Final Geotechnical Design Report

US 395 North Valleys
Washoe County, Nevada
Nevada Department of Transportation

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INTRODUCTION

Presented herein is the Final Geotechnical Design Report for the US 395 North Valleys Project (Project) located in Washoe County, Nevada on US Highway 395 (US-395) from North McCarran Blvd to Lemmon Drive, (Mileposts WA 27.064 to WA 32.580). The Project consists of the addition of a southbound travel lane, addition of northbound and southbound auxiliary lanes, and construction of a diverging diamond interchange (DDI) at Lemmon Drive. These capacity enhancements will improve congestion and freeway operations.

This report was prepared in support of the Project improvements. The analyses and recommendations in this report are based on the subsurface geotechnical investigation performed by NewFields Mining Design & Technical Services (NewFields) in 2019.

This report includes design- and construction-related recommendations for the following project improvements:

- Widening of Bridges G-1092 N&S (US 395 Milepost WA 30.04) Panther Valley UPRR Overpass.
- Widening of Bridges G-1748 N&S (US 395 Milepost WA 30.54) Panther Branch UPRR Grade Separation.
- Retaining Walls RW1, RW2, RW3, RW4, RW5, RW6, RW7, RW8, RW9, RW10, RW11, RW12 and RW14.

Geotechnical design- and construction-related recommendations for the following project improvements were provided by NewFields in separate reports:

- Parr-Dandini Interchange Bridge I-1306
- Panther Valley Bridge I-1093 N&S
- Panther/Virginia Braid Ramp I-3262
- Golden Valley Bridge I-1749 N&S
- Lemmon Valley Bridge I-1770 N&S
- Sound Walls SW1 through SW10, inclusive

GEOTECHNICAL INVESTIGATION

The geotechnical investigation for this phase of the improvements was performed by NewFields between April 20th and July 31st, 2019. Results of the geotechnical investigation for the above-mentioned bridges and retaining walls are included in two geotechnical data memos by NewFields provided in Appendix A of this report. The subsurface investigation included drilling and soil sampling by hollow-stem auger methods, and refraction microtremor (ReMi) geophysical surveys. Due to the generally highly weathered condition of the bedrock at the Project site, core drilling of the rock was not performed. Additional information regarding the investigation methods and procedures can be found in the following NewFields reports: Phase 1A: Parr-Dandini Bridge Project report (NewFields, 2019), and Phase 1B: US395 North Valleys report (NewFields, 2020). These reports were submitted under separate cover and are not included with this report.

The geotechnical investigation for the UPRR Panther Valley G-1092N&S bridges included eight borings (BH19-BR-04 to BH19-BR-11, inclusive) drilled to depths ranging from 44 to 102 feet below ground surface (bgs).

The geotechnical investigation for the Panther Branch UPRR Grade Separation G-1748N&S bridges included four borings (BH19-BR-20 to BH19-BR-23, inclusive) drilled to depths ranging from 57 to 102 feet bgs.

The geotechnical investigation for retaining walls RW1 to RW12 (inclusive) included the following borings:

- RW1 - Borings BH19-RW1-01 to BH19-RW1-06, depths 30 to 31.5 feet
- RW2 - Borings BH19-RW2-07 to BH19-RW2-08, depths 30 to 31.5 feet
- RW3 - Borings BH19-RW3-09 to BH19-RW3-25, depths 15 to 31.5 feet
- RW4 - Borings BH19-RW4-26 to BH19-RW4-27, depths 60 to 62 feet
- RW5 - Borings BH19-RW5-28 to BH19-RW5-29, depths 52 to 56 feet
- RW6 - Borings BH19-RW6-30 to BH19-RW6-33, depths 31.5 feet
- RW7 - Borings BH19-RW7-34 to BH19-RW7-46, depths 24 to 31.5 feet
- RW8 - Borings BH19-RW8-47 to BH19-RW8-50, depths 27 to 31.4 feet
- RW9 - Borings BH19-RW9-51 to BH19-RW9-52, depths 31 to 31.5 feet
- RW10- Boring BH19-RW10-53, depth 31.4 feet
- RW11- Borings BH19-RW11-54 to BH19-RW11-66, depths 30.5 to 31.5 feet
- RW12- Borings BH19-RW12-67 to BH19-RW12-70, depths 60 to 61.5 feet
- RW14- Boring BH19-BR-19, depth of 100.4 feet

Laboratory Testing

Laboratory testing was performed on selected soil samples obtained during the investigation to characterized encountered soils and rock and the subsurface conditions. The laboratory program included the following tests and test methods:

- Natural Moisture Content (AASHTO T265)
- In-Situ Density (ASTM D7236)
- Particle Size – Sieve Analysis (AASHTO T88)
- Atterberg Limits (AASHTO T89 and T90)
- Maximum Density and Optimum Moisture Content (NDOT T108 and AASHTO T99)
- Direct Shear (AASHTO T236)
- pH (AASHTO T289)
- Minimum Resistivity (AASHTO T288 modified)
- Sulfate (AASHTO T290)
- Chloride (AASHTO T291)

The lab testing results are summarized in Table 2 of each geotechnical data memo in Appendix A.

Selected 90% design plan sheets are provided in Appendix B of this report, and selected as-built plans for Bridges G-1092N&S and G-1748N&S are contained in Appendix C.

SITE GEOLOGY

The site geology is described as follows excerpted from the NewFields US395 North Valleys Phase 1B report; NewFields, 2020:

The area is underlain by granitic intrusives of granodiorite and quartz monzonite and metavolcanics of the Peavine Sequence, including rhyolitic and pyroclastic rocks and dacitic to andesitic flows with occasional laharic breccias (Gates, 1992).

The southern (portion of the US-395) alignment, extending from roughly the Clear Acre Interchange to the Panther Valley UPRR Overpass, is mapped as being underlain by shallow bedrock composed of andesite, breccia, and related granitic stock in a zone of intense hydrothermal alteration. This formation is known locally as the Alta Formation. The lithology of the rock is largely composed of flows of dark colored pyroxene andesite and flow breccias with mud matrices. Alteration by the introduction of hydrothermal fluids with pyrite sulfides has resulted in zones of corrosive sulfates and expansive clay minerals.

The center (portion) of the alignment, extending roughly from the Panther Valley UPPR Overpass to the Golden Valley Interchange, is mapped as being underlain by granitic alluvium composed of weathered granitic sand and shallow bedrock composed of granodiorite. The granodiorite can exhibit hydrothermal alteration with clay mineralization.

The north (portion of the) alignment, extending to the Lemmon Valley Interchange, is mapped as being underlain by older alluvial fan deposits of Peavine Mountain. The deposits consist of gravelly muddy sand (Gates, 1992).

Refer to Section 2.1 and Figure 2 of the NewFields Phase 1B report (NewFields, 2020) for additional discussion of the site geology, seismic hazards, and a geologic map.

SUBSURFACE SOIL CONDITIONS

The subsurface conditions vary along the project alignment consistent with the differing geologic conditions described above. Based on the geotechnical investigation performed by NewFields, the depth of existing fill soil and/or existing native soil overlying weathered bedrock varies significantly. The depth of existing fill at the proposed retaining wall locations varies from zero to about 30 feet in thickness. However, existing fill depths of 40 feet bgs were recorded at Borings RW4-27 and RW12-68. It’s possible that some of the material below a depth of 30 feet bgs was incorrectly identified as fill because the existing fills at these locations don’t appear to be 40 feet above existing grade according to the Plans, but it is possible that a previous localized depression was backfilled, or over-excavation and replacement of poor subgrade material was performed at these locations.

Based on the boring logs the thickness of native soils over the andesite or granodiorite rock is relatively thin to moderate, varying between zero to 20 feet bgs along all the retaining walls except for Retaining Wall 11. The borings for Retaining Wall 11 did not encounter weathered rock within the full depth of investigation of 30 feet bgs. At the north end of Retaining Wall 11 Boring BR-29 for the Lemmon Valley Interchange encountered weathered granodiorite at a depth of 75 feet bgs.

Based on the boring logs it appears that there is a transition in the bedrock along the length of Retaining Wall 6. South of Retaining Wall 6 there is varying thickness of weathered andesite overlying weathered granodiorite. North of Retaining Wall 6 andesite was noted at a few locations but in general weathered granodiorite rock was encountered.

Both the andesite and granodiorite bedrock units are highly weathered to a degree that drilling in these units was performed with hollow-stem auger to the full depth of the subsurface investigation. Due to the weathered condition of the bedrock units, these units were considered as soil for the engineering analyses in this report.

The weathered andesite rock encountered during the investigation was generally described as clayey sand with gravel with some layers of sandy clay, with the following engineering properties:

- Percent fines (clay and silt particles passing the #200 sieve) ranged from 6.3 to 77.8 percent with an average of 30 percent.
- The plasticity index ranged from non-plastic to 43 with an average of 19.
- The moisture content ranged from 9.5 to 32.8 percent with an average of 18 percent.
- Only one in situ density test was performed on a relatively undisturbed Modified California sample which resulted in a dry density of 114.3 pounds per cubic foot (pcf) and a moisture content of 10.7 percent.

The weathered granodiorite encountered during the investigation was generally described as clayey or silty sand with varying amounts of gravel and with some layers of sandy clay and sandy silt, with the following engineering properties:

- Percent fines (clay and silt particles passing the #200 sieve) ranged from 6.2 to 78.8 percent with an average of 33 percent.
- The plasticity index ranged from non-plastic to 29 with an average of 13.
- The moisture content ranged from 5.2 to 25 percent with an average of 15 percent.
- Eight in situ density tests were performed; the dry density ranged from 97.9 to 128.7 pcf with an average of 117 pcf.

The native soils over the weathered rock predominately consist of clayey sand with varying amounts of gravel and lesser amounts of silty sand, sandy clay, and sandy silt, with the following engineering properties:

- Percent fines (clay and silt particles passing the #200 sieve) ranged from 12.1 to 81.5 percent with an average of 32 percent.
- The plasticity index ranged from non-plastic to 47 with an average of 19.
- The moisture content ranged from 6.2 to 34.3 percent with an average of 15 percent.
- Thirteen in situ density tests were performed; the dry density ranged from 83.2 to 126.8 pcf with an average of 105 pcf.

The existing fill soils over the native soils and weathered rock predominately consist of clayey sand with varying amounts of gravel and clayey gravel, with lesser amounts of silty sand and silty gravel, with the following engineering properties:

- Percent fines (clay and silt particles passing the #200 sieve) ranged from 7.9 to 34.6 percent with an average of 20 percent.
- The plasticity index ranged from non-plastic to 27 with an average of 16.
- The moisture content ranged from 5.1 to 25.5 percent with an average of 12 percent.
- Eight in situ density tests were performed; the dry density ranged from 83.3 to 124.4 pcf with an average of 111 pcf. It is possible that there was some sample disturbance with the lowest tested value of 83.3 pcf given that the sample was described as clayey gravel. However, it is also possible that there are infrequent zones of low-density existing fill material that was not fully compacted to the requirements for embankment fill.

The subsurface conditions at Bridges B-1092 and G-1748 and the retaining walls were evaluated based on the boring logs and design profiles were developed for analysis. The design profiles were established within limits of similar subsurface conditions. Some of the longer retaining walls required more than one design profile, such as Walls RW3 and RW7, which were each divided into three separate design profiles. Subsurface design profiles are included in Tables D-1 through D-9, inclusive in Appendix D. The profiles are plotted by elevation with the standard penetration test (SPT) field N-values and color-coded soil types. The SPT N-values for samples obtained with the modified California sampler were corrected by multiplying the field value by a factor of 0.65 as recommended by NewFields.

GROUNDWATER CONDITIONS

Groundwater was encountered in numerous borings during the subsurface investigation at varying depths. In many cases, the depth to groundwater varied significantly over short distances between adjacent borings, and in some cases, groundwater was not encountered in an adjacent boring. The analyses in this report were completed using conservative assumptions based on the measured groundwater depths and elevations from the borings. Groundwater elevations are included in the subsurface design profiles in Tables D-1 through D-9, inclusive in Appendix D.

The depth to groundwater likely varies seasonally and groundwater should be anticipated to be encountered in drilled shaft excavations and at any other deep excavations.

SITE SEISMICITY

Seismic design coefficients and seismic zones for the project are as follows:

PGA = 0.5g	Peak ground acceleration coefficient (1)
S_s = 1.25g	Short-period coefficient (1)
S_1 = 0.5g	Long-period coefficient (1)

$F_v = 1.5$ Site factor for long-period range of acceleration response spectrum (2)
$S_{D1} = 0.75$ Horizontal response spectral acceleration coefficient at 1.0-second period modified by the long-period site factor (3)
Seismic Zone (4) = 4

Notes: 1) From Section 12.3.5 of the NDOT Structures Manual (NDOT, 2008).
2) From Table 3.10.3.2.3 of AASHTO LRFD Bridge Design Specifications (AASHTO, 2017).
3) From Section 3.10.4.2 of AASHTO (2017).
4) According to US 395 North Valleys Basis of Technical Design Report (NDOT, 2019) all structures shall be detailed for Seismic Zone 4.

Seismic refraction microtremor (geophysical) surveys were performed by NewFields at Bridges G-1092 and G-1748 during the subsurface investigation. The results of the geophysical survey lines are summarized as follows:

- Bridge G-1092
  - Shear wave velocities between 1,200 and 3,400 feet per second (ft/s) with an overall average of 2,055 ft/s in the upper 100 feet from existing ground surface.
- Bridge G-1748
  - Shear wave velocities between 1,000 and 3,250 ft/s with an overall average of 2,372 ft/s in the upper 100 feet from existing ground surface.

Regarding the Site Class, the average shear wave velocities fall within the range for Site Class C soils for both bridges. Additionally, the field SPT N-values average greater than 50, also indicating Site Class C.

SPREAD FOOTING FOUNDATIONS

HDR was tasked with providing geotechnical design recommendations for spread footing foundations for the G-1092 bridge widening, the G-1748 bridge widening, and retaining Walls RW1 to RW12, inclusive. the existing foundations for Bridges G-1092 and G-1748 consist of spread footing foundations according to as-built plans; selected as-built plan sheets are provided in Appendix C.

It is assumed that the spread footing extensions will be rigidly connected to the existing footings. The width of the roadway widening from the 60% plans was added to the existing footing lengths from the as-built plans. The pier foundations for Bridge G-1748 were assumed to be founded on same-sized square spread footing foundations as for the existing piers. A summary of the existing and proposed foundations for Bridges G-1092 and G-1748 is provided in Tables D-1 and D-2 in Appendix D.

Cast-in-place (CIP) reinforced concrete cantilever retaining walls are to be designed in accordance with NDOT Standard Plans for Road and Bridge Construction (NDOT, 2020). The wall footing analysis was performed with the following assumptions:

- Depth of embedment of 2.5 feet below adjacent finished grade.
- Wall segment length of 24 feet (Maximum spacing of construction joints)
- The walls are not founded on or adjacent to a slope

Spread Footings Factored Bearing Resistance & Estimated Settlement

The spread footing analysis was completed using in-house Excel spreadsheets developed by HDR based on the methods in Article 10.6 of the AASHTO LRFD Bridge Design Specifications (AASHTO, 2017). The factored bearing resistance was determined using a resistance factor of 0.45 based on Table 10.5.5.2.2-1 (AASHTO, 2017).

Charts of factored bearing resistance versus effective footing width and estimated settlement (both immediate and total settlement) for Bridges G-1092 and G-1746 are included in Appendix E as Charts E-1 through E-9. Charts for retaining Walls RW1 to RW12 (inclusive) are included in Appendix F as Charts F-1 to F-16. The factored net bearing resistance curve (upper curve) on each chart does not include adjustment of the bearing resistance for the effect of an adjacent slope below the footing, as this case is not applicable to the planned footing locations. Each set of two charts for each bridge spread footing and retaining wall footing includes an immediate settlement chart (Chart ‘a’) and a total settlement chart (Chart ‘b’). It is recommended that the structural designer utilize the “total settlement” chart as the basis for selection of footing width and service limit bearing resistance for a tolerable value of total settlement. Then, the immediate settlement should be determined, and the effect (if any) of the incremental additional settlement (total minus immediate) be evaluated. Each chart includes the estimated factored bearing resistance for settlements of 0.25, 0.5, 0.75, 1.00, 1.50, and 2.00 inches.

The elastic settlement of spread footings was estimated using elastic theory with empirical correlations to soil type and SPT N-values. Several correlations of SPT N-values to the elastic (Young’s) modulus were considered, but the following correlations in Table C10.4.6.3-1 in AASHTO were selected (AASHTO, 2017):

- Fill and Native Soil:
    - $E = 0.097\ N1_{60}$, Clean fine to medium sands and slightly silty sands.
- Weathered Andesite and Granodiorite:
    - $E = 0.167\ N1_{60}$, Sandy gravel and gravels

Use of the AASHTO correlations listed above are in agreement with the analyses performed by NewFields for other bridges associated with this project.

Sliding Coefficient of Friction

Coefficients of friction for footings founded on undisturbed and prepared firm native soils, properly compacted structure backfill, or new or existing embankment fill material are as follows:

- Footing with shear key:

  Toe side of the shear key - coefficient of friction of 0.60 (equivalent to tan φ, with φ=32 degrees) on the, reflecting soil-soil shear. This soil-soil shear friction coefficient may only be used when passive resistance against the face of the shear key is neglected.

  Heel side of the shear key - coefficient of friction of 0.40 (equivalent to 2/3[tan φ] with φ=32 degrees) reflecting soil-concrete shear.

- Footing without shear key:

  Coefficient of friction of 0.40 (equivalent to 2/3[tan φ] with φ=32 degrees) reflecting soil-concrete shear.

  For the bridge spread footings on weathered rock the coefficient of friction of 0.48 may be used (equivalent to 2/3[tan φ] with φ=36 degrees) reflecting soil-concrete shear.

Resistance factor φ_{τ} taken from Table 10.5.5.2.2-1 of AASHTO (2017) should be applied to determine factored coefficients of friction for sliding analyses.

Passive Resistance Against Footing Edge

- For footings at a depth greater than or equal to 3.0 feet below finished grade or with a shear key:

  Factored passive resistance against the footing edge in contact with undisturbed native soils, properly compacted structure backfill or embankment fill is equivalent to 150 psf, which is based on an equivalent fluid pressure of 300 psf per foot of depth and a resistance factor, ϕ_{ep}, equal to 0.5 per Table 10.5.5.2.2-1 of AASHTO (2017).

  - Footing at a depth of less than 3.0 feet below finished grade or without a shear key – recommend neglecting the passive resistance against the footing edge.

Over-Excavation & Subgrade Preparation

Over-excavation below the bridge and retaining wall spread footings bottom of footing elevation is not anticipated but may be required if unacceptable subgrade conditions are encountered.

All spread footings should be founded on a properly prepared surface of relatively undisturbed native soils, or on properly prepared and compacted embankment fill, as follows:

- Scarify subgrade at planned bearing elevation to a minimum depth of 1.0 foot below bottom of footing grade.
- Moisture-condition the scarified subgrade to within the limits of +/-2 percent of the optimum moisture content as determined by NDOT Test Method T108.
- Compact to a minimum dry density corresponding to 90% of the Standard Proctor effort in accordance with NDOT Test Method T108 and Section 206.03.01 of the NDOT Standard Specifications.
- Loose or soft zones within the subgrade which are observed during excavation and scarification should be over-excavated to contact with dense and undisturbed material and replaced with properly moisture-conditioned and compacted material that meets the Selected Borrow material in Section 704.03.13 of NDOT Standard Specifications.

Over-excavation is not required when dense weathered rock is encountered at the planned bearing elevation.

Drainage and Utility Considerations for Walls

Weep holes shall be included for all retaining walls in accordance with NDOT Standard Plans for Road and Bridge Construction (NDOT, 2020). Surface water should be prevented from entering wall backfill or otherwise provided a clear path out of the wall. All wet utilities (water, sewer, stormwater and irrigation) required to be located behind or within wall backfill should be fitted with water-tight joints. All utilities beneath or crossing walls should be capable of resisting vertical and lateral forces such that they do not deform or break.

DRILLED SHAFT FOUNDATIONS

It is understood that drilled shaft foundations will be required for the pier foundations adjacent to the UPRR tracks at Bridge G-1092. Drilled shaft axial resistance was computed using the Beta method for side resistance in drained cohesionless soils and the O’Neill and Reese Method for tip resistance, in accordance with Article 10.8 in AASHTO (2017). Nominal and factored axial resistances for drilled shafts were evaluated using the program SHAFT 2017 (Ensoft, 2017). Guidance presented in FHWA (2018) was also considered in drilled shaft analysis.

The drilled shaft design was performed using the results of the geotechnical investigation including SPT N-value, unit weight, results of shear strength tests, descriptions of the encountered soils and subsurface conditions, and the following assumptions:

- The profile in Table D-1 (Appendix D) was used to develop the design profiles for the drilled shafts.
- Permanent or isolation surface casings will be constructed for the Piers 1 through 4, inclusive drilled shafts. Axial resistance shall neglected to the bottom of the permanent or isolation casing as follows:
  - Piers 1 and 4 shafts isolation casing length ranges from 12.25 feet to 14.67 feet.
  - Piers 2 and 3 shafts permanent casing length ranges from 16.17 feet to 16.67 feet.
- No reduction for tip resistance is included for shafts greater than 50 inches in diameter.
- The side resistance was computed using the sand model for determination of the Beta values.

Strength Limit State

Resistance factors for factored geotechnical resistance of drilled shafts were determined in accordance with AASHTO (2017), with values of 0.5 and 0.55 assigned to the nominal tip and side resistance, respectively. Resistance factors assume redundant foundations as defined in AASHTO (2017). Design charts for strength limit analysis of Bridge G-1092 are provided in Figures G-1 and G-2, inclusive in Appendix G.

Service Limit State

The magnitude of axial resistance provided by the soil is a function of the relative movement between the drilled shaft and the surrounding soil. AASHTO (2017) and FHWA (2010) provide relationships for the development of skin friction and end bearing as a function of settlement normalized to the drilled-shaft diameter, for various soil types. Service limit axial resistances of drilled shafts for deflections of 0.10, 0.25, 0.50, 0.75 and 1.00 inches were estimated using these relationships. The results of this analysis are provided in Figures G-1A to G-1E and G-2A to G-2E, inclusive, in Appendix G.

Resistance to Lateral Loads

Recommendations for the lateral loading analysis of drilled shafts were prepared based on the boring logs and results of laboratory testing previously described. The soil profile and recommended soil parameters for Bridge G-1092 drilled shaft foundations are presented in Table D-10 in Appendix D. Lateral soil-structure interaction analyses of single shafts should be performed in accordance with the procedure in Appendix B1, Lateral Design of Deep Foundations, in NDOT (2019). Lateral resistance shall be neglected to the bottom of the permanent and isolation casings for Piers 1 to 4 shafts, inclusive.

Parameters for analysis in both the LPILE (Ensoft, 2018) and Strain Wedge programs are provided in Tables D-10 and D-11. It is outside of the scope of this study to provide detailed analysis comparing the results of these two programs, but it is understood that each program models the drilled shaft loading differently, such that the resulting solutions will differ. It is recommended that the structural designer use caution when comparing the results of the programs.

Group Effects

It is assumed that single drilled shafts will be required for the bridge widenings. The group effects should be determined based on Section 10.8.3.6 in AASHTO (AASHTO, 2017).

SOIL NAIL WALLS

Soil nail walls were selected for Retaining Walls RW3, RW10 and RW14. The soil nail-walls were designed following the procedures presented in the FHWA Geotechnical Engineering Circular No. 7 (GEC7) (FHWA, 2015). Design analysis of the soil nail walls was performed using the Caltrans computer program Snail 2.2.2 (Caltrans, 2018). The program analyzes internal and external (global) stability using a bi-linear failure wedge approach, which incorporates a limit equilibrium method wherein all forces are balanced, and inter-slice forces are included. The selected analysis procedure incorporated factored punching shear, bond stress and yield stress (nail bar steel) values, and the allowable stress design (ASD) approach. Internal and global stability and sliding, both static and pseudostatic, were analyzed for all design cross sections.

In accordance with FHWA (2015), minimum recommended factors of safety used in design of the permanent soil nail walls using the ASD method were as follows in Table 1:

Table 1 – Minimum Required Factors of Safety for Soil-Nail Wall Design

Failure Mode		Minimum Required Factor of Safety	Loading
External Stability			
	Global stability {long-term} and sliding	1.5	Static
		1.1	Seismic
	Global stability (for excavation)	1.2	Static
Internal Stability			
	Nail pullout resistance	2.0	Static
		1.5	Seismic
	Nail bar tensile strength	1.8	Static
		1.35	Seismic
Facing Strength			
	Facing flexure and punching shear	1.5	Static
		1.1	Seismic
	Headed-stud tensile strength	2.0	Static
		1.5	Seismic

For analysis of external (global) stability for the temporary excavation condition, for each design cross section, the wall excavation was carried to its full depth and the lowermost row of soil nails was removed, resulting in the lowest portion of the cut being unsupported. Results of the analyses are provided in Appendix H.

Wall RW3 is being constructed to provide grade separation between the US 395 northbound and southbound lanes. A crash barrier will be constructed at the top of the wall using a moment slab that will not transfer any load to the wall. A traffic surcharge of 250 psf is included behind the wall to account for vehicle loading.

Walls RW10 and RW14 were designed with a U-shaped channel (crown ditch) behind the top of wall, then a 2H:1V slope upward to the existing grade. The soil nail wall analysis includes a 250 psf surcharge load on the slope to account for vehicle loading and a 600 psf surcharge load behind the crest of the slope to account for NV Energy (NVE) maintenance vehicle loading. Existing NVE transmission poles are located behind Walls RW10 (at approximately 34.6 feet behind the wall face) and RW14 (at approximately 32.5 feet behind the wall face). The NVE pole behind Wall RW14 is at an angle point in the transmission line alignment, such that the direction of the resultant pole load is away from the wall and will not add any lateral load to the wall. The NVE pole behind Wall RW10 will impose a lateral load in the direction of the wall and as such was evaluated and incorporated in the soil-nail wall design.

Nail Bar Steel

Nail bars were sized by examining the output nail forces from the Snail program. The nail bars used in the analysis of the typical wall design section were No. 8, Grade 75 deformed bars conforming to ASTM A615. The nail bar parameters used in design are presented in the following Table 2:

Table 2 – Soil-Nail Bar Reinforcement Parameters

Bar Size and Type	Tensile Yield Stress	Allowable Tensile Stress	Bar Diameter	Steel Area
(feet)	**(ksi)**	**(ksi)**	**(in)**	**(sq. in)**
Deformed No. 8	75	41	1.0	0.79
Note: Allowable tensile stress = 0.55 * (tensile yield stress), per FHWA (2015)				

In accordance with FHWA recommendations, self-drilling, hollow-core nail bars with sacrificial drill bits are not permitted to be used in the permanent soil-nail walls for this Project.

Nail Head Strength and Facing Design

The critical failure mechanisms for a soil-nail wall facing and connection system, including facing flexure and punching shear, were checked in accordance with the requirements of FHWA (2015). Two critical locations on Wall RW3 were checked for the facing design which was then used for the remainder of the RW3 sections. Wall facing designs for RW10 and RW14 were performed for the maximum wall heights. The design calculations are included in Appendix H of this report.

The temporary wall facing consists of 4-inch thick reinforced shotcrete, with a design 28-day compressive strength of 3,000 pounds per square inch (psi). The shotcrete reinforcement consists of continuous 6 x 6 – W4.0 x W4.0 welded wire reinforcement conforming to ASTM A82 and A185, with two No. 4 bars in the horizontal and vertical directions along the nail rows, and the horizontal (waler) bars continuous for the entire length of all walls. The vertical (bearing) bars are each 2'-6" in length and centered on the nail head. All reinforcing steel for the wall facing shall be Grade 60 conforming to ASTM A615.

The permanent wall facing is 6-inch thick 4,000 psi concrete with No. 5 bars at 12-inch spacing both vertically and horizontally and shall be Grade 60 conforming to ASTM A615. Refer to the design plan sheets in Appendix B for additional details regarding the facing design.

The headed-stud/bearing plate assembly (one plate with studs per each soil-nail) for anchoring the permanent wall facing consists of an 8-inch by 8-inch square, 1-inch thick, Grade 60 steel bearing plate with center hole. The headed-studs each consist of 5-1/4-inch long, 3/4-inch diameter, Grade 60 studs spaced 5 inches on-center and welded to the bearing plates. All welds shall be full-penetration buttwelds. All nail head assembly elements, including headed-studs/bearing plate, wedge washer and hexagonal nut, shall be galvanized.

Wall Drainage

Drainage elements behind the temporary wall facing consist of 1-foot-6-inch wide prefabricated geocomposite drain strips with separating geotextile wall drain fabric. The geocomposite drain strips are located between the vertical rows of soil nails and connect to the lateral perforated PVC drainage pipe. Refer to the typical wall section in the design plans in Appendix B.

Corrosion Protection

Results of pH and electrical resistivity tests on representative samples of site soils were in the range of 3.76 to 11.48 and 230 to 2,550 ohm-centimeters (ohm-cm), respectively. FHWA (2015) indicates soils exhibiting resistivity values less than about 2,000 ohm-cm are considered as having strong corrosion potential, and some on-site soils are within this range. Therefore, double-corrosion protection (or encapsulation as described in Section 6.44.02.01 of the NDOT Standard Specifications) for the soil-nail bars is recommended, and shall consist of a factory-applied, fusion-bonded purple marine epoxy coating on the bars (meeting the requirements of ASTM A775) centralized and encapsulated in the grout-filled corrugated HDPE tube. Corrosion protection for the bearing plate/headed stud assemblies, washers and nuts consists of galvanizing.

Soil Nail Wall Installation Conditions

Based on the subsurface investigation performed by NewFields, it is expected that drill holes for soil-nail installation will primarily encounter clayey sand embankment fill and weathered andesite and granodiorite. In general, there is enough clay content in the soils for open-hole drilling for the soil nails. However, there are variable subsurface conditions across the site especially in the existing embankment fill, and caving or difficult drilling conditions may be encountered. The Contractor should anticipate that temporary casing or other stabilization techniques may be required to stabilize the soil nail drill holes.

Soil-Nail Wall RW3 Recommendations

Soil-nail Wall RW3 is 2,331 feet long and varies in height from 6.3 feet to a maximum of 14.8 feet. The wall was designed based on the geotechnical profile and the height of the wall. Portions of the wall will be constructed in existing embankment fill, other portions will support native soils and weathered andesite, and yet other portions will be within a combination of fill and native soils. Soil strength parameters used for the design are included in the results figures H-1 to H-23, inclusive provided in Appendix H followed by the Snail output files. The recommendations for the soil-nail lengths and spacing are summarized in Table H-1 in Appendix H.

Soil-Nail Wall RW10 Recommendations

Soil-nail Wall RW10 is 74 feet long and varies in height from 5 feet to a maximum of 11.4 feet. As previously mentioned, there is an existing NVE transmission tower (NVE #3453 Line Str78) behind the proposed wall. The maximum loads for this structure were provided by NVE and the soil-structure interaction was modeled in LPILE (Ensoft, 2018). The loads used for the analysis are as follows:

- Axial Load = 30 kips (not including weight of tower foundation)

- Shear Load = 15 kips
- Bending Moment = 1,500 foot-kips

Based on the LPILE analysis and projection of the lateral load using Boussinesq pressure distribution, a lateral pressure of 2,850 psf was applied to the full length of the wall. Since this is a maximum load, it was considered an extreme event. Under typical working conditions the lateral load will be much less and will not apply a significant lateral pressure to Wall RW10. Soil strength parameters used for the design are included in the results figures H-24 to H-29, inclusive provided in Appendix H followed by the Snail output files. The recommendations for the soil-nail lengths and spacing are summarized in Table H-2 in Appendix H.

Soil-Nail Wall RW14 Recommendations

Soil-nail Wall RW14 is 48 feet long and varies in height from 5 feet to a maximum of 8.25 feet. As previously mentioned, there is an existing NVE transmission tower (NVE #3453 Line Str79) behind the proposed wall. This transmission tower is at an angle point in the conductor alignment with the resultant loading directed away from Wall RW14, such that no load cases result in loading imposed on Wall RW14. Soil strength parameters used for the design are included in the result figures H-30 to H-34, inclusive provided in Appendix H followed by the Snail output files. The recommendations for the soil-nail lengths and spacing are summarized in Table H-3 in Appendix H.

MECHANICALLY STABILIZED EARTH (MSE) WALL

Retaining Wall RW12 will be constructed as a mechanically stabilized earth wall; design plans for the wall are provided in Appendix B. The wall will be constructed on an existing embankment fill of varying thickness along the length of the wall. The existing slope of the embankment fill is 2H:1V, the finished slope will be at the same inclination.

Five potential external failure mechanisms were considered in evaluating the MSE Wall RW12, including the following:

- Bearing resistance
- Settlement
- Overall slope stability
- External stability (sliding and overturning), and
- Limiting the location of the resultant of all forces (eccentricity).

External Stability Analysis (Bearing Resistance)

Nominal and factored bearing resistance for MSE Wall RW12 were evaluated in accordance with AASHTO (2017) and FHWA (2009) using the computer program MSEW 3.0 (ADAMA Engineering, 2019). MSE Wall RW12 cross sections which were analyzed include the existing embankment fill and the proposed wall with a minimum depth of embedment of 4.5 feet.

Factored bearing resistance was estimated based on the results of the geotechnical investigation and our analysis. The MSEW 3.0 program is based on a single soil layer for foundation soils. The wall will be constructed on existing embankment fill that generally consists of clayey sand with varying amounts of gravel.

Internal stability of the MSE walls was not checked and is the responsibility of the MSE wall vendor. In our analysis the size and spacing (both horizontal and vertical) of metal strip reinforcement was increased to the point at which the resultant required reinforcing strip length is based on external factors and not internal design factors.

External Stability (Resistance to Sliding & Overturning)

MSE Wall RW12 was evaluated for external stability in accordance with AASHTO (2017) Article 11.10. A minimum reinforcing strip length of 0.7 H (where H is the total height of the wall) or a minimum of 8 ft - 0 inches shall be provided for external stability. Nominal sliding resistance and overturning resistance of the MSE wall was evaluated in accordance with AASHTO (2017) using MSEW 3.0 (ADAMA, 2019). Live load surcharge was not included as a stabilizing force when checking sliding. The actual minimum required reinforced width (strip length) and the calculated capacity/demand ratios (CDR) for sliding and overturning were determined.

Lateral Earth Pressures

Lateral earth pressure on MSE Wall RW12 was determined in accordance with AASHTO (2017). Seismic lateral earth pressures assumed that some permanent deformation is allowed due to the design seismic event and one-half of the PGA was applied as the horizontal acceleration.

Surcharge Loading

A traffic surcharge load of 250 psf superimposed at the top of the MSE wall and reinforced backfill was utilized in the analysis of external stability and global stability.

A surcharge strip load of 2,291 pounds/foot was applied at 2 feet from the back of wall over a width of 4 feet to model the loading from the soundwall and barrier that will be founded on a moment slab.

Material Properties

Material properties for the MSE Wall RW12 reinforced zone assume that it will consist of properly compacted granular material. The retained fill embankment properties are based on the existing embankment fill and neglect cohesion for the newly placed fill material. The foundation soils are comprised of existing embankment fill that consists primarily of clayey sand with varying amounts of gravel. Strength parameters for the existing embankment fill were assigned based on review of the material descriptions, SPT N-values and laboratory testing.

Table 3 – MSE Wall RW12 Soil & Fill Material Properties

Material	Moist Unit Weight (pcf)	Friction Angle, ϕ (degrees)	Cohesion, c (psf)
Reinforced Soil	135	34	0
Fill Embankment	120	35	0
Foundation Soil	120	35	150

MSE Wall RW12 Design Recommendations

The analyses were performed for the proposed MSE Wall RW12 based on cross sections and wall plans provided by NDOT and the results of the geotechnical investigation. Critical locations and sections of wall were selected for analysis; it is noted that not every section of wall was analyzed. Analyses were completed at Wall RW12 Stations 2+80, 4+00 and 7+00; the results are provided in Appendix I. Based on these results it is recommended that a minimum reinforcement strip length of 0.9H be specified for the Wall RW12.

Slope Stability Analysis

Slope stability analyses were performed using two-dimensional limit equilibrium methods in accordance with AASHTO (2017) and FHWA (2009). Spencer’s method of slices was used in the analyses, which satisfies both force and moment equilibrium. Spencer’s method assumes that inter-slice forces are parallel, and that the normal force on each slice acts at the center of the base of each slice. The analysis used the widely used and accepted slope stability program Slope/W™ by Geo-Slope International (Geo-Slope, 2019). Evaluation of global stability involves developing a cross section of the existing ground or embankment and the proposed new embankment/wall, developing a generalized soil profile and drained soil strength parameters, and calculating the factor of safety (FOS) under various embankment/wall stress conditions. The minimum required factor of safety for static analysis is 1.5 and for seismic analysis is 1.1 based on FHWA and NDOT recommendations.

The potential slip surfaces which pass through the MSE wall reinforcement (compound stability) will not be considered in the global stability analyses, since these slip surfaces will be accounted for in internal stability evaluations for which the MSE wall vendor will be responsible. The reinforced zone was modeled as a “high strength” material in Slope/W which forces the failure surface outside of the MSE wall reinforcement zone.

The analysis was performed for both static and seismic cases with the same seismic loading previously described. The horizontal acceleration was assigned at 0.25g and the vertical acceleration was neglected. A traffic surcharge loading of 250 psf was added on top of the MSE wall and fill section. A surcharge pressure of 573 psf was applied from back of wall to 4 feet back of wall to represent the strip load for the soundwall and barrier with moment slab. The same subsurface soil properties described in the MSEW analysis were used in this slope stability analysis.

The slope stability for Wall RW12 was evaluated at Stations 4+00 and 7+00; results for both static and seismic analysis are included in Appendix I. The computed factors of safety exceed the minimum requirements for FOS for static and seismic design.

CONSTRUCTION CONSIDERATIONS

Site Preparation & Over-excavation

Preparation of subgrade soils at the base of embankment fills and at the footing bottom for spread footings should be observed by a representative of the geotechnical engineer. If loose, soft, or unstable subgrade conditions are encountered, over-excavation of the unsuitable material is required to a depth where acceptable material is encountered.

Placing & Keying In of New Embankment Fill

New embankment fill should be placed and compacted in accordance with NDOT standard specifications, including placement in uniform horizontal lifts not exceeding eight (8) inches loose thickness, and compaction to at least 90 percent of maximum dry density as determined by NDOT Test Method T108. Prior to placement, the fill should be moisture-conditioned to within the limits of ±2 percent of the optimum moisture content.

New embankment fill sections, where placed on existing slopes steeper than 4H:1V, should be keyed into the existing soil slope using horizontal benches. It is recommended that the wedge of new embankment fill be horizontally keyed into the existing embankment a minimum distance of 6.0 feet for each lift of new fill.

Preparation of Subgrade Beneath Spread Footings

Subgrade at the planned bearing elevation of bridge and retaining wall spread footings and MSE Wall RW12 should be scarified to a depth of at least 1.0 foot, moisture-conditioned to within the limits of ±2 percent of the optimum moisture content, and compacted to achieve a minimum dry density corresponding to 90% of the modified Proctor effort in accordance with NDOT Test Method T108. Loose or soft zones within the subgrade which are observed during scarification should be over-excavated to contact with dense and undisturbed material and replaced with properly moisture-conditioned and compacted fill.

Temporary Excavations

Temporary cut slopes should be excavated in accordance with OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926, Subpart P (OSHA, 2005). In accordance with the OSHA standards, the existing embankment fill soils and native soils would be considered predominantly “Type B” soils. For excavations in such soils, Subpart P indicates a maximum allowable (steepest) un-shored slope of 1H:1V. This recommendation is based on the soil moisture contents being maintained at or near in-situ moisture contents for cut slopes. Significant moisture increases in the soils within the temporary cut slope could weaken the slope due to a decrease in shear strength.

Should steeper temporary cut slopes be required due to proximity to existing improvements or structures, or for purposes of construction economy, the geotechnical engineer should be contacted to evaluate the slope stability and potential effect on adjacent structures, such as existing spread footings or roadway pavements.

All excavations should be protected against water infiltration from surface runoff or other sources. Moderate to severe raveling and erosion of temporary excavation slopes may occur due to water infiltration or surface runoff.

Heavy equipment, traffic, and excavation spoils should be permitted no closer than 10 feet from the edge of any excavation.

Excavations for Drilled Shafts

As previously discussed, the groundwater conditions varied significantly and sometimes over short distances along the Project. The drilled shaft contractor should anticipate encountering groundwater during excavation of the drilled shaft foundations. Bridge G-1092 Piers 1 to 4 require permanent casing to be advanced to the depths detailed in the Plans. The casing should be advanced ahead of the excavation by vibrating, twisting, or driving in accordance with the Special Provisions. The drilled shaft design and construction should be in accordance with Chapter 17 of the NDOT Structures Manual and all applicable, relevant NDOT Standard Specifications and Project special provisions.

The following are construction considerations for drilled shafts to ensure that the geotechnical design assumptions are satisfied:

1. Drilled shafts shall be constructed in accordance with the requirements of Section 509 of the NDOT Standard Specifications and the Project special provisions.

2. It is recommended that all drilled shaft excavations be inspected by a representative of the geotechnical engineer to verify that the encountered soils and rock and the bearing strata are consistent with design assumptions.

3. Integrity testing of all drilled shafts shall consist of installing integrity testing tubes and performing cross-hole sonic logging in accordance with Section 509 of the NDOT Standard Specifications and the Project special provisions.

4. The local groundwater conditions should be verified at the time of shaft excavation, if practicable, to determine whether seasonal groundwater fluctuations may affect the excavation and construction of drilled shafts. Groundwater conditions at the site are discussed above in the Groundwater Conditions section.

5. Excavations for drilled shafts may encounter caving and sloughing of existing embankment fill soils, native soils, and weathered rock materials. Should a significant amount of caving and/or sloughing occur, shaft excavation walls will become unstable, undesirable soil inclusions or anomalies in the shaft concrete may result, and concrete quantities will exceed neat-line excavation volumes. Therefore, use of steel casing and/or the wet construction method using mineral or synthetic drilling slurry should be anticipated to be required. Drilled shaft casing and wet construction method materials and procedures shall be in accordance with Section 509 of the NDOT Standard Specifications and the project special provisions. Should a significant amount of caving still occur, construction should cease and the excavation stabilized as described in Item (7) below.

6. Where drilled shaft spacing is closer than four diameters center-to-center (CTC), the shaft concrete should be allowed to cure a minimum of 24 hours before adjacent shafts are excavated.

7. It is recommended that contract documents be written in such a manner that payment be made on the basis of neat volume or linear footage for straight drilled shafts. In this manner, the Drilled Shaft Contractor will be responsible for selecting and employing techniques for shaft excavation stabilization in order to minimize concrete quantity overruns.

REFERENCES

ADAMA Engineering, 2019. *MSEW 3.0 – A Program for Design and Analysis of Mechanically Stabilized Earth Walls*. Clackamas, Oregon. Update 14.981, April 7.

American Association of State Highway and Transportation Officials (AASHTO), 2017. *AASHTO LRFD Bridge Design Specifications.* 8th Edition. Washington, DC: American Association of State Highway and Transportation Officials. Publication Code LRFD-8, September with May 2018 Errata.

AASHTO, 2011. *AASHTO Guide Specifications for LRFD Seismic Bridge Design*. 2nd Edition with interims through 2015. Washington, DC: American Association of State Highway and Transportation Officials. Publication Code LRFDSEIS-2.

Caltrans, 2018. *Snail, Version 2.2.2,* Division of Engineering Services / Geotechnical Services.

Ensoft, Inc., 2017. *SHAFT 2017: A Program to Analyze the Axial Capacity and Short-Term Settlement of Drilled Shafts Under Axial Loading.* July 11.

Ensoft, Inc., 2018. *LPILE 2018: A Program to Analyze Deep Foundations Under Lateral Loading.* January 17.

FHWA, 2006. *Soils and Foundations Reference Manual,* prepared for U.S. Department of Transportation, Publication No. FHWA-HNI-06-088, USDOT, Washington, D.C., December.

FHWA, 2009. *Geotechnical Engineering Circular No. 11, Design and Construction of Mechanically Stabilized Earth Walls and Reinforced Soil Slopes – Volume 1.* Final Report. Prepared by Ryan R. Berg & Associates, Inc. Woodbury, Minnesota. Report No. FHWA-NHI-10-024, FHWA GEC 011 – Volume I. November.

FHWA, 2018. *Drilled Shafts: Construction Procedures and LRFD Design Methods, Geotechnical Engineering Circular No. 10.* Prepared by PB Americas, Inc., Dan Brown and Associates, PLLC., and the University of Wyoming, Laramie, Wyoming. Publication No. FHWA-NHI-18-024, September.

FHWA, 2015. *Geotechnical Engineering Circular No. 7, Soil Nail Walls,* Report No. FHWA-NHI-14-007, Office of Technology Application, Office of Engineering/Bridge Division, Washington, D.C., February.

Gates, W.C.B., and Waters, R.J., 1992. *Geology of Reno and Truckee Meadows, Nevada, United States of America,* Bulletin of the Association of Engineering Geologies, Vol. XXIX, No. 3., pp 229-298.

Geo-Slope International, 2019. *SLOPE/W, GeoStudio 2019 R2.* Calgary, Alberta, Canada.

Nevada Department of Transportation (NDOT), 2008. *Structures Manual,* Structures Division, September.

NDOT, 2019. *US 395 North Valleys Basis of Technical Design,* Draft Version 1.0, April.

NDOT, 2020. *Standard Plans for Road and Bridge Construction,* Edition. 2020.

NDOT, 2014. Standard Specifications for Road and Bridge Construction, Carson City, Nevada.

NewFields, 2019. *Geotechnical Design Report, Phase 1A: Parr-Dandini Bridge Project, Washoe County, Nevada*, Project ID 60941, November.

NewFields, 2020. *Geotechnical Design Report, Phase 1B: US395 North Valleys, Washoe County, Nevada,* February.

Schmertmann, J.H. 1970. Static Cone to Compute Static Settlement over Sand. *Journal of the Soil Mechanics and Foundations Division, Proceedings of the American Society of Civil Engineers,* Vol. 96, No. SM3. May.

Schmertmann, J.H., J.P. Hartman and P.R. Brown, 1978. Improved Strain Influence Factor Diagrams. *Journal of the Geotechnical Engineering Division, Proceedings of the American Society of Civil Engineers,* Vol. 104, No. GT8. August.

APPENDIX A

NewFields UPRR Grade Separation Bridge Structures Memo

NewFields Retaining Walls Memo

TECHNICAL MEMORANDUM

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To:	**Mr. Ruedy Edgington, P.E.** **Project Manager**
From:	**Mark Doehring, P.E.**
Reviewed by:	**Jesse Ruzicka, P.E.**
Project:	**US 395 North Valleys Project**
Project No:	**475.0398.000**
Subject:	**UPRR Bridge Structures, Boring Logs, Laboratory Testing Results and ReMI Survey Results**
Date:	**December 4, 2019**

This technical memorandum presents the boring logs, laboratory test results, and ReMi survey results to support HDR's engineering and final design of the bridge structures UPRR Panther Valley (G-1092N&S) at milepost 30.04 and the UPRR Panther Branch-UPRR-grade separation (G-1748N&S) at milepost 30.54 for the US 395 North Valleys Phase 1B project in Washoe County, Nevada.

Boring locations were selected based on the following information:

- Preliminary alignments as shown on NDOT *Construction Plans*, Sheets No. 15 and No. 18 (NDOT, 2019);
- Table 3-2, Guidelines for minimum number, location, and depth of exploration points (FHWA, 2017);
- Site constraints (i.e. site topography and utility clearances).

The boring identification numbers, applicable bridge structures, drill rig identification numbers, coordinates, elevations, and depths (below ground surface) are summarized in **Table 1**. Approximate boring locations are provided on the site plans in **Attachment A**.

Boring logs are provided in **Attachment B**. The blow counts presented on the boring logs are field counts and have not been corrected for overburden pressures, hammer efficency, or sampler type. Copies of the energy transfer efficiency for the automatic hammers used during drilling are provided in **Attachment C.** A sampler correction factor of 0.65 is recommended for Mod Cal samplers 3 inch OD x 2.5 inch ID (Rogers, 2006).

Laboratory testing was performed on geotechnical samples representative of subsurface conditions encountered during the field investigation. The following geotechnical tests were performed:

- Natural Moisture Content (AASHTO T265);
- In-Situ Density (ASTM D7236);

- Particle Size – Sieve Analysis (AASHTO T88);
- Atterberg Limits (AASHTO T89 and T90);
- Maximum Density and Optimum Moisture Content (NDOT T108 and AASHTO T99);
- Direct Shear (AASHTO T236).

Direct shears were performed on remolded samples of the embankment fill. Index test results are summarized in **Table 2.** Maximum density, optimum moisture, and direct shear results are summarized in **Table 3**.

Chemical tests were performed to evaluate corrosion potential and potential for sulfate attack on concrete. The following chemical tests were performed by Sunland Analytical of Rancho Cordova, California:

- pH (AASHTO T289);
- Minimum Resistivity (AASHTO T288 modified);
- Sulfate (AASHTO T290);
- Chloride (AASHTO T291).

Chemical test results are summarized in **Table 4**.

Laboratory and Chemical test results provided in **Attachment D**.

Two ReMi surveys were performed north and south of each of the UPPR structures to estimate vertical shear wave velocity profiles in the upper 100 ft for site class definition. ReMi survey locations (Panther South, Panther North, UPRR South and UPRR North) are shown on the site plans in **Attachment A**.

ReMi surveys were performed using a DAQLink 24 channel seismograph with laptop and 4.5 Hz geophones. A geophone spacing of 10 feet was used for a total line length of 230 feet. Broadband ambient site noise was used as a surface wave energy source, as well as, a ten-pound sledgehammer struck against an aluminum plate. A total of 20 readings, 10 passive (ambient noise) records and 10 active (hammer strike) records, were recorded at each location. For the active records, the energy source was offset 5 ft from both ends of the survey line. A sampling time and interval of 30 seconds and 2 milliseconds was used for each record, respectively.

ReMi survey data was interpreted using the SeisOpt Version 4.0 software package by Optim, LLC. The software converts the data from each sampling into a spectral energy shear wave frequency versus shear wave velocity plot. A dispersion curve consisting of the lower bound of the spectral energy shear wave velocity versus frequency trend is manually selected from the shear wave plot. An interpreted vertical s-wave profile is then obtained by fitting multiple layers and S-wave velocities to match the selected dispersion curve. ReMi survey results are provided in **Attachment E.**

If you have any questions or require additional information, please do not hesitate to contact either Mark Doehring or Jesse Ruzicka at 775-525-2575.

LIST OF ATTACHMENTS

- Attachment A – Site Plans
- Attachment B – Boring Logs and Exploration Key
- Attachment C – Hammer Efficiency and Calibration Reports
- Attachment D - Laboratory Test Results
- Attachment E – ReMi Survey Results

REFERENCES

City of Reno, 2019. Community Development Map, http://cityofreno.maps.arcgis.com/apps/MapTools/index.html?appid=de47c7ee33f04a7592219ed6bc9ced53, 29 October.

FHWA, 2017. Geotechnical Engineering Circular No. 5, Geotechnical Site Characterization, Publication No. FHWA NHI-16-072, April.

NDOT, 2019. Construction Plans, Carson City and Washoe County from US50/Williams Street to the Neil Road Int. Exit #62 from the Junction of I80 at the US395 Int. to California/Nevada State Line, Sheets No. 15 and No. 18, 26 February.

Rogers, J. David, 2006. Subsurface Exploration Using the Standard Penetration Test and the Cone Penetrometer Test. ENVIRONMENTAL & ENGINEERING GEOSCIENCE XII. No. 2: 161-179

Table 1: Summary of Geotechnical Borings for UPRR Bridge Structures

Boring ID	Bridge Structure	Drill Rig ID	Station[1]	Offset[1]	Elevation[2] (ft) amsl	Exploration Depth (ft)
BH19-BR-04	UPRR Panther Valley (G-1092N&S)	Geotechnical Drilling Unit 5	"XN" 755+90	115'L	5062	91.5
BH19-BR-05		HazTech BK81 (1541)	"XN" 756+25	20'R	5062	95.2
BH19-BR-06		HazTech 105	"XN" 757+10	130'L	5035	100.5
BH19-BR-07		HazTech 105	"XN" 757+45	25'L	5035	101.5
BH19-BR-08		Geotechnical Drilling Unit 5	"XN" 758+10	65'L	5032	50.5[3]
BH19-BR-09		Geotechnical Drilling Unit 17	"XN" 758+40	45'R	5034	43.5[3]
BH19-BR-10		Geotechnical Drilling Unit 5	"XN" 759+10	115'L	5064	80.8
BH19-BR-11		Geotechnical Drilling Unit 5	"XN" 759+55	30'L	5064	100.5
BH19-BR-20	Panther Branch-UPRR-grade separation (G-1748N&S)	Geotechnical Drilling Unit 5	"XN" 799+90	30'L	5191	101.0
BH19-BR-21		Geotechnical Drilling Unit 5	"XN" 800+60	60'L	5188	80.0[4]
BH19-BR-22		HazTech BK81 (1541)	"XN" 803+00	15'R	5192	101.5
BH19-BR-23		Geotechnical Drilling Unit 5	"XN" 803+85	50'L	5192	57.0[3]

Notes:

[1] Station and offset estimated using Construction Plans (NDOT, 2019).

[2] Boring elevations were estimated using the City of Reno Community Development Map (City of Reno, 2019).

[3] Boring encountered practical refusal.

[4] Boring terminated due to mechanical problems.

Table 2: Laboratory Test Summary

Boring ID	Depth (feet bgs)	USCS Group Name	USCS Group Symbol	GRAIN SIZE DISTRIBUTION (% PASSING)														Atterberg Limits			Natural Moisture Content (%)	Natural Dry Density (PCF)
				GRAVEL							SAND						FINES	Liquid Limit	Plastic Limit	Plastic Index		
				3.0"	2.0"	1.5"	1.0"	0.75"	0.5"	0.375"	#4	#10	#16	#40	#50	#100	#200					
BH19-BR-04	11-11.5	Fill – clayey sand with gravel	SC	100.0	100.0	100.0	97.3	94.8	84.0	79.6	69.2	56.6	49.4	36.9	33.5	27.2	21.8	32	20	12	12.8	111.2
BH19-BR-04	25-26.5	Fill – clayey sand with gravel	SC	100.0	100.0	100.0	96.0	92.3	84.9	80.8	65.8	51.5	44.6	34.1	31.1	25.2	20.7	39	21	18	16.6	-
BH19-BR-05	6-6.5	Fill – silty sand with gravel	SM	100.0	100.0	100.0	100.0	85.0	79.3	78.1	59.5	46.5	40.0	29.9	27.0	21.8	16.8	NP	NP	NP	10.8	124.4
BH19-BR-05	11-11.5	Fill – clayey sand with gravel	SC	100.0	100.0	100.0	100.0	95.6	89.7	88.7	69.6	55.8	49.1	41.9	35.6	29.8	24.3	34	21	13	15.5	107.5
BH19-BR-05	20-21.5	Andesite – clayey sand with gravel	SC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14.1	-
BH19-BR-05	35-36.5	Andesite - clayey sand with gravel	SC	100.0	100.0	100.00	100.0	100.0	100.0	100.0	79.5	62.2	54.2	41.9	38.4	31.5	25.6	39	24	15	17.1	-
BH19-BR-06	7.5-9	Clayey Sand	SC	100.0	100.0	100.0	100.0	100.0	100.0	100.0	88.6	80.4	70.9	52.1	46.5	36.7	27.8	30	11	19	15.3	-
BH19-BR-06	20-21	Clayey Sand	SC	100.0	100.0	100.0	100.0	100.0	100.0	100.0	89.6	75.9	66.3	51.6	48.3	42.4	37.3	45	17	28	29.9	90.2
BH19-BR-06	40-41	Andesite - clayey sand with gravel	SC	100.0	100.0	100.0	100.0	98.2	90.0	85.5	60.4	39.8	32.9	23.3	20.8	16.3	13.3	29	16	13	20.2	-
BH19-BR-07	10-11	Sandy Clay	CL	100.0	100.0	100.0	100.0	100.0	98.8	98.2	93.9	89.4	86.5	78.8	75.3	66.2	56.0	44	15	29	-	-
BH19-BR-07	11-11.5	Sandy Clay	CL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	24.0	97.7
BH19-BR-07	25-26.5	Andesite – sandy clay	CL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	91.4	83.1	79.5	73.6	71.8	67.9	64.7	32	20	12	20.8	-
BH19-BR-07	50-51.5	Andesite - clayey sand with gravel	SC	100.0	100.0	100.0	100.0	100.0	91.8	89.1	74.2	61.4	55.8	45.9	42.2	34.3	28.6	33	20	13	20.0	-
BH19-BR-08	11-11.5	Clayey Sand	SC	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.8	97.2	93.5	82.8	78.5	65.4	47.4	38	20	18	24.7	102.2
BH19-BR-08	15’-16.5’	Clayey Sand with Gravel	SC	100.0	100.0	100.0	86.7	86.7	83.4	81.4	78.5	75.1	72.1	64.4	61.7	54.2	43.0	43	19	24	17.9	-
BH19-BR-08	30-31.5	Andesite – clayey gravel with sand	GC	100.0	100.0	100.0	94.6	90.7	80.9	74.2	57.2	42.9	36.6	27.2	24.7	19.8	16.5	30	17	13	16.7	-
BH19-BR-09	6-6.5	Clayey Sand	SC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11.6	126.8
BH19-BR-09	11-11.5	Clayey Sand	SC	100.0	100.0	100.0	100.0	100.0	100.0	100.0	98.6	92.3	84.6	64.6	57.0	42.7	29.7	25	15	10	18.6	-
BH19-BR-09	20.5-21	Andesite - clayey sand with gravel	SC	100.0	100.0	100.0	90.8	89.3	88.7	88.7	75.8	63.3	55.9	40.4	34.9	24.3	16.9	23	15	8	10.7	114.3
BH19-BR-10	11-11.5	Fill – clayey gravel with sand	GC	100.0	100.0	100.0	86.9	76.6	66.8	61.8	50.0	40.2	35.8	28.7	26.4	21.8	17.8	37	24	13	18.7	83.3
BH19-BR-10	45-46.5	Sandy Clay	CL	100.0	100.0	100.0	100.0	100.0	97.0	95.6	93.6	90.7	89.1	85.4	83.7	79.2	72.4	49	23	26	22.9	-
BH19-BR-11	7.5-9	Fill – clayey sand with gravel	SC	100.0	100.0	100.0	100.0	96.6	88.0	85.7	77.0	64.6	58.1	47.4	44.2	37.3	31.3	40	20	20	19.0	-

Boring ID	Depth (feet bgs)	USCS Group Name	USCS Group Symbol	GRAIN SIZE DISTRIBUTION (% PASSING)														Atterberg Limits			Natural Moisture Content (%)	Natural Dry Density (PCF)
				GRAVEL							SAND						FINES	Liquid Limit	Plastic Limit	Plastic Index		
				3.0"	2.0"	1.5"	1.0"	0.75"	0.5"	0.375"	#4	#10	#16	#40	#50	#100	#200					
BH19-BR-11	20-21	Fill – clayey sand with gravel	SC	100.0	100.0	90.5	88.2	84.8	79.4	76.3	67.0	54.4	47.1	35.9	33.1	27.8	23.3	34	16	18	9.8	-
BH19-BR-11	41-41.5	Sandy Silt	MH	100.0	100.0	100.0	100.0	100.0	100.0	100.0	98.3	95.8	93.4	86.7	83.8	73.0	58.4	57	32	25	32.6	83.2
BH19-BR-11	75-76.5	Granodiorite –sand with silt	SP/SM	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.6	91.0	78.7	35.7	23.8	10.1	6.2	NP	NP	NP	25.0	-
BH19-BR-20	20-21	Fill –clayey sand with gravel	SC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9.0	123.6
BH19-BR-20	21-21.5	Fill –clayey sand with gravel	SC	100.0	100.0	100.0	100.0	100.0	97.0	95.9	87.7	68.3	54.9	35.7	31.4	24.1	18.3	27	16	11	-	-
BH19-BR-20	40.5-41	Granodiorite - clayey sand	SC	100.0	100.0	100.0	100.0	100.0	98.4	96.8	87.8	73.1	63.4	42.5	36.2	25.3	18.1	34	19	15	11.5	-
BH19-BR-20	65-66.5	Granodiorite – clayey sand	SC	100.0	100.0	100.0	100.0	100.0	97.7	97.2	89.7	78.2	71.3	60.5	57.7	52.2	46.9	34	16	18	12.0	-
BH19-BR-21	15-16.5	Fill- clayey sand	SC	100.0	100.0	100.0	100.0	97.3	95.4	92.0	84.7	70.8	59.3	40.8	36.3	28.6	22.8	24	15	9	7.2	-
BH19-BR-21	35-36	Granodiorite – silty sand with gravel	SM	100.0	100.0	100.0	100.0	98.3	95.8	87.2	70.6	55.4	47.6	34.6	31.2	26.2	22.7	20	17	3	7.0	-
BH19-BR-22	11-11.5	Fill – silty sand with gravel	SM	100.0	100.0	100.0	100.0	97.9	91.0	88.5	82.1	67.4	56.0	38.6	34.5	27.3	21.7	NP	NP	NP	8.6	117.0
BH19-BR-22	31-31.5	Granodiorite – clayey sand	SC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13.1	114.3
BH19-BR-22	41-41.5	Granodiorite - sandy clay	CL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.2	95.6	91.6	81.2	77.6	69.6	63.1	45	16	29	21.0	110.8
BH19-BR-23	10-11	Fill – clayey sand	SC	100.0	100.0	100.0	100.0	98.9	98.0	96.9	89.7	73.0	60.0	41.4	36.7	29.3	23.4	27	18	9	11.0	-
BH19-BR-23	25-26.5	Fill – clayey sand	SC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9.5	-
BH19-BR-23	35-36.5	Clayey Sand with Gravel	SC	100.0	100.0	100.0	100.0	98.6	82.0	78.6	69.9	59.0	53.6	44.1	40.9	34.0	28.4	32	20	12	15.1	-

Table 3: Maxiumum Density, Optimum Moisture and Direct Shear Test Summay

Boring ID	Depth (ft)	Maximum Dry Density (pcf)	Optimum Moisture (%)	Peak Stress	
				Angle of Internal Friction (degrees)	Cohesion (psf)
BH19-BR-05	4 – 7	129.0	11.5	31.3	692
BH19-BR-23	7.5 – 9	126.4	9.8	41.0	0

Table 4: Chemical Test Summary

Boring ID	Depth (ft)	Soil pH	Minimum Resistivity (ohm-cm)	Chloride (ppm)	Sulfate (ppm)
BH19-BR-04	15 – 16.5	7.15	380	380.4	1602.5
BH19-BR-09	7.5 – 9	6.64	720	49.4	63.2
BH19-BR-11	31 – 31.5	6.73	700	52.9	364.9
BH19-BR-21	25 – 26.5	7.06	2680	32.4	9.5
BH19-BR-23	30 – 31.5	7.51	1470	18.1	16.3

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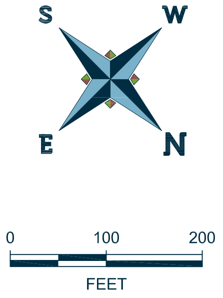
ATTACHMENT A

Site Plans



LEGEND:

GEOPHYSICS LINES

BORING LOCATIONS

● BRIDGE BORING

NewFields

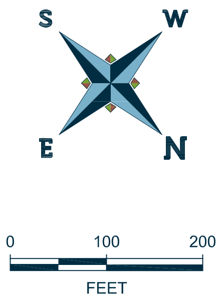
PROJECT NUMBER 475.0398.000	LOCATION WASHOE COUNTY, NEVADA
DOCUMENT FILENAME FIG2UPRR.DWG	

AREA US395	CLIENT NDOT
PROJECT NDOT US395 NORTH VALLEYS	
FIGURE TITLE UPRR PANTHER VALLEY (G-1092N&S)	

NEVADA DOT SAFE AND CONNECTED

FIGURE NUMBER 1A	REVISION 0

S:\PROJECTS\0398.000_NDOT US395 NORTH VALLEYS\00-DESIGN\FIGS\FIG2UPRR.DWG - Last saved by: RBERG on 12/4/2019



LEGEND:

▬	GEOPHYSICS LINES

BORING LOCATIONS

●	BRIDGE BORING

NewFields	AREA US395	CLIENT NDOT	NEVADA DOT SAFE AND CONNECTED
PROJECT NUMBER 475.0398.000	LOCATION WASHOE COUNTY, NEVADA	PROJECT NDOT US395 NORTH VALLEYS	
DOCUMENT FILENAME FIG2.PANTHER BRANCH1.DWG		FIGURE TITLE UPRR PANTHER BRANCH-UPRR-GRADE SEPARATION (G-1748N&S)	FIGURE NUMBER 2A
			REVISION 0

S:\PROJECTS\0398.000_NDOT US395 NORTH VALLEYS\00-DESIGN\FIGS\FIG2.PANTHER BRANCH1.DWG - Last saved by: RBERG on 12/4/2019

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ATTACHMENT B

Boring Logs and Exploration Key

UNIFIED SOIL CLASSIFICATION SYSTEM

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

COARSE-GRAINED SOILS (more than 50% of material is larger than No. 200 sieve size.)		
	Clean Gravels (Less than 5% fines)	
GRAVELS More than 50% of coarse fraction larger than No. 4 sieve size	GW	Well-graded gravels, gravel-sand mixtures, little or no fines
	GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
	Gravels with fines (More than 12% fines)	
	GM	Silty gravels, gravel-sand-silt mixtures
	GC	Clayey gravels, gravel-sand-clay mixtures
	Clean Sands (Less than 5% fines)	
SANDS 50% or more of coarse fraction smaller than No. 4 sieve size	SW	Well-graded sands, gravelly sands, little or no fines
	SP	Poorly graded sands, gravelly sands, little or no fines
	Sands with fines (More than 12% fines)	
	SM	Silty sands, sand-silt mixtures
	SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (50% or more of material is smaller than No. 200 sieve size.)		
SILTS AND CLAYS Liquid limit less than 50%	ML	Inorganic silts and very fine sands, rock flour, silty of clayey fine sands or clayey silts with slight plasticity
	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
	OL	Organic silts and organic silty clays of low plasticity
SILTS AND CLAYS Liquid limit 50% or greater	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
	CH	Inorganic clays of high plasticity, fat clays
	OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS	PT	Peat and other highly organic soils

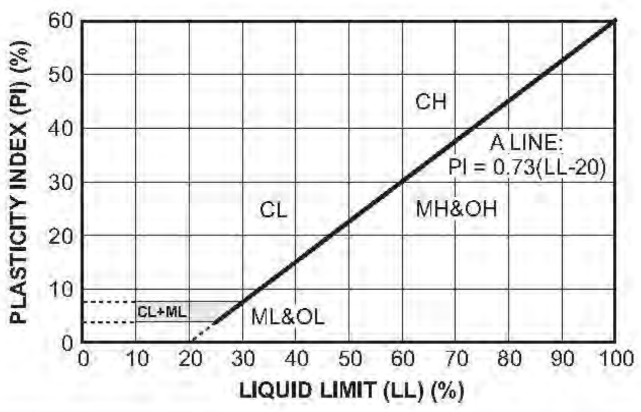
LABORATORY CLASSIFICATION CRITERIA

GW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
GP	Not meeting all gradation requirements for GW	
GM	Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
GC	Atterberg limits above "A" line with P.I. greater than 7	
SW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
SP	Not meeting all gradation requirements for GW	
SM	Atterberg limits below "A" line or P.I. less than 4	Limits plotting in shaded zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols.
SC	Atterberg limits above "A" line with P.I. greater than 7	

Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

Less than 5 percent	GW, GP, SW, SP
More than 12 percent	GM, GC, SM, SC
5 to 12 percent	Borderline cases requiring dual symbols

PLASTICITY CHART



CORE LOG – KEY TO SYMBOLS

Soil and Rock Hardness Grading Scale

Grade	Description	Field Identification	Approximate Range of Uniaxial Compressive Strength (MPa)
S1	Very Soft Clay	Easily penetrated several inches by fist	< 0.025
S2	Soft Clay	Easily penetrated several inches by thumb	0.025 - 0.05
S3	Firm Clay	Can be penetrated several inches by thumb with moderate effort	0.05 - 0.10
S4	Stiff Clay	Readily indented by thumbnail but penetrated only with great effort	0.10 - 0.25
S5	Very Stiff Clay	Readily indented by thumbnail	0.25 - 0.50
S6	Hard Clay	Indented with difficulty by thumbnail	> 0.50
R0	Extremely Weak Rock	Indented with thumbnail	0.25 - 1.0
R1	Very Weak Rock	Crumbles under firm blows with point of geological hammer, can be peeled by a pocket knife	1.0 - 5.0
R2	Weak Rock	Can be peeled by a pocket knife with difficulty, shallow indentations made by firm blow with point of geological hammer	5.0 - 25.0
R3	Medium Strong Rock	Cannot be scraped or peeled with a pocket knife, specimen can be fractured with single firm blow of geological hammer	25.0 - 50.0
R4	Strong Rock	Specimen requires more than one blow of geological hammer to fracture	50.0 - 100.0
R5	Very Strong Rock	Specimen requires many blows of geological hammer to fracture	100.0 - 250.0
R6	Extremely Strong Rock	Specimen can only be chipped with geological hammer	> 250.0

Fracture Spacing

Symbol	Description	Field Identification
UF	Unfractured	Fracture spacing greater than 6 feet
SF	Slightly Fractured	Fracture spacing between 2 to 6 feet
MF	Moderately Fractured	Fracture spacing between 8 inches to 2 feet
HF	Highly Fractured	Fracture spacing between 2 to 8 inches
IF	Intensely Fractured	Fracture spacing less than 2 inches

Degree of Weathering

Weathering Grade	Description
Fresh	No visible sign of rock material weathering; perhaps slight discoloration on major discontinuity surfaces
Slightly Weathered	Discoloration indicates weathering of rock material and discontinuity surfaces. All of the rock material may be discolored by weathering and may be somewhat weaker externally than in its fresh condition
Moderately Weathered	Less than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a continuous framework or as corestones
Highly Weathered	More than half of the rock materials is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present as a discontinuous framework or as corestones
Completely Weathered	All rock material is decomposed and/or disintegrated to soil. The original mass structure is still largely intact
Residual Soil	All rock material has been weathered to a soil. The mass structure and material fabrics are destroyed. There is a large change in volume, but the soil has not been significantly transported

BH19-BR-04

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NewFields

CLIENT	Nevada Department of Transportation	**PROJECT NAME**	US395 North Valleys
PROJECT NUMBER	475.0398.000	**PROJECT LOCATION**	Between Mileposts WA 27.1 and WA 32.6
DATE STARTED	5/19/19	**COMPLETED**	5/19/19
GROUND ELEVATION	5062 ft	**HOLE SIZE**	8" Diameter
DRILLING CONTRACTOR	Geotechnical Drilling	**COORDINATES ():**	
DRILLING METHOD	HSA	**LATITUDE**	
LONGITUDE			
LOGGED BY	M. Walden	**CHECKED BY**	M.Doehring
DEPTH TO WATER (FT BGS)	40		
NOTES	Rig Unit 5 Station 'XN' 755+90 Offset (ft) 115 Left		

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		**6" ASPHALT**										Drilling started at 9:30pm
5060		▨	**FILL: Clayey Sand with Gravel (SC)**, trace cobble, orange brown, moist, medium dense, low to medium plasticity, fine to coarse sand, subangular gravel										
		▨		SPT	8-6-6 (12)	16							10:02pm
	5	▨		MC	9-14-12 (26)	3							10:08pm
5055		▨											
		▨		SPT	10-15-14 (29)	18							10:13pm
	10	▨	brown, medium plasticity, fine and coarse gravel	MC	17-16-12 (28)	18	12.8	32	12	31	47	22	10:19pm
5050		▨											
	15	▨		SPT	9-13-12 (25)	18							10:26pm
5045		▨											
	20	▨		MC	13-13-11 (24)	18							10:34pm
5040		▨											
	25	▨	light brown	SPT	8-11-10 (21)	17	16.6	39	18	34	45	21	10:47pm
5035		▨											
	30	▨	**Clayey Sand (SC)**, trace gravel and cobble, orange brown, moist, medium dense, low to medium plasticity, fine to coarse sand, subangular gravel	MC	11-11-17 (28)	18							11:05pm
5030		▨											
	35												

(Continued Next Page)

CLIENT Nevada Department of Transportation
PROJECT NUMBER 475.0398.000
PROJECT NAME US395 North Valleys
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
								LIQUID LIMIT	PLASTICITY INDEX				
	35	▨		SPT	7-8-8 (16)	16							11:14pm
5025													
	40	▨	∇ **ANDESITE:** highly weathered, weak, clayey sand and gravel, brown, wet, very dense, low plasticity, fine to coarse sand, angular gravel	MC	70/5in	5							Water at 40ft, 11:27pm
5020													
	45			SPT	50/3in	3							11:46pm
5015													
	50			SPT	50/4in	4							12:13am
5010													
	55			SPT	50/3in	0							12:32am
5005													
	60			SPT	50/3in	3							12:54am
5000													
	65												
4995													
	70			SPT	50/5in	5							1:30am
4990													
	75												

(Continued Next Page)

CLIENT Nevada Department of Transportation

PROJECT NUMBER 475.0398.000

PROJECT NAME US395 North Valleys

PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	75	▨											
4985		▨											
	80	▨	**GRANODIORITE:** highly weathered, very weak, dark gray	SPT	15-50/5in	11							2:07am Heaving sand
4980		▨											
	85	▨											
4975		▨											
	90	▨	gray	SPT	20-25-50/5in	17							Drilling completed at 2:55am

EOH at 91.5ft; backfilled with cuttings and bentonite chips to 20ft bgs then grouted to surface

NewFields

BH19-BR-05

PAGE 1 OF 3

CLIENT Nevada Department of Transportation

PROJECT NAME US395 North Valleys

PROJECT NUMBER 475.0398.000

PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

DATE STARTED 7/26/19 COMPLETED 7/26/19

GROUND ELEVATION 5062 ft HOLE SIZE 8" Diameter

DRILLING CONTRACTOR Haz-Tech Drilling, Inc.

COORDINATES ():

DRILLING METHOD HSA

LATITUDE LONGITUDE

LOGGED BY M. Walden CHECKED BY M.Doehring

DEPTH TO WATER (FT BGS) 55

NOTES BK81 Station 'XN' 756+25 Offset (ft) 20 Right

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		**6" ASPHALT**										Drilling started at 9:41pm
5060			**FILL: Silty Sand with Gravel (SM)**, orangish brown, moist, loose, nonplastic, fine to coarse sand, fine and coarse angular to subangular gravel										
				SPT	4-3-4 (7)	15							9:45pm
	5		medium dense	MC	7-10-14 (24)	18	10.8	NP	NP	40	43	17	9:49pm
5055													
				SPT	7-11-10 (21)	17							9:54pm
	10		**FILL: Clayey Sand with Gravel (SC)**, light brown, moist, loose, medium plasticity, fine to coarse sand, fine gravel	MC	4-5-6 (11)	18	15.5	34	13	31	45	24	9:58pm
5050													
	15		medium dense	SPT	7-12-14 (26)	15							10:03pm
5045													
	20		**ANDESITE:** highly weathered, extremely weak, very intensely fractured, clayey sand with gravel, orangish brown, high plasticity, fine to coarse sand, fine and course subangular to angular gravel, cemented	MC	21-36-43 (79)	18	14.1						10:10pm
5040													
	25			SPT	19-31-42 (73)	16							10:17pm
5035													
	30		**ANDESITE:** completely weathered, extremely weak, silty sand, some gravel, orangish brown, low plasticity, fine to coarse sand, angular to subangular gravel, cemented, friable	MC	50/4in	4							10:23pm
5030													
	35												

(Continued Next Page)

NewFields

BH19-BR-05
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CLIENT Nevada Department of Transportation
PROJECT NUMBER 475.0398.000
PROJECT NAME US395 North Valleys
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
5025	35		**ANDESITE:** completely weathered, extremely weak, clayey sand with gravel, orangish brown, moist, medium plasticity, fine to coarse sand, fine angular to subangular gravel	SPT	23-33-21 (54)	18	17.1	39	15	20	54	26	10:40pm
5020	40			MC	50/5in	5							10:48pm
5015	45			SPT	23-46-50/5in	17							10:58pm
5010	50		very intensely fractured	MC	50/5in	5							11:07pm
5005	55 ∇		**ANDESITE:** highly to completely weathered, extremely weak, clayey sand, some gravel, orangish brown, wet, high plasticity, fine to coarse sand, fine angular to subangular gravel	SPT	46-50/3in	9							11:21pm Water table at 55'
5000	60			SPT	50/5in	5							11:38pm
4995	65			SPT	50/5in	5							11:46pm
4990	70		increasing gravel	SPT	25-45-50/5in	17							11:59pm
	75												

(Continued Next Page)

NewFields

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CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	75			SPT	50/4in	4							12:04am
4985													
	80		**GRANODIORITE:** highly weathered, weak, very intensely fractured, sandy gravel with clay, gray, wet, medium to high plasticity, fine and coarse angular gravel, iron oxide staining	SPT	50/5in	5							12:18am
4980													
	85			SPT	47-50/2in	8							12:36am
4975													
	90			SPT	50/3in	3							12:55am
4970													Very hard drilling at 92' 1:20am
	95			SPT	50/2in	2							

Practical refusal encountered at 95.2ft; backfilled with bentonite chips and cuttings to 3ft bgs then grouted to the surface

NewFields

BH19-BR-06

PAGE 1 OF 3

CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6
DATE STARTED 7/11/19 **COMPLETED** 7/11/19
GROUND ELEVATION 5035 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR Haz-Tech Drilling, Inc.
COORDINATES ():
DRILLING METHOD HSA
LATITUDE **LONGITUDE**
LOGGED BY N. Owens **CHECKED BY** M.Doehring
DEPTH TO WATER (FT BGS) 28
NOTES Rig Unit 105 Station 'XN' 757+10 Offset (ft) 130 Left

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
5035	0		**8" ASPHALT**										Drilling started at 7:30am
			Clayey Gravel with Sand (GC), brown, moist, medium dense, low plasticity, fine to coarse sand, fine and coarse angular gravel	SPT	5-7-4 (11)	10							7:34am
5030	5		**Sand with Silt (SP-SM)**, brown, moist, loose, non to low plasticity, medium and coarse sand	MC	5-5-5 (10)	18							
			Clayey Sand (SC), brown, moist, medium dense, medium plasticity, fine to coarse sand, fine gravel	SPT	3-7-12 (19)	15	15.3	30	19	11	61	28	
5025	10			MC	5-11-14 (25)	18							7:46am
5020	15		dense	SPT	7-14-17 (31)	14							7:50am
5015	20		medium dense, high plasticity	MC	9-15-16 (31)	18	29.9	45	28	11	52	37	7:56am
5010	25		very dense	SPT	14-50/6in	10							8:05am
			∇										
5005	30		**ANDESITE:** highly weathered, extremely weak, intensely fractured, clayey gravel with sand, brown, wet, low to medium plasticity, fine to coarse sand, angular gravel up to 1-1/2" diameter	MC	52-60/4in	10							8:20am
5000	35												

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NewFields

CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
5000	35		**ANDESITE:** completely weathered, extremely weak, clayey sand with gravel, brown, wet, medium plasticity, fine to coarse sand, fine angular gravel	SPT	18-50/5in	8							
4995	40			MC	4-14-25 (39)	14	20.2	29	13	40	47	13	8:37am
4990	45			SPT	20-35-50/4in	13							8:48am
4985	50		**GRANODIORITE:** completely to highly weathered, very weak, clayey sand with gravel, gray, wet, medium plasticity, fine to coarse sand, angular gravel	MC	16-35-46 (81)	12							
4980	55			SPT	20-43-50 (93)	13							9:24am
4975	60			MC	58-60/2in	7							
4970	65		completely weathered	SPT	21-30-27 (57)	12							10:03am
4965	70		**GRANODIORITE:** highly weathered, weak, very intensely fractured, clayey gravel with sand, gray, wet, low plasticity, medium and coarse sand, fine and coarse angular gravel	MC	60/3in	3							10:18am
4960	75												

(Continued Next Page)

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
4960	75			SPT	50/5in	5							10:35am
4955	80		**GRANODIORITE:** highly weathered, extremely weak, sand and gravel, gray, wet, fine to coarse sand, fine angular gravel	SPT	50/4in	5							11:01am
4950	85		**GRANODIORITE:** highly to completely weathered, extremely weak, clayey sand, gray, wet, low to medium plasticity, fine to coarse sand	SPT	50/3in	3							11:24am
4945	90			SPT	50/5in	5							11:48am
4940	95			SPT	50/6in	6							12:16pm
4935	100			SPT	50/6in	6							Drilling completed at 1:06pm

EOH at 100.5ft; backfilled with bentonite chips and cuttings to 4ft bgs then grouted to surface

NewFields

BH19-BR-07

CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6
DATE STARTED 7/12/19 **COMPLETED** 7/12/19
GROUND ELEVATION 5035 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR Haz-Tech Drilling, Inc.
COORDINATES ():
DRILLING METHOD HSA
LATITUDE **LONGITUDE**
LOGGED BY N. Owens **CHECKED BY** M.Doehring
DEPTH TO WATER (FT BGS) 20
NOTES Rig Unit 105 Station 'XN' 757+40 Offset (ft) 25 Left

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
5035	0		**8" ASPHALT**										Drilling started at 7:30am
			Clayey Sand with Gravel (SC), brown, moist, medium dense, low plasticity, fine and medium sand, angular gravel										
				SPT	4-4-6 (10)	11							7:33am
5030	5												
				MC	5-10-6 (16)	16							
			less gravel	SPT	6-12-14 (26)	13							7:43am
5025	10												
			Sandy Clay (CL), moist, very stiff, high plasticity, fine to coarse sand, some fine gravel	MC	6-12-14 (26)	17	24.0	44	29	6	38	56	
5020	15												
				SPT	15-14-16 (30)	12							7:53am
5015	20		▽										
			ANDESITE: completely weathered, very weak, hydrothermally altered, sandy clay with gravel, wet	MC	15-27-34 (61)	18							8:02am
5010	25												
			medium plasticity, fine gravel	SPT	22-41-50/4in	11	20.8	32	12	9	26	65	
5005	30												
				MC	60/3in	0							8:20am No recovery
5000	35												

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BH19-BR-07

CLIENT Nevada Department of Transportation
PROJECT NUMBER 475.0398.000
PROJECT NAME US395 North Valleys
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
5000	35		SPT	41-50/2in	7							8:35am
4995	40	**ANDESITE:** highly weathered, very weak, very intensely fractured, clayey gravel with sand, brown, wet, low plasticity, medium sand, angular gravel	MC	60/6in	6							
4990	45		SPT	50/4in	3							8:57am
4985	50	**GRANODIORITE:** highly weathered, extremely weak, clayey sand with gravel, gray, medium plasticity, fine to coarse sand, fine gravel, iron oxide staining	SPT	22-16-13 (29)	12	20.0	33	13	26	45	29	9:24am
4980	55		MC	46-60/5in	7							9:40am
4975	60		SPT	49-50/6in	9							9:55am
4970	65		MC	40-60/3in	9							10:00am
4965	70		SPT	36-50/5in	7							10:23am
4960	75											

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NewFields

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CLIENT Nevada Department of Transportation

PROJECT NAME US395 North Valleys

PROJECT NUMBER 475.0398.000

PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
								LIQUID LIMIT	PLASTICITY INDEX				
4960	75	▨		MC	10-60/6in	6							10:40am
4955	80	▨		SPT	50/6in	5							10:57am Heaving sand
4950	85	▨		MC	16-60/4in	6							11:23am Heaving sand
4945	90	▨		SPT	50/3in	2							11:50am
4940	95	▨		SPT	50/4in	4							12:10pm
4935	100	▨		SPT	22-48-41 (89)	12							Drilling completed at 12:40pm

EOH at 101.5ft; backfilled with bentonite chips and cuttings to 4ft bgs then grouted to surface

BH19-BR-08

CLIENT Nevada Department of Transportation	**PROJECT NAME** US395 North Valleys
PROJECT NUMBER 475.0398.000	**PROJECT LOCATION** Between Mileposts WA 27.1 and WA 32.6
DATE STARTED 4/22/19 **COMPLETED** 4/22/19	**GROUND ELEVATION** 5032 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR Geotechnical Drilling	**COORDINATES ():**
DRILLING METHOD HSA	**LATITUDE** **LONGITUDE**
LOGGED BY M. Walden **CHECKED BY** M.Doehring	**DEPTH TO WATER (FT BGS)** 25

NOTES Rig Unit 5 Station 'XN' 758+10 Offset (ft) 65 Left

ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0	**Clayey Sand (SC)**, some silt, light brown, dry to moist, medium dense, medium plasticity, fine to coarse sand										
5030												
			SPT	12-7-11 (18)	18							
	5											
			MC	16-15-16 (31)	18							
5025												
			SPT	4-8-12 (20)	18							
	10											
		moist	MC	6-13-21 (34)	18	24.7	38	18	0	53	47	
5020												
	15											
		Clayey Sand with Gravel (SC), brown, moist, medium dense, high plasticity, fine to coarse sand, fine and coarse gravel	SPT	7-11-12 (23)	9	17.9	43	24	22	35	43	Rock in the bottom of sampler
5015												
	20	very dense	MC	70/5in	5							
5010												
	25	∇ wet	SPT	50/6in	6							Water at 25ft, 9:40pm
5005												
	30	**ANDESITE:** completely to highly weathered, extremely weak, clayey gravel with sand, some cobble, brown, wet, medium plasticity, fine and coarse angular to subangular gravel, iron oxide staining	MC	13-40-37 (77)	18	16.7	30	13	43	41	17	
5000												
	35											

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NewFields

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CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6
DATE STARTED 5/30/19 **COMPLETED** 5/30/19
GROUND ELEVATION 5034 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR Geotechnical Drilling
COORDINATES ():
DRILLING METHOD HSA
LATITUDE **LONGITUDE**
LOGGED BY M. Walden **CHECKED BY** M.Doehring
DEPTH TO WATER (FT BGS) 30
NOTES Rig Unit 17 Station 'XN' 758+40 Offset (ft) 45 Right

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0	▨	**Clayey Sand (SC)**, brown, moist, medium dense, low to medium plasticity, fine to coarse sand, subangular gravel										Drilling started at 8:19am
		▨		SPT	6-8-8 (16)	18							
5030	5	▨		MC	6-16-24 (40)	18	11.6						
		▨		SPT	4-8-14 (22)	18							
5025	10	▨	low plasticity	MC	6-14-19 (33)	18	18.6	25	10	1	69	30	8:47am
5020	15	▨	**ANDESITE:** completely weathered, extremely weak, clayey sand, orange to brown, medium to high plasticity, fine to coarse sand, subangular gravel	SPT	5-10-13 (23)	18							8:55am
5015	20	▨	**ANDESITE:** highly weathered, very weak, very intensely fractured, clayey sand with gravel, orange brown, moist, low plasticity, fine to coarse sand, fine and coarse subangular gravel	MC	54-70/5in	11	10.7	23	8	24	59	17	9:07am
5010	25	▨	clayey sand with gravel, gray, medium plasticity, fine to coarse sand, angular gravel	SPT	24-50/3in	9							9:34am
5005	30	▨	∇ completely weathered, extremely weak, hydrothermally altered, orange brown, wet, medium to high plasticity, iron oxide staining	SPT	12-33-41 (74)	12							10:04am, Water table at 30ft
5000	35	▨											

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NewFields

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CLIENT Nevada Department of Transportation

PROJECT NAME US395 North Valleys

PROJECT NUMBER 475.0398.000

PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	35	▨		SPT	10-14-21 (35)	18							10:16am
4995	40	▨		SPT	18-50/3in	9							10:37am
4990	45	▨	**GRANODIORITE:** highly weathered, very weak, very intensely fractured, sand and gravel, some clay, gray, low plasticity, fine to coarse sand, subangular to angular gravel	SPT	50/3in	3							Drilling completed at 11:30am

Practical refusal encountered at 45.3ft; backfilled with bentonite chips and cuttings to 4ft bgs then grouted to the surface

NewFields

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CLIENT Nevada Department of Transportation
PROJECT NUMBER 475.0398.000
DATE STARTED 5/18/19 **COMPLETED** 5/18/19
DRILLING CONTRACTOR Geotechnical Drilling
DRILLING METHOD HSA
LOGGED BY M. Walden **CHECKED BY** M.Doehring
NOTES Rig Unit 5 Station 'XN' 759+10 Offset (ft) 115 Left

PROJECT NAME US395 North Valleys
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6
GROUND ELEVATION 5064 ft **HOLE SIZE** 8" Diameter
COORDINATES ():
LATITUDE **LONGITUDE**
DEPTH TO WATER (FT BGS) 40

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		**6" ASPHALT**										10:16pm
		▨	**FILL: Clayey Sand (SC),** some gravel, trace cobble, orange brown, moist, medium dense, medium plasticity, fine to coarse sand, fine and coarse subangular to angular gravel										
5060		▨		SPT	4-6-5 (11)	0							10:28pm
	5	▨	loose	MC	4-5-6 (11)	18							10:34pm
5055		▨		SPT	3-5-4 (9)	18							10:39pm
	10	▨	medium dense	MC	13-10-8 (18)	12	18.7	37	13	50	32	18	10:46pm
5050	15	▨		SPT	11-12-13 (25)	14							10:57pm
5045	20	▨		MC	16-14-7 (21)	18							11:09pm
5040	25	▨	dense	SPT	26-21-14 (35)	1							11:21pm
5035	30	▨	**FILL: Clayey Sand (SC),** trace gravel, gray, moist, dense, low to medium plasticity, subrounded gravel, asphalt surface	MC	15-35-36 (71)	18							11:31pm
5030	35	▨											

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NF-GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 12/2/19 09:49 - S:\PROJECTS\0398.000_NDOT US395 NORTH VALLEYS\18_GINT_LOGS\NORTH_VALLEYS.GPJ

CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	35		**Clayey Sand (SC),** some silt, trace gravel, brown, moist, dense, low to medium plasticity	SPT	13-17-19 (36)	18							11:44pm
5025	40		▽ yellow brown	MC	12-24-39 (63)	18							Water at 40ft, 11:56pm
5020	45		**Lean Clay with Sand (CL),** brown, moist, very stiff, high plasticity, fine sand, fine gravel	SPT	6-11-18 (29)	18	22.9	49	26	7	21	72	12:09pm
5015	50		**ANDESITE:** completely to highly weathered, weak, clayey sand with gravel, orange brown, wet, very dense, medium plasticity, fine to coarse sand, fine and coarse angular to subangular gravel	MC	41-70/5in	11							12:33pm
5010	55			SPT	50	6							12:51pm
5005	60			SPT	45-50/5in	10							1:17pm
5000	65												
4995	70		extremely weak, iron oxide staining	SPT	11-50/5in	11							1:54pm
4990	75												

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CLIENT Nevada Department of Transportation
PROJECT NUMBER 475.0398.000
PROJECT NAME US395 North Valleys
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	75												
4985													
	80		**GRANODIORITE:** highly to completely weathered, extremely weak, clayey sand and gravel, gray, wet, medium to high plasticity, fine to coarse sand, angular gravel, iron oxide veins	☒ SPT	38-50/3in	9							Drilling completed at 2:51pm

EOH at 80.8ft; backfilled with bentonite chips and cuttings to 20ft bgs then grouted to surface

NewFields

BH19-BR-11

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CLIENT Nevada Department of Transportation

PROJECT NAME US395 North Valleys

PROJECT NUMBER 475.0398.000

PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

DATE STARTED 4/20/19 **COMPLETED** 4/21/19

GROUND ELEVATION 5064 ft **HOLE SIZE** 8" Diameter

DRILLING CONTRACTOR Geotechnical Drilling

COORDINATES ():

DRILLING METHOD HSA

LATITUDE ________ **LONGITUDE** ________

LOGGED BY M. Walden **CHECKED BY** M.Doehring

DEPTH TO WATER (FT BGS) 50

NOTES Rig Unit 5 Station 'XN' 759+55 Offset (ft) 30 Left

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		**FILL: Clayey Sand (SC)**, some silt, trace gravel, dry to moist, loose, low to medium plasticity, fine to coarse sand, subrounded gravel										
				SPT	2-2-3 (5)	18							
5060													
	5												
				MC	4-7-6 (13)	18							
			FILL: Clayey Sand with Gravel (SC), moist, medium dense, medium plasticity, fine to coarse sand, fine and coarse gravel	SPT	3-4-8 (12)	18	19.0	40	20	23	46	31	
5055													
	10												
				MC	3-4-9 (13)	18							
5050													
	15												
				SPT	11-12-12 (24)	18							
5045													
	20												
			dense	MC	15-25-24 (49)	18	9.8	34	18	33	44	23	
5040													
	25												
			medium dense	SPT	7-8-9 (17)	18							
5035													
	30												
			Clayey Sand (SC), trace gravel, dry to moist, very dense, low to medium plasticity, fine to coarse sand, subangular gravel to 1" diameter	MC	6-24- 70/5in	17							
5030													
	35												

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NewFields

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CLIENT Nevada Department of Transportation
PROJECT NUMBER 475.0398.000
PROJECT NAME US395 North Valleys
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	35		dense, no gravel	SPT	11-13-18 (31)	18							
5025													
	40		**Sandy Elastic Silt (MH)**, light brown, wet, hard, high plasticity, fine to medium sand	MC	14-21-31 (52)	18	32.6	57	25	2	40	58	
5020													
	45			SPT	9-16-21 (37)	18							
5015													
	50		▽ **ANDESITE:** completely to highly weathered, very weak, clayey sand and gravel, reddish brown, moist to wet, low plasticity, fine to coarse sand, low plasticity, subangular gravel, iron oxide staining	MC	35-56-62 (118)	18							Water at 50ft
5010													
	55			SPT	50-51/0in	6							
5005													
	60			MC	42-70	12							
5000													
	65		brown	SPT	50/3in	3							
4995													
	70		orange brown	MC	5-37-70/3in	15							
4990													
	75												

(Continued Next Page)

NewFields

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PAGE 3 OF 3

CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	75		**GRANODIORITE:** completely weathered, very weak, sand with silt, gray, wet, nonplastic, fine to coarse sand, poorly graded	SPT	5-10-11 (21)	18	25.0	NP	NP	0	94	6	Heaving sand; blow counts are suspect from 75 to 80ft bgs
4985	80												
			iron oxide veins	MC	15-39-70/5in	17							
4980	85												
4975	90												
				MC	52-70/4in	10							
4970	95												
				SPT	50/5in	5							
4965	100												
				MC	50/5in	5							

EOH at 100.5ft; backfilled with bentonite chips and cuttings to 20ft bgs then grouted to the surface

NewFields

BH19-BR-20

PAGE 1 OF 3

CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6
DATE STARTED 5/3/19 **COMPLETED** 5/3/19
GROUND ELEVATION 5191 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR Geotechnical Drilling
COORDINATES ():
DRILLING METHOD HSA
LATITUDE **LONGITUDE**
LOGGED BY N. Owens **CHECKED BY** M. Doehring
DEPTH TO WATER (FT BGS) 80
NOTES Rig Unit 5 Station 'XN' 799+90 Offset (ft) 30 Left

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
								LIQUID LIMIT	PLASTICITY INDEX				
5190	0		**12" CONCRETE**										Drilling Time:
			FILL: Clayey Sand with Gravel (SC), brown, moist, very dense, low plasticity, medium to coarse sand, angular gravel										
				SPT	11-17-34 (51)	14							
5185	5		medium dense	MC	10-20-22 (42)	18							
				SPT	9-13-10 (23)	14							10:30pm
5180	10		dense, iron oxide staining	MC	10-23-24 (47)	18							10:31pm
5175	15		**FILL: Clayey Sand (SC)**, some gravel, brown, moist, medium dense, medium plasticity, fine to coarse sand, fine angular gravel	SPT	14-14-14 (28)	16							10:37pm
5170	20			MC	12-19-16 (35)	18	9.0	27	11	12	70	18	10:45pm
5165	25		**FILL: Silty Sand (SM)**, trace gravel, moist, very dense, non-plastic, medium to coarse sand	SPT	14-26-27 (53)	18							10:57pm
5160	30		**Clayey Sand with Gravel (SC)**, brown, moist, dense, low plasticity, fine to medium sand, angular gravel, iron oxide staining	MC	17-25-26 (51)	18							11:24pm
	35												

(Continued Next Page)

CLIENT Nevada Department of Transportation
PROJECT NUMBER 475.0398.000
PROJECT NAME US395 North Valleys
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
5155	35	▨	**GRANODIORITE:** completely to highly weathered, extremely weak, clayey sand, some gravel, light brown, moist, medium plasticity, fine to coarse sand, fine gravel	SPT	47-50/3in	9							11:41pm
5150	40	▨		MC	44-70/4in	10	11.5	34	15	12	70	18	12:01am
5145	45	▨		SPT	49-50/3in	9							
5140	50	▨	**GRANODIORITE:** completely to highly weathered, very weak, very intensely fractured, clayey sand, some silt and gravel, brown, moist, medium plasticity, fine to coarse sand, fine subangular gravel, iron oxide staining	MC	28-44-49 (93)	18							
5135	55	▨	white mineralization	SPT	10-15-23 (38)	18							
5130	60	▨		MC	18-21-28 (49)	18							12:26am
5125	65	▨		SPT	8-13-23 (36)	18	12.0	34	18	10	43	47	12:38am
5120	70	▨	hydrothermally altered	MC	11-21-29 (50)	18							12:53am
	75	▨											

(Continued Next Page)

NewFields

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CLIENT Nevada Department of Transportation

PROJECT NUMBER 475.0398.000

PROJECT NAME US395 North Valleys

PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	75												
5115													
	80		∇	SPT	8-12-16 (28)	18							1:17am
5110													
	85												
5105													
	90			MC	17-29-39 (68)	18							1:45am
5100													
	95												
5095													
	100			SPT	35-50/5in	11							Drilling completed at 2:12am
5090													

EOH at 101ft; backfilled with bentonite chips and cuttings to 20ft bgs then grouted to surface

NewFields

BH19-BR-21

PAGE 1 OF 3

CLIENT Nevada Department of Transportation	**PROJECT NAME** US395 North Valleys
PROJECT NUMBER 475.0398.000	**PROJECT LOCATION** Between Mileposts WA 27.1 and WA 32.6
DATE STARTED 5/17/19 **COMPLETED** 5/17/19	**GROUND ELEVATION** 5188 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR Geotechnical Drilling	**COORDINATES ():**
DRILLING METHOD HSA	**LATITUDE** **LONGITUDE**
LOGGED BY M. Walden **CHECKED BY** M.Doehring	**DEPTH TO WATER (FT BGS)** 50

NOTES Rig Unit 5 Station 'XN' 800+60 Offset (ft) 60 Left

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		**8" CONCRETE**										Drilling started at 9:35pm
			FILL: Clayey Sand (SC), trace gravel, brown, moist, dense, medium plasticity, fine to coarse sand, subangular gravel										
5185				SPT	7-14-18 (32)	18							10:20pm
	5												
				MC	25-43-29 (72)	18							10:27pm
5180			medium dense	SPT	3-8-7 (15)	18							10:34pm
	10												
				MC	14-15-16 (31)	18							10:40pm
5175													
	15		fine gravel, low plasticity	SPT	14-12-14 (26)	18	7.2	24	9	15	62	23	10:47pm
5170													
	20		dense	MC	21-31-30 (61)	18							
5165													
	25			SPT	11-17-19 (36)	18							10:54pm
5160													
	30		**GRANODIORITE:** highly to completely weathered, extremely weak, clayey sand, trace gravel, orange brown, moist, medium plasticity, fine subrounded gravel	MC	25-23-29 (52)	18							11:15pm
5155													
	35												

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NewFields

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CLIENT Nevada Department of Transportation
PROJECT NUMBER 475.0398.000
PROJECT NAME US395 North Valleys
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	35	**GRANODIORITE:** highly weathered, extremely weak, silty sand with gravel, gray/light brown, moist, low plasticity, fine to coarse sand, fine angular gravel	SPT	23-50/5in	11	7.0	20	3	29	48	23	11:32pm
5150												
	40	orange brown	MC	70/4in	2							10:55pm
5145												
	45		SPT	50/3in	0							11:38pm
5140												
	50	▽ **GRANODIORITE:** completely weathered, extremely weak, clayey sand, some gravel, orange brown, wet, medium plasticity, fine to coarse sand, angular gravel	SPT	50/2in	2							Water at 50ft, 12:24am
5135												
	55		SPT	50/4in	4							1:09am
5130												
	60		SPT	50/2in	2							1:34am
5125												
	65											
5120												
	70		SPT	46-50/3in	9							2:08am
5115												
	75											

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NewFields

BH19-BR-21

CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
								LIQUID LIMIT	PLASTICITY INDEX				
	75	▨											
5110		▨											
	80	▨											Drilling completed at 2:30am

Drilling at 80ft due to mechanical problem backfilled with bentonite chips and cuttings to 20ft bgs then grouted to surface

NewFields

BH19-BR-22

CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6
DATE STARTED 7/27/19 **COMPLETED** 7/27/19
GROUND ELEVATION 5192 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR Haz-Tech Drilling, Inc.
COORDINATES ():
DRILLING METHOD HSA
LATITUDE **LONGITUDE**
LOGGED BY M. Walden **CHECKED BY** M.Doehring
DEPTH TO WATER (FT BGS) 90
NOTES BK81 Station 'XN' 803+00 Offset (ft) 15 Right

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		**5" ASPHALT**										Drilling started at 9:48pm
5190			**FILL: Clayey Sand with Gravel (SC)**, brown, moist, medium dense, low plasticity, fine to coarse sand, subangular gravel										
				SPT	6-12-14 (26)	16							9:55pm
	5			MC	13-19-21 (40)	18							9:59pm
5185													
				SPT	11-8-6 (14)	18							10:04pm
	10		**FILL: Silty Sand with Gravel (SC)**, brown, moist, dense, non plastic, fine to coarse sand, fine subangular gravel	MC	20-22-25 (47)	18	8.6	NP	NP	18	60	22	10:08pm
5180													
	15			SPT	11-12-19 (31)	18							10:14pm
5175													
	20			MC	20-33-20 (53)	18							10:19pm
5170													
	25			SPT	13-14-13 (27)	18							10:25pm
5165													
	30		**GRANODIORITE:** highly to completely weathered, very weak, clayey sand, some gravel, orange brown, low plasticity, fine to coarse sand, fine and coarse subangular to angular gravel	MC	16-24-20 (44)	18	13.1						10:92pm
5160													
	35												

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NewFields

BH19-BR-22

CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
5155	35	▨		SPT	8-14-12 (26)	18							10:40pm
5150	40	▨	**GRANODIORITE:** completely weathered, extremely weak, sandy lean clay, brown, wet, high plasticity, fine to coarse sand	MC	6-8-12 (20)	18	21.0	45	29	1	36	63	10:49pm perched water at 40ft
5145	45	▨	**GRANODIORITE:** highly to completely weathered, extremely weak, clayey sand, trace gravel, brown, moist, medium to high plasticity, fine sand, subangular gravel	SPT	17-39-50 (89)	18							11:01pm
5140	50	▨		SPT	7-12-18 (30)	18							11:16pm
5135	55	▨	some gravel	SPT	8-20-28 (48)	18							11:29pm
5130	60	▨		SPT	17-31-38 (69)	18							11:44pm
5125	65	▨		SPT	20-41-35 (76)	18							11:58pm
5120	70	▨		SPT	26-50/5in	11							12:17pm
	75	▨											

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CLIENT Nevada Department of Transportation
PROJECT NUMBER 475.0398.000
PROJECT NAME US395 North Valleys
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	75			SPT	13-50/3in	9							12:30am
5115													
	80			SPT	28-50/5in	11							12:49am
5110													
	85			SPT	39-50/3in	9							1:08am
5105													
	90		∇ **GRANODIORITE:** completely weathered, extremely weak, hydrothermally altered, sandy clay, white to orange brown, wet, high plasticity, fine sand, iron oxide veining	SPT	18-35-41 (76)	17							1:24am
5100													
	95			SPT	50/5in	5							1:43am
5095													
	100		trace gravel	SPT	8-12-16 (28)	18							Drilling completed at 2:05am

EOH at 101.5ft; backfilled with bentonite chips and cuttings to 20ft bgs then grouted to surface

NewFields

BH19-BR-23

CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6
DATE STARTED 5/29/19 **COMPLETED** 5/31/19
GROUND ELEVATION 5192 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR Geotechnical Drilling
COORDINATES ():
DRILLING METHOD HSA
LATITUDE **LONGITUDE**
LOGGED BY M. Walden **CHECKED BY** M.Doehring
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Rig Unit 5 Station 'XN' 803+85 Offset (ft) 50 Left

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		**FILL: Clayey Sand with Gravel (SC)**, brown, moist, medium dense, low plasticity, medium and coarse sand, angular gravel										Drilling started at 12:32pm
5190													
				SPT	10-14-16 (30)	17							12:58pm
	5												
				MC	14-22-20 (42)	17							1:04pm
5185													
			dense	SPT	12-21-20 (41)	0							no recovery
	10												
			FILL: Clayey Sand (SC), purple/brown, moist, medium dense, low plasticity, medium and coarse sand, fine angular gravel	MC	5-13-28 (41)	18	11.0	27	9	10	67	23	1:18pm
5180													
	15		dense	SPT	21-20-21 (41)	17							1:23pm
5175													
	20			MC	47-27-38 (65)	18							1:34pm
5170													
	25		medium dense	SPT	14-13-16 (29)	18	9.5						1:45pm
5165													
	30		dense	MC	17-18-36 (54)	18							2:02pm
5160			**Clayey Sand with Gravel (SC)**, purple/brown, moist, medium dense, low to medium plasticity, medium to coarse sand, fine angular gravel										
	35												

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NewFields

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CLIENT Nevada Department of Transportation
PROJECT NUMBER 475.0398.000
PROJECT NAME US395 North Valleys
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	35		medium plasticity	SPT	10-15-11 (26)	18	15.1	32	12	30	42	28	2:19pm
5155													
	40		**GRANODIORITE:** highly to completely weathered, very weak, silty gravel with sand, tan, moist, fine angular gravel	MC	48-70/0in	9							2:35pm
5150													
	45		breaks into plates approximately 1/4" to 1/2" thick	SPT	50/5in	1							7:40am (31 July), extremely slow/hard drilling
5145													
	50			SPT	50/2in	0							no recovery, 8:17am
5140													
	55			SPT	50/2in	0							no recovery, 8:44am
5135													Drilling completed at 9:30am

Practical refusal encountered at 57ft; backfilled to 20ft bgs then grouted to surface

NewFields

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CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6
DATE STARTED 5/14/19 **COMPLETED** 5/15/19
GROUND ELEVATION 5166 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR Geotechnical Drilling
COORDINATES ():
DRILLING METHOD HSA
LATITUDE **LONGITUDE**
LOGGED BY M. Walden **CHECKED BY** M.Doehring
DEPTH TO WATER (FT BGS) 40
NOTES Rig Unit 17 Station 'XS' 817+55 Offset (ft) 15 Left

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
								LIQUID LIMIT	PLASTICITY INDEX				
5165	0		**8" CONCRETE** **FILL: Silty Sand (SM)**, some clay, trace gravel and cobble, brown, moist, medium dense, low plasticity, fine to coarse sand, subangular gravel										Drilling started at 9:40pm
				SPT	11-12-16 (28)	18							9:51pm
5160	5		dense	MC	21-39-34 (73)	18							9:56pm
			FILL: Clayey Sand (SC), some silt, trace gravel and cobble, orange brown, moist, medium dense, medium plasticity, fine to coarse sand, subangular gravel	SPT	14-11-10 (21)	18							10:04pm
5155	10			MC	9-14-20 (34)	18							10:13pm
5150	15		brown, fine subangular gravel	SPT	7-13-13 (26)	18	8.8	25	13	11	67	21	10:19pm
5145	20		**FILL: Clayey Sand (SC)**, some silt, trace gravel and cobble and organics, gray, moist, very dense, medium plasticity, fine to coarse sand, subangular gravel	MC	33-39-45 (84)	18							10:26pm
5140	25		**FILL: Clayey Sand (SC)**, some silt, some gravel and cobble, orange brown/brown, moist, dense, low to medium plasticity, fine to coarse sand, fine subangular gravel	SPT	12-16-33 (49)	18	6.9	26	11	8	69	23	10:36pm
5135	30		**GRANODIORITE:** highly to completely weathered, extremely weak, silty sand, some gravel, orange brown, moist, nonplastic, fine to coarse sand, subrounded gravel	MC	70/4in	0							No recovery, 10:54pm
	35												

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ATTACHMENT C

Hammer Efficiency and Calibration Reports

GRL engineers, inc.

Dynamic Measurements and Analyses

Job No. 198060-1

Report on:
Energy Measurement for Dynamic Penetrometers – Standard Penetration Test
Mobile B-57 Drill Rig (Truck 102724P)
Las Vegas, NV

Prepared for Geotechnical Drilling
By Camilo Alvarez, PE & William Chambers

April 15, 2019

www.GRLengineers.com info@GRLengineers.com

GRL Dynamic Measurements and Analyses
engineers, inc.

April 15, 2019

Mr. Tom Beall
Geotechnical Drilling

Re: Energy Measurement for Dynamic Penetrometers
Standard Penetration Test (SPT) on Truck 102724P Mobile B-57 Drill rig
Las Vegas, NV GRL Job No. 198060-1

Dear Mr. Beall:

This report transmits our findings from energy measurements and related data analysis conducted by GRL Engineers, Inc. (GRL) for your truck mounted Mobile B-57 Drill Rig located in Las Vegas, NV. One automatic hammer and penetrometer system was monitored during Standard Penetration Test (SPT) of the test Borehole BH5. Dynamic testing summarized in this report was conducted on April 11, 2019.

The purpose in collecting the SPT energy measurements was to compute the energy transfer efficiency for 1 SPT hammer. To meet this objective, an 8G Model, Pile Driving Analyzer® (PDA) utilizing the SPT Analyzer feature was used to acquire and process the dynamic test data. Additional information regarding the testing equipment and analytical procedures is provided in Appendix A.

Test Sequence

Using an instrumented NW-J rod for a Mobile B-57 Drill Rig at Borehole BH5, energy measurements were made at various sample depths for the drill rig. Dynamic measurements were obtained for sample depths at 5.0, 10.0 and 15.0 feet. Each sample depth consisted of energy measurements for at least 50 blows of driving. It is noted that N-value calculation analysis cannot be completed due to refusal conditions encountered during the 18 inches of driving.

Energy Transfer Measurements

A Model 8G Pile Driving Analyzer was used to take measurements of strain and acceleration. The strain and acceleration signals were conditioned and converted to forces and velocities by the PDA. The PDA interprets the measured dynamic data according to the Case Method equations. Force and velocity records from the PDA were also viewed graphically on an LCD screen to evaluate data quality. All force and velocity records were also digitally stored for subsequent analysis.

The maximum energy transferred to the rod (EMX) was calculated by integrating both the force and velocity records over time as follows:

$$EMX = \int F(t)V(t)dt$$

Where: $F(t)$ = the force at time t
$V(t)$ = the velocity at time t

The energy transfer ratio or efficiency is computed by dividing EMX by the theoretical SPT hammer energy of 350 lb-ft (computed from the product of the hammer weight, assumed to be the standard 140 lbs, and the fall height, assumed to be 2.5 ft). The SPT N values can then be corrected for a nominal 60% transfer efficiency, $N_{60,}$ as follows:

$$N_{60} = (e_m / 60)\, N_m$$

Where: e_m = the measured transfer ratio (ETR)
N_m = the measured SPT “N” value

Conclusions

Table 1 presents a summary of the average transferred energies, energy transfer ratios and hammer operating rate for the Mobile B-57 drill rig at each sample depth calculated using the *EMX* equation. Appendix B includes the above summary as well as average values of the maximum impact force and maximum velocity of the rod. Complete data, including the maximum, minimum and standard deviation for each sampling depth, is also included in Appendix B.

For the truck mounted Mobile B-57 Drill Rig at BH5, the average energy transfer ratio from individual sample depths ranged from 76.6 to 87.9%.

Table 1: Summary of SPT results

Sample Depth (ft)	Measured SPT Blows/inch	Average EMX (ft-lb)	Average ETR (%)	Average BPM (bpm)
5.0	50 / 4.5	268.1	76.6	46.3
10.5	50 / 2.75	281.9	80.5	44.5
15.0	50 / 4.5	307.6	87.9	50.4

For an overall transfer ratio of:

SPT Rig (*Serial Number*)	**Overall Transfer Efficiency**	**Hammer Operating Rate (BPM)**
Mobile B-57 Drill Rig at BH5 (Truck 102724P)	**81.7%**	**47.1**

We appreciate the opportunity to be of assistance to you. Please do not hesitate to contact us if you have any questions regarding this report, or if we may be of further service.

Respectfully,

GRL Engineers, Inc.

PROFESSIONAL ENGINEER - STATE OF NEVADA
CAMILO A. ALVAREZ
Exp: 12/31/2020
CIVIL
No. 17525

Alvarez

Camilo Alvarez, P.E.

William Chambers, CPEng RPEQ

Appendix A

Introduction to SPT Dynamic Pile Testing

APPENDIX A
AN INTRODUCTION INTO SPT DYNAMIC PILE TESTING

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1. BACKGROUND

The Standard Penetration Test is frequently conducted as an in-situ assessment of soil strength. This test requires that a 140 lb weight is dropped 30 inches onto a drive rod at whose bottom a sampler is usually installed. The sampler is driven for 18 inches; the number of blows required for the last 12 inches of driving is the so-called N-value. The N-value may be used as a strength indicator for foundation design or as a means of assessing the liquefaction potential of soils.

Obviously, the SPT hammer efficiency is an important consideration when using the N-values for design purposes. Measurements have indicated that the energy in the drive rod is sometimes only 30% and and may reach 90% of the potential or rated energy of the SPT hammer (E-rated = 0.35 kip-ft or 0.475 kJ). The type of hammer used to drive the rod is the main reason for these variations. On the average, the energy in the drive rod is 60% of the standard rated energy.

Because of the variability of energy, methods based on N-values are considered unreliable. However, measurements during SPT testing using the Case Method can be done on a routine basis and these measurements yield the transferred energy values. With measured energy, EMX, known, an adjustment of the measured N-value, N_m, can be made as follows.

$$N_{60} = N_m \left[E_m / (0.6E_r)\right] \quad (1)$$

Thus, if the measured energy value is equal to the normally expected transferred energy of 60% of E-rated then the adjusted and measured N-values are identical. On the other hand, if the measured energy is only 30% then the adjusted blow count will be reduced by 50%.

2. DYNAMIC TESTING AND ANALYSIS METHODS APPLIED TO SPT

The Case Method of dynamic pile testing, named after the Case Institute of Technology where it was developed between 1964 and 1975, requires that a substantial ram mass (e.g. a pile driving hammer) impacts the pile top such that the pile undergoes at least a small permanent set. Thus, the method is also referred to as a “High Strain Method”. The Case Method requires dynamic measurements on the pile or shaft under the ram impact and then a calculation of various quantities. Conveniently, for SPT applications, the measurements and analyses are done by a single piece of equipment: the SPT Analyzer. The Pile Driving Analyzer® (PDA) is also suitable to perform these measurements and data processing.

A related analysis method is the “Wave Equation Analysis” which calculates a relationship between bearing capacity, pile stresses, transferred energy and field blow count. The GRLWEAP™ program performs this analysis and provides a complete set of helpful information and input data. This program can be used very effectively to simulate the SPT driving process.

3. MEASUREMENTS

GRL uses equipment manufactured by Pile Dynamics, Inc. The system includes either an SPT-Analyzer™ (SPTA) or a Pile Driving Analyzer® (PDA), an instrumented rod section and two accelerometers. SPT energy testing is very closely related to and borrows procedures from dynamic pile testing. Those interested in the basis of the SPT energy testing method may obtain extensive literature on dynamic pile testing from GRL Engineers, Inc.

3.1 SPT Analyzer or Pile Driving Analyzer

The basis for the results calculated by the SPTA or PDA are strain and acceleration measured in an instrumented rod section. These signals are converted to rod top force, F(t), and rod top velocity, v(t). The SPTA or PDA conditions, calibrates and displays these signals and immediately computes average pile force and velocity thereby eliminating bending effects. The product of these two

measurements is then integrated over time which yields the energy transferred to the instrumented section as a function of time (see Section 4.1).

For convenience and accuracy, strain measurements are usually taken on an instrumented section of SPT drive rod. Ideally, the section properties of the instrumented rod and those of the drive rod are the same, however, using subs, other sections can also be utilized.

For the instrumented section, PDI provides a force calibration in such a way that the output of the instrumented rod is directly calculated without the need for an accurate elastic modulus or cross sectional area of the rod section.

The acceleration measurements are often demanding in the SPT environment, because of high frequency and high acceleration motion components. An experienced measurement engineer, therefore, has to evaluate the quality of this data before final conclusions are drawn from the numerical results calculated by SPTA or PDA.

SPTA or PDA records are taken while the standard N-value is acquired in the conventional manner. This then allows a direct correlation between N-value and average transferred energy.

3.2 HPA

The SPT hammer's ram velocity may be directly obtained using radar technology in the Hammer Performance Analyzer™. The impact velocity results can be automatically processed with a PC or recorded on a strip chart. HPA measurements yield a hammer kinetic energy, but not the energy transferred to the drive rod.

4 RECORD EVALUATION BY SPTA OR PDA

4.1 HAMMER PERFORMANCE

The PDA calculates the energy transferred to the pile top from:

$$E(t) = \int_0^t F(\tau)v(\tau)\, d\tau \qquad (2)$$

The maximum of the E(t) curve is often called **ENTHRU or EMX;** it is the most important quantity for an overall evaluation of the performance of a hammer and driving system. **EMX** allows for a classification of the hammer's performance when presented as, e_T, the rated transfer efficiency, also called energy transfer ratio (**ETR**) or global efficiency.

$$e_T = EMX/E_R \qquad (3)$$

where E_R is the hammer manufacturer's rated energy value or 0.35 kip-ft (0.475 kJ) in the case of the SPT hammer.

Often in the SPT literature one finds also reference to the EF2 energy. This evaluation is based on assumed proportionality between force and velocity (see also Section 5):

$$v(t) = F(t) / Z \qquad (4)$$

where Z = EA/c is the pile impedance, E is the elastic modulus, A is the cross sectional area and c is the speed of the stress wave in the pile material..

Combining equations 2 and 4 leads to

$$EF(t) = \int_0^t F(\tau)^2 / Z\, d\tau \qquad (5)$$

The EF2 transferred energy value is the EF-value at the time t = 2L/c, where L is the drive rod length and c is the stress wave speed in steel (16,800 ft/s or 5,124 m/s). Since the force is easier to measure than both force and velocity, Equation 5 is preferred by some test engineers. However, the EF method is fraught with errors and certain correction factors have to be applied to make it approximately correct. Among the error sources are the following:

- Proportionality is often violated prior to time 2L/c. The proportionality between force and velocity in a downward traveling wave only holds if the wave does not encounter a disturbance prior to reflecting off the pile toe. Such disturbances include a change in cross sectional area, an open or loose splice or joint, or resistance along the shaft.

- Using only one force measurement precludes a data quality check based on the proportionality between force and velocity. Thus, a force measurement that is for some reason in error may not be detectable, which will lead to errors in the EF2 value. Data quality checks will be discussed further in Section 5.

The use if EF2 is therefore not recommended but it is often included in result presentations for the sake of completeness.

4.2 STRESSES

During SPT monitoring, it is also of interest to monitor compressive stresses at both the top of the drive rod and at its bottom.

At the pile top (location of sensors) the maximum compression stress averaged over the rod's cross section, **CSX**, is directly obtained from the measurements. Note that this stress value refers to the instrumented section. If the rod has a different cross sectional area then the stress in the rod will be different from CSX.

The SPTA or PDA can also calculate, in an approximate manner, the force at the rod bottom, **CFB**. To obtain the corresponding stress, this force value should be divided by the appropriate cross sectional area, e.g. by the rod area just above the sampler or by the sampler area itself. Of course, non-uniform stress components as they might occur at the sampler tip due to a sloping rock are not considered in this calculation.

5. DATA QUALITY CHECKS

Quality data is the first and foremost requirement for accurate dynamic testing results. It is therefore important that the measurement engineer performing SPTA or PDA tests has the experience necessary to recognize measurement problems and take appropriate corrective action should problems develop. Fortunately, dynamic pile testing allows for certain data quality checks because two independent measurements are taken that have to conform to the so-called proportionality relationship.

As long as there is only a wave traveling in one direction, as is the case during impact when only a downward traveling wave exists in the rod, force and velocity measured at its top are proportional

$$F = v\,Z \qquad (5)$$

where Z is again the pile impedance, Z = EA/c. This relationship can also be expressed in terms of stress

$$\sigma = F/A = v\,(E/c) \qquad (6)$$

or strain

$$\epsilon = \sigma/E = v\,/\,c \qquad (7)$$

This means that the early portion of strain times wave speed must be equal to the velocity unless the proportionality is affected by high friction near the pile top or by a pile cross sectional change not far below the sensors. Checking the proportionality is an excellent means of assuring meaningful measurements but is only truly meaningful for perfectly uniform rods. Open or loose splices, for example, will lead to a non-proportionality. For SPT rods it is fortunate that usually no soil resistance acts along the shaft and for that reason, proportionality can exist until the stress wave returns from sampler top or rod bottom unless connectors are not sufficiently tightened or have a significant mass.

Velocity data quality can also be checked by looking at the final displacement, DFN, which is calculated from the acceleration by double integration. If the calculated final displacement is much higher or lower than indicated by the N-value, the accelerometer attachment may be loose or the sensor may be faulty. If major drift in the velocity is observed, the EMX value may be in error, even though proportionality from impact to time 2L/c exists. In this case, it may be useful to evaluate the energy transferred to the drill rod at time 2L/c, which is calculated by the PDA or SPTA as the E2E quantity.

Appendix B

SPT Results

Geotech Rig Calibration - MOBILE B-57 5ft BH5 (102724P)
OP: GRL CA Date: 11-April-2019

AR: 1.48 in² SP: 0.492 k/ft³
LE: 9.50 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 0.90

EMX: Maximum Energy FMX: Maximum Force
ETR: Energy Transfer Ratio - Rated VMX: Maximum Velocity
BPM: Blows/Minute

BL#	Depth ft	BLC bl/in	TYPE	EMX ft-lb	ETR (%)	BPM bpm	FMX kips	VMX f/s
50	5.38	11	AV50	268.1	76.6	46.3	42	14.8
			STD	5.8	1.6	6.4	1	0.6
			MAX	280.5	80.1	47.9	45	18.2
			MIN	256.5	73.3	1.9	41	13.8
			Average	268.1	76.6	46.3	42	14.8
			Std. Dev.	5.8	1.6	6.4	1	0.6
			Maximum	280.5	80.1	47.9	45	18.2
			Minimum	256.5	73.3	1.9	41	13.8

Total number of blows analyzed: 50

BL#	Sensors
1-50	F2: [145NW1] 207.5 (1.00); F4: [145NW2] 206.0 (1.00); A1: [K10813] 374.0 (1.00); A3: [K10815] 396.0 (1.00)

Time Summary

Drive 1 minute 2 seconds 9:53 AM - 9:54 AM BN 1 - 50

Geotech Rig Calibration - MOBILE B57 10ft BH5 (102724P)
OP: GRL CA Date: 11-April-2019

AR: 1.48 in² SP: 0.492 k/ft³
LE: 14.50 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 0.90

EMX: Maximum Energy FMX: Maximum Force
ETR: Energy Transfer Ratio - Rated VMX: Maximum Velocity
BPM: Blows/Minute

BL#	Depth ft	BLC bl/in	TYPE	EMX ft-lb	ETR (%)	BPM bpm	FMX kips	VMX f/s
50	10.23	18	AV50	281.9	80.5	44.5	42	14.5
			STD	3.0	0.8	6.1	1	0.2
			MAX	289.6	82.7	46.0	43	15.2
			MIN	272.7	77.9	1.9	40	13.9
			Average	281.9	80.5	44.5	42	14.5
			Std. Dev.	3.0	0.8	6.1	1	0.2
			Maximum	289.6	82.7	46.0	43	15.2
			Minimum	272.7	77.9	1.9	40	13.9

Total number of blows analyzed: 50

BL# Sensors

1-50 F2: [145NW1] 207.5 (1.00); F4: [145NW2] 206.0 (1.00); A1: [K10813] 374.0 (1.00);
A3: [K10815] 396.0 (1.00)

Time Summary

Drive 1 minute 4 seconds 10:04 AM - 10:05 AM BN 1 - 50

Geotech Rig Calibration - MOBILE B57 15ft BH5 (102724P)
OP: GRL CA Date: 11-April-2019

AR: 1.48 in² SP: 0.492 k/ft³
LE: 19.00 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 0.90

EMX: Maximum Energy FMX: Maximum Force
ETR: Energy Transfer Ratio - Rated VMX: Maximum Velocity
BPM: Blows/Minute

BL#	Depth ft	BLC bl/in	TYPE	EMX ft-lb	ETR (%)	BPM bpm	FMX kips	VMX f/s
50	15.38	11	AV50	307.6	87.9	50.4	44	14.7
			STD	9.6	2.7	7.5	1	0.5
			MAX	335.5	95.9	60.9	45	16.7
			MIN	297.0	84.9	1.9	41	13.9
			Average	307.6	87.9	50.4	44	14.7
			Std. Dev.	9.6	2.7	7.5	1	0.5
			Maximum	335.5	95.9	60.9	45	16.7
			Minimum	297.0	84.9	1.9	41	13.9

Total number of blows analyzed: 50

BL#	Sensors
1-50	F2: [145NW1] 207.5 (1.00); F4: [145NW2] 206.0 (1.00); A1: [K10813] 374.0 (1.00); A3: [K10815] 396.0 (1.00)

Time Summary

Drive 57 seconds 10:14 AM - 10:15 AM BN 1 - 50

GRL engineers, inc.

Dynamic
Measurements
and Analyses

Job No. 198060-1

Report on:
Energy Measurement for Dynamic Penetrometers – Standard Penetration Test
Mobile B-57 Drill Rig (Truck 102750P)
Las Vegas, NV

Prepared for Geotechnical Drilling
By Camilo Alvarez, PE & William Chambers

April 15, 2019

GRL engineers, inc.
Dynamic Measurements and Analyses

April 15, 2019

Mr. Tom Beall
Geotechnical Drilling

Re: Energy Measurement for Dynamic Penetrometers
Standard Penetration Test (SPT) on Truck 102750P Mobile B-57 Drill rig
Las Vegas, NV GRL Job No. 198060-1

Dear Mr. Beall:

This report transmits our findings from energy measurements and related data analysis conducted by GRL Engineers, Inc. (GRL) for your truck mounted Mobile B-57 Drill Rig located in Las Vegas, NV. One automatic hammer and penetrometer system was monitored during Standard Penetration Test (SPT) of the test Borehole BH1. Dynamic testing summarized in this report was conducted on April 11, 2019.

The purpose in collecting the SPT energy measurements was to compute the energy transfer efficiency for 1 SPT hammer. To meet this objective, an 8G Model, Pile Driving Analyzer® (PDA) utilizing the SPT Analyzer feature was used to acquire and process the dynamic test data. Additional information regarding the testing equipment and analytical procedures is provided in Appendix A.

Test Sequence

Using an instrumented NW-J rod for a Mobile B-57 Drill Rig at Borehole BH1, energy measurements were made at various sample depths for the drill rig. Dynamic measurements were obtained for sample depths at 5.0, 10.0 and 15.0 feet. Each sample depth consisted of energy measurements for at least 50 blows of driving. It is noted that N-value calculation analysis cannot be completed due to refusal conditions encountered during the 18 inches of driving.

Energy Transfer Measurements

A Model 8G Pile Driving Analyzer was used to take measurements of strain and acceleration. The strain and acceleration signals were conditioned and converted to forces and velocities by the PDA. The PDA interprets the measured dynamic data according to the Case Method equations. Force and velocity records from the PDA were also viewed graphically on an LCD screen to evaluate data quality. All force and velocity records were also digitally stored for subsequent analysis.

The maximum energy transferred to the rod (EMX) was calculated by integrating both the force and velocity records over time as follows:

$$EMX = \int F(t)V(t)dt$$

Where: $F(t)$ = the force at time t
$V(t)$ = the velocity at time t

The energy transfer ratio or efficiency is computed by dividing EMX by the theoretical SPT hammer energy of 350 lb-ft (computed from the product of the hammer weight, assumed to be the standard 140 lbs, and the fall height, assumed to be 2.5 ft). The SPT N values can then be corrected for a nominal 60% transfer efficiency, $N_{60,}$ as follows:

$$N_{60} = (e_m / 60)\ N_m$$

Where: e_m = the measured transfer ratio (ETR)
N_m = the measured SPT “N” value

Conclusions

Table 1 presents a summary of the average transferred energies, energy transfer ratios and hammer operating rate for the Mobile B-57 drill rig at each sample depth calculated using the *EMX* equation. Appendix B includes the above summary as well as average values of the maximum impact force and maximum velocity of the rod. Complete data, including the maximum, minimum and standard deviation for each sampling depth, is also included in Appendix B.

For the truck mounted Mobile B-57 Drill Rig at BH1, the average energy transfer ratio from individual sample depths ranged from 65.1 to 73.2%.

Table 1: Summary of SPT results

Sample Depth (ft)	Measured SPT Blows/inch	Average EMX (ft-lb)	Average ETR (%)	Average BPM (bpm)
5.0	50 / 4.0	243.2	69.5	43.1
10.5	50 / 4.75	228.0	65.1	42.9
15.0	50 / 5.5	256.2	73.2	42.1

For an overall transfer ratio of:

SPT Rig (*Serial Number*)	**Overall Transfer Efficiency**	**Hammer Operating Rate (BPM)**
Mobile B-57 Drill Rig at BH1 (Truck 102750P)	**69.3%**	**42.7**

We appreciate the opportunity to be of assistance to you. Please do not hesitate to contact us if you have any questions regarding this report, or if we may be of further service.

Respectfully,

GRL Engineers, Inc.

Alvarez

Camilo Alvarez, P.E.

PROFESSIONAL ENGINEER - STATE OF NEVADA
CAMILO A.
ALVAREZ
Exp: 12/31/2020
CIVIL
No. 17525

William Chambers, CPEng RPEQ

Appendix A

Introduction to SPT Dynamic Pile Testing

APPENDIX A
AN INTRODUCTION INTO SPT DYNAMIC PILE TESTING

The following has been written by GRL Engineers, Inc. and may only be copied with its written permission.

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1. BACKGROUND

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Because of the variability of energy, methods based on N-values are considered unreliable. However, measurements during SPT testing using the Case Method can be done on a routine basis and these measurements yield the transferred energy values. With measured energy, EMX, known, an adjustment of the measured N-value, N_m, can be made as follows.

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where E_R is the hammer manufacturer’s rated energy value or 0.35 kip-ft (0.475 kJ) in the case of the SPT hammer.

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The EF2 transferred energy value is the EF-value at the time t = 2L/c, where L is the drive rod length and c is the stress wave speed in steel (16,800 ft/s or 5,124 m/s). Since the force is easier to measure than both force and velocity, Equation 5 is preferred by some test engineers. However, the EF method is fraught with errors and certain correction factors have to be applied to make it approximately correct. Among the error sources are the following:

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Appendix B

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OP: GRL CA Date: 11-April-2019

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Total number of blows analyzed: 50

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Time Summary

Drive 1 minute 7 seconds 8:18 AM - 8:19 AM BN 1 - 50

GRL Engineers, Inc.
Case Method & iCAP® Results PDIPLOT2 2017.2.58.5 - Printed 12-April-2019

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EMX: Maximum Energy FMX: Maximum Force
ETR: Energy Transfer Ratio - Rated VMX: Maximum Velocity
BPM: Blows/Minute

BL#	Depth	BLC	TYPE	EMX	ETR	BPM	FMX	VMX
	ft	bl/in		ft-lb	(%)	bpm	kips	f/s
50	10.40	11	AV50	228.0	65.1	42.9	37	15.6
			STD	46.9	13.4	6.1	6	2.1
			MAX	296.3	84.7	48.4	45	18.4
			MIN	105.5	30.1	1.9	19	9.7
			Average	228.0	65.1	42.9	37	15.6
			Std. Dev.	46.9	13.4	6.1	6	2.1
			Maximum	296.3	84.7	48.4	45	18.4
			Minimum	105.5	30.1	1.9	19	9.7

Total number of blows analyzed: 50

BL#	Sensors
1-50	F3: [145NW2] 206.0 (1.00); F4: [145NW1] 207.5 (1.00); A1: [K10813] 374.0 (1.00); A2: [K10815] 396.0 (1.00)

Time Summary

Drive 1 minute 7 seconds 8:25 AM - 8:26 AM BN 1 - 50

GRL Engineers, Inc.
Case Method & iCAP® Results

PDIPLOT2 2017.2.58.5 - Printed 12-April-2019

Geotech Rig Calibration - Mobile B57 15ft
BH1
OP: GRL CA
Date: 11-April-2019

AR: 1.48 in²
LE: 19.50 ft
WS: 16,807.9 f/s
SP: 0.492 k/ft³
EM: 30,000 ksi
JC: 0.90

EMX: Maximum Energy
ETR: Energy Transfer Ratio - Rated
BPM: Blows/Minute
FMX: Maximum Force
VMX: Maximum Velocity

BL#	Depth	BLC	TYPE	EMX	ETR	BPM	FMX	VMX
	ft	bl/in		ft-lb	(%)	bpm	kips	f/s
50	15.46	9	AV50	256.2	73.2	42.1	41	15.5
			STD	35.8	10.2	5.8	4	1.5
			MAX	295.7	84.5	46.6	47	17.5
			MIN	132.5	37.9	8.0	25	11.1
			Average	256.2	73.2	42.1	41	15.5
			Std. Dev.	35.8	10.2	5.8	4	1.5
			Maximum	295.7	84.5	46.6	47	17.5
			Minimum	132.5	37.9	8.0	25	11.1

Total number of blows analyzed: 50

BL# Sensors

1-50 F3: [145NW2] 206.0 (1.00); F4: [145NW1] 207.5 (1.00); A1: [K10813] 374.0 (1.00);
A2: [K10815] 396.0 (1.00)

Time Summary

Drive 1 minute 9 seconds 8:33 AM - 8:34 AM BN 1 - 50

HAMMER CALIBRATION (2019)

TRUCK DRILLS

UNIT NUMER	*TYPE*	*PERCENTAGE*	*DATE*
#1-05	CME-75	75.10%	1/9/2019
#2-04	CME-75	82.80%	1/9/2019
#1466	CME-75	82.70%	1/9/2019
#93	CME-75 4X4	83.10%	1/9/2019
#3010	CME-75 6X6	88.90%	1/9/2019
#7697	GREEN BK-81	87.40%	1/9/2019
#1541	BK-81	84.40%	1/9/2019
#85	CME-85	91.70%	1/9/2019

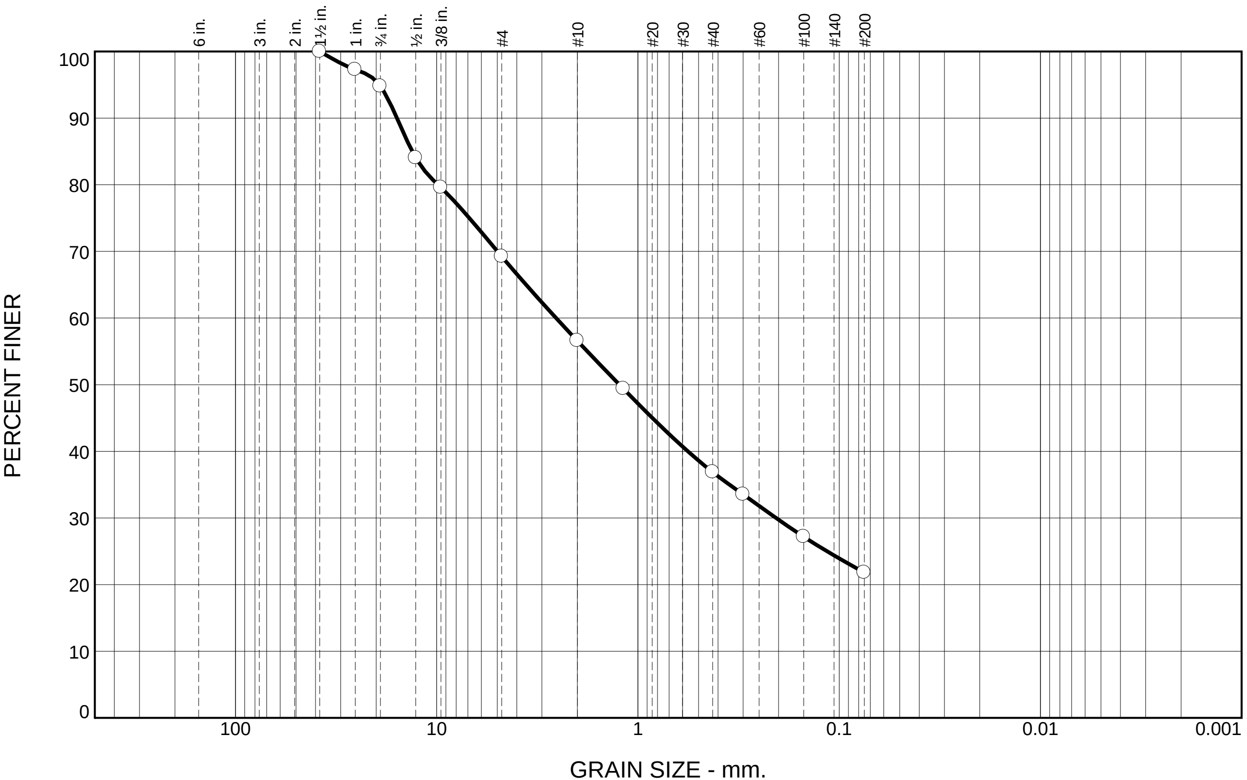
TRACK DRILLS

UNIT NUMBER	*TYPE*	*PERCENTAGE*	*DATE*
#22	CME-850	83.60%	1/9/2019
#23	CME-850	79.60%	1/9/2019
#ODOT850	CME-850	80.60%	1/9/2019

ATTACHMENT D

Laboratory Test Results

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	5.2	25.6	12.6	19.7	15.1	21.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	97.3		
.75	94.8		
.5	84.0		
.375	79.6		
#4	69.2		
#10	56.6		
#16	49.4		
#40	36.9		
#50	33.5		
#100	27.2		
#200	21.8		

* (no specification provided)

Material Description

Brown clayey sand with gravel

Atterberg Limits

PL= 20 LL= 32 PI= 12

Coefficients

D_{90}= 15.7343 D_{85}= 13.2172 D_{60}= 2.5503
D_{50}= 1.2356 D_{30}= 0.2059 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-6(0)

Remarks

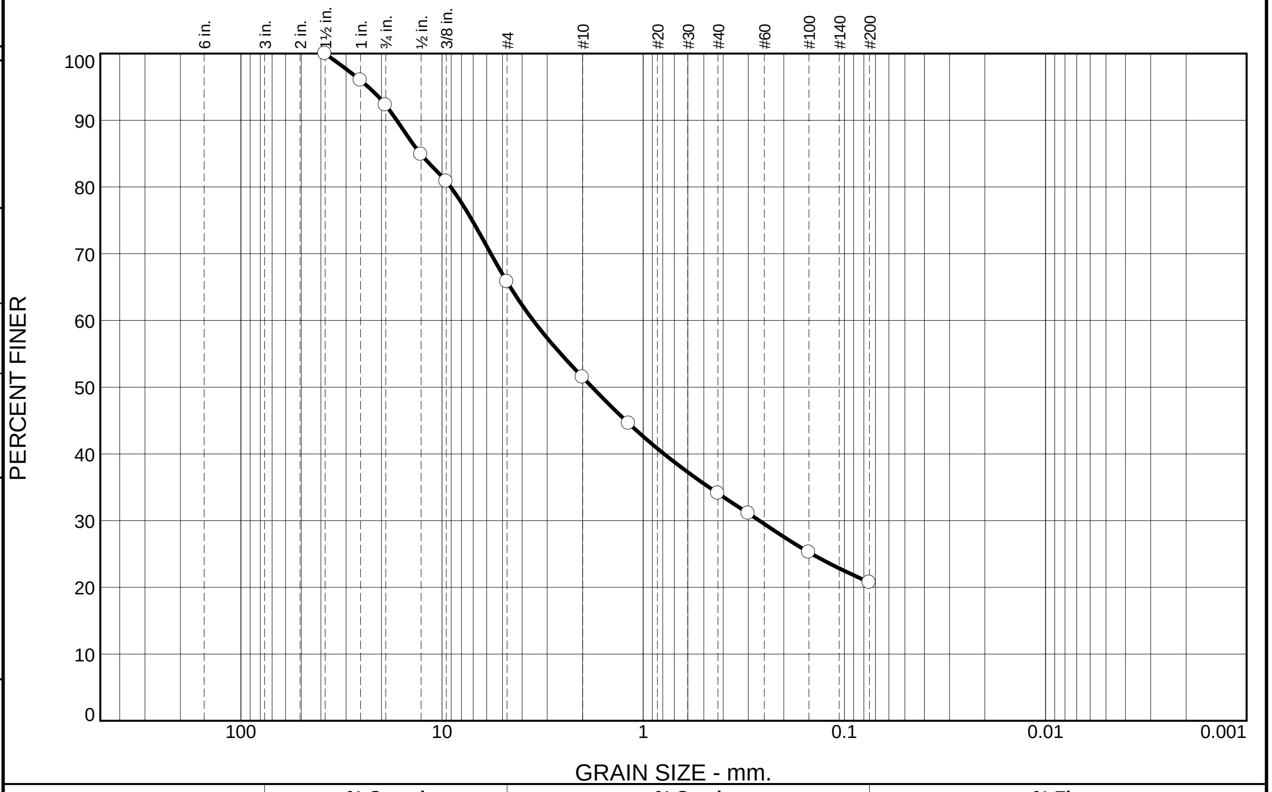
Location: BH19-BR-04
Sample Number: 19-160-09 **Depth:** 11-11.5' **Date:** 6/4/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-160-09

Tested By: OS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	7.7	26.5	14.3	17.4	13.4	20.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	96.0		
.75	92.3		
.5	84.9		
.375	80.8		
#4	65.8		
#10	51.5		
#16	44.6		
#40	34.1		
#50	31.1		
#100	25.2		
#200	20.7		

* (no specification provided)

Material Description

Light Brown clayey sand with gravel

Atterberg Limits

PL= 21 LL= 39 PI= 18

Coefficients

D_{90}= 16.7778 D_{85}= 12.8101 D_{60}= 3.5239

D_{50}= 1.7933 D_{30}= 0.2651 D_{15}=

D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-6(0)

Remarks

Location: BH19-BR-04

Sample Number: 19-160-10 **Depth:** 25-26.5' **Date:** 5/31/2019

NewFields

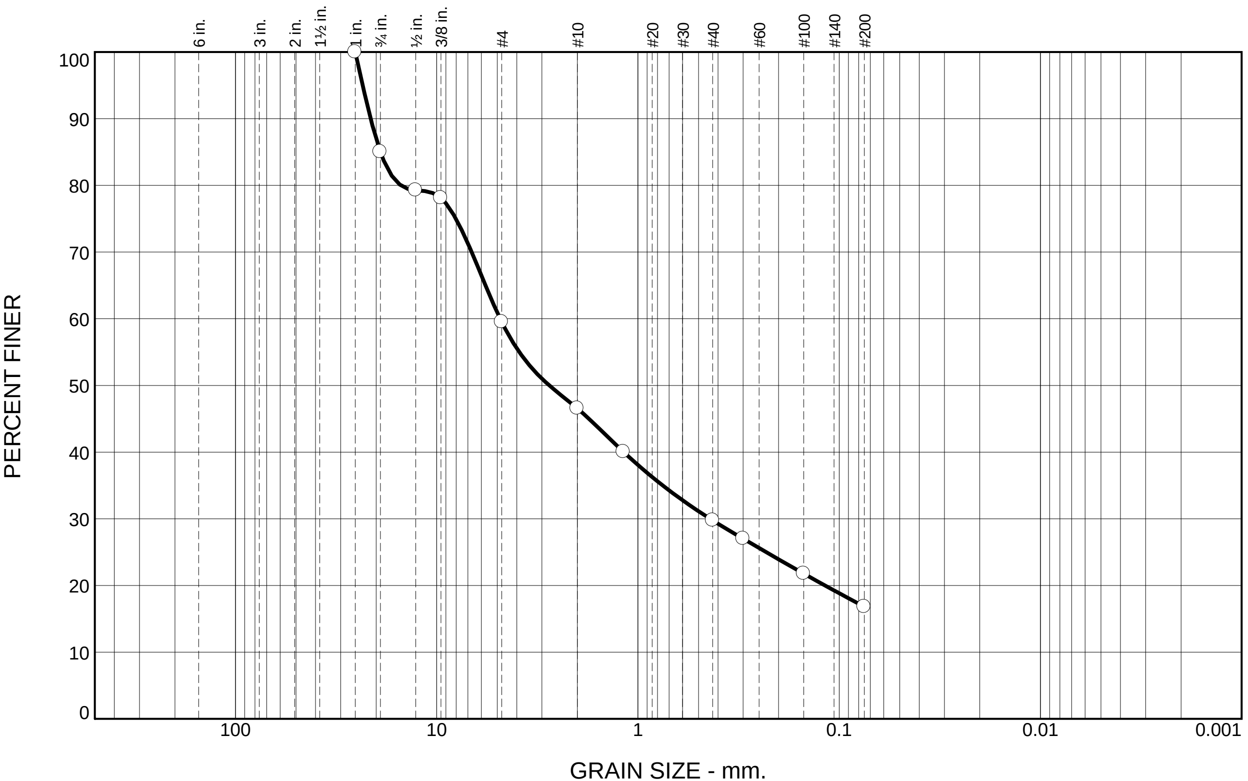
Client: NDOT

Project: US395 NDOT North Valleys

Project No: 475.0398.000 **Figure** 19-160-10

Tested By: OS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	15.0	25.5	13.0	16.7	13.0	16.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	85.0		
.5	79.3		
.375	78.1		
#4	59.5		
#10	46.5		
#16	40.0		
#40	29.8		
#50	27.0		
#100	21.8		
#200	16.8		

* (no specification provided)

Material Description

Brown silty sand with gravel

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 21.3024 D_{85}= 19.0381 D_{60}= 4.8382
D_{50}= 2.7558 D_{30}= 0.4374 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-1-b

Remarks

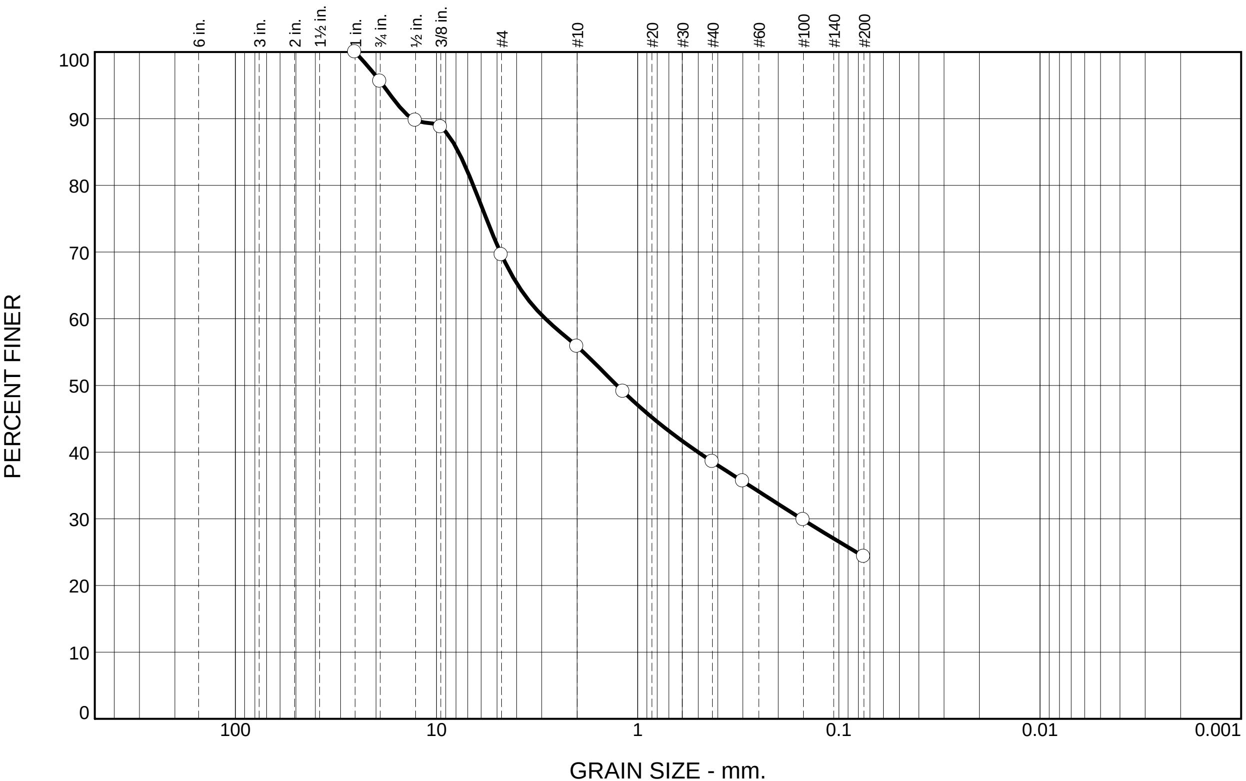
Location: BR-05
Sample Number: 19-279-01 **Depth:** 6-6.5 **Date:** 8/15/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-279-01

Tested By: AR **Checked By:** CC

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	4.4	26.0	13.8	17.2	14.3	24.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	95.6		
.5	89.7		
.375	88.7		
#4	69.6		
#10	55.8		
#16	49.1		
#40	38.6		
#50	35.6		
#100	29.8		
#200	24.3		

* (no specification provided)

Material Description

Brown clayey sand with gravel

Atterberg Limits

PL= 21 LL= 34 PI= 13

Coefficients

D_{90}= 13.2033 D_{85}= 7.7708 D_{60}= 2.8752
D_{50}= 1.2687 D_{30}= 0.1534 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-6(0)

Remarks

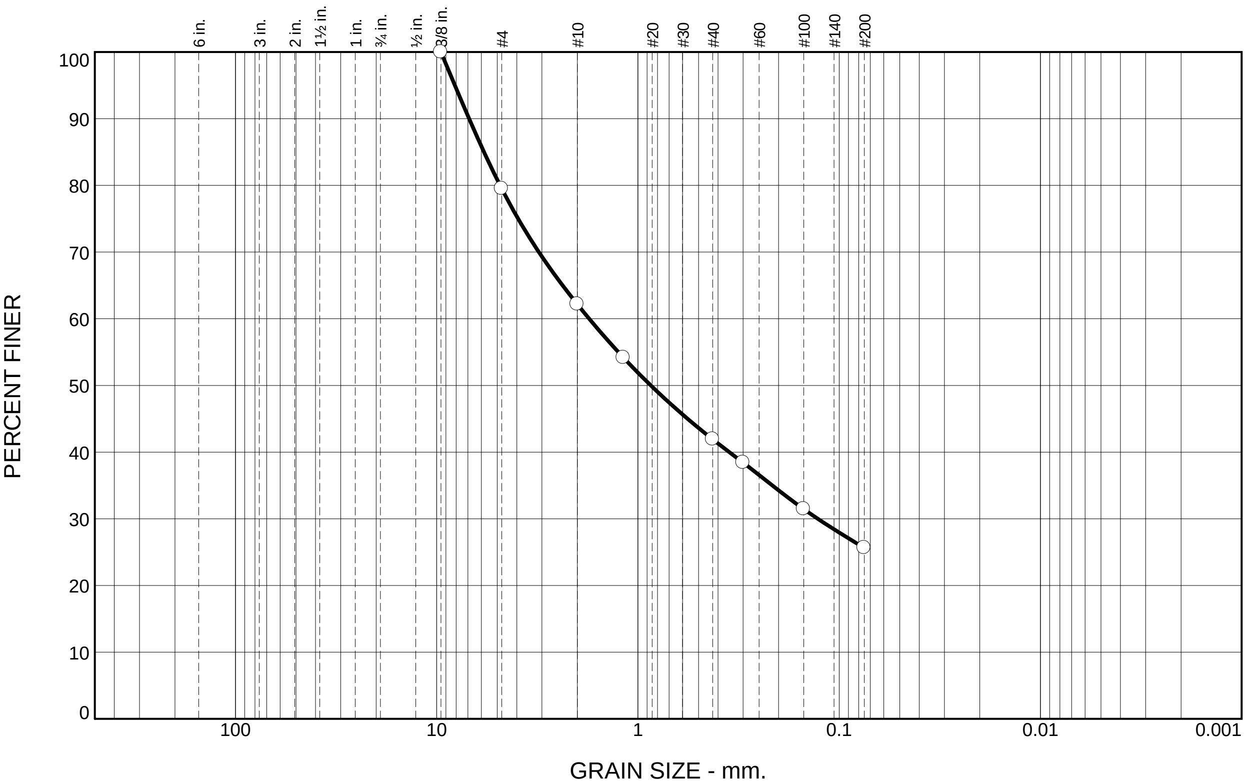
Location: BR-05
Sample Number: 19-279-02 **Depth:** 11-11.5 **Date:** 8/15/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-279-02

Tested By: AR **Checked By:** CC

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	20.5	17.3	20.3	16.3	25.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375	100.0		
#4	79.5		
#10	62.2		
#16	54.2		
#40	41.9		
#50	38.4		
#100	31.5		
#200	25.6		

* (no specification provided)

Material Description

Brown clayey sand with gravel

Atterberg Limits

PL= 24　LL= 39　PI= 15

Coefficients

D_{90}= 6.8994　D_{85}= 5.8197　D_{60}= 1.7469
D_{50}= 0.8630　D_{30}= 0.1277　D_{15}=
D_{10}=　C_u=　C_c=

Classification

USCS= SC　AASHTO= A-2-6(1)

