Arching Side Slope Width, B2	--	ft
	σmax Arching	0	psf

Notes:
1) Compacted fill where settlement of the material is considered to be negligible.
2)
3)
4)
5)
6)
7)

Total Settlement at Midpoint Between Shear Keys=	--	inches
Total Settlement at Shear Keys=	--	inches
Differential Settlement=	--	inches

		Depth (GS=0-ft)		Elevation (ft)		Unit Weight		Settlement					Staged Construction		
		Top	Bottom	Top	Bottom	Moist	Saturated	$C_{c\varepsilon} = C_c/(1+e_o)$	$C_{r\varepsilon} = C_{c\varepsilon}/5$	OCR	Total Layer Settlement		Reduction	Total Layer Settlement	
Layer	Description	(ft)	(ft)	(ft)	(ft)	(pcf)	(pcf)	(-)	(-)	(-)	(in)	(ft)	(%)	(in)	(ft)
1	Embankment Fill	-33	0	28	-5	115	120	0.01	0.002	5	0	0.00	100%	0	0.00
2	Organics	0	15	-5	-20	85	90	0.180	0.036	1	0.0	0.00	0%	0	0.00
3a	Soft to Medium Stiff Fine-Grained	15	30	-20	-35	105	110	0.120	0.024	1	0.0	0.00	0%	0	0.00
4	Medium Stiff Fine-Grained	30	50	-35	-55	115	120	0.070	0.014	1	8.9	0.74	0%	9	0.74
5	Stiff Fine-Grained	50	100	-55	-105	120	125	0.017	0.0034	1	2.8	0.24	0%	3	0.24
6	Dense Coarse-Grained	100	150	-105	-155	120	125	0.017	0.0034	1	1.4	0.11	0%	1	0.11
7	Stiff Fine-Grained	150	200	-155	-205	120	125	0.017	0.0034	1	0.7	0.06	0%	1	0.06
										Σ=	13.8	1.2	Σ=	13.8	1.2

							Pre Construction							Δσ due to Embankment Load (Das - 5.6)			Δσ due to Foundation R&R (2:1)			Δσ With Arching for Shear Keys (Das - 5.6)									
Top of Layer	Bottom of Layer	Depth (ft)	Layer (-)	Elevation (ft)	Moist Unit Weight (pcf)	Saturated Unit Weight (pcf)	Total Stress (psf)	Pore Pressure (psf)	Effective stress (psf)	OCR (-)	Pre- Consolidation Pressure (psf)	α_1 (rad)	α_2 (rad)	Influence Value I'	Δσ below Embankment middle (psf)	Foundation Removal (psf)	Foundation Replacement (psf)	Net Stress Change in Layer (psf)	α1 (rad)	α2 (rad)	Influence Value I'	Δσ between shear keys above shear key raft foundation (psf)	Δσ below shear key raft foundation	Final Stress (psf)	$C_{c\varepsilon}$ (-)	$C_{r\varepsilon}$ (-)	Vertical Strain $\varepsilon_{v,i}$ (%)	Change in Layer Thickness Δh_i (in)
0	1	0.5	Organics	-5.5	85	90	45	31	14	1.0	14	0.03	1.54	0.50	3960	-45	60	15	0.00	0.00	0.0	0	0	3989	0.18	0.036	0.0	0.00
1	2	1.5	Organics	-6.5	85	90	135	94	41	1.0	41	0.08	1.48	0.50	3960	-135	180	45	0.00	0.00	0.0	0	0	4046	0.18	0.036	0.0	0.00
2	3	2.5	Organics	-7.5	85	90	225	156	69	1.0	69	0.13	1.42	0.50	3959	-225	300	75	0.00	0.00	0.0	0	0	4103	0.18	0.036	0.0	0.00
3	4	3.5	Organics	-8.5	85	90	315	218	97	1.0	97	0.18	1.36	0.50	3959	-315	420	105	0.00	0.00	0.0	0	0	4160	0.18	0.036	0.0	0.00
4	5	4.5	Organics	-9.5	85	90	405	281	124	1.0	124	0.24	1.30	0.50	3957	-405	540	135	0.00	0.00	0.0	0	0	4216	0.18	0.036	0.0	0.00
5	6	5.5	Organics	-10.5	85	90	495	343	152	1.0	152	0.28	1.24	0.50	3955	-495	660	165	0.00	0.00	0.0	0	0	4272	0.18	0.036	0.0	0.00
6	7	6.5	Organics	-11.5	85	90	585	406	179	1.0	179	0.33	1.18	0.50	3952	-585	780	195	0.00	0.00	0.0	0	0	4326	0.18	0.036	0.0	0.00
7	8	7.5	Organics	-12.5	85	90	675	468	207	1.0	207	0.37	1.13	0.50	3948	-675	900	225	0.00	0.00	0.0	0	0	4380	0.18	0.036	0.0	0.00
8	9	8.5	Organics	-13.5	85	90	765	530	235	1.0	235	0.41	1.08	0.50	3943	-765	1020	255	0.00	0.00	0.0	0	0	4433	0.18	0.036	0.0	0.00
9	10	9.5	Organics	-14.5	85	90	855	593	262	1.0	262	0.45	1.03	0.50	3937	-855	1140	285	0.00	0.00	0.0	0	0	4484	0.18	0.036	0.0	0.00
10	11	10.5	Organics	-15.5	85	90	945	655	290	1.0	290	0.49	0.99	0.50	3930	-945	1260	315	0.00	0.00	0.0	0	0	4535	0.18	0.036	0.0	0.00
11	12	11.5	Organics	-16.5	85	90	1035	718	317	1.0	317	0.52	0.95	0.50	3922	-1035	1380	345	0.00	0.00	0.0	0	0	4584	0.18	0.036	0.0	0.00
12	13	12.5	Organics	-17.5	85	90	1125	780	345	1.0	345	0.55	0.91	0.49	3913	-1125	1500	375	0.00	0.00	0.0	0	0	4633	0.18	0.036	0.0	0.00
13	14	13.5	Organics	-18.5	85	90	1215	842	373	1.0	373	0.58	0.87	0.49	3903	-1215	1620	405	0.00	0.00	0.0	0	0	4681	0.18	0.036	0.0	0.00
14	15	14.5	Organics	-19.5	85	90	1305	905	400	1.0	400	0.61	0.83	0.49	3893	-1305	1740	435	0.00	0.00	0.0	0	0	4728	0.18	0.036	0.0	0.00
15	16	15.5	Soft to Medium Stiff Fine-Grained	-20.5	105	110	1415	967	448	1.0	448	0.64	0.80	0.49	3881	-1415	1860	445	0.00	0.00	0.0	0	0	4774	0.12	0.024	0.0	0.00
16	17	16.5	Soft to Medium Stiff Fine-Grained	-21.5	105	110	1525	1030	495	1.0	495	0.66	0.77	0.49	3869	-1525	1980	455	0.00	0.00	0.0	0	0	4819	0.12	0.024	0.0	0.00
17	18	17.5	Soft to Medium Stiff Fine-Grained	-22.5	105	110	1635	1092	543	1.0	543	0.68	0.74	0.49	3856	-1635	2100	465	0.00	0.00	0.0	0	0	4864	0.12	0.024	0.0	0.00
18	19	18.5	Soft to Medium Stiff Fine-Grained	-23.5	105	110	1745	1154	591	1.0	591	0.70	0.71	0.49	3842	-1745	2220	475	0.00	0.00	0.0	0	0	4908	0.12	0.024	0.0	0.00
19	20	19.5	Soft to Medium Stiff Fine-Grained	-24.5	105	110	1855	1217	638	1.0	638	0.72	0.69	0.48	3828	-1855	2340	485	0.00	0.00	0.0	0	0	4951	0.12	0.024	0.0	0.00
20	21	20.5	Soft to Medium Stiff Fine-Grained	-25.5	105	110	1965	1279	686	1.0	686	0.73	0.66	0.48	3813	-1965	2460	495	0.00	0.00	0.0	0	0	4994	0.12	0.024	0.0	0.00
21	22	21.5	Soft to Medium Stiff Fine-Grained	-26.5	105	110	2075	1342	733	1.0	733	0.75	0.64	0.48	3798	-2075	2580	505	0.00	0.00	0.0	0	0	5036	0.12	0.024	0.0	0.00
22	23	22.5	Soft to Medium Stiff Fine-Grained	-27.5	105	110	2185	1404	781	1.0	781	0.76	0.62	0.48	3782	-2185	2700	515	0.00	0.00	0.0	0	0	5078	0.12	0.024	0.0	0.00
23	24	23.5	Soft to Medium Stiff Fine-Grained	-28.5	105	110	2295	1466	829	1.0	829	0.77	0.60	0.48	3766	-2295	2820	525	0.00	0.00	0.0	0	0	5120	0.12	0.024	0.0	0.00
24	25	24.5	Soft to Medium Stiff Fine-Grained	-29.5	105	110	2405	1529	876	1.0	876	0.78	0.58	0.47	3750	-2405	2940	535	0.00	0.00	0.0	0	0	5161	0.12	0.024	0.0	0.00
25	26	25.5	Soft to Medium Stiff Fine-Grained	-30.5	105	110	2515	1591	924	1.0	924	0.79	0.56	0.47	3733	-2515	3060	545	0.00	0.00	0.0	0	0	5201	0.12	0.024	0.0	0.00
26	27	26.5	Soft to Medium Stiff Fine-Grained	-31.5	105	110	2625	1654	971	1.0	971	0.80	0.54	0.47	3715	-2625	3180	555	0.00	0.00	0.0	0	0	5242	0.12	0.024	0.0	0.00
27	28	27.5	Soft to Medium Stiff Fine-Grained	-32.5	105	110	2735	1716	1019	1.0	1019	0.81	0.53	0.47	3698	-2735	3300	565	0.00	0.00	0.0	0	0	5282	0.12	0.024	0.0	0.00
28	29	28.5	Soft to Medium Stiff Fine-Grained	-33.5	105	110	2845	1778	1067	1.0	1067	0.82	0.51	0.46	3680	-2845	3420	575	0.00	0.00	0.0	0	0	5322	0.12	0.024	0.0	0.00
29	30	29.5	Soft to Medium Stiff Fine-Grained	-34.5	105	110	2955	1841	1114	1.0	1114	0.82	0.50	0.46	3662	-2955	3540	585	0.00	0.00	0.0	0	0	5361	0.12	0.024	0.0	0.00
30	31	30.5	Medium Stiff Fine-Grained	-35.5	115	120	3075	1903	1172	1.0	1172	0.83	0.48	0.46	3644	-2945	3528	583	0.00	0.00	0.0	0	0	5399	0.07	0.014	0.0	0.56
31	32	31.5	Medium Stiff Fine-Grained	-36.5	115	120	3195	1966	1229	1.0	1229	0.83	0.47	0.46	3626	-2925	3504	579	0.00	0.00	0.0	0	0	5434	0.07	0.014	0.0	0.54
32	33	32.5	Medium Stiff Fine-Grained	-37.5	115	120	3315	2028	1287	1.0	1287	0.84	0.46	0.46	3607	-2905	3480	575	0.00	0.00	0.0	0	0	5469	0.07	0.014	0.0	0.53
33	34	33.5	Medium Stiff Fine-Grained	-38.5	115	120	3435	2090	1345	1.0	1345	0.84	0.45	0.45	3588	-2885	3456	571	0.00	0.00	0.0	0	0	5504	0.07	0.014	0.0	0.51
34	35	34.5	Medium Stiff Fine-Grained	-39.5	115	120	3555	2153	1402	1.0	1402	0.85	0.43	0.45	3570	-2865	3433	567	0.00	0.00	0.0	0	0	5539	0.07	0.014	0.0	0.50
35	36	35.5	Medium Stiff Fine-Grained	-40.5	115	120	3675	2215	1460	1.0	1460	0.85	0.42	0.45	3551	-2846	3409	563	0.00	0.00	0.0	0	0	5574	0.07	0.014	0.0	0.49
36	37	36.5	Medium Stiff Fine-Grained	-41.5	115	120	3795	2278	1517	1.0	1517	0.85	0.41	0.45	3532	-2827	3386	560	0.00	0.00	0.0	0	0	5609	0.07	0.014	0.0	0.48
37	38	37.5	Medium Stiff Fine-Grained	-42.5	115	120	3915	2340	1575	1.0	1575	0.85	0.40	0.44	3513	-2808	3364	556	0.00	0.00	0.0	0	0	5643	0.07	0.014	0.0	0.47
38	39	38.5	Medium Stiff Fine-Grained	-43.5	115	120	4035	2402	1633	1.0	1633	0.85	0.39	0.44	3493	-2789	3341	552	0.00	0.00	0.0	0	0	5678	0.07	0.014	0.0	0.45
39	40	39.5	Medium Stiff Fine-Grained	-44.5	115	120	4155	2465	1690	1.0	1690	0.86	0.38	0.44	3474	-2771	3319	548	0.00	0.00	0.0	0	0	5713	0.07	0.014	0.0	0.44
40	41	40.5	Medium Stiff Fine-Grained	-45.5	115	120	4275	2527	1748	1.0	1748	0.86	0.38	0.44	3455	-2752	3297	545	0.00	0.00	0.0	0	0	5748	0.07	0.014	0.0	0.43
41	42	41.5	Medium Stiff Fine-Grained	-46.5	115	120	4395	2590	1805	1.0	1805	0.86	0.37	0.43	3436	-2734	3275	541	0.00	0.00	0.0	0	0	5782	0.07	0.014	0.0	0.42
42	43	42.5	Medium Stiff Fine-Grained	-47.5	115	120	4515	2652	1863	1.0	1863	0.86	0.36	0.43	3417	-2716	3253	538	0.00	0.00	0.0	0	0	5817	0.07	0.014	0.0	0.42
43	44	43.5	Medium Stiff Fine-Grained	-48.5	115	120	4635	2714	1921	1.0	1921	0.86	0.35	0.43	3397	-2698	3232	534	0.00	0.00	0.0	0	0	5852	0.07	0.014	0.0	0.41
44	45	44.5	Medium Stiff Fine-Grained	-49.5	115	120	4755	2777	1978	1.0	1978	0.86	0.35	0.43	3378	-2680	3211	531	0.00	0.00	0.0	0	0	5887	0.07	0.014	0.0	0.40
45	46	45.5	Medium Stiff Fine-Grained	-50.5	115	120	4875	2839	2036	1.0	2036	0.86	0.34	0.42	3359	-2663	3190	527	0.00	0.00	0.0	0	0	5922	0.07	0.014	0.0	0.39
46	47	46.5	Medium Stiff Fine-Grained	-51.5	115	120	4995	2902	2093	1.0	2093	0.86	0.33	0.42	3340	-2645	3169	524	0.00	0.00	0.0	0	0	5957	0.07	0.014	0.0	0.38
47	48	47.5	Medium Stiff Fine-Grained	-52.5	115	120	5115	2964	2151	1.0	2151	0.85	0.32	0.42	3321	-2628	3149	520	0.00	0.00	0.0	0	0	5992	0.07	0.014	0.0	0.37
48	49	48.5	Medium Stiff Fine-Grained	-53.5	115	120	5235	3026	2209	1.0	2209	0.85	0.32	0.42	3301	-2611	3128	517	0.00	0.00	0.0	0	0	6027	0.07	0.014	0.0	0.37

Configuration **3H1V_P1_G2-AR15**

by: E. Ticen
Last Updated: February 2020

Geometry	Embankment Height, H	33	ft
	Embankment Side Slopes	3	xH:1V
	Crown Width	32	ft
	Half Crown Width, B1	16	ft
	Side Slope Width, B2	99	ft
	Unit Weight of Embankment, γ	120	pcf
	Depth to Ground Water	0	ft
	Maximum Stress Increase	3960	psf
	Water Surface Elevation	-5	ft
	Ground Surface Elevation	-5	ft
Foundation Improvements	Remove & Replace Depth [1]	6	ft
	Area Replacement Ratio	0.15	-
	Shear Key Thickness	2.5	ft
	Shear Key Depth	40	ft
	Shear Key Raft Foundation Depth	26.7	ft
	Shear key Spacing	16.7	ft
	Soil Arching b/w Shear Key	0.5	xV:1H
	Arching Stress Height	4	ft
	Arching Side Slope Width, B2	8.3	ft
	σmax Arching	425	psf

Notes:
1) Compacted fill where settlement of the material is considered to be negligible.
2)
3)
4)
5)
6)
7)

Total Settlement at Midpoint Between Shear Keys=	26.2	inches
Total Settlement at Shear Keys=	15.7	inches
Differential Settlement=	10.5	inches

		Depth (GS=0-ft)		Elevation (ft)		Unit Weight		Settlement					Staged Construction		
		Top	Bottom	Top	Bottom	Moist	Saturated	$C_{c\varepsilon} = C_c/(1+e_o)$	$C_{r\varepsilon} = C_{cE}/5$	OCR	Total Layer Settlement		Reduction	Total Layer Settlement	
Layer	Description	(ft)	(ft)	(ft)	(ft)	(pcf)	(pcf)	(-)	(-)	(-)	(in)	(ft)	(%)	(in)	(ft)
1	Embankment Fill	-33	0	28	-5	115	120	0.01	0.002	5	0	0.00	100%	0	0.00
2	Organics	0	15	-5	-20	85	90	0.180	0.036	1	7.3	0.61	0%	7	0.61
3a	Soft to Medium Stiff Fine-Grained	15	30	-20	-35	105	110	0.120	0.024	1	6.1	0.51	0%	6	0.51
4	Medium Stiff Fine-Grained	30	50	-35	-55	115	120	0.070	0.014	1	8.5	0.71	0%	8	0.71
5	Stiff Fine-Grained	50	100	-55	-105	120	125	0.017	0.0034	1	2.5	0.21	0%	3	0.21
6	Dense Coarse-Grained	100	150	-105	-155	120	125	0.017	0.0034	1	1.2	0.10	0%	1	0.10
7	Stiff Fine-Grained	150	200	-155	-205	120	125	0.017	0.0034	1	0.6	0.05	0%	1	0.05
										Σ=	26.2	2.2	Σ=	26.2	2.2

							Pre Construction					Δσ due to Embankment Load (Das - 5.6)				Δσ due to Foundation R&R (2:1)			Δσ With Arching for Shear Keys (Das - 5.6)									
Top of Layer	Bottom of Layer	Depth (ft)	Layer (-)	Elevation (ft)	Moist Unit Weight (pcf)	Saturated Unit Weight (pcf)	Total Stress (psf)	Pore Pressure (psf)	Effective stress (psf)	OCR (-)	Pre- Consolidation Pressure (psf)	α_1 (rad)	α_2 (rad)	Influence Value I'	Δσ below Embankment middle (psf)	Foundation Removal (psf)	Foundation Replacement (psf)	Net Stress Change in Layer (psf)	α1 (rad)	α2 (rad)	Influence Value I'	Δσ between shear keys above shear key raft foundation (psf)	Δσ below shear key raft foundation	Final Stress (psf)	$C_{c\varepsilon}$ (-)	$C_{r\varepsilon}$ (-)	Vertical Strain $\varepsilon_{v,i}$ (%)	Change in Layer Thickness Δh_i (in)
0	1	0.5	Organics	-5.5	85	90	45	31	14	1.0	14	0.03	1.54	0.50	3960	-45	60	15	1.51	0.00	0.5	409	0	438	0.18	0.036	0.0	0.00
1	2	1.5	Organics	-6.5	85	90	135	94	41	1.0	41	0.08	1.48	0.50	3960	-135	180	45	1.39	0.00	0.4	377	0	463	0.18	0.036	0.0	0.00
2	3	2.5	Organics	-7.5	85	90	225	156	69	1.0	69	0.13	1.42	0.50	3959	-225	300	75	1.28	0.00	0.4	346	0	490	0.18	0.036	0.0	0.00
3	4	3.5	Organics	-8.5	85	90	315	218	97	1.0	97	0.18	1.36	0.50	3959	-315	420	105	1.17	0.00	0.4	317	0	519	0.18	0.036	0.0	0.00
4	5	4.5	Organics	-9.5	85	90	405	281	124	1.0	124	0.24	1.30	0.50	3957	-405	540	135	1.08	0.00	0.3	291	0	550	0.18	0.036	0.0	0.00
5	6	5.5	Organics	-10.5	85	90	495	343	152	1.0	152	0.28	1.24	0.50	3955	-495	660	165	0.99	0.00	0.3	267	0	584	0.18	0.036	0.0	0.00
6	7	6.5	Organics	-11.5	85	90	585	406	179	1.0	179	0.33	1.18	0.50	3952	-493	657	164	0.91	0.00	0.3	246	0	589	0.18	0.036	0.1	1.12
7	8	7.5	Organics	-12.5	85	90	675	468	207	1.0	207	0.37	1.13	0.50	3948	-489	652	163	0.84	0.00	0.3	227	0	597	0.18	0.036	0.1	0.99
8	9	8.5	Organics	-13.5	85	90	765	530	235	1.0	235	0.41	1.08	0.50	3943	-485	647	162	0.78	0.00	0.2	213	0	609	0.18	0.036	0.1	0.89
9	10	9.5	Organics	-14.5	85	90	855	593	262	1.0	262	0.45	1.03	0.50	3937	-481	641	160	0.72	0.00	0.2	213	0	635	0.18	0.036	0.1	0.83
10	11	10.5	Organics	-15.5	85	90	945	655	290	1.0	290	0.49	0.99	0.50	3930	-477	636	159	0.67	0.00	0.2	213	0	661	0.18	0.036	0.1	0.77
11	12	11.5	Organics	-16.5	85	90	1035	718	317	1.0	317	0.52	0.95	0.50	3922	-473	631	158	0.63	0.00	0.2	213	0	688	0.18	0.036	0.1	0.73
12	13	12.5	Organics	-17.5	85	90	1125	780	345	1.0	345	0.55	0.91	0.49	3913	-469	626	156	0.59	0.00	0.2	213	0	714	0.18	0.036	0.1	0.68
13	14	13.5	Organics	-18.5	85	90	1215	842	373	1.0	373	0.58	0.87	0.49	3903	-466	621	155	0.55	0.00	0.2	213	0	740	0.18	0.036	0.1	0.64
14	15	14.5	Organics	-19.5	85	90	1305	905	400	1.0	400	0.61	0.83	0.49	3893	-462	616	154	0.52	0.00	0.2	213	0	767	0.18	0.036	0.1	0.61
15	16	15.5	Soft to Medium Stiff Fine-Grained	-20.5	105	110	1415	967	448	1.0	448	0.64	0.80	0.49	3881	-458	611	153	0.49	0.00	0.2	213	0	813	0.12	0.024	0.0	0.37
16	17	16.5	Soft to Medium Stiff Fine-Grained	-21.5	105	110	1525	1030	495	1.0	495	0.66	0.77	0.49	3869	-455	606	152	0.47	0.00	0.1	213	0	859	0.12	0.024	0.0	0.34
17	18	17.5	Soft to Medium Stiff Fine-Grained	-22.5	105	110	1635	1092	543	1.0	543	0.68	0.74	0.49	3856	-451	601	150	0.44	0.00	0.1	213	0	906	0.12	0.024	0.0	0.32
18	19	18.5	Soft to Medium Stiff Fine-Grained	-23.5	105	110	1745	1154	591	1.0	591	0.70	0.71	0.49	3842	-448	597	149	0.42	0.00	0.1	213	0	952	0.12	0.024	0.0	0.30
19	20	19.5	Soft to Medium Stiff Fine-Grained	-24.5	105	110	1855	1217	638	1.0	638	0.72	0.69	0.48	3828	-444	592	148	0.40	0.00	0.1	213	0	999	0.12	0.024	0.0	0.28
20	21	20.5	Soft to Medium Stiff Fine-Grained	-25.5	105	110	1965	1279	686	1.0	686	0.73	0.66	0.48	3813	-441	587	147	0.39	0.00	0.1	213	0	1045	0.12	0.024	0.0	0.26
21	22	21.5	Soft to Medium Stiff Fine-Grained	-26.5	105	110	2075	1342	733	1.0	733	0.75	0.64	0.48	3798	-437	583	146	0.37	0.00	0.1	213	0	1092	0.12	0.024	0.0	0.25
22	23	22.5	Soft to Medium Stiff Fine-Grained	-27.5	105	110	2185	1404	781	1.0	781	0.76	0.62	0.48	3782	-434	578	145	0.35	0.00	0.1	213	0	1138	0.12	0.024	0.0	0.24
23	24	23.5	Soft to Medium Stiff Fine-Grained	-28.5	105	110	2295	1466	829	1.0	829	0.77	0.60	0.48	3766	-430	574	143	0.34	0.00	0.1	213	0	1185	0.12	0.024	0.0	0.22
24	25	24.5	Soft to Medium Stiff Fine-Grained	-29.5	105	110	2405	1529	876	1.0	876	0.78	0.58	0.47	3750	-427	570	142	0.33	0.00	0.1	213	0	1231	0.12	0.024	0.0	0.21
25	26	25.5	Soft to Medium Stiff Fine-Grained	-30.5	105	110	2515	1591	924	1.0	924	0.79	0.56	0.47	3733	-424	565	141	0.32	0.00	0.1	213	0	1278	0.12	0.024	0.0	0.20
26	27	26.5	Soft to Medium Stiff Fine-Grained	-31.5	105	110	2625	1654	971	1.0	971	0.80	0.54	0.47	3715	-421	561	140	0.30	0.00	0.1	213	0	1324	0.12	0.024	0.0	0.19
27	28	27.5	Soft to Medium Stiff Fine-Grained	-32.5	105	110	2735	1716	1019	1.0	1019	0.81	0.53	0.47	3698	-418	557	139	0.29	0.00	0.1	0	3931	5090	0.12	0.024	0.1	1.01
28	29	28.5	Soft to Medium Stiff Fine-Grained	-33.5	105	110	2845	1778	1067	1.0	1067	0.82	0.51	0.46	3680	-414	552	138	0.28	0.00	0.1	0	3898	5102	0.12	0.024	0.1	0.98
29	30	29.5	Soft to Medium Stiff Fine-Grained	-34.5	105	110	2955	1841	1114	1.0	1114	0.82	0.50	0.46	3662	-411	548	137	0.28	0.00	0.1	0	3864	5115	0.12	0.024	0.1	0.95
30	31	30.5	Medium Stiff Fine-Grained	-35.5	115	120	3075	1903	1172	1.0	1172	0.83	0.48	0.46	3644	-408	544	136	0.27	0.00	0.1	0	3831	5139	0.07	0.014	0.0	0.54
31	32	31.5	Medium Stiff Fine-Grained	-36.5	115	120	3195	1966	1229	1.0	1229	0.83	0.47	0.46	3626	-405	540	135	0.26	0.00	0.1	0	3799	5163	0.07	0.014	0.0	0.52
32	33	32.5	Medium Stiff Fine-Grained	-37.5	115	120	3315	2028	1287	1.0	1287	0.84	0.46	0.46	3607	-402	536	134	0.25	0.00	0.1	0	3767	5188	0.07	0.014	0.0	0.51
33	34	33.5	Medium Stiff Fine-Grained	-38.5	115	120	3435	2090	1345	1.0	1345	0.84	0.45	0.45	3588	-399	532	133	0.24	0.00	0.1	0	3735	5212	0.07	0.014	0.0	0.49
34	35	34.5	Medium Stiff Fine-Grained	-39.5	115	120	3555	2153	1402	1.0	1402	0.85	0.43	0.45	3570	-396	528	132	0.24	0.00	0.1	0	3703	5238	0.07	0.014	0.0	0.48
35	36	35.5	Medium Stiff Fine-Grained	-40.5	115	120	3675	2215	1460	1.0	1460	0.85	0.42	0.45	3551	-393	524	131	0.23	0.00	0.1	0	3672	5263	0.07	0.014	0.0	0.47
36	37	36.5	Medium Stiff Fine-Grained	-41.5	115	120	3795	2278	1517	1.0	1517	0.85	0.41	0.45	3532	-390	521	130	0.22	0.00	0.1	0	3642	5289	0.07	0.014	0.0	0.46
37	38	37.5	Medium Stiff Fine-Grained	-42.5	115	120	3915	2340	1575	1.0	1575	0.85	0.40	0.44	3513	-388	517	129	0.22	0.00	0.1	0	3612	5316	0.07	0.014	0.0	0.44
38	39	38.5	Medium Stiff Fine-Grained	-43.5	115	120	4035	2402	1633	1.0	1633	0.85	0.39	0.44	3493	-385	513	128	0.21	0.00	0.1	0	3582	5343	0.07	0.014	0.0	0.43
39	40	39.5	Medium Stiff Fine-Grained	-44.5	115	120	4155	2465	1690	1.0	1690	0.86	0.38	0.44	3474	-382	509	127	0.21	0.00	0.1	0	3553	5370	0.07	0.014	0.0	0.42
40	41	40.5	Medium Stiff Fine-Grained	-45.5	115	120	4275	2527	1748	1.0	1748	0.86	0.38	0.44	3455	-379	506	126	0.20	0.00	0.1	0	3523	5398	0.07	0.014	0.0	0.41
41	42	41.5	Medium Stiff Fine-Grained	-46.5	115	120	4395	2590	1805	1.0	1805	0.86	0.37	0.43	3436	-376	502	125	0.20	0.00	0.1	0	3495	5426	0.07	0.014	0.0	0.40
42	43	42.5	Medium Stiff Fine-Grained	-47.5	115	120	4515	2652	1863	1.0	1863	0.86	0.36	0.43	3417	-374	498	125	0.19	0.00	0.1	0	3466	5454	0.07	0.014	0.0	0.39
43	44	43.5	Medium Stiff Fine-Grained	-48.5	115	120	4635	2714	1921	1.0	1921	0.86	0.35	0.43	3397	-371	495	124	0.19	0.00	0.1	0	3438	5483	0.07	0.014	0.0	0.38
44	45	44.5	Medium Stiff Fine-Grained	-49.5	115	120	4755	2777	1978	1.0	1978	0.86	0.35	0.43	3378	-368	491	123	0.19	0.00	0.1	0	3411	5512	0.07	0.014	0.0	0.37
45	46	45.5	Medium Stiff Fine-Grained	-50.5	115	120	4875	2839	2036	1.0	2036	0.86	0.34	0.42	3359	-366	488	122	0.18	0.00	0.1	0	3383	5541	0.07	0.014	0.0	0.37
46	47	46.5	Medium Stiff Fine-Grained	-51.5	115	120	4995	2902	2093	1.0	2093	0.86	0.33	0.42	3340	-363	484	121	0.18	0.00	0.1	0	3356	5571	0.07	0.014	0.0	0.36
47	48	47.5	Medium Stiff Fine-Grained	-52.5	115	120	5115	2964	2151	1.0	2151	0.85	0.32	0.42	3321	-361	481	120	0.17	0.00	0.1	0	3330	5601	0.07	0.014	0.0	0.35
48	49	48.5	Medium Stiff Fine-Grained	-53.5	115	120	5235	3026	2209	1.0	2209	0.85	0.32	0.42	3301	-358	478	119	0.17	0.00	0.1	0	3303	5631	0.07	0.014	0.0	0.34

Configuration **3H1V_P1_G2-AR25**

by: E. Ticen
Last Updated: February 2020

Geometry	Embankment Height, H	33	ft
	Embankment Side Slopes	3	xH:1V
	Crown Width	32	ft
	Half Crown Width, B1	16	ft
	Side Slope Width, B2	99	ft
	Unit Weight of Embankment, γ	120	pcf
	Depth to Ground Water	0	ft
	Maximum Stress Increase	3960	psf
	Water Surface Elevation	-5	ft
	Ground Surface Elevation	-5	ft
Foundation Improvements	Remove & Replace Depth [1]	6	ft
	Area Replacement Ratio	0.25	-
	Shear Key Thickness	2.5	ft
	Shear Key Depth	40	ft
	Shear Key Raft Foundation Depth	26.7	ft
	Shear key Spacing	10.0	ft
	Soil Arching b/w Shear Key	0.5	xV:1H
	Arching Stress Height	2	ft
	Arching Side Slope Width, B2	5.0	ft
	σmax Arching	225	psf

Notes:
1) Compacted fill where settlement of the material is considered to be negligible.
2)
3)
4)
5)
6)
7)

Total Settlement at Midpoint Between Shear Keys=	23.9	inches
Total Settlement at Shear Keys=	15.7	inches
Differential Settlement=	8.2	inches

		Depth (GS=0-ft)		Elevation (ft)		Unit Weight		Settlement					Staged Construction		
		Top	Bottom	Top	Bottom	Moist	Saturated	$C_{c\varepsilon} = C_c/(1+e_o)$	$C_{r\varepsilon} = C_{cd}/5$	OCR	Total Layer Settlement		Reduction	Total Layer Settlement	
Layer	Description	(ft)	(ft)	(ft)	(ft)	(pcf)	(pcf)	(-)	(-)	(-)	(in)	(ft)	(%)	(in)	(ft)
1	Embankment Fill	-33	0	28	-5	115	120	0.01	0.002	5	0	0.00	100%	0	0.00
2	Organics	0	15	-5	-20	85	90	0.180	0.036	1	5.8	0.48	0%	6	0.48
3a	Soft to Medium Stiff Fine-Grained	15	30	-20	-35	105	110	0.120	0.024	1	5.4	0.45	0%	5	0.45
4	Medium Stiff Fine-Grained	30	50	-35	-55	115	120	0.070	0.014	1	8.5	0.71	0%	8	0.71
5	Stiff Fine-Grained	50	100	-55	-105	120	125	0.017	0.0034	1	2.5	0.21	0%	3	0.21
6	Dense Coarse-Grained	100	150	-105	-155	120	125	0.017	0.0034	1	1.2	0.10	0%	1	0.10
7	Stiff Fine-Grained	150	200	-155	-205	120	125	0.017	0.0034	1	0.6	0.05	0%	1	0.05
										Σ=	23.9	2.0	Σ=	23.9	2.0

							Pre Construction					Δσ due to Embankment Load (Das - 5.6)				Δσ due to Foundation R&R (2:1)			Δσ With Arching for Shear Keys (Das - 5.6)								
Top of Layer	Bottom of Layer	Depth (ft)	Layer (-)	Elevation (ft)	Moist Unit Weight (pcf)	Saturated Unit Weight (pcf)	Total Stress (psf)	Pore Pressure (psf)	Effective stress (psf)	OCR (-)	Pre- Consolidation Pressure (psf)	α_1 (rad)	α_2 (rad)	Influence Value I'	Δσ below Embankment middle (psf)	Foundation Removal (psf)	Foundation Replacement (psf)	Net Stress Change in Layer (psf)	α1 (rad)	α2 (rad)	Influence Value I'	Δσ between shear keys above shear key raft foundation (psf)	Δσ below shear key raft foundation	Final Stress (psf)	$C_{c\varepsilon}$ (-)	$C_{r\varepsilon}$ (-)	Vertical Strain $\varepsilon_{v,i}$ (%)	Change in Layer Thickness Δh_i (in)
0	1	0.5	Organics	-5.5	85	90	45	31	14	1.0	14	0.03	1.54	0.50	3960	-45	60	15	1.47	0.00	0.5	211	0	240	0.18	0.036	0.0	0.00
1	2	1.5	Organics	-6.5	85	90	135	94	41	1.0	41	0.08	1.48	0.50	3960	-135	180	45	1.28	0.00	0.4	183	0	270	0.18	0.036	0.0	0.00
2	3	2.5	Organics	-7.5	85	90	225	156	69	1.0	69	0.13	1.42	0.50	3959	-225	300	75	1.11	0.00	0.4	159	0	303	0.18	0.036	0.0	0.00
3	4	3.5	Organics	-8.5	85	90	315	218	97	1.0	97	0.18	1.36	0.50	3959	-315	420	105	0.96	0.00	0.3	138	0	339	0.18	0.036	0.0	0.00
4	5	4.5	Organics	-9.5	85	90	405	281	124	1.0	124	0.24	1.30	0.50	3957	-405	540	135	0.84	0.00	0.3	120	0	379	0.18	0.036	0.0	0.00
5	6	5.5	Organics	-10.5	85	90	495	343	152	1.0	152	0.28	1.24	0.50	3955	-495	660	165	0.74	0.00	0.2	113	0	429	0.18	0.036	0.0	0.00
6	7	6.5	Organics	-11.5	85	90	585	406	179	1.0	179	0.33	1.18	0.50	3952	-493	657	164	0.66	0.00	0.2	113	0	456	0.18	0.036	0.1	0.88
7	8	7.5	Organics	-12.5	85	90	675	468	207	1.0	207	0.37	1.13	0.50	3948	-489	652	163	0.59	0.00	0.2	113	0	482	0.18	0.036	0.1	0.79
8	9	8.5	Organics	-13.5	85	90	765	530	235	1.0	235	0.41	1.08	0.50	3943	-485	647	162	0.53	0.00	0.2	113	0	509	0.18	0.036	0.1	0.73
9	10	9.5	Organics	-14.5	85	90	855	593	262	1.0	262	0.45	1.03	0.50	3937	-481	641	160	0.48	0.00	0.2	113	0	535	0.18	0.036	0.1	0.67
10	11	10.5	Organics	-15.5	85	90	945	655	290	1.0	290	0.49	0.99	0.50	3930	-477	636	159	0.44	0.00	0.1	113	0	561	0.18	0.036	0.1	0.62
11	12	11.5	Organics	-16.5	85	90	1035	718	317	1.0	317	0.52	0.95	0.50	3922	-473	631	158	0.41	0.00	0.1	113	0	588	0.18	0.036	0.0	0.58
12	13	12.5	Organics	-17.5	85	90	1125	780	345	1.0	345	0.55	0.91	0.49	3913	-469	626	156	0.38	0.00	0.1	113	0	614	0.18	0.036	0.0	0.54
13	14	13.5	Organics	-18.5	85	90	1215	842	373	1.0	373	0.58	0.87	0.49	3903	-466	621	155	0.35	0.00	0.1	113	0	640	0.18	0.036	0.0	0.51
14	15	14.5	Organics	-19.5	85	90	1305	905	400	1.0	400	0.61	0.83	0.49	3893	-462	616	154	0.33	0.00	0.1	113	0	667	0.18	0.036	0.0	0.48
15	16	15.5	Soft to Medium Stiff Fine-Grained	-20.5	105	110	1415	967	448	1.0	448	0.64	0.80	0.49	3881	-458	611	153	0.31	0.00	0.1	113	0	713	0.12	0.024	0.0	0.29
16	17	16.5	Soft to Medium Stiff Fine-Grained	-21.5	105	110	1525	1030	495	1.0	495	0.66	0.77	0.49	3869	-455	606	152	0.29	0.00	0.1	113	0	759	0.12	0.024	0.0	0.27
17	18	17.5	Soft to Medium Stiff Fine-Grained	-22.5	105	110	1635	1092	543	1.0	543	0.68	0.74	0.49	3856	-451	601	150	0.28	0.00	0.1	113	0	806	0.12	0.024	0.0	0.25
18	19	18.5	Soft to Medium Stiff Fine-Grained	-23.5	105	110	1745	1154	591	1.0	591	0.70	0.71	0.49	3842	-448	597	149	0.26	0.00	0.1	113	0	852	0.12	0.024	0.0	0.23
19	20	19.5	Soft to Medium Stiff Fine-Grained	-24.5	105	110	1855	1217	638	1.0	638	0.72	0.69	0.48	3828	-444	592	148	0.25	0.00	0.1	113	0	899	0.12	0.024	0.0	0.21
20	21	20.5	Soft to Medium Stiff Fine-Grained	-25.5	105	110	1965	1279	686	1.0	686	0.73	0.66	0.48	3813	-441	587	147	0.24	0.00	0.1	113	0	945	0.12	0.024	0.0	0.20
21	22	21.5	Soft to Medium Stiff Fine-Grained	-26.5	105	110	2075	1342	733	1.0	733	0.75	0.64	0.48	3798	-437	583	146	0.23	0.00	0.1	113	0	992	0.12	0.024	0.0	0.19
22	23	22.5	Soft to Medium Stiff Fine-Grained	-27.5	105	110	2185	1404	781	1.0	781	0.76	0.62	0.48	3782	-434	578	145	0.22	0.00	0.1	113	0	1038	0.12	0.024	0.0	0.18
23	24	23.5	Soft to Medium Stiff Fine-Grained	-28.5	105	110	2295	1466	829	1.0	829	0.77	0.60	0.48	3766	-430	574	143	0.21	0.00	0.1	113	0	1085	0.12	0.024	0.0	0.17
24	25	24.5	Soft to Medium Stiff Fine-Grained	-29.5	105	110	2405	1529	876	1.0	876	0.78	0.58	0.47	3750	-427	570	142	0.20	0.00	0.1	113	0	1131	0.12	0.024	0.0	0.16
25	26	25.5	Soft to Medium Stiff Fine-Grained	-30.5	105	110	2515	1591	924	1.0	924	0.79	0.56	0.47	3733	-424	565	141	0.19	0.00	0.1	113	0	1178	0.12	0.024	0.0	0.15
26	27	26.5	Soft to Medium Stiff Fine-Grained	-31.5	105	110	2625	1654	971	1.0	971	0.80	0.54	0.47	3715	-421	561	140	0.19	0.00	0.1	113	0	1224	0.12	0.024	0.0	0.14
27	28	27.5	Soft to Medium Stiff Fine-Grained	-32.5	105	110	2735	1716	1019	1.0	1019	0.81	0.53	0.47	3698	-418	557	139	0.18	0.00	0.1	0	3931	5090	0.12	0.024	0.1	1.01
28	29	28.5	Soft to Medium Stiff Fine-Grained	-33.5	105	110	2845	1778	1067	1.0	1067	0.82	0.51	0.46	3680	-414	552	138	0.17	0.00	0.1	0	3898	5102	0.12	0.024	0.1	0.98
29	30	29.5	Soft to Medium Stiff Fine-Grained	-34.5	105	110	2955	1841	1114	1.0	1114	0.82	0.50	0.46	3662	-411	548	137	0.17	0.00	0.1	0	3864	5115	0.12	0.024	0.1	0.95
30	31	30.5	Medium Stiff Fine-Grained	-35.5	115	120	3075	1903	1172	1.0	1172	0.83	0.48	0.46	3644	-408	544	136	0.16	0.00	0.1	0	3831	5139	0.07	0.014	0.0	0.54
31	32	31.5	Medium Stiff Fine-Grained	-36.5	115	120	3195	1966	1229	1.0	1229	0.83	0.47	0.46	3626	-405	540	135	0.16	0.00	0.1	0	3799	5163	0.07	0.014	0.0	0.52
32	33	32.5	Medium Stiff Fine-Grained	-37.5	115	120	3315	2028	1287	1.0	1287	0.84	0.46	0.46	3607	-402	536	134	0.15	0.00	0.0	0	3767	5188	0.07	0.014	0.0	0.51
33	34	33.5	Medium Stiff Fine-Grained	-38.5	115	120	3435	2090	1345	1.0	1345	0.84	0.45	0.45	3588	-399	532	133	0.15	0.00	0.0	0	3735	5212	0.07	0.014	0.0	0.49
34	35	34.5	Medium Stiff Fine-Grained	-39.5	115	120	3555	2153	1402	1.0	1402	0.85	0.43	0.45	3570	-396	528	132	0.14	0.00	0.0	0	3703	5238	0.07	0.014	0.0	0.48
35	36	35.5	Medium Stiff Fine-Grained	-40.5	115	120	3675	2215	1460	1.0	1460	0.85	0.42	0.45	3551	-393	524	131	0.14	0.00	0.0	0	3672	5263	0.07	0.014	0.0	0.47
36	37	36.5	Medium Stiff Fine-Grained	-41.5	115	120	3795	2278	1517	1.0	1517	0.85	0.41	0.45	3532	-390	521	130	0.14	0.00	0.0	0	3642	5289	0.07	0.014	0.0	0.46
37	38	37.5	Medium Stiff Fine-Grained	-42.5	115	120	3915	2340	1575	1.0	1575	0.85	0.40	0.44	3513	-388	517	129	0.13	0.00	0.0	0	3612	5316	0.07	0.014	0.0	0.44
38	39	38.5	Medium Stiff Fine-Grained	-43.5	115	120	4035	2402	1633	1.0	1633	0.85	0.39	0.44	3493	-385	513	128	0.13	0.00	0.0	0	3582	5343	0.07	0.014	0.0	0.43
39	40	39.5	Medium Stiff Fine-Grained	-44.5	115	120	4155	2465	1690	1.0	1690	0.86	0.38	0.44	3474	-382	509	127	0.13	0.00	0.0	0	3553	5370	0.07	0.014	0.0	0.42
40	41	40.5	Medium Stiff Fine-Grained	-45.5	115	120	4275	2527	1748	1.0	1748	0.86	0.38	0.44	3455	-379	506	126	0.12	0.00	0.0	0	3523	5398	0.07	0.014	0.0	0.41
41	42	41.5	Medium Stiff Fine-Grained	-46.5	115	120	4395	2590	1805	1.0	1805	0.86	0.37	0.43	3436	-376	502	125	0.12	0.00	0.0	0	3495	5426	0.07	0.014	0.0	0.40
42	43	42.5	Medium Stiff Fine-Grained	-47.5	115	120	4515	2652	1863	1.0	1863	0.86	0.36	0.43	3417	-374	498	125	0.12	0.00	0.0	0	3466	5454	0.07	0.014	0.0	0.39
43	44	43.5	Medium Stiff Fine-Grained	-48.5	115	120	4635	2714	1921	1.0	1921	0.86	0.35	0.43	3397	-371	495	124	0.11	0.00	0.0	0	3438	5483	0.07	0.014	0.0	0.38
44	45	44.5	Medium Stiff Fine-Grained	-49.5	115	120	4755	2777	1978	1.0	1978	0.86	0.35	0.43	3378	-368	491	123	0.11	0.00	0.0	0	3411	5512	0.07	0.014	0.0	0.37
45	46	45.5	Medium Stiff Fine-Grained	-50.5	115	120	4875	2839	2036	1.0	2036	0.86	0.34	0.42	3359	-366	488	122	0.11	0.00	0.0	0	3383	5541	0.07	0.014	0.0	0.37
46	47	46.5	Medium Stiff Fine-Grained	-51.5	115	120	4995	2902	2093	1.0	2093	0.86	0.33	0.42	3340	-363	484	121	0.11	0.00	0.0	0	3356	5571	0.07	0.014	0.0	0.36
47	48	47.5	Medium Stiff Fine-Grained	-52.5	115	120	5115	2964	2151	1.0	2151	0.85	0.32	0.42	3321	-361	481	120	0.10	0.00	0.0	0	3330	5601	0.07	0.014	0.0	0.35
48	49	48.5	Medium Stiff Fine-Grained	-53.5	115	120	5235	3026	2209	1.0	2209	0.85	0.32	0.42	3301	-358	478	119	0.10	0.00	0.0	0	3303	5631	0.07	0.014	0.0	0.34

Configuration **3H1V_P2_E**

by: E. Ticen
Last Updated: February 2020

Geometry	Embankment Height, H	33	ft
	Embankment Side Slopes	3	xH:1V
	Crown Width	32	ft
	Half Crown Width, B1	16	ft
	Side Slope Width, B2	99	ft
	Unit Weight of Embankment, γ	120	pcf
	Depth to Ground Water	0	ft
	Maximum Stress Increase	3960	psf
	Water Surface Elevation	-5	ft
	Ground Surface Elevation	-5	ft
Foundation Improvements	Remove & Replace Depth [1]	6	ft
	Area Replacement Ratio	0	-
	Shear Key Thickness	0	ft
	Shear Key Depth	0	ft
	Shear Key Raft Foundation Depth	0.0	ft
	Shear key Spacing	--	ft
	Soil Arching b/w Shear Key	0	xV:1H
	Arching Stress Height	--	ft
	Arching Side Slope Width, B2	--	ft
	σmax Arching	0	psf

Notes:
1) Compacted fill where settlement of the material is considered to be negligible.
2)
3)
4)
5)
6)
7)

Total Settlement at Midpoint Between Shear Keys=	--	inches
Total Settlement at Shear Keys=	--	inches
Differential Settlement=	--	inches

		Depth (GS=0-ft)		Elevation (ft)		Unit Weight		Settlement					Staged Construction		
		Top	Bottom	Top	Bottom	Moist	Saturated	$C_{c\varepsilon} = C_c/(1+e_o)$	$C_{r\varepsilon} = C_{c\varepsilon}/5$	OCR	Total Layer Settlement		Reduction	Total Layer Settlement	
Layer	Description	(ft)	(ft)	(ft)	(ft)	(pcf)	(pcf)	(-)	(-)	(-)	(in)	(ft)	(%)	(in)	(ft)
1	Embankment Fill	-33	0	28	-5	115	120	0.01	0.002	5	0	0.00	100%	0	0.00
2	Organics	0	15	-5	-20	85	90	0.180	0.036	1	23.2	1.93	0%	23	1.93
3b	Loose - Coarse Grained	15	30	-20	-35	105	110	0.005	0.001	1	0.7	0.06	0%	1	0.06
4	Medium Stiff Fine-Grained	30	50	-35	-55	115	120	0.070	0.014	1	8.4	0.70	0%	8	0.70
5	Stiff Fine-Grained	50	100	-55	-105	120	125	0.017	0.0034	1	2.6	0.22	0%	3	0.22
6	Dense Coarse-Grained	100	150	-105	-155	120	125	0.017	0.0034	1	1.2	0.10	0%	1	0.10
7	Stiff Fine-Grained	150	200	-155	-205	120	125	0.017	0.0034	1	0.7	0.05	0%	1	0.05
										∑=	36.8	3.1		∑= 36.8	3.1

							Pre Construction							Δσ due to Embankment Load (Das - 5.6)			Δσ due to Foundation R&R (2:1)			Δσ With Arching for Shear Keys (Das - 5.6)									
Top of Layer	Bottom of Layer	Depth (ft)	Layer (-)	Elevation (ft)	Moist Unit Weight (pcf)	Saturated Unit Weight (pcf)	Total Stress (psf)	Pore Pressure (psf)	Effective stress (psf)	OCR (-)	Pre- Consolidation Pressure (psf)	α_1 (rad)	α_2 (rad)	Influence Value I'	Δσ below Embankment middle (psf)	Foundation Removal (psf)	Foundation Replacement (psf)	Net Stress Change in Layer (psf)	α1 (rad)	α2 (rad)	Influence Value I'	Δσ between shear keys above shear key raft foundation (psf)	Δσ below shear key raft foundation	Final Stress (psf)	$C_{c\varepsilon}$ (-)	$C_{r\varepsilon}$ (-)	Vertical Strain $\varepsilon_{v,i}$ (%)	Change in Layer Thickness Δh_i (in)
0	1	0.5	Organics	-5.5	85	90	45	31	14	1.0	14	0.03	1.54	0.50	3960	-45	60	15	0.00	0.00	0.0	0	0	3989	0.18	0.036	0.0	0.00
1	2	1.5	Organics	-6.5	85	90	135	94	41	1.0	41	0.08	1.48	0.50	3960	-135	180	45	0.00	0.00	0.0	0	0	4046	0.18	0.036	0.0	0.00
2	3	2.5	Organics	-7.5	85	90	225	156	69	1.0	69	0.13	1.42	0.50	3959	-225	300	75	0.00	0.00	0.0	0	0	4103	0.18	0.036	0.0	0.00
3	4	3.5	Organics	-8.5	85	90	315	218	97	1.0	97	0.18	1.36	0.50	3959	-315	420	105	0.00	0.00	0.0	0	0	4160	0.18	0.036	0.0	0.00
4	5	4.5	Organics	-9.5	85	90	405	281	124	1.0	124	0.24	1.30	0.50	3957	-405	540	135	0.00	0.00	0.0	0	0	4216	0.18	0.036	0.0	0.00
5	6	5.5	Organics	-10.5	85	90	495	343	152	1.0	152	0.28	1.24	0.50	3955	-495	660	165	0.00	0.00	0.0	0	0	4272	0.18	0.036	0.0	0.00
6	7	6.5	Organics	-11.5	85	90	585	406	179	1.0	179	0.33	1.18	0.50	3952	-493	657	164	0.00	0.00	0.0	0	0	4296	0.18	0.036	0.2	2.98
7	8	7.5	Organics	-12.5	85	90	675	468	207	1.0	207	0.37	1.13	0.50	3948	-489	652	163	0.00	0.00	0.0	0	0	4318	0.18	0.036	0.2	2.85
8	9	8.5	Organics	-13.5	85	90	765	530	235	1.0	235	0.41	1.08	0.50	3943	-485	647	162	0.00	0.00	0.0	0	0	4339	0.18	0.036	0.2	2.74
9	10	9.5	Organics	-14.5	85	90	855	593	262	1.0	262	0.45	1.03	0.50	3937	-481	641	160	0.00	0.00	0.0	0	0	4359	0.18	0.036	0.2	2.64
10	11	10.5	Organics	-15.5	85	90	945	655	290	1.0	290	0.49	0.99	0.50	3930	-477	636	159	0.00	0.00	0.0	0	0	4379	0.18	0.036	0.2	2.55
11	12	11.5	Organics	-16.5	85	90	1035	718	317	1.0	317	0.52	0.95	0.50	3922	-473	631	158	0.00	0.00	0.0	0	0	4397	0.18	0.036	0.2	2.47
12	13	12.5	Organics	-17.5	85	90	1125	780	345	1.0	345	0.55	0.91	0.49	3913	-469	626	156	0.00	0.00	0.0	0	0	4415	0.18	0.036	0.2	2.39
13	14	13.5	Organics	-18.5	85	90	1215	842	373	1.0	373	0.58	0.87	0.49	3903	-466	621	155	0.00	0.00	0.0	0	0	4431	0.18	0.036	0.2	2.32
14	15	14.5	Organics	-19.5	85	90	1305	905	400	1.0	400	0.61	0.83	0.49	3893	-462	616	154	0.00	0.00	0.0	0	0	4447	0.18	0.036	0.2	2.26
15	16	15.5	Loose - Coarse Grained	-20.5	105	110	1415	967	448	1.0	448	0.64	0.80	0.49	3881	-458	611	153	0.00	0.00	0.0	0	0	4482	0.005	0.001	0.0	0.06
16	17	16.5	Loose - Coarse Grained	-21.5	105	110	1525	1030	495	1.0	495	0.66	0.77	0.49	3869	-455	606	152	0.00	0.00	0.0	0	0	4516	0.005	0.001	0.0	0.06
17	18	17.5	Loose - Coarse Grained	-22.5	105	110	1635	1092	543	1.0	543	0.68	0.74	0.49	3856	-451	601	150	0.00	0.00	0.0	0	0	4549	0.005	0.001	0.0	0.06
18	19	18.5	Loose - Coarse Grained	-23.5	105	110	1745	1154	591	1.0	591	0.70	0.71	0.49	3842	-448	597	149	0.00	0.00	0.0	0	0	4582	0.005	0.001	0.0	0.05
19	20	19.5	Loose - Coarse Grained	-24.5	105	110	1855	1217	638	1.0	638	0.72	0.69	0.48	3828	-444	592	148	0.00	0.00	0.0	0	0	4614	0.005	0.001	0.0	0.05
20	21	20.5	Loose - Coarse Grained	-25.5	105	110	1965	1279	686	1.0	686	0.73	0.66	0.48	3813	-441	587	147	0.00	0.00	0.0	0	0	4646	0.005	0.001	0.0	0.05
21	22	21.5	Loose - Coarse Grained	-26.5	105	110	2075	1342	733	1.0	733	0.75	0.64	0.48	3798	-437	583	146	0.00	0.00	0.0	0	0	4677	0.005	0.001	0.0	0.05
22	23	22.5	Loose - Coarse Grained	-27.5	105	110	2185	1404	781	1.0	781	0.76	0.62	0.48	3782	-434	578	145	0.00	0.00	0.0	0	0	4708	0.005	0.001	0.0	0.05
23	24	23.5	Loose - Coarse Grained	-28.5	105	110	2295	1466	829	1.0	829	0.77	0.60	0.48	3766	-430	574	143	0.00	0.00	0.0	0	0	4738	0.005	0.001	0.0	0.05
24	25	24.5	Loose - Coarse Grained	-29.5	105	110	2405	1529	876	1.0	876	0.78	0.58	0.47	3750	-427	570	142	0.00	0.00	0.0	0	0	4768	0.005	0.001	0.0	0.04
25	26	25.5	Loose - Coarse Grained	-30.5	105	110	2515	1591	924	1.0	924	0.79	0.56	0.47	3733	-424	565	141	0.00	0.00	0.0	0	0	4798	0.005	0.001	0.0	0.04
26	27	26.5	Loose - Coarse Grained	-31.5	105	110	2625	1654	971	1.0	971	0.80	0.54	0.47	3715	-421	561	140	0.00	0.00	0.0	0	0	4827	0.005	0.001	0.0	0.04
27	28	27.5	Loose - Coarse Grained	-32.5	105	110	2735	1716	1019	1.0	1019	0.81	0.53	0.47	3698	-418	557	139	0.00	0.00	0.0	0	0	4856	0.005	0.001	0.0	0.04
28	29	28.5	Loose - Coarse Grained	-33.5	105	110	2845	1778	1067	1.0	1067	0.82	0.51	0.46	3680	-414	552	138	0.00	0.00	0.0	0	0	4885	0.005	0.001	0.0	0.04
29	30	29.5	Loose - Coarse Grained	-34.5	105	110	2955	1841	1114	1.0	1114	0.82	0.50	0.46	3662	-411	548	137	0.00	0.00	0.0	0	0	4913	0.005	0.001	0.0	0.04
30	31	30.5	Medium Stiff Fine-Grained	-35.5	115	120	3075	1903	1172	1.0	1172	0.83	0.48	0.46	3644	-408	544	136	0.00	0.00	0.0	0	0	4952	0.07	0.014	0.0	0.53
31	32	31.5	Medium Stiff Fine-Grained	-36.5	115	120	3195	1966	1229	1.0	1229	0.83	0.47	0.46	3626	-405	540	135	0.00	0.00	0.0	0	0	4990	0.07	0.014	0.0	0.51
32	33	32.5	Medium Stiff Fine-Grained	-37.5	115	120	3315	2028	1287	1.0	1287	0.84	0.46	0.46	3607	-402	536	134	0.00	0.00	0.0	0	0	5028	0.07	0.014	0.0	0.50
33	34	33.5	Medium Stiff Fine-Grained	-38.5	115	120	3435	2090	1345	1.0	1345	0.84	0.45	0.45	3588	-399	532	133	0.00	0.00	0.0	0	0	5066	0.07	0.014	0.0	0.48
34	35	34.5	Medium Stiff Fine-Grained	-39.5	115	120	3555	2153	1402	1.0	1402	0.85	0.43	0.45	3570	-396	528	132	0.00	0.00	0.0	0	0	5104	0.07	0.014	0.0	0.47
35	36	35.5	Medium Stiff Fine-Grained	-40.5	115	120	3675	2215	1460	1.0	1460	0.85	0.42	0.45	3551	-393	524	131	0.00	0.00	0.0	0	0	5142	0.07	0.014	0.0	0.46
36	37	36.5	Medium Stiff Fine-Grained	-41.5	115	120	3795	2278	1517	1.0	1517	0.85	0.41	0.45	3532	-390	521	130	0.00	0.00	0.0	0	0	5179	0.07	0.014	0.0	0.45
37	38	37.5	Medium Stiff Fine-Grained	-42.5	115	120	3915	2340	1575	1.0	1575	0.85	0.40	0.44	3513	-388	517	129	0.00	0.00	0.0	0	0	5217	0.07	0.014	0.0	0.44
38	39	38.5	Medium Stiff Fine-Grained	-43.5	115	120	4035	2402	1633	1.0	1633	0.85	0.39	0.44	3493	-385	513	128	0.00	0.00	0.0	0	0	5254	0.07	0.014	0.0	0.43
39	40	39.5	Medium Stiff Fine-Grained	-44.5	115	120	4155	2465	1690	1.0	1690	0.86	0.38	0.44	3474	-382	509	127	0.00	0.00	0.0	0	0	5292	0.07	0.014	0.0	0.42
40	41	40.5	Medium Stiff Fine-Grained	-45.5	115	120	4275	2527	1748	1.0	1748	0.86	0.38	0.44	3455	-379	506	126	0.00	0.00	0.0	0	0	5329	0.07	0.014	0.0	0.41
41	42	41.5	Medium Stiff Fine-Grained	-46.5	115	120	4395	2590	1805	1.0	1805	0.86	0.37	0.43	3436	-376	502	125	0.00	0.00	0.0	0	0	5367	0.07	0.014	0.0	0.40
42	43	42.5	Medium Stiff Fine-Grained	-47.5	115	120	4515	2652	1863	1.0	1863	0.86	0.36	0.43	3417	-374	498	125	0.00	0.00	0.0	0	0	5404	0.07	0.014	0.0	0.39
43	44	43.5	Medium Stiff Fine-Grained	-48.5	115	120	4635	2714	1921	1.0	1921	0.86	0.35	0.43	3397	-371	495	124	0.00	0.00	0.0	0	0	5442	0.07	0.014	0.0	0.38
44	45	44.5	Medium Stiff Fine-Grained	-49.5	115	120	4755	2777	1978	1.0	1978	0.86	0.35	0.43	3378	-368	491	123	0.00	0.00	0.0	0	0	5479	0.07	0.014	0.0	0.37
45	46	45.5	Medium Stiff Fine-Grained	-50.5	115	120	4875	2839	2036	1.0	2036	0.86	0.34	0.42	3359	-366	488	122	0.00	0.00	0.0	0	0	5517	0.07	0.014	0.0	0.36
46	47	46.5	Medium Stiff Fine-Grained	-51.5	115	120	4995	2902	2093	1.0	2093	0.86	0.33	0.42	3340	-363	484	121	0.00	0.00	0.0	0	0	5554	0.07	0.014	0.0	0.36
47	48	47.5	Medium Stiff Fine-Grained	-52.5	115	120	5115	2964	2151	1.0	2151	0.85	0.32	0.42	3321	-361	481	120	0.00	0.00	0.0	0	0	5592	0.07	0.014	0.0	0.35
48	49	48.5	Medium Stiff Fine-Grained	-53.5	115	120	5235	3026	2209	1.0	2209	0.85	0.32	0.42	3301	-358	478	119	0.00	0.00	0.0	0	0	5629	0.07	0.014	0.0	0.34