Remarks

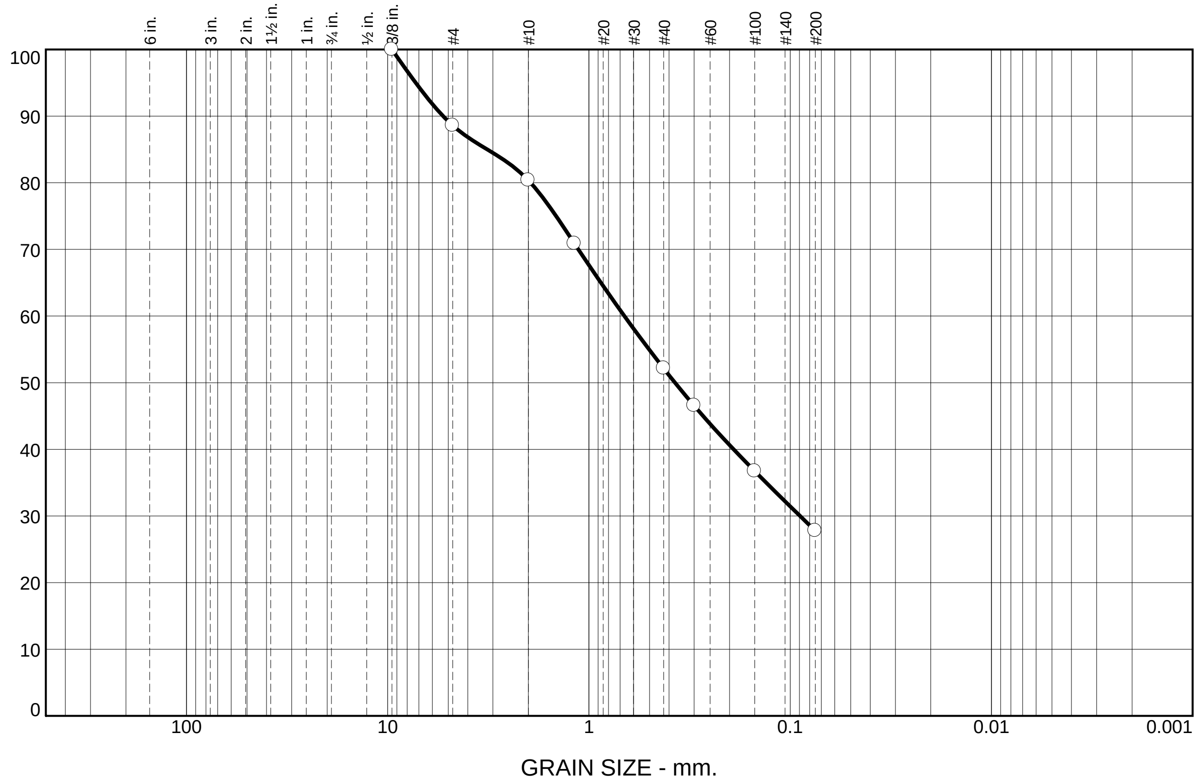
Location: BR-05
Sample Number: 19-279-04　**Depth:** 35-36.5　**Date:** 8/15/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000　**Figure** 19-279-04

Tested By: AR　**Checked By:** CC

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	11.4	8.2	28.3	24.3	27.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375"	100.0		
#4	88.6		
#10	80.4		
#16	70.9		
#40	52.1		
#50	46.5		
#100	36.7		
#200	27.8		

* (no specification provided)

Material Description

Brown clayey sand

Atterberg Limits

PL= 11   LL= 30   PI= 19

Coefficients

D_{90}= 5.3019 D_{85}= 3.1998 D_{60}= 0.6660
D_{50}= 0.3733 D_{30}= 0.0893 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC   AASHTO= A-2-6(1)

Remarks

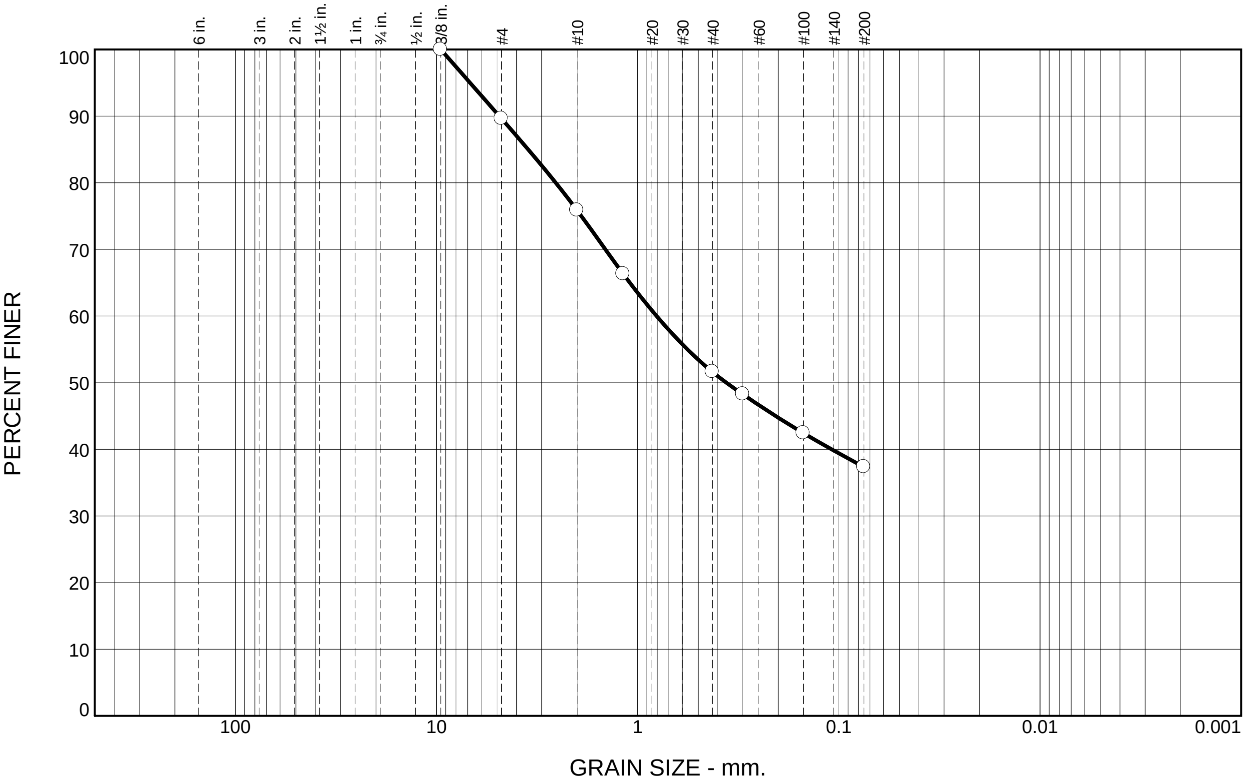
Location: BH19-BR-06
Sample Number: 19-248-02   **Depth:** 7.5-9'   **Date:** 8/1/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000   **Figure** 19-248-02

Tested By: JH   **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	10.4	13.7	24.3	14.3	37.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375"	100.0		
#4	89.6		
#10	75.9		
#16	66.3		
#40	51.6		
#50	48.3		
#100	42.4		
#200	37.3		

* (no specification provided)

Material Description

Light Brown clayey sand

Atterberg Limits

PL= 17 LL= 45 PI= 28

Coefficients

D_{90}= 4.8720 D_{85}= 3.5018 D_{60}= 0.8050
D_{50}= 0.3621 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-7-6(4)

Remarks

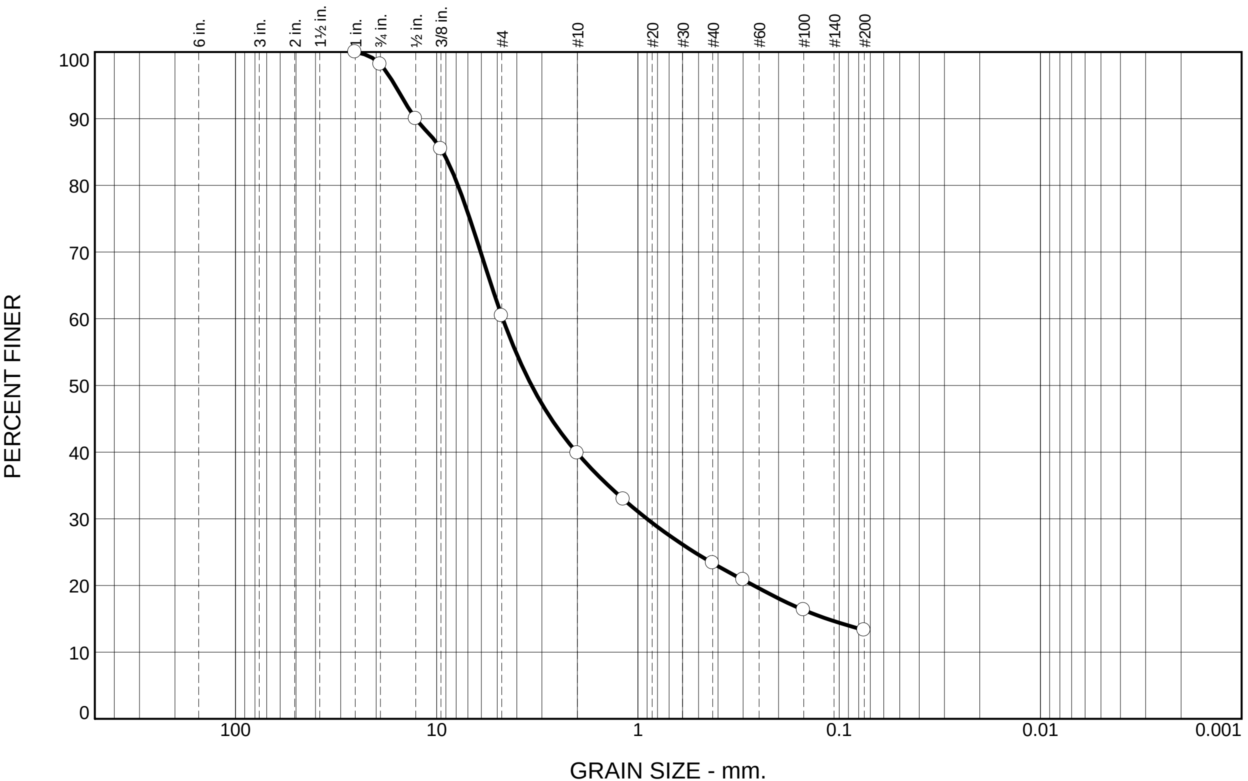
Location: BH19-BR-06
Sample Number: 19-248-03 **Depth:** 20-21' **Date:** 8/1/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-248-03

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	1.8	37.8	20.6	16.5	10.0	13.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1"	100.0		
.75	98.2		
.5	90.0		
.375	85.5		
#4	60.4		
#10	39.8		
#16	32.9		
#40	23.3		
#50	20.8		
#100	16.3		
#200	13.3		

* (no specification provided)

Material Description

White clayey sand with gravel

Atterberg Limits

PL= 16 LL= 29 PI= 13

Coefficients

D_{90}= 12.7225 D_{85}= 9.3237 D_{60}= 4.6947
D_{50}= 3.3769 D_{30}= 0.9014 D_{15}= 0.1149
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-6(0)

Remarks

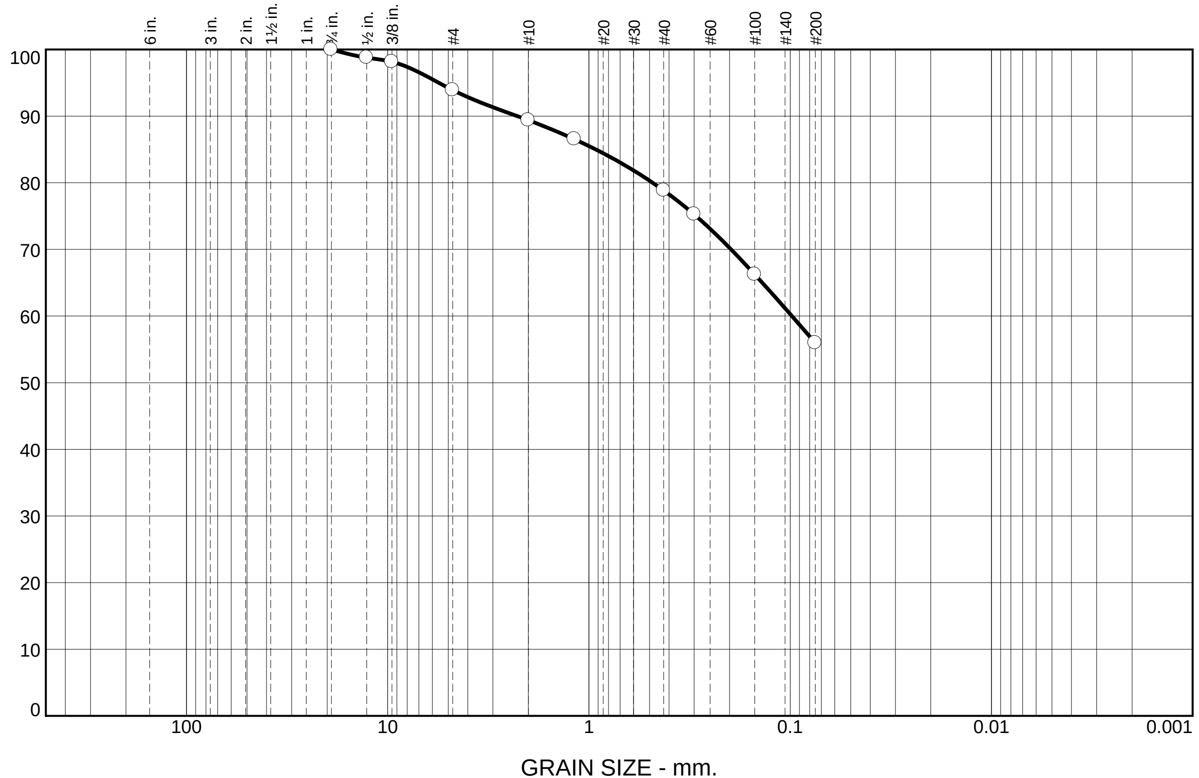
Location: BH19-BR-06
Sample Number: 19-248-04 **Depth:** 40-41' **Date:** 8/1/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-248-04

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	6.1	4.5	10.6	22.8	56.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	98.8		
.375	98.2		
#4	93.9		
#10	89.4		
#16	86.5		
#40	78.8		
#50	75.3		
#100	66.2		
#200	56.0		

* (no specification provided)

Material Description

Brown sandy lean clay

Atterberg Limits

PL= 15 LL= 44 PI= 29

Coefficients

D_{90}= 2.2682 D_{85}= 0.9246 D_{60}= 0.0980
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-7-6(12)

Remarks

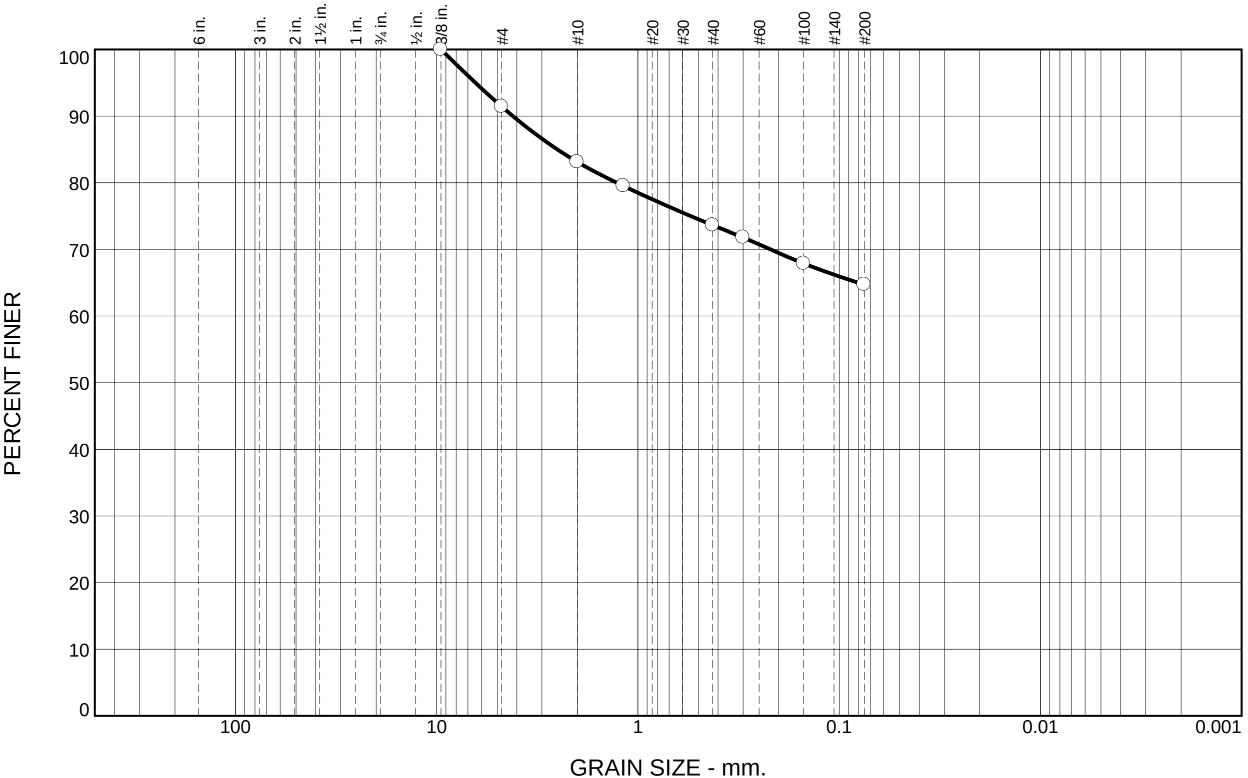
Location: BH19-BR-07
Sample Number: 19-248-05 **Depth:** 10-11' **Date:** 8/1/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-248-05

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	8.6	8.3	9.5	8.9	64.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	91.4		
#10	83.1		
#16	79.5		
#40	73.6		
#50	71.8		
#100	67.9		
#200	64.7		

* (no specification provided)

Material Description

White sandy lean clay

Atterberg Limits

PL= 20 LL= 32 PI= 12

Coefficients

D_{90}= 4.1807 D_{85}= 2.5131 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-6(6)

Remarks

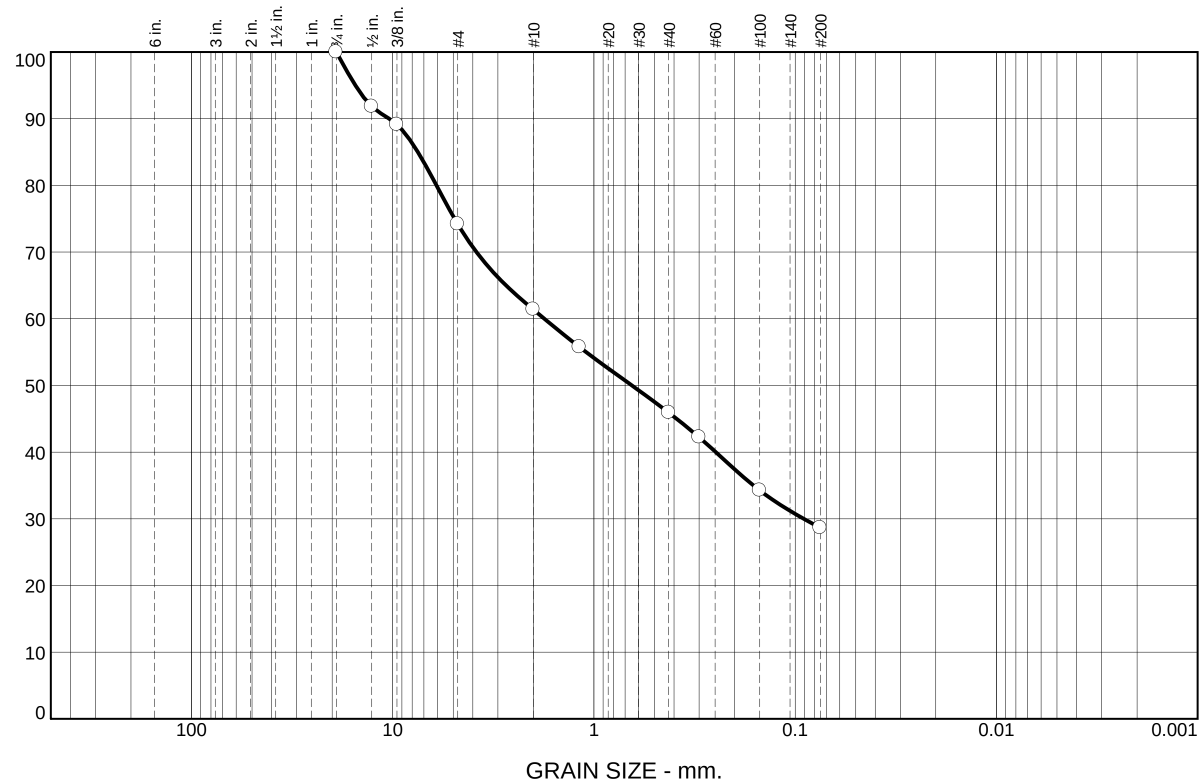
Location: BH19-BR-07
Sample Number: 19-248-06 **Depth:** 25-26.5' **Date:** 8/1/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-248-06

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	25.8	12.8	15.5	17.3	28.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	91.8		
.375	89.1		
#4	74.2		
#10	61.4		
#16	55.8		
#40	45.9		
#50	42.2		
#100	34.3		
#200	28.6		

* (no specification provided)

Material Description

Gray clayey sand with gravel

Atterberg Limits

PL= 20 LL= 33 PI= 13

Coefficients

D_{90}= 10.4074 D_{85}= 7.4979 D_{60}= 1.7645
D_{50}= 0.6477 D_{30}= 0.0906 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-6(0)

Remarks

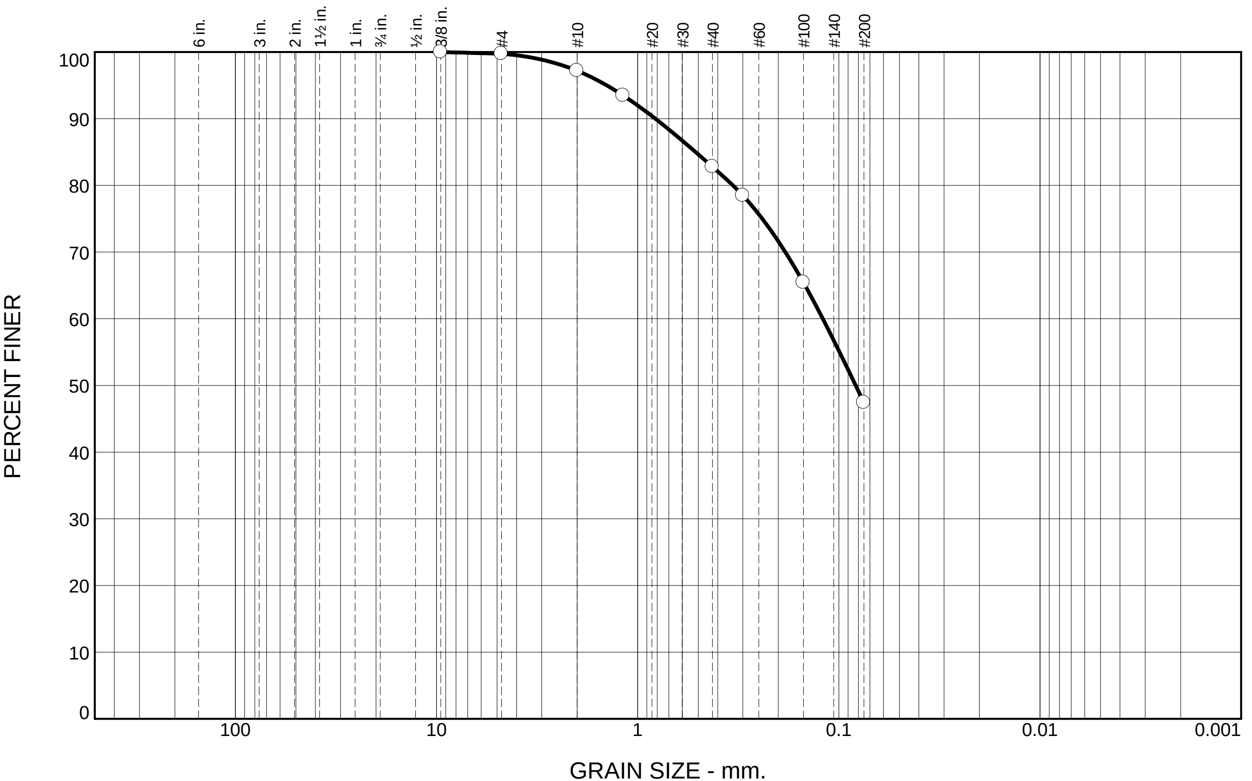
Location: BH19-BR-07
Sample Number: 19-248-07 **Depth:** 50-51.5' **Date:** 8/1/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-248-07

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.2	2.6	14.4	35.4	47.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	99.8		
#10	97.2		
#16	93.5		
#40	82.8		
#50	78.5		
#100	65.4		
#200	47.4		

* (no specification provided)

Material Description

Light Brown clayey sand

Atterberg Limits

PL= 20 LL= 38 PI= 18

Coefficients

D_{90}= 0.8164 D_{85}= 0.5151 D_{60}= 0.1201
D_{50}= 0.0824 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-6(5)

Remarks

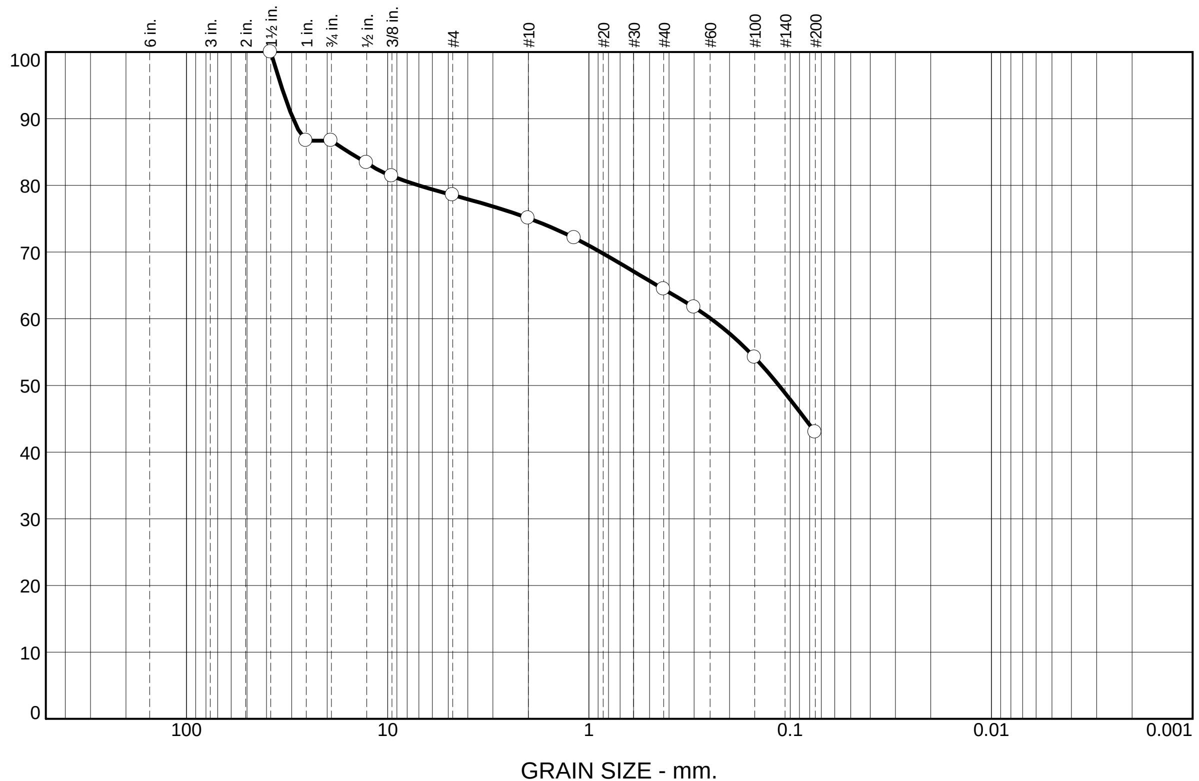
Location: BH19-BR-08
Sample Number: 19-131-05 **Depth:** 11-11.5' **Date:** 5/13/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-131-05

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	13.3	8.2	3.4	10.7	21.4	43.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	86.7		
.75	86.7		
.5	83.4		
.375	81.4		
#4	78.5		
#10	75.1		
#16	72.1		
#40	64.4		
#50	61.7		
#100	54.2		
#200	43.0		

* (no specification provided)

Material Description

Brown clayey sand with gravel

Atterberg Limits

PL= 19 LL= 43 PI= 24

Coefficients

D_{90}= 29.5238 D_{85}= 15.6021 D_{60}= 0.2480
D_{50}= 0.1137 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-7-6(6)

Remarks

Location: BH19-BR-08
Sample Number: 19-131-06 **Depth:** 15-16.5' **Date:** 5/13/2019

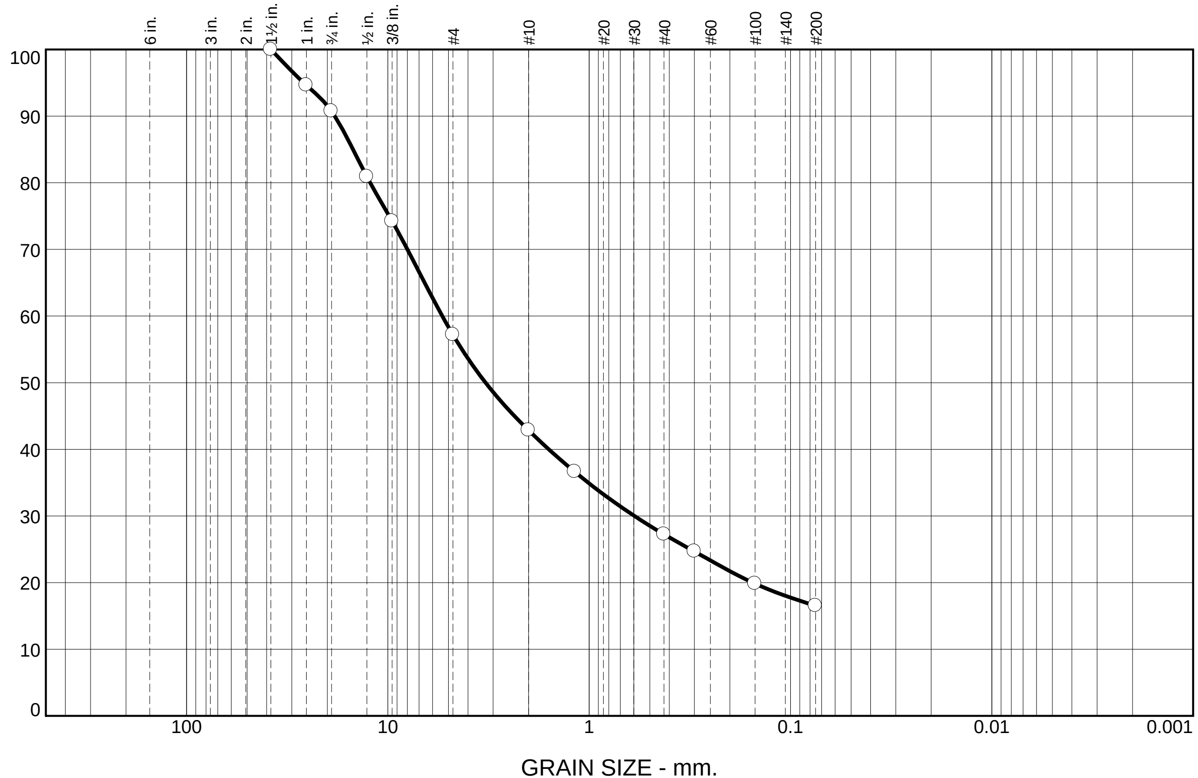
NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-131-06

Tested By: JH **Checked By:** JH

Test results included in this report relate only to the items inspected or tested. This report shall not be reproduced, in full, without prior written approval of NewFields.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	9.3	33.5	14.3	15.7	10.7	16.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	94.6		
.75	90.7		
.5	80.9		
.375	74.2		
#4	57.2		
#10	42.9		
#16	36.6		
#40	27.2		
#50	24.7		
#100	19.8		
#200	16.5		

* (no specification provided)

Material Description

Brown clayey gravel with sand

Atterberg Limits

PL= 17 LL= 30 PI= 13

Coefficients

D_{90}= 18.3395 D_{85}= 14.8842 D_{60}= 5.3664

D_{50}= 3.2722 D_{30}= 0.5959 D_{15}=

D_{10}= C_u= C_c=

Classification

USCS= GC AASHTO= A-2-6(0)

Remarks

Location: BH19-BR-08

Sample Number: 19-131-07 **Depth:** 30-31.5' **Date:** 5/13/2019

NewFields

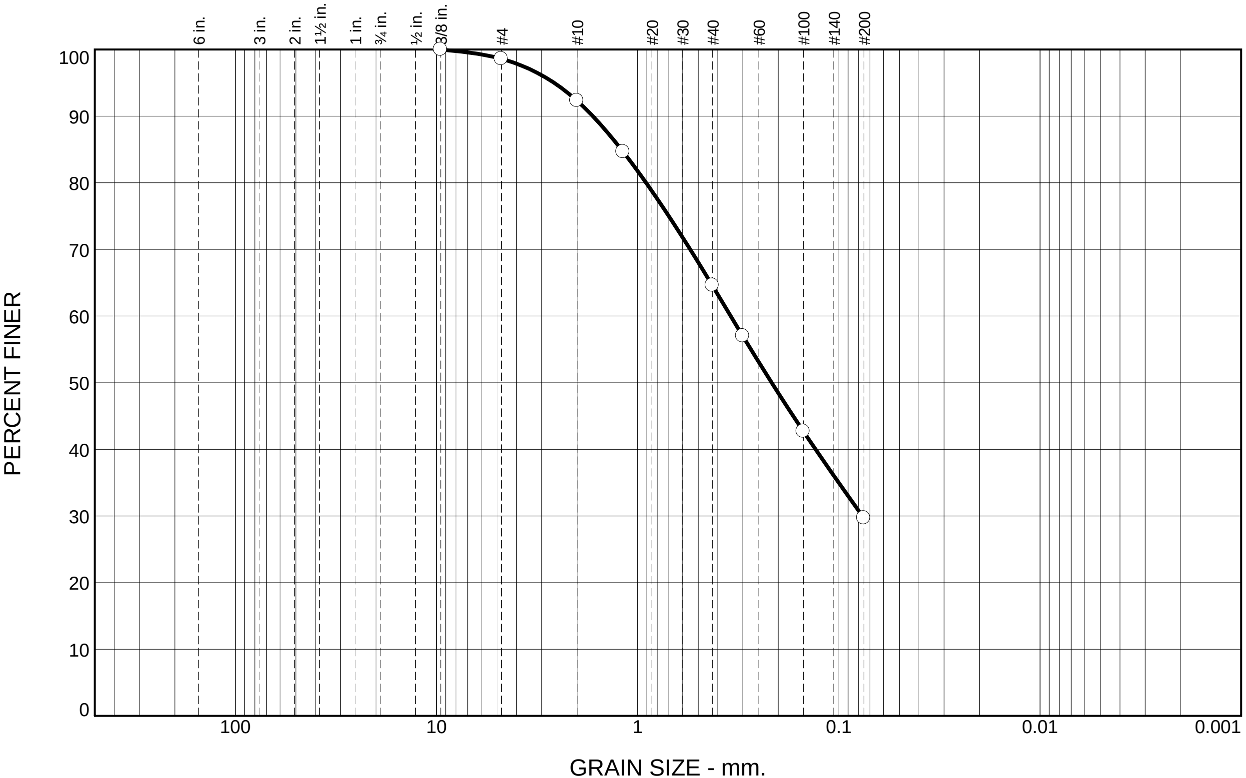
Client: NDOT

Project: US395 NDOT North Valleys

Project No: 475.0398.000 **Figure** 19-131-07

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.4	6.3	27.7	34.9	29.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	98.6		
#10	92.3		
#16	84.6		
#40	64.6		
#50	57.0		
#100	42.7		
#200	29.7		

* (no specification provided)

Material Description

Light Brown clayey sand

Atterberg Limits

PL= 15 LL= 25 PI= 10

Coefficients

D_{90}= 1.6707 D_{85}= 1.2059 D_{60}= 0.3446
D_{50}= 0.2157 D_{30}= 0.0764 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-4(0)

Remarks

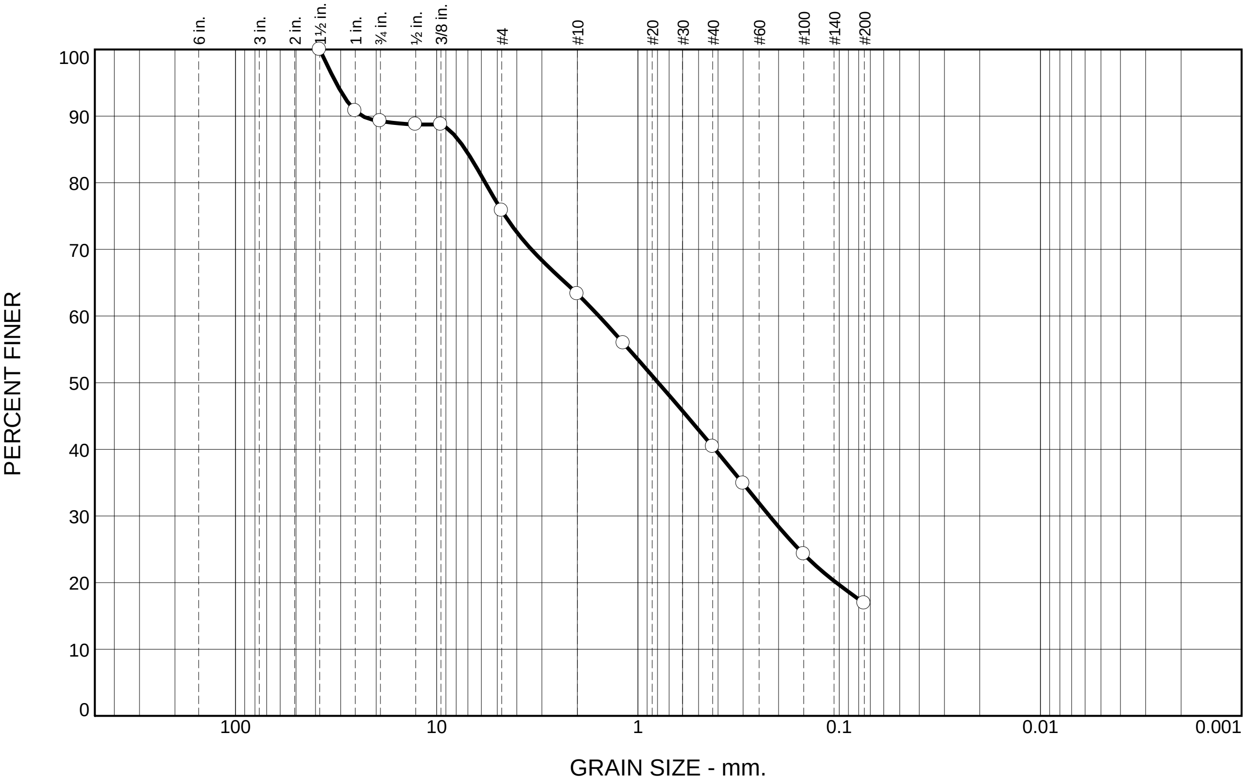
Location: BH19-BR-09
Sample Number: 19-213-08 **Depth:** 11-11.5' **Date:** 7/2/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-213-08

Tested By: JH/KG **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	10.7	13.5	12.5	22.9	23.5	16.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	90.8		
.75	89.3		
.5	88.7		
.375	88.7		
#4	75.8		
#10	63.3		
#16	55.9		
#40	40.4		
#50	34.9		
#100	24.3		
#200	16.9		

* (no specification provided)

Material Description

Light Brown clayey sand with gravel

Atterberg Limits

PL= 15 LL= 23 PI= 8

Coefficients

D_{90}= 23.3866 D_{85}= 7.2029 D_{60}= 1.5634
D_{50}= 0.7929 D_{30}= 0.2219 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-4(0)

Remarks

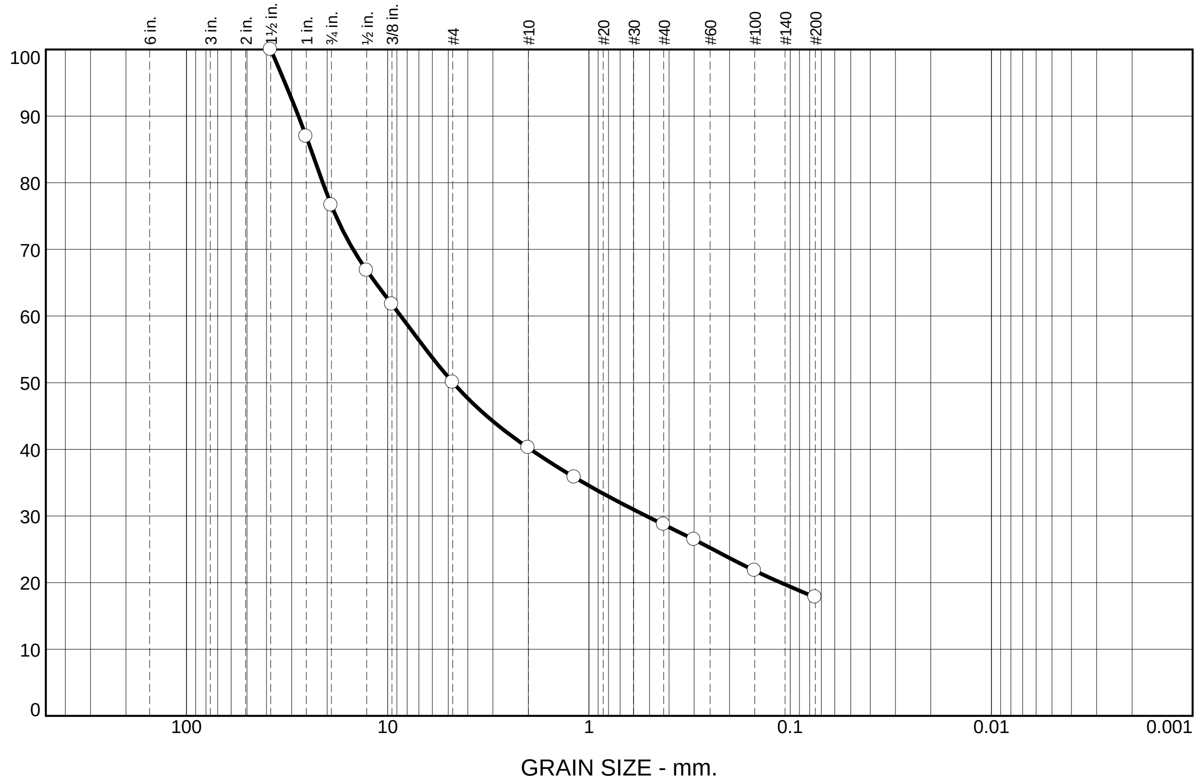
Location: BH19-BR-09
Sample Number: 19-213-09 **Depth:** 20.5-21' **Date:** 7/2/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-213-09

Tested By: JH/KG **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	23.4	26.6	9.8	11.5	10.9	17.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	86.9		
.75	76.6		
.5	66.8		
.375	61.8		
#4	50.0		
#10	40.2		
#16	35.8		
#40	28.7		
#50	26.4		
#100	21.8		
#200	17.8		

* (no specification provided)

Material Description

Brown clayey gravel with sand

Atterberg Limits

PL= 24 LL= 37 PI= 13

Coefficients

D_{90}= 27.7520	D_{85}= 24.0868	D_{60}= 8.6066
D_{50}= 4.7350	D_{30}= 0.5188	D_{15}=
D_{10}=	C_u=	C_c=

Classification

USCS= GC AASHTO= A-2-6(0)

Remarks

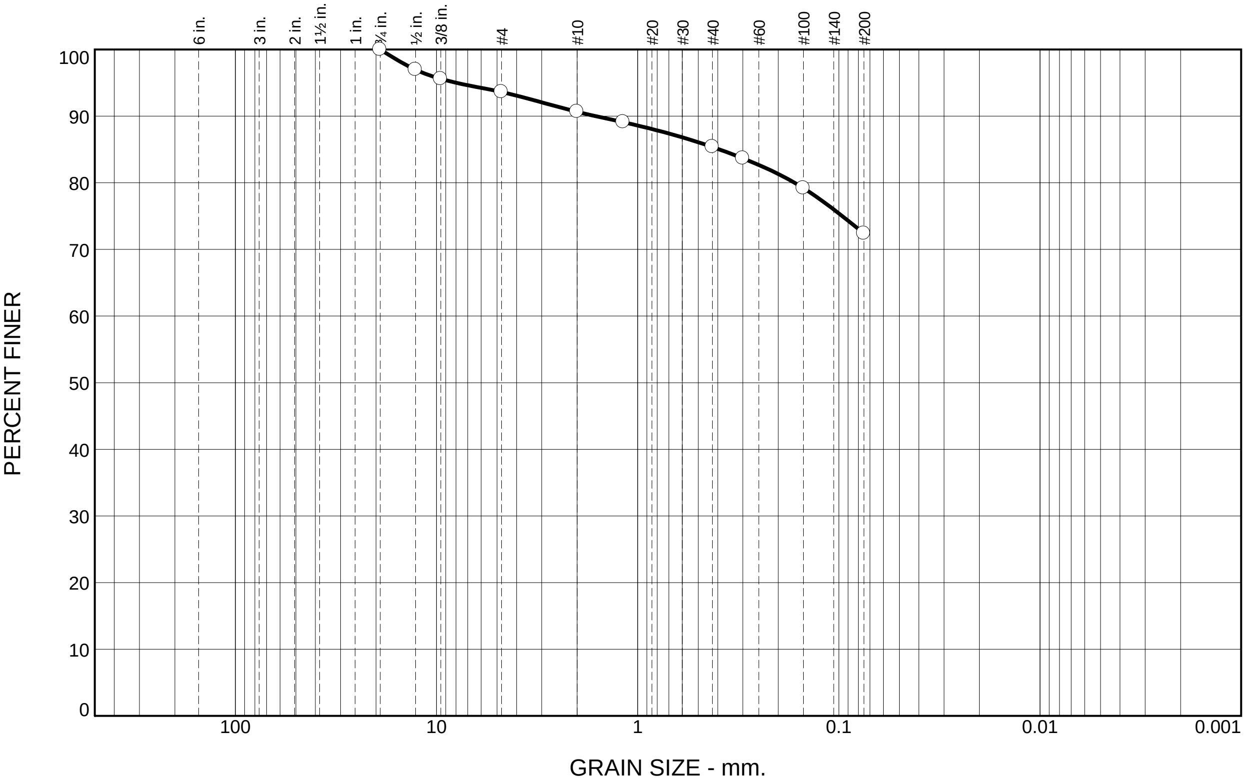
Location: BH19-BR-10
Sample Number: 19-160-01 **Depth:** 11-11.5' **Date:** 6/4/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-160-01

Tested By: OS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	6.4	2.9	5.3	13.0	72.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	97.0		
.375	95.6		
#4	93.6		
#10	90.7		
#16	89.1		
#40	85.4		
#50	83.7		
#100	79.2		
#200	72.4		

* (no specification provided)

Material Description

Brown lean clay with sand

Atterberg Limits

PL= 23 LL= 49 PI= 26

Coefficients

D_{90}= 1.6156 D_{85}= 0.3918 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-7-6(18)

Remarks

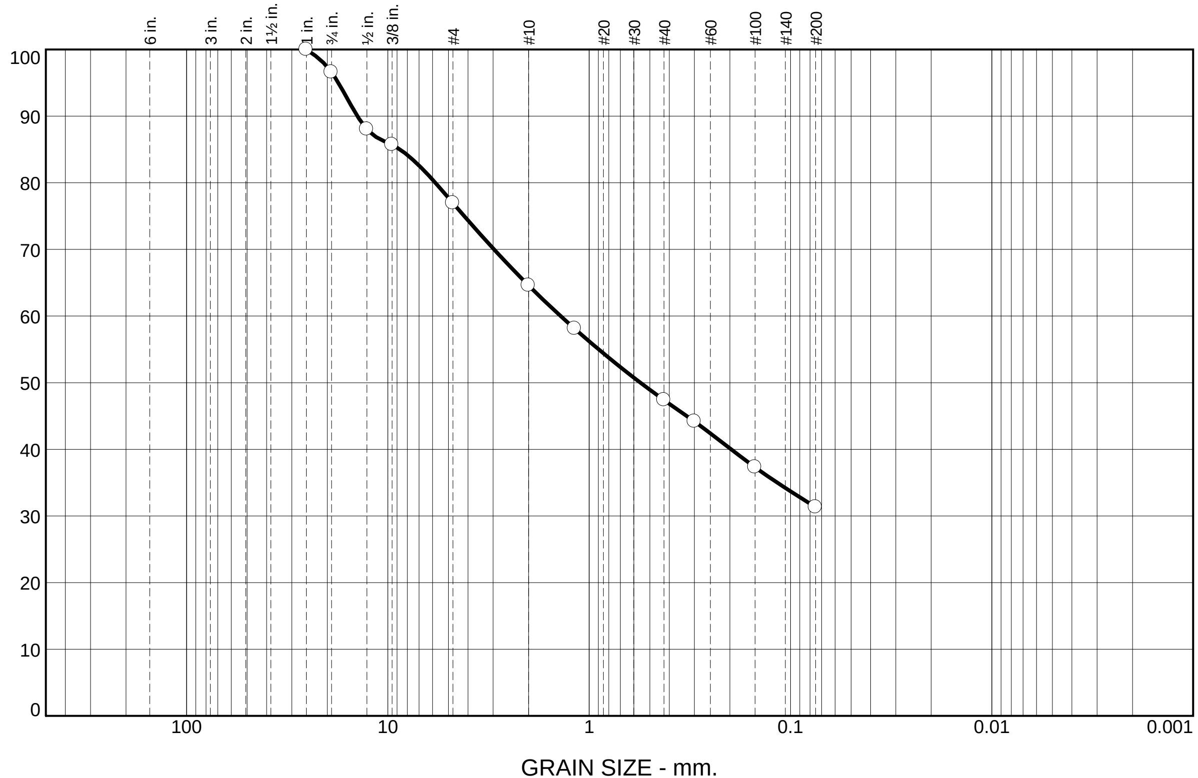
Location: BH19-BR-10
Sample Number: 19-160-03 **Depth:** 45-46.5' **Date:** 5/31/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-160-03

Tested By: OS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	3.4	19.6	12.4	17.2	16.1	31.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	96.6		
.5	88.0		
.375	85.7		
#4	77.0		
#10	64.6		
#16	58.1		
#40	47.4		
#50	44.2		
#100	37.3		
#200	31.3		

* (no specification provided)

Material Description

Light Brown clayey sand with gravel

Atterberg Limits

PL= 20 LL= 40 PI= 20

Coefficients

D_{90}= 14.1616 D_{85}= 8.7120 D_{60}= 1.3862
D_{50}= 0.5564 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-6(2)

Remarks

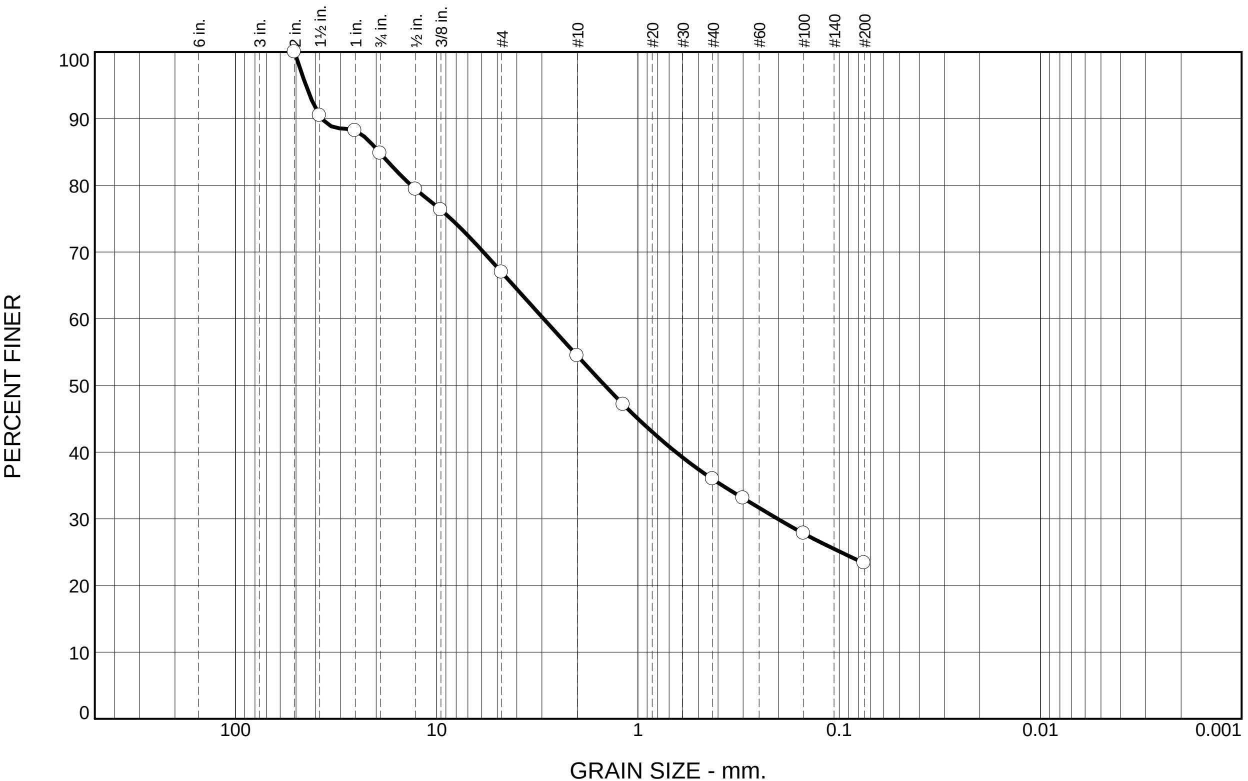
Location: BH19-BR-11
Sample Number: 19-131-08 **Depth:** 7.5-9' **Date:** 5/13/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-131-08

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	15.2	17.8	12.6	18.5	12.6	23.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2	100.0		
1.5	90.5		
1	88.2		
.75	84.8		
.5	79.4		
.375	76.3		
#4	67.0		
#10	54.4		
#16	47.1		
#40	35.9		
#50	33.1		
#100	27.8		
#200	23.3		

* (no specification provided)

Material Description

Brown clayey sand with gravel

Atterberg Limits

PL= 16 LL= 34 PI= 18

Coefficients

D_{90}= 37.1607 D_{85}= 19.3120 D_{60}= 2.9432
D_{50}= 1.4603 D_{30}= 0.2024 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-6(1)

Remarks

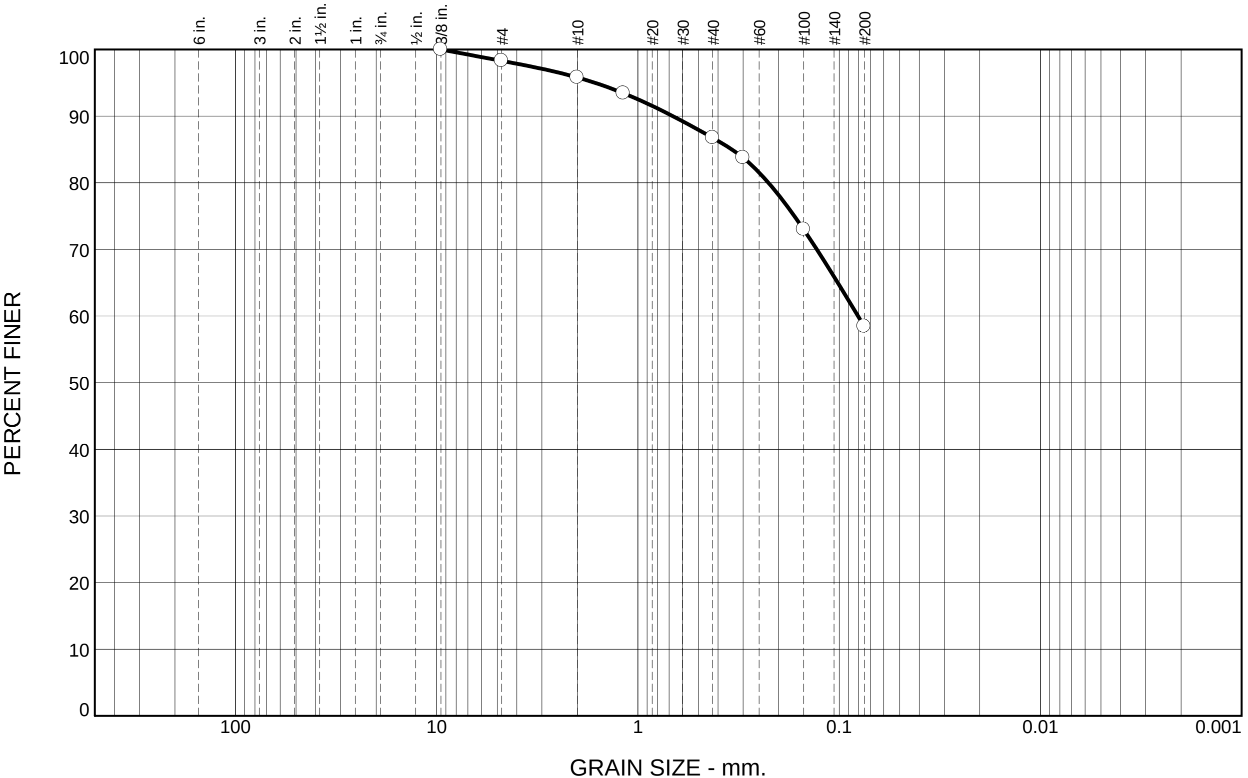
Location: BH19-BR-11
Sample Number: 19-131-09 **Depth:** 20-21' **Date:** 5/13/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-131-09

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.7	2.5	9.1	28.3	58.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	98.3		
#10	95.8		
#16	93.4		
#40	86.7		
#50	83.8		
#100	73.0		
#200	58.4		

* (no specification provided)

Material Description

Light Brown sandy elastic silt

Atterberg Limits

PL= 32 LL= 57 PI= 25

Coefficients

D_{90}= 0.6704 D_{85}= 0.3410 D_{60}= 0.0806
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= MH AASHTO= A-7-5(13)

Remarks

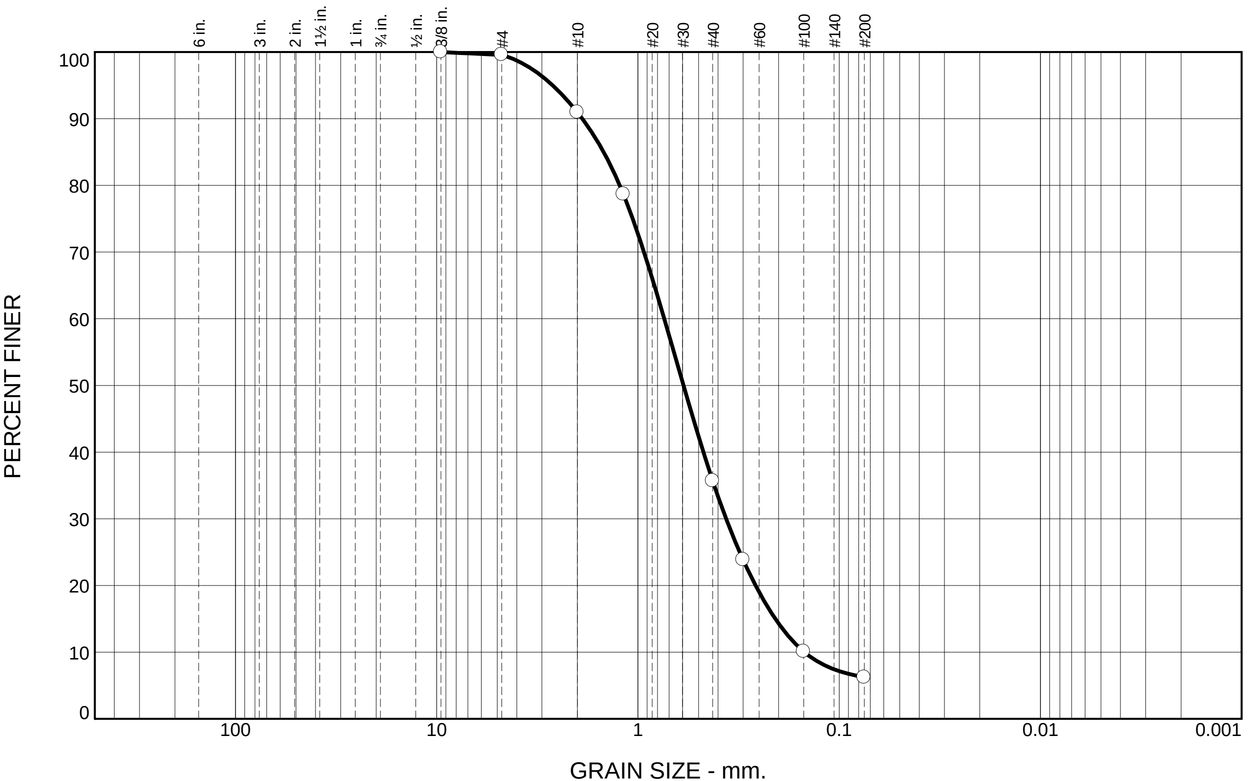
Location: BH19-BR-11
Sample Number: 19-131-10 **Depth:** 41-41.5' **Date:** 5/13/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-131-10

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.4	8.6	55.3	29.5	6.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	99.6		
#10	91.0		
#16	78.7		
#40	35.7		
#50	23.8		
#100	10.1		
#200	6.2		

* (no specification provided)

Material Description

Gray poorly graded sand with silt

Atterberg Limits

PL= NP	LL= NP	PI= NP

Coefficients

D_{90}= 1.8908	D_{85}= 1.4809	D_{60}= 0.7398
D_{50}= 0.5935	D_{30}= 0.3642	D_{15}= 0.2078
D_{10}= 0.1490	C_u= 4.97	C_c= 1.20

Classification

USCS= SP-SM AASHTO= A-1-b

Remarks

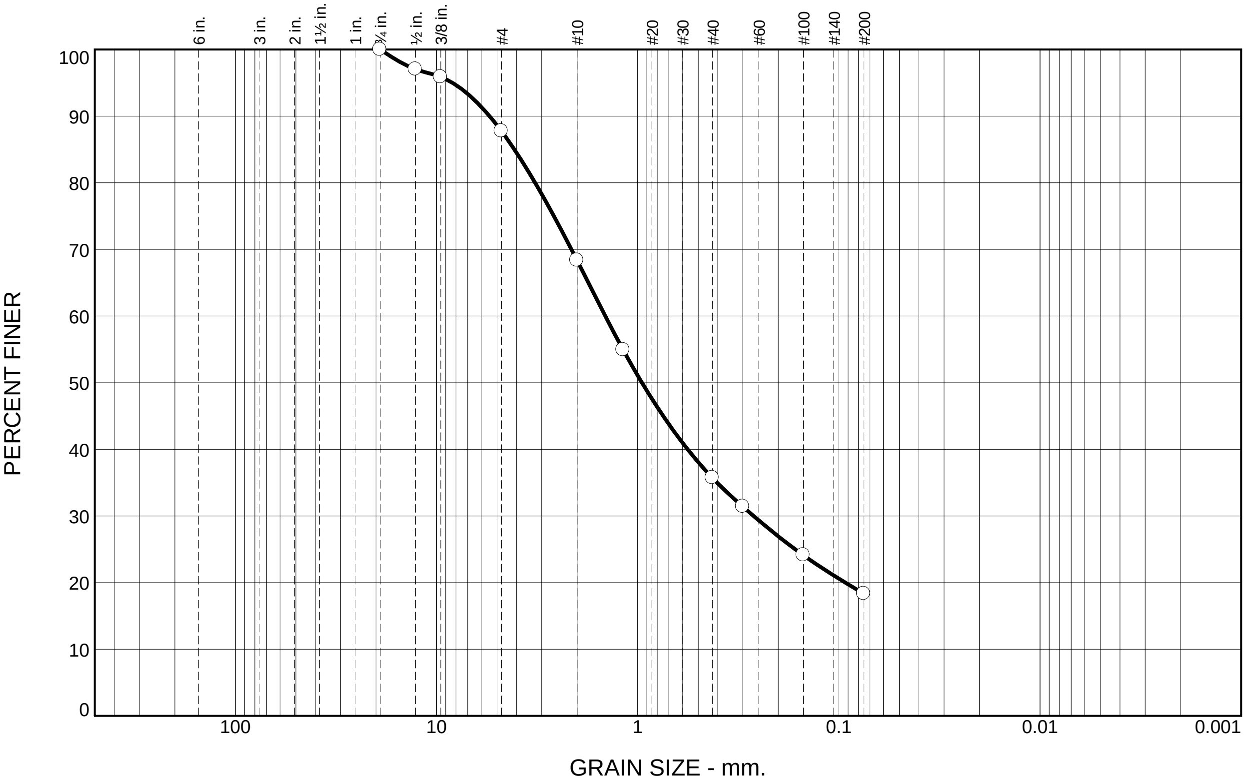
Location: BH19-BR-11
Sample Number: 19-131-11 **Depth:** 75-76.5' **Date:** 5/13/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-131-11

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	12.3	19.4	32.6	17.4	18.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	97.0		
.375	95.9		
#4	87.7		
#10	68.3		
#16	54.9		
#40	35.7		
#50	31.4		
#100	24.1		
#200	18.3		

* (no specification provided)

Material Description

Brown clayey sand

Atterberg Limits

PL= 16 LL= 27 PI= 11

Coefficients

D_{90}= 5.4479 D_{85}= 4.1023 D_{60}= 1.4486
D_{50}= 0.9525 D_{30}= 0.2654 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-6(0)

Remarks

Location: BH19-BR-20
Sample Number: 19-147-01 **Depth:** 21-21.5' **Date:** 5/23/2019

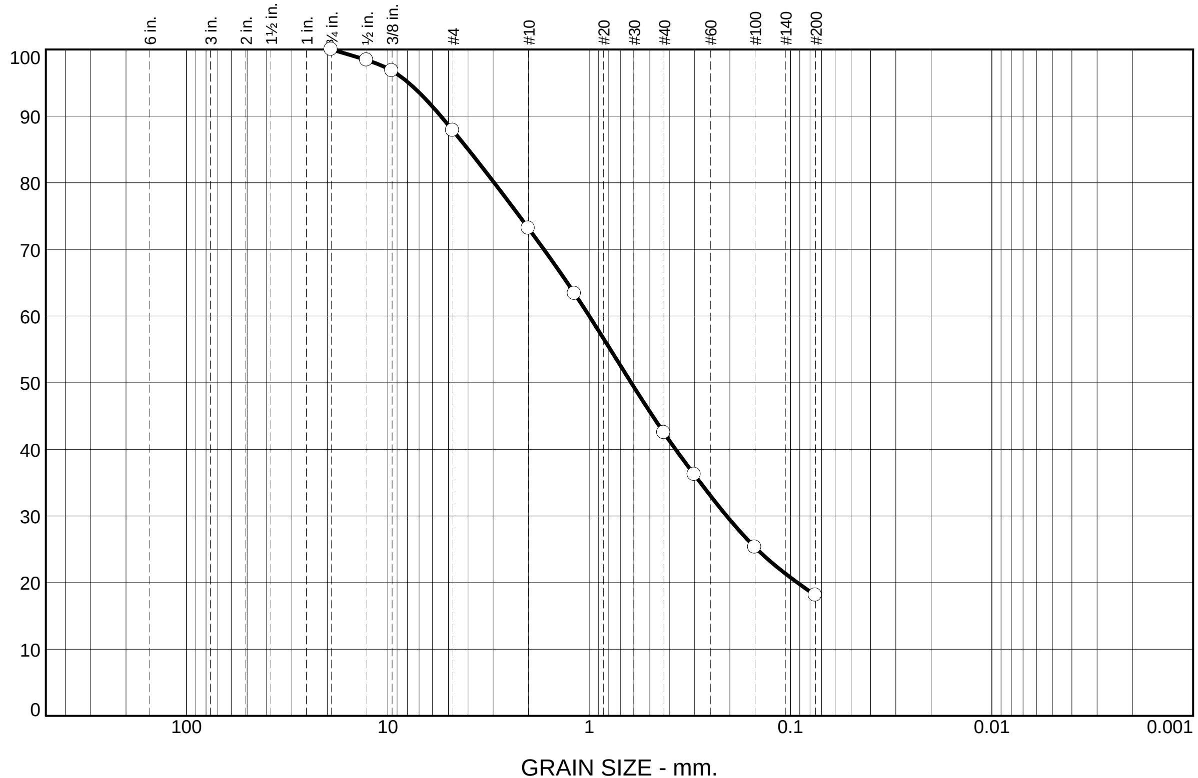
NewFields

Client: NDOT
Project: US395 NDOT North Valleys

Project No: 475.0398.000 **Figure** 19-147-01

Tested By: JH/KS/JS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	12.2	14.7	30.6	24.4	18.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	98.4		
.375	96.8		
#4	87.8		
#10	73.1		
#16	63.4		
#40	42.5		
#50	36.2		
#100	25.3		
#200	18.1		

* (no specification provided)

Material Description

Light Brown clayey sand

Atterberg Limits

PL= 19 LL= 34 PI= 15

Coefficients

D_{90}= 5.4555 D_{85}= 3.9898 D_{60}= 0.9988
D_{50}= 0.6185 D_{30}= 0.2076 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-6(0)

Remarks

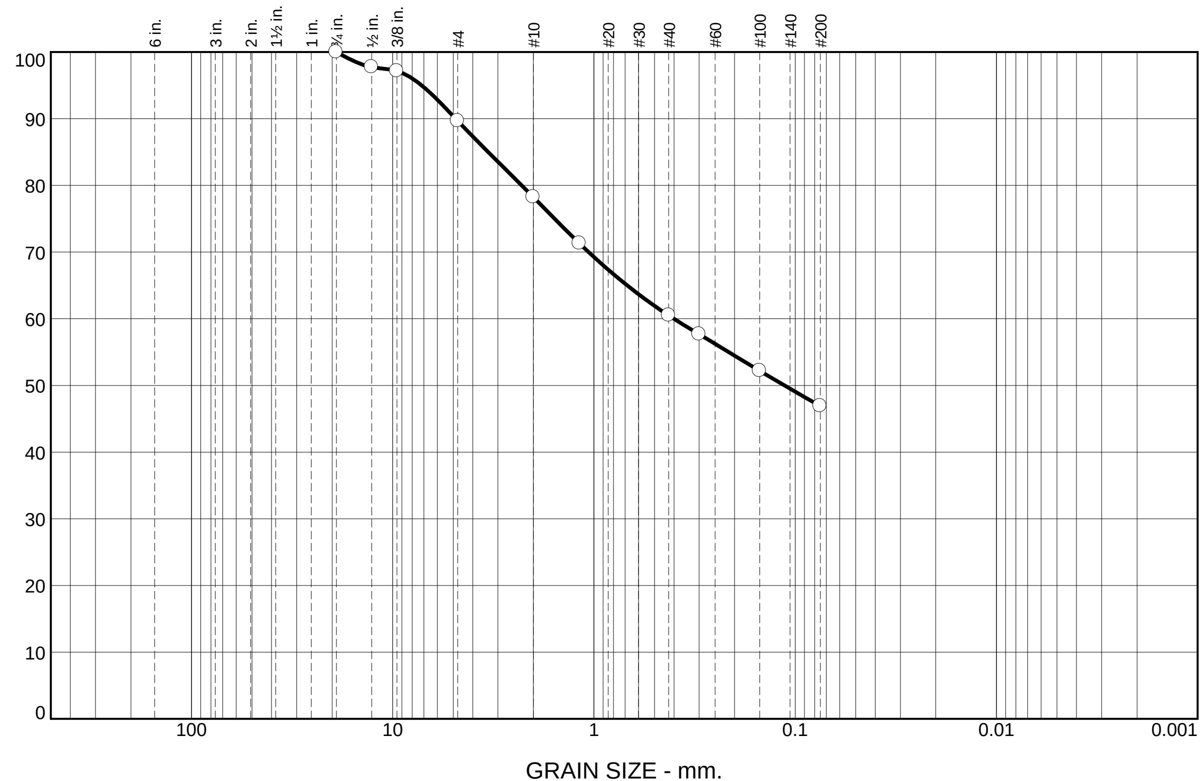
Location: BH19-BR-20
Sample Number: 19-147-02 **Depth:** 40.5-41' **Date:** 5/23/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-147-02

Tested By: JH/KS/JS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	10.3	11.5	17.7	13.6	46.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	97.7		
.375	97.2		
#4	89.7		
#10	78.2		
#16	71.3		
#40	60.5		
#50	57.7		
#100	52.2		
#200	46.9		

* (no specification provided)

Material Description

Light Brown clayey sand

Atterberg Limits

PL= 16 LL= 34 PI= 18

Coefficients

D_{90}= 4.8656 D_{85}= 3.3512 D_{60}= 0.4004
D_{50}= 0.1130 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-6(5)

Remarks

Location: BH19-BR-20
Sample Number: 19-147-03 **Depth:** 65-66.5' **Date:** 5/23/2019

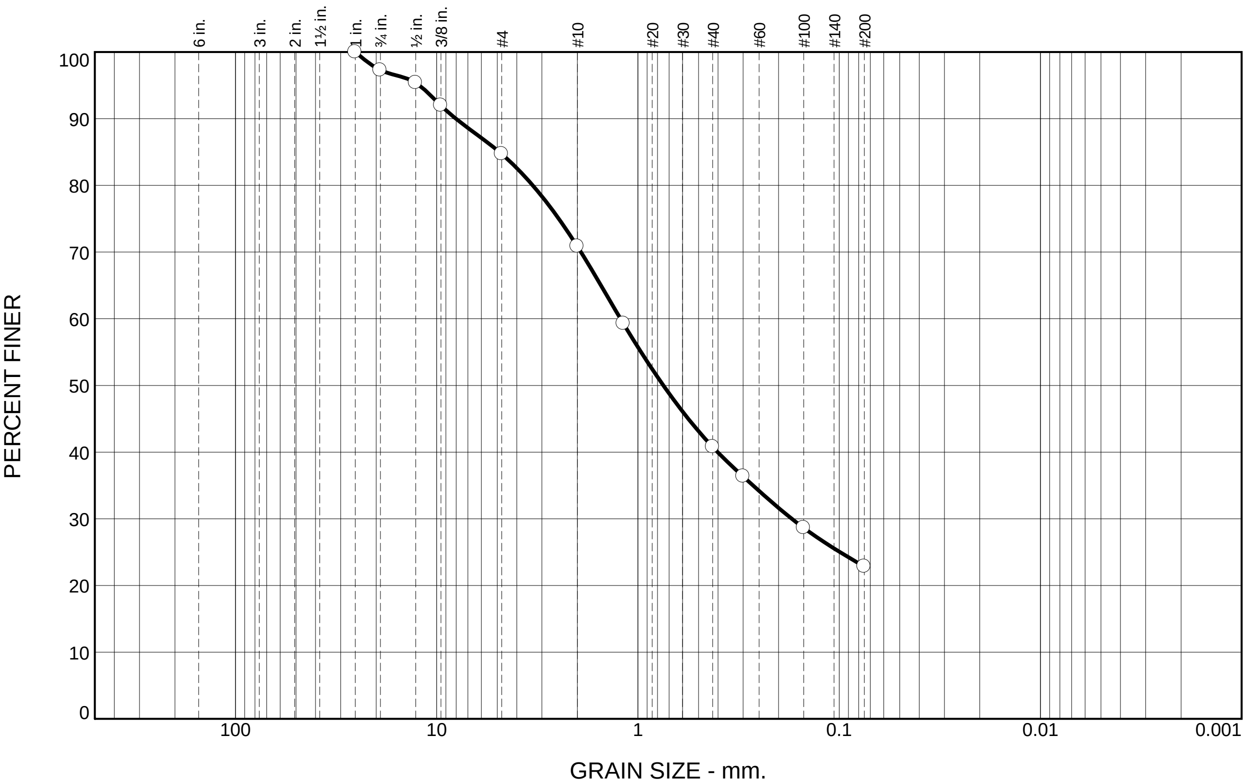
NewFields

Client: NDOT
Project: US395 NDOT North Valleys

Project No: 475.0398.000 **Figure** 19-147-03

Tested By: JH/KS/JS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	2.7	12.6	13.9	30.0	18.0	22.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	97.3		
.5	95.4		
.375	92.0		
#4	84.7		
#10	70.8		
#16	59.3		
#40	40.8		
#50	36.3		
#100	28.6		
#200	22.8		

* (no specification provided)

Material Description

Brown clayey sand with gravel

Atterberg Limits

PL= 15 LL= 24 PI= 9

Coefficients

D_{90}= 8.0190 D_{85}= 4.8777 D_{60}= 1.2205
D_{50}= 0.7476 D_{30}= 0.1719 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-4(0)

Remarks

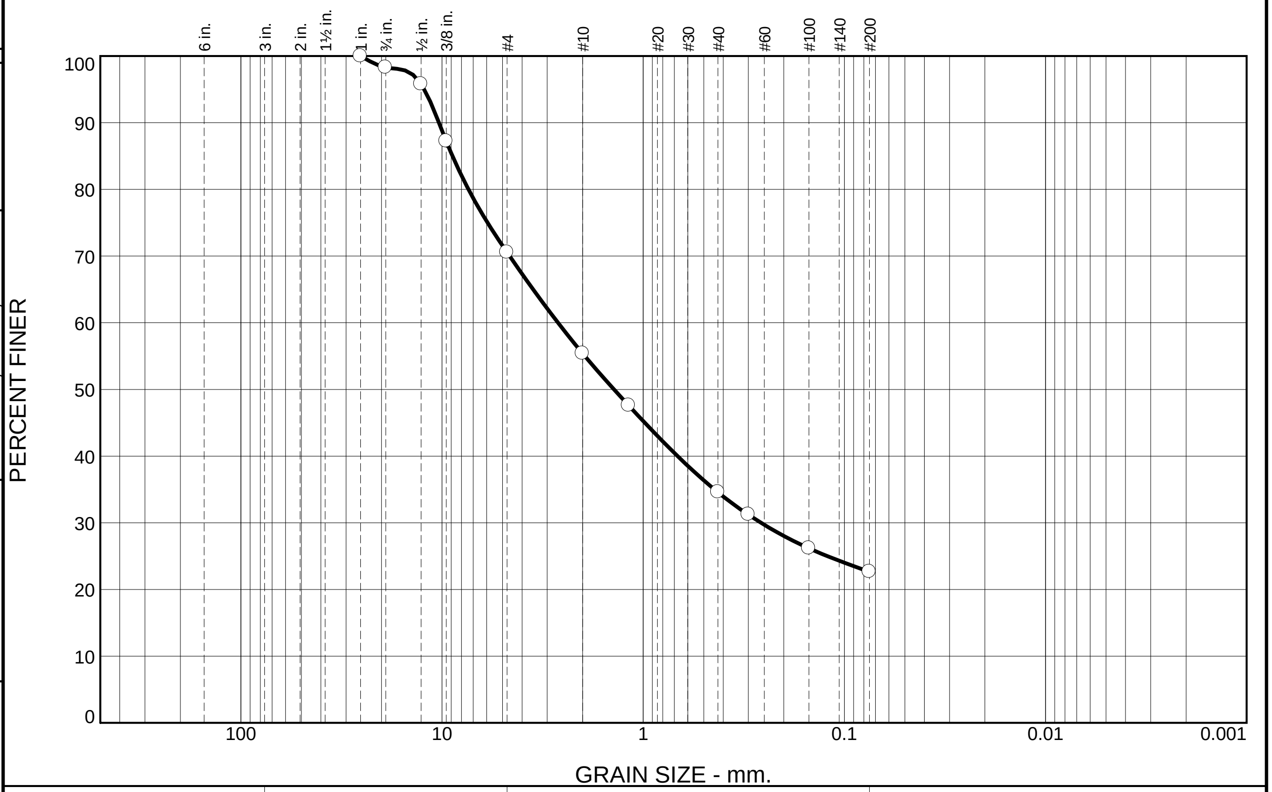
Location: BH19-BR-21
Sample Number: 19-160-04 **Depth:** 15-16.5' **Date:** 5/31/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-160-04

Tested By: OS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	1.7	27.7	15.2	20.8	11.9	22.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	98.3		
.5	95.8		
.375	87.2		
#4	70.6		
#10	55.4		
#16	47.6		
#40	34.6		
#50	31.2		
#100	26.2		
#200	22.7		

* (no specification provided)

Material Description

Light Brown silty sand with gravel

Atterberg Limits

PL= 17 LL= 20 PI= 3

Coefficients

D_{90}= 10.3611 D_{85}= 8.8709 D_{60}= 2.6506
D_{50}= 1.3968 D_{30}= 0.2597 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-1-b

Remarks

Location: BH19-BR-21
Sample Number: 19-160-05 **Depth:** 35-36' **Date:** 5/31/2019

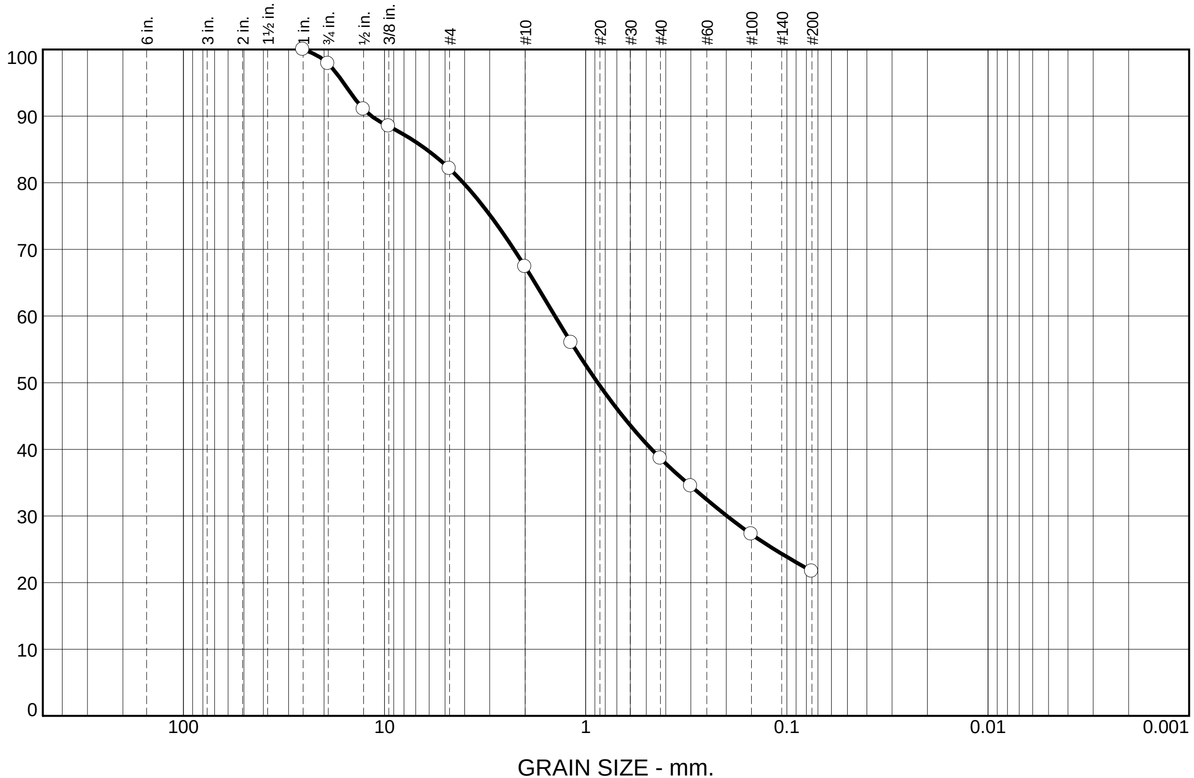
NewFields

Client: NDOT
Project: US395 NDOT North Valleys

Project No: 475.0398.000 **Figure** 19-160-05

Tested By: OS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	2.1	15.8	14.7	28.8	16.9	21.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	97.9		
.5	91.0		
.375	88.5		
#4	82.1		
#10	67.4		
#16	56.0		
#40	38.6		
#50	34.5		
#100	27.3		
#200	21.7		

* (no specification provided)

Material Description

Brown silty sand with gravel

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 11.6065 D_{85}= 6.1814 D_{60}= 1.4215
D_{50}= 0.8712 D_{30}= 0.1987 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-1-b

Remarks

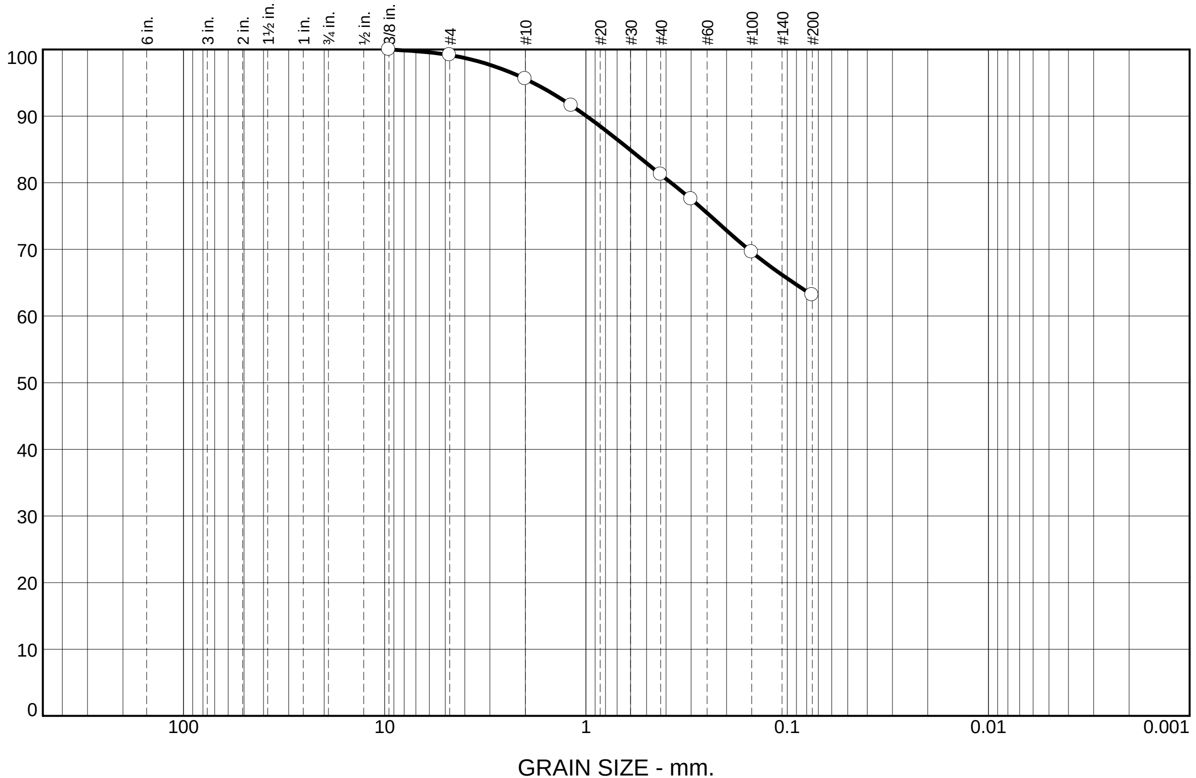
Location: BR-22
Sample Number: 19-279-13 **Depth:** 11-11.5 **Date:** 8/15/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-279-13

Tested By: AR **Checked By:** CC

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.8	3.6	14.4	18.1	63.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	99.2		
#10	95.6		
#16	91.6		
#40	81.2		
#50	77.6		
#100	69.6		
#200	63.1		

* (no specification provided)

Material Description

Dark Brown sandy lean clay

Atterberg Limits

PL= 16 LL= 45 PI= 29

Coefficients

D_{90}= 0.9925 D_{85}= 0.6062 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-7-6(15)

Remarks

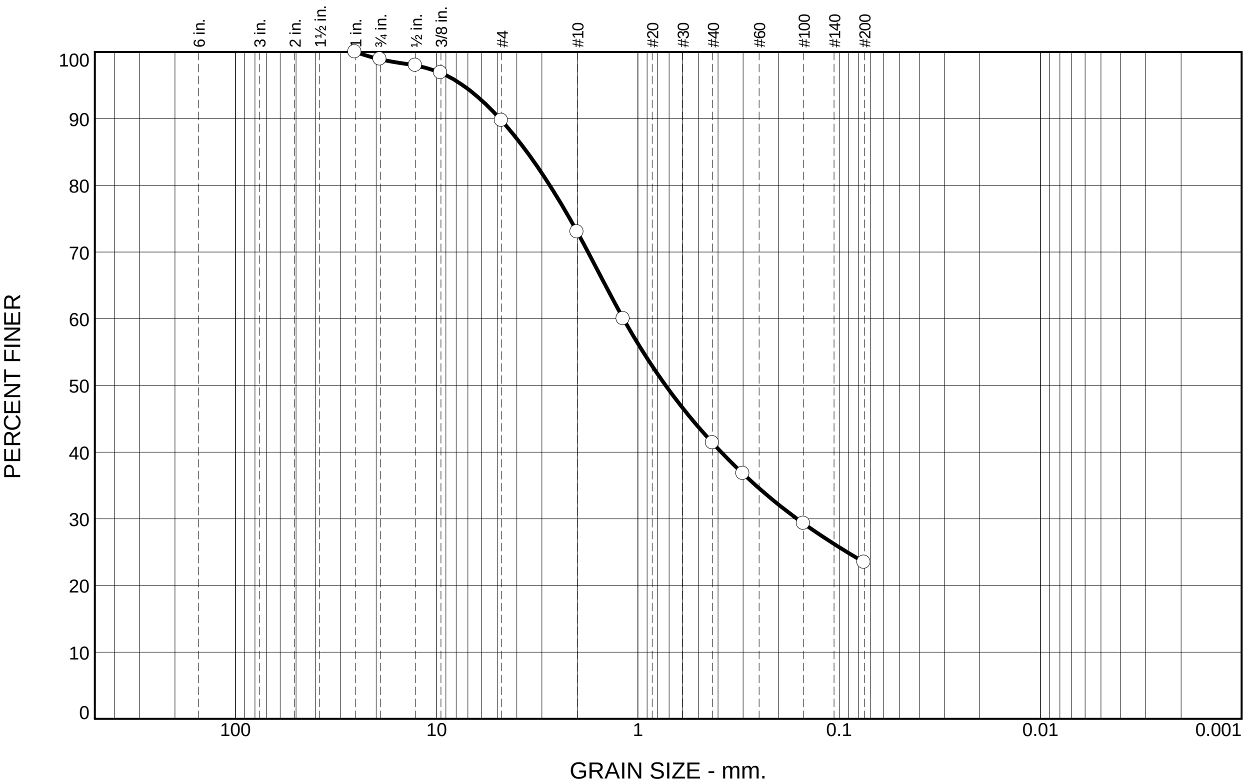
Location: BR-22
Sample Number: 19-279-15 **Depth:** 41-41.5 **Date:** 8/15/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-279-15

Tested By: AR **Checked By:** CC

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	1.1	9.2	16.7	31.6	18.0	23.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	98.9		
.5	98.0		
.375	96.9		
#4	89.7		
#10	73.0		
#16	60.0		
#40	41.4		
#50	36.7		
#100	29.3		
#200	23.4		

* (no specification provided)

Material Description

Brown clayey sand

Atterberg Limits

PL= 18 LL= 27 PI= 9

Coefficients

D_{90}= 4.8530 D_{85}= 3.5569 D_{60}= 1.1814
D_{50}= 0.7284 D_{30}= 0.1620 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-4(0)

Remarks

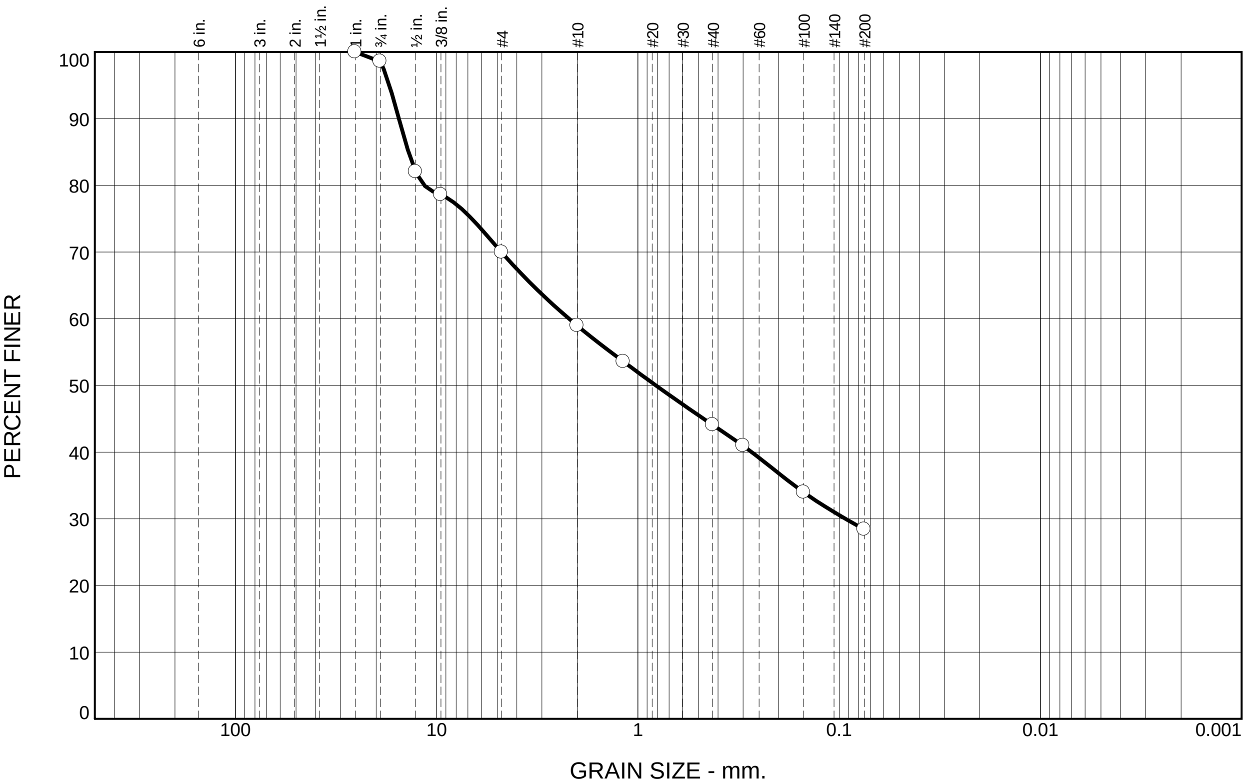
Location: BH19-BR-23
Sample Number: 19-213-14 **Depth:** 10-11' **Date:** 7/2/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-213-14

Tested By: JH/KG **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	1.4	28.7	10.9	14.9	15.7	28.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	98.6		
.5	82.0		
.375	78.6		
#4	69.9		
#10	59.0		
#16	53.6		
#40	44.1		
#50	40.9		
#100	34.0		
#200	28.4		

* (no specification provided)

Material Description

Light Brown clayey sand with gravel

Atterberg Limits

PL= 20　LL= 32　PI= 12

Coefficients

D_{90}= 15.3967　D_{85}= 13.7991　D_{60}= 2.1992
D_{50}= 0.8136　D_{30}= 0.0930　D_{15}=
D_{10}=　C_u=　C_c=

Classification

USCS= SC　AASHTO= A-2-6(0)

Remarks

Location: BH19-BR-23
Sample Number: 19-213-16　**Depth:** 35-36.5'　**Date:** 7/5/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000　**Figure** 19-213-16

Tested By: JH　**Checked By:** JH

NewFields

NATURAL DENSITY (ASTM 2937)

LABORATORY WORKSHEET

NF Form #16

Client:	NDOT	**Location:**	See Below
Project Title:	US395 NDOT North Valleys	**Elevation:**	See Below
Project Number:	475.0398.000	**Test Date:**	5/30/2019
Project Engineer:	Mark Doehring	**Tested By:**	OS
Field Sample ID:	See Below	**Checked By:**	JH
Laboratory Sample ID:	19-160		

Drying Conditions: 60 deg C / [✓ **110 deg C**]   Method: [✓ **Oven (O)**] / Microwave (M)

Trail No.		**1**	**2**	**3**	**4**	**5**
Sample No.		19-160-01	19-160-09			
Location		BR-10	BR-04			
Depth		11-11.5'	11-11.5'			
Soil Description						
(USCS)						
Soil + Liner Wt., g.	**A**	967.5	1164.4			
Liner Wt., g.	**B**	240.8	252.7			
Soil Wt., g.	**C= A-B**	726.7	911.7			
Liner Length, in.	**D_1**	6.010	6.015			
Sample Length, in.	**D_2**	6.010	6.001			
Liner Diameter, in.	**E**	2.435	2.424			
Liner Area, in^2	**$F= (E^2/4)*pi$**	4.66	4.61			
Sample Volume, in^3	**$G= D_2*F$**	27.99	27.69			
Sample Wet Density, pcf	**H= (C/G)*3.81**	98.9	125.4			
Sample Dry Density, pcf	**H/(1+(N/100))**	83.3	111.2			
Tare No.						
Tare + Wet Soil	**I**	951.7	1101.4			
Tare + Dry Soil	**J**	837.1	998			
Tare	**K**	225.6	190.14			
Wt. of Water	**L= I-J**	114.6	103.4			
Dry Soil, Ws	**M=-J-K**	611.5	807.9			
Moisture Content, (%)	**N= (L/M) x100**	18.7%	12.8%			

Remarks:

NewFields

NATURAL DENSITY (ASTM 2937)

LABORATORY WORKSHEET

NF Form #16

Client:	NDOT	**Location:**	See Below
Project Title:	S395 NDOT NORTH VALLEYS	**Elevation:**	See Below
Project Number:	475.0398.000	**Test Date:**	8/15/2019
Project Engineer:	MARK DOEHRING	**Tested By:**	OS
Field Sample ID:	BH19-BR	**Checked By:**	JH
Laboratory Sample ID:	19-279		

Drying Conditions: 60 deg C / [✓ 110 deg C] Method: [✓ Oven (O)] / Microwave (M)

Trail No.		**1**	**2**	**3**	**4**	**5**
Sample No.		19-279-01	19-279-02	19-279-08	19-279-10	19-279-13
Location		BR-05	BR-05	BR-13	BR-16	BR-22
Depth		6-6.5	11-11.5	41-41.5	11-11.5	11-11.5
Soil Description						
(USCS)						
Soil + Liner Wt., g.	**A**	1241.9	1160.5	1207.8	1155.6	1183.0
Liner Wt., g.	**B**	245.9	259.8	274.4	258.3	259.3
Soil Wt., g.	**C= A-B**	996.0	900.7	933.4	897.3	923.7
Liner Length, in.	**D_1**	5.995	6.01	6.004	6.014	6.004
Sample Length, in.	**D_2**	5.995	6.01	6.004	6.014	6.004
Liner Diameter, in.	**E**	2.419	2.419	2.403	2.425	2.423
Liner Area, in^2	**$F= (E^2/4)*pi$**	4.60	4.60	4.54	4.62	4.61
Sample Volume, in^3	**$G= D_2*F$**	27.55	27.62	27.23	27.78	27.68
Sample Wet Density, pcf	**H= (C/G)*3.81**	137.7	124.2	130.6	123.1	127.1
Sample Dry Density, pcf	**H/(1+(N/100))**	124.4	107.5	110.7	103.7	117.0
Tare No.						
Tare + Wet Soil	**I**	1038.7	1022.7	1049	1016.4	964.3
Tare + Dry Soil	**J**	942.2	902	908	875.3	891.4
Tare	**K**	45.1	124.5	124.5	121.3	44.8
Wt. of Water	**L= I-J**	96.5	120.7	141.0	141.1	72.9
Dry Soil, Ws	**M=-J-K**	897.1	777.5	783.5	754.0	846.6
Moisture Content, (%)	**N= (L/M) x100**	10.8%	15.5%	18.0%	18.7%	8.6%

Remarks:

NewFields

NATURAL DENSITY (ASTM 2937)

LABORATORY WORKSHEET

NF Form #16

Client:	NDOT	**Location:**	See Below
Project Title:	US395 NDOT North Valleys	**Elevation:**	See Below
Project Number:	475.0398.000	**Test Date:**	7/26/2019
Project Engineer:	Mark Doehring	**Tested By:**	AR/AS
Field Sample ID:	BH19-BR	**Checked By:**	JH
Laboratory Sample ID:	See Below		

Drying Conditions: 60 deg C / [✓ 110 deg C] Method: [✓ Oven (O)] / Microwave (M)

Trail No.		**1**	**2**	**3**	**4**	**5**
Sample No.		19-248-03	19-248-05	19-248-10	19-248-11	19-248-12
Location		BR-06	BR-07	BR-15	BR-15	BR-15
Depth		21-21.5'	11-11.5'	6-6.5'	11-11.5'	36-36.5'
Soil Description						
(USCS)						
Soil + Liner Wt., g.	**A**	1076.5	1048.1	1077.6	1065.0	1173.5
Liner Wt., g.	**B**	238.7	235.3	238.3	235.0	242.5
Soil Wt., g.	**C= A-B**	837.8	812.8	839.3	830.0	931.0
Liner Length, in.	**D_1**	5.982	5.941	5.94	5.96	5.938
Sample Length, in.	**D_2**	5.982	5.564	5.223	5.112	5.464
Liner Diameter, in.	**E**	2.408	2.419	2.417	2.412	2.417
Liner Area, in^2	**F= (E^2/4)*pi**	4.55	4.60	4.59	4.57	4.59
Sample Volume, in^3	**G= D_2*F**	27.24	25.57	23.96	23.36	25.07
Sample Wet Density, pcf	**H= (C/G)*3.81**	117.2	121.1	133.4	135.4	141.5
Sample Dry Density, pcf	**H/(1+(N/100))**	90.2	97.7	123.1	114.5	112.8
Tare No.						
Tare + Wet Soil	**I**	882.2	934.4	839.4	1018.2	1157.8
Tare + Dry Soil	**J**	689.4	777.6	783.8	890.6	968.5
Tare	**K**	45.0	124	121.5	190	225.5
Wt. of Water	**L= I-J**	192.8	156.8	55.6	127.6	189.3
Dry Soil, Ws	**M=-J-K**	644.4	653.6	662.3	700.6	743.0
Moisture Content, (%)	**N= (L/M) x100**	29.9%	24.0%	8.4%	18.2%	25.5%

Remarks:

NewFields

NATURAL DENSITY (ASTM 2937)

LABORATORY WORKSHEET

NF Form #16

Client:	NDOT	**Location:**	BH19-BR
Project Title:	US395 NDOT North Valleys	**Elevation:**	See Below
Project Number:	475.0398.000	**Test Date:**	5/10/2019
Project Engineer:	Mark Doehring	**Tested By:**	JH
Field Sample ID:	BH19-BR	**Checked By:**	JH
Laboratory Sample ID:	19-131		

Drying Conditions: 60 deg C / **110 deg C** Method: **Oven (O)** / Microwave (M)

Trail No.		**1**	**2**	**3**	**4**	**5**
Sample No.		19-131-05	19-131-10	19-131-12	19-131-17	19-131-20
Location		BR-08	BR-11	BR-12	BR-27	BR-27
Depth		11-11.5'	41-41.5'	11-11.5'	16-16.5	66-66.5'
Soil Description						
(USCS)						
Soil + Liner Wt., g.	**A**	1162.5	1024.1	996.5	996.5	1310.9
Liner Wt., g.	**B**	233.5	240.6	234.3	234.3	243.1
Soil Wt., g.	**C= A-B**	929.0	783.5	762.2	762.2	1067.8
Liner Length, in.	**D_1**	5.963	5.955	5.949	5.965	5.958
Sample Length, in.	**D_2**	5.963	5.955	5.509	5.965	5.958
Liner Diameter, in.	**E**	2.435	2.405	2.388	2.400	2.406
Liner Area, in^2	**F= $(D_2^2/4)$*pi**	4.66	4.54	4.48	4.52	4.55
Sample Volume, in^3	**G= D_2*F**	27.77	27.05	24.67	26.99	27.09
Sample Wet Density, pcf	**H= (C/G)*3.81**	127.5	110.3	117.7	107.6	150.2
Sample Dry Density, pcf	**H/(1+(N/100))**	102.2	83.2	100.4	96.6	132.1
Tare No.						
Tare + Wet Soil	**I**	947.0	802.6	784.1	975.4	1089.6
Tare + Dry Soil	**J**	763.9	610.5	671.9	877.9	960.8
Tare	**K**	22.2	22	22.1	22.5	22.2
Wt. of Water	**L= I-J**	183.1	192.1	112.2	97.5	128.8
Dry Soil, Ws	**M=-J-K**	741.7	588.5	649.8	855.4	938.6
Moisture Content, (%)	**N= (L/M) x100**	24.7%	32.6%	17.3%	11.4%	13.7%

Remarks: ____________________

NewFields

NATURAL DENSITY (ASTM 2937)

LABORATORY WORKSHEET

NF Form #16

Client:	NDOT	**Location:**	See Below
Project Title:	US395 NDOT North Valleys	**Elevation:**	See Below
Project Number:	475.0398.000	**Test Date:**	7/1/2019
Project Engineer:	Mark Doehring	**Tested By:**	AS/KG
Field Sample ID:	See Below	**Checked By:**	JH
Laboratory Sample ID:	19-213		

Drying Conditions: 60 deg C / [✓ **110 deg C**] Method: [✓ **Oven (O)**] / Microwave (M)

Trail No.		1	2	3	4	5
Sample No.		19-213-04	19-213-05	19-213-06	19-213-07	19-213-09
Location		BR-03	BR-03	BR-03	BR-09	BR-09
Depth		11-11.5'	21-21.5'	31-31.5'	6-6.5'	20.5-21'
Soil Description						
(USCS)						
Soil + Liner Wt., g.	**A**	1229.4	1198.3	1248.9	1231.8	1123.6
Liner Wt., g.	**B**	250.2	247.2	224.4	258.5	256.4
Soil Wt., g.	**C= A-B**	979.2	951.1	1024.5	973.3	867.2
Liner Length, in.	**D_1**	5.950	5.966	5.93	5.951	5.969
Sample Length, in.	**D_2**	5.950	5.966	5.93	5.727	5.69
Liner Diameter, in.	**E**	2.399	2.413	2.410	2.414	2.417
Liner Area, in^2	**$F= (E^2/4)*pi$**	4.52	4.57	4.56	4.58	4.59
Sample Volume, in^3	**$G= D_2*F$**	26.89	27.28	27.05	26.21	26.11
Sample Wet Density, pcf	**H= (C/G)*3.81**	138.7	132.8	144.3	141.5	126.6
Sample Dry Density, pcf	**H/(1+(N/100))**	123.2	118.5	127.1	126.8	114.3
Tare No.						
Tare + Wet Soil	**I**	1000.3	971.7	1042	994	887.5
Tare + Dry Soil	**J**	891.0	869.1	920.5	893	803.8
Tare	**K**	22.0	22	22	22	22
Wt. of Water	**L= I-J**	109.3	102.6	121.5	101.0	83.7
Dry Soil, Ws	**M=-J-K**	869.0	847.1	898.5	871.0	781.8
Moisture Content, (%)	**N= (L/M) x100**	12.6%	12.1%	13.5%	11.6%	10.7%

Remarks:

NATURAL DENSITY (ASTM 2937)
LABORATORY WORKSHEET

Client:	NDOT	**Location:**	See Below
Project Title:	US395 NDOT North Valleys	**Elevation:**	See Below
Project Number:	475.0398.000	**Test Date:**	5/22/2019
Project Engineer:	Mark Doehring	**Tested By:**	JH
Field Sample ID:	BH19-BR-20	**Checked By:**	JH
Laboratory Sample ID:	19-147		

Drying Conditions: 60 deg C / **110 deg C** Method: **Oven (O)** / Microwave (M)

Trail No.		**1**	**2**	**3**	**4**	**5**
Sample No.		19-147-01				
Location		BR-20				
Depth		21-21.5'				
Soil Description						
(USCS)						
Soil + Liner Wt., g.	**A**	1190.2				
Liner Wt., g.	**B**	236.2				
Soil Wt., g.	**C= A-B**	954.0				
Liner Length, in.	**D_1**	5.959				
Sample Length, in.	**D_2**	5.959				
Liner Diameter, in.	**E**	2.401				
Liner Area, in^2	**$F= (E^2/4)*pi$**	4.53				
Sample Volume, in^3	**$G= D_2*F$**	26.98				
Sample Wet Density, pcf	**H= (C/G)*3.81**	134.7				
Sample Dry Density, pcf	**H/(1+(N/100))**	123.6				
Tare No.						
Tare + Wet Soil	**I**	973.7				
Tare + Dry Soil	**J**	895.3				
Tare	**K**	21.8				
Wt. of Water	**L= I-J**	78.4				
Dry Soil, Ws	**M=-J-K**	873.5				
Moisture Content, (%)	**N= (L/M) x100**	9.0%				

Remarks:

NewFields **NATURAL DENSITY (ASTM 2937)**

LABORATORY WORKSHEET

NF Form #16

Client:	NDOT	**Location:**	See Below
Project Title:	S395 NDOT NORTH VALLEYS	**Elevation:**	See Below
Project Number:	475.0398.000	**Test Date:**	8/15/2019
Project Engineer:	MARK DOEHRING	**Tested By:**	OS
Field Sample ID:	BH19-BR	**Checked By:**	JH
Laboratory Sample ID:	19-279		

Drying Conditions: 60 deg C / 110 deg C Method: Oven (O) / Microwave (M)

Trail No.		**6**	**7**	**8**	**9**	**10**
Sample No.		19-279-14	19-279-15	19-279-18	19-279-20	19-279-22
Location		BR-22	BR-22	BR-25B	BR-25C	BR-25C
Depth		31-31.5	41-41.5	21-21.5	5.5-6	30-30.5
Soil Description						
(USCS)						
Soil + Liner Wt., g.	**A**	1194.1	1232.6	1146.1	1115.3	1044.4
Liner Wt., g.	**B**	251.1	258.4	259.8	258.6	254.5
Soil Wt., g.	**C= A-B**	943.0	974.2	886.3	856.7	789.9
Liner Length, in.	**D_1**	6.010	6.011	6.007	6.018	6.002
Sample Length, in.	**D_2**	6.010	6.011	6.007	6.018	6.002
Liner Diameter, in.	**E**	2.426	2.422	2.421	2.422	2.437
Liner Area, in^2	**$F= (D_2^2/4)*pi$**	4.62	4.61	4.60	4.61	4.66
Sample Volume, in^3	**$G= D_2*F$**	27.78	27.69	27.65	27.73	28.00
Sample Wet Density, pcf	**H= (C/G)*3.81**	129.3	134.0	122.1	117.7	107.5
Sample Dry Density, pcf	**H/(1+(N/100))**	114.3	110.8	111.3	106.6	96.0
Tare No.						
Tare + Wet Soil	**I**	1055.0	1092.7	1006.1	1079.6	1056
Tare + Dry Soil	**J**	946.9	924.5	928.1	999	970.4
Tare	**K**	122.3	122.3	121.4	223.7	254.5
Wt. of Water	**L= I-J**	108.1	168.2	78.0	80.6	85.6
Dry Soil, Ws	**M=-J-K**	824.6	802.2	806.7	775.3	715.9
Moisture Content, (%)	**N= (L/M) x100**	13.1%	21.0%	9.7%	10.4%	12.0%

Remarks:

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

NF Form #15

Client:	NDOT	**Location:**	See Below
Project Title:	US395 NDOT North Valleys	**Elevation:**	See Below
Project Number:	475.0398.000	**Test Date:**	5/30/2019
Project Engineer:	Mark Doehring	**Tested By:**	OS
Field Sample ID:	See Below	**Checked By:**	JH

Drying Conditions: 60 deg C / **110 deg C** Method: **Oven (O)** / Microwave (M) / Hot Plate (H)

Sample No.		19-160-03	19-160-04	19-160-05	19-160-06	19-160-07
Location		BR-10	BR-21	BR-21	BR-24	BR-24
Depth		45-46.5'	15-16.5'	35-36'	15-16.5'	25-26.5'
Soil Description						
(USCS)						
Trial No.		**1**	**2**	**3**	**4**	**5**
Tare No.						
Tare + Wet Soil	**A**	855.5	924.1	751.3	1016.6	939.9
Tare + Dry Soil	**B**	704.7	870	714.6	950	887.04
Tare	**C**	44.9	120.2	190.5	190.95	122.64
Wt. of Water	**D= A-B**	150.8	54.1	36.7	66.6	52.86
Dry Soil, Ws	**E= B-C**	659.8	749.8	524.1	759.05	764.4
Moisture Content, (%)	**(D/E) x100**	**22.9%**	**7.2%**	**7.0%**	**8.8%**	**6.9%**

Sample No.		19-160-08	19-160-10			
Location		BR-24	BR-04			
Depth		50-50.5'	25-26.5'			
Soil Description						
(USCS)						
Trial No.		**6**	**7**	**8**	**9**	**10**
Tare No.						
Tare + Wet Soil	**A**	825.6	915.9			
Tare + Dry Soil	**B**	736.7	812.8			
Tare	**C**	122.9	192.25			
Wt. of Water	**D= A-B**	88.9	103.1			
Dry Soil, Ws	**E= B-C**	613.8	620.55			
Moisture Content, (%)	**(D/E) x100**	**14.5%**	**16.6%**			

Remarks:

NewFields

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

NF Form #15

Client:	NDOT	**Location:**	See Below
Project Title:	US395 NDOT NORTH VALLEYS	**Elevation:**	See Below
Project Number:	475.0398.000	**Test Date:**	8/13/2019
Project Engineer:	MARK DOEHRING	**Tested By:**	AJH
Field Sample ID:	BH19-BR	**Checked By:**	CC

Drying Conditions: 60 deg C / 110 deg C Method: Oven (O) / Microwave (M) / Hot Plate (H)

Sample No.		19-279-03	19-279-04	19-279-05	19-279-06	19-279-07
Location		BR-05	BR-05	BR-13	BR-13	BR-13
Depth		20-21.5	35-36.5	7.5-9	25-26.5	35-36.5
Soil Description						
(USCS)						
Trial No.		**1**	**2**	**3**	**4**	**5**
Tare No.						
Tare + Wet Soil	A	2629.2	1138.3	827.8	954.1	1086.7
Tare + Dry Soil	B	2326.2	1011.5	726.2	826.2	973.2
Tare	C	181.3	269	182.2	200.1	112.1
Wt. of Water	D= A-B	303	126.8	101.6	127.9	113.5
Dry Soil, Ws	E= B-C	2144.9	742.5	544	626.1	861.1
Moisture Content, (%)	(D/E) x100	**14.1%**	**17.1%**	**18.7%**	**20.4%**	**13.2%**

Sample No.		19-279-09	19-279-11	19-279-12	19-279-17	19-279-19
Location		BR-13	BR-16	BR-16	BR-25B	BR-25B
Depth		45-46.5	35	45	7.5-9	35-36.5
Soil Description						
(USCS)						
Trial No.		**6**	**7**	**8**	**9**	**10**
Tare No.						
Tare + Wet Soil	A	782.1	442	711.2	893.8	683.9
Tare + Dry Soil	B	711.2	405.8	649.2	831.8	609.3
Tare	C	180.7	100.9	181	180.7	240.6
Wt. of Water	D= A-B	70.9	36.2	62	62	74.6
Dry Soil, Ws	E= B-C	530.5	304.9	468.2	651.1	368.7
Moisture Content, (%)	(D/E) x100	**13.4%**	**11.9%**	**13.2%**	**9.5%**	**20.2%**

Remarks:

NewFields

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

NF Form #15

Client:	NDOT	**Location:**	See Below
Project Title:	US395 NDOT North Valleys	**Elevation:**	See Below
Project Number:	475.0398.000	**Test Date:**	7/26/2019
Project Engineer:	Mark Doehring	**Tested By:**	JH
Field Sample ID:	BH19-BR	**Checked By:**	JH

Drying Conditions: 60 deg C / **110 deg C** Method: **Oven (O)** / Microwave (M) / Hot Plate (H)

Sample No.		19-248-01	19-248-02	19-248-04	19-248-06	19-248-07
Location		BH19-BR-03	BH19-BR-06	BHH19-BR-06	BH19-BR-07	BH19-BR-07
Depth		55-55.5'	7.5-9'	40-41'	25-26.5'	50-51.5'
Soil Description						
(USCS)						
Trial No.		**1**	**2**	**3**	**4**	**5**
Tare No.						
Tare + Wet Soil	A	341.7	801.9	1302.8	729.6	829.3
Tare + Dry Soil	B	318.6	701.6	1105	624.6	711.7
Tare	C	125.4	45.1	126.6	120.2	124.7
Wt. of Water	D= A-B	23.1	100.3	197.8	105	117.6
Dry Soil, Ws	E= B-C	193.2	656.5	978.4	504.4	587
Moisture Content, (%)	**(D/E) x100**	**12.0%**	**15.3%**	**20.2%**	**20.8%**	**20.0%**

Sample No.		19-248-08	19-248-09	19-248-14	19-248-15	19-248-17
Location		BH19-BR-14	BH19-BR-14	BH19-BR-19	BH19-BR-19	BH19-BR-25A
Depth		7.5-9'	20-21.5'	35-36'	50-51'	35-36.5'
Soil Description						
(USCS)						
Trial No.		**6**	**7**	**8**	**9**	**10**
Tare No.						
Tare + Wet Soil	A	711.2	723.5	606	670.8	836.1
Tare + Dry Soil	B	622.6	642	537.6	595.2	790.7
Tare	C	121.7	44.8	121.2	124.6	189.4
Wt. of Water	D= A-B	88.6	81.5	68.4	75.6	45.4
Dry Soil, Ws	E= B-C	500.9	597.2	416.4	470.6	601.3
Moisture Content, (%)	**(D/E) x100**	**17.7%**	**13.6%**	**16.4%**	**16.1%**	**7.6%**

Remarks:

NewFields

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

NF Form #15

Client:	NDOT	**Location:**	BH19-BR
Project Title:	US395 NDOT North Valleys	**Elevation:**	See Below
Project Number:	475.0398.000	**Test Date:**	5/10/2019
Project Engineer:	Mark Doehring	**Tested By:**	JH
Field Sample ID:	BH19-BR	**Checked By:**	JH

Drying Conditions: 60 deg C / [✓ **110 deg C**]   Method: [✓ **Oven (O)**] / Microwave (M) / Hot Plate (H)

Sample No.		19-131-02	19-131-04	19-131-06	19-131-07	19-131-08
Location		BH19-BR-01	BH19-BR-01	BH19-BR-08	BH19-BR-08	BH19-BR-11
Depth		7.5-8.5'	35-36'	15-16.5'	30-31.5'	7.5-9'
Soil Description						
(USCS)						
Trial No.		**1**	**2**	**3**	**4**	**5**
Tare No.						
Tare + Wet Soil	**A**	641	489.1	374.7	826.2	892.6
Tare + Dry Soil	**B**	567.8	415.7	321.2	711.1	753.5
Tare	**C**	22.2	22.3	22.2	22.3	22.5
Wt. of Water	**D= A-B**	73.2	73.4	53.5	115.1	139.1
Dry Soil, Ws	**E= B-C**	545.6	393.4	299	688.8	731
Moisture Content, (%)	**(D/E) x100**	**13.4%**	**18.7%**	**17.9%**	**16.7%**	**19.0%**

Sample No.		19-131-09	19-131-11	19-131-13	19-131-14	19-131-15
Location		BH19-BR-11	BH19-BR-11	BH19-BR-12	BH19-BR-12	BH19-BR-12
Depth		20-21'	75-76.5'	20-21'	30-31'	45-46.5'
Soil Description						
(USCS)						
Trial No.		**6**	**7**	**8**	**9**	**10**
Tare No.						
Tare + Wet Soil	**A**	1766.5	1018.8	1978.4	1871.2	855.5
Tare + Dry Soil	**B**	1611.2	819.3	1673.4	1648.6	681.6
Tare	**C**	22.1	22.3	22	22.2	22.4
Wt. of Water	**D= A-B**	155.3	199.5	305	222.6	173.9
Dry Soil, Ws	**E= B-C**	1589.1	797	1651.4	1626.4	659.2
Moisture Content, (%)	**(D/E) x100**	**9.8%**	**25.0%**	**18.5%**	**13.7%**	**26.4%**

Remarks:

NewFields

NF Form #15

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

Client:	NDOT	**Location:**	See Below
Project Title:	US395 NDOT North Valleys	**Elevation:**	See Below
Project Number:	475.0398.000	**Test Date:**	7/1/2019
Project Engineer:	Mark Doehring	**Tested By:**	JH
Field Sample ID:	See Below	**Checked By:**	JH

Drying Conditions: 60 deg C / [✓ **110 deg C**] Method: [✓ **Oven (O)**] / Microwave (M) / Hot Plate (H)

Sample No.		19-213-01	19-213-02	19-213-03	19-213-08	19-213-10
Location		BH19-BR-02	BH19-BR-02	BH19-BR-02	BH19-BR-09	BH19-BR-17
Depth		15-15.5'	25-25.5'	40-41.5'	11-11.5'	15-16.5'
Soil Description						
(USCS)						
Trial No.		**1**	**2**	**3**	**4**	**5**
Tare No.						
Tare + Wet Soil	**A**	398.6	320.6	1223.5	961.1	689.4
Tare + Dry Soil	**B**	372.7	300	1098.7	813.9	553.8
Tare	**C**	22	22	22	22	22
Wt. of Water	**D= A-B**	25.9	20.6	124.8	147.2	135.6
Dry Soil, Ws	**E= B-C**	350.7	278	1076.7	791.9	531.8
Moisture Content, (%)	**(D/E) x100**	**7.4%**	**7.4%**	**11.6%**	**18.6%**	**25.5%**

Sample No.		19-213-13	19-213-14	19-213-15	19-213-16	
Location		BH19-BR-17	BH19-BR-23	BH19-BR-23	BH19-BR-23	
Depth		65-66.5'	10-11'	25-26.5'	35-36.5'	
Soil Description						
(USCS)						
Trial No.		**6**	**7**	**8**	**9**	**10**
Tare No.						
Tare + Wet Soil	**A**	876.9	1438.4	941.1	829.1	
Tare + Dry Soil	**B**	713.2	1298	861.1	723.2	
Tare	**C**	22	22	22	22	
Wt. of Water	**D= A-B**	163.7	140.4	80	105.9	
Dry Soil, Ws	**E= B-C**	691.2	1276	839.1	701.2	
Moisture Content, (%)	**(D/E) x100**	**23.7%**	**11.0%**	**9.5%**	**15.1%**	

Remarks:

NewFields

NF Form #15

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

Client:	NDOT	**Location:**	See Below
Project Title:	US395 NDOT North Valleys	**Elevation:**	See Below
Project Number:	475.0398.000	**Test Date:**	5/22/2019
Project Engineer:	Mark Doehring	**Tested By:**	JH
Field Sample ID:	BH19-BR-20	**Checked By:**	JH

Drying Conditions: 60 deg C / [✓ **110 deg C**] Method: [✓ **Oven (O)**] / Microwave (M) / Hot Plate (H)

Sample No.		19-147-02	19-147-03			
Location		BR-20	BR-20			
Depth		40.5-41'	65-66.5'			
Soil Description						
(USCS)						
Trial No.		**1**	**2**	**3**	**4**	**5**
Tare No.						
Tare + Wet Soil	**A**	858	1206			
Tare + Dry Soil	**B**	771.7	1079.2			
Tare	**C**	21.8	21.8			
Wt. of Water	**D= A-B**	86.3	126.8			
Dry Soil, Ws	**E= B-C**	749.9	1057.4			
Moisture Content, (%)	**(D/E) x100**	**11.5%**	**12.0%**			

Sample No.						
Location						
Depth						
Soil Description						
(USCS)						
Trial No.		**6**	**7**	**8**	**9**	**10**
Tare No.						
Tare + Wet Soil	**A**					
Tare + Dry Soil	**B**					
Tare	**C**					
Wt. of Water	**D= A-B**					
Dry Soil, Ws	**E= B-C**					
Moisture Content, (%)	**(D/E) x100**					

Remarks:

NewFields

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

NF Form #15

Client:	NDOT	**Location:**	See Below
Project Title:	US395 NDOT North Valleys	**Elevation:**	See Below
Project Number:	475.0398.000	**Test Date:**	7/1/2019
Project Engineer:	Mark Doehring	**Tested By:**	JH
Field Sample ID:	See Below	**Checked By:**	JH

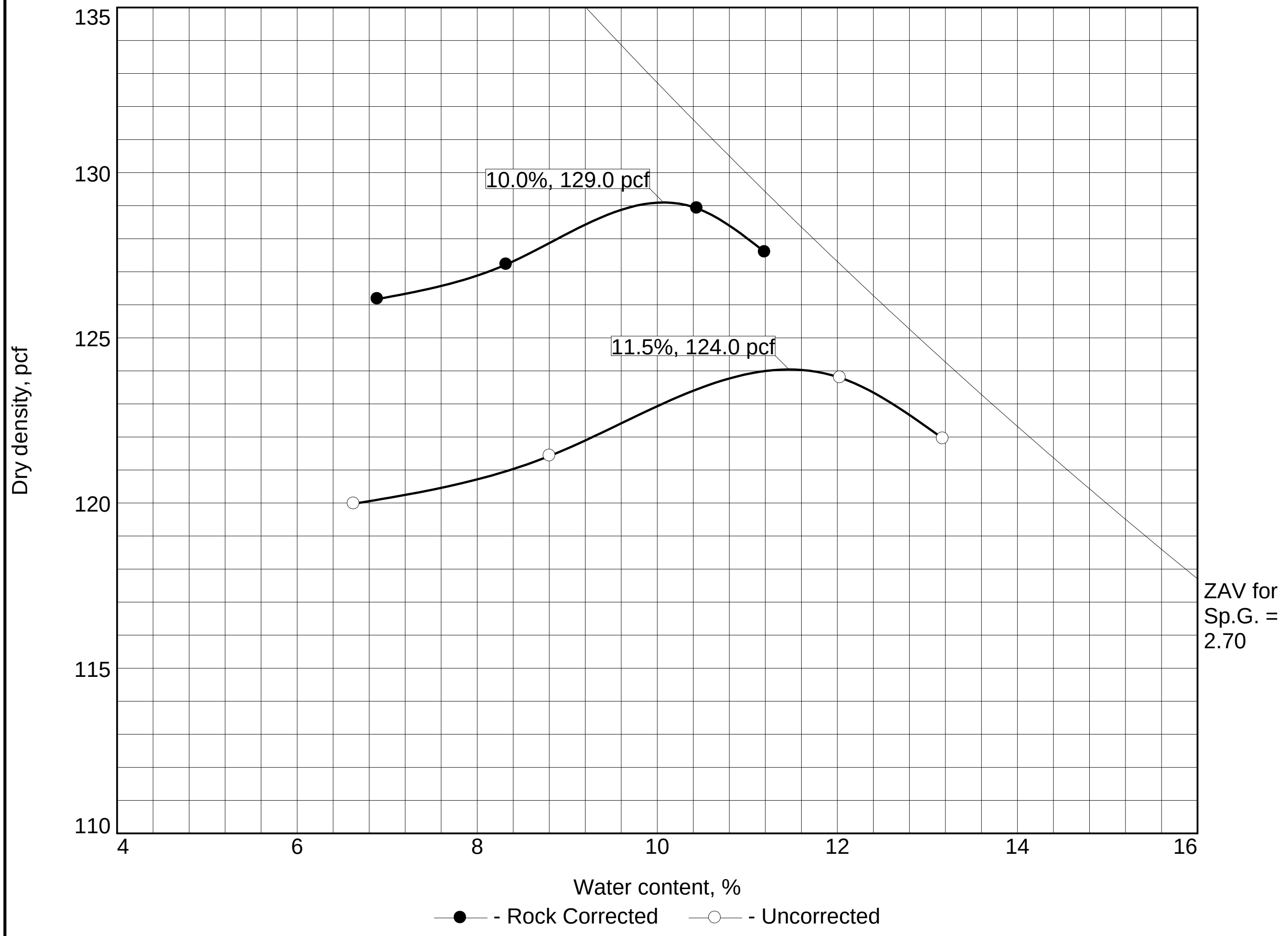
Drying Conditions: 60 deg C / **110 deg C** Method: **Oven (O)** / Microwave (M) / Hot Plate (H)

Sample No.		19-213-01	19-213-02	19-213-03	19-213-08	19-213-10
Location		BH19-BR-02	BH19-BR-02	BH19-BR-02	BH19-BR-09	BH19-BR-17
Depth		15-15.5'	25-25.5'	40-41.5'	11-11.5'	15-16.5'
Soil Description						
(USCS)						
Trial No.		**1**	**2**	**3**	**4**	**5**
Tare No.						
Tare + Wet Soil	A	398.6	320.6	1223.5	961.1	689.4
Tare + Dry Soil	B	372.7	300	1098.7	813.9	553.8
Tare	C	22	22	22	22	22
Wt. of Water	D= A-B	25.9	20.6	124.8	147.2	135.6
Dry Soil, Ws	E= B-C	350.7	278	1076.7	791.9	531.8
Moisture Content, (%)	**(D/E) x100**	**7.4%**	**7.4%**	**11.6%**	**18.6%**	**25.5%**

Sample No.		19-213-13	19-213-14	19-213-15	19-213-16	
Location		BH19-BR-17	BH19-BR-23	BH19-BR-23	BH19-BR-23	
Depth		65-66.5'	10-11'	25-26.5'	35-36.5'	
Soil Description						
(USCS)						
Trial No.		**6**	**7**	**8**	**9**	**10**
Tare No.						
Tare + Wet Soil	A	876.9	1438.4	941.1	829.1	
Tare + Dry Soil	B	713.2	1298	861.1	723.2	
Tare	C	22	22	22	22	
Wt. of Water	D= A-B	163.7	140.4	80	105.9	
Dry Soil, Ws	E= B-C	691.2	1276	839.1	701.2	
Moisture Content, (%)	**(D/E) x100**	**23.7%**	**11.0%**	**9.5%**	**15.1%**	

Remarks:

COMPACTION TEST REPORT



Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
4-7							34.3	

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 129.0 pcf	124.0 pcf	SITE SOIL
Optimum moisture = 10.0 %	11.5 %	

Project No. 1541 **Client:** NEWFIELDS

Project: NEWFIELDS - TESTING AS ORDERED

Date:

○ **Location:** BH19-BR-05 **Sample Number:** 33611

CME CONSTRUCTION MATERIALS ENGINEERS, INC.

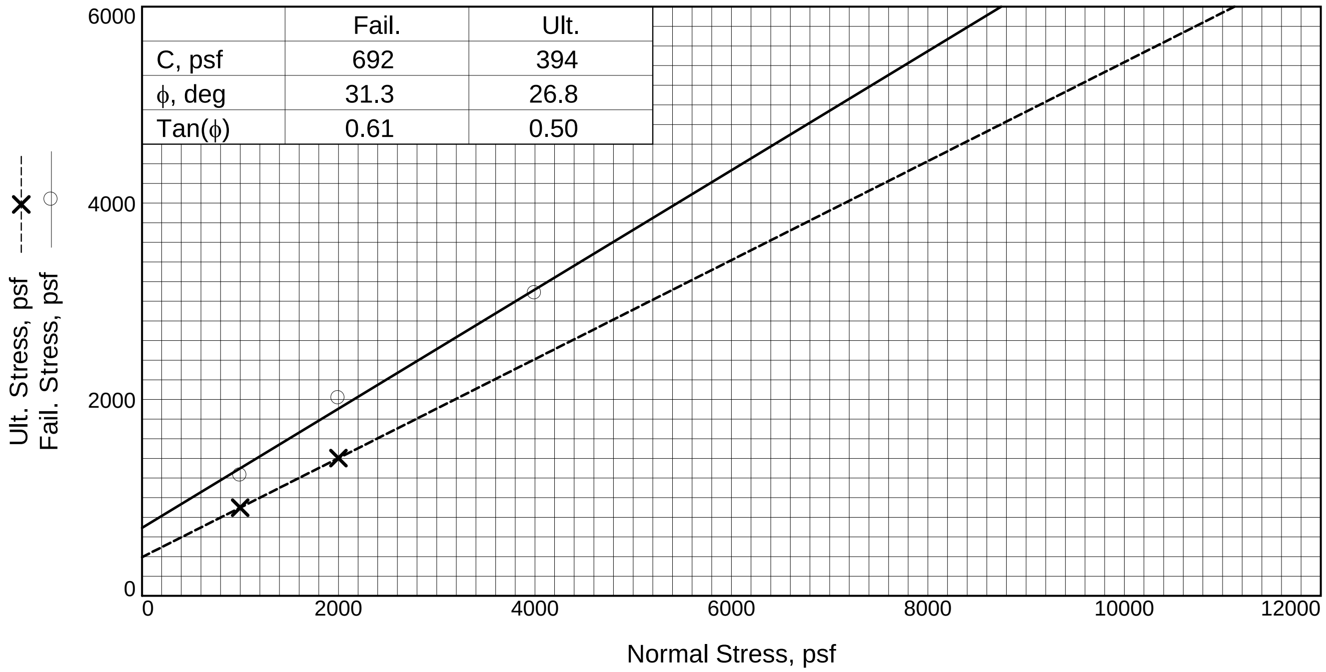
Remarks:

RECEIVED 8/8/2019

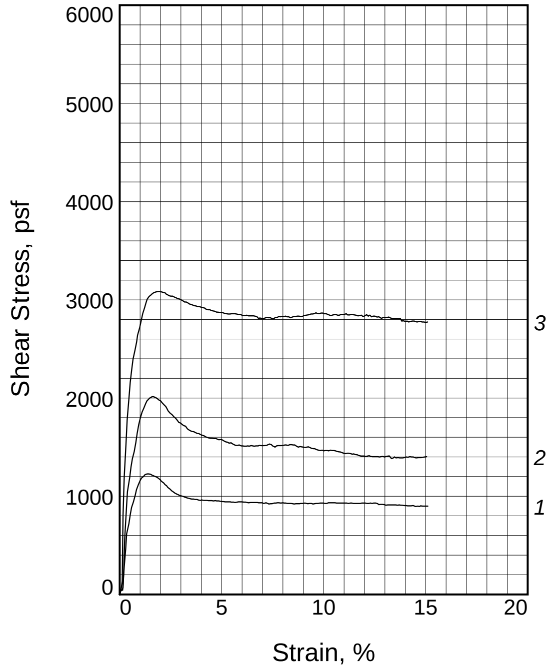
NDOT T108 - METHOD D

PLATE

Tested By: C. JONES **Checked By:** S. VINEIS



	Fail.	Ult.
C, psf	692	394
ϕ, deg	31.3	26.8
Tan(ϕ)	0.61	0.50



	Sample No.	1	2	3
Initial	Water Content, %	10.1	10.1	10.1
	Dry Density, pcf	121.1	119.8	121.1
	Saturation, %	73.1	70.2	73.0
	Void Ratio	0.3656	0.3805	0.3657
	Diameter, in.	2.42	2.42	2.42
	Height, in.	1.01	1.02	1.01
At Test	Water Content, %	13.1	13.9	13.4
	Dry Density, pcf	121.1	119.8	121.1
	Saturation, %	94.9	96.9	97.2
	Void Ratio	0.3656	0.3805	0.3657
	Diameter, in.	2.42	2.42	2.42
	Height, in.	1.01	1.02	1.01
	Normal Stress, psf	1000	2000	4000
	Fail. Stress, psf	1227	2013	3084
	Strain, %	1.4	1.6	1.9
	Ult. Stress, psf	899	1403	
	Strain, %	15.1	15.0	
	Strain rate, in./min.	0.001	0.001	0.001

Sample Type: REMOLDED

Description: SITE SOIL

Assumed Specific Gravity= 2.65

Remarks: SAMPLE INUNDATED PRIOR TO CONSOLIDATION AND SHEAR.
SAMPLE REMOLDED TO 95% RELATIVE COMPACTION PER NDOT T108.

PLATE ________

Client: NEWFIELDS

Project: NEWFIELDS - TESTING AS ORDERED

Location: BH19-BR-05

Sample Number: 33611 **Depth:** 4-7

Proj. No.: 1541 **Date Sampled:** DELIVERED BY 3/9/1

CME CONSTRUCTION MATERIALS ENGINEERS, INC.

Tested By: C.JONES **Checked By:** N. ANDERSON

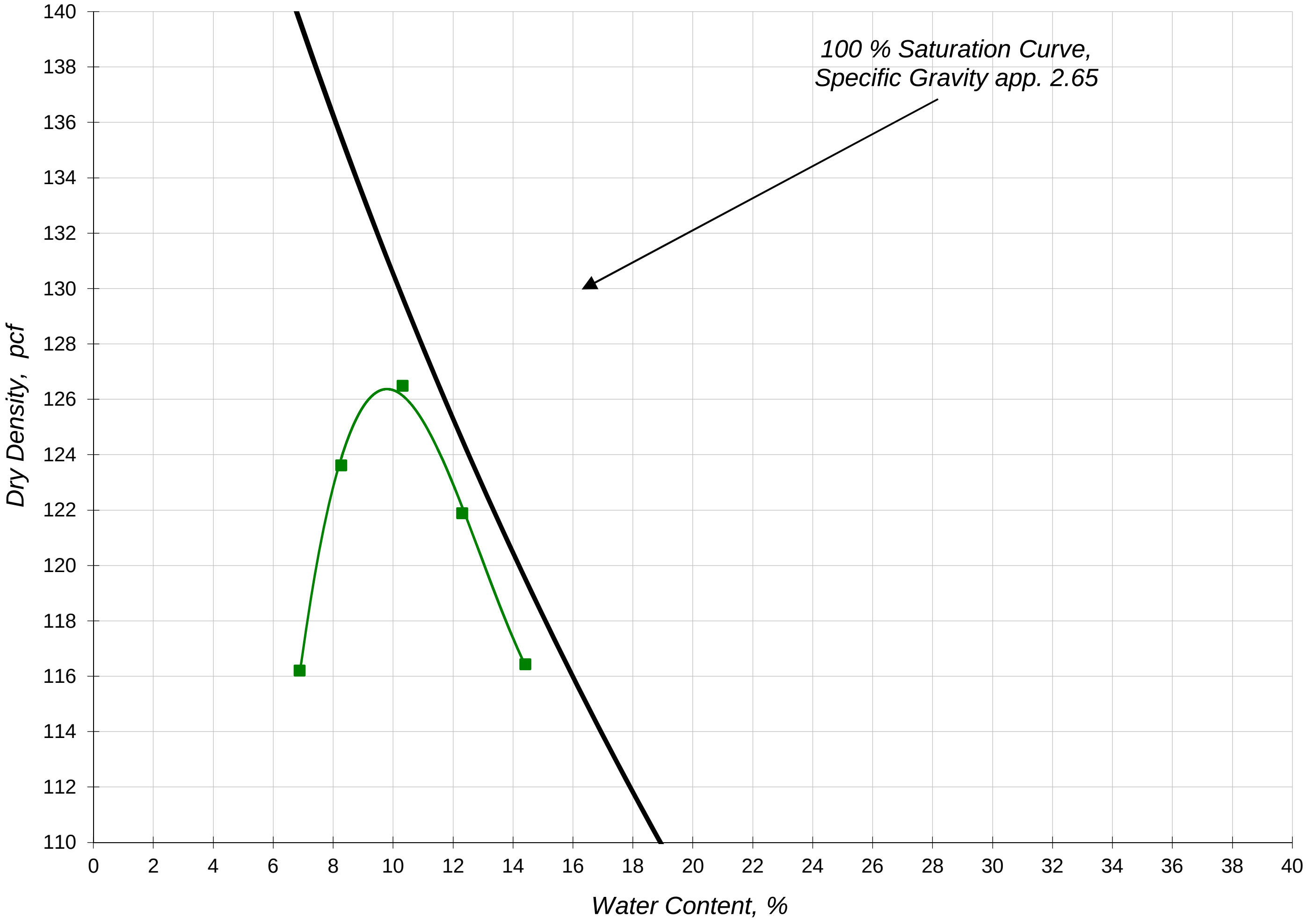
MOISTURE / DENSITY RELATIONSHIPS

Geo-Logic
ASSOCIATES

Test Report
NEVT99

Client: NewFields
Project No.: AU19.1193.00
Lab Log No.: **4516A**

Project Name: US395 NDOT North Valleys
Report Date: July 22, 2019



100 % Saturation Curve, Specific Gravity app. 2.65

Symbol	Lab No.	Sample Identification	Description	Maximum Dry Density pcf	Maximum Dry Density kg / m^3	Optimum Water Content (OMC) %
🟩	4516A	BH19-BR-23	sandy clay w/ gravel	126.4	2024	9.8

Corrected Values For Oversized Particles, per ASTM D-4718

🟩 4516A with 8.6 Percent +#4 Gravel, the maximum Dry Density = 129 pcf @ 9 % OMC

Note: The test was conducted as method A with 0 percent retained on the no. 4 sieve (minus #4)
Using an Automatic Hammer

Print Date: 8/13/2019
Entered By: RZS
Reviewed By: PP
LSN: **4516A**

DIRECT SHEAR REPORT

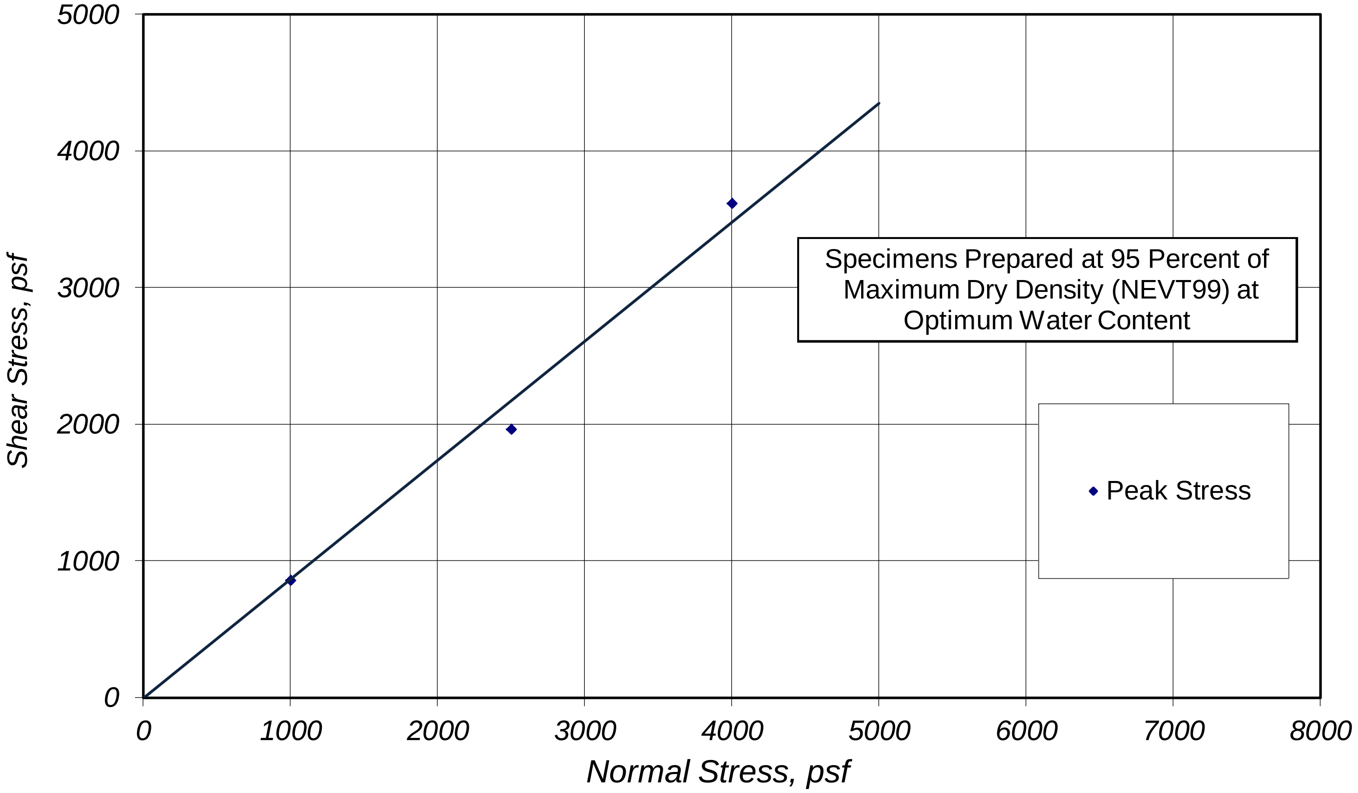
Consolidated - Drained Test

AASHTO T236

Client / Project Name:	*Project No. :*	*Lab Log:*
Newfields / US395 NDOT North Valleys	AU19.1193.00	4516A

Sample :	*Soil Description:*	*Report Date:*
BH19-BR-23	Brown Sandy Clay	August 3, 2019

STRENGTH ENVELOPE



		Peak	Post Peak
Coefficient of Friction	:	0.870	
Friction Angle	:	41.0	
Cohesion, psf:	:	0	

Note: Intercept changed to "0" for post peak

Point No.	Normal Stress psf	Shear Stress Peak psf	Shear Stress Post-Peak psf		Initial Water Content %	Initial Dry Density pcf	Final Water Content %	Final Dry Density pcf
1	1000	859			9.9	119.8	15.2	121.9
2	2500	1963			10.2	118.1	15.0	125.3
3	4000	3615			9.8	119.3	13.6	125.7

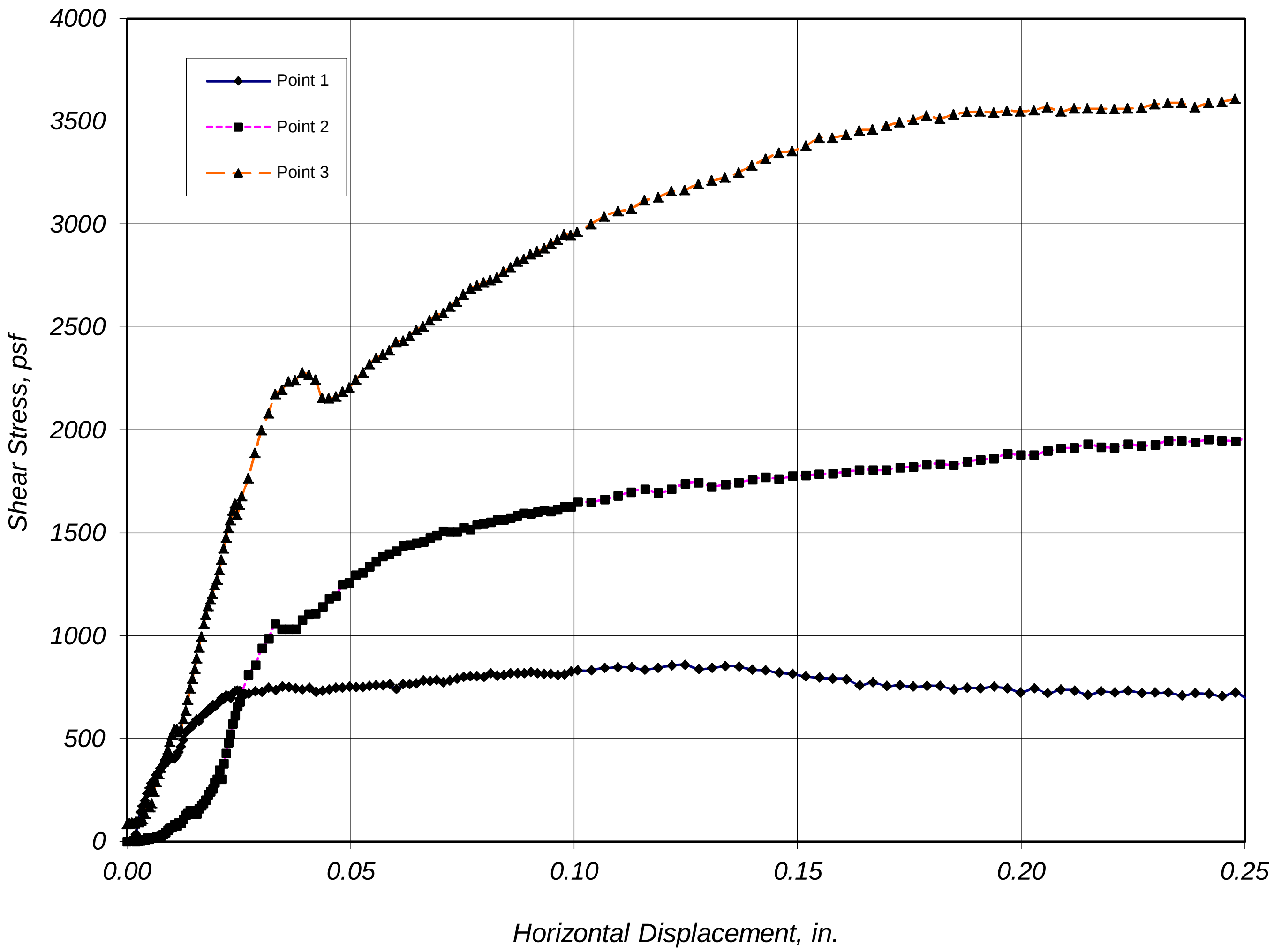
Horizontal Displacement Rate, in. / min. : 0.002 *Sample Diameter, in.:* 2.50

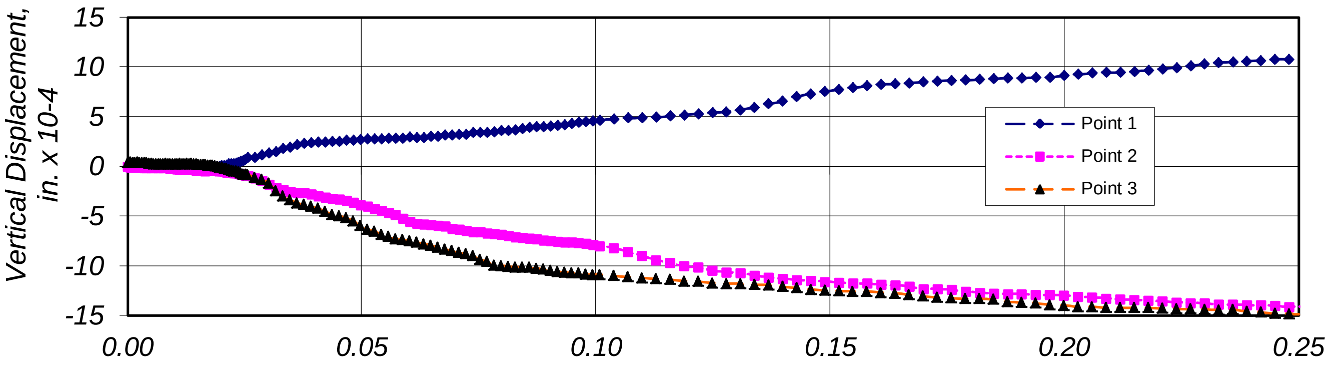
Labexcel \ FORMS \ GLA Forms \ Reports \ AU19.1193.00 \ 4516A-SDS-RP"	*Print Date:*	*Entered By:*	*Reviewed By:*	*LLN:*
DCN: SDS-rp (rev. 03/23/10)	8/13/2019	PP	krc	**4516A**

DIRECT SHEAR REPORT

AASHTO T236

Client / Project Name. Newfields / US395 NDOT North Valleys	*Project No. :* AU19.1193.00	*Lab Log:* 4516A
Sample : BH19-BR-23	*Soil Description.* Brown Sandy Clay	*Report Date:* August 3, 2019





NORMAL STRESSES, psf :	Point - 1	1000	Point - 2	2500	Point - 3	4000

Print Date:	*Entered By:*	*Reviewed By:*	*LLN:*
8/13/2019	PP	krc	**4516A**

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 06/19/2019
Date Submitted 06/12/2019

To: Kerry Magner
Newfields MDTS
2227 N. 5th St.
Elko, NV 89801

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 475.0398.000 Site ID : BH19-BR-04@16.5.
Thank you for your business.

* For future reference to this analysis please use SUN # 79836-166805.

EVALUATION FOR SOIL CORROSION

Soil pH	7.15	
Minimum Resistivity	0.38 ohm-cm (x1000)	
Chloride	380.4 ppm	00.03804 %
Sulfate	1602.5ppm	00.16025 %
Redox Potential	No Test	
Sulfides	No Test	

METHODS
pH AASTO T289, Min.Resistivity AASTO T288 Mod.(Sm.Cell)
Sulfate AASHTO T290, Chloride AASHTO T291
Redox Potential ASTM G-200, Sulfides AWWA C105/A25.5

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 07/10/2019
Date Submitted 07/01/2019

To: Kerry Magner
Newfields MDTS
2227 N. 5th St.
Elko, NV 89801

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : BH19-BR09 7.5-9 FT Site ID : SS-02.
Your purchase order number is 4750398.
Thank you for your business.

* For future reference to this analysis please use SUN # 79995-167119.

EVALUATION FOR SOIL CORROSION

Soil pH	6.64		
Minimum Resistivity	0.72	ohm-cm (x1000)	
Chloride	49.4 ppm	00.00494	%
Sulfate	62.3ppm	00.00623	%
Redox Potential	No Test		
Sulfides	No Test		

METHODS
pH AASTO T289, Min.Resistivity AASTO T288 Mod.(Sm.Cell)
Sulfate AASHTO T290, Chloride AASHTO T291
Redox Potential ASTM G-200, Sulfides AWWA C105/A25.5

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 07/10/2019
Date Submitted 07/01/2019

To: Kerry Magner
Newfields MDTS
2227 N. 5th St.
Elko, NV 89801

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : BH19-BR11 31-31.5 FT Site ID : BR11-15.
Your purchase order number is 4750398.
Thank you for your business.

* For future reference to this analysis please use SUN # 79994-167112.

EVALUATION FOR SOIL CORROSION

Soil pH	6.73	
Minimum Resistivity	0.70 ohm-cm (x1000)	
Chloride	52.9 ppm	00.00529 %
Sulfate	364.9ppm	00.03649 %
Redox Potential	No Test	
Sulfides	No Test	

METHODS
pH AASTO T289, Min.Resistivity AASTO T288 Mod.(Sm.Cell)
Sulfate AASHTO T290, Chloride AASHTO T291
Redox Potential ASTM G-200, Sulfides AWWA C105/A25.5

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 06/19/2019
Date Submitted 06/12/2019

To: Kerry Magner
Newfields MDTS
2227 N. 5th St.
Elko, NV 89801

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 475.0398.000 Site ID : BH19-BR-21@25.
Thank you for your business.

* For future reference to this analysis please use SUN # 79836-166806.

EVALUATION FOR SOIL CORROSION

Soil pH	7.06	
Minimum Resistivity	2.68 ohm-cm (x1000)	
Chloride	32.4 ppm	00.00324 %
Sulfate	9.5ppm	00.00095 %
Redox Potential	No Test	
Sulfides	No Test	

METHODS
pH AASTO T289, Min.Resistivity AASTO T288 Mod.(Sm.Cell)
Sulfate AASHTO T290, Chloride AASHTO T291
Redox Potential ASTM G-200, Sulfides AWWA C105/A25.5

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 07/10/2019
Date Submitted 07/01/2019

To: Kerry Magner
Newfields MDTS
2227 N. 5th St.
Elko, NV 89801

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : BH19-BR23 30-31.5 FT Site ID : S-8Z.
Your purchase order number is 4750398.
Thank you for your business.

* For future reference to this analysis please use SUN # 79994-167114.

EVALUATION FOR SOIL CORROSION

Soil pH	7.51	
Minimum Resistivity	1.47 ohm-cm (x1000)	
Chloride	18.1 ppm	00.00181 %
Sulfate	16.3ppm	00.00163 %
Redox Potential	No Test	
Sulfides	No Test	

METHODS
pH AASTO T289, Min.Resistivity AASTO T288 Mod.(Sm.Cell)
Sulfate AASHTO T290, Chloride AASHTO T291
Redox Potential ASTM G-200, Sulfides AWWA C105/A25.5

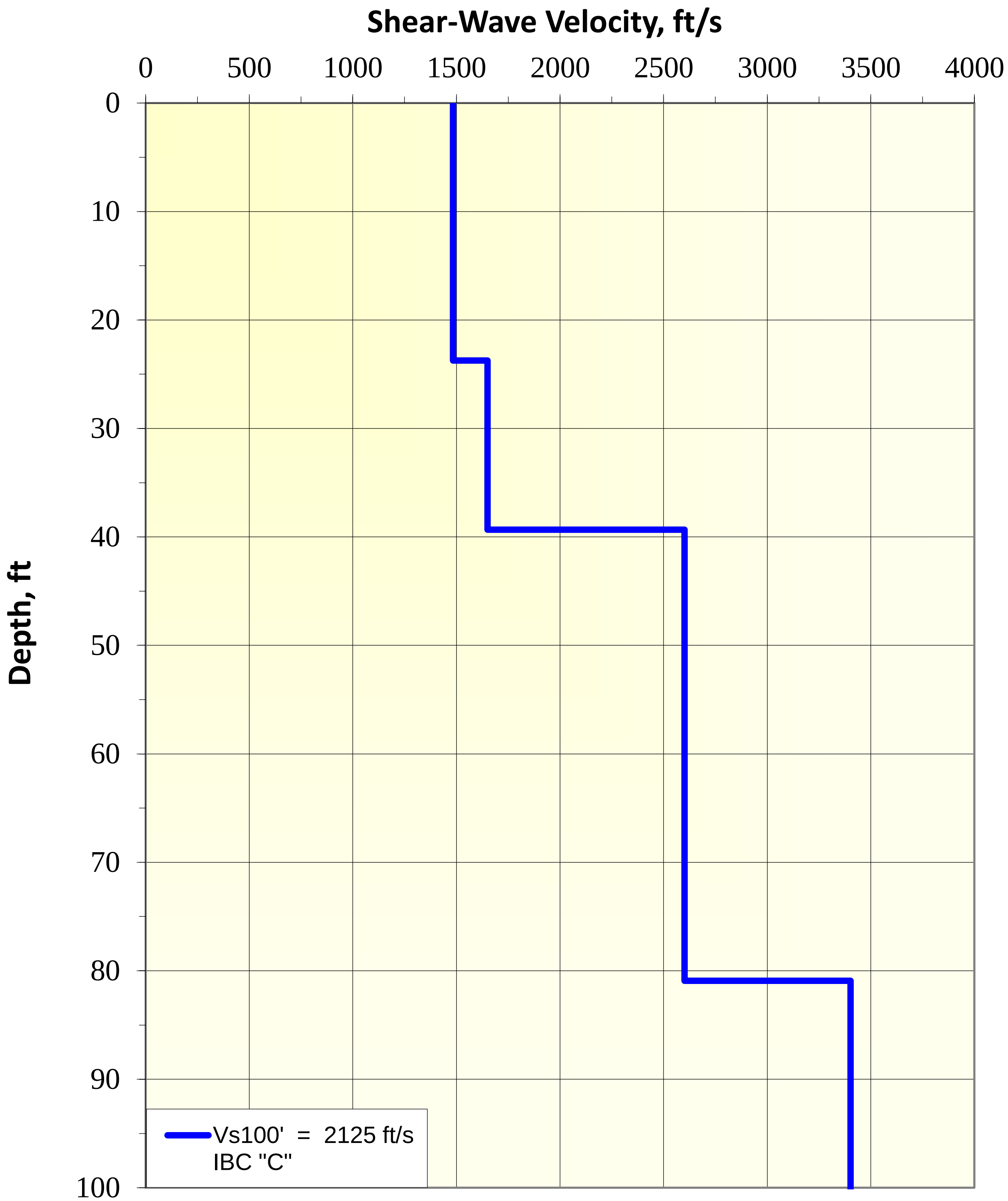
ATTACHMENT E

ReMi Survey Results

SeisOpt ReMi© Shear Wave Velocity Profile

US395 North Valleys
Panther Valley - South Abutment
Job 12

Data Processed by: Morgan Stipe Geologist, Data Analyst morgan.stipe@optimsoftware.com	**Prepaired for**: Jesse Ruzicka NewFields jruzicka@newfields.com	**Date**: 7/31/19	200 S. Virginia St. #560 Reno, NV 89501 support@optimsoftware.com www.optimsoftware.com

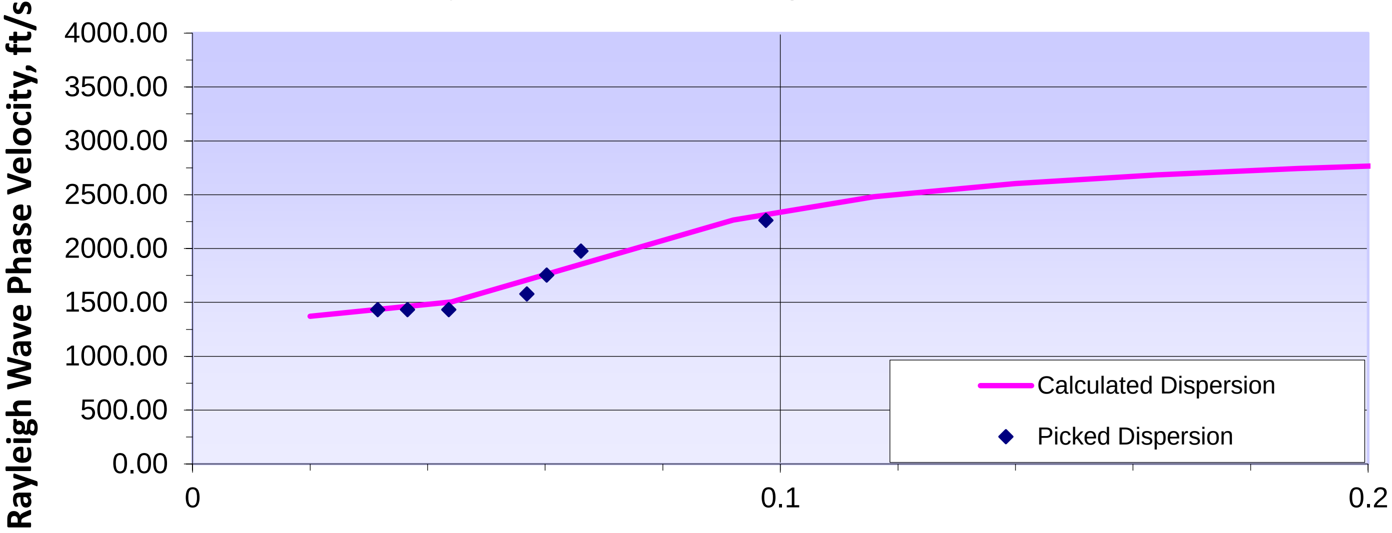


SeisOpt ReMi© Dispersion Curve and Slowness Spectrum

US395 North Valleys
Panther
Job 12

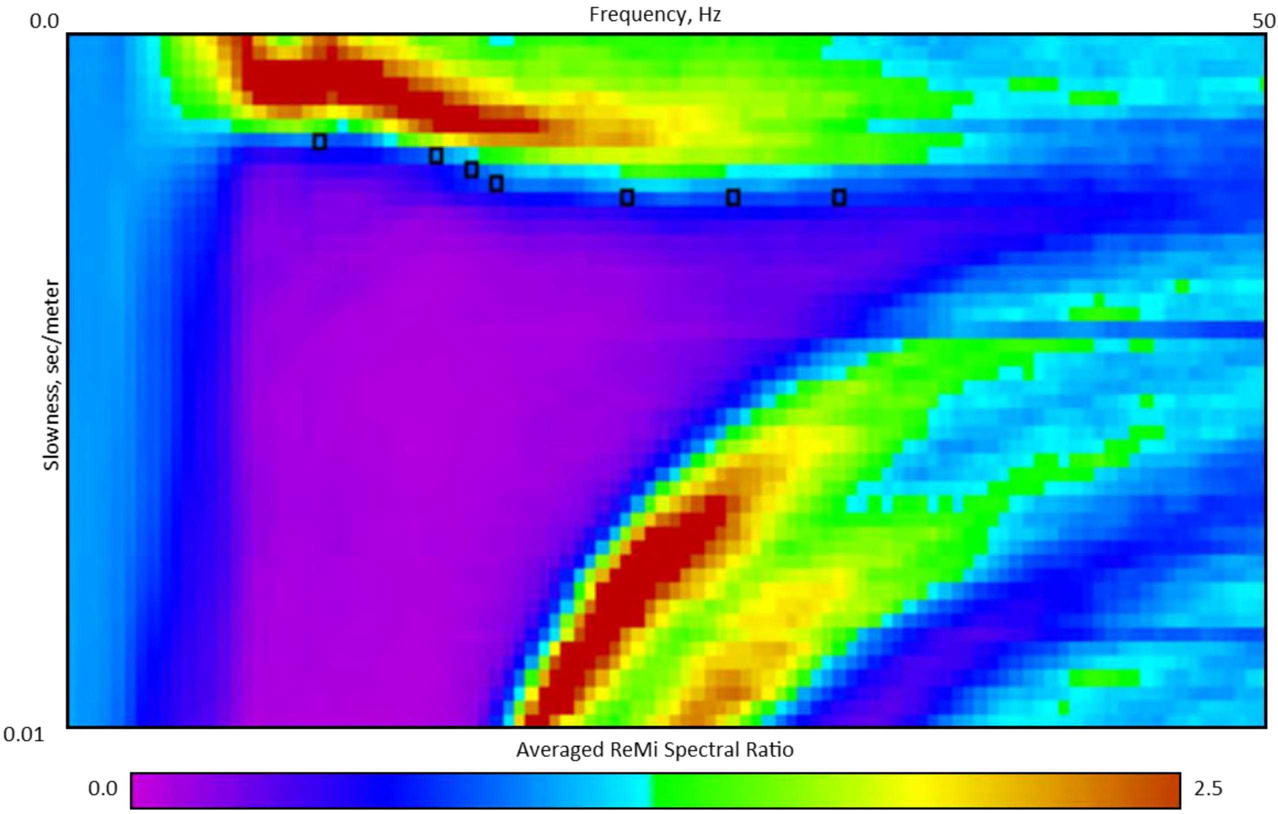
Data Processed by: Morgan Stipe Geologist, Data Analyst morgan.stipe@optimsoftware.com	**Prepaired for**: Jesse Ruzicka NewFields jruzicka@newfields.com	**Date:** 7/31/19	200 S. Virginia St. #560 Reno, NV 89501 support@optimsoftware.com www.optimsoftware.com

Dispersion Curve Showing Picks and Fit



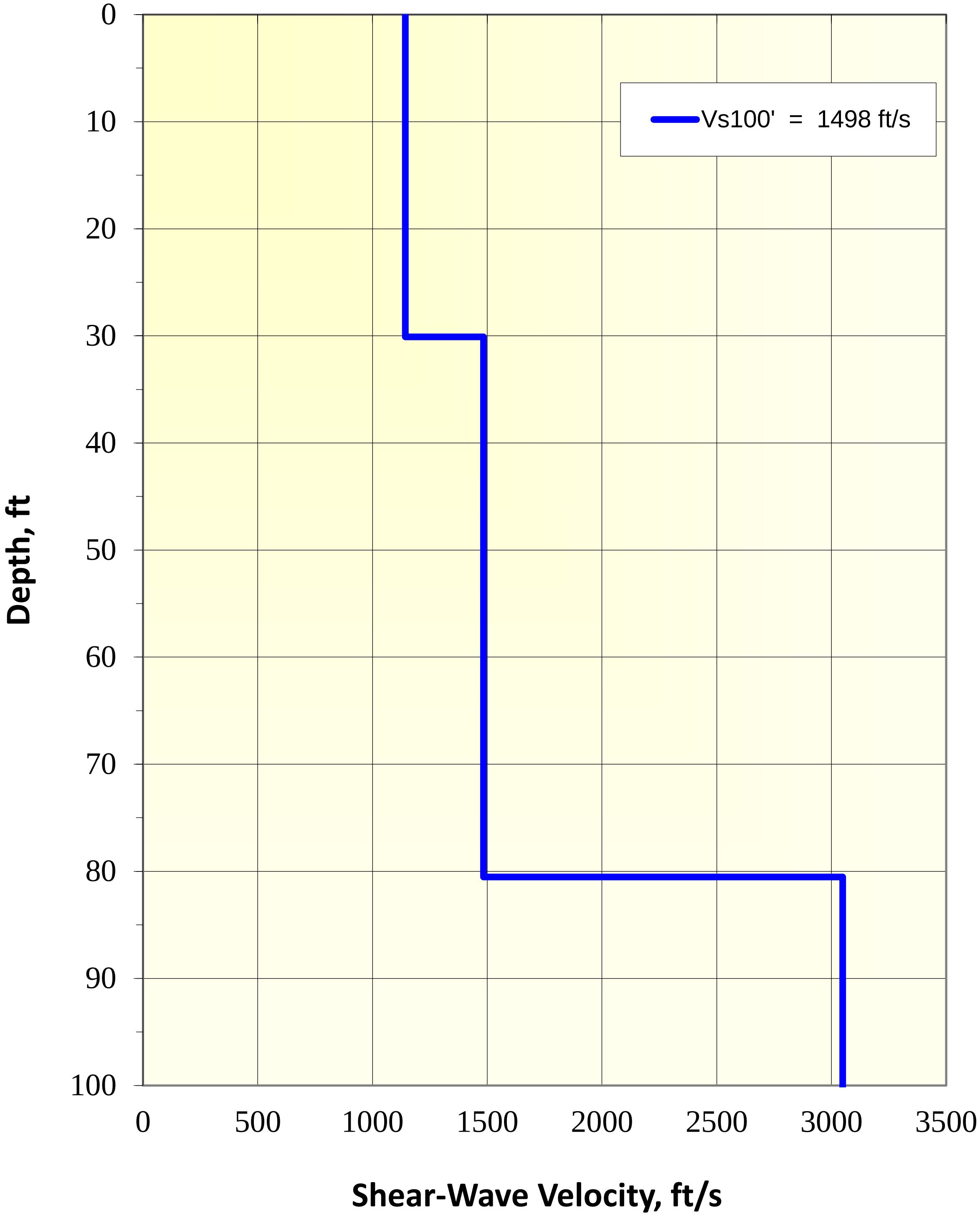
Period, s

p-f Image with Dispersion Modeling Picks



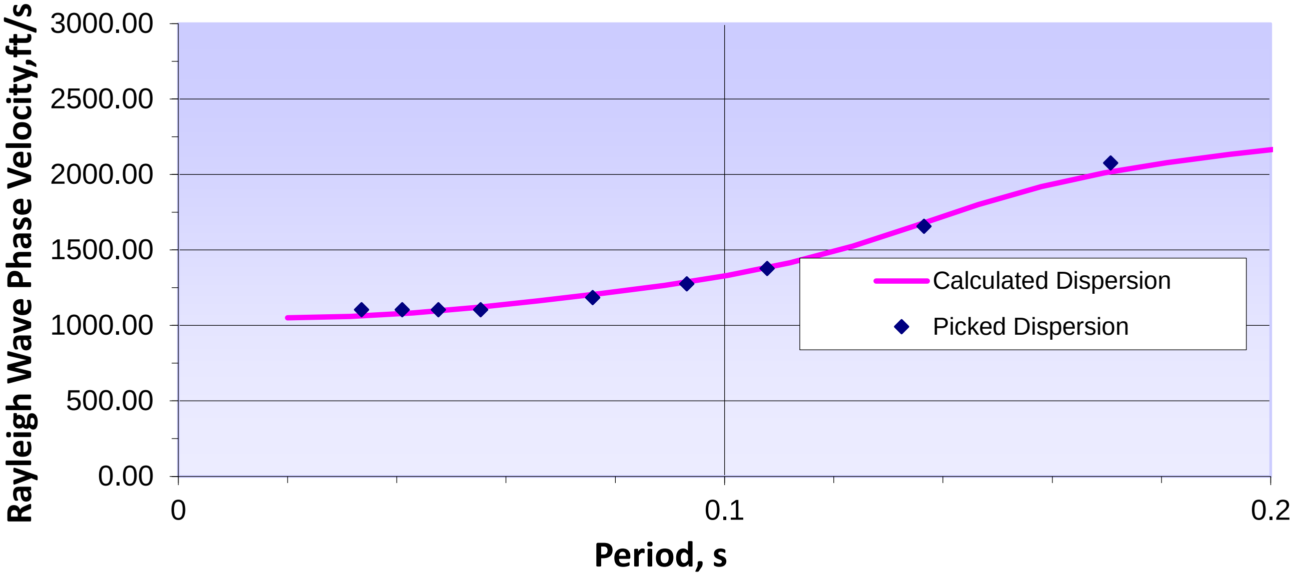
Shear Wave Velocity Profile

Panther Valley, North Abutment



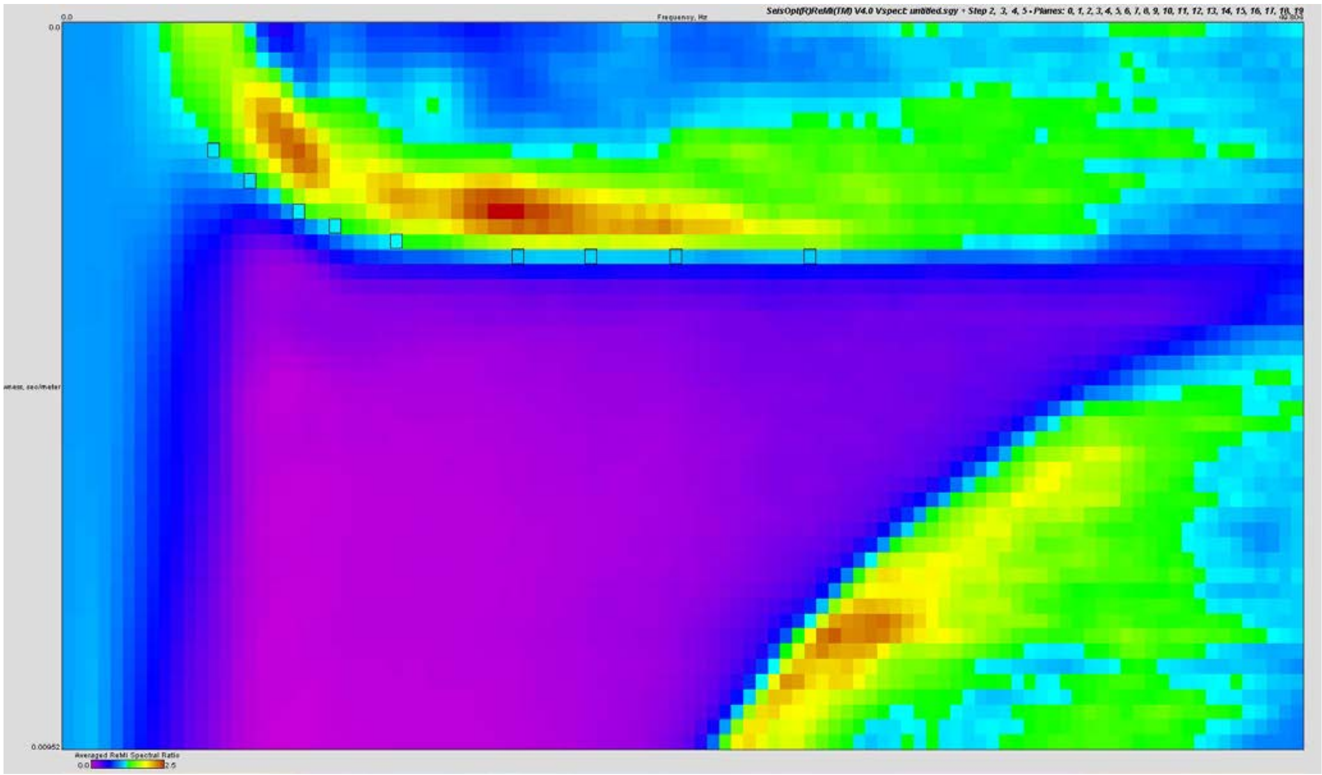
Dispersion Curve and Slowness Spectrum

Panther Valley, North Abutment



Dispersion Curve Showing Picks and Fit

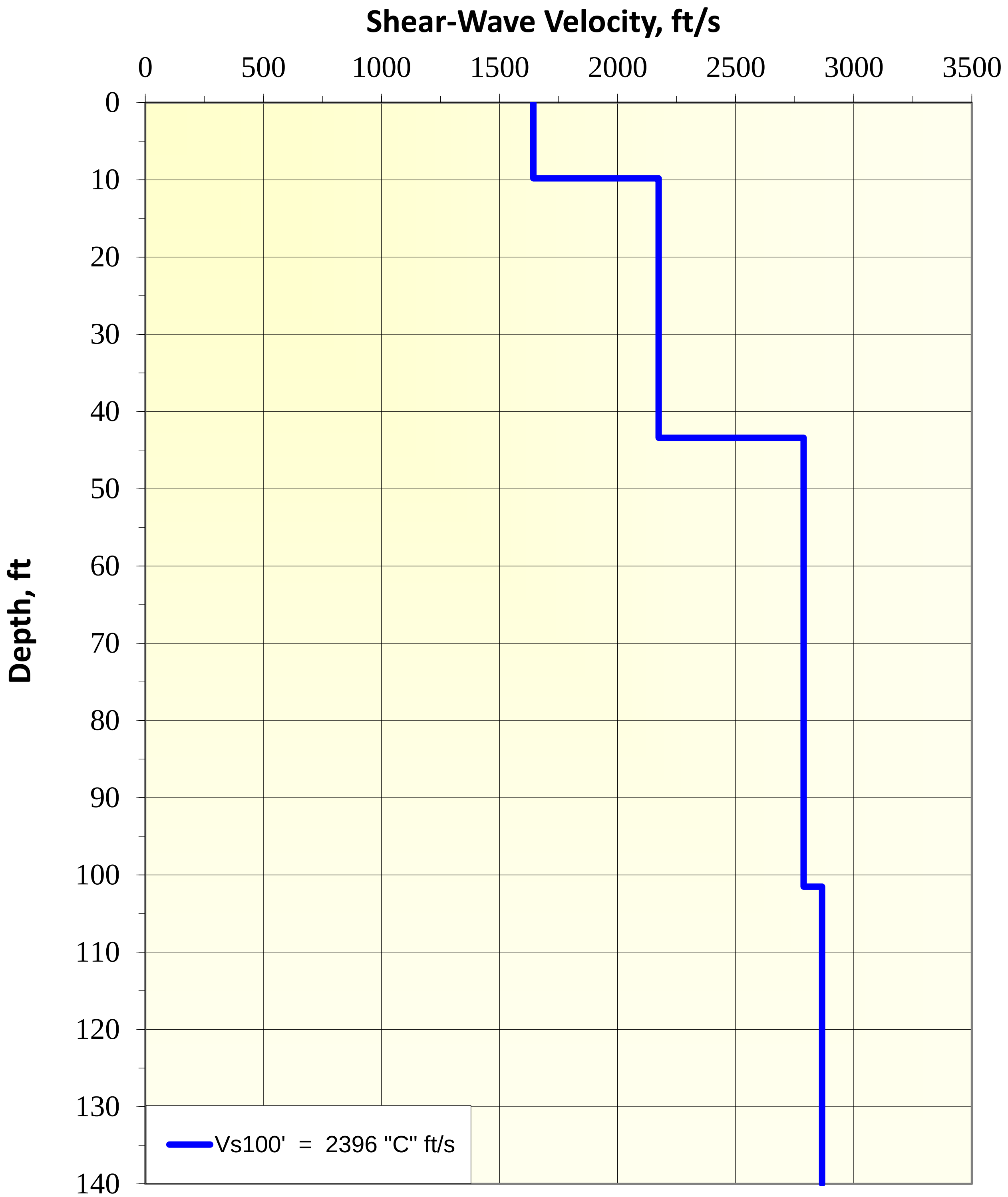
p-f Image with Dispersion Modeling Picks



SeisOpt ReMi© Shear Wave Velocity Profile

US 395 North Valleys
UPRR Grade Separation - South Abutment

Data Processed by: Andrew Rosenberg-Main Geophysicist, Data Analyst andrew.main@optimsoftware.com	Jesse Ruzicka Newfields	**Date**: 8/9/19	200 S. Virginia St. #560 Reno, NV 89501 support@optimsoftware.com www.optimsoftware.com

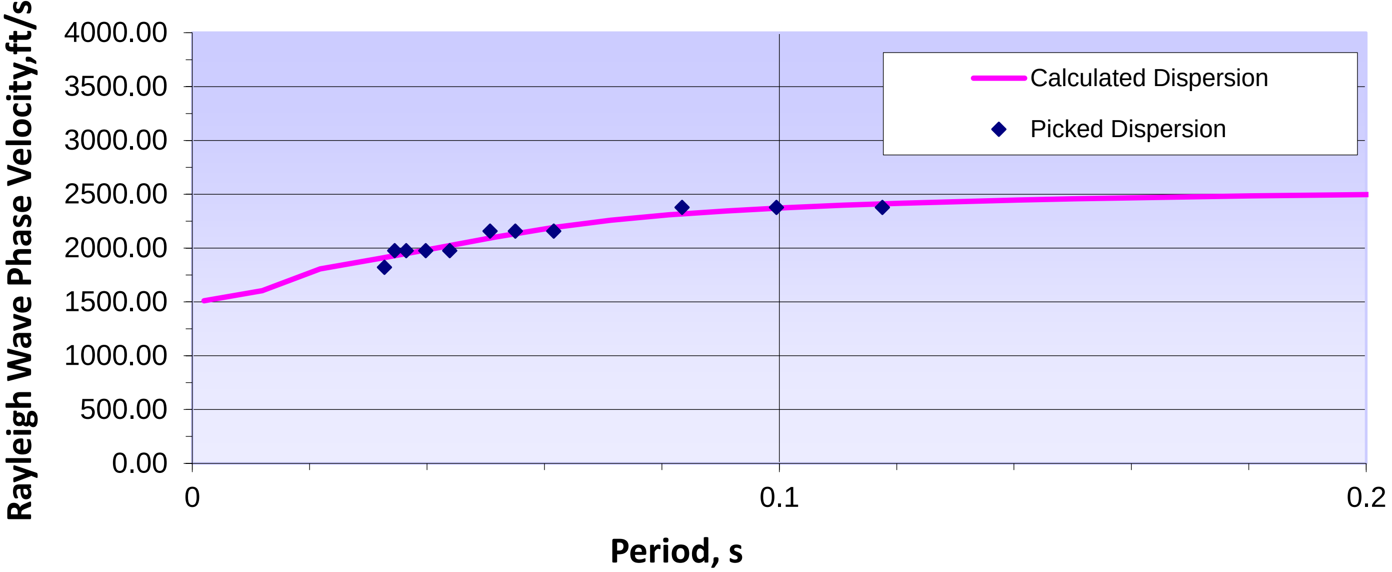


SeisOpt ReMi© Dispersion Curve and Slowness Spectrum

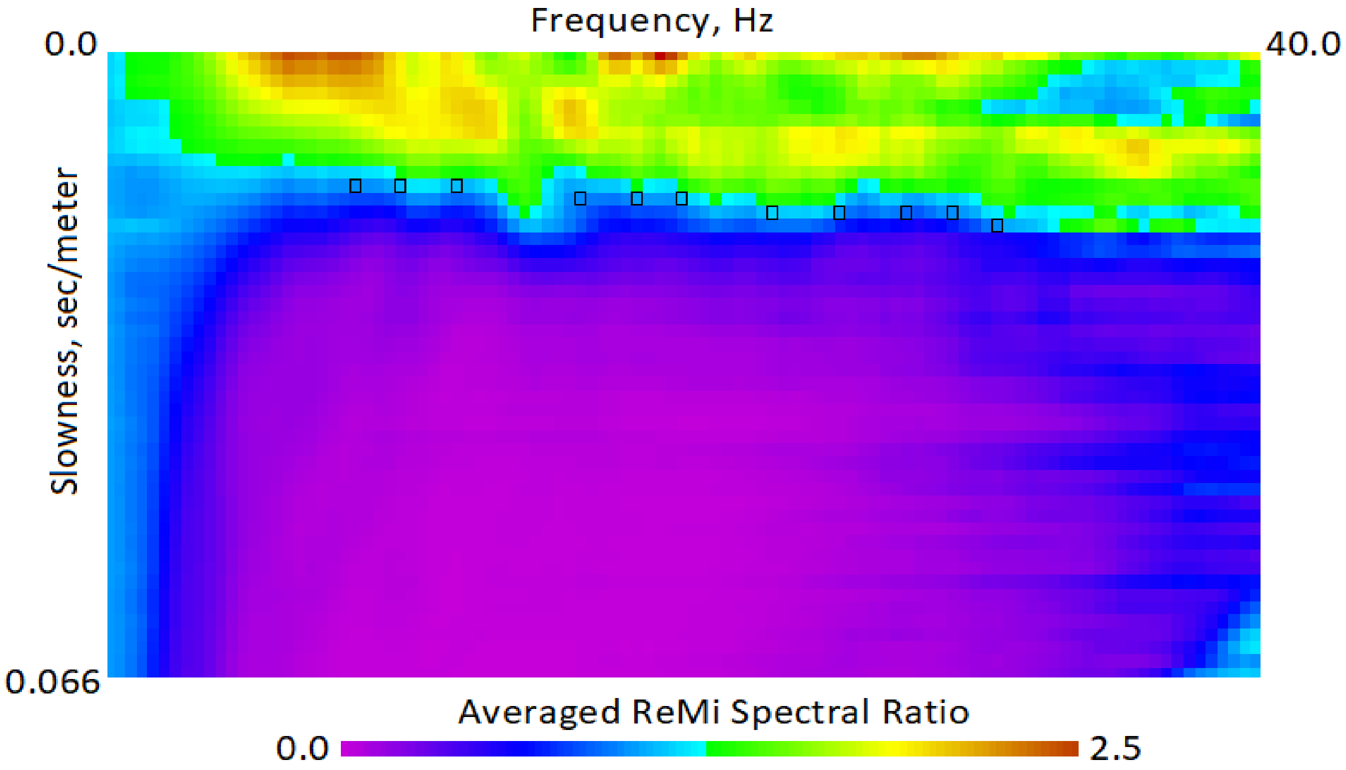
US 395 North Valleys
UPRR Grade Separation- South Abutment

Data Processed by: Andrew Rosenberg-Main Geophysicist, Data Analyst andrew.main@optimsoftware.com	Jesse Ruzicka Newfields	**Date:** 8/9/19	200 S. Virginia St. #560 Reno, NV 89501 support@optimsoftware.com www.optimsoftware.com

Dispersion Curve Showing Picks and Fit

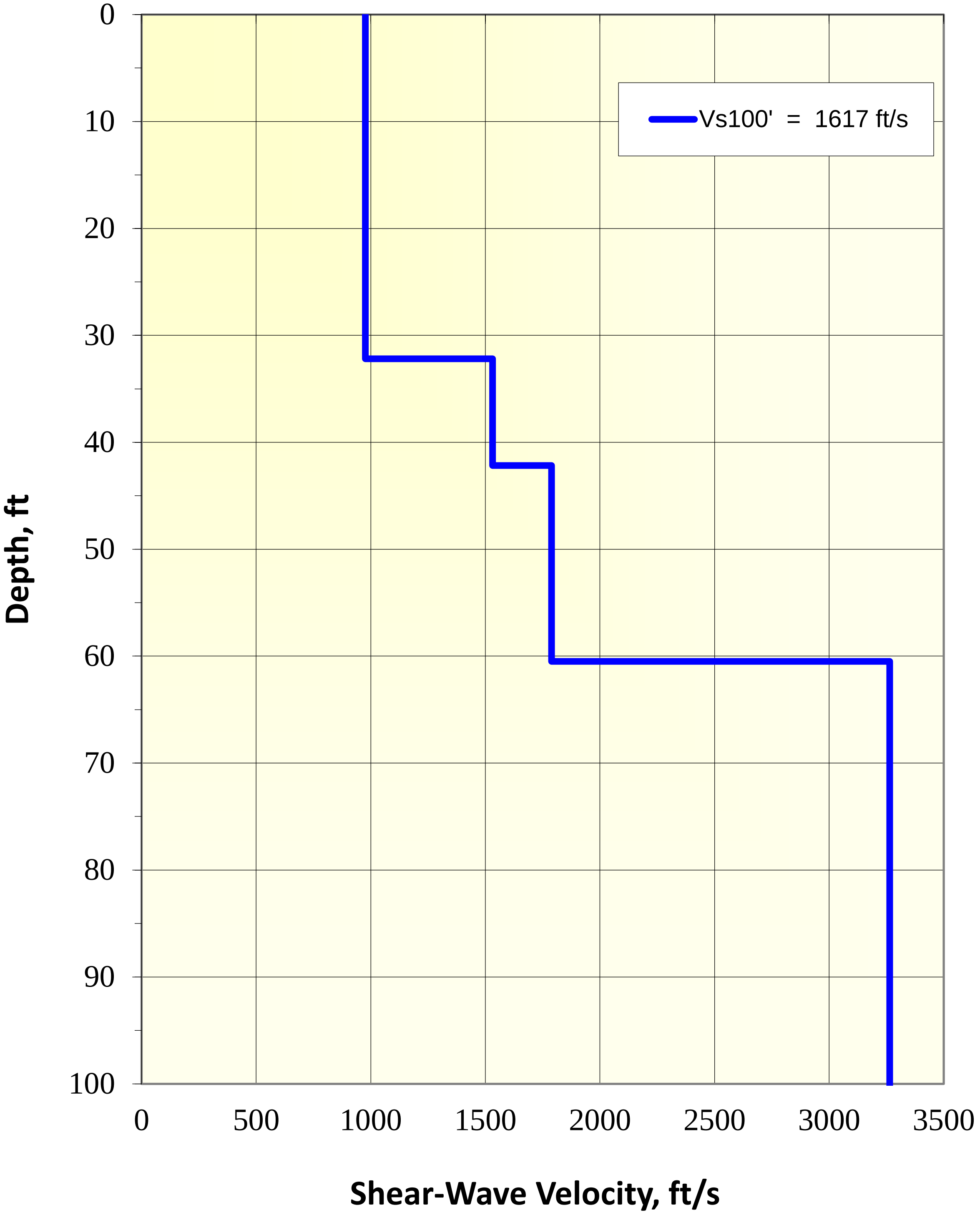


p-f Image with Dispersion Modeling Picks



Shear Wave Velocity Profile

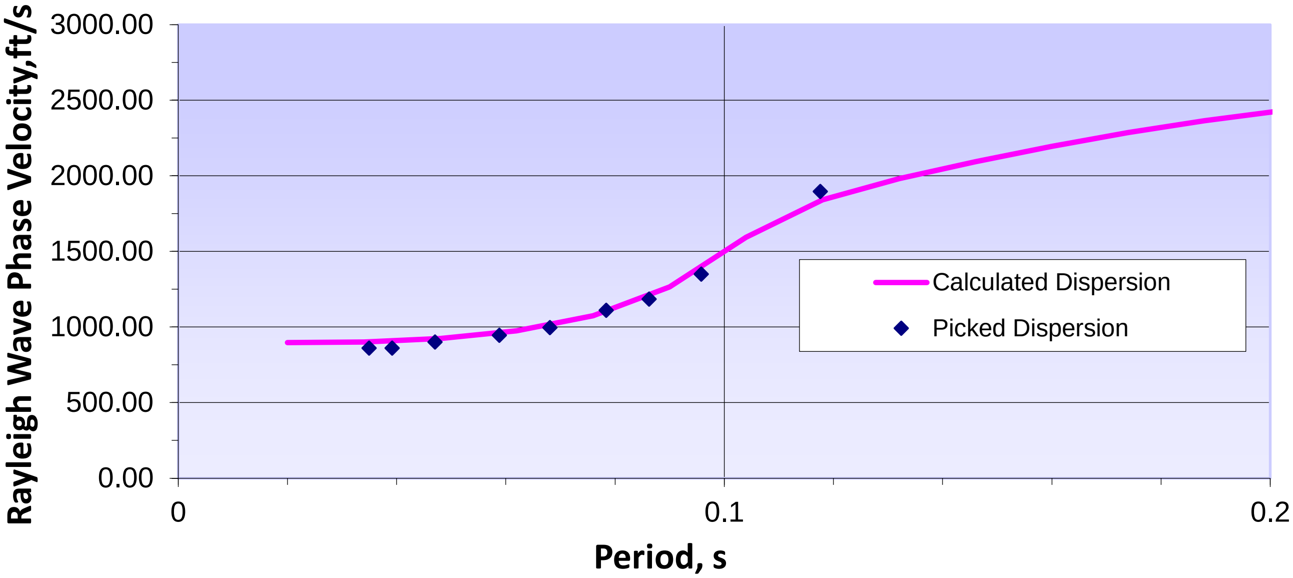
UPRR Grade Separation, North Abutment



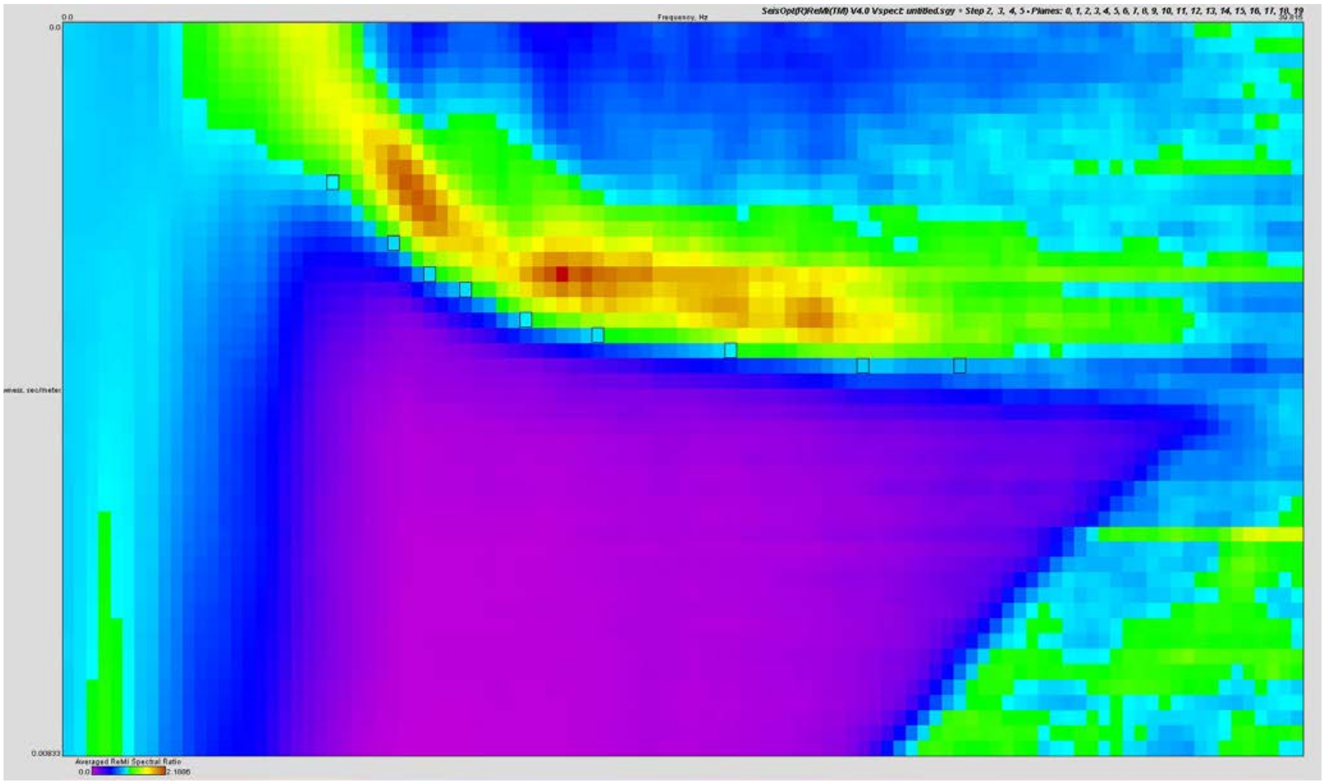
Dispersion Curve and Slowness Spectrum

UPRR Grade Separation, North Abutment

Dispersion Curve Showing Picks and Fit



p-f Image with Dispersion Modeling Picks



TECHNICAL MEMORANDUM

1301 N McCarran Blvd
Suite 101
Sparks, NV 89431

T: 775.525.2575
F: 775.525.2577

To: **Mr. Ruedy Edgington, P.E.**
Project Manager

From: **Mark Doehring, P.E.**

Reviewed by: **Jesse Ruzicka, P.E.**

Project: **US 395 North Valleys Project**

Project No: **475.0398.000**

Subject: **Retaining Wall Boring Logs and Laboratory Testing Results**

Date: **December 5, 2019**

This technical memorandum presents the boring logs and laboratory test results to support HDR's engineering and final design of project Retaining Walls No. 1 through 12.

Boring locations were selected based on the following information:

- Preliminary retaining wall alignments as shown on NDOT *Construction Plans*, Sheets No. 5 through No. 24 (NDOT, 2019);
- Table 3-2, Guidelines for minimum number, location, and depth of exploration points (FHWA, 2017);
- Site constraints (i.e. site topography and utility clearances).

The boring identification numbers, applicable retaining structures, drill rig identification numbers, stationing, offsets, elevations, and depths (below ground surface) are summarized in **Table 1**. The 'XN' line was used to determine stationing and offsets for borings drilled in the northbound lanes and highway median of US395. The 'XS' line was used to determine stationing and offsets for borings drilling in the southbound lanes. The 'V4' line was used to determine stationing and offsets for Retaining Wall No. 8. **Table 1** includes the pertinent bridge borings drilled to support both bridge and retaining wall design. Approximate boring locations are provided on the site plans in **Attachment A**.

Boring logs are provided in **Attachment B**. Boring logs are presented in the same order as listed in **Table 1**. The blow counts presented on the boring logs are field counts and have not been corrected for overburden pressures, hammer efficency, or sampler type. Copies of the energy transfer efficieny for the automatic hammers used during drilling are provided in **Attachment C.** A sampler correction factor of 0.65 is recommended for Mod Cal samplers 3 inch OD x 2.5 inch ID (Rogers, 2006).

Laboratory testing was performed on geotechnical samples representative of subsurface conditions encountered during the field investigation. The following geotechnical tests were performed:

- Natural Moisture Content (ASSHTO T265);
- In-Situ Density (ASTM D7236);
- Particle Size - Sieve Analysis (ASSHTO T88);
- Atterberg Limits (AASHTO T89 and T90).

Laboratory test results are summarized in **Table 2.**

Chemical tests were performed to evaluate corrosion potential and potential for sulfate attack on concrete. The following chemical tests were performed by Sunland Analytical of Rancho Cordova, California:

- pH (AASHTO T289);
- Minimum Resistivity (AASHTO T288 modified);
- Sulfate (AASHTO T290);
- Chloride (AASHTO T291).

Chemical test results are summarized in **Table 3**.

Laboratory and Chemical test results provided in **Attachment D**.

If you have any questions or require additional information, please do not hesitate to contact either Mark Doehring or Jesse Ruzicka at 775-525-2575.

LIST OF ATTACHMENTS

- Attachment A – Site Plans
- Attachment B – Boring Logs and Exploration Key
- Attachment C – Hammer Efficiency and Calibration Reports
- Attachment D - Laboratory Test Results

REFERENCES

FHWA, 2017. Geotechnical Engineering Circular No. 5, Geotechnical Site Characterization, Publication No. FHWA NHI-16-072, April.

NDOT, 2019a. Construction Plans, Carson City and Washoe County from US50/Williams Street to the Neil Road Int. Exit #62 from the Junction of I80 at the US395 Int. to California/Nevada State Line, Sheets No. 5 to No. 24, 26 February.

NDOT, 2019b. Wall X Sections for NewFields. 23 March

Rogers, J. David, 2006. Subsurface Exploration Using the Standard Penetration Test and the Cone Penetrometer Test. ENVIRONMENTAL & ENGINEERING GEOSCIENCE XII. No. 2: 161-179

Table 1: Summary of Retaining Wall Geotechnical Borings

Boring ID	Retaining Wall	Drill Rig ID	Line and Station[1]	Offset (ft)[1]	Elevation[2] (ft) amsl	Exploration Depth (ft)
BH19-RW1-01	Retaining Wall No. 1	HazTech 105	‘XN’ 620+40	20L	4628	31.5
BH19-RW1-02	Retaining Wall No. 1	HazTech 105	‘XN’ 622+15	20L	4637	30.1
BH19-RW1-03	Retaining Wall No. 1	HazTech 105	‘XN’ 624+20	20L	4646	30.8
BH19-RW1-04	Retaining Wall No. 1	HazTech 204	‘XN’ 626+10	20L	4656	30.4
BH19-RW1-05	Retaining Wall No. 1	HazTech 105	‘XN’ 627+90	20L	4665	30.0
BH19-RW1-06	Retaining Wall No. 1	HazTech 105	‘XN’ 629+95	20L	4675	30.5
BH19-RW2-07	Retaining Wall No. 2	HazTech BK81 (1541)	‘XN’ 628+75	25R	4670	31.5
BH19-RW2-08	Retaining Wall No. 2	HazTech 105	‘XN’ 631+10	20R	4679	30.1
BH19-RW3-09	Retaining Wall No. 3	HazTech 105	‘XN’ 700+30	30L	4918	30.9
BH19-RW3-10	Retaining Wall No. 3	HazTech BK81 (1541)	‘XN’ 702+40	30L	4924	30.8
BH19-RW3-11	Retaining Wall No. 3	HazTech 105	‘XN’ 704+40	30L	4929	30.1
BH19-RW3-12	Retaining Wall No. 3	HazTech 105	‘XN’ 706+50	30L	4934	31.4
BH19-RW3-13	Retaining Wall No. 3	HazTech 105	‘XN’ 708+65	30L	4937	30.3
BH19-RW3-14	Retaining Wall No. 3	HazTech BK81 (1541)	‘XN’ 710+75	30L	4941	31.5
BH19-RW3-15	Retaining Wall No. 3	HazTech 105	‘XN’ 712+80	60L	4936	30.9
BH19-RW3-16	Retaining Wall No. 3	HazTech 105	‘XN’ 714+85	30L	4948	30.7
BH19-RW3-17	Retaining Wall No. 3	HazTech 105	‘XN’ 716+90	55L	4939	30.7
BH19-RW3-18	Retaining Wall No. 3	HazTech BK81 (1541)	‘XN’ 718+85	25L	4951	31.5
BH19-RW3-19	Retaining Wall No. 3	HazTech BK81 (1541	‘XN’ 720+90	60L	4945	31.5
BH19-RW3-20	Retaining Wall No. 3	HazTech 105	‘XN’ 722+85	20L	4960	30.1
BH19-RW3-21	Retaining Wall No. 3	HazTech BK81 (1541)	‘XN’ 724+70	55L	4956	31.5
BH19-RW3-22	Retaining Wall No. 3	HazTech BK81 (1541)	‘XN’ 726+90	30L	4973	31.5

Boring ID	Retaining Wall	Drill Rig ID	Line and Station[1]	Offset (ft)[1]	Elevation[2] (ft) amsl	Exploration Depth (ft)
BH19-RW3-23	Retaining Wall No. 3	HazTech BK81 (1541)	'XN' 728+95	55L	4975	15.0[3]
BH19-RW3-24	Retaining Wall No. 3	HazTech BK81 (1541)	'XN' 731+00	25L	4989	30.5
BH19-RW3-25	Retaining Wall No. 3	HazTech BK81 (1541)	'XN' 733+00	55L	4998	31.5
BH19-RW4-26	Retaining Wall No. 4	Geotechnical Drilling Unit 17 / HazTech 105[4]	'XS' 723+60	30L	4953	60.3
BH19-RW4-27	Retaining Wall No. 4	Geotechnical Drilling Unit 5	'XS' 724+90	30L	4958	61.5
BH19-RW5-28	Retaining Wall No. 5	Geotechnical Drilling Unit 17	'XN' 724+30	40R	4961	52.0[3]
BH19-RW5-29	Retaining Wall No. 5	Geotechnical Drilling Unit 5	'XN' 725+50	35L	4966	56.0[3]
BH19-RW6-30	Retaining Wall No. 6	Geotechnical Drilling Unit 5	'XN' 762+00	30L	5067	31.5
BH19-RW6-31	Retaining Wall No. 6	Geotechnical Drilling Unit 5	'XN' 764+00	35L	5069	31.5
BH19-RW6-32	Retaining Wall No. 6	Geotechnical Drilling Unit 5	'XN' 766+10	50L	5075	31.5
BH19-RW6-33	Retaining Wall No. 6	Geotechnical Drilling Unit 5	'XN' 767+85	40L	5081	31.5
BH19-BR-17	Retaining Wall No. 7	Geotechnical Drilling Unit 5	'XN' 772+20	35L	5099	100.7
BH19-RW7-34	Retaining Wall No. 7	Geotechnical Drilling Unit 5	'XN' 774+35	25L	5103	30.3
BH19-RW7-35	Retaining Wall No. 7	Geotechnical Drilling Unit 5	'XN' 776+40	30L	5111	30.3
BH19-RW7-36	Retaining Wall No. 7	Geotechnical Drilling Unit 5	'XN' 778+40	30L	5122	30.5
BH19-RW7-37	Retaining Wall No. 7	Geotechnical Drilling Unit 5	'XN' 780+55	30L	5132	30.3
BH19-RW7-38	Retaining Wall No. 7	Geotechnical Drilling Unit 17	'XN' 782+50	30L	5139	30.5
BH19-RW7-39	Retaining Wall No. 7	Geotechnical Drilling Unit 17	'XN' 784+60	30L	5147	30.8
BH19-RW7-40	Retaining Wall No. 7	Geotechnical Drilling Unit 17	'XN' 786+80	30L	5158	24.0[3]
BH19-RW7-41	Retaining Wall No. 7	Geotechnical Drilling Unit 17	'XN' 788+80	30L	5163	30.5
BH19-RW7-42	Retaining Wall No. 7	Geotechnical Drilling Unit 17	'XN' 790+80	30L	5169	30.5
BH19-RW7-43	Retaining Wall No. 7	Geotechnical Drilling Unit 17	'XN' 792+80	30L	5176	24.0[3]

Boring ID	Retaining Wall	Drill Rig ID	Line and Station[1]	Offset (ft)[1]	Elevation[2] (ft) amsl	Exploration Depth (ft)
BH19-RW7-44	Retaining Wall No. 7	Geotechnical Drilling Unit 5	‘XN’ 794+85	30L	5182	30.0
BH19-RW7-45	Retaining Wall No. 7	Geotechnical Drilling Unit 5	‘XN’ 796+80	30L	5186	31.0
BH19-RW7-46	Retaining Wall No. 7	Geotechnical Drilling Unit 5	‘XN’ 798+70	30L	5189	31.5
BH19-BR-20	Retaining Wall No. 7	Geotechnical Drilling Unit 5	‘XN’ 799+90	30L	5191	101.0
BH19-RW8-47	Retaining Wall No. 8	HazTech 204	‘V4’ 22+15	35L	5077	30.3
BH19-RW8-48	Retaining Wall No. 8	HazTech 204	‘V4’ 24+40	35L	5088	31.3
BH19-RW8-49	Retaining Wall No. 8	Geotechnical Drilling Unit 17	‘V4’ 26+80	35L	5098	27.0[3]
BH19-RW8-50	Retaining Wall No. 8	HazTech 204	‘V4’ 29+25	15L	5110	31.4
BH19-BR-18	Retaining Wall No. 8	Geotechnical Drilling Unit 17	‘V4’ 32+15	15L	5132	101.0
BH19-BR-19	Retaining Wall No.9	HazTech 204	‘XN’ 782+45	80R	5136	100.5
BH19-RW9-51	Retaining Wall No.9	HazTech 204	‘XN’ 784+70	55R	5145	31.3
BH19-RW9-52	Retaining Wall No. 9	HazTech 204	‘XN’ 785+95	50R	5152	31.5
BH19-RW10-53	Retaining Wall No. 10	HazTech 204	‘XN’ 787+25	115R	5157	31.4
BH19-RW11-54	Retaining Wall No. 11	Geotechnical Drilling Unit 5	‘XN’ 847+50	35L	5153	31.5
BH19-RW11-55	Retaining Wall No. 11	Geotechnical Drilling Unit 5	‘XN’ 849+50	30L	5148	31.5
BH19-RW11-56	Retaining Wall No. 11	Geotechnical Drilling Unit 5	‘XN’ 851+60	50L	5143	30.5
BH19-RW11-57	Retaining Wall No. 11	Geotechnical Drilling Unit 5	‘XN’ 853+65	50L	5134	31.5
BH19-RW11-58	Retaining Wall No. 11	Geotechnical Drilling Unit 5	‘XN’ 855+65	10L	5128	31.5
BH19-RW11-59	Retaining Wall No. 11	HazTech 105	‘XN’ 857+70	10L	5123	31.5
BH19-RW11-60	Retaining Wall No. 11	HazTech 105	‘XS’ 859+70	10R	5127	31.5
BH19-RW11-61	Retaining Wall No. 11	HazTech 105	‘XS’ 861+75	10R	5127	31.5
BH19-RW11-62	Retaining Wall No. 11	HazTech 105	‘XN’ 863+80	10L	5120	31.5
BH19-RW11-63	Retaining Wall No. 11	HazTech 105	‘XN’ 865+85	10L	5121	31.5

Boring ID	Retaining Wall	Drill Rig ID	Line and Station[1]	Offset (ft)[1]	Elevation[2] (ft) amsl	Exploration Depth (ft)
BH19-RW11-64	Retaining Wall No. 11	HazTech 105	‘XS’ 867+80	10R	5127	31.5
BH19-RW11-65	Retaining Wall No. 11	HazTech 105	‘XN’ 870+05	10L	5123	31.5
BH19-RW11-66	Retaining Wall No. 11	HazTech 105	‘XS’ 871+95	10R	5129	31.5
BH19-BR-29	Retaining Wall No. 11	HazTech BK81	‘XN’ 873+90	10L	5125	101.5
BH19-RW12-67	Retaining Wall No. 12	HazTech BK81	‘XS’ 641+15	30L	4722	60.3
BH19-RW12-68	Retaining Wall No. 12	HazTech BK81	‘XS’ 643+05	30L	4726	61.5
BH19-RW12-69	Retaining Wall No. 12	Geotechnical Drilling Unit 5	‘XS’ 645+00	30L	4730	61.5
BH19-RW12-70	Retaining Wall No. 12	Geotechnical Drilling Unit 5	‘XS’ 647+00	30L	4734	61.5

Notes:

[1] **Stationing and offsets were estimated using the *Construction Drawings* (NDOT, 2019a).**

[2] **Elevations are based on Wall Sections (NDOT, 2019b)**

[3] **Boring encountered practical refusal.**

[4] **Surface to 26.5 ft was drilled using Geotechnical Drilling Unit 17; 26.5 ft to 60.3 ft drilling using HazTech Unit 105.**

Table 2: Laboratory Test Summary

Boring ID	Depth (feet bgs)	USCS Group Name	USCS Group Symbol	GRAIN SIZE DISTRIBUTION (% PASSING)														Atterberg Limits			Natural Moisture Content (%)	Natural Dry Density (PCF)
				GRAVEL							SAND						FINES	Liquid Limit	Plastic Limit	Plastic Index		
				3.0"	2.0"	1.5"	1.0"	0.75"	0.5"	0.375"	#4	#10	#16	#40	#50	#100	#200					
BH19-RW1-02	5'-6.5'	Clayey Gravel with Sand	GC	100.0	100.0	94.7	81.4	77.8	71.4	69.3	64.8	59.2	55.8	48.0	44.8	37.0	30.5	63	23	40	25.9	-
BH19-RW1-03	7.5'-9'	Andesite – clayey sand / sandy clay	CH/SC	100.0	100.0	100.0	100.0	100.0	98.5	98.5	97.5	95.8	94.4	90.3	86.2	68.4	50.1	-	-	-	32.8	-
BH19-RW1-03	11'-11.5'	Andesite – sandy clay	CH	100.0	100.0	100.0	100.0	100.0	100.0	100.0	98.5	92.7	88.3	79.9	76.7	66.4	56.1	61	28	33	-	-
BH19-RW1-05	7.5'-9'	Andesite - clayey sand	SC	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.3	95.7	90.2	68.9	59.4	40.4	28.6	69	26	43	29.9	-
BH19-RW2-07	7.5'-9'	Andesite - clayey sand with gravel	SC	100.0	100.0	100.00	100.0	100.0	94.6	89.6	71.7	52.1	42.8	28.6	25.1	18.8	14.5	44	23	21	17.3	-
BH19-RW2-08	7.5'-9'	Andesite – sandy clay	CH	100.0	100.0	100.0	100.0	100.0	100.0	99.6	99.6	99.6	99.5	98.4	97.5	92.6	77.8	61	30	31	22.5	-
BH19-RW3-11	5'-5.5'	Andesite - sandy gravel with silt	GP/GM	100.0	100.0	100.0	91.3	85.3	66.4	58.3	38.3	24.5	18.8	12.0	10.5	7.9	6.3	NP	NP	NP	9.5	-
BH19-RW3-13	7.5'-9'	Andesite – clayey gravel with sand	GC	100.0	100.0	100.0	93.8	78.5	70.8	64.9	53.1	39.7	33.8	25.1	22.8	18.9	16.1	31	18	13	10.7	-
BH19-RW3-16	10’-11.5'	Fill - clayey sand with gravel	SC	100.0	100.0	100.0	100.0	98.7	97.9	97.6	68.6	49.9	41.1	29.8	26.7	20.7	16.4	35	20	15	13.9	-
BH19-RW3-18	15'-16.5'	Andesite - clayey sand	SC	100.0	100.0	100.0	100.0	100.0	100.0	100.0	88.1	76.7	69.0	57.6	53.9	45.4	38.3	53	19	34	21.9	-
BH19-RW3-21	7.5'-9'	Fill – clayey sand	SC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	34	15	19	12.5	-
BH19-RW3-22	15'-16.5	Fill – clayey gravel with sand	GC	100.0	100.0	100.0	85.3	78.1	71.7	67.3	52.2	38.3	32.2	23.2	20.9	16.6	13.6	32	16	16	8.7	-
BH19-RW3-24	5’-6.5’	Clayey Gravel with Sand	GC	100.0	100.0	94.6	88.7	80.2	72.5	69.5	52.8	38.1	31.6	23.2	21.1	17.2	14.4	36	17	19	10.4	-
BH19-RW4-26	6’-6.5’	Fill – clayey gravel with sand	GC	100.0	100.0	83.1	77.4	72.9	68.6	65.6	60.9	53.1	47.3	37.6	34.8	29.5	25.5	39	15	24	15.1	-
BH19-RW4-26	15’-16.5’	Fill – silty sand with gravel	SM	100.0	100.0	100.0	100.0	94.9	85.4	78.0	69.0	59.4	54.7	46.7	44.1	38.8	34.6	43	31	12	17.0	-
BH19-RW4-26	30’-31.5’	Andesite – clayey sand with gravel	SC	100.0	100.0	100.0	100.0	93.1	87.1	82.0	64.4	46.7	38.5	27.3	24.3	18.8	14.7	37	18	19	14.4	-
BH19-RW4-27	15’-16.5’	Fill – clayey sand with gravel	SC	100.0	100.0	100.0	100.0	93.5	84.6	78.5	68.1	57.8	52.1	41.7	38.5	32.5	27.8	34	17	17	12.1	-
BH19-RW4-27	35’-36.5’	Fill – clayey gravel with sand	GC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.9	-
BH19-RW4-27	40.5’-41’	Sandy Clay	CH	100.0	100.0	100.0	100.0	100.0	99.6	99.0	98.3	97.2	96.1	92.7	90.8	86.4	81.5	66	19	47	24.4	-
BH19-RW5-28	5’-6’	Fill – clayey gravel with sand	GC	100.0	100.0	100.0	89.1	79.4	72.1	68.3	58.0	45.5	38.6	27.5	24.8	20.2	17.0	33	17	16	16.8	-
BH19-RW5-28	10’-11.5’	Fill – clayey gravel with sand	GC	100.0	100.0	100.0	88.5	73.3	62.5	58.0	45.5	34.4	29.5	22.0	20.0	16.3	13.6	38	17	21	13.1	-
BH19-RW5-28	40’-41.5’	Clayey Sand with Gravel	SC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	24.6	-

Boring ID	Depth (feet bgs)	USCS Group Name	USCS Group Symbol	GRAIN SIZE DISTRIBUTION (% PASSING)														Atterberg Limits			Natural Moisture Content (%)	Natural Dry Density (PCF)
				GRAVEL							SAND						FINES	Liquid Limit	Plastic Limit	Plastic Index		
				3.0"	2.0"	1.5"	1.0"	0.75"	0.5"	0.375"	#4	#10	#16	#40	#50	#100	#200					
BH19-RW5-29	6’-6.5’	Fill – gravel with clay and sand	GP/GC	100.0	100.0	79.7	71.1	59.9	50.3	45.8	31.9	22.6	18.7	13.2	11.8	9.5	7.9	35	15	20	9.8	-
BH19-RW5-29	15’-16.5’	Fill –clayey gravel with sand	GC	100.0	100.0	100.0	85.8	77.5	68.4	66.2	55.5	45.0	39.9	31.3	28.4	22.2	17.5	29	13	16	10.0	-
BH19-RW5-29	26’-26.5’	Fill – clayey sand with gravel	SC	100.0	100.0	100.0	100.0	96.0	84.9	80.8	69.9	56.7	49.9	38.7	35.3	28.6	23.5	39	15	24	16.0	-
BH19-RW5-29	35’-36.5’	Clayey Sand with Gravel	SC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20.2	-
BH19-RW6-31	2.5’-4’	Fill – clayey gravel with sand	GC	100.0	100.0	100.0	92.0	77.3	62.1	56.1	46.2	35.8	31.2	23.3	21.0	16.4	12.8	31	21	10	8.0	-
BH19-RW6-31	6’-6.5’	Fill- clayey gravel with sand	GC	100.0	100.0	100.0	85.4	80.6	69.1	63.9	52.9	41.8	36.8	28.6	26.0	21.0	16.7	28	21	7	12.6	-
BH19-RW6-32	2.5’-4’	Fill – silty sand with grave	SM	100.0	100.0	100.0	100.0	92.3	86.3	84.2	70.6	51.3	42.0	29.2	25.8	19.6	15.2	NP	NP	NP	6.2	-
BH19-RW6-32	15’-16.5’	Fill – clayey sand with gravel	GC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14.5	-
BH19-RW7-34	2.5’-4’	Fill – clayey sand with gravel	SC	100.0	100.0	100.0	94.0	85.2	78.4	75.6	62.9	48.8	42.0	30.9	27.6	21.2	16.2	31	17	14	5.3	-
BH19-RW7-34	5’-6’	Fill – clayey sand with gravel	SC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9.7	-
BH19-RW7-34	11’-11.5’	Fill – clayey gravel with sand	GC	100.0	100.0	81.6	64.2	59.9	52.1	49.9	40.5	31.8	27.9	21.5	19.6	15.6	12.3	30	15	15	11.9	-
BH19-RW7-34	15’-16.5’	Fill – clayey gravel with sand	GC	100.0	100.0	100.0	79.4	64.5	56.1	54.9	46.0	34.8	30.3	22.8	20.7	17.0	13.9	26	18	8	9.8	-
BH19-RW7-36	6’-6.5’	Fill – clayey gravel with sand	GC	100.0	100.0	100.0	89.1	73.7	63.5	60.6	49.4	36.6	30.4	22.0	19.8	16.1	13.3	31	16	15	10.1	-
BH19-RW7-38	2.5’-4’	Clayey Sand with Gravel	SC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10.4	-
BH19-RW7-38	10’-10.5’	Granodiorite – gravel with clay and sand	GP/GC	100.0	100.0	93.2	69.5	59.8	51.0	46.3	35.0	25.3	20.8	14.4	12.8	10.0	8.2	24	15	9	10.2	-
BH19-RW7-40	6’-6.5’	Granodiorite – gravel with clay and sand	GP/GC	100.0	100.0	100.0	95.6	90.5	73.7	69.6	52.4	32.9	25.1	15.2	13.1	9.5	7.1	23	14	9	5.2	-
BH19-RW7-41	2.5’-4’	Clayey Sand with Gravel	SC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9.1	-
BH19-RW7-41	11’-11.5’	Granodiorite – clayey sand	SC	100.0	100.0	100.0	100.0	96.2	94.7	94.5	87.4	74.9	68.3	56.3	51.8	40.6	30.5	35	20	15	15.5	-
BH19-RW7-42	2.5’-4’	Silty Sand with Gravel	SM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.3	-
BH19-RW7-42	7.5’-9’	Clayey Sand with Gravel	SC	100.0	100.0	100.0	100.0	94.8	84.0	80.3	72.9	61.3	53.2	38.3	33.7	24.9	18.3	26	18	8	10.1	-
BH19-RW7-43	6’-6.5’	Granodiorite – sand with clay and gravel	SP/SC	100.0	100.0	100.0	83.2	78.3	76.2	73.8	59.7	42.9	34.3	21.6	18.5	13.1	9.4	29	19	10	8.9	-
BH19-RW7-44	7.5’-9’	Clayey Gravel with Sand	GC	100.0	100.0	100.0	87.5	78.9	65.0	60.8	47.5	36.5	31.3	23.4	21.1	16.8	13.3	28	17	11	8.1	-

Boring ID	Depth (feet bgs)	USCS Group Name	USCS Group Symbol	GRAIN SIZE DISTRIBUTION (% PASSING)														Atterberg Limits			Natural Moisture Content (%)	Natural Dry Density (PCF)
				GRAVEL							SAND						FINES	Liquid Limit	Plastic Limit	Plastic Index		
				3.0"	2.0"	1.5"	1.0"	0.75"	0.5"	0.375"	#4	#10	#16	#40	#50	#100	#200					
BH19-RW7-44	15'-16.5'	Clayey Sand with Gravel	SC	100.0	100.0	100.0	100.0	94.6	90.7	87.8	76.9	60.0	48.4	32.5	28.7	22.0	16.9	28	17	11	15.1	-
BH19-RW7-45	2.5'-4'	Silty Clayey Sand	SC/SM	100.0	100.0	100.0	100.0	97.6	95.9	95.3	85.3	64.6	52.3	35.4	31.3	24.1	18.4	24	18	6	7.9	-
BH19-RW7-46	2.5'-4'	Fill – clayey sand with gravel	GC	100.0	100.0	100.0	100.0	97.4	94.3	93.5	85.5	63.8	51.0	33.5	29.5	22.6	17.3	27	18	9	9.7	-
BH19-RW7-46	11'-11.5'	Fill – sand with silt	SP/SM	100.0	100.0	100.0	100.0	100.0	99.3	98.9	88.4	63.3	47.5	27.2	22.9	15.7	10.7	NP	NP	NP	9.3	114.2
BH19-RW8-47	2.5'-4'	Andesite – clayey sand with gravel	SC	100.0	100.0	100.0	100.0	94.2	89.2	86.2	68.6	50.4	41.8	29.4	26.2	20.7	16.7	32	22	10	11.8	-
BH19-RW8-47	15'-15.5'	Andesite – clayey sand with gravel	SC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16.7	-
BH19-RW8-48	6'-6.5'	Granodiorite – sandy silt	ML	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.6	97.9	85.8	79.5	74.4	66.2	55.6	NP	NP	NP	23.6	-
BH19-RW8-49	2.5'-3'	Fill – silty sand with gravel	SM	100.0	100.0	100.0	100.0	100.0	90.5	85.4	73.1	55.6	46.8	31.8	27.4	19.6	14.2	NP	NP	NP	5.1	-
BH19-RW8-50	6'-6.5'	Fill – clayey sand with gravel	SC	100.0	100.0	100.0	100.0	100.0	92.8	91.3	79.5	68.1	62.1	51.6	48.0	40.4	33.6	41	21	20	19.1	-
BH19-RW9-51	2.5'-4'	Silty Sand with Gravel	SM	100.0	100.0	100.0	100.0	100.0	100.0	100.0	84.9	68.5	60.3	45.5	41.1	31.2	24.2	28	22	6	11.0	-
BH19-RW9-51	10.5'-11'	Granodiorite – clayey sand with gravel	GC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18.1	-
BH19-RW9-52	5.5'-6'	Granodiorite – silty sand with gravel	SM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12.5	128.7
BH19-RW9-52	7.5'-9'	Granodiorite – silty sand with gravel	SM	100.0	100.0	100.0	100.0	97.1	93.1	90.2	69.5	53.5	46.1	35.7	32.8	26.9	21.6	32	25	7	-	-
BH19-RW9-52	11'-11.5'	Granodiorite – silty sand with gravel	SM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14.9	113.0
BH19-RW10-53	5'-6.5'	Granodiorite – sandy silt	ML	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.9	99.8	97.4	96.0	89.9	78.8	39	26	13	22.0	-
BH19-RW10-53	10'-11.5'	Granodiorite – sandy silt	ML	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16.6	-
BH19-RW11-54	2.5'-4'	Clayey Sand	SC	100.0	100.0	100.0	100.0	98.3	94.9	94.0	88.6	74.8	62.9	43.7	38.6	28.6	22.5	32	13	19	11.0	106.5
BH19-RW11-54	10'-11.5'	Clayey Sand	SC	100.0	100.0	100.0	100.0	100.0	100.0	99.7	98.8	88.4	71.8	40.4	33.7	23.9	18.5	37	16	21	13.0	110.4
BH19-RW11-55	5'-6.5'	Clayey Sand	SC	100.0	100.0	100.0	100.0	98.9	96.6	95.6	88.3	65.4	48.9	28.6	24.5	17.5	12.4	38	21	17	11.5	111.2
BH19-RW11-56	2.5'-4'	Clayey Sand	SC	100.0	100.0	100.0	100.0	100.0	99.3	99.3	97.3	90.3	83.9	639.0	62.2	41.7	25.8	26	15	11	13.2	127.0
BH19-RW11-56	10'-11.5'	Sand	SP	100.0	100.0	100.0	100.0	100.0	99.4	98.3	94.1	73.3	56.1	26.6	18.6	6.0	0.6	NP	NP	NP	6.6	107.6
BH19-RW11-57	2.5'-4'	Clayey Sand	SC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10.1	-
BH19-RW11-57	10'-11.5'	Silty Clayey Sand	SM/SC	100.0	100.0	100.0	100.0	100.0	100.0	99.2	95.6	80.2	65.3	39.1	32.7	21.8	15.1	22	17	5	8.1	-
BH19-RW11-58	0-1.5'	Fill – sandy clay	CL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15.5	-
BH19-RW11-58	10'-11.5'	Clayey Sand	SC	100.0	100.0	100.0	100.0	97.9	96.9	96.3	90.2	78.7	68.8	50.3	44.8	33.7	25.8	31	13	18	15.5	-

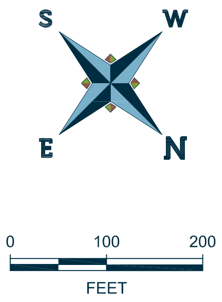
Boring ID	Depth (feet bgs)	USCS Group Name	USCS Group Symbol	GRAIN SIZE DISTRIBUTION (% PASSING)														Atterberg Limits			Natural Moisture Content (%)	Natural Dry Density (PCF)
				GRAVEL							SAND						FINES					
				3.0"	2.0"	1.5"	1.0"	0.75"	0.5"	0.375"	#4	#10	#16	#40	#50	#100	#200	Liquid Limit	Plastic Limit	Plastic Index		
BH19-RW11-58	15'-16.5'	Clayey Sand	SC	100.0	100.0	100.0	100.0	96.0	93.6	93.0	89.8	79.8	70.6	52.8	47.5	37.0	29.9	35	13	22	9.4	-
BH19-RW11-61	10'-11.5'	Silty Sand	SM	100.0	100.0	100.0	100.0	100.0	97.9	97.0	92.3	73.5	59.0	35.5	27.9	16.9	12.1	NP	NP	NP	7.0	111.1
BH19-RW11-64	7.5'-8.5'	Clayey Sand with Gravel	SC	100.0	100.0	100.0	100.0	97.5	87.8	85.1	72.1	59.3	51.3	36.1	32.0	24.4	18.8	29	13	16	9.6	-
BH19-RW11-66	10'-11.5'	Silty Clayey Sand	SM/SC	100.0	100.0	100.0	100.0	100.0	100.0	100.0	98.7	91.3	83.2	69.8	65.4	52.3	37.9	23	16	7	12.4	107.8
BH19-RW12-67	21'-21.5'	Fill – clayey gravel with sand	GC	100.0	100.0	76.7	76.7	75.9	63.6	60.2	57.7	52.6	48.3	38.5	35.6	30.1	25.8	49	22	27	-	-
BH19-RW12-67	25'-26.5'	Sandy Clay	CL	100.0	100.0	100.0	100.0	100.0	99.2	97.7	95.2	92.4	90.7	86.3	84.4	78.8	73.2	-	-	-	24.5	-
BH19-RW12-67	41'-41.5'	Silty Sand	SM	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.9	99.4	95.6	79.2	70.8	51.9	36.8	NP	NP	NP	34.3	84.8
BH19-RW12-69	7.5'-9'	Fill - gravel with silt and sand	GM/GP	100.0	100.0	100.0	90.7	84.0	74.3	70.0	49.6	35.6	29.8	21.0	18.5	14.5	11.5	44	31	13	11.6	-
BH19-RW12-69	15'-16.5'	Fill - gravel with silt and sand	GM/GP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.6	-
BH19-RW12-69	30'-30.5'	Clayey Sand	SC	100.0	100.0	100.0	100.0	100.0	100.0	100.0	93.2	85.4	79.9	69.1	65.4	55.2	47.0	66	20	46	7.1	-
BH19-RW12-69	40'-41.5'	Clayey Gravel with Sand	GC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.2	-
BH19-RW12-70	11'-11.5'	Fill - silty sand with gravel	SM	100.0	100.0	82.3	82.3	77.7	74.9	73.8	73.0	71.4	66.6	40.6	33.5	23.8	18.2	52	30	22	14.3	108.6
BH19-RW12-70	35'-36'	Clayey Sand	SC	100.0	100.0	100.0	100.0	100.0	100.0	100.0	91.6	78.3	70.3	55.1	50.0	40.6	32.6	34	24	10	16.7	-
BH19-BR-17	15'-16.5'	Fill – clayey sand	SC	100.0	100.0	100.0	96.6	88.0	82.7	82.3	72.8	59.7	52.6	41.4	38.2	31.8	26.6	44	25	19	25.5	-
BH19-BR-17	40.5'-41'	Granodiorite – silty sand	SM	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.9	99.1	82.6	69.3	43.9	28.6	NP	NP	NP	15.5	124.5
BH19-BR-17	51'-51.5'	Granodiorite - silty sand	SM	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	98.9	99.3	90.9	79.8	51.1	33.2	NP	NP	NP	18.3	121.7
BH19-BR-17	65'-66.5'	Granodiorite – silty sand	SM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	23.7	-
BH19-BR-18	25'-26.5'	Granodiorite – clayey sand	SC	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.5	98.3	93.8	72.3	65.5	53.2	43.4	33	18	15	15.7	-
BH19-BR-18	31'-31.5'	Granodiorite – clayey sand	SC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9.4	-
BH19-BR-18	40.5'-41'	Granodiorite – clayey sand	SC	100.0	100.0	100.0	100.0	100.0	100.0	100.0	86.8	74.8	67.2	47.9	42.6	31.9	24.0	32	23	9	13.4	-
BH19-BR-19	20'-20.5'	Granodiorite – sandy clay	CL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	88.0	78.8	75.9	73.1	72.2	68.9	62.1	41	26	15	-	-
BH19-BR-19	20.5'-21	Granodiorite – sandy clay	CL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	17.8	97.9

Boring ID	Depth (feet bgs)	USCS Group Name	USCS Group Symbol	GRAIN SIZE DISTRIBUTION (% PASSING)														Atterberg Limits			Natural Moisture Content (%)	Natural Dry Density (PCF)
				GRAVEL							SAND						FINES	Liquid Limit	Plastic Limit	Plastic Index		
				3.0"	2.0"	1.5"	1.0"	0.75"	0.5"	0.375"	#4	#10	#16	#40	#50	#100	#200					
BH19-BR-19	35’-36’	Granodiorite – clayey sand	SC	100.0	100.0	100.0	100.0	100.0	100.0	100.0	93.3	82.1	75.5	66.1	62.8	53.4	44.7	33	24	9	16.4	-
BH19-BR-19	50’-51’	Granodiorite – clayey silt	ML	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16.1	-
BH19-BR-20	21’-21.5	Granodiorite – clayey sand	SC	100.0	100.0	100.0	100.0	100.0	97.0	95.9	87.7	68.3	54.9	35.7	31.4	24.1	18.3	27	16	11	9.0	123.6
BH19-BR-20	40.5’-41	Granodiorite – clayey sand	SC	100.0	100.0	100.0	100.0	100.0	98.4	96.8	87.8	73.1	63.4	42.5	36.2	25.3	18.1	34	19	15	11.5	-
BH19-BR-20	65’-66.5	Granodiorite – clayey sand	SC	100.0	100.0	100.0	100.0	100.0	97.7	97.2	89.7	78.2	71.3	60.5	57.7	52.2	46.9	34	16	18	12.0	-
BH19-BR-29	15’-16.5’	Fill – clayey sand	SC	100.0	100.0	100.0	100.0	100.0	100.0	100.0	98.1	87.5	77.2	61.3	57.1	46.9	36.0	27	13	14	12.3	-
BH19-BR-29	35’-36.5’	Clayey Sand	SC	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.2	89.6	79.6	59.9	54.2	42.6	33.2	24	12	12	12.6	-
BH19-BR-29	45’-46.5’	Clayey Sand	SC	100.0	100.0	100.0	100.0	100.0	100.0	99.3	98.5	88.7	78.0	57.7	51.5	38.9	29.1	25	13	12	13.9	-

Table 3: Chemical Test Summary

Boring ID	Depth (ft)	Soil pH	Min Resistivity (ohm-cm)	Chloride (ppm)	Sulfate (ppm)
BH19-RW1-03	7.5 - 9	7.85	270	97.0	148.9
BH19-RW2-07	7.5 - 9	6.17	350	338.0	31.0
BH19-RW3-11	5.5 - 6	7.05	860	95.1	8.2
BH19-RW3-17	10 - 11.5	6.98	230	280.2	1380.4
BH19-RW4-26	5 - 6	7.20	250	258.5	630.6
BH19-RW5-28	7.5 - 9	11.48	350	31.3	51.3
BH19-RW6-32	7.7 - 9	7.05	1310	47.41	0.4
BH19-RW7-44	10 -11.5	6.03	2280	38.6	7.3
BH19-RW8-48	2.5 - 4	5.90	320	352.5	720.9
BH19-RW8-49	5 – 6.5	6.41	1210	78.5	21.7
BH19-RW9-51	7.5 - 9	4.71	380	76.5	127.7
BH19-RW10-53	8 - 9	6.75	1340	20.8	24.0
BH19-RW11-58	7.5 - 8	7.06	830	74.4	12.6
BH19-RW11-64	5.5 - 6	6.90	480	323.6	176.9
BH19-RW12-70	25 - 26.5	7.33	720	173.3	393.5
BH19-BR-17	45 – 46.5	6.47	640	110.5	64.3
BH19-BR-18	20 - 21	6.30	1070	77.6	69.6
BH19-BR-19	25 - 26.5	3.76	2550	52.6	1.9

ATTACHMENT A
Site Plans



LEGEND:

BORING LOCATIONS

● RETAINING WALL BORING

NewFields

AREA	CLIENT
US395	NDOT

PROJECT
NDOT US395 NORTH VALLEYS

PROJECT NUMBER
475.0398.000

LOCATION
WASHOE COUNTY,
NEVADA

DOCUMENT FILENAME
FIG8RW1_MISSINGORTHO.DWG

FIGURE TITLE
SITE PLAN - RETAINING WALLS 1, 2, AND 12

NEVADA DOT SAFE AND CONNECTED

FIGURE NUMBER	REVISION
1	0

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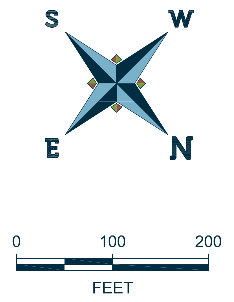

LEGEND:

BORING LOCATIONS

● RETAINING WALL BORING

NewFields

AREA	CLIENT
US395	NDOT

PROJECT NUMBER: 475.0398.000

LOCATION: WASHOE COUNTY, NEVADA

DOCUMENT FILENAME: FIG7RW3A_BETTER.DWG

PROJECT: NDOT US395 NORTH VALLEYS

FIGURE TITLE: SITE PLAN - RETAINING WALL 3

NEVADA DOT SAFE AND CONNECTED

FIGURE NUMBER: 2

REVISION: 0

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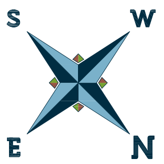
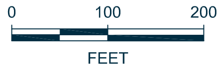
LEGEND:

BORING LOCATIONS

● RETAINING WALL BORING



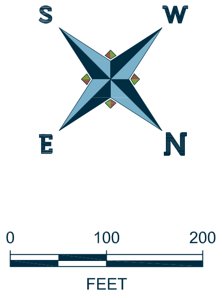


NewFields

AREA US395	CLIENT NDOT		
PROJECT NUMBER 475.0398.000	LOCATION WASHOE COUNTY, NEVADA	PROJECT NDOT US395 NORTH VALLEYS	
DOCUMENT FILENAME FIG6RW5.DWG		FIGURE TITLE SITE PLAN - RETAINING WALLS 3, 4, AND 5	FIGURE NUMBER 3	REVISION 0

NEVADA DOT SAFE AND CONNECTED

S:\PROJECTS\0398.000_NDOT US395 NORTH VALLEYS\00-DESIGN\FIGS\FIG6RW5.DWG - Last saved by: RBERG on 12/3/2019



LEGEND:

BORING LOCATIONS

● RETAINING WALL BORING

NewFields

PROJECT NUMBER	LOCATION	AREA	CLIENT
475.0398.000	WASHOE COUNTY, NEVADA	US395	NDOT

PROJECT: NDOT US395 NORTH VALLEYS

DOCUMENT FILENAME: FIG5RW6.DWG

FIGURE TITLE: SITE PLAN - RETAINING WALL 6

NEVADA DOT SAFE AND CONNECTED

FIGURE NUMBER: 4

REVISION: 0

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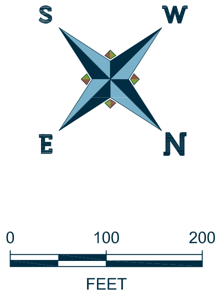


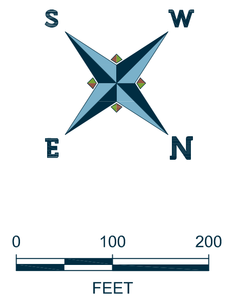
LEGEND:

BORING LOCATIONS

🟥 RETAINING WALL BORING

🟩 BRIDGE BORING

NewFields	AREA US395	CLIENT NDOT	NEVADA DOT SAFE AND CONNECTED
PROJECT NUMBER 475.0398.000	LOCATION WASHOE COUNTY, NEVADA	PROJECT NDOT US395 NORTH VALLEYS	
DOCUMENT FILENAME FIG4RW10.DWG		FIGURE TITLE SITE PLAN - RETAINING WALLS 7, 8, 9, AND 10	FIGURE NUMBER 5 / REVISION 0



LEGEND:

BORING LOCATIONS

🟥 RETAINING WALL BORING

🟩 BRIDGE BORING

NewFields	AREA US395	CLIENT NDOT	NEVADA DOT SAFE AND CONNECTED
PROJECT NUMBER 475.0398.000	LOCATION WASHOE COUNTY, NEVADA	PROJECT NDOT US395 NORTH VALLEYS	
DOCUMENT FILENAME FIG3RW1.DWG		FIGURE TITLE SITE PLAN - RETAINING WALL 11	FIGURE NUMBER 6
			REVISION 0

S:\PROJECTS\0398.000_NDOT US395 NORTH VALLEYS\00-DESIGN\FIGS\FIG3RW1.DWG - Last saved by: RBERG on 12/4/2019

ATTACHMENT B

Retaining Wall Boring Logs and Exploration Key

UNIFIED SOIL CLASSIFICATION SYSTEM

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

COARSE-GRAINED SOILS (more than 50% of material is larger than No. 200 sieve size.)			
	Clean Gravels (Less than 5% fines)		
GRAVELS More than 50% of coarse fraction larger than No. 4 sieve size	▨	GW	Well-graded gravels, gravel-sand mixtures, little or no fines
	▨	GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
	Gravels with fines (More than 12% fines)		
	▨	GM	Silty gravels, gravel-sand-silt mixtures
	▨	GC	Clayey gravels, gravel-sand-clay mixtures
	Clean Sands (Less than 5% fines)		
SANDS 50% or more of coarse fraction smaller than No. 4 sieve size	▨	SW	Well-graded sands, gravelly sands, little or no fines
	▨	SP	Poorly graded sands, gravelly sands, little or no fines
	Sands with fines (More than 12% fines)		
	▨	SM	Silty sands, sand-silt mixtures
	▨	SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (50% or more of material is smaller than No. 200 sieve size.)			
SILTS AND CLAYS Liquid limit less than 50%	▨	ML	Inorganic silts and very fine sands, rock flour, silty of clayey fine sands or clayey silts with slight plasticity
	▨	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
	▨	OL	Organic silts and organic silty clays of low plasticity
SILTS AND CLAYS Liquid limit 50% or greater	▨	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
	▨	CH	Inorganic clays of high plasticity, fat clays
	▨	OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS	▨	PT	Peat and other highly organic soils

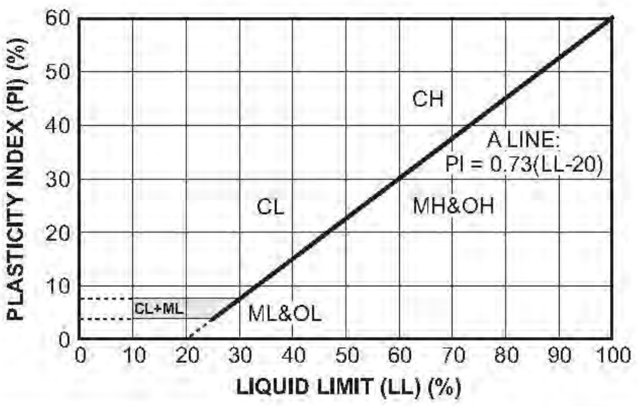
LABORATORY CLASSIFICATION CRITERIA

GW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
GP	Not meeting all gradation requirements for GW	
GM	Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
GC	Atterberg limits above "A" line with P.I. greater than 7	
SW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
SP	Not meeting all gradation requirements for GW	
SM	Atterberg limits below "A" line or P.I. less than 4	Limits plotting in shaded zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols.
SC	Atterberg limits above "A" line with P.I. greater than 7	

Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

Less than 5 percent .... GW, GP, SW, SP
More than 12 percent .... GM, GC, SM, SC
5 to 12 percent .... Borderline cases requiring dual symbols

PLASTICITY CHART



CORE LOG – KEY TO SYMBOLS

Soil and Rock Hardness Grading Scale			
Grade	**Description**	**Field Identification**	**Approximate Range of Uniaxial Compressive Strength (MPa)**
S1	Very Soft Clay	Easily penetrated several inches by fist	< 0.025
S2	Soft Clay	Easily penetrated several inches by thumb	0.025 - 0.05
S3	Firm Clay	Can be penetrated several inches by thumb with moderate effort	0.05 - 0.10
S4	Stiff Clay	Readily indented by thumbnail but penetrated only with great effort	0.10 - 0.25
S5	Very Stiff Clay	Readily indented by thumbnail	0.25 - 0.50
S6	Hard Clay	Indented with difficulty by thumbnail	> 0.50
R0	Extremely Weak Rock	Indented with thumbnail	0.25 - 1.0
R1	Very Weak Rock	Crumbles under firm blows with point of geological hammer, can be peeled by a pocket knife	1.0 - 5.0
R2	Weak Rock	Can be peeled by a pocket knife with difficulty, shallow indentations made by firm blow with point of geological hammer	5.0 - 25.0
R3	Medium Strong Rock	Cannot be scraped or peeled with a pocket knife, specimen can be fractured with single firm blow of geological hammer	25.0 - 50.0
R4	Strong Rock	Specimen requires more than one blow of geological hammer to fracture	50.0 - 100.0
R5	Very Strong Rock	Specimen requires many blows of geological hammer to fracture	100.0 - 250.0
R6	Extremely Strong Rock	Specimen can only be chipped with geological hammer	> 250.0

Fracture Spacing		
Symbol	**Description**	**Field Identification**
UF	Unfractured	Fracture spacing greater than 6 feet
SF	Slightly Fractured	Fracture spacing between 2 to 6 feet
MF	Moderately Fractured	Fracture spacing between 8 inches to 2 feet
HF	Highly Fractured	Fracture spacing between 2 to 8 inches
IF	Intensely Fractured	Fracture spacing less than 2 inches

Degree of Weathering

Weathering Grade	Description
Fresh	No visible sign of rock material weathering; perhaps slight discoloration on major discontinuity surfaces
Slightly Weathered	Discoloration indicates weathering of rock material and discontinuity surfaces. All of the rock material may be discolored by weathering and may be somewhat weaker externally than in its fresh condition
Moderately Weathered	Less than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a continuous framework or as corestones
Highly Weathered	More than half of the rock materials is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present as a discontinuous framework or as corestones
Completely Weathered	All rock material is decomposed and/or disintegrated to soil. The original mass structure is still largely intact
Residual Soil	All rock material has been weathered to a soil. The mass structure and material fabrics are destroyed. There is a large change in volume, but the soil has not been significantly transported

NewFields

BH19-RW1-01

PAGE 1 OF 1

CLIENT Nevada Department of Transportation

PROJECT NAME US395 North Valleys

PROJECT NUMBER 475.0398.000

PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

DATE STARTED 7/23/19 **COMPLETED** 7/23/19

GROUND ELEVATION 4628 ft **HOLE SIZE** 8" Diameter

DRILLING CONTRACTOR Haz-Tech Drilling, Inc.

COORDINATES ():

DRILLING METHOD HSA

LATITUDE **LONGITUDE**

LOGGED BY M. Walden **CHECKED BY** M.Doehring

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Rig Unit 105 Station 'XN' 620+40 Offset (ft) 20 Left

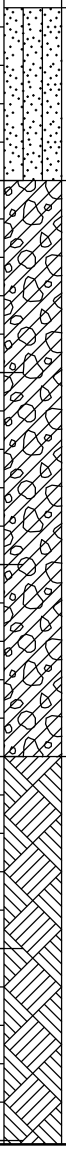
ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
								LIQUID LIMIT	PLASTICITY INDEX				
	0		**6" ASPHALT**										
			Clayey Sand (SC), some gravel, brown, moist, medium dense, medium plasticity, fine to coarse sand, subangular gravel										
4625				SPT	10-7-9 (16)	18							
	5		trace cobble	MC	7-9-14 (23)	18							
4620				SPT	4-13-8 (21)	9							
	10			MC	10-19-18 (37)	18							
4615													
	15			SPT	4-6-11 (17)	16							
4610													
	20			MC	4-8-12 (20)	18							
4605													
	25			SPT	6-9-13 (22)	18							
4600													
	30		**Clayey Sand with Gravel (SC)**, grayish brown, slightly moist, dense, low plasticity, fine to coarse sand, fine and coarse angular to subangular gravel	MC	32-32-40 (72)	18							

EOH at 31.5ft; backfilled with bentonite chips and cuttings to 3ft bgs then grouted to surface

NewFields

CLIENT	Nevada Department of Transportation	**PROJECT NAME**	US395 North Valleys
PROJECT NUMBER	475.0398.000	**PROJECT LOCATION**	Between Mileposts WA 27.1 and WA 32.6
DATE STARTED	7/23/19 **COMPLETED** 7/23/19	**GROUND ELEVATION**	4637 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR	Haz-Tech Drilling, Inc.	**COORDINATES ():**	
DRILLING METHOD	HSA	**LATITUDE**	**LONGITUDE**
LOGGED BY	M. Walden **CHECKED BY** M.Doehring	**DEPTH TO WATER (FT BGS)**	No free water encountered

NOTES Rig Unit 105 Station 'XN' 622+15 Offset (ft) 20 Left



ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0	**6" ASPHALT**										
4635		**Silty Sand with Gravel (SM)**, grayish brown, moist, medium dense, nonplastic, fine to coarse sand, subangular gravel	SPT	14-9-9 (18)	9							
4630	5	**Clayey Gravel with Sand (GC)**, orange brown, moist, medium dense, high plasticity, fine to coarse sand, subangular gravel	MC	4-9-10 (19)	18	25.9	63	40	35	34	31	
			SPT	6-11-8 (19)	15							
4625	10		MC	3-6-14 (20)	18							
4620	15	trace cobble	SPT	2-6-9 (15)	18							
4615	20	**ANDESITE:** highly weathered, very weak, very intensely fractured, silty gravel with sand, gray, moist, nonplastic, fine to coarse sand, fine and coarse angular to subangular gravel	MC	29-50/4in	10							
4610	25		SPT	31-50	12							
	30		MC	50/1in	0							
		EOH at 30.1ft; backfilled with bentonite chips and cuttings to 3ft bgs then grouted to surface										

NewFields

BH19-RW1-03

PAGE 1 OF 1

CLIENT Nevada Department of Transportation

PROJECT NAME US395 North Valleys

PROJECT NUMBER 475.0398.000

PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

DATE STARTED 7/23/19 **COMPLETED** 7/23/19

GROUND ELEVATION 4646 ft **HOLE SIZE** 8" Diameter

DRILLING CONTRACTOR Haz-Tech Drilling, Inc.

COORDINATES ():

DRILLING METHOD HSA

LATITUDE

LONGITUDE

LOGGED BY M. Walden **CHECKED BY** M.Doehring

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Rig Unit 105 Station 'XN' 624+20 Offset (ft) 20 Left

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		**7" ASPHALT**										
4645			**Clayey Sand (SC)**, some gravel, brown, moist, medium dense, low to medium plasticity, fine to coarse sand, subangular gravel										
				SPT	12-14-6 (20)	18							
4640	5		**ANDESITE:** completely weathered, extremely weak, hydrothermally altered, clayey sand/sandy clay, trace gravel, brown, moist, high plasticity, fine sand	MC	7-13-21 (34)	18							
				SPT	4-8-8 (16)	18	32.8			3	47	50	
4635	10		sandy clay	MC	6-16-18 (34)	18		61	33	2	42	56	
4630	15		**ANDESITE:** completely weathered, extremely weak, clayey sand, trace gravel, brown, moist, low to medium plasticity, fine to coarse sand, white mineralization	SPT	14-35-50 (85)	18							
4625	20		**ANDESITE:** completely weathered, extremely weak, hydrothermally altered, clayey sand, trace gravel, orange brown, moist, high plasticity, fine to coarse sand	MC	9-25-35 (60)	18							
4620	25		orange and red brown	SPT	14-18-15 (33)	18							
	30		**ANDESITE:** completely weathered, clayey sand with some gravel, brown, moist, low plasticity, fine to coarse sand, angular to subangular gravel	MC	33-50/2in	8							

EOH at 30.8ft; backfilled with bentonite chips and cuttings to 3ft bgs then grouted to surface

BH19-RW1-04

PAGE 1 OF 1

NewFields

CLIENT Nevada Department of Transportation	**PROJECT NAME** US395 North Valleys
PROJECT NUMBER 475.0398.000	**PROJECT LOCATION** Between Mileposts WA 27.1 and WA 32.6
DATE STARTED 7/22/19 **COMPLETED** 7/23/19	**GROUND ELEVATION** 4656 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR Haz-Tech Drilling, Inc.	**COORDINATES ():**
DRILLING METHOD HSA	**LATITUDE** **LONGITUDE**
LOGGED BY M.Doehring **CHECKED BY** M.Doehring	**DEPTH TO WATER (FT BGS)** No free water encountered

NOTES Rig Unit 204 Station 'XN' 626+10 Offset (ft) 20 Left

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		**7" ASPHALT**										Drilling started at 9:59pm
4655			**Silty Sand (SM)**, orange and white, moist, dense, low plasticity, fine sand, iron oxide veins										
				SPT	9-13-18 (31)	9							10:00pm
4650	5		orange, weakly cemented	MC	26-35-22 (57)	16							10:02pm
				SPT	4-22-17 (39)	16							10:06pm
4645	10		**ANDESITE:** highly weathered, extremely weak, slightly rough, slickenside, orange, clayey sand, medium plasticity, fine sand	MC	20-25-50/4in	15							10:20pm
4640	15		**ANDESITE:** highly weathered, extremely weak, slightly rough, iron oxide veins, gray, clayey sand	SPT	43-50/4in	10							10:38pm
4635	20			SPT	32-41/3in	9							11:08pm Problem with rig. Unable to complete hammering sample. Changed drill rigs
4630	25		white veins of mineralization, angular gravel up to 1" diameter	SPT	50/6in	6							1:52am
	30		intensely fractured, platey, angular gravel up to 1-1/2" diameter	SPT	50/5in	5							Drilling completed at 1:59am

EOH at 30.4ft; backfilled with bentonite chips and cuttings to 3ft bgs then grouted to surface

BH19-RW1-05

PAGE 1 OF 1

CLIENT Nevada Department of Transportation

PROJECT NAME US395 North Valleys

PROJECT NUMBER 475.0398.000

PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

DATE STARTED 7/23/19 **COMPLETED** 7/23/19

GROUND ELEVATION 4665 ft **HOLE SIZE** 8" Diameter

DRILLING CONTRACTOR Haz-Tech Drilling, Inc.

COORDINATES ():

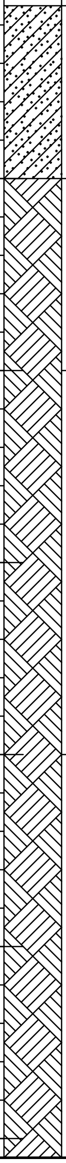
DRILLING METHOD HSA

LATITUDE **LONGITUDE**

LOGGED BY M. Walden **CHECKED BY** M.Doehring

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Rig Unit 105 Station 'XN' 627+90 Offset (ft) 20 Left



ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
4665	0	**6" ASPHALT**										
		Clayey Sand (SC), some gravel, brown, moist, medium dense, medium plasticity, fine to coarse sand, angular to subangular gravel										
			SPT	13-11-15 (26)	18							
4660	5	**ANDESITE:** completely weathered, extremely weak, hydrothermally altered, clayey sand, yellowish brown, moist, high plasticity, fine to coarse sand	MC	5-12-17 (29)	18							
			SPT	9-16-20 (36)	18	29.9	69	43	1	71	28	
4655	10	**ANDESITE:** highly to completely weathered, very weak, clayey sand with gravel, yellowish brown, moist, high plasticity, fine to coarse sand, fine and coarse angular gravel	MC	14-43-57 (100)	18							
4650	15		SPT	10-17-17 (34)	18							
4645	20	**ANDESITE:** moderately to highly weathered, very weak, intensely fractured, silty gravel with sand, grayish brown, dry, nonplastic, fine to coarse sand, fine and coarse angular to subangular gravel	MC	16-30-36 (66)	18							
4640	25		SPT	30-50/3in	9							
4635	30		MC	50/0in	0							

EOH at 30ft; backfilled with bentonite chips and cuttings to 3ft bgs then grouted to surface

NewFields

BH19-RW1-06

PAGE 1 OF 1

CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6
DATE STARTED 7/23/19 **COMPLETED** 7/23/19
GROUND ELEVATION 4675 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR Haz-Tech Drilling, Inc.
COORDINATES ():
DRILLING METHOD HSA
LATITUDE **LONGITUDE**
LOGGED BY M. Walden **CHECKED BY** M.Doehring
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Rig Unit 105 Station 'XN' 629+95 Offset (ft) 20 Left

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
4675	0		**6" ASPHALT**										
			ANDESITE: completely weathered, extremely weak, clayey sand, trace gravel, grayish brown, moist, medium plasticity, fine to coarse sand, subangular gravel	SPT	16-17-31 (48)	18							
4670	5		**ANDESITE:** moderately to highly weathered, very weak, clayey gravel, grayish brown, dry, nonplastic, fine to coarse sand, angular to subangular gravel	MC	50/4in	0							difficult drilling below 5ft
				SPT	50/3in	3							
4665	10			MC	50/3in	3							
4660	15			SPT	42-50/2in	8							
4655	20		**ANDESITE:** completely weathered, extremely weak, hydrothermally altered, clayey sand, trace gravel, orange brown, moist, high plasticity, fine sand	MC	12-26-32 (58)	18							
4650	25			SPT	40-50/4in	10							
4645	30		**ANDESITE:** moderately to highly weathered, very weak, highly fractured, clayey gravel, grayish brown, dry, nonplastic, fine to coarse sand, angular to subangular gravel	MC	50/5in	5							

EOH at 30.5ft; backfilled with bentonite chips and cuttings to 3ft bgs then grouted to surface

NewFields

BH19-RW2-07

CLIENT Nevada Department of Transportation

PROJECT NAME US395 North Valleys

PROJECT NUMBER 475.0398.000

PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

DATE STARTED 7/24/19 **COMPLETED** 7/24/19

GROUND ELEVATION 4670 ft **HOLE SIZE** 8" Diameter

DRILLING CONTRACTOR Haz-Tech Drilling, Inc.

COORDINATES ():

DRILLING METHOD HSA

LATITUDE **LONGITUDE**

LOGGED BY M. Walden **CHECKED BY** M.Doehring

DEPTH TO WATER (FT BGS) No free water encountered

NOTES BK81 Station 'XN' 628+75 Offset (ft) 25 Right

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
4670	0		**12" CONCRETE**										Drilling started at 9:33pm
			FILL: Clayey Sand with Gravel (SC), brown, moist, dense, low plasticity, fine to coarse sand, fine and coarse subangular gravel	SPT	8-23-20 (43)	18							9:39pm
4665	5			MC	18-23-25 (48)	18							9:43pm
			ANDESITE: highly weathered, extremely weak, clayey sand with gravel, orange brown, moist, medium to high plasticity, fine to coarse sand, fine subangular gravel	SPT	6-27-31 (58)	18	17.3	44	21	28	57	15	9:47pm
4660	10			MC	15-18-24 (42)	18							9:51pm
4655	15												
			ANDESITE: completely weathered, extremely weak, clayey sand, with gravel, purple brown, moist, high plasticity, fine sand, subangular gravel	SPT	10-15-9 (24)	18							9:57pm
4650	20												
			ANDESITE: highly to moderately weathered, weak, very intensely fractured, gray, moist, fine to coarse sand, fine and coarse angular and subangular gravel	MC	28-50/4in	10							10:10pm
4645	25												
				SPT	18-24-27 (51)	18							10:15pm
			yellow brown										
4640	30												
			gray	MC	18-47-43 (90)	18							Drilling completed at 10:20pm

EOH at 31.5ft; backfilled with bentonite chips and cuttings to 3ft bgs then grouted to surface

NewFields

BH19-RWW2-08

PAGE 1 OF 1

CLIENT	Nevada Department of Transportation	**PROJECT NAME**	US395 North Valleys
PROJECT NUMBER	475.0398.000	**PROJECT LOCATION**	Between Mileposts WA 27.1 and WA 32.6
DATE STARTED	7/24/19 **COMPLETED** 7/24/19	**GROUND ELEVATION**	4679 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR	Haz-Tech Drilling, Inc.	**COORDINATES ():**	
DRILLING METHOD	HSA	**LATITUDE**	**LONGITUDE**
LOGGED BY	M.Doehring **CHECKED BY** M.Doehring	**DEPTH TO WATER (FT BGS)**	Perched water at 30
NOTES	Rig Unit 105 Station 'XN' 631+10 Offset (ft) 20 Right		

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		**10" CONCRETE**										Drilling started at 9:49pm
4675	5		**Silty Gravel with Sand (GM)**, dark brown, slightly moist, medium dense, nonplastic, fine to coarse sand, angular gravel up to 1" diameter	SPT	13-15-14 (29)	14							9:50pm
			ANDESITE: highly weathered, extremely weak, very intensely fractured, gray and yellow, iron oxide staining, clayey sand with gravel, low plasticity, fine to coarse sand, angular gravel up to 1" diameter	MC	14-33-36 (69)	16							9:54pm
4670	10		**ANDESITE:** completely weathered, extremely weak, iron oxide veins, clay with sand, high plasticity, fine sand	SPT	27-37-39 (76)	18	22.5	61	31	0	22	78	9:59pm
			slickenside, some angular gravel up to 1" diameter	MC	8-19-33 (52)	12							10:05pm
4665	15		very weak, platey, (>1/8" thickness)	SPT	50/4in	3							10:12pm
4660	20		gray and dark brown, extremely weak, white mineralization, low plasticity	SPT	47-50/3in	9							10:20pm
4655	25		orange and yellow, completely weathered, extremely weak, hydrothermally altered, medium plasticity	SPT	13-17-24 (41)	18							10:29pm
4650	30		▽ **ANDESITE:** moderately weathered, weak, very intensely fractured, moderately weathered, sandy gravel, gray, wet, angular gravel (mechanically fractured)	SPT	50/1in	1							Drilling completed at 10:39pm

EOH at 30.1ft; backfilled with bentonite chips and cuttings to 2ft bgs then grouted to surface

NewFields

BH19-RW3-09

PAGE 1 OF 1

CLIENT Nevada Department of Transportation

PROJECT NAME US395 North Valleys

PROJECT NUMBER 475.0398.000

PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

DATE STARTED 7/25/19 **COMPLETED** 7/25/19

GROUND ELEVATION 4918 ft **HOLE SIZE** 8" Diameter

DRILLING CONTRACTOR Haz-Tech Drilling, Inc.

COORDINATES ():

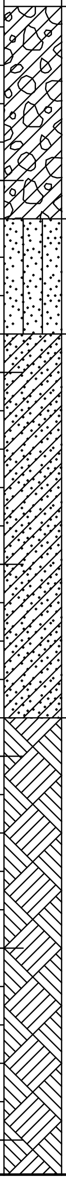
DRILLING METHOD HSA

LATITUDE **LONGITUDE**

LOGGED BY M.Doehring **CHECKED BY** M.Doehring

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Rig Unit 105 Station 'XN' 700+30 Offset (ft) 30 Left



ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0	**5-1/2" ASPHALT**										Drilling started at 1:17am
4915		**Clayey Gravel with Sand (GC)**, orange/brown, moist, medium dense, low plasticity, fine to coarse sand, subangular gravel up to 3/4" diameter	SPT	8-12-11 (23)	12							1:18am
	5	dense, subangular gravel up to 2-1/2" diameter	MC	11-19-32 (51)	12							1:21am
4910		**Silty Sand (SM)**, orange brown, slightly moist, very dense, nonplastic, fine to coarse sand, fine subrounded gravel	SPT	38-50/3in	6							1:27am
4905	10	**Clayey Sand (SC)**, orange, moist, medium dense, low to medium plasticity, fine sand, trace fine subrounded gravel	SPT	3-6-12 (18)	18							1:32am
4900	15	dense, iron oxide veins	SPT	13-21-24 (45)	18							1:37am
4895	20	**ANDESITE:** highly to completely weathered, extremely weak, very intensely fractured, orange and white, iron oxide staining, white mineralization, clay infilling, medium plasticity, fine to coarse sand, angular gravel up to 1/2" diameter	SPT	16-48-50/4in	18							1:45am
4890	25	yellow and white, low plasticity, weakly cemented pieces	SPT	36-50/5in	10							1:54am
	30	completely weathered, hydrothermally altered, clayey sand, trace gravel, orange, yellow, and white, medium plasticity, fine to coarse sand, angular gravel up to 1/2" diameter	SPT	31-50/6in	11							Drilling completed at 2:02am

EOH at 30.9ft; backfilled with bentonite chips and cuttings to 2ft bgs then grouted to surface

NewFields

BH19-RW3-10

CLIENT Nevada Department of Transportation

PROJECT NAME US395 North Valleys

PROJECT NUMBER 475.0398.000

PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

DATE STARTED 7/24/19 **COMPLETED** 7/25/19

GROUND ELEVATION 4924 ft **HOLE SIZE** 8" Diameter

DRILLING CONTRACTOR Haz-Tech Drilling, Inc.

COORDINATES ():

DRILLING METHOD HSA

LATITUDE **LONGITUDE**

LOGGED BY M. Walden **CHECKED BY** M.Doehring

DEPTH TO WATER (FT BGS) No free water encountered

NOTES BK81 Station 'XN' 702+40 Offset (ft) 30 Left

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
								LIQUID LIMIT	PLASTICITY INDEX				
	0		**7" ASPHALT**										Drilling started at 11:20pm
			ANDESITE: completely weathered, extremely weak, cemented, clayey sand, trace gravel, yellow white, dry, high plasticity, fine to coarse sand, fine angular to subangular gravel										
				SPT	7-43-50/3in	15							11:28pm
4920	5												
			fine and coarse gravel	MC	50/4in	4							11:34pm
				SPT	42-50/1in	7							11:38pm
			hydrothermally altered										
4915	10												
				MC	50/5in	5							11:44pm
4910	15												
				SPT	45-50/2in	8							11:50pm
4905	20												
				MC	50/4in	4							11:56pm
4900	25												
				SPT	34-50/3in	9							12:03pm
4895	30												
				MC	35-50/3in	9							Drilling completed at 12:10pm

EOH at 30.8ft; backfilled with bentonite chips and cuttings to 3ft bgs then grouted to surface

NewFields

CLIENT	Nevada Department of Transportation	**PROJECT NAME**	US395 North Valleys
PROJECT NUMBER	475.0398.000	**PROJECT LOCATION**	Between Mileposts WA 27.1 and WA 32.6
DATE STARTED	7/24/19 **COMPLETED** 7/25/19	**GROUND ELEVATION**	4929 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR	Haz-Tech Drilling, Inc.	**COORDINATES ():**	
DRILLING METHOD	HSA	**LATITUDE**	**LONGITUDE**
LOGGED BY	M.Doehring **CHECKED BY** M.Doehring	**DEPTH TO WATER (FT BGS)**	No free water encountered
NOTES	Rig Unit 105 Station 'XN' 704+40 Offset (ft) 30 Left		

ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0	**6" ASPHALT**										Drilling started at 11:35pm
		ANDESITE: moderately weathered, very weak, very intensely fractured, platey, silty sand and gravel, gray, nonplastic, fine to coarse sand, angular gravel up to 1" diameter	SPT	50/5in	3							11:36pm
4925	5											
		ANDESITE: highly to completely weathered, extremely weak, very intensely fractured, sandy gravel with silt, orange, non plastic, fine to coarse sand, fine and coarse angular gravel	MC	31-50/4in	9	9.5	NP	NP	62	32	6	11:39pm
		completely weathered, platey, silty sand and gravel, gray brown	SPT	50/5in	4							11:45pm
4920	10											
		highly to completely weathered, silty gravel with sand, orange, nonplastic, fine to coarse sand, angular gravel up to 1" diameter	SPT	50/6in	5							11:49pm
4915	15											
		gray, angular gravel up to 3/4" diameter	SPT	50/5in	4							11:57pm auger grinding below 15ft
4910	20		SPT	50/0in	0							12:06am
4905	25		SPT	50/2in	0							12:24am
4900	30		SPT	50/1in	0							Drilling completed at 12:32am
		EOH at 30.1ft; backfilled with bentonite chips and cuttings to 2ft bgs then grouted to surface										

NewFields

BH19-RW3-12

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CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6
DATE STARTED 7/25/19 **COMPLETED** 7/25/19
GROUND ELEVATION 4934 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR Haz-Tech Drilling, Inc.
COORDINATES ():
DRILLING METHOD HSA
LATITUDE **LONGITUDE**
LOGGED BY M.Doehring **CHECKED BY** M.Doehring
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Rig Unit 105 Station 'XN' 706+50 Offset (ft) 30 Left

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		**6" ASPHALT**										Drilling started at 2:47am
4930			**ANDESITE:** highly to completely weathered, extremely weak, very intensely fractured, iron oxide staining, clayey sand with gravel, orange, low to medium plasticity, fine to coarse sand, fine gravel	SPT	24-37-49 (86)	18							2:52am
	5		slickenside, silty sand, nonplastic, fine to coarse sand, fine and coarse angular gravel	MC	29-50/6in	12							2:53am
4925			completely weathered, silty clay, orange and yellow, low plasticity, white mineralization, weakly cemented, iron oxide veins	SPT	26-47-50/6in	18							2:59am
4920	10		completely weathered, hydrothermally altered, clayey sand, orange, low plasticity, fine to coarse sand, infill layers of medium plasticity, white mineralization	MC	17-50/6in	12							3:05am
4915	15		highly weathered, very weak, very intensely fractured, sandy gravel, fine to coarse sand, fine and coarse angular gravel up to 3/4" diameter (mechanically fractured)	SPT	50/5in	4							3:13am
4910	20		completely weathered, extremely weak, clayey sand, orange, medium plasticity, fine to coarse sand, white mineralization	SPT	22-34-37 (71)	18							3:22am
4905	25		iron oxide staining, white mineralization, silty sand and gravel, nonplastic, fine to coarse sand, angular gravel up to 1/2" diameter	SPT	25-47-50/3in	18							3:31am
	30		orange and white, medium plasticity	SPT	26-47-50/5in	13							Drilling completed at 3:42am

EOH at 31.4ft; backfilled with bentonite chips and cuttings to 2ft bgs then grouted to surface

NewFields

BH19-RW3-13

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CLIENT Nevada Department of Transportation

PROJECT NAME US395 North Valleys

PROJECT NUMBER 475.0398.000

PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

DATE STARTED 7/25/19 **COMPLETED** 7/25/19

GROUND ELEVATION 4937 ft **HOLE SIZE** 8" Diameter

DRILLING CONTRACTOR Haz-Tech Drilling, Inc.

COORDINATES ():

DRILLING METHOD HSA

LATITUDE **LONGITUDE**

LOGGED BY M.Doehring **CHECKED BY** M.Doehring

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Rig Unit 105 Station 'XN' 708+65 Offset (ft) 30 Left

ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0	**6" ASPHALT**										Drilling started at 9:45pm
		FILL: Clayey Gravel with Sand (GC), orange gray, slightly moist, medium dense, low plasticity, fine to coarse sand, angular and subangular gravel up to 1" diameter										
4935												
			SPT	7-11-8 (19)	18							9:46pm
	5											
		yellow brown, moist, medium plasticity, fine to coarse sand, angular gravel up to 2-1/2" diameter	MC	8-15-18 (33)	14							9:49pm
4930												
		medium dense, fine and coarse gravel	SPT	3-8-16 (24)	16	10.7	31	13	47	37	16	9:54pm
	10											
		angular gravel up to 2-1/2" diameter	MC	9-10-15 (25)	14							9:57pm
4925												
	15											
			SPT	3-3-7 (10)	3							10:01pm change in material occurred within the sampler
		Clayey Sand (SC), dark brown, moist to wet, loose to medium dense, low plasticity, fine sand										
4920												
		ANDESITE: highly to moderately weathered, very weak to weak, very intensely fractured, silty gravel with sand, orange, nonplastic, fine to coarse sand, angular gravel up to 2" diameter (mechanically fractured)										
	20		MC	50/5in	2							10:06pm
4915												
	25		SPT	50/2in	2							10:16pm
		moderately weathered, gray, angular gravel up to 3/4" diameter										
4910												
	30		SPT	50/4in	4							Drilling completed at 10:23pm

EOH at 30.3ft; backfilled with bentonite chips and cuttings to 2ft bgs then grouted to surface

NewFields

BH19-RW3-14

PAGE 1 OF 1

CLIENT Nevada Department of Transportation

PROJECT NAME US395 North Valleys

PROJECT NUMBER 475.0398.000

PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

DATE STARTED 7/25/19 **COMPLETED** 7/25/19

GROUND ELEVATION 4941 ft **HOLE SIZE** 8" Diameter

DRILLING CONTRACTOR Haz-Tech Drilling, Inc.

COORDINATES ():

DRILLING METHOD HSA

LATITUDE

LONGITUDE

LOGGED BY M. Walden **CHECKED BY** M.Doehring

DEPTH TO WATER (FT BGS) No free water encountered

NOTES BK81 Station 'XN' 710+75 Offset (ft) 30 Left

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0												
4940			**6" ASPHALT**										Drilling started at 9:40pm
			ANDESITE: highly weathered, extremely weak, hydrothermally altered, clayey sand, some gravel, orange brown with some white inclusions, moist, high plasticity, fine to coarse sand, fine and coarse subangular gravel	SPT	9-8-7 (15)	18							9:51pm
4935	5		**ANDESITE:** moderately weathered, weak, very intensely fractured, clayey gravel, some cobble, some sand, brown, moist, high plasticity, fine to coarse sand, fine and coarse angular gravel	MC	8-11-15 (26)	12							9:56pm
			ANDESITE: highly weathered, extremely weak, hydrothermally altered, clayey sand, some gravel, orange brown with some white inclusions, moist, high plasticity, fine to coarse sand, fine and coarse subangular gravel	SPT	9-8-6 (14)	16							10:00pm
4930	10			MC	12-9-9 (18)	18							10:04pm
4925	15			SPT	11-10-14 (24)	18							10:09pm
4920	20		increase in density	MC	22-30-42/0in	18							10:15pm
4915	25			SPT	13-29-42 (71)	18							10:19pm
4910	30			MC	42-45-50/5in	17							Drilling completed at 10:24pm

EOH at 31.5ft; backfilled with bentonite chips and cuttings to 3ft bgs then grouted to surface

NewFields

BH19-RW3-15

PAGE 1 OF 1

CLIENT	Nevada Department of Transportation	**PROJECT NAME**	US395 North Valleys
PROJECT NUMBER	475.0398.000	**PROJECT LOCATION**	Between Mileposts WA 27.1 and WA 32.6
DATE STARTED	7/31/19 **COMPLETED** 7/31/19	**GROUND ELEVATION**	4936 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR	Geotechnical Drilling	**COORDINATES ():**	
DRILLING METHOD	HSA	**LATITUDE**	**LONGITUDE**
LOGGED BY	M.Doehring **CHECKED BY** M.Doehring	**DEPTH TO WATER (FT BGS)**	No free water encountered
NOTES	Rig Unit 105 Station 'XN' 712+80 Offset (ft) 60 Left		

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
4935	0		**ANDESITE:** completely to highly weathered, extremely weak, intensely fractured, silty gravel with sand, orange, red, and white, nonplastic, fine to coarse sand, angular gravel up to 1" diameter										Drilling started at 12:30am
				SPT	10-21-28 (49)	18							12:31am
4930	5		highly weathered, very weak, orange, angular gravel up to 1-1/2" diameter	MC	43-50/5in	11							12:37am
			sandy gravel, fine to coarse sand, angular platey gravel <1/4" thick	SPT	50	6							12:41am
4925	10		completely weathered, extremely weak, hydrothermally altered, silty clay, high plasticity	MC	21-32-36 (68)	18							12:47am
4920	15		extremely to very weak, silty gravel with sand, white, nonplastic, fine to coarse sand, angular gravel up to 1/2" diameter	SPT	31-50/4in	10							12:52am
4915	20		white and orange, clay infill, medium plasticity	MC	18-23-32 (55)	18							12:59am
4910	25		white, completely weathered, silty clay, high plasticity	SPT	18-31-50/5in	18							1:07am
	30		extremely to very weak, highly weathered below 30.5ft	SPT	20-50/5in	11							Drilling completed at 1:16am

EOH at 30.9ft; backfilled with bentonite chips and cuttings

BH19-RW3-16

CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6
DATE STARTED 7/25/19 **COMPLETED** 7/25/19
GROUND ELEVATION 4948 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR Haz-Tech Drilling, Inc.
COORDINATES ():
DRILLING METHOD HSA
LATITUDE **LONGITUDE**
LOGGED BY M.Doehring **CHECKED BY** M.Doehring
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Rig Unit 105 Station 'XN' 714+85 Offset (ft) 30 Left

ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0	**5-1/2" ASPHALT** **ANDESITE:** completely weathered, extremely weak, hydrothermally altered, iron oxide veins, silty clay, white, low to medium plasticity										Drilling started at 11:05pm
4945			SPT	8-14-19 (33)	18							11:06pm
	5		MC	14-23-35 (58)	14							11:10pm
4940		weakly cemented	SPT	8-11-17 (28)	14							11:15pm
	10	yellow and white, clayey sand with gravel, medium plasticity, fine to coarse sand, cemented, fine subrounded gravel	MC	9-14-19 (33)	16	13.9	35	15	31	47	16	11:20pm
4935												
	15	iron oxide veins	SPT	9-14-21 (35)	18							11:24pm
4930												
	20	weakly cemented, angular gravel up to 1-1/2" diameter, weak gravel	MC	14-21-39 (60)	12							11:30pm
4925												
	25	gray and yellow, iron oxide veins	SPT	23-48-50/5in	17							11:38pm
4920												
	30	**ANDESITE:** highly weathered, very weak, platey breaks 1/8 to 1/2" thick, silty gravel with sand, orange, nonplastic, fine to coarse sand, angular gravel	SPT	23-50/3in	9							Drilling completed at 11:50pm

EOH at 30.7ft; backfilled with bentonite chips and cuttings to 2ft bgs then grouted to surface

BH19-RW3-17

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NewFields

CLIENT Nevada Department of Transportation

PROJECT NAME US395 North Valleys

PROJECT NUMBER 475.0398.000

PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

DATE STARTED 7/30/19 **COMPLETED** 7/31/19

GROUND ELEVATION 4937 ft **HOLE SIZE** 8" Diameter

DRILLING CONTRACTOR Haz-Tech Drilling, Inc.

COORDINATES ():

DRILLING METHOD HSA

LATITUDE ____ **LONGITUDE** ____

LOGGED BY M.Doehring **CHECKED BY** M.Doehring

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Rig Unit 105 Station 'XN' 716+90 Offset (ft) 55 Left

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		**Silty Clay (CH)**, orange brown, slightly moist, hard, high plasticity										Drilling stared at 11:19pm
4935													
				SPT	17-20-21 (41)	12							11:20pm
	5		**ANDESITE:** completely weathered, extremely weak, hydrothermally altered, clay, orange, high plasticity, trace angular gravel up to 1/2" diameter										
				MC	11-16-21 (37)	12							11:25pm
4930													
			iron oxide staining										
				SPT	5-14-21 (35)	14							11:33pm change in material at 8-1/2ft
			ANDESITE: highly to completely weathered, very weak, platey										
	10												
				MC	11-26-49 (75)	14							11:35pm
4925													
	15												
			extremely weak, completely weathered, iron oxide veins, silty clay, medium plasticity	SPT	8-26-31 (57)	12							11:42pm
4920													
	20												
				MC	16-18-21 (39)	16							11:50pm
4915													
	25												
			hydrothermally altered	SPT	5-13-16 (29)	14							11:56pm
4910													
	30												
				SPT	4-10-16 (26)	18							Drilling completed at 12:02am

EOH at 30.7ft; backfilled with bentonite chips and cuttings to 2ft bgs then grouted to surface

NewFields

BH19-RW3-18

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CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6
DATE STARTED 7/25/19 **COMPLETED** 7/25/19
GROUND ELEVATION 4951 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR Haz-Tech Drilling, Inc.
COORDINATES ():
DRILLING METHOD HSA
LATITUDE **LONGITUDE**
LOGGED BY M. Walden **CHECKED BY** M.Doehring
DEPTH TO WATER (FT BGS) No free water encountered
NOTES BK81 Station 'XN' 718+85 Offset (ft) 25 Left

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		**5" ASPHALT**										
4950			**FILL: Silty Sand with Gravel (SM)**, brown, moist, medium dense, nonplastic, fine to coarse sand, angular to subangular gravel	SPT	6-11-6 (17)	18							
4945	5		**ANDESITE:** highly weathered, very weak, clayey sand, some gravel, orange brown, moist, high plasticity, fine to coarse sand, fine and coarse subangular gravel	MC	12-9-10 (19)	12							
				SPT	9-8-6 (14)	4							
4940	10		**ANDESITE:** completely weathered, extremely weak, hydrothermally altered, clayey sand, some gravel, orange brown, and yellow, moist, high plasticity, fine to coarse sand, fine subangular gravel	MC	4-8-12 (20)	18							
4935	15		white yellow	SPT	6-10-12 (22)	18	21.9	53	34	12	50	38	
4930	20		orange brown	MC	12-19-22 (41)	18							
4925	25			SPT	8-12-23 (35)	18							
4920	30			MC	40-45-50 (95)	18							

EOH at 31.5ft; backfilled with bentonite chips and cuttings to 3ft bgs then grouted to surface

NewFields

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CLIENT Nevada Department of Transportation

PROJECT NAME US395 North Valleys

PROJECT NUMBER 475.0398.000

PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

DATE STARTED 7/30/19 **COMPLETED** 7/30/19

GROUND ELEVATION 4945 ft **HOLE SIZE** 8" Diameter

DRILLING CONTRACTOR Haz-Tech Drilling, Inc.

COORDINATES ():

DRILLING METHOD HSA

LATITUDE **LONGITUDE**

LOGGED BY M. Walden **CHECKED BY** M.Doehring

DEPTH TO WATER (FT BGS) No free water encountered

NOTES BK81 Station 'XN' 720+90 Offset (ft) 60 Left

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
								LIQUID LIMIT	PLASTICITY INDEX				
4945	0												
		▨	**4" ASPHALT** **FILL: Clayey Sand (SC)**, trace gravel, brown, moist, loose to medium dense, high plasticity, fine sand, subangular gravel										Drilling started at 12:50am
				SPT	5-3-7 (10)	18							12:54am
4940	5	▨	**ANDESITE:** highly weathered, very weak, gravelly sand, some clay, grayish brown, moist, nonplastic, fine to coarse sand, fine and coarse subangular gravel	MC	30-34-48 (82)	18							12:57am
				SPT	21-27-39 (66)	18							1:00am
4935	10	▨	**ANDESITE:** highly weathered, very weak clayey sand, some gravel, orange brown, moist, medium to high plasticity, fine to coarse sand, fine and coarse angular to subangular gravel	MC	15-15-17 (32)	18							1:03am
4930	15			SPT	27-42-50 (92)	18							1:07am
4925	20			MC	38-42-50 (92)	18							1:12am
4920	25	▨	**ANDESITE:** completely weathered, extremely weak, hydrothermally altered, clayey sand, whitish orange, moist, high plasticity, fine sand	SPT	8-16-29 (45)	18							1:18am
4915	30			MC	19-24-38 (62)	18							Drilling completed at 1:23am

EOH at 31.5ft; backfilled with bentonite chips and cuttings to 3ft bgs then grouted to surface

NewFields

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CLIENT Nevada Department of Transportation

PROJECT NAME US395 North Valleys

PROJECT NUMBER 475.0398.000

PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

DATE STARTED 7/26/19 **COMPLETED** 7/26/19

GROUND ELEVATION 4960 ft **HOLE SIZE** 8" Diameter

DRILLING CONTRACTOR Haz-Tech Drilling, Inc.

COORDINATES ():

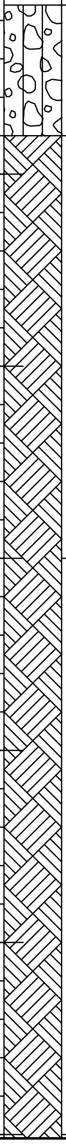
DRILLING METHOD HSA

LATITUDE **LONGITUDE**

LOGGED BY M.Doehring **CHECKED BY** M.Doehring

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Rig Unit 105 Station 'XN' 722+85 Offset (ft) 20 Left



ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
							LIQUID LIMIT	PLASTICITY INDEX				
4960	0	**7" ASPHALT**										Drilling started at 12:28am
		Silty Gravel with Sand (GM), dark brown, slightly moist, medium dense, nonplastic, fine to coarse sand, angular gravel up to 3/4" diameter	SPT	8-10-5 (15)	16							12:31am
4955	5	**ANDESITE:** completely weathered, extremely weak, yellow and orange	MC	8-15-19 (34)	14							12:35am
		hydrothermally altered, silty clay, orange, medium plasticity, white mineralization, iron oxide staining	SPT	10-14-17 (31)	18							12:38am
4950	10	moderately to highly weathered, extremely weak, slickenside, gray, medium plasticity, iron oxide veins	MC	9-24-34 (58)	18							12:42am
4945	15	**ANDESITE:** highly weathered, very weak, silty sand, orange and brown, nonplastic, fine sand, weakly cemented pieces	SPT	43-50/4in	10							12:48am
4940	20		MC	50/6in	4							12:59am
4935	25		SPT	50/3in	0							1:10am
4930	30	**ANDESITE:** slightly weathered, weak, very intensely fractured, platey, gray	SPT	50/2in	1							Drilling completed at 1:22am

EOH at 30.1ft; backfilled with bentonite chips and cuttings to 2ft bgs then grouted to surface

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NewFields

CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6
DATE STARTED 7/30/19 **COMPLETED** 7/31/19
GROUND ELEVATION 4956 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR Haz-Tech Drilling, Inc.
COORDINATES ():
DRILLING METHOD HSA
LATITUDE **LONGITUDE**
LOGGED BY M. Walden **CHECKED BY** M.Doehring
DEPTH TO WATER (FT BGS) No free water encountered
NOTES BK81 Station 'XN' 724+70 Offset (ft) 55 Left

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
4955	0		**6" ASPHALT** **FILL: Clayey Sand with Gravel (SC)**, orange brown, moist, loose, high plasticity, fine to coarse sand, angular to subangular gravel										Drilling started at 11:52pm
				SPT	6-6-2 (8)	15							11:58pm
4950	5		dense	MC	8-21-44 (65)	18							12:03am
			medium dense, medium plasticity	SPT	2-8-9 (17)	18	12.5	34	19	43	54	3	12:05am
4945	10			MC	12-19-17 (36)	18							12:09am
4940	15		dense	SPT	7-11-21 (32)	18							12:13am
4935	20		medium dense	MC	5-7-9 (16)	18							12:18am
4930	25			SPT	6-4-9 (13)	18							12:21am
4925	30		**ANDESITE:** completely weathered, extremely weak, clayey sand, trace gravel, orange brown, moist, fine sand, subangular gravel	MC	6-9-11 (20)	18							Drilling completed at 12:25am

EOH at 31.5ft; backfilled with bentonite chips and cuttings to 3ft bgs then grouted to surface

NF-GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 12/2/19 09:50 - S:\PROJECTS\0398.000_NDOT US395 NORTH VALLEYS\18_GINT_LOGS\NORTH_VALLEYS.GPJ

NewFields

BH19-RW3-22

CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6
DATE STARTED 7/25/19 **COMPLETED** 7/25/19
GROUND ELEVATION 4973 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR Haz-Tech Drilling, Inc.
COORDINATES ():
DRILLING METHOD HSA
LATITUDE **LONGITUDE**
LOGGED BY M. Walden **CHECKED BY** M.Doehring
DEPTH TO WATER (FT BGS) No free water encountered
NOTES BK81 Station 'XN' 726+90 Offset (ft) 30 Left

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		**5" ASPHALT**										
		▨	**FILL: Clayey Sand with Gravel (SC)**, brown, moist, medium dense, low plasticity, fine to coarse sand, fine and coarse angular to subangular gravel										
4970				SPT	10-17-10 (27)	18							
	5	▨	**FILL: Clayey Sand with Gravel (SC)**, trace cobble, orange brown, moist, medium dense, medium plasticity, fine to coarse sand, fine and coarse angular to subangular gravel	MC	4-8-7 (15)	18							
4965				SPT	8-12-6 (18)	15							
	10			MC	11-12-14 (26)	18							
4960													
	15	▨	**FILL: Clayey Gravel with Sand (GC)**, light brown, moist, medium dense, medium plasticity, fine to coarse sand, fine and coarse subangular gravel	SPT	20-15-15 (30)	18	8.7	32	16	48	38	14	
4955													
	20			MC	8-15-16 (31)	18							
4950													
	25	▧	**ANDESITE:** highly weathered, very weak, clayey sand, some gravel, orange brown, moist, high plasticity, fine to coarse sand	SPT	50/5in	5							
4945													
	30			MC	34-43-50 (93)	18							

EOH at 31.5ft; backfilled with bentonite chips and cuttings to 3ft bgs then grouted to surface

NewFields

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CLIENT Nevada Department of Transportation

PROJECT NAME US395 North Valleys

PROJECT NUMBER 475.0398.000

PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

DATE STARTED 7/30/19 **COMPLETED** 7/30/19

GROUND ELEVATION 4975 ft **HOLE SIZE** 8" Diameter

DRILLING CONTRACTOR Haz-Tech Drilling, Inc.

COORDINATES ():

DRILLING METHOD HSA

LATITUDE **LONGITUDE**

LOGGED BY M. Walden **CHECKED BY** M.Doehring

DEPTH TO WATER (FT BGS) No free water encountered

NOTES BK81 Station 'XN' 728+95 Offset (ft) 55 Left

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
4975	0		**6" Asphalt**										Drilling stared at 10:58pm
			FILL: Clayey Sand (SC), some gravel, brown, moist, very dense, medium plasticity, fine to coarse sand, fine and coarse subangular gravel										
				SPT	14-24-50/4in	16							11:03pm
4970	5		**ANDESITE:** slightly weathered, weak, very intensely fractured, sandy gravel, some clay, gray, moist, nonplastic, fine to coarse sand, fine and coarse subangular to angular gravel										
				MC	50/1in	0							11:12pm
				SPT	50/3in	1							
4965	10		grayish brown, very weak	MC	20-37-35 (72)	18							11:18pm
4960	15												Practical refusal at 11:24pm
			EOH at 15.0ft: backfilled with bentonite chips and cuttings to 3ft bgs then grouted to surface	SPT	50/1in	0							No recovery

NewFields

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CLIENT Nevada Department of Transportation

PROJECT NAME US395 North Valleys

PROJECT NUMBER 475.0398.000

PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

DATE STARTED 7/26/19 **COMPLETED** 7/26/19

GROUND ELEVATION 4987 ft **HOLE SIZE** 8" Diameter

DRILLING CONTRACTOR Haz-Tech Drilling, Inc.