Configuration **3H1V_P2_G1-RR15**

by: E. Ticen
Last Updated: February 2020

Geometry	Embankment Height, H	33	ft
	Embankment Side Slopes	3	xH:1V
	Crown Width	32	ft
	Half Crown Width, B1	16	ft
	Side Slope Width, B2	99	ft
	Unit Weight of Embankment, γ	120	pcf
	Depth to Ground Water	0	ft
	Maximum Stress Increase	3960	psf
	Water Surface Elevation	-5	ft
	Ground Surface Elevation	-5	ft
Foundation Improvements	Remove & Replace Depth [1]	15	ft
	Area Replacement Ratio	0	-
	Shear Key Thickness	0	ft
	Shear Key Depth	0	ft
	Shear Key Raft Foundation Depth	0.0	ft
	Shear key Spacing	--	ft
	Soil Arching b/w Shear Key	0	xV:1H
	Arching Stress Height	--	ft
	Arching Side Slope Width, B2	--	ft
	σmax Arching	0	psf

Notes:
1) Compacted fill where settlement of the material is considered to be negligible.
2)
3)
4)
5)
6)
7)

Total Settlement at Midpoint Between Shear Keys=	--	inches
Total Settlement at Shear Keys=	--	inches
Differential Settlement=	--	inches

		Depth (GS=0-ft)		Elevation (ft)		Unit Weight		Settlement					Staged Construction		
		Top	Bottom	Top	Bottom	Moist	Saturated	$C_{cc} = C_c/(1+e_o)$	$C_{rc} = C_{cc}/5$	OCR	Total Layer Settlement		Reduction	Total Layer Settlement	
Layer	Description	(ft)	(ft)	(ft)	(ft)	(pcf)	(pcf)	(-)	(-)	(-)	(in)	(ft)	(%)	(in)	(ft)
1	Embankment Fill	-33	0	28	-5	115	120	0.01	0.002	5	0	0.00	100%	0	0.00
2	Organics	0	15	-5	-20	85	90	0.180	0.036	1	0.0	0.00	0%	0	0.00
3b	Loose - Coarse Grained	15	30	-20	-35	105	110	0.005	0.001	1	0.7	0.06	0%	1	0.06
4	Medium Stiff Fine-Grained	30	50	-35	-55	115	120	0.070	0.014	1	8.7	0.72	0%	9	0.72
5	Stiff Fine-Grained	50	100	-55	-105	120	125	0.017	0.0034	1	2.7	0.23	0%	3	0.23
6	Dense Coarse-Grained	100	150	-105	-155	120	125	0.017	0.0034	1	1.3	0.11	0%	1	0.11
7	Stiff Fine-Grained	150	200	-155	-205	120	125	0.017	0.0034	1	0.7	0.06	0%	1	0.06
										∑=	14.1	1.2	∑=	14.1	1.2

							Pre Construction					Δσ due to Embankment Load (Das - 5.6)				Δσ due to Foundation R&R (2:1)			Δσ With Arching for Shear Keys (Das - 5.6)									
Top of Layer	Bottom of Layer	Depth (ft)	Layer (-)	Elevation (ft)	Moist Unit Weight (pcf)	Saturated Unit Weight (pcf)	Total Stress (psf)	Pore Pressure (psf)	Effective stress (psf)	OCR (-)	Pre- Consolidation Pressure (psf)	α_1 (rad)	α_2 (rad)	Influence Value I'	Δσ below Embankment middle (psf)	Foundation Removal (psf)	Foundation Replacement (psf)	Net Stress Change in Layer (psf)	α1 (rad)	α2 (rad)	Influence Value I'	Δσ between shear keys above shear key raft foundation (psf)	Δσ below shear key raft foundation	Final Stress (psf)	C_{cc} (-)	C_{rc} (-)	Vertical Strain $\varepsilon_{v,i}$ (%)	Change in Layer Thickness Δh_i (in)
0	1	0.5	Organics	-5.5	85	90	45	31	14	1.0	14	0.03	1.54	0.50	3960	-45	60	15	0.00	0.00	0.0	0	0	3989	0.18	0.036	0.0	0.00
1	2	1.5	Organics	-6.5	85	90	135	94	41	1.0	41	0.08	1.48	0.50	3960	-135	180	45	0.00	0.00	0.0	0	0	4046	0.18	0.036	0.0	0.00
2	3	2.5	Organics	-7.5	85	90	225	156	69	1.0	69	0.13	1.42	0.50	3959	-225	300	75	0.00	0.00	0.0	0	0	4103	0.18	0.036	0.0	0.00
3	4	3.5	Organics	-8.5	85	90	315	218	97	1.0	97	0.18	1.36	0.50	3959	-315	420	105	0.00	0.00	0.0	0	0	4160	0.18	0.036	0.0	0.00
4	5	4.5	Organics	-9.5	85	90	405	281	124	1.0	124	0.24	1.30	0.50	3957	-405	540	135	0.00	0.00	0.0	0	0	4216	0.18	0.036	0.0	0.00
5	6	5.5	Organics	-10.5	85	90	495	343	152	1.0	152	0.28	1.24	0.50	3955	-495	660	165	0.00	0.00	0.0	0	0	4272	0.18	0.036	0.0	0.00
6	7	6.5	Organics	-11.5	85	90	585	406	179	1.0	179	0.33	1.18	0.50	3952	-585	780	195	0.00	0.00	0.0	0	0	4326	0.18	0.036	0.0	0.00
7	8	7.5	Organics	-12.5	85	90	675	468	207	1.0	207	0.37	1.13	0.50	3948	-675	900	225	0.00	0.00	0.0	0	0	4380	0.18	0.036	0.0	0.00
8	9	8.5	Organics	-13.5	85	90	765	530	235	1.0	235	0.41	1.08	0.50	3943	-765	1020	255	0.00	0.00	0.0	0	0	4433	0.18	0.036	0.0	0.00
9	10	9.5	Organics	-14.5	85	90	855	593	262	1.0	262	0.45	1.03	0.50	3937	-855	1140	285	0.00	0.00	0.0	0	0	4484	0.18	0.036	0.0	0.00
10	11	10.5	Organics	-15.5	85	90	945	655	290	1.0	290	0.49	0.99	0.50	3930	-945	1260	315	0.00	0.00	0.0	0	0	4535	0.18	0.036	0.0	0.00
11	12	11.5	Organics	-16.5	85	90	1035	718	317	1.0	317	0.52	0.95	0.50	3922	-1035	1380	345	0.00	0.00	0.0	0	0	4584	0.18	0.036	0.0	0.00
12	13	12.5	Organics	-17.5	85	90	1125	780	345	1.0	345	0.55	0.91	0.49	3913	-1125	1500	375	0.00	0.00	0.0	0	0	4633	0.18	0.036	0.0	0.00
13	14	13.5	Organics	-18.5	85	90	1215	842	373	1.0	373	0.58	0.87	0.49	3903	-1215	1620	405	0.00	0.00	0.0	0	0	4681	0.18	0.036	0.0	0.00
14	15	14.5	Organics	-19.5	85	90	1305	905	400	1.0	400	0.61	0.83	0.49	3893	-1305	1740	435	0.00	0.00	0.0	0	0	4728	0.18	0.036	0.0	0.00
15	16	15.5	Loose - Coarse Grained	-20.5	105	110	1415	967	448	1.0	448	0.64	0.80	0.49	3881	-1300	1733	433	0.00	0.00	0.0	0	0	4762	0.005	0.001	0.0	0.06
16	17	16.5	Loose - Coarse Grained	-21.5	105	110	1525	1030	495	1.0	495	0.66	0.77	0.49	3869	-1290	1720	430	0.00	0.00	0.0	0	0	4794	0.005	0.001	0.0	0.06
17	18	17.5	Loose - Coarse Grained	-22.5	105	110	1635	1092	543	1.0	543	0.68	0.74	0.49	3856	-1280	1707	427	0.00	0.00	0.0	0	0	4826	0.005	0.001	0.0	0.06
18	19	18.5	Loose - Coarse Grained	-23.5	105	110	1745	1154	591	1.0	591	0.70	0.71	0.49	3842	-1271	1694	424	0.00	0.00	0.0	0	0	4856	0.005	0.001	0.0	0.05
19	20	19.5	Loose - Coarse Grained	-24.5	105	110	1855	1217	638	1.0	638	0.72	0.69	0.48	3828	-1261	1681	420	0.00	0.00	0.0	0	0	4887	0.005	0.001	0.0	0.05
20	21	20.5	Loose - Coarse Grained	-25.5	105	110	1965	1279	686	1.0	686	0.73	0.66	0.48	3813	-1251	1669	417	0.00	0.00	0.0	0	0	4916	0.005	0.001	0.0	0.05
21	22	21.5	Loose - Coarse Grained	-26.5	105	110	2075	1342	733	1.0	733	0.75	0.64	0.48	3798	-1242	1656	414	0.00	0.00	0.0	0	0	4946	0.005	0.001	0.0	0.05
22	23	22.5	Loose - Coarse Grained	-27.5	105	110	2185	1404	781	1.0	781	0.76	0.62	0.48	3782	-1233	1644	411	0.00	0.00	0.0	0	0	4974	0.005	0.001	0.0	0.05
23	24	23.5	Loose - Coarse Grained	-28.5	105	110	2295	1466	829	1.0	829	0.77	0.60	0.48	3766	-1224	1632	408	0.00	0.00	0.0	0	0	5003	0.005	0.001	0.0	0.05
24	25	24.5	Loose - Coarse Grained	-29.5	105	110	2405	1529	876	1.0	876	0.78	0.58	0.47	3750	-1215	1619	405	0.00	0.00	0.0	0	0	5031	0.005	0.001	0.0	0.05
25	26	25.5	Loose - Coarse Grained	-30.5	105	110	2515	1591	924	1.0	924	0.79	0.56	0.47	3733	-1206	1608	402	0.00	0.00	0.0	0	0	5058	0.005	0.001	0.0	0.04
26	27	26.5	Loose - Coarse Grained	-31.5	105	110	2625	1654	971	1.0	971	0.80	0.54	0.47	3715	-1197	1596	399	0.00	0.00	0.0	0	0	5086	0.005	0.001	0.0	0.04
27	28	27.5	Loose - Coarse Grained	-32.5	105	110	2735	1716	1019	1.0	1019	0.81	0.53	0.47	3698	-1188	1584	396	0.00	0.00	0.0	0	0	5113	0.005	0.001	0.0	0.04
28	29	28.5	Loose - Coarse Grained	-33.5	105	110	2845	1778	1067	1.0	1067	0.82	0.51	0.46	3680	-1179	1572	393	0.00	0.00	0.0	0	0	5140	0.005	0.001	0.0	0.04
29	30	29.5	Loose - Coarse Grained	-34.5	105	110	2955	1841	1114	1.0	1114	0.82	0.50	0.46	3662	-1171	1561	390	0.00	0.00	0.0	0	0	5167	0.005	0.001	0.0	0.04
30	31	30.5	Medium Stiff Fine-Grained	-35.5	115	120	3075	1903	1172	1.0	1172	0.83	0.48	0.46	3644	-1162	1550	387	0.00	0.00	0.0	0	0	5203	0.07	0.014	0.0	0.54
31	32	31.5	Medium Stiff Fine-Grained	-36.5	115	120	3195	1966	1229	1.0	1229	0.83	0.47	0.46	3626	-1154	1539	385	0.00	0.00	0.0	0	0	5240	0.07	0.014	0.0	0.53
32	33	32.5	Medium Stiff Fine-Grained	-37.5	115	120	3315	2028	1287	1.0	1287	0.84	0.46	0.46	3607	-1146	1527	382	0.00	0.00	0.0	0	0	5276	0.07	0.014	0.0	0.51
33	34	33.5	Medium Stiff Fine-Grained	-38.5	115	120	3435	2090	1345	1.0	1345	0.84	0.45	0.45	3588	-1137	1517	379	0.00	0.00	0.0	0	0	5312	0.07	0.014	0.0	0.50
34	35	34.5	Medium Stiff Fine-Grained	-39.5	115	120	3555	2153	1402	1.0	1402	0.85	0.43	0.45	3570	-1129	1506	376	0.00	0.00	0.0	0	0	5348	0.07	0.014	0.0	0.49
35	36	35.5	Medium Stiff Fine-Grained	-40.5	115	120	3675	2215	1460	1.0	1460	0.85	0.42	0.45	3551	-1121	1495	374	0.00	0.00	0.0	0	0	5384	0.07	0.014	0.0	0.48
36	37	36.5	Medium Stiff Fine-Grained	-41.5	115	120	3795	2278	1517	1.0	1517	0.85	0.41	0.45	3532	-1113	1484	371	0.00	0.00	0.0	0	0	5420	0.07	0.014	0.0	0.46
37	38	37.5	Medium Stiff Fine-Grained	-42.5	115	120	3915	2340	1575	1.0	1575	0.85	0.40	0.44	3513	-1105	1474	368	0.00	0.00	0.0	0	0	5456	0.07	0.014	0.0	0.45
38	39	38.5	Medium Stiff Fine-Grained	-43.5	115	120	4035	2402	1633	1.0	1633	0.85	0.39	0.44	3493	-1098	1463	366	0.00	0.00	0.0	0	0	5492	0.07	0.014	0.0	0.44
39	40	39.5	Medium Stiff Fine-Grained	-44.5	115	120	4155	2465	1690	1.0	1690	0.86	0.38	0.44	3474	-1090	1453	363	0.00	0.00	0.0	0	0	5528	0.07	0.014	0.0	0.43
40	41	40.5	Medium Stiff Fine-Grained	-45.5	115	120	4275	2527	1748	1.0	1748	0.86	0.38	0.44	3455	-1082	1443	361	0.00	0.00	0.0	0	0	5564	0.07	0.014	0.0	0.42
41	42	41.5	Medium Stiff Fine-Grained	-46.5	115	120	4395	2590	1805	1.0	1805	0.86	0.37	0.43	3436	-1075	1433	358	0.00	0.00	0.0	0	0	5600	0.07	0.014	0.0	0.41
42	43	42.5	Medium Stiff Fine-Grained	-47.5	115	120	4515	2652	1863	1.0	1863	0.86	0.36	0.43	3417	-1067	1423	356	0.00	0.00	0.0	0	0	5635	0.07	0.014	0.0	0.40
43	44	43.5	Medium Stiff Fine-Grained	-48.5	115	120	4635	2714	1921	1.0	1921	0.86	0.35	0.43	3397	-1060	1413	353	0.00	0.00	0.0	0	0	5671	0.07	0.014	0.0	0.40
44	45	44.5	Medium Stiff Fine-Grained	-49.5	115	120	4755	2777	1978	1.0	1978	0.86	0.35	0.43	3378	-1053	1403	351	0.00	0.00	0.0	0	0	5707	0.07	0.014	0.0	0.39
45	46	45.5	Medium Stiff Fine-Grained	-50.5	115	120	4875	2839	2036	1.0	2036	0.86	0.34	0.42	3359	-1045	1394	348	0.00	0.00	0.0	0	0	5743	0.07	0.014	0.0	0.38
46	47	46.5	Medium Stiff Fine-Grained	-51.5	115	120	4995	2902	2093	1.0	2093	0.86	0.33	0.42	3340	-1038	1384	346	0.00	0.00	0.0	0	0	5779	0.07	0.014	0.0	0.37
47	48	47.5	Medium Stiff Fine-Grained	-52.5	115	120	5115	2964	2151	1.0	2151	0.85	0.32	0.42	3321	-1031	1375	344	0.00	0.00	0.0	0	0	5815	0.07	0.014	0.0	0.36
48	49	48.5	Medium Stiff Fine-Grained	-53.5	115	120	5235	3026	2209	1.0	2209	0.85	0.32	0.42	3301	-1024	1365	341	0.00	0.00	0.0	0	0	5851	0.07	0.014	0.0	0.36

Configuration **3H1V_P2_G1-RR30**

by: E. Ticen
Last Updated: February 2020

Geometry	Embankment Height, H	33	ft
	Embankment Side Slopes	3	xH:1V
	Crown Width	32	ft
	Half Crown Width, B1	16	ft
	Side Slope Width, B2	99	ft
	Unit Weight of Embankment, γ	120	pcf
	Depth to Ground Water	0	ft
	Maximum Stress Increase	3960	psf
	Water Surface Elevation	-5	ft
	Ground Surface Elevation	-5	ft
Foundation Improvements	Remove & Replace Depth [1]	30	ft
	Area Replacement Ratio	0	-
	Shear Key Thickness	0	ft
	Shear Key Depth	0	ft
	Shear Key Raft Foundation Depth	0.0	ft
	Shear key Spacing	--	ft
	Soil Arching b/w Shear Key	0	xV:1H
	Arching Stress Height	--	ft
	Arching Side Slope Width, B2	--	ft
	σmax Arching	0	psf

Notes:
1) Compacted fill where settlement of the material is considered to be negligible.
2)
3)
4)
5)
6)
7)

Total Settlement at Midpoint Between Shear Keys=	--	inches
Total Settlement at Shear Keys=	--	inches
Differential Settlement=	--	inches

		Depth (GS=0-ft)		Elevation (ft)		Unit Weight		Settlement					Staged Construction		
		Top	Bottom	Top	Bottom	Moist	Saturated	$C_{c\varepsilon} = C_c/(1+e_o)$	$C_{r\varepsilon} = C_{cd}/5$	OCR	Total Layer Settlement		Reduction	Total Layer Settlement	
Layer	Description	(ft)	(ft)	(ft)	(ft)	(pcf)	(pcf)	(-)	(-)	(-)	(in)	(ft)	(%)	(in)	(ft)
1	Embankment Fill	-33	0	28	-5	115	120	0.01	0.002	5	0	0.00	100%	0	0.00
2	Organics	0	15	-5	-20	85	90	0.180	0.036	1	0.0	0.00	0%	0	0.00
3b	Loose - Coarse Grained	15	30	-20	-35	105	110	0.005	0.001	1	0.0	0.00	0%	0	0.00
4	Medium Stiff Fine-Grained	30	50	-35	-55	115	120	0.070	0.014	1	8.9	0.74	0%	9	0.74
5	Stiff Fine-Grained	50	100	-55	-105	120	125	0.017	0.0034	1	2.8	0.24	0%	3	0.24
6	Dense Coarse-Grained	100	150	-105	-155	120	125	0.017	0.0034	1	1.4	0.11	0%	1	0.11
7	Stiff Fine-Grained	150	200	-155	-205	120	125	0.017	0.0034	1	0.7	0.06	0%	1	0.06
										Σ=	13.8	1.2	Σ=	13.8	1.2

							Pre Construction							Δσ due to Embankment Load (Das - 5.6)			Δσ due to Foundation R&R (2:1)			Δσ With Arching for Shear Keys (Das - 5.6)									
Top of Layer	Bottom of Layer	Depth (ft)	Layer (-)	Elevation (ft)	Moist Unit Weight (pcf)	Saturated Unit Weight (pcf)	Total Stress (psf)	Pore Pressure (psf)	Effective stress (psf)	OCR (-)	Pre- Consolidation Pressure (psf)	α_1 (rad)	α_2 (rad)	Influence Value I'	Δσ below Embankment middle (psf)	Foundation Removal (psf)	Foundation Replacement (psf)	Net Stress Change in Layer (psf)	α1 (rad)	α2 (rad)	Influence Value I'	Δσ between shear keys above shear key raft foundation (psf)	Δσ below shear key raft foundation	Final Stress (psf)	$C_{c\varepsilon}$ (-)	$C_{r\varepsilon}$ (-)	Vertical Strain $\varepsilon_{v,i}$ (%)	Change in Layer Thickness Δh_i (in)
0	1	0.5	Organics	-5.5	85	90	45	31	14	1.0	14	0.03	1.54	0.50	3960	-45	60	15	0.00	0.00	0.0	0	0	3989	0.18	0.036	0.0	0.00
1	2	1.5	Organics	-6.5	85	90	135	94	41	1.0	41	0.08	1.48	0.50	3960	-135	180	45	0.00	0.00	0.0	0	0	4046	0.18	0.036	0.0	0.00
2	3	2.5	Organics	-7.5	85	90	225	156	69	1.0	69	0.13	1.42	0.50	3959	-225	300	75	0.00	0.00	0.0	0	0	4103	0.18	0.036	0.0	0.00
3	4	3.5	Organics	-8.5	85	90	315	218	97	1.0	97	0.18	1.36	0.50	3959	-315	420	105	0.00	0.00	0.0	0	0	4160	0.18	0.036	0.0	0.00
4	5	4.5	Organics	-9.5	85	90	405	281	124	1.0	124	0.24	1.30	0.50	3957	-405	540	135	0.00	0.00	0.0	0	0	4216	0.18	0.036	0.0	0.00
5	6	5.5	Organics	-10.5	85	90	495	343	152	1.0	152	0.28	1.24	0.50	3955	-495	660	165	0.00	0.00	0.0	0	0	4272	0.18	0.036	0.0	0.00
6	7	6.5	Organics	-11.5	85	90	585	406	179	1.0	179	0.33	1.18	0.50	3952	-585	780	195	0.00	0.00	0.0	0	0	4326	0.18	0.036	0.0	0.00
7	8	7.5	Organics	-12.5	85	90	675	468	207	1.0	207	0.37	1.13	0.50	3948	-675	900	225	0.00	0.00	0.0	0	0	4380	0.18	0.036	0.0	0.00
8	9	8.5	Organics	-13.5	85	90	765	530	235	1.0	235	0.41	1.08	0.50	3943	-765	1020	255	0.00	0.00	0.0	0	0	4433	0.18	0.036	0.0	0.00
9	10	9.5	Organics	-14.5	85	90	855	593	262	1.0	262	0.45	1.03	0.50	3937	-855	1140	285	0.00	0.00	0.0	0	0	4484	0.18	0.036	0.0	0.00
10	11	10.5	Organics	-15.5	85	90	945	655	290	1.0	290	0.49	0.99	0.50	3930	-945	1260	315	0.00	0.00	0.0	0	0	4535	0.18	0.036	0.0	0.00
11	12	11.5	Organics	-16.5	85	90	1035	718	317	1.0	317	0.52	0.95	0.50	3922	-1035	1380	345	0.00	0.00	0.0	0	0	4584	0.18	0.036	0.0	0.00
12	13	12.5	Organics	-17.5	85	90	1125	780	345	1.0	345	0.55	0.91	0.49	3913	-1125	1500	375	0.00	0.00	0.0	0	0	4633	0.18	0.036	0.0	0.00
13	14	13.5	Organics	-18.5	85	90	1215	842	373	1.0	373	0.58	0.87	0.49	3903	-1215	1620	405	0.00	0.00	0.0	0	0	4681	0.18	0.036	0.0	0.00
14	15	14.5	Organics	-19.5	85	90	1305	905	400	1.0	400	0.61	0.83	0.49	3893	-1305	1740	435	0.00	0.00	0.0	0	0	4728	0.18	0.036	0.0	0.00
15	16	15.5	Loose - Coarse Grained	-20.5	105	110	1415	967	448	1.0	448	0.64	0.80	0.49	3881	-1415	1860	445	0.00	0.00	0.0	0	0	4774	0.005	0.001	0.0	0.00
16	17	16.5	Loose - Coarse Grained	-21.5	105	110	1525	1030	495	1.0	495	0.66	0.77	0.49	3869	-1525	1980	455	0.00	0.00	0.0	0	0	4819	0.005	0.001	0.0	0.00
17	18	17.5	Loose - Coarse Grained	-22.5	105	110	1635	1092	543	1.0	543	0.68	0.74	0.49	3856	-1635	2100	465	0.00	0.00	0.0	0	0	4864	0.005	0.001	0.0	0.00
18	19	18.5	Loose - Coarse Grained	-23.5	105	110	1745	1154	591	1.0	591	0.70	0.71	0.49	3842	-1745	2220	475	0.00	0.00	0.0	0	0	4908	0.005	0.001	0.0	0.00
19	20	19.5	Loose - Coarse Grained	-24.5	105	110	1855	1217	638	1.0	638	0.72	0.69	0.48	3828	-1855	2340	485	0.00	0.00	0.0	0	0	4951	0.005	0.001	0.0	0.00
20	21	20.5	Loose - Coarse Grained	-25.5	105	110	1965	1279	686	1.0	686	0.73	0.66	0.48	3813	-1965	2460	495	0.00	0.00	0.0	0	0	4994	0.005	0.001	0.0	0.00
21	22	21.5	Loose - Coarse Grained	-26.5	105	110	2075	1342	733	1.0	733	0.75	0.64	0.48	3798	-2075	2580	505	0.00	0.00	0.0	0	0	5036	0.005	0.001	0.0	0.00
22	23	22.5	Loose - Coarse Grained	-27.5	105	110	2185	1404	781	1.0	781	0.76	0.62	0.48	3782	-2185	2700	515	0.00	0.00	0.0	0	0	5078	0.005	0.001	0.0	0.00
23	24	23.5	Loose - Coarse Grained	-28.5	105	110	2295	1466	829	1.0	829	0.77	0.60	0.48	3766	-2295	2820	525	0.00	0.00	0.0	0	0	5120	0.005	0.001	0.0	0.00
24	25	24.5	Loose - Coarse Grained	-29.5	105	110	2405	1529	876	1.0	876	0.78	0.58	0.47	3750	-2405	2940	535	0.00	0.00	0.0	0	0	5161	0.005	0.001	0.0	0.00
25	26	25.5	Loose - Coarse Grained	-30.5	105	110	2515	1591	924	1.0	924	0.79	0.56	0.47	3733	-2515	3060	545	0.00	0.00	0.0	0	0	5201	0.005	0.001	0.0	0.00
26	27	26.5	Loose - Coarse Grained	-31.5	105	110	2625	1654	971	1.0	971	0.80	0.54	0.47	3715	-2625	3180	555	0.00	0.00	0.0	0	0	5242	0.005	0.001	0.0	0.00
27	28	27.5	Loose - Coarse Grained	-32.5	105	110	2735	1716	1019	1.0	1019	0.81	0.53	0.47	3698	-2735	3300	565	0.00	0.00	0.0	0	0	5282	0.005	0.001	0.0	0.00
28	29	28.5	Loose - Coarse Grained	-33.5	105	110	2845	1778	1067	1.0	1067	0.82	0.51	0.46	3680	-2845	3420	575	0.00	0.00	0.0	0	0	5322	0.005	0.001	0.0	0.00
29	30	29.5	Loose - Coarse Grained	-34.5	105	110	2955	1841	1114	1.0	1114	0.82	0.50	0.46	3662	-2955	3540	585	0.00	0.00	0.0	0	0	5361	0.005	0.001	0.0	0.00
30	31	30.5	Medium Stiff Fine-Grained	-35.5	115	120	3075	1903	1172	1.0	1172	0.83	0.48	0.46	3644	-2945	3528	583	0.00	0.00	0.0	0	0	5399	0.07	0.014	0.0	0.56
31	32	31.5	Medium Stiff Fine-Grained	-36.5	115	120	3195	1966	1229	1.0	1229	0.83	0.47	0.46	3626	-2925	3504	579	0.00	0.00	0.0	0	0	5434	0.07	0.014	0.0	0.54
32	33	32.5	Medium Stiff Fine-Grained	-37.5	115	120	3315	2028	1287	1.0	1287	0.84	0.46	0.46	3607	-2905	3480	575	0.00	0.00	0.0	0	0	5469	0.07	0.014	0.0	0.53
33	34	33.5	Medium Stiff Fine-Grained	-38.5	115	120	3435	2090	1345	1.0	1345	0.84	0.45	0.45	3588	-2885	3456	571	0.00	0.00	0.0	0	0	5504	0.07	0.014	0.0	0.51
34	35	34.5	Medium Stiff Fine-Grained	-39.5	115	120	3555	2153	1402	1.0	1402	0.85	0.43	0.45	3570	-2865	3433	567	0.00	0.00	0.0	0	0	5539	0.07	0.014	0.0	0.50
35	36	35.5	Medium Stiff Fine-Grained	-40.5	115	120	3675	2215	1460	1.0	1460	0.85	0.42	0.45	3551	-2846	3409	563	0.00	0.00	0.0	0	0	5574	0.07	0.014	0.0	0.49
36	37	36.5	Medium Stiff Fine-Grained	-41.5	115	120	3795	2278	1517	1.0	1517	0.85	0.41	0.45	3532	-2827	3386	560	0.00	0.00	0.0	0	0	5609	0.07	0.014	0.0	0.48
37	38	37.5	Medium Stiff Fine-Grained	-42.5	115	120	3915	2340	1575	1.0	1575	0.85	0.40	0.44	3513	-2808	3364	556	0.00	0.00	0.0	0	0	5643	0.07	0.014	0.0	0.47
38	39	38.5	Medium Stiff Fine-Grained	-43.5	115	120	4035	2402	1633	1.0	1633	0.85	0.39	0.44	3493	-2789	3341	552	0.00	0.00	0.0	0	0	5678	0.07	0.014	0.0	0.45
39	40	39.5	Medium Stiff Fine-Grained	-44.5	115	120	4155	2465	1690	1.0	1690	0.86	0.38	0.44	3474	-2771	3319	548	0.00	0.00	0.0	0	0	5713	0.07	0.014	0.0	0.44
40	41	40.5	Medium Stiff Fine-Grained	-45.5	115	120	4275	2527	1748	1.0	1748	0.86	0.38	0.44	3455	-2752	3297	545	0.00	0.00	0.0	0	0	5748	0.07	0.014	0.0	0.43
41	42	41.5	Medium Stiff Fine-Grained	-46.5	115	120	4395	2590	1805	1.0	1805	0.86	0.37	0.43	3436	-2734	3275	541	0.00	0.00	0.0	0	0	5782	0.07	0.014	0.0	0.42
42	43	42.5	Medium Stiff Fine-Grained	-47.5	115	120	4515	2652	1863	1.0	1863	0.86	0.36	0.43	3417	-2716	3253	538	0.00	0.00	0.0	0	0	5817	0.07	0.014	0.0	0.42
43	44	43.5	Medium Stiff Fine-Grained	-48.5	115	120	4635	2714	1921	1.0	1921	0.86	0.35	0.43	3397	-2698	3232	534	0.00	0.00	0.0	0	0	5852	0.07	0.014	0.0	0.41
44	45	44.5	Medium Stiff Fine-Grained	-49.5	115	120	4755	2777	1978	1.0	1978	0.86	0.35	0.43	3378	-2680	3211	531	0.00	0.00	0.0	0	0	5887	0.07	0.014	0.0	0.40
45	46	45.5	Medium Stiff Fine-Grained	-50.5	115	120	4875	2839	2036	1.0	2036	0.86	0.34	0.42	3359	-2663	3190	527	0.00	0.00	0.0	0	0	5922	0.07	0.014	0.0	0.39
46	47	46.5	Medium Stiff Fine-Grained	-51.5	115	120	4995	2902	2093	1.0	2093	0.86	0.33	0.42	3340	-2645	3169	524	0.00	0.00	0.0	0	0	5957	0.07	0.014	0.0	0.38
47	48	47.5	Medium Stiff Fine-Grained	-52.5	115	120	5115	2964	2151	1.0	2151	0.85	0.32	0.42	3321	-2628	3149	520	0.00	0.00	0.0	0	0	5992	0.07	0.014	0.0	0.37
48	49	48.5	Medium Stiff Fine-Grained	-53.5	115	120	5235	3026	2209	1.0	2209	0.85	0.32	0.42	3301	-2611	3128	517	0.00	0.00	0.0	0	0	6027	0.07	0.014	0.0	0.37

Configuration **3H1V_P2_G2-AR15**

by: E. Ticen
Last Updated: February 2020

Geometry	Embankment Height, H	33	ft
	Embankment Side Slopes	3	xH:1V
	Crown Width	32	ft
	Half Crown Width, B1	16	ft
	Side Slope Width, B2	99	ft
	Unit Weight of Embankment, γ	120	pcf
	Depth to Ground Water	0	ft
	Maximum Stress Increase	3960	psf
	Water Surface Elevation	-5	ft
	Ground Surface Elevation	-5	ft
Foundation Improvements	Remove & Replace Depth [1]	6	ft
	Area Replacement Ratio	0.15	-
	Shear Key Thickness	2.5	ft
	Shear Key Depth	40	ft
	Shear Key Raft Foundation Depth	26.7	ft
	Shear key Spacing	16.7	ft
	Soil Arching b/w Shear Key	0.5	xV:1H
	Arching Stress Height	4	ft
	Arching Side Slope Width, B2	8.3	ft
	σmax Arching	425	psf

Notes:
1) Compacted fill where settlement of the material is considered to be negligible.
2)
3)
4)
5)
6)
7)

Total Settlement at Midpoint Between Shear Keys=	20.3	inches
Total Settlement at Shear Keys=	12.9	inches
Differential Settlement=	7.4	inches

		Depth (GS=0-ft)		Elevation (ft)		Unit Weight		Settlement					Staged Construction		
		Top	Bottom	Top	Bottom	Moist	Saturated	$C_{c\varepsilon} = C_c/(1+e_o)$	$C_{r\varepsilon} = C_{cε}/5$	OCR	Total Layer Settlement		Reduction	Total Layer Settlement	
Layer	Description	(ft)	(ft)	(ft)	(ft)	(pcf)	(pcf)	(-)	(-)	(-)	(in)	(ft)	(%)	(in)	(ft)
1	Embankment Fill	-33	0	28	-5	115	120	0.01	0.002	5	0	0.00	100%	0	0.00
2	Organics	0	15	-5	-20	85	90	0.180	0.036	1	7.3	0.61	0%	7	0.61
3b	Loose - Coarse Grained	15	30	-20	-35	105	110	0.005	0.001	1	0.3	0.02	0%	0	0.02
4	Medium Stiff Fine-Grained	30	50	-35	-55	115	120	0.070	0.014	1	8.5	0.71	0%	8	0.71
5	Stiff Fine-Grained	50	100	-55	-105	120	125	0.017	0.0034	1	2.5	0.21	0%	3	0.21
6	Dense Coarse-Grained	100	150	-105	-155	120	125	0.017	0.0034	1	1.2	0.10	0%	1	0.10
7	Stiff Fine-Grained	150	200	-155	-205	120	125	0.017	0.0034	1	0.6	0.05	0%	1	0.05
										Σ=	20.3	1.7	Σ=	20.3	1.7

							Pre Construction					Δσ due to Embankment Load (Das - 5.6)				Δσ due to Foundation R&R (2:1)			Δσ With Arching for Shear Keys (Das - 5.6)									
Top of Layer	Bottom of Layer	Depth (ft)	Layer (-)	Elevation (ft)	Moist Unit Weight (pcf)	Saturated Unit Weight (pcf)	Total Stress (psf)	Pore Pressure (psf)	Effective stress (psf)	OCR (-)	Pre- Consolidation Pressure (psf)	α_1 (rad)	α_2 (rad)	Influence Value I'	Δσ below Embankment middle (psf)	Foundation Removal (psf)	Foundation Replacement (psf)	Net Stress Change in Layer (psf)	α1 (rad)	α2 (rad)	Influence Value I'	Δσ between shear keys above shear key raft foundation (psf)	Δσ below shear key raft foundation	Final Stress (psf)	$C_{c\varepsilon}$ (-)	$C_{r\varepsilon}$ (-)	Vertical Strain $\varepsilon_{v,i}$ (%)	Change in Layer Thickness Δh_i (in)
0	1	0.5	Organics	-5.5	85	90	45	31	14	1.0	14	0.03	1.54	0.50	3960	-45	60	15	1.51	0.00	0.5	409	0	438	0.18	0.036	0.0	0.00
1	2	1.5	Organics	-6.5	85	90	135	94	41	1.0	41	0.08	1.48	0.50	3960	-135	180	45	1.39	0.00	0.4	377	0	463	0.18	0.036	0.0	0.00
2	3	2.5	Organics	-7.5	85	90	225	156	69	1.0	69	0.13	1.42	0.50	3959	-225	300	75	1.28	0.00	0.4	346	0	490	0.18	0.036	0.0	0.00
3	4	3.5	Organics	-8.5	85	90	315	218	97	1.0	97	0.18	1.36	0.50	3959	-315	420	105	1.17	0.00	0.4	317	0	519	0.18	0.036	0.0	0.00
4	5	4.5	Organics	-9.5	85	90	405	281	124	1.0	124	0.24	1.30	0.50	3957	-405	540	135	1.08	0.00	0.3	291	0	550	0.18	0.036	0.0	0.00
5	6	5.5	Organics	-10.5	85	90	495	343	152	1.0	152	0.28	1.24	0.50	3955	-495	660	165	0.99	0.00	0.3	267	0	584	0.18	0.036	0.0	0.00
6	7	6.5	Organics	-11.5	85	90	585	406	179	1.0	179	0.33	1.18	0.50	3952	-493	657	164	0.91	0.00	0.3	246	0	589	0.18	0.036	0.1	1.12
7	8	7.5	Organics	-12.5	85	90	675	468	207	1.0	207	0.37	1.13	0.50	3948	-489	652	163	0.84	0.00	0.3	227	0	597	0.18	0.036	0.1	0.99
8	9	8.5	Organics	-13.5	85	90	765	530	235	1.0	235	0.41	1.08	0.50	3943	-485	647	162	0.78	0.00	0.2	213	0	609	0.18	0.036	0.1	0.89
9	10	9.5	Organics	-14.5	85	90	855	593	262	1.0	262	0.45	1.03	0.50	3937	-481	641	160	0.72	0.00	0.2	213	0	635	0.18	0.036	0.1	0.83
10	11	10.5	Organics	-15.5	85	90	945	655	290	1.0	290	0.49	0.99	0.50	3930	-477	636	159	0.67	0.00	0.2	213	0	661	0.18	0.036	0.1	0.77
11	12	11.5	Organics	-16.5	85	90	1035	718	317	1.0	317	0.52	0.95	0.50	3922	-473	631	158	0.63	0.00	0.2	213	0	688	0.18	0.036	0.1	0.73
12	13	12.5	Organics	-17.5	85	90	1125	780	345	1.0	345	0.55	0.91	0.49	3913	-469	626	156	0.59	0.00	0.2	213	0	714	0.18	0.036	0.1	0.68
13	14	13.5	Organics	-18.5	85	90	1215	842	373	1.0	373	0.58	0.87	0.49	3903	-466	621	155	0.55	0.00	0.2	213	0	740	0.18	0.036	0.1	0.64
14	15	14.5	Organics	-19.5	85	90	1305	905	400	1.0	400	0.61	0.83	0.49	3893	-462	616	154	0.52	0.00	0.2	213	0	767	0.18	0.036	0.1	0.61
15	16	15.5	Loose - Coarse Grained	-20.5	105	110	1415	967	448	1.0	448	0.64	0.80	0.49	3881	-458	611	153	0.49	0.00	0.2	213	0	813	0.005	0.001	0.0	0.02
16	17	16.5	Loose - Coarse Grained	-21.5	105	110	1525	1030	495	1.0	495	0.66	0.77	0.49	3869	-455	606	152	0.47	0.00	0.1	213	0	859	0.005	0.001	0.0	0.01
17	18	17.5	Loose - Coarse Grained	-22.5	105	110	1635	1092	543	1.0	543	0.68	0.74	0.49	3856	-451	601	150	0.44	0.00	0.1	213	0	906	0.005	0.001	0.0	0.01
18	19	18.5	Loose - Coarse Grained	-23.5	105	110	1745	1154	591	1.0	591	0.70	0.71	0.49	3842	-448	597	149	0.42	0.00	0.1	213	0	952	0.005	0.001	0.0	0.01
19	20	19.5	Loose - Coarse Grained	-24.5	105	110	1855	1217	638	1.0	638	0.72	0.69	0.48	3828	-444	592	148	0.40	0.00	0.1	213	0	999	0.005	0.001	0.0	0.01
20	21	20.5	Loose - Coarse Grained	-25.5	105	110	1965	1279	686	1.0	686	0.73	0.66	0.48	3813	-441	587	147	0.39	0.00	0.1	213	0	1045	0.005	0.001	0.0	0.01
21	22	21.5	Loose - Coarse Grained	-26.5	105	110	2075	1342	733	1.0	733	0.75	0.64	0.48	3798	-437	583	146	0.37	0.00	0.1	213	0	1092	0.005	0.001	0.0	0.01
22	23	22.5	Loose - Coarse Grained	-27.5	105	110	2185	1404	781	1.0	781	0.76	0.62	0.48	3782	-434	578	145	0.35	0.00	0.1	213	0	1138	0.005	0.001	0.0	0.01
23	24	23.5	Loose - Coarse Grained	-28.5	105	110	2295	1466	829	1.0	829	0.77	0.60	0.48	3766	-430	574	143	0.34	0.00	0.1	213	0	1185	0.005	0.001	0.0	0.01
24	25	24.5	Loose - Coarse Grained	-29.5	105	110	2405	1529	876	1.0	876	0.78	0.58	0.47	3750	-427	570	142	0.33	0.00	0.1	213	0	1231	0.005	0.001	0.0	0.01
25	26	25.5	Loose - Coarse Grained	-30.5	105	110	2515	1591	924	1.0	924	0.79	0.56	0.47	3733	-424	565	141	0.32	0.00	0.1	213	0	1278	0.005	0.001	0.0	0.01
26	27	26.5	Loose - Coarse Grained	-31.5	105	110	2625	1654	971	1.0	971	0.80	0.54	0.47	3715	-421	561	140	0.30	0.00	0.1	213	0	1324	0.005	0.001	0.0	0.01
27	28	27.5	Loose - Coarse Grained	-32.5	105	110	2735	1716	1019	1.0	1019	0.81	0.53	0.47	3698	-418	557	139	0.29	0.00	0.1	0	3931	5090	0.005	0.001	0.0	0.04
28	29	28.5	Loose - Coarse Grained	-33.5	105	110	2845	1778	1067	1.0	1067	0.82	0.51	0.46	3680	-414	552	138	0.28	0.00	0.1	0	3898	5102	0.005	0.001	0.0	0.04
29	30	29.5	Loose - Coarse Grained	-34.5	105	110	2955	1841	1114	1.0	1114	0.82	0.50	0.46	3662	-411	548	137	0.28	0.00	0.1	0	3864	5115	0.005	0.001	0.0	0.04
30	31	30.5	Medium Stiff Fine-Grained	-35.5	115	120	3075	1903	1172	1.0	1172	0.83	0.48	0.46	3644	-408	544	136	0.27	0.00	0.1	0	3831	5139	0.07	0.014	0.0	0.54
31	32	31.5	Medium Stiff Fine-Grained	-36.5	115	120	3195	1966	1229	1.0	1229	0.83	0.47	0.46	3626	-405	540	135	0.26	0.00	0.1	0	3799	5163	0.07	0.014	0.0	0.52
32	33	32.5	Medium Stiff Fine-Grained	-37.5	115	120	3315	2028	1287	1.0	1287	0.84	0.46	0.46	3607	-402	536	134	0.25	0.00	0.1	0	3767	5188	0.07	0.014	0.0	0.51
33	34	33.5	Medium Stiff Fine-Grained	-38.5	115	120	3435	2090	1345	1.0	1345	0.84	0.45	0.45	3588	-399	532	133	0.24	0.00	0.1	0	3735	5212	0.07	0.014	0.0	0.49
34	35	34.5	Medium Stiff Fine-Grained	-39.5	115	120	3555	2153	1402	1.0	1402	0.85	0.43	0.45	3570	-396	528	132	0.24	0.00	0.1	0	3703	5238	0.07	0.014	0.0	0.48
35	36	35.5	Medium Stiff Fine-Grained	-40.5	115	120	3675	2215	1460	1.0	1460	0.85	0.42	0.45	3551	-393	524	131	0.23	0.00	0.1	0	3672	5263	0.07	0.014	0.0	0.47
36	37	36.5	Medium Stiff Fine-Grained	-41.5	115	120	3795	2278	1517	1.0	1517	0.85	0.41	0.45	3532	-390	521	130	0.22	0.00	0.1	0	3642	5289	0.07	0.014	0.0	0.46
37	38	37.5	Medium Stiff Fine-Grained	-42.5	115	120	3915	2340	1575	1.0	1575	0.85	0.40	0.44	3513	-388	517	129	0.22	0.00	0.1	0	3612	5316	0.07	0.014	0.0	0.44
38	39	38.5	Medium Stiff Fine-Grained	-43.5	115	120	4035	2402	1633	1.0	1633	0.85	0.39	0.44	3493	-385	513	128	0.21	0.00	0.1	0	3582	5343	0.07	0.014	0.0	0.43
39	40	39.5	Medium Stiff Fine-Grained	-44.5	115	120	4155	2465	1690	1.0	1690	0.86	0.38	0.44	3474	-382	509	127	0.21	0.00	0.1	0	3553	5370	0.07	0.014	0.0	0.42
40	41	40.5	Medium Stiff Fine-Grained	-45.5	115	120	4275	2527	1748	1.0	1748	0.86	0.38	0.44	3455	-379	506	126	0.20	0.00	0.1	0	3523	5398	0.07	0.014	0.0	0.41
41	42	41.5	Medium Stiff Fine-Grained	-46.5	115	120	4395	2590	1805	1.0	1805	0.86	0.37	0.43	3436	-376	502	125	0.20	0.00	0.1	0	3495	5426	0.07	0.014	0.0	0.40
42	43	42.5	Medium Stiff Fine-Grained	-47.5	115	120	4515	2652	1863	1.0	1863	0.86	0.36	0.43	3417	-374	498	125	0.19	0.00	0.1	0	3466	5454	0.07	0.014	0.0	0.39
43	44	43.5	Medium Stiff Fine-Grained	-48.5	115	120	4635	2714	1921	1.0	1921	0.86	0.35	0.43	3397	-371	495	124	0.19	0.00	0.1	0	3438	5483	0.07	0.014	0.0	0.38
44	45	44.5	Medium Stiff Fine-Grained	-49.5	115	120	4755	2777	1978	1.0	1978	0.86	0.35	0.43	3378	-368	491	123	0.19	0.00	0.1	0	3411	5512	0.07	0.014	0.0	0.37
45	46	45.5	Medium Stiff Fine-Grained	-50.5	115	120	4875	2839	2036	1.0	2036	0.86	0.34	0.42	3359	-366	488	122	0.18	0.00	0.1	0	3383	5541	0.07	0.014	0.0	0.37
46	47	46.5	Medium Stiff Fine-Grained	-51.5	115	120	4995	2902	2093	1.0	2093	0.86	0.33	0.42	3340	-363	484	121	0.18	0.00	0.1	0	3356	5571	0.07	0.014	0.0	0.36
47	48	47.5	Medium Stiff Fine-Grained	-52.5	115	120	5115	2964	2151	1.0	2151	0.85	0.32	0.42	3321	-361	481	120	0.17	0.00	0.1	0	3330	5601	0.07	0.014	0.0	0.35
48	49	48.5	Medium Stiff Fine-Grained	-53.5	115	120	5235	3026	2209	1.0	2209	0.85	0.32	0.42	3301	-358	478	119	0.17	0.00	0.1	0	3303	5631	0.07	0.014	0.0	0.34

Configuration **3H1V_P2_G2-AR25**

by: E. Ticen
Last Updated: February 2020

Geometry	Embankment Height, H	33	ft
	Embankment Side Slopes	3	xH:1V
	Crown Width	32	ft
	Half Crown Width, B1	16	ft
	Side Slope Width, B2	99	ft
	Unit Weight of Embankment, γ	120	pcf
	Depth to Ground Water	0	ft
	Maximum Stress Increase	3960	psf
	Water Surface Elevation	-5	ft
	Ground Surface Elevation	-5	ft
Foundation Improvements	Remove & Replace Depth [1]	6	ft
	Area Replacement Ratio	0.25	-
	Shear Key Thickness	2.5	ft
	Shear Key Depth	40	ft
	Shear Key Raft Foundation Depth	26.7	ft
	Shear key Spacing	10.0	ft
	Soil Arching b/w Shear Key	0.5	xV:1H
	Arching Stress Height	2	ft
	Arching Side Slope Width, B2	5.0	ft
	σmax Arching	225	psf

Notes:
1) Compacted fill where settlement of the material is considered to be negligible.
2)
3)
4)
5)
6)
7)

Total Settlement at Midpoint Between Shear Keys=	18.8	inches
Total Settlement at Shear Keys=	12.9	inches
Differential Settlement=	5.9	inches

		Depth (GS=0-ft)		Elevation (ft)		Unit Weight		Settlement					Staged Construction		
		Top	Bottom	Top	Bottom	Moist	Saturated	$C_{c\varepsilon} = C_c/(1+e_o)$	$C_{r\varepsilon} = C_{cd}/5$	OCR	Total Layer Settlement		Reduction	Total Layer Settlement	
Layer	Description	(ft)	(ft)	(ft)	(ft)	(pcf)	(pcf)	(-)	(-)	(-)	(in)	(ft)	(%)	(in)	(ft)
1	Embankment Fill	-33	0	28	-5	115	120	0.01	0.002	5	0	0.00	100%	0	0.00
2	Organics	0	15	-5	-20	85	90	0.180	0.036	1	5.8	0.48	0%	6	0.48
3b	Loose - Coarse Grained	15	30	-20	-35	105	110	0.005	0.001	1	0.2	0.02	0%	0	0.02
4	Medium Stiff Fine-Grained	30	50	-35	-55	115	120	0.070	0.014	1	8.5	0.71	0%	8	0.71
5	Stiff Fine-Grained	50	100	-55	-105	120	125	0.017	0.0034	1	2.5	0.21	0%	3	0.21
6	Dense Coarse-Grained	100	150	-105	-155	120	125	0.017	0.0034	1	1.2	0.10	0%	1	0.10
7	Stiff Fine-Grained	150	200	-155	-205	120	125	0.017	0.0034	1	0.6	0.05	0%	1	0.05
										Σ=	18.8	1.6	Σ=	18.8	1.6