COORDINATES ():

DRILLING METHOD HSA

LATITUDE **LONGITUDE**

LOGGED BY M. Walden **CHECKED BY** M.Doehring

DEPTH TO WATER (FT BGS) Perched water at 30

NOTES BK81 Station 'XN' 731+00 Offset (ft) 25 Left

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		**5" ASPHALT**										Drilling started at 1:18am
4985			**Clayey Sand (SC)**, trace gravel, orange brown, moist, medium plasticity, fine to coarse sand, subangular gravel										
				SPT	5-10-13 (23)	18							1:25am
	5		**Clayey Gravel with Sand (GC)**, orange brown, moist, very dense, medium plasticity, fine to coarse sand, fine and coarse gravel	MC	21-16-50/2in	14	10.4	36	19	47	39	14	1:28am
4980			medium dense, high plasticity	SPT	8-11-13 (24)	18							1:32am
	10		**Clayey Sand (SC)**, trace gravel, orange brown, moist, very dense, medium plasticity, fine to coarse sand, angular gravel	MC	39-50/5in	11							1:36am
4975													
	15			SPT	28-50/5in	11							1:41am
4970													
	20			MC	50/2in	0							1:47am
4965													
	25			SPT	50/4in	0							1:54am
4960													
	30		∇	MC	50/5in	5							Drilling completed at 2:03am

EOH at 30.5ft; backfilled with bentonite chips and cuttings to 3ft bgs then grouted to surface

NewFields

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CLIENT Nevada Department of Transportation	**PROJECT NAME** US395 North Valleys
PROJECT NUMBER 475.0398.000	**PROJECT LOCATION** Between Mileposts WA 27.1 and WA 32.6
DATE STARTED 7/30/19 **COMPLETED** 7/30/19	**GROUND ELEVATION** 4998 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR Haz-Tech Drilling, Inc.	**COORDINATES ():**
DRILLING METHOD HSA	**LATITUDE** **LONGITUDE**
LOGGED BY M. Walden **CHECKED BY** M.Doehring	**DEPTH TO WATER (FT BGS)** No free water encountered

NOTES BK81 Station 'XN' 733+00 Offset (ft) 55 Left

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		**6" ASPHALT**										Drilling started at 9:48pm
		▩	**FILL: Clayey Sand (SC)**, trace gravel, brown, moist, very dense, low plasticity, fine to coarse sand, fine subangular gravel										
4995		▩		SPT	31-50/5in	11							
	5	▨	**ANDESITE:** highly weathered, very weak, clayey sand, with gravel, grayish brown, moist, low plasticity, fine to coarse sand, fine and coarse subangular gravel, cemented, friable	MC	50/3in	3							
4990		▨		SPT	50/1in	0							
	10	▨		MC	50/1in	0							
4985		▨											
	15	▨		SPT	50/3in	3							
4980		▨											
	20	▨		MC	50/5in	5							
4975		▨											
	25	▨		SPT	50/1in	0							
4970		▨											
	30	▨	**ANDESITE:** completely weathered, extremely weak, clayey sand, trace gravel, orange brown, moist, low to medium plasticity, fine sand, subangular gravel	MC	32-34-44 (78)	18								Drilling completed at 10:20pm

EOH at 31.5ft; backfilled with bentonite chips and cuttings to 3ft bgs then grouted to surface

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NewFields

CLIENT Nevada Department of Transportation

PROJECT NAME US395 North Valleys

PROJECT NUMBER 475.0398.000

PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

DATE STARTED 5/20/19 **COMPLETED** 8/1/19

GROUND ELEVATION 4953 ft **HOLE SIZE** 8" Diameter

DRILLING CONTRACTOR Geotechnical Drilling and Haz-Tech Drilling

COORDINATES ():

DRILLING METHOD HSA

LATITUDE **LONGITUDE**

LOGGED BY M. Walden/M. Doehring **CHECKED BY** M.Doehring

DEPTH TO WATER (FT BGS) 50

NOTES Rig Unit 17 and BK81 Station 'XS' 723+60 Offset (ft) 30 Left

ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0	**6" ASPHALT**										Drilling started at 12:26am
		FILL: Clayey Gravel with Sand (GC), some cobble and boulders, orange brown, moist, medium dense, high plasticity, fine to coarse sand, fine and coarse subangular gravel										
4950			SPT	4-4-7 (11)	18							12:31am
	5	brown	MC	7-8-9 (17)	18	15.1	39	24	39	35	26	12:39am, refusal on a boulder, moved 6ft south and started to redrill
4945		very dense	SPT	3-46-30 (76)	8							1:34am
	10		MC	70/6in	6							1:42am
4940												
	15	**FILL: Silty Sand with Gravel (SM)**, brown, moist, medium dense, medium plasticity, fine to coarse sand, fine and coarse gravel	SPT	8-11-7 (18)	18	17.0	43	12	31	34	35	2:34am
4935												
	20	dense	MC	15-26-30 (56)	18							2:50am
4930												
	25	**FILL: Silty Sand and Gravel (SM-GM)**, brown, moist, very dense, nonplastic, fine to coarse sand, subangular gravel	SPT	17-29-42 (71)	18							Drilling completed at 3:20am on 5/20/2019
4925												
	30	**ANDESITE:** highly weathered, extremely weak, orange, red and white, clayey sand with gravel. medium plasticity, clay infilling, fine to coarse sand, fine and coarse angular gravel	SPT	7-15-32 (47)	17	14.4	37	19	35	50	15	Drilling started again at 11:51pm on 8/1/2019 12:18am
4920												
	35											

(Continued Next Page)

CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	35		angular gravel up to 2-1/2" diameter (rock stuck in shoe)	MC	50/2in	2							12:33am rock stuck in shoe
4915													
	40		gray and orange, clay infill, fine to coarse sand, angular gravel up to 1/2" diameter	SPT	50/4in	3							12:48am
4910													
	45		**ANDESITE:** highly weathered, very weak, very intensely fractured, platey, sandy gravel, gray, fine to coarse sand, angular gravel up to 1/2" diameter	SPT	50/1in	1							1:00am
4905													
	50	∇	extremely weak, high plasticity clay infill	SPT	50/2in	2							1:18am
4900													
	55		**ANDESITE:** completely weathered, extremely weak, hydrothermally altered, clay infill, orange red and white, high plasticity	SPT	17-37-50/3in	14							1:29am
4895													
	60		**ANDESITE:** highly weathered, very weak, very intensely fractured, fine to coarse sand, angular gravel up to 1" diameter	SPT	50/4in	2							Drilling completed at 1:46am

EOH at 60.3ft; backfilled with bentonite chips and cuttings to 2ft bgs then grouted to surface

NewFields

BH19-RW4-27

PAGE 1 OF 2

CLIENT	Nevada Department of Transportation	**PROJECT NAME**	US395 North Valleys
PROJECT NUMBER	475.0398.000	**PROJECT LOCATION**	Between Mileposts WA 27.1 and WA 32.6
DATE STARTED	5/21/19 **COMPLETED** 5/21/19	**GROUND ELEVATION**	4958 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR	Geotechnical Drilling	**COORDINATES ():**	
DRILLING METHOD	HSA	**LATITUDE**	**LONGITUDE**
LOGGED BY	M.Doehring **CHECKED BY** M. Doehring	**DEPTH TO WATER (FT BGS)**	40
NOTES	Rig Unit 5 Station 'XS' 724+90 Offset (ft) 30 Left		

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		**7" AC**										Drilling started at 9:35pm
		▨	**FILL: Clayey Sand (SC),** orange brown, moist, medium dense, medium plasticity, fine to coarse sand, trace subangular gravel to 3/4" diameter										
4955		▨		SPT	5-13-10 (23)	9							9:41pm
	5	▨	angular gravel to 1/4" diameter	MC	9-7-16 (23)	12							9:45pm
4950		▨		SPT	4-6-10 (16)	15							9:52pm No recovery, grinding at 10ft on a boulder, stopped drilling at 10:12 and moved rig to 8ft south, started to redrill at 10:26pm
	10	▨	very dense, 2 1/2" diameter gravel stuck in shoe	MC	70/3in	0							
4945	15	▨	**FILL: Clayey Sand with Gravel (SC)**, brown, moist, medium dense, medium plasticity, fine to coarse sand, brown sandy clay layer 4" thick encountered at 16ft, fine and coarse gravel to 1" diameter	SPT	11-8-12 (20)	15	12.1	34	17	32	40	28	10:36pm
4940	20	▨	dense, fine subangular gravel	MC	24-35-25 (60)	4							10:46pm
4935	25	▨	**FILL: Sandy Gravel (GP)**, trace silt, dark brown, moist to wet, dense, fine to coarse sand, angular gravel to 2" diameter (mechanically fractured)	SPT	2-20-16 (36)	3							10:58pm
4930	30	▨	**FILL: Clayey Sand (SC)**, some gravel, brown, moist, medium dense, low to medium plasticity, fine to coarse sand, some fine angular gravel	MC	20-15-15 (30)	1							11:11pm
4925	35	▨											

(Continued Next Page)

CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
								LIQUID LIMIT	PLASTICITY INDEX				
4920	35	▩	**FILL: Clayey Gravel with Sand (GC)**, orange brown, moist, medium dense, low plasticity, fine to coarse sand, subangular gravel to 2" diameter ▽	SPT	15-14-9 (23)	8	8.9						11:26pm
4915	40	■	**Fat Clay with Sand (CH),** brown, moist, hard, medium to high plasticity, fine sand	MC	9-16-22 (38)	18	24.4	66	47	2	17	81	Water at 40ft, 11:39pm
4910	45	▨	**Clayey Sand with Gravel (SC)**, orange brown, moist, medium dense, medium plasticity, fine to coarse sand, angular gravel to 2" diameter	SPT	9-12-13 (25)	18							11:53pm
4905	50	▨	**Clayey Sand and Gravel (SC/GC)**, light brown, moist, very dense, medium plasticity, fine to coarse sand, angular gravel to 2" diameter (mechanically fractured)	SPT	50/6in	5.99							12:12am
4900	55	▧	**ANDESITE:** completely weathered, extremely weak, hydrothermally altered, clayey sand with gravel, orange, moist to wet high plasticity, fine to coarse sand, angular gravel to 1" diameter	SPT	11-22-23 (45)	14							12:30am
	60	▧		SPT	20-29-30 (59)	16							Drilling completed at 12:45am

EOH at 61.5ft; backfilled with bentonite chips and cuttings to 2ft bgs then grouted to surface

BH19-RW5-28

NewFields

CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6
DATE STARTED 5/1/19 **COMPLETED** 5/1/19
GROUND ELEVATION 4961 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR Geotechnical Drilling
COORDINATES ():
DRILLING METHOD HSA
LATITUDE **LONGITUDE**
LOGGED BY M. Walden **CHECKED BY** M.Doehring
DEPTH TO WATER (FT BGS) 40
NOTES Rig Unit 17 Station 'XN' 724+30 Offset (ft) 40 Right

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		**6" Asphalt**										
4960			**FILL: Clayey Gravel with Sand (GC),** brown, moist, dense, medium plasticity, fine to coarse sand										
				SPT	11-17-17 (34)	18							
4955	5		light brown, medium dense, fine and coarse gravel	MC	12-17-20 (37)	18	16.8	33	16	42	41	17	
				SPT	3-10-8 (18)	10							
4950	10		medium to high plasticity	MC	21-22-13 (35)	16	13.1	38	21	54	32	14	
4945	15		dense	SPT	23-17-14 (31)	0							No recovery
4940	20		**Silty Gravel with Sand (GM)**, gray, moist, very dense, nonplastic, fine to medium sand, fine and coarse angular gravel	MC	50/4in	4							Rig bouncing
			cobble encountered between 23ft to 40ft										Difficult drilling
4935	25			SPT	50/1in	0							Slow drilling 25ft to 30ft bgs No recovery
4930	30			MC	50/1in	1							
	35												

(Continued Next Page)

CLIENT	Nevada Department of Transportation	**PROJECT NAME**	US395 North Valleys
PROJECT NUMBER	475.0398.000	**PROJECT LOCATION**	Between Mileposts WA 27.1 and WA 32.6

ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
4925	35		SPT	50/1in	0							No recovery
4920	40 ∇	**Clayey Sand with Gravel (SC)**, brown, wet, dense, low to medium plasticity, fine to medium sand, fine and coarse angular gravel	MC	14-17-26 (43)	18	24.6						Water at 40ft
4915	45	**Silty Gravel with Sand (GM)**, gray, wet, very dense, medium to coarse sand, fine angular gravel	SPT	10-33-70/4in	16							
4910	50		MC	50/3in	0							No recovery

Practical refusal encountered at 52ft; backfilled with bentonite chips to 20ft bgs then grouted to surface

CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6
DATE STARTED 5/1/19 **COMPLETED** 5/1/19
GROUND ELEVATION 4966 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR Geotechnical Drilling
COORDINATES ():
DRILLING METHOD HSA
LATITUDE **LONGITUDE**
LOGGED BY N. Owens **CHECKED BY** M.Doehring
DEPTH TO WATER (FT BGS) 50
NOTES Rig Unit 5 Station 'XN' 725+50 Offset (ft) 35 Left

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0												
4965			**6" ASPHALT**										
			FILL: Poorly Graded Gravel with Clay and Sand (GP/GC), brown, moist, medium dense, medium plasticity, fine to coarse sand, fine and coarse gravel	SPT	9-11-5 (16)	18							
4960	5			MC	9-13-12 (25)	16	9.8	35	20	68	24	8	
			very dense	SPT	7-43-41 (84)	11							
4955	10		**FILL: Clayey Gravel with Sand (GC),** brown, moist, medium dense, low plasticity, fine to coarse sand, fine and coarse angular gravel	MC	17-19-17 (36)	6							
4950	15		**FILL: Clayey Gravel with Sand (GC),** light brown, moist, dense, medium plasticity, fine to coarse sand, fine and coarse angular gravel	SPT	31-20-17 (37)	12	10.0	29	16	45	38	17	
4945	20		very dense	MC	40-50/3in	0							No recovery
4940	25		**FILL: Clayey Sand with Gravel (SC),** light brown, moist, medium dense, high plasticity, fine to coarse sand, fine and coarse angular gravel	SPT	6-8-11 (19)	14	16.0	39	24	30	46	24	
4935	30			MC	13-14-28 (42)	16							
	35												

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CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
4930	35		**Clayey Sand with Gravel (SC)**, moist, high plasticity, fine to medium sand, fine and coarse gravel	SPT	6-8-14 (22)	18	20.2						
4925	40		dense	MC	29-34-38 (72)	0							No recovery
4920	45		very dense	SPT	20-21-47 (68)	13							
4915	50		▽	MC	50/3in	0.5							Water at 50ft, auger grinding
4910	55			SPT	50/3in	0.5							Refusal on cobble

EOH at 56ft; backfilled bentonite chips to 20ft bgs then grouted to surface

NewFields

BH19-RW6-30

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CLIENT Nevada Department of Transportation

PROJECT NAME US395 North Valleys

PROJECT NUMBER 475.0398.000

PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

DATE STARTED 4/21/19 **COMPLETED** 4/21/19

GROUND ELEVATION 5067 ft **HOLE SIZE** 8" Diameter

DRILLING CONTRACTOR Geotechnical Drilling

COORDINATES ():

DRILLING METHOD HSA

LATITUDE **LONGITUDE**

LOGGED BY M. Walden **CHECKED BY** M.Doehring

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Rig Unit 5 Station 'XN' 762+00 Offset (ft) 30 Left

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		**FILL: Sand and Gravel (SC-GC),** some clay and silt, grayish brown, dry, very dense, fine to coarse sand, fine and coarse angular to subangular gravel										
5065													
				SPT	10-25-35 (60)	18							
	5		dense	MC	19-23-25 (48)	18							
5060													
			very dense	SPT	10-17-34 (51)	18							
	10		dense	MC	11-22-23 (45)	18							
5055													
	15		**FILL: Clayey Sand (SC),** some silt, trace gravel, light brown, moist, medium dense, medium plasticity, fine to coarse sand, fine and coarse subangular gravel	SPT	8-8-10 (18)	18							
5050													
	20		very dense	MC	11-29-70/5in	17							Cobble stuck in shoe
5045													
	25		medium dense	SPT	4-14-10 (24)	18							
5040													
	30		**Clayey Sand with Gravel (SC)**, dark brown, medium dense, medium plasticity, fine to coarse sand, fine and coarse gravel	MC	9-14-23 (37)	18							

EOH at 31.5ft; backfilled to 20ft bgs then grouted to surface

NewFields

BH19-RW6-31

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CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6
DATE STARTED 5/29/19 **COMPLETED** 5/29/19
GROUND ELEVATION 5069 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR Geotechnical Drilling
COORDINATES ():
DRILLING METHOD HSA
LATITUDE **LONGITUDE**
LOGGED BY N. Owens **CHECKED BY** M.Doehring
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Rig Unit 5 Station 'XN' 764+00 Offset (ft) 35 Left

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		**FILL: Clayey Gravel with Sand (GC)**, brown, moist, medium dense, low plasticity, fine and coarse angular gravel										Drilling started at 10:45am
5065				SS	9-15-13 (28)	11	8.0	31	10	54	33	13	10:54am
	5		dense	MC	20-24-31 (55)	18	12.6	28	7	47	36	17	
			FILL: Clayey Gravel with Sand (GC), light brown, moist, very dense, low plasticity, fine and medium sand, fine and coarse angular gravel	SS	50/2in	0							No recovery - bouncing on rock
5060	10			MC	34-52-41 (93)	3							Driving on a rock, 11:18am
5055	15		medium dense	SS	11-16-10 (26)	14							
5050	20		**FILL: Clayey Gravel with Sand (GC)**, gray, moist, medium dense, low plasticity, fine and coarse angular gravel	MC	8-15-16 (31)	16							11:32am
5045	25		**FILL: Clayey Sand with Gravel (SC)**, light brown, moist, medium dense, low plasticity, fine angular gravel	SS	5-9-17 (26)	16							
5040	30		dense	MC	12-22-36 (58)	18							Drilling completed at 11:55am

EOH at 31.5ft; backfilled to 20ft bgs then grouted to surface

BH19-RW6-32

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NewFields

CLIENT Nevada Department of Transportation

PROJECT NAME US395 North Valleys

PROJECT NUMBER 475.0398.000

PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

DATE STARTED 5/29/19 **COMPLETED** 5/29/19

GROUND ELEVATION 5075 ft **HOLE SIZE** 8" Diameter

DRILLING CONTRACTOR Geotechnical Drilling

COORDINATES ():

DRILLING METHOD HSA

LATITUDE **LONGITUDE**

LOGGED BY N. Owens **CHECKED BY** M.Doehring

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Rig Unit 5 Station 'XN' 766+10 Offset (ft) 50 Left

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
5075	0		**FILL: Silty Sand with Gravel (SM)**, gray, moist, dense, nonplastic, fine to coarse sand, fine and coarse angular gravel										Drilling started at 7:20am
				SS	30-23-22 (45)	14	6.2	NP	NP	30	55	15	7:25am
5070	5		very dense	MC	70/3in	2							7:30am
			FILL: Clayey Sand with Gravel (SC), light brown, moist, medium dense, low plasticity, fine to coarse sand, fine to coarse angular gravel	SS	24-14-12 (26)	14							7:48am
5065	10		dense	MC	19-30-41 (71)	3							8:05am
5060	15		medium dense	SS	7-9-9 (18)	13	14.5						Difficult drilling - 8:17am
5055	20			MC	11-17-18 (35)	17							8:22am
			Clayey Sand with Grave (SC), brown/orange brown, moist, medium dense, medium plasticity, fine to coarse sand, fine and coarse subangular gravel										
5050	25		hydrothermally altered	SS	13-10-18 (28)	13							8:45am
5045	30		very dense, increasing sand and gravel	MC	38-48-70 (118)	16							

EOH at 31.5ft; backfilled to 20ft bgs then grouted to surface

BH19-RWN6-33

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CLIENT Nevada Department of Transportation

PROJECT NAME US395 North Valleys

PROJECT NUMBER 475.0398.000

PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

DATE STARTED 5/30/19 **COMPLETED** 5/30/19

GROUND ELEVATION 5081 ft **HOLE SIZE** 8" Diameter

DRILLING CONTRACTOR Geotechnical Drilling

COORDINATES ():

DRILLING METHOD HSA

LATITUDE **LONGITUDE**

LOGGED BY N. Owens **CHECKED BY** M.Doehring

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Rig Unit 5 Station 'XN' 767+85 Offset (ft) 40 Left

ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0											
5080		**FILL: Silty Gravel (GM),** gray brown, moist, very dense, fine and coarse angular gravel										Drilling started at 9:15am
			SS	23-23-50/2in	6							very gravelly
5075	5	dense	MC	43-38-23 (61)	0							no recovery
			SS	32-25-22 (47)	0							
5070	10	brown, medium dense, fine and coarse gravel to 2-1/2" diameter	MC	37-22-20 (42)	2							9:34am
5065	15	very dense	SS	24-50/1in	1							Grinding on cobbles, 9:46am
		FILL: Clayey Sand with Gravel (SC), light brown, moist, low plasticity, medium and coarse sand, fine and coarse angular gravel										
5060	20		MC	10-18-16 (34)	17							
5055	25		SS	10-9-6 (15)	18							
		Clay (CL), brown, moist, stiff, medium plasticity										
5050	30	very stiff	MC	7-12-23 (35)	17							Drilling completed at 10:27am

EOH at 31.5ft; backfilled to 20ft bgs then grouted to surface

BH19-BR-17

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NewFields

CLIENT	Nevada Department of Transportation	**PROJECT NAME**	US395 North Valleys
PROJECT NUMBER	475.0398.000	**PROJECT LOCATION**	Between Mileposts WA 27.1 and WA 32.6
DATE STARTED	5/31/19 **COMPLETED** 6/2/19	**GROUND ELEVATION**	5102 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR	Geotechnical Drilling	**COORDINATES ():**	
DRILLING METHOD	HSA	**LATITUDE**	**LONGITUDE**
LOGGED BY	N. Owens **CHECKED BY** M.Doehring	**DEPTH TO WATER (FT BGS)**	Perched water at 2.5ft
NOTES	Rig Unit 5 Station 'XN' 772+20 Offset (ft) 35 Left		

ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0	**FILL: Gravel (GP)**, gray, angular gravel to 3" diameter										Drilling started at 10:45am
5100		▽										
		FILL: Clayey Sand (SC), light brown, wet, loose, low to medium plasticity, fine and medium sand	SPT	5-3-4 (7)	7							
	5											
		medium dense	MC	12-11-13 (24)	12							
5095												
		with angular gravel	SPT	7-6-5 (11)	13							11:00am
	10											
		slightly moist	MC	10-11-12 (23)	17							11:05am
5090												
	15											
		moist, medium plasticity, fine to coarse sand, fine and coarse subangular gravel	SPT	4-6-5 (11)	18	25.5	44	19	27	46	27	11:10am
5085												
	20											
			MC	15-19-21 (40)	17							11:20am
5080												
	25											
			SPT	9-9-8 (17)	13							11:30am
5075												
	30	**Silty Sand with Gravel (SM),** brown, moist, very dense, nonplastic, fine and medium sand, angular gravel	MC	43-50/5in	11							11:40am
5070												
	35											

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NewFields

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CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
								LIQUID LIMIT	PLASTICITY INDEX				
	35		**GRANODIORITE:** highly weathered, extremely weak, silty sand, gray, moist, fine and medium sand	SPT	28-48-38 (86)	18							11:32am
5065													
	40		nonplastic, iron oxide veins	MC	12-70/5in	12	15.5	NP	NP	0	71	29	
5060													
	45			SPT	15-23-35 (58)	18							12:24pm
5055													
	50			MC	25-37-70/5in	16	18.3	NP	NP	0	67	33	12:45pm
5050													
	55			SPT	50/5in	4							1:00pm
5045													
	60		**GRANODIORITE:** highly weathered, extremely weak, silty sand, gray, moist, nonplastic, fine to coarse sand, iron oxide staining	SPT	50/5in	6							1:18pm
5040													
	65		gravel to 3/8" diameter	SPT	22-21-41 (62)	18	23.7						1:40pm
5035													
	70			SPT	50/3in	4							2:02pm
5030													
	75												

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CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	75			SPT	50/4in	4							2:24pm
5025													
	80			SPT	50/4in	4							7:30am (2 June)
5020													
	85			SPT	50/4in	3							8:00am
5015													
	90		**GRANODIORITE:** highly to completely weathered, extremely weak, clayey sand with gravel, orange brown, moist, low plasticity, fine and coarse angular gravel, iron oxide staining	SPT	50/5in	6							8:36am
5010													
	95		**GRANODIORITE:** highly weathered, very weak, intensely fractured, poorly graded gravel with sand, gray, wet, medium and coarse sand, angular gravel	SPT	50/5in	4							10:02am
5005													
	100			SPT	50/4in	4							Drilling completed at 10:30am

EOH at 100.3ft; backfilled with bentonite chips and cuttings to 20ft bgs then grouted to the surface

NewFields

BH19-RW7-34

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CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6
DATE STARTED 5/2/19 **COMPLETED** 5/2/19
GROUND ELEVATION 5103 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR Geotechnical Drilling
COORDINATES ():
DRILLING METHOD HSA
LATITUDE **LONGITUDE**
LOGGED BY N. Owens **CHECKED BY** M.Doehring
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Rig Unit 5 Station 'XN' 774+35 Offset (ft) 25 Left

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		**6" ASPHALT**										
			FILL: Clayey Sand with Gravel (SC), brown, slightly moist to moist, dense, medium plasticity, fine to coarse sand, fine and coarse angular gravel										Drilling Times:
5100				SPT	8-14-23 (37)	13	5.3	31	14	37	47	16	9:58pm
	5												
				MC	14-20-39 (59)	8	9.7						10:02pm
5095				SPT	9-11-20 (31)	6							10:09pm
	10		**FILL: Clayey Gravel with Sand (GC)**, brown, moist, dense, medium plasticity, medium sand, angular gravel	MC	29-26-26 (52)	18	11.9	30	15	60	28	12	10:16pm
5090													
	15		low plasticity	SPT	18-20-21 (41)	15	9.8	26	8	54	32	14	10:24pm
5085													
	20			MC	26-29-23 (52)	16							Difficult drilling, 10:37pm
5080													
	25		**ANDESITE:** completely to highly weathered, extremely weak, hydrothermally altered, silty sand, orange brown, moist, medium sand	SPT	16-26-49 (75)	18							11:13pm
5075													
	30			MC	70/3in	0							No recovery, Drilling completed at 11:30pm

EOH at 30.3ft; backfilled with bentonite chips to 20ft bgs then grouted to surface

NewFields

BH19-RW7-35

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CLIENT Nevada Department of Transportation	**PROJECT NAME** US395 North Valleys
PROJECT NUMBER 475.0398.000	**PROJECT LOCATION** Between Mileposts WA 27.1 and WA 32.6
DATE STARTED 5/2/19 **COMPLETED** 5/2/19	**GROUND ELEVATION** 5111 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR Geotechnical Drilling	**COORDINATES ():**
DRILLING METHOD HSA	**LATITUDE** **LONGITUDE**
LOGGED BY N. Owens **CHECKED BY** M.Doehring	**DEPTH TO WATER (FT BGS)** No free water encountered

NOTES Rig Unit 5 Station 'XN' 776+40 Offset (ft) 30 Left

ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
5110	0	**6" ASPHALT** **FILL: Clayey Sand with Gravel (SC)**, brown, moist, medium dense, low plasticity, fine to medium sand, fine angular gravel										Drilling Times:
			SPT	4-7-7 (14)	17							11:50pm
5105	5	yellow and orange brown	MC	13-13-10 (23)	10							11:55pm
		white and orange brown, dense	SPT	13-17-19 (36)	13							12:00am
5100	10	**Clayey Gravel with Sand (GC)**, orange brown, moist, dense, low plasticity, medium sand, fine and coarse angular gravel	MC	22-33-16 (49)	10							12:07am
5095	15	**Clayey Sand with Gravel (SC)**, white and brown, moist, medium dense, low plasticity, fine to medium sand, fine and coarse angular gravel	SPT	10-15-6 (21)	8							12:13am
5090	20	**Clayey Gravel with Sand (GC)**, brown, moist, very dense, medium sand, angular gravel	MC	69-70/1in	5							12:25am
5085	25	**ANDESITE:** completely to highly weathered, weak, silty sand, orange, moist, medium to coarse sand, platey	SPT	50/4in	1							12:33am
	30		SPT	50/4in	0							Drilling completed at 12:54am

EOH at 30.3ft; backfilled to 20ft bgs then grouted to surface

NewFields

BH19-RW7-36

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CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6
DATE STARTED 5/2/19 **COMPLETED** 5/2/19
GROUND ELEVATION 5122 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR Geotechnical Drilling
COORDINATES ():
DRILLING METHOD HSA
LATITUDE **LONGITUDE**
LOGGED BY N. Owens **CHECKED BY** M.Doehring
DEPTH TO WATER (FT BGS) Perched water at 5ft
NOTES Rig Unit 5 Station 'XN' 778+40 Offset (ft) 30 Left

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		**6" ASPHALT**										Drilling started at 1:08am
5120		▩	**FILL: Clayey Gravel with Sand (GC)**, brown, moist, very dense, medium sand, angular gravel										
				SPT	10-29-26 (55)	15							1:13am
	5		∇ light brown, medium dense, medium plasticity, fine to coarse sand, fine and coarse gravel	MC	15-22-10 (32)	8	10.1	31	15	51	36	13	1:20am
5115		▨	**ANDESITE:** completely weathered, extremely weak, hydrothermally altered, silty gravel with sand, brown, moist, medium to coarse sand, fine and coarse angular gravel	SPT	50/5in	4							1:26am
	10			MC	70/5in	2							
5110			brown and white										
	15		yellow brown	SPT	22-50/1in	5							1:45am
5105													
	20			MC	70/5in	4							1:56am
5100													
	25		highly weathered, very weak, platey	SPT	50/5in	5							2:10am
5095													
	30		**ANDESITE:** completely to highly weathered, extremely weak, clay infilling, clayey gravel with sand, orange brown, moist to wet, medium plasticity, fine to coarse sand, fine and coarse angular gravel	SPT	50/5in	5							Drilling completed at 2:24am

EOH at 30.5ft: backfilled to 20ft bgs then grouted to surface

BH19-RW7-37

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CLIENT Nevada Department of Transportation

PROJECT NAME US395 North Valleys

PROJECT NUMBER 475.0398.000

PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

DATE STARTED 5/2/19 **COMPLETED** 5/2/19

GROUND ELEVATION 5132 ft **HOLE SIZE** 8" Diameter

DRILLING CONTRACTOR Geotechnical Drilling

COORDINATES ():

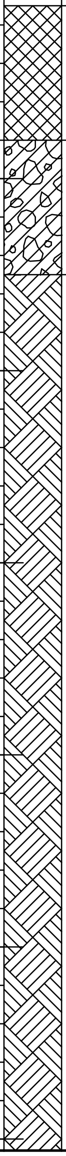
DRILLING METHOD HSA

LATITUDE **LONGITUDE**

LOGGED BY N. Owens **CHECKED BY** M.Doehring

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Rig Unit 5 Station 'XN' 780+55 Offset (ft) 30 Left



ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0	**6" ASPHALT**										2:40am
5130		**FILL: Clayey Sand with Gravel (SC)**, brown/orange brown, moist, medium dense, low plasticity, medium sand, angular gravel										
			SPT	7-11-14 (25)	16							2:52am
	5	**Clayey Gravel with Sand (GC)**, brown, moist, very dense, low plasticity, fine to coarse sand, fine and coarse angular gravel										
			MC	70/3in	0	9.7						No recovery
5125												
		GRANODIORITE: completely to highly weathered, very weak hydrothermally altered, silty gravel with sand, brown, moist, very dense, medium to coarse sand, fine and coarse angular gravel	SPT	50/3in	3							3:01am
	10		MC	70/3in	0							No recovery, 03:08am
5120												
	15		SPT	50/3in	3							3:16am
5115												
	20	completely weathered, orange brown	SPT	50/2in	1							3:30am
5110												
	25	highly weathered, very weak, brown	SPT	50/2in	1							3:40am
5105												
	30		SPT	50/3in	1							

EOH at 30.3ft; backfilled to 20ft bgs then grouted to surface

NewFields

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CLIENT Nevada Department of Transportation

PROJECT NAME US395 North Valleys

PROJECT NUMBER 475.0398.000

PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

DATE STARTED 5/3/19 **COMPLETED** 5/3/19

GROUND ELEVATION 5139 ft **HOLE SIZE** 8" Diameter

DRILLING CONTRACTOR Geotechnical Drilling

COORDINATES ():

DRILLING METHOD HSA

LATITUDE **LONGITUDE**

LOGGED BY M. Walden **CHECKED BY** M.Doehring

DEPTH TO WATER (FT BGS) 25

NOTES Rig Unit 17 Station 'XN' 782+50 Offset (ft) 30 Left

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		**6" ASPHALT**										Drilling started at 9:45pm
			Clayey Sand with Gravel (SC), brown, moist, medium dense, low plasticity, fine to coarse sand, subangular gravel										
				SPT	5-8-9 (17)	18	10.4						10:50pm
5135	5												
			GRANODIORITE: completely to highly weathered, extremely weak, clayey gravel with sand, gray brown, dry, fine to coarse sand, subangular gravel	MC	70	6.5							10:08pm
				SPT	50/5in	5							10:16pm
5130	10												
			low plasticity, fine and coarse angular gravel	MC	60-70/2in	8	10.2	24	9	65	27	8	10:27pm
5125	15												
			highly weathered, iron oxide veining	SPT	50/5in	5							10:36pm
5120	20												
				MC	70/5in	5							10:45pm
5115	25	▽											
			GRANODIORITE: completely to highly weathered, clayey sand, some gravel and silt, brown, wet, medium plasticity, fine gravel, iron oxide staining	SPT	11-15-37 (52)	18							Water at 25ft, 11:05pm
5110	30												
			GRANODIORITE: highly weathered, weak, silty sand, some gravel, trace clay, grayish brown, dry, fine to coarse sand, subangular gravel	MC	11/5in	5							Drilling completed at 11:20pm

EOH at 30.5ft; backfilled to 20ft bgs then grouted to surface

NewFields

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CLIENT Nevada Department of Transportation

PROJECT NAME US395 North Valleys

PROJECT NUMBER 475.0398.000

PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

DATE STARTED 5/3/19 **COMPLETED** 5/3/19

GROUND ELEVATION 5147 ft **HOLE SIZE** 8" Diameter

DRILLING CONTRACTOR Geotechnical Drilling

COORDINATES ():

DRILLING METHOD HSA

LATITUDE

LONGITUDE

LOGGED BY M. Walden **CHECKED BY** M.Doehring

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Rig Unit 17 Station 'XN' 784+60 Offset (ft) 30 Left

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		**6" ASPHALT**										Drilling started at 11:47pm
		▨	**GRANODIORITE:** highly weathered, extremely weak, silty sand, some gravel and clay, brown, moist to dry, low plasticity, subangular, fine and coarse gravel										
5145													
				SPT	7-21-28 (49)	18							
	5												
				MC	50-70	12							11:55pm
5140													
				SPT	50/5in	0							No recovery, 12:04pm
	10												
				MC	70/5in	5							12:10pm
5135													
	15												
				SPT	40-50/2in	8							12:22pm
5130													
	20												
			very weak, gray, iron oxide staining	MC	31-70/4in	10							12:30pm
5125													
	25												
				SPT		18							12:42pm
5120													
	30												
				MC	42-70/3in	9							Drilling completed at 12:53pm

EOH at 30.8ft; backfilled to 20ft bgs then grouted to surface

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CLIENT Nevada Department of Transportation

PROJECT NAME US395 North Valleys

PROJECT NUMBER 475.0398.000

PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

DATE STARTED 5/5/19 **COMPLETED** 5/5/19

GROUND ELEVATION 5158 ft **HOLE SIZE** 8" Diameter

DRILLING CONTRACTOR Geotechnical Drilling

COORDINATES ():

DRILLING METHOD HSA

LATITUDE

LONGITUDE

LOGGED BY M. Walden **CHECKED BY** M.Doehring

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Rig Unit 17 Station 'XN' 786+60 Offset (ft) 30 Left

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
								LIQUID LIMIT	PLASTICITY INDEX				
	0		**6" ASPHALT**										Drilling Times:
			GRANODIORITE: completely to highly weathered, extremely weak, well graded gravel with sand and some clay, gray, slightly moist to moist, low plasticity, fine to coarse sand, fine and coarse subangular gravel										
5155				SPT	8-10-10 (20)	18							1:19am
	5		iron oxide staining	MC	14-55-70/5in	17	5.2	23	9	48	45	7	1:28am
5150				SPT	22-50/4in	11							1:35am
	10		highly weathered, very weak, very intensely fractured	MC	43-70/6in	12							1:46am
5145													
	15			SPT	40-50/3in	9							1:52am
5140													
	20												No recovery, 2:01am
5135			moderately weathered, weak	SPT	50/2in	2							Hard drilling, Drilling completed at 2:30am

Practical refusal encountered at 24ft; backfilled to 20ft bgs then grouted to the surface

NewFields

BH19-RW7-41

CLIENT Nevada Department of Transportation

PROJECT NAME US395 North Valleys

PROJECT NUMBER 475.0398.000

PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

DATE STARTED 5/5/19 **COMPLETED** 5/5/19

GROUND ELEVATION 5163 ft **HOLE SIZE** 8" Diameter

DRILLING CONTRACTOR Geotechnical Drilling

COORDINATES ():

DRILLING METHOD HSA

LATITUDE **LONGITUDE**

LOGGED BY M. Walden **CHECKED BY** M.Doehring

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Rig Unit 17 Station 'XN' 788+80 Offset (ft) 30 Left

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
								LIQUID LIMIT	PLASTICITY INDEX				
	0		**6" ASPHALT**										Drilling Times:
5160			**Clayey Sand with Gravel (SC),** brown, moist, medium dense, nonplastic, fine to coarse sand, angular to subangular gravel	SPT	6-8-5 (13)	18	9.1						10:16pm
	5		**GRANODIORITE:** completely to highly weathered, very weak, clayey sand, trace gravel, brown, moist, medium plasticity, fine to coarse sand, iron oxide staining	MC	12-22-48 (70)	18							10:24pm
5155			completely weathered, hydrothermally altered, extremely weak	SPT	16-18-24 (42)	18							10:32pm
	10		completely to highly weathered, orange brown	MC	15-26-70/5in	17	15.5	35	15	13	57	30	10:41pm
5150	15			SPT	43-50/3in	9							10:54pm
5145	20		**GRANODIORITE:** completely to highly weathered, very weak, silty sand with gravel, orange brown, dry, fine to coarse sand, angular to subangular gravel	MC	70/5in	11							11:08pm
5140	25			SPT	23-50/4in	10							11:20pm
5135	30			MC	70/5in	0							No recovery, Drilling completed at 11:34pm

EOH at 30.5ft; backfilled to 20ft then grouted to surface

BH19-RW7-42

CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6
DATE STARTED 5/5/19 **COMPLETED** 5/5/19
GROUND ELEVATION 5169 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR Geotechnical Drilling
COORDINATES ():
DRILLING METHOD HSA
LATITUDE **LONGITUDE**
LOGGED BY M. Walden **CHECKED BY** M.Doehring
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Rig Unit 17 Station 'XN' 790+80 Offset (ft) 30 Left

ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0	**6" ASPHALT**										Drilling Times:
		Silty Sand with Gravel (SM), brown, medium dense, nonplastic, fine to coarse sand, subangular gravel										
			SPT	14-22-11 (33)	18	6.3						12:04am
5165												
	5											
			MC	20-30-20 (50)	0							No recovery, 12:10am
		Clayey Sand with Gravel (SC), brown, low plasticity, fine and coarse sand, fine to coarse gravel	SPT	7-8-50/5in	17	10.1	26	8	27	55	18	12:18am
5160												
	10											
			MC	70/5in	5							No recovery, 12:26am
5155												
	15											
		Sand (SP/SM), some silt and gravel, grayish brown, dry, very dense, nonplastic, fine to coarse sand, subangular gravel	SPT	50/6in	6							12:35am
5150												
	20											
		GRANODIORITE: highly weathered, very weak, silty sand, some gravel, brown, nonplastic, dry, fine to coarse sand, subangular gravel, iron oxide staining	MC	43-70/5in	11							12:43am
5145												
	25											
		extremely weak	SPT	50/6in	6							No recovery, 12:52am
5140												
	30											
			MC	70/5in	5							Drilling completed at 1:04am

EOH at 30.5ft; backfilled to 20ft bgs then grouted to surface

BH19-RV7-43

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NewFields

CLIENT Nevada Department of Transportation

PROJECT NAME US395 North Valleys

PROJECT NUMBER 475.0398.000

PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

DATE STARTED 5/5/19 **COMPLETED** 5/5/19

GROUND ELEVATION 5176 ft **HOLE SIZE** 8" Diameter

DRILLING CONTRACTOR Geotechnical Drilling

COORDINATES ():

DRILLING METHOD HSA

LATITUDE **LONGITUDE**

LOGGED BY M. Walden **CHECKED BY** M.Doehring

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Rig Unit 17 Station 'XN' 792+80 Offset (ft) 30 Left

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
5175	0		**6" ASPHALT** **Silty Sand with Gravel (SM)**, brown, moist, medium dense, nonplastic, fine to coarse sand, subangular gravel										Drilling Times:
				SPT	5-8-7 (15)	18							1:34am
5170	5		**GRANODIORITE:** completely to highly weathered, extremely weak, sand with clay and gravel, brown, moist, low plasticity, fine to coarse sand, fine and coarse subangular gravel	MC	6-6-6 (12)	18	8.9	29	10	40	51	9	1:40am
			completely weathered	SPT	4-6-7 (13)	18							1:48am
5165	10			MC	20-20-70/3in	17							1:53am
5160	15		white	SPT	16-30-50/3in	15							2:04am
5155	20		orange brown, highly weathered, very weak	MC	70/6in	6							2:11am
				SPT	50/2in	0							No recovery, Drilling completed at 2:32am

Practical refusal encountered at 24ft; backfilled to 20ft bgs then grouted to the surface

NewFields

BH19-RW7-44

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CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6
DATE STARTED 5/5/19 **COMPLETED** 5/5/19
GROUND ELEVATION 5182 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR Geotechnical Drilling
COORDINATES ():
DRILLING METHOD HSA
LATITUDE **LONGITUDE**
LOGGED BY N. Owens **CHECKED BY** M.Doehring
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Rig Unit 5 Station 'XN' 794+85 Offset (ft) 30 Left

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		**12" ASPHALT**										Drilling Times:
5180			**FILL: Clayey Sand with Gravel (SC),** brown, moist, medium dense, low plasticity, fine to medium sand, fine to coarse angular gravel										
				SPT	10-8-12 (20)	17							10:10pm
	5		**Clayey Gravel with Sand (GC),** brown, moist, very dense, low to medium plasticity, fine to coarse sand, angular gravel	MC	14-70/3in	6							Rig bouncing on the gravel, 10:12pm
5175			light brown, medium dense, fine and coarse gravel	SPT	19-16-6 (22)	8	8.1	28	11	53	34	13	
	10		very dense	MC	9-33-36 (69)	18							10:15pm
5170													
	15		**Clayey Sand with Gravel (SC)**, light brown, medium dense to dense, low to medium plasticity, fine to coarse sand, fine and coarse gravel	SPT	6-15-15 (30)	14	15.1	28	11	23	60	17	10:40pm
5165													
	20		**Clayey Sand with Gravel (SC),** white mottled brown, moist, very dense, low plasticity, fine to coarse sand, angular gravel	MC	25-24-37 (61)	18							11:10pm
5160													
	25		**GRANODIORITE:** completely weathered, extremely weak, hydrothermally altered, sand with silt and gravel, light brown/white, moist, medium to coarse sand, angular gravel	SPT	34-45-46 (91)	17							11:37pm
5155													
	30		orange brown	MC	25-49-50/5in	17							Drilling completed at 12:14am

EOH at 30ft; backfilled to 20ft bgs then grouted to surface

NewFields

BH19-RW7-45

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CLIENT Nevada Department of Transportation

PROJECT NAME US395 North Valleys

PROJECT NUMBER 475.0398.000

PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

DATE STARTED 5/5/19 **COMPLETED** 5/5/19

GROUND ELEVATION 5186 ft **HOLE SIZE** 8" Diameter

DRILLING CONTRACTOR Geotechnical Drilling

COORDINATES ():

DRILLING METHOD HSA

LATITUDE **LONGITUDE**

LOGGED BY N. Owens **CHECKED BY** M.Doehring

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Rig Unit 5 Station 'XN' 796+80 Offset (ft) 30 Left

ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0											
5185		**12" ASPHALT**										Drilling Times:
		Silty Clayey Sand (SC/SM), brown, moist, dense, low plasticity, fine to coarse sand, fine angular gravel										
			SPT	12-16-14 (30)	14	7.9	24	6	15	67	18	12:50am
5180	5	medium dense	MC	16-19-16 (35)	18							
			SPT	20-16-10 (26)	10							1:02am
5175	10		MC	13-12-26 (38)	18							1:08am
5170	15		SPT	10-6-7 (13)	8							1:15am
5165	20	**GRANODIORITE:** completely to highly weathered, sand with silt and gravel, brown, moist, medium to coarse sand	MC	11-18-16 (34)	18							1:25am
5160	25		SPT	50/3in	0							No recovery, 1:38am
5155	30		MC	38-70/5in	12							Drilling completed at 1:48am

EOH at 31ft; backfilled to 20ft bgs then grouted to surface

NewFields

BH19-RWY7-46

PAGE 1 OF 1

CLIENT Nevada Department of Transportation

PROJECT NAME US395 North Valleys

PROJECT NUMBER 475.0398.000

PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

DATE STARTED 5/5/19 **COMPLETED** 5/5/19

GROUND ELEVATION 5189 ft **HOLE SIZE** 8" Diameter

DRILLING CONTRACTOR Geotechnical Drilling

COORDINATES ():

DRILLING METHOD HSA

LATITUDE **LONGITUDE**

LOGGED BY N. Owens **CHECKED BY** M.Doehring

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Rig Unit 5 Station 'XN' 798+70 Offset (ft) 30 Left

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		**12" ASPHALT**										Drilling Times:
			FILL: Clayey Sand with Gravel (SC), brown, moist, medium dense, low plasticity, fine to coarse sand, fine and coarse angular gravel	SPT	9-14-12 (26)	12	9.7	27	9	15	68	17	2:26am
5185	5												
			dense	MC	20-27-23 (50)	16							
			medium dense	SPT	9-11-13 (24)	14							2:37am
5180	10												
			FILL: Poorly Graded Sand with Silt (SP-SM), brown, moist, medium dense, nonplastic, fine to coarse sand, some fine gravel	MC	13-17-19 (36)	12	9.3	NP	NP	11	78	11	2:43am
5175	15												
			dense	SPT	13-16-17 (33)	11							
5170	20												
			Silty Gravel with Sand (GM), light brown, moist, dense, medium to coarse sand, angular gravel	MC	17-27-31 (58)	7							3:00am
5165	25												
			Clayey Sand with Gravel (SC), brown, moist, medium dense, low plasticity, fine to medium sand, angular gravel	SPT	9-8-17 (25)	16							3:10am
5160	30												
			very dense	MC	31-41-70/3in	18							

EOH at 31.5ft: backfilled to 20ft bgs then grouted to surface

NF-GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 12/2/19 09:51 - S:\PROJECTS\0398.000_NDOT US395 NORTH VALLEYS\18_GINT_LOGS\NORTH_VALLEYS.GPJ

BH19-BR-20

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CLIENT Nevada Department of Transportation

PROJECT NAME US395 North Valleys

PROJECT NUMBER 475.0398.000

PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

DATE STARTED 5/3/19 **COMPLETED** 5/3/19

GROUND ELEVATION 5191 ft **HOLE SIZE** 8" Diameter

DRILLING CONTRACTOR Geotechnical Drilling

COORDINATES ():

DRILLING METHOD HSA

LATITUDE **LONGITUDE**

LOGGED BY N. Owens **CHECKED BY** M. Doehring

DEPTH TO WATER (FT BGS) 80

NOTES Rig Unit 5 Station 'XN' 799+90 Offset (ft) 30 Left

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		**12" CONCRETE**										Drilling Time:
5190			**FILL: Clayey Sand with Gravel (SC)**, brown, moist, very dense, low plasticity, medium to coarse sand, angular gravel										
				SPT	11-17-34 (51)	14							
5185	5		medium dense	MC	10-20-22 (42)	18							
				SPT	9-13-10 (23)	14							10:30pm
5180	10		dense, iron oxide staining	MC	10-23-24 (47)	18							10:31pm
5175	15		**FILL: Clayey Sand (SC)**, some gravel, brown, moist, medium dense, medium plasticity, fine to coarse sand, fine angular gravel	SPT	14-14-14 (28)	16							10:37pm
5170	20			MC	12-19-16 (35)	18	9.0	27	11	12	70	18	10:45pm
5165	25		**FILL: Silty Sand (SM),** trace gravel, moist, very dense, non-plastic, medium to coarse sand	SPT	14-26-27 (53)	18							10:57pm
5160	30		**Clayey Sand with Gravel (SC)**, brown, moist, dense, low plasticity, fine to medium sand, angular gravel, iron oxide staining	MC	17-25-26 (51)	18							11:24pm
	35												

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BH19-BR-20

CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	35											
5155		**GRANODIORITE:** completely to highly weathered, extremely weak, clayey sand, some gravel, light brown, moist, medium plasticity, fine to coarse sand, fine gravel	SPT	47-50/3in	9							11:41pm
5150	40		MC	44-70/4in	10	11.5	34	15	12	70	18	12:01am
5145	45		SPT	49-50/3in	9							
5140	50	**GRANODIORITE:** completely to highly weathered, very weak, very intensely fractured, clayey sand, some silt and gravel, brown, moist, medium plasticity, fine to coarse sand, fine subangular gravel, iron oxide staining	MC	28-44-49 (93)	18							
5135	55	white mineralization	SPT	10-15-23 (38)	18							
5130	60		MC	18-21-28 (49)	18							12:26am
5125	65		SPT	8-13-23 (36)	18	12.0	34	18	10	43	47	12:38am
5120	70	hydrothermally altered	MC	11-21-29 (50)	18							12:53am
	75											

(Continued Next Page)

CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	75												
5115													
	80		▽										
5110				SPT	8-12-16 (28)	18							1:17am
	85												
5105													
	90												
5100				MC	17-29-39 (68)	18							1:45am
	95												
5095													
	100												
5090				SPT	35-50/5in	11							Drilling completed at 2:12am

EOH at 101ft; backfilled with bentonite chips and cuttings to 20ft bgs then grouted to surface

BH19-RW8-47

CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6
DATE STARTED 7/12/19 **COMPLETED** 7/12/19
GROUND ELEVATION . **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR Haz-Tech Drilling, Inc.
COORDINATES ():
DRILLING METHOD HSA
LATITUDE **LONGITUDE**
LOGGED BY M.Doehring **CHECKED BY** M.Doehring
DEPTH TO WATER (FT BGS) 15
NOTES Rig Unit 204 Station 'V4' 22+15 Offset (ft) 35 Left

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		**4" ASPHALT** **Clayey Sand with Gravel (SC)**, yellow brown, low plasticity, fine to coarse sand, fine and coarse subangular gravel up to 1" diameter	SPT	12-15-17 (32)	13							Drilling started at 7:00am
			ANDESITE: highly weathered, very weak, iron oxide staining, orange and white, clayey sand with gravel, low plasticity, fine to coarse sand, fine and coarse gravel	SPT	41-31-32 (63)	18	11.8	32	10	31	52	17	7:01am
	5		completely weathered matrix, silty sand, nonplastic to low plasticity, fine sand, fine angular gravel	MC	29-50	10							7:05am
				SPT	50	0							7:12am Auger grinding at 8ft to 14ft
	10			MC	50/1in	2							7:17am
	15	▽	completely weathered, extremely weak, hydrothermally altered, clayey sand with gravel, medium plasticity, fine to coarse sand, fine angular gravel	SPT	50/4in	2	16.7						7:24am Water at 15ft
	20		yellow brown, red and white, wet	SPT	50/4in	4							7:32am
	25		iron oxide staining, yellow brown and white	SPT	48-50/4in	10							7:39am
	30			SPT	50/4in	4							Drilling complete at 7:49am

EOH at 30.3ft: backfilled with bentonite chips and cuttings to 4ft bgs then grouted to surface

BH19-RW8-48

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NewFields

CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6
DATE STARTED 7/11/19 **COMPLETED** 7/11/19
GROUND ELEVATION 5088 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR Haz-Tech Drilling, Inc.
COORDINATES ():
DRILLING METHOD HSA
LATITUDE **LONGITUDE**
LOGGED BY M.Doehring **CHECKED BY** M.Doehring
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Rig Unit 204 Station 'V4' 24+40 Offset (ft) 35 Left

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		**6" ASPHALT** **GRANODIORITE:** completely weathered, extremely weak, gray, medium plasticity, fine grained	SPT	4-12-6 (18)	10							Drilling started at 15:58pm
5085			completely weathered, orange and gray, fine to coarse sand, fine gravel	SPT	5-6-10 (16)	18							
	5		completely weathered, sandy silt, gray, nonplastic	MC	7-20-35 (55)	12	23.6	NP	NP	0	44	56	1:08pm
5080			orange and white, iron oxide staining	SPT	8-22-25 (47)	18							1:09pm
	10		completely weathered, hydrothermally altered	MC	12-25-47 (72)	12							1:11pm
5075													
	15		brown and white	SPT	8-27-14 (41)	18							1:18pm
5070													
	20			SPT	11-20-20 (40)	12							1:25pm
5065													
	25		iron oxide staining	SPT	10-31-47 (78)	18							1:33pm
5060													
	30			SPT	3-37-50/4in	16							Drilling completed at 1:44pm

EOH at 31.3ft: backfilled with bentonite chips and cuttings

NewFields

BH19-RW8-49

PAGE 1 OF 1

CLIENT	Nevada Department of Transportation	**PROJECT NAME**	US395 North Valleys
PROJECT NUMBER	475.0398.000	**PROJECT LOCATION**	Between Mileposts WA 27.1 and WA 32.6
DATE STARTED	4/21/19 **COMPLETED** 4/21/19	**GROUND ELEVATION**	5098 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR	Geotechnical Drilling	**COORDINATES ():**	
DRILLING METHOD	HSA	**LATITUDE**	**LONGITUDE**
LOGGED BY	N. Owens **CHECKED BY** M.Doehring	**DEPTH TO WATER (FT BGS)**	No free water encountered
NOTES	Rig Unit 17 Station 'V4' 26+80 Offset (ft) 35 Left		

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		**FILL: Silty Sand with Gravel (SM)**, dark brown, moist, medium dense, nonplastic, fine to coarse sand, fine angular gravel	SPT	8-12-11 (23)	12	5.1	NP	NP	27	59	14	
5095			**FILL: Silty Gravel with Sand (GM)**, dark gray, very dense, fine to coarse sand angular gravel	MC	28-50/4in	10							
	5		**Silty Gravel with Sand (GM)**, dark gray, moist, very dense, fine to coarse sand, fine and coarse angular gravel	SPT	27-46-50/5in	17							
5090				MC	37-50/6in	12							
	10		fine angular gravel	SPT	23-38-50/5in	17							
5085	15		fine and coarse angular gravel	MC	16-50/2in	7							
5080	20		**GRANODIORITE:** completely to highly weathered, very weak, clayey sand, light brown to light gray, moist, low to medium plasticity, fine to coarse sand	SPT	9-24-50/5in	17							Difficult drilling
5075	25		**GRANODIORITE:** completely to highly weathered, clayey gravel with sand, light brown and gray, moist, low plasticity, fine to coarse sand, fine and coarse angular gravel	MC	50/6in	6							

Practical refusal encountered at 27ft; backfilled to 20ft bgs then grouted to the surface

NewFields

BH19-RW8-50

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CLIENT Nevada Department of Transportation

PROJECT NAME US395 North Valleys

PROJECT NUMBER 475.0398.000

PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

DATE STARTED 7/12/19 **COMPLETED** 7/12/19

GROUND ELEVATION 5110 ft **HOLE SIZE** 8" Diameter

DRILLING CONTRACTOR Haz-Tech Drilling, Inc.

COORDINATES ():

DRILLING METHOD HSA

LATITUDE

LONGITUDE

LOGGED BY M.Doehring **CHECKED BY** M.Doehring

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Rig Unit 204 Station 'V4' 29+25 Offset (ft) 15 Left

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
								LIQUID LIMIT	PLASTICITY INDEX				
5110	0		**FILL: Clayey Sand with Gravel (SC)**, yellow brown, slightly moist, loose to medium dense, low plasticity, fine to coarse sand, subangular gravel up to 1" diameter	SPT	4-5-5 (10)	11							Drilling started at 8:31am
			asphalt debris, gravel up to 2-1/2" diameter, dense	SPT	5-19-19 (38)	14							8:32am
5105	5		light brown, medium dense, medium plasticity, subangular gravel up to 3/4" diameter	MC	14-9-12 (21)	12	19.1	41	20	20	46	34	8:34am
				SPT	16-12-15 (27)	11							8:40am
5100	10		asphalt debris, angular gravel up to 2-1/2" diameter	MC	12-14-18 (32)	13							8:44am delay due to sampler dropped in hole
			GRANODIORITE: highly weathered, very weak, highly weathered, rough, iron oxide staining										
5095	15		extremely weak, completely weathered, slickenside, nonplastic, fine to coarse sand, fine angular gravel	SPT	15-17-50 (67)	18							9:14am
5090	20		iron oxide staining	SPT	22-35-50/5in	16							9:21am
5085	25		orange and white, iron oxide veining	SPT	13-32-35 (67)	18							9:30am
5080	30			SPT	25-39-50/4in	14							Drilling completed at 9:38am

EOH at 31.4ft: backfilled with bentonite chips and cuttings

NewFields

BH19-BR-18

PAGE 1 OF 3

CLIENT	Nevada Department of Transportation	**PROJECT NAME**	US395 North Valleys
PROJECT NUMBER	475.0398.000	**PROJECT LOCATION**	Between Mileposts WA 27.1 and WA 32.6
DATE STARTED	6/3/19 **COMPLETED** 6/4/19	**GROUND ELEVATION**	5132 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR	Geotechnical Drilling	**COORDINATES ():**	
DRILLING METHOD	HSA	**LATITUDE**	**LONGITUDE**
LOGGED BY	M. Walden **CHECKED BY** M.Doehring	**DEPTH TO WATER (FT BGS)**	45
NOTES	Rig Unit 17 Station 'VA' 32+15 Offset (ft) 15 Left		

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		**FILL: Silty Sand (SM)**, brown, moist, medium dense, nonplastic, fine to coarse sand, some subangular gravel										Drilling started at 11:38am
5130													
				SPT	6-6-5 (11)	18							12:02pm
	5		**FILL: Clayey Sand (SC)**, some gravel, trace cobble, orange brown, moist, loose, low to medium plasticity, fine to coarse sand, subangular gravel	MC	7-7-6 (13)	18							12:10pm
5125													
				SPT	4-2-2 (4)	14							12:18pm
	10		very dense	MC	11-60-70/5in	9							12:28pm
5120													
	15		**FILL: Clayey Sand (SC)**, trace gravel, brown, moist, medium dense, low to medium plasticity, fine to coarse sand, subangular gravel	SPT	4-8-16 (24)	14							12:40pm
5115													
	20			MC	13-12-14 (26)	18							12:30am
5110													
	25		**GRANODIORITE:** extremely weak, highly weathered, clayey sand, trace gravel, whitish brown, moist, medium plasticity, fine to medium sand	SPT	7-17-31 (48)	18	15.7	33	15	1	56	43	1:03pm
5105													
	30			SPT	70	6	9.4						1:20pm
5100													
	35												

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CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	35			SPT	50	6							1:49pm
5095													
	40		**GRANODIORITE:** extremely weak, highly to completely weathered, silty sand, some gravel, orange brown, wet, low plasticity, fine to coarse sand, fine subangular gravel, iron oxide staining	SPT	31-49-50/5in	17	40.5	32	9	13	63	24	2:20pm
5090													
	45		∇ completely weathered	SPT	50/5in	5							Water table at 45', 2:55pm
5085													
	50			SPT	50/4in	4							7:05am (4 June)
5080													
	55			SPT	50/3in	3							7:32am
5075													
	60			SPT	50/5in	5							8:04am
5070													
	65			SPT	50/3in	3							8:36am
5065													
	70			SPT	31-49-50/0in	14							9:16am
5060													
	75												

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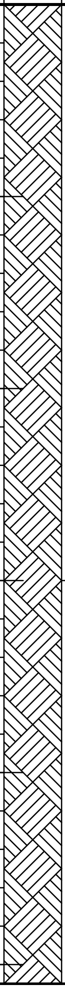
CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
								LIQUID LIMIT	PLASTICITY INDEX				
	75												
5055													
	80			SPT	50/5in	5							10:12am
5050													
	85												
5045													
	90		**GRANODIORITE:** extremely weak, highly weathered, clayey sand, trace gravel, gray, wet, high plasticity, subangular gravel, iron oxide staining	SPT	50/5in	5							11:18am
5040													
	95												
5035													
	100			SPT	50/5in	5							
			EOH at 100.5ft; backfilled with bentonite chips and cuttings to the surface										

CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6
DATE STARTED 7/15/19 **COMPLETED** 7/15/19
GROUND ELEVATION 5136 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR Haz-Tech Drilling, Inc.
COORDINATES ():
DRILLING METHOD HSA
LATITUDE ________ **LONGITUDE** ________
LOGGED BY M.Doehring **CHECKED BY** M.Doehring
DEPTH TO WATER (FT BGS) 65
NOTES Rig Unit 204 Station 'XN' 782+45 Offset (ft) 80 Right

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
5135	0		**FILL: Silty Sand with Gravel (SM)**, dark brown, slightly moist, medium dense, nonplastic, fine to coarse sand, angular gravel up to 1/2" diameter, asphalt debris	SPT	7-11-6 (17)	12							Drilling started at 8:22am
			Clayey Sand (SC), moist, medium dense, medium plasticity, fine to coarse sand, angular gravel up to 1-1/2" diameter	SPT	5-8-8 (16)	18							8:23am
5130	5		**Silty Clay (CL)**, orange, moist, very stiff, low plasticity	MC	8-17-20 (37)	17							8:26am
			Clayey Sand (SC), orange, moist, medium dense, low plasticity, fine to coarse sand, angular gravel up to 3/4" diameter, iron oxide staining	SPT	17-32-50 (82)	18							8:30am
5125	10		**Silt (ML)**, orange and white, slightly moist, hard, nonplastic, iron oxide staining, weakly cemented pieces	MC	34-50	12							8:35am
5120	15		**GRANODIORITE:** completely weathered, extremely weak, hydrothermally altered, silty sand with gravel, orange and white, low plasticity, fine to coarse sand, angular gravel up to 1/2" diameter, iron oxide veins, slickensides	SPT	26-36-50/5in	17							8:43am
5115	20		**GRANODIORITE:** completely weathered, extremely weak, sandy clay, red, medium plasticity, fine to coarse sand, fine gravel, some high plasticity clay seams	MC	36-50/4in	10	17.8	41	15	12	26	62	8:53am
5110	25		silty clay, orange, low plasticity, white mineralization	SPT	24-36-39 (75)	18							9:05am
5105	30		**GRANODIORITE:** completely weathered, very weak, intensely fractured, highly weathered, white mineralization, platey pieces of weak rock 1/4 to 1/2" thick	MC	50	4							9:19am
	35												

(Continued Next Page)

CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
5100	35	completely weathered, silty sand, smooth, low plasticity, iron oxide staining, white mineralization, some fine gravel	SPT	26-50/4in	13	13.6	33	9	7	48	45	9:33am
5095	40		SPT	22-50/4in	8							10:00am
5090	45	highly weathered, silty sand and gravel, nonplastic, fine to coarse sand, angular gravel up to 1/2" diameter (mechanically fractured, predominantly platey)	SPT	25-50/2in	6							10:22am
5085	50	completely weathered, clayey silt, orange, trace cemented angular pieces up to 1/2" diameter	SPT	25-50/4in	10	16.1						10:39am
5080	55	**GRANODIORITE:** completely weathered, very weak rock, hydrothermally altered, very intensely fractured, rough, clayey sand matrix, gray/white, low plasticity, fine to coarse sand, angular and platey gravel (mechanically fractured) up to 1/2" diameter, 1/4 to 1/8" plates	SPT	50/5in	4							11:13am Perched water at 55ft bgs
5075	60	yellow brown, completely weathered, clay silt, some angular gravel up to 3/4" diameter, weakly cemented pieces	SPT	50/5in	5							11:30am
5070	65	▽ **GRANODIORITE:** completely weathered, extremely weak, silty sand, orange and white, wet, nonplastic, fine to coarse sand, iron oxide veins and staining, feldspar	SPT	50	5							11:48am Water table at 65ft
5065	70	completely weathered, silty sand, gray, low plasticity, fine sand	SPT	50/6in	5.5							12:00pm
	75											

(Continued Next Page)

CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
5060	75		completely weathered, silty clay, gray, medium plasticity, trace fine to coarse sand	SPT	43-50/3in	10							12:19pm
5055	80		highly weathered, extremely weak, very intensely fractured, silty, clayey, sand, low plasticity, fine to coarse sand, trace fine angular gravel up to 1/4" diameter	SPT	35-50/3in	10							12:35pm
5050	85		medium plasticity, iron oxide veins	SPT	17-22-33 (55)	18							12:36pm
5045	90		low plasticity	SPT	32-50/4in	10							1:14pm
5040	95		nonplastic, fine to coarse sand, angular gravel up to 1/2" diameter	SPT	50/4in	3							1:36pm
	100		intensely fractured, clay sand matrix, medium plasticity, angular gravel up to 3/4" diameter	SPT	50/4in	3							2:00pm

EOH at 100.4ft; backfilled with bentonite chips and cuttings to the surface

NewFields

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CLIENT Nevada Department of Transportation

PROJECT NAME US395 North Valleys

PROJECT NUMBER 475.0398.000

PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

DATE STARTED 7/11/19 **COMPLETED** 7/11/19

GROUND ELEVATION . **HOLE SIZE** 8" Diameter

DRILLING CONTRACTOR Haz-Tech Drilling, Inc.

COORDINATES ():

DRILLING METHOD HSA

LATITUDE **LONGITUDE**

LOGGED BY M.Doehring **CHECKED BY** M.Doehring

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Rig Unit 204 Station 'XN' 784+70 Offset (ft) 55 Right

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
								LIQUID LIMIT	PLASTICITY INDEX				
	0	▒	**6" ASPHALT** **Silty Sand with Gravel (SM)**, light brown, slightly moist, medium dense, low plasticity, fine to coarse sand, fine gravel	SPT	7-9-5 (14)	12							Drilling started at 7:00am
		▒		SPT	11-50/5in	11	11.0	28	6	15	61	24	7:01am
	5	▨	**GRANODIORITE:** highly weathered, very weak, hydrothermally altered, yellow and white, fine grained	MC	50/5in	4							
		▨	completely weathered, hydrothermally altered, low plasticity	SPT	14-29-10 (39)	18							7:12am
	10	▨	highly weathered, iron oxide staining, angular gravel up to 1/2" diameter	MC	20-35-50/4in	17	18.1						7:17am
	15	▨	completely weathered, low plasticity, predominantly fine sand	SPT	16-15-14 (29)	18							7:25am
	20	▨		MC	16-26-43 (69)	16							7:36am
	25	▨	moist, medium plasticity, some fine angular gravel in clay matrix	SPT	5-7-9 (16)	18							7:43am
	30	▨	angular gravel, moderately strong up to 2-1/2" diameter	MC	28-50/4in	12							Drilling completed at 7:49am

EOH at 31.3ft: backfilled with bentonite chips and cuttings

NewFields

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CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6
DATE STARTED 7/11/19 **COMPLETED** 7/11/19
GROUND ELEVATION 5152 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR Haz-Tech Drilling, Inc.
COORDINATES ():
DRILLING METHOD HSA
LATITUDE **LONGITUDE**
LOGGED BY M.Doehring **CHECKED BY** M.Doehring
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Rig Unit 204 Station 'XN' 785+95 Offset (ft) 50 Right

ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0	**6" ASPHALT**	SPT	4-12-12 (24)	12							Drilling stared at 8:42am
5150		**Clayey sand with Gravel (SC)**, brown, slightly moist, medium dense, low plasticity, fine to coarse sand, fine subangular gravel										
		GRANODIORITE: completely weathered, extremely weak, orange white, medium plasticity, fine grained	SPT	18-35-37 (72)	18							8:43am
	5	highly weathered, angular gravel up to 3/4"	MC	48-50/3in	9							8:49am
5145		highly fractured, very weak to weak, silty sand with gravel, gray, low plasticity, fine to coarse sand, fine angular gravel, iron oxide staining	SPT	11-25-28 (53)	16	12.5	32	7	30	48	22	8:55am
	10		MC	29-38-44 (82)	12	14.9						9:00am
5140												
	15	highly to completely weathered, iron oxide veins, nonplastic	SPT	28-40-50/5in	16							9:06am
5135												
	20	orange and gray, angular gravel up to 1" diameter	MC	31-50/3in	12							9:14am
5130												
	25	hydrothermally altered	SPT	18-42-48 (90)	18							9:23am
5125												
	30	some orange, white mineralization, iron oxide staining, weak angular gravel up to 3/4" diameter	MC	28-50/6in	12							Drilling completed at 10:03am

EOH at 31.5ft: backfilled with bentonite chips and cuttings

NewFields

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CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6
DATE STARTED 7/11/19 **COMPLETED** 7/11/19
GROUND ELEVATION 5157 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR Haz-Tech Drilling, Inc.
COORDINATES ():
DRILLING METHOD HSA
LATITUDE **LONGITUDE**
LOGGED BY M.Doehring **CHECKED BY** M.Doehring
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Rig Unit 204 Station 'XN' 787+25 Offset (ft) 115 Right

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0	⁘	**Silty Gravel with Sand (SM)**, dry to slightly moist, very dense, nonplastic, fine to coarse sand, fine and coarse angular gravel up to 2" diameter	SPT	2-28-39 (67)	14							Drilling stared at 10:44am
5155		⁘		MC	50/0in	0							10:47am auger grinding between 2 and 4 feet
	5	▨	**GRANODIORITE:** completely weathered, extremely weak, silt with sand, orange and brown, medium plasticity, fine grained sand, slickenside	SPT	12-24-35 (59)	16	22.0	39	13	0	21	79	10:55am
5150		▨		MC	13-49-44 (93)	16							11:00am
5145	10	▨	light brown	SPT	20-30-45 (75)	18	16.6						11:05am
5140	15	▨	highly weathered, weak, rough, gray, fine grained, highly fractured, iron oxide staining, angular gravel up to 2" diameter (mechanically fractured)	MC	16-39-50/5in	18							11:15am
5135	20	▨	completely weathered, extremely weak, hydrothermally altered, low plasticity	SPT	15-50/5in	11							11:20am
5130	25	▨	orange	MC	19-50/5in	11							11:27am
	30	▨	extremely weak, completely weathered, gray brown, nonplastic	SPT	50/5in	2							Drilling completed at 11:35am

EOH at 31.4ft: backfilled with bentonite chips and cuttings

NewFields

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CLIENT Nevada Department of Transportation

PROJECT NAME US395 North Valleys

PROJECT NUMBER 475.0398.000

PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

DATE STARTED 4/16/19 **COMPLETED** 4/16/19

GROUND ELEVATION 5153 ft **HOLE SIZE** 8" Diameter

DRILLING CONTRACTOR Geotechnical Drilling

COORDINATES ():

DRILLING METHOD HSA

LATITUDE **LONGITUDE**

LOGGED BY A. Thibedeau **CHECKED BY** M.Doehring

DEPTH TO WATER (FT BGS) No free water encounter

NOTES Rig Unit 5 Station 'XN' 847+50 Offset (ft) 35 Left

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		**Clayey Sand (SC)**, some gravel, red-brown, medium dense, medium plasticity, fine to coarse sand, fine subangular gravel										Drilling started at 7:06am
5150				MC	7-11-13 (24)	18	11.0	32	19	11	66	23	
	5		loose	MC	6-5-7 (12)	18							
5145			medium dense	MC	7-12-18 (30)	18							
	10		medium to high plasticity	MC	8-17-21 (38)	18	13.0	37	21	1	80	19	
5140													
	15		fine to medium sand, dense	MC	10-21-28 (49)	18							
5135													
	20		red-grey, medium dense, trace gravel, thin (approximately 1" thick) layers of sandy clay with fine sand, high plasticity	MC	8-17-22 (39)	18							Difficult to remove soil from tube, sticky
5130													
	25		some gravel, fine to coarse sand, dense	MC	14-25-25 (50)	18							
5125													
	30		**Sand with Clay (SW-SC)**, dense, low plasticity, fine to coarse sand, some fine and coarse gravel	MC	18-28-40 (68)	18							

EOH at 31.5ft; backfilled to 16ft bgs then grouted to the surface.

NewFields

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CLIENT	Nevada Department of Transportation	**PROJECT NAME**	US395 North Valleys
PROJECT NUMBER	475.0398.000	**PROJECT LOCATION**	Between Mileposts WA 27.1 and WA 32.6
DATE STARTED	4/16/19 **COMPLETED** 4/16/19	**GROUND ELEVATION**	5148 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR	Geotechnical Drilling	**COORDINATES ():**	
DRILLING METHOD	HSA	**LATITUDE**	**LONGITUDE**
LOGGED BY	A. Thibedeau **CHECKED BY** M.Doehring	**DEPTH TO WATER (FT BGS)**	No free water encountered
NOTES	Rig Unit 5 Station 'XN' 849+50 Offset (ft) 30 Left		

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0	▨	**Clayey Sand (SC)**, some gravel, red to gray, moist, medium dense, low to medium plasticity, medium and coarse sand, fine gravel										Drilling started at 8:40am
5145		▨		MC	6-14-16 (30)								
	5	▨	light brown, very dense, medium plasticity, fine to coarse sand, fine gravel	MC	22-35-31 (66)		11.5	38	17	12	76	12	
5140		▨	dense	MC	11-19-20 (39)								
	10	▨	large gravel and weathered clasts, increased fines	MC	13-20-24 (44)								
5135		▨											
	15	▨	grades coarser, pockets of clay	MC	12-21-23 (44)								
5130		▨											
	20	▨	grades finer, fine to medium sand, no gravel	MC	16-25-31 (56)								
5125		▨											
	25	▨	fine sand, low to medium plasticity	MC	9-23-26 (49)								
5120		▨											
	30	▨	fine to medium sand, trace angular gravel	MC	18-26-31 (57)								

EOH at 31.5ft; backfilled to 16ft bgs then grouted to surface

NewFields

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CLIENT Nevada Department of Transportation

PROJECT NAME US395 North Valleys

PROJECT NUMBER 475.0398.000

PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

DATE STARTED 4/16/19 **COMPLETED** 4/16/19

GROUND ELEVATION 5143 ft **HOLE SIZE** 8" Diameter

DRILLING CONTRACTOR Geotechnical Drilling

COORDINATES ():

DRILLING METHOD HSA

LATITUDE **LONGITUDE**

LOGGED BY A. Thibedeau **CHECKED BY** M.Doehring

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Rig Unit 5 Station 'XN' 851+60 Offset (ft) 50 Left

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0	▨	**Clayey Sand (SC)**, red-brown, moist, medium dense, medium plasticity, fine to coarse sand										Drilling started at 10:04am
5140		▨	brown, low to medium plasticity, fine to medium sand	MC	4-7-15 (22)	18	13.2	26	11	3	71	26	
	5	▨	**Clayey Sand with Gravel (SC)**, brown, moist, medium dense, medium plasticity, fine to coarse sand, gravel to 1.5" diameter	MC	12-17-20 (37)	18							
5135		▨	dense, increased fines, fine to medium sand, trace fine gravel	MC	11-24-29 (53)	18							
	10	░	**Poorly Graded Sand (SP)**, red-brown, slightly moist to moist, dense, nonplastic, fine to coarse sand, fine gravel	MC	17-26-26 (52)	18	6.6	NP	NP	6	93	1	
5130		░											
	15	▨	**Clayey Sand (SC)**, brown, slightly moist to moist, dense, low to medium plasticity, fine to coarse sand, some fine and coarse subangular gravel	MC	17-22-27 (49)	18							
5125		▨											
	20	▨	fine sand	MC	15-23-27 (50)	18							
5120		▨											
	25	▨	weathered granitic cobble, very dense	MC	50/5in	5							Rig bouncing
5115		▨											Hard drilling
	30	▨		MC	50/5in	0							No recovery
			EOH at 30.5ft; backfilled to 16ft bgs then grouted to the surface										

NewFields

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CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6
DATE STARTED 4/16/19 **COMPLETED** 4/16/19
GROUND ELEVATION 5134 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR Geotechnical Drilling
COORDINATES ():
DRILLING METHOD HSA
LATITUDE
LONGITUDE
LOGGED BY A. Thibedeau **CHECKED BY** M.Doehring
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Rig Unit 5 Station 'XN' 853+65 Offset (ft) 50 Left

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		**Clayey Sand (SC),** orange brown, moist, medium dense, medium plasticity, fine to medium sand, some fine gravel										Drilling started at 11:22am
				MC	5-8-9 (17)		10.1						
5130	5		dark brown, quartzite cobble, thin sandy layers, fine to coarse sand	MC	5-7-13 (20)								
			very dense	MC	15-27- 50/5in								
5125	10		**Silty Clayey Sand (SC/SM),** brown, moist, dense, low plasticity, fine to coarse sand, trace fine gravel	MC	13-33-39 (72)		8.1	22	5	4	81	15	
5120	15		**Clayey Sand (SC)**, brown, moist, dense, medium plasticity, fine sand	MC	13-23-31 (54)								Weathered granite cobble in shoe
5115	20		fine to medium sand, some angular gravel	MC	16-28-32 (60)								
5110													Rig bouncing
	25		**Sand with Clay (SP-SC)**, red-brown, slightly moist, dense, low plasticity, fine to medium sand, trace fine gravel,	MC	21-28-36 (64)								
5105	30			MC	39-35-40 (75)								

EOH at 31.5ft; backfilled to 20ft bgs then grouted to the surface

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CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6
DATE STARTED 4/16/19 **COMPLETED** 4/16/19
GROUND ELEVATION 5128 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR Geotechnical Drilling
COORDINATES ():
DRILLING METHOD HSA
LATITUDE **LONGITUDE**
LOGGED BY A. Thibedeau **CHECKED BY** M.Doehring
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Rig Unit 5 Station 'XN' 855+65 Offset (ft) 10 Left

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		**FILL: Sandy Clay (CL),** trace fine gravel, orange-brown to olive-brown, moist, very stiff, medium plasticity, clasts of high plasticity, iron oxide staining	GB			15.5						Drilling started at 1:12pm
5125				MC	6-9-16 (25)								
	5		**Clayey Sand (SC)**, brown, moist, medium dense, medium to high plasticity, fine to medium sand, interbedded layers (approximately 1"-2" thick) of clay with organic material, dark brown no organics, some fine gravel, orange brown, loose	MC	5-6-5 (11)								
5120			**Sandy Clay (CL),** trace fine gravel, orange-brown, moist, stiff, medium to high plasticity, fine to medium sand	MC	4-6-12 (18)								
	10		**Clayey Sand (SC),** light brown, slightly moist to moist, medium dense, medium plasticity, fine to coarse sand, clay clasts, some fine and coarse gravel	MC	4-5-11 (16)		15.5	31	18	10	64	26	
5115	15		orange to brown, medium to high plasticity	MC	8-16-21 (37)		9.4	35	22	10	60	30	
5110	20		dense, some coarse gravel	MC	17-23-28 (51)								
5105	25		medium dense	MC	7-11-13 (24)								
5100	30		dense	MC	13-22-24 (46)								

EOH at 31.5ft; backfilled to 16ft bgs then grouted to the surface

NewFields

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CLIENT Nevada Department of Transportation		**PROJECT NAME** US395 North Valleys	
PROJECT NUMBER 475.0398.000		**PROJECT LOCATION** Between Mileposts WA 27.1 and WA 32.6	
DATE STARTED 7/27/19	**COMPLETED** 7/27/19	**GROUND ELEVATION** 5123 ft	**HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR Haz-Tech Drilling, Inc.		**COORDINATES ():**	
DRILLING METHOD HSA		**LATITUDE**	**LONGITUDE**
LOGGED BY M.Doehring	**CHECKED BY** M.Doehring	**DEPTH TO WATER (FT BGS)** No free water encountered	
NOTES Rig Unit 105 Station 'XN' 857+70 Offset (ft) 10 Left			

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		**8" ASPHALT**										Drilling started at 10:05pm
			Clayey Sand with Gravel (SC), orange brown, moist, medium dense, low plasticity, fine to coarse sand, fine angular gravel										
5120				SPT	6-8-10 (18)	17							10:06pm
	5		**Silty Sand with Gravel (SM)**, brown, moist, medium dense, nonplastic, fine to coarse sand, subangular gravel up to 1/2" diameter	MC	7-9-9 (18)	14							10:09pm
5115				SPT	4-14-7 (21)	12							10:10pm
	10		loose, angular gravel up to 1-1/2" diameter	MC	4-5-4 (9)	12							10:18pm
5110													
	15		moist to wet, loose	SPT	5-3-6 (9)	16							10:20pm
5105			**Clayey Sand (SC)**, dark brown, moist, low plasticity, fine to coarse sand										
	20			MC	2-5-6 (11)	16							10:25pm
5100													
	25		**Silty Sand (SM)**, yellow brown, moist, dense, seams of dark brown clay, medium plasticity, fine to coarse sand	SPT	6-16-30 (46)	18							10:31pm
5095													
	30			MC	16-20-35 (55)	18							Drilling completed at 10:39pm

EOH at 31.5ft; backfilled with bentonite chips and cuttings to 2ft bgs then grouted to the surface

CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6
DATE STARTED 7/29/19 **COMPLETED** 7/29/19
GROUND ELEVATION 5127 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR Haz-Tech Drilling, Inc.
COORDINATES ():
DRILLING METHOD HSA
LATITUDE
LONGITUDE
LOGGED BY M.Doehring **CHECKED BY** M.Doehring
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Rig Unit 105 Station 'XS' 859+70 Offset (ft) 10 Right

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		**14" ASPHALT**										Drilling started at 12:51am
5125			**Clayey Sand (SC)**, orange brown, slightly moist to moist, dense, low plasticity, fine to coarse sand										
				SPT	8-15-18 (33)	18							12:52am
	5												
				MC	19-20-33 (53)	18							12:55am
5120			**Silty Sand (SM)**, orange, moist, dense, nonplastic, fine to coarse sand										
				SPT	8-15-16 (31)	18							1:01am
	10												
				MC	13-25-30 (55)	16							1:05am
5115													
	15												
				SPT	11-17-20 (37)	18							1:15am
5110													
			Sand (SP), yellow brown, moist, dense, nonplastic, fine to coarse sand, some fine subangular gravel										
	20												
				MC	11-15-25 (40)	18							1:22am
5105													
	25		**Silty Sand (SM)**, orange brown, moist, medium dense, nonplastic, fine sand, layers of clayey sand of low plasticity										
				SPT	7-14-15 (29)	18							1:34am
5100													
	30												
			dense, fine to coarse sand, some subrounded gravel up to 1/2" diameter	MC	7-20-25 (45)	18							Drilling completed at 1:46am

EOH at 31.5ft; backfilled with bentonite chips and cuttings to 2ft bgs then grouted to the surface

NewFields

BH19-RW11-61

CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6
DATE STARTED 7/29/19 **COMPLETED** 7/30/19
GROUND ELEVATION 5127 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR Haz-Tech Drilling, Inc.
COORDINATES ():
DRILLING METHOD HSA
LATITUDE **LONGITUDE**
LOGGED BY M.Doehring **CHECKED BY** M.Doehring
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Rig Unit 105 Station 'XS' 861+75 Offset (ft) 10 Right

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		**13.5" ASPHALT**										Drilling started at 11:18pm
5125		▨	**Clayey Sand (SC)**, orange brown, slightly moist, dense, low plasticity, fine to coarse sand										
		▨		SPT	10-22-26 (48)	18							11:19pm
	5	▨											
		▨		MC	41-31-39 (70)	18							11:23pm
5120		░	**Silty Sand (SM)**, brown, moist, dense, nonplastic, fine to coarse sand, fine subangular gravel										
		░		SPT	17-21-20 (41)	18							11:29pm
	10	░											
		░		MC	17-28-29 (57)	16	7.0	NP	NP	8	80	12	11:34pm
5115		░	subangular gravel up to 3/4" diameter										
		▨	**Clayey Sand (SC)**, orange brown, moist, dense, low plasticity, fine to coarse sand										
	15	▨											
		▨		SPT	7-18-17 (35)	18							11:42pm
5110		▨											
		░	**Silty Sand (SM)**, orange brown, moist, dense, nonplastic, fine to coarse sand, trace subangular gravel up to 3/4" diameter										
	20	░											
		░		MC	14-24-31 (55)	18							11:50pm
5105		░											
	25	░											
		░		SPT	14-17-17 (34)	18							11:59pm
5100		░											
		⁘	**Sand (SP)**, brown, moist, dense, nonplastic, fine to coarse sand										
	30	⁘											
		⁘		MC	10-20-25 (45)	18							Drilling completed at 12:09am

EOH at 31.5ft; backfilled with bentonite chips and cuttings to 3ft bgs then grouted to the surface

NewFields

BH19-RW11-62

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CLIENT Nevada Department of Transportation

PROJECT NAME US395 North Valleys

PROJECT NUMBER 475.0398.000

PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

DATE STARTED 7/27/19 **COMPLETED** 7/28/19

GROUND ELEVATION 5120 ft **HOLE SIZE** 8" Diameter

DRILLING CONTRACTOR Haz-Tech Drilling, Inc.

COORDINATES ():

DRILLING METHOD HSA

LATITUDE **LONGITUDE**

LOGGED BY M.Doehring **CHECKED BY** M.Doehring

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Rig Unit 105 Station 'XN' 863+80 Offset (ft) 10 Left

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
5120	0		**11" ASPHALT**										Drilling started at 11:22pm
		▩	**FILL: Silty Sand (SM)**, orange brown, moist, medium dense, nonplastic, fine to coarse sand, subrounded gravel up to 1-1/2" diameter	SPT	6-11-12 (23)	16							11:23pm
5115	5	▩		MC	7-6-10 (16)	15							11:26pm
		▨	**Clay (CH)**, gray brown, moist, stiff to very stiff, high plasticity	SPT	1-5-10 (15)	13							11:31pm
5110	10	▧	**Clayey Sand (SC)**, orange brown, moist, dense, low plasticity, fine to coarse sand	MC	6-15-23 (38)	18							11:34pm
5105	15	▧		SPT	10-16-23 (39)	18							11:41pm
5100	20	░	**Silty Sand (SM)**, orange brown, moist, very dense, nonplastic, fine to coarse sand, some angular gravel up to 1" diameter	MC	34-50/6in	11							11:50pm
5095	25	░		SPT	15-23-24 (47)	16							12:07am
5090	30	░	very dense, with gravel, subangular and angular gravel up to 1" diameter	MC	13-23-40 (63)	18							Drilling completed at 12:19am

EOH at 31.5ft; backfilled with bentonite chips and cuttings to 2ft bgs then grouted to the surface

NewFields

BH19-RW11-63

PAGE 1 OF 1

CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6
DATE STARTED 7/28/19 **COMPLETED** 7/28/19
GROUND ELEVATION 5121 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR Haz-Tech Drilling, Inc.
COORDINATES ():
DRILLING METHOD HSA
LATITUDE **LONGITUDE**
LOGGED BY M.Doehring **CHECKED BY** M.Doehring
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Rig Unit 105 Station 'XN' 865+85 Offset (ft) 10 Left

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
5120	0		**14" ASPHALT**										Drilling started at 1:01am
		▩	**FILL: Clayey Gravel with Sand (GC)**, orange brown, moist, medium dense, low plasticity, fine to coarse sand, angular gravel up to 3/4" diameter	SPT	7-9-9 (18)	16							1:02am
5115	5	▩	subangular gravel up to 2-1/2" diameter	MC	6-7-10 (17)	18							1:03am
		▩	**FILL: Silty Sand (SM)**, brown, moist, medium dense, nonplastic, fine to coarse sand,	SPT	2-3-8 (11)	18							1:08am
5110	10	▩	orange brown	MC	9-16-24 (40)	18							1:12am
5105	15	▧	**Clayey Sand (SC)**, brown, moist, dense, low plasticity, fine to coarse sand	SPT	11-19-27 (46)	17							1:18am
5100	20	▧	medium dense	MC	11-19-20 (39)	18							1:28am
5095	25	⁘	**Silty Sand (SM)**, orange brown, moist, dense, nonplastic, fine to coarse sand	SPT	9-17-20 (37)	18							1:38am
5090	30	⁘		MC	20-30-37 (67)	18							Drilling completed at 1:45am

EOH at 31.5ft; backfilled with bentonite chips and cuttings to 2ft bgs then grouted to the surface

NewFields

BH19-RW11-64

PAGE 1 OF 1

CLIENT	Nevada Department of Transportation	**PROJECT NAME**	US395 North Valleys
PROJECT NUMBER	475.0398.000	**PROJECT LOCATION**	Between Mileposts WA 27.1 and WA 32.6
DATE STARTED	7/28/19 **COMPLETED** 7/29/19	**GROUND ELEVATION**	5127 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR	Geotechnical Drilling	**COORDINATES ():**	
DRILLING METHOD	HSA	**LATITUDE**	**LONGITUDE**
LOGGED BY	M.Doehring **CHECKED BY** M.Doehring	**DEPTH TO WATER (FT BGS)**	No free water encountered
NOTES	Rig Unit 5 Station 'XS' 867+80 Offset (ft) 10 Right		

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
								LIQUID LIMIT	PLASTICITY INDEX				
	0		**11.5" ASPHALT**										Drilling started at 11:42pm
5125			**FILL: Clayey Gravel with Sand (GC)**, brown, moist, medium dense, medium plasticity, fine to coarse sand, angular gravel up to 1" diameter										
				SPT	3-6-7 (13)	18							11:43pm
	5			MC	6-6-10 (16)	18							11:45pm
5120			**Clayey Sand with Gravel (SC)**, orange brown, moist, dense, medium plasticity, fine to coarse sand, angular gravel	SPT	8-16-17 (33)	17	9.6	29	16	28	53	19	11:49pm
	10			MC	7-21-29 (50)	18							11:52pm
5115													
	15		very dense, trace angular gravel up to 1/2" diameter	SPT	17-83-33 (116)	18							12:01am
5110													
			Silty Sand (SM), orange brown, moist, dense, nonplastic, fine to coarse sand										
	20			MC	22-33-39 (72)	18							12:14am
5105													Drill rig mechanical problems. Drilled from 0 to 25ft 9:57pm to 10:25pm (7/29/19)
	25			SPT	17-17-28 (45)	18							10:25pm
5100													
	30		**Clayey Sand (SC)**, brown, moist, medium dense, low plasticity, fine to coarse sand	MC	11-18-25 (43)	18							10:38pm

EOH at 31.5ft; backfilled with bentonite chips and cuttings to 2ft bgs then grouted to the surface

BH19-RW11-65

NewFields

CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6
DATE STARTED 7/28/19 **COMPLETED** 7/28/19
GROUND ELEVATION 5123 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR Haz-Tech Drilling, Inc.
COORDINATES ():
DRILLING METHOD HSA
LATITUDE
LONGITUDE
LOGGED BY M.Doehring **CHECKED BY** M.Doehring
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Rig Unit 105 Station 'XN' 870+05 Offset (ft) 10 Left

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		**12.5" ASPHALT**										Drilling started at 2:32pm
5120			**FILL: Clayey Gravel with Sand (GC)**, dark brown, slightly moist, medium dense, medium plasticity, fine to coarse sand, angular gravel up to 2" diameter	SPT	7-11-15 (26)	16							2:33am
	5		dense, angular gravel up to 2-12" diameter (mechanically fractured)	MC	19-21-31 (52)	18							2:36am
5115			**Clayey Sand (SC)**, orange brown, moist, very dense, low plasticity, fine to coarse sand, trace fine gravel	SPT	19-36-50/6in	18							2:42am
	10			MC	24-36-50/5in	16							2:48am
5110	15		**Silty Sand (SM)**, orange brown, moist, medium dense to dense, nonplastic, fine to coarse sand	SPT	7-14-16 (30)	18							3:02am
5105	20		dense	MC	13-21-30 (51)	18							3:10am
5100	25		**Clayey Sand (SC)**, brown, moist, dense, low to medium plasticity, fine sand	SPT	5-13-19 (32)	18							3:20am
5095	30		**Silty Sand (SM)**, orange brown, moist, dense, nonplastic, fine sand	MC	5-16-20 (36)	18							Drilling completed at 3:30am

EOH at 31.5ft; backfilled with bentonite chips and cuttings to 2ft bgs then grouted to the surface

BH19-RW11-66

CLIENT	Nevada Department of Transportation	**PROJECT NAME**	US395 North Valleys
PROJECT NUMBER	475.0398.000	**PROJECT LOCATION**	Between Mileposts WA 27.1 and WA 32.6
DATE STARTED	7/28/19 **COMPLETED** 7/28/19	**GROUND ELEVATION**	5129 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR	Haz-Tech Drilling, Inc.	**COORDINATES ():**	
DRILLING METHOD	HSA	**LATITUDE**	**LONGITUDE**
LOGGED BY	M.Doehring **CHECKED BY** M.Doehring	**DEPTH TO WATER (FT BGS)**	No free water encountered
NOTES	Rig Unit 105 Station 'XS' 871+95 Offset (ft) 10 Right		

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		**9.5" ASPHALT**										Drilling started at 10:10pm
			FILL: Silty Sand (SM), orange brown, slightly moist, medium dense, nonplastic, fine to coarse sand										
5125				SPT	3-12-15 (27)	18							10:11pm
	5			MC	14-21-22 (43)	16							10:15pm
5120			dense, increasing fines	SPT	9-21-25 (46)	18							10:21pm
	10		**Silty Clayey Sand (SC/SM)**, orange brown, moist, dense, low plasticity, fine to medium sand	MC	19-25-35 (60)	18	12.4	23	7	1	61	38	10:25pm
5115	15		**Silty Sand (SM)**, orange brown, moist, dense, nonplastic, fine to coarse sand	SPT	8-19-21 (40)	18							10:33pm
5110	20		light brown, slightly moist	MC	12-28-28 (56)	16							10:47pm
5105	25			SPT	10-23-17 (40)	16							10:55pm
5100	30			MC	14-28-34 (62)	18							Drilling completed at 11:06pm

EOH at 31.5ft; backfilled with bentonite chips and cuttings to 2ft bgs then grouted to the surface

CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6
DATE STARTED 7/28/19 **COMPLETED** 7/28/19
GROUND ELEVATION 5125 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR Haz-Tech Drilling, Inc.
COORDINATES ():
DRILLING METHOD HSA
LATITUDE **LONGITUDE**
LOGGED BY M. Walden **CHECKED BY** M.Doehring
DEPTH TO WATER (FT BGS) 45
NOTES BK81 Station 'XN' 873+90 Offset (ft) 10 Left

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
5125	0		**7" ASPHALT**										Drilling started at 9:48pm
			FILL: Clayey Sand (SC), some gravel, brown, moist, medium dense, low plasticity, fine to coarse sand, subangular gravel										
				SPT	7-11-17 (28)	18							9:51pm
5120	5												
				MC	16-11-16 (27)	18							9:55pm
				SPT	15-12-13 (25)	18							9:59pm
5115	10												
				MC	8-18-17 (35)	18							10:03pm
5110	15												
			dark brown, medium plasticity	SPT	8-11-14 (25)	18	12.3	27	14	2	62	36	10:09pm
5105	20												
			brown, low plasticity	MC	12-16-14 (30)	18							10:13pm
5100	25												
			Silty Sand (SM), trace gravel, brown, moist, medium dense, nonplastic, subangular	SPT	13-12-13 (25)	18							10:20pm
5095	30												
			Clayey Sand (SC), brown, moist, medium dense, medium plasticity, fine to coarse sand, subangular gravel	MC	15-19-19 (38)	18							10:26pm
5090	35												

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CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
5090	35		dark brown	SPT	5-12-14 (26)	18	12.9	24	12	1	66	33	10:33pm
5085	40		dense	MC	15-31-36 (67)	18							10:40pm
5080	45		∇	SPT	15-18-18 (36)	18	13.9	25	12	2	69	29	10:48pm Water table at 45ft
5075	50			MC	15-26-38 (64)	18							10:59pm
5070	55			SPT	14-16-18 (34)	18							11:10pm
5065	60		very dense	SPT	18-32-35 (67)	6							11:21pm Black rock stuck in shoe
5060	65		**Clayey Sand (SC)**, some gravel, orange brown, moist, very dense, medium to high plasticity, fine to coarse sand, black gravel	SPT	23-29-36 (65)	9							11:32pm
5055	70			SPT	46-43-42 (85)	2							11:44pm
5050	75												

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CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
5050	75	▨	**GRANODIORITE:** highly weathered, extremely weak, clayey sand, some gravel, brown, moist, medium to low plasticity, fine to coarse sand, angular black gravel	SPT	50/2in	2							11:56pm
5045	80	▨		SPT	50/1in	1							12:10am
5040	85	▨	**GRANODIORITE:** highly weathered, extremely weak to very weak, silty sand, trace gravel, grayish brown, wet, nonplastic, fine sand, subangular gravel	SPT	50/3in	3							12:24am Hard drilling
5035	90	▨	**GRANODIORITE:** highly weathered, extremely weak to very weak, clayey sand, trace gravel, grayish brown, medium plasticity, fine sand, subangular gravel	SPT	50/5in	5							1:27am
5030	95	▨	orange brown, iron oxide staining	SPT	32-50/5in	11							1:45am
5025	100	▨		SPT	13-24-42 (66)	14							Drilling completed at 2:02am

EOH at 101.5ft; backfilled with bentonite chips and cuttings to 3ft bgs then grouted to surface

BH19-RW12-67

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CLIENT Nevada Department of Transportation	**PROJECT NAME** US395 North Valleys
PROJECT NUMBER 475.0398.000	**PROJECT LOCATION** Between Mileposts WA 27.1 and WA 32.6
DATE STARTED 7/31/19 **COMPLETED** 7/31/19	**GROUND ELEVATION** 4722 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR Haz-Tech Drilling, Inc.	**COORDINATES ():**
DRILLING METHOD HSA	**LATITUDE** **LONGITUDE**
LOGGED BY M. Walden **CHECKED BY** M.Doehring	**DEPTH TO WATER (FT BGS)** 45

NOTES BK81 Station 'XS' 641+15 Offset (ft) 30 Left

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		**14" CONCRETE**										Drilling started at 12:23am
4720			**FILL: Clayey Sand (SC)**, some gravel, brown, moist, medium dense, medium plasticity, fine sand, subangular gravel	SPT	7-6-7 (13)	18							12:28am
	5		**FILL: Clayey Sand (SC)**, some gravel, trace cobble, orange brown, wet, medium dense, medium to high plasticity, fine to coarse sand, fine and coarse angular to subangular gravel	MC	16-24-15 (39)	18							12:31am
4715				SPT	5-4-5 (9)	18							12:35am
	10		loose, no gravel										
4710			medium dense, fine and coarse gravel	MC	12-18-18 (36)	18							12:38am
	15		decreasing gravel	SPT	5-9-10 (19)	18							12:42am
4705													
	20		**FILL: Clayey Gravel with Sand (GC)**, trace cobble, brown, high plasticity, fine to coarse sand, fine and coarse gravel	MC	47-19-27 (46)	18		49	27	42	32	26	12:47am
4700													
	25		**Sandy Clay (CL)**, trace gravel, moist, medium dense, brown, medium plasticity, fine to coarse sand, fine subangular gravel	SPT	5-7-8 (15)	18	24.5			5	22	73	12:54am
4695													
	30		**Clayey Sand (SC)**, some gravel, whitish gray, dry to slightly moist, medium dense, low plasticity, fine to coarse sand, subangular to angular	MC	9-14-17 (31)	18							1:01am
4690													
	35												

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CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
4685	35		**Gravelly Sand with Clay (SC)**, brown, moist, very dense, low to medium plasticity, fine to coarse sand, angular to subangular	SPT	8-9-50 (59)	9							1:08am
4680	40		**Silty Sand (SM)**, brown, moist, medium dense, nonplastic, fine to medium sand	MC	12-17-18 (35)	18	34.3	NP	NP	0	63	37	1:18am
4675	45	▽	**ANDESITE:** highly weathered, very weak, gravelly sand with clay, brown, moist, low to medium plasticity, fine to coarse sand, angular to subangular	SPT	19-37-50/5in	17							1:28am
4670	50		dark brown	MC	30-39-50/4in	16							1:38am
4665	55		light brown	SPT	9-47-43 (90)	18							1:49am
	60			MC	60/3in	0							Drilling completed at 1:59am

EOH at 60ft; backfilled to 3ft bgs then grouted to the surface

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NewFields

CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6
DATE STARTED 7/31/19 **COMPLETED** 7/31/19
GROUND ELEVATION 4726 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR Haz-Tech Drilling, Inc.
COORDINATES ():
DRILLING METHOD HSA
LATITUDE
LONGITUDE
LOGGED BY M. Walden **CHECKED BY** M.Doehring
DEPTH TO WATER (FT BGS) No free water encountered
NOTES BK81 Station 'XS' 643+05 Offset (ft) 30 Left

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
4725	0		**12" CONCRETE**										Drilling started at 9:58pm
			FILL: Clayey Sand (SC), some gravel, brown, moist, medium dense, low to medium plasticity, fine to coarse sand, subangular gravel										
				SPT	6-7-11 (18)	18							10:04pm
4720	5		orange brown, high plasticity	MC	9-9-12 (21)	18							10:08pm
			FILL: Clayey Sand with Gravel (SC), orange brown, moist, medium dense, medium to high plasticity, fine to coarse sand, subangular to angular gravel	SPT	6-7-15 (22)	11							
4715	10			MC	12-15-16 (31)	18							
4710	15			SPT	14-16-19 (35)	18							
4705	20			MC	14-16-26 (42)	18							10:25pm
4700	25		**FILL: Clayey Sand**, some gravel, orange brown, moist, medium dense, high plasticity, fine to coarse sand, subangular to angular gravel	SPT	6-8-11 (19)	18							10:31pm
4695	30			MC	6-10-12 (22)	18							10:37pm
	35												

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CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
								LIQUID LIMIT	PLASTICITY INDEX				
4690	35			SPT	5-7-10 (17)	15							10:44pm
4685	40		**Clayey Sand with Gravel (SC)**, trace cobble, high plasticity, fine to coarse sand, fine and coarse angular to subangular gravel	MC	25-35-12 (47)	18							10:52pm
4680	45			SPT	19-27-26 (53)	18							11:03pm
4675	50		**ANDESITE:** highly weathered, very weak, hydrothermally altered, clayey sand, trace gravel, yellow brown, moist, high plasticity, subangular gravel	MC	4-12-19 (31)	18							11:19pm
4670	55			SPT	3-8-12 (20)	18							11:25pm
4665	60			MC	21-31-50 (81)	18							Drilling completed at 11:34pm

EOH at 61.5ft; backfilled to 3ft bgs then grouted to the surface

NewFields

BH19-RW12-69

PAGE 1 OF 2

CLIENT	Nevada Department of Transportation	**PROJECT NAME**	US395 North Valleys
PROJECT NUMBER	475.0398.000	**PROJECT LOCATION**	Between Mileposts WA 27.1 and WA 32.6
DATE STARTED	5/21/19 **COMPLETED** 5/23/19	**GROUND ELEVATION**	4730 ft **HOLE SIZE** 8" Diameter
DRILLING CONTRACTOR	Geotechnical Drilling	**COORDINATES ():**	
DRILLING METHOD	HSA	**LATITUDE**	**LONGITUDE**
LOGGED BY	M. Walden **CHECKED BY** M.Doehring	**DEPTH TO WATER (FT BGS)**	No free water encountered
NOTES	Rig Unit 5 Station 'XS' 645+00 Offset (ft) 30 Left		

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
4730	0		**8" CONCRETE**										Drilling 10:10pm
			FILL: Silty Sand (SM), some clay, trace gravel, brown, moist, medium dense, subangular gravel	SPT	7-10-10 (20)	18							10:29pm
4725	5		**FILL: Clayey Sand (SC)**, trace gravel, orange brown, moist, medium dense, medium plasticity	MC	6-14-17 (31)	18							10:41pm
			FILL: Silty Gravel with Sand (GM/GP), gray/light brown, moist, medium dense, medium plasticity, fine to coarse sand, fine and coarse angular gravel	SPT	10-12-12 (24)	11	11.6	44	13	50	38	12	Drilling night of 5/22 - 9:05pm
4720	10		very dense	MC	40-41-30 (71)	18							9:55pm
4715	15			SPT	13-41-42 (83)	18	8.6						10:08pm
4710	20			MC	58-62-33 (95)	6							10:20pm
4705	25		medium dense	SPT	30-15-7 (22)	0							No recovery, 10:37pm
			Clayey Sand (SC), brown, slightly moist, dense, high plasticity, fine to coarse sand, some fine gravel										
4700	30			MC	22-33-28 (61)	6	7.1	66	46	7	46	47	10:56pm
4695	35												

(Continued Next Page)

CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
4695	35	▨	**Clayey Gravel with Sand (GC)**, brown, moist, medium dense, low plasticity, fine gravel, angular gravel	SPT	17-13-16 (29)	8							11:13pm
4690	40	▨	very dense	MC	21-27-41 (68)	10	6.2						11:25pm
4685	45	▨		SPT	22-24-26 (50)	11							11:30pm
4680	50	▨	**ANDESITE:** highly weathered, very weak, very intensely fractured, hydrothermally altered, clayey gravel with sand, brown, moist, low plasticity, fine and coarse angular gravel	MC	51-54-70/4in	16							No recovery, 12:17am
4675	55	▨	completely weathered	SPT	50/6in	0							12:50am
4670	60	▨	hydrothermally altered	MC	10-15-24 (39)	16							Drilling completed at 1:30am

EOH at 61.5ft; backfilled to 20ft bgs then grouted to surface

NewFields

BH19-RW12-70

PAGE 1 OF 2

CLIENT Nevada Department of Transportation

PROJECT NAME US395 North Valleys

PROJECT NUMBER 475.0398.000

PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

DATE STARTED 5/22/19 **COMPLETED** 5/22/19

GROUND ELEVATION 4734 ft **HOLE SIZE** 8" Diameter

DRILLING CONTRACTOR Geotechnical Drilling

COORDINATES ():

DRILLING METHOD HSA

LATITUDE **LONGITUDE**

LOGGED BY N Owens **CHECKED BY** M.Doehring

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Rig Unit 5 Station 'XS' 647+00 Offset (ft) 30 Left

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		**9" CONCRETE**										Drilling started at 10:05pm
			FILL: Silty Sand (SM), brown, moist, medium dense, nonplastic, fine sand										
4730				SPT	12-13-8 (21)	9							10:15pm
	5		**FILL: Clayey Gravel with Sand (GC)**, brown, moist, dense, low plasticity, fine to medium sand, angular gravel										
				MC	3-18-24 (42)	12							10:20pm
4725			medium dense	SPT	8-8-9 (17)	0							No recovery, 10:25pm
	10		**FILL: Silty Sand with Gravel (GM)**, gray, moist, dense, medium to high plasticity, fine to coarse sand, angular gravel up to 2" diameter	MC	16-16-31 (47)	10	14.3	52	22	27	55	18	10:35pm
4720	15												
				SPT	16-16-17 (33)	9							10:45pm Drill rig down for repair
4715	20		very dense	MC	70/5in	0							No recovery
4710	25												
			Lean Clay with Sand (CL), brown, moist, stiff, low to medium plasticity	SPT	4-6-8 (14)	18							
4705	30												
			very stiff	MC	16-18-23 (41)	16							
4700	35												

(Continued Next Page)

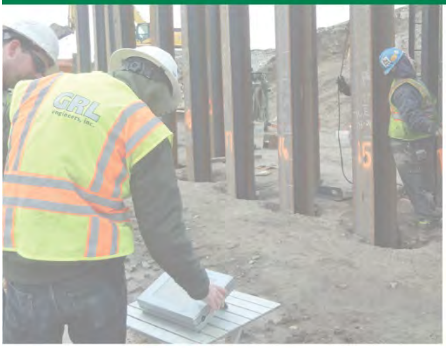
CLIENT Nevada Department of Transportation
PROJECT NAME US395 North Valleys
PROJECT NUMBER 475.0398.000
PROJECT LOCATION Between Mileposts WA 27.1 and WA 32.6

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	35	▨	**ANDESITE:** completely to highly weathered, extremely weak, clayey sand, light brown/brown, moist, low plasticity, fine to coarse sand, some fine angular gravel	SPT	36-50/5in	7	16.7	34	10	8	59	33	11:13pm
4695		▨											
	40	▨	hydrothermally altered	MC	24-50-70/3in	15							11:44pm
4690		▨											
	45	▨		SPT	23-27-47 (74)	10							12:02am
4685		▨											
	50	▨		MC	26-46-70/4in	14							12:40am
4680		▨											
	55	▨		SPT	50/4in	4							1:25am
4675		▨											
	60	▨		SPT	12-9-17 (26)	8							Drilling completed at 2:02am

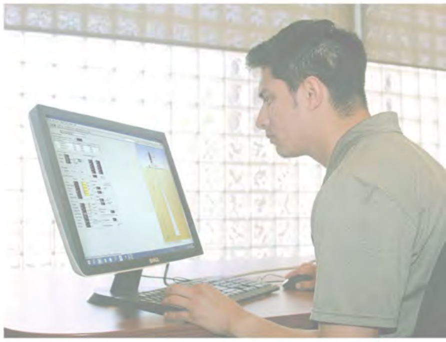
EOH at 61.5ft; backfilled to 20ft bgs then grouted to surface

ATTACHMENT C

Hammer Efficiency and Calibration Reports

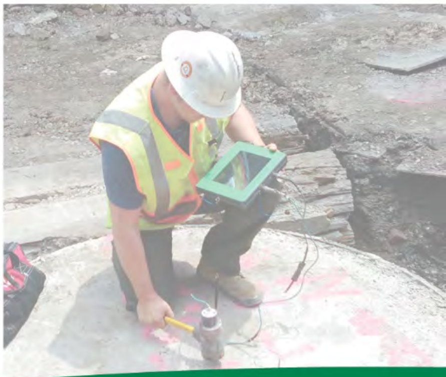










GRL engineers, inc.

Dynamic Measurements and Analyses

Job No. 198060-1

Report on:
Energy Measurement for Dynamic Penetrometers – Standard Penetration Test
Mobile B-57 Drill Rig (Truck 102724P)
Las Vegas, NV

Prepared for Geotechnical Drilling
By Camilo Alvarez, PE & William Chambers

April 15, 2019

GRL
Dynamic
Measurements
and Analyses
engineers, inc.

April 15, 2019

Mr. Tom Beall
Geotechnical Drilling

Re: Energy Measurement for Dynamic Penetrometers
Standard Penetration Test (SPT) on Truck 102724P Mobile B-57 Drill rig
Las Vegas, NV GRL Job No. 198060-1

Dear Mr. Beall:

This report transmits our findings from energy measurements and related data analysis conducted by GRL Engineers, Inc. (GRL) for your truck mounted Mobile B-57 Drill Rig located in Las Vegas, NV. One automatic hammer and penetrometer system was monitored during Standard Penetration Test (SPT) of the test Borehole BH5. Dynamic testing summarized in this report was conducted on April 11, 2019.

The purpose in collecting the SPT energy measurements was to compute the energy transfer efficiency for 1 SPT hammer. To meet this objective, an 8G Model, Pile Driving Analyzer® (PDA) utilizing the SPT Analyzer feature was used to acquire and process the dynamic test data. Additional information regarding the testing equipment and analytical procedures is provided in Appendix A.

Test Sequence

Using an instrumented NW-J rod for a Mobile B-57 Drill Rig at Borehole BH5, energy measurements were made at various sample depths for the drill rig. Dynamic measurements were obtained for sample depths at 5.0, 10.0 and 15.0 feet. Each sample depth consisted of energy measurements for at least 50 blows of driving. It is noted that N-value calculation analysis cannot be completed due to refusal conditions encountered during the 18 inches of driving.

Energy Transfer Measurements

A Model 8G Pile Driving Analyzer was used to take measurements of strain and acceleration. The strain and acceleration signals were conditioned and converted to forces and velocities by the PDA. The PDA interprets the measured dynamic data according to the Case Method equations. Force and velocity records from the PDA were also viewed graphically on an LCD screen to evaluate data quality. All force and velocity records were also digitally stored for subsequent analysis.

The maximum energy transferred to the rod (EMX) was calculated by integrating both the force and velocity records over time as follows:

$$EMX = \int F(t)V(t)dt$$

Where: $F(t)$ = the force at time t
$V(t)$ = the velocity at time t

The energy transfer ratio or efficiency is computed by dividing EMX by the theoretical SPT hammer energy of 350 lb-ft (computed from the product of the hammer weight, assumed to be the standard 140 lbs, and the fall height, assumed to be 2.5 ft). The SPT N values can then be corrected for a nominal 60% transfer efficiency, $N_{60,}$ as follows:

$$N_{60} = (e_m / 60)\, N_m$$

Where: e_m = the measured transfer ratio (ETR)
N_m = the measured SPT “N” value

Conclusions

Table 1 presents a summary of the average transferred energies, energy transfer ratios and hammer operating rate for the Mobile B-57 drill rig at each sample depth calculated using the *EMX* equation. Appendix B includes the above summary as well as average values of the maximum impact force and maximum velocity of the rod. Complete data, including the maximum, minimum and standard deviation for each sampling depth, is also included in Appendix B.

For the truck mounted Mobile B-57 Drill Rig at BH5, the average energy transfer ratio from individual sample depths ranged from 76.6 to 87.9%.

Table 1: Summary of SPT results

Sample Depth (ft)	Measured SPT Blows/inch	Average EMX (ft-lb)	Average ETR (%)	Average BPM (bpm)
5.0	50 / 4.5	268.1	76.6	46.3
10.5	50 / 2.75	281.9	80.5	44.5
15.0	50 / 4.5	307.6	87.9	50.4

For an overall transfer ratio of:

SPT Rig (*Serial Number*)	**Overall Transfer Efficiency**	**Hammer Operating Rate (BPM)**
Mobile B-57 Drill Rig at BH5 (Truck 102724P)	**81.7%**	**47.1**

We appreciate the opportunity to be of assistance to you. Please do not hesitate to contact us if you have any questions regarding this report, or if we may be of further service.

Respectfully,

GRL Engineers, Inc.

PROFESSIONAL ENGINEER - STATE OF NEVADA
CAMILO A. ALVAREZ
Exp: 12/31/2020
CIVIL
No. 17525

Alvarez

Camilo Alvarez, P.E.

William Chambers, CPEng RPEQ

Appendix A

Introduction to SPT Dynamic Pile Testing

APPENDIX A
AN INTRODUCTION INTO SPT DYNAMIC PILE TESTING

The following has been written by GRL Engineers, Inc. and may only be copied with its written permission.

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1. BACKGROUND

The Standard Penetration Test is frequently conducted as an in-situ assessment of soil strength. This test requires that a 140 lb weight is dropped 30 inches onto a drive rod at whose bottom a sampler is usually installed. The sampler is driven for 18 inches; the number of blows required for the last 12 inches of driving is the so-called N-value. The N-value may be used as a strength indicator for foundation design or as a means of assessing the liquefaction potential of soils.

Obviously, the SPT hammer efficiency is an important consideration when using the N-values for design purposes. Measurements have indicated that the energy in the drive rod is sometimes only 30% and and may reach 90% of the potential or rated energy of the SPT hammer (E-rated = 0.35 kip-ft or 0.475 kJ). The type of hammer used to drive the rod is the main reason for these variations. On the average, the energy in the drive rod is 60% of the standard rated energy.

Because of the variability of energy, methods based on N-values are considered unreliable. However, measurements during SPT testing using the Case Method can be done on a routine basis and these measurements yield the transferred energy values. With measured energy, EMX, known, an adjustment of the measured N-value, N_m, can be made as follows.

$$N_{60} = N_m \left[E_m / (0.6E_r)\right] \qquad (1)$$

Thus, if the measured energy value is equal to the normally expected transferred energy of 60% of E-rated then the adjusted and measured N-values are identical. On the other hand, if the measured energy is only 30% then the adjusted blow count will be reduced by 50%.

2. DYNAMIC TESTING AND ANALYSIS METHODS APPLIED TO SPT

The Case Method of dynamic pile testing, named after the Case Institute of Technology where it was developed between 1964 and 1975, requires that a substantial ram mass (e.g. a pile driving hammer) impacts the pile top such that the pile undergoes at least a small permanent set. Thus, the method is also referred to as a “High Strain Method”. The Case Method requires dynamic measurements on the pile or shaft under the ram impact and then a calculation of various quantities. Conveniently, for SPT applications, the measurements and analyses are done by a single piece of equipment: the SPT Analyzer. The Pile Driving Analyzer® (PDA) is also suitable to perform these measurements and data processing.

A related analysis method is the “Wave Equation Analysis” which calculates a relationship between bearing capacity, pile stresses, transferred energy and field blow count. The GRLWEAP™ program performs this analysis and provides a complete set of helpful information and input data. This program can be used very effectively to simulate the SPT driving process.

3. MEASUREMENTS

GRL uses equipment manufactured by Pile Dynamics, Inc. The system includes either an SPT-Analyzer™ (SPTA) or a Pile Driving Analyzer® (PDA), an instrumented rod section and two accelerometers. SPT energy testing is very closely related to and borrows procedures from dynamic pile testing. Those interested in the basis of the SPT energy testing method may obtain extensive literature on dynamic pile testing from GRL Engineers, Inc.

3.1 SPT Analyzer or Pile Driving Analyzer

The basis for the results calculated by the SPTA or PDA are strain and acceleration measured in an instrumented rod section. These signals are converted to rod top force, F(t), and rod top velocity, v(t). The SPTA or PDA conditions, calibrates and displays these signals and immediately computes average pile force and velocity thereby eliminating bending effects. The product of these two

measurements is then integrated over time which yields the energy transferred to the instrumented section as a function of time (see Section 4.1).

For convenience and accuracy, strain measurements are usually taken on an instrumented section of SPT drive rod. Ideally, the section properties of the instrumented rod and those of the drive rod are the same, however, using subs, other sections can also be utilized.

For the instrumented section, PDI provides a force calibration in such a way that the output of the instrumented rod is directly calculated without the need for an accurate elastic modulus or cross sectional area of the rod section.

The acceleration measurements are often demanding in the SPT environment, because of high frequency and high acceleration motion components. An experienced measurement engineer, therefore, has to evaluate the quality of this data before final conclusions are drawn from the numerical results calculated by SPTA or PDA.

SPTA or PDA records are taken while the standard N-value is acquired in the conventional manner. This then allows a direct correlation between N-value and average transferred energy.

3.2 HPA

The SPT hammer's ram velocity may be directly obtained using radar technology in the Hammer Performance Analyzer™. The impact velocity results can be automatically processed with a PC or recorded on a strip chart. HPA measurements yield a hammer kinetic energy, but not the energy transferred to the drive rod.

4 RECORD EVALUATION BY SPTA OR PDA

4.1 HAMMER PERFORMANCE

The PDA calculates the energy transferred to the pile top from:

$$E(t) = \int_0^t F(\tau)v(\tau)\, d\tau \qquad (2)$$

The maximum of the E(t) curve is often called **ENTHRU or EMX;** it is the most important quantity for an overall evaluation of the performance of a hammer and driving system. **EMX** allows for a classification of the hammer's performance when presented as, e_T, the rated transfer efficiency, also called energy transfer ratio (**ETR**) or global efficiency.

$$e_T = EMX/E_R \qquad (3)$$

where E_R is the hammer manufacturer's rated energy value or 0.35 kip-ft (0.475 kJ) in the case of the SPT hammer.

Often in the SPT literature one finds also reference to the EF2 energy. This evaluation is based on assumed proportionality between force and velocity (see also Section 5):

$$v(t) = F(t) / Z \qquad (4)$$

where Z = EA/c is the pile impedance, E is the elastic modulus, A is the cross sectional area and c is the speed of the stress wave in the pile material..

Combining equations 2 and 4 leads to

$$EF(t) = \int_0^t F(\tau)^2 / Z\, d\tau \qquad (5)$$

The EF2 transferred energy value is the EF-value at the time t = 2L/c, where L is the drive rod length and c is the stress wave speed in steel (16,800 ft/s or 5,124 m/s). Since the force is easier to measure than both force and velocity, Equation 5 is preferred by some test engineers. However, the EF method is fraught with errors and certain correction factors have to be applied to make it approximately correct. Among the error sources are the following:

- Proportionality is often violated prior to time 2L/c. The proportionality between force and velocity in a downward traveling wave only holds if the wave does not encounter a disturbance prior to reflecting off the pile toe. Such disturbances include a change in cross sectional area, an open or loose splice or joint, or resistance along the shaft.

- Using only one force measurement precludes a data quality check based on the proportionality between force and velocity. Thus, a force measurement that is for some reason in error may not be detectable, which will lead to errors in the EF2 value. Data quality checks will be discussed further in Section 5.

The use if EF2 is therefore not recommended but it is often included in result presentations for the sake of completeness.

4.2 STRESSES

During SPT monitoring, it is also of interest to monitor compressive stresses at both the top of the drive rod and at its bottom.

At the pile top (location of sensors) the maximum compression stress averaged over the rod's cross section, **CSX**, is directly obtained from the measurements. Note that this stress value refers to the instrumented section. If the rod has a different cross sectional area then the stress in the rod will be different from CSX.

The SPTA or PDA can also calculate, in an approximate manner, the force at the rod bottom, **CFB**. To obtain the corresponding stress, this force value should be divided by the appropriate cross sectional area, e.g. by the rod area just above the sampler or by the sampler area itself. Of course, non-uniform stress components as they might occur at the sampler tip due to a sloping rock are not considered in this calculation.

5. DATA QUALITY CHECKS

Quality data is the first and foremost requirement for accurate dynamic testing results. It is therefore important that the measurement engineer performing SPTA or PDA tests has the experience necessary to recognize measurement problems and take appropriate corrective action should problems develop. Fortunately, dynamic pile testing allows for certain data quality checks because two independent measurements are taken that have to conform to the so-called proportionality relationship.

As long as there is only a wave traveling in one direction, as is the case during impact when only a downward traveling wave exists in the rod, force and velocity measured at its top are proportional

$$F = v\,Z \qquad (5)$$

where Z is again the pile impedance, Z = EA/c. This relationship can also be expressed in terms of stress

$$\sigma = F/A = v\,(E/c) \qquad (6)$$

or strain

$$\epsilon = \sigma/E = v\,/\,c \qquad (7)$$

This means that the early portion of strain times wave speed must be equal to the velocity unless the proportionality is affected by high friction near the pile top or by a pile cross sectional change not far below the sensors. Checking the proportionality is an excellent means of assuring meaningful measurements but is only truly meaningful for perfectly uniform rods. Open or loose splices, for example, will lead to a non-proportionality. For SPT rods it is fortunate that usually no soil resistance acts along the shaft and for that reason, proportionality can exist until the stress wave returns from sampler top or rod bottom unless connectors are not sufficiently tightened or have a significant mass.

Velocity data quality can also be checked by looking at the final displacement, DFN, which is calculated from the acceleration by double integration. If the calculated final displacement is much higher or lower than indicated by the N-value, the accelerometer attachment may be loose or the sensor may be faulty. If major drift in the velocity is observed, the EMX value may be in error, even though proportionality from impact to time 2L/c exists. In this case, it may be useful to evaluate the energy transferred to the drill rod at time 2L/c, which is calculated by the PDA or SPTA as the E2E quantity.

Appendix B

SPT Results

Geotech Rig Calibration - MOBILE B-57 5ft
OP: GRL CA

BH5 (102724P)
Date: 11-April-2019

AR: 1.48 in²
LE: 9.50 ft
WS: 16,807.9 f/s

SP: 0.492 k/ft³
EM: 30,000 ksi
JC: 0.90

EMX: Maximum Energy
ETR: Energy Transfer Ratio - Rated
BPM: Blows/Minute

FMX: Maximum Force
VMX: Maximum Velocity

BL#	Depth ft	BLC bl/in	TYPE	EMX ft-lb	ETR (%)	BPM bpm	FMX kips	VMX f/s
50	5.38	11	AV50	268.1	76.6	46.3	42	14.8
			STD	5.8	1.6	6.4	1	0.6
			MAX	280.5	80.1	47.9	45	18.2
			MIN	256.5	73.3	1.9	41	13.8
			Average	268.1	76.6	46.3	42	14.8
			Std. Dev.	5.8	1.6	6.4	1	0.6
			Maximum	280.5	80.1	47.9	45	18.2
			Minimum	256.5	73.3	1.9	41	13.8

Total number of blows analyzed: 50

BL#	Sensors
1-50	F2: [145NW1] 207.5 (1.00); F4: [145NW2] 206.0 (1.00); A1: [K10813] 374.0 (1.00); A3: [K10815] 396.0 (1.00)

Time Summary

Drive 1 minute 2 seconds 9:53 AM - 9:54 AM BN 1 - 50

Geotech Rig Calibration - MOBILE B57 10ft
OP: GRL CA

BH5 (102724P)
Date: 11-April-2019

AR: 1.48 in²
LE: 14.50 ft
WS: 16,807.9 f/s

SP: 0.492 k/ft³
EM: 30,000 ksi
JC: 0.90

EMX: Maximum Energy
ETR: Energy Transfer Ratio - Rated
BPM: Blows/Minute

FMX: Maximum Force
VMX: Maximum Velocity

BL#	Depth ft	BLC bl/in	TYPE	EMX ft-lb	ETR (%)	BPM bpm	FMX kips	VMX f/s
50	10.23	18	AV50	281.9	80.5	44.5	42	14.5
			STD	3.0	0.8	6.1	1	0.2
			MAX	289.6	82.7	46.0	43	15.2
			MIN	272.7	77.9	1.9	40	13.9
			Average	281.9	80.5	44.5	42	14.5
			Std. Dev.	3.0	0.8	6.1	1	0.2
			Maximum	289.6	82.7	46.0	43	15.2
			Minimum	272.7	77.9	1.9	40	13.9

Total number of blows analyzed: 50

BL# Sensors

1-50 F2: [145NW1] 207.5 (1.00); F4: [145NW2] 206.0 (1.00); A1: [K10813] 374.0 (1.00);
A3: [K10815] 396.0 (1.00)

Time Summary

Drive 1 minute 4 seconds 10:04 AM - 10:05 AM BN 1 - 50

Geotech Rig Calibration - MOBILE B57 15ft BH5 (102724P)
OP: GRL CA Date: 11-April-2019

AR: 1.48 in²
LE: 19.00 ft
WS: 16,807.9 f/s
SP: 0.492 k/ft³
EM: 30,000 ksi
JC: 0.90

EMX: Maximum Energy
ETR: Energy Transfer Ratio - Rated
BPM: Blows/Minute
FMX: Maximum Force
VMX: Maximum Velocity

BL#	Depth ft	BLC bl/in	TYPE	EMX ft-lb	ETR (%)	BPM bpm	FMX kips	VMX f/s
50	15.38	11	AV50	307.6	87.9	50.4	44	14.7
			STD	9.6	2.7	7.5	1	0.5
			MAX	335.5	95.9	60.9	45	16.7
			MIN	297.0	84.9	1.9	41	13.9
			Average	307.6	87.9	50.4	44	14.7
			Std. Dev.	9.6	2.7	7.5	1	0.5
			Maximum	335.5	95.9	60.9	45	16.7
			Minimum	297.0	84.9	1.9	41	13.9

Total number of blows analyzed: 50

BL#	Sensors
1-50	F2: [145NW1] 207.5 (1.00); F4: [145NW2] 206.0 (1.00); A1: [K10813] 374.0 (1.00); A3: [K10815] 396.0 (1.00)

Time Summary

Drive 57 seconds 10:14 AM - 10:15 AM BN 1 - 50

GRL engineers, inc.

Dynamic Measurements and Analyses

Job No. 198060-1

Report on:
Energy Measurement for Dynamic Penetrometers – Standard Penetration Test
Mobile B-57 Drill Rig (Truck 102750P)
Las Vegas, NV

Prepared for Geotechnical Drilling
By Camilo Alvarez, PE & William Chambers

April 15, 2019

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GRL
Dynamic
Measurements
and Analyses
engineers, inc.

April 15, 2019

Mr. Tom Beall
Geotechnical Drilling

Re: Energy Measurement for Dynamic Penetrometers
Standard Penetration Test (SPT) on Truck 102750P Mobile B-57 Drill rig
Las Vegas, NV GRL Job No. 198060-1

Dear Mr. Beall:

This report transmits our findings from energy measurements and related data analysis conducted by GRL Engineers, Inc. (GRL) for your truck mounted Mobile B-57 Drill Rig located in Las Vegas, NV. One automatic hammer and penetrometer system was monitored during Standard Penetration Test (SPT) of the test Borehole BH1. Dynamic testing summarized in this report was conducted on April 11, 2019.

The purpose in collecting the SPT energy measurements was to compute the energy transfer efficiency for 1 SPT hammer. To meet this objective, an 8G Model, Pile Driving Analyzer® (PDA) utilizing the SPT Analyzer feature was used to acquire and process the dynamic test data. Additional information regarding the testing equipment and analytical procedures is provided in Appendix A.

Test Sequence

Using an instrumented NW-J rod for a Mobile B-57 Drill Rig at Borehole BH1, energy measurements were made at various sample depths for the drill rig. Dynamic measurements were obtained for sample depths at 5.0, 10.0 and 15.0 feet. Each sample depth consisted of energy measurements for at least 50 blows of driving. It is noted that N-value calculation analysis cannot be completed due to refusal conditions encountered during the 18 inches of driving.

Energy Transfer Measurements

A Model 8G Pile Driving Analyzer was used to take measurements of strain and acceleration. The strain and acceleration signals were conditioned and converted to forces and velocities by the PDA. The PDA interprets the measured dynamic data according to the Case Method equations. Force and velocity records from the PDA were also viewed graphically on an LCD screen to evaluate data quality. All force and velocity records were also digitally stored for subsequent analysis.

The maximum energy transferred to the rod (EMX) was calculated by integrating both the force and velocity records over time as follows:

$$EMX = \int F(t)V(t)dt$$

Where: $F(t)$ = the force at time t
$V(t)$ = the velocity at time t

The energy transfer ratio or efficiency is computed by dividing EMX by the theoretical SPT hammer energy of 350 lb-ft (computed from the product of the hammer weight, assumed to be the standard 140 lbs, and the fall height, assumed to be 2.5 ft). The SPT N values can then be corrected for a nominal 60% transfer efficiency, $N_{60,}$ as follows:

$$N_{60} = (e_m / 60)\ N_m$$

Where: e_m = the measured transfer ratio (ETR)
N_m = the measured SPT “N” value

Conclusions

Table 1 presents a summary of the average transferred energies, energy transfer ratios and hammer operating rate for the Mobile B-57 drill rig at each sample depth calculated using the *EMX* equation. Appendix B includes the above summary as well as average values of the maximum impact force and maximum velocity of the rod. Complete data, including the maximum, minimum and standard deviation for each sampling depth, is also included in Appendix B.

For the truck mounted Mobile B-57 Drill Rig at BH1, the average energy transfer ratio from individual sample depths ranged from 65.1 to 73.2%.

Table 1: Summary of SPT results

Sample Depth (ft)	Measured SPT Blows/inch	Average EMX (ft-lb)	Average ETR (%)	Average BPM (bpm)
5.0	50 / 4.0	243.2	69.5	43.1
10.5	50 / 4.75	228.0	65.1	42.9
15.0	50 / 5.5	256.2	73.2	42.1

For an overall transfer ratio of:

SPT Rig (*Serial Number*)	**Overall Transfer Efficiency**	**Hammer Operating Rate (BPM)**
Mobile B-57 Drill Rig at BH1 (Truck 102750P)	**69.3%**	**42.7**

We appreciate the opportunity to be of assistance to you. Please do not hesitate to contact us if you have any questions regarding this report, or if we may be of further service.

Respectfully,

GRL Engineers, Inc.

PROFESSIONAL ENGINEER - STATE OF NEVADA
CAMILO A. ALVAREZ
Exp: 12/31/2020
CIVIL
No. 17525

Camilo Alvarez, P.E.

William Chambers, CPEng RPEQ

Appendix A

Introduction to SPT Dynamic Pile Testing

APPENDIX A
AN INTRODUCTION INTO SPT DYNAMIC PILE TESTING

The following has been written by GRL Engineers, Inc. and may only be copied with its written permission.

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1. BACKGROUND

The Standard Penetration Test is frequently conducted as an in-situ assessment of soil strength. This test requires that a 140 lb weight is dropped 30 inches onto a drive rod at whose bottom a sampler is usually installed. The sampler is driven for 18 inches; the number of blows required for the last 12 inches of driving is the so-called N-value. The N-value may be used as a strength indicator for foundation design or as a means of assessing the liquefaction potential of soils.

Obviously, the SPT hammer efficiency is an important consideration when using the N-values for design purposes. Measurements have indicated that the energy in the drive rod is sometimes only 30% and and may reach 90% of the potential or rated energy of the SPT hammer (E-rated = 0.35 kip-ft or 0.475 kJ). The type of hammer used to drive the rod is the main reason for these variations. On the average, the energy in the drive rod is 60% of the standard rated energy.

Because of the variability of energy, methods based on N-values are considered unreliable. However, measurements during SPT testing using the Case Method can be done on a routine basis and these measurements yield the transferred energy values. With measured energy, EMX, known, an adjustment of the measured N-value, N_m, can be made as follows.

$$N_{60} = N_m \left[E_m / (0.6E_r)\right] \qquad (1)$$

Thus, if the measured energy value is equal to the normally expected transferred energy of 60% of E-rated then the adjusted and measured N-values are identical. On the other hand, if the measured energy is only 30% then the adjusted blow count will be reduced by 50%.

2. DYNAMIC TESTING AND ANALYSIS METHODS APPLIED TO SPT

The Case Method of dynamic pile testing, named after the Case Institute of Technology where it was developed between 1964 and 1975, requires that a substantial ram mass (e.g. a pile driving hammer) impacts the pile top such that the pile undergoes at least a small permanent set. Thus, the method is also referred to as a "High Strain Method". The Case Method requires dynamic measurements on the pile or shaft under the ram impact and then a calculation of various quantities. Conveniently, for SPT applications, the measurements and analyses are done by a single piece of equipment: the SPT Analyzer. The Pile Driving Analyzer® (PDA) is also suitable to perform these measurements and data processing.

A related analysis method is the "Wave Equation Analysis" which calculates a relationship between bearing capacity, pile stresses, transferred energy and field blow count. The GRLWEAP™ program performs this analysis and provides a complete set of helpful information and input data. This program can be used very effectively to simulate the SPT driving process.

3. MEASUREMENTS

GRL uses equipment manufactured by Pile Dynamics, Inc. The system includes either an SPT-Analyzer™ (SPTA) or a Pile Driving Analyzer® (PDA), an instrumented rod section and two accelerometers. SPT energy testing is very closely related to and borrows procedures from dynamic pile testing. Those interested in the basis of the SPT energy testing method may obtain extensive literature on dynamic pile testing from GRL Engineers, Inc.

3.1 SPT Analyzer or Pile Driving Analyzer

The basis for the results calculated by the SPTA or PDA are strain and acceleration measured in an instrumented rod section. These signals are converted to rod top force, F(t), and rod top velocity, v(t). The SPTA or PDA conditions, calibrates and displays these signals and immediately computes average pile force and velocity thereby eliminating bending effects. The product of these two

measurements is then integrated over time which yields the energy transferred to the instrumented section as a function of time (see Section 4.1).

For convenience and accuracy, strain measurements are usually taken on an instrumented section of SPT drive rod. Ideally, the section properties of the instrumented rod and those of the drive rod are the same, however, using subs, other sections can also be utilized.

For the instrumented section, PDI provides a force calibration in such a way that the output of the instrumented rod is directly calculated without the need for an accurate elastic modulus or cross sectional area of the rod section.

The acceleration measurements are often demanding in the SPT environment, because of high frequency and high acceleration motion components. An experienced measurement engineer, therefore, has to evaluate the quality of this data before final conclusions are drawn from the numerical results calculated by SPTA or PDA.

SPTA or PDA records are taken while the standard N-value is acquired in the conventional manner. This then allows a direct correlation between N-value and average transferred energy.

3.2 HPA

The SPT hammer’s ram velocity may be directly obtained using radar technology in the Hammer Performance Analyzer™. The impact velocity results can be automatically processed with a PC or recorded on a strip chart. HPA measurements yield a hammer kinetic energy, but not the energy transferred to the drive rod.

4 RECORD EVALUATION BY SPTA OR PDA

4.1 HAMMER PERFORMANCE

The PDA calculates the energy transferred to the pile top from:

$$E(t) = \int_0^t F(\tau)v(\tau)\, d\tau \qquad (2)$$

The maximum of the E(t) curve is often called **ENTHRU or EMX;** it is the most important quantity for an overall evaluation of the performance of a hammer and driving system. **EMX** allows for a classification of the hammer's performance when presented as, e_T, the rated transfer efficiency, also called energy transfer ratio (**ETR**) or global efficiency.

$$e_T = EMX/E_R \qquad (3)$$

where E_R is the hammer manufacturer’s rated energy value or 0.35 kip-ft (0.475 kJ) in the case of the SPT hammer.

Often in the SPT literature one finds also reference to the EF2 energy. This evaluation is based on assumed proportionality between force and velocity (see also Section 5):

$$v(t) = F(t) / Z \qquad (4)$$

where Z = EA/c is the pile impedance, E is the elastic modulus, A is the cross sectional area and c is the speed of the stress wave in the pile material..

Combining equations 2 and 4 leads to

$$EF(t) = \int_0^t F(\tau)^2 / Z\, d\tau \qquad (5)$$

The EF2 transferred energy value is the EF-value at the time t = 2L/c, where L is the drive rod length and c is the stress wave speed in steel (16,800 ft/s or 5,124 m/s). Since the force is easier to measure than both force and velocity, Equation 5 is preferred by some test engineers. However, the EF method is fraught with errors and certain correction factors have to be applied to make it approximately correct. Among the error sources are the following:

- Proportionality is often violated prior to time 2L/c. The proportionality between force and velocity in a downward traveling wave only holds if the wave does not encounter a disturbance prior to reflecting off the pile toe. Such disturbances include a change in cross sectional area, an open or loose splice or joint, or resistance along the shaft.

- Using only one force measurement precludes a data quality check based on the proportionality between force and velocity. Thus, a force measurement that is for some reason in error may not be detectable, which will lead to errors in the EF2 value. Data quality checks will be discussed further in Section 5.

The use if EF2 is therefore not recommended but it is often included in result presentations for the sake of completeness.

4.2 STRESSES

During SPT monitoring, it is also of interest to monitor compressive stresses at both the top of the drive rod and at its bottom.

At the pile top (location of sensors) the maximum compression stress averaged over the rod’s cross section, **CSX**, is directly obtained from the measurements. Note that this stress value refers to the instrumented section. If the rod has a different cross sectional area then the stress in the rod will be different from CSX.

The SPTA or PDA can also calculate, in an approximate manner, the force at the rod bottom, **CFB**. To obtain the corresponding stress, this force value should be divided by the appropriate cross sectional area, e.g. by the rod area just above the sampler or by the sampler area itself. Of course, non-uniform stress components as they might occur at the sampler tip due to a sloping rock are not considered in this calculation.

5. DATA QUALITY CHECKS

Quality data is the first and foremost requirement for accurate dynamic testing results. It is therefore important that the measurement engineer performing SPTA or PDA tests has the experience necessary to recognize measurement problems and take appropriate corrective action should problems develop. Fortunately, dynamic pile testing allows for certain data quality checks because two independent measurements are taken that have to conform to the so-called proportionality relationship.

As long as there is only a wave traveling in one direction, as is the case during impact when only a downward traveling wave exists in the rod, force and velocity measured at its top are proportional

$$F = v\,Z \qquad (5)$$

where Z is again the pile impedance, Z = EA/c. This relationship can also be expressed in terms of stress

$$\sigma = F/A = v\,(E/c) \qquad (6)$$

or strain

$$\epsilon = \sigma/E = v / c \qquad (7)$$

This means that the early portion of strain times wave speed must be equal to the velocity unless the proportionality is affected by high friction near the pile top or by a pile cross sectional change not far below the sensors. Checking the proportionality is an excellent means of assuring meaningful measurements but is only truly meaningful for perfectly uniform rods. Open or loose splices, for example, will lead to a non-proportionality. For SPT rods it is fortunate that usually no soil resistance acts along the shaft and for that reason, proportionality can exist until the stress wave returns from sampler top or rod bottom unless connectors are not sufficiently tightened or have a significant mass.

Velocity data quality can also be checked by looking at the final displacement, DFN, which is calculated from the acceleration by double integration. If the calculated final displacement is much higher or lower than indicated by the N-value, the accelerometer attachment may be loose or the sensor may be faulty. If major drift in the velocity is observed, the EMX value may be in error, even though proportionality from impact to time 2L/c exists. In this case, it may be useful to evaluate the energy transferred to the drill rod at time 2L/c, which is calculated by the PDA or SPTA as the E2E quantity.

Appendix B

SPT Results

Geotech Rig Calibration - Mobile B57 5ft
BH1
OP: GRL CA
Date: 11-April-2019

AR: 1.48 in²
LE: 9.50 ft
WS: 16,807.9 f/s
SP: 0.492 k/ft³
EM: 30,000 ksi
JC: 0.90

EMX: Maximum Energy
ETR: Energy Transfer Ratio - Rated
BPM: Blows/Minute
FMX: Maximum Force
VMX: Maximum Velocity

BL#	Depth ft	BLC bl/in	TYPE	EMX ft-lb	ETR (%)	BPM bpm	FMX kips	VMX f/s
50	5.33	13	AV50	243.2	69.5	43.1	45	17.0
			STD	27.0	7.7	6.7	4	1.1
			MAX	292.6	83.6	46.8	51	21.1
			MIN	153.7	43.9	1.9	34	14.4
			Average	243.2	69.5	43.1	45	17.0
			Std. Dev.	27.0	7.7	6.7	4	1.1
			Maximum	292.6	83.6	46.8	51	21.1
			Minimum	153.7	43.9	1.9	34	14.4

Total number of blows analyzed: 50

BL# Sensors

1-50 F3: [145NW2] 206.0 (1.00); F4: [145NW1] 207.5 (1.00); A1: [K10813] 374.0 (1.00);
A2: [K10815] 396.0 (1.00)

Time Summary

Drive 1 minute 7 seconds 8:18 AM - 8:19 AM BN 1 - 50

Geotech Rig Calibration - Mobile B57 10ft BH1
OP: GRL CA Date: 11-April-2019

AR: 1.48 in² SP: 0.492 k/ft³
LE: 14.50 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 0.90

EMX: Maximum Energy FMX: Maximum Force
ETR: Energy Transfer Ratio - Rated VMX: Maximum Velocity
BPM: Blows/Minute

BL#	Depth	BLC	TYPE	EMX	ETR	BPM	FMX	VMX
	ft	bl/in		ft-lb	(%)	bpm	kips	f/s
50	10.40	11	AV50	228.0	65.1	42.9	37	15.6
			STD	46.9	13.4	6.1	6	2.1
			MAX	296.3	84.7	48.4	45	18.4
			MIN	105.5	30.1	1.9	19	9.7
			Average	228.0	65.1	42.9	37	15.6
			Std. Dev.	46.9	13.4	6.1	6	2.1
			Maximum	296.3	84.7	48.4	45	18.4
			Minimum	105.5	30.1	1.9	19	9.7

Total number of blows analyzed: 50

BL#	Sensors
1-50	F3: [145NW2] 206.0 (1.00); F4: [145NW1] 207.5 (1.00); A1: [K10813] 374.0 (1.00); A2: [K10815] 396.0 (1.00)

Time Summary

Drive 1 minute 7 seconds 8:25 AM - 8:26 AM BN 1 - 50

GRL Engineers, Inc.
Case Method & iCAP® Results

PDIPLOT2 2017.2.58.5 - Printed 12-April-2019

Geotech Rig Calibration - Mobile B57 15ft
BH1
OP: GRL CA
Date: 11-April-2019

AR: 1.48 in²
LE: 19.50 ft
WS: 16,807.9 f/s
SP: 0.492 k/ft³
EM: 30,000 ksi
JC: 0.90

EMX: Maximum Energy
ETR: Energy Transfer Ratio - Rated
BPM: Blows/Minute
FMX: Maximum Force
VMX: Maximum Velocity

BL#	Depth ft	BLC bl/in	TYPE	EMX ft-lb	ETR (%)	BPM bpm	FMX kips	VMX f/s
50	15.46	9	AV50	256.2	73.2	42.1	41	15.5
			STD	35.8	10.2	5.8	4	1.5
			MAX	295.7	84.5	46.6	47	17.5
			MIN	132.5	37.9	8.0	25	11.1
			Average	256.2	73.2	42.1	41	15.5
			Std. Dev.	35.8	10.2	5.8	4	1.5
			Maximum	295.7	84.5	46.6	47	17.5
			Minimum	132.5	37.9	8.0	25	11.1

Total number of blows analyzed: 50

BL#	Sensors
1-50	F3: [145NW2] 206.0 (1.00); F4: [145NW1] 207.5 (1.00); A1: [K10813] 374.0 (1.00); A2: [K10815] 396.0 (1.00)

Time Summary

Drive 1 minute 9 seconds 8:33 AM - 8:34 AM BN 1 - 50

HAMMER CALIBRATION (2019)

TRUCK DRILLS

UNIT NUMER	*TYPE*	*PERCENTAGE*	*DATE*
#1-05	CME-75	75.10%	1/9/2019
#2-04	CME-75	82.80%	1/9/2019
#1466	CME-75	82.70%	1/9/2019
#93	CME-75 4X4	83.10%	1/9/2019
#3010	CME-75 6X6	88.90%	1/9/2019
#7697	GREEN BK-81	87.40%	1/9/2019
#1541	BK-81	84.40%	1/9/2019
#85	CME-85	91.70%	1/9/2019

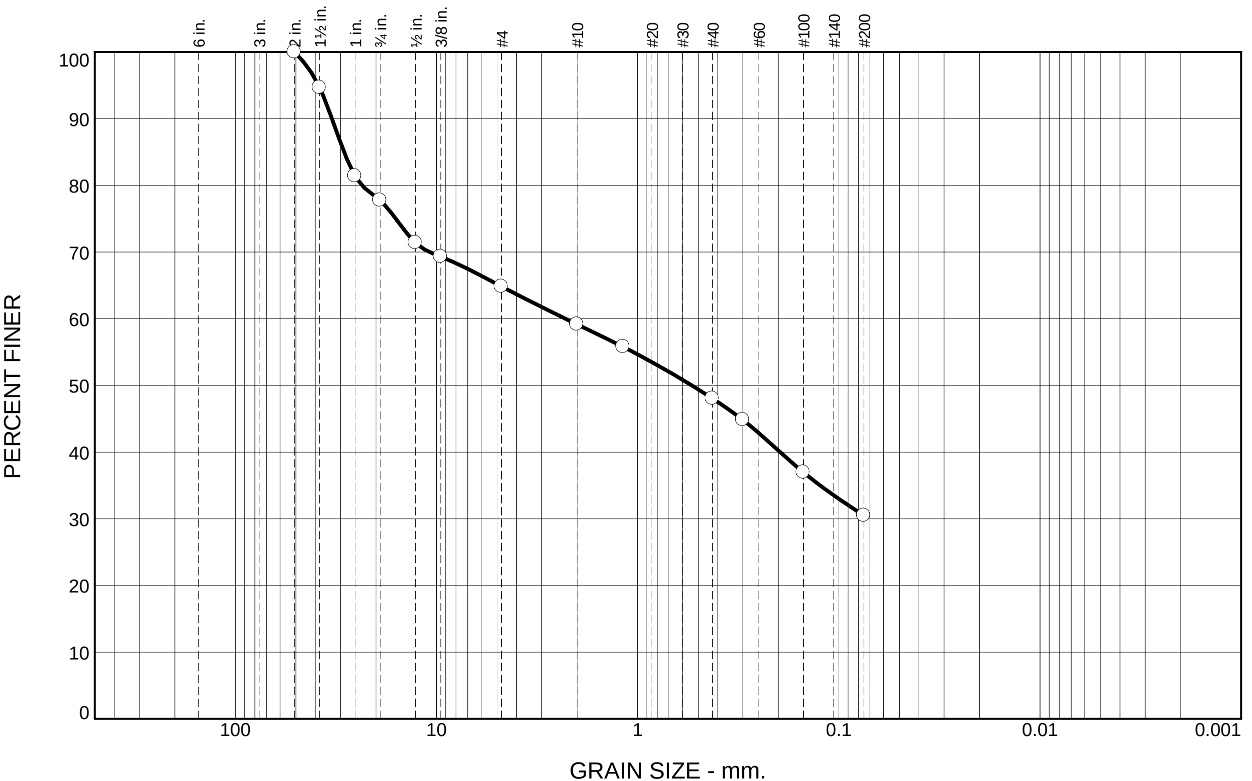
TRACK DRILLS

UNIT NUMBER	*TYPE*	*PERCENTAGE*	*DATE*
#22	CME-850	83.60%	1/9/2019
#23	CME-850	79.60%	1/9/2019
#ODOT850	CME-850	80.60%	1/9/2019

ATTACHMENT D

Laboratory Test Results

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	22.2	13.0	5.6	11.2	17.5	30.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2	100.0		
1.5	94.7		
1	81.4		
.75	77.8		
.5	71.4		
.375	69.3		
#4	64.8		
#10	59.2		
#16	55.8		
#40	48.0		
#50	44.8		
#100	37.0		
#200	30.5		

* (no specification provided)

Material Description

Brown clayey gravel with sand

Atterberg Limits

PL= 23 LL= 63 PI= 40

Coefficients

D_{90}= 33.0885 D_{85}= 28.8055 D_{60}= 2.2842
D_{50}= 0.5382 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= GC AASHTO= A-2-7(4)

Remarks

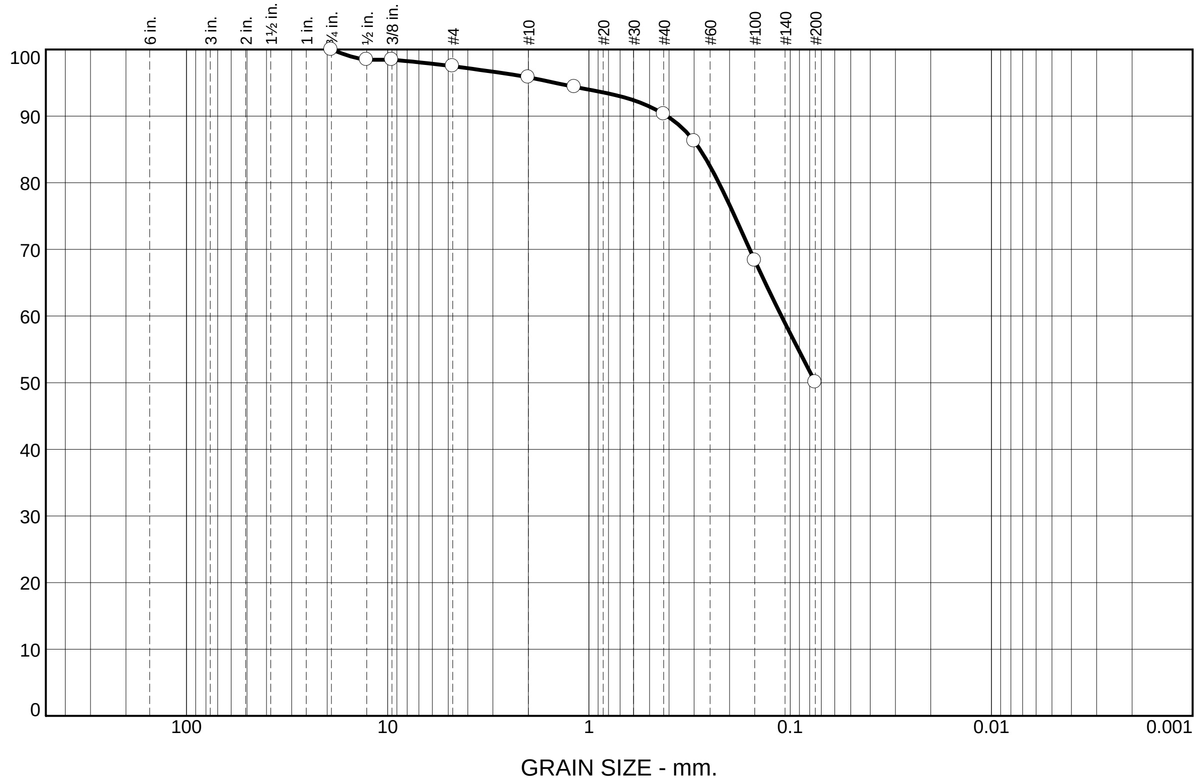
Location: RW1-02
Sample Number: 19-277-01 **Depth:** 5-6.5' **Date:** 8/15/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-277-01

Tested By: AH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.5	1.7	5.5	40.2	50.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	98.5		
.375	98.5		
#4	97.5		
#10	95.8		
#16	94.4		
#40	90.3		
#50	86.2		
#100	68.4		
#200	50.1		

* (no specification provided)

Material Description

Brown

Atterberg Limits

PL= - LL= - PI= -

Coefficients

D_{90}= 0.4086 D_{85}= 0.2805 D_{60}= 0.1104
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

*Atterberg was washed and unable to be ran

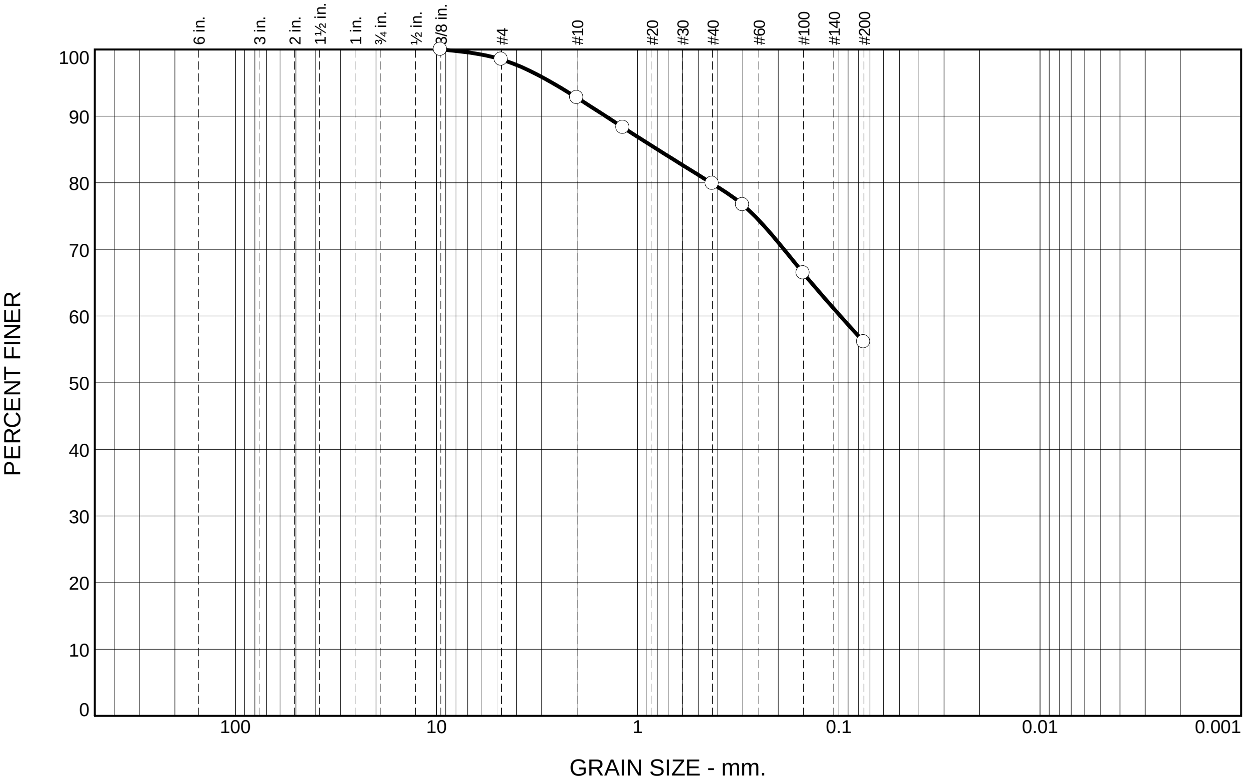
Location: RW1-03
Sample Number: 19-277-02 **Depth:** 7.5-9' **Date:** 8/15/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-277-02

Tested By: AH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.5	5.8	12.8	23.8	56.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	98.5		
#10	92.7		
#16	88.3		
#40	79.9		
#50	76.7		
#100	66.4		
#200	56.1		

* (no specification provided)

Material Description

Orange sandy fat clay

Atterberg Limits

PL= 28 LL= 61 PI= 33

Coefficients

$D_{90}=$ 1.4444 $D_{85}=$ 0.7963 $D_{60}=$ 0.0982
$D_{50}=$ $D_{30}=$ $D_{15}=$
$D_{10}=$ $C_u=$ $C_c=$

Classification

USCS= CH AASHTO= A-7-6(16)

Remarks

Location: RW1-03
Depth: 11-11.5'

Date: 9/13/2019

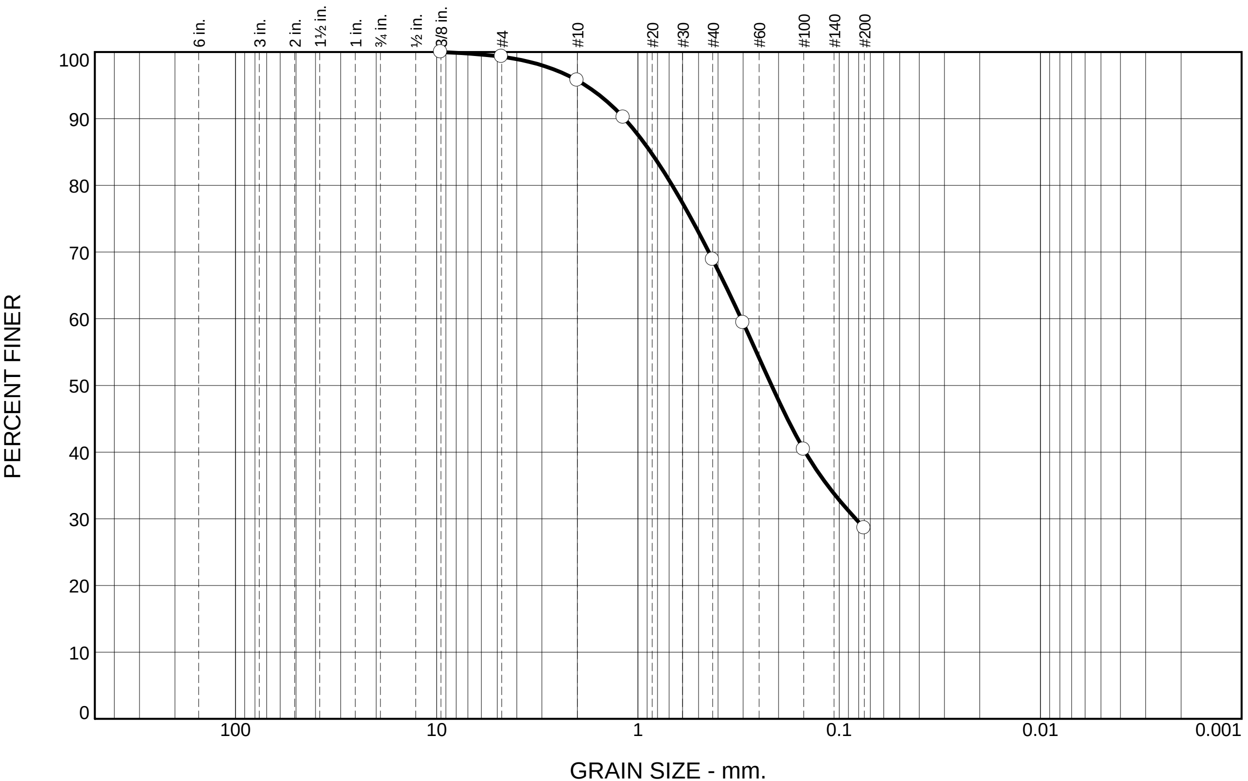
NewFields

Client: NDOT
Project: US395 NDOT North Valleys

Project No: 475.0398.000 **Figure** RW1-03

Tested By: AR **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.7	3.6	26.8	40.3	28.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	99.3		
#10	95.7		
#16	90.2		
#40	68.9		
#50	59.4		
#100	40.4		
#200	28.6		

* (no specification provided)

Material Description

Light Brown clayey sand

Atterberg Limits

PL= 26 LL= 69 PI= 43

Coefficients

D_{90}= 1.1653 D_{85}= 0.8634 D_{60}= 0.3065
D_{50}= 0.2168 D_{30}= 0.0827 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-7(5)

Remarks

Location: RW1-05
Sample Number: 19-277-03 **Depth:** 7.5-9' **Date:** 8/15/2019

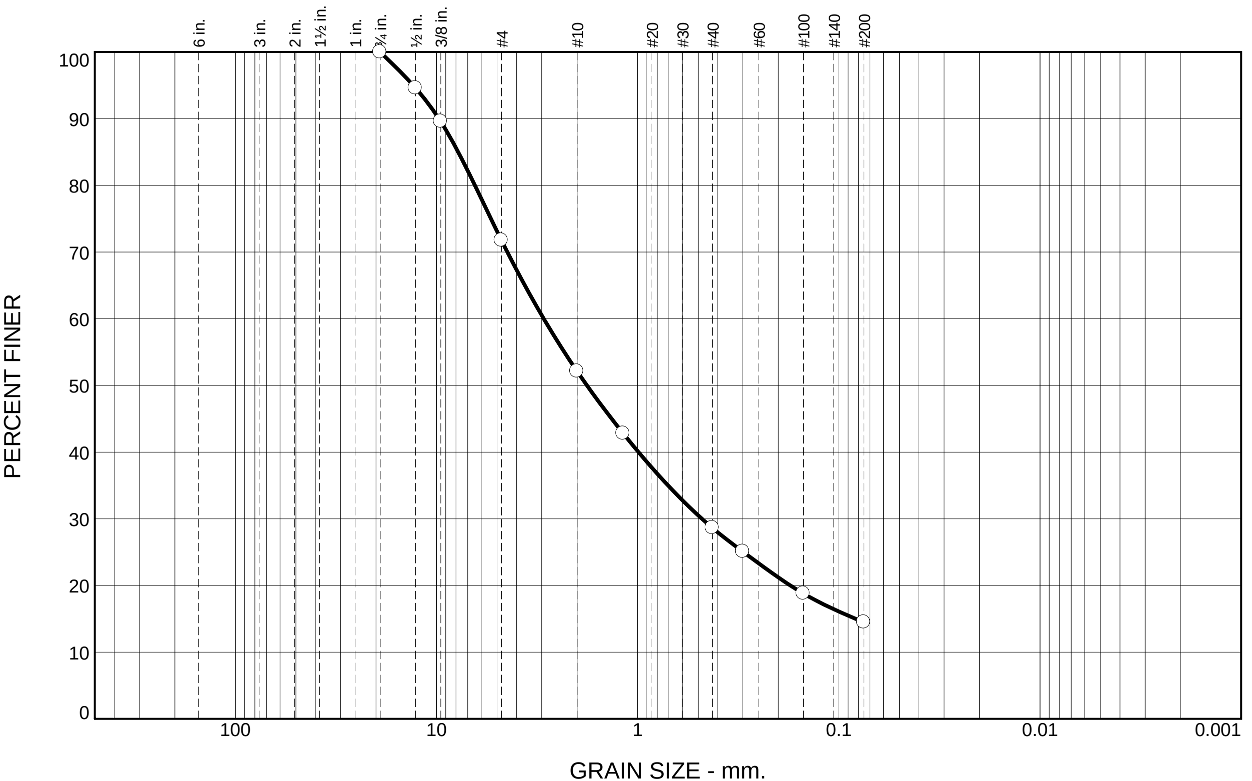
NewFields

Client: NDOT
Project: US395 NDOT North Valleys

Project No: 475.0398.000 **Figure** 19-277-03

Tested By: AH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	28.3	19.6	23.5	14.1	14.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	94.6		
.375	89.6		
#4	71.7		
#10	52.1		
#16	42.8		
#40	28.6		
#50	25.1		
#100	18.8		
#200	14.5		

* (no specification provided)

Material Description

Brown clayey sand with gravel

Atterberg Limits

PL= 23　LL= 44　PI= 21

Coefficients

D_{90}= 9.7265　D_{85}= 7.8005　D_{60}= 2.9298
D_{50}= 1.7884　D_{30}= 0.4793　D_{15}= 0.0826
D_{10}=　C_u=　C_c=

Classification

USCS= SC　AASHTO= A-2-7(0)

Remarks

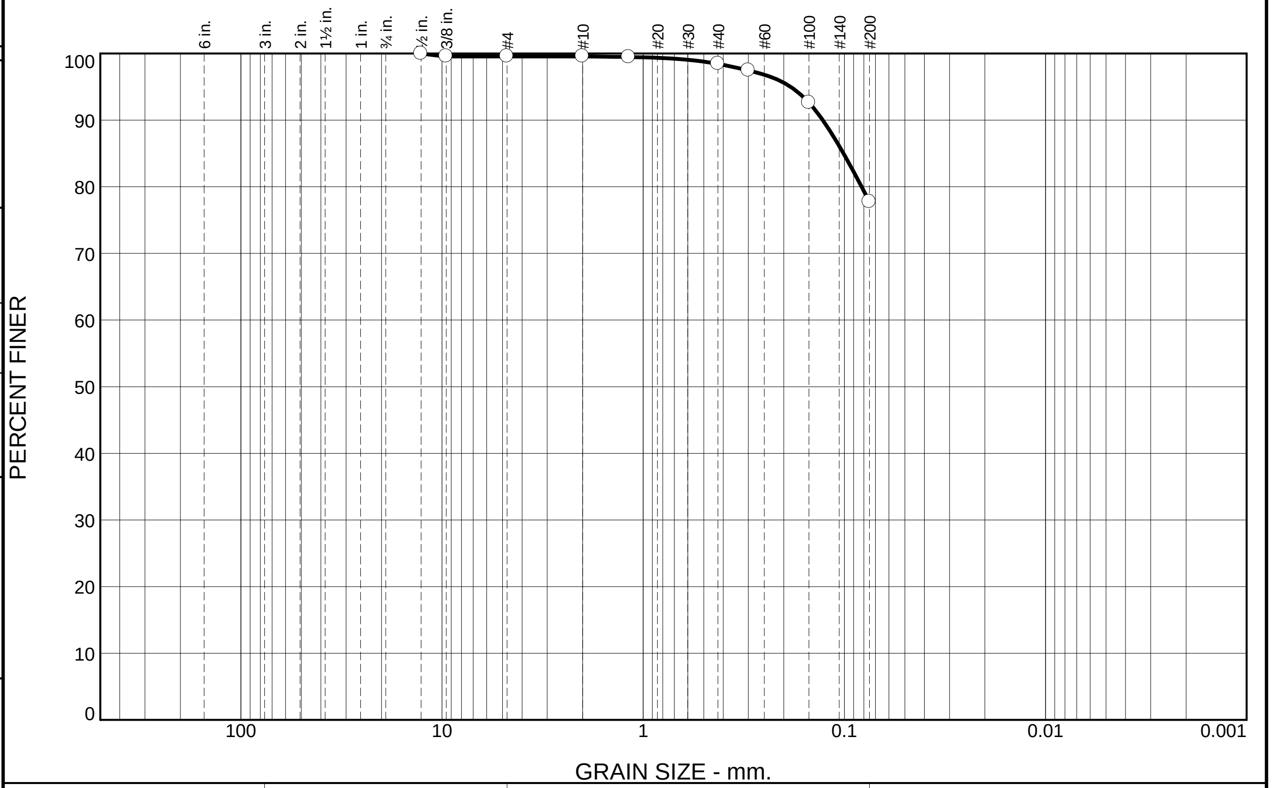
Location: RW2-07
Sample Number: 19-277-04　**Depth:** 7.5-9'　**Date:** 8/15/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000　**Figure** 19-277-04

Tested By: AH　**Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.4	0.0	1.2	20.6	77.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.5	100.0		
.375	99.6		
#4	99.6		
#10	99.6		
#16	99.5		
#40	98.4		
#50	97.5		
#100	92.6		
#200	77.8		

* (no specification provided)

Material Description

Brown fat clay with sand

Atterberg Limits

PL= 30 LL= 61 PI= 31

Coefficients

D_{90}= 0.1280 D_{85}= 0.1009 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CH AASHTO= A-7-5(26)

Remarks

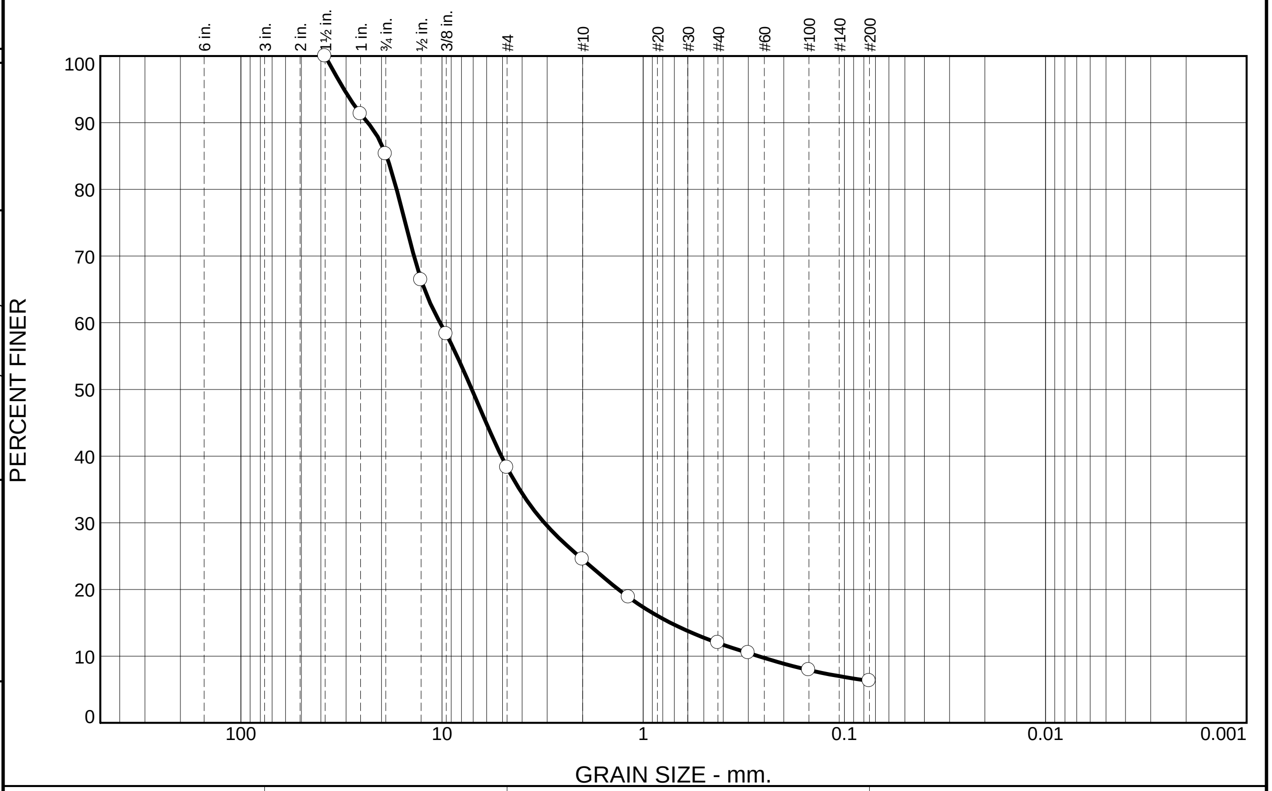
Location: RW2-08
Sample Number: 19-277-05 **Depth:** 7.5-9' **Date:** 8/15/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-277-05

Tested By: AH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	14.7	47.0	13.8	12.5	5.7	6.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	91.3		
.75	85.3		
.5	66.4		
.375	58.3		
#4	38.3		
#10	24.5		
#16	18.8		
#40	12.0		
#50	10.5		
#100	7.9		
#200	6.3		

* (no specification provided)

Material Description

Dark Brown poorly graded gravel with silt and sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 23.3836 D_{85}= 18.8774 D_{60}= 10.2181
D_{50}= 7.1107 D_{30}= 3.0999 D_{15}= 0.7317
D_{10}= 0.2677 C_u= 38.17 C_c= 3.51

Classification

USCS= GP-GM AASHTO= A-1-a

Remarks

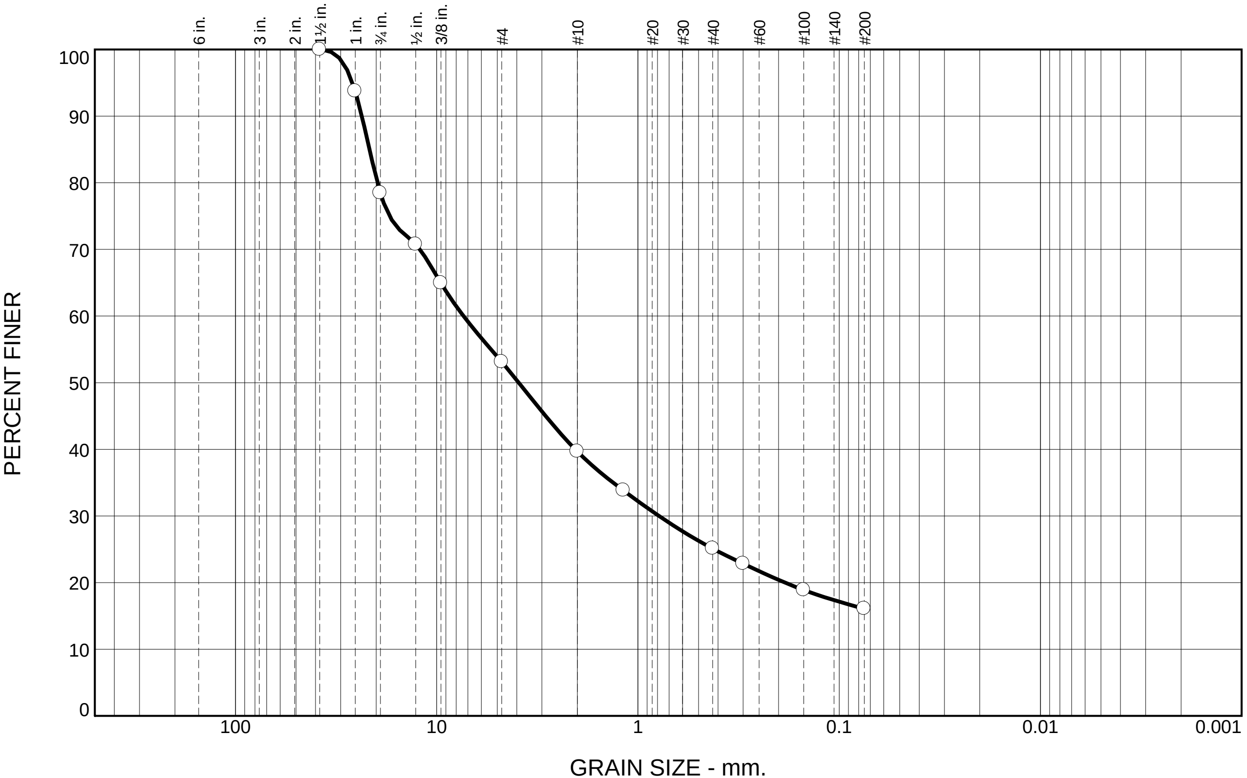
Location: RW3-11
Sample Number: 19-277-06 **Depth:** 5-5.5' **Date:** 8/15/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-277-06