							Pre Construction							Δσ due to Embankment Load (Das - 5.6)				Δσ due to Foundation R&R (2:1)			Δσ With Arching for Shear Keys (Das - 5.6)								
Top of Layer	Bottom of Layer	Depth (ft)	Layer (-)	Elevation (ft)	Moist Unit Weight (pcf)	Saturated Unit Weight (pcf)	Total Stress (psf)	Pore Pressure (psf)	Effective stress (psf)	OCR (-)	Pre- Consolidation Pressure (psf)	α_1 (rad)	α_2 (rad)	Influence Value I'	Δσ below Embankment middle (psf)	Foundation Removal (psf)	Foundation Replacement (psf)	Net Stress Change in Layer (psf)	α1 (rad)	α2 (rad)	Influence Value I'	Δσ between shear keys above shear key raft foundation (psf)	Δσ below shear key raft foundation	Final Stress (psf)	$C_{c\varepsilon}$ (-)	$C_{r\varepsilon}$ (-)	Vertical Strain $\varepsilon_{v,i}$ (%)	Change in Layer Thickness Δh_i (in)
0	1	0.5	Organics	-5.5	85	90	45	31	14	1.0	14	0.03	1.54	0.50	3960	-45	60	15	1.47	0.00	0.5	211	0	240	0.18	0.036	0.0	0.00
1	2	1.5	Organics	-6.5	85	90	135	94	41	1.0	41	0.08	1.48	0.50	3960	-135	180	45	1.28	0.00	0.4	183	0	270	0.18	0.036	0.0	0.00
2	3	2.5	Organics	-7.5	85	90	225	156	69	1.0	69	0.13	1.42	0.50	3959	-225	300	75	1.11	0.00	0.4	159	0	303	0.18	0.036	0.0	0.00
3	4	3.5	Organics	-8.5	85	90	315	218	97	1.0	97	0.18	1.36	0.50	3959	-315	420	105	0.96	0.00	0.3	138	0	339	0.18	0.036	0.0	0.00
4	5	4.5	Organics	-9.5	85	90	405	281	124	1.0	124	0.24	1.30	0.50	3957	-405	540	135	0.84	0.00	0.3	120	0	379	0.18	0.036	0.0	0.00
5	6	5.5	Organics	-10.5	85	90	495	343	152	1.0	152	0.28	1.24	0.50	3955	-495	660	165	0.74	0.00	0.2	113	0	429	0.18	0.036	0.0	0.00
6	7	6.5	Organics	-11.5	85	90	585	406	179	1.0	179	0.33	1.18	0.50	3952	-493	657	164	0.66	0.00	0.2	113	0	456	0.18	0.036	0.1	0.88
7	8	7.5	Organics	-12.5	85	90	675	468	207	1.0	207	0.37	1.13	0.50	3948	-489	652	163	0.59	0.00	0.2	113	0	482	0.18	0.036	0.1	0.79
8	9	8.5	Organics	-13.5	85	90	765	530	235	1.0	235	0.41	1.08	0.50	3943	-485	647	162	0.53	0.00	0.2	113	0	509	0.18	0.036	0.1	0.73
9	10	9.5	Organics	-14.5	85	90	855	593	262	1.0	262	0.45	1.03	0.50	3937	-481	641	160	0.48	0.00	0.2	113	0	535	0.18	0.036	0.1	0.67
10	11	10.5	Organics	-15.5	85	90	945	655	290	1.0	290	0.49	0.99	0.50	3930	-477	636	159	0.44	0.00	0.1	113	0	561	0.18	0.036	0.1	0.62
11	12	11.5	Organics	-16.5	85	90	1035	718	317	1.0	317	0.52	0.95	0.50	3922	-473	631	158	0.41	0.00	0.1	113	0	588	0.18	0.036	0.0	0.58
12	13	12.5	Organics	-17.5	85	90	1125	780	345	1.0	345	0.55	0.91	0.49	3913	-469	626	156	0.38	0.00	0.1	113	0	614	0.18	0.036	0.0	0.54
13	14	13.5	Organics	-18.5	85	90	1215	842	373	1.0	373	0.58	0.87	0.49	3903	-466	621	155	0.35	0.00	0.1	113	0	640	0.18	0.036	0.0	0.51
14	15	14.5	Organics	-19.5	85	90	1305	905	400	1.0	400	0.61	0.83	0.49	3893	-462	616	154	0.33	0.00	0.1	113	0	667	0.18	0.036	0.0	0.48
15	16	15.5	Loose - Coarse Grained	-20.5	105	110	1415	967	448	1.0	448	0.64	0.80	0.49	3881	-458	611	153	0.31	0.00	0.1	113	0	713	0.005	0.001	0.0	0.01
16	17	16.5	Loose - Coarse Grained	-21.5	105	110	1525	1030	495	1.0	495	0.66	0.77	0.49	3869	-455	606	152	0.29	0.00	0.1	113	0	759	0.005	0.001	0.0	0.01
17	18	17.5	Loose - Coarse Grained	-22.5	105	110	1635	1092	543	1.0	543	0.68	0.74	0.49	3856	-451	601	150	0.28	0.00	0.1	113	0	806	0.005	0.001	0.0	0.01
18	19	18.5	Loose - Coarse Grained	-23.5	105	110	1745	1154	591	1.0	591	0.70	0.71	0.49	3842	-448	597	149	0.26	0.00	0.1	113	0	852	0.005	0.001	0.0	0.01
19	20	19.5	Loose - Coarse Grained	-24.5	105	110	1855	1217	638	1.0	638	0.72	0.69	0.48	3828	-444	592	148	0.25	0.00	0.1	113	0	899	0.005	0.001	0.0	0.01
20	21	20.5	Loose - Coarse Grained	-25.5	105	110	1965	1279	686	1.0	686	0.73	0.66	0.48	3813	-441	587	147	0.24	0.00	0.1	113	0	945	0.005	0.001	0.0	0.01
21	22	21.5	Loose - Coarse Grained	-26.5	105	110	2075	1342	733	1.0	733	0.75	0.64	0.48	3798	-437	583	146	0.23	0.00	0.1	113	0	992	0.005	0.001	0.0	0.01
22	23	22.5	Loose - Coarse Grained	-27.5	105	110	2185	1404	781	1.0	781	0.76	0.62	0.48	3782	-434	578	145	0.22	0.00	0.1	113	0	1038	0.005	0.001	0.0	0.01
23	24	23.5	Loose - Coarse Grained	-28.5	105	110	2295	1466	829	1.0	829	0.77	0.60	0.48	3766	-430	574	143	0.21	0.00	0.1	113	0	1085	0.005	0.001	0.0	0.01
24	25	24.5	Loose - Coarse Grained	-29.5	105	110	2405	1529	876	1.0	876	0.78	0.58	0.47	3750	-427	570	142	0.20	0.00	0.1	113	0	1131	0.005	0.001	0.0	0.01
25	26	25.5	Loose - Coarse Grained	-30.5	105	110	2515	1591	924	1.0	924	0.79	0.56	0.47	3733	-424	565	141	0.19	0.00	0.1	113	0	1178	0.005	0.001	0.0	0.01
26	27	26.5	Loose - Coarse Grained	-31.5	105	110	2625	1654	971	1.0	971	0.80	0.54	0.47	3715	-421	561	140	0.19	0.00	0.1	113	0	1224	0.005	0.001	0.0	0.01
27	28	27.5	Loose - Coarse Grained	-32.5	105	110	2735	1716	1019	1.0	1019	0.81	0.53	0.47	3698	-418	557	139	0.18	0.00	0.1	0	3931	5090	0.005	0.001	0.0	0.04
28	29	28.5	Loose - Coarse Grained	-33.5	105	110	2845	1778	1067	1.0	1067	0.82	0.51	0.46	3680	-414	552	138	0.17	0.00	0.1	0	3898	5102	0.005	0.001	0.0	0.04
29	30	29.5	Loose - Coarse Grained	-34.5	105	110	2955	1841	1114	1.0	1114	0.82	0.50	0.46	3662	-411	548	137	0.17	0.00	0.1	0	3864	5115	0.005	0.001	0.0	0.04
30	31	30.5	Medium Stiff Fine-Grained	-35.5	115	120	3075	1903	1172	1.0	1172	0.83	0.48	0.46	3644	-408	544	136	0.16	0.00	0.1	0	3831	5139	0.07	0.014	0.0	0.54
31	32	31.5	Medium Stiff Fine-Grained	-36.5	115	120	3195	1966	1229	1.0	1229	0.83	0.47	0.46	3626	-405	540	135	0.16	0.00	0.1	0	3799	5163	0.07	0.014	0.0	0.52
32	33	32.5	Medium Stiff Fine-Grained	-37.5	115	120	3315	2028	1287	1.0	1287	0.84	0.46	0.46	3607	-402	536	134	0.15	0.00	0.0	0	3767	5188	0.07	0.014	0.0	0.51
33	34	33.5	Medium Stiff Fine-Grained	-38.5	115	120	3435	2090	1345	1.0	1345	0.84	0.45	0.45	3588	-399	532	133	0.15	0.00	0.0	0	3735	5212	0.07	0.014	0.0	0.49
34	35	34.5	Medium Stiff Fine-Grained	-39.5	115	120	3555	2153	1402	1.0	1402	0.85	0.43	0.45	3570	-396	528	132	0.14	0.00	0.0	0	3703	5238	0.07	0.014	0.0	0.48
35	36	35.5	Medium Stiff Fine-Grained	-40.5	115	120	3675	2215	1460	1.0	1460	0.85	0.42	0.45	3551	-393	524	131	0.14	0.00	0.0	0	3672	5263	0.07	0.014	0.0	0.47
36	37	36.5	Medium Stiff Fine-Grained	-41.5	115	120	3795	2278	1517	1.0	1517	0.85	0.41	0.45	3532	-390	521	130	0.14	0.00	0.0	0	3642	5289	0.07	0.014	0.0	0.46
37	38	37.5	Medium Stiff Fine-Grained	-42.5	115	120	3915	2340	1575	1.0	1575	0.85	0.40	0.44	3513	-388	517	129	0.13	0.00	0.0	0	3612	5316	0.07	0.014	0.0	0.44
38	39	38.5	Medium Stiff Fine-Grained	-43.5	115	120	4035	2402	1633	1.0	1633	0.85	0.39	0.44	3493	-385	513	128	0.13	0.00	0.0	0	3582	5343	0.07	0.014	0.0	0.43
39	40	39.5	Medium Stiff Fine-Grained	-44.5	115	120	4155	2465	1690	1.0	1690	0.86	0.38	0.44	3474	-382	509	127	0.13	0.00	0.0	0	3553	5370	0.07	0.014	0.0	0.42
40	41	40.5	Medium Stiff Fine-Grained	-45.5	115	120	4275	2527	1748	1.0	1748	0.86	0.38	0.44	3455	-379	506	126	0.12	0.00	0.0	0	3523	5398	0.07	0.014	0.0	0.41
41	42	41.5	Medium Stiff Fine-Grained	-46.5	115	120	4395	2590	1805	1.0	1805	0.86	0.37	0.43	3436	-376	502	125	0.12	0.00	0.0	0	3495	5426	0.07	0.014	0.0	0.40
42	43	42.5	Medium Stiff Fine-Grained	-47.5	115	120	4515	2652	1863	1.0	1863	0.86	0.36	0.43	3417	-374	498	125	0.12	0.00	0.0	0	3466	5454	0.07	0.014	0.0	0.39
43	44	43.5	Medium Stiff Fine-Grained	-48.5	115	120	4635	2714	1921	1.0	1921	0.86	0.35	0.43	3397	-371	495	124	0.11	0.00	0.0	0	3438	5483	0.07	0.014	0.0	0.38
44	45	44.5	Medium Stiff Fine-Grained	-49.5	115	120	4755	2777	1978	1.0	1978	0.86	0.35	0.43	3378	-368	491	123	0.11	0.00	0.0	0	3411	5512	0.07	0.014	0.0	0.37
45	46	45.5	Medium Stiff Fine-Grained	-50.5	115	120	4875	2839	2036	1.0	2036	0.86	0.34	0.42	3359	-366	488	122	0.11	0.00	0.0	0	3383	5541	0.07	0.014	0.0	0.37
46	47	46.5	Medium Stiff Fine-Grained	-51.5	115	120	4995	2902	2093	1.0	2093	0.86	0.33	0.42	3340	-363	484	121	0.11	0.00	0.0	0	3356	5571	0.07	0.014	0.0	0.36
47	48	47.5	Medium Stiff Fine-Grained	-52.5	115	120	5115	2964	2151	1.0	2151	0.85	0.32	0.42	3321	-361	481	120	0.10	0.00	0.0	0	3330	5601	0.07	0.014	0.0	0.35
48	49	48.5	Medium Stiff Fine-Grained	-53.5	115	120	5235	3026	2209	1.0	2209	0.85	0.32	0.42	3301	-358	478	119	0.10	0.00	0.0	0	3303	5631	0.07	0.014	0.0	0.34

Configuration **4H1V_P1_E**

by: E. Ticen
Last Updated: February 2020

Geometry	Embankment Height, H	33	ft
	Embankment Side Slopes	4	xH:1V
	Crown Width	32	ft
	Half Crown Width, B1	16	ft
	Side Slope Width, B2	132	ft
	Unit Weight of Embankment, γ	120	pcf
	Depth to Ground Water	0	ft
	Maximum Stress Increase	3960	psf
	Water Surface Elevation	-5	ft
	Ground Surface Elevation	-5	ft
Foundation Improvements	Remove & Replace Depth [1]	6	ft
	Area Replacement Ratio	0	-
	Shear Key Thickness	0	ft
	Shear Key Depth	0	ft
	Shear Key Raft Foundation Depth	0.0	ft
	Shear key Spacing	--	ft
	Soil Arching b/w Shear Key	0	xV:1H
	Arching Stress Height	--	ft
	Arching Side Slope Width, B2	--	ft
	σmax Arching	0	psf

Notes:
1) Compacted fill where settlement of the material is considered to be negligible.
2)
3)
4)
5)
6)
7)

Total Settlement at Midpoint Between Shear Keys=	--	inches
Total Settlement at Shear Keys=	--	inches
Differential Settlement=	--	inches

		Depth (GS=0-ft)		Elevation (ft)		Unit Weight		Settlement					Staged Construction		
		Top	Bottom	Top	Bottom	Moist	Saturated	$C_{c\varepsilon} = C_c/(1+e_o)$	$C_{r\varepsilon} = C_{c\varepsilon}/5$	OCR	Total Layer Settlement		Reduction	Total Layer Settlement	
Layer	Description	(ft)	(ft)	(ft)	(ft)	(pcf)	(pcf)	(-)	(-)	(-)	(in)	(ft)	(%)	(in)	(ft)
1	Embankment Fill	-33	0	28	-5	115	120	0.01	0.002	5	0	0.00	100%	0	0.00
2	Organics	0	15	-5	-20	85	90	0.180	0.036	1	23.2	1.93	0%	23	1.93
3a	Soft to Medium Stiff Fine-Grained	15	30	-20	-35	105	110	0.120	0.024	1	17.3	1.44	0%	17	1.44
4	Medium Stiff Fine-Grained	30	50	-35	-55	115	120	0.070	0.014	1	8.5	0.71	0%	9	0.71
5	Stiff Fine-Grained	50	100	-55	-105	120	125	0.017	0.0034	1	2.8	0.23	0%	3	0.23
6	Dense Coarse-Grained	100	150	-105	-155	120	125	0.017	0.0034	1	1.4	0.12	0%	1	0.12
7	Stiff Fine-Grained	150	200	-155	-205	120	125	0.017	0.0034	1	0.8	0.06	0%	1	0.06
										Σ=	53.9	4.5	Σ=	53.9	4.5

							Pre Construction					Δσ due to Embankment Load (Das - 5.6)				Δσ due to Foundation R&R (2:1)			Δσ With Arching for Shear Keys (Das - 5.6)									
Top of Layer	Bottom of Layer	Depth (ft)	Layer (-)	Elevation (ft)	Moist Unit Weight (pcf)	Saturated Unit Weight (pcf)	Total Stress (psf)	Pore Pressure (psf)	Effective stress (psf)	OCR (-)	Pre- Consolidation Pressure (psf)	α_1 (rad)	α_2 (rad)	Influence Value I'	Δσ below Embankment middle (psf)	Foundation Removal (psf)	Foundation Replacement (psf)	Net Stress Change in Layer (psf)	α1 (rad)	α2 (rad)	Influence Value I'	Δσ between shear keys above shear key raft foundation (psf)	Δσ below shear key raft foundation	Final Stress (psf)	$C_{c\varepsilon}$ (-)	$C_{r\varepsilon}$ (-)	Vertical Strain $\varepsilon_{v,i}$ (%)	Change in Layer Thickness Δh_i (in)
0	1	0.5	Organics	-5.5	85	90	45	31	14	1.0	14	0.03	1.54	0.50	3960	-45	60	15	0.00	0.00	0.0	0	0	3989	0.18	0.036	0.0	0.00
1	2	1.5	Organics	-6.5	85	90	135	94	41	1.0	41	0.08	1.48	0.50	3960	-135	180	45	0.00	0.00	0.0	0	0	4046	0.18	0.036	0.0	0.00
2	3	2.5	Organics	-7.5	85	90	225	156	69	1.0	69	0.14	1.42	0.50	3960	-225	300	75	0.00	0.00	0.0	0	0	4104	0.18	0.036	0.0	0.00
3	4	3.5	Organics	-8.5	85	90	315	218	97	1.0	97	0.19	1.36	0.50	3959	-315	420	105	0.00	0.00	0.0	0	0	4161	0.18	0.036	0.0	0.00
4	5	4.5	Organics	-9.5	85	90	405	281	124	1.0	124	0.24	1.30	0.50	3958	-405	540	135	0.00	0.00	0.0	0	0	4217	0.18	0.036	0.0	0.00
5	6	5.5	Organics	-10.5	85	90	495	343	152	1.0	152	0.29	1.24	0.50	3956	-495	660	165	0.00	0.00	0.0	0	0	4273	0.18	0.036	0.0	0.00
6	7	6.5	Organics	-11.5	85	90	585	406	179	1.0	179	0.34	1.18	0.50	3954	-493	658	164	0.00	0.00	0.0	0	0	4298	0.18	0.036	0.2	2.98
7	8	7.5	Organics	-12.5	85	90	675	468	207	1.0	207	0.39	1.13	0.50	3951	-490	654	163	0.00	0.00	0.0	0	0	4321	0.18	0.036	0.2	2.85
8	9	8.5	Organics	-13.5	85	90	765	530	235	1.0	235	0.43	1.08	0.50	3947	-487	649	162	0.00	0.00	0.0	0	0	4344	0.18	0.036	0.2	2.74
9	10	9.5	Organics	-14.5	85	90	855	593	262	1.0	262	0.47	1.03	0.50	3943	-484	645	161	0.00	0.00	0.0	0	0	4366	0.18	0.036	0.2	2.64
10	11	10.5	Organics	-15.5	85	90	945	655	290	1.0	290	0.51	0.99	0.50	3937	-481	641	160	0.00	0.00	0.0	0	0	4387	0.18	0.036	0.2	2.55
11	12	11.5	Organics	-16.5	85	90	1035	718	317	1.0	317	0.55	0.95	0.50	3931	-478	637	159	0.00	0.00	0.0	0	0	4408	0.18	0.036	0.2	2.47
12	13	12.5	Organics	-17.5	85	90	1125	780	345	1.0	345	0.58	0.91	0.50	3924	-475	633	158	0.00	0.00	0.0	0	0	4428	0.18	0.036	0.2	2.39
13	14	13.5	Organics	-18.5	85	90	1215	842	373	1.0	373	0.61	0.87	0.49	3917	-472	629	157	0.00	0.00	0.0	0	0	4447	0.18	0.036	0.2	2.33
14	15	14.5	Organics	-19.5	85	90	1305	905	400	1.0	400	0.64	0.83	0.49	3909	-469	625	156	0.00	0.00	0.0	0	0	4465	0.18	0.036	0.2	2.26
15	16	15.5	Soft to Medium Stiff Fine-Grained	-20.5	105	110	1415	967	448	1.0	448	0.67	0.80	0.49	3900	-466	621	155	0.00	0.00	0.0	0	0	4503	0.12	0.024	0.1	1.44
16	17	16.5	Soft to Medium Stiff Fine-Grained	-21.5	105	110	1525	1030	495	1.0	495	0.69	0.77	0.49	3891	-463	617	154	0.00	0.00	0.0	0	0	4541	0.12	0.024	0.1	1.39
17	18	17.5	Soft to Medium Stiff Fine-Grained	-22.5	105	110	1635	1092	543	1.0	543	0.71	0.74	0.49	3881	-460	613	153	0.00	0.00	0.0	0	0	4577	0.12	0.024	0.1	1.33
18	19	18.5	Soft to Medium Stiff Fine-Grained	-23.5	105	110	1745	1154	591	1.0	591	0.73	0.71	0.49	3871	-457	610	152	0.00	0.00	0.0	0	0	4614	0.12	0.024	0.1	1.29
19	20	19.5	Soft to Medium Stiff Fine-Grained	-24.5	105	110	1855	1217	638	1.0	638	0.75	0.69	0.49	3860	-454	606	151	0.00	0.00	0.0	0	0	4649	0.12	0.024	0.1	1.24
20	21	20.5	Soft to Medium Stiff Fine-Grained	-25.5	105	110	1965	1279	686	1.0	686	0.77	0.66	0.49	3848	-451	602	150	0.00	0.00	0.0	0	0	4685	0.12	0.024	0.1	1.20
21	22	21.5	Soft to Medium Stiff Fine-Grained	-26.5	105	110	2075	1342	733	1.0	733	0.79	0.64	0.48	3837	-449	598	150	0.00	0.00	0.0	0	0	4720	0.12	0.024	0.1	1.16
22	23	22.5	Soft to Medium Stiff Fine-Grained	-27.5	105	110	2185	1404	781	1.0	781	0.80	0.62	0.48	3825	-446	595	149	0.00	0.00	0.0	0	0	4754	0.12	0.024	0.1	1.13
23	24	23.5	Soft to Medium Stiff Fine-Grained	-28.5	105	110	2295	1466	829	1.0	829	0.82	0.60	0.48	3812	-443	591	148	0.00	0.00	0.0	0	0	4789	0.12	0.024	0.1	1.10
24	25	24.5	Soft to Medium Stiff Fine-Grained	-29.5	105	110	2405	1529	876	1.0	876	0.83	0.58	0.48	3800	-440	587	147	0.00	0.00	0.0	0	0	4823	0.12	0.024	0.1	1.07
25	26	25.5	Soft to Medium Stiff Fine-Grained	-30.5	105	110	2515	1591	924	1.0	924	0.84	0.56	0.48	3786	-438	584	146	0.00	0.00	0.0	0	0	4856	0.12	0.024	0.1	1.04
26	27	26.5	Soft to Medium Stiff Fine-Grained	-31.5	105	110	2625	1654	971	1.0	971	0.85	0.54	0.48	3773	-435	580	145	0.00	0.00	0.0	0	0	4890	0.12	0.024	0.1	1.01
27	28	27.5	Soft to Medium Stiff Fine-Grained	-32.5	105	110	2735	1716	1019	1.0	1019	0.86	0.53	0.47	3760	-433	577	144	0.00	0.00	0.0	0	0	4923	0.12	0.024	0.1	0.99
28	29	28.5	Soft to Medium Stiff Fine-Grained	-33.5	105	110	2845	1778	1067	1.0	1067	0.87	0.51	0.47	3746	-430	573	143	0.00	0.00	0.0	0	0	4956	0.12	0.024	0.1	0.96
29	30	29.5	Soft to Medium Stiff Fine-Grained	-34.5	105	110	2955	1841	1114	1.0	1114	0.88	0.50	0.47	3732	-427	570	142	0.00	0.00	0.0	0	0	4989	0.12	0.024	0.1	0.94
30	31	30.5	Medium Stiff Fine-Grained	-35.5	115	120	3075	1903	1172	1.0	1172	0.88	0.48	0.47	3718	-425	566	142	0.00	0.00	0.0	0	0	5031	0.07	0.014	0.0	0.53
31	32	31.5	Medium Stiff Fine-Grained	-36.5	115	120	3195	1966	1229	1.0	1229	0.89	0.47	0.47	3704	-422	563	141	0.00	0.00	0.0	0	0	5074	0.07	0.014	0.0	0.52
32	33	32.5	Medium Stiff Fine-Grained	-37.5	115	120	3315	2028	1287	1.0	1287	0.90	0.46	0.47	3689	-420	560	140	0.00	0.00	0.0	0	0	5116	0.07	0.014	0.0	0.50
33	34	33.5	Medium Stiff Fine-Grained	-38.5	115	120	3435	2090	1345	1.0	1345	0.90	0.45	0.46	3675	-417	556	139	0.00	0.00	0.0	0	0	5158	0.07	0.014	0.0	0.49
34	35	34.5	Medium Stiff Fine-Grained	-39.5	115	120	3555	2153	1402	1.0	1402	0.91	0.43	0.46	3660	-415	553	138	0.00	0.00	0.0	0	0	5200	0.07	0.014	0.0	0.48
35	36	35.5	Medium Stiff Fine-Grained	-40.5	115	120	3675	2215	1460	1.0	1460	0.91	0.42	0.46	3645	-412	550	137	0.00	0.00	0.0	0	0	5242	0.07	0.014	0.0	0.47
36	37	36.5	Medium Stiff Fine-Grained	-41.5	115	120	3795	2278	1517	1.0	1517	0.92	0.41	0.46	3630	-410	546	137	0.00	0.00	0.0	0	0	5284	0.07	0.014	0.0	0.46
37	38	37.5	Medium Stiff Fine-Grained	-42.5	115	120	3915	2340	1575	1.0	1575	0.92	0.40	0.46	3615	-407	543	136	0.00	0.00	0.0	0	0	5326	0.07	0.014	0.0	0.44
38	39	38.5	Medium Stiff Fine-Grained	-43.5	115	120	4035	2402	1633	1.0	1633	0.92	0.39	0.45	3600	-405	540	135	0.00	0.00	0.0	0	0	5368	0.07	0.014	0.0	0.43
39	40	39.5	Medium Stiff Fine-Grained	-44.5	115	120	4155	2465	1690	1.0	1690	0.93	0.38	0.45	3585	-403	537	134	0.00	0.00	0.0	0	0	5410	0.07	0.014	0.0	0.42
40	41	40.5	Medium Stiff Fine-Grained	-45.5	115	120	4275	2527	1748	1.0	1748	0.93	0.38	0.45	3570	-400	534	133	0.00	0.00	0.0	0	0	5451	0.07	0.014	0.0	0.41
41	42	41.5	Medium Stiff Fine-Grained	-46.5	115	120	4395	2590	1805	1.0	1805	0.93	0.37	0.45	3555	-398	531	133	0.00	0.00	0.0	0	0	5493	0.07	0.014	0.0	0.41
42	43	42.5	Medium Stiff Fine-Grained	-47.5	115	120	4515	2652	1863	1.0	1863	0.93	0.36	0.45	3540	-396	528	132	0.00	0.00	0.0	0	0	5534	0.07	0.014	0.0	0.40
43	44	43.5	Medium Stiff Fine-Grained	-48.5	115	120	4635	2714	1921	1.0	1921	0.93	0.35	0.44	3524	-393	525	131	0.00	0.00	0.0	0	0	5576	0.07	0.014	0.0	0.39
44	45	44.5	Medium Stiff Fine-Grained	-49.5	115	120	4755	2777	1978	1.0	1978	0.93	0.35	0.44	3509	-391	521	130	0.00	0.00	0.0	0	0	5618	0.07	0.014	0.0	0.38
45	46	45.5	Medium Stiff Fine-Grained	-50.5	115	120	4875	2839	2036	1.0	2036	0.93	0.34	0.44	3494	-389	518	130	0.00	0.00	0.0	0	0	5659	0.07	0.014	0.0	0.37
46	47	46.5	Medium Stiff Fine-Grained	-51.5	115	120	4995	2902	2093	1.0	2093	0.93	0.33	0.44	3478	-387	516	129	0.00	0.00	0.0	0	0	5701	0.07	0.014	0.0	0.37
47	48	47.5	Medium Stiff Fine-Grained	-52.5	115	120	5115	2964	2151	1.0	2151	0.94	0.32	0.44	3463	-384	513	128	0.00	0.00	0.0	0	0	5742	0.07	0.014	0.0	0.36
48	49	48.5	Medium Stiff Fine-Grained	-53.5	115	120	5235	3026	2209	1.0	2209	0.94	0.32	0.44	3448	-382	510	127	0.00	0.00	0.0	0	0	5784	0.07	0.014	0.0	0.35

Configuration **4H1V_P1_G1-RR15**

by: E. Ticen
Last Updated: February 2020

Geometry	Embankment Height, H	33	ft
	Embankment Side Slopes	4	xH:1V
	Crown Width	32	ft
	Half Crown Width, B1	16	ft
	Side Slope Width, B2	132	ft
	Unit Weight of Embankment, γ	120	pcf
	Depth to Ground Water	0	ft
	Maximum Stress Increase	3960	psf
	Water Surface Elevation	-5	ft
	Ground Surface Elevation	-5	ft
Foundation Improvements	Remove & Replace Depth [1]	15	ft
	Area Replacement Ratio	0	-
	Shear Key Thickness	0	ft
	Shear Key Depth	0	ft
	Shear Key Raft Foundation Depth	0.0	ft
	Shear key Spacing	--	ft
	Soil Arching b/w Shear Key	0	xV:1H
	Arching Stress Height	--	ft
	Arching Side Slope Width, B2	--	ft
	σmax Arching	0	psf

Notes:
1) Compacted fill where settlement of the material is considered to be negligible.
2)
3)
4)
5)
6)
7)

Total Settlement at Midpoint Between Shear Keys=	--	inches
Total Settlement at Shear Keys=	--	inches
Differential Settlement=	--	inches

		Depth (GS=0-ft)		Elevation (ft)		Unit Weight		Settlement					Staged Construction		
		Top	Bottom	Top	Bottom	Moist	Saturated	$C_{c\varepsilon} = C_c/(1+e_o)$	$C_{r\varepsilon} = C_{cd}/5$	OCR	Total Layer Settlement		Reduction	Total Layer Settlement	
Layer	Description	(ft)	(ft)	(ft)	(ft)	(pcf)	(pcf)	(-)	(-)	(-)	(in)	(ft)	(%)	(in)	(ft)
1	Embankment Fill	-33	0	28	-5	115	120	0.01	0.002	5	0	0.00	100%	0	0.00
2	Organics	0	15	-5	-20	85	90	0.180	0.036	1	0.0	0.00	0%	0	0.00
3a	Soft to Medium Stiff Fine-Grained	15	30	-20	-35	105	110	0.120	0.024	1	17.8	1.48	0%	18	1.48
4	Medium Stiff Fine-Grained	30	50	-35	-55	115	120	0.070	0.014	1	8.8	0.74	0%	9	0.74
5	Stiff Fine-Grained	50	100	-55	-105	120	125	0.017	0.0034	1	2.9	0.24	0%	3	0.24
6	Dense Coarse-Grained	100	150	-105	-155	120	125	0.017	0.0034	1	1.5	0.12	0%	1	0.12
7	Stiff Fine-Grained	150	200	-155	-205	120	125	0.017	0.0034	1	0.8	0.07	0%	1	0.07
										Σ=	31.8	2.6	Σ=	31.8	2.6

							Pre Construction					Δσ due to Embankment Load (Das - 5.6)					Δσ due to Foundation R&R (2:1)			Δσ With Arching for Shear Keys (Das - 5.6)									
Top of Layer	Bottom of Layer	Depth (ft)	Layer (-)	Elevation (ft)	Moist Unit Weight (pcf)	Saturated Unit Weight (pcf)	Total Stress (psf)	Pore Pressure (psf)	Effective stress (psf)	OCR (-)	Pre- Consolidation Pressure (psf)	α_1 (rad)	α_2 (rad)	Influence Value I'	Δσ below Embankment middle (psf)	Foundation Removal (psf)	Foundation Replacement (psf)	Net Stress Change in Layer (psf)	α1 (rad)	α2 (rad)	Influence Value I'	Δσ between shear keys above shear key raft foundation (psf)	Δσ below shear key raft foundation	Final Stress (psf)	$C_{c\varepsilon}$ (-)	$C_{r\varepsilon}$ (-)	Vertical Strain $\varepsilon_{v,i}$ (%)	Change in Layer Thickness Δh_i (in)
0	1	0.5	Organics	-5.5	85	90	45	31	14	1.0	14	0.03	1.54	0.50	3960	-45	60	15	0.00	0.00	0.0	0	0	3989	0.18	0.036	0.0	0.00
1	2	1.5	Organics	-6.5	85	90	135	94	41	1.0	41	0.08	1.48	0.50	3960	-135	180	45	0.00	0.00	0.0	0	0	4046	0.18	0.036	0.0	0.00
2	3	2.5	Organics	-7.5	85	90	225	156	69	1.0	69	0.14	1.42	0.50	3960	-225	300	75	0.00	0.00	0.0	0	0	4104	0.18	0.036	0.0	0.00
3	4	3.5	Organics	-8.5	85	90	315	218	97	1.0	97	0.19	1.36	0.50	3959	-315	420	105	0.00	0.00	0.0	0	0	4161	0.18	0.036	0.0	0.00
4	5	4.5	Organics	-9.5	85	90	405	281	124	1.0	124	0.24	1.30	0.50	3958	-405	540	135	0.00	0.00	0.0	0	0	4217	0.18	0.036	0.0	0.00
5	6	5.5	Organics	-10.5	85	90	495	343	152	1.0	152	0.29	1.24	0.50	3956	-495	660	165	0.00	0.00	0.0	0	0	4273	0.18	0.036	0.0	0.00
6	7	6.5	Organics	-11.5	85	90	585	406	179	1.0	179	0.34	1.18	0.50	3954	-585	780	195	0.00	0.00	0.0	0	0	4328	0.18	0.036	0.0	0.00
7	8	7.5	Organics	-12.5	85	90	675	468	207	1.0	207	0.39	1.13	0.50	3951	-675	900	225	0.00	0.00	0.0	0	0	4383	0.18	0.036	0.0	0.00
8	9	8.5	Organics	-13.5	85	90	765	530	235	1.0	235	0.43	1.08	0.50	3947	-765	1020	255	0.00	0.00	0.0	0	0	4437	0.18	0.036	0.0	0.00
9	10	9.5	Organics	-14.5	85	90	855	593	262	1.0	262	0.47	1.03	0.50	3943	-855	1140	285	0.00	0.00	0.0	0	0	4490	0.18	0.036	0.0	0.00
10	11	10.5	Organics	-15.5	85	90	945	655	290	1.0	290	0.51	0.99	0.50	3937	-945	1260	315	0.00	0.00	0.0	0	0	4542	0.18	0.036	0.0	0.00
11	12	11.5	Organics	-16.5	85	90	1035	718	317	1.0	317	0.55	0.95	0.50	3931	-1035	1380	345	0.00	0.00	0.0	0	0	4594	0.18	0.036	0.0	0.00
12	13	12.5	Organics	-17.5	85	90	1125	780	345	1.0	345	0.58	0.91	0.50	3924	-1125	1500	375	0.00	0.00	0.0	0	0	4644	0.18	0.036	0.0	0.00
13	14	13.5	Organics	-18.5	85	90	1215	842	373	1.0	373	0.61	0.87	0.49	3917	-1215	1620	405	0.00	0.00	0.0	0	0	4695	0.18	0.036	0.0	0.00
14	15	14.5	Organics	-19.5	85	90	1305	905	400	1.0	400	0.64	0.83	0.49	3909	-1305	1740	435	0.00	0.00	0.0	0	0	4744	0.18	0.036	0.0	0.00
15	16	15.5	Soft to Medium Stiff Fine-Grained	-20.5	105	110	1415	967	448	1.0	448	0.67	0.80	0.49	3900	-1301	1735	434	0.00	0.00	0.0	0	0	4782	0.12	0.024	0.1	1.48
16	17	16.5	Soft to Medium Stiff Fine-Grained	-21.5	105	110	1525	1030	495	1.0	495	0.69	0.77	0.49	3891	-1293	1724	431	0.00	0.00	0.0	0	0	4817	0.12	0.024	0.1	1.42
17	18	17.5	Soft to Medium Stiff Fine-Grained	-22.5	105	110	1635	1092	543	1.0	543	0.71	0.74	0.49	3881	-1285	1714	428	0.00	0.00	0.0	0	0	4852	0.12	0.024	0.1	1.37
18	19	18.5	Soft to Medium Stiff Fine-Grained	-23.5	105	110	1745	1154	591	1.0	591	0.73	0.71	0.49	3871	-1277	1703	426	0.00	0.00	0.0	0	0	4887	0.12	0.024	0.1	1.32
19	20	19.5	Soft to Medium Stiff Fine-Grained	-24.5	105	110	1855	1217	638	1.0	638	0.75	0.69	0.49	3860	-1270	1693	423	0.00	0.00	0.0	0	0	4921	0.12	0.024	0.1	1.28
20	21	20.5	Soft to Medium Stiff Fine-Grained	-25.5	105	110	1965	1279	686	1.0	686	0.77	0.66	0.49	3848	-1262	1683	421	0.00	0.00	0.0	0	0	4955	0.12	0.024	0.1	1.24
21	22	21.5	Soft to Medium Stiff Fine-Grained	-26.5	105	110	2075	1342	733	1.0	733	0.79	0.64	0.48	3837	-1254	1673	418	0.00	0.00	0.0	0	0	4988	0.12	0.024	0.1	1.20
22	23	22.5	Soft to Medium Stiff Fine-Grained	-27.5	105	110	2185	1404	781	1.0	781	0.80	0.62	0.48	3825	-1247	1663	416	0.00	0.00	0.0	0	0	5021	0.12	0.024	0.1	1.16
23	24	23.5	Soft to Medium Stiff Fine-Grained	-28.5	105	110	2295	1466	829	1.0	829	0.82	0.60	0.48	3812	-1240	1653	413	0.00	0.00	0.0	0	0	5054	0.12	0.024	0.1	1.13
24	25	24.5	Soft to Medium Stiff Fine-Grained	-29.5	105	110	2405	1529	876	1.0	876	0.83	0.58	0.48	3800	-1232	1643	411	0.00	0.00	0.0	0	0	5086	0.12	0.024	0.1	1.10
25	26	25.5	Soft to Medium Stiff Fine-Grained	-30.5	105	110	2515	1591	924	1.0	924	0.84	0.56	0.48	3786	-1225	1633	408	0.00	0.00	0.0	0	0	5119	0.12	0.024	0.1	1.07
26	27	26.5	Soft to Medium Stiff Fine-Grained	-31.5	105	110	2625	1654	971	1.0	971	0.85	0.54	0.48	3773	-1218	1623	406	0.00	0.00	0.0	0	0	5150	0.12	0.024	0.1	1.04
27	28	27.5	Soft to Medium Stiff Fine-Grained	-32.5	105	110	2735	1716	1019	1.0	1019	0.86	0.53	0.47	3760	-1210	1614	403	0.00	0.00	0.0	0	0	5182	0.12	0.024	0.1	1.02
28	29	28.5	Soft to Medium Stiff Fine-Grained	-33.5	105	110	2845	1778	1067	1.0	1067	0.87	0.51	0.47	3746	-1203	1604	401	0.00	0.00	0.0	0	0	5214	0.12	0.024	0.1	0.99
29	30	29.5	Soft to Medium Stiff Fine-Grained	-34.5	105	110	2955	1841	1114	1.0	1114	0.88	0.50	0.47	3732	-1196	1595	399	0.00	0.00	0.0	0	0	5245	0.12	0.024	0.1	0.97
30	31	30.5	Medium Stiff Fine-Grained	-35.5	115	120	3075	1903	1172	1.0	1172	0.88	0.48	0.47	3718	-1189	1586	396	0.00	0.00	0.0	0	0	5286	0.07	0.014	0.0	0.55
31	32	31.5	Medium Stiff Fine-Grained	-36.5	115	120	3195	1966	1229	1.0	1229	0.89	0.47	0.47	3704	-1182	1576	394	0.00	0.00	0.0	0	0	5327	0.07	0.014	0.0	0.53
32	33	32.5	Medium Stiff Fine-Grained	-37.5	115	120	3315	2028	1287	1.0	1287	0.90	0.46	0.47	3689	-1175	1567	392	0.00	0.00	0.0	0	0	5368	0.07	0.014	0.0	0.52
33	34	33.5	Medium Stiff Fine-Grained	-38.5	115	120	3435	2090	1345	1.0	1345	0.90	0.45	0.46	3675	-1169	1558	390	0.00	0.00	0.0	0	0	5409	0.07	0.014	0.0	0.51
34	35	34.5	Medium Stiff Fine-Grained	-39.5	115	120	3555	2153	1402	1.0	1402	0.91	0.43	0.46	3660	-1162	1549	387	0.00	0.00	0.0	0	0	5449	0.07	0.014	0.0	0.50
35	36	35.5	Medium Stiff Fine-Grained	-40.5	115	120	3675	2215	1460	1.0	1460	0.91	0.42	0.46	3645	-1155	1540	385	0.00	0.00	0.0	0	0	5490	0.07	0.014	0.0	0.48
36	37	36.5	Medium Stiff Fine-Grained	-41.5	115	120	3795	2278	1517	1.0	1517	0.92	0.41	0.46	3630	-1149	1531	383	0.00	0.00	0.0	0	0	5531	0.07	0.014	0.0	0.47
37	38	37.5	Medium Stiff Fine-Grained	-42.5	115	120	3915	2340	1575	1.0	1575	0.92	0.40	0.46	3615	-1142	1523	381	0.00	0.00	0.0	0	0	5571	0.07	0.014	0.0	0.46
38	39	38.5	Medium Stiff Fine-Grained	-43.5	115	120	4035	2402	1633	1.0	1633	0.92	0.39	0.45	3600	-1135	1514	378	0.00	0.00	0.0	0	0	5611	0.07	0.014	0.0	0.45
39	40	39.5	Medium Stiff Fine-Grained	-44.5	115	120	4155	2465	1690	1.0	1690	0.93	0.38	0.45	3585	-1129	1505	376	0.00	0.00	0.0	0	0	5652	0.07	0.014	0.0	0.44
40	41	40.5	Medium Stiff Fine-Grained	-45.5	115	120	4275	2527	1748	1.0	1748	0.93	0.38	0.45	3570	-1123	1497	374	0.00	0.00	0.0	0	0	5692	0.07	0.014	0.0	0.43
41	42	41.5	Medium Stiff Fine-Grained	-46.5	115	120	4395	2590	1805	1.0	1805	0.93	0.37	0.45	3555	-1116	1488	372	0.00	0.00	0.0	0	0	5732	0.07	0.014	0.0	0.42
42	43	42.5	Medium Stiff Fine-Grained	-47.5	115	120	4515	2652	1863	1.0	1863	0.93	0.36	0.45	3540	-1110	1480	370	0.00	0.00	0.0	0	0	5773	0.07	0.014	0.0	0.41
43	44	43.5	Medium Stiff Fine-Grained	-48.5	115	120	4635	2714	1921	1.0	1921	0.93	0.35	0.44	3524	-1104	1471	368	0.00	0.00	0.0	0	0	5813	0.07	0.014	0.0	0.40
44	45	44.5	Medium Stiff Fine-Grained	-49.5	115	120	4755	2777	1978	1.0	1978	0.93	0.35	0.44	3509	-1097	1463	366	0.00	0.00	0.0	0	0	5853	0.07	0.014	0.0	0.40
45	46	45.5	Medium Stiff Fine-Grained	-50.5	115	120	4875	2839	2036	1.0	2036	0.93	0.34	0.44	3494	-1091	1455	364	0.00	0.00	0.0	0	0	5893	0.07	0.014	0.0	0.39
46	47	46.5	Medium Stiff Fine-Grained	-51.5	115	120	4995	2902	2093	1.0	2093	0.93	0.33	0.44	3478	-1085	1447	362	0.00	0.00	0.0	0	0	5933	0.07	0.014	0.0	0.38
47	48	47.5	Medium Stiff Fine-Grained	-52.5	115	120	5115	2964	2151	1.0	2151	0.94	0.32	0.44	3463	-1079	1439	360	0.00	0.00	0.0	0	0	5974	0.07	0.014	0.0	0.37
48	49	48.5	Medium Stiff Fine-Grained	-53.5	115	120	5235	3026	2209	1.0	2209	0.94	0.32	0.44	3448	-1073	1431	358	0.00	0.00	0.0	0	0	6014	0.07	0.014	0.0	0.37

Configuration **4H1V_P1_G1-RR30**

by: E. Ticen
Last Updated: February 2020

Geometry	Embankment Height, H	33	ft
	Embankment Side Slopes	4	xH:1V
	Crown Width	32	ft
	Half Crown Width, B1	16	ft
	Side Slope Width, B2	132	ft
	Unit Weight of Embankment, γ	120	pcf
	Depth to Ground Water	0	ft
	Maximum Stress Increase	3960	psf
	Water Surface Elevation	-5	ft
	Ground Surface Elevation	-5	ft
Foundation Improvements	Remove & Replace Depth [1]	30	ft
	Area Replacement Ratio	0	-
	Shear Key Thickness	0	ft
	Shear Key Depth	0	ft
	Shear Key Raft Foundation Depth	0.0	ft
	Shear key Spacing	--	ft
	Soil Arching b/w Shear Key	0	xV:1H
	Arching Stress Height	--	ft
	Arching Side Slope Width, B2	--	ft
	σmax Arching	0	psf

Notes:
1) Compacted fill where settlement of the material is considered to be negligible.
2)
3)
4)
5)
6)
7)

Total Settlement at Midpoint Between Shear Keys=	--	inches
Total Settlement at Shear Keys=	--	inches
Differential Settlement=	--	inches

		Depth (GS=0-ft)		Elevation (ft)		Unit Weight		Settlement					Staged Construction		
		Top	Bottom	Top	Bottom	Moist	Saturated	$C_{c\varepsilon} = C_c/(1+e_o)$	$C_{r\varepsilon} = C_{cε}/5$	OCR	Total Layer Settlement		Reduction	Total Layer Settlement	
Layer	Description	(ft)	(ft)	(ft)	(ft)	(pcf)	(pcf)	(-)	(-)	(-)	(in)	(ft)	(%)	(in)	(ft)
1	Embankment Fill	-33	0	28	-5	115	120	0.01	0.002	5	0	0.00	100%	0	0.00
2	Organics	0	15	-5	-20	85	90	0.180	0.036	1	0.0	0.00	0%	0	0.00
3a	Soft to Medium Stiff Fine-Grained	15	30	-20	-35	105	110	0.120	0.024	1	0.0	0.00	0%	0	0.00
4	Medium Stiff Fine-Grained	30	50	-35	-55	115	120	0.070	0.014	1	9.1	0.76	0%	9	0.76
5	Stiff Fine-Grained	50	100	-55	-105	120	125	0.017	0.0034	1	3.0	0.25	0%	3	0.25
6	Dense Coarse-Grained	100	150	-105	-155	120	125	0.017	0.0034	1	1.5	0.13	0%	2	0.13
7	Stiff Fine-Grained	150	200	-155	-205	120	125	0.017	0.0034	1	0.8	0.07	0%	1	0.07
										Σ=	14.4	1.2	Σ=	14.4	1.2

							Pre Construction							Δσ due to Embankment Load (Das - 5.6)			Δσ due to Foundation R&R (2:1)			Δσ With Arching for Shear Keys (Das - 5.6)									
Top of Layer	Bottom of Layer	Depth (ft)	Layer (-)	Elevation (ft)	Moist Unit Weight (pcf)	Saturated Unit Weight (pcf)	Total Stress (psf)	Pore Pressure (psf)	Effective stress (psf)	OCR (-)	Pre- Consolidation Pressure (psf)	α_1 (rad)	α_2 (rad)	Influence Value I'	Δσ below Embankment middle (psf)	Foundation Removal (psf)	Foundation Replacement (psf)	Net Stress Change in Layer (psf)	α1 (rad)	α2 (rad)	Influence Value I'	Δσ between shear keys above shear key raft foundation (psf)	Δσ below shear key raft foundation	Final Stress (psf)	$C_{c\varepsilon}$ (-)	$C_{r\varepsilon}$ (-)	Vertical Strain $\varepsilon_{v,i}$ (%)	Change in Layer Thickness Δh_i (in)
0	1	0.5	Organics	-5.5	85	90	45	31	14	1.0	14	0.03	1.54	0.50	3960	-45	60	15	0.00	0.00	0.0	0	0	3989	0.18	0.036	0.0	0.00
1	2	1.5	Organics	-6.5	85	90	135	94	41	1.0	41	0.08	1.48	0.50	3960	-135	180	45	0.00	0.00	0.0	0	0	4046	0.18	0.036	0.0	0.00
2	3	2.5	Organics	-7.5	85	90	225	156	69	1.0	69	0.14	1.42	0.50	3960	-225	300	75	0.00	0.00	0.0	0	0	4104	0.18	0.036	0.0	0.00
3	4	3.5	Organics	-8.5	85	90	315	218	97	1.0	97	0.19	1.36	0.50	3959	-315	420	105	0.00	0.00	0.0	0	0	4161	0.18	0.036	0.0	0.00
4	5	4.5	Organics	-9.5	85	90	405	281	124	1.0	124	0.24	1.30	0.50	3958	-405	540	135	0.00	0.00	0.0	0	0	4217	0.18	0.036	0.0	0.00
5	6	5.5	Organics	-10.5	85	90	495	343	152	1.0	152	0.29	1.24	0.50	3956	-495	660	165	0.00	0.00	0.0	0	0	4273	0.18	0.036	0.0	0.00
6	7	6.5	Organics	-11.5	85	90	585	406	179	1.0	179	0.34	1.18	0.50	3954	-585	780	195	0.00	0.00	0.0	0	0	4328	0.18	0.036	0.0	0.00
7	8	7.5	Organics	-12.5	85	90	675	468	207	1.0	207	0.39	1.13	0.50	3951	-675	900	225	0.00	0.00	0.0	0	0	4383	0.18	0.036	0.0	0.00
8	9	8.5	Organics	-13.5	85	90	765	530	235	1.0	235	0.43	1.08	0.50	3947	-765	1020	255	0.00	0.00	0.0	0	0	4437	0.18	0.036	0.0	0.00
9	10	9.5	Organics	-14.5	85	90	855	593	262	1.0	262	0.47	1.03	0.50	3943	-855	1140	285	0.00	0.00	0.0	0	0	4490	0.18	0.036	0.0	0.00
10	11	10.5	Organics	-15.5	85	90	945	655	290	1.0	290	0.51	0.99	0.50	3937	-945	1260	315	0.00	0.00	0.0	0	0	4542	0.18	0.036	0.0	0.00
11	12	11.5	Organics	-16.5	85	90	1035	718	317	1.0	317	0.55	0.95	0.50	3931	-1035	1380	345	0.00	0.00	0.0	0	0	4594	0.18	0.036	0.0	0.00
12	13	12.5	Organics	-17.5	85	90	1125	780	345	1.0	345	0.58	0.91	0.50	3924	-1125	1500	375	0.00	0.00	0.0	0	0	4644	0.18	0.036	0.0	0.00
13	14	13.5	Organics	-18.5	85	90	1215	842	373	1.0	373	0.61	0.87	0.49	3917	-1215	1620	405	0.00	0.00	0.0	0	0	4695	0.18	0.036	0.0	0.00
14	15	14.5	Organics	-19.5	85	90	1305	905	400	1.0	400	0.64	0.83	0.49	3909	-1305	1740	435	0.00	0.00	0.0	0	0	4744	0.18	0.036	0.0	0.00
15	16	15.5	Soft to Medium Stiff Fine-Grained	-20.5	105	110	1415	967	448	1.0	448	0.67	0.80	0.49	3900	-1415	1860	445	0.00	0.00	0.0	0	0	4793	0.12	0.024	0.0	0.00
16	17	16.5	Soft to Medium Stiff Fine-Grained	-21.5	105	110	1525	1030	495	1.0	495	0.69	0.77	0.49	3891	-1525	1980	455	0.00	0.00	0.0	0	0	4841	0.12	0.024	0.0	0.00
17	18	17.5	Soft to Medium Stiff Fine-Grained	-22.5	105	110	1635	1092	543	1.0	543	0.71	0.74	0.49	3881	-1635	2100	465	0.00	0.00	0.0	0	0	4889	0.12	0.024	0.0	0.00
18	19	18.5	Soft to Medium Stiff Fine-Grained	-23.5	105	110	1745	1154	591	1.0	591	0.73	0.71	0.49	3871	-1745	2220	475	0.00	0.00	0.0	0	0	4936	0.12	0.024	0.0	0.00
19	20	19.5	Soft to Medium Stiff Fine-Grained	-24.5	105	110	1855	1217	638	1.0	638	0.75	0.69	0.49	3860	-1855	2340	485	0.00	0.00	0.0	0	0	4983	0.12	0.024	0.0	0.00
20	21	20.5	Soft to Medium Stiff Fine-Grained	-25.5	105	110	1965	1279	686	1.0	686	0.77	0.66	0.49	3848	-1965	2460	495	0.00	0.00	0.0	0	0	5029	0.12	0.024	0.0	0.00
21	22	21.5	Soft to Medium Stiff Fine-Grained	-26.5	105	110	2075	1342	733	1.0	733	0.79	0.64	0.48	3837	-2075	2580	505	0.00	0.00	0.0	0	0	5075	0.12	0.024	0.0	0.00
22	23	22.5	Soft to Medium Stiff Fine-Grained	-27.5	105	110	2185	1404	781	1.0	781	0.80	0.62	0.48	3825	-2185	2700	515	0.00	0.00	0.0	0	0	5121	0.12	0.024	0.0	0.00
23	24	23.5	Soft to Medium Stiff Fine-Grained	-28.5	105	110	2295	1466	829	1.0	829	0.82	0.60	0.48	3812	-2295	2820	525	0.00	0.00	0.0	0	0	5166	0.12	0.024	0.0	0.00
24	25	24.5	Soft to Medium Stiff Fine-Grained	-29.5	105	110	2405	1529	876	1.0	876	0.83	0.58	0.48	3800	-2405	2940	535	0.00	0.00	0.0	0	0	5211	0.12	0.024	0.0	0.00
25	26	25.5	Soft to Medium Stiff Fine-Grained	-30.5	105	110	2515	1591	924	1.0	924	0.84	0.56	0.48	3786	-2515	3060	545	0.00	0.00	0.0	0	0	5255	0.12	0.024	0.0	0.00
26	27	26.5	Soft to Medium Stiff Fine-Grained	-31.5	105	110	2625	1654	971	1.0	971	0.85	0.54	0.48	3773	-2625	3180	555	0.00	0.00	0.0	0	0	5300	0.12	0.024	0.0	0.00
27	28	27.5	Soft to Medium Stiff Fine-Grained	-32.5	105	110	2735	1716	1019	1.0	1019	0.86	0.53	0.47	3760	-2735	3300	565	0.00	0.00	0.0	0	0	5344	0.12	0.024	0.0	0.00
28	29	28.5	Soft to Medium Stiff Fine-Grained	-33.5	105	110	2845	1778	1067	1.0	1067	0.87	0.51	0.47	3746	-2845	3420	575	0.00	0.00	0.0	0	0	5388	0.12	0.024	0.0	0.00
29	30	29.5	Soft to Medium Stiff Fine-Grained	-34.5	105	110	2955	1841	1114	1.0	1114	0.88	0.50	0.47	3732	-2955	3540	585	0.00	0.00	0.0	0	0	5431	0.12	0.024	0.0	0.00
30	31	30.5	Medium Stiff Fine-Grained	-35.5	115	120	3075	1903	1172	1.0	1172	0.88	0.48	0.47	3718	-2947	3530	583	0.00	0.00	0.0	0	0	5473	0.07	0.014	0.0	0.56
31	32	31.5	Medium Stiff Fine-Grained	-36.5	115	120	3195	1966	1229	1.0	1229	0.89	0.47	0.47	3704	-2930	3510	580	0.00	0.00	0.0	0	0	5513	0.07	0.014	0.0	0.55
32	33	32.5	Medium Stiff Fine-Grained	-37.5	115	120	3315	2028	1287	1.0	1287	0.90	0.46	0.47	3689	-2914	3491	577	0.00	0.00	0.0	0	0	5553	0.07	0.014	0.0	0.53
33	34	33.5	Medium Stiff Fine-Grained	-38.5	115	120	3435	2090	1345	1.0	1345	0.90	0.45	0.46	3675	-2898	3471	574	0.00	0.00	0.0	0	0	5593	0.07	0.014	0.0	0.52
34	35	34.5	Medium Stiff Fine-Grained	-39.5	115	120	3555	2153	1402	1.0	1402	0.91	0.43	0.46	3660	-2882	3452	570	0.00	0.00	0.0	0	0	5633	0.07	0.014	0.0	0.51
35	36	35.5	Medium Stiff Fine-Grained	-40.5	115	120	3675	2215	1460	1.0	1460	0.91	0.42	0.46	3645	-2866	3433	567	0.00	0.00	0.0	0	0	5672	0.07	0.014	0.0	0.50
36	37	36.5	Medium Stiff Fine-Grained	-41.5	115	120	3795	2278	1517	1.0	1517	0.92	0.41	0.46	3630	-2850	3414	564	0.00	0.00	0.0	0	0	5712	0.07	0.014	0.0	0.48
37	38	37.5	Medium Stiff Fine-Grained	-42.5	115	120	3915	2340	1575	1.0	1575	0.92	0.40	0.46	3615	-2834	3395	561	0.00	0.00	0.0	0	0	5751	0.07	0.014	0.0	0.47
38	39	38.5	Medium Stiff Fine-Grained	-43.5	115	120	4035	2402	1633	1.0	1633	0.92	0.39	0.45	3600	-2819	3377	558	0.00	0.00	0.0	0	0	5791	0.07	0.014	0.0	0.46
39	40	39.5	Medium Stiff Fine-Grained	-44.5	115	120	4155	2465	1690	1.0	1690	0.93	0.38	0.45	3585	-2803	3358	555	0.00	0.00	0.0	0	0	5830	0.07	0.014	0.0	0.45
40	41	40.5	Medium Stiff Fine-Grained	-45.5	115	120	4275	2527	1748	1.0	1748	0.93	0.38	0.45	3570	-2788	3340	552	0.00	0.00	0.0	0	0	5870	0.07	0.014	0.0	0.44
41	42	41.5	Medium Stiff Fine-Grained	-46.5	115	120	4395	2590	1805	1.0	1805	0.93	0.37	0.45	3555	-2773	3322	549	0.00	0.00	0.0	0	0	5909	0.07	0.014	0.0	0.43
42	43	42.5	Medium Stiff Fine-Grained	-47.5	115	120	4515	2652	1863	1.0	1863	0.93	0.36	0.45	3540	-2758	3304	546	0.00	0.00	0.0	0	0	5949	0.07	0.014	0.0	0.42
43	44	43.5	Medium Stiff Fine-Grained	-48.5	115	120	4635	2714	1921	1.0	1921	0.93	0.35	0.44	3524	-2743	3286	543	0.00	0.00	0.0	0	0	5988	0.07	0.014	0.0	0.41
44	45	44.5	Medium Stiff Fine-Grained	-49.5	115	120	4755	2777	1978	1.0	1978	0.93	0.35	0.44	3509	-2728	3268	540	0.00	0.00	0.0	0	0	6027	0.07	0.014	0.0	0.41
45	46	45.5	Medium Stiff Fine-Grained	-50.5	115	120	4875	2839	2036	1.0	2036	0.93	0.34	0.44	3494	-2714	3251	537	0.00	0.00	0.0	0	0	6067	0.07	0.014	0.0	0.40
46	47	46.5	Medium Stiff Fine-Grained	-51.5	115	120	4995	2902	2093	1.0	2093	0.93	0.33	0.44	3478	-2699	3233	534	0.00	0.00	0.0	0	0	6106	0.07	0.014	0.0	0.39
47	48	47.5	Medium Stiff Fine-Grained	-52.5	115	120	5115	2964	2151	1.0	2151	0.94	0.32	0.44	3463	-2685	3216	531	0.00	0.00	0.0	0	0	6145	0.07	0.014	0.0	0.38
48	49	48.5	Medium Stiff Fine-Grained	-53.5	115	120	5235	3026	2209	1.0	2209	0.94	0.32	0.44	3448	-2670	3199	529	0.00	0.00	0.0	0	0	6185	0.07	0.014	0.0	0.38

Configuration **4H1V_P1_G2-AR15**

by: E. Ticen
Last Updated: February 2020

Geometry	Embankment Height, H	33	ft
	Embankment Side Slopes	4	xH:1V
	Crown Width	32	ft
	Half Crown Width, B1	16	ft
	Side Slope Width, B2	132	ft
	Unit Weight of Embankment, γ	120	pcf
	Depth to Ground Water	0	ft
	Maximum Stress Increase	3960	psf
	Water Surface Elevation	-5	ft
	Ground Surface Elevation	-5	ft
Foundation Improvements	Remove & Replace Depth [1]	6	ft
	Area Replacement Ratio	0.15	-
	Shear Key Thickness	2.5	ft
	Shear Key Depth	40	ft
	Shear Key Raft Foundation Depth	26.7	ft
	Shear key Spacing	16.7	ft
	Soil Arching b/w Shear Key	0.5	xV:1H
	Arching Stress Height	4	ft
	Arching Side Slope Width, B2	8.3	ft
	σmax Arching	425	psf