Tested By: AH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	21.5	25.4	13.4	14.6	9.0	16.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	93.8		
.75	78.5		
.5	70.8		
.375	64.9		
#4	53.1		
#10	39.7		
#16	33.8		
#40	25.1		
#50	22.8		
#100	18.9		
#200	16.1		

* (no specification provided)

Material Description

Brown clayey gravel with sand

Atterberg Limits

PL= 18 LL= 31 PI= 13

Coefficients

D_{90}= 23.5554 D_{85}= 21.5863 D_{60}= 7.3599
D_{50}= 3.9113 D_{30}= 0.7853 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= GC AASHTO= A-2-6(0)

Remarks

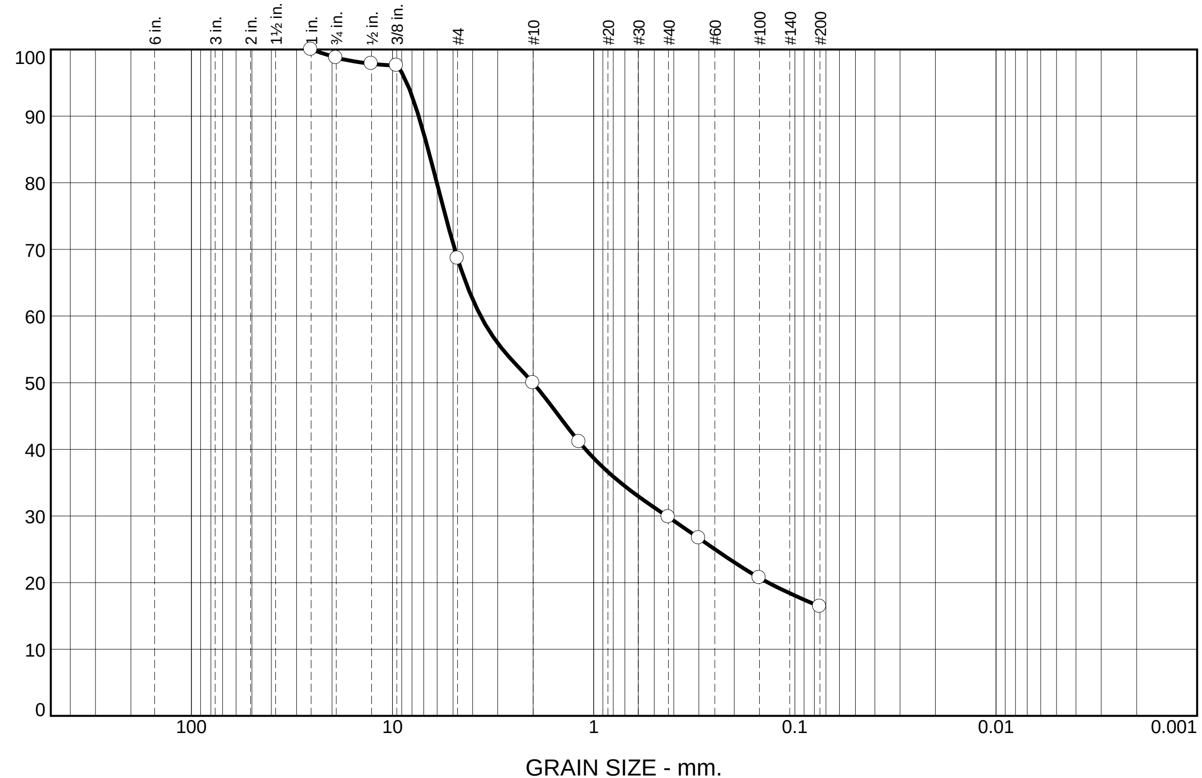
Location: RW3-13
Sample Number: 19-277-07 **Depth:** 7.5-9' **Date:** 8/15/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-277-07

Tested By: AH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	1.3	30.1	18.7	20.1	13.4	16.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	98.7		
.5	97.9		
.375	97.6		
#4	68.6		
#10	49.9		
#16	41.1		
#40	29.8		
#50	26.7		
#100	20.7		
#200	16.4		

* (no specification provided)

Material Description

Brown clayey sand with gravel

Atterberg Limits

PL= 20 LL= 35 PI= 15

Coefficients

D_{90}= 7.4137 D_{85}= 6.6539 D_{60}= 3.6468
D_{50}= 2.0082 D_{30}= 0.4334 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-6(0)

Remarks

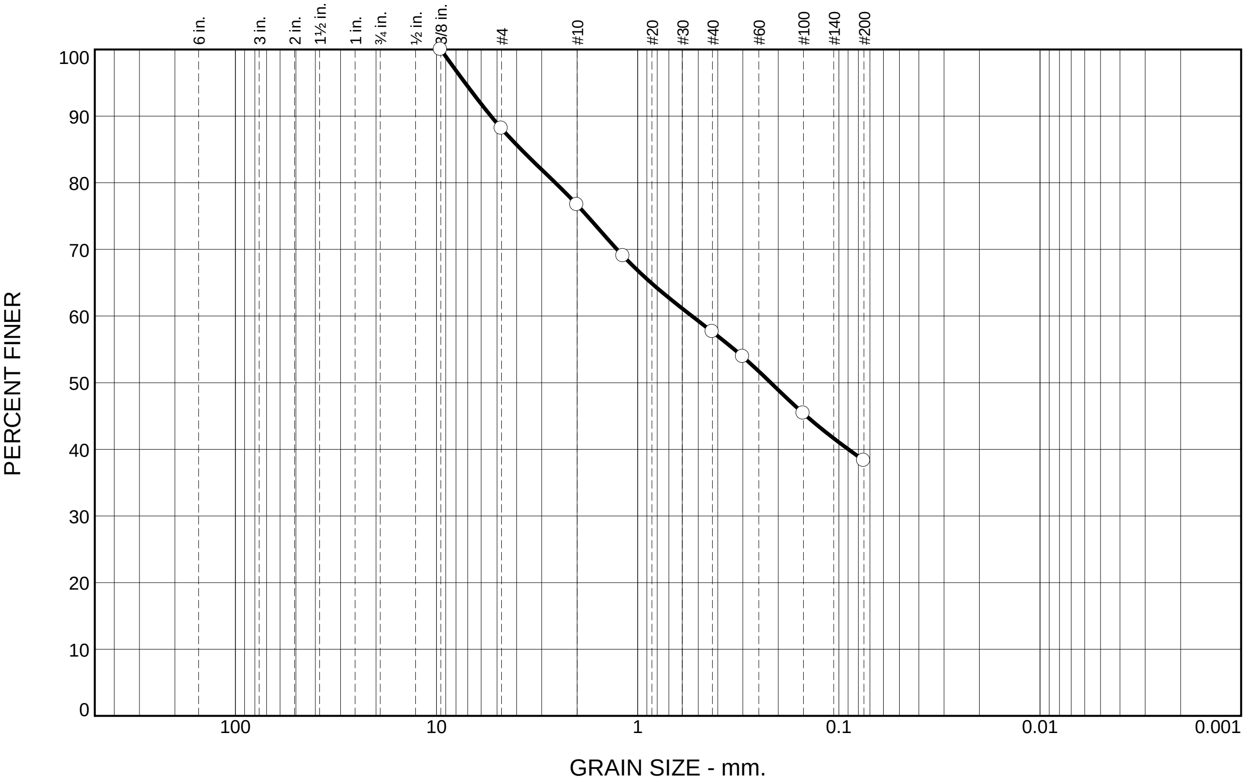
Location: RW3-16
Sample Number: 19-277-08 **Depth:** 10-11.5' **Date:** 8/15/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-277-08

Tested By: AH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	11.9	11.4	19.1	19.3	38.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	88.1		
#10	76.7		
#16	69.0		
#40	57.6		
#50	53.9		
#100	45.4		
#200	38.3		

* (no specification provided)

Material Description

Brown clayey sand

Atterberg Limits

PL= 19 LL= 53 PI= 34

Coefficients

D_{90}= 5.3607 D_{85}= 3.7964 D_{60}= 0.5372

D_{50}= 0.2182 D_{30}= D_{15}=

D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-7-6(6)

Remarks

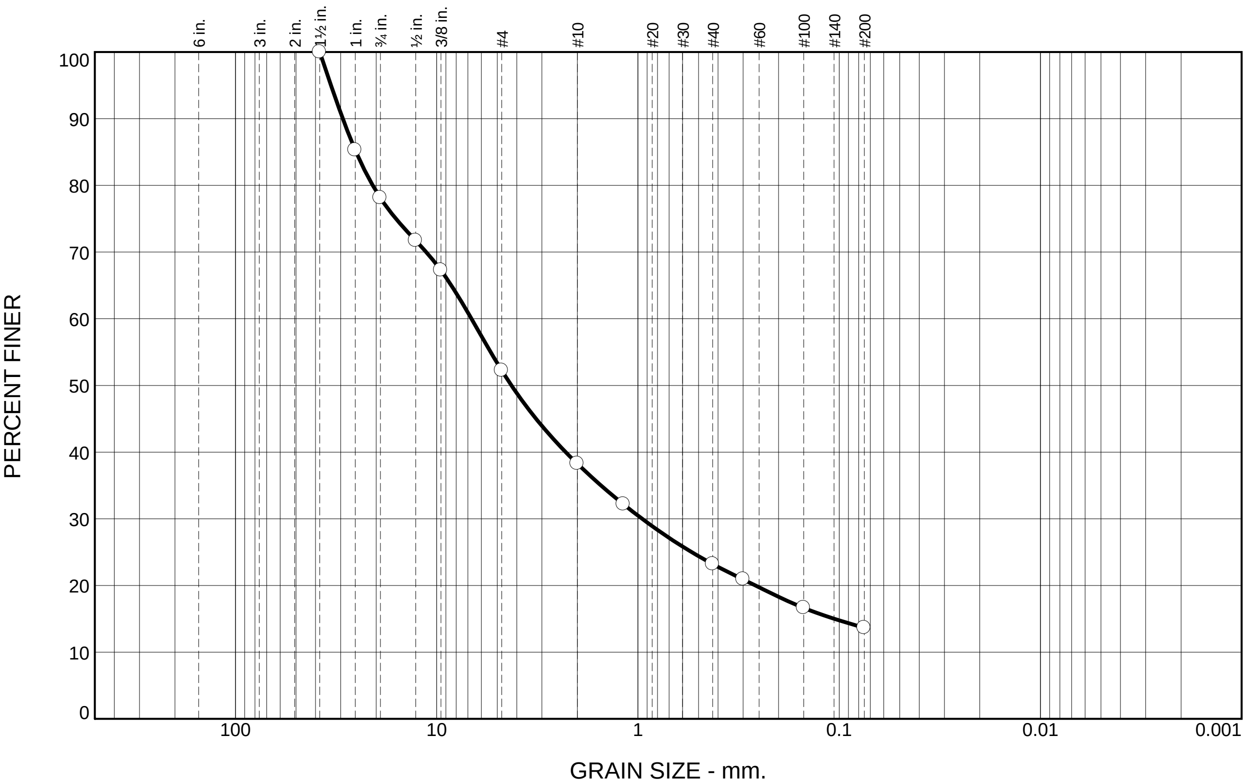
Location: RW3-18
Sample Number: 19-277-09 **Depth:** 15-16.5' **Date:** 8/15/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-277-09

Tested By: AH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	21.9	25.9	13.9	15.1	9.6	13.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	85.3		
.75	78.1		
.5	71.7		
.375	67.3		
#4	52.2		
#10	38.3		
#16	32.2		
#40	23.2		
#50	20.9		
#100	16.6		
#200	13.6		

* (no specification provided)

Material Description

Brown clayey gravel with sand

Atterberg Limits

PL= 16 LL= 32 PI= 16

Coefficients

D_{90}= 29.2775 D_{85}= 25.1611 D_{60}= 6.7179
D_{50}= 4.2515 D_{30}= 0.9525 D_{15}= 0.1057
D_{10}= C_u= C_c=

Classification

USCS= GC AASHTO= A-2-6(0)

Remarks

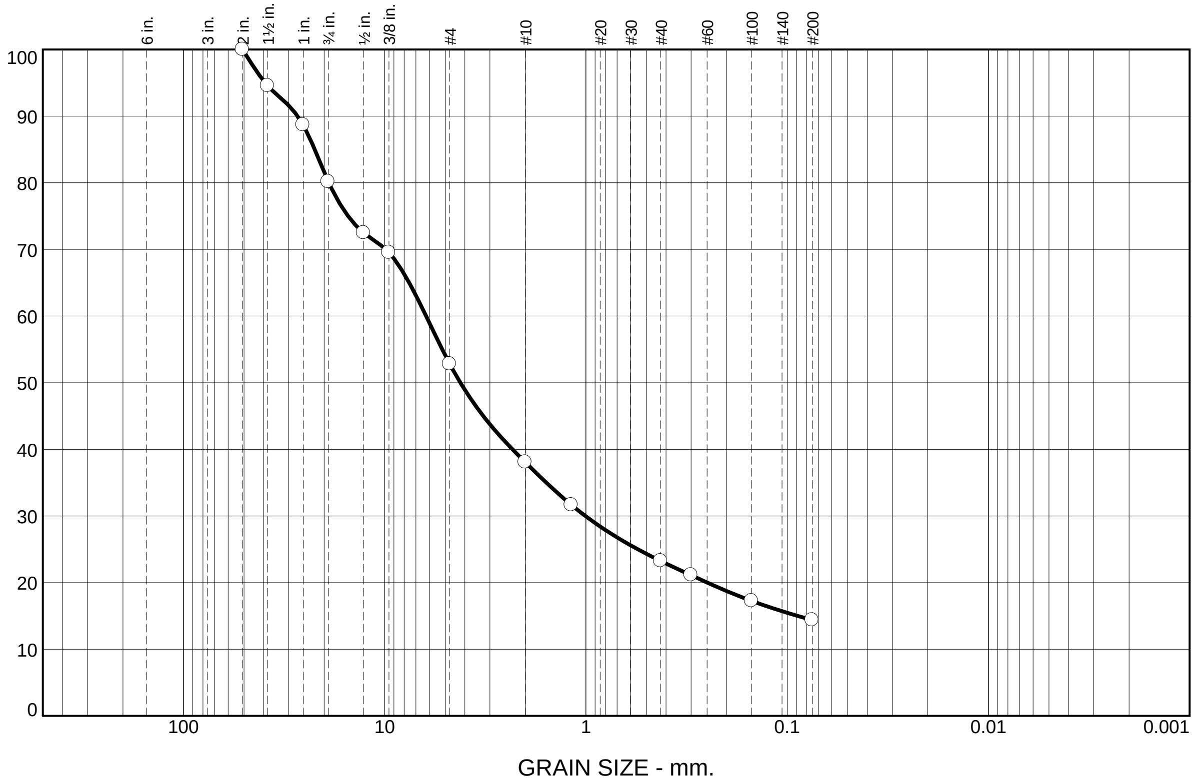
Location: RW3-22
Sample Number: 19-277-11 **Depth:** 15-16.5' **Date:** 8/15/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-277-11

Tested By: AH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	19.8	27.4	14.7	14.9	8.8	14.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2	100.0		
1.5	94.6		
1	88.7		
.75	80.2		
.5	72.5		
.375	69.5		
#4	52.8		
#10	38.1		
#16	31.6		
#40	23.2		
#50	21.1		
#100	17.2		
#200	14.4		

* (no specification provided)

Material Description

Brown clayey gravel with sand

Atterberg Limits

PL= 17 LL= 36 PI= 19

Coefficients

D_{90}= 27.0730 D_{85}= 22.2855 D_{60}= 6.2259
D_{50}= 4.2066 D_{30}= 1.0067 D_{15}= 0.0886
D_{10}= C_u= C_c=

Classification

USCS= GC AASHTO= A-2-6(0)

Remarks

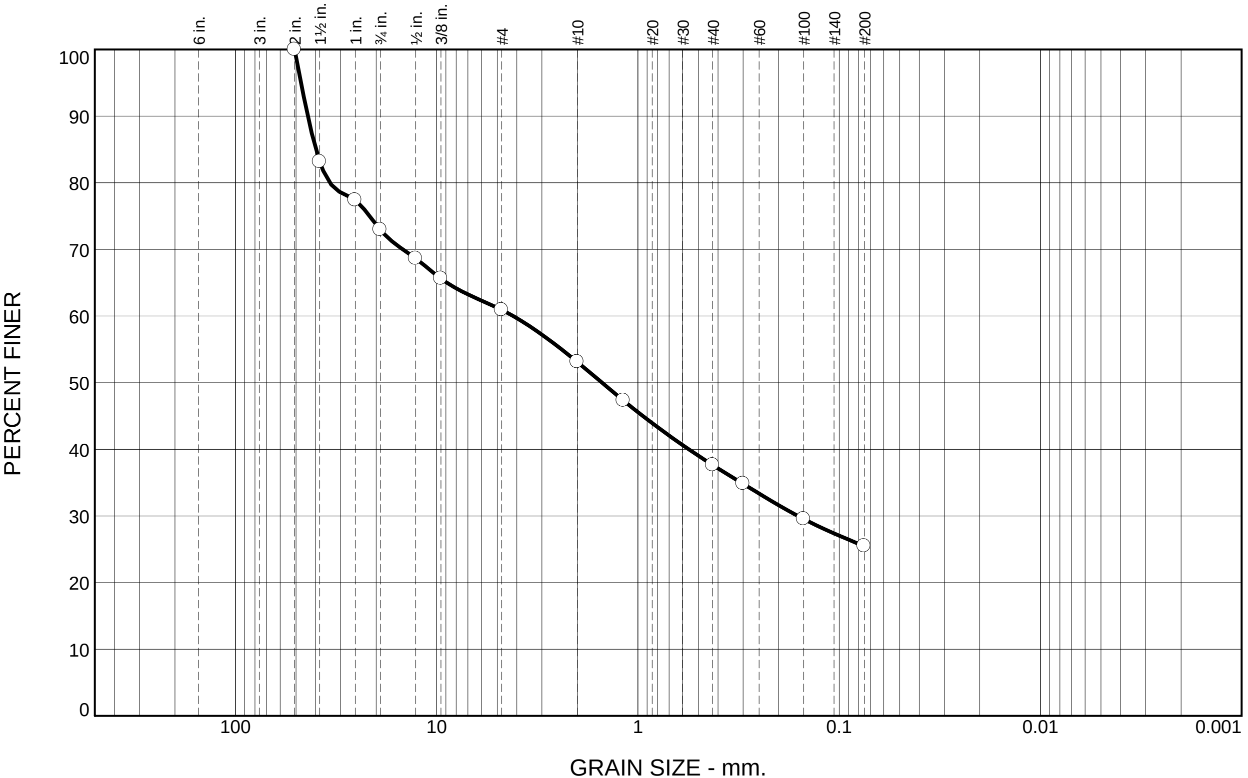
Location: RW3-24
Sample Number: 19-277-12 **Depth:** 5-6.5' **Date:** 8/15/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-277-12

Tested By: AH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	27.1	12.0	7.8	15.5	12.1	25.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2	100.0		
1.5	83.1		
1	77.4		
.75	72.9		
.5	68.6		
.375	65.6		
#4	60.9		
#10	53.1		
#16	47.3		
#40	37.6		
#50	34.8		
#100	29.5		
#200	25.5		

* (no specification provided)

Material Description

Brown clayey gravel with sand

Atterberg Limits

PL= 15 LL= 39 PI= 24

Coefficients

D_{90}= 43.6640	D_{85}= 39.8074	D_{60}= 4.1701
D_{50}= 1.5085	D_{30}= 0.1605	D_{15}=
D_{10}=	C_u=	C_c=

Classification

USCS= GC AASHTO= A-2-6(2)

Remarks

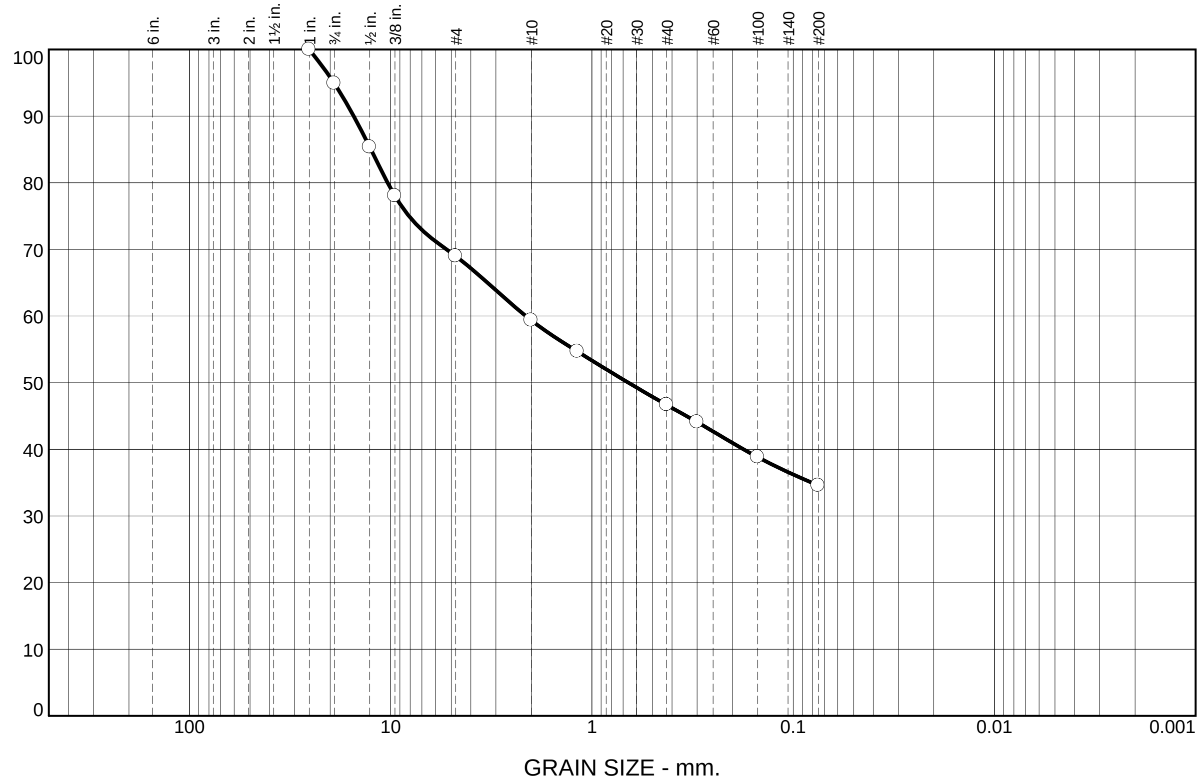
Location: BH19-RW4-26
Sample Number: 19-161-01 **Depth:** 6-6.5' **Date:** 5/31/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-161-01

Tested By: OS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	5.1	25.9	9.6	12.7	12.1	34.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	94.9		
.5	85.4		
.375	78.0		
#4	69.0		
#10	59.4		
#16	54.7		
#40	46.7		
#50	44.1		
#100	38.8		
#200	34.6		

* (no specification provided)

Material Description

Brown silty sand with gravel

Atterberg Limits

PL= 31 LL= 43 PI= 12

Coefficients

D_{90}= 15.2555 D_{85}= 12.5335 D_{60}= 2.1285
D_{50}= 0.6581 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-7(0)

Remarks

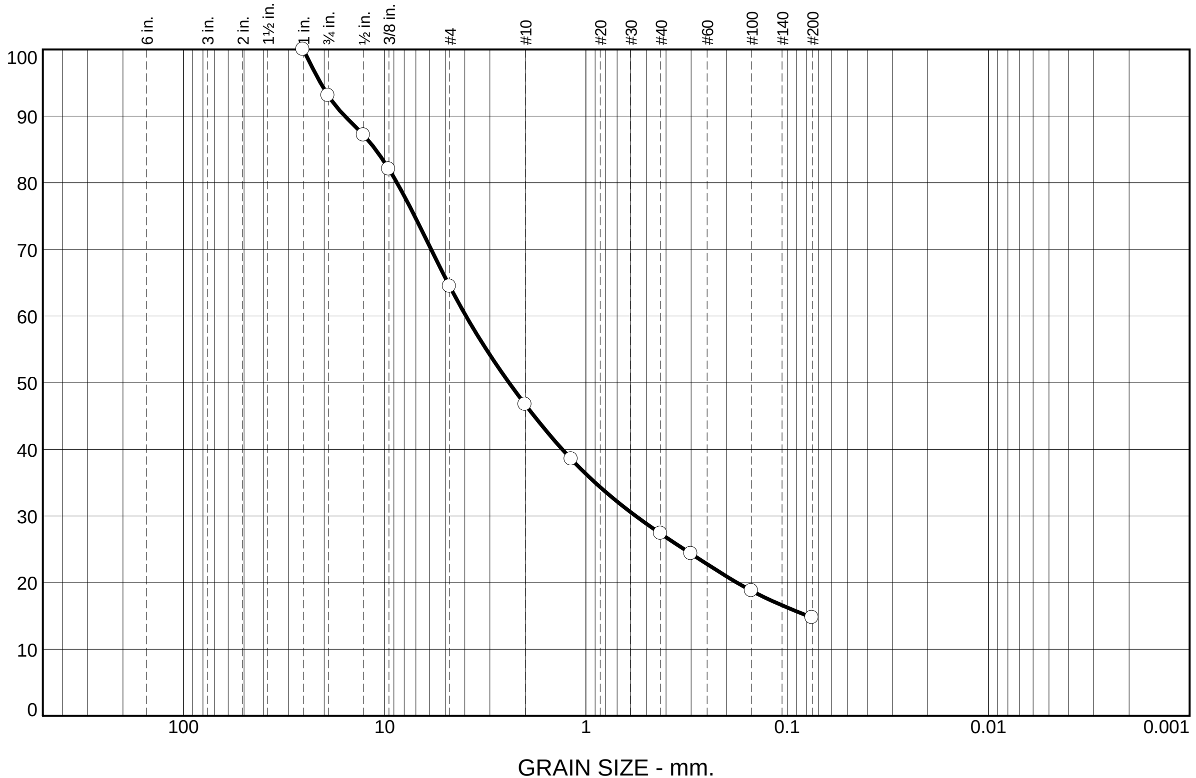
Location: BH19-RW4-26
Sample Number: 19-161-02 **Depth:** 15-16.5' **Date:** 5/31/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-161-02

Tested By: OS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	6.9	28.7	17.7	19.4	12.6	14.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	93.1		
.5	87.1		
.375	82.0		
#4	64.4		
#10	46.7		
#16	38.5		
#40	27.3		
#50	24.3		
#100	18.8		
#200	14.7		

* (no specification provided)

Material Description

Brown clayey sand with gravel

Atterberg Limits

PL= 18 LL= 37 PI= 19

Coefficients

D_{90}= 15.7578 D_{85}= 11.1095 D_{60}= 3.9448
D_{50}= 2.4114 D_{30}= 0.5655 D_{15}= 0.0790
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-6(0)

Remarks

Location: RW4-26
Sample Number: 19-277-13 **Depth:** 30-31.5' **Date:** 8/15/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-277-13

Tested By: AH **Checked By:** JH

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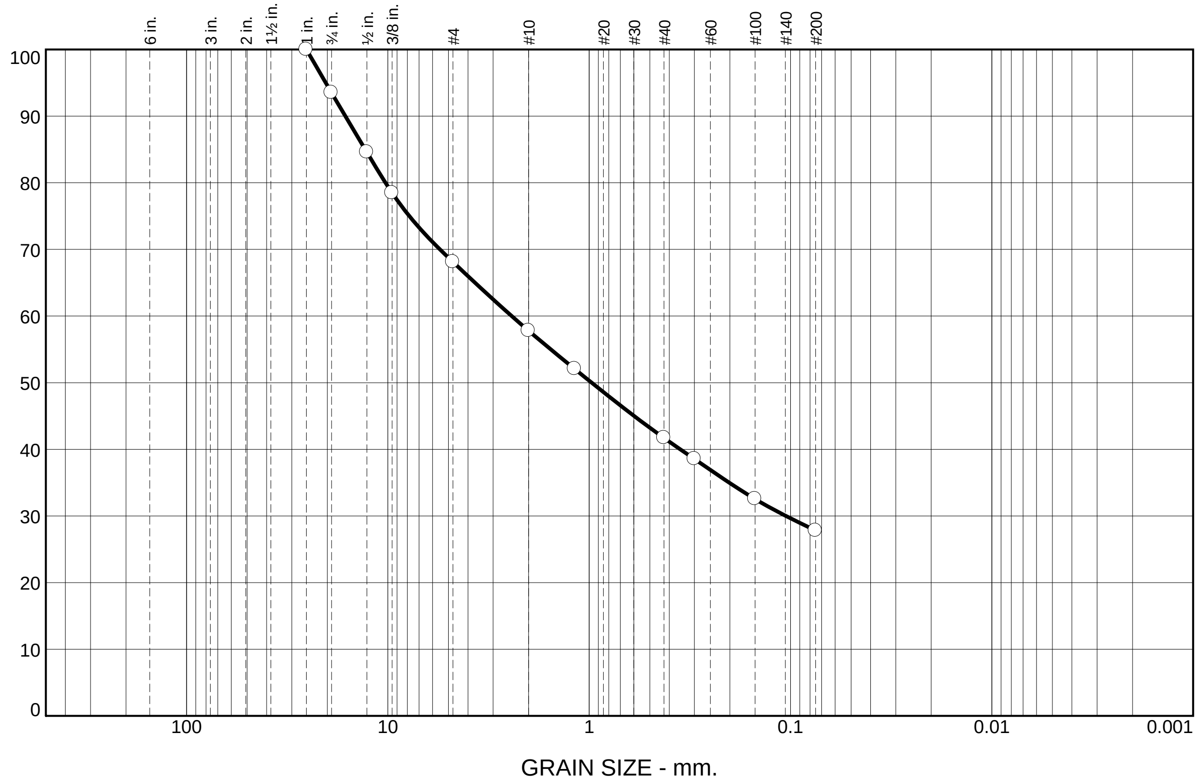
Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	6.5	25.4	10.3	16.1	13.9	27.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	93.5		
.5	84.6		
.375	78.5		
#4	68.1		
#10	57.8		
#16	52.1		
#40	41.7		
#50	38.5		
#100	32.5		
#200	27.8		

* (no specification provided)

Material Description

Brown clayey sand with gravel

Atterberg Limits

PL= 17 LL= 34 PI= 17

Coefficients

D_{90}= 16.2513 D_{85}= 12.9495 D_{60}= 2.4253
D_{50}= 0.9716 D_{30}= 0.1053 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-6(1)

Remarks

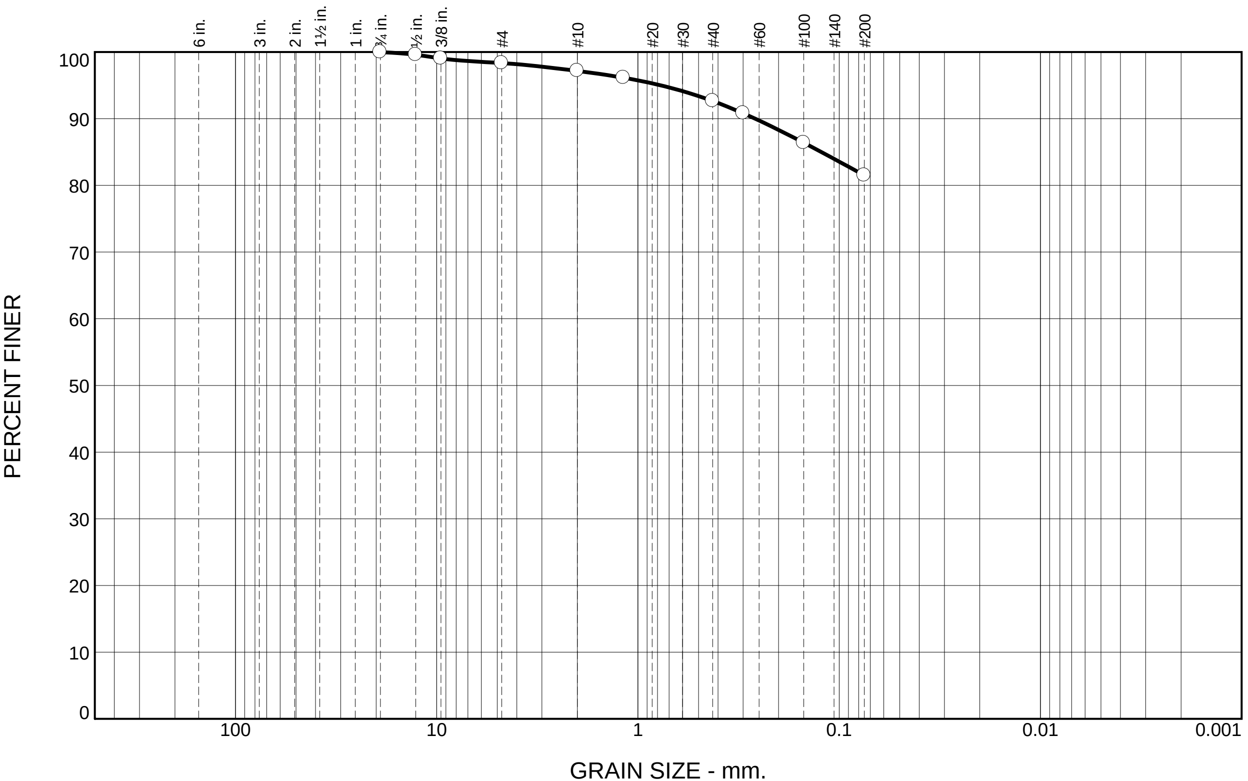
Location: BH19-RW4-27
Sample Number: 19-161-03 **Depth:** 15-16.5' **Date:** 5/31/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-161-03

Tested By: OS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.7	1.1	4.5	11.2	81.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	99.6		
.375	99.0		
#4	98.3		
#10	97.2		
#16	96.1		
#40	92.7		
#50	90.8		
#100	86.4		
#200	81.5		

* (no specification provided)

Material Description

Brown fat clay with sand

Atterberg Limits

PL= 19 LL= 66 PI= 47

Coefficients

D_{90}= 0.2613 D_{85}= 0.1226 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CH AASHTO= A-7-6(40)

Remarks

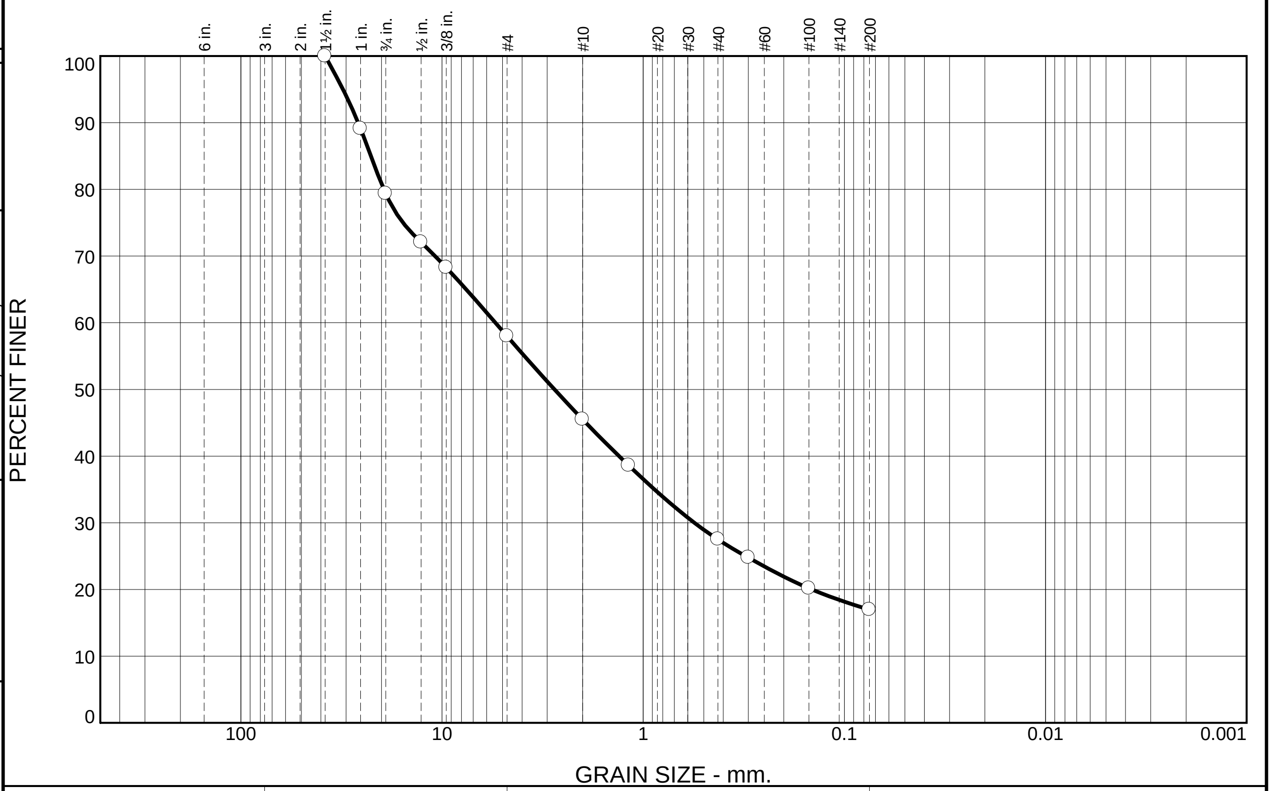
Location: BH19-RW4-27
Sample Number: 19-161-05 **Depth:** 40.5-41' **Date:** 5/31/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-161-05

Tested By: OS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	20.6	21.4	12.5	18.0	10.5	17.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	89.1		
.75	79.4		
.5	72.1		
.375	68.3		
#4	58.0		
#10	45.5		
#16	38.6		
#40	27.5		
#50	24.8		
#100	20.2		
#200	17.0		

* (no specification provided)

Material Description

Light Brown clayey gravel with sand

Atterberg Limits

PL= 17 LL= 33 PI= 16

Coefficients

D_{90}= 26.1079 D_{85}= 22.5818 D_{60}= 5.4279
D_{50}= 2.7604 D_{30}= 0.5560 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= GC AASHTO= A-2-6(0)

Remarks

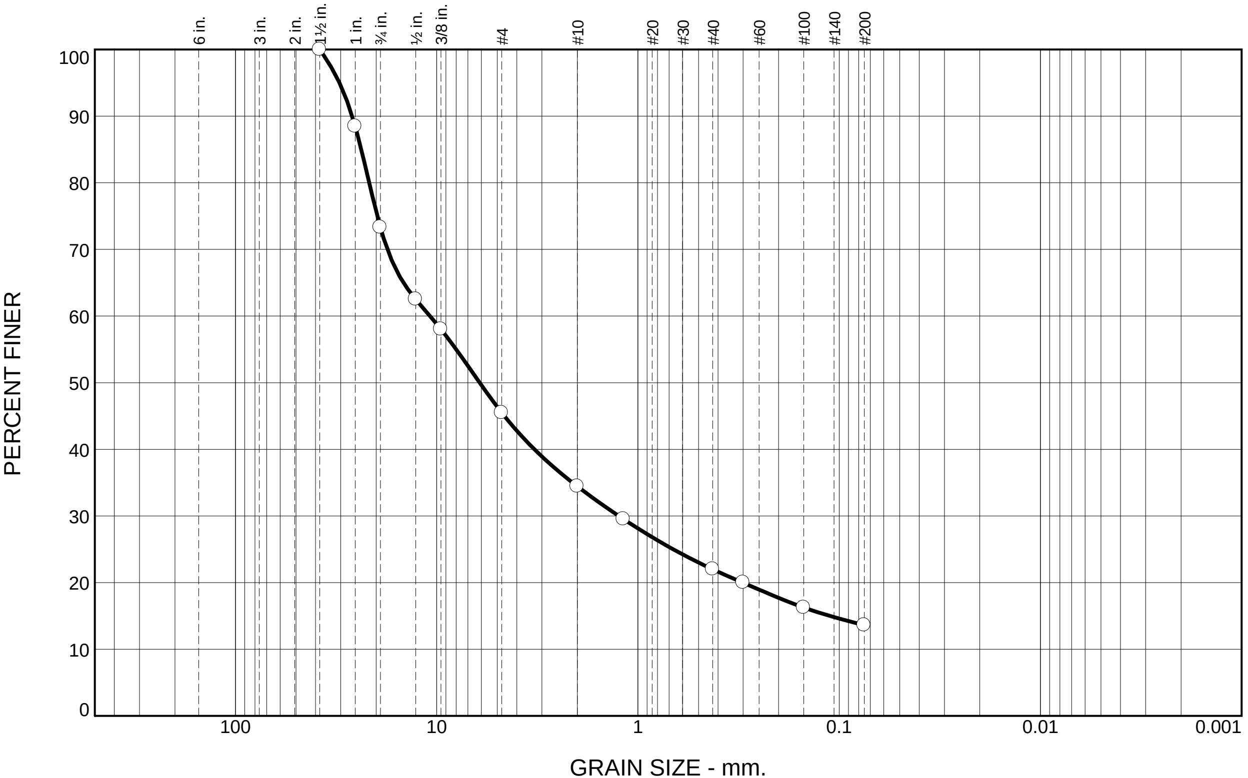
Location: BH19-RW5-28
Sample Number: 19-148-01 **Depth:** 5-6' **Date:** 5/23/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-148-01

Tested By: JH/KS/JS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	26.7	27.8	11.1	12.4	8.4	13.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	88.5		
.75	73.3		
.5	62.5		
.375	58.0		
#4	45.5		
#10	34.4		
#16	29.5		
#40	22.0		
#50	20.0		
#100	16.3		
#200	13.6		

* (no specification provided)

Material Description

Light Brown clayey gravel with sand

Atterberg Limits

PL= 17 LL= 38 PI= 21

Coefficients

D_{90}= 26.2928 D_{85}= 23.7087 D_{60}= 10.8069
D_{50}= 6.1160 D_{30}= 1.2462 D_{15}= 0.1111
D_{10}= C_u= C_c=

Classification

USCS= GC AASHTO= A-2-6(0)

Remarks

Location: BH19-RW5-28
Sample Number: 19-148-02 **Depth:** 10-11.5' **Date:** 5/23/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-148-02

Tested By: JH **Checked By:** JH

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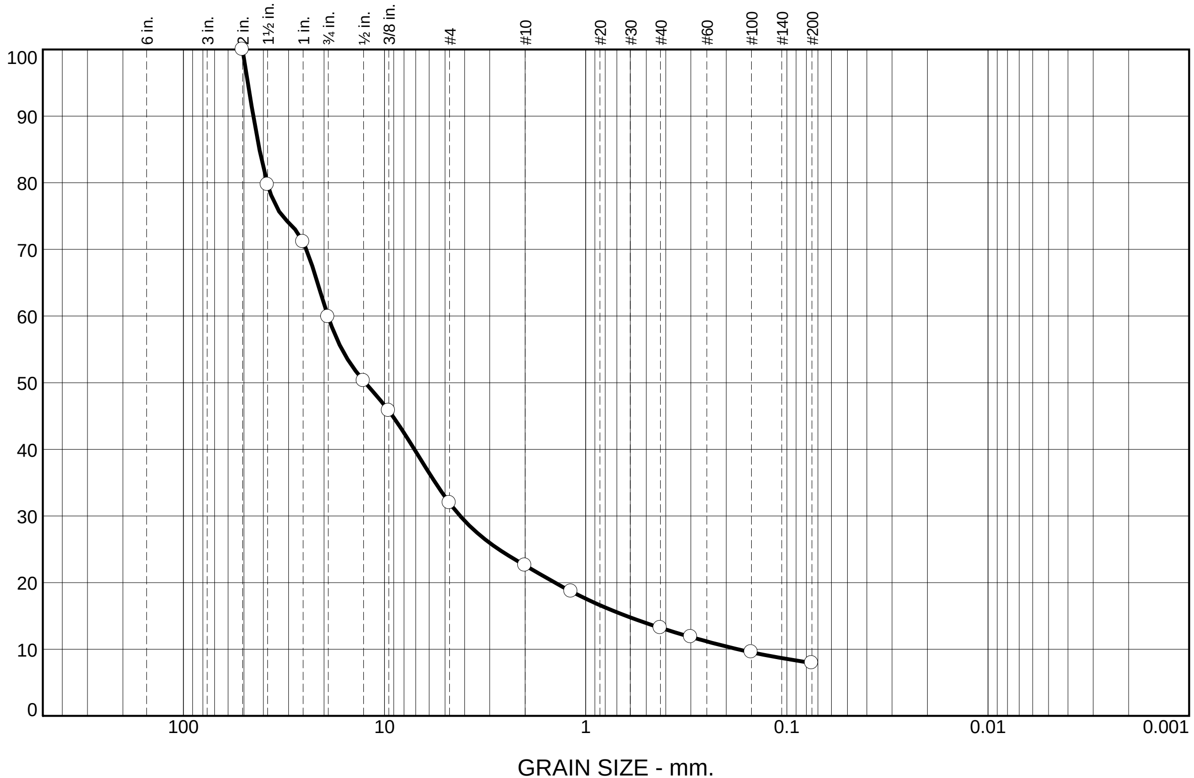
Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	40.1	28.0	9.3	9.4	5.3	7.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2	100.0		
1.5	79.7		
1	71.1		
.75	59.9		
.5	50.3		
.375	45.8		
#4	31.9		
#10	22.6		
#16	18.7		
#40	13.2		
#50	11.8		
#100	9.5		
#200	7.9		

* (no specification provided)

Material Description

Gray poorly graded gravel with clay and sand

Atterberg Limits

PL= 15 LL= 35 PI= 20

Coefficients

D_{90}= 44.8903 D_{85}= 41.8552 D_{60}= 19.1205
D_{50}= 12.4702 D_{30}= 4.2069 D_{15}= 0.6294
D_{10}= 0.1755 C_u= 108.94 C_c= 5.27

Classification

USCS= GP-GC AASHTO= A-2-6(0)

Remarks

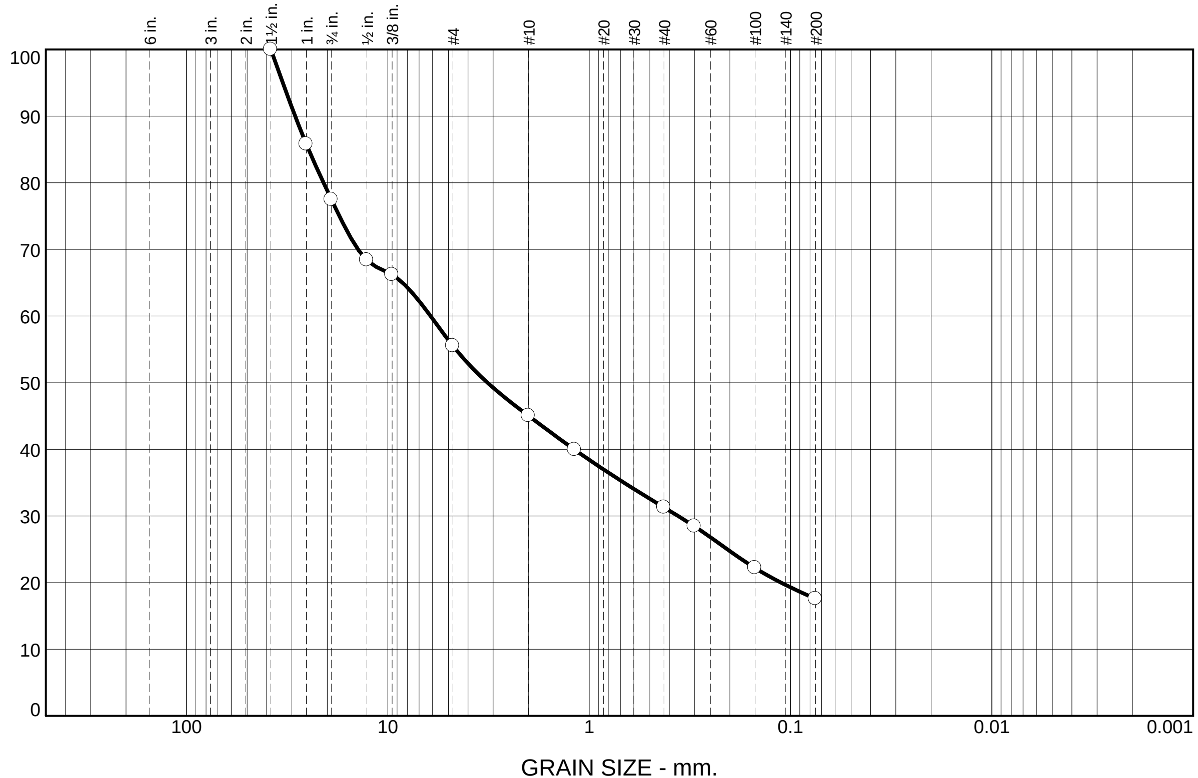
Location: BH19-RW5-29
Sample Number: 19-148-04 **Depth:** 6-6.5' **Date:** 5/23/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-148-04

Tested By: JH/JS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	22.5	22.0	10.5	13.7	13.8	17.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	85.8		
.75	77.5		
.5	68.4		
.375	66.2		
#4	55.5		
#10	45.0		
#16	39.9		
#40	31.3		
#50	28.4		
#100	22.2		
#200	17.5		

* (no specification provided)

Material Description

Light Brown clayey gravel with sand

Atterberg Limits

PL= 13 LL= 29 PI= 16

Coefficients

D_{90}= 28.8720 D_{85}= 24.7793 D_{60}= 6.1338
D_{50}= 3.2010 D_{30}= 0.3616 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= GC AASHTO= A-2-6(0)

Remarks

Location: BH19-RW5-29
Sample Number: 19-148-05 **Depth:** 15-16.5' **Date:** 5/23/2019

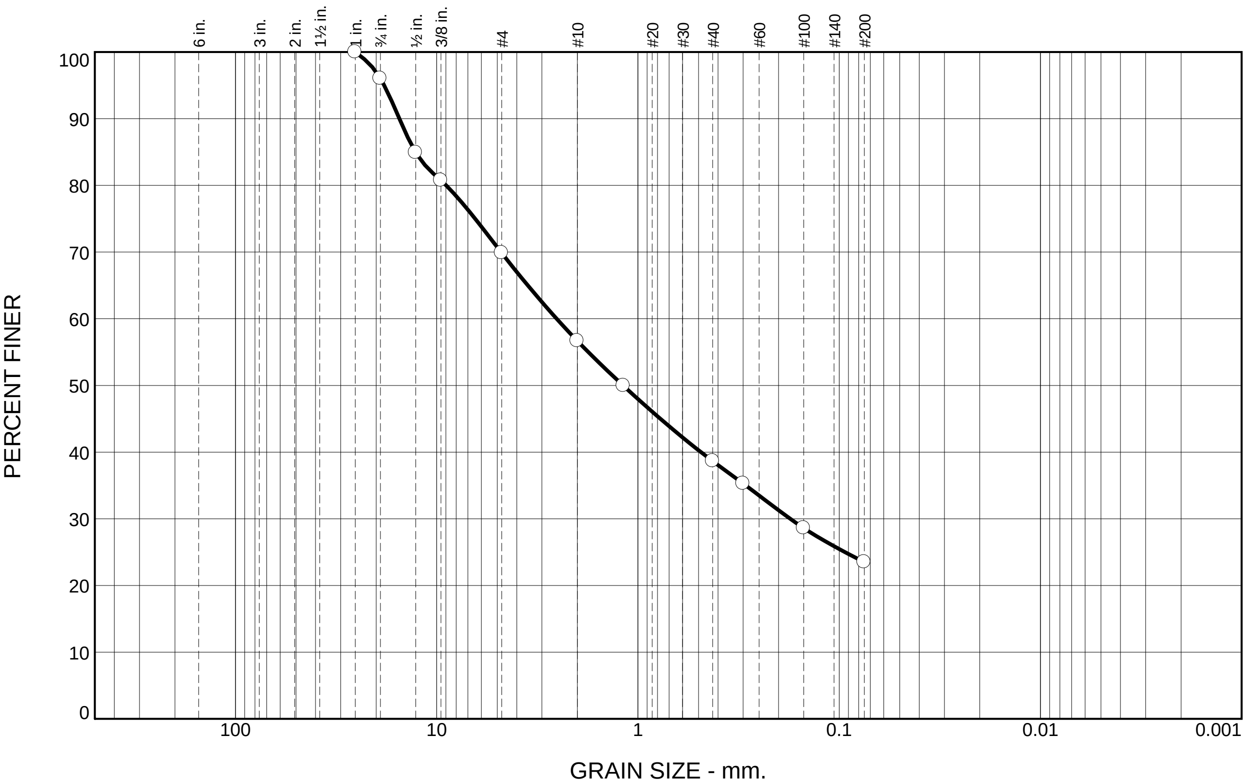
NewFields

Client: NDOT
Project: US395 NDOT North Valleys

Project No: 475.0398.000 **Figure** 19-148-05

Tested By: JH/JS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	4.0	26.1	13.2	18.0	15.2	23.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	96.0		
.5	84.9		
.375	80.8		
#4	69.9		
#10	56.7		
#16	49.9		
#40	38.7		
#50	35.3		
#100	28.6		
#200	23.5		

* (no specification provided)

Material Description

Light Brown clayey sand with gravel

Atterberg Limits

PL= 15 LL= 39 PI= 24

Coefficients

D_{90}= 15.3133 D_{85}= 12.7462 D_{60}= 2.5337
D_{50}= 1.1849 D_{30}= 0.1751 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-6(1)

Remarks

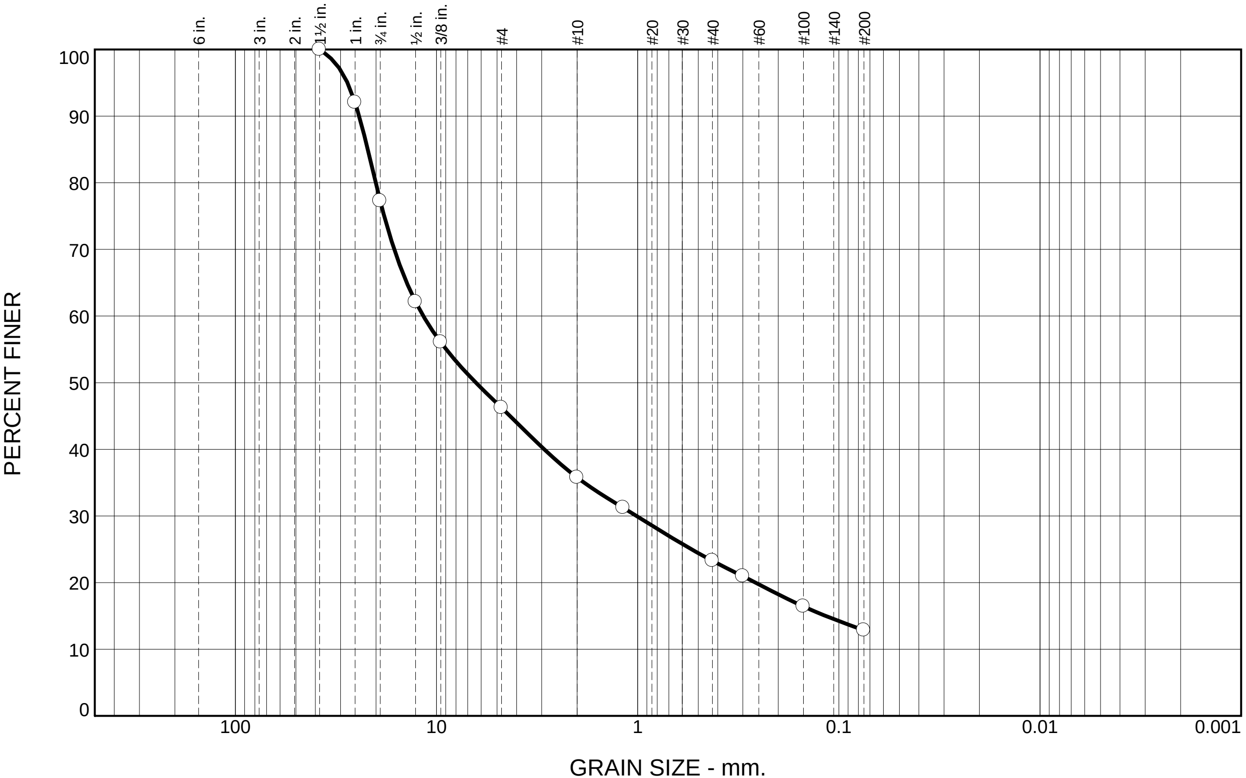
Location: BH19-RW5-29
Sample Number: 19-148-06 **Depth:** 25-26.5' **Date:** 5/23/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-148-06

Tested By: JH/KS/JS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	22.7	31.1	10.4	12.5	10.5	12.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	92.0		
.75	77.3		
.5	62.1		
.375	56.1		
#4	46.2		
#10	35.8		
#16	31.2		
#40	23.3		
#50	21.0		
#100	16.4		
#200	12.8		

* (no specification provided)

Material Description

Brown clayey gravel with sand

Atterberg Limits

PL= 21 LL= 31 PI= 10

Coefficients

D_{90}= 24.2389 D_{85}= 21.9794 D_{60}= 11.6354
D_{50}= 6.3696 D_{30}= 1.0142 D_{15}= 0.1162
D_{10}= C_u= C_c=

Classification

USCS= GC AASHTO= A-2-4(0)

Remarks

Location: BH19-RW6-31
Sample Number: 19-211-01 **Depth:** 2.5-4' **Date:** 7/2/2019

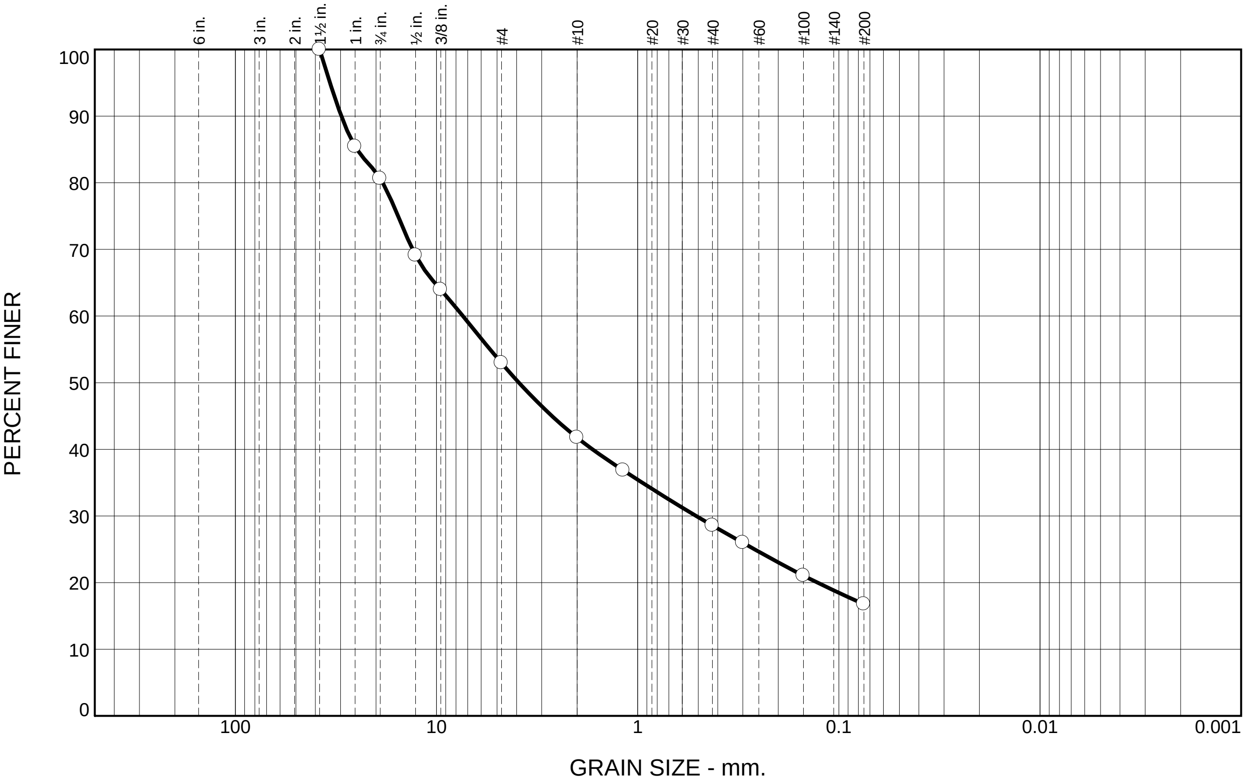
NewFields

Client: NDOT
Project: US395 NDOT North Valleys

Project No: 475.0398.000 **Figure** 19-211-01

Tested By: JH/KG **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	19.4	27.7	11.1	13.2	11.9	16.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	85.4		
.75	80.6		
.5	69.1		
.375	63.9		
#4	52.9		
#10	41.8		
#16	36.8		
#40	28.6		
#50	26.0		
#100	21.0		
#200	16.7		

* (no specification provided)

Material Description

Brown silty clayey gravel with sand

Atterberg Limits

PL= 21 LL= 28 PI= 7

Coefficients

D_{90}= 29.7212 D_{85}= 24.8842 D_{60}= 7.3953
D_{50}= 3.8935 D_{30}= 0.5121 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= GC-GM AASHTO= A-2-4(0)

Remarks

Location: RW6-31
Sample Number: 19-277-19 **Depth:** 6-6.5' **Date:** 8/15/2019

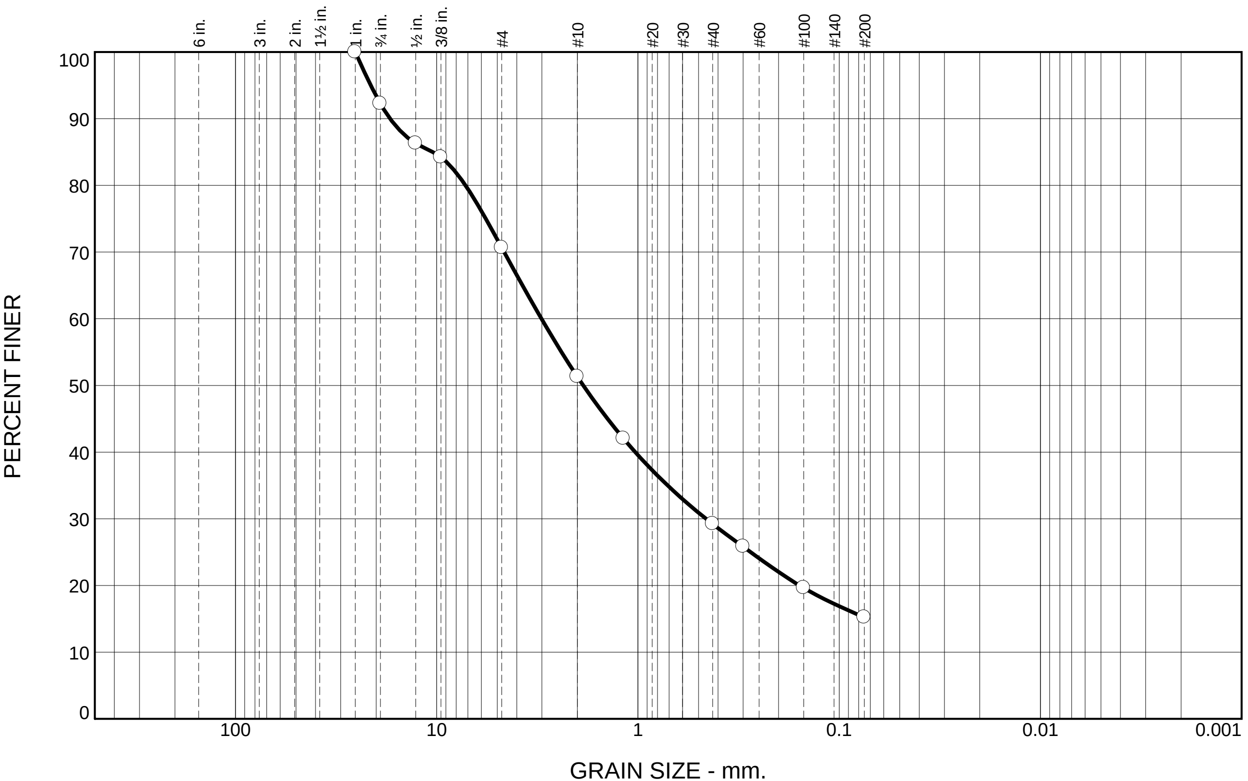
NewFields

Client: NDOT
Project: US395 NDOT North Valleys

Project No: 475.0398.000 **Figure** 19-277-19

Tested By: AH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	7.7	21.7	19.3	22.1	14.0	15.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	92.3		
.5	86.3		
.375	84.2		
#4	70.6		
#10	51.3		
#16	42.0		
#40	29.2		
#50	25.8		
#100	19.6		
#200	15.2		

* (no specification provided)

Material Description

Gray silty sand with gravel

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 17.0309 D_{85}= 10.4515 D_{60}= 3.0140
D_{50}= 1.8703 D_{30}= 0.4585 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-1-b

Remarks

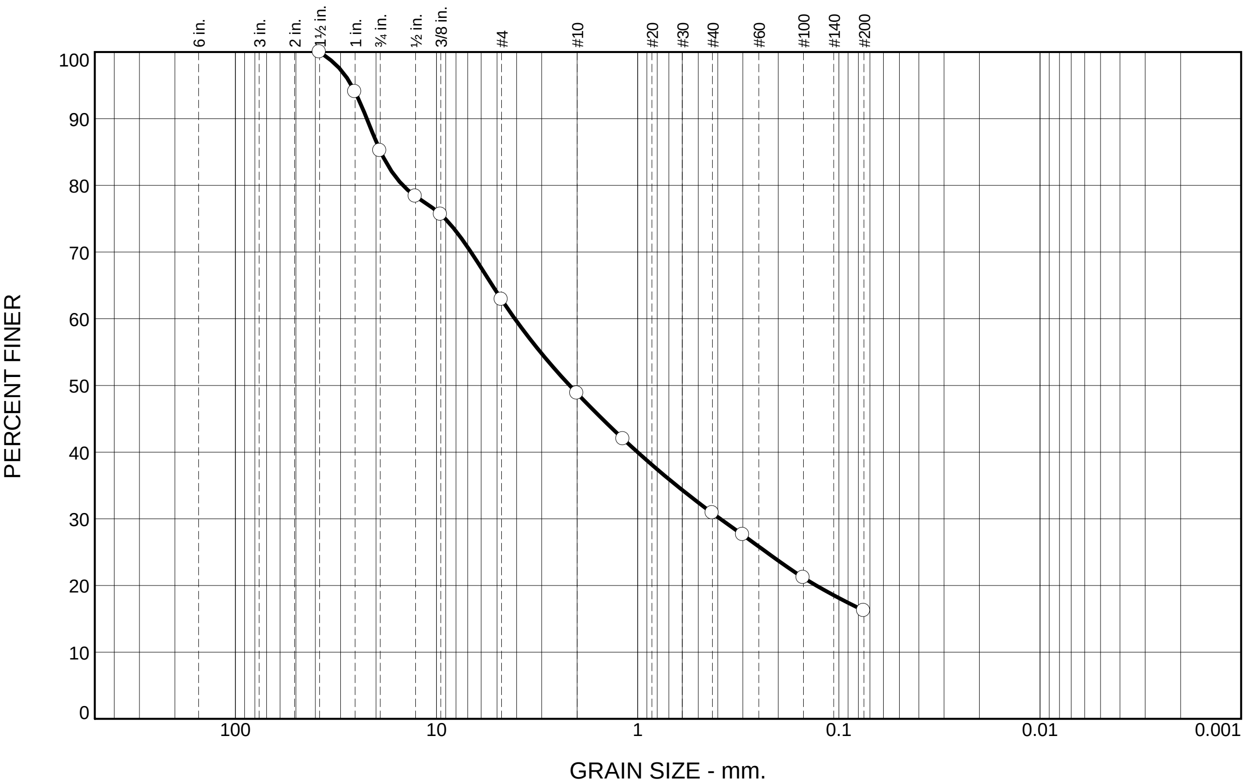
Location: BH19-RW6-32
Sample Number: 19-211-07 **Depth:** 2.5-4' **Date:** 7/2/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-211-07

Tested By: JH/KG **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	14.8	22.3	14.1	17.9	14.7	16.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	94.0		
.75	85.2		
.5	78.4		
.375	75.6		
#4	62.9		
#10	48.8		
#16	42.0		
#40	30.9		
#50	27.6		
#100	21.2		
#200	16.2		

* (no specification provided)

Material Description

Light Brown clayey sand with gravel

Atterberg Limits

PL= 17
LL= 31
PI= 14

Coefficients

D_{90}= 22.2214
D_{85}= 18.9270
D_{60}= 4.0812
D_{50}= 2.1780
D_{30}= 0.3885
D_{15}=
D_{10}=
C_u=
C_c=

Classification

USCS= SC
AASHTO= A-2-6(0)

Remarks

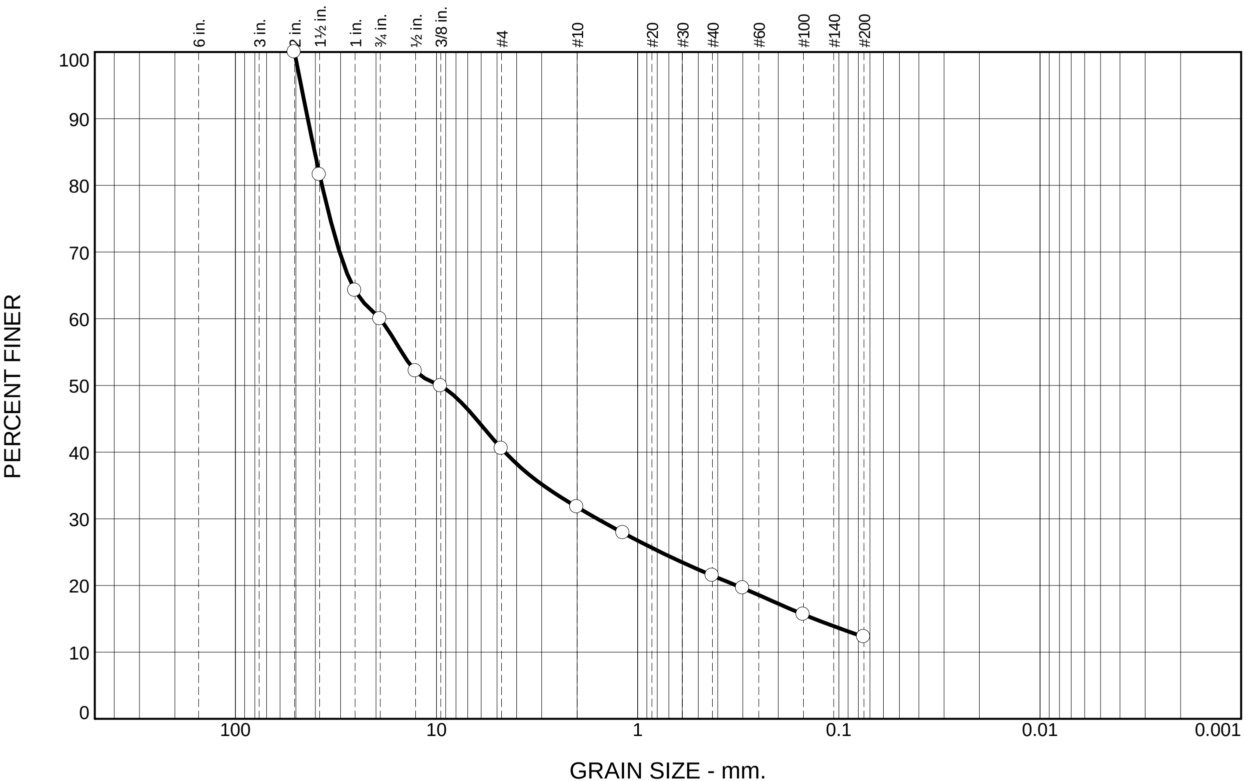
Location: BH19-RW7-34
Sample Number: 19-148-08
Depth: 2.5-4'
Date: 5/23/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000
Figure 19-148-08

Tested By: JH/JS
Checked By: JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	40.1	19.4	8.7	10.3	9.2	12.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2	100.0		
1.5	81.6		
1	64.2		
.75	59.9		
.5	52.1		
.375	49.9		
#4	40.5		
#10	31.8		
#16	27.9		
#40	21.5		
#50	19.6		
#100	15.6		
#200	12.3		

* (no specification provided)

Material Description

Light Brown clayey gravel with sand

Atterberg Limits

PL= 15 LL= 30 PI= 15

Coefficients

D_{90}= 43.6539 D_{85}= 40.3258 D_{60}= 19.1231
D_{50}= 9.6245 D_{30}= 1.5867 D_{15}= 0.1326
D_{10}= C_u= C_c=

Classification

USCS= GC AASHTO= A-2-6(0)

Remarks

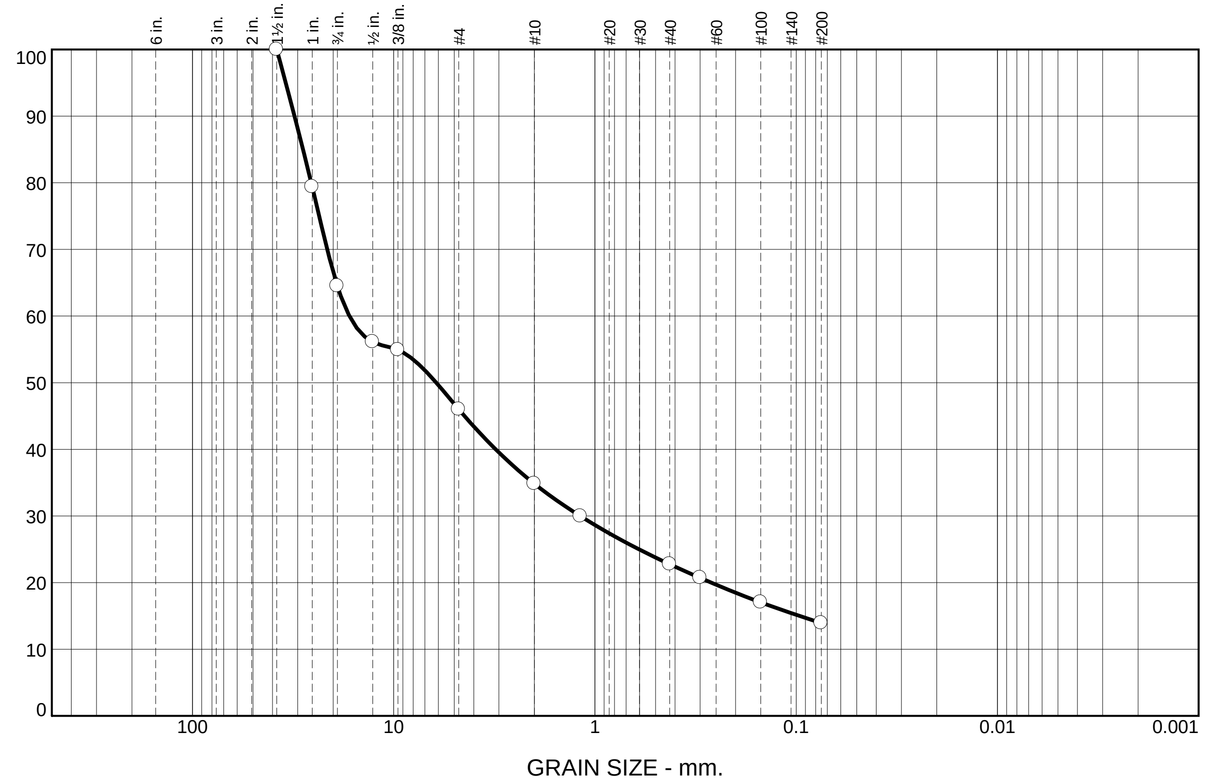
Location: BH19-RW7-34
Sample Number: 19-148-11 **Depth:** 11-11.5' **Date:** 5/23/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-148-11

Tested By: JH/JS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	35.5	18.5	11.2	12.0	8.9	13.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	79.4		
.75	64.5		
.5	56.1		
.375	54.9		
#4	46.0		
#10	34.8		
#16	30.0		
#40	22.8		
#50	20.7		
#100	17.0		
#200	13.9		

* (no specification provided)

Material Description

Gray clayey gravel with sand

Atterberg Limits

PL= 18 LL= 26 PI= 8

Coefficients

D_{90}= 31.1096 D_{85}= 28.2156 D_{60}= 16.5930
D_{50}= 6.1441 D_{30}= 1.1853 D_{15}= 0.0961
D_{10}= C_u= C_c=

Classification

USCS= GC AASHTO= A-2-4(0)

Remarks

Location: BH19-RW7-34
Sample Number: 19-148-09 **Depth:** 15-16.5' **Date:** 5/23/2019

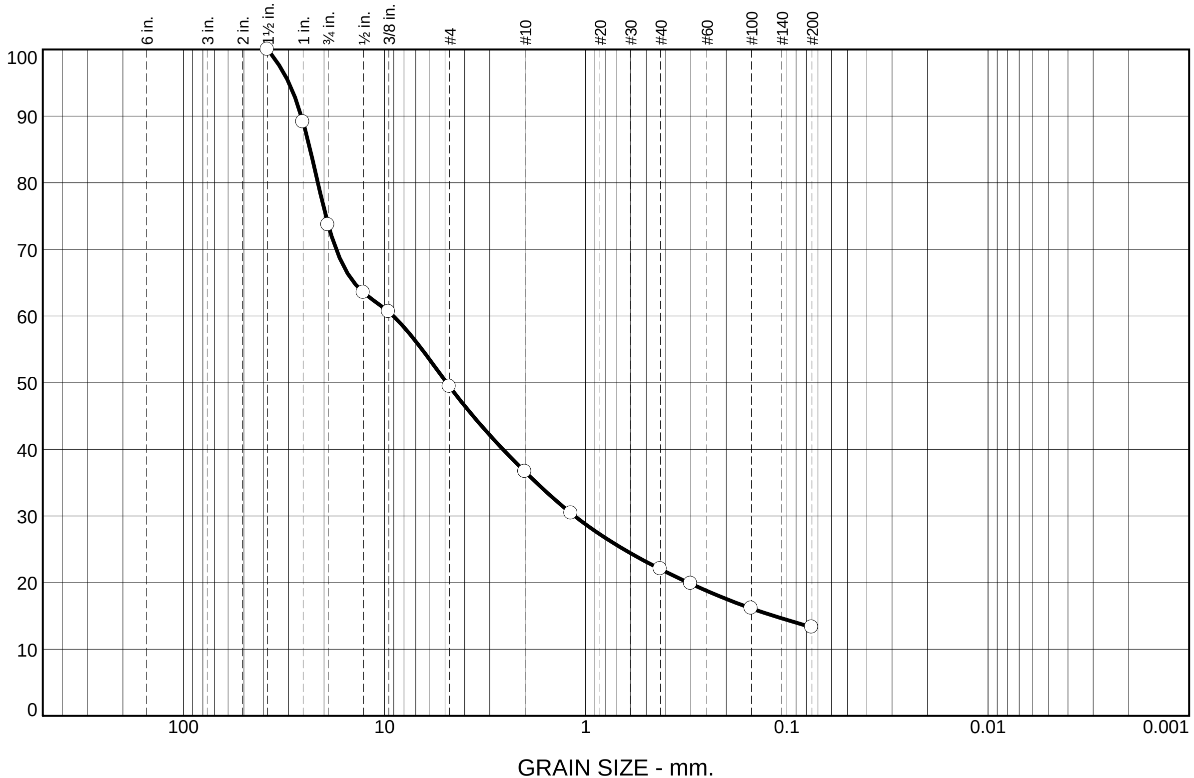
NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-148-09

Tested By: JH/JS **Checked By:** JH

Test results included in this report relate only to the items inspected or tested. This report shall not be reproduced, in full, without prior written approval of NewFields.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	26.3	24.3	12.8	14.6	8.7	13.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	89.1		
.75	73.7		
.5	63.5		
.375	60.6		
#4	49.4		
#10	36.6		
#16	30.4		
#40	22.0		
#50	19.8		
#100	16.1		
#200	13.3		

* (no specification provided)

Material Description

Light Brown clayey gravel with sand

Atterberg Limits

PL= 16 LL= 31 PI= 15

Coefficients

D_{90}= 25.9048 D_{85}= 23.4467 D_{60}= 9.0397
D_{50}= 4.9128 D_{30}= 1.1357 D_{15}= 0.1161
D_{10}= C_u= C_c=

Classification

USCS= GC AASHTO= A-2-6(0)

Remarks

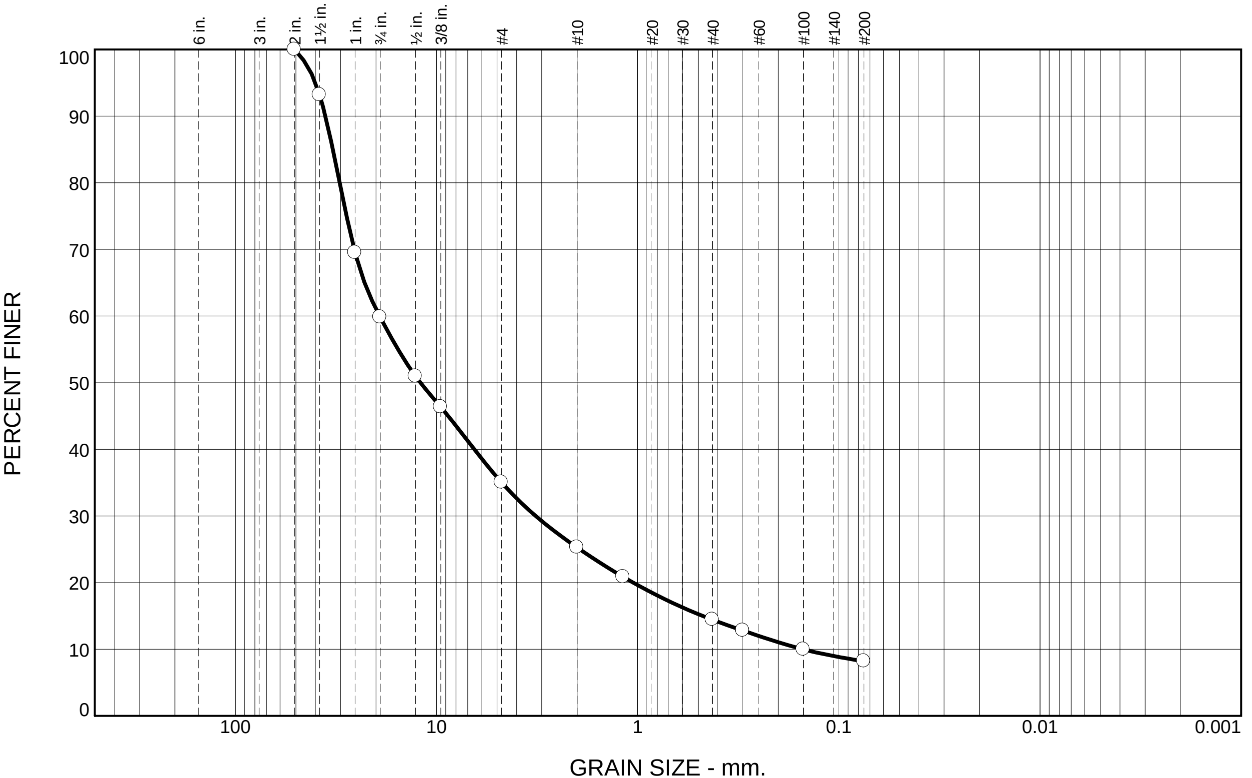
Location: BH19-RW7-36
Sample Number: 19-148-12 **Depth:** 6-6.5' **Date:** 5/23/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-148-12

Tested By: JH/JS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	40.2	24.8	9.7	10.9	6.2	8.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2	100.0		
1.5	93.2		
1	69.5		
.75	59.8		
.5	51.0		
.375	46.3		
#4	35.0		
#10	25.3		
#16	20.8		
#40	14.4		
#50	12.8		
#100	10.0		
#200	8.2		

* (no specification provided)

Material Description

Gray poorly graded gravel with clay and sand

Atterberg Limits

PL= 15 LL= 24 PI= 9

Coefficients

D_{90}= 35.6845 D_{85}= 32.7626 D_{60}= 19.1716
D_{50}= 12.0211 D_{30}= 3.2148 D_{15}= 0.4757
D_{10}= 0.1512 C_u= 126.81 C_c= 3.57

Classification

USCS= GP-GC AASHTO= A-2-4(0)

Remarks

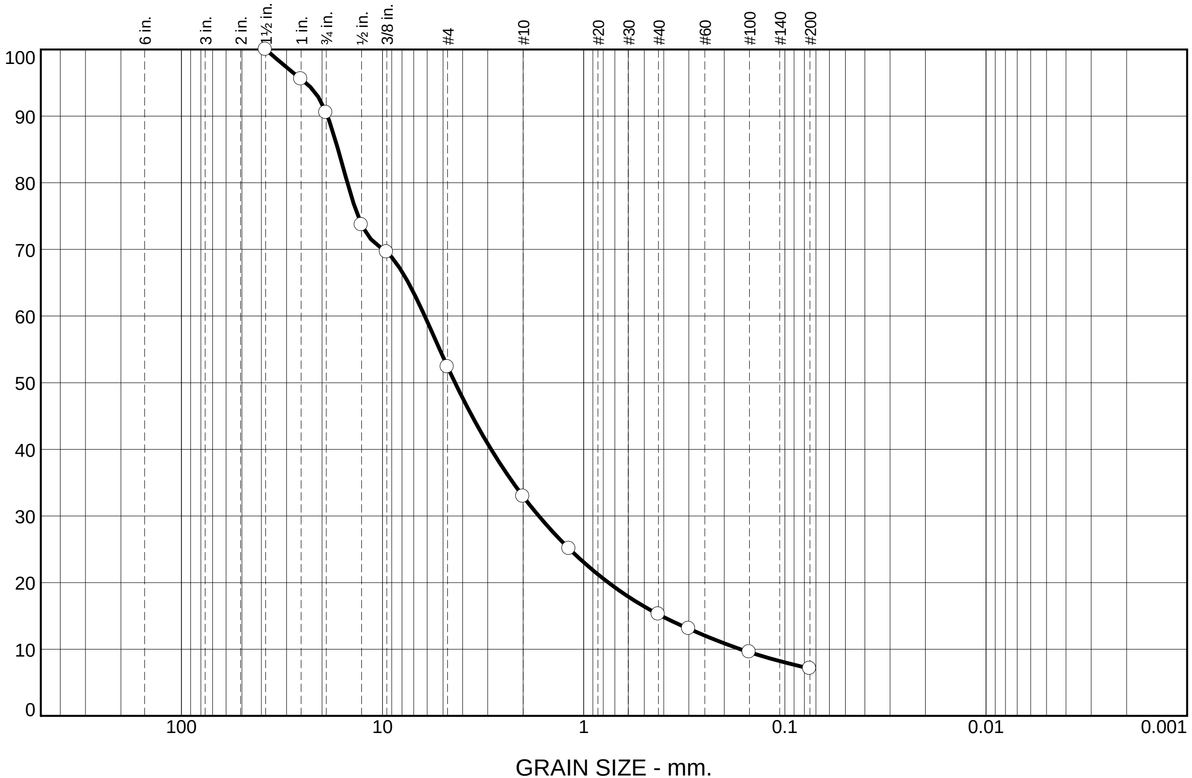
Location: BH19-RW7-38
Sample Number: 19-148-14 **Depth:** 10'2"-10'8" **Date:** 5/23/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-148-14

Tested By: JH/KS/JS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	9.5	38.1	19.5	17.7	8.1	7.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	95.6		
.75	90.5		
.5	73.7		
.375	69.6		
#4	52.4		
#10	32.9		
#16	25.1		
#40	15.2		
#50	13.1		
#100	9.5		
#200	7.1		

* (no specification provided)

Material Description

Gray well-graded gravel with clay and sand

Atterberg Limits

PL= 14 LL= 23 PI= 9

Coefficients

D_{90}= 18.7650 D_{85}= 16.6257 D_{60}= 6.1668
D_{50}= 4.3628 D_{30}= 1.6732 D_{15}= 0.4107
D_{10}= 0.1663 C_u= 37.07 C_c= 2.73

Classification

USCS= GW-GC AASHTO= A-2-4(0)

Remarks

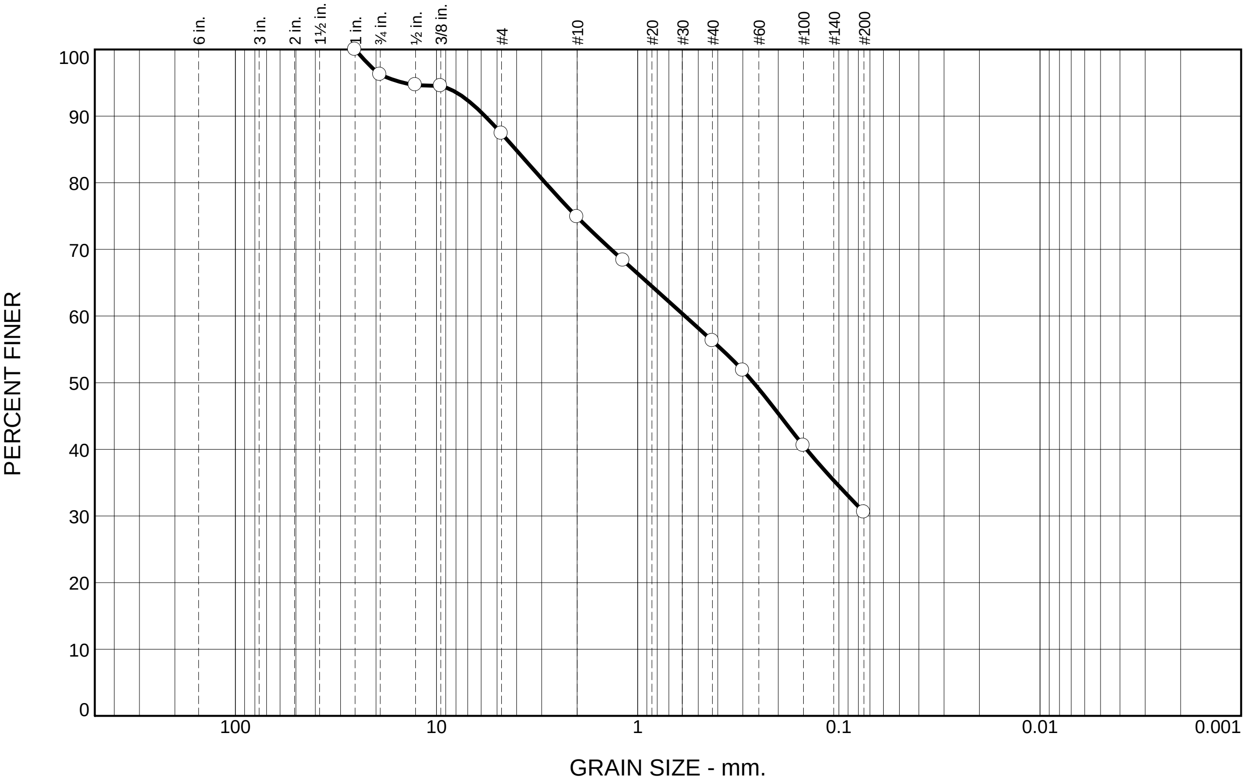
Location: BH19-RW7-40
Sample Number: 19-148-15 **Depth:** 5'11"-6.5' **Date:** 5/23/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-148-15

Tested By: JH/KS/JS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	3.8	8.8	12.5	18.6	25.8	30.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	96.2		
.5	94.7		
.375	94.5		
#4	87.4		
#10	74.9		
#16	68.3		
#40	56.3		
#50	51.8		
#100	40.6		
#200	30.5		

* (no specification provided)

Material Description

Brown clayey sand

Atterberg Limits

PL= 20 LL= 35 PI= 15

Coefficients

D_{90}= 5.7337 D_{85}= 4.0374 D_{60}= 0.5820
D_{50}= 0.2652 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-6(1)

Remarks

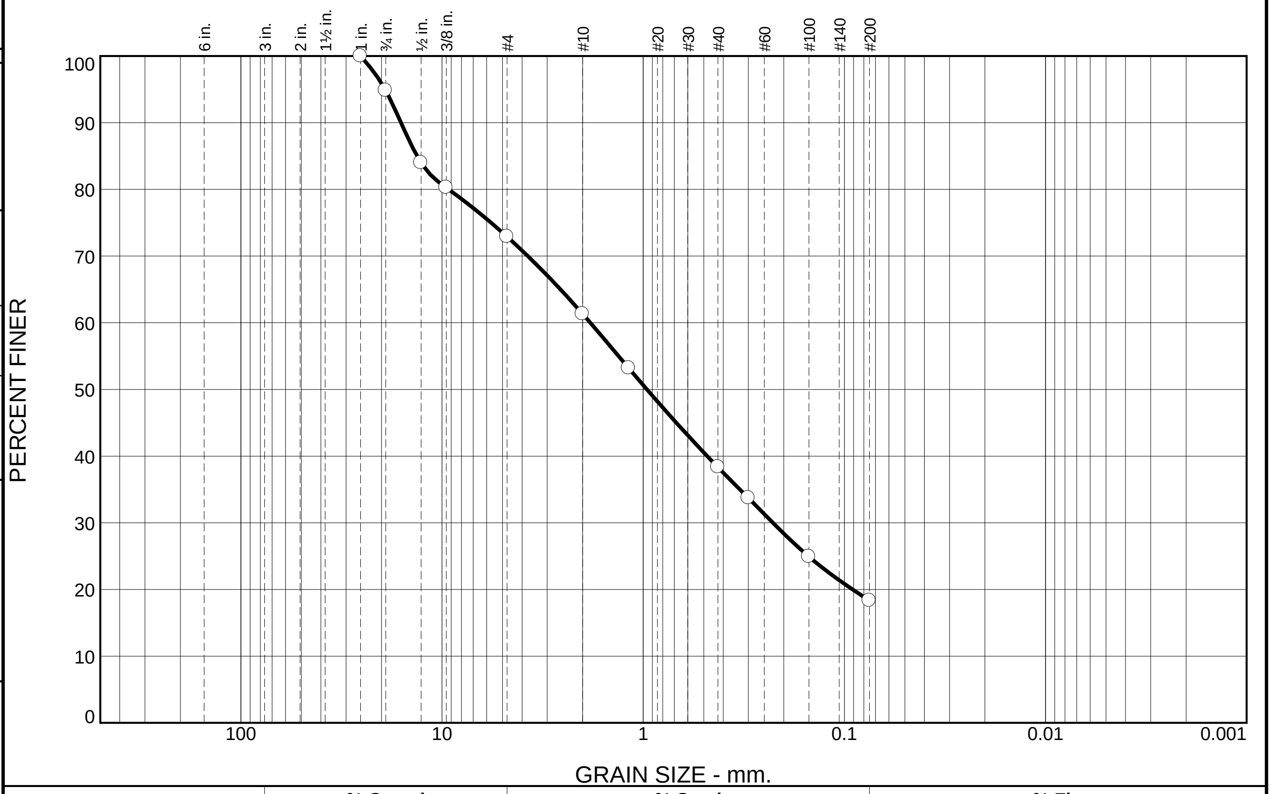
Location: BH19-RW7-41
Sample Number: 19-148-17 **Depth:** 11-11.5' **Date:** 5/23/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-148-17

Tested By: JH/KS/JS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	5.2	21.9	11.6	23.0	20.0	18.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	94.8		
.5	84.0		
.375	80.3		
#4	72.9		
#10	61.3		
#16	53.2		
#40	38.3		
#50	33.7		
#100	24.9		
#200	18.3		

* (no specification provided)

Material Description

Brown clayey sand with gravel

Atterberg Limits

PL= 18 LL= 26 PI= 8

Coefficients

D_{90}= 15.9746 D_{85}= 13.3030 D_{60}= 1.8319
D_{50}= 0.9577 D_{30}= 0.2265 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-4(0)

Remarks

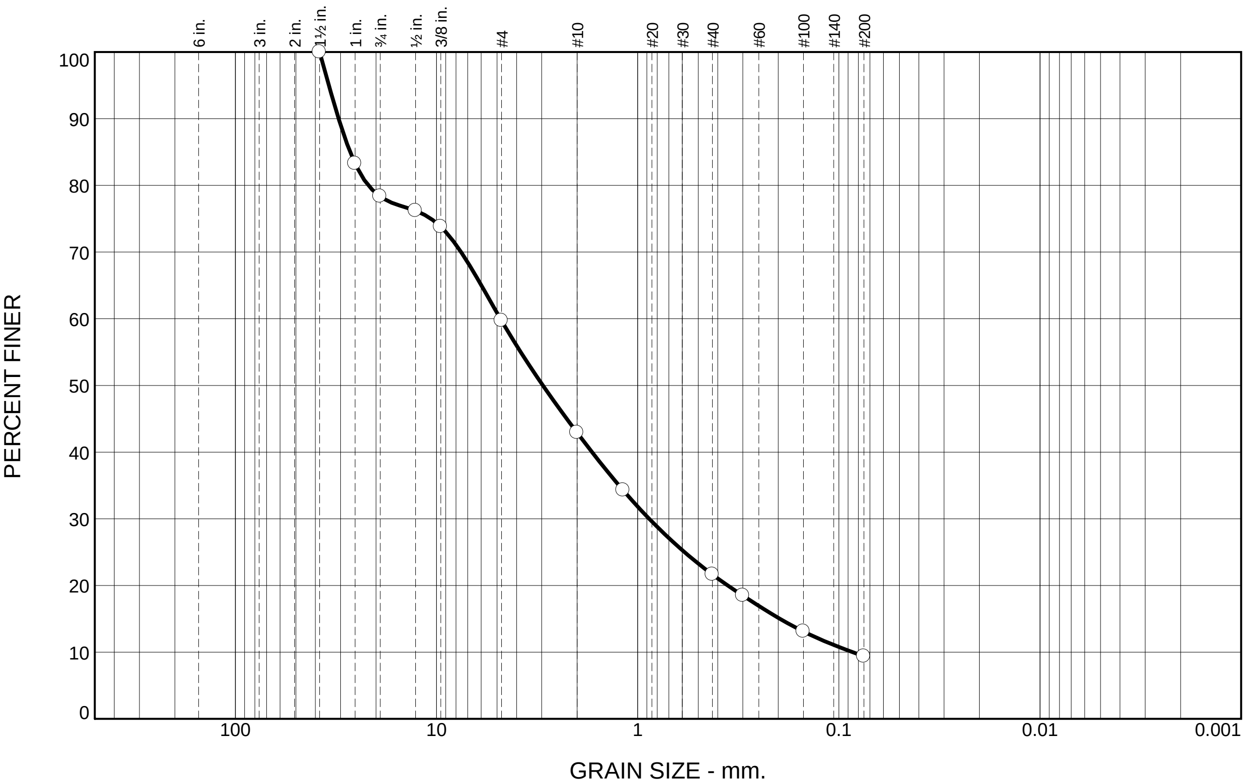
Location: BH19-RW7-42
Sample Number: 19-148-19 **Depth:** 7.5-9' **Date:** 5/23/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-148-19

Tested By: JH/KS/JS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	21.7	18.6	16.8	21.3	12.2	9.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	83.2		
.75	78.3		
.5	76.2		
.375	73.8		
#4	59.7		
#10	42.9		
#16	34.3		
#40	21.6		
#50	18.5		
#100	13.1		
#200	9.4		

* (no specification provided)

Material Description

Brown well-graded sand with clay and gravel

Atterberg Limits

PL= 19 LL= 29 PI= 10

Coefficients

D_{90}= 30.6574 D_{85}= 26.8869 D_{60}= 4.8113
D_{50}= 2.9613 D_{30}= 0.8760 D_{15}= 0.1962
D_{10}= 0.0854 C_u= 56.31 C_c= 1.87

Classification

USCS= SW-SC AASHTO= A-2-4(0)

Remarks

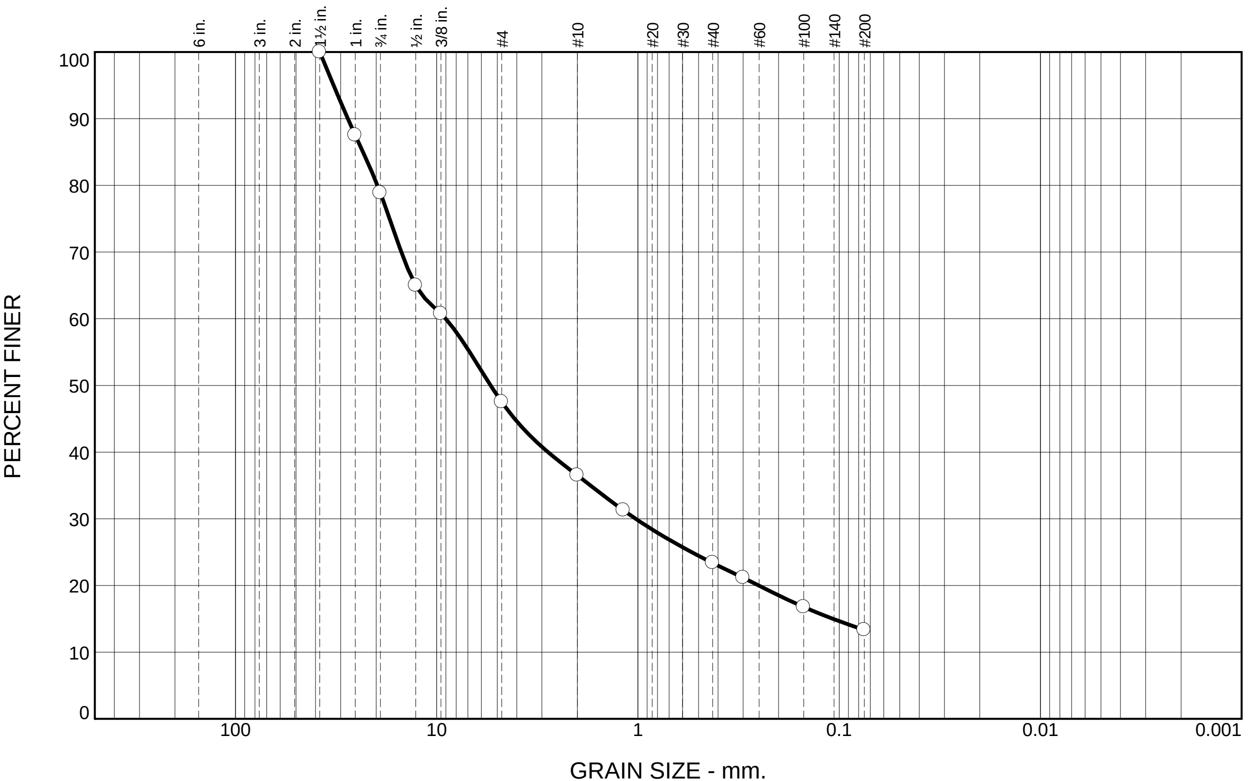
Location: BH19-RW7-43
Sample Number: 19-148-20 **Depth:** 6-6.5' **Date:** 5/23/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-148-20

Tested By: JH/JS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	21.1	31.4	11.0	13.1	10.1	13.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	87.5		
.75	78.9		
.5	65.0		
.375	60.8		
#4	47.5		
#10	36.5		
#16	31.3		
#40	23.4		
#50	21.1		
#100	16.8		
#200	13.3		

* (no specification provided)

Material Description

Light Brown clayey gravel with sand

Atterberg Limits

PL= 17 LL= 28 PI= 11

Coefficients

D_{90}= 27.6279 D_{85}= 23.2522 D_{60}= 9.0179
D_{50}= 5.3957 D_{30}= 1.0259 D_{15}= 0.1073
D_{10}= C_u= C_c=

Classification

USCS= GC AASHTO= A-2-6(0)

Remarks

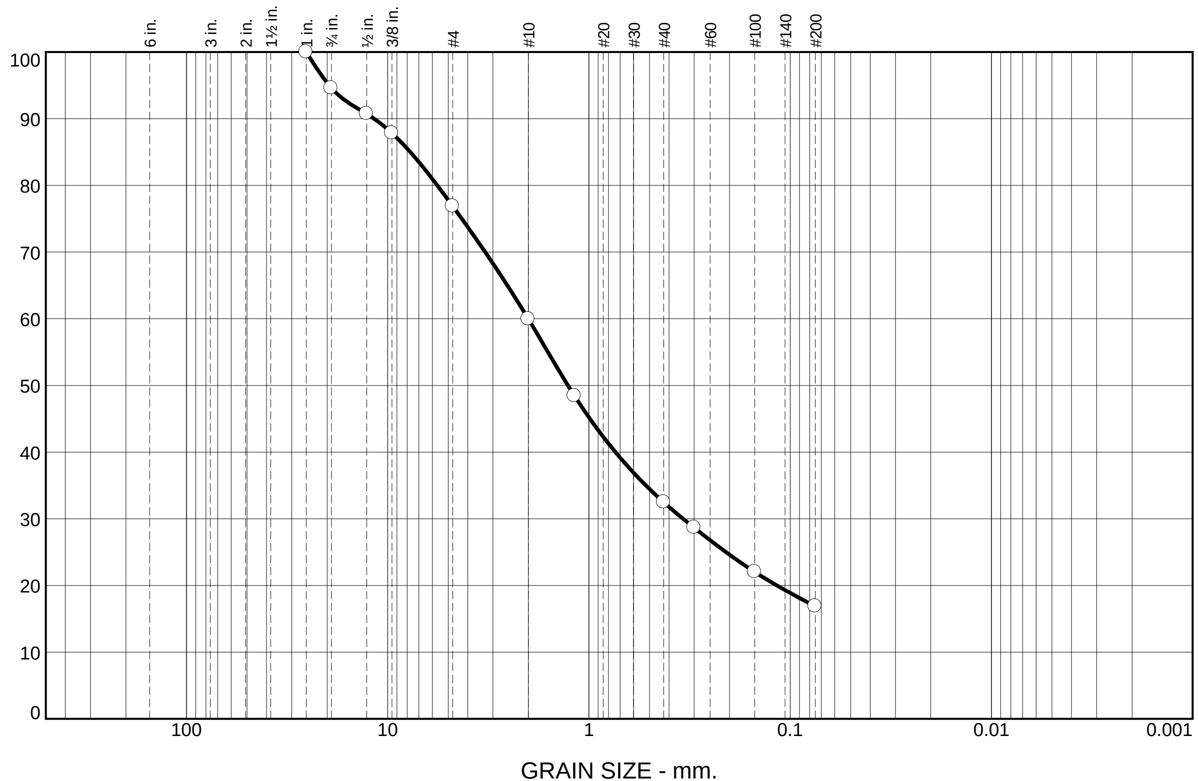
Location: BH19-RW7-44
Sample Number: 19-148-21 **Depth:** 7.5-9' **Date:** 5/23/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-148-21

Tested By: JH/KS/JS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	5.4	17.7	16.9	27.5	15.6	16.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	94.6		
.5	90.7		
.375	87.8		
#4	76.9		
#10	60.0		
#16	48.4		
#40	32.5		
#50	28.7		
#100	22.0		
#200	16.9		

* (no specification provided)

Material Description

Light Brown clayey sand with gravel

Atterberg Limits

PL= 17 LL= 28 PI= 11

Coefficients

D_{90}= 11.6750 D_{85}= 7.7186 D_{60}= 2.0036
D_{50}= 1.2718 D_{30}= 0.3405 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-6(0)

Remarks

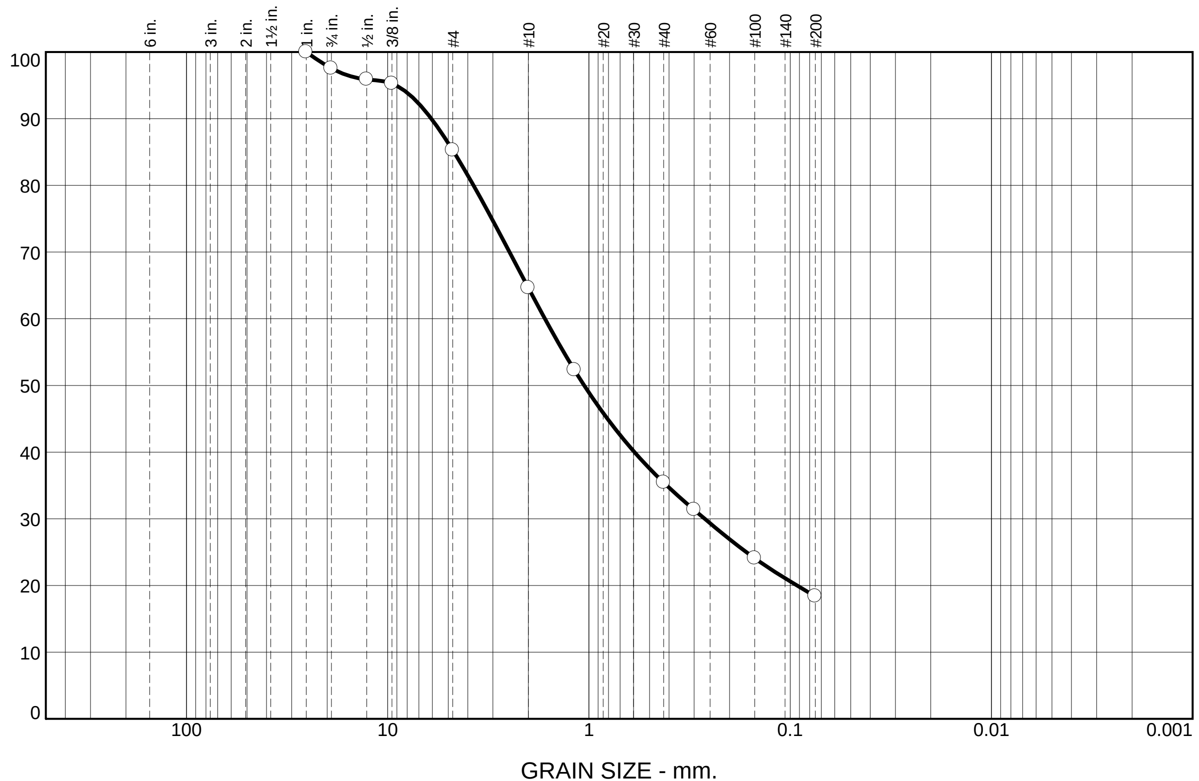
Location: BH19-RW7-44
Sample Number: 19-148-22 **Depth:** 15-16.5' **Date:** 5/23/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-148-22

Tested By: JH/KS/JS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	2.4	12.3	20.7	29.2	17.0	18.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	97.6		
.5	95.9		
.375	95.3		
#4	85.3		
#10	64.6		
#16	52.3		
#40	35.4		
#50	31.3		
#100	24.1		
#200	18.4		

* (no specification provided)

Material Description

Brown silty, clayey sand

Atterberg Limits

PL= 18 LL= 24 PI= 6

Coefficients

D_{90}= 6.0663 D_{85}= 4.6886 D_{60}= 1.6546
D_{50}= 1.0558 D_{30}= 0.2659 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC-SM AASHTO= A-1-b

Remarks

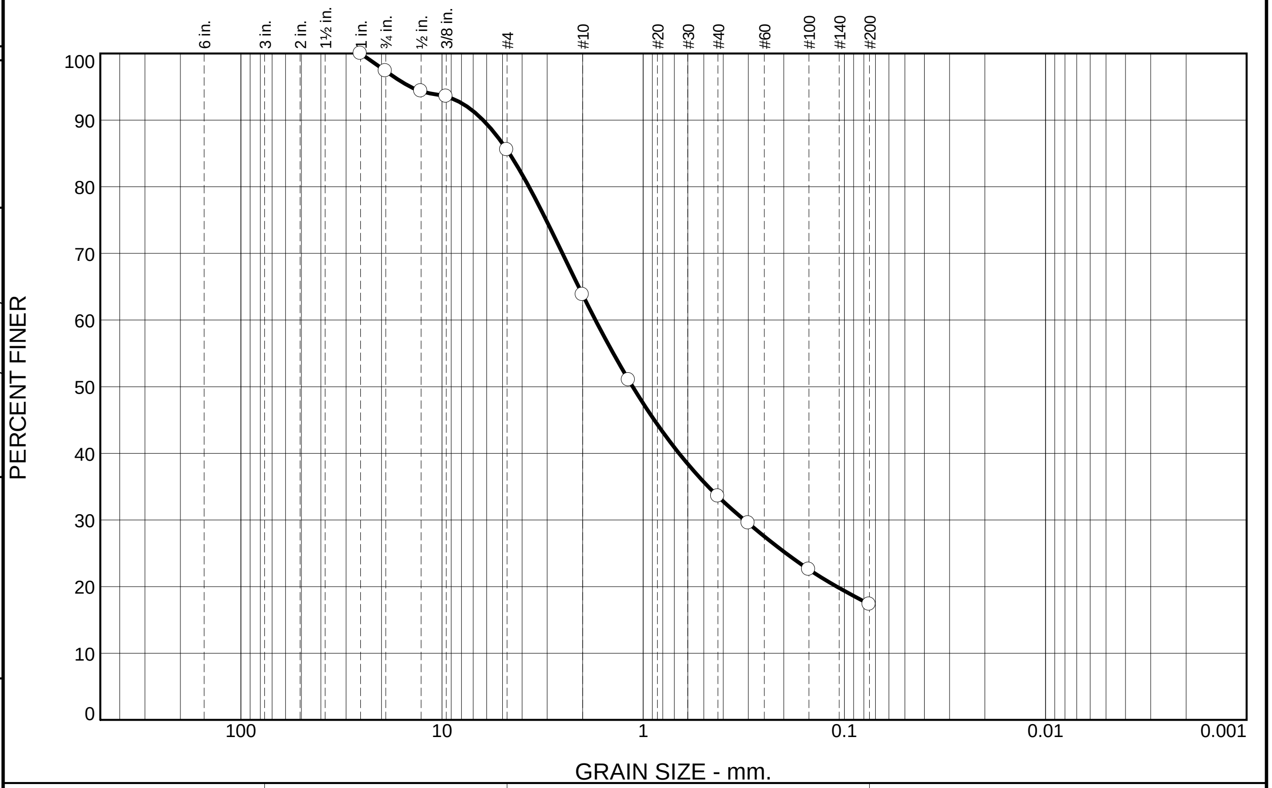
Location: BH19-RW7-45
Sample Number: 19-148-23 **Depth:** 2.5-4' **Date:** 5/23/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-148-23

Tested By: JH/JS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	2.6	11.9	21.7	30.3	16.2	17.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	97.4		
.5	94.3		
.375	93.5		
#4	85.5		
#10	63.8		
#16	51.0		
#40	33.5		
#50	29.5		
#100	22.6		
#200	17.3		

* (no specification provided)

Material Description

Brown clayey sand

Atterberg Limits

PL= 18 LL= 27 PI= 9

Coefficients

D_{90}= 6.2484 D_{85}= 4.6255 D_{60}= 1.7280
D_{50}= 1.1278 D_{30}= 0.3140 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-4(0)

Remarks

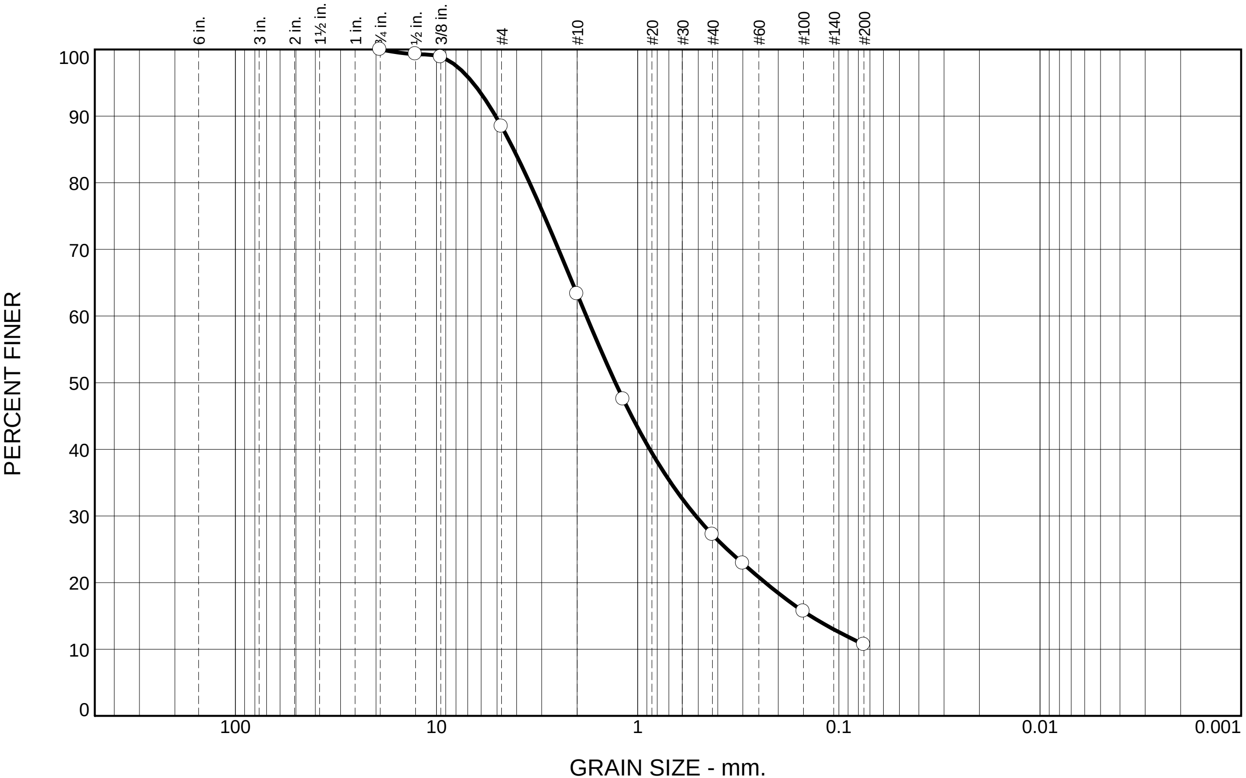
Location: BH19-RW7-46
Sample Number: 19-148-24 **Depth:** 2.5-4' **Date:** 5/23/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-148-24

Tested By: JH/JS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	11.6	25.1	36.1	16.5	10.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	99.3		
.375	98.9		
#4	88.4		
#10	63.3		
#16	47.5		
#40	27.2		
#50	22.9		
#100	15.7		
#200	10.7		

* (no specification provided)

Material Description

Brown poorly graded sand with silt

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 5.0829 D_{85}= 4.1364 D_{60}= 1.8001
D_{50}= 1.2905 D_{30}= 0.5140 D_{15}= 0.1384
D_{10}= C_u= C_c=

Classification

USCS= SP-SM AASHTO= A-1-b

Remarks

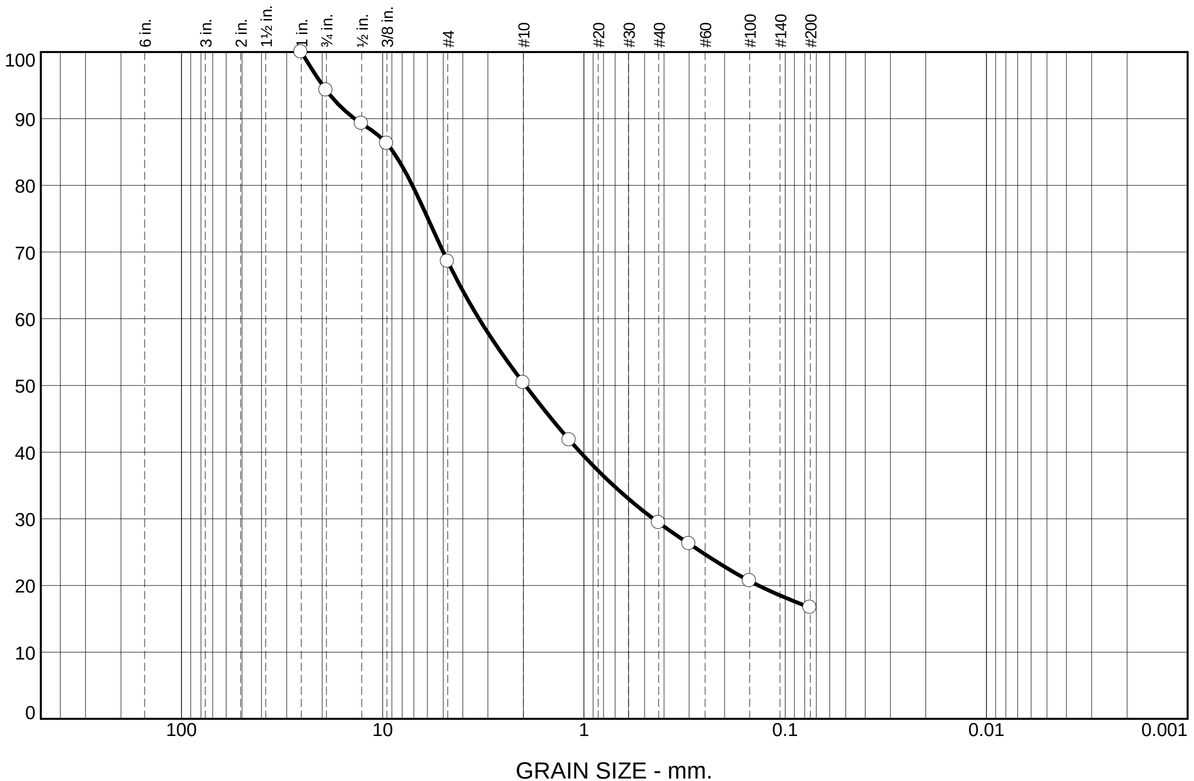
Location: BH19-RW7-46
Sample Number: 19-148-25 **Depth:** 11-11.5' **Date:** 5/23/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-148-25

Tested By: JH/JS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	5.8	25.6	18.2	21.0	12.7	16.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	94.2		
.5	89.2		
.375	86.2		
#4	68.6		
#10	50.4		
#16	41.8		
#40	29.4		
#50	26.2		
#100	20.7		
#200	16.7		

* (no specification provided)

Material Description

White clayey sand with gravel

Atterberg Limits

PL= 22 LL= 32 PI= 10

Coefficients

D_{90}= 13.7619 D_{85}= 8.8497 D_{60}= 3.3225
D_{50}= 1.9555 D_{30}= 0.4517 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-4(0)

Remarks

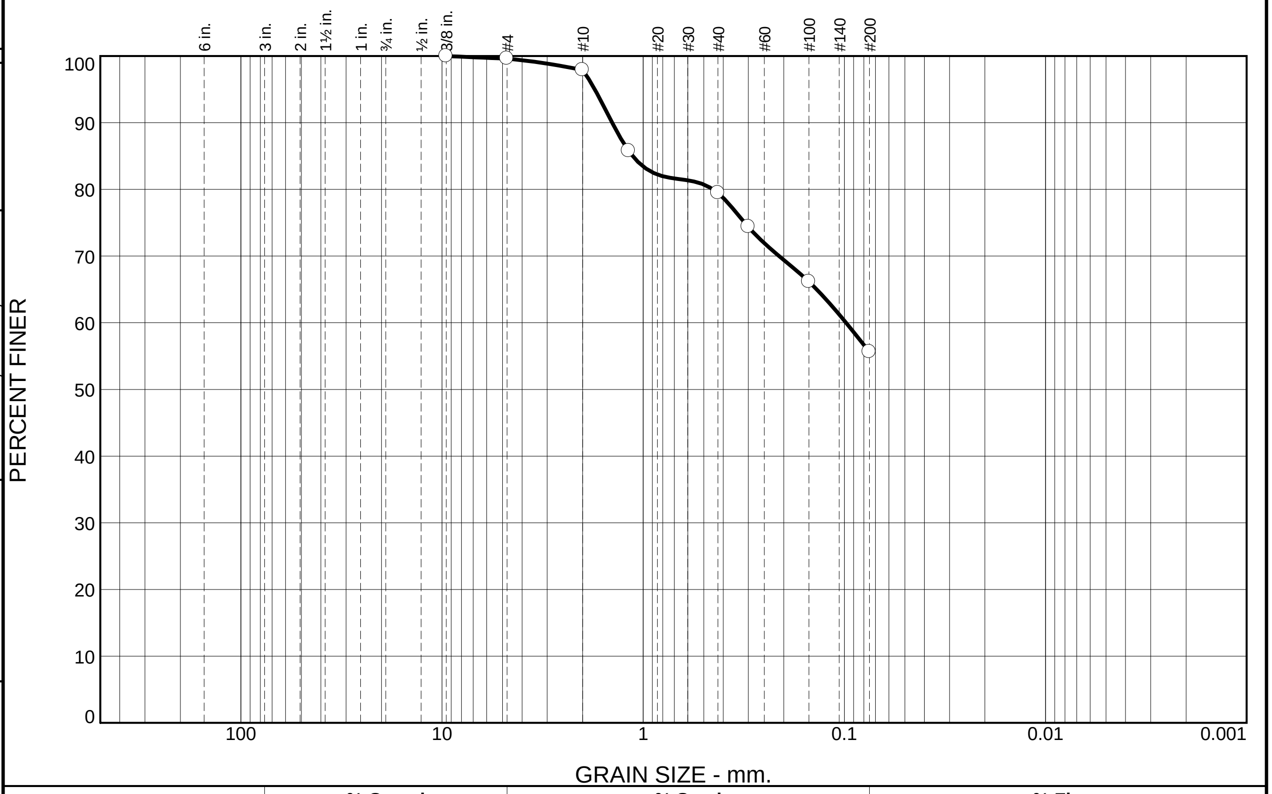
Location: BH19-RW8-47
Sample Number: 19-249-01 **Depth:** 2.5-4' **Date:** 8/1/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-249-01

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.4	1.7	18.4	23.9	55.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	99.6		
#10	97.9		
#16	85.8		
#40	79.5		
#50	74.4		
#100	66.2		
#200	55.6		

* (no specification provided)

Material Description

Brown sandy silt

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 1.4258 D_{85}= 1.1282 D_{60}= 0.0980
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= ML AASHTO= A-4(0)

Remarks

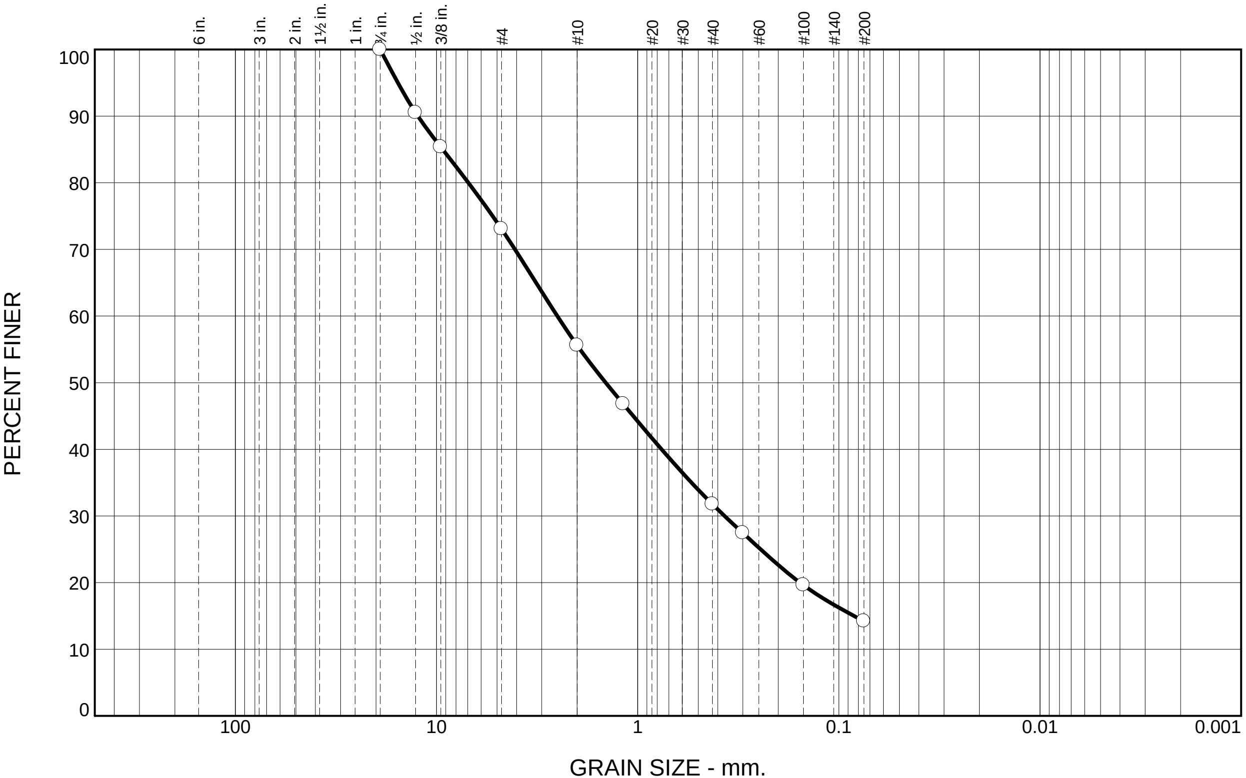
Location: BH19-RW8-48
Sample Number: 19-249-03 **Depth:** 6-6.5' **Date:** 8/1/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-249-03

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	26.9	17.5	23.8	17.6	14.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	90.5		
.375	85.4		
#4	73.1		
#10	55.6		
#16	46.8		
#40	31.8		
#50	27.4		
#100	19.6		
#200	14.2		

* (no specification provided)

Material Description

Dark Brown silty sand with gravel

Atterberg Limits

PL= NP   LL= NP   PI= NP

Coefficients

D_{90}= 12.3752 D_{85}= 9.3196 D_{60}= 2.5090
D_{50}= 1.4428 D_{30}= 0.3697 D_{15}= 0.0840
D_{10}= C_u= C_c=

Classification

USCS= SM   AASHTO= A-1-b

Remarks

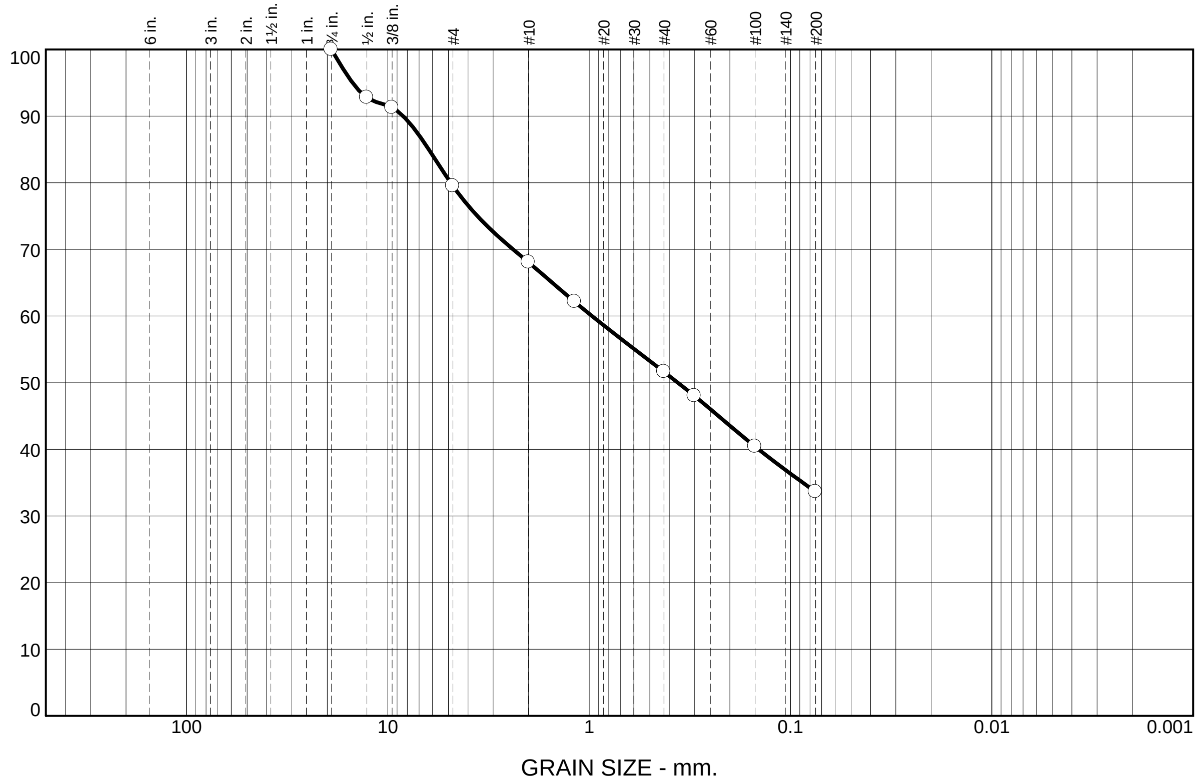
Location: BH19-RW8-49
Sample Number: 19-148-26   **Depth:** 2.5-3'   **Date:** 5/23/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000   **Figure** 19-148-26

Tested By: JH/JS   **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	20.5	11.4	16.5	18.0	33.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	92.8		
.375	91.3		
#4	79.5		
#10	68.1		
#16	62.1		
#40	51.6		
#50	48.0		
#100	40.4		
#200	33.6		

* (no specification provided)

Material Description

Light Brown clayey sand with gravel

Atterberg Limits

PL= 21 LL= 41 PI= 20

Coefficients

D_{90}= 8.3878 D_{85}= 6.2613 D_{60}= 0.9677
D_{50}= 0.3625 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-7(2)

Remarks

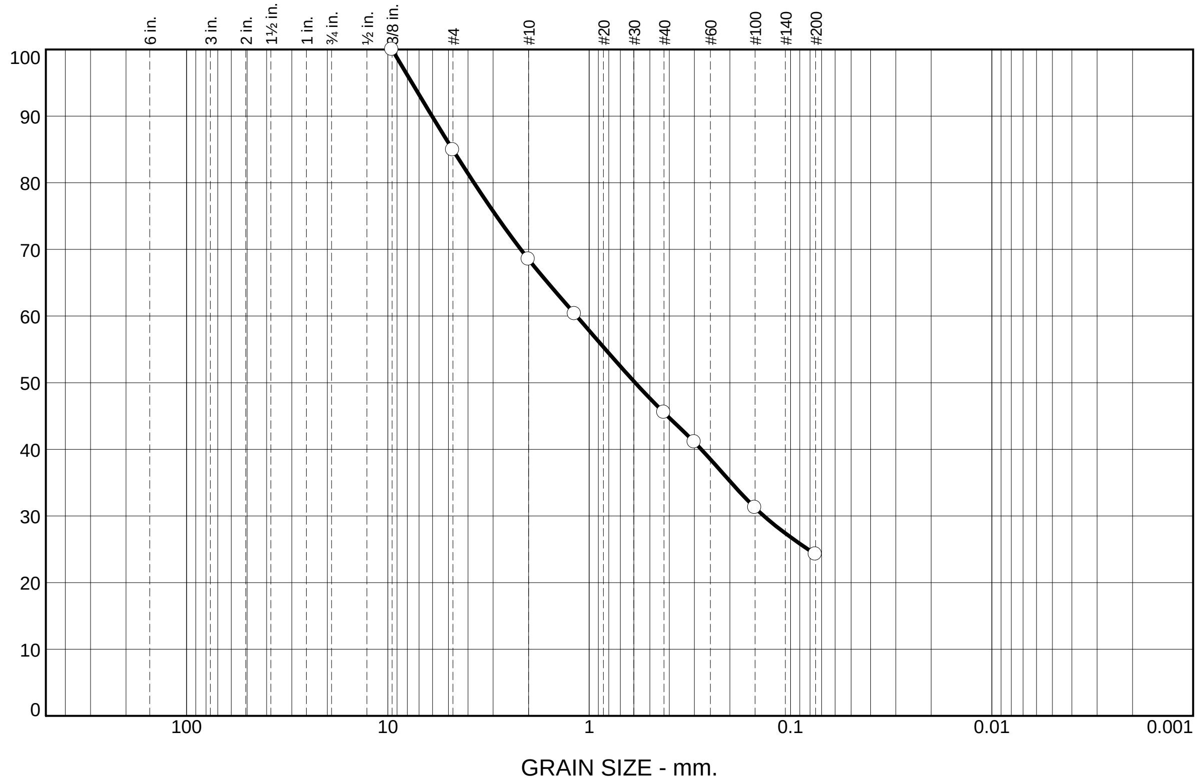
Location: BH19-RW8-50
Sample Number: 19-249-04 **Depth:** 6-6.5' **Date:** 8/1/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-249-04

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	15.1	16.4	23.0	21.3	24.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	84.9		
#10	68.5		
#16	60.3		
#40	45.5		
#50	41.1		
#100	31.2		
#200	24.2		

* (no specification provided)

Material Description

Light Brown silty, clayey sand with gravel

Atterberg Limits

PL= 22 LL= 28 PI= 6

Coefficients

D_{90}= 6.0327 D_{85}= 4.7683 D_{60}= 1.1552
D_{50}= 0.5910 D_{30}= 0.1355 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC-SM AASHTO= A-1-b

Remarks

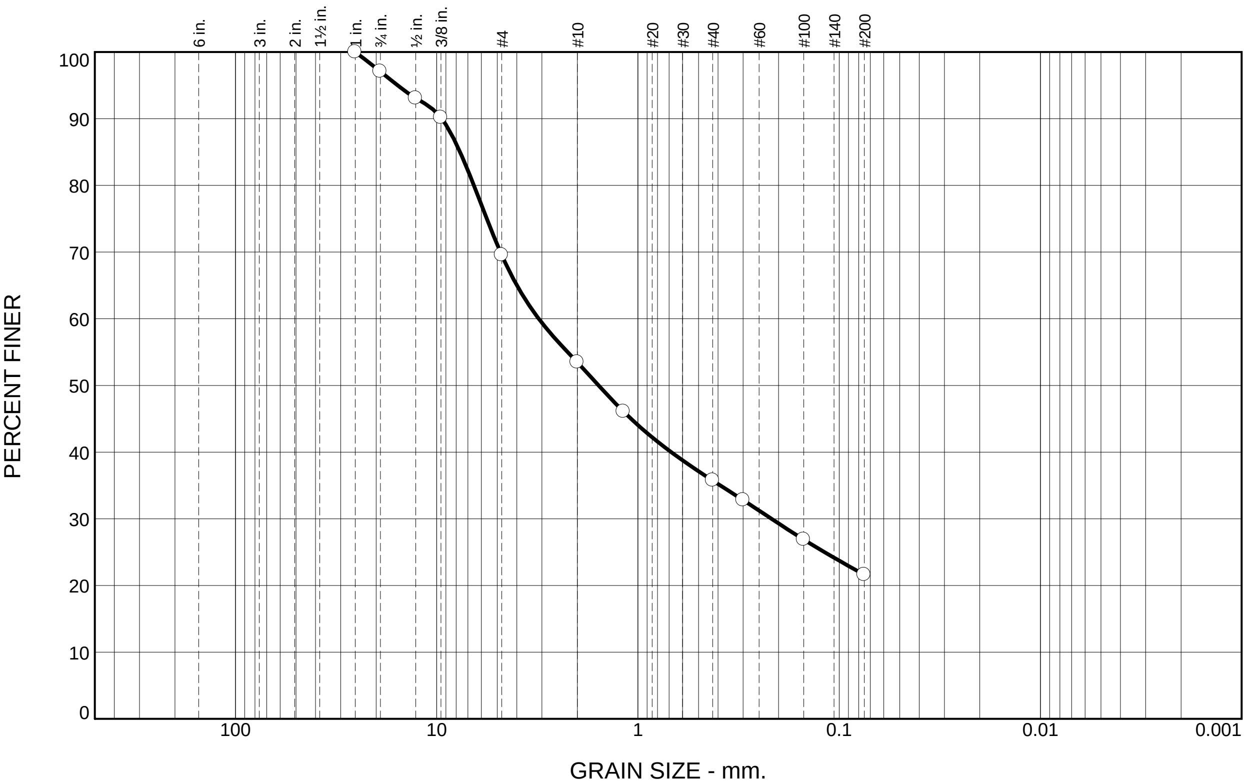
Location: BH19-RW9-51
Sample Number: 19-249-05 **Depth:** 2.5-4' **Date:** 8/1/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-249-05

Tested By: Jh **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	2.9	27.6	16.0	17.8	14.1	21.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	97.1		
.5	93.1		
.375	90.2		
#4	69.5		
#10	53.5		
#16	46.1		
#40	35.7		
#50	32.8		
#100	26.9		
#200	21.6		

* (no specification provided)

Material Description

Gray silty sand with gravel

Atterberg Limits

PL= 25 LL= 32 PI= 7

Coefficients

D_{90}= 9.4336 D_{85}= 7.6527 D_{60}= 3.1109
D_{50}= 1.5688 D_{30}= 0.2170 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

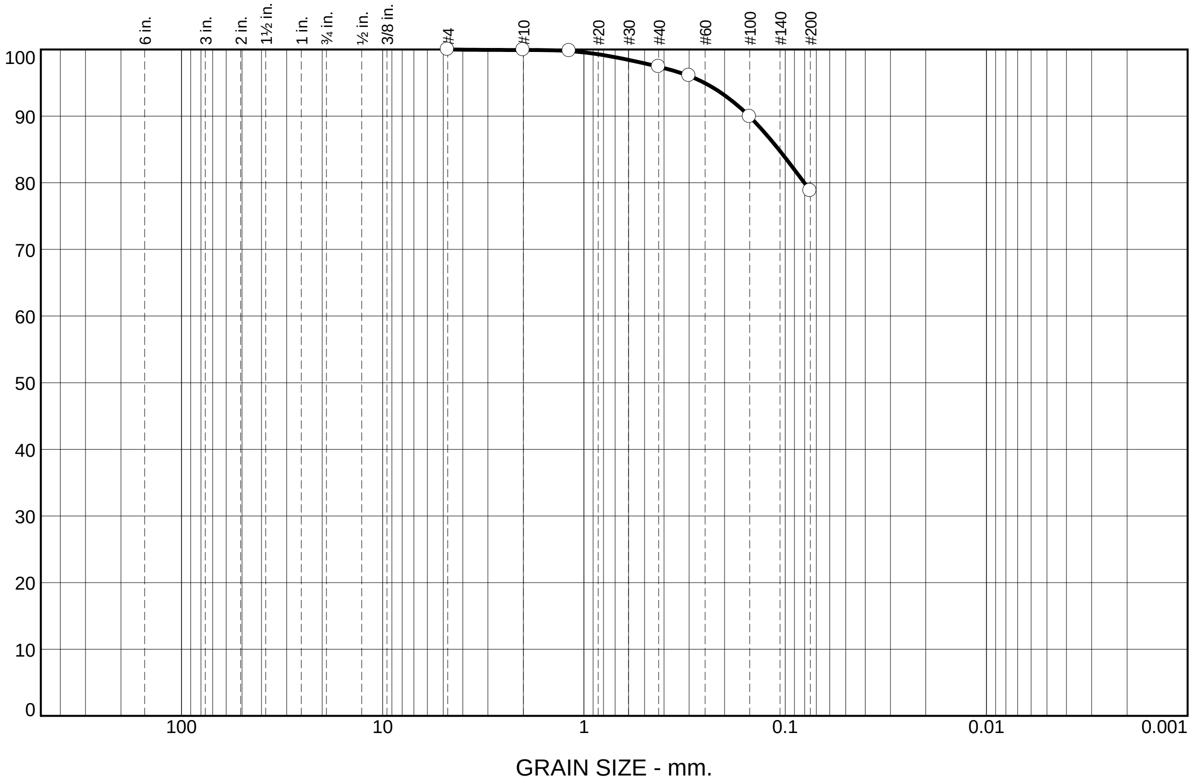
Location: BH19-RW9-52
Sample Number: 19-249-07 **Depth:** 7.5-9' **Date:** 8/1/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-249-07

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	2.5	18.6	78.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.9		
#16	99.8		
#40	97.4		
#50	96.0		
#100	89.9		
#200	78.8		

* (no specification provided)

Material Description

Brown silt with sand

Atterberg Limits

PL= 26 LL= 39 PI= 13

Coefficients

D_{90}= 0.1509 D_{85}= 0.1077 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= ML AASHTO= A-6(10)

Remarks

Location: BH19-RW10-53
Sample Number: 19-249-09 **Depth:** 5-6.5' **Date:** 8/1/2019

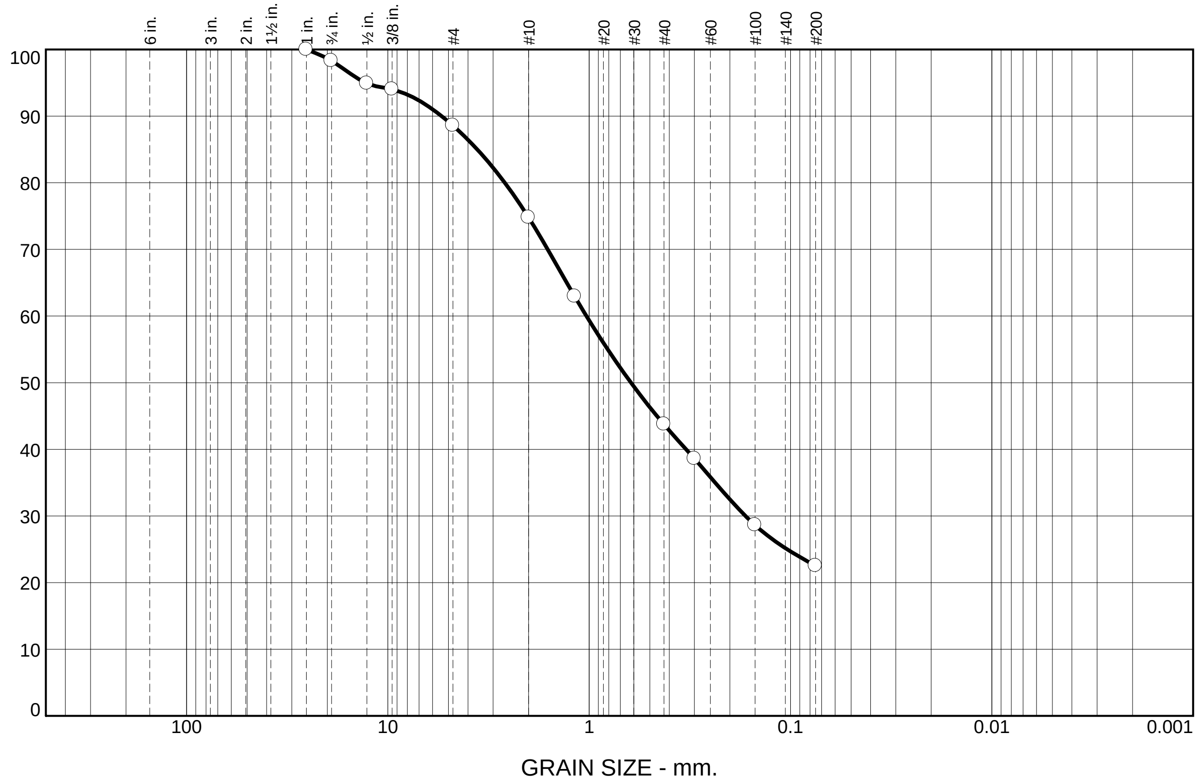
NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-249-09

Tested By: Jh **Checked By:** JH

Test results included in this report relate only to the items inspected or tested. This report shall not be reproduced, in full, without prior written approval of NewFields.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	1.7	9.7	13.8	31.1	21.2	22.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	98.3		
.5	94.9		
.375	94.0		
#4	88.6		
#10	74.8		
#16	62.9		
#40	43.7		
#50	38.6		
#100	28.6		
#200	22.5		

* (no specification provided)

Material Description

Dark Brown clayey sand

Atterberg Limits

PL= 13 LL= 32 PI= 19

Coefficients

D_{90}= 5.4015 D_{85}= 3.5974 D_{60}= 1.0317
D_{50}= 0.6198 D_{30}= 0.1674 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-6(1)

Remarks

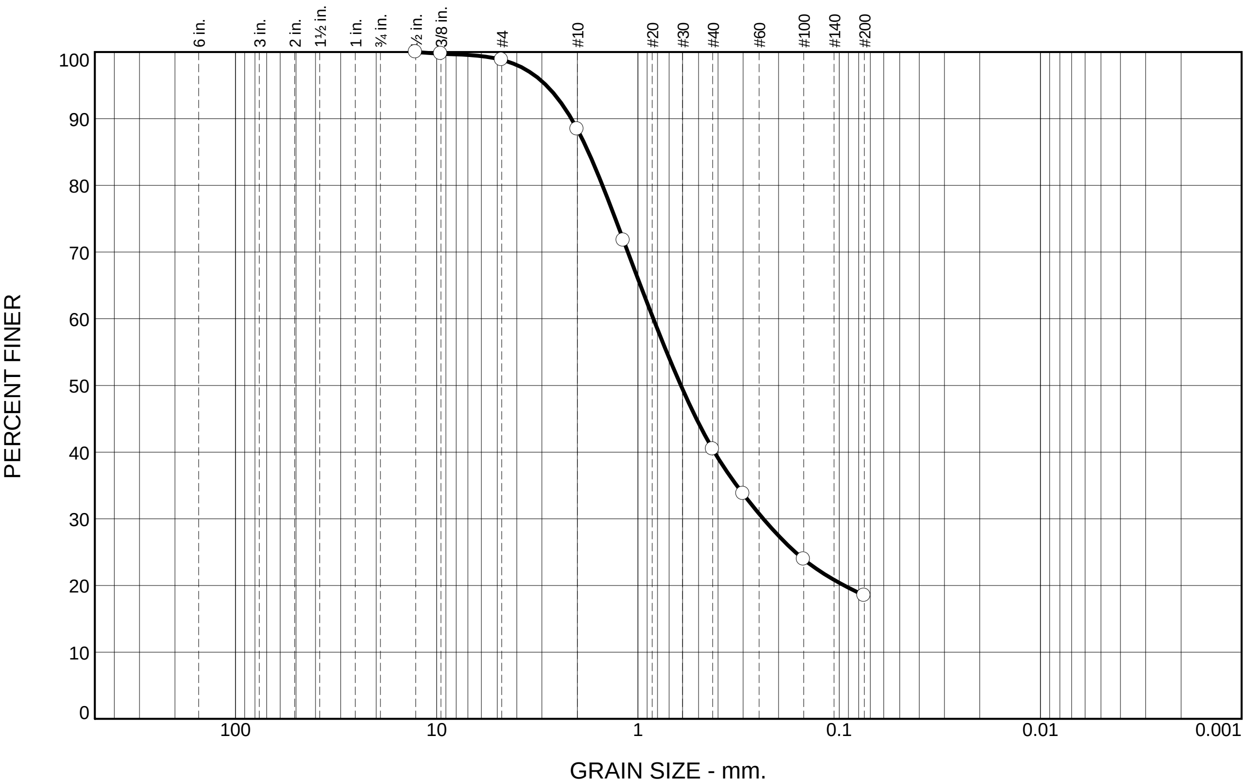
Location: BH19-RW11-54
Sample Number: 19-148-27 **Depth:** 2.5-4' **Date:** 5/23/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-148-27

Tested By: JH/JS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.2	10.4	48.0	21.9	18.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.5	100.0		
.375	99.7		
#4	98.8		
#10	88.4		
#16	71.8		
#40	40.4		
#50	33.7		
#100	23.9		
#200	18.5		

* (no specification provided)

Material Description

Light Brown clayey sand

Atterberg Limits

PL= 16 LL= 37 PI= 21

Coefficients

D_{90}= 2.1399 D_{85}= 1.7626 D_{60}= 0.8383
D_{50}= 0.6116 D_{30}= 0.2383 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-6(0)

Remarks

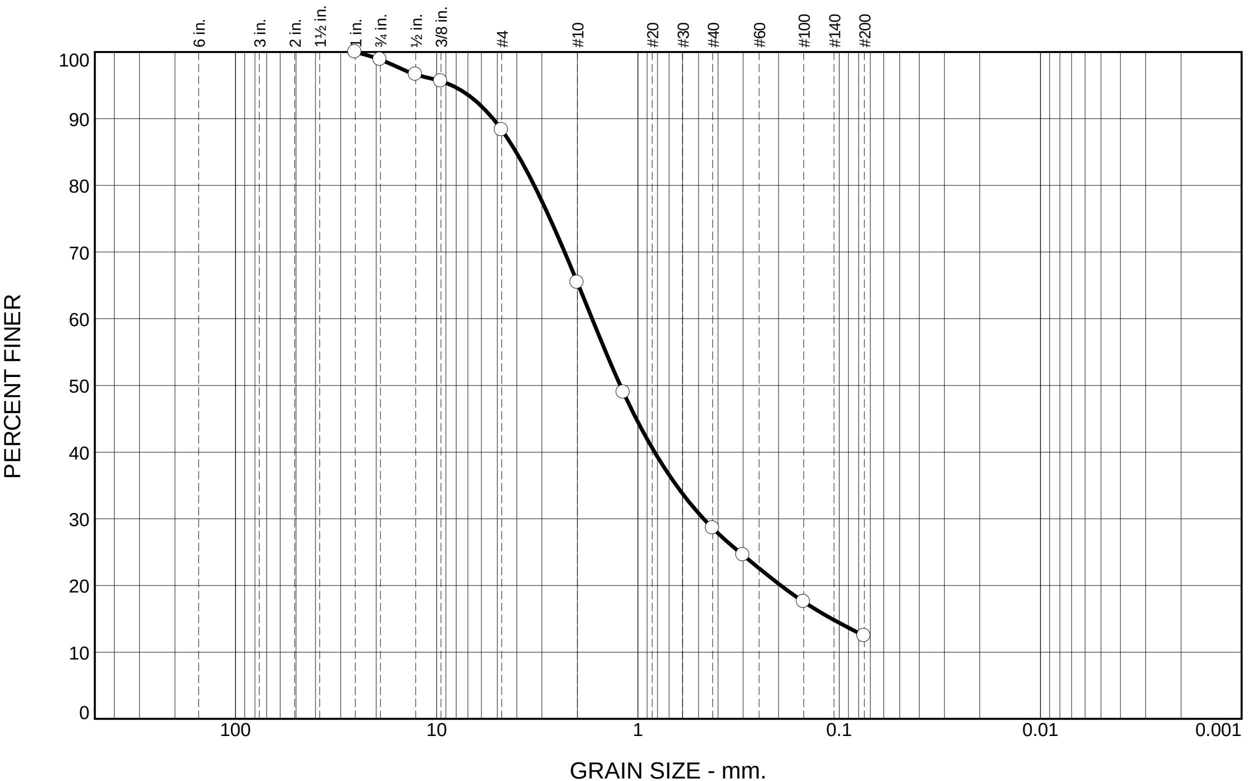
Location: BH19-RW11-54
Sample Number: 19-148-28 **Depth:** 10-11.5' **Date:** 5/23/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-148-28

Tested By: JH/JS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	1.1	10.6	22.9	36.8	16.2	12.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	98.9		
.5	96.6		
.375	95.6		
#4	88.3		
#10	65.4		
#16	48.9		
#40	28.6		
#50	24.5		
#100	17.5		
#200	12.4		

* (no specification provided)

Material Description

Light Brown clayey sand

Atterberg Limits

PL= 21　LL= 38　PI= 17

Coefficients

D_{90}= 5.2457　D_{85}= 4.0296　D_{60}= 1.6894
D_{50}= 1.2243　D_{30}= 0.4716　D_{15}= 0.1087
D_{10}=　C_u=　C_c=

Classification

USCS= SC　AASHTO= A-2-6(0)

Remarks

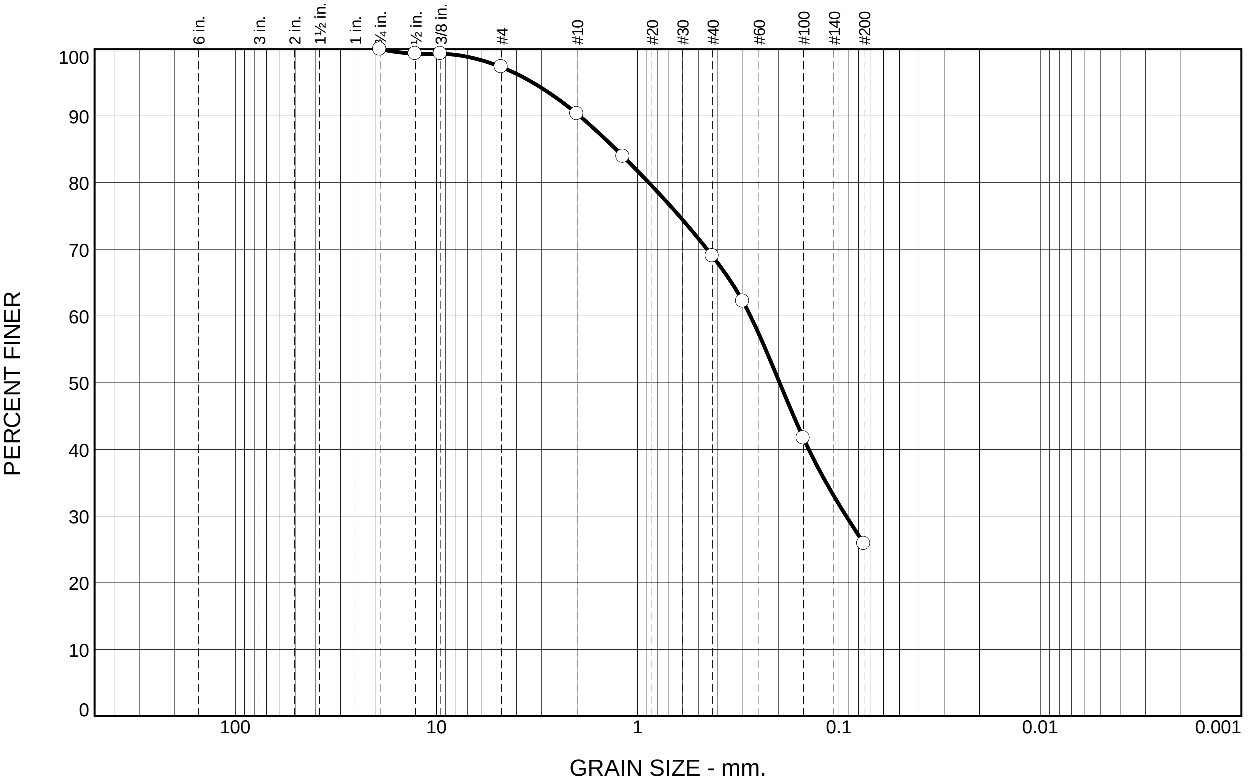
Location: BH19-RW11-55
Sample Number: 19-148-29　**Depth:** 5-6.5'　**Date:** 5/23/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000　**Figure** 19-148-29

Tested By: JH/JS　**Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.7	7.0	21.3	43.2	25.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	99.3		
.375	99.3		
#4	97.3		
#10	90.3		
#16	83.9		
#40	69.0		
#50	62.2		
#100	41.7		
#200	25.8		

* (no specification provided)

Material Description

Brown clayey sand

Atterberg Limits

PL= 15
LL= 26
PI= 11

Coefficients

D_{90}= 1.9432
D_{85}= 1.2825
D_{60}= 0.2751
D_{50}= 0.1972
D_{30}= 0.0920
D_{15}=
D_{10}=
C_u=
C_c=

Classification

USCS= SC
AASHTO= A-2-6(0)

Remarks

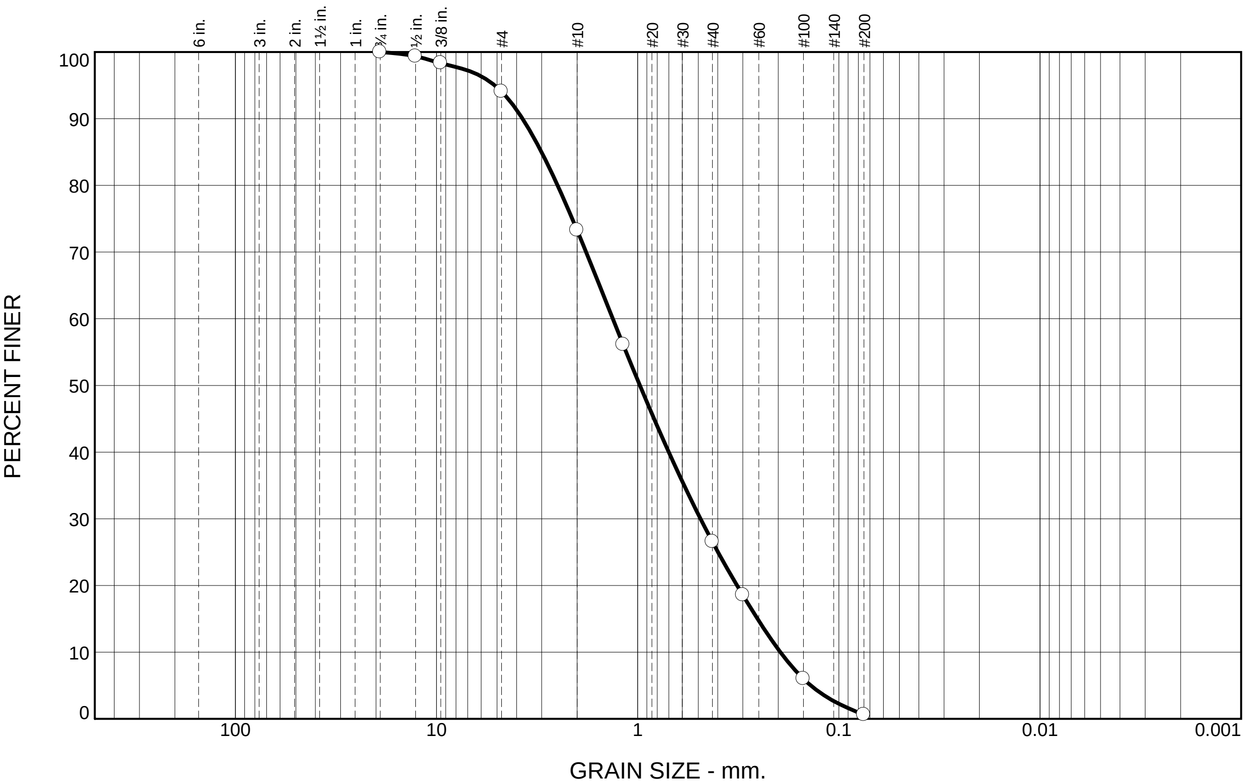
Location: BH19-RW11-56
Sample Number: 19-148-30
Depth: 2.5-4'
Date: 5/23/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000
Figure 19-148-30

Tested By: JH/JS
Checked By: JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	5.9	20.8	46.7	26.0	0.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	99.4		
.375	98.3		
#4	94.1		
#10	73.3		
#16	56.1		
#40	26.6		
#50	18.6		
#100	6.0		
#200	0.6		

* (no specification provided)

Material Description

Light Brown poorly graded sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 3.7351 D_{85}= 3.0058 D_{60}= 1.3298
D_{50}= 0.9748 D_{30}= 0.4871 D_{15}= 0.2537
D_{10}= 0.1954 C_u= 6.81 C_c= 0.91

Classification

USCS= SP AASHTO= A-1-b

Remarks

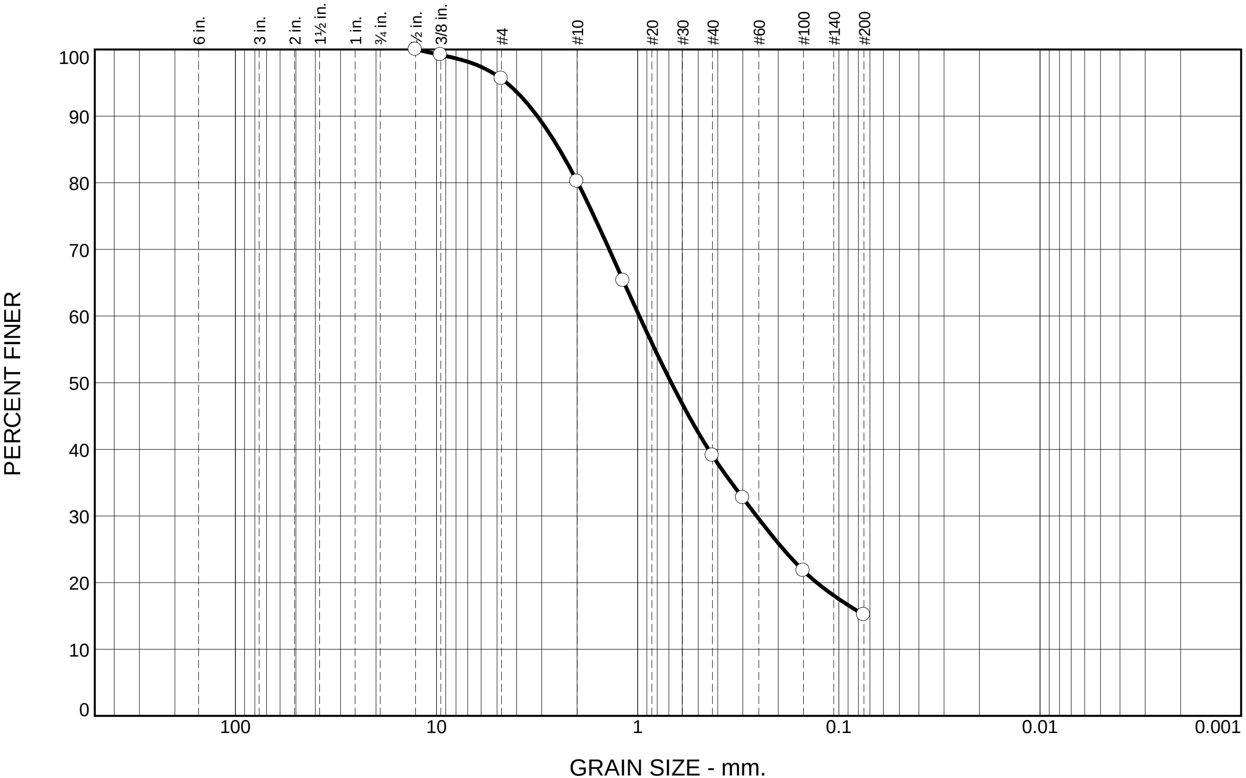
Location: BH19-RW11-56
Sample Number: 19-148-31 **Depth:** 10-11.5' **Date:** 5/23/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-148-31

Tested By: JH/JS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	4.4	15.4	41.1	24.0	15.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.5	100.0		
.375	99.2		
#4	95.6		
#10	80.2		
#16	65.3		
#40	39.1		
#50	32.7		
#100	21.8		
#200	15.1		

* (no specification provided)

Material Description

Brown silty, clayey sand

Atterberg Limits

PL= 17 LL= 22 PI= 5

Coefficients

D_{90}= 3.1522 D_{85}= 2.4493 D_{60}= 0.9817
D_{50}= 0.6807 D_{30}= 0.2565 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC-SM AASHTO= A-1-b

Remarks

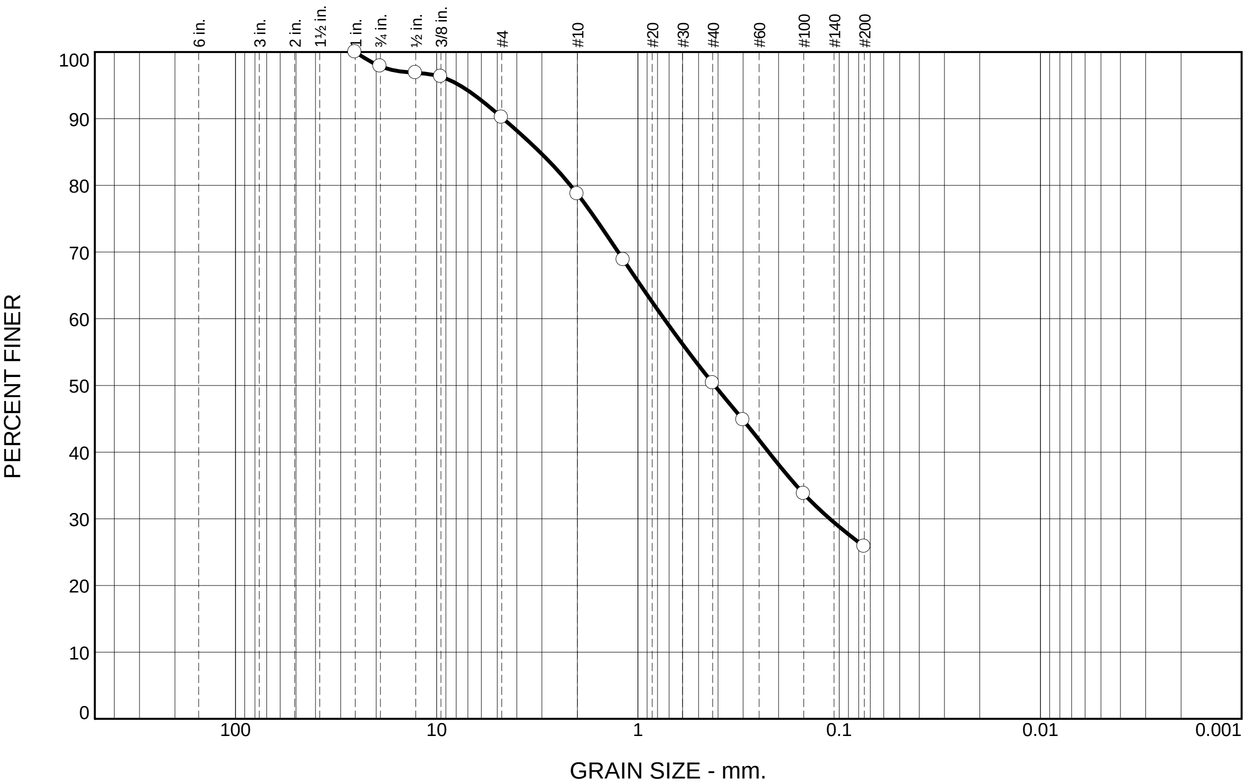
Location: BH19-RW11-57
Sample Number: 19-148-33 **Depth:** 10-11.5' **Date:** 5/23/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-148-33

Tested By: JH/JS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	2.1	7.7	11.5	28.4	24.5	25.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	97.9		
.5	96.9		
.375	96.3		
#4	90.2		
#10	78.7		
#16	68.8		
#40	50.3		
#50	44.8		
#100	33.7		
#200	25.8		

* (no specification provided)

Material Description

Light Brown clayey sand

Atterberg Limits

PL= 13 LL= 31 PI= 18

Coefficients

D_{90}= 4.6715 D_{85}= 3.0694 D_{60}= 0.7415
D_{50}= 0.4159 D_{30}= 0.1113 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-6(1)

Remarks

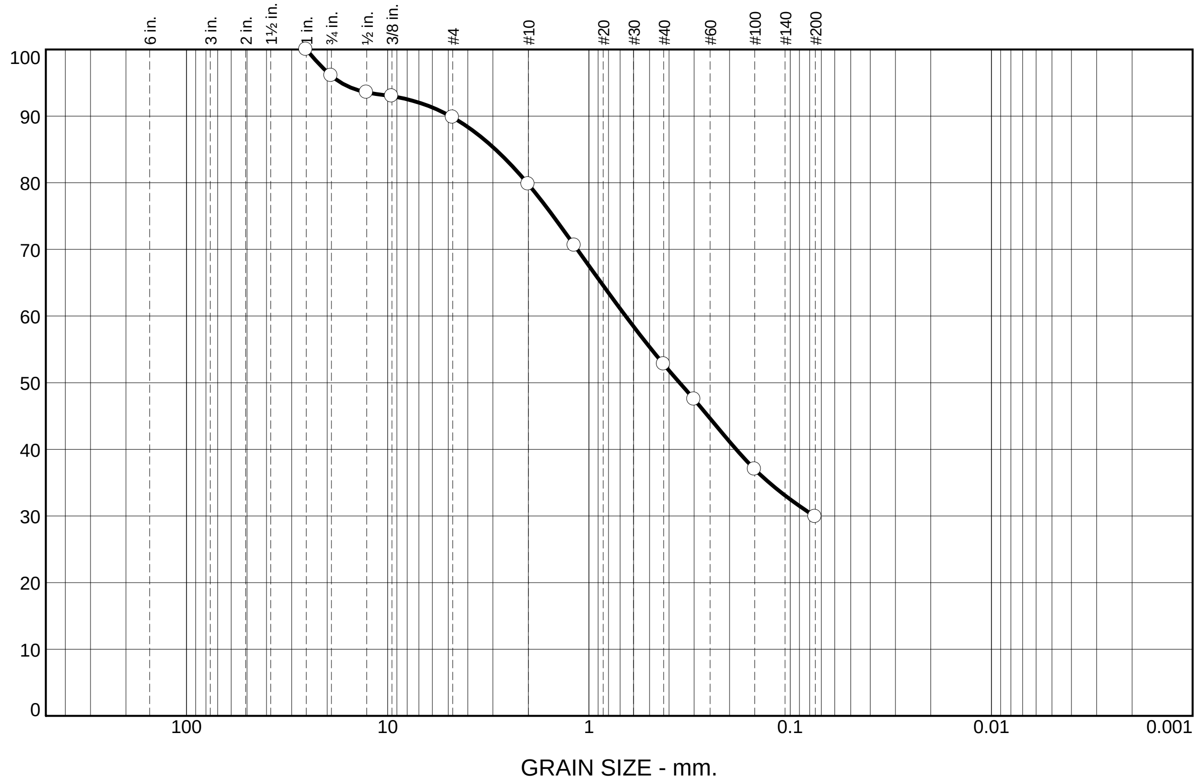
Location: BH19-RW11-58
Sample Number: 19-148-35 **Depth:** 10-11.5' **Date:** 5/23/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-148-35

Tested By: JH/JS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	4.0	6.2	10.0	27.0	22.9	29.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	96.0		
.5	93.6		
.375	93.0		
#4	89.8		
#10	79.8		
#16	70.6		
#40	52.8		
#50	47.5		
#100	37.0		
#200	29.9		

* (no specification provided)

Material Description

Brown clayey sand

Atterberg Limits

PL= 13 LL= 35 PI= 22

Coefficients

D_{90}= 4.8784 D_{85}= 2.9117 D_{60}= 0.6567
D_{50}= 0.3541 D_{30}= 0.0761 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-6(2)

Remarks

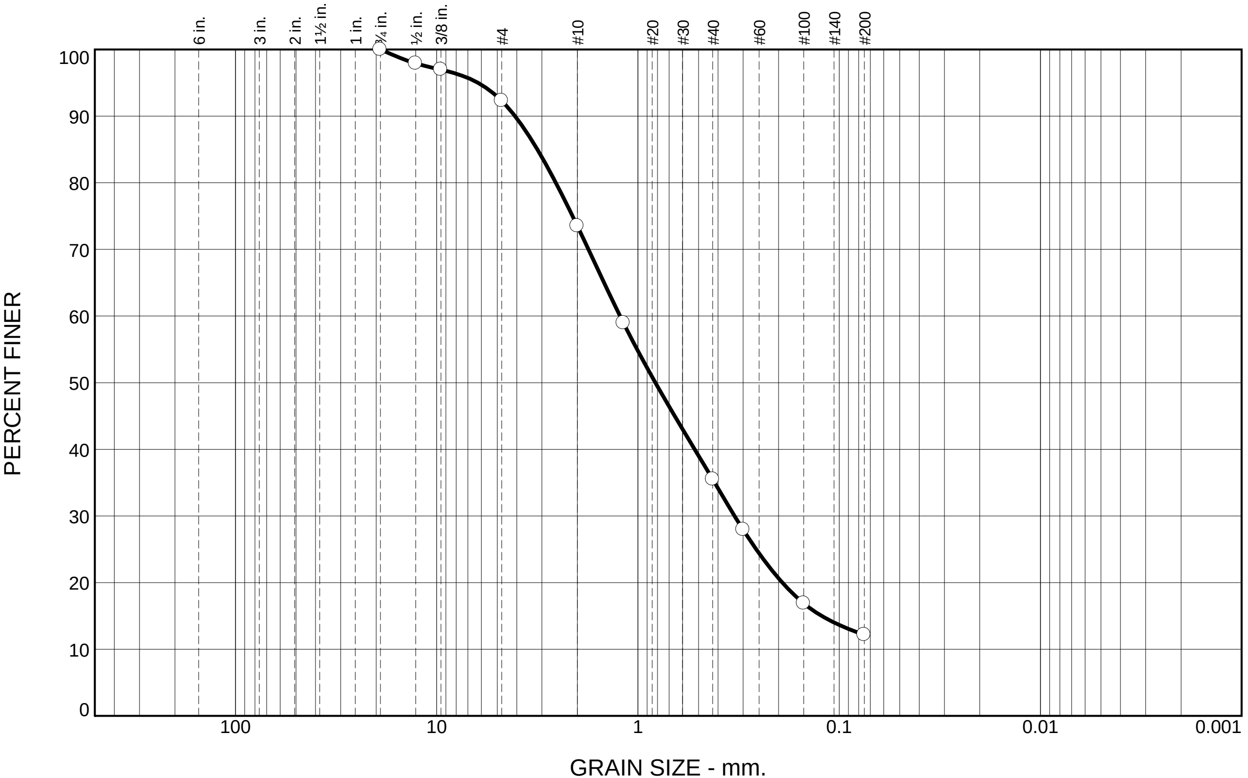
Location: BH19-RW11-58
Sample Number: 19-148-36 **Depth:** 15-16.5' **Date:** 5/23/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-148-36

Tested By: JH/JS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	7.7	18.8	38.0	23.4	12.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	97.9		
.375	97.0		
#4	92.3		
#10	73.5		
#16	59.0		
#40	35.5		
#50	27.9		
#100	16.9		
#200	12.1		

* (no specification provided)

Material Description

Brown silty sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 4.0805 D_{85}= 3.1610 D_{60}= 1.2274
D_{50}= 0.8190 D_{30}= 0.3310 D_{15}= 0.1222
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-1-b

Remarks

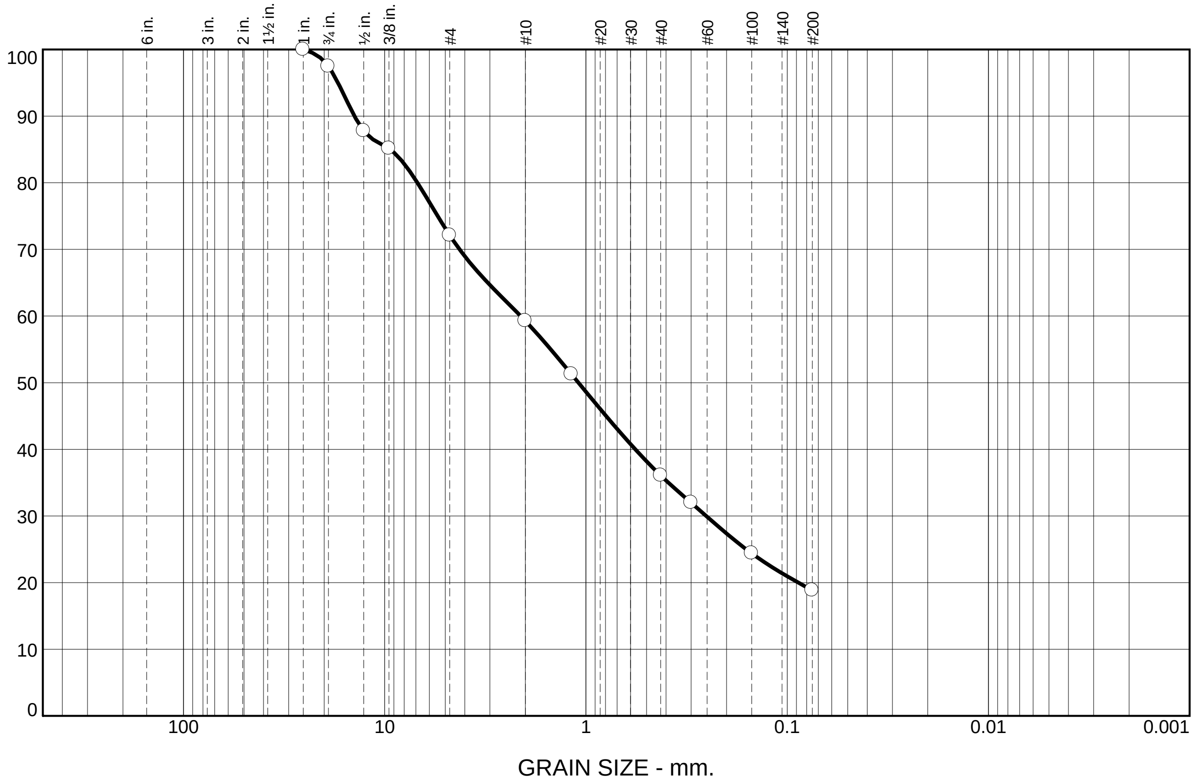
Location: RW11-61
Sample Number: 19-277-14 **Depth:** 10-11.5' **Date:** 8/15/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-277-14

Tested By: AH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	2.5	25.4	12.8	23.2	17.3	18.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	97.5		
.5	87.8		
.375	85.1		
#4	72.1		
#10	59.3		
#16	51.3		
#40	36.1		
#50	32.0		
#100	24.4		
#200	18.8		

* (no specification provided)

Material Description

Brown clayey sand with gravel

Atterberg Limits

PL= 13 LL= 29 PI= 16

Coefficients

D_{90}= 14.1207 D_{85}= 9.3816 D_{60}= 2.1109
D_{50}= 1.0896 D_{30}= 0.2526 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-6(0)

Remarks

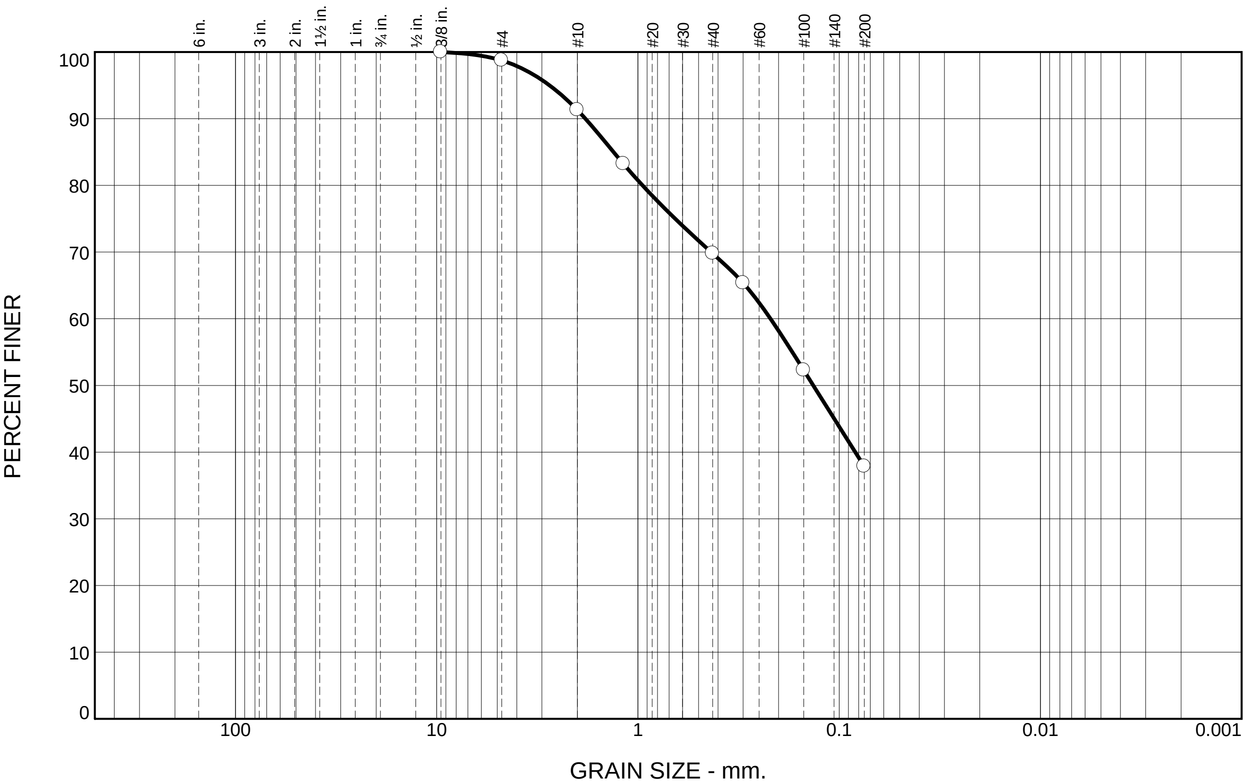
Location: RW11-64
Sample Number: 19-277-15 **Depth:** 7.5-8.5' **Date:** 8/15/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-277-15

Tested By: AH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.3	7.4	21.5	31.9	37.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	98.7		
#10	91.3		
#16	83.2		
#40	69.8		
#50	65.4		
#100	52.3		
#200	37.9		

* (no specification provided)

Material Description

Brown silty, clayey sand

Atterberg Limits

PL= 16 LL= 23 PI= 7

Coefficients

D_{90}= 1.8248 D_{85}= 1.3221 D_{60}= 0.2194
D_{50}= 0.1345 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC-SM AASHTO= A-4(0)

Remarks

Location: RW11-66
Sample Number: 19-277-16 **Depth:** 10-11.5' **Date:** 8/15/2019

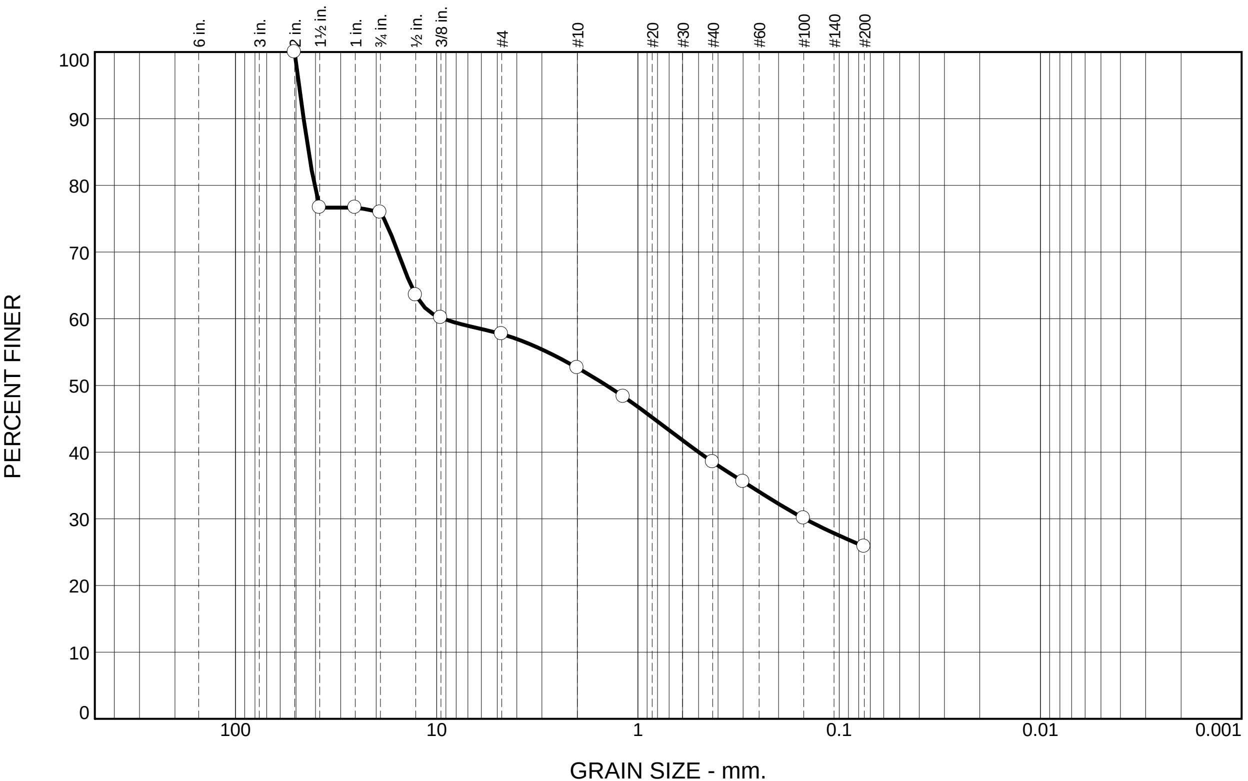
NewFields

Client: NDOT
Project: US395 NDOT North Valleys

Project No: 475.0398.000 **Figure** 19-277-16

Tested By: AH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	24.1	18.2	5.1	14.1	12.7	25.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2	100.0		
1.5	76.7		
1	76.7		
.75	75.9		
.5	63.6		
.375	60.2		
#4	57.7		
#10	52.6		
#16	48.3		
#40	38.5		
#50	35.6		
#100	30.1		
#200	25.8		

* (no specification provided)

Material Description

Brown clayey gravel with sand

Atterberg Limits

PL= 22 LL= 49 PI= 27

Coefficients

D_{90}= 45.8164 D_{85}= 43.2746 D_{60}= 9.2334
D_{50}= 1.4316 D_{30}= 0.1483 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= GC AASHTO= A-2-7(2)

Remarks

Location: RW12-67
Depth: 21-21.5'

Date: 9/13/2019

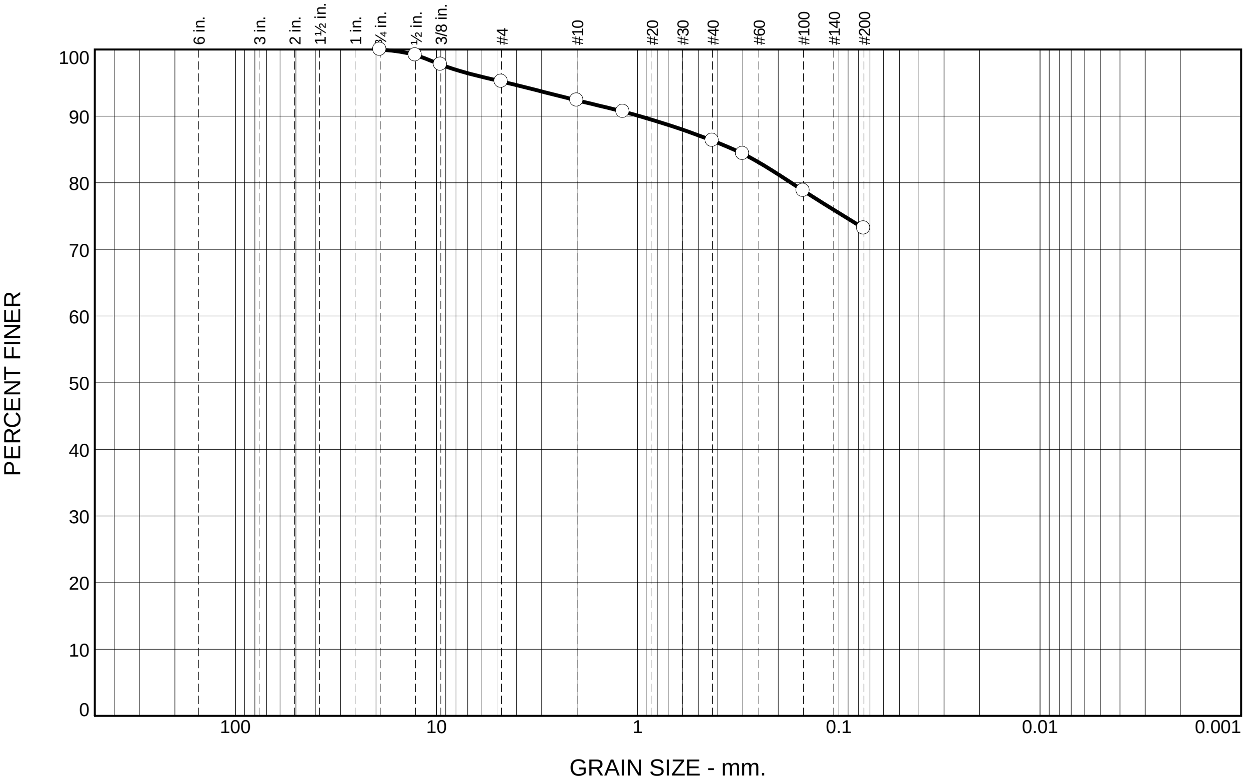
NewFields

Client: NDOT
Project: US395 NDOT North Valleys

Project No: 475.0398.000 **Figure** RW12-67

Tested By: AR **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	4.8	2.8	6.1	13.1	73.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	99.2		
.375	97.7		
#4	95.2		
#10	92.4		
#16	90.7		
#40	86.3		
#50	84.4		
#100	78.8		
#200	73.2		

* (no specification provided)

Material Description

Brown

Atterberg Limits

PL= - LL= - PI= -

Coefficients

D_{90}= 0.9784 D_{85}= 0.3328 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

*Atterberg was washed and unable to be ran

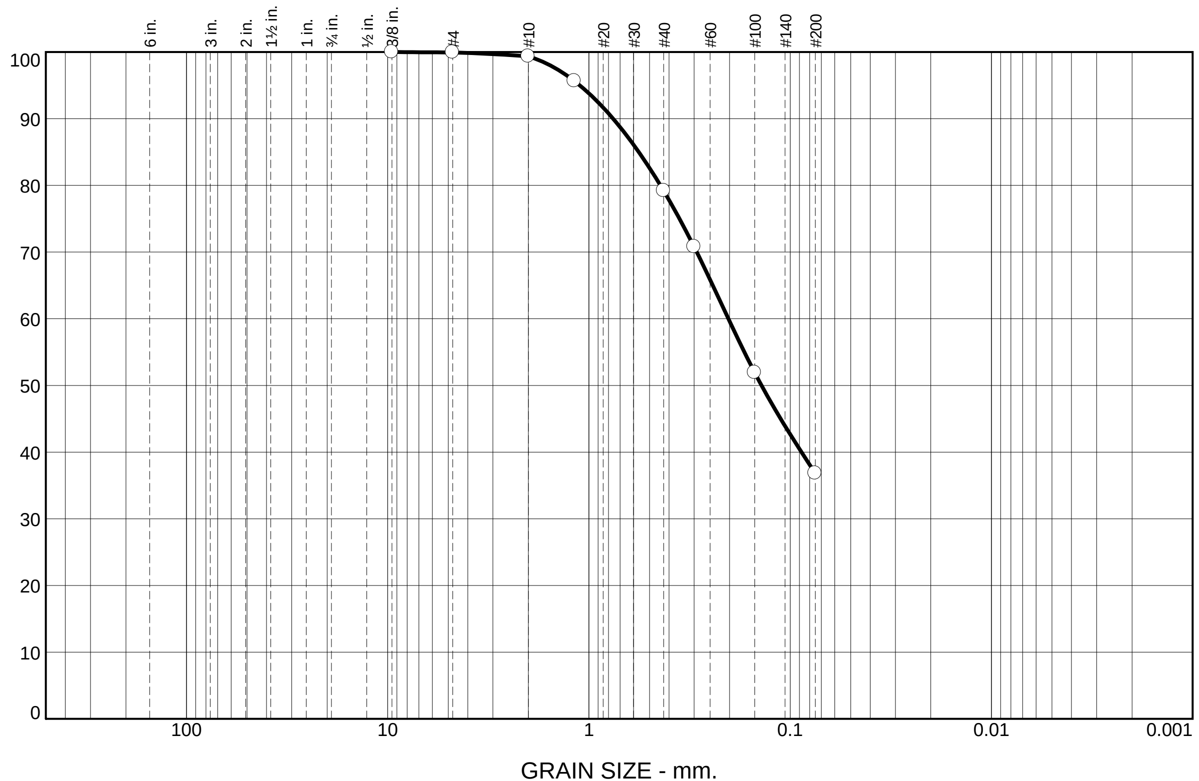
Location: RW12-67
Sample Number: 19-277-17 **Depth:** 25-26.5' **Date:** 8/15/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-277-17

Tested By: AH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.1	0.5	20.2	42.4	36.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	99.9		
#10	99.4		
#16	95.6		
#40	79.2		
#50	70.8		
#100	51.9		
#200	36.8		

* (no specification provided)

Material Description

Brown silty sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.7577 D_{85}= 0.5651 D_{60}= 0.2027
D_{50}= 0.1388 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-4(0)

Remarks

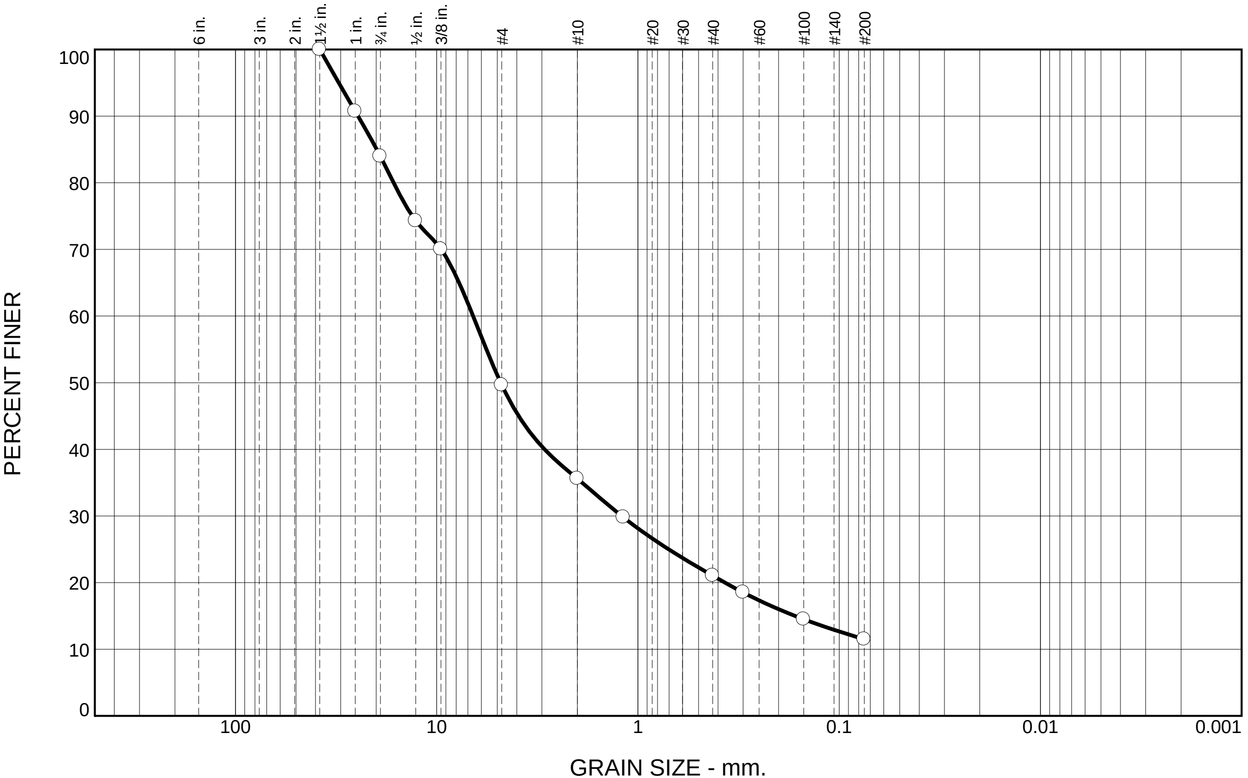
Location: RW12-67
Sample Number: 19-277-18 **Depth:** 41-41.5' **Date:** 8/15/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-277-18

Tested By: AH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	16.0	34.4	14.0	14.6	9.5	11.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	90.7		
.75	84.0		
.5	74.3		
.375	70.0		
#4	49.6		
#10	35.6		
#16	29.8		
#40	21.0		
#50	18.5		
#100	14.5		
#200	11.5		

* (no specification provided)

Material Description

Light Brown poorly graded gravel with silt and sand

Atterberg Limits

PL= 31 LL= 44 PI= 13

Coefficients

D_{90}= 24.6084 D_{85}= 19.8573 D_{60}= 6.5909
D_{50}= 4.8104 D_{30}= 1.2043 D_{15}= 0.1660
D_{10}= C_u= C_c=

Classification

USCS= GP-GM AASHTO= A-2-7(0)

Remarks

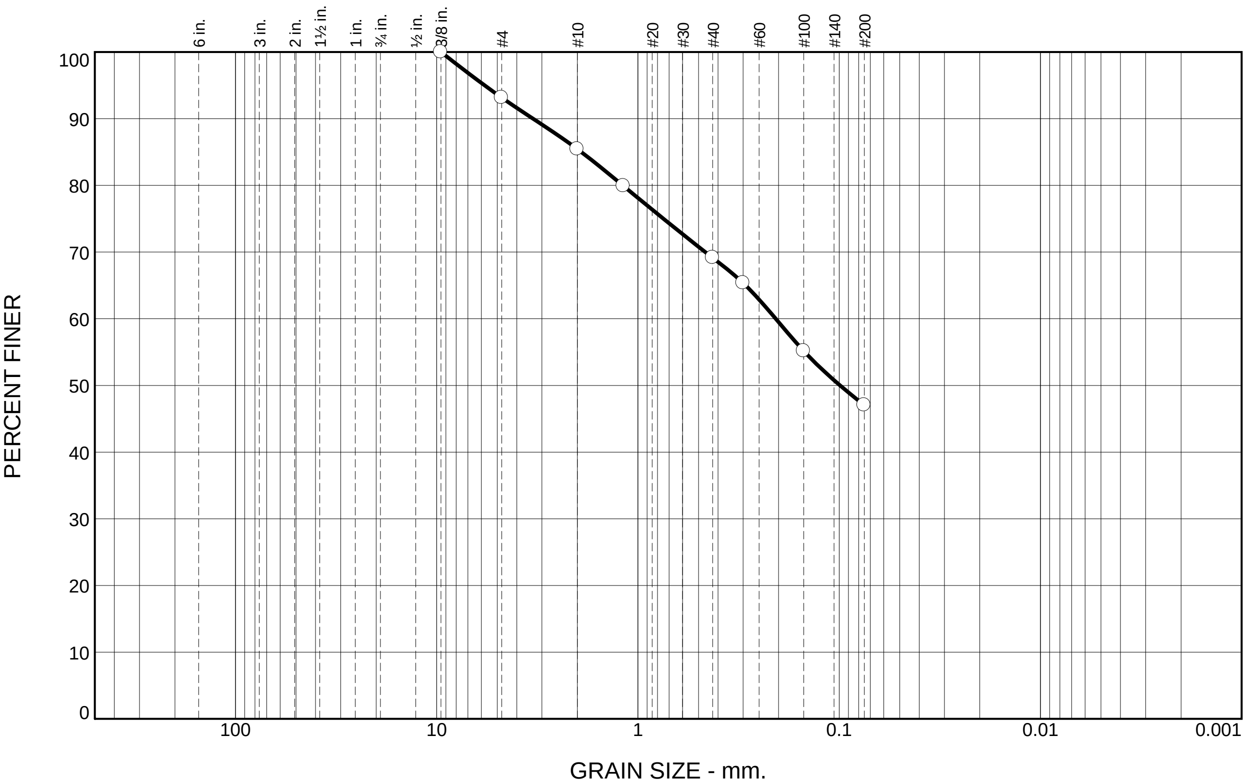
Location: BH19-RW12-69
Sample Number: 19-211-03 **Depth:** 7.5-9' **Date:** 7/2/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-211-03

Tested By: JH/KG **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	6.8	7.8	16.3	22.1	47.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	93.2		
#10	85.4		
#16	79.9		
#40	69.1		
#50	65.4		
#100	55.2		
#200	47.0		

* (no specification provided)

Material Description

Brown clayey sand

Atterberg Limits

PL= 20 LL= 66 PI= 46

Coefficients

D_{90}= 3.3170 D_{85}= 1.9118 D_{60}= 0.2067
D_{50}= 0.0989 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-7-6(15)

Remarks

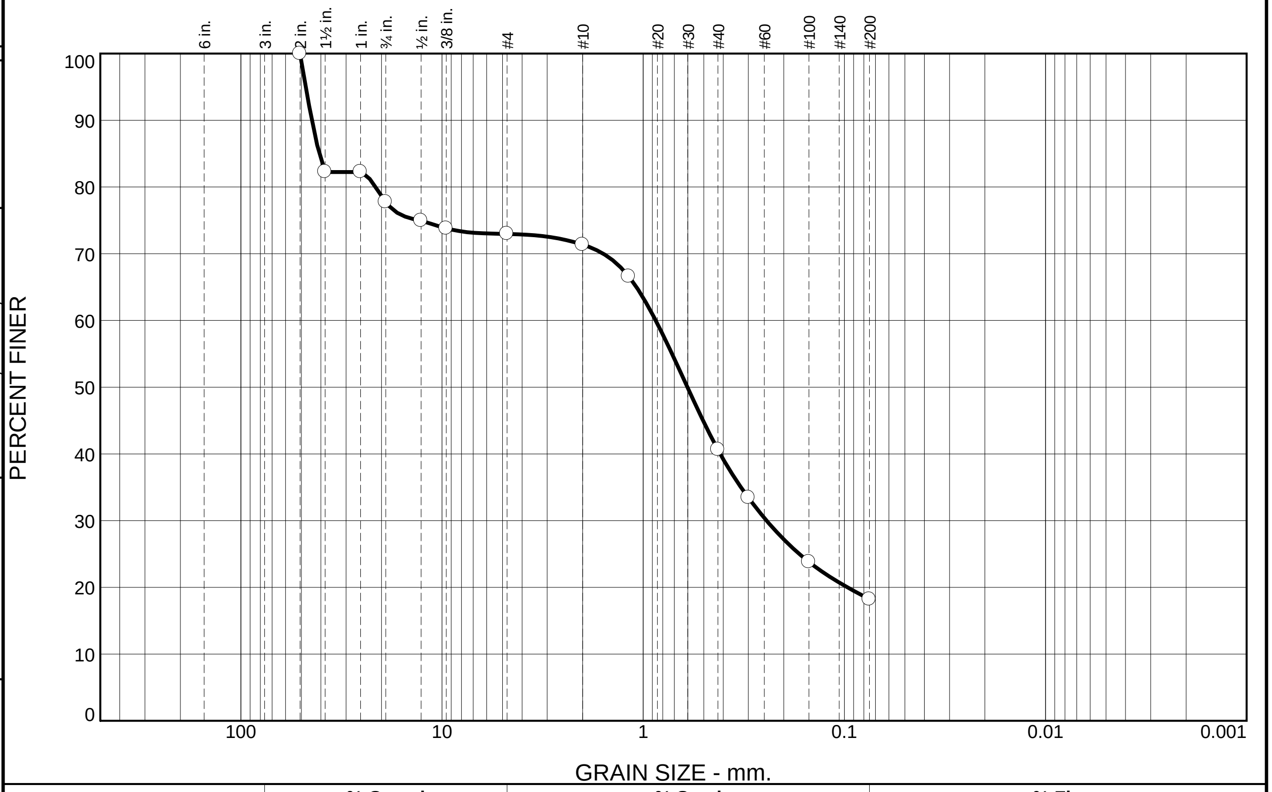
Location: BH19-RW12-69
Sample Number: 19-211-05 **Depth:** 30-30.5' **Date:** 7/2/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-211-05

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	22.3	4.7	1.6	30.8	22.4	18.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2	100.0		
1.5	82.3		
1	82.3		
.75	77.7		
.5	74.9		
.375	73.8		
#4	73.0		
#10	71.4		
#16	66.6		
#40	40.6		
#50	33.5		
#100	23.8		
#200	18.2		

* (no specification provided)

Material Description

Gray silty sand with gravel

Atterberg Limits

PL= 30 LL= 52 PI= 22

Coefficients

D_{90}= 44.3430 D_{85}= 40.7416 D_{60}= 0.8663
D_{50}= 0.6026 D_{30}= 0.2437 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-7(0)

Remarks

Location: BH19-RW12-70
Sample Number: 19-211-08 **Depth:** 11-11.5' **Date:** 7/2/2019

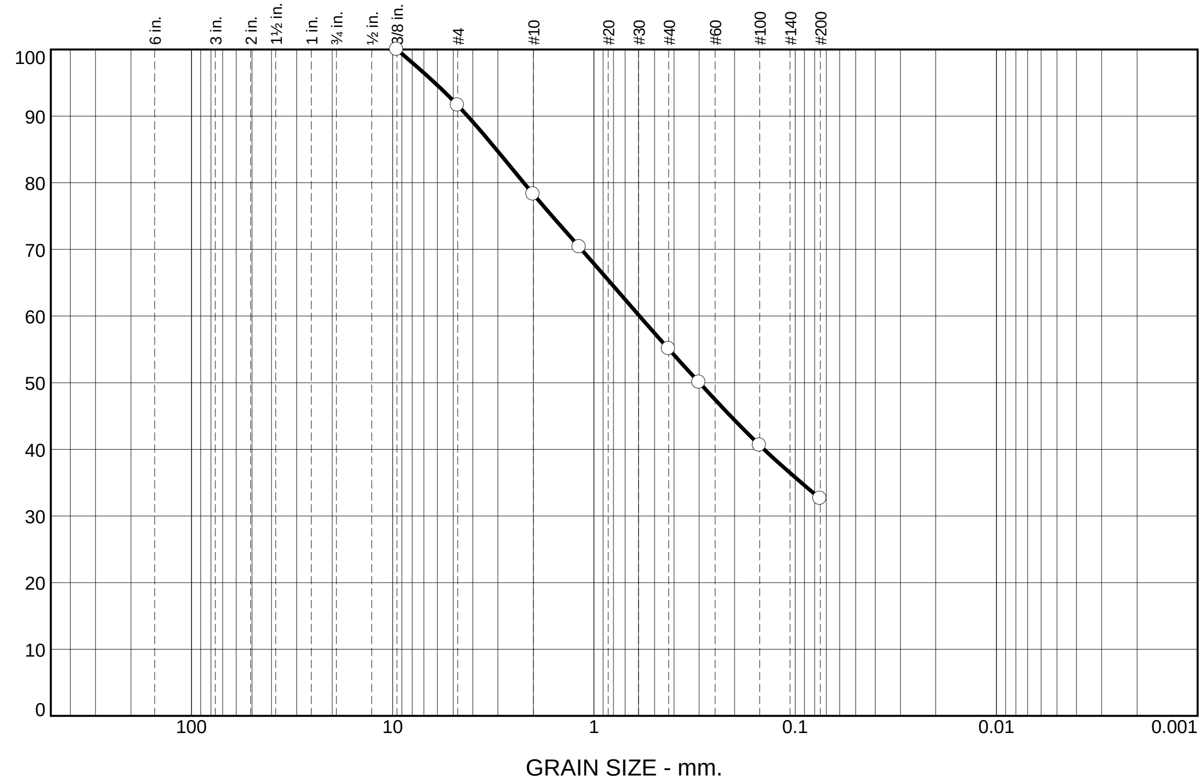
NewFields

Client: NDOT
Project: US395 NDOT North Valleys

Project No: 475.0398.000 **Figure** 19-211-08

Tested By: JH/KG **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	8.4	13.3	23.2	22.5	32.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	91.6		
#10	78.3		
#16	70.3		
#40	55.1		
#50	50.0		
#100	40.6		
#200	32.6		

* (no specification provided)

Material Description

Brown clayey sand

Atterberg Limits

PL= 24 LL= 34 PI= 10

Coefficients

D_{90}= 4.2391 D_{85}= 3.0558 D_{60}= 0.5933
D_{50}= 0.2992 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-4(0)

Remarks

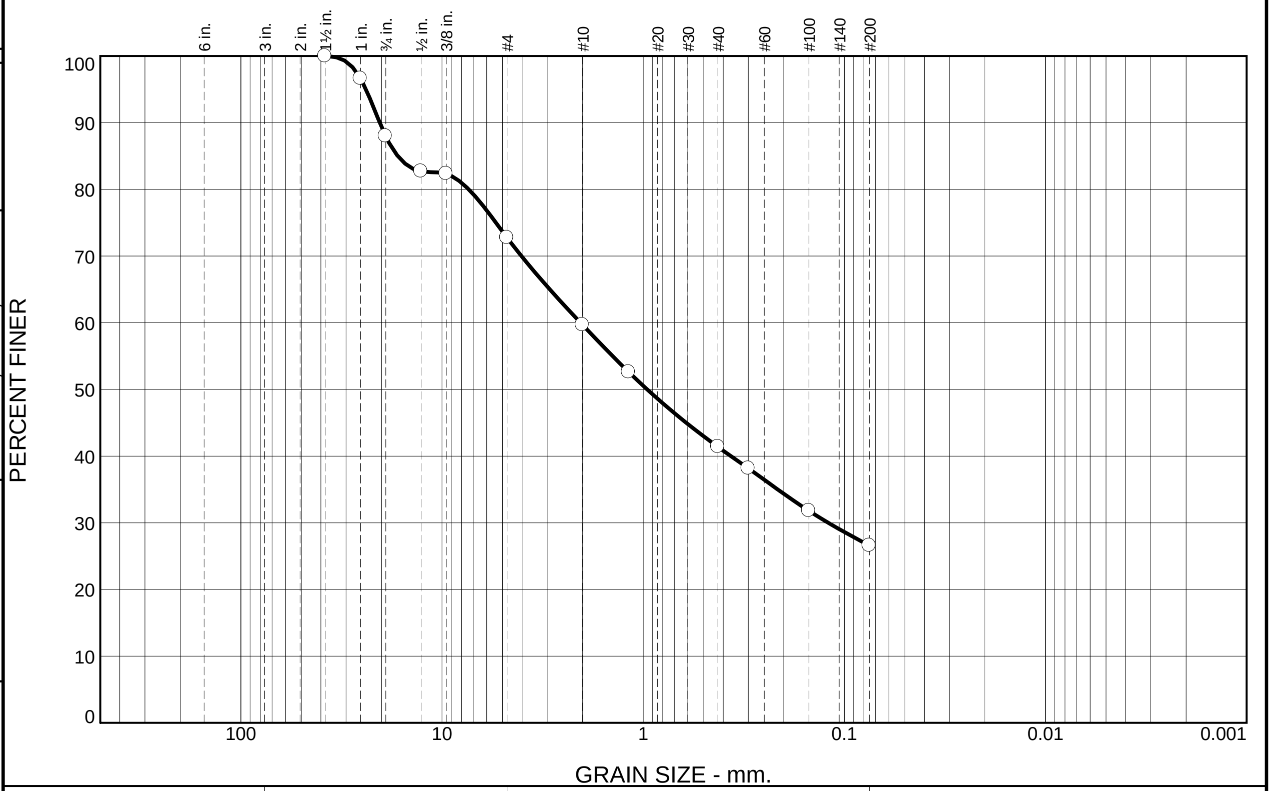
Location: BH19-RW12-70
Sample Number: 19-211-09 **Depth:** 35-36' **Date:** 7/2/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-211-09

Tested By: JH/KG **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	12.0	15.2	13.1	18.3	14.8	26.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	96.6		
.75	88.0		
.5	82.7		
.375	82.3		
#4	72.8		
#10	59.7		
#16	52.6		
#40	41.4		
#50	38.2		
#100	31.8		
#200	26.6		

* (no specification provided)

Material Description

Light Brown clayey sand with gravel

Atterberg Limits

PL= 25 LL= 44 PI= 19

Coefficients

D_{90}= 20.4058 D_{85}= 16.5892 D_{60}= 2.0471
D_{50}= 0.9551 D_{30}= 0.1202 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-7(1)

Remarks

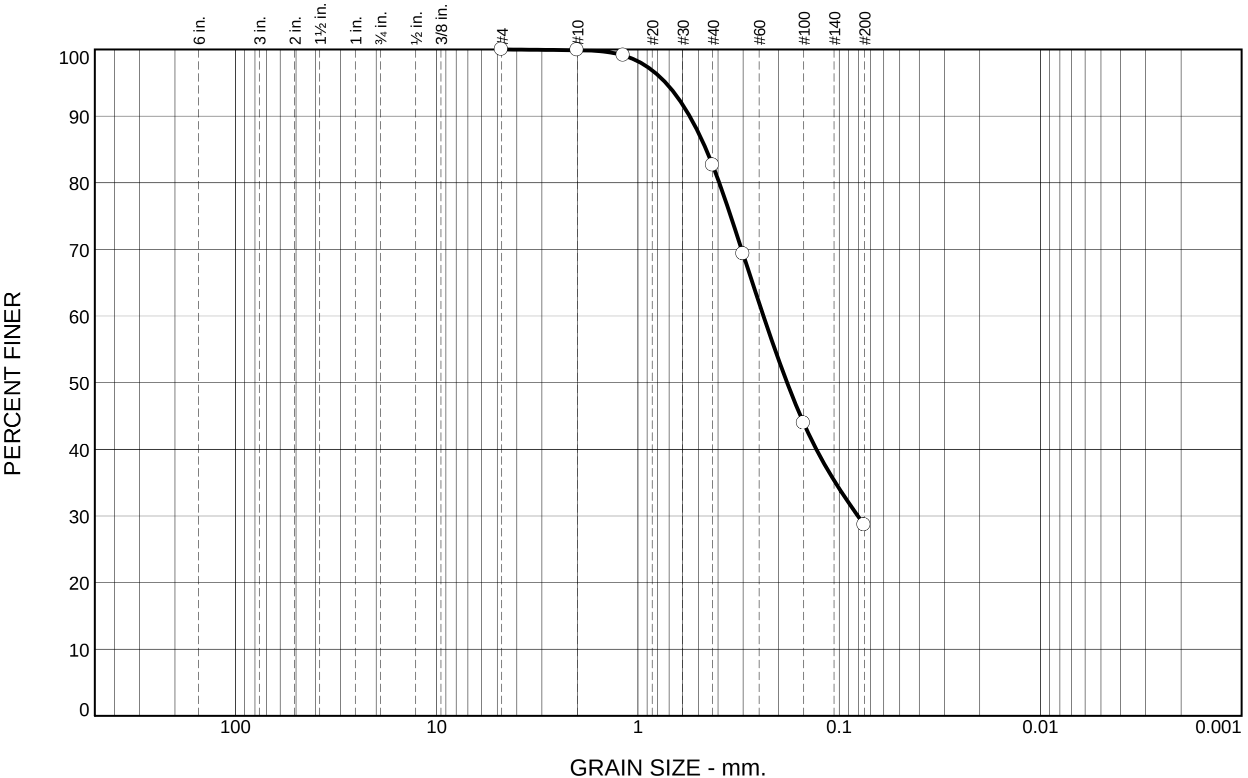
Location: BH19-BR-17
Sample Number: 19-213-10 **Depth:** 15-16.5' **Date:** 7/2/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-213-10

Tested By: JH/KG **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	17.3	54.0	28.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.9		
#16	99.1		
#40	82.6		
#50	69.3		
#100	43.9		
#200	28.6		

* (no specification provided)

Material Description

Gray silty sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.5531 D_{85}= 0.4578 D_{60}= 0.2378
D_{50}= 0.1815 D_{30}= 0.0807 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

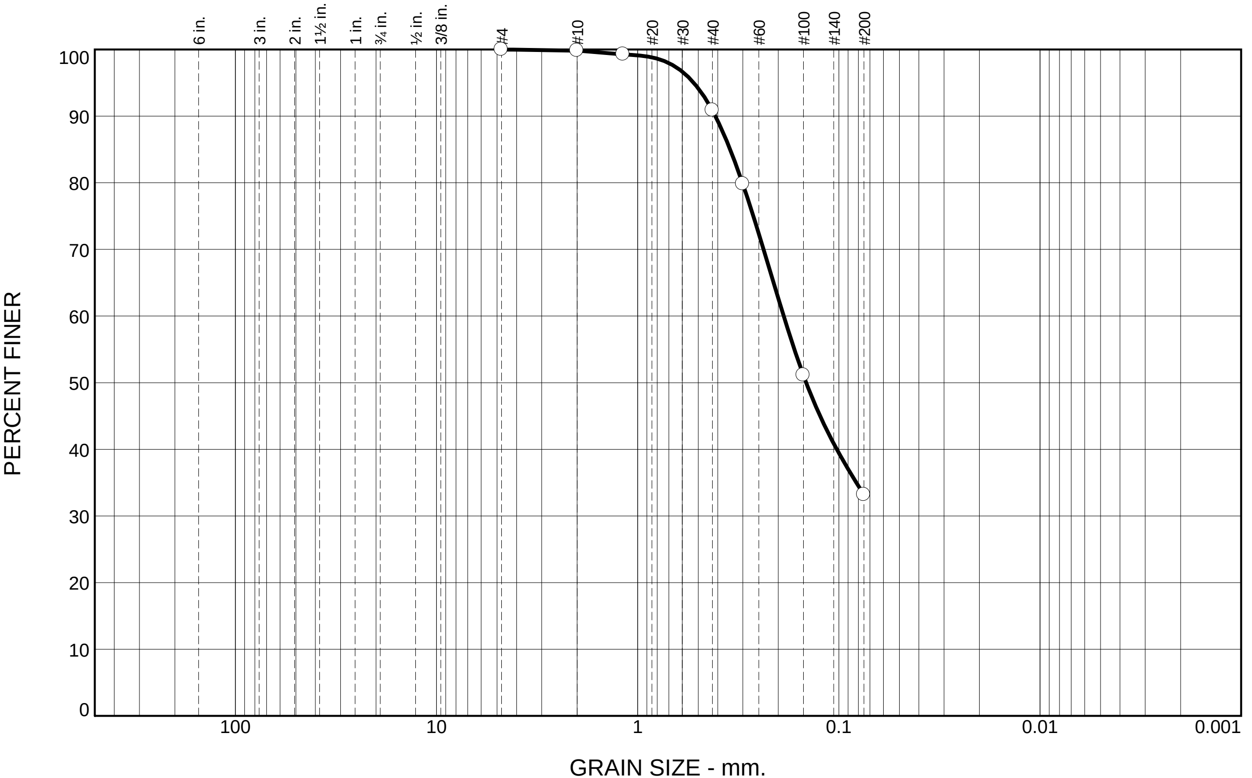
Location: BH19-BR-17
Sample Number: 19-213-11 **Depth:** 40.5-41' **Date:** 7/2/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-213-11

Tested By: JH/KG **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.2	8.9	57.7	33.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.8		
#16	99.3		
#40	90.9		
#50	79.8		
#100	51.1		
#200	33.2		

* (no specification provided)

Material Description

Gray silty sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.4107 D_{85}= 0.3468 D_{60}= 0.1880
D_{50}= 0.1454 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

Location: BH19-BR-17
Sample Number: 19-213-12 **Depth:** 51-51.5' **Date:** 7/2/2019

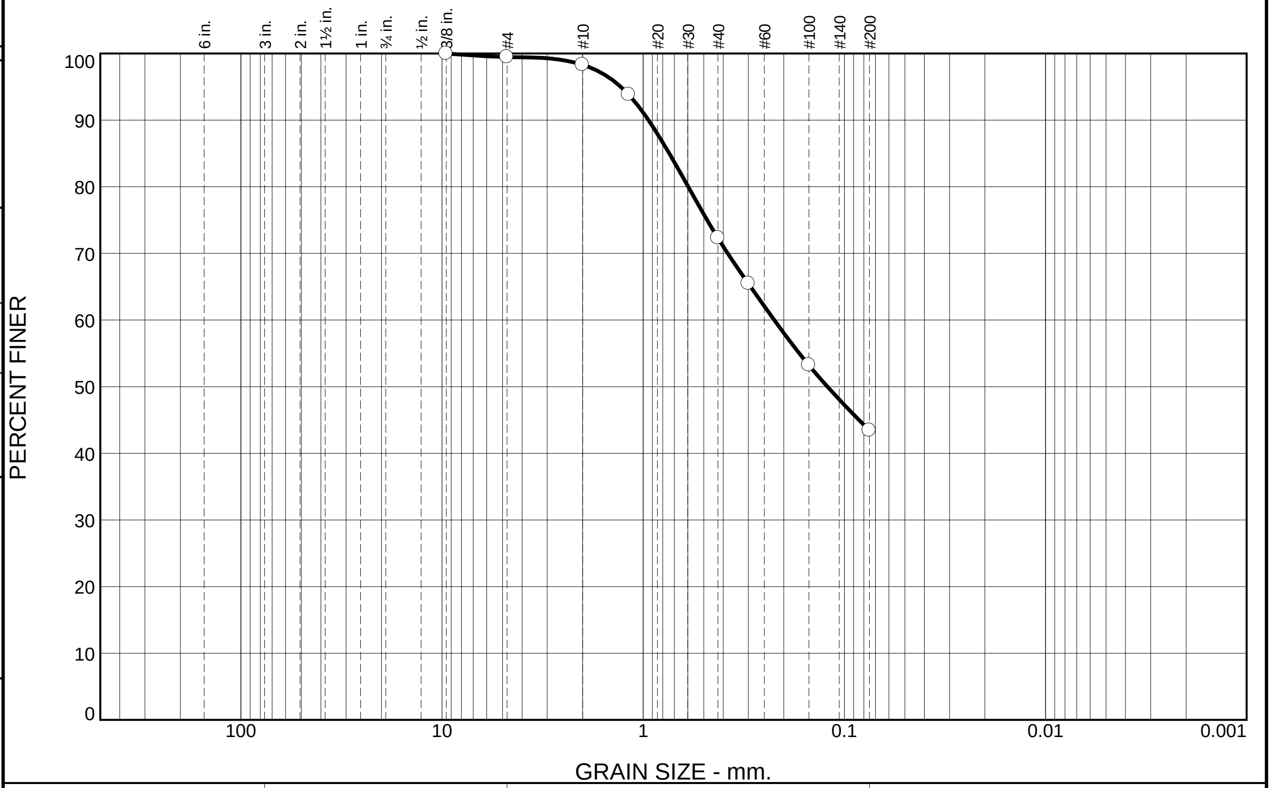
NewFields

Client: NDOT
Project: US395 NDOT North Valleys

Project No: 475.0398.000 **Figure** 19-213-12

Tested By: JH/KG **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.5	1.2	26.0	28.9	43.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	99.5		
#10	98.3		
#16	93.8		
#40	72.3		
#50	65.5		
#100	53.2		
#200	43.4		

* (no specification provided)

Material Description

Light Brown clayey sand

Atterberg Limits

PL= 18 LL= 33 PI= 15

Coefficients

D_{90}= 0.9407 D_{85}= 0.7415 D_{60}= 0.2231
D_{50}= 0.1213 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-6(3)

Remarks

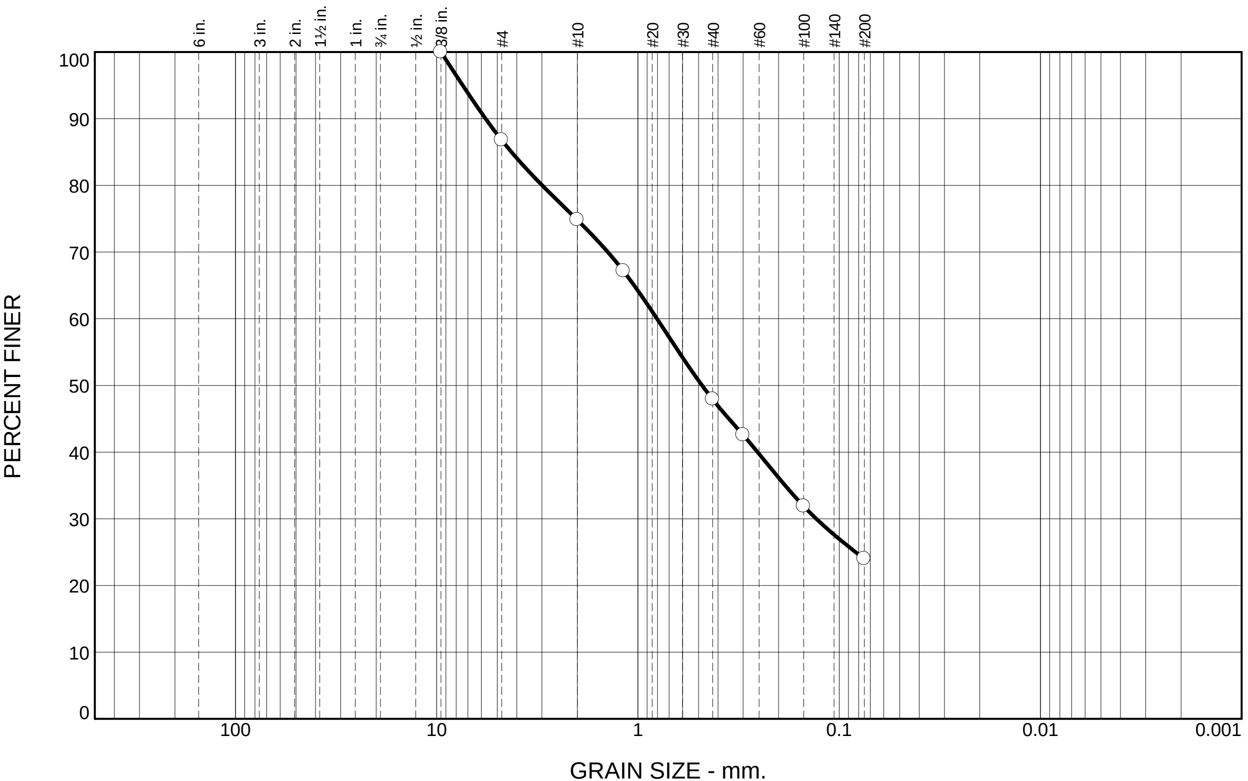
Location: BH19-BR18
Sample Number: 19-212-01 **Depth:** 25-26.5' **Date:** 7/1/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-212-01

Tested By: JH/KG **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	13.2	12.0	26.9	23.9	24.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	86.8		
#10	74.8		
#16	67.2		
#40	47.9		
#50	42.6		
#100	31.9		
#200	24.0		

* (no specification provided)

Material Description

Brown clayey sand

Atterberg Limits

PL= 23 LL= 32 PI= 9

Coefficients

D_{90}= 5.7160 D_{85}= 4.2517 D_{60}= 0.8039
D_{50}= 0.4800 D_{30}= 0.1299 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-4(0)

Remarks

Location: BH19-BR-18
Sample Number: 19-212-03 **Depth:** 40.5-41' **Date:** 7/2/2019

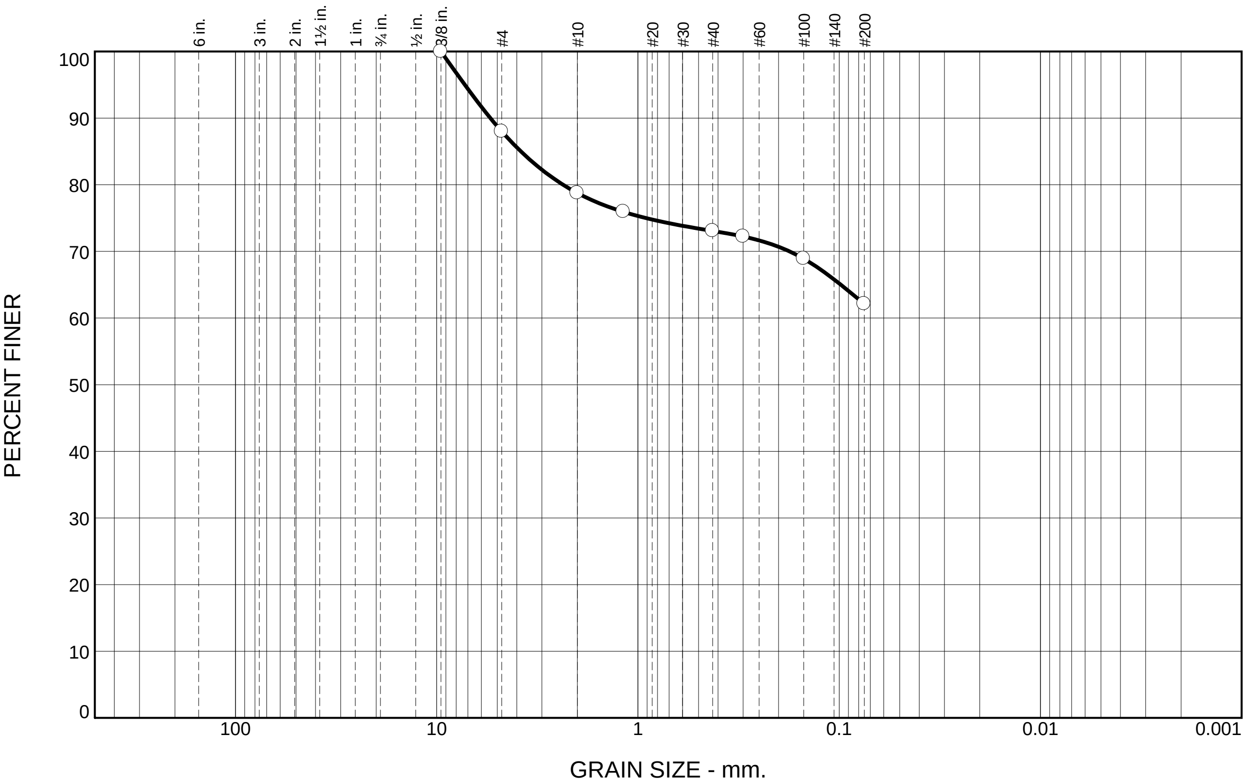
NewFields

Client: NDOT
Project: US395 NDOT North Valleys

Project No: 475.0398.000 **Figure** 19-212-03

Tested By: JH/KG **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	12.0	9.2	5.7	11.0	62.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	88.0		
#10	78.8		
#16	75.9		
#40	73.1		
#50	72.2		
#100	68.9		
#200	62.1		

* (no specification provided)

Material Description

Red sandy lean clay

Atterberg Limits

PL= 26 LL= 41 PI= 15

Coefficients

D_{90}= 5.4084 D_{85}= 3.8154 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-7-6(8)

Remarks

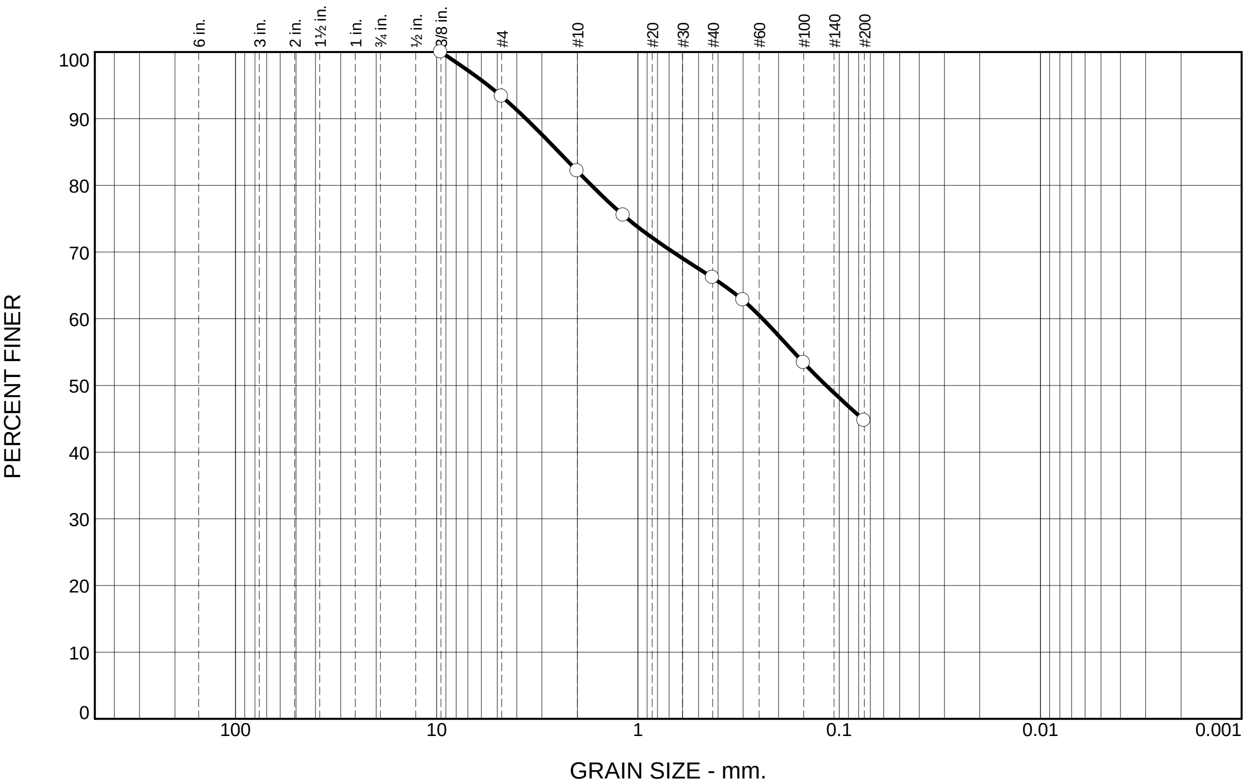
Location: BH19-BR-19
Sample Number: 19-248-13 **Depth:** 20-20.5' **Date:** 8/1/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-248-13

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	6.7	11.2	16.0	21.4	44.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	93.3		
#10	82.1		
#16	75.5		
#40	66.1		
#50	62.8		
#100	53.4		
#200	44.7		

* (no specification provided)

Material Description

Brown clayey sand

Atterberg Limits

PL= 24 LL= 33 PI= 9

Coefficients

D_{90}= 3.5997 D_{85}= 2.4698 D_{60}= 0.2400
D_{50}= 0.1160 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-4(1)

Remarks

Location: BH19-BR-19
Sample Number: 19-248-14 **Depth:** 35-36' **Date:** 8/1/2019

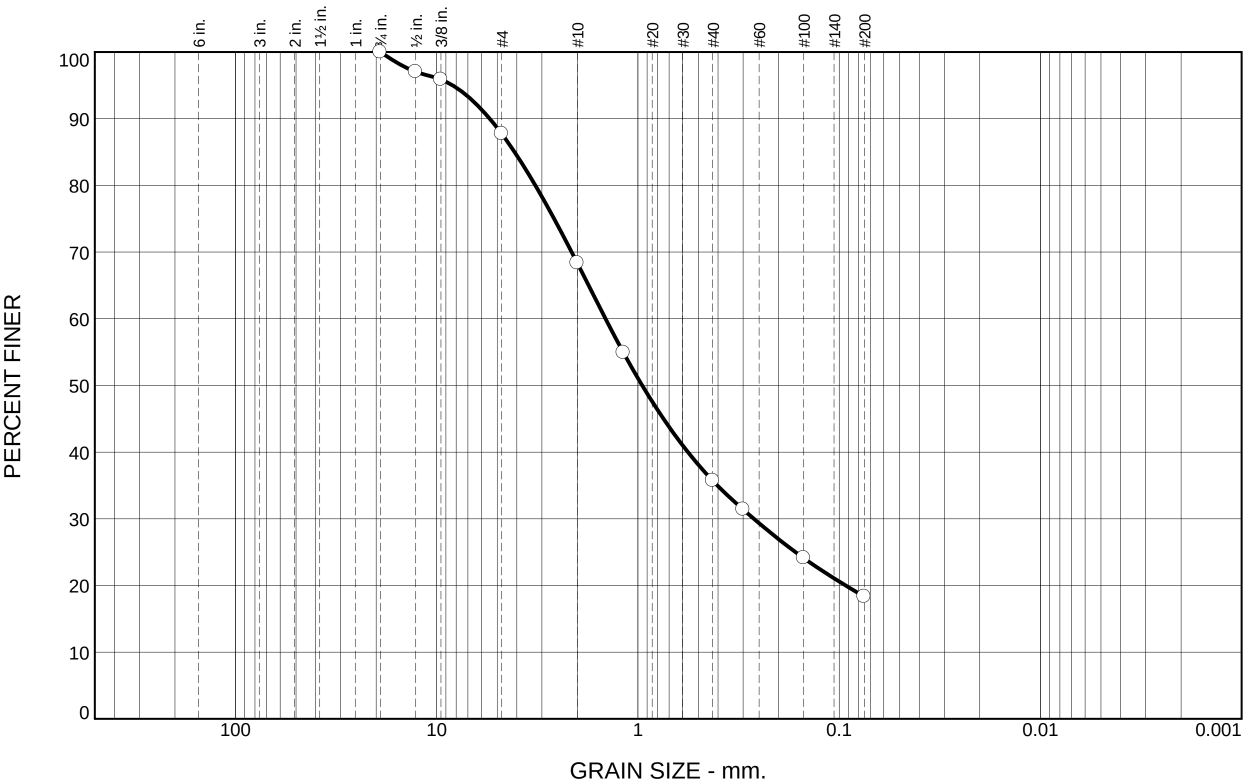
NewFields

Client: NDOT
Project: US395 NDOT North Valleys

Project No: 475.0398.000 **Figure** 19-248-14

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	12.3	19.4	32.6	17.4	18.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	97.0		
.375	95.9		
#4	87.7		
#10	68.3		
#16	54.9		
#40	35.7		
#50	31.4		
#100	24.1		
#200	18.3		

* (no specification provided)

Material Description

Brown clayey sand

Atterberg Limits

PL= 16 LL= 27 PI= 11

Coefficients

D_{90}= 5.4479 D_{85}= 4.1023 D_{60}= 1.4486
D_{50}= 0.9525 D_{30}= 0.2654 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-6(0)

Remarks

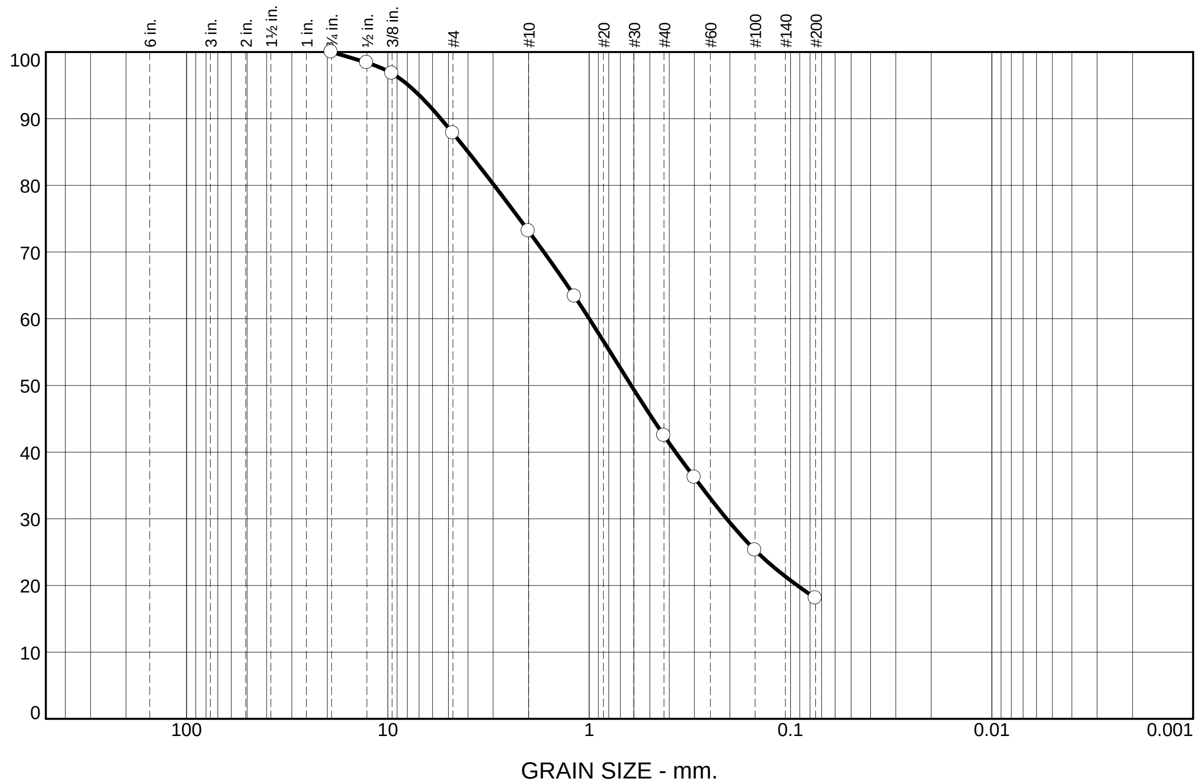
Location: BH19-BR-20
Sample Number: 19-147-01 **Depth:** 21-21.5' **Date:** 5/23/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-147-01

Tested By: JH/KS/JS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	12.2	14.7	30.6	24.4	18.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	98.4		
.375	96.8		
#4	87.8		
#10	73.1		
#16	63.4		
#40	42.5		
#50	36.2		
#100	25.3		
#200	18.1		

* (no specification provided)

Material Description

Light Brown clayey sand

Atterberg Limits

PL= 19 LL= 34 PI= 15

Coefficients

D_{90}= 5.4555 D_{85}= 3.9898 D_{60}= 0.9988
D_{50}= 0.6185 D_{30}= 0.2076 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-6(0)

Remarks

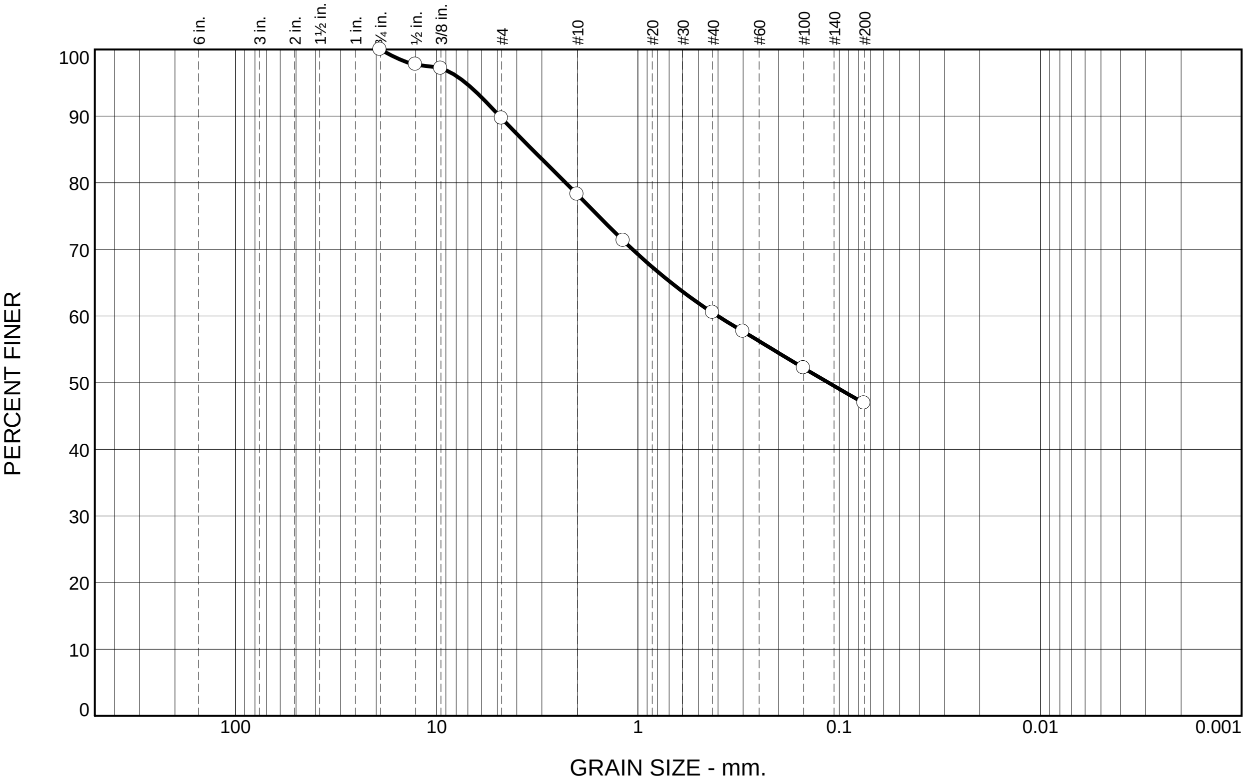
Location: BH19-BR-20
Sample Number: 19-147-02 **Depth:** 40.5-41' **Date:** 5/23/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-147-02

Tested By: JH/KS/JS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	10.3	11.5	17.7	13.6	46.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	97.7		
.375	97.2		
#4	89.7		
#10	78.2		
#16	71.3		
#40	60.5		
#50	57.7		
#100	52.2		
#200	46.9		

* (no specification provided)

Material Description

Light Brown clayey sand

Atterberg Limits

PL= 16 LL= 34 PI= 18

Coefficients

D_{90}= 4.8656 D_{85}= 3.3512 D_{60}= 0.4004
D_{50}= 0.1130 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-6(5)

Remarks

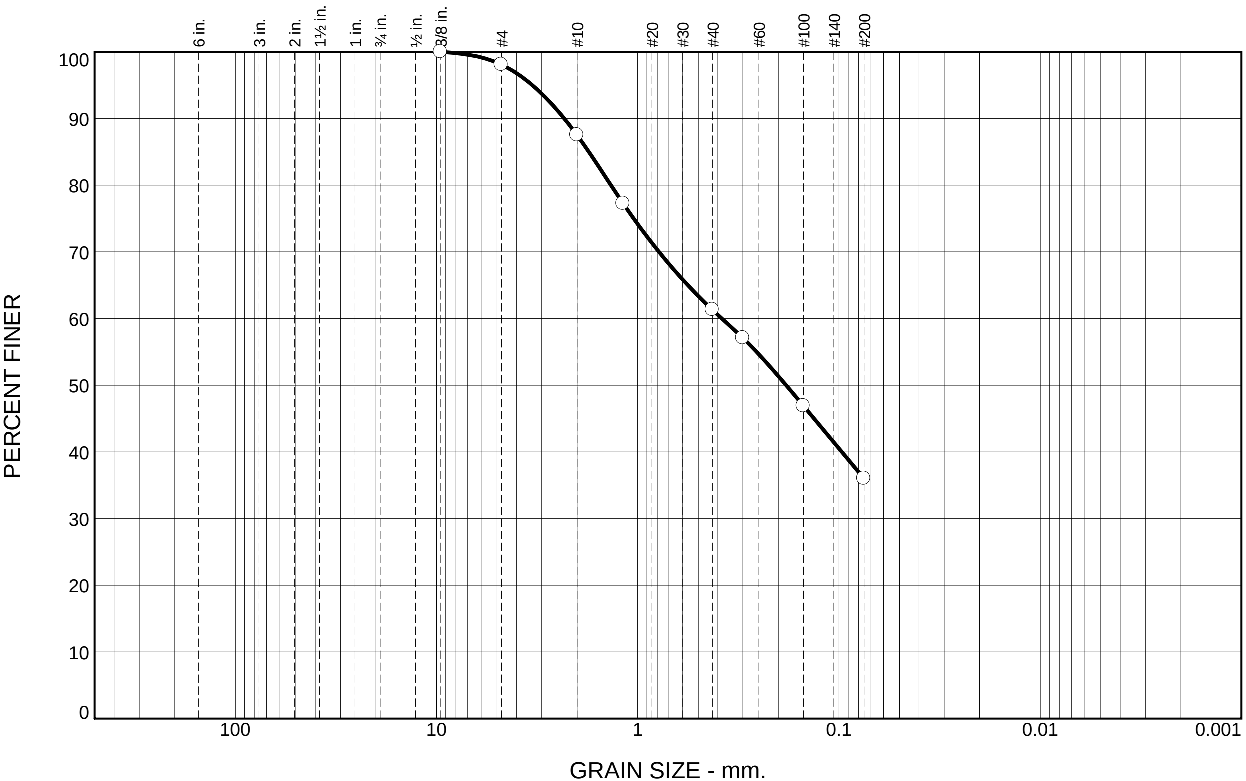
Location: BH19-BR-20
Sample Number: 19-147-03 **Depth:** 65-66.5' **Date:** 5/23/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-147-03

Tested By: JH/KS/JS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.9	10.6	26.2	25.3	36.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	98.1		
#10	87.5		
#16	77.2		
#40	61.3		
#50	57.1		
#100	46.9		
#200	36.0		

* (no specification provided)

Material Description

Dark Brown clayey sand

Atterberg Limits

PL= 13 LL= 27 PI= 14

Coefficients

D_{90}= 2.3180 D_{85}= 1.7500 D_{60}= 0.3816
D_{50}= 0.1831 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-6(1)

Remarks

Location: BR-29
Sample Number: 19-279-23 **Depth:** 15-16.5 **Date:** 8/15/2019

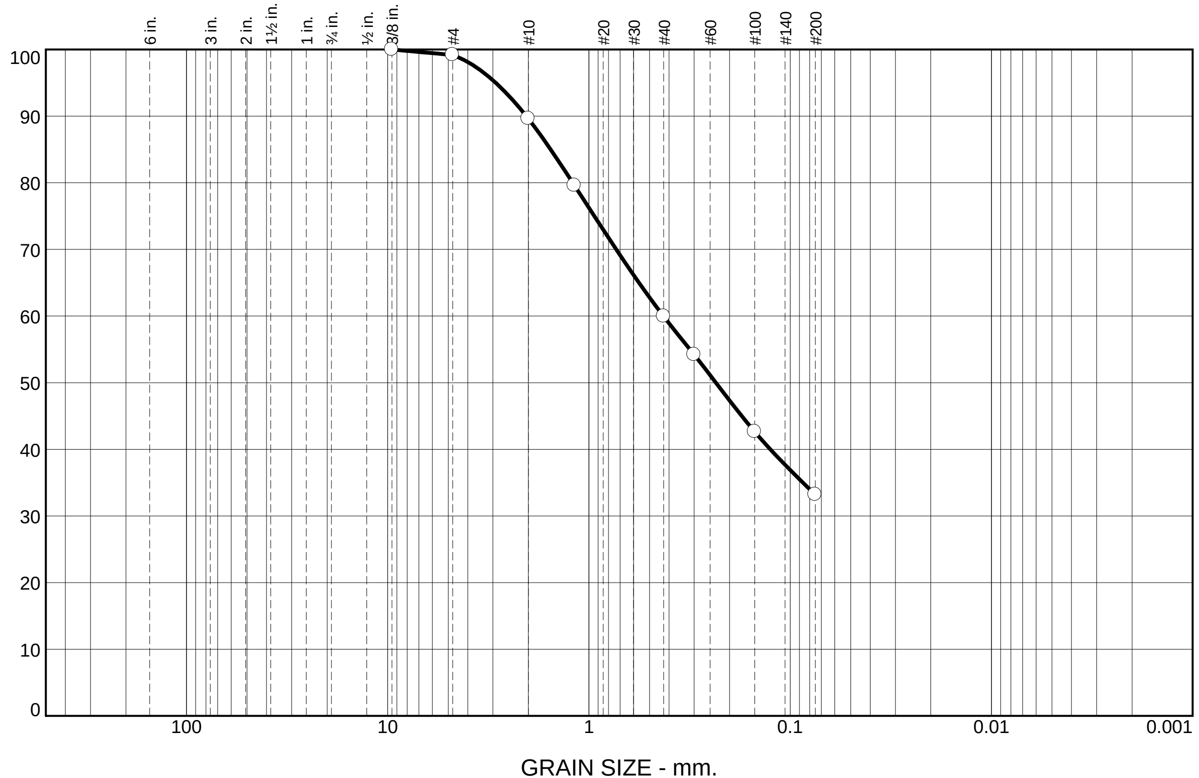
NewFields

Client: NDOT
Project: US395 NDOT North Valleys

Project No: 475.0398.000 **Figure** 19-279-23

Tested By: AR **Checked By:** CC

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.8	9.6	29.7	26.7	33.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	99.2		
#10	89.6		
#16	79.6		
#40	59.9		
#50	54.2		
#100	42.6		
#200	33.2		

* (no specification provided)

Material Description

Dark Brown clayey sand

Atterberg Limits

PL= 12 LL= 24 PI= 12

Coefficients

D_{90}= 2.0472 D_{85}= 1.5502 D_{60}= 0.4265
D_{50}= 0.2340 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-6(0)

Remarks

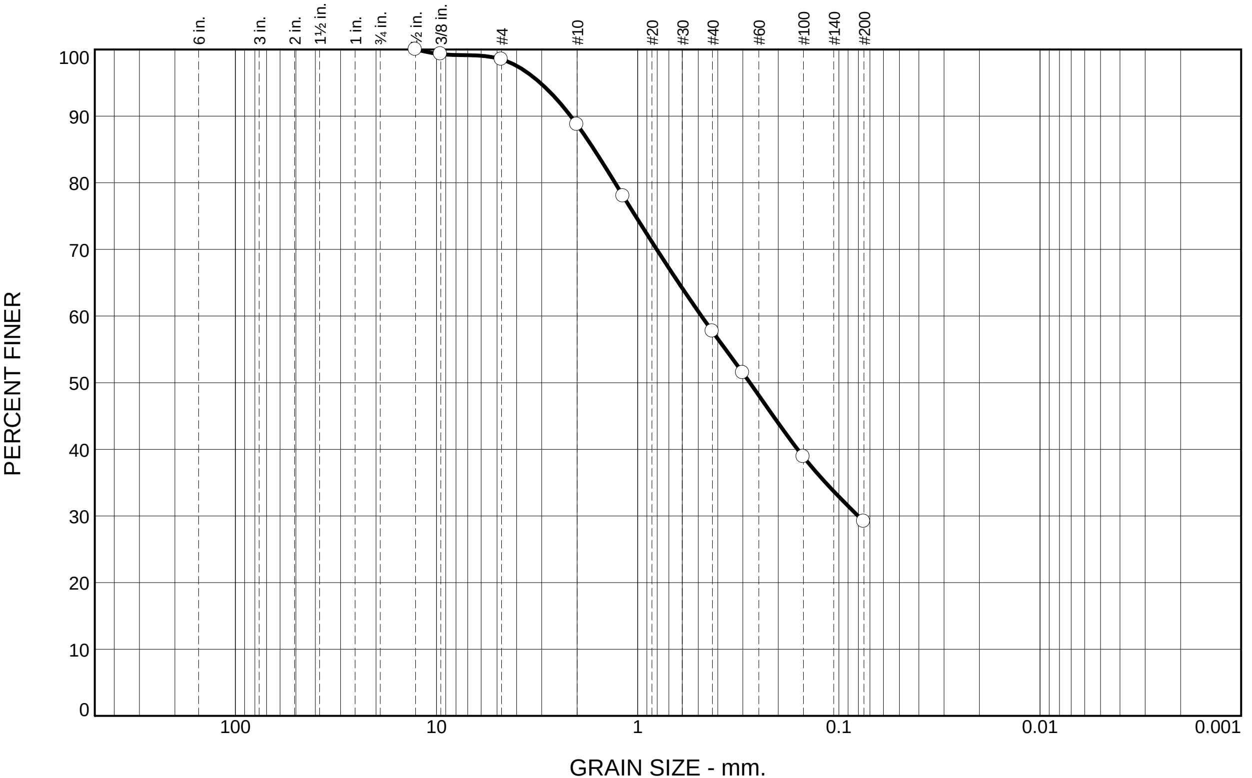
Location: BR-29
Sample Number: 19-279-24 **Depth:** 35-36.5 **Date:** 8/15/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-279-24

Tested By: AR **Checked By:** CC

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.5	9.8	31.0	28.6	29.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.5	100.0		
.375	99.3		
#4	98.5		
#10	88.7		
#16	78.0		
#40	57.7		
#50	51.5		
#100	38.9		
#200	29.1		

* (no specification provided)

Material Description

Dark Brown clayey sand

Atterberg Limits

PL= 13 LL= 25 PI= 12

Coefficients

D_{90}= 2.1513 D_{85}= 1.6474 D_{60}= 0.4816
D_{50}= 0.2770 D_{30}= 0.0802 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-6(0)

Remarks

Location: BR-29
Sample Number: 19-279-25 **Depth:** 45-46.5 **Date:** 8/15/2019

NewFields

Client: NDOT
Project: US395 NDOT North Valleys
Project No: 475.0398.000 **Figure** 19-279-25

Tested By: AR **Checked By:** CC

NewFields

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

NF Form #15

Client:	NDOT	**Location:**	See Below
Project Title:	US395 NDOT North Valleys	**Elevation:**	See Below
Project Number:	475.0398.000	**Test Date:**	8/13/2019
Project Engineer:	Mark Doehring	**Tested By:**	AH
Field Sample ID:	BH19-RW	**Checked By:**	JH

Drying Conditions: 60 deg C / **110 deg C** Method: **Oven (O)** / Microwave (M) / Hot Plate (H)

Sample No.		19-277-01	19-277-02	19-277-03	19-227-04	19-277-05
Location		RW1-02	RW1-03	RW1-05	RW2-07	RW2-08
Depth		5-6.5'	7.5-9'	7.5-9'	7.5-9'	7.5-9'
Soil Description						
(USCS)						
Trial No.		**1**	**2**	**3**	**4**	**5**
Tare No.						
Tare + Wet Soil	A	2433.5	530.1	975	519.9	865.5
Tare + Dry Soil	B	2054.6	446	778.4	461.4	728.7
Tare	C	590.6	189.6	121.2	122.8	120.1
Wt. of Water	D= A-B	378.9	84.1	196.6	58.5	136.8
Dry Soil, Ws	E= B-C	1464	256.4	657.2	338.6	608.6
Moisture Content, (%)	**(D/E) x100**	**25.9%**	**32.8%**	**29.9%**	**17.3%**	**22.5%**

Sample No.		19-277-07	19-277-08	19-277-09	19-277-10	19-277-11
Location		RW3-13	RW3-16	RW3-18	RW3-21	RW3-22
Depth		7.5-9'	10-11.5'	15-16.5'	7.5-9'	15-16.5'
Soil Description						
(USCS)						
Trial No.		**6**	**7**	**8**	**9**	**10**
Tare No.						
Tare + Wet Soil	A	678.4	949.6	823.9	899.7	890.7
Tare + Dry Soil	B	624.7	849	698.4	813.7	829.1
Tare	C	123.4	123.6	125.2	124.7	125
Wt. of Water	D= A-B	53.7	100.6	125.5	86	61.6
Dry Soil, Ws	E= B-C	501.3	725.4	573.2	689	704.1
Moisture Content, (%)	**(D/E) x100**	**10.7%**	**13.9%**	**21.9%**	**12.5%**	**8.7%**

Remarks:

NewFields

NF Form #15

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

Client:	NDOT	**Location:**	See Below
Project Title:	US395 NDOT North Valleys	**Elevation:**	See Below
Project Number:	475.0398.000	**Test Date:**	8/13/2019
Project Engineer:	Mark Doehring	**Tested By:**	AH
Field Sample ID:	BH19-RW	**Checked By:**	JH

Drying Conditions: 60 deg C / [✓ 110 deg C] Method: [✓ Oven (O)] / Microwave (M) / Hot Plate (H)

Sample No.		19-277-12	19-277-13	19-277-15	19-277-17	19-277-19
Location		RW3-24	RW4-26	RW11-64	RW12-67	RW6-31
Depth		5-6.5'	30-31.5'	7.5-8.5'	25-26.5'	6-6.5'
Soil Description						
(USCS)						
Trial No.		**11**	**12**	**13**	**14**	**15**
Tare No.						
Tare + Wet Soil	**A**	3299.1	840.2	487.7	823.5	882.7
Tare + Dry Soil	**B**	3045.1	758.1	448.8	670.5	788.7
Tare	**C**	597.1	189.6	44.9	45.2	45.3
Wt. of Water	**D= A-B**	254	82.1	38.9	153	94
Dry Soil, Ws	**E= B-C**	2448	568.5	403.9	625.3	743.4
Moisture Content, (%)	**(D/E) x100**	**10.4%**	**14.4%**	**9.6%**	**24.5%**	**12.6%**

Sample No.		19-277-06				
Location		RW3-11				
Depth		5-5.5'				
Soil Description						
(USCS)						
Trial No.		**16**	**17**	**18**	**19**	**20**
Tare No.						
Tare + Wet Soil	**A**	729.1				
Tare + Dry Soil	**B**	669.6				
Tare	**C**	45				
Wt. of Water	**D= A-B**	59.5				
Dry Soil, Ws	**E= B-C**	624.6				
Moisture Content, (%)	**(D/E) x100**	**9.5%**				

Remarks:

NewFields

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

NF Form #15

Client:	NDOT	**Location:**	See Below
Project Title:	US395 NDOT North Valleys	**Elevation:**	See Below
Project Number:	475.0398.001	**Test Date:**	7/1/2019
Project Engineer:	Mark Doehring	**Tested By:**	JH
Field Sample ID:	See Below	**Checked By:**	JH

Drying Conditions: 60 deg C / **110 deg C** Method: **Oven (O)** / Microwave (M) / Hot Plate (H)

Sample No.		19-211-01	19-211-02	19-211-03	19-211-04	19-211-05
Location		RW6-31	RW6-32	RW12-69	RW12-69	RW12-69
Depth		2.5-4'	15-16.5'	7.5-9'	15-16.5'	30-30.5'
Soil Description						
(USCS)						
Trial No.		**1**	**2**	**3**	**4**	**5**
Tare No.						
Tare + Wet Soil	A	592.5	567.5	495.8	709.4	479.1
Tare + Dry Soil	B	550	498.4	446.6	654.8	448.7
Tare	C	22	22	22	22	22
Wt. of Water	D= A-B	42.5	69.1	49.2	54.6	30.4
Dry Soil, Ws	E= B-C	528	476.4	424.6	632.8	426.7
Moisture Content, (%)	**(D/E) x100**	**8.0%**	**14.5%**	**11.6%**	**8.6%**	**7.1%**

Sample No.		19-211-05	19-211-07	19-211-09		
Location		RW12-69	RW6-32	RW12-70		
Depth		40-41.5'	2.5-4'	35-36'		
Soil Description						
(USCS)						
Trial No.		**6**	**7**	**8**	**9**	**10**
Tare No.						
Tare + Wet Soil	A	736.1	736.1	341.7		
Tare + Dry Soil	B	694.3	694.3	296		
Tare	C	22	22	22		
Wt. of Water	D= A-B	41.8	41.8	45.7		
Dry Soil, Ws	E= B-C	672.3	672.3	274		
Moisture Content, (%)	**(D/E) x100**	**6.2%**	**6.2%**	**16.7%**		

Remarks:

NewFields

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

NF Form #15

Client:	NDOT	**Location:**	See Below
Project Title:	US395 NDOT North Valleys	**Elevation:**	See Below
Project Number:	475.0398.000	**Test Date:**	5/30/2019
Project Engineer:	Mark Doehring	**Tested By:**	OS
Field Sample ID:	See Below	**Checked By:**	JH

Drying Conditions: 60 deg C / [✓ 110 deg C] Method: [✓ Oven (O)] / Microwave (M) / Hot Plate (H)

Sample No.		19-161-02	19-161-03	19-161-04		
Location		RW4-26	RW4-27	RW4-27		
Depth		15-16.5'	15-16.5'	35-36.5'		
Soil Description						
(USCS)						
Trial No.		**1**	**2**	**3**	**4**	**5**
Tare No.						
Tare + Wet Soil	**A**	779	633.8	395.2		
Tare + Dry Soil	**B**	672.6	570.1	366.5		
Tare	**C**	45.1	45.2	44.8		
Wt. of Water	**D= A-B**	106.4	63.7	28.7		
Dry Soil, Ws	**E= B-C**	627.5	524.9	321.7		
Moisture Content, (%)	**(D/E) x100**	**17.0%**	**12.1%**	**8.9%**		

Sample No.						
Location						
Depth						
Soil Description						
(USCS)						
Trial No.		**6**	**7**	**8**	**9**	**10**
Tare No.						
Tare + Wet Soil	**A**					
Tare + Dry Soil	**B**					
Tare	**C**					
Wt. of Water	**D= A-B**					
Dry Soil, Ws	**E= B-C**					
Moisture Content, (%)	**(D/E) x100**					

Remarks:

NewFields

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

NF Form #15

Client:	NDOT	**Location:**	See Below
Project Title:	US395 NDOT North Valleys	**Elevation:**	See Below
Project Number:	475.0398.000	**Test Date:**	5/22/2019
Project Engineer:	Mark Doehring	**Tested By:**	JH
Field Sample ID:	BH19-RW	**Checked By:**	JH

Drying Conditions: 60 deg C / **110 deg C** Method: **Oven (O)** / Microwave (M) / Hot Plate (H)

Sample No.		19-148-01	19-148-03	19-148-05	19-148-06	19-148-07
Location		RW5-28	RW5-28	RW5-29	RW5-29	RW5-29
Depth		5-6'	40-41.5'	15-16.5'	25-26.5'	35-36.5'
Soil Description						
(USCS)						
Trial No.		**1**	**2**	**3**	**4**	**5**
Tare No.						
Tare + Wet Soil	**A**	1641.1	811	578.5	605.5	803.1
Tare + Dry Soil	**B**	1408.4	655.2	527.9	525.1	672.1
Tare	**C**	21.9	21.8	22.1	22.1	22.1
Wt. of Water	**D= A-B**	232.7	155.8	50.6	80.4	131
Dry Soil, Ws	**E= B-C**	1386.5	633.4	505.8	503	650
Moisture Content, (%)	**(D/E) x100**	**16.8%**	**24.6%**	**10.0%**	**16.0%**	**20.2%**

Sample No.		19-148-08	19-148-09	19-148-10	19-148-13	19-148-14
Location		RW7-34	RW7-34	RW7-34	RW7-38	RW7-38
Depth		2.5-4'	15-16.5'	5-6'	2.5-4'	10'2"-10'8"
Soil Description						
(USCS)						
Trial No.		**6**	**7**	**8**	**9**	**10**
Tare No.						
Tare + Wet Soil	**A**	639.9	480.8	994.5	742.6	715.3
Tare + Dry Soil	**B**	608.7	439.9	908.6	674.7	651.2
Tare	**C**	22	22	22	22.1	22
Wt. of Water	**D= A-B**	31.2	40.9	85.9	67.9	64.1
Dry Soil, Ws	**E= B-C**	586.7	417.9	886.6	652.6	629.2
Moisture Content, (%)	**(D/E) x100**	**5.3%**	**9.8%**	**9.7%**	**10.4%**	**10.2%**

Remarks:

NewFields

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

NF Form #15

Client:	NDOT	**Location:**	See Below
Project Title:	US395 NDOT North Valleys	**Elevation:**	See Below
Project Number:	475.0398.000	**Test Date:**	5/22/2019
Project Engineer:	Mark Doehring	**Tested By:**	JH
Field Sample ID:	BH19-RW	**Checked By:**	JH

Drying Conditions: 60 deg C / [✓ **110 deg C**] Method: [✓ **Oven (O)**] / Microwave (M) / Hot Plate (H)

Sample No.	19-148-15	19-148-16	19-148-17	19-148-18	19-148-19
Location	RW7-40	RW7-41	RW7-41	RW7-42	RW7-42
Depth	5'11"-6.5'	2.5-4'	11-11.5'	2.5-4'	7.5-9'
Soil Description					
(USCS)					
Trial No.	**11**	**12**	**13**	**14**	**15**
Tare No.					
Tare + Wet Soil **A**	896.5	772.4	907.8	543.5	702.7
Tare + Dry Soil **B**	853.2	709.8	788.7	512.6	640.3
Tare **C**	22.3	22	22	22.3	22
Wt. of Water **D= A-B**	43.3	62.6	119.1	30.9	62.4
Dry Soil, Ws **E= B-C**	830.9	687.8	766.7	490.3	618.3
Moisture Content, (%) **(D/E) x100**	**5.2%**	**9.1%**	**15.5%**	**6.3%**	**10.1%**

Sample No.	19-148-21	19-148-22	19-148-23	19-148-24	19-148-26
Location	RW7-44	RW7-44	RW7-45	RW7-46	RW8-49
Depth	7.5-9'	15-16.5'	2.5-4'	2.5-4'	2.5-3'
Soil Description					
(USCS)					
Trial No.	**16**	**17**	**18**	**19**	**20**
Tare No.					
Tare + Wet Soil **A**	559	618.7	730.1	853.4	410
Tare + Dry Soil **B**	518.9	540.2	678.1	780.2	391.2
Tare **C**	22	22	22	22	22.1
Wt. of Water **D= A-B**	40.1	78.5	52	73.2	18.8
Dry Soil, Ws **E= B-C**	496.9	518.2	656.1	758.2	369.1
Moisture Content, (%) **(D/E) x100**	**8.1%**	**15.1%**	**7.9%**	**9.7%**	**5.1%**

Remarks:

NewFields

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

NF Form #15

Client:	NDOT	**Location:**	See Below
Project Title:	US395 NDOT North Valleys	**Elevation:**	See Below
Project Number:	475.0398.000	**Test Date:**	7/26/2019
Project Engineer:	Mark Doehring	**Tested By:**	JH
Field Sample ID:	BH19-RW	**Checked By:**	JH

Drying Conditions: 60 deg C / **110 deg C** Method: **Oven (O)** / Microwave (M) / Hot Plate (H)

Sample No.		19-249-01	19-249-02	19-249-03	19-249-05	19-249-06
Location		RW8-47	RW8-47	RW8-48	RW9-51	RW9-51
Depth		2.5-4'	15-15.5'	6-6.5'	2.5-4'	10.5-11'
Soil Description						
(USCS)						
Trial No.		**1**	**2**	**3**	**4**	**5**
Tare No.						
Tare + Wet Soil	**A**	1082.7	264.5	1141.9	529.4	988.2
Tare + Dry Soil	**B**	988.5	243.9	966.6	489.4	855.8
Tare	**C**	189.4	120.9	223	125	123.3
Wt. of Water	**D= A-B**	94.2	20.6	175.3	40	132.4
Dry Soil, Ws	**E= B-C**	799.1	123	743.6	364.4	732.5
Moisture Content, (%)	**(D/E) x100**	**11.8%**	**16.7%**	**23.6%**	**11.0%**	**18.1%**

Sample No.		19-249-09	19-249-10			
Location		RW10-53	RW10-53			
Depth		5-6.5'	10-11.5'			
Soil Description						
(USCS)						
Trial No.		**6**	**7**	**8**	**9**	**10**
Tare No.						
Tare + Wet Soil	**A**	643	643.3			
Tare + Dry Soil	**B**	535.1	578.8			
Tare	**C**	44.5	190.2			
Wt. of Water	**D= A-B**	107.9	64.5			
Dry Soil, Ws	**E= B-C**	490.6	388.6			
Moisture Content, (%)	**(D/E) x100**	**22.0%**	**16.6%**			

Remarks:

NewFields

NF Form #15

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

Client:	NDOT	**Location:**	See Below
Project Title:	US395 NDOT North Valleys	**Elevation:**	See Below
Project Number:	475.0398.000	**Test Date:**	5/22/2019
Project Engineer:	Mark Doehring	**Tested By:**	JH
Field Sample ID:	BH19-RW	**Checked By:**	JH

Drying Conditions: 60 deg C / [✓ **110 deg C**] Method: [✓ **Oven (O)**] / Microwave (M) / Hot Plate (H)

Sample No.		19-148-32	19-148-33	19-148-34	19-148-35	19-148-36
Location		RW11-57	RW11-57	RW11-58	RW11-58	RW11-58
Depth		2.5-4'	10-11.5'	0-1.5'	10-11.5'	15-16.5'
Soil Description						
(USCS)						
Trial No.		**21**	**22**	**23**	**24**	**25**
Tare No.						
Tare + Wet Soil	**A**	1011.3	950.8	1097.3	1206.6	1739.9
Tare + Dry Soil	**B**	920.5	881.2	952.9	1047.8	1591.9
Tare	**C**	22.1	22	22	22	22
Wt. of Water	**D= A-B**	90.8	69.6	144.4	158.8	148
Dry Soil, Ws	**E= B-C**	898.4	859.2	930.9	1025.8	1569.9
Moisture Content, (%)	**(D/E) x100**	**10.1%**	**8.1%**	**15.5%**	**15.5%**	**9.4%**

Sample No.						
Location						
Depth						
Soil Description						
(USCS)						
Trial No.		**26**	**27**	**28**	**29**	**30**
Tare No.						
Tare + Wet Soil	**A**					
Tare + Dry Soil	**B**					
Tare	**C**					
Wt. of Water	**D= A-B**					
Dry Soil, Ws	**E= B-C**					
Moisture Content, (%)	**(D/E) x100**					

Remarks:

NewFields

NF Form #15

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

Client:	NDOT	**Location:**	See Below
Project Title:	US395 NDOT North Valleys	**Elevation:**	See Below
Project Number:	475.0398.000	**Test Date:**	7/1/2019
Project Engineer:	Mark Doehring	**Tested By:**	JH
Field Sample ID:	See Below	**Checked By:**	JH

Drying Conditions: 60 deg C / [✓ **110 deg C**] Method: [✓ **Oven (O)**] / Microwave (M) / Hot Plate (H)

Sample No.		19-213-01	19-213-02	19-213-03	19-213-08	19-213-10
Location		BH19-BR-02	BH19-BR-02	BH19-BR-02	BH19-BR-09	BH19-BR-17
Depth		15-15.5'	25-25.5'	40-41.5'	11-11.5'	15-16.5'
Soil Description						
(USCS)						
Trial No.		**1**	**2**	**3**	**4**	**5**
Tare No.						
Tare + Wet Soil	A	398.6	320.6	1223.5	961.1	689.4
Tare + Dry Soil	B	372.7	300	1098.7	813.9	553.8
Tare	C	22	22	22	22	22
Wt. of Water	D= A-B	25.9	20.6	124.8	147.2	135.6
Dry Soil, Ws	E= B-C	350.7	278	1076.7	791.9	531.8
Moisture Content, (%)	**(D/E) x100**	**7.4%**	**7.4%**	**11.6%**	**18.6%**	**25.5%**

Sample No.		19-213-13	19-213-14	19-213-15	19-213-16	
Location		BH19-BR-17	BH19-BR-23	BH19-BR-23	BH19-BR-23	
Depth		65-66.5'	10-11'	25-26.5'	35-36.5'	
Soil Description						
(USCS)						
Trial No.		**6**	**7**	**8**	**9**	**10**
Tare No.						
Tare + Wet Soil	A	876.9	1438.4	941.1	829.1	
Tare + Dry Soil	B	713.2	1298	861.1	723.2	
Tare	C	22	22	22	22	
Wt. of Water	D= A-B	163.7	140.4	80	105.9	
Dry Soil, Ws	E= B-C	691.2	1276	839.1	701.2	
Moisture Content, (%)	**(D/E) x100**	**23.7%**	**11.0%**	**9.5%**	**15.1%**	

Remarks:

NewFields

MOISTURE CONTENT

(ASTM D 2216 / ASTM D 4643)

LABORATORY WORKSHEET

NF Form #15

Client:	NDOT	**Location:**	See Below
Project Title:	US395 NDOT North Valleys	**Elevation:**	See Below
Project Number:	475.0398.000	**Test Date:**	7/1/2019
Project Engineer:	Mark Doehring	**Tested By:**	JH
Field Sample ID:	See Below	**Checked By:**	JH

Drying Conditions: 60 deg C / **110 deg C** Method: **Oven (O)** / Microwave (M) / Hot Plate (H)

Sample No.		19-212-01	19-212-02	19-212-03	19-212-05	19-212-06
Location		BH19-BR18	BH19-BR18	BH19-BR18	BH19-BR25	BH19-BR25
Depth		25-26.5'	31-31.5'	40.5-41'	11-11.5'	21-21.5'
Soil Description						
(USCS)						
Trial No.		**1**	**2**	**3**	**4**	**5**
Tare No.						
Tare + Wet Soil	**A**	1101.4	975.1	1053.4	834.5	869.7
Tare + Dry Soil	**B**	954.7	893	931.3	723	718.6
Tare	**C**	22	22	22	22	22
Wt. of Water	**D= A-B**	146.7	82.1	122.1	111.5	151.1
Dry Soil, Ws	**E= B-C**	932.7	871	909.3	701	696.6
Moisture Content, (%)	**(D/E) x100**	**15.7%**	**9.4%**	**13.4%**	**15.9%**	**21.7%**

Sample No.		19-212-07				
Location		BH19-BR25				
Depth		31-31.5'				
Soil Description						
(USCS)						
Trial No.		**6**	**7**	**8**	**9**	**10**
Tare No.						
Tare + Wet Soil	**A**	887.5				
Tare + Dry Soil	**B**	696.9				
Tare	**C**	22				
Wt. of Water	**D= A-B**	190.6				
Dry Soil, Ws	**E= B-C**	674.9				
Moisture Content, (%)	**(D/E) x100**	**28.2%**				

Remarks:

NewFields

NF Form #15

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

Client:	NDOT	**Location:**	See Below
Project Title:	US395 NDOT North Valleys	**Elevation:**	See Below
Project Number:	475.0398.000	**Test Date:**	7/26/2019
Project Engineer:	Mark Doehring	**Tested By:**	JH
Field Sample ID:	BH19-BR	**Checked By:**	JH

Drying Conditions: 60 deg C / [✓ 110 deg C] Method: [✓ Oven (O)] / Microwave (M) / Hot Plate (H)

Sample No.	19-248-01	19-248-02	19-248-04	19-248-06	19-248-07
Location	BH19-BR-03	BH19-BR-06	BHH19-BR-06	BH19-BR-07	BH19-BR-07
Depth	55-55.5'	7.5-9'	40-41'	25-26.5'	50-51.5'
Soil Description					
(USCS)					
Trial No.	**1**	**2**	**3**	**4**	**5**
Tare No.					
Tare + Wet Soil **A**	341.7	801.9	1302.8	729.6	829.3
Tare + Dry Soil **B**	318.6	701.6	1105	624.6	711.7
Tare **C**	125.4	45.1	126.6	120.2	124.7
Wt. of Water **D= A-B**	23.1	100.3	197.8	105	117.6
Dry Soil, Ws **E= B-C**	193.2	656.5	978.4	504.4	587
Moisture Content, (%) **(D/E) x100**	**12.0%**	**15.3%**	**20.2%**	**20.8%**	**20.0%**

Sample No.	19-248-08	19-248-09	19-248-14	19-248-15	19-248-17
Location	BH19-BR-14	BH19-BR-14	BH19-BR-19	BH19-BR-19	BH19-BR-25A
Depth	7.5-9'	20-21.5'	35-36'	50-51'	35-36.5'
Soil Description					
(USCS)					
Trial No.	**6**	**7**	**8**	**9**	**10**
Tare No.					
Tare + Wet Soil **A**	711.2	723.5	606	670.8	836.1
Tare + Dry Soil **B**	622.6	642	537.6	595.2	790.7
Tare **C**	121.7	44.8	121.2	124.6	189.4
Wt. of Water **D= A-B**	88.6	81.5	68.4	75.6	45.4
Dry Soil, Ws **E= B-C**	500.9	597.2	416.4	470.6	601.3
Moisture Content, (%) **(D/E) x100**	**17.7%**	**13.6%**	**16.4%**	**16.1%**	**7.6%**

Remarks:

NewFields

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

NF Form #15

Client:	NDOT	**Location:**	See Below
Project Title:	US395 NDOT North Valleys	**Elevation:**	See Below
Project Number:	475.0398.000	**Test Date:**	5/22/2019
Project Engineer:	Mark Doehring	**Tested By:**	JH
Field Sample ID:	BH19-BR-20	**Checked By:**	JH

Drying Conditions: 60 deg C / [✓ **110 deg C**] Method: [✓ **Oven (O)**] / Microwave (M) / Hot Plate (H)

Sample No.		19-147-02	19-147-03			
Location		BR-20	BR-20			
Depth		40.5-41'	65-66.5'			
Soil Description						
(USCS)						
Trial No.		**1**	**2**	**3**	**4**	**5**
Tare No.						
Tare + Wet Soil	**A**	858	1206			
Tare + Dry Soil	**B**	771.7	1079.2			
Tare	**C**	21.8	21.8			
Wt. of Water	**D= A-B**	86.3	126.8			
Dry Soil, Ws	**E= B-C**	749.9	1057.4			
Moisture Content, (%)	**(D/E) x100**	**11.5%**	**12.0%**			

Sample No.						
Location						
Depth						
Soil Description						
(USCS)						
Trial No.		**6**	**7**	**8**	**9**	**10**
Tare No.						
Tare + Wet Soil	**A**					
Tare + Dry Soil	**B**					
Tare	**C**					
Wt. of Water	**D= A-B**					
Dry Soil, Ws	**E= B-C**					
Moisture Content, (%)	**(D/E) x100**					

Remarks:

NewFields

NF Form #15

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

Client:	NDOT	**Location:**	See Below
Project Title:	US395 NDOT NORTH VALLEYS	**Elevation:**	See Below
Project Number:	475.0398.000	**Test Date:**	8/13/2019
Project Engineer:	MARK DOEHRING	**Tested By:**	AJH
Field Sample ID:	BH19-BR	**Checked By:**	CC

Drying Conditions: 60 deg C / [✓ **110 deg C**] Method: [✓ **Oven (O)**] / Microwave (M) / Hot Plate (H)

Sample No.	19-279-21	19-279-23	19-279-24	19-279-25	
Location	BR-25C	BR-29	BR-29	BR-29	
Depth	15-16.5	15-16.5	35-36.5	45-46.5	
Soil Description					
(USCS)					
Trial No.	**11**	**12**	**13**	**14**	**15**
Tare No.					
Tare + Wet Soil **A**	599.8	1351.7	1240.7	1383.3	
Tare + Dry Soil **B**	552.9	1222.2	1104	1229.2	
Tare **C**	120.5	173.2	44.8	119.6	
Wt. of Water **D= A-B**	46.9	129.5	136.7	154.1	
Dry Soil, Ws **E= B-C**	432.4	1049	1059.2	1109.6	
Moisture Content, (%) **(D/E) x100**	**10.8%**	**12.3%**	**12.9%**	**13.9%**	

Sample No.					
Location					
Depth					
Soil Description					
(USCS)					
Trial No.	**16**	**17**	**18**	**19**	**20**
Tare No.					
Tare + Wet Soil **A**					
Tare + Dry Soil **B**					
Tare **C**					
Wt. of Water **D= A-B**					
Dry Soil, Ws **E= B-C**					
Moisture Content, (%) **(D/E) x100**					

Remarks:

NewFields

NATURAL DENSITY (ASTM 2937)

LABORATORY WORKSHEET

NF Form #16

Client:	NDOT	**Location:**	See Below
Project Title:	US395 NDOT North Valleys	**Elevation:**	See Below
Project Number:	475.0398.000	**Test Date:**	5/30/2019
Project Engineer:	Mark Doehring	**Tested By:**	OS
Field Sample ID:	See Below	**Checked By:**	JH
Laboratory Sample ID:	19-161		

Drying Conditions: 60 deg C / **110 deg C** Method: **Oven (O)** / Microwave (M)

Trail No.		1	2	3	4	5
Sample No.		19-161-01	19-161-05			
Location		RW4-26	RW4-27			
Depth		6-6.5'	40.5-41'			
Soil Description						
(USCS)						
Soil + Liner Wt., g.	**A**	1134.2	1163.9			
Liner Wt., g.	**B**	253.1	245.3			
Soil Wt., g.	**C= A-B**	881.1	918.6			
Liner Length, in.	**D_1**	5.998	5.991			
Sample Length, in.	**D_2**	5.998	5.991			
Liner Diameter, in.	**E**	2.413	2.435			
Liner Area, in^2	**F= $(E^2/4)$*pi**	4.57	4.66			
Sample Volume, in^3	**G= D_2*F**	27.43	27.90			
Sample Wet Density, pcf	**H= (C/G)*3.81**	122.4	125.4			
Sample Dry Density, pcf	**H/(1+(N/100))**	106.3	100.9			
Tare No.						
Tare + Wet Soil	**I**	1137.9	1031.5			
Tare + Dry Soil	**J**	1022.5	853.2			
Tare	**K**	257.5	121.12			
Wt. of Water	**L= I-J**	115.4	178.3			
Dry Soil, Ws	**M=-J-K**	765.0	732.1			
Moisture Content, (%)	**N= (L/M) x100**	15.1%	24.4%			

Remarks:

NATURAL DENSITY (ASTM 2937)

LABORATORY WORKSHEET

NF Form #16

Client:	NDOT	**Location:**	See Below
Project Title:	US395 NDOT North Valleys	**Elevation:**	See Below
Project Number:	475.0398.000	**Test Date:**	5/22/2019
Project Engineer:	Mark Doehring	**Tested By:**	JH
Field Sample ID:	See Below	**Checked By:**	JH
Laboratory Sample ID:	19-148		

Drying Conditions: 60 deg C / **110 deg C** Method: **Oven (O)** / Microwave (M)

Trail No.		**1**	**2**	**3**	**4**	**5**
Sample No.		19-148-02	19-148-04	19-148-11	19-148-12	19-148-20
Location		RW5-28	RW5-29	RW7-34	RW7-36	RW7-43
Depth		10-11.5'	6-6.5'	11-11.5'	6-6.5'	6-6.5'
Soil Description						
(USCS)						
Soil + Liner Wt., g.	**A**	1169.9	1024.3	999.1	842.9	1104.5
Liner Wt., g.	**B**	234.0	243.8	239.4	235.8	239.9
Soil Wt., g.	**C= A-B**	935.9	780.5	759.7	607.1	864.6
Liner Length, in.	**D_1**	5.958	5.95	5.954	5.958	5.934
Sample Length, in.	**D_2**	5.958	4.981	5.255	5.14	5.697
Liner Diameter, in.	**E**	2.407	2.401	2.405	2.421	2.406
Liner Area, in^2	**F= $(E^2/4)$*pi**	4.55	4.53	4.54	4.60	4.55
Sample Volume, in^3	**G= D_2*F**	27.11	22.55	23.87	23.66	25.90
Sample Wet Density, pcf	**H= (C/G)*3.81**	131.5	131.9	121.2	97.8	127.2
Sample Dry Density, pcf	**H/(1+(N/100))**	116.3	120.1	108.4	88.8	116.8
Tare No.						
Tare + Wet Soil	**I**	954.6	802	781.5	629	886.6
Tare + Dry Soil	**J**	846.3	732.4	701	573.2	815.9
Tare	**K**	22.0	22	22	22.3	22.1
Wt. of Water	**L= I-J**	108.3	69.6	80.5	55.8	70.7
Dry Soil, Ws	**M=-J-K**	824.3	710.4	679.0	550.9	793.8
Moisture Content, (%)	**N= (L/M) x100**	13.1%	9.8%	11.9%	10.1%	8.9%

Remarks:

NewFields **NATURAL DENSITY (ASTM 2937)** NF Form #16

LABORATORY WORKSHEET

Client:	NDOT	**Location:**	See Below
Project Title:	US395 NDOT North Valleys	**Elevation:**	See Below
Project Number:	475.0398.000	**Test Date:**	5/22/2019
Project Engineer:	Mark Doehring	**Tested By:**	JH
Field Sample ID:	See Below	**Checked By:**	JH
Laboratory Sample ID:	19-148		

Drying Conditions: 60 deg C / 110 deg C Method: Oven (O) / Microwave (M)

Trail No.		**6**	**7**	**8**	**9**	**10**
Sample No.		19-148-25	19-148-27	19-148-28	19-148-29	19-148-30
Location		RW7-46	RW11-54	RW11-54	RW11-55	RW11-56
Depth		11-11.5'	2.5-4	10-11.5'	5-6.5'	2.5-4'
Soil Description						
(USCS)						
Soil + Liner Wt., g.	**A**	1015.6	1084.6	1121.8	1130.1	1271.4
Liner Wt., g.	**B**	234.4	232.7	235.2	236.0	241.5
Soil Wt., g.	**C= A-B**	781.2	851.9	886.6	894.1	1029.9
Liner Length, in.	**D_1**	5.937	5.957	5.953	5.944	5.943
Sample Length, in.	**D_2**	5.210	5.957	5.953	5.944	5.943
Liner Diameter, in.	**E**	2.414	2.422	2.406	2.426	2.418
Liner Area, in^2	**$F= (D_2^2/4)*pi$**	4.58	4.61	4.55	4.62	4.59
Sample Volume, in^3	**$G= D_2*F$**	23.85	27.45	27.07	27.48	27.29
Sample Wet Density, pcf	**H= (C/G)*3.81**	124.8	118.3	124.8	124.0	143.8
Sample Dry Density, pcf	**H/(1+(N/100))**	114.2	106.5	110.4	111.2	127.0
Tare No.						
Tare + Wet Soil	**I**	803.4	873.9	908.4	914.8	1026.6
Tare + Dry Soil	**J**	737.1	789.4	806.1	822.7	909.4
Tare	**K**	22.1	22	21.8	21.9	22.1
Wt. of Water	**L= I-J**	66.3	84.5	102.3	92.1	117.2
Dry Soil, Ws	**M=-J-K**	715.0	767.4	784.3	800.8	887.3
Moisture Content, (%)	**N= (L/M) x100**	9.3%	11.0%	13.0%	11.5%	13.2%

Remarks:

NewFields

NATURAL DENSITY (ASTM 2937)

LABORATORY WORKSHEET

NF Form #16

Client:	NDOT	**Location:**	See Below
Project Title:	US395 NDOT North Valleys	**Elevation:**	See Below
Project Number:	475.0398.000	**Test Date:**	7/26/2019
Project Engineer:	Mark Doehring	**Tested By:**	AR
Field Sample ID:	BH19-RW	**Checked By:**	JH
Laboratory Sample ID:	19-249		

Drying Conditions: 60 deg C / **110 deg C** Method: **Oven (O)** / Microwave (M)

Trail No.		**1**	**2**	**3**	**4**	**5**
Sample No.		19-249-08	19-249-07			
Location		RW9-52	RW9-52			
Depth		11-11.5'	5.5-6'			
Soil Description						
(USCS)						
Soil + Liner Wt., g.	**A**	1169.5	1053.8			
Liner Wt., g.	**B**	242.4	257.8			
Soil Wt., g.	**C= A-B**	927.1	796.0			
Liner Length, in.	**D_1**	5.964	5.977			
Sample Length, in.	**D_2**	5.964	5.512			
Liner Diameter, in.	**E**	2.410	2.200			
Liner Area, in^2	**F= $(E^2/4)$*pi**	4.56	3.80			
Sample Volume, in^3	**G= D_2*F**	27.21	20.95			
Sample Wet Density, pcf	**H= (C/G)*3.81**	129.8	144.7			
Sample Dry Density, pcf	**H/(1+(N/100))**	113.0	128.7			
Tare No.						
Tare + Wet Soil	**I**	1112.3	913.3			
Tare + Dry Soil	**J**	992.6	825.7			
Tare	**K**	188.8	122.2			
Wt. of Water	**L= I-J**	119.7	87.6			
Dry Soil, Ws	**M=-J-K**	803.8	703.5			
Moisture Content, (%)	**N= (L/M) x100**	14.9%	12.5%			

Remarks: ____________________

NewFields

NATURAL DENSITY (ASTM 2937)

LABORATORY WORKSHEET

NF Form #16

Client:	NDOT	**Location:**	See Below
Project Title:	US395 NDOT North Valleys	**Elevation:**	See Below
Project Number:	475.0398.000	**Test Date:**	5/22/2019
Project Engineer:	Mark Doehring	**Tested By:**	JH
Field Sample ID:	See Below	**Checked By:**	JH
Laboratory Sample ID:	19-148		

Drying Conditions: 60 deg C / 110 deg C   Method: Oven (O) / Microwave (M)

Trail No.		**11**	**12**	**13**	**14**	**15**
Sample No.		19-148-31				
Location		RW11-56				
Depth		10-11.5'				
Soil Description						
(USCS)						
Soil + Liner Wt., g.	**A**	1071.8				
Liner Wt., g.	**B**	240.0				
Soil Wt., g.	**C= A-B**	831.8				
Liner Length, in.	**D_1**	5.968				
Sample Length, in.	**D_2**	5.968				
Liner Diameter, in.	**E**	2.428				
Liner Area, in^2	**F= $(D_2^2/4)$*pi**	4.63				
Sample Volume, in^3	**G= D_2*F**	27.63				
Sample Wet Density, pcf	**H= (C/G)*3.81**	114.7				
Sample Dry Density, pcf	**H/(1+(N/100))**	107.6				
Tare No.						
Tare + Wet Soil	**I**	853.8				
Tare + Dry Soil	**J**	802.5				
Tare	**K**	22.2				
Wt. of Water	**L= I-J**	51.3				
Dry Soil, Ws	**M=-J-K**	780.3				
Moisture Content, (%)	**N= (L/M) x100**	6.6%				

Remarks: ____________________

NewFields

NATURAL DENSITY (ASTM 2937)

LABORATORY WORKSHEET

NF Form #16

Client:	NDOT	**Location:**	See Below
Project Title:	US395 NDOT North Valleys	**Elevation:**	See Below
Project Number:	475.0398.000	**Test Date:**	8/13/2019
Project Engineer:	Mark Doehring	**Tested By:**	OS
Field Sample ID:	BH19-RW	**Checked By:**	JH
Laboratory Sample ID:	19-277		

Drying Conditions: 60 deg C / [✓ 110 deg C] Method: [✓ Oven (O)] / Microwave (M)

Trail No.		1	2	3	4	5
Sample No.		19-277-14	19-277-16	19-277-18		
Location		RW11-61	RW11-66	RW12-67		
Depth		10.5-11'	10.5-11'	41-41.5'		
Soil Description						
(USCS)						
Soil + Liner Wt., g.	**A**	1113.9	1133.3	1082.0		
Liner Wt., g.	**B**	251.6	257.0	255.0		
Soil Wt., g.	**C= A-B**	862.3	876.3	827.0		
Liner Length, in.	**D_1**	5.955	5.963	5.988		
Sample Length, in.	**D_2**	5.955	5.963	5.988		
Liner Diameter, in.	**E**	2.431	2.425	2.425		
Liner Area, in^2	**$F= (E^2/4)*pi$**	4.64	4.62	4.62		
Sample Volume, in^3	**$G= D_2*F$**	27.64	27.54	27.66		
Sample Wet Density, pcf	**H= (C/G)*3.81**	118.9	121.2	113.9		
Sample Dry Density, pcf	**H/(1+(N/100))**	111.1	107.8	84.8		
Tare No.						
Tare + Wet Soil	**I**	976.4	1000	1012		
Tare + Dry Soil	**J**	920.7	903.2	801.8		
Tare	**K**	121.1	125.6	188.9		
Wt. of Water	**L= I-J**	55.7	96.8	210.2		
Dry Soil, Ws	**M=-J-K**	799.6	777.6	612.9		
Moisture Content, (%)	**N= (L/M) x100**	7.0%	12.4%	34.3%		

Remarks:

NewFields **NATURAL DENSITY (ASTM 2937)** NF Form #16

LABORATORY WORKSHEET

Client:	NDOT	**Location:**	See Below
Project Title:	US395 NDOT North Valleys	**Elevation:**	See Below
Project Number:	475.0398.000	**Test Date:**	7/1/2019
Project Engineer:	Mark Doehring	**Tested By:**	JH
Field Sample ID:	See Below	**Checked By:**	JH
Laboratory Sample ID:	19-211		

Drying Conditions: 60 deg C / **110 deg C** Method: **Oven (O)** / Microwave (M)

Trail No.		**1**	**2**	**3**	**4**	**5**
Sample No.		19-211-08				
Location		RW12-70				
Depth		11-11.5'				
Soil Description						
(USCS)						
Soil + Liner Wt., g.	**A**	1067.0				
Liner Wt., g.	**B**	255.2				
Soil Wt., g.	**C= A-B**	811.8				
Liner Length, in.	**D_1**	5.944				
Sample Length, in.	**D_2**	5.450				
Liner Diameter, in.	**E**	2.412				
Liner Area, in^2	**F= $(E^2/4)$*pi**	4.57				
Sample Volume, in^3	**G= D_2*F**	24.90				
Sample Wet Density, pcf	**H= (C/G)*3.81**	124.2				
Sample Dry Density, pcf	**H/(1+(N/100))**	108.6				
Tare No.						
Tare + Wet Soil	**I**	833.2				
Tare + Dry Soil	**J**	731.5				
Tare	**K**	22.0				
Wt. of Water	**L= I-J**	101.7				
Dry Soil, Ws	**M=-J-K**	709.5				
Moisture Content, (%)	**N= (L/M) x100**	14.3%				

Remarks:

NewFields **NATURAL DENSITY (ASTM 2937)** NF Form #16

LABORATORY WORKSHEET

Client:	NDOT	**Location:**	See Below
Project Title:	US395 NDOT North Valleys	**Elevation:**	See Below
Project Number:	475.0398.000	**Test Date:**	7/1/2019
Project Engineer:	Mark Doehring	**Tested By:**	AS/KG
Field Sample ID:	See Below	**Checked By:**	JH
Laboratory Sample ID:	19-213		

Drying Conditions: 60 deg C / 110 deg C Method: Oven (O) / Microwave (M)

Trail No.		**6**	**7**	**8**	**9**	**10**
Sample No.		19-213-11	19-213-12			
Location		BR-17	BR-17			
Depth		40.5-41'	51-51.5'			
Soil Description						
(USCS)						
Soil + Liner Wt., g.	**A**	1258.0	1239.8			
Liner Wt., g.	**B**	229.9	232.7			
Soil Wt., g.	**C= A-B**	1028.1	1007.1			
Liner Length, in.	**D_1**	5.977	5.953			
Sample Length, in.	**D_2**	5.977	5.953			
Liner Diameter, in.	**E**	2.409	2.388			
Liner Area, in^2	**$F= (D_2^2/4)*pi$**	4.56	4.48			
Sample Volume, in^3	**$G= D_2*F$**	27.24	26.66			
Sample Wet Density, pcf	**H= (C/G)*3.81**	143.8	143.9			
Sample Dry Density, pcf	**H/(1+(N/100))**	124.5	121.7			
Tare No.						
Tare + Wet Soil	**I**	1048.8	1029.8			
Tare + Dry Soil	**J**	911.0	873.9			
Tare	**K**	22.0	22			
Wt. of Water	**L= I-J**	137.8	155.9			
Dry Soil, Ws	**M=-J-K**	889.0	851.9			
Moisture Content, (%)	**N= (L/M) x100**	15.5%	18.3%			

Remarks:

NewFields

NATURAL DENSITY (ASTM 2937)

LABORATORY WORKSHEET

NF Form #16

Client:	NDOT	**Location:**	See Below
Project Title:	US395 NDOT North Valleys	**Elevation:**	See Below
Project Number:	475.0398.000	**Test Date:**	7/26/2019
Project Engineer:	Mark Doehring	**Tested By:**	AR/AS
Field Sample ID:	BH19-BR	**Checked By:**	JH
Laboratory Sample ID:	See Below		

Drying Conditions: 60 deg C / 110 deg C

Method: Oven (O) / Microwave (M)

Trail No.		**6**	**7**	**8**	**9**	**10**
Sample No.		19-248-13	19-248-16	19-248-18	19-248-19	
Location		BR-19	BR-25A	BR-28	BR-28	
Depth		20.5-21'	21-21.5'	21-21.5'	31-31.5'	
Soil Description						
(USCS)						
Soil + Liner Wt., g.	**A**	991.5	1168.4	1196.4	1167.4	
Liner Wt., g.	**B**	236.5	250.3	238.2	202.2	
Soil Wt., g.	**C= A-B**	755.0	918.1	958.2	965.2	
Liner Length, in.	**D_1**	5.946	5.995	5.96	5.913	
Sample Length, in.	**D_2**	5.377	5.651	5.72	5.913	
Liner Diameter, in.	**E**	2.431	2.407	2.397	2.246	
Liner Area, in^2	**$F= (D_2^2/4)*pi$**	4.64	4.55	4.51	3.96	
Sample Volume, in^3	**$G= D_2*F$**	24.96	25.71	25.81	23.43	
Sample Wet Density, pcf	**H= (C/G)*3.81**	115.3	136.0	141.4	157.0	
Sample Dry Density, pcf	**H/(1+(N/100))**	97.9	122.2	126.1	142.2	
Tare No.						
Tare + Wet Soil	**I**	868.3	959.2	1145	1151.1	
Tare + Dry Soil	**J**	755.4	866.1	1041.9	1060.6	
Tare	**K**	120.2	45	191.1	188.5	
Wt. of Water	**L= I-J**	112.9	93.1	103.1	90.5	
Dry Soil, Ws	**M=-J-K**	635.2	821.1	850.8	872.1	
Moisture Content, (%)	**N= (L/M) x100**	17.8%	11.3%	12.1%	10.4%	

Remarks:

NewFields

NATURAL DENSITY (ASTM 2937)

LABORATORY WORKSHEET

NF Form #16

Client:	NDOT	**Location:**	See Below
Project Title:	US395 NDOT North Valleys	**Elevation:**	See Below
Project Number:	475.0398.000	**Test Date:**	5/22/2019
Project Engineer:	Mark Doehring	**Tested By:**	JH
Field Sample ID:	BH19-BR-20	**Checked By:**	JH
Laboratory Sample ID:	19-147		

Drying Conditions: 60 deg C / [✓ 110 deg C] Method: [✓ Oven (O)] / Microwave (M)

Trail No.		**1**	**2**	**3**	**4**	**5**
Sample No.		19-147-01				
Location		BR-20				
Depth		21-21.5'				
Soil Description						
(USCS)						
Soil + Liner Wt., g.	**A**	1190.2				
Liner Wt., g.	**B**	236.2				
Soil Wt., g.	**C= A-B**	954.0				
Liner Length, in.	**D_1**	5.959				
Sample Length, in.	**D_2**	5.959				
Liner Diameter, in.	**E**	2.401				
Liner Area, in^2	**$F= (E^2/4)*pi$**	4.53				
Sample Volume, in^3	**$G= D_2*F$**	26.98				
Sample Wet Density, pcf	**H= (C/G)*3.81**	134.7				
Sample Dry Density, pcf	**H/(1+(N/100))**	123.6				
Tare No.						
Tare + Wet Soil	**I**	973.7				
Tare + Dry Soil	**J**	895.3				
Tare	**K**	21.8				
Wt. of Water	**L= I-J**	78.4				
Dry Soil, Ws	**M=-J-K**	873.5				
Moisture Content, (%)	**N= (L/M) x100**	9.0%				

Remarks:

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 08/23/2019
Date Submitted 08/20/2019

To: Kerry Magner
Newfields MDTS
2227 N. 5th St.
Elko, NV 89801

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : BH19-RW1-03 Site ID : 7.5-9 FT.
Your purchase order number is 4750398.
Thank you for your business.

* For future reference to this analysis please use SUN # 80415-168071.

EVALUATION FOR SOIL CORROSION

Soil pH	7.85	
Minimum Resistivity	0.27 ohm-cm (x1000)	
Chloride	97.0 ppm	00.00970 %
Sulfate	148.9ppm	00.01489 %
Redox Potential	No Test	
Sulfides	No Test	

METHODS
pH AASHTO T289, Min.Resistivity AASHTO T288 Mod.(Sm.Cell)
Sulfate AASHTO T290, Chloride AASHTO T291
Redox Potential ASTM G-200, Sulfides AWWA C105/A25.5

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 08/23/2019
Date Submitted 08/20/2019

To: Kerry Magner
Newfields MDTS
2227 N. 5th St.
Elko, NV 89801

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : BH19-RW2-07 Site ID : 7.5-9 FT.
Your purchase order number is 4750398.
Thank you for your business.

* For future reference to this analysis please use SUN # 80415-168072.

EVALUATION FOR SOIL CORROSION

Soil pH	6.17	
Minimum Resistivity	0.35 ohm-cm (x1000)	
Chloride	338.2 ppm	00.03382 %
Sulfate	31.0ppm	00.00310 %
Redox Potential	No Test	
Sulfides	No Test	

METHODS
pH AASHTO T289, Min.Resistivity AASHTO T288 Mod.(Sm.Cell)
Sulfate AASHTO T290, Chloride AASHTO T291
Redox Potential ASTM G-200, Sulfides AWWA C105/A25.5

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 08/23/2019
Date Submitted 08/20/2019

To: Kerry Magner
Newfields MDTS
2227 N. 5th St.
Elko, NV 89801

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : BH19-RW3-11 Site ID : 5.5-6 FT.
Your purchase order number is 4750398.
Thank you for your business.

* For future reference to this analysis please use SUN # 80415-168073.

EVALUATION FOR SOIL CORROSION

Soil pH	7.05	
Minimum Resistivity	0.86 ohm-cm (x1000)	
Chloride	95.1 ppm	00.00951 %
Sulfate	8.2ppm	00.00082 %
Redox Potential	No Test	
Sulfides	No Test	

METHODS
pH AASHTO T289, Min.Resistivity AASHTO T288 Mod.(Sm.Cell)
Sulfate AASHTO T290, Chloride AASHTO T291
Redox Potential ASTM G-200, Sulfides AWWA C105/A25.5

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 08/23/2019
Date Submitted 08/20/2019

To: Kerry Magner
Newfields MDTS
2227 N. 5th St.
Elko, NV 89801

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : BH19-RW3-17 Site ID : 10-11.5 FT.
Your purchase order number is 4750398.
Thank you for your business.

* For future reference to this analysis please use SUN # 80415-168074.

EVALUATION FOR SOIL CORROSION

Soil pH	6.98		
Minimum Resistivity	0.23 ohm-cm (x1000)		
Chloride	280.2 ppm	00.02802	%
Sulfate	1380.4ppm	00.13804	%
Redox Potential	No Test		
Sulfides	No Test		

METHODS
pH AASHTO T289, Min.Resistivity AASHTO T288 Mod.(Sm.Cell)
Sulfate AASHTO T290, Chloride AASHTO T291
Redox Potential ASTM G-200, Sulfides AWWA C105/A25.5

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 06/19/2019
Date Submitted 06/12/2019

To: Kerry Magner
Newfields MDTS
2227 N. 5th St.
Elko, NV 89801

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 475.0398.000 Site ID : BH19-RW4-26@5-6.
Thank you for your business.