Notes:
1) Compacted fill where settlement of the material is considered to be negligible.
2)
3)
4)
5)
6)
7)

Total Settlement at Midpoint Between Shear Keys=	26.7	inches
Total Settlement at Shear Keys=	16.2	inches
Differential Settlement=	10.5	inches

		Depth (GS=0-ft)		Elevation (ft)		Unit Weight		Settlement					Staged Construction		
		Top	Bottom	Top	Bottom	Moist	Saturated	$C_{c\varepsilon} = C_c/(1+e_o)$	$C_{r\varepsilon} = C_{cε}/5$	OCR	Total Layer Settlement		Reduction	Total Layer Settlement	
Layer	Description	(ft)	(ft)	(ft)	(ft)	(pcf)	(pcf)	(-)	(-)	(-)	(in)	(ft)	(%)	(in)	(ft)
1	Embankment Fill	-33	0	28	-5	115	120	0.01	0.002	5	0	0.00	100%	0	0.00
2	Organics	0	15	-5	-20	85	90	0.180	0.036	1	7.3	0.61	0%	7	0.61
3a	Soft to Medium Stiff Fine-Grained	15	30	-20	-35	105	110	0.120	0.024	1	6.2	0.51	0%	6	0.51
4	Medium Stiff Fine-Grained	30	50	-35	-55	115	120	0.070	0.014	1	8.6	0.72	0%	9	0.72
5	Stiff Fine-Grained	50	100	-55	-105	120	125	0.017	0.0034	1	2.7	0.22	0%	3	0.22
6	Dense Coarse-Grained	100	150	-105	-155	120	125	0.017	0.0034	1	1.3	0.11	0%	1	0.11
7	Stiff Fine-Grained	150	200	-155	-205	120	125	0.017	0.0034	1	0.7	0.06	0%	1	0.06
										Σ=	26.7	2.2	Σ=	26.7	2.2

							Pre Construction					Δσ due to Embankment Load (Das - 5.6)				Δσ due to Foundation R&R (2:1)			Δσ With Arching for Shear Keys (Das - 5.6)									
Top of Layer	Bottom of Layer	Depth (ft)	Layer (-)	Elevation (ft)	Moist Unit Weight (pcf)	Saturated Unit Weight (pcf)	Total Stress (psf)	Pore Pressure (psf)	Effective stress (psf)	OCR (-)	Pre- Consolidation Pressure (psf)	α_1 (rad)	α_2 (rad)	Influence Value I'	Δσ below Embankment middle (psf)	Foundation Removal (psf)	Foundation Replacement (psf)	Net Stress Change in Layer (psf)	α1 (rad)	α2 (rad)	Influence Value I'	Δσ between shear keys above shear key raft foundation (psf)	Δσ below shear key raft foundation	Final Stress (psf)	$C_{c\varepsilon}$ (-)	$C_{r\varepsilon}$ (-)	Vertical Strain $\varepsilon_{v,i}$ (%)	Change in Layer Thickness Δh_i (in)
0	1	0.5	Organics	-5.5	85	90	45	31	14	1.0	14	0.03	1.54	0.50	3960	-45	60	15	1.51	0.00	0.5	409	0	438	0.18	0.036	0.0	0.00
1	2	1.5	Organics	-6.5	85	90	135	94	41	1.0	41	0.08	1.48	0.50	3960	-135	180	45	1.39	0.00	0.4	377	0	463	0.18	0.036	0.0	0.00
2	3	2.5	Organics	-7.5	85	90	225	156	69	1.0	69	0.14	1.42	0.50	3960	-225	300	75	1.28	0.00	0.4	346	0	490	0.18	0.036	0.0	0.00
3	4	3.5	Organics	-8.5	85	90	315	218	97	1.0	97	0.19	1.36	0.50	3959	-315	420	105	1.17	0.00	0.4	317	0	519	0.18	0.036	0.0	0.00
4	5	4.5	Organics	-9.5	85	90	405	281	124	1.0	124	0.24	1.30	0.50	3958	-405	540	135	1.08	0.00	0.3	291	0	550	0.18	0.036	0.0	0.00
5	6	5.5	Organics	-10.5	85	90	495	343	152	1.0	152	0.29	1.24	0.50	3956	-495	660	165	0.99	0.00	0.3	267	0	584	0.18	0.036	0.0	0.00
6	7	6.5	Organics	-11.5	85	90	585	406	179	1.0	179	0.34	1.18	0.50	3954	-493	658	164	0.91	0.00	0.3	246	0	590	0.18	0.036	0.1	1.12
7	8	7.5	Organics	-12.5	85	90	675	468	207	1.0	207	0.39	1.13	0.50	3951	-490	654	163	0.84	0.00	0.3	227	0	597	0.18	0.036	0.1	0.99
8	9	8.5	Organics	-13.5	85	90	765	530	235	1.0	235	0.43	1.08	0.50	3947	-487	649	162	0.78	0.00	0.2	213	0	609	0.18	0.036	0.1	0.90
9	10	9.5	Organics	-14.5	85	90	855	593	262	1.0	262	0.47	1.03	0.50	3943	-484	645	161	0.72	0.00	0.2	213	0	636	0.18	0.036	0.1	0.83
10	11	10.5	Organics	-15.5	85	90	945	655	290	1.0	290	0.51	0.99	0.50	3937	-481	641	160	0.67	0.00	0.2	213	0	663	0.18	0.036	0.1	0.78
11	12	11.5	Organics	-16.5	85	90	1035	718	317	1.0	317	0.55	0.95	0.50	3931	-478	637	159	0.63	0.00	0.2	213	0	689	0.18	0.036	0.1	0.73
12	13	12.5	Organics	-17.5	85	90	1125	780	345	1.0	345	0.58	0.91	0.50	3924	-475	633	158	0.59	0.00	0.2	213	0	716	0.18	0.036	0.1	0.68
13	14	13.5	Organics	-18.5	85	90	1215	842	373	1.0	373	0.61	0.87	0.49	3917	-472	629	157	0.55	0.00	0.2	213	0	742	0.18	0.036	0.1	0.65
14	15	14.5	Organics	-19.5	85	90	1305	905	400	1.0	400	0.64	0.83	0.49	3909	-469	625	156	0.52	0.00	0.2	213	0	769	0.18	0.036	0.1	0.61
15	16	15.5	Soft to Medium Stiff Fine-Grained	-20.5	105	110	1415	967	448	1.0	448	0.67	0.80	0.49	3900	-466	621	155	0.49	0.00	0.2	213	0	816	0.12	0.024	0.0	0.37
16	17	16.5	Soft to Medium Stiff Fine-Grained	-21.5	105	110	1525	1030	495	1.0	495	0.69	0.77	0.49	3891	-463	617	154	0.47	0.00	0.1	213	0	862	0.12	0.024	0.0	0.35
17	18	17.5	Soft to Medium Stiff Fine-Grained	-22.5	105	110	1635	1092	543	1.0	543	0.71	0.74	0.49	3881	-460	613	153	0.44	0.00	0.1	213	0	909	0.12	0.024	0.0	0.32
18	19	18.5	Soft to Medium Stiff Fine-Grained	-23.5	105	110	1745	1154	591	1.0	591	0.73	0.71	0.49	3871	-457	610	152	0.42	0.00	0.1	213	0	955	0.12	0.024	0.0	0.30
19	20	19.5	Soft to Medium Stiff Fine-Grained	-24.5	105	110	1855	1217	638	1.0	638	0.75	0.69	0.49	3860	-454	606	151	0.40	0.00	0.1	213	0	1002	0.12	0.024	0.0	0.28
20	21	20.5	Soft to Medium Stiff Fine-Grained	-25.5	105	110	1965	1279	686	1.0	686	0.77	0.66	0.49	3848	-451	602	150	0.39	0.00	0.1	213	0	1049	0.12	0.024	0.0	0.27
21	22	21.5	Soft to Medium Stiff Fine-Grained	-26.5	105	110	2075	1342	733	1.0	733	0.79	0.64	0.48	3837	-449	598	150	0.37	0.00	0.1	213	0	1095	0.12	0.024	0.0	0.25
22	23	22.5	Soft to Medium Stiff Fine-Grained	-27.5	105	110	2185	1404	781	1.0	781	0.80	0.62	0.48	3825	-446	595	149	0.35	0.00	0.1	213	0	1142	0.12	0.024	0.0	0.24
23	24	23.5	Soft to Medium Stiff Fine-Grained	-28.5	105	110	2295	1466	829	1.0	829	0.82	0.60	0.48	3812	-443	591	148	0.34	0.00	0.1	213	0	1189	0.12	0.024	0.0	0.23
24	25	24.5	Soft to Medium Stiff Fine-Grained	-29.5	105	110	2405	1529	876	1.0	876	0.83	0.58	0.48	3800	-440	587	147	0.33	0.00	0.1	213	0	1236	0.12	0.024	0.0	0.21
25	26	25.5	Soft to Medium Stiff Fine-Grained	-30.5	105	110	2515	1591	924	1.0	924	0.84	0.56	0.48	3786	-438	584	146	0.32	0.00	0.1	213	0	1282	0.12	0.024	0.0	0.21
26	27	26.5	Soft to Medium Stiff Fine-Grained	-31.5	105	110	2625	1654	971	1.0	971	0.85	0.54	0.48	3773	-435	580	145	0.30	0.00	0.1	213	0	1329	0.12	0.024	0.0	0.20
27	28	27.5	Soft to Medium Stiff Fine-Grained	-32.5	105	110	2735	1716	1019	1.0	1019	0.86	0.53	0.47	3760	-433	577	144	0.29	0.00	0.1	0	3938	5101	0.12	0.024	0.1	1.01
28	29	28.5	Soft to Medium Stiff Fine-Grained	-33.5	105	110	2845	1778	1067	1.0	1067	0.87	0.51	0.47	3746	-430	573	143	0.28	0.00	0.1	0	3911	5121	0.12	0.024	0.1	0.98
29	30	29.5	Soft to Medium Stiff Fine-Grained	-34.5	105	110	2955	1841	1114	1.0	1114	0.88	0.50	0.47	3732	-427	570	142	0.28	0.00	0.1	0	3885	5142	0.12	0.024	0.1	0.96
30	31	30.5	Medium Stiff Fine-Grained	-35.5	115	120	3075	1903	1172	1.0	1172	0.88	0.48	0.47	3718	-425	566	142	0.27	0.00	0.1	0	3859	5173	0.07	0.014	0.0	0.54
31	32	31.5	Medium Stiff Fine-Grained	-36.5	115	120	3195	1966	1229	1.0	1229	0.89	0.47	0.47	3704	-422	563	141	0.26	0.00	0.1	0	3834	5204	0.07	0.014	0.0	0.53
32	33	32.5	Medium Stiff Fine-Grained	-37.5	115	120	3315	2028	1287	1.0	1287	0.90	0.46	0.47	3689	-420	560	140	0.25	0.00	0.1	0	3808	5235	0.07	0.014	0.0	0.51
33	34	33.5	Medium Stiff Fine-Grained	-38.5	115	120	3435	2090	1345	1.0	1345	0.90	0.45	0.46	3675	-417	556	139	0.24	0.00	0.1	0	3783	5267	0.07	0.014	0.0	0.50
34	35	34.5	Medium Stiff Fine-Grained	-39.5	115	120	3555	2153	1402	1.0	1402	0.91	0.43	0.46	3660	-415	553	138	0.24	0.00	0.1	0	3758	5299	0.07	0.014	0.0	0.48
35	36	35.5	Medium Stiff Fine-Grained	-40.5	115	120	3675	2215	1460	1.0	1460	0.91	0.42	0.46	3645	-412	550	137	0.23	0.00	0.1	0	3734	5331	0.07	0.014	0.0	0.47
36	37	36.5	Medium Stiff Fine-Grained	-41.5	115	120	3795	2278	1517	1.0	1517	0.92	0.41	0.46	3630	-410	546	137	0.22	0.00	0.1	0	3709	5363	0.07	0.014	0.0	0.46
37	38	37.5	Medium Stiff Fine-Grained	-42.5	115	120	3915	2340	1575	1.0	1575	0.92	0.40	0.46	3615	-407	543	136	0.22	0.00	0.1	0	3685	5396	0.07	0.014	0.0	0.45
38	39	38.5	Medium Stiff Fine-Grained	-43.5	115	120	4035	2402	1633	1.0	1633	0.92	0.39	0.45	3600	-405	540	135	0.21	0.00	0.1	0	3661	5429	0.07	0.014	0.0	0.44
39	40	39.5	Medium Stiff Fine-Grained	-44.5	115	120	4155	2465	1690	1.0	1690	0.93	0.38	0.45	3585	-403	537	134	0.21	0.00	0.1	0	3638	5462	0.07	0.014	0.0	0.43
40	41	40.5	Medium Stiff Fine-Grained	-45.5	115	120	4275	2527	1748	1.0	1748	0.93	0.38	0.45	3570	-400	534	133	0.20	0.00	0.1	0	3614	5496	0.07	0.014	0.0	0.42
41	42	41.5	Medium Stiff Fine-Grained	-46.5	115	120	4395	2590	1805	1.0	1805	0.93	0.37	0.45	3555	-398	531	133	0.20	0.00	0.1	0	3591	5529	0.07	0.014	0.0	0.41
42	43	42.5	Medium Stiff Fine-Grained	-47.5	115	120	4515	2652	1863	1.0	1863	0.93	0.36	0.45	3540	-396	528	132	0.19	0.00	0.1	0	3568	5563	0.07	0.014	0.0	0.40
43	44	43.5	Medium Stiff Fine-Grained	-48.5	115	120	4635	2714	1921	1.0	1921	0.93	0.35	0.44	3524	-393	525	131	0.19	0.00	0.1	0	3545	5597	0.07	0.014	0.0	0.39
44	45	44.5	Medium Stiff Fine-Grained	-49.5	115	120	4755	2777	1978	1.0	1978	0.93	0.35	0.44	3509	-391	521	130	0.19	0.00	0.1	0	3523	5631	0.07	0.014	0.0	0.38
45	46	45.5	Medium Stiff Fine-Grained	-50.5	115	120	4875	2839	2036	1.0	2036	0.93	0.34	0.44	3494	-389	518	130	0.18	0.00	0.1	0	3500	5666	0.07	0.014	0.0	0.37
46	47	46.5	Medium Stiff Fine-Grained	-51.5	115	120	4995	2902	2093	1.0	2093	0.93	0.33	0.44	3478	-387	516	129	0.18	0.00	0.1	0	3478	5701	0.07	0.014	0.0	0.37
47	48	47.5	Medium Stiff Fine-Grained	-52.5	115	120	5115	2964	2151	1.0	2151	0.94	0.32	0.44	3463	-384	513	128	0.17	0.00	0.1	0	3456	5735	0.07	0.014	0.0	0.36
48	49	48.5	Medium Stiff Fine-Grained	-53.5	115	120	5235	3026	2209	1.0	2209	0.94	0.32	0.44	3448	-382	510	127	0.17	0.00	0.1	0	3435	5771	0.07	0.014	0.0	0.35

Configuration **4H1V_P1_G2-AR25**

by: E. Ticen
Last Updated: February 2020

Geometry	Embankment Height, H	33	ft
	Embankment Side Slopes	4	xH:1V
	Crown Width	32	ft
	Half Crown Width, B1	16	ft
	Side Slope Width, B2	132	ft
	Unit Weight of Embankment, γ	120	pcf
	Depth to Ground Water	0	ft
	Maximum Stress Increase	3960	psf
	Water Surface Elevation	-5	ft
	Ground Surface Elevation	-5	ft
Foundation Improvements	Remove & Replace Depth [1]	6	ft
	Area Replacement Ratio	0.25	-
	Shear Key Thickness	2.5	ft
	Shear Key Depth	40	ft
	Shear Key Raft Foundation Depth	26.7	ft
	Shear key Spacing	10.0	ft
	Soil Arching b/w Shear Key	0.5	xV:1H
	Arching Stress Height	2	ft
	Arching Side Slope Width, B2	5.0	ft
	σmax Arching	225	psf

Notes:
1) Compacted fill where settlement of the material is considered to be negligible.
2)
3)
4)
5)
6)
7)

Total Settlement at Midpoint Between Shear Keys=	24.5	inches
Total Settlement at Shear Keys=	16.2	inches
Differential Settlement=	8.3	inches

		Depth (GS=0-ft)		Elevation (ft)		Unit Weight		Settlement					Staged Construction		
		Top	Bottom	Top	Bottom	Moist	Saturated	$C_{c\varepsilon} = C_c/(1+e_o)$	$C_{r\varepsilon} = C_{c\varepsilon}/5$	OCR	Total Layer Settlement		Reduction	Total Layer Settlement	
Layer	Description	(ft)	(ft)	(ft)	(ft)	(pcf)	(pcf)	(-)	(-)	(-)	(in)	(ft)	(%)	(in)	(ft)
1	Embankment Fill	-33	0	28	-5	115	120	0.01	0.002	5	0	0.00	100%	0	0.00
2	Organics	0	15	-5	-20	85	90	0.180	0.036	1	5.8	0.48	0%	6	0.48
3a	Soft to Medium Stiff Fine-Grained	15	30	-20	-35	105	110	0.120	0.024	1	5.4	0.45	0%	5	0.45
4	Medium Stiff Fine-Grained	30	50	-35	-55	115	120	0.070	0.014	1	8.6	0.72	0%	9	0.72
5	Stiff Fine-Grained	50	100	-55	-105	120	125	0.017	0.0034	1	2.7	0.22	0%	3	0.22
6	Dense Coarse-Grained	100	150	-105	-155	120	125	0.017	0.0034	1	1.3	0.11	0%	1	0.11
7	Stiff Fine-Grained	150	200	-155	-205	120	125	0.017	0.0034	1	0.7	0.06	0%	1	0.06
										Σ=	24.5	2.0	Σ=	24.5	2.0

							Pre Construction							Δσ due to Embankment Load (Das - 5.6)				Δσ due to Foundation R&R (2:1)			Δσ With Arching for Shear Keys (Das - 5.6)								
Top of Layer	Bottom of Layer	Depth (ft)	Layer (-)	Elevation (ft)	Moist Unit Weight (pcf)	Saturated Unit Weight (pcf)	Total Stress (psf)	Pore Pressure (psf)	Effective stress (psf)	OCR (-)	Pre- Consolidation Pressure (psf)	α_1 (rad)	α_2 (rad)	Influence Value I'	Δσ below Embankment middle (psf)	Foundation Removal (psf)	Foundation Replacement (psf)	Net Stress Change in Layer (psf)	α1 (rad)	α2 (rad)	Influence Value I'	Δσ between shear keys above shear key raft foundation (psf)	Δσ below shear key raft foundation	Final Stress (psf)	$C_{c\varepsilon}$ (-)	$C_{r\varepsilon}$ (-)	Vertical Strain $\varepsilon_{v,i}$ (%)	Change in Layer Thickness Δh_i (in)
0	1	0.5	Organics	-5.5	85	90	45	31	14	1.0	14	0.03	1.54	0.50	3960	-45	60	15	1.47	0.00	0.5	211	0	240	0.18	0.036	0.0	0.00
1	2	1.5	Organics	-6.5	85	90	135	94	41	1.0	41	0.08	1.48	0.50	3960	-135	180	45	1.28	0.00	0.4	183	0	270	0.18	0.036	0.0	0.00
2	3	2.5	Organics	-7.5	85	90	225	156	69	1.0	69	0.14	1.42	0.50	3960	-225	300	75	1.11	0.00	0.4	159	0	303	0.18	0.036	0.0	0.00
3	4	3.5	Organics	-8.5	85	90	315	218	97	1.0	97	0.19	1.36	0.50	3959	-315	420	105	0.96	0.00	0.3	138	0	339	0.18	0.036	0.0	0.00
4	5	4.5	Organics	-9.5	85	90	405	281	124	1.0	124	0.24	1.30	0.50	3958	-405	540	135	0.84	0.00	0.3	120	0	379	0.18	0.036	0.0	0.00
5	6	5.5	Organics	-10.5	85	90	495	343	152	1.0	152	0.29	1.24	0.50	3956	-495	660	165	0.74	0.00	0.2	113	0	429	0.18	0.036	0.0	0.00
6	7	6.5	Organics	-11.5	85	90	585	406	179	1.0	179	0.34	1.18	0.50	3954	-493	658	164	0.66	0.00	0.2	113	0	456	0.18	0.036	0.1	0.88
7	8	7.5	Organics	-12.5	85	90	675	468	207	1.0	207	0.39	1.13	0.50	3951	-490	654	163	0.59	0.00	0.2	113	0	483	0.18	0.036	0.1	0.79
8	9	8.5	Organics	-13.5	85	90	765	530	235	1.0	235	0.43	1.08	0.50	3947	-487	649	162	0.53	0.00	0.2	113	0	509	0.18	0.036	0.1	0.73
9	10	9.5	Organics	-14.5	85	90	855	593	262	1.0	262	0.47	1.03	0.50	3943	-484	645	161	0.48	0.00	0.2	113	0	536	0.18	0.036	0.1	0.67
10	11	10.5	Organics	-15.5	85	90	945	655	290	1.0	290	0.51	0.99	0.50	3937	-481	641	160	0.44	0.00	0.1	113	0	563	0.18	0.036	0.1	0.62
11	12	11.5	Organics	-16.5	85	90	1035	718	317	1.0	317	0.55	0.95	0.50	3931	-478	637	159	0.41	0.00	0.1	113	0	589	0.18	0.036	0.0	0.58
12	13	12.5	Organics	-17.5	85	90	1125	780	345	1.0	345	0.58	0.91	0.50	3924	-475	633	158	0.38	0.00	0.1	113	0	616	0.18	0.036	0.0	0.54
13	14	13.5	Organics	-18.5	85	90	1215	842	373	1.0	373	0.61	0.87	0.49	3917	-472	629	157	0.35	0.00	0.1	113	0	642	0.18	0.036	0.0	0.51
14	15	14.5	Organics	-19.5	85	90	1305	905	400	1.0	400	0.64	0.83	0.49	3909	-469	625	156	0.33	0.00	0.1	113	0	669	0.18	0.036	0.0	0.48
15	16	15.5	Soft to Medium Stiff Fine-Grained	-20.5	105	110	1415	967	448	1.0	448	0.67	0.80	0.49	3900	-466	621	155	0.31	0.00	0.1	113	0	716	0.12	0.024	0.0	0.29
16	17	16.5	Soft to Medium Stiff Fine-Grained	-21.5	105	110	1525	1030	495	1.0	495	0.69	0.77	0.49	3891	-463	617	154	0.29	0.00	0.1	113	0	762	0.12	0.024	0.0	0.27
17	18	17.5	Soft to Medium Stiff Fine-Grained	-22.5	105	110	1635	1092	543	1.0	543	0.71	0.74	0.49	3881	-460	613	153	0.28	0.00	0.1	113	0	809	0.12	0.024	0.0	0.25
18	19	18.5	Soft to Medium Stiff Fine-Grained	-23.5	105	110	1745	1154	591	1.0	591	0.73	0.71	0.49	3871	-457	610	152	0.26	0.00	0.1	113	0	855	0.12	0.024	0.0	0.23
19	20	19.5	Soft to Medium Stiff Fine-Grained	-24.5	105	110	1855	1217	638	1.0	638	0.75	0.69	0.49	3860	-454	606	151	0.25	0.00	0.1	113	0	902	0.12	0.024	0.0	0.22
20	21	20.5	Soft to Medium Stiff Fine-Grained	-25.5	105	110	1965	1279	686	1.0	686	0.77	0.66	0.49	3848	-451	602	150	0.24	0.00	0.1	113	0	949	0.12	0.024	0.0	0.20
21	22	21.5	Soft to Medium Stiff Fine-Grained	-26.5	105	110	2075	1342	733	1.0	733	0.79	0.64	0.48	3837	-449	598	150	0.23	0.00	0.1	113	0	995	0.12	0.024	0.0	0.19
22	23	22.5	Soft to Medium Stiff Fine-Grained	-27.5	105	110	2185	1404	781	1.0	781	0.80	0.62	0.48	3825	-446	595	149	0.22	0.00	0.1	113	0	1042	0.12	0.024	0.0	0.18
23	24	23.5	Soft to Medium Stiff Fine-Grained	-28.5	105	110	2295	1466	829	1.0	829	0.82	0.60	0.48	3812	-443	591	148	0.21	0.00	0.1	113	0	1089	0.12	0.024	0.0	0.17
24	25	24.5	Soft to Medium Stiff Fine-Grained	-29.5	105	110	2405	1529	876	1.0	876	0.83	0.58	0.48	3800	-440	587	147	0.20	0.00	0.1	113	0	1136	0.12	0.024	0.0	0.16
25	26	25.5	Soft to Medium Stiff Fine-Grained	-30.5	105	110	2515	1591	924	1.0	924	0.84	0.56	0.48	3786	-438	584	146	0.19	0.00	0.1	113	0	1182	0.12	0.024	0.0	0.15
26	27	26.5	Soft to Medium Stiff Fine-Grained	-31.5	105	110	2625	1654	971	1.0	971	0.85	0.54	0.48	3773	-435	580	145	0.19	0.00	0.1	113	0	1229	0.12	0.024	0.0	0.15
27	28	27.5	Soft to Medium Stiff Fine-Grained	-32.5	105	110	2735	1716	1019	1.0	1019	0.86	0.53	0.47	3760	-433	577	144	0.18	0.00	0.1	0	3938	5101	0.12	0.024	0.1	1.01
28	29	28.5	Soft to Medium Stiff Fine-Grained	-33.5	105	110	2845	1778	1067	1.0	1067	0.87	0.51	0.47	3746	-430	573	143	0.17	0.00	0.1	0	3911	5121	0.12	0.024	0.1	0.98
29	30	29.5	Soft to Medium Stiff Fine-Grained	-34.5	105	110	2955	1841	1114	1.0	1114	0.88	0.50	0.47	3732	-427	570	142	0.17	0.00	0.1	0	3885	5142	0.12	0.024	0.1	0.96
30	31	30.5	Medium Stiff Fine-Grained	-35.5	115	120	3075	1903	1172	1.0	1172	0.88	0.48	0.47	3718	-425	566	142	0.16	0.00	0.1	0	3859	5173	0.07	0.014	0.0	0.54
31	32	31.5	Medium Stiff Fine-Grained	-36.5	115	120	3195	1966	1229	1.0	1229	0.89	0.47	0.47	3704	-422	563	141	0.16	0.00	0.1	0	3834	5204	0.07	0.014	0.0	0.53
32	33	32.5	Medium Stiff Fine-Grained	-37.5	115	120	3315	2028	1287	1.0	1287	0.90	0.46	0.47	3689	-420	560	140	0.15	0.00	0.0	0	3808	5235	0.07	0.014	0.0	0.51
33	34	33.5	Medium Stiff Fine-Grained	-38.5	115	120	3435	2090	1345	1.0	1345	0.90	0.45	0.46	3675	-417	556	139	0.15	0.00	0.0	0	3783	5267	0.07	0.014	0.0	0.50
34	35	34.5	Medium Stiff Fine-Grained	-39.5	115	120	3555	2153	1402	1.0	1402	0.91	0.43	0.46	3660	-415	553	138	0.14	0.00	0.0	0	3758	5299	0.07	0.014	0.0	0.48
35	36	35.5	Medium Stiff Fine-Grained	-40.5	115	120	3675	2215	1460	1.0	1460	0.91	0.42	0.46	3645	-412	550	137	0.14	0.00	0.0	0	3734	5331	0.07	0.014	0.0	0.47
36	37	36.5	Medium Stiff Fine-Grained	-41.5	115	120	3795	2278	1517	1.0	1517	0.92	0.41	0.46	3630	-410	546	137	0.14	0.00	0.0	0	3709	5363	0.07	0.014	0.0	0.46
37	38	37.5	Medium Stiff Fine-Grained	-42.5	115	120	3915	2340	1575	1.0	1575	0.92	0.40	0.46	3615	-407	543	136	0.13	0.00	0.0	0	3685	5396	0.07	0.014	0.0	0.45
38	39	38.5	Medium Stiff Fine-Grained	-43.5	115	120	4035	2402	1633	1.0	1633	0.92	0.39	0.45	3600	-405	540	135	0.13	0.00	0.0	0	3661	5429	0.07	0.014	0.0	0.44
39	40	39.5	Medium Stiff Fine-Grained	-44.5	115	120	4155	2465	1690	1.0	1690	0.93	0.38	0.45	3585	-403	537	134	0.13	0.00	0.0	0	3638	5462	0.07	0.014	0.0	0.43
40	41	40.5	Medium Stiff Fine-Grained	-45.5	115	120	4275	2527	1748	1.0	1748	0.93	0.38	0.45	3570	-400	534	133	0.12	0.00	0.0	0	3614	5496	0.07	0.014	0.0	0.42
41	42	41.5	Medium Stiff Fine-Grained	-46.5	115	120	4395	2590	1805	1.0	1805	0.93	0.37	0.45	3555	-398	531	133	0.12	0.00	0.0	0	3591	5529	0.07	0.014	0.0	0.41
42	43	42.5	Medium Stiff Fine-Grained	-47.5	115	120	4515	2652	1863	1.0	1863	0.93	0.36	0.45	3540	-396	528	132	0.12	0.00	0.0	0	3568	5563	0.07	0.014	0.0	0.40
43	44	43.5	Medium Stiff Fine-Grained	-48.5	115	120	4635	2714	1921	1.0	1921	0.93	0.35	0.44	3524	-393	525	131	0.11	0.00	0.0	0	3545	5597	0.07	0.014	0.0	0.39
44	45	44.5	Medium Stiff Fine-Grained	-49.5	115	120	4755	2777	1978	1.0	1978	0.93	0.35	0.44	3509	-391	521	130	0.11	0.00	0.0	0	3523	5631	0.07	0.014	0.0	0.38
45	46	45.5	Medium Stiff Fine-Grained	-50.5	115	120	4875	2839	2036	1.0	2036	0.93	0.34	0.44	3494	-389	518	130	0.11	0.00	0.0	0	3500	5666	0.07	0.014	0.0	0.37
46	47	46.5	Medium Stiff Fine-Grained	-51.5	115	120	4995	2902	2093	1.0	2093	0.93	0.33	0.44	3478	-387	516	129	0.11	0.00	0.0	0	3478	5701	0.07	0.014	0.0	0.37
47	48	47.5	Medium Stiff Fine-Grained	-52.5	115	120	5115	2964	2151	1.0	2151	0.94	0.32	0.44	3463	-384	513	128	0.10	0.00	0.0	0	3456	5735	0.07	0.014	0.0	0.36
48	49	48.5	Medium Stiff Fine-Grained	-53.5	115	120	5235	3026	2209	1.0	2209	0.94	0.32	0.44	3448	-382	510	127	0.10	0.00	0.0	0	3435	5771	0.07	0.014	0.0	0.35

Configuration **4H1V_P2_E**

by: E. Ticen
Last Updated: February 2020

Geometry	Embankment Height, H	33	ft
	Embankment Side Slopes	4	xH:1V
	Crown Width	32	ft
	Half Crown Width, B1	16	ft
	Side Slope Width, B2	132	ft
	Unit Weight of Embankment, γ	120	pcf
	Depth to Ground Water	0	ft
	Maximum Stress Increase	3960	psf
	Water Surface Elevation	-5	ft
	Ground Surface Elevation	-5	ft
Foundation Improvements	Remove & Replace Depth [1]	6	ft
	Area Replacement Ratio	0	-
	Shear Key Thickness	0	ft
	Shear Key Depth	0	ft
	Shear Key Raft Foundation Depth	0.0	ft
	Shear key Spacing	--	ft
	Soil Arching b/w Shear Key	0	xV:1H
	Arching Stress Height	--	ft
	Arching Side Slope Width, B2	--	ft
	σmax Arching	0	psf

Notes:
1) Compacted fill where settlement of the material is considered to be negligible.
2)
3)
4)
5)
6)
7)

Total Settlement at Midpoint Between Shear Keys=	--	inches
Total Settlement at Shear Keys=	--	inches
Differential Settlement=	--	inches

		Depth (GS=0-ft)		Elevation (ft)		Unit Weight		Settlement					Staged Construction		
		Top	Bottom	Top	Bottom	Moist	Saturated	$C_{c\varepsilon} = C_c/(1+e_o)$	$C_{r\varepsilon} = C_{cd}/5$	OCR	Total Layer Settlement		Reduction	Total Layer Settlement	
Layer	Description	(ft)	(ft)	(ft)	(ft)	(pcf)	(pcf)	(-)	(-)	(-)	(in)	(ft)	(%)	(in)	(ft)
1	Embankment Fill	-33	0	28	-5	115	120	0.01	0.002	5	0	0.00	100%	0	0.00
2	Organics	0	15	-5	-20	85	90	0.180	0.036	1	23.2	1.93	0%	23	1.93
3B	Loose - Coarse Grained	15	30	-20	-35	105	110	0.005	0.001	1	0.7	0.06	0%	1	0.06
4	Medium Stiff Fine-Grained	30	50	-35	-55	115	120	0.070	0.014	1	8.5	0.71	0%	9	0.71
5	Stiff Fine-Grained	50	100	-55	-105	120	125	0.017	0.0034	1	2.8	0.23	0%	3	0.23
6	Dense Coarse-Grained	100	150	-105	-155	120	125	0.017	0.0034	1	1.4	0.12	0%	1	0.12
7	Stiff Fine-Grained	150	200	-155	-205	120	125	0.017	0.0034	1	0.8	0.06	0%	1	0.06
										∑=	37.3	3.1		37.3	3.1

							Pre Construction							Δσ due to Embankment Load (Das - 5.6)				Δσ due to Foundation R&R (2:1)			Δσ With Arching for Shear Keys (Das - 5.6)								
Top of Layer	Bottom of Layer	Depth (ft)	Layer (-)	Elevation (ft)	Moist Unit Weight (pcf)	Saturated Unit Weight (pcf)	Total Stress (psf)	Pore Pressure (psf)	Effective stress (psf)	OCR (-)	Pre- Consolidation Pressure (psf)	α_1 (rad)	α_2 (rad)	Influence Value I'	Δσ below Embankment middle (psf)	Foundation Removal (psf)	Foundation Replacement (psf)	Net Stress Change in Layer (psf)	α1 (rad)	α2 (rad)	Influence Value I'	Δσ between shear keys above shear key raft foundation (psf)	Δσ below shear key raft foundation	Final Stress (psf)	$C_{c\varepsilon}$ (-)	$C_{r\varepsilon}$ (-)	Vertical Strain $\varepsilon_{v,i}$ (%)	Change in Layer Thickness Δh_i (in)
0	1	0.5	Organics	-5.5	85	90	45	31	14	1.0	14	0.03	1.54	0.50	3960	-45	60	15	0.00	0.00	0.0	0	0	3989	0.18	0.036	0.0	0.00
1	2	1.5	Organics	-6.5	85	90	135	94	41	1.0	41	0.08	1.48	0.50	3960	-135	180	45	0.00	0.00	0.0	0	0	4046	0.18	0.036	0.0	0.00
2	3	2.5	Organics	-7.5	85	90	225	156	69	1.0	69	0.14	1.42	0.50	3960	-225	300	75	0.00	0.00	0.0	0	0	4104	0.18	0.036	0.0	0.00
3	4	3.5	Organics	-8.5	85	90	315	218	97	1.0	97	0.19	1.36	0.50	3959	-315	420	105	0.00	0.00	0.0	0	0	4161	0.18	0.036	0.0	0.00
4	5	4.5	Organics	-9.5	85	90	405	281	124	1.0	124	0.24	1.30	0.50	3958	-405	540	135	0.00	0.00	0.0	0	0	4217	0.18	0.036	0.0	0.00
5	6	5.5	Organics	-10.5	85	90	495	343	152	1.0	152	0.29	1.24	0.50	3956	-495	660	165	0.00	0.00	0.0	0	0	4273	0.18	0.036	0.0	0.00
6	7	6.5	Organics	-11.5	85	90	585	406	179	1.0	179	0.34	1.18	0.50	3954	-493	658	164	0.00	0.00	0.0	0	0	4298	0.18	0.036	0.2	2.98
7	8	7.5	Organics	-12.5	85	90	675	468	207	1.0	207	0.39	1.13	0.50	3951	-490	654	163	0.00	0.00	0.0	0	0	4321	0.18	0.036	0.2	2.85
8	9	8.5	Organics	-13.5	85	90	765	530	235	1.0	235	0.43	1.08	0.50	3947	-487	649	162	0.00	0.00	0.0	0	0	4344	0.18	0.036	0.2	2.74
9	10	9.5	Organics	-14.5	85	90	855	593	262	1.0	262	0.47	1.03	0.50	3943	-484	645	161	0.00	0.00	0.0	0	0	4366	0.18	0.036	0.2	2.64
10	11	10.5	Organics	-15.5	85	90	945	655	290	1.0	290	0.51	0.99	0.50	3937	-481	641	160	0.00	0.00	0.0	0	0	4387	0.18	0.036	0.2	2.55
11	12	11.5	Organics	-16.5	85	90	1035	718	317	1.0	317	0.55	0.95	0.50	3931	-478	637	159	0.00	0.00	0.0	0	0	4408	0.18	0.036	0.2	2.47
12	13	12.5	Organics	-17.5	85	90	1125	780	345	1.0	345	0.58	0.91	0.50	3924	-475	633	158	0.00	0.00	0.0	0	0	4428	0.18	0.036	0.2	2.39
13	14	13.5	Organics	-18.5	85	90	1215	842	373	1.0	373	0.61	0.87	0.49	3917	-472	629	157	0.00	0.00	0.0	0	0	4447	0.18	0.036	0.2	2.33
14	15	14.5	Organics	-19.5	85	90	1305	905	400	1.0	400	0.64	0.83	0.49	3909	-469	625	156	0.00	0.00	0.0	0	0	4465	0.18	0.036	0.2	2.26
15	16	15.5	Loose - Coarse Grained	-20.5	105	110	1415	967	448	1.0	448	0.67	0.80	0.49	3900	-466	621	155	0.00	0.00	0.0	0	0	4503	0.005	0.001	0.0	0.06
16	17	16.5	Loose - Coarse Grained	-21.5	105	110	1525	1030	495	1.0	495	0.69	0.77	0.49	3891	-463	617	154	0.00	0.00	0.0	0	0	4541	0.005	0.001	0.0	0.06
17	18	17.5	Loose - Coarse Grained	-22.5	105	110	1635	1092	543	1.0	543	0.71	0.74	0.49	3881	-460	613	153	0.00	0.00	0.0	0	0	4577	0.005	0.001	0.0	0.06
18	19	18.5	Loose - Coarse Grained	-23.5	105	110	1745	1154	591	1.0	591	0.73	0.71	0.49	3871	-457	610	152	0.00	0.00	0.0	0	0	4614	0.005	0.001	0.0	0.05
19	20	19.5	Loose - Coarse Grained	-24.5	105	110	1855	1217	638	1.0	638	0.75	0.69	0.49	3860	-454	606	151	0.00	0.00	0.0	0	0	4649	0.005	0.001	0.0	0.05
20	21	20.5	Loose - Coarse Grained	-25.5	105	110	1965	1279	686	1.0	686	0.77	0.66	0.49	3848	-451	602	150	0.00	0.00	0.0	0	0	4685	0.005	0.001	0.0	0.05
21	22	21.5	Loose - Coarse Grained	-26.5	105	110	2075	1342	733	1.0	733	0.79	0.64	0.48	3837	-449	598	150	0.00	0.00	0.0	0	0	4720	0.005	0.001	0.0	0.05
22	23	22.5	Loose - Coarse Grained	-27.5	105	110	2185	1404	781	1.0	781	0.80	0.62	0.48	3825	-446	595	149	0.00	0.00	0.0	0	0	4754	0.005	0.001	0.0	0.05
23	24	23.5	Loose - Coarse Grained	-28.5	105	110	2295	1466	829	1.0	829	0.82	0.60	0.48	3812	-443	591	148	0.00	0.00	0.0	0	0	4789	0.005	0.001	0.0	0.05
24	25	24.5	Loose - Coarse Grained	-29.5	105	110	2405	1529	876	1.0	876	0.83	0.58	0.48	3800	-440	587	147	0.00	0.00	0.0	0	0	4823	0.005	0.001	0.0	0.04
25	26	25.5	Loose - Coarse Grained	-30.5	105	110	2515	1591	924	1.0	924	0.84	0.56	0.48	3786	-438	584	146	0.00	0.00	0.0	0	0	4856	0.005	0.001	0.0	0.04
26	27	26.5	Loose - Coarse Grained	-31.5	105	110	2625	1654	971	1.0	971	0.85	0.54	0.48	3773	-435	580	145	0.00	0.00	0.0	0	0	4890	0.005	0.001	0.0	0.04
27	28	27.5	Loose - Coarse Grained	-32.5	105	110	2735	1716	1019	1.0	1019	0.86	0.53	0.47	3760	-433	577	144	0.00	0.00	0.0	0	0	4923	0.005	0.001	0.0	0.04
28	29	28.5	Loose - Coarse Grained	-33.5	105	110	2845	1778	1067	1.0	1067	0.87	0.51	0.47	3746	-430	573	143	0.00	0.00	0.0	0	0	4956	0.005	0.001	0.0	0.04
29	30	29.5	Loose - Coarse Grained	-34.5	105	110	2955	1841	1114	1.0	1114	0.88	0.50	0.47	3732	-427	570	142	0.00	0.00	0.0	0	0	4989	0.005	0.001	0.0	0.04
30	31	30.5	Medium Stiff Fine-Grained	-35.5	115	120	3075	1903	1172	1.0	1172	0.88	0.48	0.47	3718	-425	566	142	0.00	0.00	0.0	0	0	5031	0.07	0.014	0.0	0.53
31	32	31.5	Medium Stiff Fine-Grained	-36.5	115	120	3195	1966	1229	1.0	1229	0.89	0.47	0.47	3704	-422	563	141	0.00	0.00	0.0	0	0	5074	0.07	0.014	0.0	0.52
32	33	32.5	Medium Stiff Fine-Grained	-37.5	115	120	3315	2028	1287	1.0	1287	0.90	0.46	0.47	3689	-420	560	140	0.00	0.00	0.0	0	0	5116	0.07	0.014	0.0	0.50
33	34	33.5	Medium Stiff Fine-Grained	-38.5	115	120	3435	2090	1345	1.0	1345	0.90	0.45	0.46	3675	-417	556	139	0.00	0.00	0.0	0	0	5158	0.07	0.014	0.0	0.49
34	35	34.5	Medium Stiff Fine-Grained	-39.5	115	120	3555	2153	1402	1.0	1402	0.91	0.43	0.46	3660	-415	553	138	0.00	0.00	0.0	0	0	5200	0.07	0.014	0.0	0.48
35	36	35.5	Medium Stiff Fine-Grained	-40.5	115	120	3675	2215	1460	1.0	1460	0.91	0.42	0.46	3645	-412	550	137	0.00	0.00	0.0	0	0	5242	0.07	0.014	0.0	0.47
36	37	36.5	Medium Stiff Fine-Grained	-41.5	115	120	3795	2278	1517	1.0	1517	0.92	0.41	0.46	3630	-410	546	137	0.00	0.00	0.0	0	0	5284	0.07	0.014	0.0	0.46
37	38	37.5	Medium Stiff Fine-Grained	-42.5	115	120	3915	2340	1575	1.0	1575	0.92	0.40	0.46	3615	-407	543	136	0.00	0.00	0.0	0	0	5326	0.07	0.014	0.0	0.44
38	39	38.5	Medium Stiff Fine-Grained	-43.5	115	120	4035	2402	1633	1.0	1633	0.92	0.39	0.45	3600	-405	540	135	0.00	0.00	0.0	0	0	5368	0.07	0.014	0.0	0.43
39	40	39.5	Medium Stiff Fine-Grained	-44.5	115	120	4155	2465	1690	1.0	1690	0.93	0.38	0.45	3585	-403	537	134	0.00	0.00	0.0	0	0	5410	0.07	0.014	0.0	0.42
40	41	40.5	Medium Stiff Fine-Grained	-45.5	115	120	4275	2527	1748	1.0	1748	0.93	0.38	0.45	3570	-400	534	133	0.00	0.00	0.0	0	0	5451	0.07	0.014	0.0	0.41
41	42	41.5	Medium Stiff Fine-Grained	-46.5	115	120	4395	2590	1805	1.0	1805	0.93	0.37	0.45	3555	-398	531	133	0.00	0.00	0.0	0	0	5493	0.07	0.014	0.0	0.41
42	43	42.5	Medium Stiff Fine-Grained	-47.5	115	120	4515	2652	1863	1.0	1863	0.93	0.36	0.45	3540	-396	528	132	0.00	0.00	0.0	0	0	5534	0.07	0.014	0.0	0.40
43	44	43.5	Medium Stiff Fine-Grained	-48.5	115	120	4635	2714	1921	1.0	1921	0.93	0.35	0.44	3524	-393	525	131	0.00	0.00	0.0	0	0	5576	0.07	0.014	0.0	0.39
44	45	44.5	Medium Stiff Fine-Grained	-49.5	115	120	4755	2777	1978	1.0	1978	0.93	0.35	0.44	3509	-391	521	130	0.00	0.00	0.0	0	0	5618	0.07	0.014	0.0	0.38
45	46	45.5	Medium Stiff Fine-Grained	-50.5	115	120	4875	2839	2036	1.0	2036	0.93	0.34	0.44	3494	-389	518	130	0.00	0.00	0.0	0	0	5659	0.07	0.014	0.0	0.37
46	47	46.5	Medium Stiff Fine-Grained	-51.5	115	120	4995	2902	2093	1.0	2093	0.93	0.33	0.44	3478	-387	516	129	0.00	0.00	0.0	0	0	5701	0.07	0.014	0.0	0.37
47	48	47.5	Medium Stiff Fine-Grained	-52.5	115	120	5115	2964	2151	1.0	2151	0.94	0.32	0.44	3463	-384	513	128	0.00	0.00	0.0	0	0	5742	0.07	0.014	0.0	0.36
48	49	48.5	Medium Stiff Fine-Grained	-53.5	115	120	5235	3026	2209	1.0	2209	0.94	0.32	0.44	3448	-382	510	127	0.00	0.00	0.0	0	0	5784	0.07	0.014	0.0	0.35

Configuration **4H1V_P2_G1-RR15**

by: E. Ticen
Last Updated: February 2020

Geometry	Embankment Height, H	33	ft
	Embankment Side Slopes	4	xH:1V
	Crown Width	32	ft
	Half Crown Width, B1	16	ft
	Side Slope Width, B2	132	ft
	Unit Weight of Embankment, γ	120	pcf
	Depth to Ground Water	0	ft
	Maximum Stress Increase	3960	psf
	Water Surface Elevation	-5	ft
	Ground Surface Elevation	-5	ft
Foundation Improvements	Remove & Replace Depth [1]	15	ft
	Area Replacement Ratio	0	-
	Shear Key Thickness	0	ft
	Shear Key Depth	0	ft
	Shear Key Raft Foundation Depth	0.0	ft
	Shear key Spacing	--	ft
	Soil Arching b/w Shear Key	0	xV:1H
	Arching Stress Height	--	ft
	Arching Side Slope Width, B2	--	ft
	σmax Arching	0	psf

Notes:
1) Compacted fill where settlement of the material is considered to be negligible.
2)
3)
4)
5)
6)
7)

Total Settlement at Midpoint Between Shear Keys=	--	inches
Total Settlement at Shear Keys=	--	inches
Differential Settlement=	--	inches

		Depth (GS=0-ft)		Elevation (ft)		Unit Weight		Settlement					Staged Construction		
		Top	Bottom	Top	Bottom	Moist	Saturated	$C_{c\varepsilon} = C_c/(1+e_o)$	$C_{r\varepsilon} = C_{cE}/5$	OCR	Total Layer Settlement		Reduction	Total Layer Settlement	
Layer	Description	(ft)	(ft)	(ft)	(ft)	(pcf)	(pcf)	(-)	(-)	(-)	(in)	(ft)	(%)	(in)	(ft)
1	Embankment Fill	-33	0	28	-5	115	120	0.01	0.002	5	0	0.00	100%	0	0.00
2	Organics	0	15	-5	-20	85	90	0.180	0.036	1	0.0	0.00	0%	0	0.00
3b	Loose - Coarse Grained	15	30	-20	-35	105	110	0.005	0.001	1	0.7	0.06	0%	1	0.06
4	Medium Stiff Fine-Grained	30	50	-35	-55	115	120	0.070	0.014	1	8.8	0.74	0%	9	0.74
5	Stiff Fine-Grained	50	100	-55	-105	120	125	0.017	0.0034	1	2.9	0.24	0%	3	0.24
6	Dense Coarse-Grained	100	150	-105	-155	120	125	0.017	0.0034	1	1.5	0.12	0%	1	0.12
7	Stiff Fine-Grained	150	200	-155	-205	120	125	0.017	0.0034	1	0.8	0.07	0%	1	0.07
										Σ=	14.7	1.2	Σ=	14.7	1.2

							Pre Construction							Δσ due to Embankment Load (Das - 5.6)			Δσ due to Foundation R&R (2:1)			Δσ With Arching for Shear Keys (Das - 5.6)									
Top of Layer	Bottom of Layer	Depth (ft)	Layer (-)	Elevation (ft)	Moist Unit Weight (pcf)	Saturated Unit Weight (pcf)	Total Stress (psf)	Pore Pressure (psf)	Effective stress (psf)	OCR (-)	Pre- Consolidation Pressure (psf)	α_1 (rad)	α_2 (rad)	Influence Value I'	Δσ below Embankment middle (psf)	Foundation Removal (psf)	Foundation Replacement (psf)	Net Stress Change in Layer (psf)	α1 (rad)	α2 (rad)	Influence Value I'	Δσ between shear keys above shear key raft foundation (psf)	Δσ below shear key raft foundation	Final Stress (psf)	$C_{c\varepsilon}$ (-)	$C_{r\varepsilon}$ (-)	Vertical Strain $\varepsilon_{v,i}$ (%)	Change in Layer Thickness Δh_i (in)
0	1	0.5	Organics	-5.5	85	90	45	31	14	1.0	14	0.03	1.54	0.50	3960	-45	60	15	0.00	0.00	0.0	0	0	3989	0.18	0.036	0.0	0.00
1	2	1.5	Organics	-6.5	85	90	135	94	41	1.0	41	0.08	1.48	0.50	3960	-135	180	45	0.00	0.00	0.0	0	0	4046	0.18	0.036	0.0	0.00
2	3	2.5	Organics	-7.5	85	90	225	156	69	1.0	69	0.14	1.42	0.50	3960	-225	300	75	0.00	0.00	0.0	0	0	4104	0.18	0.036	0.0	0.00
3	4	3.5	Organics	-8.5	85	90	315	218	97	1.0	97	0.19	1.36	0.50	3959	-315	420	105	0.00	0.00	0.0	0	0	4161	0.18	0.036	0.0	0.00
4	5	4.5	Organics	-9.5	85	90	405	281	124	1.0	124	0.24	1.30	0.50	3958	-405	540	135	0.00	0.00	0.0	0	0	4217	0.18	0.036	0.0	0.00
5	6	5.5	Organics	-10.5	85	90	495	343	152	1.0	152	0.29	1.24	0.50	3956	-495	660	165	0.00	0.00	0.0	0	0	4273	0.18	0.036	0.0	0.00
6	7	6.5	Organics	-11.5	85	90	585	406	179	1.0	179	0.34	1.18	0.50	3954	-585	780	195	0.00	0.00	0.0	0	0	4328	0.18	0.036	0.0	0.00
7	8	7.5	Organics	-12.5	85	90	675	468	207	1.0	207	0.39	1.13	0.50	3951	-675	900	225	0.00	0.00	0.0	0	0	4383	0.18	0.036	0.0	0.00
8	9	8.5	Organics	-13.5	85	90	765	530	235	1.0	235	0.43	1.08	0.50	3947	-765	1020	255	0.00	0.00	0.0	0	0	4437	0.18	0.036	0.0	0.00
9	10	9.5	Organics	-14.5	85	90	855	593	262	1.0	262	0.47	1.03	0.50	3943	-855	1140	285	0.00	0.00	0.0	0	0	4490	0.18	0.036	0.0	0.00
10	11	10.5	Organics	-15.5	85	90	945	655	290	1.0	290	0.51	0.99	0.50	3937	-945	1260	315	0.00	0.00	0.0	0	0	4542	0.18	0.036	0.0	0.00
11	12	11.5	Organics	-16.5	85	90	1035	718	317	1.0	317	0.55	0.95	0.50	3931	-1035	1380	345	0.00	0.00	0.0	0	0	4594	0.18	0.036	0.0	0.00
12	13	12.5	Organics	-17.5	85	90	1125	780	345	1.0	345	0.58	0.91	0.50	3924	-1125	1500	375	0.00	0.00	0.0	0	0	4644	0.18	0.036	0.0	0.00
13	14	13.5	Organics	-18.5	85	90	1215	842	373	1.0	373	0.61	0.87	0.49	3917	-1215	1620	405	0.00	0.00	0.0	0	0	4695	0.18	0.036	0.0	0.00
14	15	14.5	Organics	-19.5	85	90	1305	905	400	1.0	400	0.64	0.83	0.49	3909	-1305	1740	435	0.00	0.00	0.0	0	0	4744	0.18	0.036	0.0	0.00
15	16	15.5	Loose - Coarse Grained	-20.5	105	110	1415	967	448	1.0	448	0.67	0.80	0.49	3900	-1301	1735	434	0.00	0.00	0.0	0	0	4782	0.005	0.001	0.0	0.06
16	17	16.5	Loose - Coarse Grained	-21.5	105	110	1525	1030	495	1.0	495	0.69	0.77	0.49	3891	-1293	1724	431	0.00	0.00	0.0	0	0	4817	0.005	0.001	0.0	0.06
17	18	17.5	Loose - Coarse Grained	-22.5	105	110	1635	1092	543	1.0	543	0.71	0.74	0.49	3881	-1285	1714	428	0.00	0.00	0.0	0	0	4852	0.005	0.001	0.0	0.06
18	19	18.5	Loose - Coarse Grained	-23.5	105	110	1745	1154	591	1.0	591	0.73	0.71	0.49	3871	-1277	1703	426	0.00	0.00	0.0	0	0	4887	0.005	0.001	0.0	0.06
19	20	19.5	Loose - Coarse Grained	-24.5	105	110	1855	1217	638	1.0	638	0.75	0.69	0.49	3860	-1270	1693	423	0.00	0.00	0.0	0	0	4921	0.005	0.001	0.0	0.05
20	21	20.5	Loose - Coarse Grained	-25.5	105	110	1965	1279	686	1.0	686	0.77	0.66	0.49	3848	-1262	1683	421	0.00	0.00	0.0	0	0	4955	0.005	0.001	0.0	0.05
21	22	21.5	Loose - Coarse Grained	-26.5	105	110	2075	1342	733	1.0	733	0.79	0.64	0.48	3837	-1254	1673	418	0.00	0.00	0.0	0	0	4988	0.005	0.001	0.0	0.05
22	23	22.5	Loose - Coarse Grained	-27.5	105	110	2185	1404	781	1.0	781	0.80	0.62	0.48	3825	-1247	1663	416	0.00	0.00	0.0	0	0	5021	0.005	0.001	0.0	0.05
23	24	23.5	Loose - Coarse Grained	-28.5	105	110	2295	1466	829	1.0	829	0.82	0.60	0.48	3812	-1240	1653	413	0.00	0.00	0.0	0	0	5054	0.005	0.001	0.0	0.05
24	25	24.5	Loose - Coarse Grained	-29.5	105	110	2405	1529	876	1.0	876	0.83	0.58	0.48	3800	-1232	1643	411	0.00	0.00	0.0	0	0	5086	0.005	0.001	0.0	0.05
25	26	25.5	Loose - Coarse Grained	-30.5	105	110	2515	1591	924	1.0	924	0.84	0.56	0.48	3786	-1225	1633	408	0.00	0.00	0.0	0	0	5119	0.005	0.001	0.0	0.04
26	27	26.5	Loose - Coarse Grained	-31.5	105	110	2625	1654	971	1.0	971	0.85	0.54	0.48	3773	-1218	1623	406	0.00	0.00	0.0	0	0	5150	0.005	0.001	0.0	0.04
27	28	27.5	Loose - Coarse Grained	-32.5	105	110	2735	1716	1019	1.0	1019	0.86	0.53	0.47	3760	-1210	1614	403	0.00	0.00	0.0	0	0	5182	0.005	0.001	0.0	0.04
28	29	28.5	Loose - Coarse Grained	-33.5	105	110	2845	1778	1067	1.0	1067	0.87	0.51	0.47	3746	-1203	1604	401	0.00	0.00	0.0	0	0	5214	0.005	0.001	0.0	0.04
29	30	29.5	Loose - Coarse Grained	-34.5	105	110	2955	1841	1114	1.0	1114	0.88	0.50	0.47	3732	-1196	1595	399	0.00	0.00	0.0	0	0	5245	0.005	0.001	0.0	0.04
30	31	30.5	Medium Stiff Fine-Grained	-35.5	115	120	3075	1903	1172	1.0	1172	0.88	0.48	0.47	3718	-1189	1586	396	0.00	0.00	0.0	0	0	5286	0.07	0.014	0.0	0.55
31	32	31.5	Medium Stiff Fine-Grained	-36.5	115	120	3195	1966	1229	1.0	1229	0.89	0.47	0.47	3704	-1182	1576	394	0.00	0.00	0.0	0	0	5327	0.07	0.014	0.0	0.53
32	33	32.5	Medium Stiff Fine-Grained	-37.5	115	120	3315	2028	1287	1.0	1287	0.90	0.46	0.47	3689	-1175	1567	392	0.00	0.00	0.0	0	0	5368	0.07	0.014	0.0	0.52
33	34	33.5	Medium Stiff Fine-Grained	-38.5	115	120	3435	2090	1345	1.0	1345	0.90	0.45	0.46	3675	-1169	1558	390	0.00	0.00	0.0	0	0	5409	0.07	0.014	0.0	0.51
34	35	34.5	Medium Stiff Fine-Grained	-39.5	115	120	3555	2153	1402	1.0	1402	0.91	0.43	0.46	3660	-1162	1549	387	0.00	0.00	0.0	0	0	5449	0.07	0.014	0.0	0.50
35	36	35.5	Medium Stiff Fine-Grained	-40.5	115	120	3675	2215	1460	1.0	1460	0.91	0.42	0.46	3645	-1155	1540	385	0.00	0.00	0.0	0	0	5490	0.07	0.014	0.0	0.48
36	37	36.5	Medium Stiff Fine-Grained	-41.5	115	120	3795	2278	1517	1.0	1517	0.92	0.41	0.46	3630	-1149	1531	383	0.00	0.00	0.0	0	0	5531	0.07	0.014	0.0	0.47
37	38	37.5	Medium Stiff Fine-Grained	-42.5	115	120	3915	2340	1575	1.0	1575	0.92	0.40	0.46	3615	-1142	1523	381	0.00	0.00	0.0	0	0	5571	0.07	0.014	0.0	0.46
38	39	38.5	Medium Stiff Fine-Grained	-43.5	115	120	4035	2402	1633	1.0	1633	0.92	0.39	0.45	3600	-1135	1514	378	0.00	0.00	0.0	0	0	5611	0.07	0.014	0.0	0.45
39	40	39.5	Medium Stiff Fine-Grained	-44.5	115	120	4155	2465	1690	1.0	1690	0.93	0.38	0.45	3585	-1129	1505	376	0.00	0.00	0.0	0	0	5652	0.07	0.014	0.0	0.44
40	41	40.5	Medium Stiff Fine-Grained	-45.5	115	120	4275	2527	1748	1.0	1748	0.93	0.38	0.45	3570	-1123	1497	374	0.00	0.00	0.0	0	0	5692	0.07	0.014	0.0	0.43
41	42	41.5	Medium Stiff Fine-Grained	-46.5	115	120	4395	2590	1805	1.0	1805	0.93	0.37	0.45	3555	-1116	1488	372	0.00	0.00	0.0	0	0	5732	0.07	0.014	0.0	0.42
42	43	42.5	Medium Stiff Fine-Grained	-47.5	115	120	4515	2652	1863	1.0	1863	0.93	0.36	0.45	3540	-1110	1480	370	0.00	0.00	0.0	0	0	5773	0.07	0.014	0.0	0.41
43	44	43.5	Medium Stiff Fine-Grained	-48.5	115	120	4635	2714	1921	1.0	1921	0.93	0.35	0.44	3524	-1104	1471	368	0.00	0.00	0.0	0	0	5813	0.07	0.014	0.0	0.40
44	45	44.5	Medium Stiff Fine-Grained	-49.5	115	120	4755	2777	1978	1.0	1978	0.93	0.35	0.44	3509	-1097	1463	366	0.00	0.00	0.0	0	0	5853	0.07	0.014	0.0	0.40
45	46	45.5	Medium Stiff Fine-Grained	-50.5	115	120	4875	2839	2036	1.0	2036	0.93	0.34	0.44	3494	-1091	1455	364	0.00	0.00	0.0	0	0	5893	0.07	0.014	0.0	0.39
46	47	46.5	Medium Stiff Fine-Grained	-51.5	115	120	4995	2902	2093	1.0	2093	0.93	0.33	0.44	3478	-1085	1447	362	0.00	0.00	0.0	0	0	5933	0.07	0.014	0.0	0.38
47	48	47.5	Medium Stiff Fine-Grained	-52.5	115	120	5115	2964	2151	1.0	2151	0.94	0.32	0.44	3463	-1079	1439	360	0.00	0.00	0.0	0	0	5974	0.07	0.014	0.0	0.37
48	49	48.5	Medium Stiff Fine-Grained	-53.5	115	120	5235	3026	2209	1.0	2209	0.94	0.32	0.44	3448	-1073	1431	358	0.00	0.00	0.0	0	0	6014	0.07	0.014	0.0	0.37