* For future reference to this analysis please use SUN # 79836-166808.

EVALUATION FOR SOIL CORROSION

Soil pH	7.20	
Minimum Resistivity	0.25 ohm-cm (x1000)	
Chloride	258.5 ppm	00.02585 %
Sulfate	630.6ppm	00.06306 %
Redox Potential	No Test	
Sulfides	No Test	

METHODS
pH AASTO T289, Min.Resistivity AASTO T288 Mod.(Sm.Cell)
Sulfate AASHTO T290, Chloride AASHTO T291
Redox Potential ASTM G-200, Sulfides AWWA C105/A25.5

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Reprint of Report

Date Reported 07/10/2019
Date Submitted 07/01/2019

To: Kerry Magner
Newfields MDTS
2227 N. 5th St.
Elko, NV 89801

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : BH19-RW5-28 7.5 FT Site ID : 12.
Your purchase order number is 4750398.
Thank you for your business.

* For future reference to this analysis please use SUN # 79994-167109.

EVALUATION FOR SOIL CORROSION

Soil pH	11.48		
Minimum Resistivity	0.35	ohm-cm (x1000)	
Chloride	31.3 ppm	00.00313	%
Sulfate	51.3ppm	00.00513	%
Redox Potential	No Test		
Sulfides	No Test		

METHODS
pH AASHTO T289, Min.Resistivity AASHTO T288 Mod.(Sm.Cell)
Sulfate AASHTO T290, Chloride AASHTO T291
Redox Potential ASTM G-200, Sulfides AWWA C105/A25.5

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 07/10/2019
Date Submitted 07/01/2019

To: Kerry Magner
Newfields MDTS
2227 N. 5th St.
Elko, NV 89801

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : BH19-RW6-32 7.5-9 FT Site ID : S3.
Your purchase order number is 4750398.
Thank you for your business.

* For future reference to this analysis please use SUN # 79995-167123.

EVALUATION FOR SOIL CORROSION

Soil pH	7.05	
Minimum Resistivity	1.31 ohm-cm (x1000)	
Chloride	47.4 ppm	00.00474 %
Sulfate	0.4ppm	00.00004 %
Redox Potential	No Test	
Sulfides	No Test	

METHODS
pH AASTO T289, Min.Resistivity AASTO T288 Mod.(Sm.Cell)
Sulfate AASHTO T290, Chloride AASHTO T291
Redox Potential ASTM G-200, Sulfides AWWA C105/A25.5

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(916) 852-8557

Date Reported 07/10/2019
Date Submitted 07/01/2019

To: Kerry Magner
Newfields MDTS
2227 N. 5th St.
Elko, NV 89801

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : BH19-RW7-44 10-11.5 Site ID : S-4.
Your purchase order number is 4750398.
Thank you for your business.

* For future reference to this analysis please use SUN # 79994-167110.

EVALUATION FOR SOIL CORROSION

Soil pH	6.03		
Minimum Resistivity	2.28	ohm-cm (x1000)	
Chloride	38.6 ppm	00.00386	%
Sulfate	7.3ppm	00.00073	%
Redox Potential	No Test		
Sulfides	No Test		

METHODS
pH AASTO T289, Min.Resistivity AASTO T288 Mod.(Sm.Cell)
Sulfate AASHTO T290, Chloride AASHTO T291
Redox Potential ASTM G-200, Sulfides AWWA C105/A25.5

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 08/14/2019
Date Submitted 08/09/2019

To: Kerry Magner
Newfields MDTS
2227 N. 5th St.
Elko, NV 89801

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : BH19-RW8-48 Site ID : 2.5-4 FT.
Your purchase order number is 4750398.
Thank you for your business.

* For future reference to this analysis please use SUN # 80337-167915.

EVALUATION FOR SOIL CORROSION

Soil pH	5.90		
Minimum Resistivity	0.32	ohm-cm (x1000)	
Chloride	352.5 ppm	00.03525	%
Sulfate	720.9ppm	00.07209	%
Redox Potential	No Test		
Sulfides	No Test		

METHODS
pH AASHTO T289, Min.Resistivity AASHTO T288 Mod.(Sm.Cell)
Sulfate AASHTO T290, Chloride AASHTO T291
Redox Potential ASTM G-200, Sulfides AWWA C105/A25.5

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Reprint of Report
Dated ______

Date Reported 07/10/2019
Date Submitted 07/01/2019

To: Kerry Magner
Newfields MDTS
2227 N. 5th St.
Elko, NV 89801

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : BH19-RW8-49 5-6.5 FT Site ID : S-61.
Your purchase order number is 4750398.
Thank you for your business.

* For future reference to this analysis please use SUN # 79994-167111.

EVALUATION FOR SOIL CORROSION

Soil pH	6.41		
Minimum Resistivity	1.21	ohm-cm (x1000)	
Chloride	78.5 ppm	00.00785	%
Sulfate	21.7ppm	00.00217	%
Redox Potential	No Test		
Sulfides	No Test		

METHODS
pH AASHTO T289, Min.Resistivity AASHTO T288 Mod.(Sm.Cell)
Sulfate AASHTO T290, Chloride AASHTO T291
Redox Potential ASTM G-200, Sulfides AWWA C105/A25.5

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 08/14/2019
Date Submitted 08/09/2019

To: Kerry Magner
Newfields MDTS
2227 N. 5th St.
Elko, NV 89801

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : BH19-RW9-51 Site ID : 7.5-9 FT.
Your purchase order number is 4750398.
Thank you for your business.

* For future reference to this analysis please use SUN # 80337-167916.

EVALUATION FOR SOIL CORROSION

Soil pH	4.71	
Minimum Resistivity	0.38 ohm-cm (x1000)	
Chloride	76.5 ppm	00.00765 %
Sulfate	127.7ppm	00.01277 %
Redox Potential	No Test	
Sulfides	No Test	

METHODS
pH AASHTO T289, Min.Resistivity AASHTO T288 Mod.(Sm.Cell)
Sulfate AASHTO T290, Chloride AASHTO T291
Redox Potential ASTM G-200, Sulfides AWWA C105/A25.5

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 08/14/2019
Date Submitted 08/09/2019

To: Kerry Magner
Newfields MDTS
2227 N. 5th St.
Elko, NV 89801

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : BH19-RW10-53 Site ID : 8-9 FT.
Your purchase order number is 4750398.
Thank you for your business.

* For future reference to this analysis please use SUN # 80337-167917.

EVALUATION FOR SOIL CORROSION

Soil pH	6.75		
Minimum Resistivity	1.34	ohm-cm (x1000)	
Chloride	20.8 ppm	00.00208	%
Sulfate	24.0ppm	00.00240	%
Redox Potential	No Test		
Sulfides	No Test		

METHODS
pH AASHTO T289, Min.Resistivity AASHTO T288 Mod.(Sm.Cell)
Sulfate AASHTO T290, Chloride AASHTO T291
Redox Potential ASTM G-200, Sulfides AWWA C105/A25.5

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Reprint of Report
Dated

Date Reported 07/10/2019
Date Submitted 07/01/2019

To: Kerry Magner
Newfields MDTS
2227 N. 5th St.
Elko, NV 89801

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : BH19-RW11-58 7.5-8FT Site ID : 4.
Your purchase order number is 4750398.
Thank you for your business.

* For future reference to this analysis please use SUN # 79995-167117.

EVALUATION FOR SOIL CORROSION

Soil pH	7.06	
Minimum Resistivity	0.83 ohm-cm (x1000)	
Chloride	74.4 ppm	00.00744 %
Sulfate	12.6ppm	00.00126 %
Redox Potential	No Test	
Sulfides	No Test	

METHODS
pH AASHTO T289, Min.Resistivity AASHTO T288 Mod.(Sm.Cell)
Sulfate AASHTO T290, Chloride AASHTO T291
Redox Potential ASTM G-200, Sulfides AWWA C105/A25.5

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 08/23/2019
Date Submitted 08/20/2019

To: Kerry Magner
Newfields MDTS
2227 N. 5th St.
Elko, NV 89801

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : BH19-RW11-64 Site ID : 5.5-6 FT.
Your purchase order number is 4750398.
Thank you for your business.

* For future reference to this analysis please use SUN # 80415-168075.

EVALUATION FOR SOIL CORROSION

Soil pH	6.90		
Minimum Resistivity	0.48	ohm-cm (x1000)	
Chloride	323.6 ppm	00.03236	%
Sulfate	176.9ppm	00.01769	%
Redox Potential	No Test		
Sulfides	No Test		

METHODS
pH AASHTO T289, Min.Resistivity AASHTO T288 Mod.(Sm.Cell)
Sulfate AASHTO T290, Chloride AASHTO T291
Redox Potential ASTM G-200, Sulfides AWWA C105/A25.5

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Reprint of Report
Dated ____________

Date Reported 07/10/2019
Date Submitted 07/01/2019

To: Kerry Magner
Newfields MDTS
2227 N. 5th St.
Elko, NV 89801

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : BH19-RW12-70 25-26.5 Site ID : S-5.
Your purchase order number is 4750398.
Thank you for your business.

* For future reference to this analysis please use SUN # 79995-167122.

EVALUATION FOR SOIL CORROSION

Soil pH	7.33	
Minimum Resistivity	0.72 ohm-cm (x1000)	
Chloride	173.3 ppm	00.01733 %
Sulfate	393.5ppm	00.03935 %
Redox Potential	No Test	
Sulfides	No Test	

METHODS
pH AASHTO T289, Min.Resistivity AASHTO T288 Mod.(Sm.Cell)
Sulfate AASHTO T290, Chloride AASHTO T291
Redox Potential ASTM G-200, Sulfides AWWA C105/A25.5

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 07/10/2019
Date Submitted 07/01/2019

To: Kerry Magner
Newfields MDTS
2227 N. 5th St.
Elko, NV 89801

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : BH19-BR17 45-46.5 FT Site ID : S-11.
Your purchase order number is 4750398.
Thank you for your business.

* For future reference to this analysis please use SUN # 79995-167118.

EVALUATION FOR SOIL CORROSION

Soil pH	6.47	
Minimum Resistivity	0.64 ohm-cm (x1000)	
Chloride	110.5 ppm	00.01105 %
Sulfate	64.3ppm	00.00643 %
Redox Potential	No Test	
Sulfides	No Test	

METHODS
pH AASTO T289, Min.Resistivity AASTO T288 Mod.(Sm.Cell)
Sulfate AASHTO T290, Chloride AASHTO T291
Redox Potential ASTM G-200, Sulfides AWWA C105/A25.5

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Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 07/10/2019
Date Submitted 07/01/2019

To: Kerry Magner
Newfields MDTS
2227 N. 5th St.
Elko, NV 89801

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager \

The reported analysis was requested for the following location:
Location : BH19-BR18 20-21 FT Site ID : MC03B.
Your purchase order number is 4750398.
Thank you for your business.

* For future reference to this analysis please use SUN # 79995-167121.

EVALUATION FOR SOIL CORROSION

Soil pH	6.30	
Minimum Resistivity	1.07 ohm-cm (x1000)	
Chloride	77.6 ppm	00.00776 %
Sulfate	69.6ppm	00.00696 %
Redox Potential	No Test	
Sulfides	No Test	

METHODS
pH AASTO T289, Min.Resistivity AASTO T288 Mod.(Sm.Cell)
Sulfate AASHTO T290, Chloride AASHTO T291
Redox Potential ASTM G-200, Sulfides AWWA C105/A25.5

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Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 08/14/2019
Date Submitted 08/09/2019

To: Kerry Magner
Newfields MDTS
2227 N. 5th St.
Elko, NV 89801

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : BH19-BR-19 Site ID : 25-26.5 FT.
Your purchase order number is 4750398.
Thank you for your business.

* For future reference to this analysis please use SUN # 80337-167912.

EVALUATION FOR SOIL CORROSION

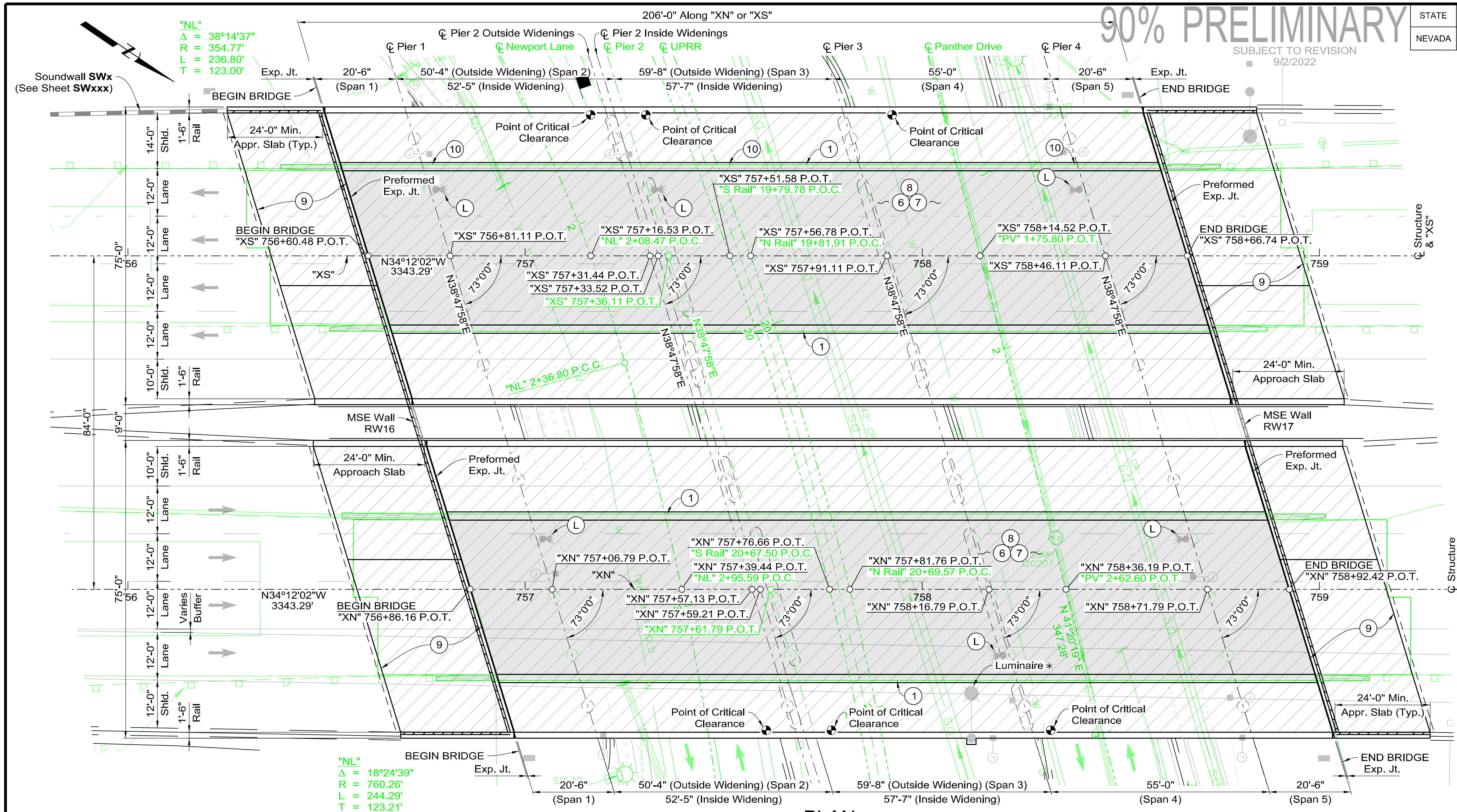
Soil pH	3.76	
Minimum Resistivity	2.55 ohm-cm (x1000)	
Chloride	52.6 ppm	00.00526 %
Sulfate	1.9ppm	00.00019 %
Redox Potential	No Test	
Sulfides	No Test	

METHODS
pH AASHTO T289, Min.Resistivity AASHTO T288 Mod.(Sm.Cell)
Sulfate AASHTO T290, Chloride AASHTO T291
Redox Potential ASTM G-200, Sulfides AWWA C105/A25.5

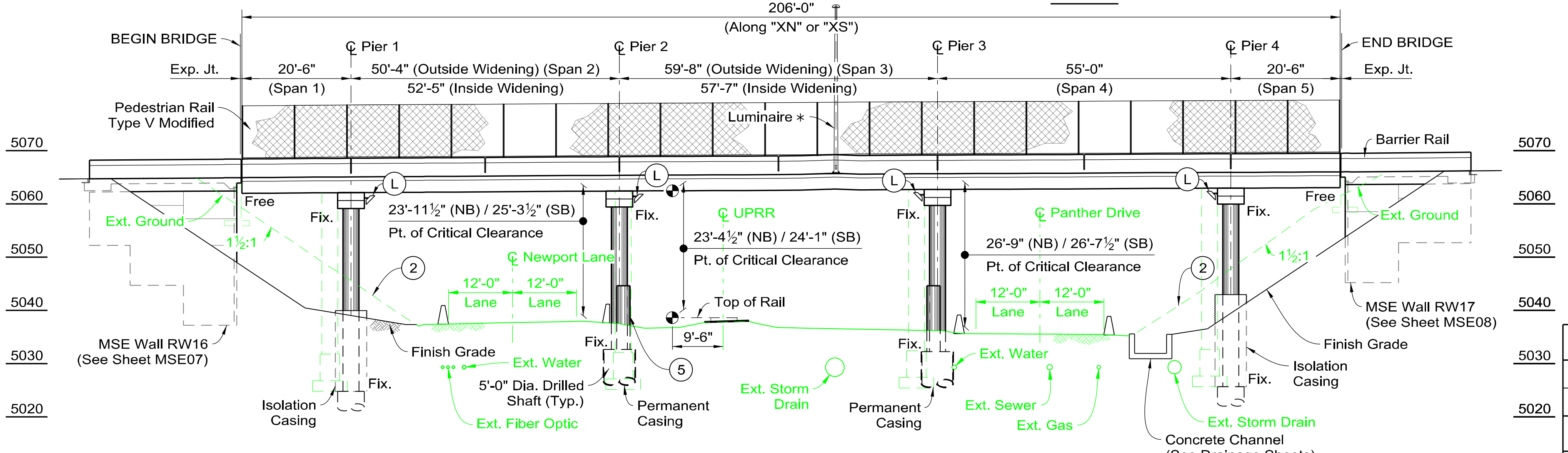
APPENDIX B

Select 90% Plans

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	B100



PLAN



Ⓛ - Denotes under deck lighting
(See Lighting Plans)

∗ - Luminaire
(See Lighting Plans)

DEVELOPED ELEVATION

DESCRIPTION OF WORK

① Remove existing barrier rail, and overhang (Bid Item 202 0125). See Sheet B108 for removal limits and details.

② Remove existing concrete slope paving, abutments, wingwalls, and approach slabs. Construct MSE walls. See MSE wall plans for details and quantities. See Landscape and Aesthetic Plans for new slope treatment.

③ Construct bridge widenings, see Sheet B106 for construction sequencing.

④ Retrofit all existing columns (Item No. 502 0450) (See details on Sheet **B1xx**).
  - A. Chip concrete to depth of longitudinal rebar and cut specified bars.
  - B. Patch exposed reinforcing streel.
  - C. Where specified, wrap columns with composite casing.

⑤ Construct railroad crash walls for all columns at Pier 2 See Sheet B117 for details.

⑥ Remove existing composite overlay (Bid Item 202 0120). Care shall be taken to protect existing concrete bridge deck from damage.

⑦ Repair existing concrete bridge deck (Bid Item 502 0360). Remove damaged concrete to such a depth that sound concrete is exposed over the entire repair area. Blast clean any exposed reinforcing steel. Prepare repair areas and patch per 502.03.15. Submit proposed patch material for review 30 days prior to start of deck repair.

⑧ Bridge deck and approach slab preparation and polymer concrete overlay placement.
  - A. Prepare bridge deck and approach slabs in accordance with the manufacturer's recommendations (Bid Item 496 0130).
  - B. Place polyester based overlay system for a total depth of approximately ¾" on bridge deck and ¾" on approach slabs (Bid Item 496 0130, 496 0160, & 496 0170).

⑨ Expansion joint replacement.
  - A. Remove existing preformed expansion joint filler (Bid Item 202 0160)
  - B. Install new 2-inch preformed expansion joint filler at abutments per manufacturer's specifications and as shown in detail on Sheet B144 (Bid Item 502 2000).
  - C. Install new 2-inch preformed expansion joint filler at approach slabs and roadway per manufacturer's specifications and as shown in detail on Sheet B144 (Bid Item 502 2000).

⑩ Concrete superstructure repair (Bid Item 502 0380). Remove damaged concrete to such a depth that sound concrete is exposed over the entire repair area. Blast clean any exposed reinforcing steel. Prepare repair areas and patch per 502.03.15.

LEGEND

▩	Limits of Polymer Concrete Overlay Removal, Barrier Rail Removal, and Concrete Bridge Deck Repair
▨	Limits of Polymer Concrete Overlay

∗∗ - All utility locations are approximate and are for coordination purposes only. All utilities are to be field located prior to start of construction and protected in place unless noted otherwise in plans.

Note: See Geometrics Sheet B103 for Roadway profiles.

ORIGINAL CONTRACT: 1286
MODIFIED CONTRACTS: 1513,2032,2325,2983,3272

UPRR MILEPOST:	8.15
UPRR SUBDIVISION:	RENO IND. LD.
PROJECT CITY:	RENO
REVISION DATE:	OCTOBER 28,2021
LAT. / LONG.:	39°35'12.77" N / 119°49'25.69" W

GEOTECHNICAL DESIGN DIVISION
DESIGNED BY: GEORGE HELGERSON
PRINCIPAL: KYLE JERMSTAD

STRUCTURAL DESIGN DIVISION
DESIGNED BY: NATHAN HARRISON
DRAWN BY: ANNA CLOSE
PRINCIPAL: MICHAEL TAYLOR

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

US 395 - WA 30.04
PANTHER VALLEY
UPRR OVERPASS

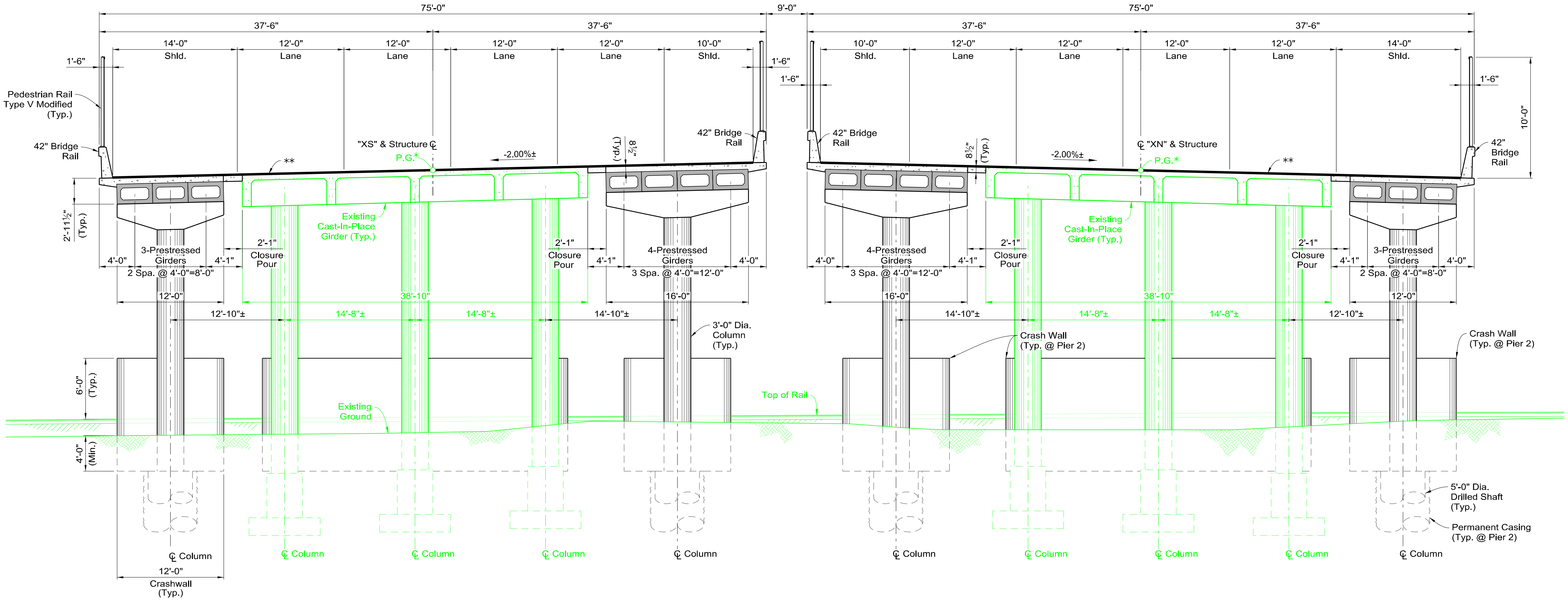
G-1092 N&S

DATE : 9/2/2022

90% PRELIMINARY
SUBJECT TO REVISION
9/2/2022

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	B101

∗ - Riding surface of Bridge Deck and Approach Slabs ¾" above Profile Grade.
∗∗ - ¾" Polymer Concrete Overlay (See Sheet B102, Note 18)



TYPICAL SECTION

LOOKING AHEAD ON LINE
NORMAL TO ALIGNMENT
(THROUGH PIER 2)

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

TYPICAL
SECTION

G-1092 N&S

DATE : 9/2/2022

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	B102

GENERAL NOTES

1. Design Specifications: AASHTO "LRFD Bridge Design Specifications" Eighth Edition 2017, AASHTO "Guide Specifications for LRFD Seismic Bridge Design" Second Edition 2011, with interims through 2015, and "NDOT Structures Manual" 2008, with interims through 2019. Seismic Retrofit designed in accordance with FHWA "Seismic Retrofitting Manual for Highway Structures: Part 1 Bridges" 2006.

2. Construction Specifications: State of Nevada Department of Transportation "Standard Specifications for Road and Bridge Construction, 2014" except as noted below and in The Special Provisions of this Contract.

3. Dead Load: In accordance with Specifications with an allowance of 38 psf for future wearing surface and 12 psf for stay-in-place deck formwork.

4. Live Load: AASHTO HL-93 Loading. Overload design based on California "Standard Permit Design Vehicles" (Maximum Overload P-13 Truck). Deck Design based on the Equivalent Strip Method with a 40.0 kip axle.

5. Seismic Load: PGA Coefficient = 0.50g, Short Period Coefficient (S_s) = 1.25g, Long Period Coefficient (S_1) = 0.50g, Site Class C Soil Profile (SDC D). γ_{EQ} = 0.25.

6. Concrete: See Concrete Placement Schedule and Diagram for concrete class and compressive strengths.

7. Reinforcing Steel: All reinforcing steel shall be ASTM A706. Reinforcing steel for precast girders may be A615 or A706. Dimensions relating to bar spacing are center to center. Bending dimensions are from out to out of the bars. Bar sizes three (3) to nine (9) are indicated by the first number of the mark; ten (10) or larger by the first two numbers. Bar marks with a letter prefix indicate a bent bar. Bar marks with a "D" suffix indicate a doweled bar. Bar marks ending with either the letter "E" or "ED" indicate that the bar shall be epoxy coated the length of the bar. Sizes four (4) and five (5), when considered as bars to control temperature, shrinkage, and distribution stresses by the Engineer, may be adjusted upon concurrence and approval of the Engineer.

8. Dowelled reinforcing steel: Reinforcing to be dowelled in the existing concrete shall be epoxied in drilled holes with a maximum diameter equal to the bar diameter plus ¼". Holes shall be cleaned with oil free compressed air after drilling. Care shall be taken to avoid damaging existing reinforcing. Minimum embedment shall be 12" unless shown otherwise.

9. Foundations: Piers shall be on drilled shaft foundations. For factored axial resistance, refer to Geotechnical Report from NewFields titled "Geotechnical Design Report, US395 North Valleys, Washoe County, Nevada" dated January 2021.

10. Camber: Camber shall be as shown on the Plans.

11. Barrier Rail: Designed for TL-4.

12. Construction Type Code: x581.

13. Concrete construction joints designated as a "Permissible Joint" or as an "Optional Construction Joint" may be incorporated into the construction at the Contractor's option. Joints designated as a "Construction Joint" are considered mandatory and shall be incorporated into the construction unless otherwise approved in writing by the Bridge Design Engineer.

14. Elevations and roadway profile information in these plans are approximate and are based on Contract 1286, adjusted to the survey datum for this project. Contractor to verify profile and elevations prior to construction to ensure a smooth roadway profile between new bridge deck and existing roadway. Any discrepancies shall be brought to the attention of the Engineer prior to construction.

15. All dimensions are measured at 60 °F unless noted otherwise.

16. Verification of Existing Conditions: Before ordering materials or commencing work on any item which may be affected by the dimensions or elevations of the existing structure, the Contractor shall field verify those dimensions and elevations and shall notify the Engineer of any field measured dimensions or elevations which deviate substantially from these plans prior to commencing the work. No direct payment will be made for field measurements.

17. All exposed concrete surfaces of new and existing structures (excluding bridge deck) to receive stain or surface treatments as specified in the Landscape & Aesthetic Plans (Bid Item 212 0045). Finishes to extend one foot minimum below surface grade.

18. Install ¾" polymer concrete overlay to bridge deck and approach slabs. Polymer concrete shall be installed from face of rail to face of rail. Refer to Section 496 of the Contract Special Provisions.

SHEET INDEX

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B102	General Notes and Quantities
B103	Geometrics
B104A	UPRR Coordination Plan
B104B	Railroad Profiles
B104C	Railroad Shoring Zones
B104D	Pier 2 Crashwall Shoring Plan
B105	Excavation and Backfill
B106	Bridge Construction Sequence
B107	Bridge Construction Phases
B108	Removal Details
B109	Pier 1 Elevation
B110	Pier 2 Elevation
B111	Pier 3 Elevation
B112	Pier 4 Elevation
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B114	Column and Drilled Shaft Reinforcing, 2 of 3
B115	Column and Drilled Shaft Reinforcing, 3 of 3
B116	Isolation and Permanent Casing Details
B117	Crash Wall Details
B118	Column Seismic Retrofit Details
B119	Inside Widening Pier Cap Reinforcing
B120	Outside Widening Pier Cap Reinforcing
B121	Pier Cap Details
B122	Typical Section Inside Widening
B123	Typical Section Outside Widening
B124	Precast Girder Framing Plan
B125	Precast Girder Prestressing Details
B126	Precast Girder Reinforcement
B127	Tie Rod Details
B128	CIP Soffit Reinforcing
B129	CIP Girder Reinforcing
B130	Inside Widening Pier Closure Reinforcing
B131	Outside Widening Pier Closure Reinforcing
B132	Pier Cap Closure Details
B133	Inside Widening CIP Deck Reinforcing
B134	Outside Widening CIP Deck Reinforcing
B135	Camber and Concrete Placement Diagrams
B136	NB Phase 1 Approach Slab Replacement
B137	SB Phase 1 Approach Slab Replacement
B138	NB Phase 2 Approach Slab Replacement
B139	SB Phase 2 Approach Slab Replacement
B140	Approach Slab Sections and Details
B141	Bridge Rail Spans 1, 2, and 3
B142	Bridge Rail Spans 3, 4, and 5
B143	Pedestrian Rail Type V Modified Details
B144	Expansion Joint Details
B145	Bent Bars, 1 of 2
B146	Bent Bars, 2 of 2
B147	Quantities, 1 of 4
B148	Quantities, 2 of 4
B149	Quantities, 3 of 4
B150	Quantities, 4 of 4

QUANTITIES

ITEM NO.	ITEM DESCRIPTION	UNIT	NB	SB	QUANTITY
202 0120	REMOVAL OF PORTION OF BRIDGE DECK	SQYD	893	893	1,786
202 0125	REMOVAL OF PORTION OF BRIDGE	LS	1	1	1
202 0160	REMOVAL OF EXPANSION JOINT	LIN FT	163	163	326
206 0110	STRUCTURE EXCAVATION	CUYD	144	144	288
207 0110	GRANULAR BACKFILL	CUYD	35	35	70
496 0130	BRIDGE DECK PREPARATION AND CONCRETE PLACEMENT	SQYD	2,160	2,160	4,320
496 0160	POLYMER CONCRETE AGGREGATE	POUND	151,811	151,811	303,622
496 0170	POLYMER CONCRETE RESIN	POUND	21,254	21,254	42,508
502 0360	CONCRETE BRIDGE DECK REPAIR	FA	1	1	1
502 0380	CONCRETE SUPERSTRUCTURE REPAIR	FA	1	1	1
502 0400	REPAIR SUBSTRUCTURE	FA	1	1	1
502 0450	SEISMIC RETROFIT OF COLUMNS	LS	1	1	1
502 0881	CLASS DA CONCRETE, MODIFIED (MAJOR) (STRUCTURES)	CUYD	338	338	676
502 1010	CLASS EA CONCRETE, MODIFIED (MAJOR)	CUYD	421	421	842
502 1950	BRIDGE DECK CURING COMPOUND	GAL	77	77	154
502 2000	PREFORMED JOINT FILLER (2-INCH)	LINFT	301	301	602
503 0360	48-FOOT PRECAST CONCRETE MEMBERS	EACH	3	3	6
503 0370	50-FOOT PRECAST CONCRETE MEMBERS	EACH	4	4	8
503 0400	53-FOOT PRECAST CONCRETE MEMBERS	EACH	7	7	14
503 0430	56-FOOT PRECAST CONCRETE MEMBERS	EACH	4	4	8
503 0440	58-FOOT PRECAST CONCRETE MEMBERS	EACH	3	3	6
505 0100	REINFORCING STEEL	POUND	65,977	65,977	131,954
505 0110	REINFORCING STEEL (DOWELED)	POUND	1,564	1,564	3,128
505 0120	REINFORCING STEEL (EPOXY COATED)	POUND	144,696	144,608	289,304
506 0110	STRUCTURAL STEEL	POUND	83,876	83,876	167,752
506 0810	PEDESTRIAN RAIL, TYPE V (MODIFIED)	LINFT	412	412	824
509 0170	DRILLED SHAFT FOUNDATION (60-INCH)	LINFT	400	400	800

ABBREVIATIONS

Alt.	Alternate
Brg.	Bearing
Bot.	Bottom
C.G.	Center of Gravity
C.G.S.	Center of Gravity of Steel
CIP	Cast In Place
Clr.	Clear
CMP	Corrugated Metal Pipe
Col.	Column
Const. Jt.	Construction Joint
Dbl.	Double
Dia.	Diameter
Dim.	Dimension
Ea.	Each
E.F.	Each Face
Elev.	Elevation
EQ. Spa.	Equal Space
E.S.	Each Side
Exp.	Expansion
Ext.	Existing/Exterior
E.W.	Each Way
F.F.	Far Face
Fix.	Fixed
Galv.	Galvanized
I.D.	Inner Diameter
Int.	Interior/Intermediate
Jt.	Joint
LOL	Layout Line
Max.	Maximum
Min.	Minimum
N.F.	Near Face
O.D.	Outer Diameter
Opt.	Optional
P.G.	Profile Grade
Ped.	Pedestrian
Pr.	Pair
P.S.	Prestressing
PT	Post-Tensioning
Sect.	Section
Shld.	Shoulder
Sp.	Span
Spa.	Space
Spa. Var.	Spacing Varies
Sq.	Square
Typ.	Typical

STANDARD BAR LAPS

Bar Size	Uncoated (in)	Epoxy Coated (in)
#4	20	24
#5	24	30
#6	30	34
#7	38	45
#8	48	57
#9	60	72
#10	74	88
#11	90	108

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

GENERAL NOTES
AND
QUANTITIES

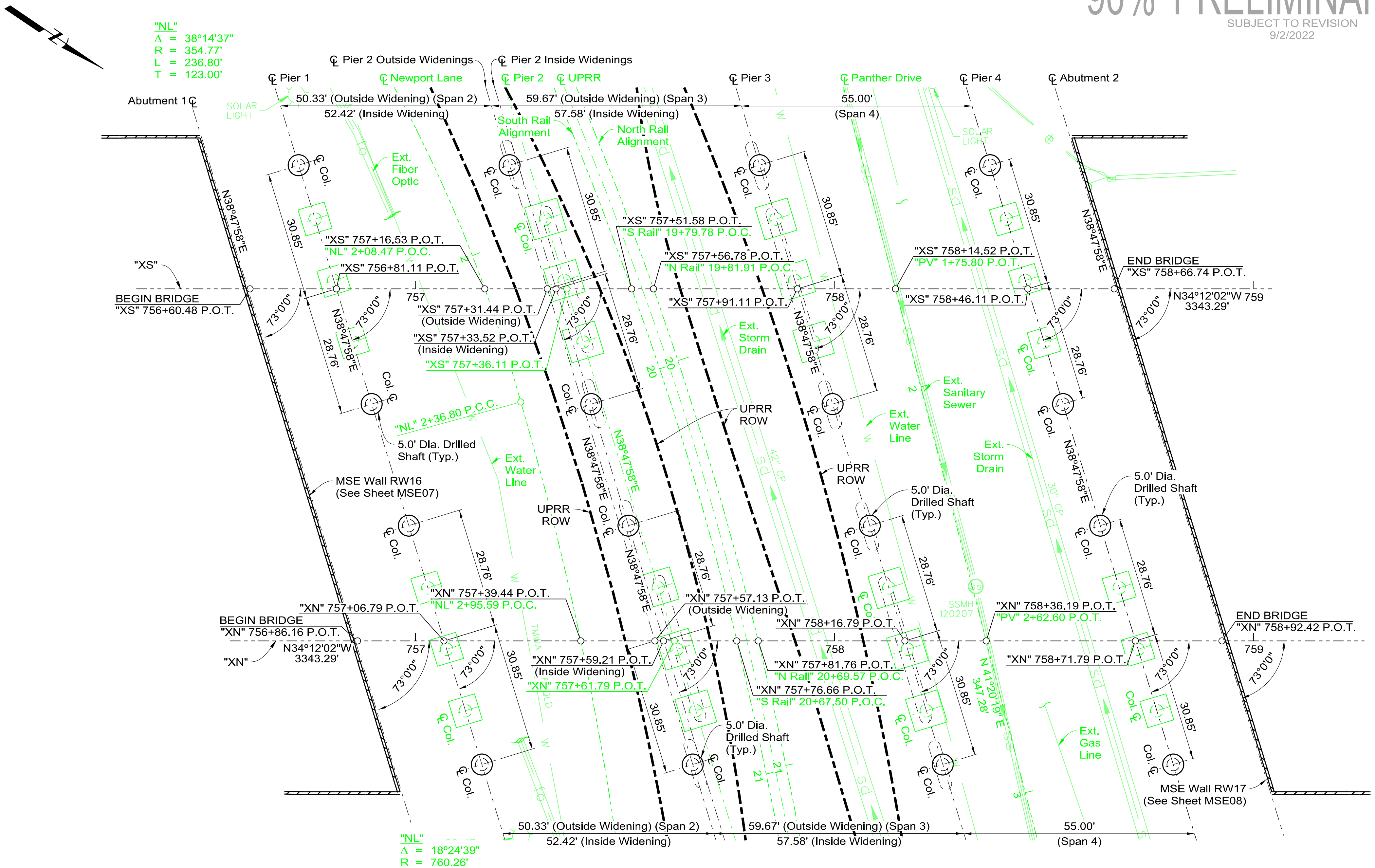
G-1092 N&S

DATE : 9/6/2022

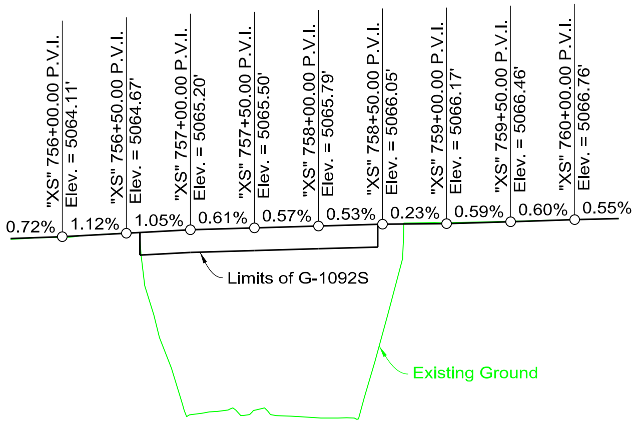
90% PRELIMINARY
SUBJECT TO REVISION
9/2/2022

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	B103

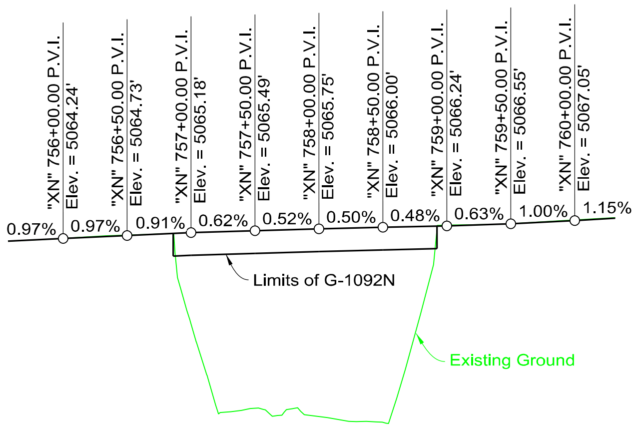
** - All utility locations are approximate and are for coordination purposes only. All utilities are to be field located prior to start of construction and protected in place unless noted otherwise in plans.



GEOMETRICS



"XS" PROFILE



"XN" PROFILE

NOTES:

1. All dimensions between piers are measured along either "XS" or "XN" lines.

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

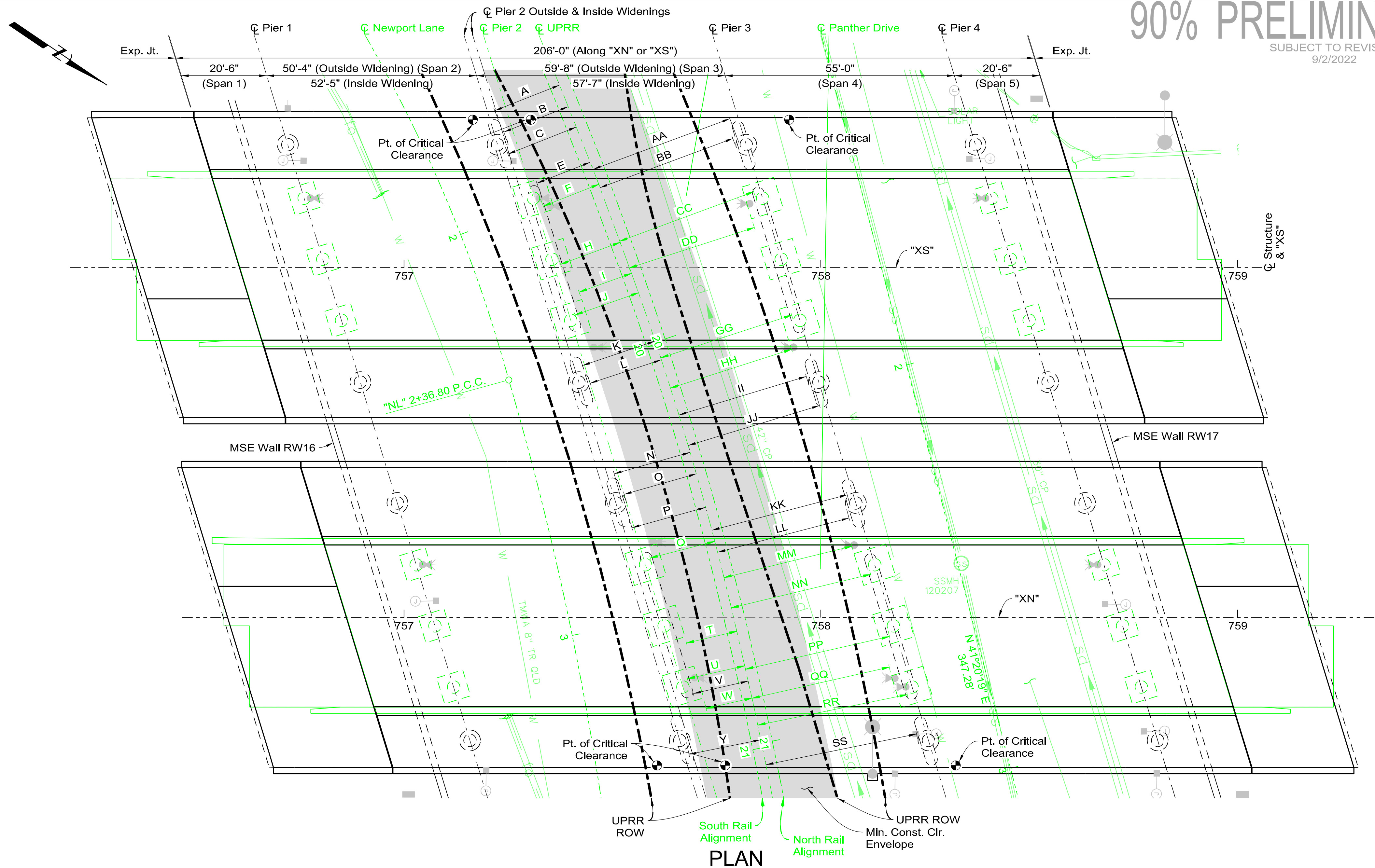
GEOMETRICS

G-1092 N&S

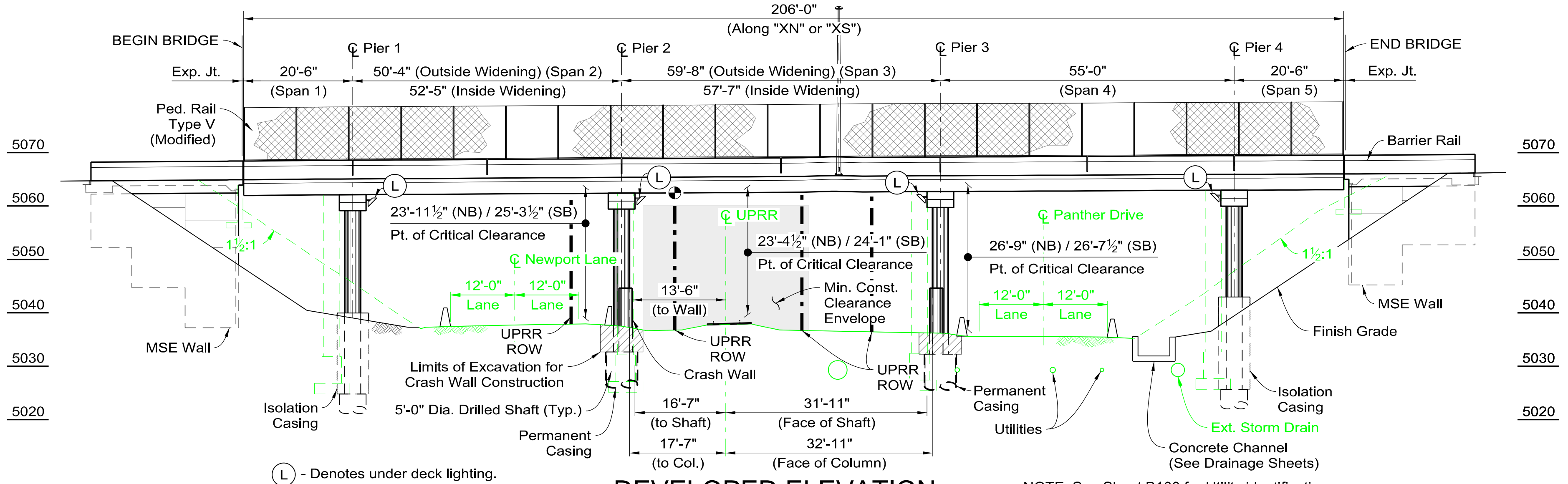
DATE : 9/2/2022

90% PRELIMINARY
SUBJECT TO REVISION
9/2/2022

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	B104A



PLAN



Ⓛ - Denotes under deck lighting.

DEVELOPED ELEVATION

NOTE: See Sheet B100 for Utility identifications

HORIZONTAL RAILROAD CLEARANCES

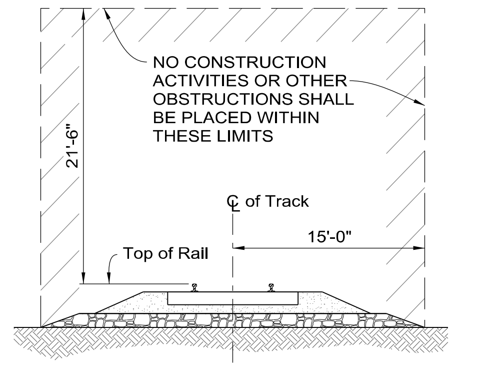
Dim.	Length (ft)	Pier 2 Element
A	16.75	New Crash Wall
B	16.63	New Drilled Shaft (5'-0" Dia.)
C	17.63	New Column (3'-0" Dia.)
D	11.54	Existing Spread Footing
E *	13.75 *	New Crash Wall *
F	14.33	Existing Column (3'-0" Dia.)
G	12.50	Existing Spread Footing
H	15.25	Existing Column (3'-0" Dia.)
I	13.38	Existing Spread Footing
J	16.13	Existing Column (3'-0" Dia.)
K	18.38	New Crash Wall
L	17.96	New Drilled Shaft (5'-0" Dia.)
M	18.96	New Column (3'-0" Dia.)
N	19.00	New Column (3'-0" Dia.)
O	18.00	New Drilled Shaft (5'-0" Dia.)
P	18.38	New Crash Wall
Q	16.00	Existing Column (3'-0" Dia.)
R	13.33	Existing Spread Footing
S	15.17	Existing Column (3'-0" Dia.)
T	12.42	Existing Spread Footing
U	14.08	Existing Column (3'-0" Dia.)
V *	13.50 *	New Crash Wall *
W	11.29	Existing Spread Footing
X	16.58	New Drilled Shaft (5'-0" Dia.)
Y	17.58	New Column (3'-0" Dia.)
Z	16.67	New Crash Wall

Dim.	Length (ft)	Pier 3 Element
AA	35.00	New Column (3'-0" Dia.)
BB	34.00	New Drilled Shaft (5'-0" Dia.)
CC	34.25	Existing Column (3'-0" Dia.)
DD	31.54	Existing Spread Footing
EE	33.50	Existing Column (3'-0" Dia.)
FF	30.83	Existing Spread Footing
GG	33.04	Existing Column (3'-0" Dia.)
HH	30.50	Existing Spread Footing
II	31.92	New Drilled Shaft (5'-0" Dia.)
JJ	32.92	New Column (3'-0" Dia.)
KK	33.58	New Column (3'-0" Dia.)
LL	32.58	New Drilled Shaft (5'-0" Dia.)
MM	33.58	Existing Spread Footing
NN	34.38	Existing Column (3'-0" Dia.)
OO	32.63	Existing Spread Footing
PP	35.42	Existing Column (3'-0" Dia.)
QQ	33.75	Existing Spread Footing
RR	36.63	Existing Column (3'-0" Dia.)
SS	36.88	New Drilled Shaft (5'-0" Dia.)
TT	37.88	New Column (3'-0" Dia.)

* - Note that crash walls required for existing piers are within the Railroad's "Minimum Construction Clearance Envelope".

CONSTRUCTION NOTES

1. Any shoring system that impacts the Railroad operations and/or supports Railroad embankment shall be designed and constructed per the Railroad's "Guidlines for Temporary Shoring".
2. All demolition within the Railroad right-of-way and/or adjacent to the Railroad that may impact the Railroad tracks or operations shall comply with the Railroad demolition requirements.
3. Erection over the Railroad right-of-way shall be designed to cause no interruption to all Railroad operations.
4. The elevation of the existing top-of-rail profile shall be verified before beginning construction. All discrepancies shall be brought to the attention of the Railroad prior to construction.
5. The proposed grade separation project shall not change the quantity and/or characteristics of the flow in the Railroad ditches and/or drainage structures.
6. The Contractor must submit a proposed method of erosion and sediment control and have the method approved by the Railroad prior to beginning any grading on the project site.
7. For Railroad coordination please refer to the Railroad's Coordination Requirements as part of the Specifications or Special Provisions of the project.
8. Temporary Construction Clearances, including falsework clearances, shall comply with Minimum Construction Clearance Envelope, shown below.
9. All permanent clearances shall be verified before project closeout.
10. For location of Points of Critical Clearance relative to the track centerline see Developed Elevation on Sheet B100.
11. For Typical Section, see Sheet B101.
12. For Railroad Profile Grade Diagrams, see Sheet B104B.
13. For top and bottom of crash wall elevations relative to top of rail, see Typical Section, Sheet B101.



MIN. CONST. CLR. ENVELOPE

(NORMAL TO RAILROAD)

UPRR MILEPOST:	8.15
UPRR SUBDIVISION:	RENO IND. LD.
PROJECT CITY:	RENO
REVISION DATE:	OCTOBER 28,2021
LAT. / LONG.:	39°35'12.77" N / 119°49'25.69" W

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

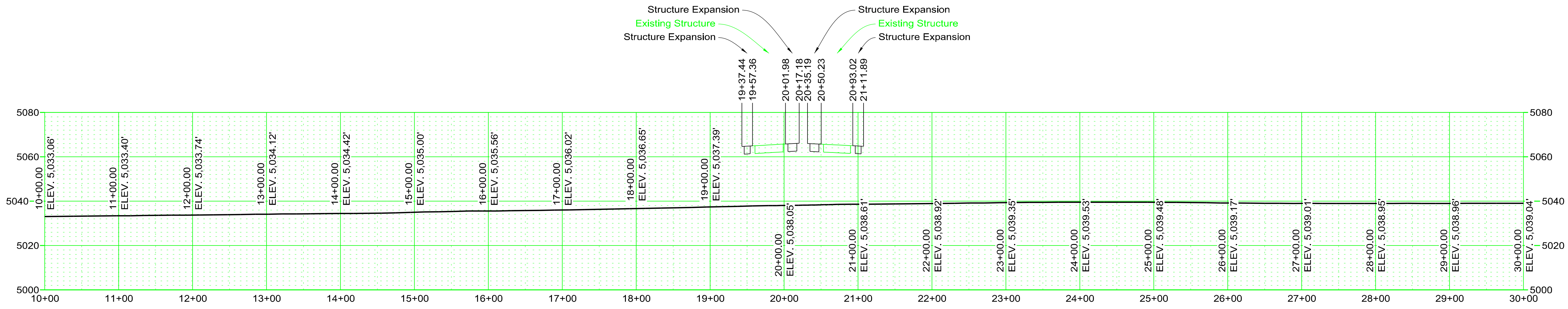
UPRR COORDINATION PLAN

G-1092 N&S

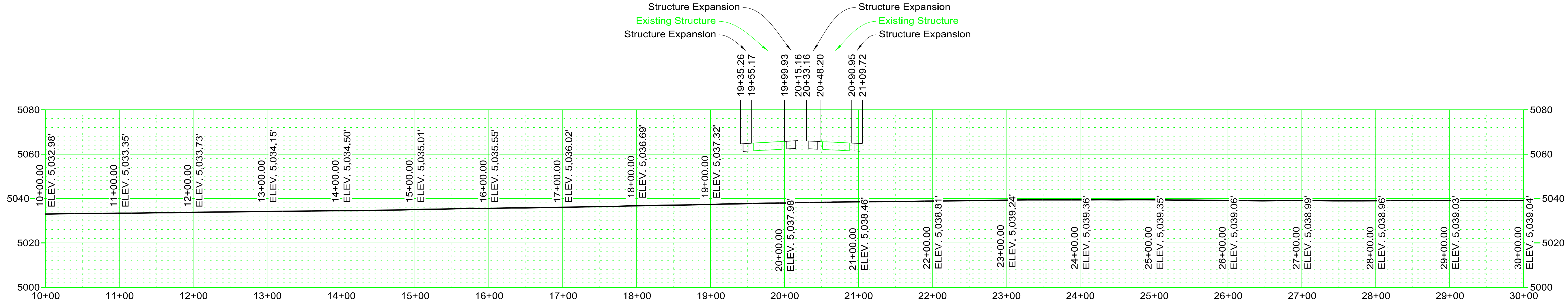
DATE : 9/2/2022

90% PRELIMINARY
SUBJECT TO REVISION
9/2/2022

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	B104B



NORTH RAIL PROFILE



SOUTH RAIL PROFILE

UPRR TRACK PROFILES

NORTH TRACK		SOUTH TRACK	
STATION	ELEVATION	STATION	ELEVATION
10+00.00	5033.06	10+00.00	5032.98
11+00.00	5033.40	11+00.00	5033.35
12+00.00	5033.74	12+00.00	5033.73
13+00.00	5034.12	13+00.00	5034.15
14+00.00	5034.42	14+00.00	5035.50
15+00.00	5035.00	15+00.00	5035.01
16+00.00	5035.56	16+00.00	5035.55
17+00.00	5036.02	17+00.00	5036.02
18+00.00	5036.65	18+00.00	5036.69
19+00.00	5037.39	19+00.00	5037.32
20+00.00	5038.05	20+00.00	5037.98
21+00.00	5038.61	21+00.00	5038.46
22+00.00	5038.92	22+00.00	5038.81
23+00.00	5039.35	23+00.00	5039.24
24+00.00	5039.53	24+00.00	5039.36
25+00.00	5039.48	25+00.00	5039.35
26+00.00	5039.17	26+00.00	5039.06
27+00.00	5039.01	27+00.00	5038.99
28+00.00	5038.95	28+00.00	5038.96
29+00.00	5038.96	29+00.00	5039.03
30+00.00	5039.04	30+00.00	5039.04

PROFILE NOTES:

1. Top of Rail Field Surveys by Nevada Department of Transportation, Location Division, July 2019.
2. Track centerlines generated from aerially mapped track planimetrics. Stationing assumed.
3. Reported rail elevations interpolated from Lidar data and mapping points, reported at 100-ft station intervals.
4. Additional track profile info is shown on sheet RR01.

UPRR MILEPOST:	8.15
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STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

RAILROAD
PROFILES

G-1092 N&S

DATE : 9/2/2022

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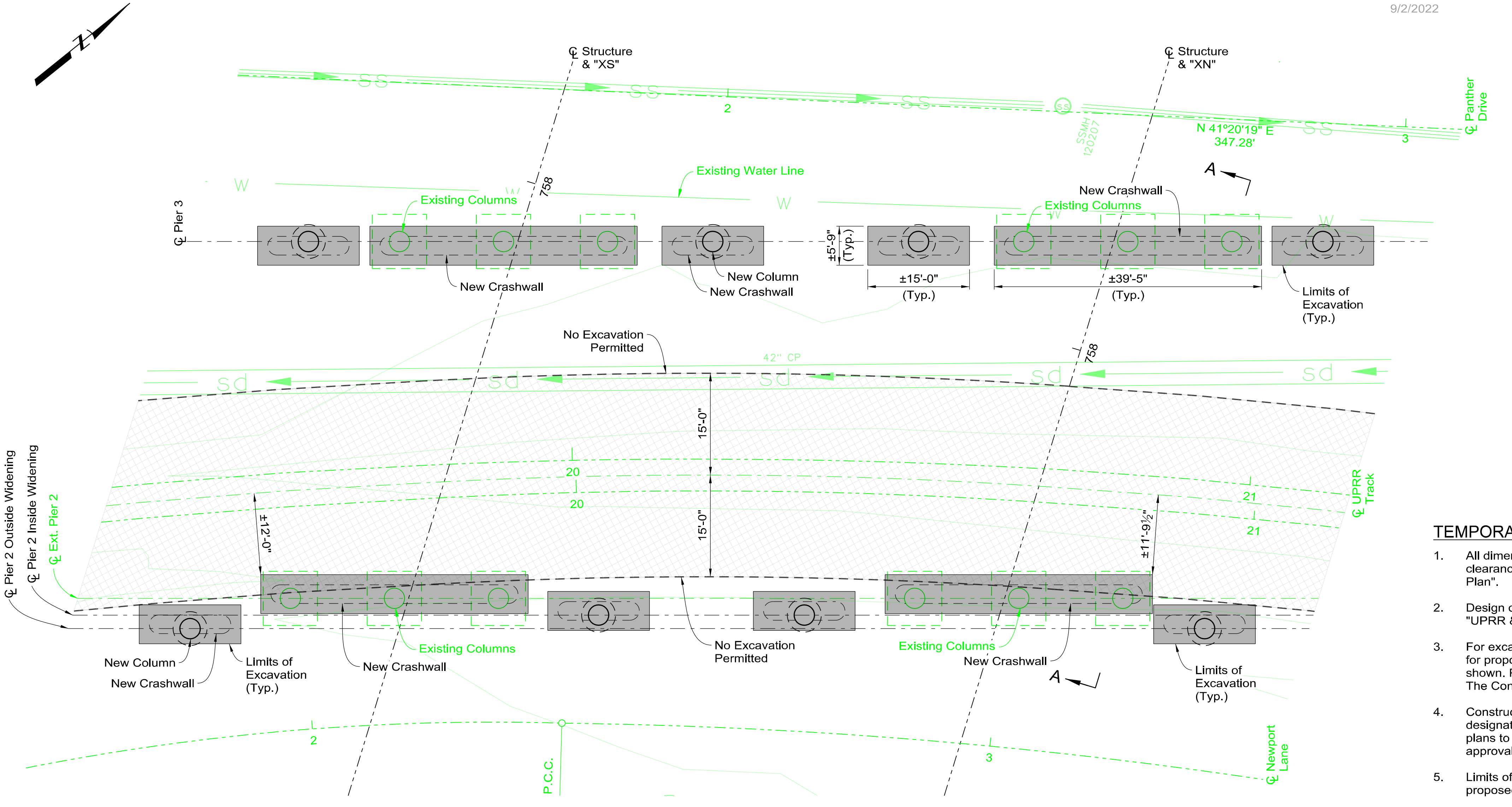
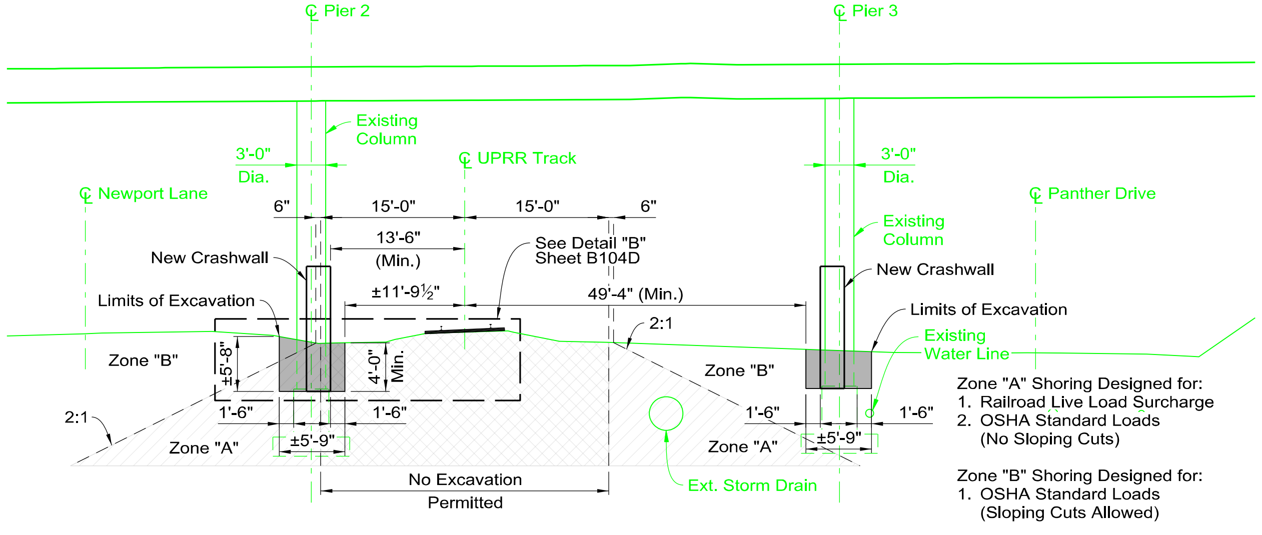
SUBJECT TO REVISION
9/2/2022

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	B104C



PLAN



Zone "A" Shoring Designed for:
1. Railroad Live Load Surcharge
2. OSHA Standard Loads
(No Sloping Cuts)

Zone "B" Shoring Designed for:
1. OSHA Standard Loads
(Sloping Cuts Allowed)

ELEVATION A-A

TEMPORARY SHORING NOTES:

1. All dimensions relative to the Railroad are measured perpendicular to the centerline of the track. For horizontal clearance between substructure elements and centerline of the track see Sheet B104A, "UPRR Coordination Plan".
2. Design of all temporary shoring within limits of Zone "A"' subject to all loading and requirements per the "UPRR & BNSF Guidelines for Temporary Shoring".
3. For excavations which encroach into Zone "A", the Contractor shall submit design calculations and drawings for proposed temporary shoring for approval by UPRR prior to commencing any excavations within limits shown. Plans and calculations shall be signed and stamped by a Professional Engineer licensed in Nevada. The Contractor shall install the temporary shoring system per the approved plans.
4. Construction of Pier 2 crashwalls are within 15'-0" of the track centerline, requiring excavations within the Zone designated "No Excavation". Refer to Sheet B104D, "Pier 2 Crash Wall Shoring Plan" for conceptual shoring plans to construct the Pier 2 crashwalls. Any changes or deviations from the conceptual plans will require approval and concurrence by UPRR.
5. Limits of excavation and temporary shoring layout shown herein are for conceptual purposes only. Layout of proposed shoring system is subject to all requirements of UPRR.
6. Design loading and deflection limits shall comply with UPRR Temporary Shoring Guidelines and AREMA Manual for Cooper E80 loading.
7. Refer to requirements for track and ground monitoring, see the "Union Pacific Railroad Guidelines for Track & Ground Monitoring."
8. Shoring removal is subject to all UPRR requirements.

LEGEND

■	Limits of Excavation
▨	Limits of No Permissible Excavation
▨	Limits of Zone "A" Shoring

UPRR MILEPOST:	8.15
UPRR SUBDIVISION:	RENO IND. LD.
PROJECT CITY:	RENO
REVISION DATE:	OCTOBER 28,2021
LAT. / LONG.:	39°35'12.77" N / 119°49'25.69" W

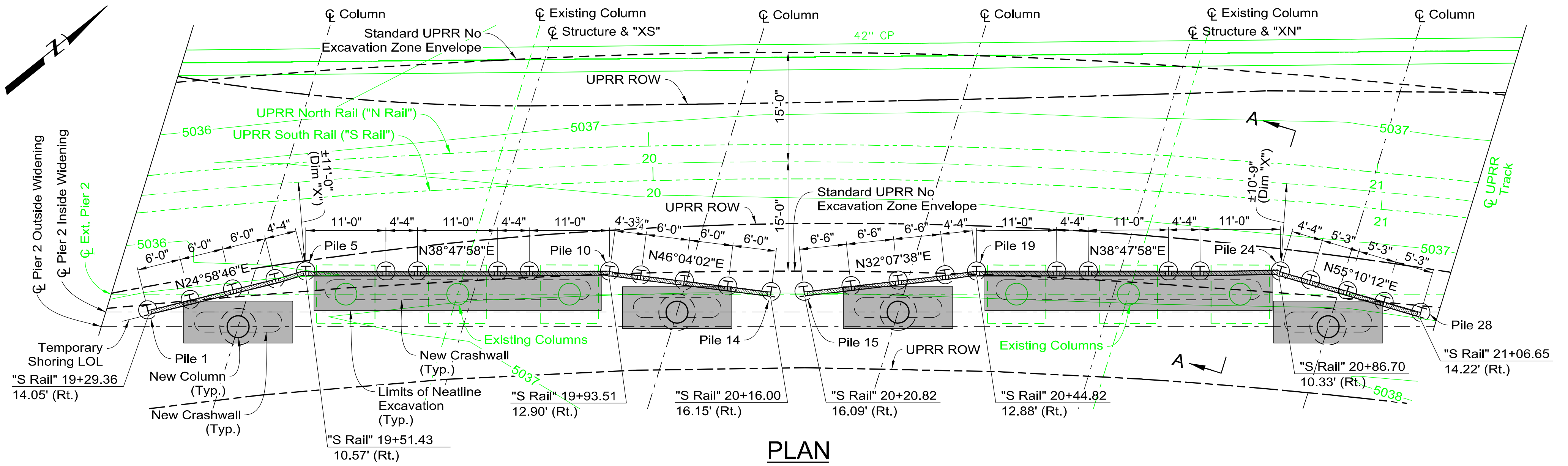
STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

RAILROAD SHORING ZONES

G-1092 N&S

DATE : 9/2/2022

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	B104D



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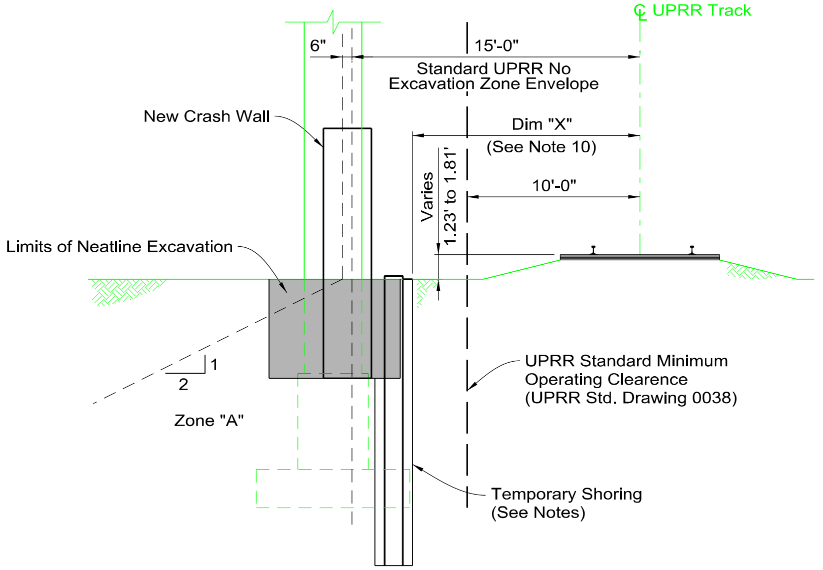
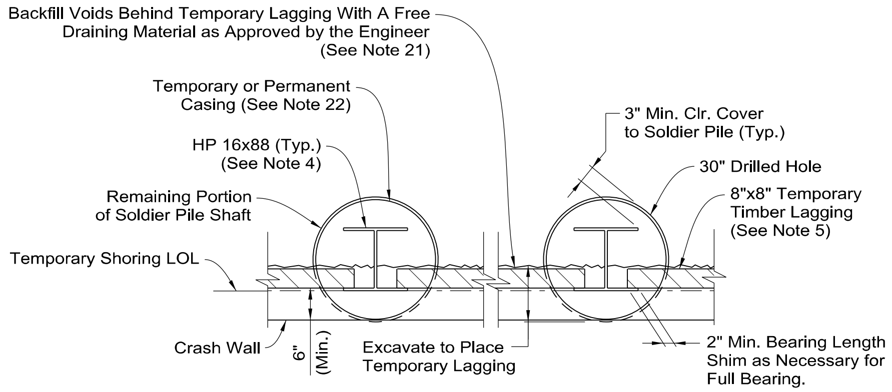
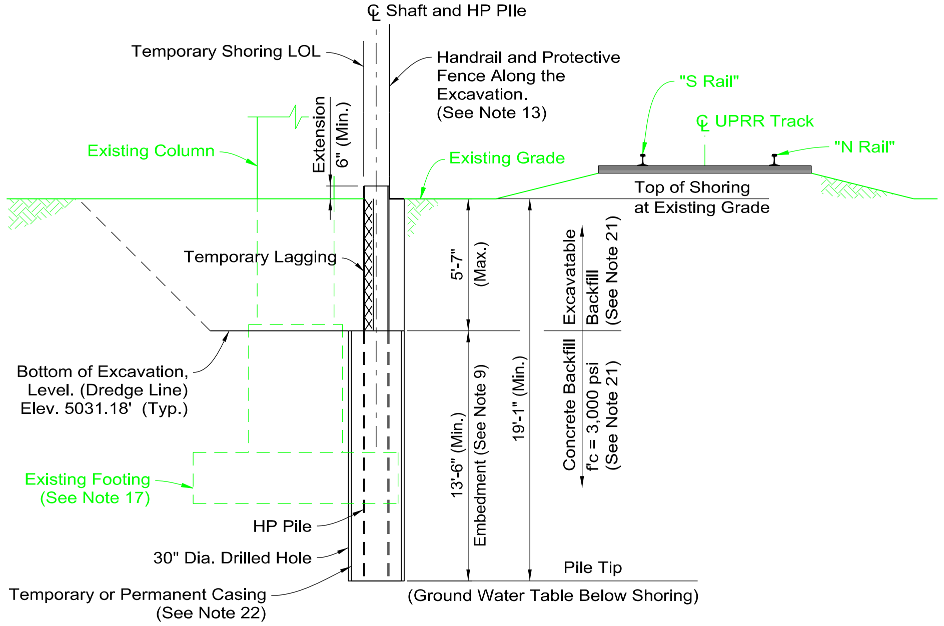


DETAIL "B"

TEMPORARY SHORING
UPRR GEOMETRIC CONSTRAINTS



PLAN
SOLDIER PILE WALL



SECTION A-A

SEE DETAIL "B" FOR UPRR GEOMETRIC CONSTRAINTS

GENERAL NOTES:

1. Design Specifications: UPRR & BNSF Guidelines for Temporary Shoring, 2021 Ed. AREMA Manual for Railroad Engineering, 2021 Ed. AISC Steel Construction Manual, 15th Ed. National Design Specification for Wood Construction, 2015 Ed. National Design Specifications Supplement Design Values for Wood Construction, 2015 Ed.

2. Dead Load Surcharge Loading: Spoil Pile is equal to 2-feet adjacent to the excavation. Track is equal to 200 lbs/linear foot for rails, inside guardrails, and fasteners. Roadbed is equal to 1.81-feet for the ballast and track ties.

3. Live Load Surcharge Loading: Cooper E80 live load 10'-9" perpendicular from centerline of track to outside face of shoring. Loading parallel to shoring alignment.

4. Structural Steel: HP piles shall be ASTM A572 Gr. 50. Maximum allowable bending stress shall not exceed 0.55 Fy. Maximum allowable shear stress shall not exceed 0.35 Fy.

5. Timber Lagging: Timber lagging shall be Douglas Fir Larch Gr. 1 or better.

6. Temporary overstress allowances for any shoring element are not allowed.

7. Deflection Criteria: Total deflection of the shoring system, including pile and lagging shall not exceed ⅜" under service load condition.

8. Design Data: Temporary shoring is designed based on following UPRR parameters.
Level Front and back slopes with ground water table below shoring.
Soil Properties: Unit Weight: γ = 125 pcf, Internal Friction Angle: ϕ = 34°, Cohesion: c = 0 psf, Active Pressure Coefficient: Ka = 0.25, Passive Pressure Coefficient: Kp = 7.

   Groundwater was encountered in all borings advanced for Bridge G1092 at elevations ranging from 5004-feet to 5024-feet in July 2019. Groundwater levels may fluctuate seasonally and in response to recent precipitation events. It should be anticipated that groundwater may be encountered during construction and use of temporary shoring. Furthermore, refer to Supplemental Geotechnical Memo from HDR titled "Geotechnical Recommendations for Temporary Shoring, US395 North Valleys, Washoe County, Nevada" dated July 2022.

   For additional information on subsurface conditions and boring locations, refer to Geotechnical Report from HDR titled "Draft Geotechnical Design Report, Phase 1B: US395 North Valleys, Washoe County, Nevada" dated January 2021.

   See Railroad Profiles sheet for UPRR track profile information.

9. Notify Engineer if HP piles do not attain the minimum embedment depth required.

10. Dimension "X" is the offset measured perpendicular from the centerline of the track to the outside face of the drilled hole at all changes in horizontal alignment and nearest substructure elements.

11. All dimensions relative to the Railroad are measured perpendicular to the centerline of the track.

12. Any deviation from the plans as shown requires design by a Nevada Registered Professional Engineer, resubmittal, and prior approval by the Engineer and Railroad prior to proceeding with said deviation. Approval from the Railroad may not be granted.

13. Contractor to submit plans and details for handrail and protective fence along all edges of the excavation for review and approval by the Engineer and Railroad prior to proceeding with excavation.

14. Contractor is responsible to protect the Railroad ballast and subballast from contamination.

15. All removed soils shall be disposed of outside the Railroad Right-of-Way.

16. The Contractor must monitor the track, ground, and shoring for movement during construction. Refer to requirements for track and ground monitoring, see the "Union Pacific Railroad Guidelines for Track & Ground Monitoring." Any damage to Railroad property such as track, signal equipment, or structure could result in a train derailment. All damage must be reported immediately to the Railroad representative in charge of the project and to the Railroad Track Maintenance Representative.

17. Contractor to pothole and locate edges of existing bridge spread footings prior to drilling for temporary shoring piles.

18. Contractor to submit excavation plan showing proposed limits of excavation, excavation slopes and cross sections for review and approval by the Engineer and Railroad prior to proceeding with excavation. The plan shall include a detailed construction sequence for installation and removal of temporary shoring system.

19. Any required changes to limits of shoring shall be brought to the attention of the Engineer and are subject to review and approval and resubmittal to UPRR for review and approval.

20. Shoring to be removed at least 3-feet below the final finished grade or at least 3-feet below the base of rail, whichever is lower. Existing site drainage to be restored to pre-construction conditions.

21. Contractor to submit material specifications for excavatable backfill, concrete backfill, and compaction criteria for review and approval by the Engineer and Railroad. Refer to Section 207 of the NDOT Standard Specifications for excavatable backfill criteria.

22. Temporary or permanent casing is required for drilled soldier pile holes, and shall be designed by the contractor using a minimum lateral pressure of 1ksf. Size, grade and thickness of the casing shall be submitted for review and approval.

23. For additional Railroad standards and requirements concerning design and construction of temporary shoring, refer to the current edition of UPRR & BNSF Guidelines for Temporary Shoring.

24. Payment for all shoring required to construct Pier 2 Crashwalls is incidental to the crashwall bid items.

SHORING DIMENSIONS

Location	Dim. "X"
Pile 1	14.48'
Pile 5	11.00'
Pile10	13.33'
Pile 14	16.58'
Pile 15	16.53'
Pile 19	13.31'
Pile 24	10.75'
Pile 28	14.66'

CALL BEFORE YOU DIG:

Contractor to verify any underground utilities before construction begins. A Union Pacific Railroad 24-hr by 7-day communication center to assist in protecting, documenting and notifying callers of other utilities installed within the Railroad right-of-way.
1-800-336-9193

LEGEND:

▨ - Limits of Neatline Excavation

UPRR MILEPOST:	8.15
UPRR SUBDIVISION:	RENO IND. LD.
PROJECT CITY:	RENO
REVISION DATE:	OCTOBER 28,2021
LAT. / LONG.:	39°35'12.77" N / 119°49'25.69" W

BLAKE SCHMITT
Exp. 06/30/2024
No. 029836
CIVIL

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

PIER 2 CRASHWALL SHORING PLAN

G-1092 N&S

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	B105

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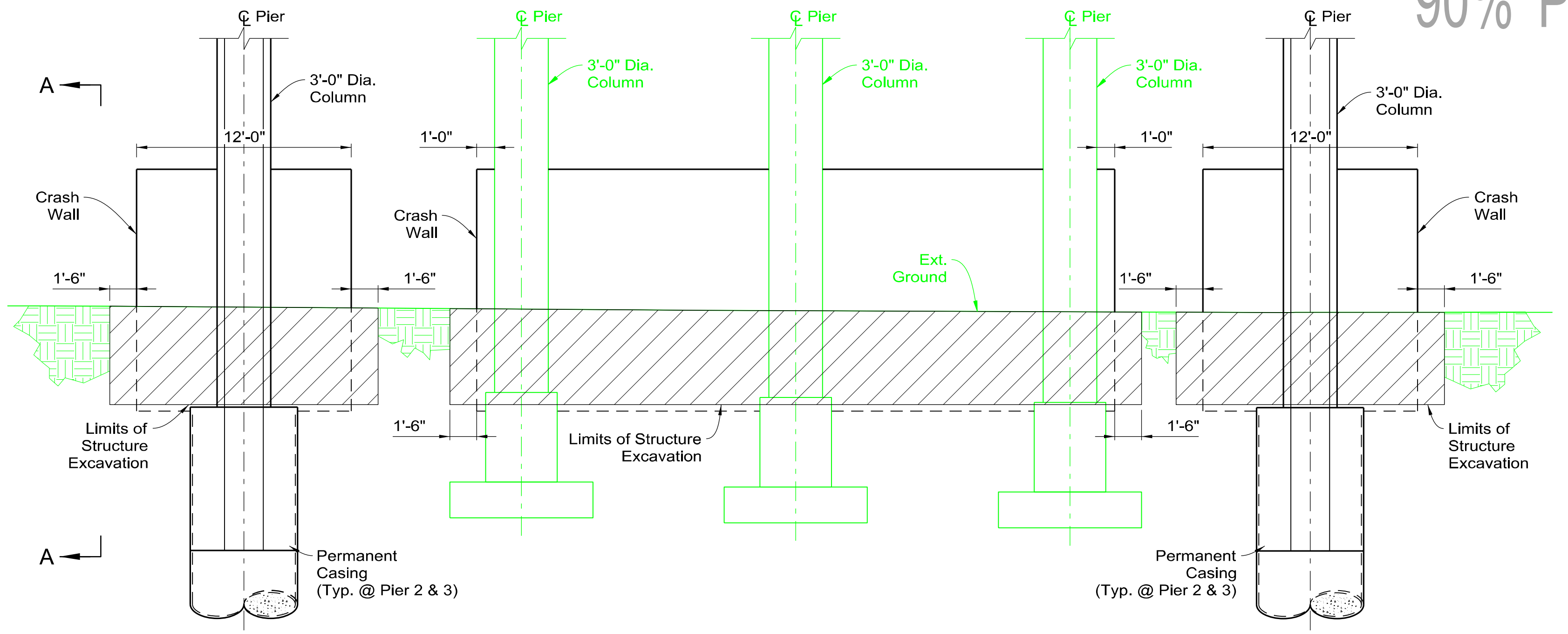
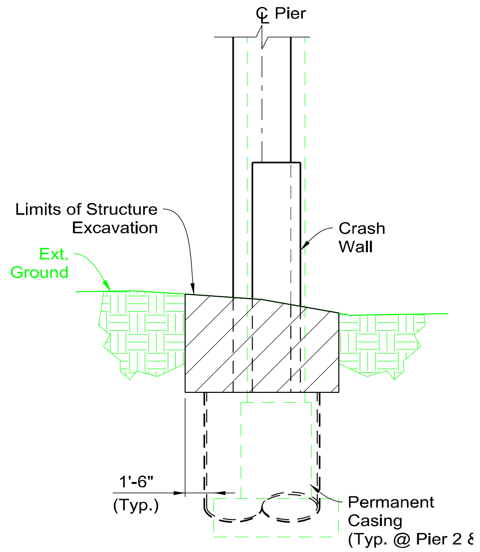
9/2/2022



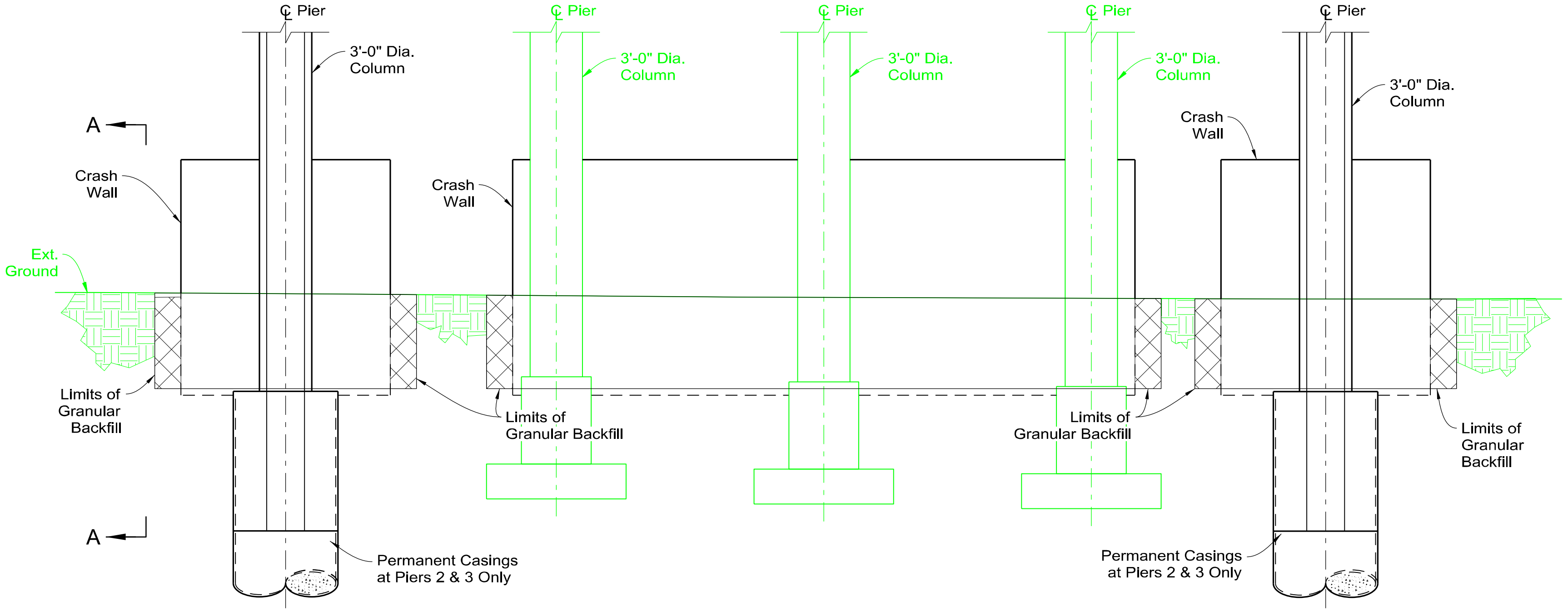
COLUMN EXCAVATION SCHEMATIC

PIERS 2 AND 3



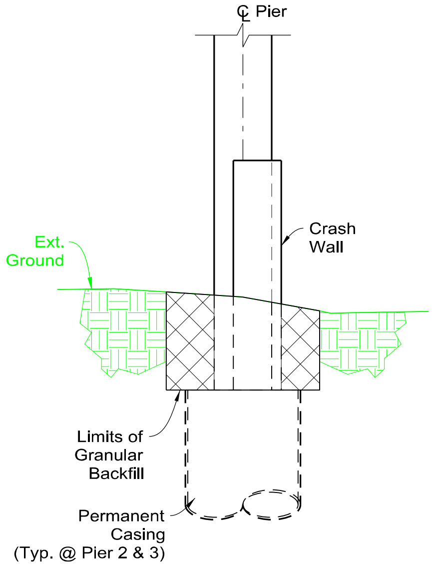
SECTION A-A

EXCAVATION SCHEMATIC



COLUMN BACKFILL SCHEMATIC

PIERS 2 AND 3



SECTION A-A

BACKFILL SCHEMATIC

LEGEND

▨	Structure Excavation
☒	Granular Backfill

EARTHWORK SUMMARY

Quantity (Cu. Yd.)	Pier 1	Pier 2	Pier 3	Pier 4
NB Structure Excavation	30	87	87	26
NB Granular Backfill	0	35	35	0
SB Structure Excavation	30	88	88	26
SB Granular Backfill	0	35	35	0

NOTES:

1. Any shoring system that impacts the Railroad operations and/or supports Railroad embankment shall be designed and constructed per the Railroad temporary shoring requirements.
2. Trenches more than 4' deep shall be shored, laid back to at least the angle of repose for existing field conditions, or some other means of protection shall be provided.
3. If hazardous field conditions indicate ground movemenet may be expected, trenches less than 4' deep shall also be protected as indicated in Note 2.
4. For the purpose of payment, structure excavation and backfill quantities are based on these drawings and no additional payment will be made for shoring.
5. Trench excavation shoring shall conform to OSHA Regulations 29 CFR Part 1926, Subpart P.
6. The quantity of structure excavation and backfill measured for payment shall be the number of cubic yards calculated minus any duplication of limits which overlap.
7. The limits of structure excavation and backfill shown herein shall be used for the method of measurement and payment only. There shall be no additional compensation for any additional excavation or backfill required for excavations to meet OSHA regulations.

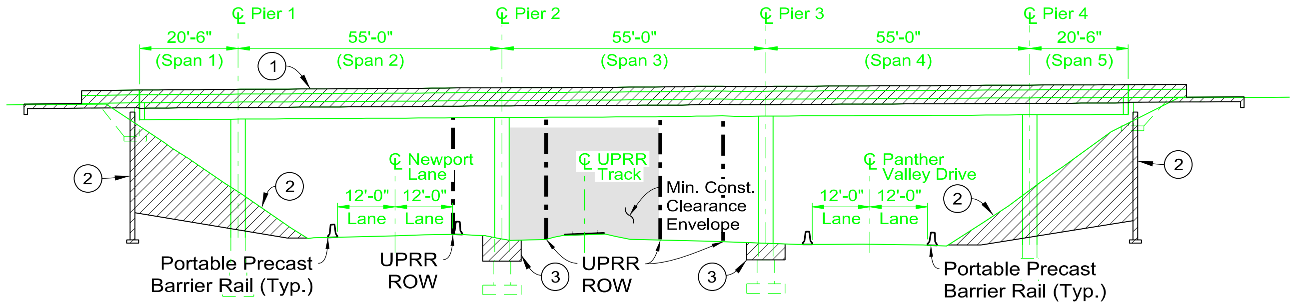
DATE : 9/2/2022

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

EXCAVATION
AND
BACKFILL

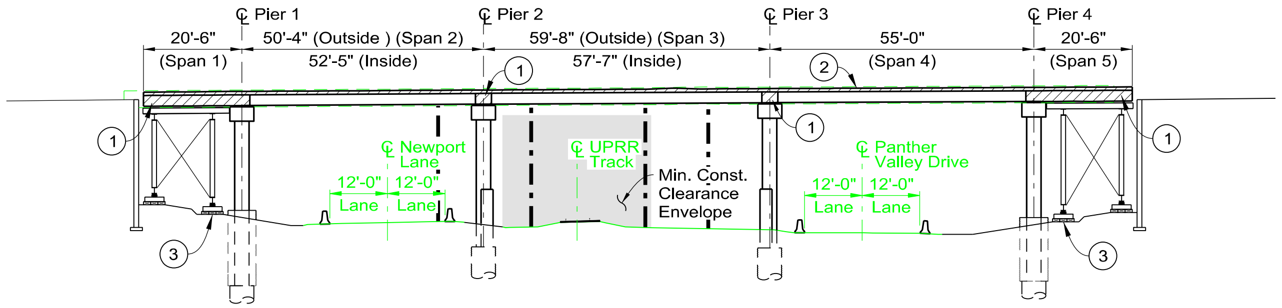
G-1092 N&S

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	B106



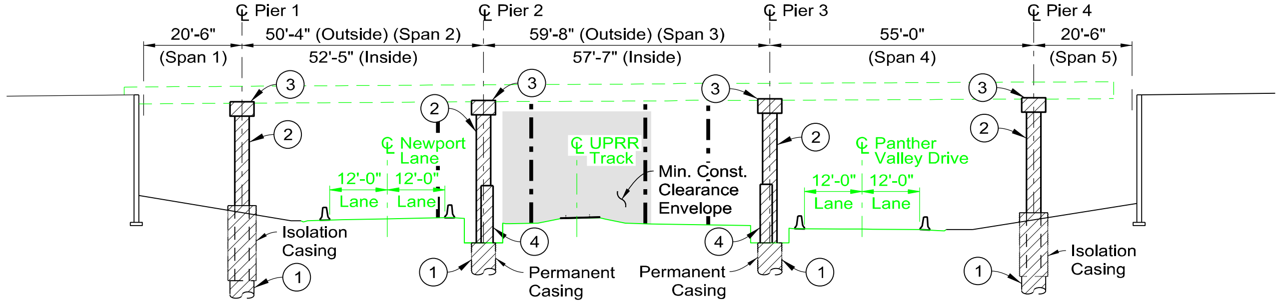
STAGE 1

1. Remove barrier rail, overhang, and portion of approach slab from existing structure. See Sheet B1xxx for construction phasing and Sheet B1xx for limits of removal.
2. Excavate fill slopes and construct MSE walls adjacent to Piers 1 and 4. See MSE Wall Sheets Wxxx for details.
3. Install shoring systems as approved by UPRR. Excavate soil adjacent to Piers 2 & 3 columns to facilitate construction of Railroad crashwalls and new drilled shafts and columns at Piers 2 & 3. For limits of excavation see Sheet B1xx. For shoring requirements see Sheet B1xx and refer to "UPRR and BNSF Guidelines for Temporary Shoring".



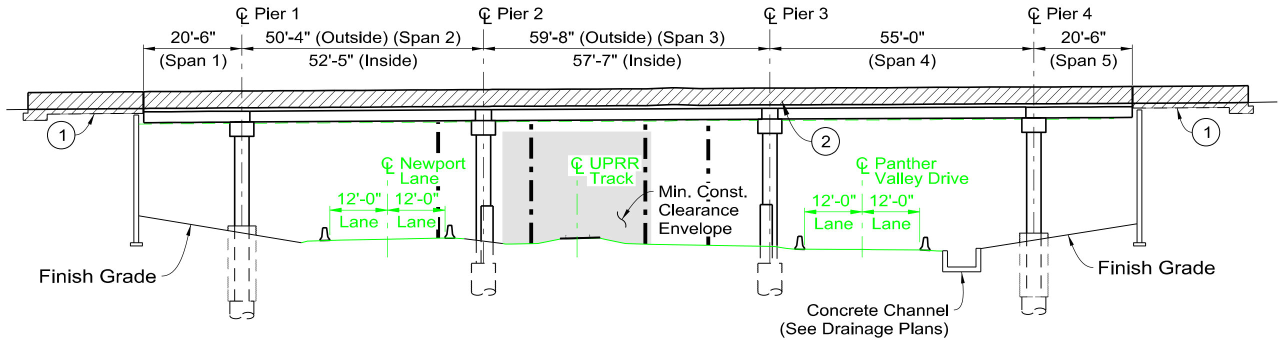
STAGE 4

1. Construct CIP Spans 1 & 5 and closure diaphragms at Piers 2 & 3.
2. Construct CIP deck.
3. Remove falsework.



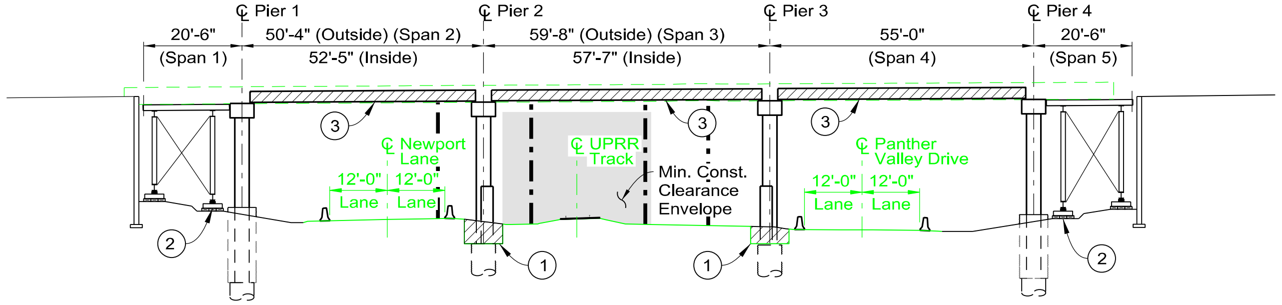
STAGE 2

1. Construct drilled shaft foundations at Piers 1, 2, 3, & 4.
2. Construct columns at Piers 1, 2, 3, & 4.
3. Construct pier caps at Piers 1, 2, 3, & 4.
4. Construct Railroad crashwalls at Piers 2 & 3.



STAGE 5

1. Construct approach slabs at Begin and End Bridge.
2. Construct bridge rail.
3. Construct deck closure pour; wait a minimum of 30 days after release of falsework before placing closure pour. For closure reinforcing, see typical sections on Sheets B122-B123.



STAGE 3

1. Remove installed shoring and back fill soil adjacent to columns at Piers 2 & 3 after constructing Railroad crashwalls.
2. Erect falsework to support CIP Spans 1 & 5
3. Erect precast girders at Spans 2, 3, & 4.

NOTES:

1. Refer to Section 108.04, Limitations of Operations, of the Special Provisions for requirements related to maintenance of traffic.
2. All demolition within the Railroad right-of-way and/ or demolition that may impact the Railroad tracks or operations shall comply with the Railroad demolition requirements. For limits of Railroad right-of-way see Sheet B103, Railroad Coordination Plan.
3. Any shoring system that may impact the Railroad operations and/or supports Railroad embankments shall be designed and constructed per "UPRR and BNSF Guidelines for Temporary Shoring".

LEGEND

▨ To be constructed this stage

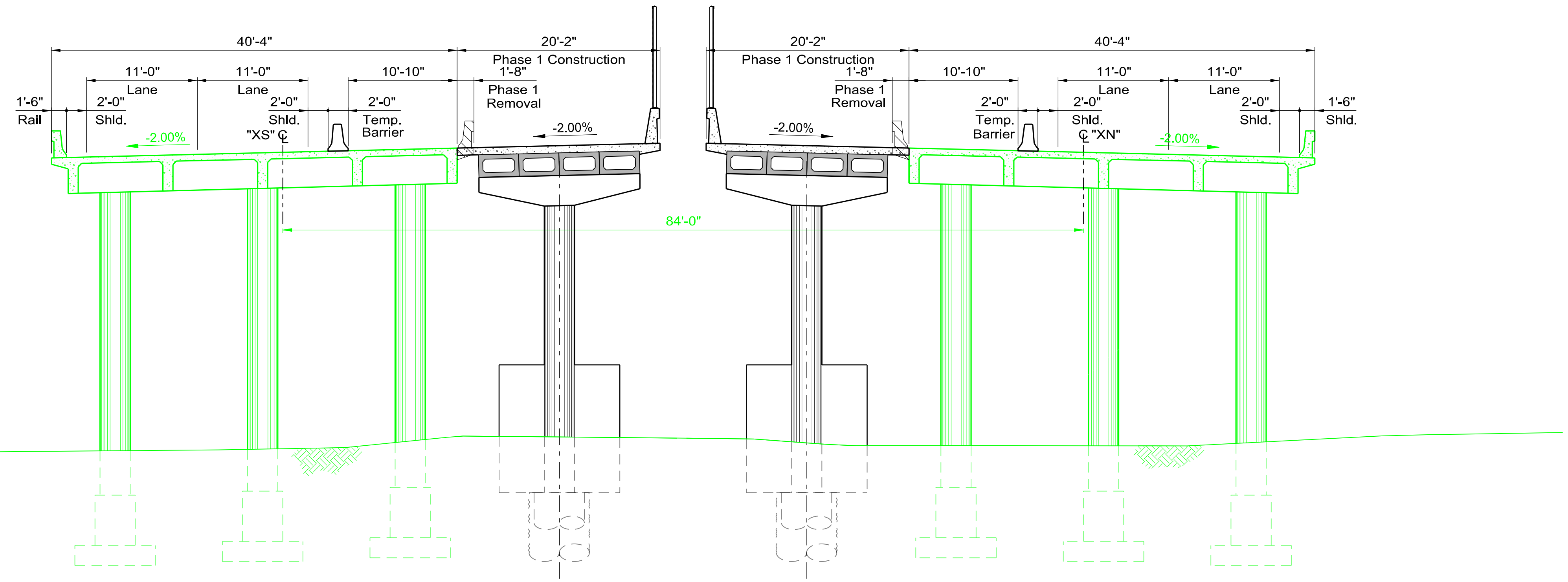
STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

BRIDGE CONSTRUCTION SEQUENCE

G-1092 N&S

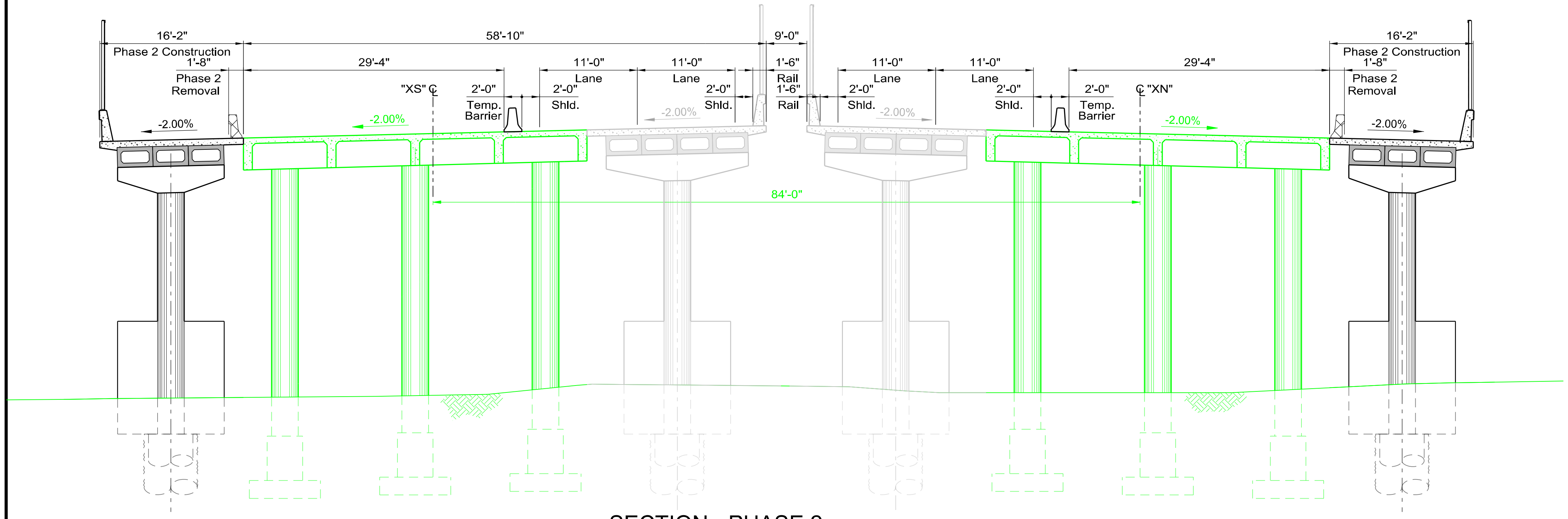
DATE : 9/2/2022

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	B107



SECTION - PHASE 1

LOOKING AHEAD ON LINE
NORMAL TO ALIGNMENT



SECTION - PHASE 2

LOOKING AHEAD ON LINE
NORMAL TO ALIGNMENT

LEGEND

▨ Phase 1 - Limits of Removal

▦ Phase 2 - Limits of Removal

NOTES:

1. Phasing shown is conceptual. Refer to Traffic Control plans and Contract Special Provisions for limitations and phasing requirements.

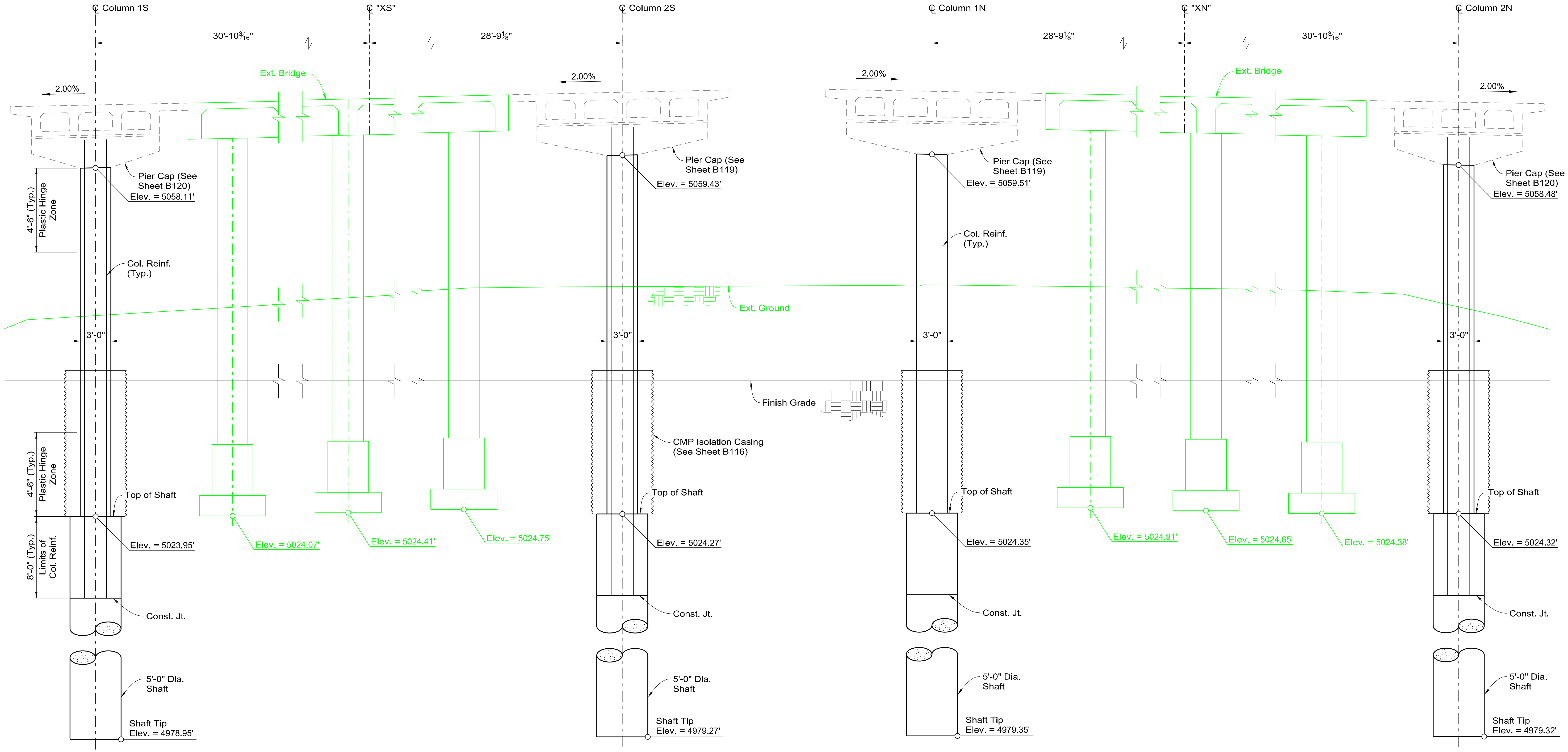
STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

BRIDGE
CONSTRUCTION
PHASES 1 & 2

G-1092 N&S

DATE : 9/2/2022

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	B109



ELEVATION PIER 1

LOOKING AHEAD ON LINE
ALONG SKEW

NOTES:

1. Elevations noted taken through centerline of shaft/column.
2. Lap splices in longitudinal column reinforcing not permitted.
3. For pier cap details, see Sheet B121.
4. For column/shaft details not shown, see Sheets B113-B115.

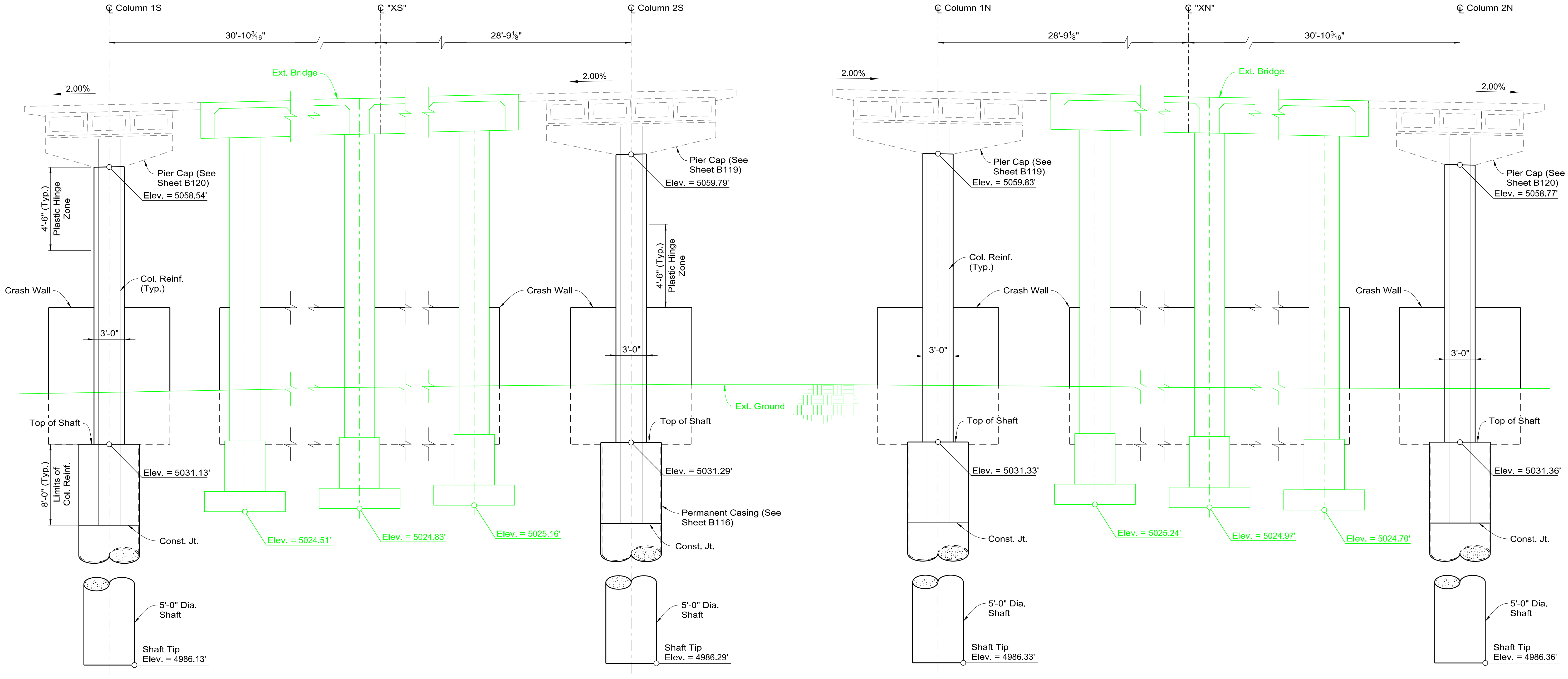
STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

PIER 1 ELEVATION

G-1092 N&S

DATE : 9/2/2022

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	B110



ELEVATION PIER 2

LOOKING AHEAD ON LINE
ALONG SKEW

NOTES:

1. Elevations noted taken through centerline of shaft/column.
2. Lap splices in longitudinal column reinforcing not permitted.
3. For pier cap details, see Sheet B121.
4. For column/shaft details not shown, see Sheets B113-B115.
5. For crashwall details, see Sheet B117.

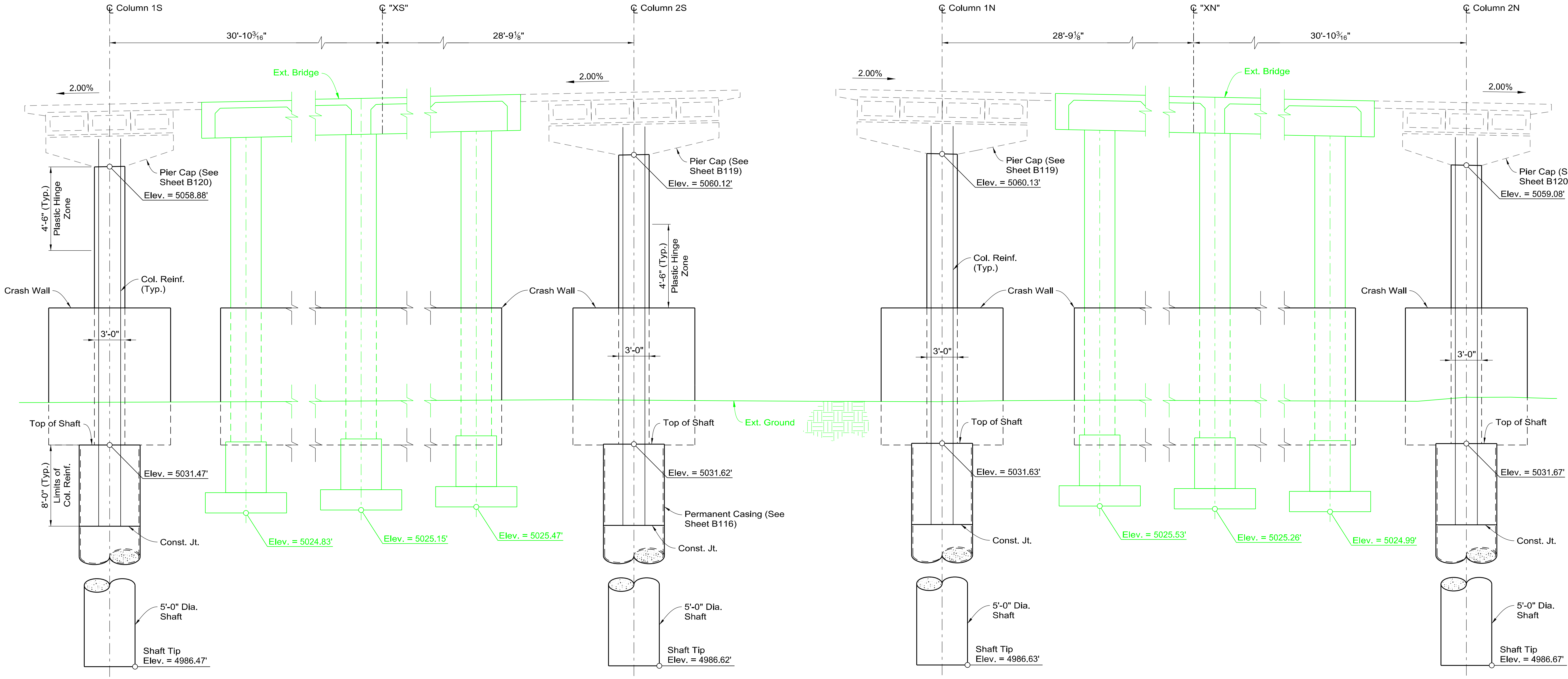
STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

PIER 2 ELEVATION

G-1092 N&S

DATE : 9/2/2022

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	B111



ELEVATION PIER 3

LOOKING AHEAD ON LINE
ALONG SKEW

NOTES:

1. Elevations noted taken through centerline of shaft/column.
2. Lap splices in longitudinal column reinforcing not permitted.
3. For pier cap details, see Sheet B121.
4. For column/shaft details not shown, see Sheet B113-B115.
5. For crashwall details, see Sheet B117.

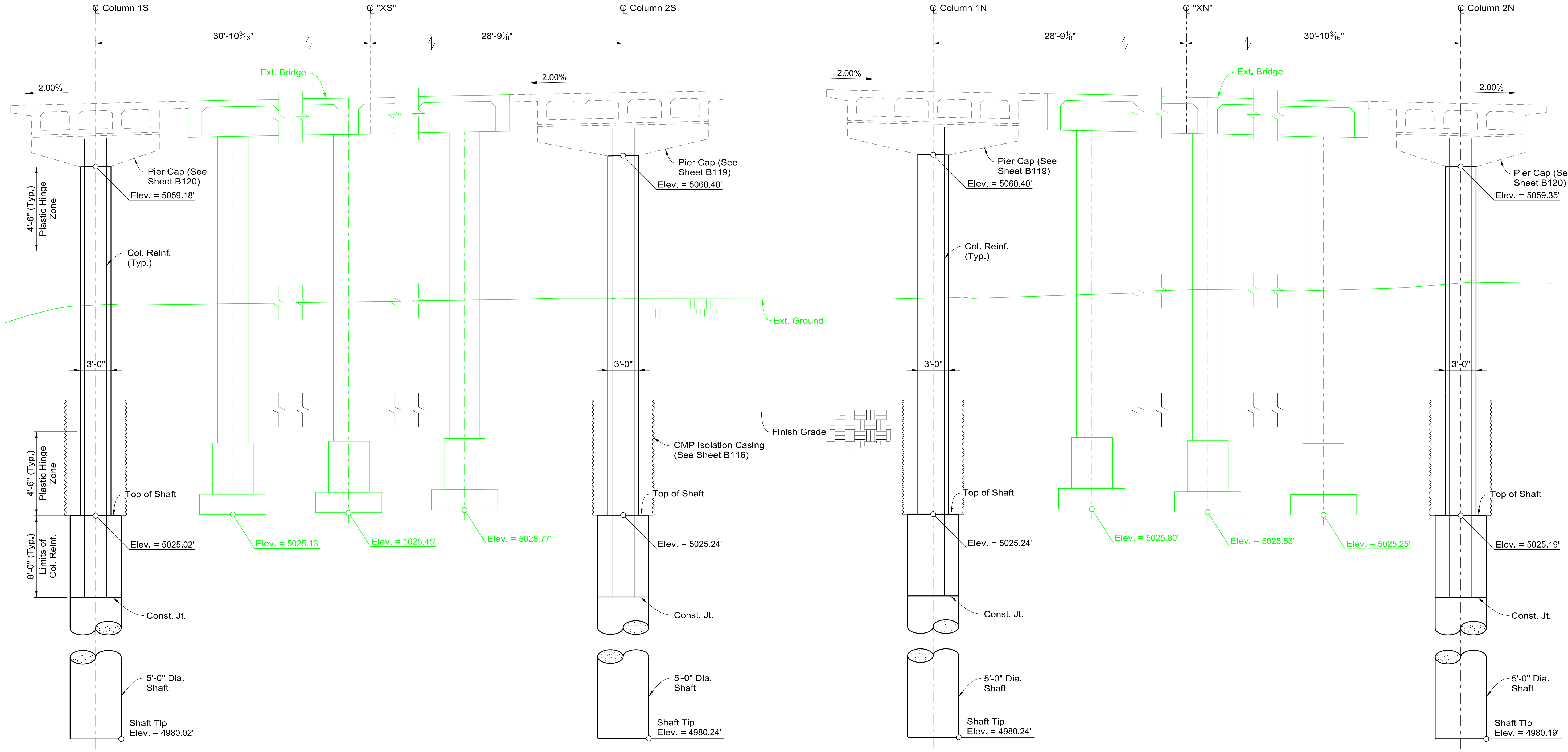
STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

PIER 3 ELEVATION

G-1092 N&S

DATE : 9/2/2022

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	B112



ELEVATION PIER 4

LOOKING AHEAD ON LINE
ALONG SKEW

NOTES:

1. Elevations noted taken through centerline of shaft/column.
2. Lap splices in longitudinal column reinforcing not permitted.
3. For pier cap details, see Sheet B121.
4. For column/shaft details not shown, see Sheets B113-B115.

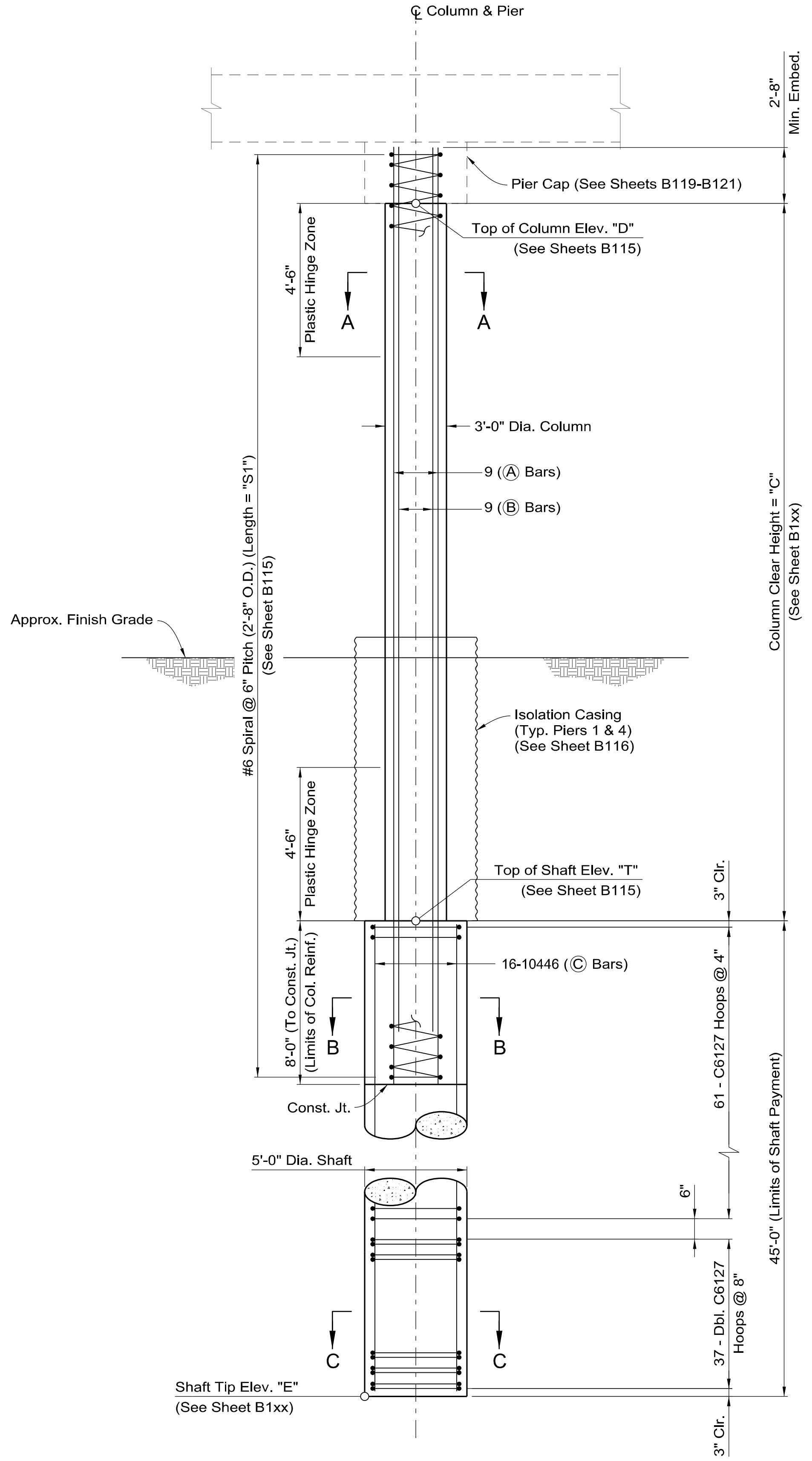
STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

PIER 4 ELEVATION

G-1092 N&S

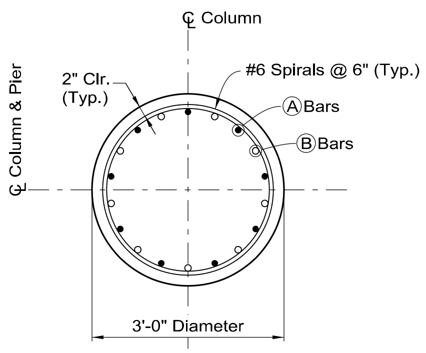
DATE : 9/2/2022

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	B113



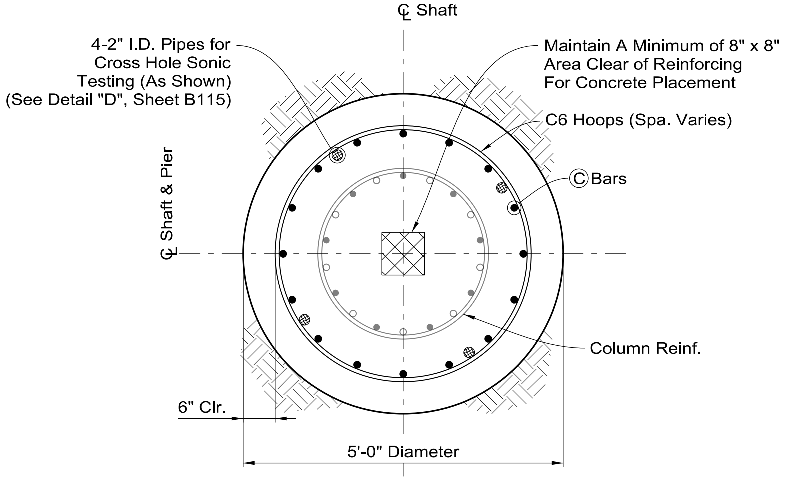
ELEVATION

TYPICAL COLUMNS, PIERS 1 AND 4
NORMAL TO SKEW



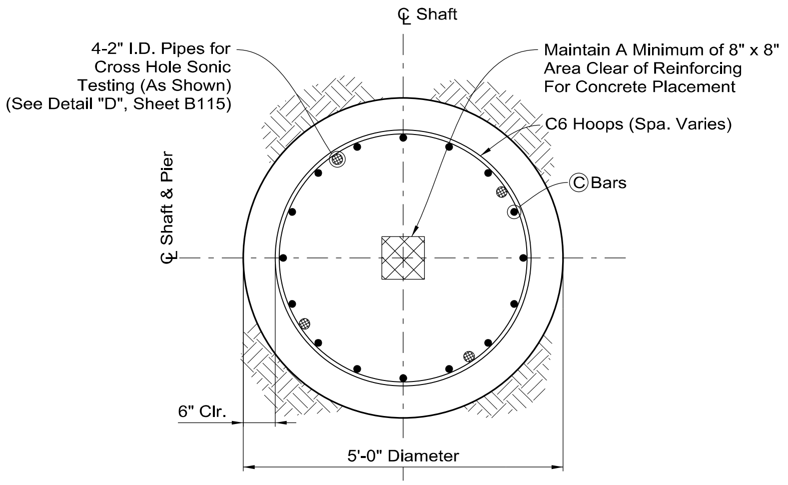
SECTION A-A

TYPICAL COLUMN SECTION, PIERS 1 AND 4



SECTION B-B

TOP OF DRILLED SHAFT, PIERS 1 AND 4



SECTION C-C

BOTTOM OF DRILLED SHAFT, PIERS 1 AND 4

NOTES:

1. Elevations noted taken through centerline of shaft/column.
2. Lap splices in longitudinal column reinforcing not permitted.
3. For pier cap details, see Sheet B121.
4. For column/shaft details not shown, see Sheet B115.

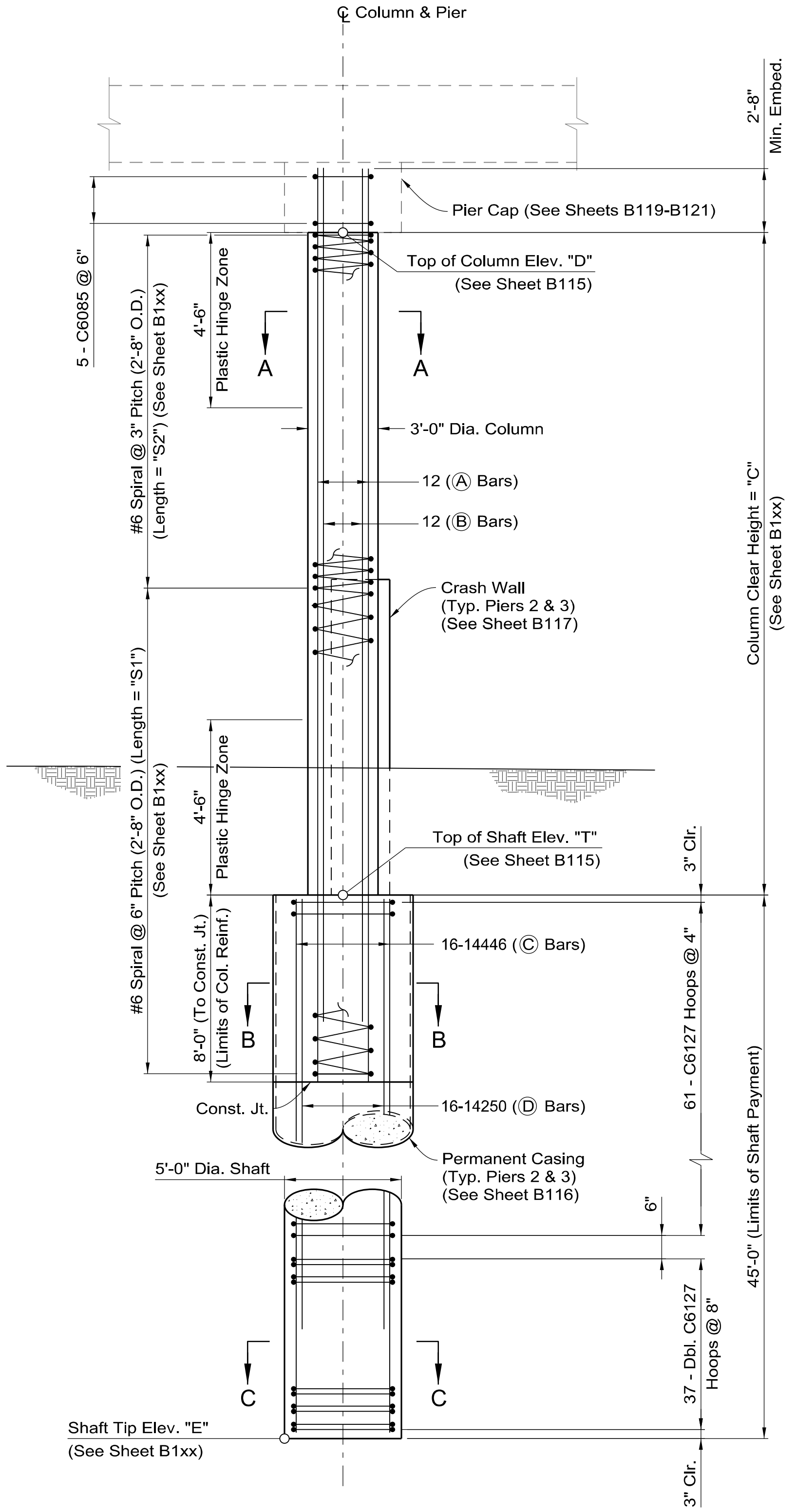
STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

COLUMN AND DRILLED SHAFT REINFORCING

1 OF 3
G-1092 N&S

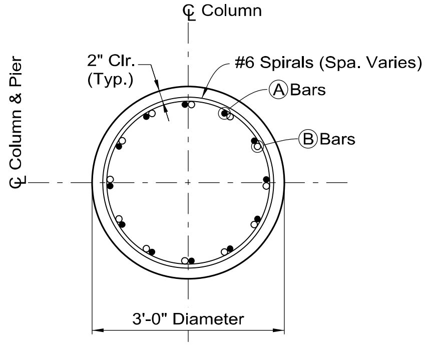
DATE : 9/2/2022

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	B114



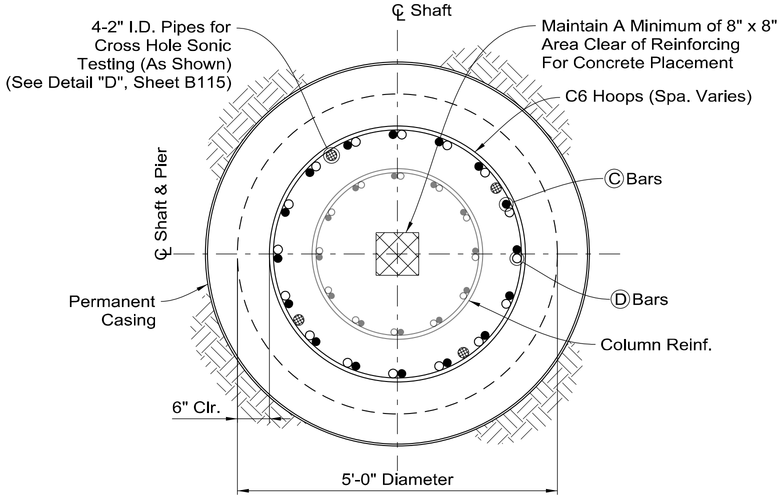
ELEVATION

TYPICAL COLUMNS, PIERS 2 AND 3
NORMAL TO SKEW



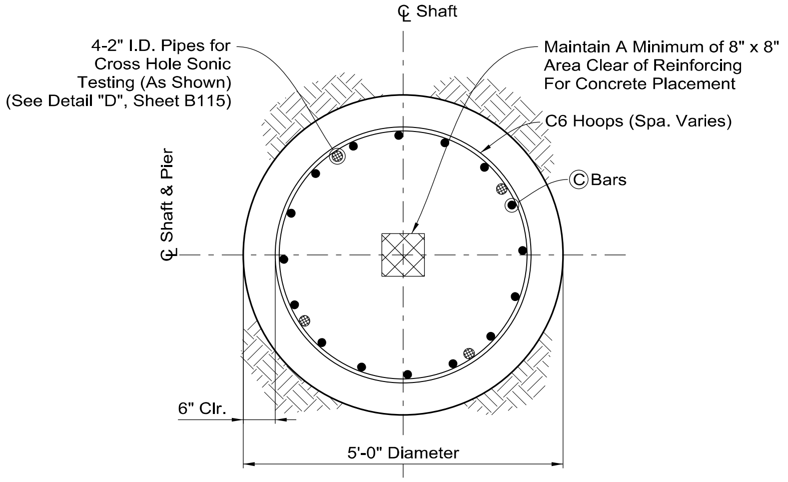
SECTION A-A

TYPICAL COLUMN SECTION, PIERS 2 AND 3



SECTION B-B

TOP OF DRILLED SHAFT. PIERS 2 AND 3



SECTION C-C

BOTTOM OF DRILLED SHAFT, PIERS 2 AND 3

NOTES:

1. Elevations noted taken through centerline of shaft/column.
2. Lap splices in longitudinal column reinforcing not permitted.
3. For pier cap details, see Sheet B121.
4. For column/shaft details not shown, see Sheet B115.
5. See Sheet B117 for Crash Wall reinforcing not shown for clarity.

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

COLUMN AND DRILLED SHAFT REINFORCING

2 OF 3
G-1092 N&S

DATE : 9/2/2022

COLUMN REINFORCING TABLE

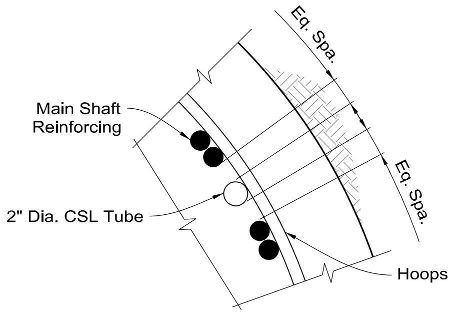
Location		Column Clear Height "C"	Top of Column Elev. "D"	Top of Shaft Elev. "T"	"A" Bars	"B" Bars	Length of Spiral "S1"	Length of Spiral "S2"
PIER 1	1S	34.17'	5058.11'	5023.95'	9-84410	9-8425	779'-6"	----
	2S	35.17'	5059.43'	5024.27'	9-84510	9-8435	796'-4"	----
	1N	35.17'	5059.51'	5024.35'	9-84510	9-8435	796'-4"	----
	2N	34.17'	5058.48'	5024.32'	9-84410	9-8425	779'-6"	----
PIER 2	1S	27.42'	5058.54'	5031.13'	12-8381	12-8358	387'-10"	506'-1"
	2S	28.50'	5059.79'	5031.29'	12-8392	12-8369	387'-10"	542'-5"
	1N	28.50'	5059.83'	5031.33'	12-8392	12-8369	387'-10"	542'-5"
	2N	27.42'	5058.77'	5031.36'	12-8381	12-8358	387'-10"	506'-1"
PIER 3	1S	27.42'	5058.88'	5031.47'	12-8381	12-8358	387'-10"	506'-1"
	2S	28.50'	5060.12'	5031.62'	12-8392	12-8369	387'-10"	542'-5"
	1N	28.50'	5060.13'	5031.63'	12-8392	12-8369	387'-10"	542'-5"
	2N	27.42'	5059.08'	5031.67'	12-8381	12-8358	387'-10"	506'-1"
PIER 4	1S	34.17'	5059.18'	5025.02'	9-84410	9-8425	779'-6"	----
	2S	35.17'	5060.40'	5025.24'	9-84510	9-8435	796'-4"	----
	1N	35.17'	5060.40'	5025.24'	9-84510	9-8435	796'-4"	----
	2N	34.17'	5059.35'	5025.19'	9-84410	9-8425	779'-6"	----

DRILLED SHAFT ELEVATION TABLE

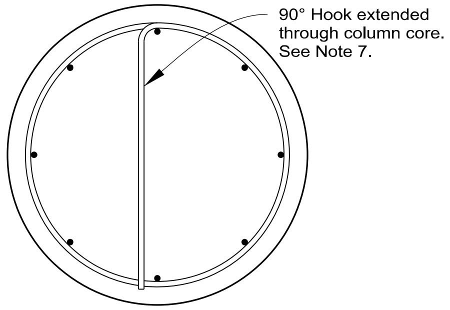
Location		Shaft Length "L"	Top of Shaft Elev. "T"	Shaft Tip Elev. "E"
PIER 1	1S	45.00'	5023.95'	4978.95'
	2S	45.00'	5024.27'	4979.27'
	1N	45.00'	5024.35'	4979.35'
	2N	45.00'	5024.32'	4979.32'
PIER 2	1S	45.00'	5031.13'	4986.13'
	2S	45.00'	5031.29'	4986.29'
	1N	45.00'	5031.33'	4986.33'
	2N	45.00'	5031.36'	4986.36'
PIER 3	1S	45.00'	5031.47'	4986.47'
	2S	45.00'	5031.62'	4986.62'
	1N	45.00'	5031.63'	4986.63'
	2N	45.00'	5031.67'	4986.67'
PIER 4	1S	45.00'	5025.02'	4980.02'
	2S	45.00'	5025.24'	4980.24'
	1N	45.00'	5025.24'	4980.24'
	2N	45.00'	5025.19'	4980.19'

NOTES:

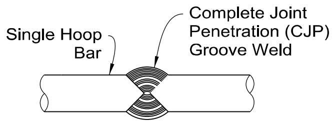
1. Elevations noted taken through centerline of shaft/column.
2. Lap splices in longitudinal column reinforcing not allowed.
3. Construction joints in column are not allowed in the upper and lower 4'-6" of the column length.
4. For column/shaft details not shown, see Sheet **B1xx**.
5. For pier cap details, see Sheet B121.
6. Hoop reinforcing shall be butt welded with a Complete Joint Penetration Groove Weld (CJP) (see detail). Rotate location of butt welds a minimum of 90 degrees between adjacent hoops/bundles. Where welded hoops are bundled, stagger butt welds within each bundle a minimum of 1'-0".
7. Splicing of spiral reinforcing is not permitted within the designated plastic hinge regions. Spiral may be dicontinuous at the bottom of pier cap. Spirals shall terminate with an extra turn with ½ the specified pitch in addition to a 90º hook around longitudinal reinforcing, extended through the column core (See Detail "E").
8. For aesthetic treatments to the columns, see Landscape & Aesthetic Plans.
9. Lap splices in longitudinal shaft reinforcing not allowed except where noted. Mechanical couplers are not permissable in longitudinal shaft reinforcing.
10. Roughen construction joints to ¼" amplitude. Thoroughly clean the surface of debris and laitance.
11. Concrete for drilled shafts shall be Class "S" conforming to Section 509 of the Standard Specifications.
12. All shaft reinforcing included in the cost of Drilled Shaft Foundation.
13. CSL tubes shall be installed per Detail "D". For additional CSL details and requirements, refer to Standard Specifications Section 509.03.14.



DETAIL "D"
CSL TUBE DETAIL



DETAIL "E"
SPIRAL TERMINATION



BUTT WELDED
CONTINUOUS HOOP

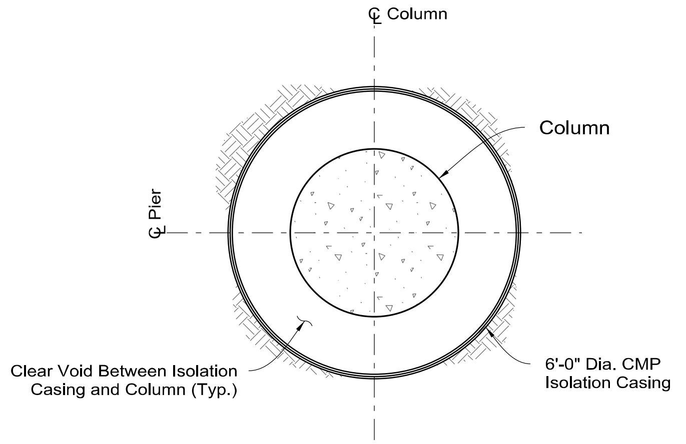
STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

COLUMN AND DRILLED SHAFT REINFORCING

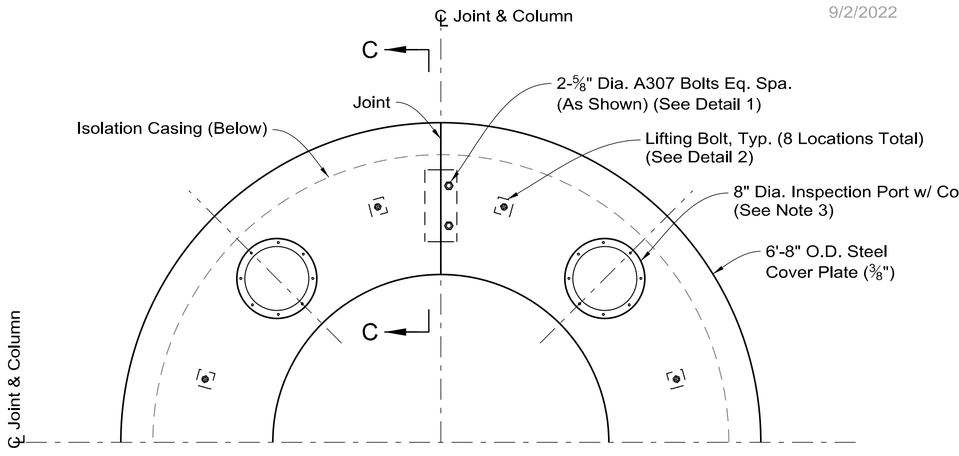
3 OF 3
G-1092 N&S

DATE : 9/2/2022

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	B116

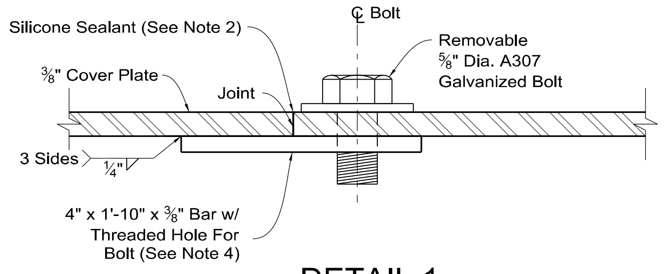


SECTION A-A

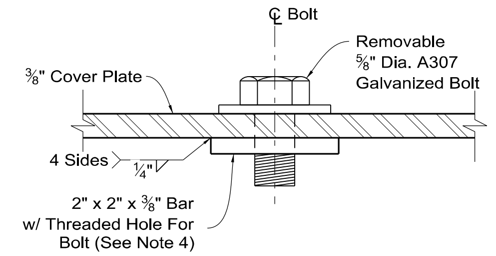


DETAIL "B"

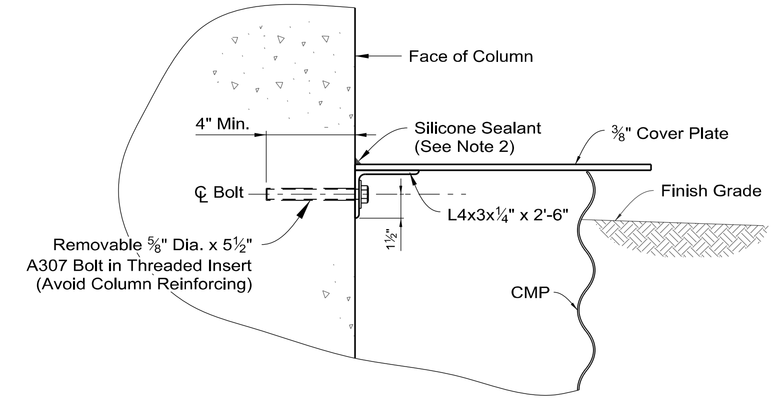
STEEL COVER PLATE PARTIAL PLAN



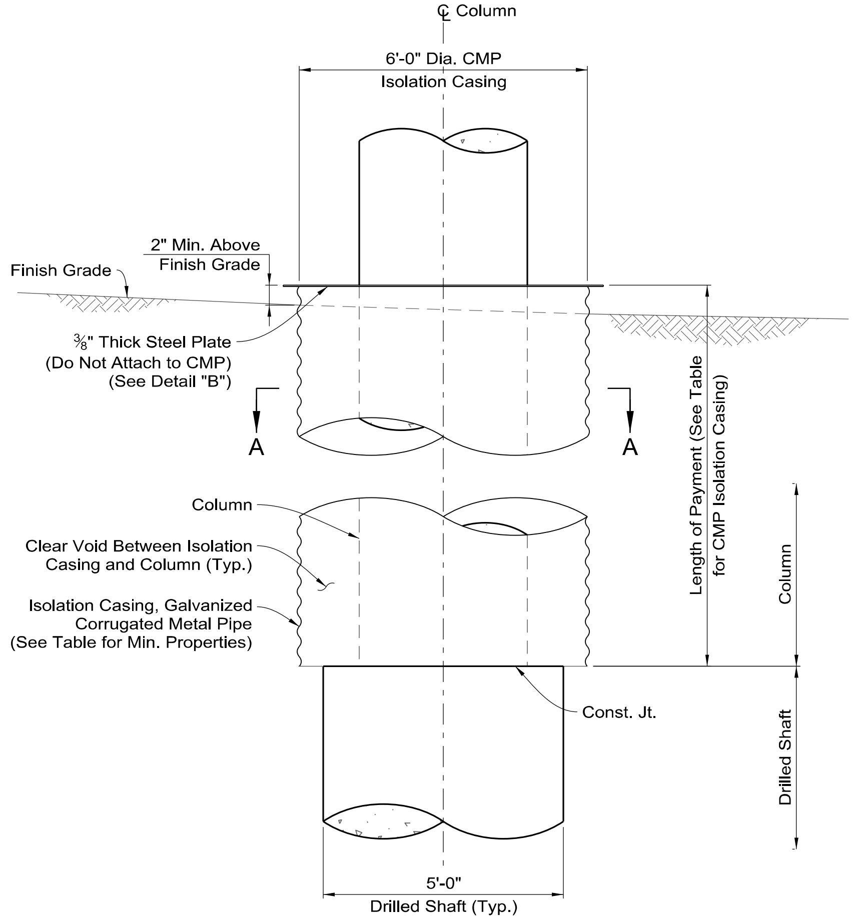
DETAIL 1



DETAIL 2



SECTION C-C



ELEVATION

MINIMUM CMP PROPERTIES

Property	Dimension	
Thickness	0.1090	in
Area	1.390	in²/ft
Radius of Gyration	0.3677	in
Moment of Inertia	0.0156	in⁴/in
Diameter	72	in

DESIGN CASING LENGTHS

Location		Casing Length
PIER 1	1S	13' - 7"
	2S	14' - 0"
	1N	14' - 2"
	2N	14' - 8"
PIER 2	1S	16' - 2"
	2S	16' - 4"
	1N	16' - 4"
	2N	16' - 4"
PIER 3	1S	16' - 6"
	2S	16' - 7"
	1N	16' - 8"
	2N	16' - 8"
PIER 4	1S	12' - 4"
	2S	12' - 3"
	1N	12' - 4"
	2N	12' - 6"

CASING NOTES

1. Steel for isolation casing CMP shall be AASHTO M36. CMP shall be galvanized.
2. Backfill shall be brought up uniformly around isolation casing.
3. Isolation Casing and Top Plate shall be paid for under Bid Item 506 0110 "Structural Steel".
4. All metal used in anchoring CMP to shaft shall be galvanized.

COVER PLATE NOTES

1. Steel material for cover plate assembly shall be AASHTO M270 Grade 36. Steel cover assembly shall be galvanized after fabrication.
2. Fabricate removable steel cover assembly in four sections as shown. Seal joints and joint between column and cover plate with silicone sealant after installation.
3. Provide 8" diameter opening in each quadrant of cover plate for Inspection. Cover opening using ¼" steel plate installed with removable screws or bolts. Provide continuous neoprene gasket around opening.
4. Threaded holes to receive lifting bolts. Bolts are removable allowing attachment of hardware for lifting assemblies or the insertion of threaded eye bolt.

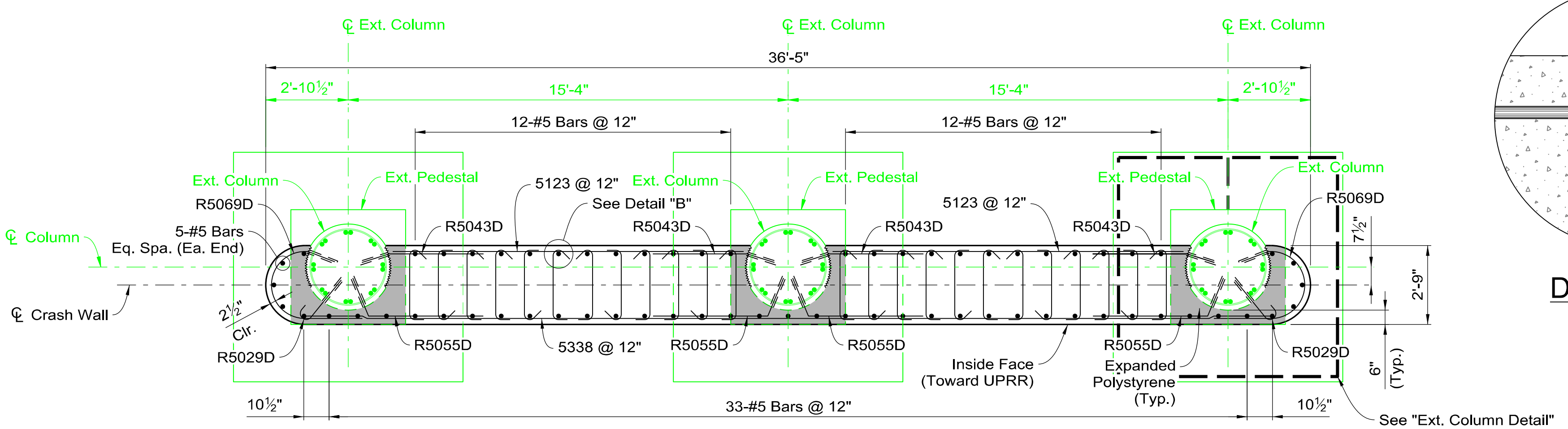
STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

ISOLATION AND PERMANENT CASING DETAILS

G-1092 N&S

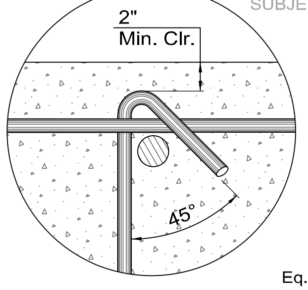
DATE : 9/2/2022

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	B117

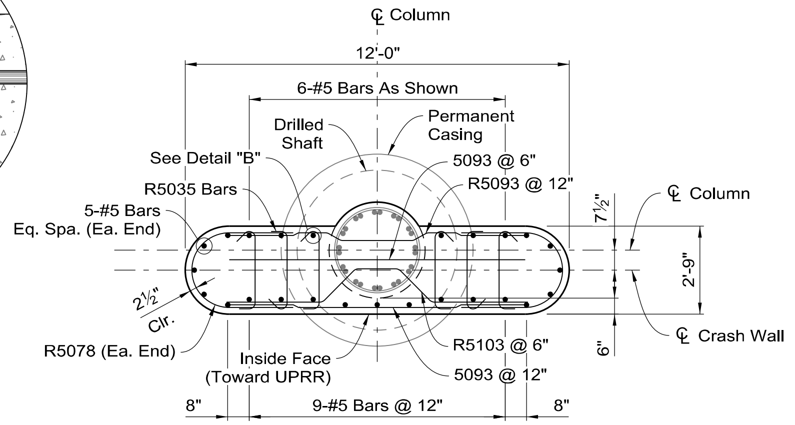


PLAN

EXISTING COLUMNS

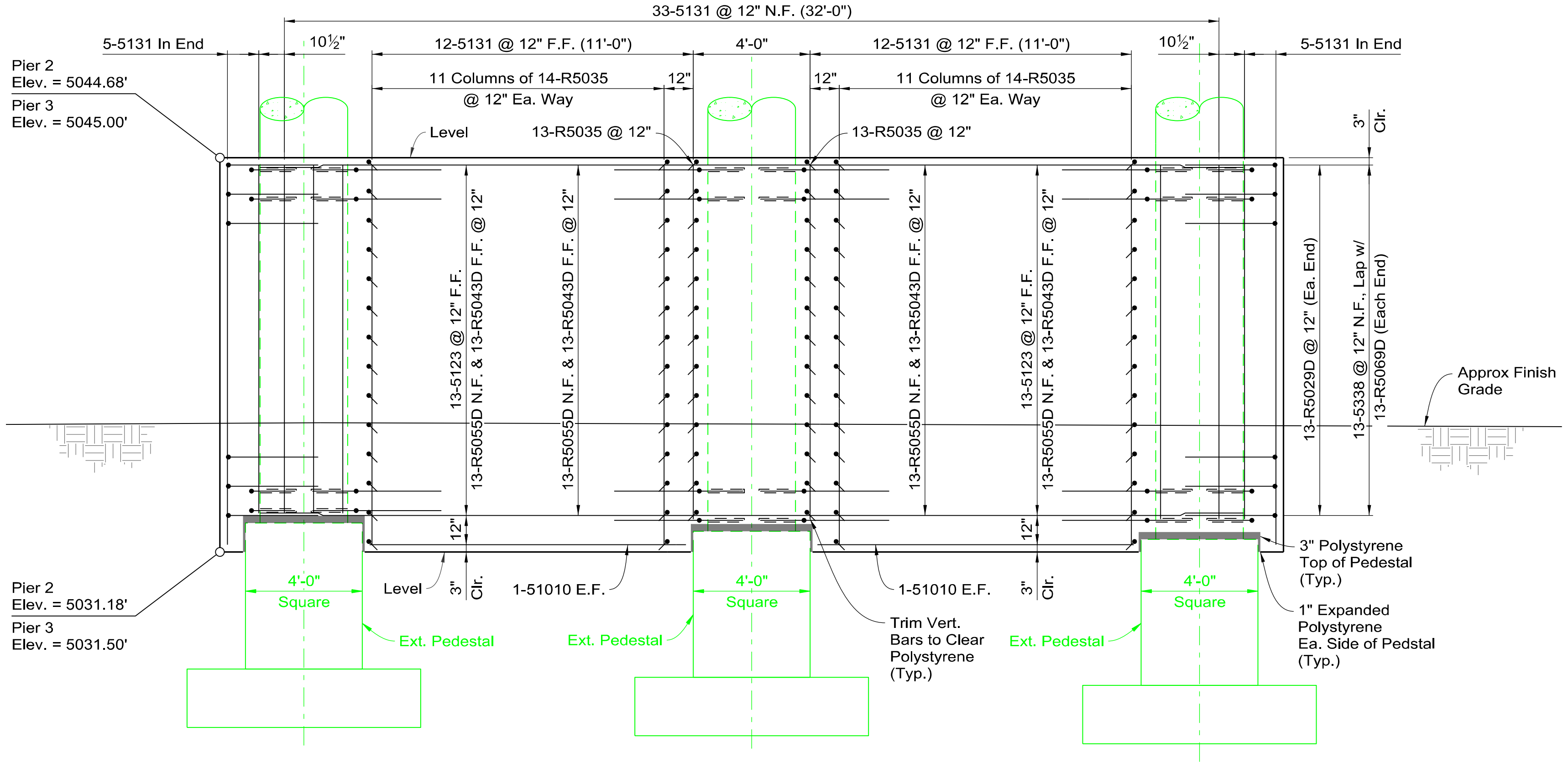


DETAIL "B"



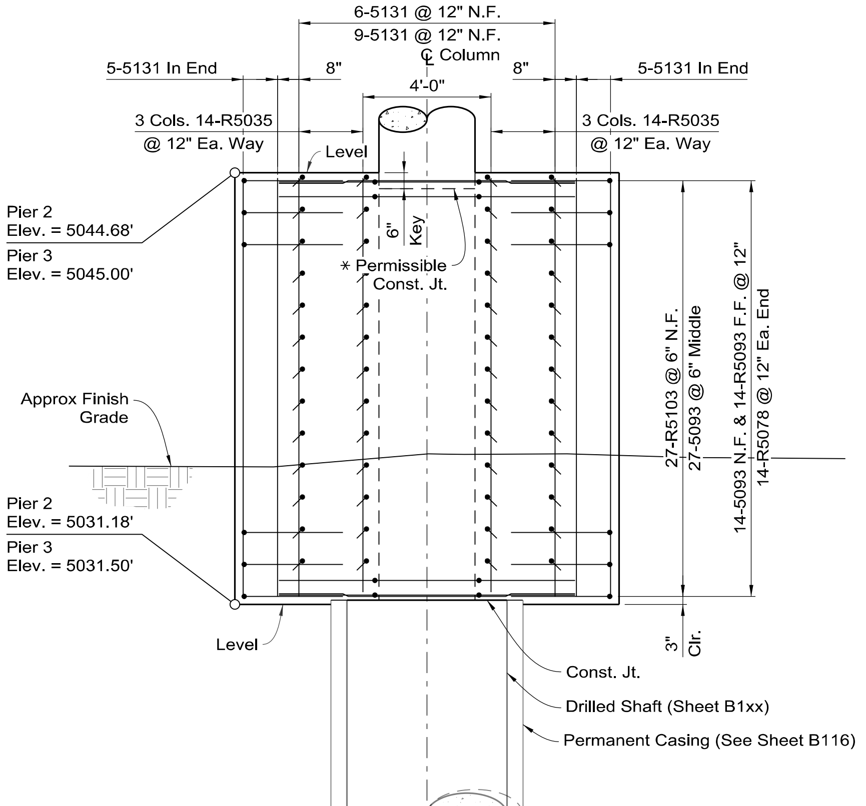
PLAN

NEW COLUMNS



ELEVATION

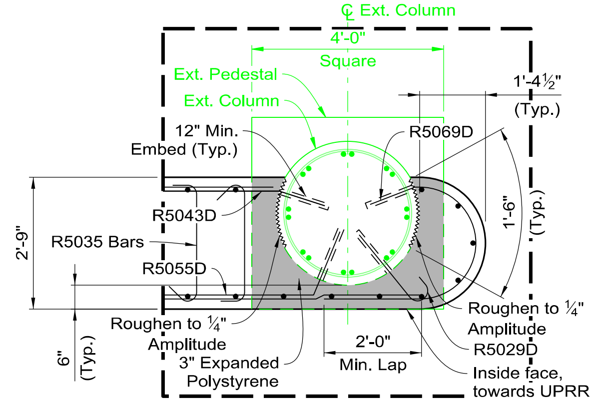
EXISTING COLUMNS



* - Omit Column Key for Column
Placed Monolithically

ELEVATION

NEW COLUMNS



EXT. COLUMN DETAIL

MINIMUM BAR LAP
#5 Bar to #5 Bar = 24"

NOTES:

1. Alternate 135° & 90° hooks on all cross ties.
2. Roughen construction joints to ¼" amplitude. Thoroughly clean the surface of debris and laitance.
3. For column reinforcing not shown, see Sheet B1xx.
4. Bottom of crashwall should be located a minimum of 4" below the top of the lowest footing pedestal in each pier line. Elevations shown are based on original as-built plans and will required field verification.