Configuration **4H1V_P2_G1-RR30**

by: E. Ticen
Last Updated: February 2020

Geometry	Embankment Height, H	33	ft
	Embankment Side Slopes	4	xH:1V
	Crown Width	32	ft
	Half Crown Width, B1	16	ft
	Side Slope Width, B2	132	ft
	Unit Weight of Embankment, γ	120	pcf
	Depth to Ground Water	0	ft
	Maximum Stress Increase	3960	psf
	Water Surface Elevation	-5	ft
	Ground Surface Elevation	-5	ft
Foundation Improvements	Remove & Replace Depth [1]	30	ft
	Area Replacement Ratio	0	-
	Shear Key Thickness	0	ft
	Shear Key Depth	0	ft
	Shear Key Raft Foundation Depth	0.0	ft
	Shear key Spacing	--	ft
	Soil Arching b/w Shear Key	0	xV:1H
	Arching Stress Height	--	ft
	Arching Side Slope Width, B2	--	ft
	σmax Arching	0	psf

Notes:
1) Compacted fill where settlement of the material is considered to be negligible.
2)
3)
4)
5)
6)
7)

Total Settlement at Midpoint Between Shear Keys=	--	inches
Total Settlement at Shear Keys=	--	inches
Differential Settlement=	--	inches

		Depth (GS=0-ft)		Elevation (ft)		Unit Weight		Settlement					Staged Construction		
		Top	Bottom	Top	Bottom	Moist	Saturated	$C_{c\varepsilon} = C_c/(1+e_o)$	$C_{r\varepsilon} = C_{cE}/5$	OCR	Total Layer Settlement		Reduction	Total Layer Settlement	
Layer	Description	(ft)	(ft)	(ft)	(ft)	(pcf)	(pcf)	(-)	(-)	(-)	(in)	(ft)	(%)	(in)	(ft)
1	Embankment Fill	-33	0	28	-5	115	120	0.01	0.002	5	0	0.00	100%	0	0.00
2	Organics	0	15	-5	-20	85	90	0.180	0.036	1	0.0	0.00	0%	0	0.00
3b	Loose - Coarse Grained	15	30	-20	-35	105	110	0.005	0.001	1	0.0	0.00	0%	0	0.00
4	Medium Stiff Fine-Grained	30	50	-35	-55	115	120	0.070	0.014	1	9.1	0.76	0%	9	0.76
5	Stiff Fine-Grained	50	100	-55	-105	120	125	0.017	0.0034	1	3.0	0.25	0%	3	0.25
6	Dense Coarse-Grained	100	150	-105	-155	120	125	0.017	0.0034	1	1.5	0.13	0%	2	0.13
7	Stiff Fine-Grained	150	200	-155	-205	120	125	0.017	0.0034	1	0.8	0.07	0%	1	0.07
										Σ=	14.4	1.2	Σ=	14.4	1.2

							Pre Construction							Δσ due to Embankment Load (Das - 5.6)			Δσ due to Foundation R&R (2:1)			Δσ With Arching for Shear Keys (Das - 5.6)									
Top of Layer	Bottom of Layer	Depth (ft)	Layer (-)	Elevation (ft)	Moist Unit Weight (pcf)	Saturated Unit Weight (pcf)	Total Stress (psf)	Pore Pressure (psf)	Effective stress (psf)	OCR (-)	Pre- Consolidation Pressure (psf)	α_1 (rad)	α_2 (rad)	Influence Value I'	Δσ below Embankment middle (psf)	Foundation Removal (psf)	Foundation Replacement (psf)	Net Stress Change in Layer (psf)	α1 (rad)	α2 (rad)	Influence Value I'	Δσ between shear keys above shear key raft foundation (psf)	Δσ below shear key raft foundation	Final Stress (psf)	$C_{c\varepsilon}$ (-)	$C_{r\varepsilon}$ (-)	Vertical Strain $\varepsilon_{v,i}$ (%)	Change in Layer Thickness Δh_i (in)
0	1	0.5	Organics	-5.5	85	90	45	31	14	1.0	14	0.03	1.54	0.50	3960	-45	60	15	0.00	0.00	0.0	0	0	3989	0.18	0.036	0.0	0.00
1	2	1.5	Organics	-6.5	85	90	135	94	41	1.0	41	0.08	1.48	0.50	3960	-135	180	45	0.00	0.00	0.0	0	0	4046	0.18	0.036	0.0	0.00
2	3	2.5	Organics	-7.5	85	90	225	156	69	1.0	69	0.14	1.42	0.50	3960	-225	300	75	0.00	0.00	0.0	0	0	4104	0.18	0.036	0.0	0.00
3	4	3.5	Organics	-8.5	85	90	315	218	97	1.0	97	0.19	1.36	0.50	3959	-315	420	105	0.00	0.00	0.0	0	0	4161	0.18	0.036	0.0	0.00
4	5	4.5	Organics	-9.5	85	90	405	281	124	1.0	124	0.24	1.30	0.50	3958	-405	540	135	0.00	0.00	0.0	0	0	4217	0.18	0.036	0.0	0.00
5	6	5.5	Organics	-10.5	85	90	495	343	152	1.0	152	0.29	1.24	0.50	3956	-495	660	165	0.00	0.00	0.0	0	0	4273	0.18	0.036	0.0	0.00
6	7	6.5	Organics	-11.5	85	90	585	406	179	1.0	179	0.34	1.18	0.50	3954	-585	780	195	0.00	0.00	0.0	0	0	4328	0.18	0.036	0.0	0.00
7	8	7.5	Organics	-12.5	85	90	675	468	207	1.0	207	0.39	1.13	0.50	3951	-675	900	225	0.00	0.00	0.0	0	0	4383	0.18	0.036	0.0	0.00
8	9	8.5	Organics	-13.5	85	90	765	530	235	1.0	235	0.43	1.08	0.50	3947	-765	1020	255	0.00	0.00	0.0	0	0	4437	0.18	0.036	0.0	0.00
9	10	9.5	Organics	-14.5	85	90	855	593	262	1.0	262	0.47	1.03	0.50	3943	-855	1140	285	0.00	0.00	0.0	0	0	4490	0.18	0.036	0.0	0.00
10	11	10.5	Organics	-15.5	85	90	945	655	290	1.0	290	0.51	0.99	0.50	3937	-945	1260	315	0.00	0.00	0.0	0	0	4542	0.18	0.036	0.0	0.00
11	12	11.5	Organics	-16.5	85	90	1035	718	317	1.0	317	0.55	0.95	0.50	3931	-1035	1380	345	0.00	0.00	0.0	0	0	4594	0.18	0.036	0.0	0.00
12	13	12.5	Organics	-17.5	85	90	1125	780	345	1.0	345	0.58	0.91	0.50	3924	-1125	1500	375	0.00	0.00	0.0	0	0	4644	0.18	0.036	0.0	0.00
13	14	13.5	Organics	-18.5	85	90	1215	842	373	1.0	373	0.61	0.87	0.49	3917	-1215	1620	405	0.00	0.00	0.0	0	0	4695	0.18	0.036	0.0	0.00
14	15	14.5	Organics	-19.5	85	90	1305	905	400	1.0	400	0.64	0.83	0.49	3909	-1305	1740	435	0.00	0.00	0.0	0	0	4744	0.18	0.036	0.0	0.00
15	16	15.5	Loose - Coarse Grained	-20.5	105	110	1415	967	448	1.0	448	0.67	0.80	0.49	3900	-1415	1860	445	0.00	0.00	0.0	0	0	4793	0.005	0.001	0.0	0.00
16	17	16.5	Loose - Coarse Grained	-21.5	105	110	1525	1030	495	1.0	495	0.69	0.77	0.49	3891	-1525	1980	455	0.00	0.00	0.0	0	0	4841	0.005	0.001	0.0	0.00
17	18	17.5	Loose - Coarse Grained	-22.5	105	110	1635	1092	543	1.0	543	0.71	0.74	0.49	3881	-1635	2100	465	0.00	0.00	0.0	0	0	4889	0.005	0.001	0.0	0.00
18	19	18.5	Loose - Coarse Grained	-23.5	105	110	1745	1154	591	1.0	591	0.73	0.71	0.49	3871	-1745	2220	475	0.00	0.00	0.0	0	0	4936	0.005	0.001	0.0	0.00
19	20	19.5	Loose - Coarse Grained	-24.5	105	110	1855	1217	638	1.0	638	0.75	0.69	0.49	3860	-1855	2340	485	0.00	0.00	0.0	0	0	4983	0.005	0.001	0.0	0.00
20	21	20.5	Loose - Coarse Grained	-25.5	105	110	1965	1279	686	1.0	686	0.77	0.66	0.49	3848	-1965	2460	495	0.00	0.00	0.0	0	0	5029	0.005	0.001	0.0	0.00
21	22	21.5	Loose - Coarse Grained	-26.5	105	110	2075	1342	733	1.0	733	0.79	0.64	0.48	3837	-2075	2580	505	0.00	0.00	0.0	0	0	5075	0.005	0.001	0.0	0.00
22	23	22.5	Loose - Coarse Grained	-27.5	105	110	2185	1404	781	1.0	781	0.80	0.62	0.48	3825	-2185	2700	515	0.00	0.00	0.0	0	0	5121	0.005	0.001	0.0	0.00
23	24	23.5	Loose - Coarse Grained	-28.5	105	110	2295	1466	829	1.0	829	0.82	0.60	0.48	3812	-2295	2820	525	0.00	0.00	0.0	0	0	5166	0.005	0.001	0.0	0.00
24	25	24.5	Loose - Coarse Grained	-29.5	105	110	2405	1529	876	1.0	876	0.83	0.58	0.48	3800	-2405	2940	535	0.00	0.00	0.0	0	0	5211	0.005	0.001	0.0	0.00
25	26	25.5	Loose - Coarse Grained	-30.5	105	110	2515	1591	924	1.0	924	0.84	0.56	0.48	3786	-2515	3060	545	0.00	0.00	0.0	0	0	5255	0.005	0.001	0.0	0.00
26	27	26.5	Loose - Coarse Grained	-31.5	105	110	2625	1654	971	1.0	971	0.85	0.54	0.48	3773	-2625	3180	555	0.00	0.00	0.0	0	0	5300	0.005	0.001	0.0	0.00
27	28	27.5	Loose - Coarse Grained	-32.5	105	110	2735	1716	1019	1.0	1019	0.86	0.53	0.47	3760	-2735	3300	565	0.00	0.00	0.0	0	0	5344	0.005	0.001	0.0	0.00
28	29	28.5	Loose - Coarse Grained	-33.5	105	110	2845	1778	1067	1.0	1067	0.87	0.51	0.47	3746	-2845	3420	575	0.00	0.00	0.0	0	0	5388	0.005	0.001	0.0	0.00
29	30	29.5	Loose - Coarse Grained	-34.5	105	110	2955	1841	1114	1.0	1114	0.88	0.50	0.47	3732	-2955	3540	585	0.00	0.00	0.0	0	0	5431	0.005	0.001	0.0	0.00
30	31	30.5	Medium Stiff Fine-Grained	-35.5	115	120	3075	1903	1172	1.0	1172	0.88	0.48	0.47	3718	-2947	3530	583	0.00	0.00	0.0	0	0	5473	0.07	0.014	0.0	0.56
31	32	31.5	Medium Stiff Fine-Grained	-36.5	115	120	3195	1966	1229	1.0	1229	0.89	0.47	0.47	3704	-2930	3510	580	0.00	0.00	0.0	0	0	5513	0.07	0.014	0.0	0.55
32	33	32.5	Medium Stiff Fine-Grained	-37.5	115	120	3315	2028	1287	1.0	1287	0.90	0.46	0.47	3689	-2914	3491	577	0.00	0.00	0.0	0	0	5553	0.07	0.014	0.0	0.53
33	34	33.5	Medium Stiff Fine-Grained	-38.5	115	120	3435	2090	1345	1.0	1345	0.90	0.45	0.46	3675	-2898	3471	574	0.00	0.00	0.0	0	0	5593	0.07	0.014	0.0	0.52
34	35	34.5	Medium Stiff Fine-Grained	-39.5	115	120	3555	2153	1402	1.0	1402	0.91	0.43	0.46	3660	-2882	3452	570	0.00	0.00	0.0	0	0	5633	0.07	0.014	0.0	0.51
35	36	35.5	Medium Stiff Fine-Grained	-40.5	115	120	3675	2215	1460	1.0	1460	0.91	0.42	0.46	3645	-2866	3433	567	0.00	0.00	0.0	0	0	5672	0.07	0.014	0.0	0.50
36	37	36.5	Medium Stiff Fine-Grained	-41.5	115	120	3795	2278	1517	1.0	1517	0.92	0.41	0.46	3630	-2850	3414	564	0.00	0.00	0.0	0	0	5712	0.07	0.014	0.0	0.48
37	38	37.5	Medium Stiff Fine-Grained	-42.5	115	120	3915	2340	1575	1.0	1575	0.92	0.40	0.46	3615	-2834	3395	561	0.00	0.00	0.0	0	0	5751	0.07	0.014	0.0	0.47
38	39	38.5	Medium Stiff Fine-Grained	-43.5	115	120	4035	2402	1633	1.0	1633	0.92	0.39	0.45	3600	-2819	3377	558	0.00	0.00	0.0	0	0	5791	0.07	0.014	0.0	0.46
39	40	39.5	Medium Stiff Fine-Grained	-44.5	115	120	4155	2465	1690	1.0	1690	0.93	0.38	0.45	3585	-2803	3358	555	0.00	0.00	0.0	0	0	5830	0.07	0.014	0.0	0.45
40	41	40.5	Medium Stiff Fine-Grained	-45.5	115	120	4275	2527	1748	1.0	1748	0.93	0.38	0.45	3570	-2788	3340	552	0.00	0.00	0.0	0	0	5870	0.07	0.014	0.0	0.44
41	42	41.5	Medium Stiff Fine-Grained	-46.5	115	120	4395	2590	1805	1.0	1805	0.93	0.37	0.45	3555	-2773	3322	549	0.00	0.00	0.0	0	0	5909	0.07	0.014	0.0	0.43
42	43	42.5	Medium Stiff Fine-Grained	-47.5	115	120	4515	2652	1863	1.0	1863	0.93	0.36	0.45	3540	-2758	3304	546	0.00	0.00	0.0	0	0	5949	0.07	0.014	0.0	0.42
43	44	43.5	Medium Stiff Fine-Grained	-48.5	115	120	4635	2714	1921	1.0	1921	0.93	0.35	0.44	3524	-2743	3286	543	0.00	0.00	0.0	0	0	5988	0.07	0.014	0.0	0.41
44	45	44.5	Medium Stiff Fine-Grained	-49.5	115	120	4755	2777	1978	1.0	1978	0.93	0.35	0.44	3509	-2728	3268	540	0.00	0.00	0.0	0	0	6027	0.07	0.014	0.0	0.41
45	46	45.5	Medium Stiff Fine-Grained	-50.5	115	120	4875	2839	2036	1.0	2036	0.93	0.34	0.44	3494	-2714	3251	537	0.00	0.00	0.0	0	0	6067	0.07	0.014	0.0	0.40
46	47	46.5	Medium Stiff Fine-Grained	-51.5	115	120	4995	2902	2093	1.0	2093	0.93	0.33	0.44	3478	-2699	3233	534	0.00	0.00	0.0	0	0	6106	0.07	0.014	0.0	0.39
47	48	47.5	Medium Stiff Fine-Grained	-52.5	115	120	5115	2964	2151	1.0	2151	0.94	0.32	0.44	3463	-2685	3216	531	0.00	0.00	0.0	0	0	6145	0.07	0.014	0.0	0.38
48	49	48.5	Medium Stiff Fine-Grained	-53.5	115	120	5235	3026	2209	1.0	2209	0.94	0.32	0.44	3448	-2670	3199	529	0.00	0.00	0.0	0	0	6185	0.07	0.014	0.0	0.38

Configuration **4H1V_P2_G2-AR15**

by: E. Ticen
Last Updated: February 2020

Geometry	Embankment Height, H	33	ft
	Embankment Side Slopes	4	xH:1V
	Crown Width	32	ft
	Half Crown Width, B1	16	ft
	Side Slope Width, B2	132	ft
	Unit Weight of Embankment, γ	120	pcf
	Depth to Ground Water	0	ft
	Maximum Stress Increase	3960	psf
	Water Surface Elevation	-5	ft
	Ground Surface Elevation	-5	ft
Foundation Improvements	Remove & Replace Depth [1]	6	ft
	Area Replacement Ratio	0.15	-
	Shear Key Thickness	2.5	ft
	Shear Key Depth	40	ft
	Shear Key Raft Foundation Depth	26.7	ft
	Shear key Spacing	16.7	ft
	Soil Arching b/w Shear Key	0.5	xV:1H
	Arching Stress Height	4	ft
	Arching Side Slope Width, B2	8.3	ft
	σmax Arching	425	psf

Notes:
1) Compacted fill where settlement of the material is considered to be negligible.
2)
3)
4)
5)
6)
7)

Total Settlement at Midpoint Between Shear Keys=	20.8	inches
Total Settlement at Shear Keys=	13.4	inches
Differential Settlement=	7.4	inches

		Depth (GS=0-ft)		Elevation (ft)		Unit Weight		Settlement					Staged Construction		
		Top	Bottom	Top	Bottom	Moist	Saturated	$C_{c\varepsilon} = C_c/(1+e_o)$	$C_{r\varepsilon} = C_{c\varepsilon}/5$	OCR	Total Layer Settlement		Reduction	Total Layer Settlement	
Layer	Description	(ft)	(ft)	(ft)	(ft)	(pcf)	(pcf)	(-)	(-)	(-)	(in)	(ft)	(%)	(in)	(ft)
1	Embankment Fill	-33	0	28	-5	115	120	0.01	0.002	5	0	0.00	100%	0	0.00
2	Organics	0	15	-5	-20	85	90	0.180	0.036	1	7.3	0.61	0%	7	0.61
3b	Loose - Coarse Grained	15	30	-20	-35	105	110	0.005	0.001	1	0.3	0.02	0%	0	0.02
4	Medium Stiff Fine-Grained	30	50	-35	-55	115	120	0.070	0.014	1	8.6	0.72	0%	9	0.72
5	Stiff Fine-Grained	50	100	-55	-105	120	125	0.017	0.0034	1	2.7	0.22	0%	3	0.22
6	Dense Coarse-Grained	100	150	-105	-155	120	125	0.017	0.0034	1	1.3	0.11	0%	1	0.11
7	Stiff Fine-Grained	150	200	-155	-205	120	125	0.017	0.0034	1	0.7	0.06	0%	1	0.06
										Σ=	20.8	1.7	Σ=	20.8	1.7

							Pre Construction					Δσ due to Embankment Load (Das - 5.6)					Δσ due to Foundation R&R (2:1)			Δσ With Arching for Shear Keys (Das - 5.6)								
Top of Layer	Bottom of Layer	Depth (ft)	Layer (-)	Elevation (ft)	Moist Unit Weight (pcf)	Saturated Unit Weight (pcf)	Total Stress (psf)	Pore Pressure (psf)	Effective stress (psf)	OCR (-)	Pre- Consolidation Pressure (psf)	α_1 (rad)	α_2 (rad)	Influence Value I'	Δσ below Embankment middle (psf)	Foundation Removal (psf)	Foundation Replacement (psf)	Net Stress Change in Layer (psf)	α1 (rad)	α2 (rad)	Influence Value I'	Δσ between shear keys above shear key raft foundation (psf)	Δσ below shear key raft foundation	Final Stress (psf)	$C_{c\varepsilon}$ (-)	$C_{r\varepsilon}$ (-)	Vertical Strain $\varepsilon_{v,i}$ (%)	Change in Layer Thickness Δh_i (in)
0	1	0.5	Organics	-5.5	85	90	45	31	14	1.0	14	0.03	1.54	0.50	3960	-45	60	15	1.51	0.00	0.5	409	0	438	0.18	0.036	0.0	0.00
1	2	1.5	Organics	-6.5	85	90	135	94	41	1.0	41	0.08	1.48	0.50	3960	-135	180	45	1.39	0.00	0.4	377	0	463	0.18	0.036	0.0	0.00
2	3	2.5	Organics	-7.5	85	90	225	156	69	1.0	69	0.14	1.42	0.50	3960	-225	300	75	1.28	0.00	0.4	346	0	490	0.18	0.036	0.0	0.00
3	4	3.5	Organics	-8.5	85	90	315	218	97	1.0	97	0.19	1.36	0.50	3959	-315	420	105	1.17	0.00	0.4	317	0	519	0.18	0.036	0.0	0.00
4	5	4.5	Organics	-9.5	85	90	405	281	124	1.0	124	0.24	1.30	0.50	3958	-405	540	135	1.08	0.00	0.3	291	0	550	0.18	0.036	0.0	0.00
5	6	5.5	Organics	-10.5	85	90	495	343	152	1.0	152	0.29	1.24	0.50	3956	-495	660	165	0.99	0.00	0.3	267	0	584	0.18	0.036	0.0	0.00
6	7	6.5	Organics	-11.5	85	90	585	406	179	1.0	179	0.34	1.18	0.50	3954	-493	658	164	0.91	0.00	0.3	246	0	590	0.18	0.036	0.1	1.12
7	8	7.5	Organics	-12.5	85	90	675	468	207	1.0	207	0.39	1.13	0.50	3951	-490	654	163	0.84	0.00	0.3	227	0	597	0.18	0.036	0.1	0.99
8	9	8.5	Organics	-13.5	85	90	765	530	235	1.0	235	0.43	1.08	0.50	3947	-487	649	162	0.78	0.00	0.2	213	0	609	0.18	0.036	0.1	0.90
9	10	9.5	Organics	-14.5	85	90	855	593	262	1.0	262	0.47	1.03	0.50	3943	-484	645	161	0.72	0.00	0.2	213	0	636	0.18	0.036	0.1	0.83
10	11	10.5	Organics	-15.5	85	90	945	655	290	1.0	290	0.51	0.99	0.50	3937	-481	641	160	0.67	0.00	0.2	213	0	663	0.18	0.036	0.1	0.78
11	12	11.5	Organics	-16.5	85	90	1035	718	317	1.0	317	0.55	0.95	0.50	3931	-478	637	159	0.63	0.00	0.2	213	0	689	0.18	0.036	0.1	0.73
12	13	12.5	Organics	-17.5	85	90	1125	780	345	1.0	345	0.58	0.91	0.50	3924	-475	633	158	0.59	0.00	0.2	213	0	716	0.18	0.036	0.1	0.68
13	14	13.5	Organics	-18.5	85	90	1215	842	373	1.0	373	0.61	0.87	0.49	3917	-472	629	157	0.55	0.00	0.2	213	0	742	0.18	0.036	0.1	0.65
14	15	14.5	Organics	-19.5	85	90	1305	905	400	1.0	400	0.64	0.83	0.49	3909	-469	625	156	0.52	0.00	0.2	213	0	769	0.18	0.036	0.1	0.61
15	16	15.5	Loose - Coarse Grained	-20.5	105	110	1415	967	448	1.0	448	0.67	0.80	0.49	3900	-466	621	155	0.49	0.00	0.2	213	0	816	0.005	0.001	0.0	0.02
16	17	16.5	Loose - Coarse Grained	-21.5	105	110	1525	1030	495	1.0	495	0.69	0.77	0.49	3891	-463	617	154	0.47	0.00	0.1	213	0	862	0.005	0.001	0.0	0.01
17	18	17.5	Loose - Coarse Grained	-22.5	105	110	1635	1092	543	1.0	543	0.71	0.74	0.49	3881	-460	613	153	0.44	0.00	0.1	213	0	909	0.005	0.001	0.0	0.01
18	19	18.5	Loose - Coarse Grained	-23.5	105	110	1745	1154	591	1.0	591	0.73	0.71	0.49	3871	-457	610	152	0.42	0.00	0.1	213	0	955	0.005	0.001	0.0	0.01
19	20	19.5	Loose - Coarse Grained	-24.5	105	110	1855	1217	638	1.0	638	0.75	0.69	0.49	3860	-454	606	151	0.40	0.00	0.1	213	0	1002	0.005	0.001	0.0	0.01
20	21	20.5	Loose - Coarse Grained	-25.5	105	110	1965	1279	686	1.0	686	0.77	0.66	0.49	3848	-451	602	150	0.39	0.00	0.1	213	0	1049	0.005	0.001	0.0	0.01
21	22	21.5	Loose - Coarse Grained	-26.5	105	110	2075	1342	733	1.0	733	0.79	0.64	0.48	3837	-449	598	150	0.37	0.00	0.1	213	0	1095	0.005	0.001	0.0	0.01
22	23	22.5	Loose - Coarse Grained	-27.5	105	110	2185	1404	781	1.0	781	0.80	0.62	0.48	3825	-446	595	149	0.35	0.00	0.1	213	0	1142	0.005	0.001	0.0	0.01
23	24	23.5	Loose - Coarse Grained	-28.5	105	110	2295	1466	829	1.0	829	0.82	0.60	0.48	3812	-443	591	148	0.34	0.00	0.1	213	0	1189	0.005	0.001	0.0	0.01
24	25	24.5	Loose - Coarse Grained	-29.5	105	110	2405	1529	876	1.0	876	0.83	0.58	0.48	3800	-440	587	147	0.33	0.00	0.1	213	0	1236	0.005	0.001	0.0	0.01
25	26	25.5	Loose - Coarse Grained	-30.5	105	110	2515	1591	924	1.0	924	0.84	0.56	0.48	3786	-438	584	146	0.32	0.00	0.1	213	0	1282	0.005	0.001	0.0	0.01
26	27	26.5	Loose - Coarse Grained	-31.5	105	110	2625	1654	971	1.0	971	0.85	0.54	0.48	3773	-435	580	145	0.30	0.00	0.1	213	0	1329	0.005	0.001	0.0	0.01
27	28	27.5	Loose - Coarse Grained	-32.5	105	110	2735	1716	1019	1.0	1019	0.86	0.53	0.47	3760	-433	577	144	0.29	0.00	0.1	0	3938	5101	0.005	0.001	0.0	0.04
28	29	28.5	Loose - Coarse Grained	-33.5	105	110	2845	1778	1067	1.0	1067	0.87	0.51	0.47	3746	-430	573	143	0.28	0.00	0.1	0	3911	5121	0.005	0.001	0.0	0.04
29	30	29.5	Loose - Coarse Grained	-34.5	105	110	2955	1841	1114	1.0	1114	0.88	0.50	0.47	3732	-427	570	142	0.28	0.00	0.1	0	3885	5142	0.005	0.001	0.0	0.04
30	31	30.5	Medium Stiff Fine-Grained	-35.5	115	120	3075	1903	1172	1.0	1172	0.88	0.48	0.47	3718	-425	566	142	0.27	0.00	0.1	0	3859	5173	0.07	0.014	0.0	0.54
31	32	31.5	Medium Stiff Fine-Grained	-36.5	115	120	3195	1966	1229	1.0	1229	0.89	0.47	0.47	3704	-422	563	141	0.26	0.00	0.1	0	3834	5204	0.07	0.014	0.0	0.53
32	33	32.5	Medium Stiff Fine-Grained	-37.5	115	120	3315	2028	1287	1.0	1287	0.90	0.46	0.47	3689	-420	560	140	0.25	0.00	0.1	0	3808	5235	0.07	0.014	0.0	0.51
33	34	33.5	Medium Stiff Fine-Grained	-38.5	115	120	3435	2090	1345	1.0	1345	0.90	0.45	0.46	3675	-417	556	139	0.24	0.00	0.1	0	3783	5267	0.07	0.014	0.0	0.50
34	35	34.5	Medium Stiff Fine-Grained	-39.5	115	120	3555	2153	1402	1.0	1402	0.91	0.43	0.46	3660	-415	553	138	0.24	0.00	0.1	0	3758	5299	0.07	0.014	0.0	0.48
35	36	35.5	Medium Stiff Fine-Grained	-40.5	115	120	3675	2215	1460	1.0	1460	0.91	0.42	0.46	3645	-412	550	137	0.23	0.00	0.1	0	3734	5331	0.07	0.014	0.0	0.47
36	37	36.5	Medium Stiff Fine-Grained	-41.5	115	120	3795	2278	1517	1.0	1517	0.92	0.41	0.46	3630	-410	546	137	0.22	0.00	0.1	0	3709	5363	0.07	0.014	0.0	0.46
37	38	37.5	Medium Stiff Fine-Grained	-42.5	115	120	3915	2340	1575	1.0	1575	0.92	0.40	0.46	3615	-407	543	136	0.22	0.00	0.1	0	3685	5396	0.07	0.014	0.0	0.45
38	39	38.5	Medium Stiff Fine-Grained	-43.5	115	120	4035	2402	1633	1.0	1633	0.92	0.39	0.45	3600	-405	540	135	0.21	0.00	0.1	0	3661	5429	0.07	0.014	0.0	0.44
39	40	39.5	Medium Stiff Fine-Grained	-44.5	115	120	4155	2465	1690	1.0	1690	0.93	0.38	0.45	3585	-403	537	134	0.21	0.00	0.1	0	3638	5462	0.07	0.014	0.0	0.43
40	41	40.5	Medium Stiff Fine-Grained	-45.5	115	120	4275	2527	1748	1.0	1748	0.93	0.38	0.45	3570	-400	534	133	0.20	0.00	0.1	0	3614	5496	0.07	0.014	0.0	0.42
41	42	41.5	Medium Stiff Fine-Grained	-46.5	115	120	4395	2590	1805	1.0	1805	0.93	0.37	0.45	3555	-398	531	133	0.20	0.00	0.1	0	3591	5529	0.07	0.014	0.0	0.41
42	43	42.5	Medium Stiff Fine-Grained	-47.5	115	120	4515	2652	1863	1.0	1863	0.93	0.36	0.45	3540	-396	528	132	0.19	0.00	0.1	0	3568	5563	0.07	0.014	0.0	0.40
43	44	43.5	Medium Stiff Fine-Grained	-48.5	115	120	4635	2714	1921	1.0	1921	0.93	0.35	0.44	3524	-393	525	131	0.19	0.00	0.1	0	3545	5597	0.07	0.014	0.0	0.39
44	45	44.5	Medium Stiff Fine-Grained	-49.5	115	120	4755	2777	1978	1.0	1978	0.93	0.35	0.44	3509	-391	521	130	0.19	0.00	0.1	0	3523	5631	0.07	0.014	0.0	0.38
45	46	45.5	Medium Stiff Fine-Grained	-50.5	115	120	4875	2839	2036	1.0	2036	0.93	0.34	0.44	3494	-389	518	130	0.18	0.00	0.1	0	3500	5666	0.07	0.014	0.0	0.37
46	47	46.5	Medium Stiff Fine-Grained	-51.5	115	120	4995	2902	2093	1.0	2093	0.93	0.33	0.44	3478	-387	516	129	0.18	0.00	0.1	0	3478	5701	0.07	0.014	0.0	0.37
47	48	47.5	Medium Stiff Fine-Grained	-52.5	115	120	5115	2964	2151	1.0	2151	0.94	0.32	0.44	3463	-384	513	128	0.17	0.00	0.1	0	3456	5735	0.07	0.014	0.0	0.36
48	49	48.5	Medium Stiff Fine-Grained	-53.5	115	120	5235	3026	2209	1.0	2209	0.94	0.32	0.44	3448	-382	510	127	0.17	0.00	0.1	0	3435	5771	0.07	0.014	0.0	0.35

Configuration **4H1V_P2_G2-AR25**

by: E. Ticen
Last Updated: February 2020

Geometry	Embankment Height, H	33	ft
	Embankment Side Slopes	4	xH:1V
	Crown Width	32	ft
	Half Crown Width, B1	16	ft
	Side Slope Width, B2	132	ft
	Unit Weight of Embankment, γ	120	pcf
	Depth to Ground Water	0	ft
	Maximum Stress Increase	3960	psf
	Water Surface Elevation	-5	ft
	Ground Surface Elevation	-5	ft
Foundation Improvements	Remove & Replace Depth [1]	6	ft
	Area Replacement Ratio	0.25	-
	Shear Key Thickness	2.5	ft
	Shear Key Depth	40	ft
	Shear Key Raft Foundation Depth	26.7	ft
	Shear key Spacing	10.0	ft
	Soil Arching b/w Shear Key	0.5	xV:1H
	Arching Stress Height	2	ft
	Arching Side Slope Width, B2	5.0	ft
	σmax Arching	225	psf

Notes:
1) Compacted fill where settlement of the material is considered to be negligible.
2)
3)
4)
5)
6)
7)

Total Settlement at Midpoint Between Shear Keys=	19.3	inches
Total Settlement at Shear Keys=	13.4	inches
Differential Settlement=	5.9	inches

		Depth (GS=0-ft)		Elevation (ft)		Unit Weight		Settlement					Staged Construction		
		Top	Bottom	Top	Bottom	Moist	Saturated	$C_{c\varepsilon} = C_c/(1+e_o)$	$C_{r\varepsilon} = C_{cd}/5$	OCR	Total Layer Settlement		Reduction	Total Layer Settlement	
Layer	Description	(ft)	(ft)	(ft)	(ft)	(pcf)	(pcf)	(-)	(-)	(-)	(in)	(ft)	(%)	(in)	(ft)
1	Embankment Fill	-33	0	28	-5	115	120	0.01	0.002	5	0	0.00	100%	0	0.00
2	Organics	0	15	-5	-20	85	90	0.180	0.036	1	5.8	0.48	0%	6	0.48
3b	Loose - Coarse Grained	15	30	-20	-35	105	110	0.005	0.001	1	0.2	0.02	0%	0	0.02
4	Medium Stiff Fine-Grained	30	50	-35	-55	115	120	0.070	0.014	1	8.6	0.72	0%	9	0.72
5	Stiff Fine-Grained	50	100	-55	-105	120	125	0.017	0.0034	1	2.7	0.22	0%	3	0.22
6	Dense Coarse-Grained	100	150	-105	-155	120	125	0.017	0.0034	1	1.3	0.11	0%	1	0.11
7	Stiff Fine-Grained	150	200	-155	-205	120	125	0.017	0.0034	1	0.7	0.06	0%	1	0.06
										Σ=	19.3	1.6	Σ=	19.3	1.6

							Pre Construction							Δσ due to Embankment Load (Das - 5.6)				Δσ due to Foundation R&R (2:1)			Δσ With Arching for Shear Keys (Das - 5.6)								
Top of Layer	Bottom of Layer	Depth (ft)	Layer (-)	Elevation (ft)	Moist Unit Weight (pcf)	Saturated Unit Weight (pcf)	Total Stress (psf)	Pore Pressure (psf)	Effective stress (psf)	OCR (-)	Pre- Consolidation Pressure (psf)	α_1 (rad)	α_2 (rad)	Influence Value I'	Δσ below Embankment middle (psf)	Foundation Removal (psf)	Foundation Replacement (psf)	Net Stress Change in Layer (psf)	α1 (rad)	α2 (rad)	Influence Value I'	Δσ between shear keys above shear key raft foundation (psf)	Δσ below shear key raft foundation	Final Stress (psf)	$C_{c\varepsilon}$ (-)	$C_{r\varepsilon}$ (-)	Vertical Strain $\varepsilon_{v,i}$ (%)	Change in Layer Thickness Δh_i (in)
0	1	0.5	Organics	-5.5	85	90	45	31	14	1.0	14	0.03	1.54	0.50	3960	-45	60	15	1.47	0.00	0.5	211	0	240	0.18	0.036	0.0	0.00
1	2	1.5	Organics	-6.5	85	90	135	94	41	1.0	41	0.08	1.48	0.50	3960	-135	180	45	1.28	0.00	0.4	183	0	270	0.18	0.036	0.0	0.00
2	3	2.5	Organics	-7.5	85	90	225	156	69	1.0	69	0.14	1.42	0.50	3960	-225	300	75	1.11	0.00	0.4	159	0	303	0.18	0.036	0.0	0.00
3	4	3.5	Organics	-8.5	85	90	315	218	97	1.0	97	0.19	1.36	0.50	3959	-315	420	105	0.96	0.00	0.3	138	0	339	0.18	0.036	0.0	0.00
4	5	4.5	Organics	-9.5	85	90	405	281	124	1.0	124	0.24	1.30	0.50	3958	-405	540	135	0.84	0.00	0.3	120	0	379	0.18	0.036	0.0	0.00
5	6	5.5	Organics	-10.5	85	90	495	343	152	1.0	152	0.29	1.24	0.50	3956	-495	660	165	0.74	0.00	0.2	113	0	429	0.18	0.036	0.0	0.00
6	7	6.5	Organics	-11.5	85	90	585	406	179	1.0	179	0.34	1.18	0.50	3954	-493	658	164	0.66	0.00	0.2	113	0	456	0.18	0.036	0.1	0.88
7	8	7.5	Organics	-12.5	85	90	675	468	207	1.0	207	0.39	1.13	0.50	3951	-490	654	163	0.59	0.00	0.2	113	0	483	0.18	0.036	0.1	0.79
8	9	8.5	Organics	-13.5	85	90	765	530	235	1.0	235	0.43	1.08	0.50	3947	-487	649	162	0.53	0.00	0.2	113	0	509	0.18	0.036	0.1	0.73
9	10	9.5	Organics	-14.5	85	90	855	593	262	1.0	262	0.47	1.03	0.50	3943	-484	645	161	0.48	0.00	0.2	113	0	536	0.18	0.036	0.1	0.67
10	11	10.5	Organics	-15.5	85	90	945	655	290	1.0	290	0.51	0.99	0.50	3937	-481	641	160	0.44	0.00	0.1	113	0	563	0.18	0.036	0.1	0.62
11	12	11.5	Organics	-16.5	85	90	1035	718	317	1.0	317	0.55	0.95	0.50	3931	-478	637	159	0.41	0.00	0.1	113	0	589	0.18	0.036	0.0	0.58
12	13	12.5	Organics	-17.5	85	90	1125	780	345	1.0	345	0.58	0.91	0.50	3924	-475	633	158	0.38	0.00	0.1	113	0	616	0.18	0.036	0.0	0.54
13	14	13.5	Organics	-18.5	85	90	1215	842	373	1.0	373	0.61	0.87	0.49	3917	-472	629	157	0.35	0.00	0.1	113	0	642	0.18	0.036	0.0	0.51
14	15	14.5	Organics	-19.5	85	90	1305	905	400	1.0	400	0.64	0.83	0.49	3909	-469	625	156	0.33	0.00	0.1	113	0	669	0.18	0.036	0.0	0.48
15	16	15.5	Loose - Coarse Grained	-20.5	105	110	1415	967	448	1.0	448	0.67	0.80	0.49	3900	-466	621	155	0.31	0.00	0.1	113	0	716	0.005	0.001	0.0	0.01
16	17	16.5	Loose - Coarse Grained	-21.5	105	110	1525	1030	495	1.0	495	0.69	0.77	0.49	3891	-463	617	154	0.29	0.00	0.1	113	0	762	0.005	0.001	0.0	0.01
17	18	17.5	Loose - Coarse Grained	-22.5	105	110	1635	1092	543	1.0	543	0.71	0.74	0.49	3881	-460	613	153	0.28	0.00	0.1	113	0	809	0.005	0.001	0.0	0.01
18	19	18.5	Loose - Coarse Grained	-23.5	105	110	1745	1154	591	1.0	591	0.73	0.71	0.49	3871	-457	610	152	0.26	0.00	0.1	113	0	855	0.005	0.001	0.0	0.01
19	20	19.5	Loose - Coarse Grained	-24.5	105	110	1855	1217	638	1.0	638	0.75	0.69	0.49	3860	-454	606	151	0.25	0.00	0.1	113	0	902	0.005	0.001	0.0	0.01
20	21	20.5	Loose - Coarse Grained	-25.5	105	110	1965	1279	686	1.0	686	0.77	0.66	0.49	3848	-451	602	150	0.24	0.00	0.1	113	0	949	0.005	0.001	0.0	0.01
21	22	21.5	Loose - Coarse Grained	-26.5	105	110	2075	1342	733	1.0	733	0.79	0.64	0.48	3837	-449	598	150	0.23	0.00	0.1	113	0	995	0.005	0.001	0.0	0.01
22	23	22.5	Loose - Coarse Grained	-27.5	105	110	2185	1404	781	1.0	781	0.80	0.62	0.48	3825	-446	595	149	0.22	0.00	0.1	113	0	1042	0.005	0.001	0.0	0.01
23	24	23.5	Loose - Coarse Grained	-28.5	105	110	2295	1466	829	1.0	829	0.82	0.60	0.48	3812	-443	591	148	0.21	0.00	0.1	113	0	1089	0.005	0.001	0.0	0.01
24	25	24.5	Loose - Coarse Grained	-29.5	105	110	2405	1529	876	1.0	876	0.83	0.58	0.48	3800	-440	587	147	0.20	0.00	0.1	113	0	1136	0.005	0.001	0.0	0.01
25	26	25.5	Loose - Coarse Grained	-30.5	105	110	2515	1591	924	1.0	924	0.84	0.56	0.48	3786	-438	584	146	0.19	0.00	0.1	113	0	1182	0.005	0.001	0.0	0.01
26	27	26.5	Loose - Coarse Grained	-31.5	105	110	2625	1654	971	1.0	971	0.85	0.54	0.48	3773	-435	580	145	0.19	0.00	0.1	113	0	1229	0.005	0.001	0.0	0.01
27	28	27.5	Loose - Coarse Grained	-32.5	105	110	2735	1716	1019	1.0	1019	0.86	0.53	0.47	3760	-433	577	144	0.18	0.00	0.1	0	3938	5101	0.005	0.001	0.0	0.04
28	29	28.5	Loose - Coarse Grained	-33.5	105	110	2845	1778	1067	1.0	1067	0.87	0.51	0.47	3746	-430	573	143	0.17	0.00	0.1	0	3911	5121	0.005	0.001	0.0	0.04
29	30	29.5	Loose - Coarse Grained	-34.5	105	110	2955	1841	1114	1.0	1114	0.88	0.50	0.47	3732	-427	570	142	0.17	0.00	0.1	0	3885	5142	0.005	0.001	0.0	0.04
30	31	30.5	Medium Stiff Fine-Grained	-35.5	115	120	3075	1903	1172	1.0	1172	0.88	0.48	0.47	3718	-425	566	142	0.16	0.00	0.1	0	3859	5173	0.07	0.014	0.0	0.54
31	32	31.5	Medium Stiff Fine-Grained	-36.5	115	120	3195	1966	1229	1.0	1229	0.89	0.47	0.47	3704	-422	563	141	0.16	0.00	0.1	0	3834	5204	0.07	0.014	0.0	0.53
32	33	32.5	Medium Stiff Fine-Grained	-37.5	115	120	3315	2028	1287	1.0	1287	0.90	0.46	0.47	3689	-420	560	140	0.15	0.00	0.0	0	3808	5235	0.07	0.014	0.0	0.51
33	34	33.5	Medium Stiff Fine-Grained	-38.5	115	120	3435	2090	1345	1.0	1345	0.90	0.45	0.46	3675	-417	556	139	0.15	0.00	0.0	0	3783	5267	0.07	0.014	0.0	0.50
34	35	34.5	Medium Stiff Fine-Grained	-39.5	115	120	3555	2153	1402	1.0	1402	0.91	0.43	0.46	3660	-415	553	138	0.14	0.00	0.0	0	3758	5299	0.07	0.014	0.0	0.48
35	36	35.5	Medium Stiff Fine-Grained	-40.5	115	120	3675	2215	1460	1.0	1460	0.91	0.42	0.46	3645	-412	550	137	0.14	0.00	0.0	0	3734	5331	0.07	0.014	0.0	0.47
36	37	36.5	Medium Stiff Fine-Grained	-41.5	115	120	3795	2278	1517	1.0	1517	0.92	0.41	0.46	3630	-410	546	137	0.14	0.00	0.0	0	3709	5363	0.07	0.014	0.0	0.46
37	38	37.5	Medium Stiff Fine-Grained	-42.5	115	120	3915	2340	1575	1.0	1575	0.92	0.40	0.46	3615	-407	543	136	0.13	0.00	0.0	0	3685	5396	0.07	0.014	0.0	0.45
38	39	38.5	Medium Stiff Fine-Grained	-43.5	115	120	4035	2402	1633	1.0	1633	0.92	0.39	0.45	3600	-405	540	135	0.13	0.00	0.0	0	3661	5429	0.07	0.014	0.0	0.44
39	40	39.5	Medium Stiff Fine-Grained	-44.5	115	120	4155	2465	1690	1.0	1690	0.93	0.38	0.45	3585	-403	537	134	0.13	0.00	0.0	0	3638	5462	0.07	0.014	0.0	0.43
40	41	40.5	Medium Stiff Fine-Grained	-45.5	115	120	4275	2527	1748	1.0	1748	0.93	0.38	0.45	3570	-400	534	133	0.12	0.00	0.0	0	3614	5496	0.07	0.014	0.0	0.42
41	42	41.5	Medium Stiff Fine-Grained	-46.5	115	120	4395	2590	1805	1.0	1805	0.93	0.37	0.45	3555	-398	531	133	0.12	0.00	0.0	0	3591	5529	0.07	0.014	0.0	0.41
42	43	42.5	Medium Stiff Fine-Grained	-47.5	115	120	4515	2652	1863	1.0	1863	0.93	0.36	0.45	3540	-396	528	132	0.12	0.00	0.0	0	3568	5563	0.07	0.014	0.0	0.40
43	44	43.5	Medium Stiff Fine-Grained	-48.5	115	120	4635	2714	1921	1.0	1921	0.93	0.35	0.44	3524	-393	525	131	0.11	0.00	0.0	0	3545	5597	0.07	0.014	0.0	0.39
44	45	44.5	Medium Stiff Fine-Grained	-49.5	115	120	4755	2777	1978	1.0	1978	0.93	0.35	0.44	3509	-391	521	130	0.11	0.00	0.0	0	3523	5631	0.07	0.014	0.0	0.38
45	46	45.5	Medium Stiff Fine-Grained	-50.5	115	120	4875	2839	2036	1.0	2036	0.93	0.34	0.44	3494	-389	518	130	0.11	0.00	0.0	0	3500	5666	0.07	0.014	0.0	0.37
46	47	46.5	Medium Stiff Fine-Grained	-51.5	115	120	4995	2902	2093	1.0	2093	0.93	0.33	0.44	3478	-387	516	129	0.11	0.00	0.0	0	3478	5701	0.07	0.014	0.0	0.37
47	48	47.5	Medium Stiff Fine-Grained	-52.5	115	120	5115	2964	2151	1.0	2151	0.94	0.32	0.44	3463	-384	513	128	0.10	0.00	0.0	0	3456	5735	0.07	0.014	0.0	0.36
48	49	48.5	Medium Stiff Fine-Grained	-53.5	115	120	5235	3026	2209	1.0	2209	0.94	0.32	0.44	3448	-382	510	127	0.10	0.00	0.0	0	3435	5771	0.07	0.014	0.0	0.35

Configuration **6H1V_P1_E**

by: E. Ticen
Last Updated: February 2020

Geometry	Embankment Height, H	33	ft
	Embankment Side Slopes	6	xH:1V
	Crown Width	32	ft
	Half Crown Width, B1	16	ft
	Side Slope Width, B2	198	ft
	Unit Weight of Embankment, γ	120	pcf
	Depth to Ground Water	0	ft
	Maximum Stress Increase	3960	psf
	Water Surface Elevation	-5	ft
	Ground Surface Elevation	-5	ft
Foundation Improvements	Remove & Replace Depth [1]	6	ft
	Area Replacement Ratio	0	-
	Shear Key Thickness	0	ft
	Shear Key Depth	0	ft
	Shear Key Raft Foundation Depth	0.0	ft
	Shear key Spacing	--	ft
	Soil Arching b/w Shear Key	0	xV:1H
	Arching Stress Height	--	ft
	Arching Side Slope Width, B2	--	ft
	σmax Arching	0	psf

Notes:
1) Compacted fill where settlement of the material is considered to be negligible.
2)
3)
4)
5)
6)
7)

Total Settlement at Midpoint Between Shear Keys=	--	inches
Total Settlement at Shear Keys=	--	inches
Differential Settlement=	--	inches

		Depth (GS=0-ft)		Elevation (ft)		Unit Weight		Settlement					Staged Construction		
		Top	Bottom	Top	Bottom	Moist	Saturated	$C_{c\varepsilon} = C_c/(1+e_o)$	$C_{r\varepsilon} = C_{c\varepsilon}/5$	OCR	Total Layer Settlement		Reduction	Total Layer Settlement	
Layer	Description	(ft)	(ft)	(ft)	(ft)	(pcf)	(pcf)	(-)	(-)	(-)	(in)	(ft)	(%)	(in)	(ft)
1	Embankment Fill	-33	0	28	-5	115	120	0.01	0.002	5	0	0.00	100%	0	0.00
2	Organics	0	15	-5	-20	85	90	0.180	0.036	1	23.2	1.94	0%	23	1.94
3a	Soft to Medium Stiff Fine-Grained	15	30	-20	-35	105	110	0.120	0.024	1	17.4	1.45	0%	17	1.45
4	Medium Stiff Fine-Grained	30	50	-35	-55	115	120	0.070	0.014	1	8.7	0.72	0%	9	0.72
5	Stiff Fine-Grained	50	100	-55	-105	120	125	0.017	0.0034	1	2.9	0.24	0%	3	0.24
6	Dense Coarse-Grained	100	150	-105	-155	120	125	0.017	0.0034	1	1.6	0.13	0%	2	0.13
7	Stiff Fine-Grained	150	200	-155	-205	120	125	0.017	0.0034	1	0.9	0.07	0%	1	0.07
										Σ=	54.7	4.6	Σ=	54.7	4.6

							Pre Construction					Δσ due to Embankment Load (Das - 5.6)				Δσ due to Foundation R&R (2:1)			Δσ With Arching for Shear Keys (Das - 5.6)									
Top of Layer	Bottom of Layer	Depth (ft)	Layer (-)	Elevation (ft)	Moist Unit Weight (pcf)	Saturated Unit Weight (pcf)	Total Stress (psf)	Pore Pressure (psf)	Effective stress (psf)	OCR (-)	Pre- Consolidation Pressure (psf)	α_1 (rad)	α_2 (rad)	Influence Value I'	Δσ below Embankment middle (psf)	Foundation Removal (psf)	Foundation Replacement (psf)	Net Stress Change in Layer (psf)	α1 (rad)	α2 (rad)	Influence Value I'	Δσ between shear keys above shear key raft foundation (psf)	Δσ below shear key raft foundation	Final Stress (psf)	$C_{c\varepsilon}$ (-)	$C_{r\varepsilon}$ (-)	Vertical Strain $\varepsilon_{v,i}$ (%)	Change in Layer Thickness Δh_i (in)
0	1	0.5	Organics	-5.5	85	90	45	31	14	1.0	14	0.03	1.54	0.50	3960	-45	60	15	0.00	0.00	0.0	0	0	3989	0.18	0.036	0.0	0.00
1	2	1.5	Organics	-6.5	85	90	135	94	41	1.0	41	0.09	1.48	0.50	3960	-135	180	45	0.00	0.00	0.0	0	0	4046	0.18	0.036	0.0	0.00
2	3	2.5	Organics	-7.5	85	90	225	156	69	1.0	69	0.14	1.42	0.50	3960	-225	300	75	0.00	0.00	0.0	0	0	4104	0.18	0.036	0.0	0.00
3	4	3.5	Organics	-8.5	85	90	315	218	97	1.0	97	0.20	1.36	0.50	3959	-315	420	105	0.00	0.00	0.0	0	0	4161	0.18	0.036	0.0	0.00
4	5	4.5	Organics	-9.5	85	90	405	281	124	1.0	124	0.25	1.30	0.50	3959	-405	540	135	0.00	0.00	0.0	0	0	4218	0.18	0.036	0.0	0.00
5	6	5.5	Organics	-10.5	85	90	495	343	152	1.0	152	0.31	1.24	0.50	3957	-495	660	165	0.00	0.00	0.0	0	0	4274	0.18	0.036	0.0	0.00
6	7	6.5	Organics	-11.5	85	90	585	406	179	1.0	179	0.36	1.18	0.50	3956	-494	659	165	0.00	0.00	0.0	0	0	4300	0.18	0.036	0.2	2.98
7	8	7.5	Organics	-12.5	85	90	675	468	207	1.0	207	0.40	1.13	0.50	3954	-492	656	164	0.00	0.00	0.0	0	0	4325	0.18	0.036	0.2	2.85
8	9	8.5	Organics	-13.5	85	90	765	530	235	1.0	235	0.45	1.08	0.50	3951	-489	653	163	0.00	0.00	0.0	0	0	4349	0.18	0.036	0.2	2.74
9	10	9.5	Organics	-14.5	85	90	855	593	262	1.0	262	0.49	1.03	0.50	3948	-487	650	162	0.00	0.00	0.0	0	0	4373	0.18	0.036	0.2	2.64
10	11	10.5	Organics	-15.5	85	90	945	655	290	1.0	290	0.53	0.99	0.50	3945	-485	647	162	0.00	0.00	0.0	0	0	4396	0.18	0.036	0.2	2.55
11	12	11.5	Organics	-16.5	85	90	1035	718	317	1.0	317	0.57	0.95	0.50	3941	-483	644	161	0.00	0.00	0.0	0	0	4419	0.18	0.036	0.2	2.47
12	13	12.5	Organics	-17.5	85	90	1125	780	345	1.0	345	0.60	0.91	0.50	3936	-481	641	160	0.00	0.00	0.0	0	0	4441	0.18	0.036	0.2	2.40
13	14	13.5	Organics	-18.5	85	90	1215	842	373	1.0	373	0.64	0.87	0.50	3931	-479	638	160	0.00	0.00	0.0	0	0	4463	0.18	0.036	0.2	2.33
14	15	14.5	Organics	-19.5	85	90	1305	905	400	1.0	400	0.67	0.83	0.50	3926	-476	635	159	0.00	0.00	0.0	0	0	4485	0.18	0.036	0.2	2.27
15	16	15.5	Soft to Medium Stiff Fine-Grained	-20.5	105	110	1415	967	448	1.0	448	0.70	0.80	0.49	3920	-474	632	158	0.00	0.00	0.0	0	0	4526	0.12	0.024	0.1	1.45
16	17	16.5	Soft to Medium Stiff Fine-Grained	-21.5	105	110	1525	1030	495	1.0	495	0.72	0.77	0.49	3913	-472	630	157	0.00	0.00	0.0	0	0	4566	0.12	0.024	0.1	1.39
17	18	17.5	Soft to Medium Stiff Fine-Grained	-22.5	105	110	1635	1092	543	1.0	543	0.75	0.74	0.49	3907	-470	627	157	0.00	0.00	0.0	0	0	4606	0.12	0.024	0.1	1.34
18	19	18.5	Soft to Medium Stiff Fine-Grained	-23.5	105	110	1745	1154	591	1.0	591	0.77	0.71	0.49	3900	-468	624	156	0.00	0.00	0.0	0	0	4646	0.12	0.024	0.1	1.29
19	20	19.5	Soft to Medium Stiff Fine-Grained	-24.5	105	110	1855	1217	638	1.0	638	0.79	0.69	0.49	3892	-466	621	155	0.00	0.00	0.0	0	0	4686	0.12	0.024	0.1	1.25
20	21	20.5	Soft to Medium Stiff Fine-Grained	-25.5	105	110	1965	1279	686	1.0	686	0.81	0.66	0.49	3885	-464	619	155	0.00	0.00	0.0	0	0	4725	0.12	0.024	0.1	1.21
21	22	21.5	Soft to Medium Stiff Fine-Grained	-26.5	105	110	2075	1342	733	1.0	733	0.83	0.64	0.49	3877	-462	616	154	0.00	0.00	0.0	0	0	4764	0.12	0.024	0.1	1.17
22	23	22.5	Soft to Medium Stiff Fine-Grained	-27.5	105	110	2185	1404	781	1.0	781	0.85	0.62	0.49	3869	-460	613	153	0.00	0.00	0.0	0	0	4803	0.12	0.024	0.1	1.14
23	24	23.5	Soft to Medium Stiff Fine-Grained	-28.5	105	110	2295	1466	829	1.0	829	0.86	0.60	0.49	3860	-458	610	153	0.00	0.00	0.0	0	0	4841	0.12	0.024	0.1	1.10
24	25	24.5	Soft to Medium Stiff Fine-Grained	-29.5	105	110	2405	1529	876	1.0	876	0.88	0.58	0.49	3852	-456	608	152	0.00	0.00	0.0	0	0	4880	0.12	0.024	0.1	1.07
25	26	25.5	Soft to Medium Stiff Fine-Grained	-30.5	105	110	2515	1591	924	1.0	924	0.89	0.56	0.49	3843	-454	605	151	0.00	0.00	0.0	0	0	4918	0.12	0.024	0.1	1.05
26	27	26.5	Soft to Medium Stiff Fine-Grained	-31.5	105	110	2625	1654	971	1.0	971	0.90	0.54	0.48	3834	-452	603	151	0.00	0.00	0.0	0	0	4956	0.12	0.024	0.1	1.02
27	28	27.5	Soft to Medium Stiff Fine-Grained	-32.5	105	110	2735	1716	1019	1.0	1019	0.92	0.53	0.48	3824	-450	600	150	0.00	0.00	0.0	0	0	4993	0.12	0.024	0.1	0.99
28	29	28.5	Soft to Medium Stiff Fine-Grained	-33.5	105	110	2845	1778	1067	1.0	1067	0.93	0.51	0.48	3815	-448	597	149	0.00	0.00	0.0	0	0	5031	0.12	0.024	0.1	0.97
29	30	29.5	Soft to Medium Stiff Fine-Grained	-34.5	105	110	2955	1841	1114	1.0	1114	0.94	0.50	0.48	3806	-446	595	149	0.00	0.00	0.0	0	0	5068	0.12	0.024	0.1	0.95
30	31	30.5	Medium Stiff Fine-Grained	-35.5	115	120	3075	1903	1172	1.0	1172	0.95	0.48	0.48	3796	-444	592	148	0.00	0.00	0.0	0	0	5116	0.07	0.014	0.0	0.54
31	32	31.5	Medium Stiff Fine-Grained	-36.5	115	120	3195	1966	1229	1.0	1229	0.95	0.47	0.48	3786	-442	590	147	0.00	0.00	0.0	0	0	5163	0.07	0.014	0.0	0.52
32	33	32.5	Medium Stiff Fine-Grained	-37.5	115	120	3315	2028	1287	1.0	1287	0.96	0.46	0.48	3776	-440	587	147	0.00	0.00	0.0	0	0	5210	0.07	0.014	0.0	0.51
33	34	33.5	Medium Stiff Fine-Grained	-38.5	115	120	3435	2090	1345	1.0	1345	0.97	0.45	0.48	3766	-438	585	146	0.00	0.00	0.0	0	0	5257	0.07	0.014	0.0	0.50
34	35	34.5	Medium Stiff Fine-Grained	-39.5	115	120	3555	2153	1402	1.0	1402	0.98	0.43	0.47	3756	-437	582	146	0.00	0.00	0.0	0	0	5304	0.07	0.014	0.0	0.49
35	36	35.5	Medium Stiff Fine-Grained	-40.5	115	120	3675	2215	1460	1.0	1460	0.98	0.42	0.47	3746	-435	580	145	0.00	0.00	0.0	0	0	5351	0.07	0.014	0.0	0.47
36	37	36.5	Medium Stiff Fine-Grained	-41.5	115	120	3795	2278	1517	1.0	1517	0.99	0.41	0.47	3736	-433	577	144	0.00	0.00	0.0	0	0	5397	0.07	0.014	0.0	0.46
37	38	37.5	Medium Stiff Fine-Grained	-42.5	115	120	3915	2340	1575	1.0	1575	0.99	0.40	0.47	3725	-431	575	144	0.00	0.00	0.0	0	0	5444	0.07	0.014	0.0	0.45
38	39	38.5	Medium Stiff Fine-Grained	-43.5	115	120	4035	2402	1633	1.0	1633	1.00	0.39	0.47	3715	-429	572	143	0.00	0.00	0.0	0	0	5490	0.07	0.014	0.0	0.44
39	40	39.5	Medium Stiff Fine-Grained	-44.5	115	120	4155	2465	1690	1.0	1690	1.00	0.38	0.47	3704	-427	570	142	0.00	0.00	0.0	0	0	5537	0.07	0.014	0.0	0.43
40	41	40.5	Medium Stiff Fine-Grained	-45.5	115	120	4275	2527	1748	1.0	1748	1.01	0.38	0.47	3694	-426	568	142	0.00	0.00	0.0	0	0	5583	0.07	0.014	0.0	0.42
41	42	41.5	Medium Stiff Fine-Grained	-46.5	115	120	4395	2590	1805	1.0	1805	1.01	0.37	0.47	3683	-424	565	141	0.00	0.00	0.0	0	0	5630	0.07	0.014	0.0	0.41
42	43	42.5	Medium Stiff Fine-Grained	-47.5	115	120	4515	2652	1863	1.0	1863	1.01	0.36	0.46	3672	-422	563	141	0.00	0.00	0.0	0	0	5676	0.07	0.014	0.0	0.41
43	44	43.5	Medium Stiff Fine-Grained	-48.5	115	120	4635	2714	1921	1.0	1921	1.02	0.35	0.46	3662	-420	560	140	0.00	0.00	0.0	0	0	5722	0.07	0.014	0.0	0.40
44	45	44.5	Medium Stiff Fine-Grained	-49.5	115	120	4755	2777	1978	1.0	1978	1.02	0.35	0.46	3651	-419	558	140	0.00	0.00	0.0	0	0	5769	0.07	0.014	0.0	0.39
45	46	45.5	Medium Stiff Fine-Grained	-50.5	115	120	4875	2839	2036	1.0	2036	1.02	0.34	0.46	3640	-417	556	139	0.00	0.00	0.0	0	0	5815	0.07	0.014	0.0	0.38
46	47	46.5	Medium Stiff Fine-Grained	-51.5	115	120	4995	2902	2093	1.0	2093	1.03	0.33	0.46	3629	-415	553	138	0.00	0.00	0.0	0	0	5861	0.07	0.014	0.0	0.38
47	48	47.5	Medium Stiff Fine-Grained	-52.5	115	120	5115	2964	2151	1.0	2151	1.03	0.32	0.46	3619	-413	551	138	0.00	0.00	0.0	0	0	5907	0.07	0.014	0.0	0.37
48	49	48.5	Medium Stiff Fine-Grained	-53.5	115	120	5235	3026	2209	1.0	2209	1.03	0.32	0.46	3608	-412	549	137	0.00	0.00	0.0	0	0	5954	0.07	0.014	0.0	0.36

Configuration **6H1V_P1_G1-RR15**

by: E. Ticen
Last Updated: February 2020

Geometry	Embankment Height, H	33	ft
	Embankment Side Slopes	6	xH:1V
	Crown Width	32	ft
	Half Crown Width, B1	16	ft
	Side Slope Width, B2	198	ft
	Unit Weight of Embankment, γ	120	pcf
	Depth to Ground Water	0	ft
	Maximum Stress Increase	3960	psf
	Water Surface Elevation	-5	ft
	Ground Surface Elevation	-5	ft
Foundation Improvements	Remove & Replace Depth [1]	15	ft
	Area Replacement Ratio	0	-
	Shear Key Thickness	0	ft
	Shear Key Depth	0	ft
	Shear Key Raft Foundation Depth	0.0	ft
	Shear key Spacing	--	ft
	Soil Arching b/w Shear Key	0	xV:1H
	Arching Stress Height	--	ft
	Arching Side Slope Width, B2	--	ft
	σmax Arching	0	psf

Notes:
1) Compacted fill where settlement of the material is considered to be negligible.
2)
3)
4)
5)
6)
7)

Total Settlement at Midpoint Between Shear Keys=	--	inches
Total Settlement at Shear Keys=	--	inches
Differential Settlement=	--	inches

		Depth (GS=0-ft)		Elevation (ft)		Unit Weight		Settlement					Staged Construction		
		Top	Bottom	Top	Bottom	Moist	Saturated	$C_{c\varepsilon} = C_c/(1+e_o)$	$C_{r\varepsilon} = C_{c\varepsilon}/5$	OCR	Total Layer Settlement		Reduction	Total Layer Settlement	
Layer	Description	(ft)	(ft)	(ft)	(ft)	(pcf)	(pcf)	(-)	(-)	(-)	(in)	(ft)	(%)	(in)	(ft)
1	Embankment Fill	-33	0	28	-5	115	120	0.01	0.002	5	0	0.00	100%	0	0.00
2	Organics	0	15	-5	-20	85	90	0.180	0.036	1	0.0	0.00	0%	0	0.00
3a	Soft to Medium Stiff Fine-Grained	15	30	-20	-35	105	110	0.120	0.024	1	17.9	1.49	0%	18	1.49
4	Medium Stiff Fine-Grained	30	50	-35	-55	115	120	0.070	0.014	1	9.0	0.75	0%	9	0.75
5	Stiff Fine-Grained	50	100	-55	-105	120	125	0.017	0.0034	1	3.1	0.26	0%	3	0.26
6	Dense Coarse-Grained	100	150	-105	-155	120	125	0.017	0.0034	1	1.7	0.14	0%	2	0.14
7	Stiff Fine-Grained	150	200	-155	-205	120	125	0.017	0.0034	1	0.9	0.08	0%	1	0.08
										Σ=	32.6	2.7	Σ=	32.6	2.7

							Pre Construction					Δσ due to Embankment Load (Das - 5.6)					Δσ due to Foundation R&R (2:1)			Δσ With Arching for Shear Keys (Das - 5.6)									
Top of Layer	Bottom of Layer	Depth (ft)	Layer (-)	Elevation (ft)	Moist Unit Weight (pcf)	Saturated Unit Weight (pcf)	Total Stress (psf)	Pore Pressure (psf)	Effective stress (psf)	OCR (-)	Pre- Consolidation Pressure (psf)	α_1 (rad)	α_2 (rad)	Influence Value I'	Δσ below Embankment middle (psf)	Foundation Removal (psf)	Foundation Replacement (psf)	Net Stress Change in Layer (psf)	α1 (rad)	α2 (rad)	Influence Value I'	Δσ between shear keys above shear key raft foundation (psf)	Δσ below shear key raft foundation	Final Stress (psf)	$C_{c\varepsilon}$ (-)	$C_{r\varepsilon}$ (-)	Vertical Strain $\varepsilon_{v,i}$ (%)	Change in Layer Thickness Δh_i (in)
0	1	0.5	Organics	-5.5	85	90	45	31	14	1.0	14	0.03	1.54	0.50	3960	-45	60	15	0.00	0.00	0.0	0	0	3989	0.18	0.036	0.0	0.00
1	2	1.5	Organics	-6.5	85	90	135	94	41	1.0	41	0.09	1.48	0.50	3960	-135	180	45	0.00	0.00	0.0	0	0	4046	0.18	0.036	0.0	0.00
2	3	2.5	Organics	-7.5	85	90	225	156	69	1.0	69	0.14	1.42	0.50	3960	-225	300	75	0.00	0.00	0.0	0	0	4104	0.18	0.036	0.0	0.00
3	4	3.5	Organics	-8.5	85	90	315	218	97	1.0	97	0.20	1.36	0.50	3959	-315	420	105	0.00	0.00	0.0	0	0	4161	0.18	0.036	0.0	0.00
4	5	4.5	Organics	-9.5	85	90	405	281	124	1.0	124	0.25	1.30	0.50	3959	-405	540	135	0.00	0.00	0.0	0	0	4218	0.18	0.036	0.0	0.00
5	6	5.5	Organics	-10.5	85	90	495	343	152	1.0	152	0.31	1.24	0.50	3957	-495	660	165	0.00	0.00	0.0	0	0	4274	0.18	0.036	0.0	0.00
6	7	6.5	Organics	-11.5	85	90	585	406	179	1.0	179	0.36	1.18	0.50	3956	-585	780	195	0.00	0.00	0.0	0	0	4330	0.18	0.036	0.0	0.00
7	8	7.5	Organics	-12.5	85	90	675	468	207	1.0	207	0.40	1.13	0.50	3954	-675	900	225	0.00	0.00	0.0	0	0	4386	0.18	0.036	0.0	0.00
8	9	8.5	Organics	-13.5	85	90	765	530	235	1.0	235	0.45	1.08	0.50	3951	-765	1020	255	0.00	0.00	0.0	0	0	4441	0.18	0.036	0.0	0.00
9	10	9.5	Organics	-14.5	85	90	855	593	262	1.0	262	0.49	1.03	0.50	3948	-855	1140	285	0.00	0.00	0.0	0	0	4495	0.18	0.036	0.0	0.00
10	11	10.5	Organics	-15.5	85	90	945	655	290	1.0	290	0.53	0.99	0.50	3945	-945	1260	315	0.00	0.00	0.0	0	0	4550	0.18	0.036	0.0	0.00
11	12	11.5	Organics	-16.5	85	90	1035	718	317	1.0	317	0.57	0.95	0.50	3941	-1035	1380	345	0.00	0.00	0.0	0	0	4603	0.18	0.036	0.0	0.00
12	13	12.5	Organics	-17.5	85	90	1125	780	345	1.0	345	0.60	0.91	0.50	3936	-1125	1500	375	0.00	0.00	0.0	0	0	4656	0.18	0.036	0.0	0.00
13	14	13.5	Organics	-18.5	85	90	1215	842	373	1.0	373	0.64	0.87	0.50	3931	-1215	1620	405	0.00	0.00	0.0	0	0	4709	0.18	0.036	0.0	0.00
14	15	14.5	Organics	-19.5	85	90	1305	905	400	1.0	400	0.67	0.83	0.50	3926	-1305	1740	435	0.00	0.00	0.0	0	0	4761	0.18	0.036	0.0	0.00
15	16	15.5	Soft to Medium Stiff Fine-Grained	-20.5	105	110	1415	967	448	1.0	448	0.70	0.80	0.49	3920	-1302	1736	434	0.00	0.00	0.0	0	0	4802	0.12	0.024	0.1	1.48
16	17	16.5	Soft to Medium Stiff Fine-Grained	-21.5	105	110	1525	1030	495	1.0	495	0.72	0.77	0.49	3913	-1296	1729	432	0.00	0.00	0.0	0	0	4841	0.12	0.024	0.1	1.43
17	18	17.5	Soft to Medium Stiff Fine-Grained	-22.5	105	110	1635	1092	543	1.0	543	0.75	0.74	0.49	3907	-1291	1721	430	0.00	0.00	0.0	0	0	4880	0.12	0.024	0.1	1.37
18	19	18.5	Soft to Medium Stiff Fine-Grained	-23.5	105	110	1745	1154	591	1.0	591	0.77	0.71	0.49	3900	-1285	1714	428	0.00	0.00	0.0	0	0	4919	0.12	0.024	0.1	1.33
19	20	19.5	Soft to Medium Stiff Fine-Grained	-24.5	105	110	1855	1217	638	1.0	638	0.79	0.69	0.49	3892	-1280	1706	427	0.00	0.00	0.0	0	0	4957	0.12	0.024	0.1	1.28
20	21	20.5	Soft to Medium Stiff Fine-Grained	-25.5	105	110	1965	1279	686	1.0	686	0.81	0.66	0.49	3885	-1274	1699	425	0.00	0.00	0.0	0	0	4995	0.12	0.024	0.1	1.24
21	22	21.5	Soft to Medium Stiff Fine-Grained	-26.5	105	110	2075	1342	733	1.0	733	0.83	0.64	0.49	3877	-1269	1692	423	0.00	0.00	0.0	0	0	5033	0.12	0.024	0.1	1.20
22	23	22.5	Soft to Medium Stiff Fine-Grained	-27.5	105	110	2185	1404	781	1.0	781	0.85	0.62	0.49	3869	-1263	1684	421	0.00	0.00	0.0	0	0	5071	0.12	0.024	0.1	1.17
23	24	23.5	Soft to Medium Stiff Fine-Grained	-28.5	105	110	2295	1466	829	1.0	829	0.86	0.60	0.49	3860	-1258	1677	419	0.00	0.00	0.0	0	0	5108	0.12	0.024	0.1	1.14
24	25	24.5	Soft to Medium Stiff Fine-Grained	-29.5	105	110	2405	1529	876	1.0	876	0.88	0.58	0.49	3852	-1253	1670	418	0.00	0.00	0.0	0	0	5145	0.12	0.024	0.1	1.11
25	26	25.5	Soft to Medium Stiff Fine-Grained	-30.5	105	110	2515	1591	924	1.0	924	0.89	0.56	0.49	3843	-1247	1663	416	0.00	0.00	0.0	0	0	5182	0.12	0.024	0.1	1.08
26	27	26.5	Soft to Medium Stiff Fine-Grained	-31.5	105	110	2625	1654	971	1.0	971	0.90	0.54	0.48	3834	-1242	1656	414	0.00	0.00	0.0	0	0	5219	0.12	0.024	0.1	1.05
27	28	27.5	Soft to Medium Stiff Fine-Grained	-32.5	105	110	2735	1716	1019	1.0	1019	0.92	0.53	0.48	3824	-1237	1649	412	0.00	0.00	0.0	0	0	5256	0.12	0.024	0.1	1.03
28	29	28.5	Soft to Medium Stiff Fine-Grained	-33.5	105	110	2845	1778	1067	1.0	1067	0.93	0.51	0.48	3815	-1231	1642	410	0.00	0.00	0.0	0	0	5292	0.12	0.024	0.1	1.00
29	30	29.5	Soft to Medium Stiff Fine-Grained	-34.5	105	110	2955	1841	1114	1.0	1114	0.94	0.50	0.48	3806	-1226	1635	409	0.00	0.00	0.0	0	0	5328	0.12	0.024	0.1	0.98
30	31	30.5	Medium Stiff Fine-Grained	-35.5	115	120	3075	1903	1172	1.0	1172	0.95	0.48	0.48	3796	-1221	1628	407	0.00	0.00	0.0	0	0	5375	0.07	0.014	0.0	0.56
31	32	31.5	Medium Stiff Fine-Grained	-36.5	115	120	3195	1966	1229	1.0	1229	0.95	0.47	0.48	3786	-1216	1621	405	0.00	0.00	0.0	0	0	5421	0.07	0.014	0.0	0.54
32	33	32.5	Medium Stiff Fine-Grained	-37.5	115	120	3315	2028	1287	1.0	1287	0.96	0.46	0.48	3776	-1211	1614	404	0.00	0.00	0.0	0	0	5467	0.07	0.014	0.0	0.53
33	34	33.5	Medium Stiff Fine-Grained	-38.5	115	120	3435	2090	1345	1.0	1345	0.97	0.45	0.48	3766	-1206	1608	402	0.00	0.00	0.0	0	0	5513	0.07	0.014	0.0	0.51
34	35	34.5	Medium Stiff Fine-Grained	-39.5	115	120	3555	2153	1402	1.0	1402	0.98	0.43	0.47	3756	-1201	1601	400	0.00	0.00	0.0	0	0	5558	0.07	0.014	0.0	0.50
35	36	35.5	Medium Stiff Fine-Grained	-40.5	115	120	3675	2215	1460	1.0	1460	0.98	0.42	0.47	3746	-1196	1594	399	0.00	0.00	0.0	0	0	5604	0.07	0.014	0.0	0.49
36	37	36.5	Medium Stiff Fine-Grained	-41.5	115	120	3795	2278	1517	1.0	1517	0.99	0.41	0.47	3736	-1191	1587	397	0.00	0.00	0.0	0	0	5650	0.07	0.014	0.0	0.48
37	38	37.5	Medium Stiff Fine-Grained	-42.5	115	120	3915	2340	1575	1.0	1575	0.99	0.40	0.47	3725	-1186	1581	395	0.00	0.00	0.0	0	0	5695	0.07	0.014	0.0	0.47
38	39	38.5	Medium Stiff Fine-Grained	-43.5	115	120	4035	2402	1633	1.0	1633	1.00	0.39	0.47	3715	-1181	1574	394	0.00	0.00	0.0	0	0	5741	0.07	0.014	0.0	0.46
39	40	39.5	Medium Stiff Fine-Grained	-44.5	115	120	4155	2465	1690	1.0	1690	1.00	0.38	0.47	3704	-1176	1568	392	0.00	0.00	0.0	0	0	5786	0.07	0.014	0.0	0.45
40	41	40.5	Medium Stiff Fine-Grained	-45.5	115	120	4275	2527	1748	1.0	1748	1.01	0.38	0.47	3694	-1171	1561	390	0.00	0.00	0.0	0	0	5832	0.07	0.014	0.0	0.44
41	42	41.5	Medium Stiff Fine-Grained	-46.5	115	120	4395	2590	1805	1.0	1805	1.01	0.37	0.47	3683	-1166	1555	389	0.00	0.00	0.0	0	0	5877	0.07	0.014	0.0	0.43
42	43	42.5	Medium Stiff Fine-Grained	-47.5	115	120	4515	2652	1863	1.0	1863	1.01	0.36	0.46	3672	-1161	1548	387	0.00	0.00	0.0	0	0	5923	0.07	0.014	0.0	0.42
43	44	43.5	Medium Stiff Fine-Grained	-48.5	115	120	4635	2714	1921	1.0	1921	1.02	0.35	0.46	3662	-1157	1542	386	0.00	0.00	0.0	0	0	5968	0.07	0.014	0.0	0.41
44	45	44.5	Medium Stiff Fine-Grained	-49.5	115	120	4755	2777	1978	1.0	1978	1.02	0.35	0.46	3651	-1152	1536	384	0.00	0.00	0.0	0	0	6013	0.07	0.014	0.0	0.41
45	46	45.5	Medium Stiff Fine-Grained	-50.5	115	120	4875	2839	2036	1.0	2036	1.02	0.34	0.46	3640	-1147	1530	382	0.00	0.00	0.0	0	0	6058	0.07	0.014	0.0	0.40
46	47	46.5	Medium Stiff Fine-Grained	-51.5	115	120	4995	2902	2093	1.0	2093	1.03	0.33	0.46	3629	-1142	1523	381	0.00	0.00	0.0	0	0	6104	0.07	0.014	0.0	0.39
47	48	47.5	Medium Stiff Fine-Grained	-52.5	115	120	5115	2964	2151	1.0	2151	1.03	0.32	0.46	3619	-1138	1517	379	0.00	0.00	0.0	0	0	6149	0.07	0.014	0.0	0.38
48	49	48.5	Medium Stiff Fine-Grained	-53.5	115	120	5235	3026	2209	1.0	2209	1.03	0.32	0.46	3608	-1133	1511	378	0.00	0.00	0.0	0	0	6194	0.07	0.014	0.0	0.38

Configuration **6H1V_P1_G1-RR30**

by: E. Ticen
Last Updated: February 2020

Geometry	Embankment Height, H	33	ft
	Embankment Side Slopes	6	xH:1V
	Crown Width	32	ft
	Half Crown Width, B1	16	ft
	Side Slope Width, B2	198	ft
	Unit Weight of Embankment, γ	120	pcf
	Depth to Ground Water	0	ft
	Maximum Stress Increase	3960	psf
	Water Surface Elevation	-5	ft
	Ground Surface Elevation	-5	ft
Foundation Improvements	Remove & Replace Depth [1]	30	ft
	Area Replacement Ratio	0	-
	Shear Key Thickness	0	ft
	Shear Key Depth	0	ft
	Shear Key Raft Foundation Depth	0.0	ft
	Shear key Spacing	--	ft
	Soil Arching b/w Shear Key	0	xV:1H
	Arching Stress Height	--	ft
	Arching Side Slope Width, B2	--	ft
	σmax Arching	0	psf

Notes:
1) Compacted fill where settlement of the material is considered to be negligible.
2)
3)
4)
5)
6)
7)

Total Settlement at Midpoint Between Shear Keys=	--	inches
Total Settlement at Shear Keys=	--	inches
Differential Settlement=	--	inches

		Depth (GS=0-ft)		Elevation (ft)		Unit Weight		Settlement					Staged Construction		
		Top	Bottom	Top	Bottom	Moist	Saturated	$C_{c\varepsilon} = C_c/(1+e_o)$	$C_{r\varepsilon} = C_{cd}/5$	OCR	Total Layer Settlement		Reduction	Total Layer Settlement	
Layer	Description	(ft)	(ft)	(ft)	(ft)	(pcf)	(pcf)	(-)	(-)	(-)	(in)	(ft)	(%)	(in)	(ft)
1	Embankment Fill	-33	0	28	-5	115	120	0.01	0.002	5	0	0.00	100%	0	0.00
2	Organics	0	15	-5	-20	85	90	0.180	0.036	1	0.0	0.00	0%	0	0.00
3a	Soft to Medium Stiff Fine-Grained	15	30	-20	-35	105	110	0.120	0.024	1	0.0	0.00	0%	0	0.00
4	Medium Stiff Fine-Grained	30	50	-35	-55	115	120	0.070	0.014	1	9.2	0.77	0%	9	0.77
5	Stiff Fine-Grained	50	100	-55	-105	120	125	0.017	0.0034	1	3.1	0.26	0%	3	0.26
6	Dense Coarse-Grained	100	150	-105	-155	120	125	0.017	0.0034	1	1.7	0.14	0%	2	0.14
7	Stiff Fine-Grained	150	200	-155	-205	120	125	0.017	0.0034	1	1.0	0.08	0%	1	0.08
										Σ=	15.1	1.3		Σ= 15.1	1.3

							Pre Construction					Δσ due to Embankment Load (Das - 5.6)				Δσ due to Foundation R&R (2:1)			Δσ With Arching for Shear Keys (Das - 5.6)									
Top of Layer	Bottom of Layer	Depth (ft)	Layer (-)	Elevation (ft)	Moist Unit Weight (pcf)	Saturated Unit Weight (pcf)	Total Stress (psf)	Pore Pressure (psf)	Effective stress (psf)	OCR (-)	Pre- Consolidation Pressure (psf)	α_1 (rad)	α_2 (rad)	Influence Value I'	Δσ below Embankment middle (psf)	Foundation Removal (psf)	Foundation Replacement (psf)	Net Stress Change in Layer (psf)	α1 (rad)	α2 (rad)	Influence Value I'	Δσ between shear keys above shear key raft foundation (psf)	Δσ below shear key raft foundation	Final Stress (psf)	$C_{c\varepsilon}$ (-)	$C_{r\varepsilon}$ (-)	Vertical Strain $\varepsilon_{v,i}$ (%)	Change in Layer Thickness Δh_i (in)
0	1	0.5	Organics	-5.5	85	90	45	31	14	1.0	14	0.03	1.54	0.50	3960	-45	60	15	0.00	0.00	0.0	0	0	3989	0.18	0.036	0.0	0.00
1	2	1.5	Organics	-6.5	85	90	135	94	41	1.0	41	0.09	1.48	0.50	3960	-135	180	45	0.00	0.00	0.0	0	0	4046	0.18	0.036	0.0	0.00
2	3	2.5	Organics	-7.5	85	90	225	156	69	1.0	69	0.14	1.42	0.50	3960	-225	300	75	0.00	0.00	0.0	0	0	4104	0.18	0.036	0.0	0.00
3	4	3.5	Organics	-8.5	85	90	315	218	97	1.0	97	0.20	1.36	0.50	3959	-315	420	105	0.00	0.00	0.0	0	0	4161	0.18	0.036	0.0	0.00
4	5	4.5	Organics	-9.5	85	90	405	281	124	1.0	124	0.25	1.30	0.50	3959	-405	540	135	0.00	0.00	0.0	0	0	4218	0.18	0.036	0.0	0.00
5	6	5.5	Organics	-10.5	85	90	495	343	152	1.0	152	0.31	1.24	0.50	3957	-495	660	165	0.00	0.00	0.0	0	0	4274	0.18	0.036	0.0	0.00
6	7	6.5	Organics	-11.5	85	90	585	406	179	1.0	179	0.36	1.18	0.50	3956	-585	780	195	0.00	0.00	0.0	0	0	4330	0.18	0.036	0.0	0.00
7	8	7.5	Organics	-12.5	85	90	675	468	207	1.0	207	0.40	1.13	0.50	3954	-675	900	225	0.00	0.00	0.0	0	0	4386	0.18	0.036	0.0	0.00
8	9	8.5	Organics	-13.5	85	90	765	530	235	1.0	235	0.45	1.08	0.50	3951	-765	1020	255	0.00	0.00	0.0	0	0	4441	0.18	0.036	0.0	0.00
9	10	9.5	Organics	-14.5	85	90	855	593	262	1.0	262	0.49	1.03	0.50	3948	-855	1140	285	0.00	0.00	0.0	0	0	4495	0.18	0.036	0.0	0.00
10	11	10.5	Organics	-15.5	85	90	945	655	290	1.0	290	0.53	0.99	0.50	3945	-945	1260	315	0.00	0.00	0.0	0	0	4550	0.18	0.036	0.0	0.00
11	12	11.5	Organics	-16.5	85	90	1035	718	317	1.0	317	0.57	0.95	0.50	3941	-1035	1380	345	0.00	0.00	0.0	0	0	4603	0.18	0.036	0.0	0.00
12	13	12.5	Organics	-17.5	85	90	1125	780	345	1.0	345	0.60	0.91	0.50	3936	-1125	1500	375	0.00	0.00	0.0	0	0	4656	0.18	0.036	0.0	0.00
13	14	13.5	Organics	-18.5	85	90	1215	842	373	1.0	373	0.64	0.87	0.50	3931	-1215	1620	405	0.00	0.00	0.0	0	0	4709	0.18	0.036	0.0	0.00
14	15	14.5	Organics	-19.5	85	90	1305	905	400	1.0	400	0.67	0.83	0.50	3926	-1305	1740	435	0.00	0.00	0.0	0	0	4761	0.18	0.036	0.0	0.00
15	16	15.5	Soft to Medium Stiff Fine-Grained	-20.5	105	110	1415	967	448	1.0	448	0.70	0.80	0.49	3920	-1415	1860	445	0.00	0.00	0.0	0	0	4813	0.12	0.024	0.0	0.00
16	17	16.5	Soft to Medium Stiff Fine-Grained	-21.5	105	110	1525	1030	495	1.0	495	0.72	0.77	0.49	3913	-1525	1980	455	0.00	0.00	0.0	0	0	4864	0.12	0.024	0.0	0.00
17	18	17.5	Soft to Medium Stiff Fine-Grained	-22.5	105	110	1635	1092	543	1.0	543	0.75	0.74	0.49	3907	-1635	2100	465	0.00	0.00	0.0	0	0	4915	0.12	0.024	0.0	0.00
18	19	18.5	Soft to Medium Stiff Fine-Grained	-23.5	105	110	1745	1154	591	1.0	591	0.77	0.71	0.49	3900	-1745	2220	475	0.00	0.00	0.0	0	0	4965	0.12	0.024	0.0	0.00
19	20	19.5	Soft to Medium Stiff Fine-Grained	-24.5	105	110	1855	1217	638	1.0	638	0.79	0.69	0.49	3892	-1855	2340	485	0.00	0.00	0.0	0	0	5016	0.12	0.024	0.0	0.00
20	21	20.5	Soft to Medium Stiff Fine-Grained	-25.5	105	110	1965	1279	686	1.0	686	0.81	0.66	0.49	3885	-1965	2460	495	0.00	0.00	0.0	0	0	5066	0.12	0.024	0.0	0.00
21	22	21.5	Soft to Medium Stiff Fine-Grained	-26.5	105	110	2075	1342	733	1.0	733	0.83	0.64	0.49	3877	-2075	2580	505	0.00	0.00	0.0	0	0	5115	0.12	0.024	0.0	0.00
22	23	22.5	Soft to Medium Stiff Fine-Grained	-27.5	105	110	2185	1404	781	1.0	781	0.85	0.62	0.49	3869	-2185	2700	515	0.00	0.00	0.0	0	0	5165	0.12	0.024	0.0	0.00
23	24	23.5	Soft to Medium Stiff Fine-Grained	-28.5	105	110	2295	1466	829	1.0	829	0.86	0.60	0.49	3860	-2295	2820	525	0.00	0.00	0.0	0	0	5214	0.12	0.024	0.0	0.00
24	25	24.5	Soft to Medium Stiff Fine-Grained	-29.5	105	110	2405	1529	876	1.0	876	0.88	0.58	0.49	3852	-2405	2940	535	0.00	0.00	0.0	0	0	5263	0.12	0.024	0.0	0.00
25	26	25.5	Soft to Medium Stiff Fine-Grained	-30.5	105	110	2515	1591	924	1.0	924	0.89	0.56	0.49	3843	-2515	3060	545	0.00	0.00	0.0	0	0	5311	0.12	0.024	0.0	0.00
26	27	26.5	Soft to Medium Stiff Fine-Grained	-31.5	105	110	2625	1654	971	1.0	971	0.90	0.54	0.48	3834	-2625	3180	555	0.00	0.00	0.0	0	0	5360	0.12	0.024	0.0	0.00
27	28	27.5	Soft to Medium Stiff Fine-Grained	-32.5	105	110	2735	1716	1019	1.0	1019	0.92	0.53	0.48	3824	-2735	3300	565	0.00	0.00	0.0	0	0	5408	0.12	0.024	0.0	0.00
28	29	28.5	Soft to Medium Stiff Fine-Grained	-33.5	105	110	2845	1778	1067	1.0	1067	0.93	0.51	0.48	3815	-2845	3420	575	0.00	0.00	0.0	0	0	5457	0.12	0.024	0.0	0.00
29	30	29.5	Soft to Medium Stiff Fine-Grained	-34.5	105	110	2955	1841	1114	1.0	1114	0.94	0.50	0.48	3806	-2955	3540	585	0.00	0.00	0.0	0	0	5505	0.12	0.024	0.0	0.00
30	31	30.5	Medium Stiff Fine-Grained	-35.5	115	120	3075	1903	1172	1.0	1172	0.95	0.48	0.48	3796	-2949	3533	584	0.00	0.00	0.0	0	0	5551	0.07	0.014	0.0	0.57
31	32	31.5	Medium Stiff Fine-Grained	-36.5	115	120	3195	1966	1229	1.0	1229	0.95	0.47	0.48	3786	-2937	3518	581	0.00	0.00	0.0	0	0	5597	0.07	0.014	0.0	0.55
32	33	32.5	Medium Stiff Fine-Grained	-37.5	115	120	3315	2028	1287	1.0	1287	0.96	0.46	0.48	3776	-2925	3504	579	0.00	0.00	0.0	0	0	5642	0.07	0.014	0.0	0.54
33	34	33.5	Medium Stiff Fine-Grained	-38.5	115	120	3435	2090	1345	1.0	1345	0.97	0.45	0.48	3766	-2913	3490	577	0.00	0.00	0.0	0	0	5687	0.07	0.014	0.0	0.53
34	35	34.5	Medium Stiff Fine-Grained	-39.5	115	120	3555	2153	1402	1.0	1402	0.98	0.43	0.47	3756	-2901	3476	574	0.00	0.00	0.0	0	0	5733	0.07	0.014	0.0	0.51
35	36	35.5	Medium Stiff Fine-Grained	-40.5	115	120	3675	2215	1460	1.0	1460	0.98	0.42	0.47	3746	-2890	3462	572	0.00	0.00	0.0	0	0	5778	0.07	0.014	0.0	0.50
36	37	36.5	Medium Stiff Fine-Grained	-41.5	115	120	3795	2278	1517	1.0	1517	0.99	0.41	0.47	3736	-2878	3448	570	0.00	0.00	0.0	0	0	5823	0.07	0.014	0.0	0.49
37	38	37.5	Medium Stiff Fine-Grained	-42.5	115	120	3915	2340	1575	1.0	1575	0.99	0.40	0.47	3725	-2866	3434	567	0.00	0.00	0.0	0	0	5868	0.07	0.014	0.0	0.48
38	39	38.5	Medium Stiff Fine-Grained	-43.5	115	120	4035	2402	1633	1.0	1633	1.00	0.39	0.47	3715	-2855	3420	565	0.00	0.00	0.0	0	0	5912	0.07	0.014	0.0	0.47
39	40	39.5	Medium Stiff Fine-Grained	-44.5	115	120	4155	2465	1690	1.0	1690	1.00	0.38	0.47	3704	-2843	3406	563	0.00	0.00	0.0	0	0	5957	0.07	0.014	0.0	0.46
40	41	40.5	Medium Stiff Fine-Grained	-45.5	115	120	4275	2527	1748	1.0	1748	1.01	0.38	0.47	3694	-2832	3392	561	0.00	0.00	0.0	0	0	6002	0.07	0.014	0.0	0.45
41	42	41.5	Medium Stiff Fine-Grained	-46.5	115	120	4395	2590	1805	1.0	1805	1.01	0.37	0.47	3683	-2821	3379	558	0.00	0.00	0.0	0	0	6047	0.07	0.014	0.0	0.44
42	43	42.5	Medium Stiff Fine-Grained	-47.5	115	120	4515	2652	1863	1.0	1863	1.01	0.36	0.46	3672	-2809	3365	556	0.00	0.00	0.0	0	0	6092	0.07	0.014	0.0	0.43
43	44	43.5	Medium Stiff Fine-Grained	-48.5	115	120	4635	2714	1921	1.0	1921	1.02	0.35	0.46	3662	-2798	3352	554	0.00	0.00	0.0	0	0	6136	0.07	0.014	0.0	0.42
44	45	44.5	Medium Stiff Fine-Grained	-49.5	115	120	4755	2777	1978	1.0	1978	1.02	0.35	0.46	3651	-2787	3339	552	0.00	0.00	0.0	0	0	6181	0.07	0.014	0.0	0.42
45	46	45.5	Medium Stiff Fine-Grained	-50.5	115	120	4875	2839	2036	1.0	2036	1.02	0.34	0.46	3640	-2776	3325	550	0.00	0.00	0.0	0	0	6226	0.07	0.014	0.0	0.41
46	47	46.5	Medium Stiff Fine-Grained	-51.5	115	120	4995	2902	2093	1.0	2093	1.03	0.33	0.46	3629	-2765	3312	547	0.00	0.00	0.0	0	0	6270	0.07	0.014	0.0	0.40
47	48	47.5	Medium Stiff Fine-Grained	-52.5	115	120	5115	2964	2151	1.0	2151	1.03	0.32	0.46	3619	-2754	3299	545	0.00	0.00	0.0	0	0	6315	0.07	0.014	0.0	0.39
48	49	48.5	Medium Stiff Fine-Grained	-53.5	115	120	5235	3026	2209	1.0	2209	1.03	0.32	0.46	3608	-2743	3286	543	0.00	0.00	0.0	0	0	6359	0.07	0.014	0.0	0.39

Configuration **6H1V_P1_G2-AR15**

by: E. Ticen
Last Updated: February 2020

Geometry	Embankment Height, H	33	ft
	Embankment Side Slopes	6	xH:1V
	Crown Width	32	ft
	Half Crown Width, B1	16	ft
	Side Slope Width, B2	198	ft
	Unit Weight of Embankment, γ	120	pcf
	Depth to Ground Water	0	ft
	Maximum Stress Increase	3960	psf
	Water Surface Elevation	-5	ft
	Ground Surface Elevation	-5	ft
Foundation Improvements	Remove & Replace Depth [1]	6	ft
	Area Replacement Ratio	0.15	-
	Shear Key Thickness	2.5	ft
	Shear Key Depth	40	ft
	Shear Key Raft Foundation Depth	26.7	ft
	Shear key Spacing	16.7	ft
	Soil Arching b/w Shear Key	0.5	xV:1H
	Arching Stress Height	4	ft
	Arching Side Slope Width, B2	8.3	ft
	σmax Arching	425	psf

Notes:
1) Compacted fill where settlement of the material is considered to be negligible.
2)
3)
4)
5)
6)
7)

Total Settlement at Midpoint Between Shear Keys=	27.4	inches
Total Settlement at Shear Keys=	16.9	inches
Differential Settlement=	10.6	inches

		Depth (GS=0-ft)		Elevation (ft)		Unit Weight		Settlement					Staged Construction		
		Top	Bottom	Top	Bottom	Moist	Saturated	$C_{c\varepsilon} = C_c/(1+e_o)$	$C_{r\varepsilon} = C_{cd}/5$	OCR	Total Layer Settlement		Reduction	Total Layer Settlement	
Layer	Description	(ft)	(ft)	(ft)	(ft)	(pcf)	(pcf)	(-)	(-)	(-)	(in)	(ft)	(%)	(in)	(ft)
1	Embankment Fill	-33	0	28	-5	115	120	0.01	0.002	5	0	0.00	100%	0	0.00
2	Organics	0	15	-5	-20	85	90	0.180	0.036	1	7.3	0.61	0%	7	0.61
3a	Soft to Medium Stiff Fine-Grained	15	30	-20	-35	105	110	0.120	0.024	1	6.2	0.52	0%	6	0.52
4	Medium Stiff Fine-Grained	30	50	-35	-55	115	120	0.070	0.014	1	8.7	0.73	0%	9	0.73
5	Stiff Fine-Grained	50	100	-55	-105	120	125	0.017	0.0034	1	2.9	0.24	0%	3	0.24
6	Dense Coarse-Grained	100	150	-105	-155	120	125	0.017	0.0034	1	1.5	0.12	0%	1	0.12
7	Stiff Fine-Grained	150	200	-155	-205	120	125	0.017	0.0034	1	0.8	0.07	0%	1	0.07
										Σ=	27.4	2.3	Σ=	27.4	2.3

							Pre Construction					Δσ due to Embankment Load (Das - 5.6)				Δσ due to Foundation R&R (2:1)			Δσ With Arching for Shear Keys (Das - 5.6)									
Top of Layer	Bottom of Layer	Depth (ft)	Layer (-)	Elevation (ft)	Moist Unit Weight (pcf)	Saturated Unit Weight (pcf)	Total Stress (psf)	Pore Pressure (psf)	Effective stress (psf)	OCR (-)	Pre- Consolidation Pressure (psf)	α_1 (rad)	α_2 (rad)	Influence Value I'	Δσ below Embankment middle (psf)	Foundation Removal (psf)	Foundation Replacement (psf)	Net Stress Change in Layer (psf)	α1 (rad)	α2 (rad)	Influence Value I'	Δσ between shear keys above shear key raft foundation (psf)	Δσ below shear key raft foundation	Final Stress (psf)	$C_{c\varepsilon}$ (-)	$C_{r\varepsilon}$ (-)	Vertical Strain $\varepsilon_{v,i}$ (%)	Change in Layer Thickness Δh_i (in)
0	1	0.5	Organics	-5.5	85	90	45	31	14	1.0	14	0.03	1.54	0.50	3960	-45	60	15	1.51	0.00	0.5	409	0	438	0.18	0.036	0.0	0.00
1	2	1.5	Organics	-6.5	85	90	135	94	41	1.0	41	0.09	1.48	0.50	3960	-135	180	45	1.39	0.00	0.4	377	0	463	0.18	0.036	0.0	0.00
2	3	2.5	Organics	-7.5	85	90	225	156	69	1.0	69	0.14	1.42	0.50	3960	-225	300	75	1.28	0.00	0.4	346	0	490	0.18	0.036	0.0	0.00
3	4	3.5	Organics	-8.5	85	90	315	218	97	1.0	97	0.20	1.36	0.50	3959	-315	420	105	1.17	0.00	0.4	317	0	519	0.18	0.036	0.0	0.00
4	5	4.5	Organics	-9.5	85	90	405	281	124	1.0	124	0.25	1.30	0.50	3959	-405	540	135	1.08	0.00	0.3	291	0	550	0.18	0.036	0.0	0.00
5	6	5.5	Organics	-10.5	85	90	495	343	152	1.0	152	0.31	1.24	0.50	3957	-495	660	165	0.99	0.00	0.3	267	0	584	0.18	0.036	0.0	0.00
6	7	6.5	Organics	-11.5	85	90	585	406	179	1.0	179	0.36	1.18	0.50	3956	-494	659	165	0.91	0.00	0.3	246	0	590	0.18	0.036	0.1	1.12
7	8	7.5	Organics	-12.5	85	90	675	468	207	1.0	207	0.40	1.13	0.50	3954	-492	656	164	0.84	0.00	0.3	227	0	598	0.18	0.036	0.1	0.99
8	9	8.5	Organics	-13.5	85	90	765	530	235	1.0	235	0.45	1.08	0.50	3951	-489	653	163	0.78	0.00	0.2	213	0	610	0.18	0.036	0.1	0.90
9	10	9.5	Organics	-14.5	85	90	855	593	262	1.0	262	0.49	1.03	0.50	3948	-487	650	162	0.72	0.00	0.2	213	0	637	0.18	0.036	0.1	0.83
10	11	10.5	Organics	-15.5	85	90	945	655	290	1.0	290	0.53	0.99	0.50	3945	-485	647	162	0.67	0.00	0.2	213	0	664	0.18	0.036	0.1	0.78
11	12	11.5	Organics	-16.5	85	90	1035	718	317	1.0	317	0.57	0.95	0.50	3941	-483	644	161	0.63	0.00	0.2	213	0	691	0.18	0.036	0.1	0.73
12	13	12.5	Organics	-17.5	85	90	1125	780	345	1.0	345	0.60	0.91	0.50	3936	-481	641	160	0.59	0.00	0.2	213	0	718	0.18	0.036	0.1	0.69
13	14	13.5	Organics	-18.5	85	90	1215	842	373	1.0	373	0.64	0.87	0.50	3931	-479	638	160	0.55	0.00	0.2	213	0	745	0.18	0.036	0.1	0.65
14	15	14.5	Organics	-19.5	85	90	1305	905	400	1.0	400	0.67	0.83	0.50	3926	-476	635	159	0.52	0.00	0.2	213	0	772	0.18	0.036	0.1	0.62
15	16	15.5	Soft to Medium Stiff Fine-Grained	-20.5	105	110	1415	967	448	1.0	448	0.70	0.80	0.49	3920	-474	632	158	0.49	0.00	0.2	213	0	818	0.12	0.024	0.0	0.38
16	17	16.5	Soft to Medium Stiff Fine-Grained	-21.5	105	110	1525	1030	495	1.0	495	0.72	0.77	0.49	3913	-472	630	157	0.47	0.00	0.1	213	0	865	0.12	0.024	0.0	0.35
17	18	17.5	Soft to Medium Stiff Fine-Grained	-22.5	105	110	1635	1092	543	1.0	543	0.75	0.74	0.49	3907	-470	627	157	0.44	0.00	0.1	213	0	912	0.12	0.024	0.0	0.32
18	19	18.5	Soft to Medium Stiff Fine-Grained	-23.5	105	110	1745	1154	591	1.0	591	0.77	0.71	0.49	3900	-468	624	156	0.42	0.00	0.1	213	0	959	0.12	0.024	0.0	0.30
19	20	19.5	Soft to Medium Stiff Fine-Grained	-24.5	105	110	1855	1217	638	1.0	638	0.79	0.69	0.49	3892	-466	621	155	0.40	0.00	0.1	213	0	1006	0.12	0.024	0.0	0.28
20	21	20.5	Soft to Medium Stiff Fine-Grained	-25.5	105	110	1965	1279	686	1.0	686	0.81	0.66	0.49	3885	-464	619	155	0.39	0.00	0.1	213	0	1053	0.12	0.024	0.0	0.27
21	22	21.5	Soft to Medium Stiff Fine-Grained	-26.5	105	110	2075	1342	733	1.0	733	0.83	0.64	0.49	3877	-462	616	154	0.37	0.00	0.1	213	0	1100	0.12	0.024	0.0	0.25
22	23	22.5	Soft to Medium Stiff Fine-Grained	-27.5	105	110	2185	1404	781	1.0	781	0.85	0.62	0.49	3869	-460	613	153	0.35	0.00	0.1	213	0	1147	0.12	0.024	0.0	0.24
23	24	23.5	Soft to Medium Stiff Fine-Grained	-28.5	105	110	2295	1466	829	1.0	829	0.86	0.60	0.49	3860	-458	610	153	0.34	0.00	0.1	213	0	1194	0.12	0.024	0.0	0.23
24	25	24.5	Soft to Medium Stiff Fine-Grained	-29.5	105	110	2405	1529	876	1.0	876	0.88	0.58	0.49	3852	-456	608	152	0.33	0.00	0.1	213	0	1241	0.12	0.024	0.0	0.22
25	26	25.5	Soft to Medium Stiff Fine-Grained	-30.5	105	110	2515	1591	924	1.0	924	0.89	0.56	0.49	3843	-454	605	151	0.32	0.00	0.1	213	0	1288	0.12	0.024	0.0	0.21
26	27	26.5	Soft to Medium Stiff Fine-Grained	-31.5	105	110	2625	1654	971	1.0	971	0.90	0.54	0.48	3834	-452	603	151	0.30	0.00	0.1	213	0	1335	0.12	0.024	0.0	0.20
27	28	27.5	Soft to Medium Stiff Fine-Grained	-32.5	105	110	2735	1716	1019	1.0	1019	0.92	0.53	0.48	3824	-450	600	150	0.29	0.00	0.1	0	3945	5114	0.12	0.024	0.1	1.01
28	29	28.5	Soft to Medium Stiff Fine-Grained	-33.5	105	110	2845	1778	1067	1.0	1067	0.93	0.51	0.48	3815	-448	597	149	0.28	0.00	0.1	0	3926	5142	0.12	0.024	0.1	0.98
29	30	29.5	Soft to Medium Stiff Fine-Grained	-34.5	105	110	2955	1841	1114	1.0	1114	0.94	0.50	0.48	3806	-446	595	149	0.28	0.00	0.1	0	3908	5171	0.12	0.024	0.1	0.96
30	31	30.5	Medium Stiff Fine-Grained	-35.5	115	120	3075	1903	1172	1.0	1172	0.95	0.48	0.48	3796	-444	592	148	0.27	0.00	0.1	0	3890	5210	0.07	0.014	0.0	0.54
31	32	31.5	Medium Stiff Fine-Grained	-36.5	115	120	3195	1966	1229	1.0	1229	0.95	0.47	0.48	3786	-442	590	147	0.26	0.00	0.1	0	3872	5249	0.07	0.014	0.0	0.53
32	33	32.5	Medium Stiff Fine-Grained	-37.5	115	120	3315	2028	1287	1.0	1287	0.96	0.46	0.48	3776	-440	587	147	0.25	0.00	0.1	0	3854	5288	0.07	0.014	0.0	0.52
33	34	33.5	Medium Stiff Fine-Grained	-38.5	115	120	3435	2090	1345	1.0	1345	0.97	0.45	0.48	3766	-438	585	146	0.24	0.00	0.1	0	3837	5327	0.07	0.014	0.0	0.50
34	35	34.5	Medium Stiff Fine-Grained	-39.5	115	120	3555	2153	1402	1.0	1402	0.98	0.43	0.47	3756	-437	582	146	0.24	0.00	0.1	0	3819	5367	0.07	0.014	0.0	0.49
35	36	35.5	Medium Stiff Fine-Grained	-40.5	115	120	3675	2215	1460	1.0	1460	0.98	0.42	0.47	3746	-435	580	145	0.23	0.00	0.1	0	3801	5406	0.07	0.014	0.0	0.48
36	37	36.5	Medium Stiff Fine-Grained	-41.5	115	120	3795	2278	1517	1.0	1517	0.99	0.41	0.47	3736	-433	577	144	0.22	0.00	0.1	0	3784	5446	0.07	0.014	0.0	0.47
37	38	37.5	Medium Stiff Fine-Grained	-42.5	115	120	3915	2340	1575	1.0	1575	0.99	0.40	0.47	3725	-431	575	144	0.22	0.00	0.1	0	3767	5486	0.07	0.014	0.0	0.46
38	39	38.5	Medium Stiff Fine-Grained	-43.5	115	120	4035	2402	1633	1.0	1633	1.00	0.39	0.47	3715	-429	572	143	0.21	0.00	0.1	0	3750	5525	0.07	0.014	0.0	0.44
39	40	39.5	Medium Stiff Fine-Grained	-44.5	115	120	4155	2465	1690	1.0	1690	1.00	0.38	0.47	3704	-427	570	142	0.21	0.00	0.1	0	3733	5565	0.07	0.014	0.0	0.43
40	41	40.5	Medium Stiff Fine-Grained	-45.5	115	120	4275	2527	1748	1.0	1748	1.01	0.38	0.47	3694	-426	568	142	0.20	0.00	0.1	0	3716	5606	0.07	0.014	0.0	0.43
41	42	41.5	Medium Stiff Fine-Grained	-46.5	115	120	4395	2590	1805	1.0	1805	1.01	0.37	0.47	3683	-424	565	141	0.20	0.00	0.1	0	3699	5646	0.07	0.014	0.0	0.42
42	43	42.5	Medium Stiff Fine-Grained	-47.5	115	120	4515	2652	1863	1.0	1863	1.01	0.36	0.46	3672	-422	563	141	0.19	0.00	0.1	0	3683	5686	0.07	0.014	0.0	0.41
43	44	43.5	Medium Stiff Fine-Grained	-48.5	115	120	4635	2714	1921	1.0	1921	1.02	0.35	0.46	3662	-420	560	140	0.19	0.00	0.1	0	3666	5727	0.07	0.014	0.0	0.40
44	45	44.5	Medium Stiff Fine-Grained	-49.5	115	120	4755	2777	1978	1.0	1978	1.02	0.35	0.46	3651	-419	558	140	0.19	0.00	0.1	0	3650	5767	0.07	0.014	0.0	0.39
45	46	45.5	Medium Stiff Fine-Grained	-50.5	115	120	4875	2839	2036	1.0	2036	1.02	0.34	0.46	3640	-417	556	139	0.18	0.00	0.1	0	3633	5808	0.07	0.014	0.0	0.38
46	47	46.5	Medium Stiff Fine-Grained	-51.5	115	120	4995	2902	2093	1.0	2093	1.03	0.33	0.46	3629	-415	553	138	0.18	0.00	0.1	0	3617	5849	0.07	0.014	0.0	0.37
47	48	47.5	Medium Stiff Fine-Grained	-52.5	115	120	5115	2964	2151	1.0	2151	1.03	0.32	0.46	3619	-413	551	138	0.17	0.00	0.1	0	3601	5890	0.07	0.014	0.0	0.37
48	49	48.5	Medium Stiff Fine-Grained	-53.5	115	120	5235	3026	2209	1.0	2209	1.03	0.32	0.46	3608	-412	549	137	0.17	0.00	0.1	0	3585	5931	0.07	0.014	0.0	0.36

Configuration **6H1V_P1_G2-AR25**

by: E. Ticen
Last Updated: February 2020

Geometry	Embankment Height, H	33	ft
	Embankment Side Slopes	6	xH:1V
	Crown Width	32	ft
	Half Crown Width, B1	16	ft
	Side Slope Width, B2	198	ft
	Unit Weight of Embankment, γ	120	pcf
	Depth to Ground Water	0	ft
	Maximum Stress Increase	3960	psf
	Water Surface Elevation	-5	ft
	Ground Surface Elevation	-5	ft
Foundation Improvements	Remove & Replace Depth [1]	6	ft
	Area Replacement Ratio	0.25	-
	Shear Key Thickness	2.5	ft
	Shear Key Depth	40	ft
	Shear Key Raft Foundation Depth	26.7	ft
	Shear key Spacing	10.0	ft
	Soil Arching b/w Shear Key	0.5	xV:1H
	Arching Stress Height	2	ft
	Arching Side Slope Width, B2	5.0	ft
	σmax Arching	225	psf

Notes:
1) Compacted fill where settlement of the material is considered to be negligible.
2)
3)
4)
5)
6)
7)

Total Settlement at Midpoint Between Shear Keys=	25.2	inches
Total Settlement at Shear Keys=	16.9	inches
Differential Settlement=	8.3	inches

		Depth (GS=0-ft)		Elevation (ft)		Unit Weight		Settlement					Staged Construction		
		Top	Bottom	Top	Bottom	Moist	Saturated	$C_{c\varepsilon} = C_c/(1+e_o)$	$C_{r\varepsilon} = C_{cd}/5$	OCR	Total Layer Settlement		Reduction	Total Layer Settlement	
Layer	Description	(ft)	(ft)	(ft)	(ft)	(pcf)	(pcf)	(-)	(-)	(-)	(in)	(ft)	(%)	(in)	(ft)
1	Embankment Fill	-33	0	28	-5	115	120	0.01	0.002	5	0	0.00	100%	0	0.00
2	Organics	0	15	-5	-20	85	90	0.180	0.036	1	5.8	0.49	0%	6	0.49
3a	Soft to Medium Stiff Fine-Grained	15	30	-20	-35	105	110	0.120	0.024	1	5.5	0.45	0%	5	0.45
4	Medium Stiff Fine-Grained	30	50	-35	-55	115	120	0.070	0.014	1	8.7	0.73	0%	9	0.73
5	Stiff Fine-Grained	50	100	-55	-105	120	125	0.017	0.0034	1	2.9	0.24	0%	3	0.24
6	Dense Coarse-Grained	100	150	-105	-155	120	125	0.017	0.0034	1	1.5	0.12	0%	1	0.12
7	Stiff Fine-Grained	150	200	-155	-205	120	125	0.017	0.0034	1	0.8	0.07	0%	1	0.07
										Σ=	25.2	2.1	Σ=	25.2	2.1

							Pre Construction					Δσ due to Embankment Load (Das - 5.6)				Δσ due to Foundation R&R (2:1)			Δσ With Arching for Shear Keys (Das - 5.6)								
Top of Layer	Bottom of Layer	Depth (ft)	Layer (-)	Elevation (ft)	Moist Unit Weight (pcf)	Saturated Unit Weight (pcf)	Total Stress (psf)	Pore Pressure (psf)	Effective stress (psf)	OCR (-)	Pre- Consolidation Pressure (psf)	α_1 (rad)	α_2 (rad)	Influence Value I'	Δσ below Embankment middle (psf)	Foundation Removal (psf)	Foundation Replacement (psf)	Net Stress Change in Layer (psf)	α1 (rad)	α2 (rad)	Influence Value I'	Δσ between shear keys above shear key raft foundation (psf)	Δσ below shear key raft foundation	Final Stress (psf)	$C_{c\varepsilon}$ (-)	$C_{r\varepsilon}$ (-)	Vertical Strain $\varepsilon_{v,i}$ (%)	Change in Layer Thickness Δh_i (in)
0	1	0.5	Organics	-5.5	85	90	45	31	14	1.0	14	0.03	1.54	0.50	3960	-45	60	15	1.47	0.00	0.5	211	0	240	0.18	0.036	0.0	0.00
1	2	1.5	Organics	-6.5	85	90	135	94	41	1.0	41	0.09	1.48	0.50	3960	-135	180	45	1.28	0.00	0.4	183	0	270	0.18	0.036	0.0	0.00
2	3	2.5	Organics	-7.5	85	90	225	156	69	1.0	69	0.14	1.42	0.50	3960	-225	300	75	1.11	0.00	0.4	159	0	303	0.18	0.036	0.0	0.00
3	4	3.5	Organics	-8.5	85	90	315	218	97	1.0	97	0.20	1.36	0.50	3959	-315	420	105	0.96	0.00	0.3	138	0	339	0.18	0.036	0.0	0.00
4	5	4.5	Organics	-9.5	85	90	405	281	124	1.0	124	0.25	1.30	0.50	3959	-405	540	135	0.84	0.00	0.3	120	0	379	0.18	0.036	0.0	0.00
5	6	5.5	Organics	-10.5	85	90	495	343	152	1.0	152	0.31	1.24	0.50	3957	-495	660	165	0.74	0.00	0.2	113	0	429	0.18	0.036	0.0	0.00
6	7	6.5	Organics	-11.5	85	90	585	406	179	1.0	179	0.36	1.18	0.50	3956	-494	659	165	0.66	0.00	0.2	113	0	457	0.18	0.036	0.1	0.88
7	8	7.5	Organics	-12.5	85	90	675	468	207	1.0	207	0.40	1.13	0.50	3954	-492	656	164	0.59	0.00	0.2	113	0	483	0.18	0.036	0.1	0.80
8	9	8.5	Organics	-13.5	85	90	765	530	235	1.0	235	0.45	1.08	0.50	3951	-489	653	163	0.53	0.00	0.2	113	0	510	0.18	0.036	0.1	0.73
9	10	9.5	Organics	-14.5	85	90	855	593	262	1.0	262	0.49	1.03	0.50	3948	-487	650	162	0.48	0.00	0.2	113	0	537	0.18	0.036	0.1	0.67
10	11	10.5	Organics	-15.5	85	90	945	655	290	1.0	290	0.53	0.99	0.50	3945	-485	647	162	0.44	0.00	0.1	113	0	564	0.18	0.036	0.1	0.62
11	12	11.5	Organics	-16.5	85	90	1035	718	317	1.0	317	0.57	0.95	0.50	3941	-483	644	161	0.41	0.00	0.1	113	0	591	0.18	0.036	0.0	0.58
12	13	12.5	Organics	-17.5	85	90	1125	780	345	1.0	345	0.60	0.91	0.50	3936	-481	641	160	0.38	0.00	0.1	113	0	618	0.18	0.036	0.0	0.55
13	14	13.5	Organics	-18.5	85	90	1215	842	373	1.0	373	0.64	0.87	0.50	3931	-479	638	160	0.35	0.00	0.1	113	0	645	0.18	0.036	0.0	0.51
14	15	14.5	Organics	-19.5	85	90	1305	905	400	1.0	400	0.67	0.83	0.50	3926	-476	635	159	0.33	0.00	0.1	113	0	672	0.18	0.036	0.0	0.49
15	16	15.5	Soft to Medium Stiff Fine-Grained	-20.5	105	110	1415	967	448	1.0	448	0.70	0.80	0.49	3920	-474	632	158	0.31	0.00	0.1	113	0	718	0.12	0.024	0.0	0.30
16	17	16.5	Soft to Medium Stiff Fine-Grained	-21.5	105	110	1525	1030	495	1.0	495	0.72	0.77	0.49	3913	-472	630	157	0.29	0.00	0.1	113	0	765	0.12	0.024	0.0	0.27
17	18	17.5	Soft to Medium Stiff Fine-Grained	-22.5	105	110	1635	1092	543	1.0	543	0.75	0.74	0.49	3907	-470	627	157	0.28	0.00	0.1	113	0	812	0.12	0.024	0.0	0.25
18	19	18.5	Soft to Medium Stiff Fine-Grained	-23.5	105	110	1745	1154	591	1.0	591	0.77	0.71	0.49	3900	-468	624	156	0.26	0.00	0.1	113	0	859	0.12	0.024	0.0	0.23
19	20	19.5	Soft to Medium Stiff Fine-Grained	-24.5	105	110	1855	1217	638	1.0	638	0.79	0.69	0.49	3892	-466	621	155	0.25	0.00	0.1	113	0	906	0.12	0.024	0.0	0.22
20	21	20.5	Soft to Medium Stiff Fine-Grained	-25.5	105	110	1965	1279	686	1.0	686	0.81	0.66	0.49	3885	-464	619	155	0.24	0.00	0.1	113	0	953	0.12	0.024	0.0	0.21
21	22	21.5	Soft to Medium Stiff Fine-Grained	-26.5	105	110	2075	1342	733	1.0	733	0.83	0.64	0.49	3877	-462	616	154	0.23	0.00	0.1	113	0	1000	0.12	0.024	0.0	0.19
22	23	22.5	Soft to Medium Stiff Fine-Grained	-27.5	105	110	2185	1404	781	1.0	781	0.85	0.62	0.49	3869	-460	613	153	0.22	0.00	0.1	113	0	1047	0.12	0.024	0.0	0.18
23	24	23.5	Soft to Medium Stiff Fine-Grained	-28.5	105	110	2295	1466	829	1.0	829	0.86	0.60	0.49	3860	-458	610	153	0.21	0.00	0.1	113	0	1094	0.12	0.024	0.0	0.17
24	25	24.5	Soft to Medium Stiff Fine-Grained	-29.5	105	110	2405	1529	876	1.0	876	0.88	0.58	0.49	3852	-456	608	152	0.20	0.00	0.1	113	0	1141	0.12	0.024	0.0	0.16
25	26	25.5	Soft to Medium Stiff Fine-Grained	-30.5	105	110	2515	1591	924	1.0	924	0.89	0.56	0.49	3843	-454	605	151	0.19	0.00	0.1	113	0	1188	0.12	0.024	0.0	0.16
26	27	26.5	Soft to Medium Stiff Fine-Grained	-31.5	105	110	2625	1654	971	1.0	971	0.90	0.54	0.48	3834	-452	603	151	0.19	0.00	0.1	113	0	1235	0.12	0.024	0.0	0.15
27	28	27.5	Soft to Medium Stiff Fine-Grained	-32.5	105	110	2735	1716	1019	1.0	1019	0.92	0.53	0.48	3824	-450	600	150	0.18	0.00	0.1	0	3945	5114	0.12	0.024	0.1	1.01
28	29	28.5	Soft to Medium Stiff Fine-Grained	-33.5	105	110	2845	1778	1067	1.0	1067	0.93	0.51	0.48	3815	-448	597	149	0.17	0.00	0.1	0	3926	5142	0.12	0.024	0.1	0.98
29	30	29.5	Soft to Medium Stiff Fine-Grained	-34.5	105	110	2955	1841	1114	1.0	1114	0.94	0.50	0.48	3806	-446	595	149	0.17	0.00	0.1	0	3908	5171	0.12	0.024	0.1	0.96
30	31	30.5	Medium Stiff Fine-Grained	-35.5	115	120	3075	1903	1172	1.0	1172	0.95	0.48	0.48	3796	-444	592	148	0.16	0.00	0.1	0	3890	5210	0.07	0.014	0.0	0.54
31	32	31.5	Medium Stiff Fine-Grained	-36.5	115	120	3195	1966	1229	1.0	1229	0.95	0.47	0.48	3786	-442	590	147	0.16	0.00	0.1	0	3872	5249	0.07	0.014	0.0	0.53
32	33	32.5	Medium Stiff Fine-Grained	-37.5	115	120	3315	2028	1287	1.0	1287	0.96	0.46	0.48	3776	-440	587	147	0.15	0.00	0.0	0	3854	5288	0.07	0.014	0.0	0.52
33	34	33.5	Medium Stiff Fine-Grained	-38.5	115	120	3435	2090	1345	1.0	1345	0.97	0.45	0.48	3766	-438	585	146	0.15	0.00	0.0	0	3837	5327	0.07	0.014	0.0	0.50
34	35	34.5	Medium Stiff Fine-Grained	-39.5	115	120	3555	2153	1402	1.0	1402	0.98	0.43	0.47	3756	-437	582	146	0.14	0.00	0.0	0	3819	5367	0.07	0.014	0.0	0.49
35	36	35.5	Medium Stiff Fine-Grained	-40.5	115	120	3675	2215	1460	1.0	1460	0.98	0.42	0.47	3746	-435	580	145	0.14	0.00	0.0	0	3801	5406	0.07	0.014	0.0	0.48
36	37	36.5	Medium Stiff Fine-Grained	-41.5	115	120	3795	2278	1517	1.0	1517	0.99	0.41	0.47	3736	-433	577	144	0.14	0.00	0.0	0	3784	5446	0.07	0.014	0.0	0.47
37	38	37.5	Medium Stiff Fine-Grained	-42.5	115	120	3915	2340	1575	1.0	1575	0.99	0.40	0.47	3725	-431	575	144	0.13	0.00	0.0	0	3767	5486	0.07	0.014	0.0	0.46
38	39	38.5	Medium Stiff Fine-Grained	-43.5	115	120	4035	2402	1633	1.0	1633	1.00	0.39	0.47	3715	-429	572	143	0.13	0.00	0.0	0	3750	5525	0.07	0.014	0.0	0.44
39	40	39.5	Medium Stiff Fine-Grained	-44.5	115	120	4155	2465	1690	1.0	1690	1.00	0.38	0.47	3704	-427	570	142	0.13	0.00	0.0	0	3733	5565	0.07	0.014	0.0	0.43
40	41	40.5	Medium Stiff Fine-Grained	-45.5	115	120	4275	2527	1748	1.0	1748	1.01	0.38	0.47	3694	-426	568	142	0.12	0.00	0.0	0	3716	5606	0.07	0.014	0.0	0.43
41	42	41.5	Medium Stiff Fine-Grained	-46.5	115	120	4395	2590	1805	1.0	1805	1.01	0.37	0.47	3683	-424	565	141	0.12	0.00	0.0	0	3699	5646	0.07	0.014	0.0	0.42
42	43	42.5	Medium Stiff Fine-Grained	-47.5	115	120	4515	2652	1863	1.0	1863	1.01	0.36	0.46	3672	-422	563	141	0.12	0.00	0.0	0	3683	5686	0.07	0.014	0.0	0.41
43	44	43.5	Medium Stiff Fine-Grained	-48.5	115	120	4635	2714	1921	1.0	1921	1.02	0.35	0.46	3662	-420	560	140	0.11	0.00	0.0	0	3666	5727	0.07	0.014	0.0	0.40
44	45	44.5	Medium Stiff Fine-Grained	-49.5	115	120	4755	2777	1978	1.0	1978	1.02	0.35	0.46	3651	-419	558	140	0.11	0.00	0.0	0	3650	5767	0.07	0.014	0.0	0.39
45	46	45.5	Medium Stiff Fine-Grained	-50.5	115	120	4875	2839	2036	1.0	2036	1.02	0.34	0.46	3640	-417	556	139	0.11	0.00	0.0	0	3633	5808	0.07	0.014	0.0	0.38
46	47	46.5	Medium Stiff Fine-Grained	-51.5	115	120	4995	2902	2093	1.0	2093	1.03	0.33	0.46	3629	-415	553	138	0.11	0.00	0.0	0	3617	5849	0.07	0.014	0.0	0.37
47	48	47.5	Medium Stiff Fine-Grained	-52.5	115	120	5115	2964	2151	1.0	2151	1.03	0.32	0.46	3619	-413	551	138	0.10	0.00	0.0	0	3601	5890	0.07	0.014	0.0	0.37
48	49	48.5	Medium Stiff Fine-Grained	-53.5	115	120	5235	3026	2209	1.0	2209	1.03	0.32	0.46	3608	-412	549	137	0.10	0.00	0.0	0	3585	5931	0.07	0.014	0.0	0.36

Configuration **6H1V_P2_E**

by: E. Ticen
Last Updated: February 2020

Geometry	Embankment Height, H	33	ft
	Embankment Side Slopes	6	xH:1V
	Crown Width	32	ft
	Half Crown Width, B1	16	ft
	Side Slope Width, B2	198	ft
	Unit Weight of Embankment, γ	120	pcf
	Depth to Ground Water	0	ft
	Maximum Stress Increase	3960	psf
	Water Surface Elevation	-5	ft
	Ground Surface Elevation	-5	ft
Foundation Improvements	Remove & Replace Depth [1]	6	ft
	Area Replacement Ratio	0	-
	Shear Key Thickness	0	ft
	Shear Key Depth	0	ft
	Shear Key Raft Foundation Depth	0.0	ft
	Shear key Spacing	--	ft
	Soil Arching b/w Shear Key	0	xV:1H
	Arching Stress Height	--	ft
	Arching Side Slope Width, B2	--	ft
	σmax Arching	0	psf

Notes:
1) Compacted fill where settlement of the material is considered to be negligible.
2)
3)
4)
5)
6)
7)

Total Settlement at Midpoint Between Shear Keys=	--	inches
Total Settlement at Shear Keys=	--	inches
Differential Settlement=	--	inches

		Depth (GS=0-ft)		Elevation (ft)		Unit Weight		Settlement					Staged Construction		
		Top	Bottom	Top	Bottom	Moist	Saturated	$C_{c\varepsilon} = C_c/(1+e_o)$	$C_{r\varepsilon} = C_{cd}/5$	OCR	Total Layer Settlement		Reduction	Total Layer Settlement	
Layer	Description	(ft)	(ft)	(ft)	(ft)	(pcf)	(pcf)	(-)	(-)	(-)	(in)	(ft)	(%)	(in)	(ft)
1	Embankment Fill	-33	0	28	-5	115	120	0.01	0.002	5	0	0.00	100%	0	0.00
2	Organics	0	15	-5	-20	85	90	0.180	0.036	1	23.2	1.94	0%	23	1.94
3b	Loose - Coarse Grained	15	30	-20	-35	105	110	0.005	0.001	1	0.7	0.06	0%	1	0.06
4	Medium Stiff Fine-Grained	30	50	-35	-55	115	120	0.070	0.014	1	8.7	0.72	0%	9	0.72
5	Stiff Fine-Grained	50	100	-55	-105	120	125	0.017	0.0034	1	2.9	0.24	0%	3	0.24
6	Dense Coarse-Grained	100	150	-105	-155	120	125	0.017	0.0034	1	1.6	0.13	0%	2	0.13
7	Stiff Fine-Grained	150	200	-155	-205	120	125	0.017	0.0034	1	0.9	0.07	0%	1	0.07
										Σ=	38.0	3.2	Σ=	38.0	3.2

							Pre Construction							Δσ due to Embankment Load (Das - 5.6)				Δσ due to Foundation R&R (2:1)			Δσ With Arching for Shear Keys (Das - 5.6)								
Top of Layer	Bottom of Layer	Depth (ft)	Layer (-)	Elevation (ft)	Moist Unit Weight (pcf)	Saturated Unit Weight (pcf)	Total Stress (psf)	Pore Pressure (psf)	Effective stress (psf)	OCR (-)	Pre- Consolidation Pressure (psf)	α_1 (rad)	α_2 (rad)	Influence Value I'	Δσ below Embankment middle (psf)	Foundation Removal (psf)	Foundation Replacement (psf)	Net Stress Change in Layer (psf)	α1 (rad)	α2 (rad)	Influence Value I'	Δσ between shear keys above shear key raft foundation (psf)	Δσ below shear key raft foundation	Final Stress (psf)	$C_{c\varepsilon}$ (-)	$C_{r\varepsilon}$ (-)	Vertical Strain $\varepsilon_{v,i}$ (%)	Change in Layer Thickness Δh_i (in)
0	1	0.5	Organics	-5.5	85	90	45	31	14	1.0	14	0.03	1.54	0.50	3960	-45	60	15	0.00	0.00	0.0	0	0	3989	0.18	0.036	0.0	0.00
1	2	1.5	Organics	-6.5	85	90	135	94	41	1.0	41	0.09	1.48	0.50	3960	-135	180	45	0.00	0.00	0.0	0	0	4046	0.18	0.036	0.0	0.00
2	3	2.5	Organics	-7.5	85	90	225	156	69	1.0	69	0.14	1.42	0.50	3960	-225	300	75	0.00	0.00	0.0	0	0	4104	0.18	0.036	0.0	0.00
3	4	3.5	Organics	-8.5	85	90	315	218	97	1.0	97	0.20	1.36	0.50	3959	-315	420	105	0.00	0.00	0.0	0	0	4161	0.18	0.036	0.0	0.00
4	5	4.5	Organics	-9.5	85	90	405	281	124	1.0	124	0.25	1.30	0.50	3959	-405	540	135	0.00	0.00	0.0	0	0	4218	0.18	0.036	0.0	0.00
5	6	5.5	Organics	-10.5	85	90	495	343	152	1.0	152	0.31	1.24	0.50	3957	-495	660	165	0.00	0.00	0.0	0	0	4274	0.18	0.036	0.0	0.00
6	7	6.5	Organics	-11.5	85	90	585	406	179	1.0	179	0.36	1.18	0.50	3956	-494	659	165	0.00	0.00	0.0	0	0	4300	0.18	0.036	0.2	2.98
7	8	7.5	Organics	-12.5	85	90	675	468	207	1.0	207	0.40	1.13	0.50	3954	-492	656	164	0.00	0.00	0.0	0	0	4325	0.18	0.036	0.2	2.85
8	9	8.5	Organics	-13.5	85	90	765	530	235	1.0	235	0.45	1.08	0.50	3951	-489	653	163	0.00	0.00	0.0	0	0	4349	0.18	0.036	0.2	2.74
9	10	9.5	Organics	-14.5	85	90	855	593	262	1.0	262	0.49	1.03	0.50	3948	-487	650	162	0.00	0.00	0.0	0	0	4373	0.18	0.036	0.2	2.64
10	11	10.5	Organics	-15.5	85	90	945	655	290	1.0	290	0.53	0.99	0.50	3945	-485	647	162	0.00	0.00	0.0	0	0	4396	0.18	0.036	0.2	2.55
11	12	11.5	Organics	-16.5	85	90	1035	718	317	1.0	317	0.57	0.95	0.50	3941	-483	644	161	0.00	0.00	0.0	0	0	4419	0.18	0.036	0.2	2.47
12	13	12.5	Organics	-17.5	85	90	1125	780	345	1.0	345	0.60	0.91	0.50	3936	-481	641	160	0.00	0.00	0.0	0	0	4441	0.18	0.036	0.2	2.40
13	14	13.5	Organics	-18.5	85	90	1215	842	373	1.0	373	0.64	0.87	0.50	3931	-479	638	160	0.00	0.00	0.0	0	0	4463	0.18	0.036	0.2	2.33
14	15	14.5	Organics	-19.5	85	90	1305	905	400	1.0	400	0.67	0.83	0.50	3926	-476	635	159	0.00	0.00	0.0	0	0	4485	0.18	0.036	0.2	2.27
15	16	15.5	Loose - Coarse Grained	-20.5	105	110	1415	967	448	1.0	448	0.70	0.80	0.49	3920	-474	632	158	0.00	0.00	0.0	0	0	4526	0.005	0.001	0.0	0.06
16	17	16.5	Loose - Coarse Grained	-21.5	105	110	1525	1030	495	1.0	495	0.72	0.77	0.49	3913	-472	630	157	0.00	0.00	0.0	0	0	4566	0.005	0.001	0.0	0.06
17	18	17.5	Loose - Coarse Grained	-22.5	105	110	1635	1092	543	1.0	543	0.75	0.74	0.49	3907	-470	627	157	0.00	0.00	0.0	0	0	4606	0.005	0.001	0.0	0.06
18	19	18.5	Loose - Coarse Grained	-23.5	105	110	1745	1154	591	1.0	591	0.77	0.71	0.49	3900	-468	624	156	0.00	0.00	0.0	0	0	4646	0.005	0.001	0.0	0.05
19	20	19.5	Loose - Coarse Grained	-24.5	105	110	1855	1217	638	1.0	638	0.79	0.69	0.49	3892	-466	621	155	0.00	0.00	0.0	0	0	4686	0.005	0.001	0.0	0.05
20	21	20.5	Loose - Coarse Grained	-25.5	105	110	1965	1279	686	1.0	686	0.81	0.66	0.49	3885	-464	619	155	0.00	0.00	0.0	0	0	4725	0.005	0.001	0.0	0.05
21	22	21.5	Loose - Coarse Grained	-26.5	105	110	2075	1342	733	1.0	733	0.83	0.64	0.49	3877	-462	616	154	0.00	0.00	0.0	0	0	4764	0.005	0.001	0.0	0.05
22	23	22.5	Loose - Coarse Grained	-27.5	105	110	2185	1404	781	1.0	781	0.85	0.62	0.49	3869	-460	613	153	0.00	0.00	0.0	0	0	4803	0.005	0.001	0.0	0.05
23	24	23.5	Loose - Coarse Grained	-28.5	105	110	2295	1466	829	1.0	829	0.86	0.60	0.49	3860	-458	610	153	0.00	0.00	0.0	0	0	4841	0.005	0.001	0.0	0.05
24	25	24.5	Loose - Coarse Grained	-29.5	105	110	2405	1529	876	1.0	876	0.88	0.58	0.49	3852	-456	608	152	0.00	0.00	0.0	0	0	4880	0.005	0.001	0.0	0.04
25	26	25.5	Loose - Coarse Grained	-30.5	105	110	2515	1591	924	1.0	924	0.89	0.56	0.49	3843	-454	605	151	0.00	0.00	0.0	0	0	4918	0.005	0.001	0.0	0.04
26	27	26.5	Loose - Coarse Grained	-31.5	105	110	2625	1654	971	1.0	971	0.90	0.54	0.48	3834	-452	603	151	0.00	0.00	0.0	0	0	4956	0.005	0.001	0.0	0.04
27	28	27.5	Loose - Coarse Grained	-32.5	105	110	2735	1716	1019	1.0	1019	0.92	0.53	0.48	3824	-450	600	150	0.00	0.00	0.0	0	0	4993	0.005	0.001	0.0	0.04
28	29	28.5	Loose - Coarse Grained	-33.5	105	110	2845	1778	1067	1.0	1067	0.93	0.51	0.48	3815	-448	597	149	0.00	0.00	0.0	0	0	5031	0.005	0.001	0.0	0.04
29	30	29.5	Loose - Coarse Grained	-34.5	105	110	2955	1841	1114	1.0	1114	0.94	0.50	0.48	3806	-446	595	149	0.00	0.00	0.0	0	0	5068	0.005	0.001	0.0	0.04
30	31	30.5	Medium Stiff Fine-Grained	-35.5	115	120	3075	1903	1172	1.0	1172	0.95	0.48	0.48	3796	-444	592	148	0.00	0.00	0.0	0	0	5116	0.07	0.014	0.0	0.54
31	32	31.5	Medium Stiff Fine-Grained	-36.5	115	120	3195	1966	1229	1.0	1229	0.95	0.47	0.48	3786	-442	590	147	0.00	0.00	0.0	0	0	5163	0.07	0.014	0.0	0.52
32	33	32.5	Medium Stiff Fine-Grained	-37.5	115	120	3315	2028	1287	1.0	1287	0.96	0.46	0.48	3776	-440	587	147	0.00	0.00	0.0	0	0	5210	0.07	0.014	0.0	0.51
33	34	33.5	Medium Stiff Fine-Grained	-38.5	115	120	3435	2090	1345	1.0	1345	0.97	0.45	0.48	3766	-438	585	146	0.00	0.00	0.0	0	0	5257	0.07	0.014	0.0	0.50
34	35	34.5	Medium Stiff Fine-Grained	-39.5	115	120	3555	2153	1402	1.0	1402	0.98	0.43	0.47	3756	-437	582	146	0.00	0.00	0.0	0	0	5304	0.07	0.014	0.0	0.49
35	36	35.5	Medium Stiff Fine-Grained	-40.5	115	120	3675	2215	1460	1.0	1460	0.98	0.42	0.47	3746	-435	580	145	0.00	0.00	0.0	0	0	5351	0.07	0.014	0.0	0.47
36	37	36.5	Medium Stiff Fine-Grained	-41.5	115	120	3795	2278	1517	1.0	1517	0.99	0.41	0.47	3736	-433	577	144	0.00	0.00	0.0	0	0	5397	0.07	0.014	0.0	0.46
37	38	37.5	Medium Stiff Fine-Grained	-42.5	115	120	3915	2340	1575	1.0	1575	0.99	0.40	0.47	3725	-431	575	144	0.00	0.00	0.0	0	0	5444	0.07	0.014	0.0	0.45
38	39	38.5	Medium Stiff Fine-Grained	-43.5	115	120	4035	2402	1633	1.0	1633	1.00	0.39	0.47	3715	-429	572	143	0.00	0.00	0.0	0	0	5490	0.07	0.014	0.0	0.44
39	40	39.5	Medium Stiff Fine-Grained	-44.5	115	120	4155	2465	1690	1.0	1690	1.00	0.38	0.47	3704	-427	570	142	0.00	0.00	0.0	0	0	5537	0.07	0.014	0.0	0.43
40	41	40.5	Medium Stiff Fine-Grained	-45.5	115	120	4275	2527	1748	1.0	1748	1.01	0.38	0.47	3694	-426	568	142	0.00	0.00	0.0	0	0	5583	0.07	0.014	0.0	0.42
41	42	41.5	Medium Stiff Fine-Grained	-46.5	115	120	4395	2590	1805	1.0	1805	1.01	0.37	0.47	3683	-424	565	141	0.00	0.00	0.0	0	0	5630	0.07	0.014	0.0	0.41
42	43	42.5	Medium Stiff Fine-Grained	-47.5	115	120	4515	2652	1863	1.0	1863	1.01	0.36	0.46	3672	-422	563	141	0.00	0.00	0.0	0	0	5676	0.07	0.014	0.0	0.41
43	44	43.5	Medium Stiff Fine-Grained	-48.5	115	120	4635	2714	1921	1.0	1921	1.02	0.35	0.46	3662	-420	560	140	0.00	0.00	0.0	0	0	5722	0.07	0.014	0.0	0.40
44	45	44.5	Medium Stiff Fine-Grained	-49.5	115	120	4755	2777	1978	1.0	1978	1.02	0.35	0.46	3651	-419	558	140	0.00	0.00	0.0	0	0	5769	0.07	0.014	0.0	0.39
45	46	45.5	Medium Stiff Fine-Grained	-50.5	115	120	4875	2839	2036	1.0	2036	1.02	0.34	0.46	3640	-417	556	139	0.00	0.00	0.0	0	0	5815	0.07	0.014	0.0	0.38
46	47	46.5	Medium Stiff Fine-Grained	-51.5	115	120	4995	2902	2093	1.0	2093	1.03	0.33	0.46	3629	-415	553	138	0.00	0.00	0.0	0	0	5861	0.07	0.014	0.0	0.38
47	48	47.5	Medium Stiff Fine-Grained	-52.5	115	120	5115	2964	2151	1.0	2151	1.03	0.32	0.46	3619	-413	551	138	0.00	0.00	0.0	0	0	5907	0.07	0.014	0.0	0.37
48	49	48.5	Medium Stiff Fine-Grained	-53.5	115	120	5235	3026	2209	1.0	2209	1.03	0.32	0.46	3608	-412	549	137	0.00	0.00	0.0	0	0	5954	0.07	0.014	0.0	0.36

Configuration **6H1V_P2_G1-RR15**

by: E. Ticen
Last Updated: February 2020

Geometry	Embankment Height, H	33	ft
	Embankment Side Slopes	6	xH:1V
	Crown Width	32	ft
	Half Crown Width, B1	16	ft
	Side Slope Width, B2	198	ft
	Unit Weight of Embankment, γ	120	pcf
	Depth to Ground Water	0	ft
	Maximum Stress Increase	3960	psf
	Water Surface Elevation	-5	ft
	Ground Surface Elevation	-5	ft
Foundation Improvements	Remove & Replace Depth [1]	15	ft
	Area Replacement Ratio	0	-
	Shear Key Thickness	0	ft
	Shear Key Depth	0	ft
	Shear Key Raft Foundation Depth	0.0	ft
	Shear key Spacing	--	ft
	Soil Arching b/w Shear Key	0	xV:1H
	Arching Stress Height	--	ft
	Arching Side Slope Width, B2	--	ft
	σmax Arching	0	psf

Notes:
1) Compacted fill where settlement of the material is considered to be negligible.
2)
3)
4)
5)
6)
7)

Total Settlement at Midpoint Between Shear Keys=	--	inches
Total Settlement at Shear Keys=	--	inches
Differential Settlement=	--	inches

		Depth (GS=0-ft)		Elevation (ft)		Unit Weight		Settlement					Staged Construction		
		Top	Bottom	Top	Bottom	Moist	Saturated	$C_{c\varepsilon} = C_c/(1+e_o)$	$C_{r\varepsilon} = C_{cE}/5$	OCR	Total Layer Settlement		Reduction	Total Layer Settlement	
Layer	Description	(ft)	(ft)	(ft)	(ft)	(pcf)	(pcf)	(-)	(-)	(-)	(in)	(ft)	(%)	(in)	(ft)
1	Embankment Fill	-33	0	28	-5	115	120	0.01	0.002	5	0	0.00	100%	0	0.00
2	Organics	0	15	-5	-20	85	90	0.180	0.036	1	0.0	0.00	0%	0	0.00
3b	Loose - Coarse Grained	15	30	-20	-35	105	110	0.005	0.001	1	0.7	0.06	0%	1	0.06
4	Medium Stiff Fine-Grained	30	50	-35	-55	115	120	0.070	0.014	1	9.0	0.75	0%	9	0.75
5	Stiff Fine-Grained	50	100	-55	-105	120	125	0.017	0.0034	1	3.1	0.26	0%	3	0.26
6	Dense Coarse-Grained	100	150	-105	-155	120	125	0.017	0.0034	1	1.7	0.14	0%	2	0.14
7	Stiff Fine-Grained	150	200	-155	-205	120	125	0.017	0.0034	1	0.9	0.08	0%	1	0.08
										Σ=	15.4	1.3	Σ=	15.4	1.3

							Pre Construction					Δσ due to Embankment Load (Das - 5.6)				Δσ due to Foundation R&R (2:1)			Δσ With Arching for Shear Keys (Das - 5.6)									
Top of Layer	Bottom of Layer	Depth (ft)	Layer (-)	Elevation (ft)	Moist Unit Weight (pcf)	Saturated Unit Weight (pcf)	Total Stress (psf)	Pore Pressure (psf)	Effective stress (psf)	OCR (-)	Pre- Consolidation Pressure (psf)	α_1 (rad)	α_2 (rad)	Influence Value I'	Δσ below Embankment middle (psf)	Foundation Removal (psf)	Foundation Replacement (psf)	Net Stress Change in Layer (psf)	α1 (rad)	α2 (rad)	Influence Value I'	Δσ between shear keys above shear key raft foundation (psf)	Δσ below shear key raft foundation	Final Stress (psf)	$C_{c\varepsilon}$ (-)	$C_{r\varepsilon}$ (-)	Vertical Strain $\varepsilon_{v,i}$ (%)	Change in Layer Thickness Δh_i (in)
0	1	0.5	Organics	-5.5	85	90	45	31	14	1.0	14	0.03	1.54	0.50	3960	-45	60	15	0.00	0.00	0.0	0	0	3989	0.18	0.036	0.0	0.00
1	2	1.5	Organics	-6.5	85	90	135	94	41	1.0	41	0.09	1.48	0.50	3960	-135	180	45	0.00	0.00	0.0	0	0	4046	0.18	0.036	0.0	0.00
2	3	2.5	Organics	-7.5	85	90	225	156	69	1.0	69	0.14	1.42	0.50	3960	-225	300	75	0.00	0.00	0.0	0	0	4104	0.18	0.036	0.0	0.00
3	4	3.5	Organics	-8.5	85	90	315	218	97	1.0	97	0.20	1.36	0.50	3959	-315	420	105	0.00	0.00	0.0	0	0	4161	0.18	0.036	0.0	0.00
4	5	4.5	Organics	-9.5	85	90	405	281	124	1.0	124	0.25	1.30	0.50	3959	-405	540	135	0.00	0.00	0.0	0	0	4218	0.18	0.036	0.0	0.00
5	6	5.5	Organics	-10.5	85	90	495	343	152	1.0	152	0.31	1.24	0.50	3957	-495	660	165	0.00	0.00	0.0	0	0	4274	0.18	0.036	0.0	0.00
6	7	6.5	Organics	-11.5	85	90	585	406	179	1.0	179	0.36	1.18	0.50	3956	-585	780	195	0.00	0.00	0.0	0	0	4330	0.18	0.036	0.0	0.00
7	8	7.5	Organics	-12.5	85	90	675	468	207	1.0	207	0.40	1.13	0.50	3954	-675	900	225	0.00	0.00	0.0	0	0	4386	0.18	0.036	0.0	0.00
8	9	8.5	Organics	-13.5	85	90	765	530	235	1.0	235	0.45	1.08	0.50	3951	-765	1020	255	0.00	0.00	0.0	0	0	4441	0.18	0.036	0.0	0.00
9	10	9.5	Organics	-14.5	85	90	855	593	262	1.0	262	0.49	1.03	0.50	3948	-855	1140	285	0.00	0.00	0.0	0	0	4495	0.18	0.036	0.0	0.00
10	11	10.5	Organics	-15.5	85	90	945	655	290	1.0	290	0.53	0.99	0.50	3945	-945	1260	315	0.00	0.00	0.0	0	0	4550	0.18	0.036	0.0	0.00
11	12	11.5	Organics	-16.5	85	90	1035	718	317	1.0	317	0.57	0.95	0.50	3941	-1035	1380	345	0.00	0.00	0.0	0	0	4603	0.18	0.036	0.0	0.00
12	13	12.5	Organics	-17.5	85	90	1125	780	345	1.0	345	0.60	0.91	0.50	3936	-1125	1500	375	0.00	0.00	0.0	0	0	4656	0.18	0.036	0.0	0.00
13	14	13.5	Organics	-18.5	85	90	1215	842	373	1.0	373	0.64	0.87	0.50	3931	-1215	1620	405	0.00	0.00	0.0	0	0	4709	0.18	0.036	0.0	0.00
14	15	14.5	Organics	-19.5	85	90	1305	905	400	1.0	400	0.67	0.83	0.50	3926	-1305	1740	435	0.00	0.00	0.0	0	0	4761	0.18	0.036	0.0	0.00
15	16	15.5	Loose - Coarse Grained	-20.5	105	110	1415	967	448	1.0	448	0.70	0.80	0.49	3920	-1302	1736	434	0.00	0.00	0.0	0	0	4802	0.005	0.001	0.0	0.06
16	17	16.5	Loose - Coarse Grained	-21.5	105	110	1525	1030	495	1.0	495	0.72	0.77	0.49	3913	-1296	1729	432	0.00	0.00	0.0	0	0	4841	0.005	0.001	0.0	0.06
17	18	17.5	Loose - Coarse Grained	-22.5	105	110	1635	1092	543	1.0	543	0.75	0.74	0.49	3907	-1291	1721	430	0.00	0.00	0.0	0	0	4880	0.005	0.001	0.0	0.06
18	19	18.5	Loose - Coarse Grained	-23.5	105	110	1745	1154	591	1.0	591	0.77	0.71	0.49	3900	-1285	1714	428	0.00	0.00	0.0	0	0	4919	0.005	0.001	0.0	0.06
19	20	19.5	Loose - Coarse Grained	-24.5	105	110	1855	1217	638	1.0	638	0.79	0.69	0.49	3892	-1280	1706	427	0.00	0.00	0.0	0	0	4957	0.005	0.001	0.0	0.05
20	21	20.5	Loose - Coarse Grained	-25.5	105	110	1965	1279	686	1.0	686	0.81	0.66	0.49	3885	-1274	1699	425	0.00	0.00	0.0	0	0	4995	0.005	0.001	0.0	0.05
21	22	21.5	Loose - Coarse Grained	-26.5	105	110	2075	1342	733	1.0	733	0.83	0.64	0.49	3877	-1269	1692	423	0.00	0.00	0.0	0	0	5033	0.005	0.001	0.0	0.05
22	23	22.5	Loose - Coarse Grained	-27.5	105	110	2185	1404	781	1.0	781	0.85	0.62	0.49	3869	-1263	1684	421	0.00	0.00	0.0	0	0	5071	0.005	0.001	0.0	0.05
23	24	23.5	Loose - Coarse Grained	-28.5	105	110	2295	1466	829	1.0	829	0.86	0.60	0.49	3860	-1258	1677	419	0.00	0.00	0.0	0	0	5108	0.005	0.001	0.0	0.05
24	25	24.5	Loose - Coarse Grained	-29.5	105	110	2405	1529	876	1.0	876	0.88	0.58	0.49	3852	-1253	1670	418	0.00	0.00	0.0	0	0	5145	0.005	0.001	0.0	0.05
25	26	25.5	Loose - Coarse Grained	-30.5	105	110	2515	1591	924	1.0	924	0.89	0.56	0.49	3843	-1247	1663	416	0.00	0.00	0.0	0	0	5182	0.005	0.001	0.0	0.04
26	27	26.5	Loose - Coarse Grained	-31.5	105	110	2625	1654	971	1.0	971	0.90	0.54	0.48	3834	-1242	1656	414	0.00	0.00	0.0	0	0	5219	0.005	0.001	0.0	0.04
27	28	27.5	Loose - Coarse Grained	-32.5	105	110	2735	1716	1019	1.0	1019	0.92	0.53	0.48	3824	-1237	1649	412	0.00	0.00	0.0	0	0	5256	0.005	0.001	0.0	0.04
28	29	28.5	Loose - Coarse Grained	-33.5	105	110	2845	1778	1067	1.0	1067	0.93	0.51	0.48	3815	-1231	1642	410	0.00	0.00	0.0	0	0	5292	0.005	0.001	0.0	0.04
29	30	29.5	Loose - Coarse Grained	-34.5	105	110	2955	1841	1114	1.0	1114	0.94	0.50	0.48	3806	-1226	1635	409	0.00	0.00	0.0	0	0	5328	0.005	0.001	0.0	0.04
30	31	30.5	Medium Stiff Fine-Grained	-35.5	115	120	3075	1903	1172	1.0	1172	0.95	0.48	0.48	3796	-1221	1628	407	0.00	0.00	0.0	0	0	5375	0.07	0.014	0.0	0.56
31	32	31.5	Medium Stiff Fine-Grained	-36.5	115	120	3195	1966	1229	1.0	1229	0.95	0.47	0.48	3786	-1216	1621	405	0.00	0.00	0.0	0	0	5421	0.07	0.014	0.0	0.54
32	33	32.5	Medium Stiff Fine-Grained	-37.5	115	120	3315	2028	1287	1.0	1287	0.96	0.46	0.48	3776	-1211	1614	404	0.00	0.00	0.0	0	0	5467	0.07	0.014	0.0	0.53
33	34	33.5	Medium Stiff Fine-Grained	-38.5	115	120	3435	2090	1345	1.0	1345	0.97	0.45	0.48	3766	-1206	1608	402	0.00	0.00	0.0	0	0	5513	0.07	0.014	0.0	0.51
34	35	34.5	Medium Stiff Fine-Grained	-39.5	115	120	3555	2153	1402	1.0	1402	0.98	0.43	0.47	3756	-1201	1601	400	0.00	0.00	0.0	0	0	5558	0.07	0.014	0.0	0.50
35	36	35.5	Medium Stiff Fine-Grained	-40.5	115	120	3675	2215	1460	1.0	1460	0.98	0.42	0.47	3746	-1196	1594	399	0.00	0.00	0.0	0	0	5604	0.07	0.014	0.0	0.49
36	37	36.5	Medium Stiff Fine-Grained	-41.5	115	120	3795	2278	1517	1.0	1517	0.99	0.41	0.47	3736	-1191	1587	397	0.00	0.00	0.0	0	0	5650	0.07	0.014	0.0	0.48
37	38	37.5	Medium Stiff Fine-Grained	-42.5	115	120	3915	2340	1575	1.0	1575	0.99	0.40	0.47	3725	-1186	1581	395	0.00	0.00	0.0	0	0	5695	0.07	0.014	0.0	0.47
38	39	38.5	Medium Stiff Fine-Grained	-43.5	115	120	4035	2402	1633	1.0	1633	1.00	0.39	0.47	3715	-1181	1574	394	0.00	0.00	0.0	0	0	5741	0.07	0.014	0.0	0.46
39	40	39.5	Medium Stiff Fine-Grained	-44.5	115	120	4155	2465	1690	1.0	1690	1.00	0.38	0.47	3704	-1176	1568	392	0.00	0.00	0.0	0	0	5786	0.07	0.014	0.0	0.45
40	41	40.5	Medium Stiff Fine-Grained	-45.5	115	120	4275	2527	1748	1.0	1748	1.01	0.38	0.47	3694	-1171	1561	390	0.00	0.00	0.0	0	0	5832	0.07	0.014	0.0	0.44
41	42	41.5	Medium Stiff Fine-Grained	-46.5	115	120	4395	2590	1805	1.0	1805	1.01	0.37	0.47	3683	-1166	1555	389	0.00	0.00	0.0	0	0	5877	0.07	0.014	0.0	0.43
42	43	42.5	Medium Stiff Fine-Grained	-47.5	115	120	4515	2652	1863	1.0	1863	1.01	0.36	0.46	3672	-1161	1548	387	0.00	0.00	0.0	0	0	5923	0.07	0.014	0.0	0.42
43	44	43.5	Medium Stiff Fine-Grained	-48.5	115	120	4635	2714	1921	1.0	1921	1.02	0.35	0.46	3662	-1157	1542	386	0.00	0.00	0.0	0	0	5968	0.07	0.014	0.0	0.41
44	45	44.5	Medium Stiff Fine-Grained	-49.5	115	120	4755	2777	1978	1.0	1978	1.02	0.35	0.46	3651	-1152	1536	384	0.00	0.00	0.0	0	0	6013	0.07	0.014	0.0	0.41
45	46	45.5	Medium Stiff Fine-Grained	-50.5	115	120	4875	2839	2036	1.0	2036	1.02	0.34	0.46	3640	-1147	1530	382	0.00	0.00	0.0	0	0	6058	0.07	0.014	0.0	0.40
46	47	46.5	Medium Stiff Fine-Grained	-51.5	115	120	4995	2902	2093	1.0	2093	1.03	0.33	0.46	3629	-1142	1523	381	0.00	0.00	0.0	0	0	6104	0.07	0.014	0.0	0.39
47	48	47.5	Medium Stiff Fine-Grained	-52.5	115	120	5115	2964	2151	1.0	2151	1.03	0.32	0.46	3619	-1138	1517	379	0.00	0.00	0.0	0	0	6149	0.07	0.014	0.0	0.38
48	49	48.5	Medium Stiff Fine-Grained	-53.5	115	120	5235	3026	2209	1.0	2209	1.03	0.32	0.46	3608	-1133	1511	378	0.00	0.00	0.0	0	0	6194	0.07	0.014	0.0	0.38

Configuration **6H1V_P2_G1-RR30**

by: E. Ticen
Last Updated: February 2020

Geometry	Embankment Height, H	33	ft
	Embankment Side Slopes	6	xH:1V
	Crown Width	32	ft
	Half Crown Width, B1	16	ft
	Side Slope Width, B2	198	ft
	Unit Weight of Embankment, γ	120	pcf
	Depth to Ground Water	0	ft
	Maximum Stress Increase	3960	psf
	Water Surface Elevation	-5	ft
	Ground Surface Elevation	-5	ft
Foundation Improvements	Remove & Replace Depth [1]	30	ft
	Area Replacement Ratio	0	-
	Shear Key Thickness	0	ft
	Shear Key Depth	0	ft
	Shear Key Raft Foundation Depth	0.0	ft
	Shear key Spacing	--	ft
	Soil Arching b/w Shear Key	0	xV:1H
	Arching Stress Height	--	ft
	Arching Side Slope Width, B2	--	ft
	σmax Arching	0	psf

Notes:
1) Compacted fill where settlement of the material is considered to be negligible.
2)
3)
4)
5)
6)
7)

Total Settlement at Midpoint Between Shear Keys=	--	inches
Total Settlement at Shear Keys=	--	inches
Differential Settlement=	--	inches

		Depth (GS=0-ft)		Elevation (ft)		Unit Weight		Settlement					Staged Construction		
		Top	Bottom	Top	Bottom	Moist	Saturated	$C_{c\varepsilon} = C_c/(1+e_o)$	$C_{r\varepsilon} = C_{cE}/5$	OCR	Total Layer Settlement		Reduction	Total Layer Settlement	
Layer	Description	(ft)	(ft)	(ft)	(ft)	(pcf)	(pcf)	(-)	(-)	(-)	(in)	(ft)	(%)	(in)	(ft)
1	Embankment Fill	-33	0	28	-5	115	120	0.01	0.002	5	0	0.00	100%	0	0.00
2	Organics	0	15	-5	-20	85	90	0.180	0.036	1	0.0	0.00	0%	0	0.00
3b	Loose - Coarse Grained	15	30	-20	-35	105	110	0.005	0.001	1	0.0	0.00	0%	0	0.00
4	Medium Stiff Fine-Grained	30	50	-35	-55	115	120	0.070	0.014	1	9.2	0.77	0%	9	0.77
5	Stiff Fine-Grained	50	100	-55	-105	120	125	0.017	0.0034	1	3.1	0.26	0%	3	0.26
6	Dense Coarse-Grained	100	150	-105	-155	120	125	0.017	0.0034	1	1.7	0.14	0%	2	0.14
7	Stiff Fine-Grained	150	200	-155	-205	120	125	0.017	0.0034	1	1.0	0.08	0%	1	0.08
										Σ=	15.1	1.3		Σ= 15.1	1.3

							Pre Construction					Δσ due to Embankment Load (Das - 5.6)				Δσ due to Foundation R&R (2:1)			Δσ With Arching for Shear Keys (Das - 5.6)									
Top of Layer	Bottom of Layer	Depth (ft)	Layer (-)	Elevation (ft)	Moist Unit Weight (pcf)	Saturated Unit Weight (pcf)	Total Stress (psf)	Pore Pressure (psf)	Effective stress (psf)	OCR (-)	Pre- Consolidation Pressure (psf)	α_1 (rad)	α_2 (rad)	Influence Value I'	Δσ below Embankment middle (psf)	Foundation Removal (psf)	Foundation Replacement (psf)	Net Stress Change in Layer (psf)	α1 (rad)	α2 (rad)	Influence Value I'	Δσ between shear keys above shear key raft foundation (psf)	Δσ below shear key raft foundation	Final Stress (psf)	$C_{c\varepsilon}$ (-)	$C_{r\varepsilon}$ (-)	Vertical Strain $\varepsilon_{v,i}$ (%)	Change in Layer Thickness Δh_i (in)
0	1	0.5	Organics	-5.5	85	90	45	31	14	1.0	14	0.03	1.54	0.50	3960	-45	60	15	0.00	0.00	0.0	0	0	3989	0.18	0.036	0.0	0.00
1	2	1.5	Organics	-6.5	85	90	135	94	41	1.0	41	0.09	1.48	0.50	3960	-135	180	45	0.00	0.00	0.0	0	0	4046	0.18	0.036	0.0	0.00
2	3	2.5	Organics	-7.5	85	90	225	156	69	1.0	69	0.14	1.42	0.50	3960	-225	300	75	0.00	0.00	0.0	0	0	4104	0.18	0.036	0.0	0.00
3	4	3.5	Organics	-8.5	85	90	315	218	97	1.0	97	0.20	1.36	0.50	3959	-315	420	105	0.00	0.00	0.0	0	0	4161	0.18	0.036	0.0	0.00
4	5	4.5	Organics	-9.5	85	90	405	281	124	1.0	124	0.25	1.30	0.50	3959	-405	540	135	0.00	0.00	0.0	0	0	4218	0.18	0.036	0.0	0.00
5	6	5.5	Organics	-10.5	85	90	495	343	152	1.0	152	0.31	1.24	0.50	3957	-495	660	165	0.00	0.00	0.0	0	0	4274	0.18	0.036	0.0	0.00
6	7	6.5	Organics	-11.5	85	90	585	406	179	1.0	179	0.36	1.18	0.50	3956	-585	780	195	0.00	0.00	0.0	0	0	4330	0.18	0.036	0.0	0.00
7	8	7.5	Organics	-12.5	85	90	675	468	207	1.0	207	0.40	1.13	0.50	3954	-675	900	225	0.00	0.00	0.0	0	0	4386	0.18	0.036	0.0	0.00
8	9	8.5	Organics	-13.5	85	90	765	530	235	1.0	235	0.45	1.08	0.50	3951	-765	1020	255	0.00	0.00	0.0	0	0	4441	0.18	0.036	0.0	0.00
9	10	9.5	Organics	-14.5	85	90	855	593	262	1.0	262	0.49	1.03	0.50	3948	-855	1140	285	0.00	0.00	0.0	0	0	4495	0.18	0.036	0.0	0.00
10	11	10.5	Organics	-15.5	85	90	945	655	290	1.0	290	0.53	0.99	0.50	3945	-945	1260	315	0.00	0.00	0.0	0	0	4550	0.18	0.036	0.0	0.00
11	12	11.5	Organics	-16.5	85	90	1035	718	317	1.0	317	0.57	0.95	0.50	3941	-1035	1380	345	0.00	0.00	0.0	0	0	4603	0.18	0.036	0.0	0.00
12	13	12.5	Organics	-17.5	85	90	1125	780	345	1.0	345	0.60	0.91	0.50	3936	-1125	1500	375	0.00	0.00	0.0	0	0	4656	0.18	0.036	0.0	0.00
13	14	13.5	Organics	-18.5	85	90	1215	842	373	1.0	373	0.64	0.87	0.50	3931	-1215	1620	405	0.00	0.00	0.0	0	0	4709	0.18	0.036	0.0	0.00
14	15	14.5	Organics	-19.5	85	90	1305	905	400	1.0	400	0.67	0.83	0.50	3926	-1305	1740	435	0.00	0.00	0.0	0	0	4761	0.18	0.036	0.0	0.00
15	16	15.5	Loose - Coarse Grained	-20.5	105	110	1415	967	448	1.0	448	0.70	0.80	0.49	3920	-1415	1860	445	0.00	0.00	0.0	0	0	4813	0.005	0.001	0.0	0.00
16	17	16.5	Loose - Coarse Grained	-21.5	105	110	1525	1030	495	1.0	495	0.72	0.77	0.49	3913	-1525	1980	455	0.00	0.00	0.0	0	0	4864	0.005	0.001	0.0	0.00
17	18	17.5	Loose - Coarse Grained	-22.5	105	110	1635	1092	543	1.0	543	0.75	0.74	0.49	3907	-1635	2100	465	0.00	0.00	0.0	0	0	4915	0.005	0.001	0.0	0.00
18	19	18.5	Loose - Coarse Grained	-23.5	105	110	1745	1154	591	1.0	591	0.77	0.71	0.49	3900	-1745	2220	475	0.00	0.00	0.0	0	0	4965	0.005	0.001	0.0	0.00
19	20	19.5	Loose - Coarse Grained	-24.5	105	110	1855	1217	638	1.0	638	0.79	0.69	0.49	3892	-1855	2340	485	0.00	0.00	0.0	0	0	5016	0.005	0.001	0.0	0.00
20	21	20.5	Loose - Coarse Grained	-25.5	105	110	1965	1279	686	1.0	686	0.81	0.66	0.49	3885	-1965	2460	495	0.00	0.00	0.0	0	0	5066	0.005	0.001	0.0	0.00
21	22	21.5	Loose - Coarse Grained	-26.5	105	110	2075	1342	733	1.0	733	0.83	0.64	0.49	3877	-2075	2580	505	0.00	0.00	0.0	0	0	5115	0.005	0.001	0.0	0.00
22	23	22.5	Loose - Coarse Grained	-27.5	105	110	2185	1404	781	1.0	781	0.85	0.62	0.49	3869	-2185	2700	515	0.00	0.00	0.0	0	0	5165	0.005	0.001	0.0	0.00
23	24	23.5	Loose - Coarse Grained	-28.5	105	110	2295	1466	829	1.0	829	0.86	0.60	0.49	3860	-2295	2820	525	0.00	0.00	0.0	0	0	5214	0.005	0.001	0.0	0.00
24	25	24.5	Loose - Coarse Grained	-29.5	105	110	2405	1529	876	1.0	876	0.88	0.58	0.49	3852	-2405	2940	535	0.00	0.00	0.0	0	0	5263	0.005	0.001	0.0	0.00
25	26	25.5	Loose - Coarse Grained	-30.5	105	110	2515	1591	924	1.0	924	0.89	0.56	0.49	3843	-2515	3060	545	0.00	0.00	0.0	0	0	5311	0.005	0.001	0.0	0.00
26	27	26.5	Loose - Coarse Grained	-31.5	105	110	2625	1654	971	1.0	971	0.90	0.54	0.48	3834	-2625	3180	555	0.00	0.00	0.0	0	0	5360	0.005	0.001	0.0	0.00
27	28	27.5	Loose - Coarse Grained	-32.5	105	110	2735	1716	1019	1.0	1019	0.92	0.53	0.48	3824	-2735	3300	565	0.00	0.00	0.0	0	0	5408	0.005	0.001	0.0	0.00
28	29	28.5	Loose - Coarse Grained	-33.5	105	110	2845	1778	1067	1.0	1067	0.93	0.51	0.48	3815	-2845	3420	575	0.00	0.00	0.0	0	0	5457	0.005	0.001	0.0	0.00
29	30	29.5	Loose - Coarse Grained	-34.5	105	110	2955	1841	1114	1.0	1114	0.94	0.50	0.48	3806	-2955	3540	585	0.00	0.00	0.0	0	0	5505	0.005	0.001	0.0	0.00
30	31	30.5	Medium Stiff Fine-Grained	-35.5	115	120	3075	1903	1172	1.0	1172	0.95	0.48	0.48	3796	-2949	3533	584	0.00	0.00	0.0	0	0	5551	0.07	0.014	0.0	0.57
31	32	31.5	Medium Stiff Fine-Grained	-36.5	115	120	3195	1966	1229	1.0	1229	0.95	0.47	0.48	3786	-2937	3518	581	0.00	0.00	0.0	0	0	5597	0.07	0.014	0.0	0.55
32	33	32.5	Medium Stiff Fine-Grained	-37.5	115	120	3315	2028	1287	1.0	1287	0.96	0.46	0.48	3776	-2925	3504	579	0.00	0.00	0.0	0	0	5642	0.07	0.014	0.0	0.54
33	34	33.5	Medium Stiff Fine-Grained	-38.5	115	120	3435	2090	1345	1.0	1345	0.97	0.45	0.48	3766	-2913	3490	577	0.00	0.00	0.0	0	0	5687	0.07	0.014	0.0	0.53
34	35	34.5	Medium Stiff Fine-Grained	-39.5	115	120	3555	2153	1402	1.0	1402	0.98	0.43	0.47	3756	-2901	3476	574	0.00	0.00	0.0	0	0	5733	0.07	0.014	0.0	0.51
35	36	35.5	Medium Stiff Fine-Grained	-40.5	115	120	3675	2215	1460	1.0	1460	0.98	0.42	0.47	3746	-2890	3462	572	0.00	0.00	0.0	0	0	5778	0.07	0.014	0.0	0.50
36	37	36.5	Medium Stiff Fine-Grained	-41.5	115	120	3795	2278	1517	1.0	1517	0.99	0.41	0.47	3736	-2878	3448	570	0.00	0.00	0.0	0	0	5823	0.07	0.014	0.0	0.49
37	38	37.5	Medium Stiff Fine-Grained	-42.5	115	120	3915	2340	1575	1.0	1575	0.99	0.40	0.47	3725	-2866	3434	567	0.00	0.00	0.0	0	0	5868	0.07	0.014	0.0	0.48
38	39	38.5	Medium Stiff Fine-Grained	-43.5	115	120	4035	2402	1633	1.0	1633	1.00	0.39	0.47	3715	-2855	3420	565	0.00	0.00	0.0	0	0	5912	0.07	0.014	0.0	0.47
39	40	39.5	Medium Stiff Fine-Grained	-44.5	115	120	4155	2465	1690	1.0	1690	1.00	0.38	0.47	3704	-2843	3406	563	0.00	0.00	0.0	0	0	5957	0.07	0.014	0.0	0.46
40	41	40.5	Medium Stiff Fine-Grained	-45.5	115	120	4275	2527	1748	1.0	1748	1.01	0.38	0.47	3694	-2832	3392	561	0.00	0.00	0.0	0	0	6002	0.07	0.014	0.0	0.45
41	42	41.5	Medium Stiff Fine-Grained	-46.5	115	120	4395	2590	1805	1.0	1805	1.01	0.37	0.47	3683	-2821	3379	558	0.00	0.00	0.0	0	0	6047	0.07	0.014	0.0	0.44
42	43	42.5	Medium Stiff Fine-Grained	-47.5	115	120	4515	2652	1863	1.0	1863	1.01	0.36	0.46	3672	-2809	3365	556	0.00	0.00	0.0	0	0	6092	0.07	0.014	0.0	0.43
43	44	43.5	Medium Stiff Fine-Grained	-48.5	115	120	4635	2714	1921	1.0	1921	1.02	0.35	0.46	3662	-2798	3352	554	0.00	0.00	0.0	0	0	6136	0.07	0.014	0.0	0.42
44	45	44.5	Medium Stiff Fine-Grained	-49.5	115	120	4755	2777	1978	1.0	1978	1.02	0.35	0.46	3651	-2787	3339	552	0.00	0.00	0.0	0	0	6181	0.07	0.014	0.0	0.42
45	46	45.5	Medium Stiff Fine-Grained	-50.5	115	120	4875	2839	2036	1.0	2036	1.02	0.34	0.46	3640	-2776	3325	550	0.00	0.00	0.0	0	0	6226	0.07	0.014	0.0	0.41
46	47	46.5	Medium Stiff Fine-Grained	-51.5	115	120	4995	2902	2093	1.0	2093	1.03	0.33	0.46	3629	-2765	3312	547	0.00	0.00	0.0	0	0	6270	0.07	0.014	0.0	0.40
47	48	47.5	Medium Stiff Fine-Grained	-52.5	115	120	5115	2964	2151	1.0	2151	1.03	0.32	0.46	3619	-2754	3299	545	0.00	0.00	0.0	0	0	6315	0.07	0.014	0.0	0.39
48	49	48.5	Medium Stiff Fine-Grained	-53.5	115	120	5235	3026	2209	1.0	2209	1.03	0.32	0.46	3608	-2743	3286	543	0.00	0.00	0.0	0	0	6359	0.07	0.014	0.0	0.39

Configuration **6H1V_P2_G2-AR15**

by: E. Ticen
Last Updated: February 2020

Geometry	Embankment Height, H	33	ft
	Embankment Side Slopes	6	xH:1V
	Crown Width	32	ft
	Half Crown Width, B1	16	ft
	Side Slope Width, B2	198	ft
	Unit Weight of Embankment, γ	120	pcf
	Depth to Ground Water	0	ft
	Maximum Stress Increase	3960	psf
	Water Surface Elevation	-5	ft
	Ground Surface Elevation	-5	ft
Foundation Improvements	Remove & Replace Depth [1]	6	ft
	Area Replacement Ratio	0.15	-
	Shear Key Thickness	2.5	ft
	Shear Key Depth	40	ft
	Shear Key Raft Foundation Depth	26.7	ft
	Shear key Spacing	16.7	ft
	Soil Arching b/w Shear Key	0.5	xV:1H
	Arching Stress Height	4	ft
	Arching Side Slope Width, B2	8.3	ft
	σmax Arching	425	psf

Notes:
1) Compacted fill where settlement of the material is considered to be negligible.
2)
3)
4)
5)
6)
7)

Total Settlement at Midpoint Between Shear Keys=	21.5	inches
Total Settlement at Shear Keys=	14.0	inches
Differential Settlement=	7.4	inches

		Depth (GS=0-ft)		Elevation (ft)		Unit Weight		Settlement					Staged Construction		
		Top	Bottom	Top	Bottom	Moist	Saturated	$C_{c\varepsilon} = C_c/(1+e_o)$	$C_{r\varepsilon} = C_{cd}/5$	OCR	Total Layer Settlement		Reduction	Total Layer Settlement	
Layer	Description	(ft)	(ft)	(ft)	(ft)	(pcf)	(pcf)	(-)	(-)	(-)	(in)	(ft)	(%)	(in)	(ft)
1	Embankment Fill	-33	0	28	-5	115	120	0.01	0.002	5	0	0.00	100%	0	0.00
2	Organics	0	15	-5	-20	85	90	0.180	0.036	1	7.3	0.61	0%	7	0.61
3b	Loose - Coarse Grained	15	30	-20	-35	105	110	0.005	0.001	1	0.3	0.02	0%	0	0.02
4	Medium Stiff Fine-Grained	30	50	-35	-55	115	120	0.070	0.014	1	8.7	0.73	0%	9	0.73
5	Stiff Fine-Grained	50	100	-55	-105	120	125	0.017	0.0034	1	2.9	0.24	0%	3	0.24
6	Dense Coarse-Grained	100	150	-105	-155	120	125	0.017	0.0034	1	1.5	0.12	0%	1	0.12
7	Stiff Fine-Grained	150	200	-155	-205	120	125	0.017	0.0034	1	0.8	0.07	0%	1	0.07
										Σ=	21.5	1.8	Σ=	21.5	1.8

							Pre Construction					Δσ due to Embankment Load (Das - 5.6)				Δσ due to Foundation R&R (2:1)			Δσ With Arching for Shear Keys (Das - 5.6)								
Top of Layer	Bottom of Layer	Depth (ft)	Layer (-)	Elevation (ft)	Moist Unit Weight (pcf)	Saturated Unit Weight (pcf)	Total Stress (psf)	Pore Pressure (psf)	Effective stress (psf)	OCR (-)	Pre- Consolidation Pressure (psf)	α_1 (rad)	α_2 (rad)	Influence Value I'	Δσ below Embankment middle (psf)	Foundation Removal (psf)	Foundation Replacement (psf)	Net Stress Change in Layer (psf)	α1 (rad)	α2 (rad)	Influence Value I'	Δσ between shear keys above shear key raft foundation (psf)	Δσ below shear key raft foundation	Final Stress (psf)	$C_{c\varepsilon}$ (-)	$C_{r\varepsilon}$ (-)	Vertical Strain $\varepsilon_{v,i}$ (%)	Change in Layer Thickness Δh_i (in)
0	1	0.5	Organics	-5.5	85	90	45	31	14	1.0	14	0.03	1.54	0.50	3960	-45	60	15	1.51	0.00	0.5	409	0	438	0.18	0.036	0.0	0.00
1	2	1.5	Organics	-6.5	85	90	135	94	41	1.0	41	0.09	1.48	0.50	3960	-135	180	45	1.39	0.00	0.4	377	0	463	0.18	0.036	0.0	0.00
2	3	2.5	Organics	-7.5	85	90	225	156	69	1.0	69	0.14	1.42	0.50	3960	-225	300	75	1.28	0.00	0.4	346	0	490	0.18	0.036	0.0	0.00
3	4	3.5	Organics	-8.5	85	90	315	218	97	1.0	97	0.20	1.36	0.50	3959	-315	420	105	1.17	0.00	0.4	317	0	519	0.18	0.036	0.0	0.00
4	5	4.5	Organics	-9.5	85	90	405	281	124	1.0	124	0.25	1.30	0.50	3959	-405	540	135	1.08	0.00	0.3	291	0	550	0.18	0.036	0.0	0.00
5	6	5.5	Organics	-10.5	85	90	495	343	152	1.0	152	0.31	1.24	0.50	3957	-495	660	165	0.99	0.00	0.3	267	0	584	0.18	0.036	0.0	0.00
6	7	6.5	Organics	-11.5	85	90	585	406	179	1.0	179	0.36	1.18	0.50	3956	-494	659	165	0.91	0.00	0.3	246	0	590	0.18	0.036	0.1	1.12
7	8	7.5	Organics	-12.5	85	90	675	468	207	1.0	207	0.40	1.13	0.50	3954	-492	656	164	0.84	0.00	0.3	227	0	598	0.18	0.036	0.1	0.99
8	9	8.5	Organics	-13.5	85	90	765	530	235	1.0	235	0.45	1.08	0.50	3951	-489	653	163	0.78	0.00	0.2	213	0	610	0.18	0.036	0.1	0.90
9	10	9.5	Organics	-14.5	85	90	855	593	262	1.0	262	0.49	1.03	0.50	3948	-487	650	162	0.72	0.00	0.2	213	0	637	0.18	0.036	0.1	0.83
10	11	10.5	Organics	-15.5	85	90	945	655	290	1.0	290	0.53	0.99	0.50	3945	-485	647	162	0.67	0.00	0.2	213	0	664	0.18	0.036	0.1	0.78
11	12	11.5	Organics	-16.5	85	90	1035	718	317	1.0	317	0.57	0.95	0.50	3941	-483	644	161	0.63	0.00	0.2	213	0	691	0.18	0.036	0.1	0.73
12	13	12.5	Organics	-17.5	85	90	1125	780	345	1.0	345	0.60	0.91	0.50	3936	-481	641	160	0.59	0.00	0.2	213	0	718	0.18	0.036	0.1	0.69
13	14	13.5	Organics	-18.5	85	90	1215	842	373	1.0	373	0.64	0.87	0.50	3931	-479	638	160	0.55	0.00	0.2	213	0	745	0.18	0.036	0.1	0.65
14	15	14.5	Organics	-19.5	85	90	1305	905	400	1.0	400	0.67	0.83	0.50	3926	-476	635	159	0.52	0.00	0.2	213	0	772	0.18	0.036	0.1	0.62
15	16	15.5	Loose - Coarse Grained	-20.5	105	110	1415	967	448	1.0	448	0.70	0.80	0.49	3920	-474	632	158	0.49	0.00	0.2	213	0	818	0.005	0.001	0.0	0.02
16	17	16.5	Loose - Coarse Grained	-21.5	105	110	1525	1030	495	1.0	495	0.72	0.77	0.49	3913	-472	630	157	0.47	0.00	0.1	213	0	865	0.005	0.001	0.0	0.01
17	18	17.5	Loose - Coarse Grained	-22.5	105	110	1635	1092	543	1.0	543	0.75	0.74	0.49	3907	-470	627	157	0.44	0.00	0.1	213	0	912	0.005	0.001	0.0	0.01
18	19	18.5	Loose - Coarse Grained	-23.5	105	110	1745	1154	591	1.0	591	0.77	0.71	0.49	3900	-468	624	156	0.42	0.00	0.1	213	0	959	0.005	0.001	0.0	0.01
19	20	19.5	Loose - Coarse Grained	-24.5	105	110	1855	1217	638	1.0	638	0.79	0.69	0.49	3892	-466	621	155	0.40	0.00	0.1	213	0	1006	0.005	0.001	0.0	0.01
20	21	20.5	Loose - Coarse Grained	-25.5	105	110	1965	1279	686	1.0	686	0.81	0.66	0.49	3885	-464	619	155	0.39	0.00	0.1	213	0	1053	0.005	0.001	0.0	0.01
21	22	21.5	Loose - Coarse Grained	-26.5	105	110	2075	1342	733	1.0	733	0.83	0.64	0.49	3877	-462	616	154	0.37	0.00	0.1	213	0	1100	0.005	0.001	0.0	0.01
22	23	22.5	Loose - Coarse Grained	-27.5	105	110	2185	1404	781	1.0	781	0.85	0.62	0.49	3869	-460	613	153	0.35	0.00	0.1	213	0	1147	0.005	0.001	0.0	0.01
23	24	23.5	Loose - Coarse Grained	-28.5	105	110	2295	1466	829	1.0	829	0.86	0.60	0.49	3860	-458	610	153	0.34	0.00	0.1	213	0	1194	0.005	0.001	0.0	0.01
24	25	24.5	Loose - Coarse Grained	-29.5	105	110	2405	1529	876	1.0	876	0.88	0.58	0.49	3852	-456	608	152	0.33	0.00	0.1	213	0	1241	0.005	0.001	0.0	0.01
25	26	25.5	Loose - Coarse Grained	-30.5	105	110	2515	1591	924	1.0	924	0.89	0.56	0.49	3843	-454	605	151	0.32	0.00	0.1	213	0	1288	0.005	0.001	0.0	0.01
26	27	26.5	Loose - Coarse Grained	-31.5	105	110	2625	1654	971	1.0	971	0.90	0.54	0.48	3834	-452	603	151	0.30	0.00	0.1	213	0	1335	0.005	0.001	0.0	0.01
27	28	27.5	Loose - Coarse Grained	-32.5	105	110	2735	1716	1019	1.0	1019	0.92	0.53	0.48	3824	-450	600	150	0.29	0.00	0.1	0	3945	5114	0.005	0.001	0.0	0.04
28	29	28.5	Loose - Coarse Grained	-33.5	105	110	2845	1778	1067	1.0	1067	0.93	0.51	0.48	3815	-448	597	149	0.28	0.00	0.1	0	3926	5142	0.005	0.001	0.0	0.04
29	30	29.5	Loose - Coarse Grained	-34.5	105	110	2955	1841	1114	1.0	1114	0.94	0.50	0.48	3806	-446	595	149	0.28	0.00	0.1	0	3908	5171	0.005	0.001	0.0	0.04
30	31	30.5	Medium Stiff Fine-Grained	-35.5	115	120	3075	1903	1172	1.0	1172	0.95	0.48	0.48	3796	-444	592	148	0.27	0.00	0.1	0	3890	5210	0.07	0.014	0.0	0.54
31	32	31.5	Medium Stiff Fine-Grained	-36.5	115	120	3195	1966	1229	1.0	1229	0.95	0.47	0.48	3786	-442	590	147	0.26	0.00	0.1	0	3872	5249	0.07	0.014	0.0	0.53
32	33	32.5	Medium Stiff Fine-Grained	-37.5	115	120	3315	2028	1287	1.0	1287	0.96	0.46	0.48	3776	-440	587	147	0.25	0.00	0.1	0	3854	5288	0.07	0.014	0.0	0.52
33	34	33.5	Medium Stiff Fine-Grained	-38.5	115	120	3435	2090	1345	1.0	1345	0.97	0.45	0.48	3766	-438	585	146	0.24	0.00	0.1	0	3837	5327	0.07	0.014	0.0	0.50
34	35	34.5	Medium Stiff Fine-Grained	-39.5	115	120	3555	2153	1402	1.0	1402	0.98	0.43	0.47	3756	-437	582	146	0.24	0.00	0.1	0	3819	5367	0.07	0.014	0.0	0.49
35	36	35.5	Medium Stiff Fine-Grained	-40.5	115	120	3675	2215	1460	1.0	1460	0.98	0.42	0.47	3746	-435	580	145	0.23	0.00	0.1	0	3801	5406	0.07	0.014	0.0	0.48
36	37	36.5	Medium Stiff Fine-Grained	-41.5	115	120	3795	2278	1517	1.0	1517	0.99	0.41	0.47	3736	-433	577	144	0.22	0.00	0.1	0	3784	5446	0.07	0.014	0.0	0.47
37	38	37.5	Medium Stiff Fine-Grained	-42.5	115	120	3915	2340	1575	1.0	1575	0.99	0.40	0.47	3725	-431	575	144	0.22	0.00	0.1	0	3767	5486	0.07	0.014	0.0	0.46
38	39	38.5	Medium Stiff Fine-Grained	-43.5	115	120	4035	2402	1633	1.0	1633	1.00	0.39	0.47	3715	-429	572	143	0.21	0.00	0.1	0	3750	5525	0.07	0.014	0.0	0.44
39	40	39.5	Medium Stiff Fine-Grained	-44.5	115	120	4155	2465	1690	1.0	1690	1.00	0.38	0.47	3704	-427	570	142	0.21	0.00	0.1	0	3733	5565	0.07	0.014	0.0	0.43
40	41	40.5	Medium Stiff Fine-Grained	-45.5	115	120	4275	2527	1748	1.0	1748	1.01	0.38	0.47	3694	-426	568	142	0.20	0.00	0.1	0	3716	5606	0.07	0.014	0.0	0.43
41	42	41.5	Medium Stiff Fine-Grained	-46.5	115	120	4395	2590	1805	1.0	1805	1.01	0.37	0.47	3683	-424	565	141	0.20	0.00	0.1	0	3699	5646	0.07	0.014	0.0	0.42
42	43	42.5	Medium Stiff Fine-Grained	-47.5	115	120	4515	2652	1863	1.0	1863	1.01	0.36	0.46	3672	-422	563	141	0.19	0.00	0.1	0	3683	5686	0.07	0.014	0.0	0.41
43	44	43.5	Medium Stiff Fine-Grained	-48.5	115	120	4635	2714	1921	1.0	1921	1.02	0.35	0.46	3662	-420	560	140	0.19	0.00	0.1	0	3666	5727	0.07	0.014	0.0	0.40
44	45	44.5	Medium Stiff Fine-Grained	-49.5	115	120	4755	2777	1978	1.0	1978	1.02	0.35	0.46	3651	-419	558	140	0.19	0.00	0.1	0	3650	5767	0.07	0.014	0.0	0.39
45	46	45.5	Medium Stiff Fine-Grained	-50.5	115	120	4875	2839	2036	1.0	2036	1.02	0.34	0.46	3640	-417	556	139	0.18	0.00	0.1	0	3633	5808	0.07	0.014	0.0	0.38
46	47	46.5	Medium Stiff Fine-Grained	-51.5	115	120	4995	2902	2093	1.0	2093	1.03	0.33	0.46	3629	-415	553	138	0.18	0.00	0.1	0	3617	5849	0.07	0.014	0.0	0.37
47	48	47.5	Medium Stiff Fine-Grained	-52.5	115	120	5115	2964	2151	1.0	2151	1.03	0.32	0.46	3619	-413	551	138	0.17	0.00	0.1	0	3601	5890	0.07	0.014	0.0	0.37
48	49	48.5	Medium Stiff Fine-Grained	-53.5	115	120	5235	3026	2209	1.0	2209	1.03	0.32	0.46	3608	-412	549	137	0.17	0.00	0.1	0	3585	5931	0.07	0.014	0.0	0.36

Configuration **6H1V_P2_G2-AR25**

by: E. Ticen
Last Updated: February 2020

Geometry	Embankment Height, H	33	ft
	Embankment Side Slopes	6	xH:1V
	Crown Width	32	ft
	Half Crown Width, B1	16	ft
	Side Slope Width, B2	198	ft
	Unit Weight of Embankment, γ	120	pcf
	Depth to Ground Water	0	ft
	Maximum Stress Increase	3960	psf
	Water Surface Elevation	-5	ft
	Ground Surface Elevation	-5	ft
Foundation Improvements	Remove & Replace Depth [1]	6	ft
	Area Replacement Ratio	0.25	-
	Shear Key Thickness	2.5	ft
	Shear Key Depth	40	ft
	Shear Key Raft Foundation Depth	26.7	ft
	Shear key Spacing	10.0	ft
	Soil Arching b/w Shear Key	0.5	xV:1H
	Arching Stress Height	2	ft
	Arching Side Slope Width, B2	5.0	ft
	σmax Arching	225	psf

Notes:
1) Compacted fill where settlement of the material is considered to be negligible.
2)
3)
4)
5)
6)
7)

Total Settlement at Midpoint Between Shear Keys=	20.0	inches
Total Settlement at Shear Keys=	14.0	inches
Differential Settlement=	5.9	inches

		Depth (GS=0-ft)		Elevation (ft)		Unit Weight		Settlement					Staged Construction		
		Top	Bottom	Top	Bottom	Moist	Saturated	$C_{c\varepsilon} = C_c/(1+e_o)$	$C_{r\varepsilon} = C_{cd}/5$	OCR	Total Layer Settlement		Reduction	Total Layer Settlement	
Layer	Description	(ft)	(ft)	(ft)	(ft)	(pcf)	(pcf)	(-)	(-)	(-)	(in)	(ft)	(%)	(in)	(ft)
1	Embankment Fill	-33	0	28	-5	115	120	0.01	0.002	5	0	0.00	100%	0	0.00
2	Organics	0	15	-5	-20	85	90	0.180	0.036	1	5.8	0.49	0%	6	0.49
3b	Loose - Coarse Grained	15	30	-20	-35	105	110	0.005	0.001	1	0.2	0.02	0%	0	0.02
4	Medium Stiff Fine-Grained	30	50	-35	-55	115	120	0.070	0.014	1	8.7	0.73	0%	9	0.73
5	Stiff Fine-Grained	50	100	-55	-105	120	125	0.017	0.0034	1	2.9	0.24	0%	3	0.24
6	Dense Coarse-Grained	100	150	-105	-155	120	125	0.017	0.0034	1	1.5	0.12	0%	1	0.12
7	Stiff Fine-Grained	150	200	-155	-205	120	125	0.017	0.0034	1	0.8	0.07	0%	1	0.07
										Σ=	20.0	1.7	Σ=	20.0	1.7

							Pre Construction							Δσ due to Embankment Load (Das - 5.6)				Δσ due to Foundation R&R (2:1)			Δσ With Arching for Shear Keys (Das - 5.6)								
Top of Layer	Bottom of Layer	Depth (ft)	Layer (-)	Elevation (ft)	Moist Unit Weight (pcf)	Saturated Unit Weight (pcf)	Total Stress (psf)	Pore Pressure (psf)	Effective stress (psf)	OCR (-)	Pre- Consolidation Pressure (psf)	α_1 (rad)	α_2 (rad)	Influence Value I'	Δσ below Embankment middle (psf)	Foundation Removal (psf)	Foundation Replacement (psf)	Net Stress Change in Layer (psf)	α1 (rad)	α2 (rad)	Influence Value I'	Δσ between shear keys above shear key raft foundation (psf)	Δσ below shear key raft foundation	Final Stress (psf)	$C_{c\varepsilon}$ (-)	$C_{r\varepsilon}$ (-)	Vertical Strain $\varepsilon_{v,i}$ (%)	Change in Layer Thickness Δh_i (in)
0	1	0.5	Organics	-5.5	85	90	45	31	14	1.0	14	0.03	1.54	0.50	3960	-45	60	15	1.47	0.00	0.5	211	0	240	0.18	0.036	0.0	0.00
1	2	1.5	Organics	-6.5	85	90	135	94	41	1.0	41	0.09	1.48	0.50	3960	-135	180	45	1.28	0.00	0.4	183	0	270	0.18	0.036	0.0	0.00
2	3	2.5	Organics	-7.5	85	90	225	156	69	1.0	69	0.14	1.42	0.50	3960	-225	300	75	1.11	0.00	0.4	159	0	303	0.18	0.036	0.0	0.00
3	4	3.5	Organics	-8.5	85	90	315	218	97	1.0	97	0.20	1.36	0.50	3959	-315	420	105	0.96	0.00	0.3	138	0	339	0.18	0.036	0.0	0.00
4	5	4.5	Organics	-9.5	85	90	405	281	124	1.0	124	0.25	1.30	0.50	3959	-405	540	135	0.84	0.00	0.3	120	0	379	0.18	0.036	0.0	0.00
5	6	5.5	Organics	-10.5	85	90	495	343	152	1.0	152	0.31	1.24	0.50	3957	-495	660	165	0.74	0.00	0.2	113	0	429	0.18	0.036	0.0	0.00
6	7	6.5	Organics	-11.5	85	90	585	406	179	1.0	179	0.36	1.18	0.50	3956	-494	659	165	0.66	0.00	0.2	113	0	457	0.18	0.036	0.1	0.88
7	8	7.5	Organics	-12.5	85	90	675	468	207	1.0	207	0.40	1.13	0.50	3954	-492	656	164	0.59	0.00	0.2	113	0	483	0.18	0.036	0.1	0.80
8	9	8.5	Organics	-13.5	85	90	765	530	235	1.0	235	0.45	1.08	0.50	3951	-489	653	163	0.53	0.00	0.2	113	0	510	0.18	0.036	0.1	0.73
9	10	9.5	Organics	-14.5	85	90	855	593	262	1.0	262	0.49	1.03	0.50	3948	-487	650	162	0.48	0.00	0.2	113	0	537	0.18	0.036	0.1	0.67
10	11	10.5	Organics	-15.5	85	90	945	655	290	1.0	290	0.53	0.99	0.50	3945	-485	647	162	0.44	0.00	0.1	113	0	564	0.18	0.036	0.1	0.62
11	12	11.5	Organics	-16.5	85	90	1035	718	317	1.0	317	0.57	0.95	0.50	3941	-483	644	161	0.41	0.00	0.1	113	0	591	0.18	0.036	0.0	0.58
12	13	12.5	Organics	-17.5	85	90	1125	780	345	1.0	345	0.60	0.91	0.50	3936	-481	641	160	0.38	0.00	0.1	113	0	618	0.18	0.036	0.0	0.55
13	14	13.5	Organics	-18.5	85	90	1215	842	373	1.0	373	0.64	0.87	0.50	3931	-479	638	160	0.35	0.00	0.1	113	0	645	0.18	0.036	0.0	0.51
14	15	14.5	Organics	-19.5	85	90	1305	905	400	1.0	400	0.67	0.83	0.50	3926	-476	635	159	0.33	0.00	0.1	113	0	672	0.18	0.036	0.0	0.49
15	16	15.5	Loose - Coarse Grained	-20.5	105	110	1415	967	448	1.0	448	0.70	0.80	0.49	3920	-474	632	158	0.31	0.00	0.1	113	0	718	0.005	0.001	0.0	0.01
16	17	16.5	Loose - Coarse Grained	-21.5	105	110	1525	1030	495	1.0	495	0.72	0.77	0.49	3913	-472	630	157	0.29	0.00	0.1	113	0	765	0.005	0.001	0.0	0.01
17	18	17.5	Loose - Coarse Grained	-22.5	105	110	1635	1092	543	1.0	543	0.75	0.74	0.49	3907	-470	627	157	0.28	0.00	0.1	113	0	812	0.005	0.001	0.0	0.01
18	19	18.5	Loose - Coarse Grained	-23.5	105	110	1745	1154	591	1.0	591	0.77	0.71	0.49	3900	-468	624	156	0.26	0.00	0.1	113	0	859	0.005	0.001	0.0	0.01
19	20	19.5	Loose - Coarse Grained	-24.5	105	110	1855	1217	638	1.0	638	0.79	0.69	0.49	3892	-466	621	155	0.25	0.00	0.1	113	0	906	0.005	0.001	0.0	0.01
20	21	20.5	Loose - Coarse Grained	-25.5	105	110	1965	1279	686	1.0	686	0.81	0.66	0.49	3885	-464	619	155	0.24	0.00	0.1	113	0	953	0.005	0.001	0.0	0.01
21	22	21.5	Loose - Coarse Grained	-26.5	105	110	2075	1342	733	1.0	733	0.83	0.64	0.49	3877	-462	616	154	0.23	0.00	0.1	113	0	1000	0.005	0.001	0.0	0.01
22	23	22.5	Loose - Coarse Grained	-27.5	105	110	2185	1404	781	1.0	781	0.85	0.62	0.49	3869	-460	613	153	0.22	0.00	0.1	113	0	1047	0.005	0.001	0.0	0.01
23	24	23.5	Loose - Coarse Grained	-28.5	105	110	2295	1466	829	1.0	829	0.86	0.60	0.49	3860	-458	610	153	0.21	0.00	0.1	113	0	1094	0.005	0.001	0.0	0.01
24	25	24.5	Loose - Coarse Grained	-29.5	105	110	2405	1529	876	1.0	876	0.88	0.58	0.49	3852	-456	608	152	0.20	0.00	0.1	113	0	1141	0.005	0.001	0.0	0.01
25	26	25.5	Loose - Coarse Grained	-30.5	105	110	2515	1591	924	1.0	924	0.89	0.56	0.49	3843	-454	605	151	0.19	0.00	0.1	113	0	1188	0.005	0.001	0.0	0.01
26	27	26.5	Loose - Coarse Grained	-31.5	105	110	2625	1654	971	1.0	971	0.90	0.54	0.48	3834	-452	603	151	0.19	0.00	0.1	113	0	1235	0.005	0.001	0.0	0.01
27	28	27.5	Loose - Coarse Grained	-32.5	105	110	2735	1716	1019	1.0	1019	0.92	0.53	0.48	3824	-450	600	150	0.18	0.00	0.1	0	3945	5114	0.005	0.001	0.0	0.04
28	29	28.5	Loose - Coarse Grained	-33.5	105	110	2845	1778	1067	1.0	1067	0.93	0.51	0.48	3815	-448	597	149	0.17	0.00	0.1	0	3926	5142	0.005	0.001	0.0	0.04
29	30	29.5	Loose - Coarse Grained	-34.5	105	110	2955	1841	1114	1.0	1114	0.94	0.50	0.48	3806	-446	595	149	0.17	0.00	0.1	0	3908	5171	0.005	0.001	0.0	0.04
30	31	30.5	Medium Stiff Fine-Grained	-35.5	115	120	3075	1903	1172	1.0	1172	0.95	0.48	0.48	3796	-444	592	148	0.16	0.00	0.1	0	3890	5210	0.07	0.014	0.0	0.54
31	32	31.5	Medium Stiff Fine-Grained	-36.5	115	120	3195	1966	1229	1.0	1229	0.95	0.47	0.48	3786	-442	590	147	0.16	0.00	0.1	0	3872	5249	0.07	0.014	0.0	0.53
32	33	32.5	Medium Stiff Fine-Grained	-37.5	115	120	3315	2028	1287	1.0	1287	0.96	0.46	0.48	3776	-440	587	147	0.15	0.00	0.0	0	3854	5288	0.07	0.014	0.0	0.52
33	34	33.5	Medium Stiff Fine-Grained	-38.5	115	120	3435	2090	1345	1.0	1345	0.97	0.45	0.48	3766	-438	585	146	0.15	0.00	0.0	0	3837	5327	0.07	0.014	0.0	0.50
34	35	34.5	Medium Stiff Fine-Grained	-39.5	115	120	3555	2153	1402	1.0	1402	0.98	0.43	0.47	3756	-437	582	146	0.14	0.00	0.0	0	3819	5367	0.07	0.014	0.0	0.49
35	36	35.5	Medium Stiff Fine-Grained	-40.5	115	120	3675	2215	1460	1.0	1460	0.98	0.42	0.47	3746	-435	580	145	0.14	0.00	0.0	0	3801	5406	0.07	0.014	0.0	0.48
36	37	36.5	Medium Stiff Fine-Grained	-41.5	115	120	3795	2278	1517	1.0	1517	0.99	0.41	0.47	3736	-433	577	144	0.14	0.00	0.0	0	3784	5446	0.07	0.014	0.0	0.47
37	38	37.5	Medium Stiff Fine-Grained	-42.5	115	120	3915	2340	1575	1.0	1575	0.99	0.40	0.47	3725	-431	575	144	0.13	0.00	0.0	0	3767	5486	0.07	0.014	0.0	0.46
38	39	38.5	Medium Stiff Fine-Grained	-43.5	115	120	4035	2402	1633	1.0	1633	1.00	0.39	0.47	3715	-429	572	143	0.13	0.00	0.0	0	3750	5525	0.07	0.014	0.0	0.44
39	40	39.5	Medium Stiff Fine-Grained	-44.5	115	120	4155	2465	1690	1.0	1690	1.00	0.38	0.47	3704	-427	570	142	0.13	0.00	0.0	0	3733	5565	0.07	0.014	0.0	0.43
40	41	40.5	Medium Stiff Fine-Grained	-45.5	115	120	4275	2527	1748	1.0	1748	1.01	0.38	0.47	3694	-426	568	142	0.12	0.00	0.0	0	3716	5606	0.07	0.014	0.0	0.43
41	42	41.5	Medium Stiff Fine-Grained	-46.5	115	120	4395	2590	1805	1.0	1805	1.01	0.37	0.47	3683	-424	565	141	0.12	0.00	0.0	0	3699	5646	0.07	0.014	0.0	0.42
42	43	42.5	Medium Stiff Fine-Grained	-47.5	115	120	4515	2652	1863	1.0	1863	1.01	0.36	0.46	3672	-422	563	141	0.12	0.00	0.0	0	3683	5686	0.07	0.014	0.0	0.41
43	44	43.5	Medium Stiff Fine-Grained	-48.5	115	120	4635	2714	1921	1.0	1921	1.02	0.35	0.46	3662	-420	560	140	0.11	0.00	0.0	0	3666	5727	0.07	0.014	0.0	0.40
44	45	44.5	Medium Stiff Fine-Grained	-49.5	115	120	4755	2777	1978	1.0	1978	1.02	0.35	0.46	3651	-419	558	140	0.11	0.00	0.0	0	3650	5767	0.07	0.014	0.0	0.39
45	46	45.5	Medium Stiff Fine-Grained	-50.5	115	120	4875	2839	2036	1.0	2036	1.02	0.34	0.46	3640	-417	556	139	0.11	0.00	0.0	0	3633	5808	0.07	0.014	0.0	0.38
46	47	46.5	Medium Stiff Fine-Grained	-51.5	115	120	4995	2902	2093	1.0	2093	1.03	0.33	0.46	3629	-415	553	138	0.11	0.00	0.0	0	3617	5849	0.07	0.014	0.0	0.37
47	48	47.5	Medium Stiff Fine-Grained	-52.5	115	120	5115	2964	2151	1.0	2151	1.03	0.32	0.46	3619	-413	551	138	0.10	0.00	0.0	0	3601	5890	0.07	0.014	0.0	0.37
48	49	48.5	Medium Stiff Fine-Grained	-53.5	115	120	5235	3026	2209	1.0	2209	1.03	0.32	0.46	3608	-412	549	137	0.10	0.00	0.0	0	3585	5931	0.07	0.014	0.0	0.36

Liquefaction Triggering Using SPT N-values - Per Boulanger and Idriss (2014)
Evaluate liquefaction susceptibility, liquefaction triggering, lateral displacement, and post-seismic settlement.

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Project Name: Delta Conveyance Southern Forebay Seismic Stability

Boring: Profile 2 - Best Estimate (Mean) Strengths

Method:
Step 1) Provide inputs from exploration and for design conditions
Step 2) Adjust correction factors for delivered hammer energy and borehole diameter
Step 3) Perform calculations using the following methodology
3.1) Classify soil as sand-like or clay-like per Idriss and Boulanger (2008).
3.2) For soils that behave sand-like, compute $(N_1)_{60}$. For soils that behave clay-like, compute N_{60}.
3.3) For sand-like soils, compute the factor of safety against pore pressure increase per Idriss and Boulanger (2008), with updates per Boulanger and Idriss (2014).

References:
1) Idriss I. M. and Boulanger, R. W. (2008). "Soil Liquefaction during Earthquakes". EERI Monograph Series, MNO-12.
2) Boulanger, R.W. and Idriss, I.M. (2014). "CPT and SPT Based Liquefaction Triggering Procedures". Report No. UCD/CGM-14/01.

Equations:

Reference	Eqn. No.	Equation
1	27	$N_{60} = N_{meas}*C_E*C_B*C_S*C_R$ for sand-like soils; $N_{60} = N_{meas}*C_E$ for clay-like soils
1	31, 39	$(N_1)_{60} = C_N*N_{60}$ where $C_N = (P_a/\sigma'_{vo})$^(0.784-0.0768 sqrt($(N_1)_{60cs}$)) ≤ 1.7 and P_a = 2116 lb/ft^2 (= 100 kPa)
1	75, 76	$(N_1)_{60cs} = (N_1)_{60} + \Delta(N_1)_{60}$ where $\Delta(N_1)_{60}$ = exp(1.63 + (9.7/(FC + 0.01)) - (15.7/(FC + 0.01)^2)
1	70	$CRR_{M=7.5,\sigma'v=1atm}$ = exp(($(N_1)_{60cs}$/14.1) + ($(N_1)_{60cs}$/126)^2 - ($(N_1)_{60cs}$/23.6)^3 + ($(N_1)_{60cs}$/25.4)^4 - 2.8)
1	25	Simplified: CSRM,s'v = 0.65*(sv/s'v)*(amax/g)*rd // 1DSRA: CSRM,σ'v = 0.65*(τmax/σ'v)
2	2.6	$CSR_{M,\sigma'v}$ = $CSR_{M=7.5,\sigma'v=1atm}$/(MSF*$K_\sigma$)
2	2.14a-c	r_d = exp((-1.012 - 1.126*sin((z/11.73) + 5.133) + (0.106 + 0.118*sin((z/11.28) + 5.142)*M_w), where depth z is in meters
2	A.8, A.10	MSF = 1 + (MSF_{max} - 1)*(8.64*exp(-M_w/4) - 1.325) where MSF_{max} = 1.09 + ($(N_1)_{60cs}$/31.5)^2 ≤ 2.2
1	54, 56	K_σ = 1 - C_σ*Ln(σ'$_{vo}$/P_a) ≤ 1.1 where C_σ = 1/(18.9 - 2.55*$(N_1)_{60cs}^{0.5}$) ≤ 0.3
1	74	FS_L = $CRR_{M=7.5,\sigma'v=1atm}$/$CSR_{M=7.5,\sigma'v=1atm}$
1	86	γ_{lim} = 1.859*(1.1 - sqrt($(N_1)_{60cs}$/46))^3 ≥ 0
1	93	F_α = 0.032 + 0.69*sqrt($(N_1)_{60cs}$) - 0.13*$(N_1)_{60cs}$ with $(N_1)_{60cs}$ limited to values ≥ 7
1	90, 92	γ_{max} = 0 if FS_{liq} ≥ 2; γ_{max} = min(γ_{lim}, 0.035*(2 - FS_{liq})*((1 - F_α)/(FS_{liq} - F_α)) if 2 > FS_{liq} > F_α; γ_{max} = γ_{lim} if FS_{liq} ≤ F_α
1	85	LDI = ∫ γ_{max}*dz for z from 0 to z_{max}
1	96	ε_v = 1.5*exp(-0.369*sqrt($(N_1)_{60cs}$))*min(0.08,γ_{max})

Notes:
1) = column which is input by the user (columns not highlighted are computed by Excel).
2) MC = Modified-California Sampler; SPT = Standard Penetration Test Split Spoon Sampler
3) Maximum depth to where sample is representative; default is midway between adjacent sample depths.
4) N_{field} = Uncorrected blowcounts measured in the field.
5) N_{meas} = Corrected MC to SPT blowcounts per Burmister (1948) where N_{corr} = N_m*(HammerWeight*HammerDrop/4200)*(OD_{SPT}^2-ID_{SPT}^2)/(OD_{MC}^2-ID_{MC}^2); OD_{MC} = 3.0 in, ID_{MC} = 2.4 in
6) PI = plasticity index and FC = fines content (% passing the No. 200 sieve). In the absence of a laboratory-measured fines contents, the fines content is estimated from field logs.
7) C = Clay-like soil, S = Sand-like soil per criteria provided by Idriss and Boulanger (2008): Clay-like for PI≥7 and fines content ≥ 50%.
8) $(\sigma_v)_a$ is the vertical total stress, and $(\sigma'_v)_a$ is the vertical effective stress computed using the depth to water at the time of drilling. Soils assumed to have the given layer unit weight for the tributary thickness.
9) Only C_E applied for clay-like soils; Rod length correction factor calculated using sum of rod stick-up length and depth.
10) Highlighted values when below design ground water elevation and where $(N_1)_{60}$ < 15; flagged for use in estimating lateral displacements
11) $(\sigma_v)_b$ is the vertical total stress, and $(\sigma'_v)_b$ is the vertical effective stress computed using the depth to water during the earthquake. Soils assumed to have the given layer unit weight for the tributary thickness.
12) CSR calculated based on 1D Site Response or Simplified procedures outlined in References 1 and 2, depending on method selected by user.
13) Highlighted values when FS_L < 1.2
14) = reliability of penetration measurements in question
15) Depth below which materials are not considered susceptible to liquefaction based on geologic age. Settlement and LDI contributions below this depth are excluded from the results.

STEP 1:

Exploration and Design Inputs		Notes:
Ground Surface Elevation (ft)	-5.0	(ft, NAVD88)
Depth to Groundwater at Time of Drilling (ft)	0.0	*assumed
Ground Surface Elevation for Design (ft)	-5.0	(ft, NAVD88)
Depth to Groundwater for Design (ft)	0.0	*assumed
Total Unit Wt. of soil added/removed for Design (lb/ft^3)	120.0	
Earthquake Magnitude (M_w)	6.7	
Site-Specific 1D Site Response Analysis (1DSRA)	#N/A	
Peak Ground Acceleration (g)	0.50	*#N/A if 1DSRA is used
SPT Sampler Inside Diameter (in)	1.375	*no liners used
Rod Stick-Up Length (ft)	5.0	*assumed

STEP 2:

Correction Factors (Ref. 1, Table 3):

Factor	Term	Correction		Notes
Energy Ratio, ER_m	C_E	ER_m = 99% (C_E = ER_m/60)	1.65	Measured
Borehole Diameter	C_B	3.875 inches	1.00	
Sampler Type	C_S	$(N_1)_{60}$ ≤ 10	1.10	Only
		1+$(N_1)_{60}$/100 for 10 < $(N_1)_{60}$ ≤ 30	f($(N_1)_{60}$)	
		$(N_1)_{60}$ > 30	1.30	
Rod Length, L	C_R	0 < L ≤ 9.84 ft (3 m)	0.75	
		9.84 ft < L ≤ 13.12 ft (4 m)	0.80	
		13.12 ft < L ≤ 19.69 ft (6 m)	0.85	
		19.69 ft < L ≤ 32.81 ft (10 m)	0.95	
		L > 32.81 ft (10 m)	1.00	

STEP 3:

Calculations (Note 1)

Perform Calculations Based On: Simplified CSR

	LDI	S
First Reading at (depth)	5.0 ft	
Depth to top of no Liq. (Note 15)	#N/A	
Entire Profile (45.0 ft)	6.26 ft	0.53 ft
Upper 15 ft	6.26 ft	0.53 ft
Upper 30 ft	6.26 ft	0.53 ft
#N/A	0.00 ft	0.00 ft

Sample No.	Elev. (ft)	Depth during Drilling (ft)	Maximum Representative Depth (ft)	N_{field}	N_{meas}	Soil Type	Fines Content, FC (%)	Est. FC (%)	PI	Flag "S" or "C" "Unreliable"	Unit Weight (pcf)	$(\sigma_v)_a$ (lb/ft^2)	$(\sigma'_v)_a$ (lb/ft^2)	C_N	C_E	C_B	C_S	C_R	N_{60}	$(N_1)_{60}$	Analysis FC (%)	$(N_1)_{60cs}$	CRR for M=7.5 & σ'$_{vc}$=1atm	Depth at Design (ft)	$(\sigma_v)_b$ (lb/ft^2)	$(\sigma'_v)_b$ (lb/ft^2)	Below Design WSE?	MSF	K_σ	r_d	CSR for M=7.5 & σ'$_{vc}$=1atm	Factor of Safety Liquefaction Triggering, FS_L	Limiting Shear Strain, γ_{lim}	Parameter F_α	Maximum Shear Strain, γ_{max}	Tributary Thickness, Δh_i (ft)	Incremental Lateral Displacement, ΔLDI_i (ft)	Vertical Strain, ε_v	Layer Settlement, ΔSi (ft)
Note 2			Note 3	Note 4	Note 5		Note 6	Note 6	Note 6	Note 7,14	Note 8	Note 8	Note 8	Note 9	Note 9	Note 9	Note 9	Note 9		Note 10					Note 11	Note 11					Note 12	Note 13							
	-10.0	5.0		#N/A	#N/A	CL/ML/OL				C	110	550	238		1.7				#N/A					5.0	550	238	Yes									7.5			
	-15.0	10.0		#N/A	#N/A	CL/ML/OL				C	110	1,100	476		1.7				#N/A					10.0	1,100	476	Yes									5.0			
	-20.0	15.0	15.0	#N/A	#N/A	CL/ML/OL				C	110	1,650	714		1.7				#N/A					15.0	1,650	714	Yes									2.5			
	-27.5	22.5	30.0	4.5	5	SP-SC		10		S	110	2,475	1,071	1.4	1.7	1.0	1.00	0.95	7	10	10	11	0.13	22.5	2,475	1,071	Yes	1.06	1.1	0.90	0.53	0.2	0.42	0.89	0.42	15.0	6.26	0.04	0.53
	-35.0	30.0		#N/A	#N/A	CL/ML/OL				C	115	3,300	1,428		1.7				#N/A					30.0	3,300	1,428	Yes									2.5			
	-40.0	35.0		#N/A	#N/A	CL/ML/OL				C	115	3,875	1,691		1.7				#N/A					35.0	3,875	1,691	Yes									5.0			
	-45.0	40.0		#N/A	#N/A	CL/ML/OL				C	115	4,450	1,954		1.7				#N/A					40.0	4,450	1,954	Yes									5.0			
	-50.0	45.0		#N/A	#N/A	CL/ML/OL				C	115	5,025	2,217		1.7				#N/A					45.0	5,025	2,217	Yes									5.0			

Liquefaction Triggering Using SPT N-values - Per Boulanger and Idriss (2014)
Evaluate liquefaction susceptibility, liquefaction triggering, lateral displacement, and post-seismic settlement.

Performed By: C. Krage
Date: 2/19/2020
Checked By:
Date:
Edited By:
Date:
Checked By:
Date:

Project Name: Delta Conveyance Southern Forebay Seismic Stability

Boring: Profile 2 - Best Estimate (Mean) Strengths

Method:
Step 1) Provide inputs from exploration and for design conditions
Step 2) Adjust correction factors for delivered hammer energy and borehole diameter
Step 3) Perform calculations using the following methodology
3.1) Classify soil as sand-like or clay-like per Idriss and Boulanger (2008).
3.2) For soils that behave sand-like, compute $(N_1)_{60}$. For soils that behave clay-like, compute N_{60}.
3.3) For sand-like soils, compute the factor of safety against pore pressure increase per Idriss and Boulanger (2008), with updates per Boulanger and Idriss (2014).

References:
1) Idriss I. M. and Boulanger, R. W. (2008). "Soil Liquefaction during Earthquakes". EERI Monograph Series, MNO-12.
2) Boulanger, R.W. and Idriss, I.M. (2014). "CPT and SPT Based Liquefaction Triggering Procedures". Report No. UCD/CGM-14/01.

Equations:

Reference	Eqn. No.	Equation
1	27	$N_{60} = N_{meas}*C_E*C_B*C_S*C_R$ for sand-like soils; $N_{60} = N_{meas}*C_E$ for clay-like soils
1	31, 39	$(N_1)_{60} = C_N*N_{60}$ where $C_N = (P_a/\sigma'_{vo})$^(0.784-0.0768 sqrt($(N_1)_{60cs}$)) ≤ 1.7 and P_a = 2116 lb/ft^2 (= 100 kPa)
1	75, 76	$(N_1)_{60cs} = (N_1)_{60} + \Delta(N_1)_{60}$ where $\Delta(N_1)_{60}$ = exp(1.63 + (9.7/(FC + 0.01)) - (15.7/(FC + 0.01)^2)
1	70	$CRR_{M=7.5,\sigma'v=1atm}$ = exp(($(N_1)_{60cs}$/14.1) + ($(N_1)_{60cs}$/126)^2 - ($(N_1)_{60cs}$/23.6)^3 + ($(N_1)_{60cs}$/25.4)^4 - 2.8)
1	25	Simplified: CSRM,s'v = 0.65*(sv/s'v)*(amax/g)*rd // 1DSRA: CSRM,σ'v = 0.65*(τmax/σ'v)
2	2.6	$CSR_{M=7.5,\sigma'v=1atm} = CSR_{M,\sigma'v}/(MSF*K_\sigma)$
2	2.14a-c	r_d = exp((-1.012 - 1.126*sin((z/11.73) + 5.133) + (0.106 + 0.118*sin((z/11.28) + 5.142)*M_w), where depth z is in meters
2	A.8, A.10	MSF = 1 + (MSF_{max} - 1)*(8.64*exp(-M_w/4) - 1.325) where MSF_{max} = 1.09 + ($(N_1)_{60cs}$/31.5)^2 ≤ 2.2
1	54, 56	$K_\sigma = 1 - C_\sigma*Ln(\sigma'_{vo}/P_a)$ ≤ 1.1 where C_σ = 1/(18.9 - 2.55*$(N_1)_{60cs}$$^{0.5}$) ≤ 0.3
1	74	$FS_L = CRR_{M=7.5,\sigma'v=1atm}/CSR_{M=7.5,\sigma'v=1atm}$
1	86	γ_{lim} = 1.859*(1.1 - sqrt($(N_1)_{60cs}$/46))^3 ≥ 0
1	93	F_α = 0.032 + 0.69*sqrt($(N_1)_{60cs}$) - 0.13*$(N_1)_{60cs}$ with $(N_1)_{60cs}$ limited to values ≥ 7
1	90, 92	γ_{max} = 0 if FS_{liq} ≥ 2; γ_{max} = min(γ_{lim}, 0.035*(2 - FS_{liq})*((1 - F_α)/(FS_{liq} - F_α)) if 2 > FS_{liq} > F_α; γ_{max} = γ_{lim} if FS_{liq} ≤ F_α
1	85	LDI = ∫ γ_{max}*dz for z from 0 to z_{max}
1	96	ε_v = 1.5*exp(-0.369*sqrt($(N_1)_{60cs}$))*min(0.08,γ_{max})

Notes:
1) = column which is input by the user (columns not highlighted are computed by Excel).
2) MC = Modified-California Sampler; SPT = Standard Penetration Test Split Spoon Sampler
3) Maximum depth to where sample is representative; default is midway between adjacent sample depths.
4) N_{field} = Uncorrected blowcounts measured in the field.
5) N_{meas} = Corrected MC to SPT blowcounts per Burmister (1948) where $N_{corr} = N_m*(HammerWeight*HammerDrop/4200)*(OD_{SPT}^2-ID_{SPT}^2)/(OD_{MC}^2-ID_{MC}^2)$; OD_{MC} = 3.0 in, ID_{MC} = 2.4 in
6) PI = plasticity index and FC = fines content (% passing the No. 200 sieve). In the absence of a laboratory-measured fines contents, the fines content is estimated from field logs.
7) C = Clay-like soil, S = Sand-like soil per criteria provided by Idriss and Boulanger (2008): Clay-like for PI≥7 and fines content ≥ 50%.
8) $(\sigma_v)_a$ is the vertical total stress, and $(\sigma'_v)_a$ is the vertical effective stress computed using the depth to water at the time of drilling. Soils assumed to have the given layer unit weight for the tributary thickness.
9) Only C_E applied for clay-like soils; Rod length correction factor calculated using sum of rod stick-up length and depth.
10) Highlighted values when below design ground water elevation and where $(N_1)_{60}$ < 15; flagged for use in estimating lateral displacements
11) $(\sigma_v)_b$ is the vertical total stress, and $(\sigma'_v)_b$ is the vertical effective stress computed using the depth to water during the earthquake. Soils assumed to have the given layer unit weight for the tributary thickness.
12) CSR calculated based on 1D Site Response or Simplified procedures outlined in References 1 and 2, depending on method selected by user.
13) Highlighted values when FS_L < 1.2
14) = reliability of penetration measurements in question
15) Depth below which materials are not considered susceptible to liquefaction based on geologic age. Settlement and LDI contributions below this depth are excluded from the results.

STEP 1:

Exploration and Design Inputs		Notes:
Ground Surface Elevation (ft)	-5.0	(ft, NAVD88)
Depth to Groundwater at Time of Drilling (ft)	0.0	*assumed
Ground Surface Elevation for Design (ft)	28.0	(ft, NAVD88)
Depth to Groundwater for Design (ft)	0.0	*assumed
Total Unit Wt. of soil added/removed for Design (lb/ft^3)	120.0	
Earthquake Magnitude (M_w)	6.7	
Site-Specific 1D Site Response Analysis (1DSRA)	#N/A	
Peak Ground Acceleration (g)	0.50	*#N/A if 1DSRA is used
SPT Sampler Inside Diameter (in)	1.375	*no liners used
Rod Stick-Up Length (ft)	5.0	*assumed

STEP 2:

Correction Factors (Ref. 1, Table 3):

Factor	Term	Correction		Notes
Energy Ratio, ER_m	C_E	ER_m = 99% (C_E = ER_m/60)	1.65	Measured
Borehole Diameter	C_B	3.875 inches	1.00	
Sampler Type	C_S	$(N_1)_{60}$ ≤ 10	1.10	Only
		1+$(N_1)_{60}$/100 for 10 < $(N_1)_{60}$ ≤ 30	f($(N_1)_{60}$)	
		$(N_1)_{60}$ > 30	1.30	
Rod Length, L	C_R	0 < L ≤ 9.84 ft (3 m)	0.75	
		9.84 ft < L ≤ 13.12 ft (4 m)	0.80	
		13.12 ft < L ≤ 19.69 ft (6 m)	0.85	
		19.69 ft < L ≤ 32.81 ft (10 m)	0.95	
		L > 32.81 ft (10 m)	1.00	

STEP 3:

Calculations (Note 1)

Perform Calculations Based On: Simplified CSR

	LDI	S
First Reading at (depth)	5.0 ft	
Depth to top of no Liq. (Note 15)	#N/A	
Entire Profile (45.0 ft)	6.26 ft	0.53 ft
Upper 15 ft	6.26 ft	0.53 ft
Upper 30 ft	6.26 ft	0.53 ft
#N/A	0.00 ft	0.00 ft

Sample No.	Elev. (ft)	Depth during Drilling (ft)	Maximum Representative Depth (ft)	N_{field}	N_{meas}	Soil Type	Fines Content, FC (%)	Est. FC (%)	PI	Flag "S" or "C" "Unreliable"	Unit Weight (pcf)	$(\sigma_v)_a$ (lb/ft^2)	$(\sigma'_v)_a$ (lb/ft^2)	C_N	C_E	C_B	C_S	C_R	N_{60}	$(N_1)_{60}$	Analysis FC (%)	$(N_1)_{60cs}$	CRR for M=7.5 & σ'$_{vc}$=1atm	Depth at Design (ft)	$(\sigma_v)_b$ (lb/ft^2)	$(\sigma'_v)_b$ (lb/ft^2)	Below Design WSE?	MSF	K_σ	r_d	CSR for M=7.5 & σ'$_{vc}$=1atm	Factor of Safety Liquefaction Triggering, FS_L	Limiting Shear Strain, γ_{lim}	Parameter F_α	Maximum Shear Strain, γ_{max}	Tributary Thickness, Δh_i (ft)	Incremental Lateral Displacement, ΔLDI_i (ft)	Vertical Strain, ε_v	Layer Settlement, ΔSi (ft)
Note 2			Note 3	Note 4	Note 5		Note 6	Note 6	Note 6	Note 7,14	Note 8	Note 8	Note 8	Note 9	Note 9	Note 9	Note 9	Note 9		Note 10					Note 11	Note 11					Note 12	Note 13							
	-10.0	5.0		#N/A	#N/A	CL/ML/OL				C	110	550	238		1.7				#N/A					38.0	4,510	4,198	Yes									7.5			
	-15.0	10.0		#N/A	#N/A	CL/ML/OL				C	110	1,100	476		1.7				#N/A					43.0	5,060	4,436	Yes									5.0			
	-20.0	15.0	15.0	#N/A	#N/A	CL/ML/OL				C	110	1,650	714		1.7				#N/A					48.0	5,610	4,674	Yes									2.5			
	-27.5	22.5	30.0	4.5	5	SP-SC		10		S	110	2,475	1,071	1.4	1.7	1.0	1.00	0.95	7	10	10	11	0.13	55.5	6,435	5,031	Yes	1.06	0.9	0.71	0.31	0.4	0.42	0.89	0.42	15.0	6.26	0.04	0.53
	-35.0	30.0		#N/A	#N/A	CL/ML/OL				C	115	3,300	1,428		1.7				#N/A					63.0	7,260	5,388	Yes									2.5			
	-40.0	35.0		#N/A	#N/A	CL/ML/OL				C	115	3,875	1,691		1.7				#N/A					68.0	7,835	5,651	Yes									5.0			
	-45.0	40.0		#N/A	#N/A	CL/ML/OL				C	115	4,450	1,954		1.7				#N/A					73.0	8,410	5,914	Yes									5.0			
	-50.0	45.0		#N/A	#N/A	CL/ML/OL				C	115	5,025	2,217		1.7				#N/A					78.0	8,985	6,177	Yes									5.0			