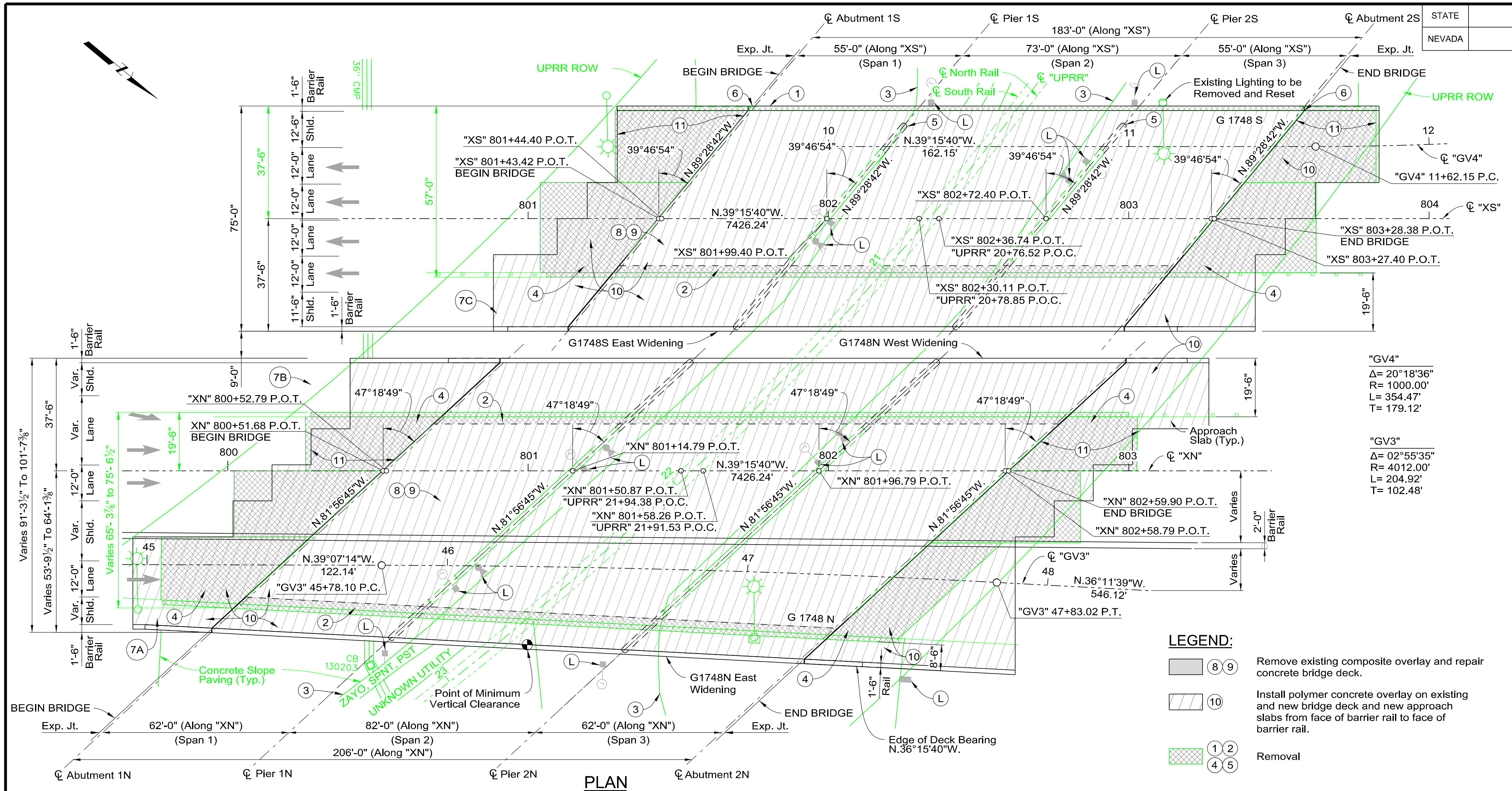
STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

CRASH WALL
DETAILS

G-1092 N&S

DATE : 9/2/2022

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	B400



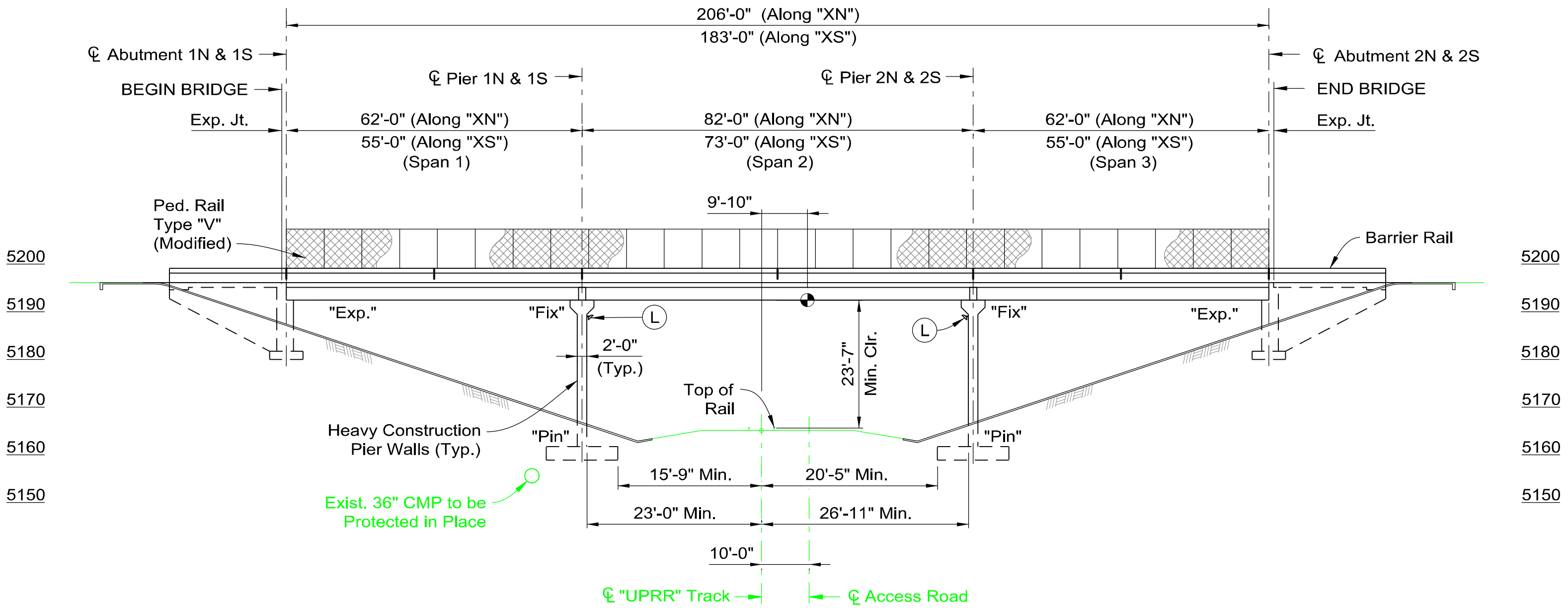
PLAN

"GV4"
Δ= 20°18'36"
R= 1000.00'
L= 354.47'
T= 179.12'

"GV3"
Δ= 02°55'35"
R= 4012.00'
L= 204.92'
T= 102.48'

LEGEND:

▒	⑧ ⑨	Remove existing composite overlay and repair concrete bridge deck.
▨	⑩	Install polymer concrete overlay on existing and new bridge deck and new approach slabs from face of barrier rail to face of barrier rail.
🟩	① ② ④ ⑤	Removal



Ⓛ - Denotes under deck lighting (Refer to Lighting Plans)

DEVELOPED ELEVATION

NOTE

See Geometrics Foundation Plan Sheet B404 for Roadway profiles

DESCRIPTION OF WORK

① Remove existing barrier rail, splashwall, pedestrian rail and portion of wingwalls. Protect in place existing reinforcing in overhang and wingwalls (Bid Item 202 0125). See Removal Details sheets.

② Remove all existing barrier rail, splashwall, pedestrian rail, and overhang at proposed widenings. Protect in place existing reinforcing in deck (Bid Item 202 0125). See Removal Details sheets.

③ Remove all existing concrete slope paving (Bid Item 202 1270). Replace with concrete slope paving treatment and concrete ditch in-kind, graded to drain to existing inlets (Bid Item 611 0120). See Standard Plans sheet SP-1 for details.

④ Remove existing wingwall, portion of abutment and portion of shear block. Protect in place existing reinforcing in abutment wall (Bid Item 202 0125). Remove existing approach slabs. (Bid Item 202 0310). Contractor responsible for temporary shoring as needed to maintain traffic. See Removal Details sheets

⑤ Remove portion of existing cantilever. Protect in place existing reinforcing in cantilever (Bid Item 202 0125). See Removal Details sheets.

⑥ Perform shear key retrofit. See B452 for details.

⑦ Construct bridge widenings; see Sheet B406, B407 and B408 for construction sequencing and phasing.

- 7A. G1748N East Widening
- 7B. G1748N West Widening
- 7C. G1748S East Widening

⑧ Remove existing composite overlay on the bridge deck (Bid Item 202 0120). Care shall be taken to protect existing concrete bridge deck from damage.

⑨ Repair existing concrete bridge deck (Bid Item 502 0360). Remove damaged concrete to such depth that sound concrete is exposed over the entire area. Blast clean any exposed reinforcing steel. Prepare repair areas and patch per 502.03.15. Submit proposed patch material for review 30 days prior to start of deck repair.

⑩ Bridge deck and approach slab preparation and polymer concrete overlay placement.

- 10A. Perform surface preparation on bridge deck and approach slabs in accordance with the manufacturer's recommendation (Bid Item 496 0130).
- 10B. Place polyester based overlay system for a total depth of approximately ¾"on the bridge deck and ¾"on the approach slabs (Bid Items 496 130, 496 0160 and 496 0170).

⑪ Expansion joint replacement.

- 11A. Remove existing strip seal expansion joints at abutments (Bid Item 202 0160).
- 11B. Install new full length 2-inch preformed joint filler at abutments per manufacturer's specifications and as shown in detail on Sheets B444 and B477 (Bid Item 502 2000).
- 11C. Install new 4-inch preformed joint filler between approach slabs and roadway per manufacturer's specifications and as shown in detail on Sheets B444 and B477 (Bid Item 502 2040).

ORIGINAL CONTRACT: 2243
MODIFIED CONTRACT: 2983, DIST. 2 CONTRACT

UPRR MILEPOST :	10.16
UPRR SUBDIVISION:	RENO IND. LD.
PROJECT CITY:	RENO
REVISION DATE:	OCTOBER 28, 2021
LAT. / LONG. :	39°35'47.01" N/ 119°50'0.75" W

90% PRELIMINARY

SUBJECT TO REVISION
09/02/2022

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

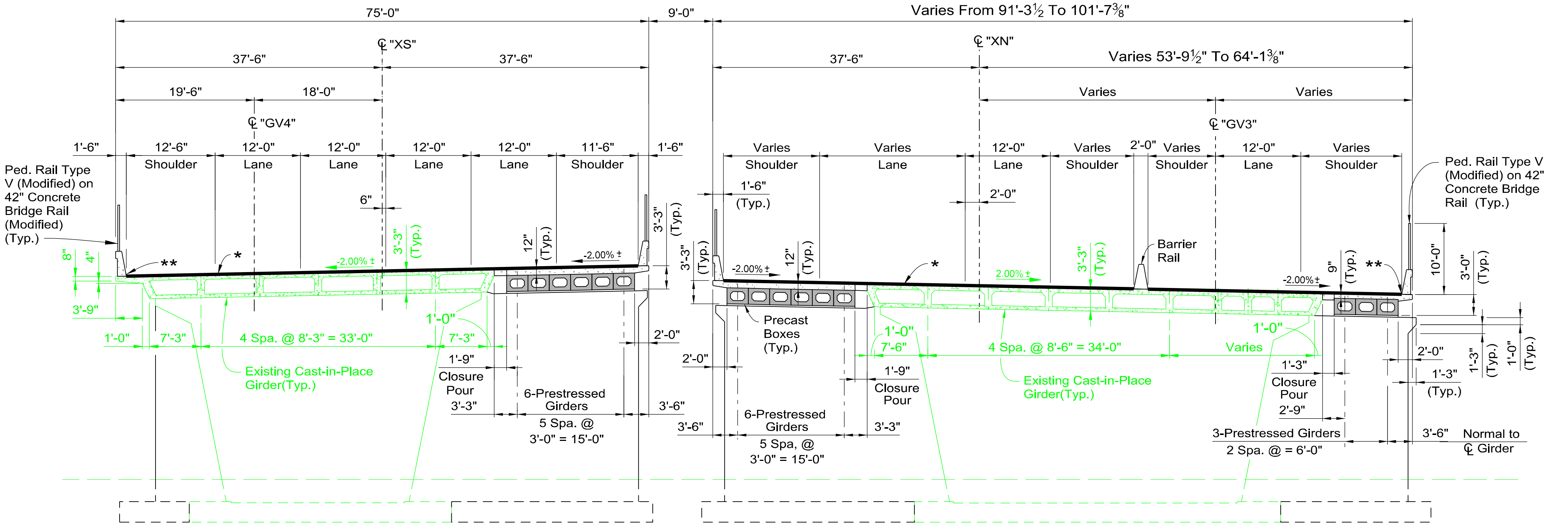
US 395 - WA 30.54
PANTHER BRANCH
UPRR OVERPASS

G-1748 N&S

HDR
HDR Engineering, Inc.

9805 Double R Boulevard, Suite 101
Reno, NV 89521-5917
PH: 775-337-4700 FAX: 775-337-4774

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	B401



* - Polymer Concrete Overlay (See Note 18)
** - Collected Deck Drainage (See Note 21)

TYPICAL SECTION LAYOUT AT PIER

LOOKING AHEAD ON LINE NORMAL TO ALIGNMENT

QUANTITIES

ITEM NO.	ITEM DESCRIPTION	UNIT	G1748S QTY	G1748N QTY	TOTAL
202 0120	REMOVAL OF PORTION OF BRIDGE DECK	SQ.YD.	1,455	1,061	2,516
202 0125	REMOVAL OF PORTION OF BRIDGE	L.S.	1	1	1
202 0160	REMOVAL OF EXPANSION JOINTS	LIN.FT.	200	141	341
202 0310	REMOVAL OF CONCRETE SLAB	SQ.YD.	500	428	928
202 1270	REMOVAL OF SLOPE PAVING	SQ.YD.	2,899	2,376	5,275
206 0110	STRUCTURE EXCAVATION	CU.YD.	1,470	961	2,431
207 0110	GRANULAR BACKFILL	CU.YD.	1,063	691	1,754
212 0045	PAINTING	SQ.YD.	3,832	2,764	6,596
496 0130	BRIDGE DECK PREPARATION AND CONCRETE PLACEMENT	SQ.YD.	2,992	2,000	4,992
496 0160	POLYMER CONCRETE AGGREGATE	POUND	262,911	175,782	438,693
496 0170	POLYMER CONCRETE RESIN	POUND	31,550	21,094	52,644
502 0360	CONCRETE BRIDGE DECK REPAIR	F.A.	1	1	1
502 0881	CLASS DA CONCRETE, MODIFIED (MAJOR)(STRUCTURES)	CU.YD.	689	426	1,115
502 1010	CLASS EA CONCRETE, MODIFIED (MAJOR)	CU.YD.	542	449	991
502 1950	BRIDGE DECK CURING COMPOUND	GAL	110	67	177
502 2020	PREFORMED JOINT FILLER (3-INCH)	LIN.FT.	278	193	471
503 0420	55 FOOT PRECAST CONCRETE MEMBERS	EACH	0	12	12
503 0440	58 FOOT PRECAST CONCRETE MEMBERS	EACH	6	0	6
503 0450	60 FOOT PRECAST CONCRETE MEMBERS	EACH	12	0	12
503 0510	70 FOOT PRECAST CONCRETE MEMBERS	EACH	0	6	6
503 0540	74 FOOT PRECAST CONCRETE MEMBERS	EACH	3	0	3
503 0560	78 FOOT PRECAST CONCRETE MEMBERS	EACH	6	0	6
505 0100	REINFORCING STEEL	POUND	90,141	56,364	146,505
505 0110	REINFORCING STEEL (DOWELED)	POUND	1,164	1,468	2,632
505 0120	REINFORCING STEEL (EPOXY COATED)	POUND	146,252	84,304	230,556
505 0130	REINFORCING STEEL (EPOXY COATED) (DOWELED)	POUND	220	0	220
506 0110	STRUCTURAL STEEL	POUND	1,514	981	2,495
506 0470	APPROACH SLAB RESTRAINER UNIT	EACH	142	98	240
506 0810	PEDESTRIAN RAIL, TYPE V (MODIFIED)	LIN.FT.	406	370	776
611 0120	CLASS AA CONCRETE SLOPE PAVEMENT	CU.YD.	216	192	408

ABBREVIATIONS

Alt.	Alternate
Abut.	Abutment
Brg.	Bearing
Bot.	Bottom
C.G.	Center of Gravity
C.G.S.	Center of Gravity of Steel
CIP	Cast In Place
Clr	Clear
CMP	Corrugated Metal Pipe
Col.	Column
Const. Jt.	Construction Joint
Dbl.	Double
Dia.	Diameter
Dim.	Dimension
Ea.	Each
E.F.	Each Face
Elev.	Elevation
Eq. Spa.	Equal Space
E.S.	Each Side
Exp.	Expansion
Ext.	Existing / Exterior
E.W.	Each Way
F.F.	Far Face
Fix.	Fixed
Galv.	Galvanized
I.D.	Inner Diameter
Int.	Interior / Intermediate
Jt.	Joint
LOL	Layout Line
Max.	Maximum
Min.	Minimum
N.F.	Near Face
O.D.	Outer Diameter
Opt.	Optional
Ped.	Pedestrian
P.G.	Profile Grade
Pr.	Pair
P.S.	Prestressing
PT	Post-Tensioning
Sect.	Section
Shld.	Sholder
Spa.	Space
Spa. Var.	Spacing Varies
Sq.	Square
Typ.	Typical
Var.	Varies

SHEET INDEX

SHEET	DESCRIPTION
B400	US395 - WA 30.54 Panther Branch UPRR Overpass
B401	General Notes and Quantities
B402	Geometrics
B403	Railroad Coordination Plan
B404	Railroad Track Profiles
B405	Excavation and Backfill
B406	Bridge Construction Sequence
B407	Bridge Construction Phase 1 & 2
B408	Removal Details (1 of 2)
B409	Removal Details (2 of 2)
	G1748N SHEETS
B410	Abutment Footing Plan 1N & 2N
B411	Abutment Footing Details
B412	Abutment 1N West Plan & Elevation
B413	Abutment 1N East Plan & Elevation
B414	Abutment 2N West Plan & Elevation
B415	Abutment 2N East Plan & Elevation
B416	Abutment 1N & 2N Details (1 of 2)
B417	Abutment 1N & 2N Details (2 of 2)
B418	Wingwall Plan & Elevation (1 of 2)
B419	Wingwall Plan & Elevation (2 of 2)
B420	Pier 1N & 2N West Footing Details Plan & Sections
B421	Pier 1N & 2N East Footing Details Plan & Sections
B422	Pier 1N & 2N West Plan & Elevation
B423	Pier 1N & 2N East Plan & Elevation
B424	Pier 1N & 2N Wall Details (1 of 3)
B425	Pier 1N & 2N Wall Details (2 of 3)
B426	Pier 1N & 2N Wall Details (3 of 3)
B427	Deck Section
B428	Prestressed Girder Framing Plan (1 of 3)
B429	Prestressed Girder Framing Plan (2 of 3)
B430	Prestressed Girder Framing Plan (3 of 3)
B431	Prestressed Girder Details (1 of 2)
B432	Prestressed Girder Details (2 of 2)
B433	Tie Rod Details (1 of 2)
B434	Tie Rod Details (2 of 2)
B435	Deck Reinforcing
B436	Camber and Classification Diagrams
B437	Finish Grade Elevations (1 of 2)
B438	Finish Grade Elevations (2 of 2)
B439	Approach Slabs (1 of 3)
B440	Approach Slabs (2 of 3)
B441	Approach Slabs (3 of 3)
B442	Approach Slab Details
B443	Expansion Joint Details
B444	Barrier Rail
B445	Barrier Rail Details
B446	Pedestrian Rail Details
B447	Concrete Slope Paving
B448	Bent Bars (1 of 2)
B449	Bent Bars (2 of 2)
B450	Bill of Materials (1 of 3)
B451	Bill of Materials (2 of 3)
B452	Bill of Materials (3 of 3)

SHEET	G1748S SHEETS
B453	Abutment Footing Plan 1S & 2S
B454	Abutment Footing Details
B455	Abutment 1S Plan & Elevation
B456	Abutment 2S Plan & Elevation
B457	Abutment 1S & 2S Details
B458	Wingwall Plan & Elevation
B459	Pier 1S & 2S West Footing Details Plan & Sections
B460	Pier 1S & 2S East Footing Details Plan & Sections
B461	Pier 1S & 2S West Plan & Elevation
B462	Pier 1S & 2S East Plan & Elevation
B463	Pier 1S & 2S Wall Details (1 of 2)
B464	Pier 1S & 2S Wall Details (2 of 2)
B465	Deck Section
B466	Prestressed Girder Framing Plan (1 of 3)
B467	Prestressed Girder Framing Plan (2 of 3)
B468	Prestressed Girder Framing Plan (3 of 3)
B469	Prestressed Girder Details (1 of 2)
B470	Prestressed Girder Details (2 of 2)
B471	Tie Rod Details (1 of 2)
B472	Tie Rod Details (2 of 2)
B473	Deck Reinforcing
B474	Camber and Classification Diagrams
B475	Finish Grade Elevations
B476	Approach Slabs (1 of 2)
B477	Approach Slabs (2 of 2)
B478	Approach Slab Details
B479	Expansion Joint Details
B480	Barrier Rail
B481	Barrier Rail Details
B482	Pedestrian Rail Details
B483	Concrete Slope Paving
B484	Bent Bars (1 of 2)
B485	Bent Bars (2 of 2)
B486	Bill of Materials (1 of 2)
B487	Bill of Materials (2 of 2)

STANDARD BAR LAPS

Bar Size	Uncoated (in)	Epoxy Coated (in)
#4	20	24
#5	24	30
#6	30	34
#7	38	45
#8	48	57
#9	60	72
#10	74	88
#11	90	108

GENERAL NOTES

1. Design Specifications: AASHTO "LRFD Bridge Design Specifications" Eighth Edition 2017, AASHTO "Guide Specifications for LRFD Seismic Bridge Design" Second Edition 2011, with interims through 2015, and "NDOT Structures Manual" 2008, with interims through 2019. Seismic Retrofit designed in accordance with FHWA "Seismic Retrofitting Manual for Highway Structures: Part 1 Bridges"2006.

2. Construction Specifications: State of Nevada Department of Transportation "Standard Specifications for Road and Bridge Construction, 2014" except as noted below and in the Special Provisions of this Contract.

3. Dead Load: In accordance with Specifications with an allowance of 38 psf for future wearing surface.

4. Live Load: AASHTO HL-93 Loading. Overload design based on California "Standard Permit Design Vehicles" (Maximum Overload P-13 Truck). Deck Design based on the Equivalent Strip Method with a 40.0 kip axle.

5. Seismic Load: PGA Coefficient = 0.50g, Short Period Coefficient (Ss) = 1.25g, Long Period Coefficient (S1) = 0.50g, Site Class C Soil Profile (Seismic Zone 3). γ_{EQ}. = 0.25.

6. Concrete: See Concrete Placement Schedule and Diagram for concrete class and compressive strengths.

7. Reinforcing Steel: All reinforcing steel to be ASTM A706. Reinforcing steel for precast girders may be A615 or A706. Dimensions relating to bar spacing are center to center. Bending dimensions are from out to out of the bars. Bar sizes three (3) to nine (9) are indicated by the first number of the mark; ten (10) or larger by the first two numbers. Bar marks with a letter prefix indicate a bent bar. Bar marks with a "D" suffix indicate a doweled bar. Bar marks ending with either the letter "E" or "ED" indicate that the bar shall be epoxy coated the length of the bar. Sizes four (4) and five (5), when considered as bars to control temperature, shrinkage, and distribution stresses by the Engineer, may be adjusted upon concurrence and approval of the Engineer.

8. Dowelled reinforcing steel: Reinforcing to be dowelled in the existing concrete shall be epoxied in drilled holes with a maximum diameter equal to the bar diameter plus ¼". Holes shall be cleaned with oil free compressed air after drilling. Care shall be taken to avoid damaging existing reinforcing. Minimum embedment shall be 12" unless shown otherwise.

9. Foundations: Piers and abutments shall be on spread footing foundations. For geotechnical information refer to Geotechnical Report from HDR titled "Draft Geotechnical Design Report, Phase 1B: US395 North Valleys, Washoe County, Nevada"dated January 2021.

10. Camber: Camber shall be as shown on the Plans.

11. Bridge Rail: Designed for TL-4. Bridge Rail (Modified): Designed for Standard Specification loading.

12. Construction Type Code: X181.

13. Concrete construction joints designated as a "Permissible Joint" or as an "Optional Construction Joint" may be incorporated into the construction at the Contractor's option. Joints designated as a "Construction Joint" are considered mandatory and shall be incorporated into the construction unless otherwise approved in writing by the Bridge Design Engineer.

14. Elevations and roadway profile information in these plans are approximate and are based on Contract xxxx, adjusted to the survey datum for this project. Contractor to verify profile and elevations to ensure a smooth roadway profile between new bridge deck and existing roadway. Any discrepancies shall be brought to the attention of the Engineer prior to construction.

15. All dimensions are measured at 60 °F unless noted otherwise.

16. Verification of Existing Conditions: Before ordering materials or commencing work on any item which may be affected by the dimensions or elevations of the existing structure, the Contractor shall field verify those dimensions and elevations and shall notify the Engineer of any field measured dimensions or elevations which deviate substantially from these plans prior to commencing the work. No direct payment will be made for field measurements.

17. All exposed concrete surfaces of new and existing structures (excluding bridge deck) to receive stain or surface treatments as specified in the Landscape & Aesthetic Plans (Bid Item 212 0045). Finishes to extend one foot minimum below surface grade.

18. Install ¾"polymer concrete overlay to bridge deck and approach slabs. Polymer concrete shall be installed from face of rail to face of rail. Refer to Section 496 of the Contract Special Provisions.

19. Design of temporary shoring as needed for maintaining the UPRR Minimum Construction Clearance Envelope shall satisfy UPRR-BNSF Guidelines for Temporary Shoring.

20. Stay-in-place deck forms to be used at locations of closure pours.

21. Deck Drainage shall be collected at roadway level. Directed to a storm drain system and discharge away from UPRR Right-of-Way.

ORIGINAL CONTRACT: 2243
MODIFIED CONTRACT: 2983, DIST. 2 CONTRACT

90% PRELIMINARY
SUBJECT TO REVISION
09/02/2022

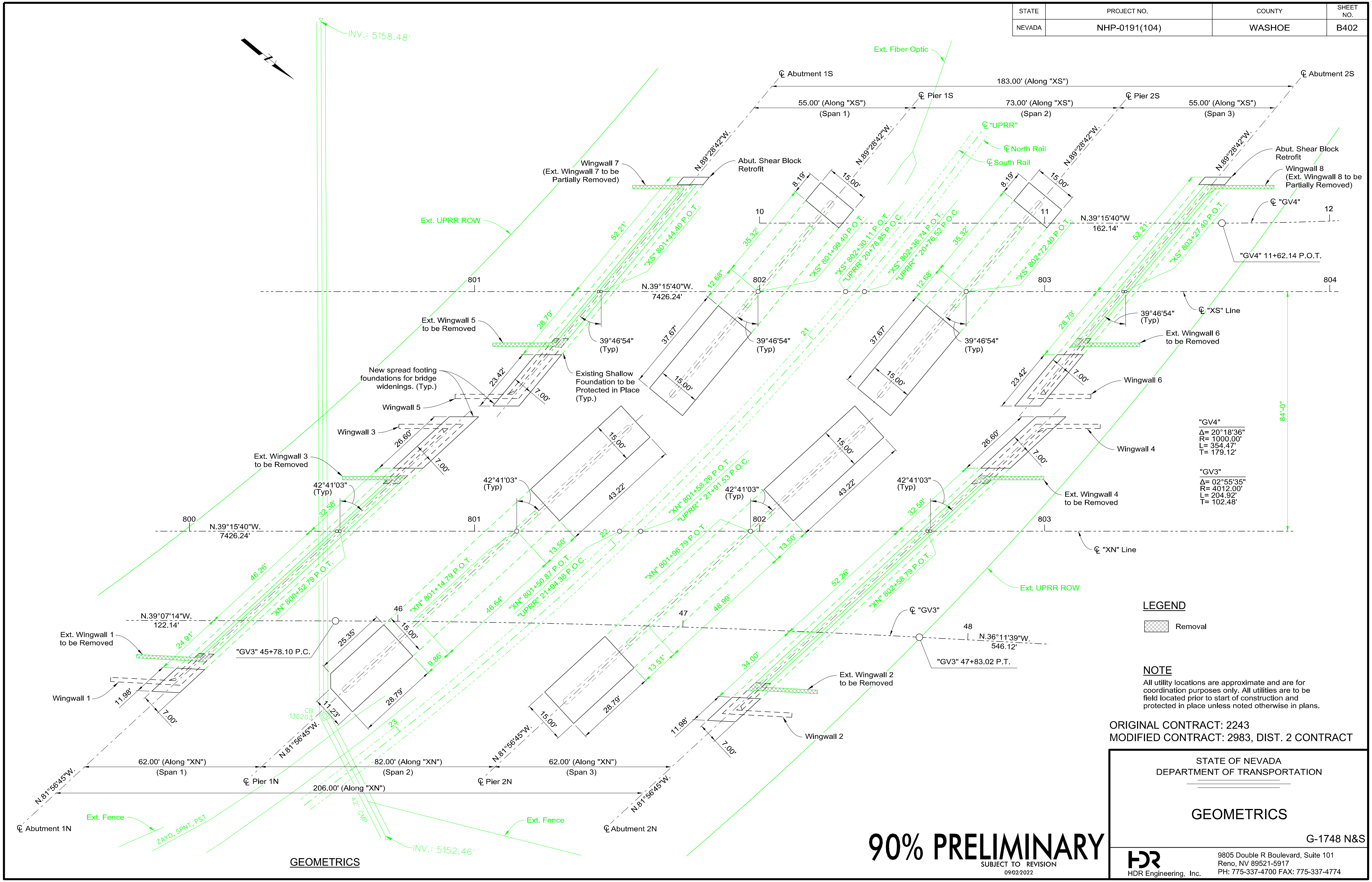
STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

GENERAL NOTES
AND QUANTITIES

G-1748 N&S

HDR Engineering, Inc.
9805 Double R Boulevard, Suite 101
Reno, NV 89521-5917
PH: 775-337-4700 FAX: 775-337-4774

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	B402



GEOMETRICS

LEGEND

▨ Removal

NOTE

All utility locations are approximate and are for coordination purposes only. All utilities are to be field located prior to start of construction and protected in place unless noted otherwise in plans.

ORIGINAL CONTRACT: 2243
MODIFIED CONTRACT: 2983, DIST. 2 CONTRACT

90% PRELIMINARY

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09/02/2022

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

GEOMETRICS

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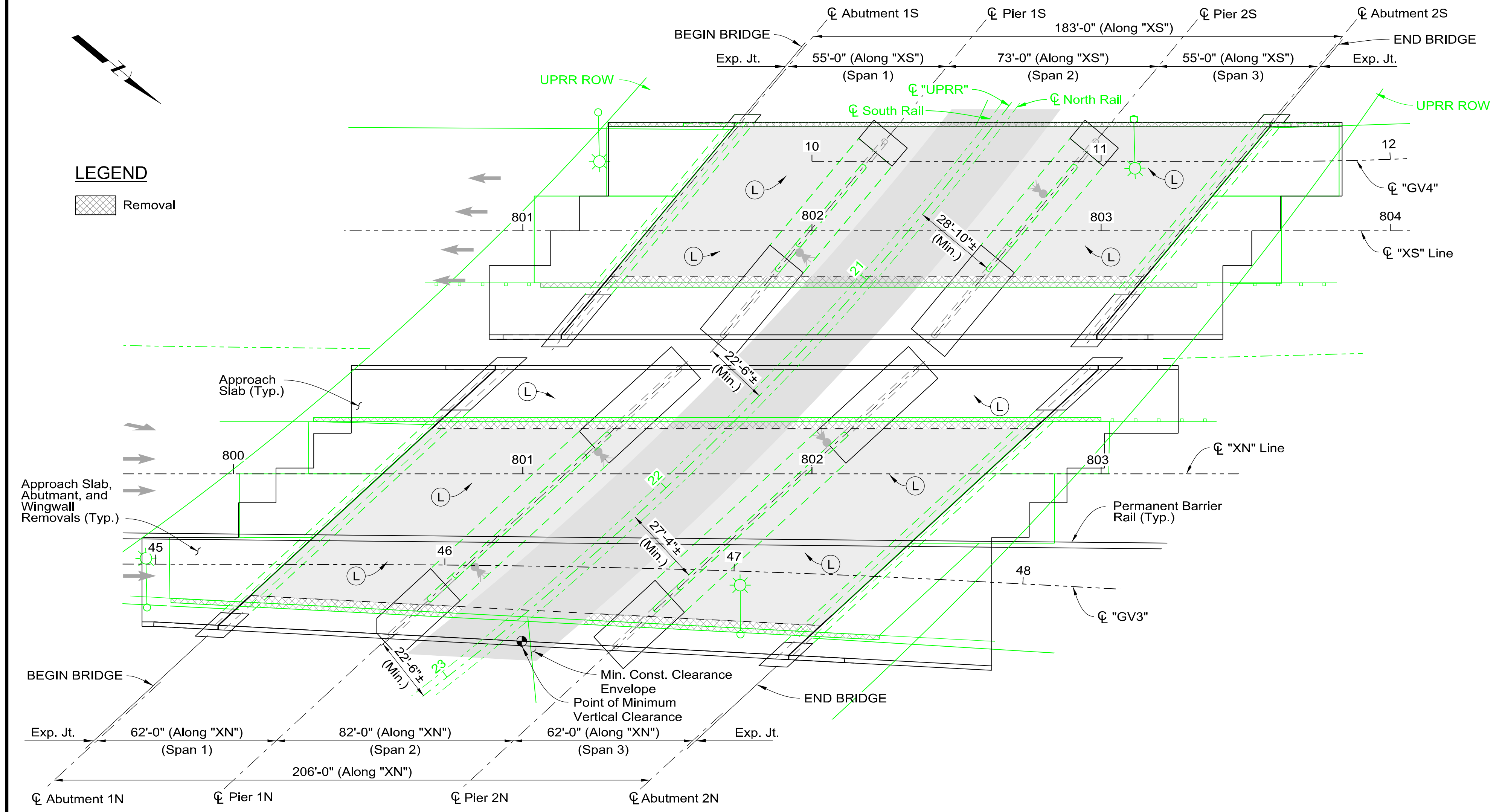
PH: 775-337-4700 FAX: 775-337-4774

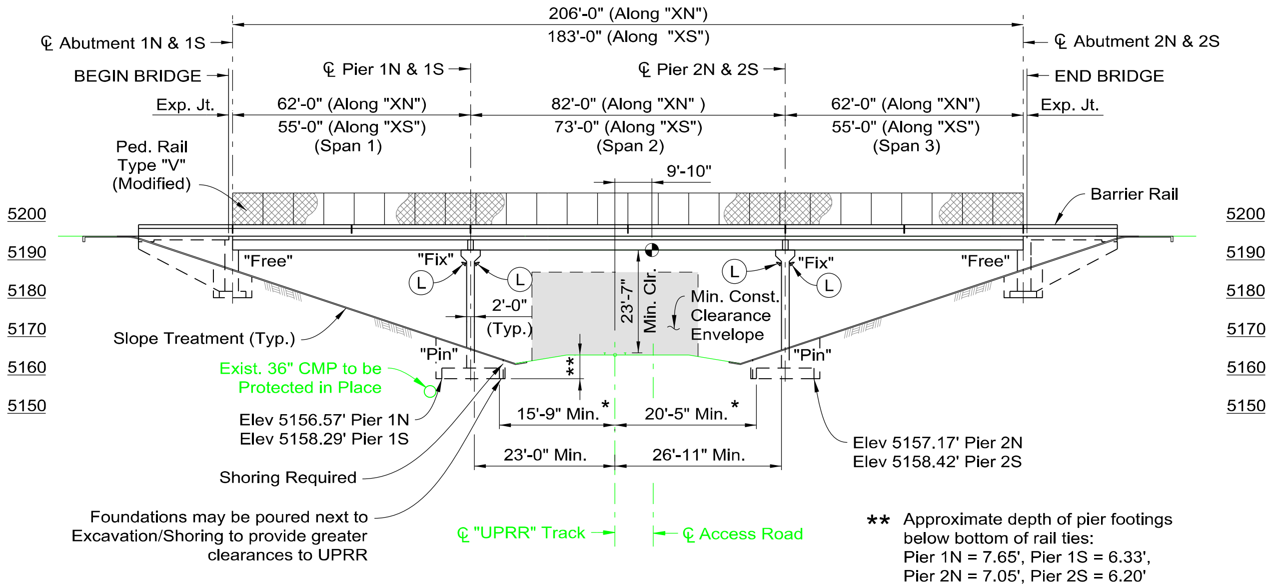
STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	B403

LEGEND

▨ Removal



PLAN

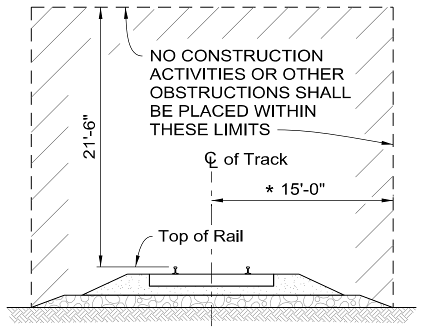


Foundations may be poured next to Excavation/Shoring to provide greater clearances to UPRR

** Approximate depth of pier footings below bottom of rail ties:
Pier 1N = 7.65', Pier 1S = 6.33',
Pier 2N = 7.05', Pier 2S = 6.20'

Ⓛ - Denotes under deck lighting (Refer to Lighting Plans)

DEVELOPED ELEVATION



MIN. CONST. CLR. ENVELOPE
(NORMAL TO RAILROAD)

* 15'-7" Temporary Horizontal Clearance is Required for the Northbound and Southbound Structures. Horizontal clearance is increased by 7" to account for railroad curvature.

CONSTRUCTION PHASING

All construction to conform to the Guidelines for Railroad Grade Separation Projects, May 2016.

The following is the proposed construction sequencing for the major items of work:

1. Install portable precast barrier rails anchored to bridge deck to separate traffic from bridge widening work on the shoulders.
2. Remove existing bridge rails and deck overhangs while protecting the railroad track below and maintaining the required minimum construction clearances.
3. Perform excavation of the abutment and pier spread footing foundations. Install excavation shoring where required to maintain minimum horizontal clearance to centerline of railroad track. Refer to the Minimum Construction Clearance Envelope.
4. Construct abutment and pier concrete spread footings. See Geometrics Foundation Plan.
5. Remove portions of the existing abutment walls, wing walls, and approach slabs as needed for extensions and connections of the new abutments and pier walls.
6. Construct new pier walls and abutments.
7. Backfill foundation excavations.
8. Construct abutment wing walls and adjacent retaining walls in the freeway median.
9. Place precast box girders on pier walls and abutments. Girder delivery and erection to be performed from the freeway above and existing bridge decks. Calculations showing sufficient capacity of existing structure shall be sealed by a Nevada registered professional engineer and provided to the engineer for approval.
10. Construct pier and abutment diaphragm connections to precast girders.
11. Construct deck slab and bridge rails.
12. Form and pour cast-in-place deck closure pours between existing bridge deck and new deck.
13. Construct approach slabs at abutments and bridge rails on the approach slabs.
14. Grade abutment fill slopes and construct slope treatment with drainage ditches parallel to railroad track.
15. Paint bridge concrete surfaces as required per aesthetic requirements while protecting the railroad track below.
16. Remove temporary precast bridge rails, perform bridge deck profile grinding, install polymer concrete overlay, construct permanent barrier rail, and open bridge lanes to traffic.

CONSTRUCTION NOTES

1. Any shoring system that impacts the Railroad operations and/or supports Railroad embankment shall be designed and constructed per the Railroad temporary shoring requirements.
2. All demolition within the Railroad right-of-way and/or demolition that may impact the Railroad tracks or operations shall comply with the Railroad demolition requirements
3. Erection over the Railroad right-of-way shall be designed to cause no interruption to all Railroad operations.
4. The elevation of the existing top-of-rail shall be verified before beginning construction. all discrepancies shall be brought to the attention of the Railroad and the Engineer prior to construction.
5. The proposed grade separation shall not increase the quantity and/or characteristics of the flow in the Railroad ditches and/or drainage structures
6. The Contractor must submit a proposed method of erosion and sediment control and have the method approved by the Railroad prior to beginning any grading on the project site.
7. For Railroad coordination please refer to the Railroad's Coordination Requirements as part of the Specifications or Special Provisions of the project.
8. Temporary Construction Clearances, including falsework clearances, shall comply with the Minimum Construction Clearance Envelope.
9. All permanent clearances shall be verified before project closeout.
10. Railroad requirements do not allow work within 50 feet of track centerline when a train passes the work site and all personnel must clear the area within 25 feet of the track centerline and secure all equipment.
11. For location of Points of Critical Clearance relative to the track centerline, see Developed Elevation on Sheet B400.
12. For Typical Section, see Sheet B401.
13. For Railroad Profile Grade Diagrams, see Sheet B403.

ORIGINAL CONTRACT: 2243
MODIFIED CONTRACT: 2983, DIST. 2 CONTRACT

UPRR MILEPOST :	10.16
UPRR SUBDIVISION:	RENO IND. LD.
PROJECT CITY:	RENO
REVISION DATE:	OCTOBER 28, 2021
LAT. / LONG. :	39°35'47.01" N/ 119°50'0.75" W

90% PRELIMINARY
SUBJECT TO REVISION
09/02/2022

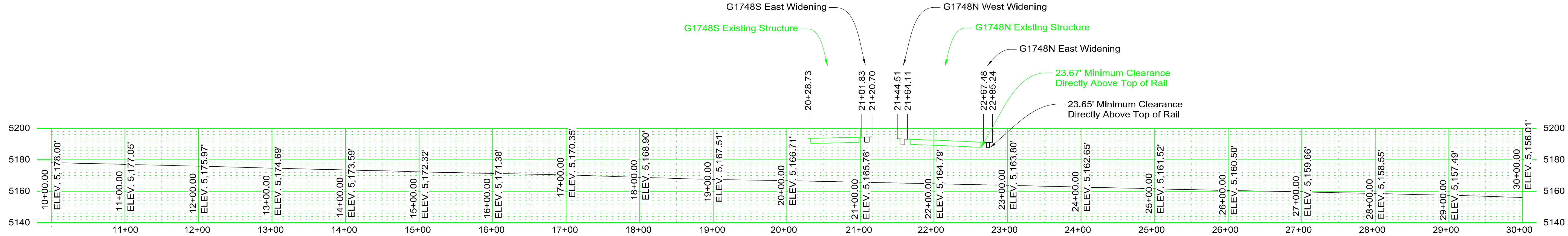
STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

RAILROAD COORDINATION PLAN

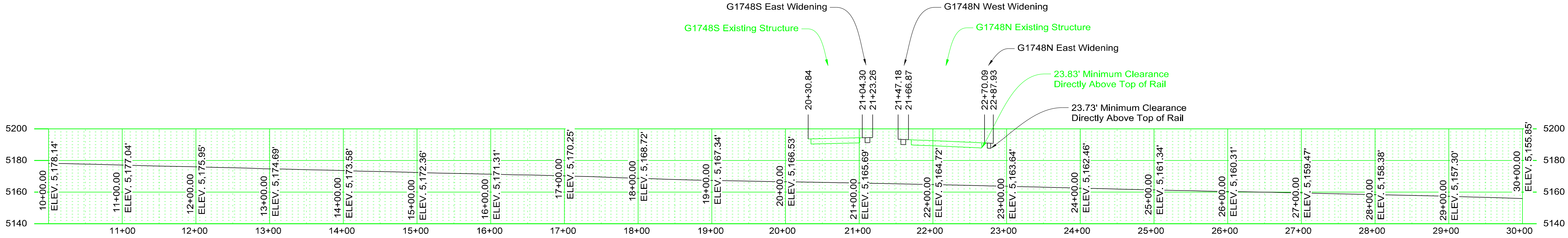
G-1748 N&S

HDR Engineering, Inc.
9805 Double R Boulevard, Suite 101
Reno, NV 89521-5917
PH: 775-337-4700 FAX: 775-337-4774

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	B404



NORTH RAIL PROFILE



SOUTH RAIL PROFILE

UPRR TRACK PROFILES

NORTH RAIL		SOUTH RAIL	
STATION	ELEVATION	STATION	ELEVATION
10+00.00	5178.00	10+00.00	5178.14
11+00.00	5177.05	11+00.00	5177.04
12+00.00	5175.97	12+00.00	5175.95
13+00.00	5174.69	13+00.00	5174.69
14+00.00	5173.59	14+00.00	5173.58
15+00.00	5172.32	15+00.00	5172.36
16+00.00	5171.83	16+00.00	5171.31
17+00.00	5170.35	17+00.00	5170.25
18+00.00	5768.90	18+00.00	5168.72
19+00.00	5167.51	19+00.00	5167.34
20+00.00	5166.71	20+00.00	5166.53
21+00.00	5165.76	21+00.00	5165.69
22+00.00	5164.79	22+00.00	5164.72
23+00.00	5163.80	23+00.00	5163.64
24+00.00	5162.65	24+00.00	5162.46
25+00.00	5161.52	25+00.00	5161.34
26+00.00	5160.50	26+00.00	5160.31
27+00.00	5159.66	27+00.00	5159.47
28+00.00	5158.55	28+00.00	5158.38
29+00.00	5157.49	29+00.00	5157.30
30+00.00	5156.01	30+00.00	5155.85

PROFILE NOTES

1. Top of Rail Field Surveys by Nevada Department of Transportation, Location Division, July 2019.
2. Track centerlines generated from aerially mapped track planimetrics. Stationing assumed.
3. Reported rail elevations interpolated from Lidar and mapping data points, reported at 100-ft station intervals.

ORIGINAL CONTRACT: 2243
MODIFIED CONTRACT: 2983, DIST. 2 CONTRACT

90% PRELIMINARY
SUBJECT TO REVISION
09/02/2022

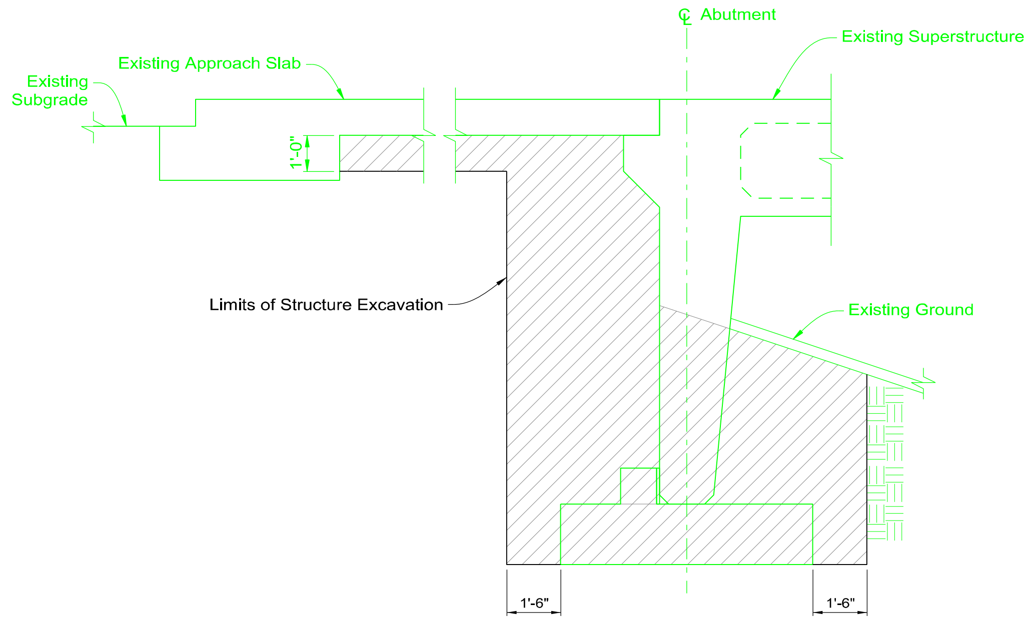
STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

RAILROAD TRACK PROFILES

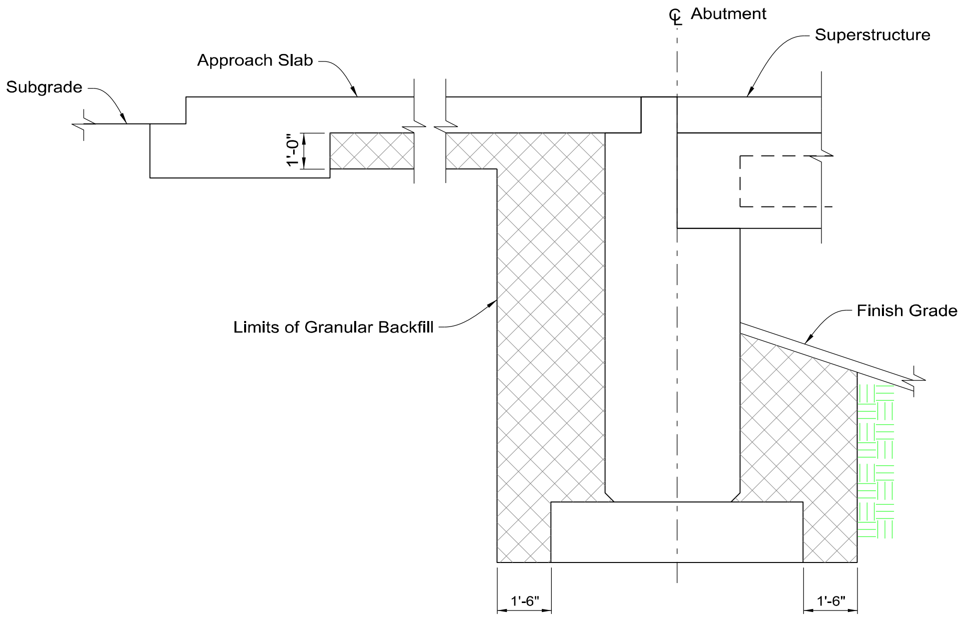
G-1748 N&S

HDR Engineering, Inc.
9805 Double R Boulevard, Suite 101
Reno, NV 89521-5917
PH: 775-337-4700 FAX: 775-337-4774

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	B405



ABUTMENT EXCAVATION SCHEMATIC



ABUTMENT BACKFILL SCHEMATIC

LEGEND

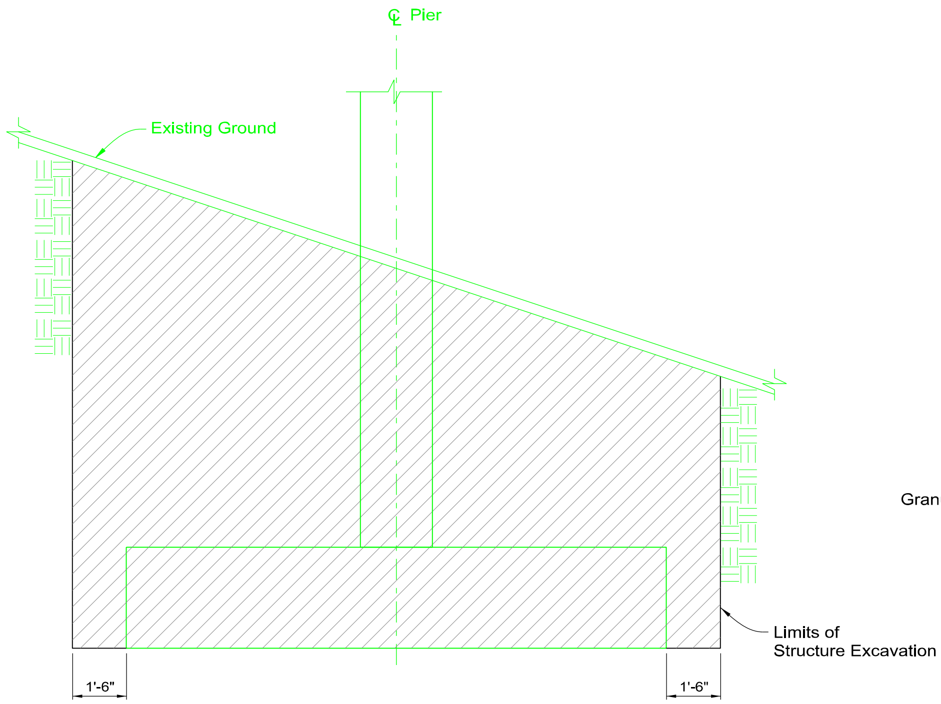
▨	Structure Excavation
▦	Granular Backfill

NOTES

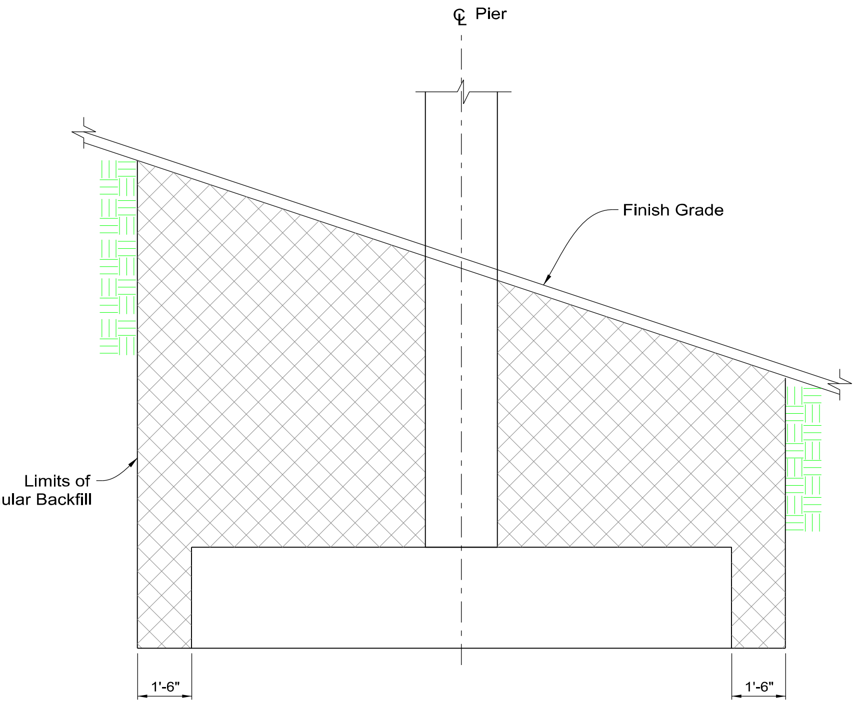
1. Any shoring system that impacts the Railroad operations and/or supports Railraod embankments shall be designed and constructed per the Railroad temporary shoring requirements.
2. Trenches more than 4' deep shall be shored, laid back to at least the angle of repose for existing field conditions, or some other means of protection shall be provided.
3. If hazardous field conditions indicate ground movement may be expected, trenches less than 4' deep shall also be protected as indicated in Note 2.
4. For the purpose of payment, structure excavation and backfill quantities are based on these drawings and no additional payment will be made for shoring.
5. Trench excavation shoring shall conform to OSHA Regulations 29 CFR Part 1926, Subpart P.
6. The quantity of structure excavation and backfill measured for payment shall be the number of cubic yards calculated minus any duplication of limits which overlap.
7. The limits of structure excavation and backfill shown herein shall be used for the method of measurement and payment only. There shall be no additional compensation for any additional excavation or backfill required for excavations to meet OSHA regulations.

EARTHWORK SUMMARY

Quantity (Cu. Yd.)	Abutment 1	Pier 1	Pier 2	Abutment 2
NB Structure Excavation	258	462	462	287
NB Granular Backfill	193	324	324	222
SB Structure Excavation	171	310	310	171
SB Granular Backfill	130	216	216	130



PIER EXCAVATION SCHEMATIC



PIER BACKFILL SCHEMATIC

ORIGINAL CONTRACT: 2243
MODIFIED CONTRACT: 2983, DIST. 2 CONTRACT

90% PRELIMINARY
SUBJECT TO REVISION
09/02/2022

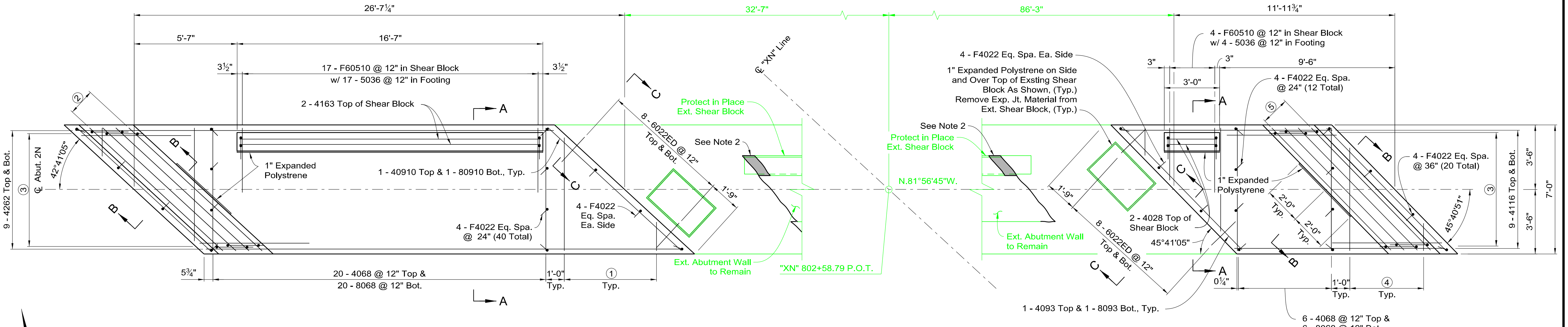
STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

EXCAVATION AND BACKFILL

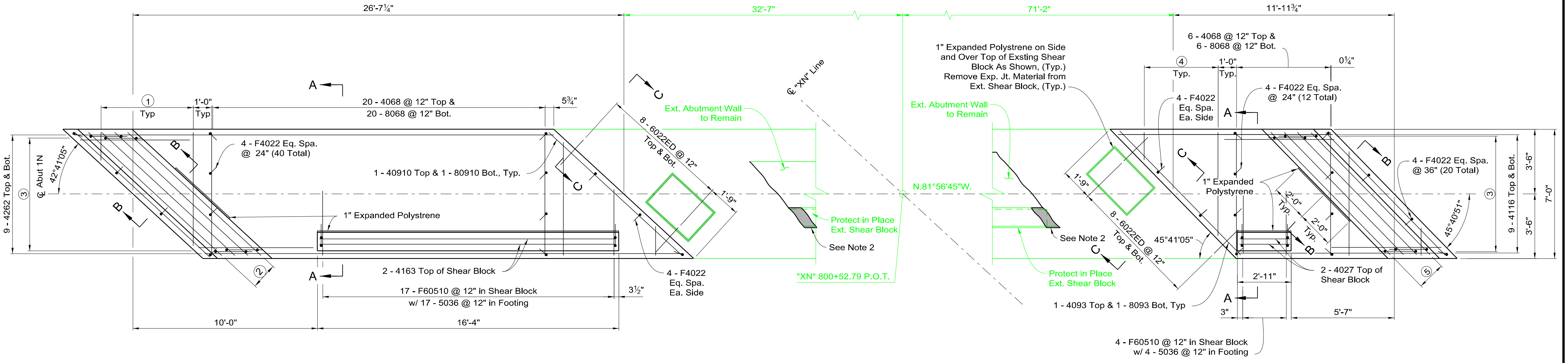
G-1748 N&S

HDR Engineering, Inc.
9805 Double R Boulevard, Suite 101
Reno, NV 89521-5917
PH: 775-337-4700 FAX: 775-337-4774

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	B410



PLAN - ABUTMENT 2N



ORIGINAL CONTRACT: 2243
MODIFIED CONTRACT: 2983, DIST. 2 CONTRACT

PLAN - ABUTMENT 1N

① 1 Set 4062 to 4017 @ 12" Top (6 Bars/Set)
1 Set 8062 to 8017 @ 12" Bot (6 Bars/Set)

② 4 - 40910 @ 3 Layers (12 Bars Total), (See Section B-B)

③ 10 - Double F7072 Eq Spa. (20 Total) &
10 - F7064 Eq. Spa.

④ 1 Set 4058 to 4016 @ 12" Top (6 Bars/Set)
1 Set 8058 to 8016 @ 12" Bot (6 Bars/Set)

⑤ 4 - 4093 @ 3 Layers (12 Bars Total), (See Section B-B)

NOTES:

1. See Abutment Footing Details sheet for Sections A-A, B-B, C-C and details not shown.
2. Partial removal of existing longitudinal shear block. Remove existing reinforcing at removal line & top of footing. Place expanded polystyrene between remaining shear block and proposed abutment wall.

SHEET
IN
PROGRESS

90% PRELIMINARY
SUBJECT TO REVISION
09/02/2022

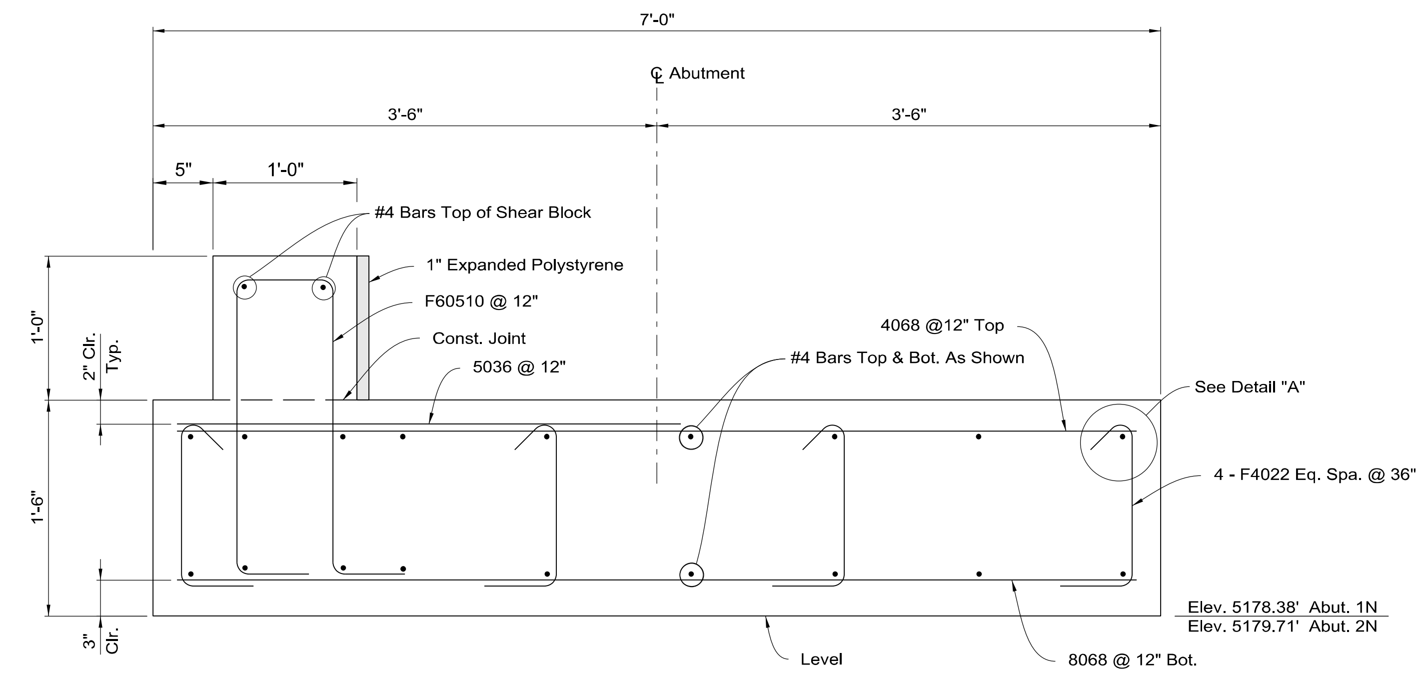
STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

ABUTMENT FOOTING PLAN
1N & 2N

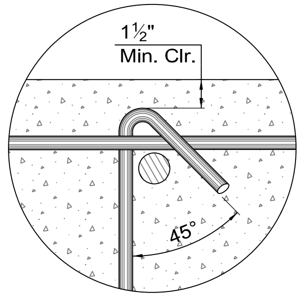
G-1748 N

HDR Engineering, Inc.
9805 Double R Boulevard, Suite 101
Reno, NV 89521-5917
PH: 775-337-4700 FAX: 775-337-4774

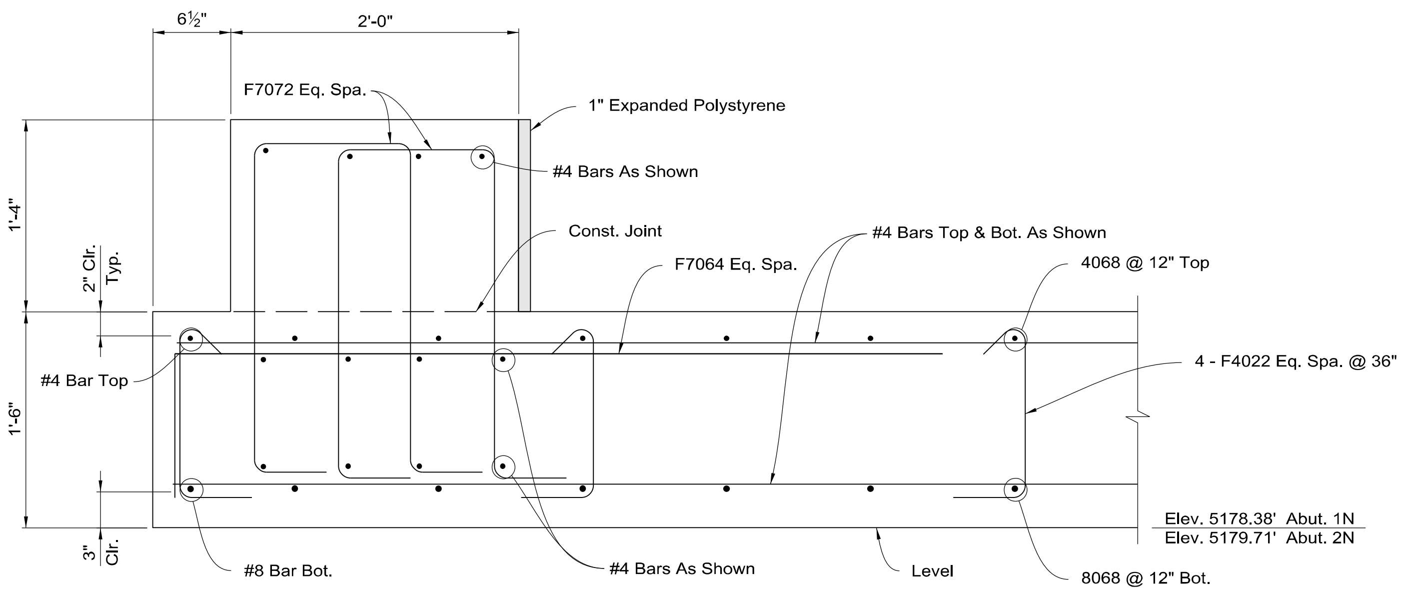
STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	B411



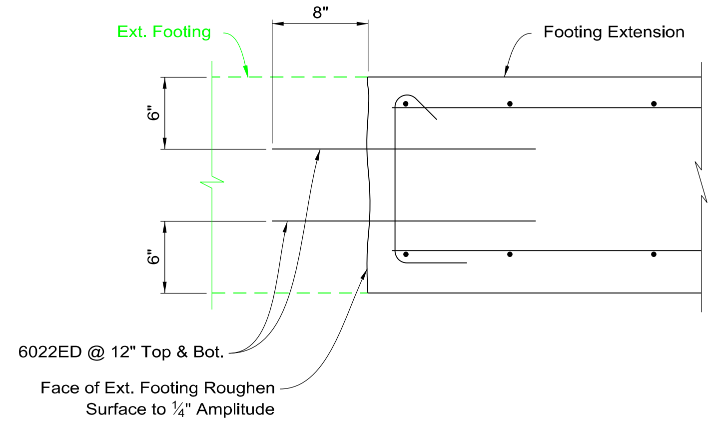
SECTION A-A



DETAIL "A"



SECTION B-B



SECTION C-C

ORIGINAL CONTRACT: 2243
MODIFIED CONTRACT: 2983, DIST. 2 CONTRACT

SHEET
IN
PROGRESS
90% PRELIMINARY
SUBJECT TO REVISION
09/02/2022

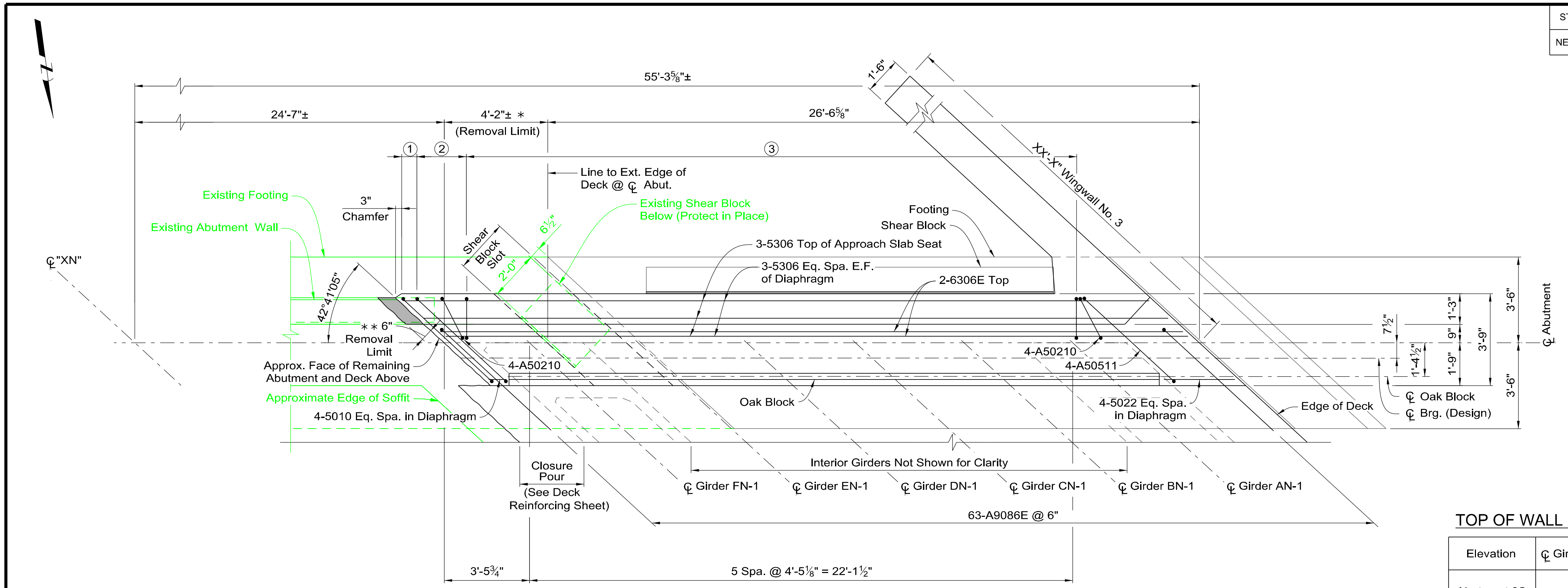
STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

ABUTMENT FOOTING
DETAILS

G-1748 N

HDR Engineering, Inc.
9805 Double R Boulevard, Suite 101
Reno, NV 89521-5917
PH: 775-337-4700 FAX: 775-337-4774

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	B412



PLAN

NOTES

1. See Abutment Details sheet for Sections B-B, C-C and details not shown.

∗ Removal of existing wingwall and portion of abutment wall. Protect in place existing reinforcing in abutment wall. Lap or embed into new wall. Abutment wall removal measured along abutment centerline.

∗∗ Partial removal of existing longitudinal shear block. Remove existing reinforcing at removal line & top of footing. Place expanded polystyrene between remaining shear block and proposed abutment wall. Abutment shear block removal measured perpendicular to abutment wall removal line.

REINFORCING STEEL;

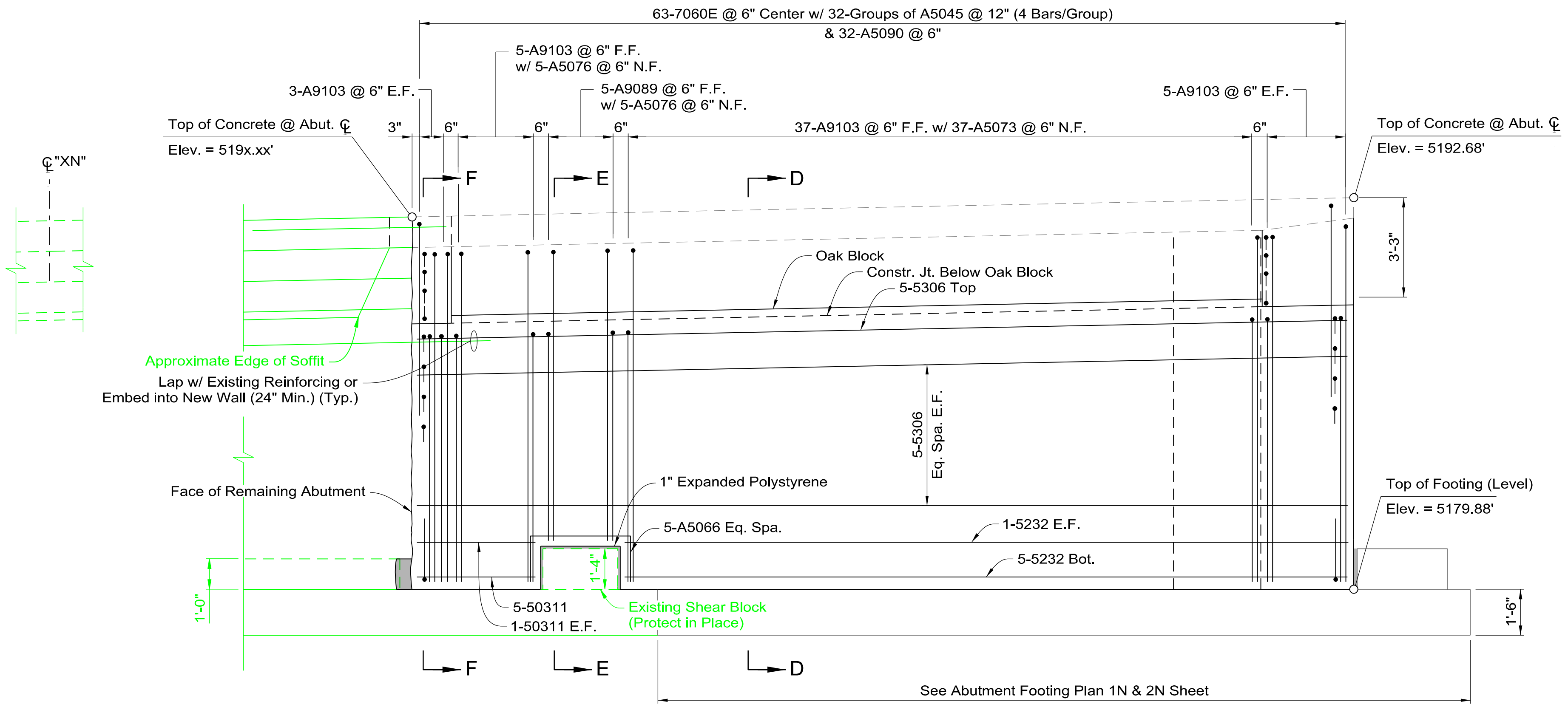
① 2 Groups of A50511 (4 Bars/Group) Eq. Spa. Vertically in Diaphragm (8-A50511 Total)

② 2 Spa. @ 9" Max. (Typ. Ea. End)

③ 25 Groups of A5028 @ 12" (4 Bars/ Group) Eq. Spa. Vertically in Diaphragm (100-A5028 Total)

TOP OF WALL ELEVATION

Elevation	℄ Girder AN-1	℄ Girder BN-1	℄ Girder CN-1	℄ Girder DN-1	℄ Girder EN-1	℄ Girder FN-1
Abutment 2S						



ELEVATION

LOOKING BACK ON LINE NORMAL TO SKEW

SHEET IN PROGRESS

90% PRELIMINARY

SUBJECT TO REVISION

09/02/2022

ORIGINAL CONTRACT: 2243
MODIFIED CONTRACT: 2983, DIST. 2 CONTRACT

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

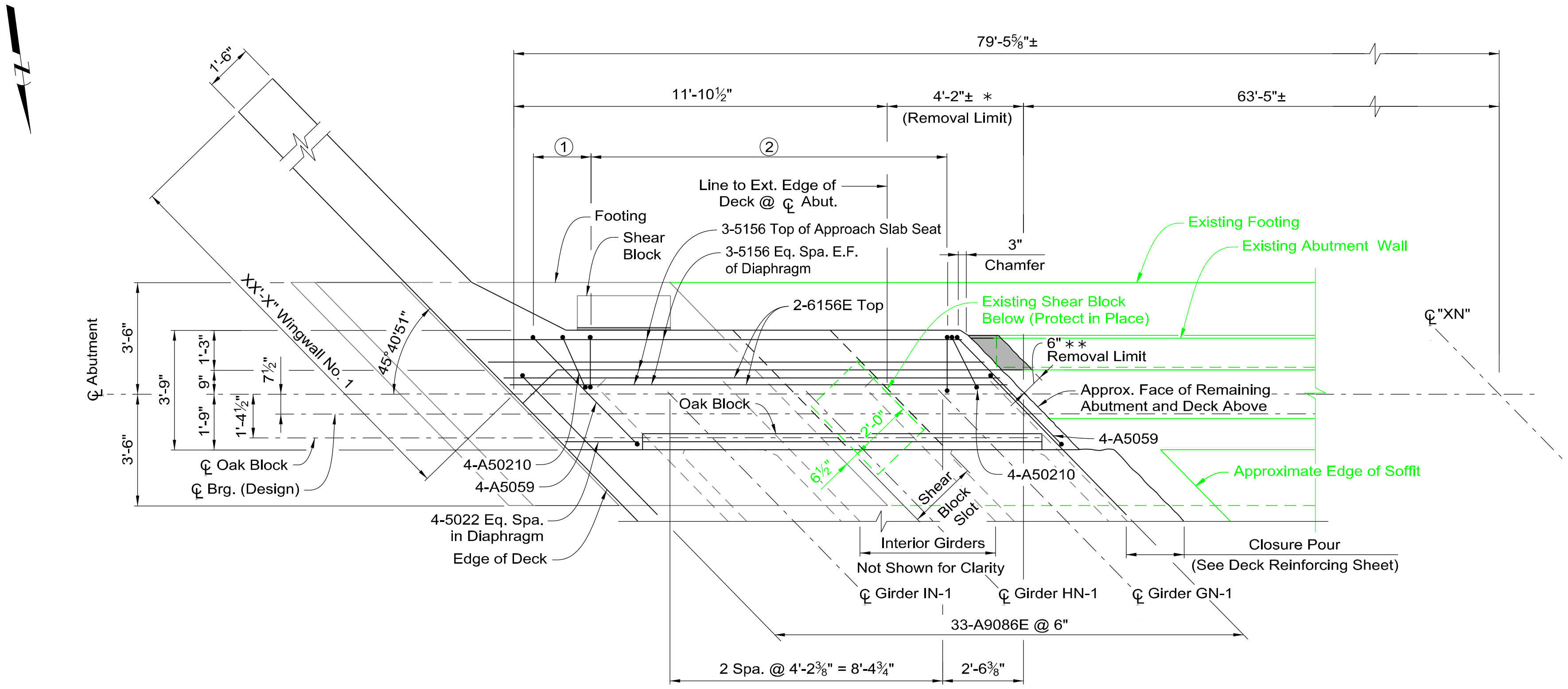
ABUTMENT 1N WEST
PLAN & ELEVATION

G-1748 N

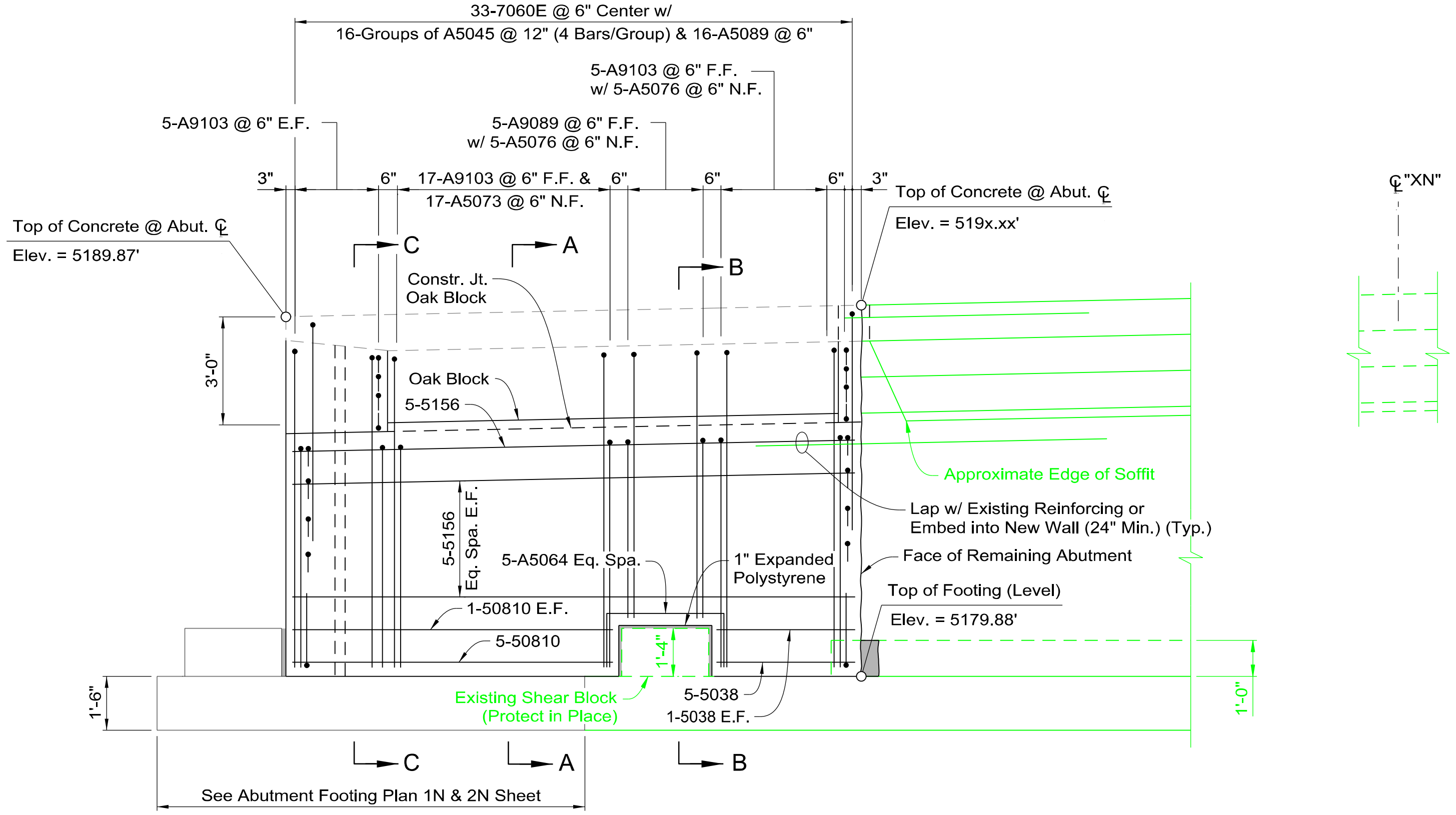
HDR Engineering, Inc.

9805 Double R Boulevard, Suite 101
Reno, NV 89521-5917
PH: 775-337-4700 FAX: 775-337-4774

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	B413



PLAN



ELEVATION

LOOKING BACK ON LINE NORMAL TO SKEW

NOTES

1. See Abutment Details sheet for Sections A-A, B-B and details not shown.

∗ Removal of existing wingwall and portion of abutment wall. Protect in place existing reinforcing in abutment wall. Lap or embed into new wall. Abutment wall removal measured along abutment centerline.

∗∗ Partial removal of existing longitudinal shear block. Remove existing reinforcing at removal line & top of footing. Place expanded polystyrene between remaining shear block and proposed abutment wall. Abutment shear block removal measured perpendicular to abutment wall removal line.

REINFORCING STEEL;

① 2 Spa. @ 9" Max. (Typ. Ea. End)

② 12 Groups of A5028 @ 12" (4 Bars/ Group) Eq. Spa. Vertically in Diaphragm (48-A5028 Total)

TOP OF WALL ELEVATION

Elevation	℄ Girder GN-1	℄ Girder HN-1	℄ Girder IN-1
Abutment 1S			

ORIGINAL CONTRACT: 2243
MODIFIED CONTRACT: 2983, DIST. 2 CONTRACT

SHEET IN PROGRESS
90% PRELIMINARY
SUBJECT TO REVISION
09/02/2022

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

ABUTMENT 1N EAST
PLAN & ELEVATION

G-1748 N

HDR Engineering, Inc.
9805 Double R Boulevard, Suite 101
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PH: 775-337-4700 FAX: 775-337-4774

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	B414

NOTES

1. See Abutment Details sheet for Sections C-C, D-D and details not shown.

* Removal of existing wingwall and portion of abutment wall. Protect in place existing reinforcing in abutment wall. Lap or embed into new wall. Abutment wall removal measured along abutment centerline.

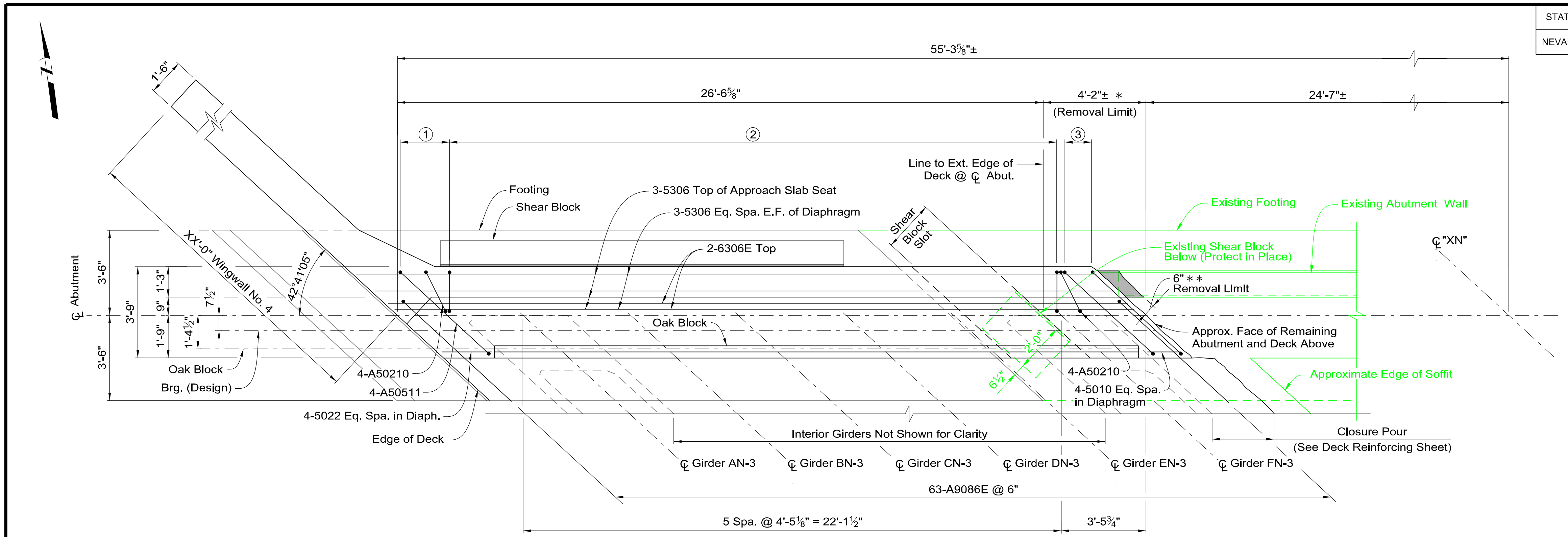
** Partial removal of existing longitudinal shear block. Remove existing reinforcing at removal line & top of footing. Place expanded polystyrene between remaining shear block and proposed abutment wall. Abutment shear block removal measured perpendicular to abutment wall removal line.

REINFORCING STEEL;

① 2 Spa. @ 9" Max. (Typ. Ea. End)

② 25 Groups of A5028 @ 12" (4 Bars/ Group) Eq. Spa. Vertically in Diaphragm (100-A5028 Total)

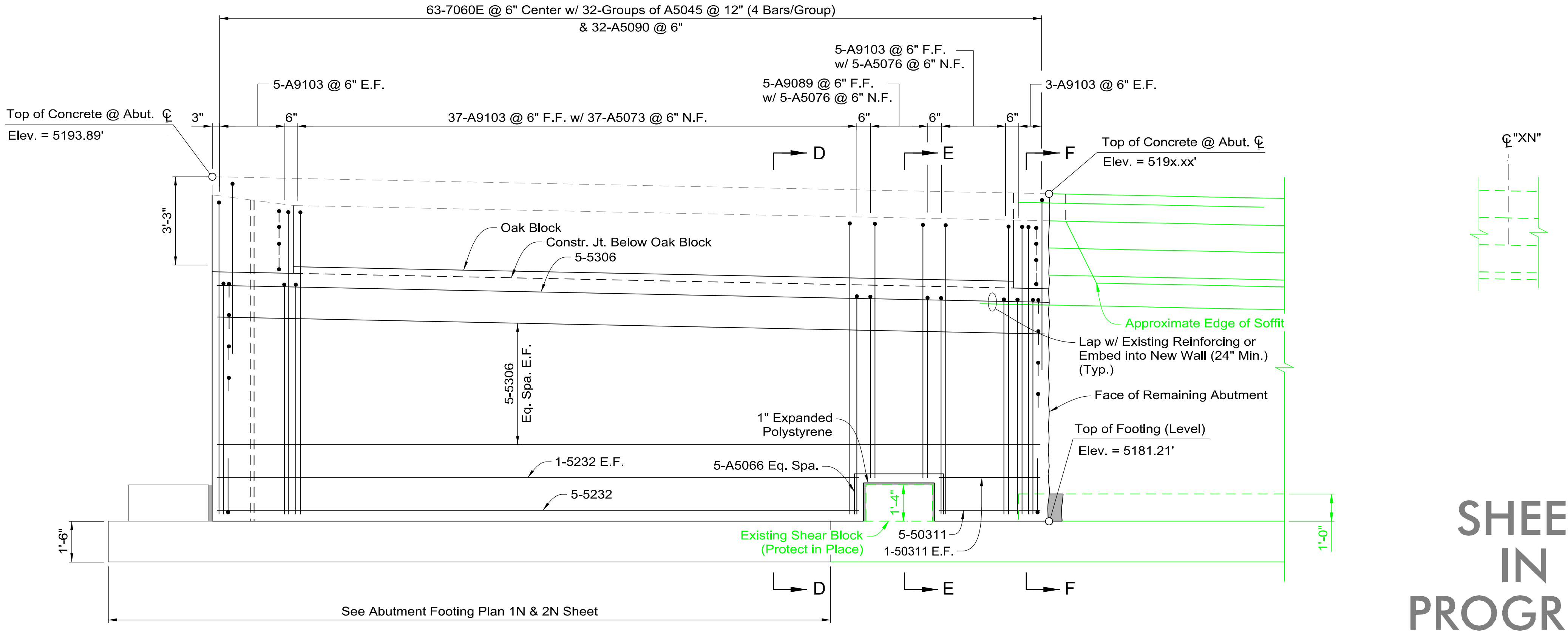
③ 2 Groups of A50511 (4 Bars/Group) Eq. Spa. Vertically in Diaphragm (8-A50511 Total)



PLAN

TOP OF WALL ELEVATION

Elevation	℄ Girder AN-3	℄ Girder BN-3	℄ Girder CN-3	℄ Girder DN-3	℄ Girder EN-3	℄ Girder FN-3
Abutment 1S						



ELEVATION

LOOKING AHEAD ON LINE NORMAL TO SKEW

ORIGINAL CONTRACT: 2243
MODIFIED CONTRACT: 2983, DIST. 2 CONTRACT

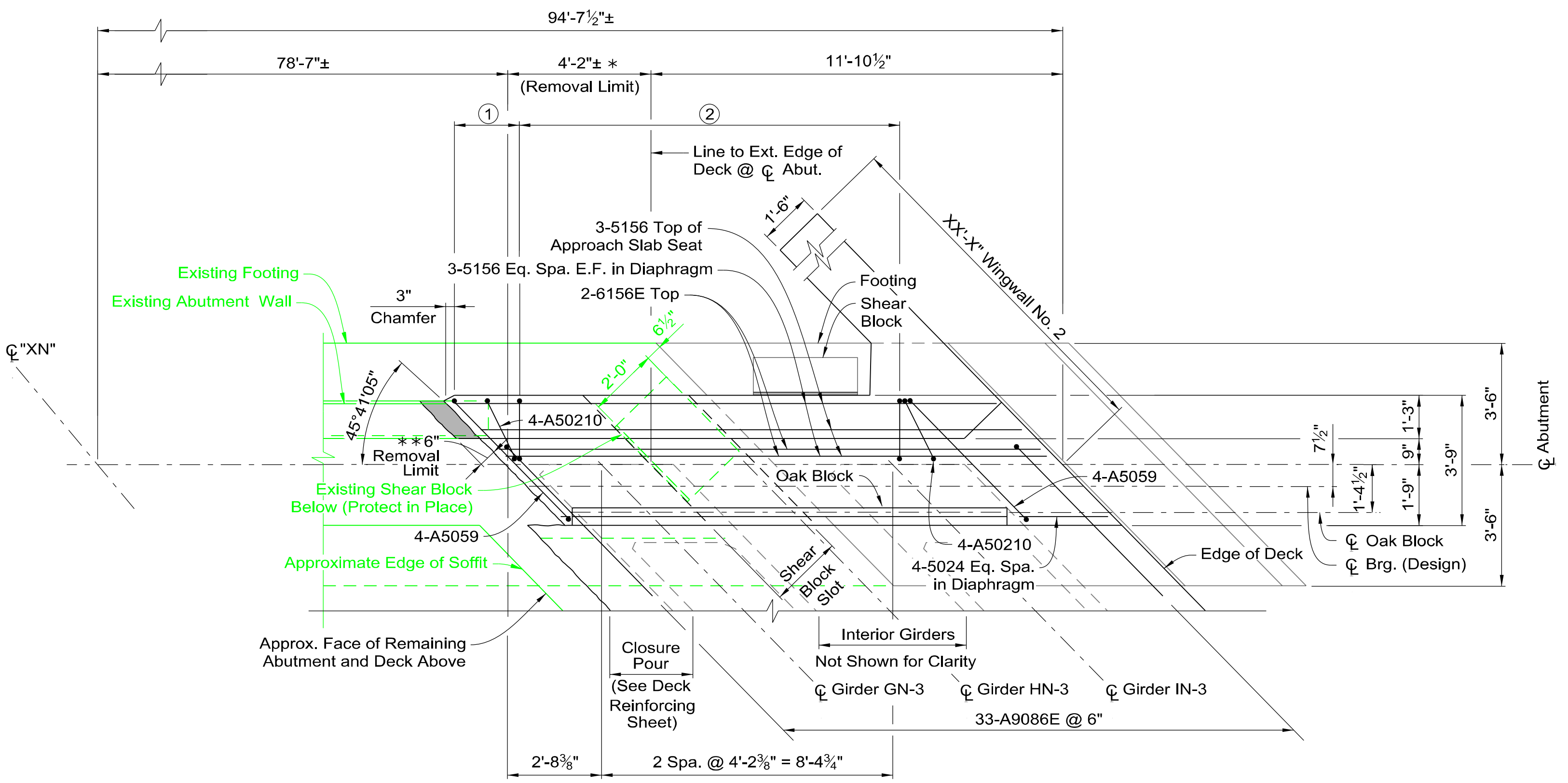
STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

ABUTMENT 2N WEST
PLAN & ELEVATION

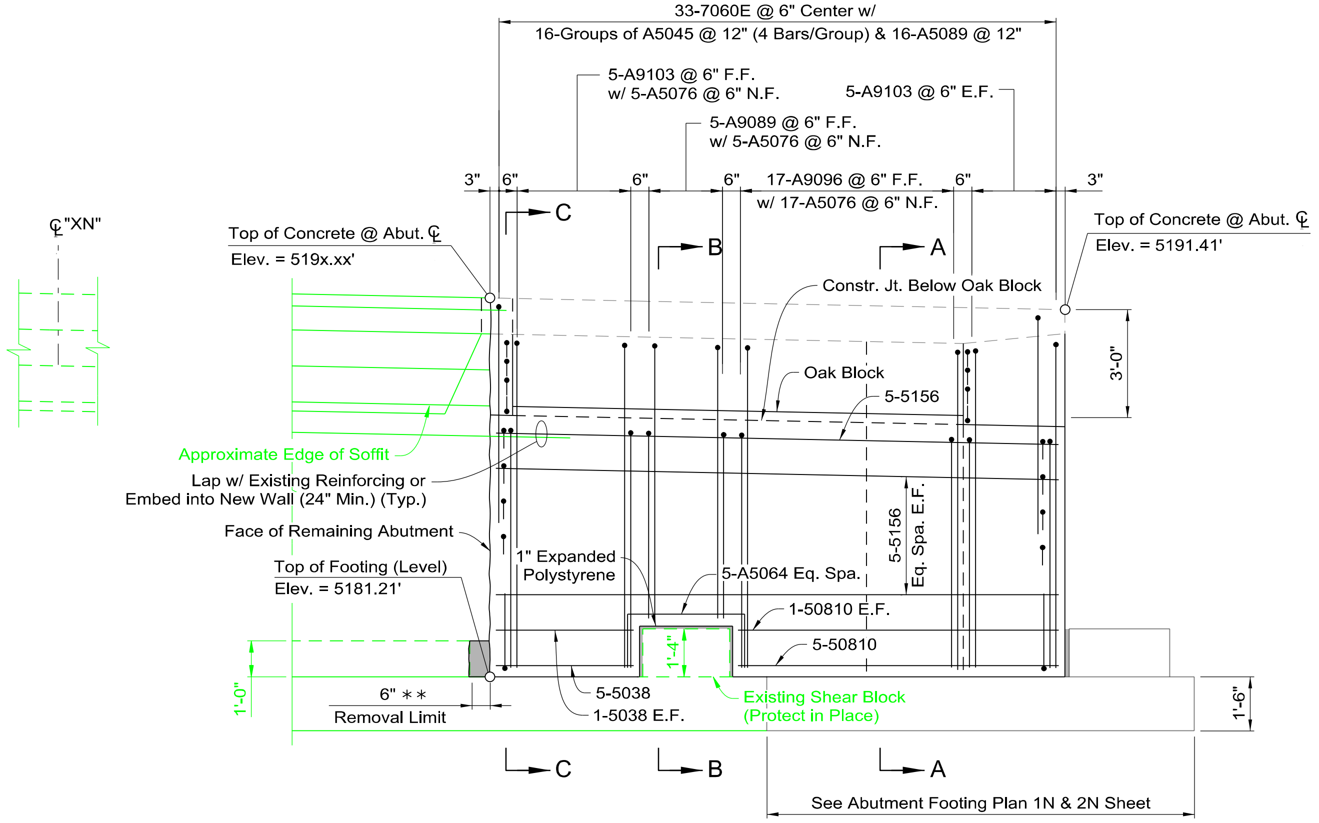
G-1748 N

HDR Engineering, Inc.
9805 Double R Boulevard, Suite 101
Reno, NV 89521-5917
PH: 775-337-4700 FAX: 775-337-4774

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	B415



PLAN



ELEVATION

LOOKING AHEAD ON LINE NORMAL TO SKEW

NOTES

1. See Abutment Details sheet for Sections A-A, B-B and details not shown.

∗ Removal of existing wingwall and portion of abutment wall. Protect in place existing reinforcing in abutment wall. Lap or embed into new wall. Abutment wall removal measured along abutment centerline.

∗∗ Partial removal of existing longitudinal shear block. Remove existing reinforcing at removal line & top of footing. Place expanded polystyrene between remaining shear block and proposed abutment wall. Abutment shear block removal measured perpendicular to abutment wall removal line.

REINFORCING STEEL;

① 2 Spa. @ 9" Max. (Typ. Ea. End)

② 12 Groups of A5028 @ 12" (4 Bars/ Group) Eq. Spa. Vertically in Diaphragm (48-A5028 Total)

TOP OF WALL ELEVATION

Elevation	℄ Girder GN-3	℄ Girder HN-3	℄ Girder IN-3
Abutment 1S			

SHEET IN PROGRESS

90% PRELIMINARY

SUBJECT TO REVISION

09/02/2022

ORIGINAL CONTRACT: 2243
MODIFIED CONTRACT: 2983, DIST. 2 CONTRACT

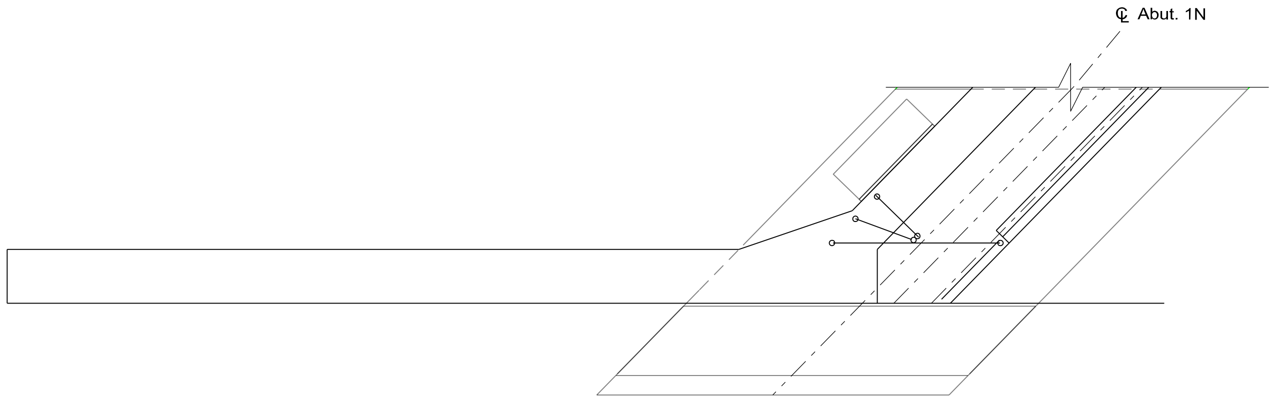
STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

ABUTMENT 2N EAST
PLAN & ELEVATION

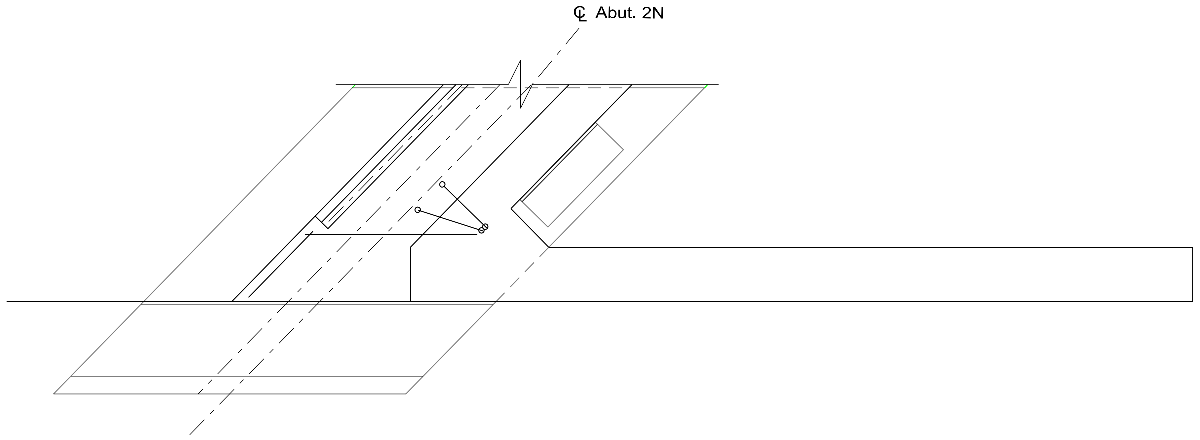
G-1748 N

HDR Engineering, Inc.
9805 Double R Boulevard, Suite 101
Reno, NV 89521-5917
PH: 775-337-4700 FAX: 775-337-4774

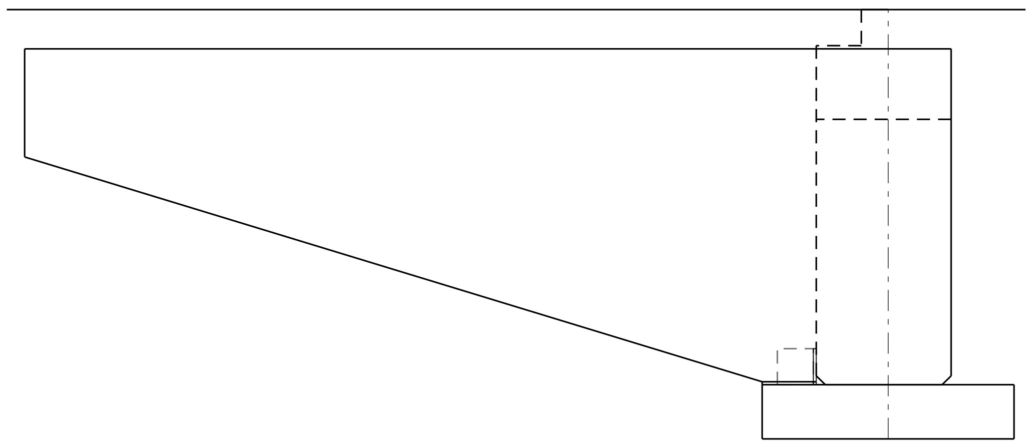
STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	B418



PLAN

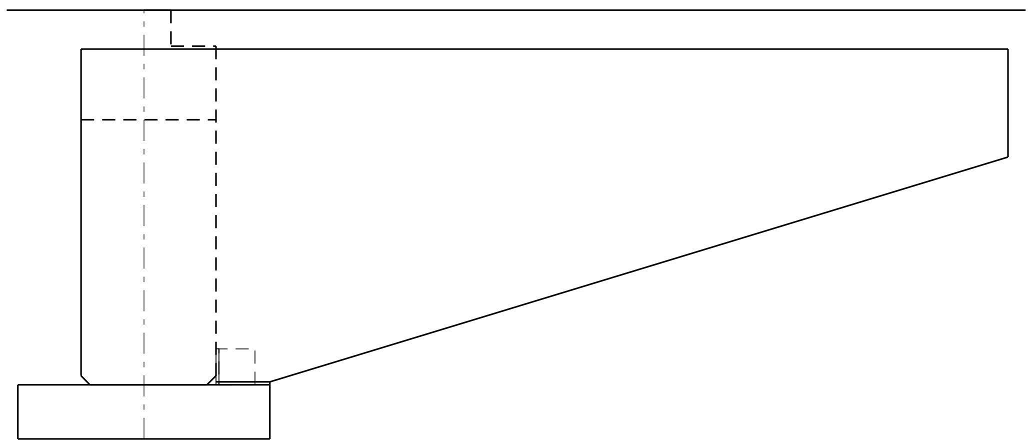


PLAN



ELEVATION

WINGWALL NO. 1



ELEVATION

WINGWALL NO. 2

ORIGINAL CONTRACT: 2243
MODIFIED CONTRACT: 2983, DIST. 2 CONTRACT

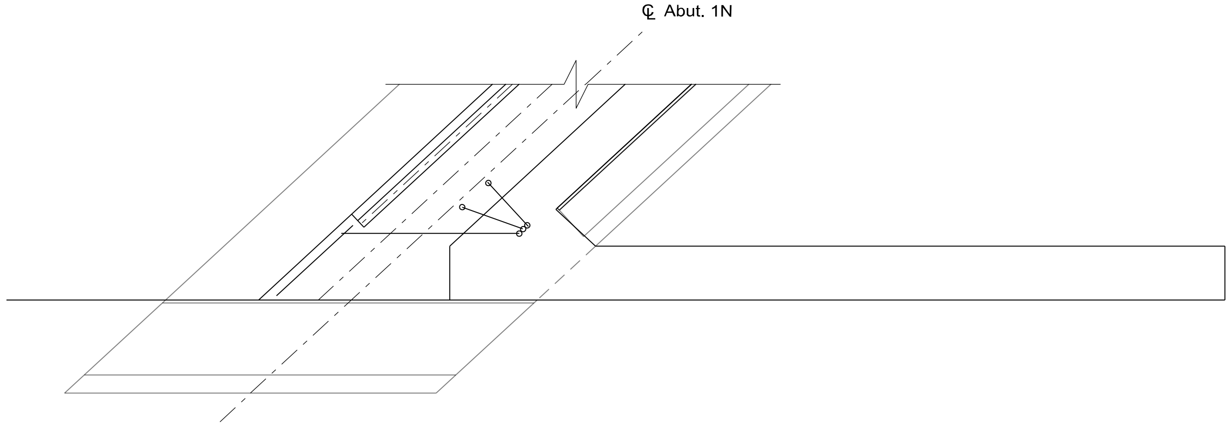
STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

WINGWALL PLAN & ELEVATION
(1 OF 2)

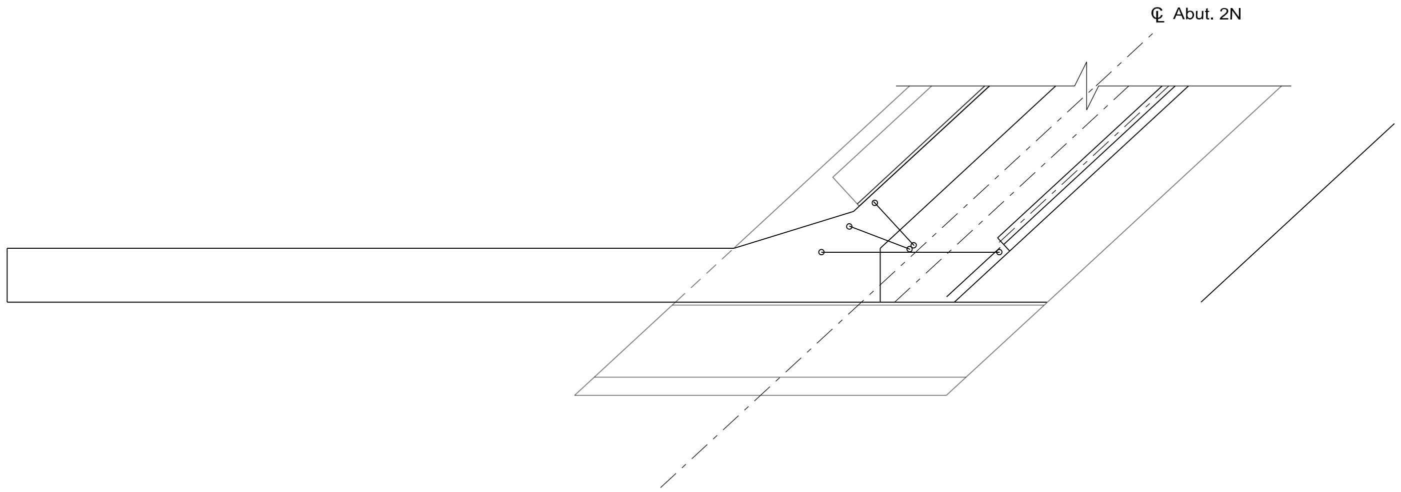
G-1748 N

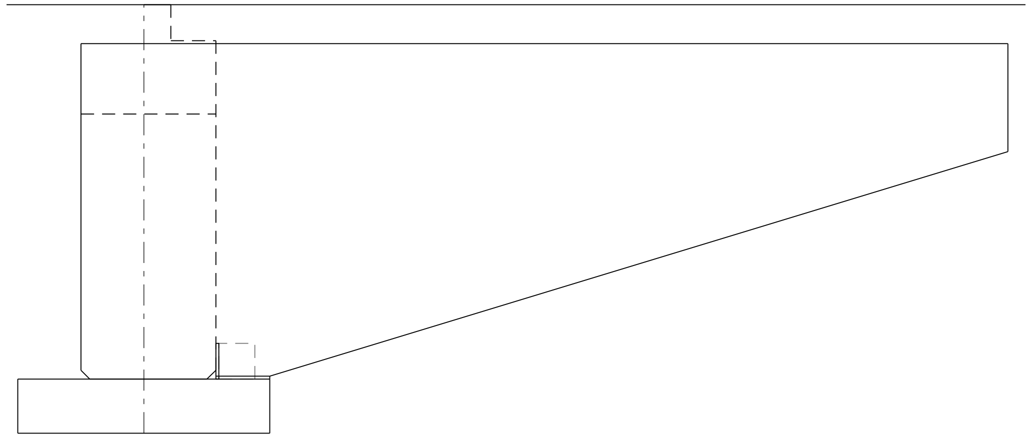
HDR Engineering, Inc.
9805 Double R Boulevard, Suite 101
Reno, NV 89521-5917
PH: 775-337-4700 FAX: 775-337-4774

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	B420



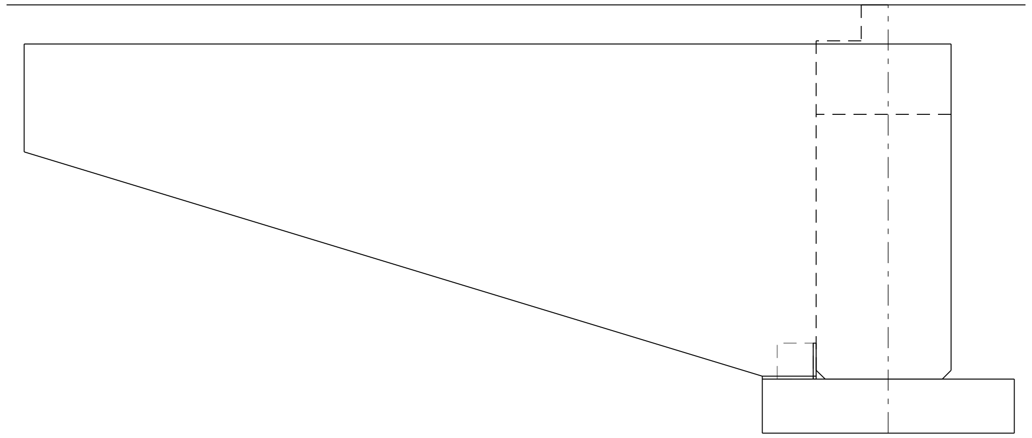
PLAN





ELEVATION

WINGWALL NO. 3



ELEVATION

WINGWALL NO. 4

ORIGINAL CONTRACT: 2243
MODIFIED CONTRACT: 2983, DIST. 2 CONTRACT

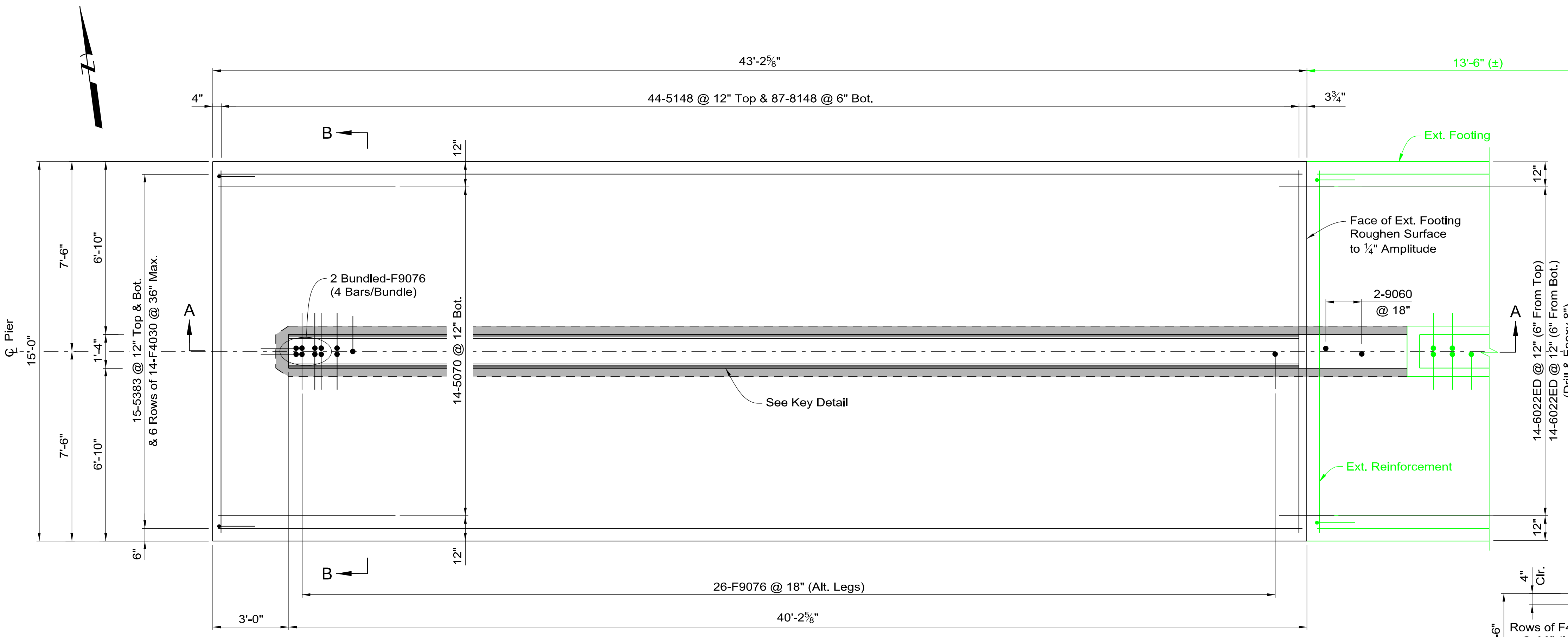
STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

WINGWALL PLAN & ELEVATION
(2 OF 2)

G-1748 N

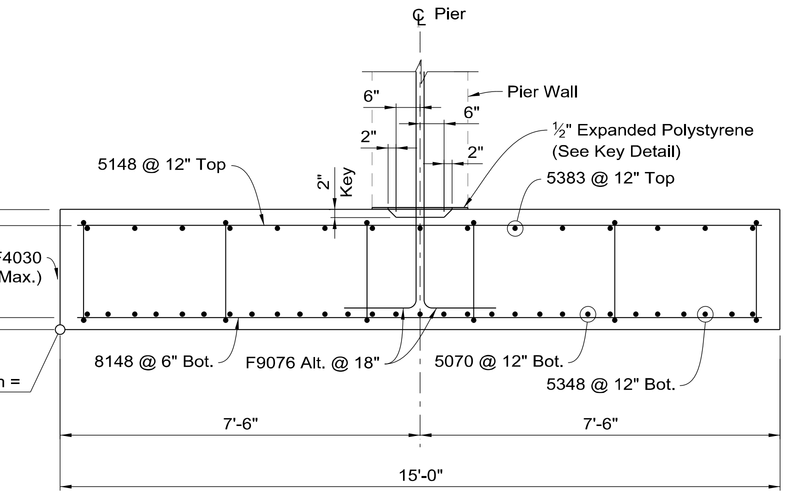
HDR Engineering, Inc.
9805 Double R Boulevard, Suite 101
Reno, NV 89521-5917
PH: 775-337-4700 FAX: 775-337-4774

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	B420



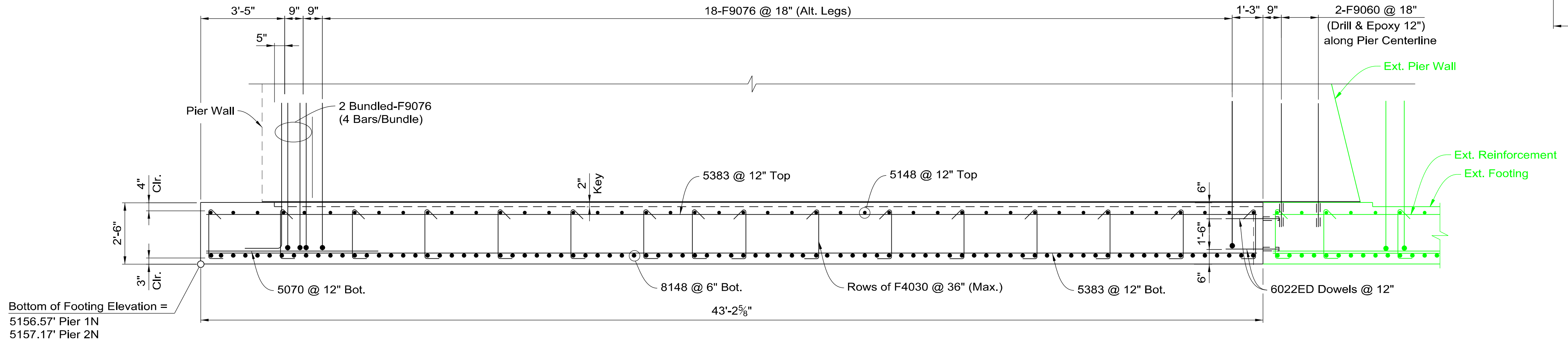
PLAN

PIER 1N WEST SHOWN,
PIER 2N WEST SIMILAR



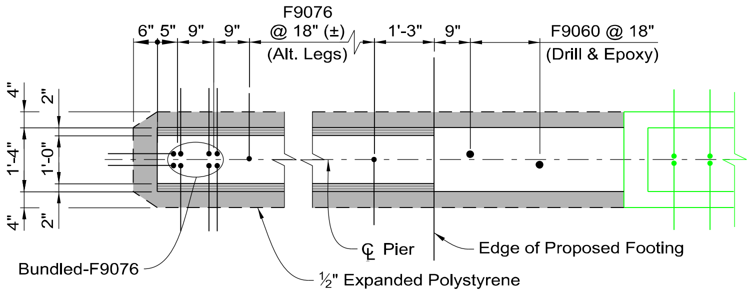
SECTION B-B

PIER 1N WEST SHOWN,
PIER 2N WEST SIMILAR



SECTION A-A

PIER 1N WEST SHOWN,
PIER 2N WEST SIMILAR



KEY DETAIL

ORIGINAL CONTRACT: 2243
MODIFIED CONTRACT: 2983, DIST. 2 CONTRACT

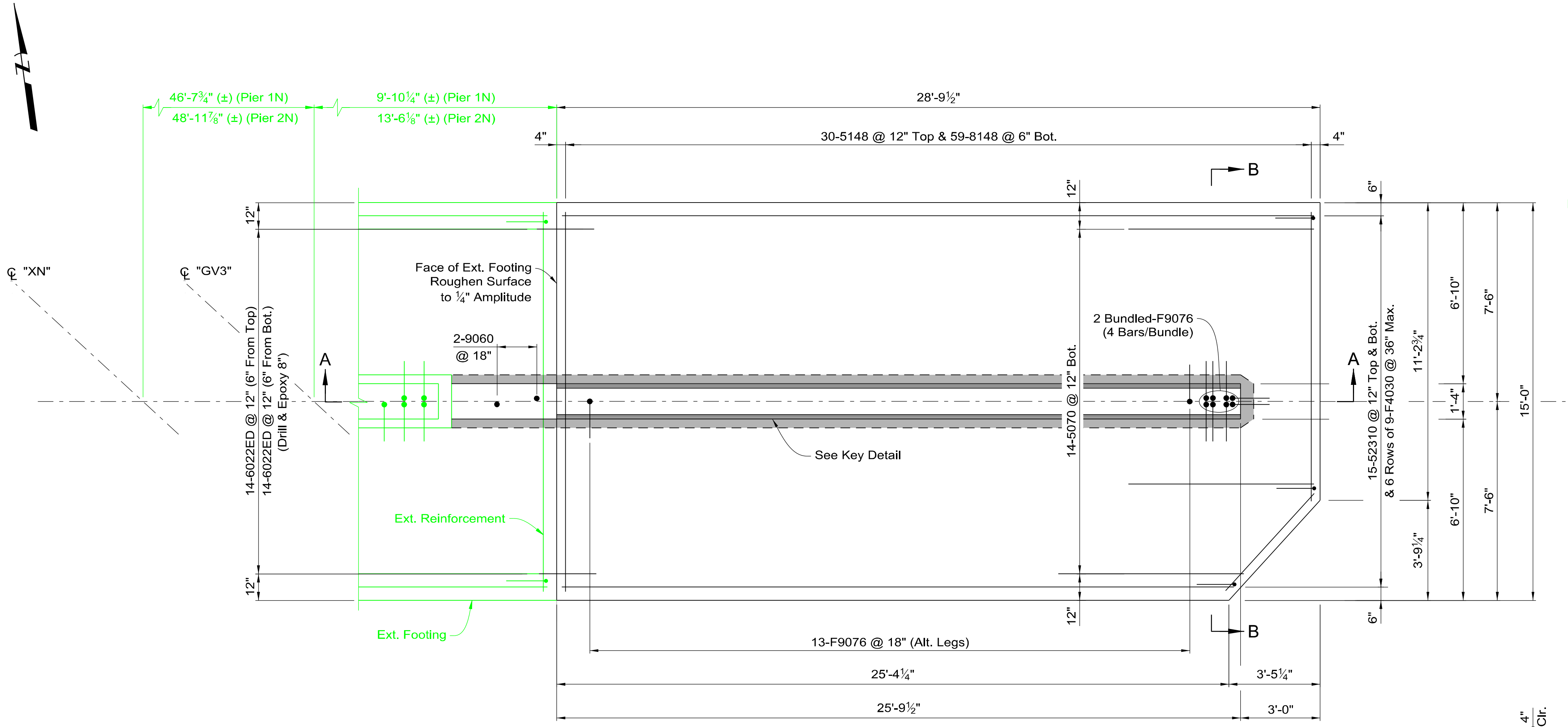
STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

PIER 1N & 2N WEST
FOOTING DETAILS
PLAN & SECTIONS

G-1748 N

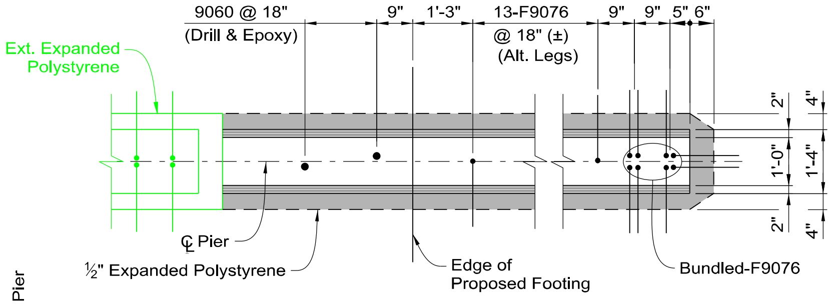
HDR Engineering, Inc.
9805 Double R Boulevard, Suite 101
Reno, NV 89521-5917
PH: 775-337-4700 FAX: 775-337-4774

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	B421

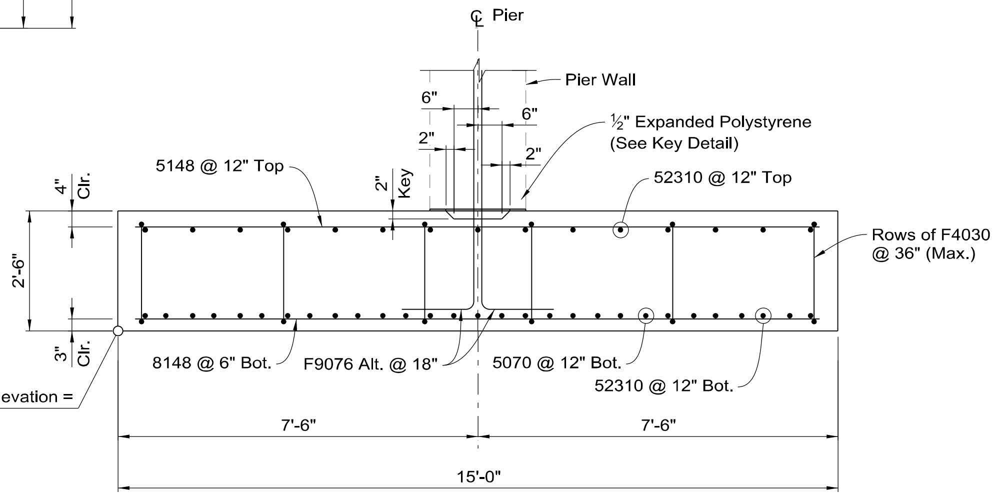


PLAN 1N

PIER 1N EAST SHOWN,
PIER 2N EAST SIMILAR



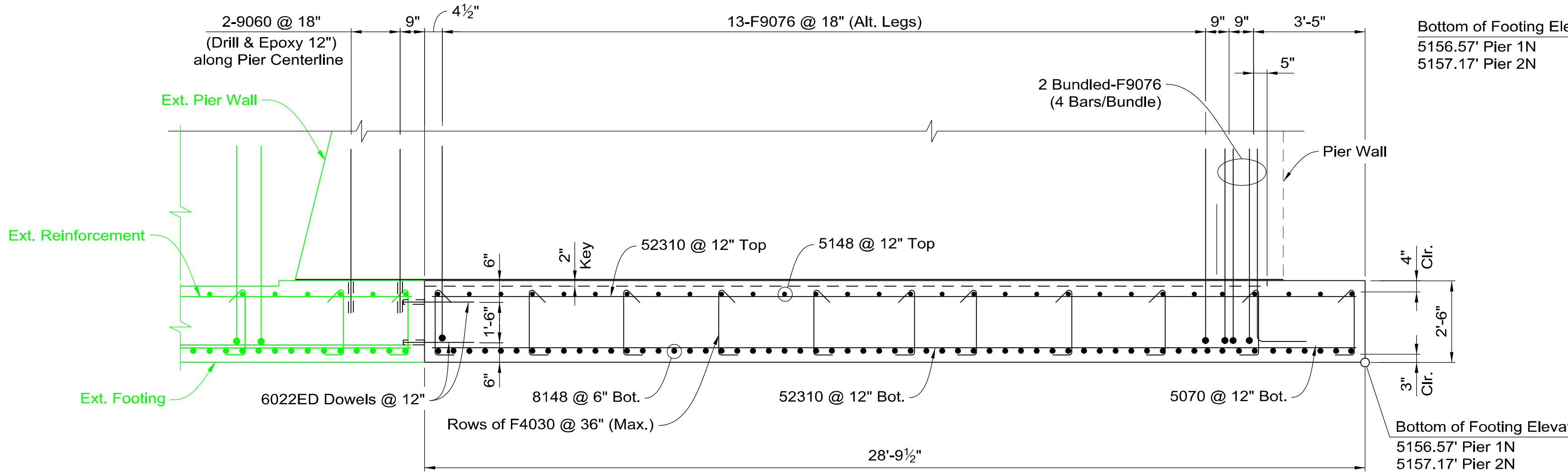
KEY DETAIL



Bottom of Footing Elevation =
5156.57' Pier 1N
5157.17' Pier 2N

SECTION B-B

PIER 1N EAST SHOWN,
PIER 2N EAST SIMILAR



Bottom of Footing Elevation =
5156.57' Pier 1N
5157.17' Pier 2N

SECTION A-A

PIER 1N EAST SHOWN,
PIER 2N EAST SIMILAR

ORIGINAL CONTRACT: 2243
MODIFIED CONTRACT: 2983, DIST. 2 CONTRACT

SHEET
IN
PROGRESS
90% PRELIMINARY
SUBJECT TO REVISION
09/02/2022

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

PIER 1N & 2N EAST
FOOTING DETAILS
PLAN & SECTIONS

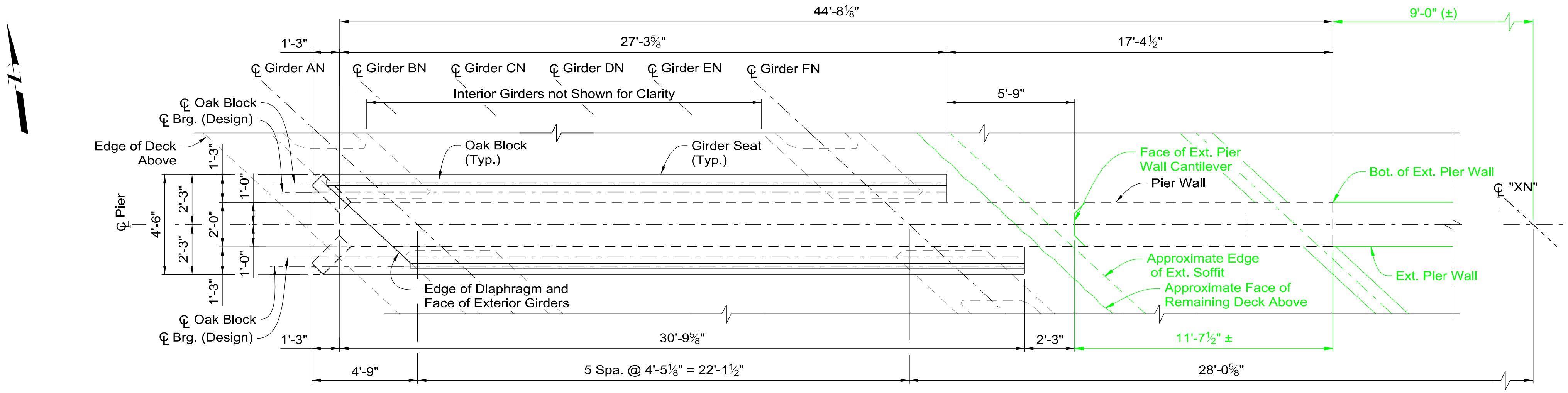
G-1748 N

HDR Engineering, Inc.
9805 Double R Boulevard, Suite 101
Reno, NV 89521-5917
PH: 775-337-4700 FAX: 775-337-4774

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	B422

NOTES

1. Pier wall reinforcing and details apply to Pier 1N and Pier 2N.

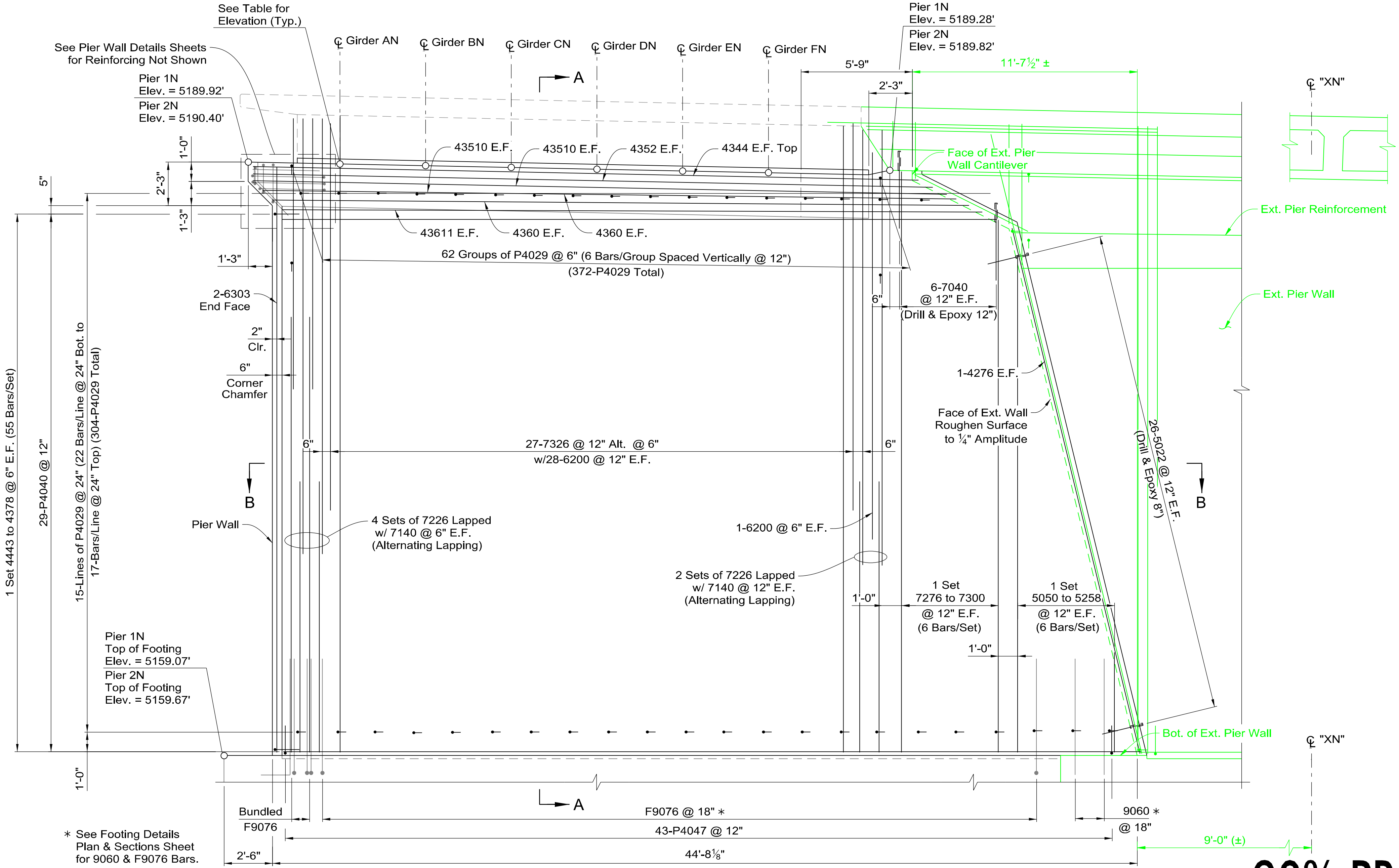


PLAN 1N

PIER 1N WEST SHOWN, PIER 2N WEST SIMILAR

TOP OF WALL ELEVATION

Elevation	℄ Girder AN	℄ Girder BN	℄ Girder CN	℄ Girder DN	℄ Girder EN	℄ Girder FN
Pier 1N						
Pier 2N						



ELEVATION 1N

PIER 1N WEST SHOWN, PIER 2N WEST SIMILAR
LOOKING AHEAD ON LINE NORMAL TO SKEW

90% PRELIMINARY
SUBJECT TO REVISION
09/02/2022

ORIGINAL CONTRACT: 2243
MODIFIED CONTRACT: 2983, DIST. 2 CONTRACT

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

PIER 1N & 2N WEST
PLAN & ELEVATION

G-1748 N

HDR
HDR Engineering, Inc.

9805 Double R Boulevard, Suite 101
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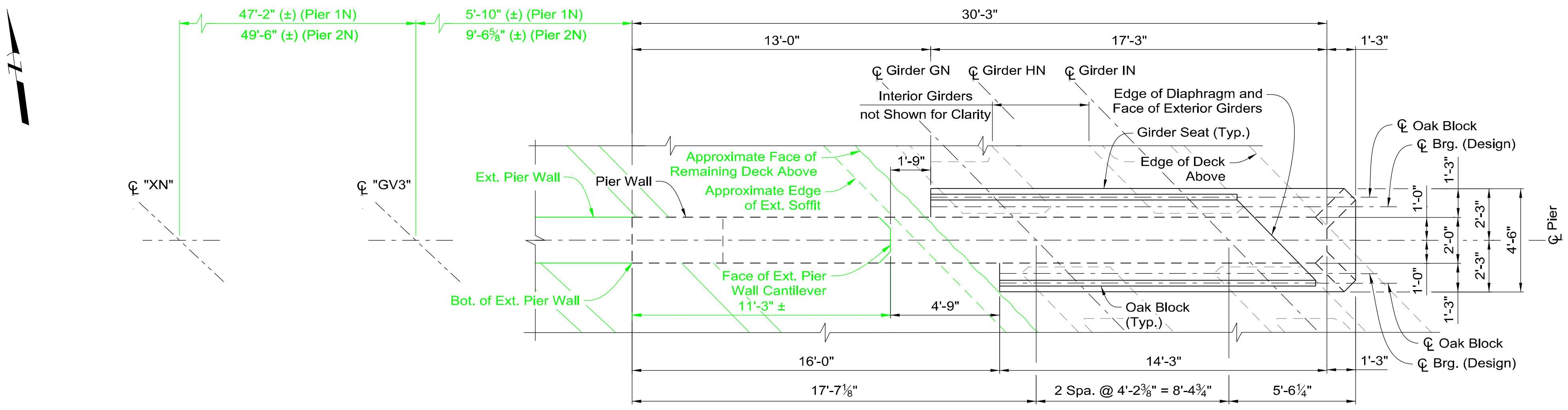
PH: 775-337-4700 FAX: 775-337-4774

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	B423

NOTES

1. Pier wall reinforcing and details apply to Pier 1N and Pier 2N.

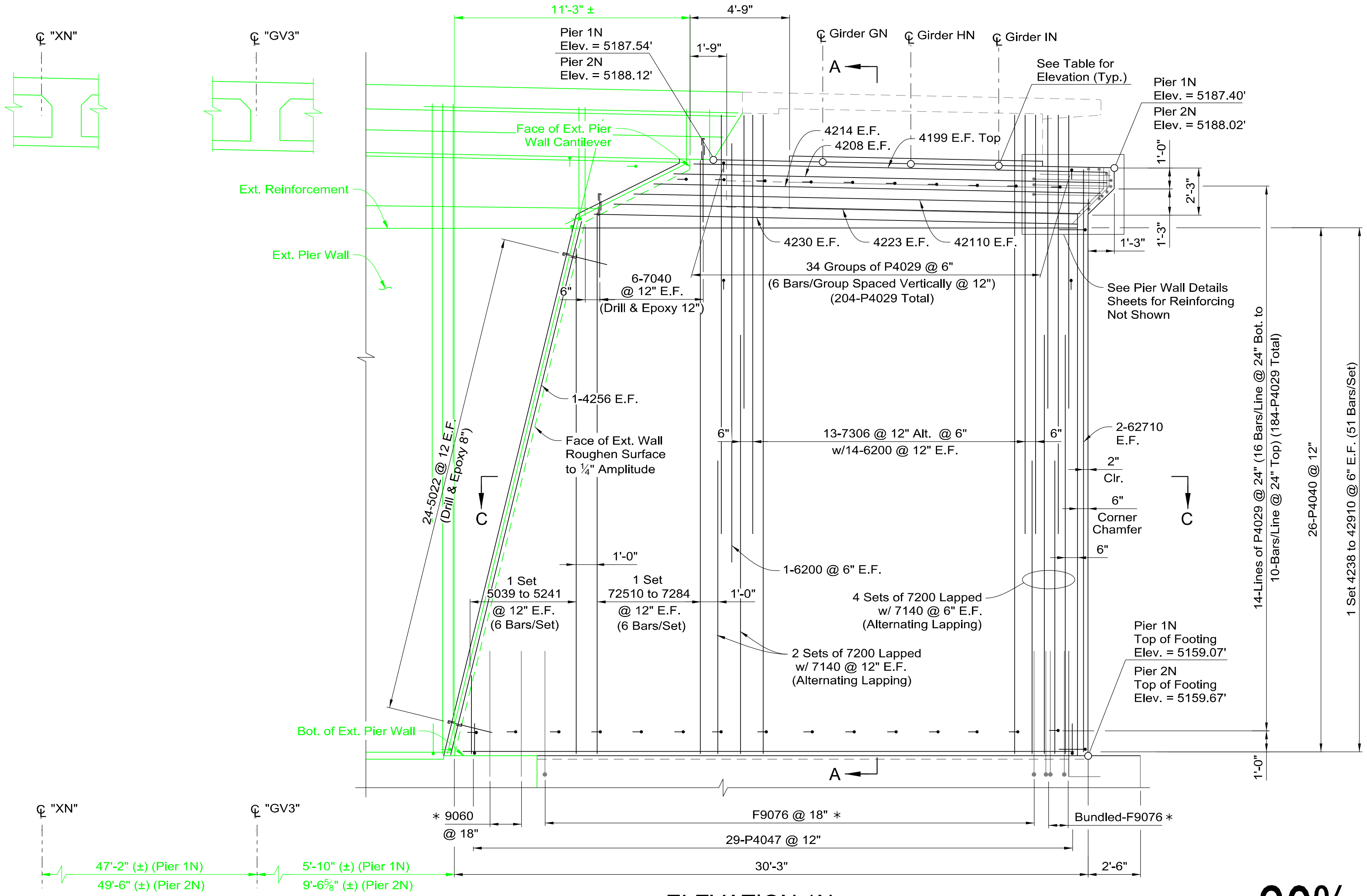


PLAN 1N

PIER 1N EAST SHOWN, PIER 2N EAST SIMILAR

TOP OF WALL ELEVATION

Elevation	℄ Girder GN	℄ Girder HN	℄ Girder IN
Pier 1N			
Pier 2N			



ELEVATION 1N

PIER 1N EAST SHOWN, PIER 2N EAST SIMILAR
LOOKING AHEAD ON LINE NORMAL TO SKEW

∗ See Footing Details Plan & Sections Sheet for 9060 & F9076 Bars.

90% PRELIMINARY
SUBJECT TO REVISION
09/02/2022

ORIGINAL CONTRACT: 2243
MODIFIED CONTRACT: 2983, DIST. 2 CONTRACT

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

PIER 1N & 2N EAST
PLAN & ELEVATION

G-1748 N

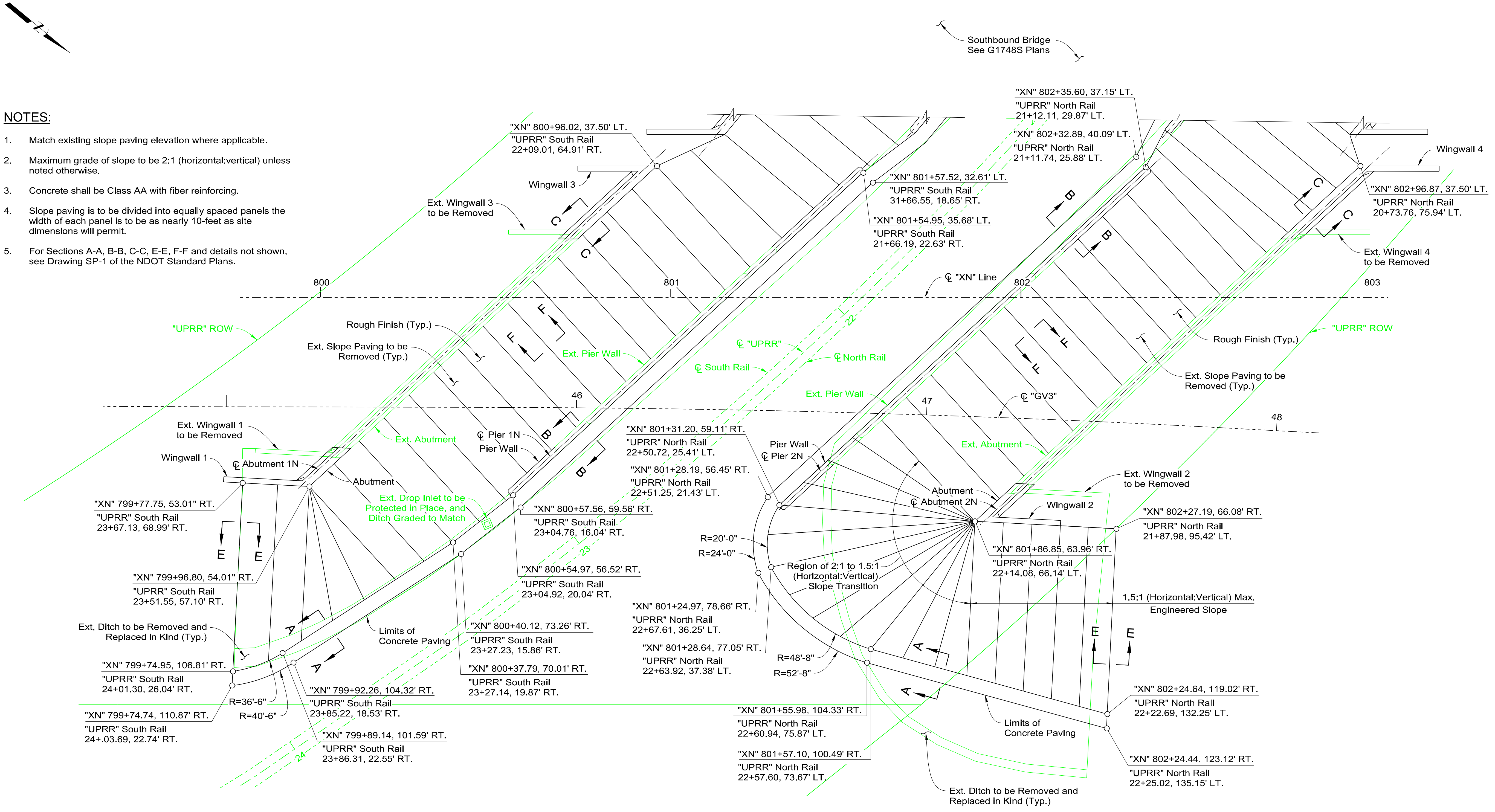
HDR Engineering, Inc.

9805 Double R Boulevard, Suite 101
Reno, NV 89521-5917
PH: 775-337-4700 FAX: 775-337-4774

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	B447

NOTES:

1. Match existing slope paving elevation where applicable.
2. Maximum grade of slope to be 2:1 (horizontal:vertical) unless noted otherwise.
3. Concrete shall be Class AA with fiber reinforcing.
4. Slope paving is to be divided into equally spaced panels the width of each panel is to be as nearly 10-feet as site dimensions will permit.
5. For Sections A-A, B-B, C-C, E-E, F-F and details not shown, see Drawing SP-1 of the NDOT Standard Plans.



PLAN

ORIGINAL CONTRACT: 2243
MODIFIED CONTRACT: 2983, DIST. 2 CONTRACT

90% PRELIMINARY
SUBJECT TO REVISION
09/02/2022

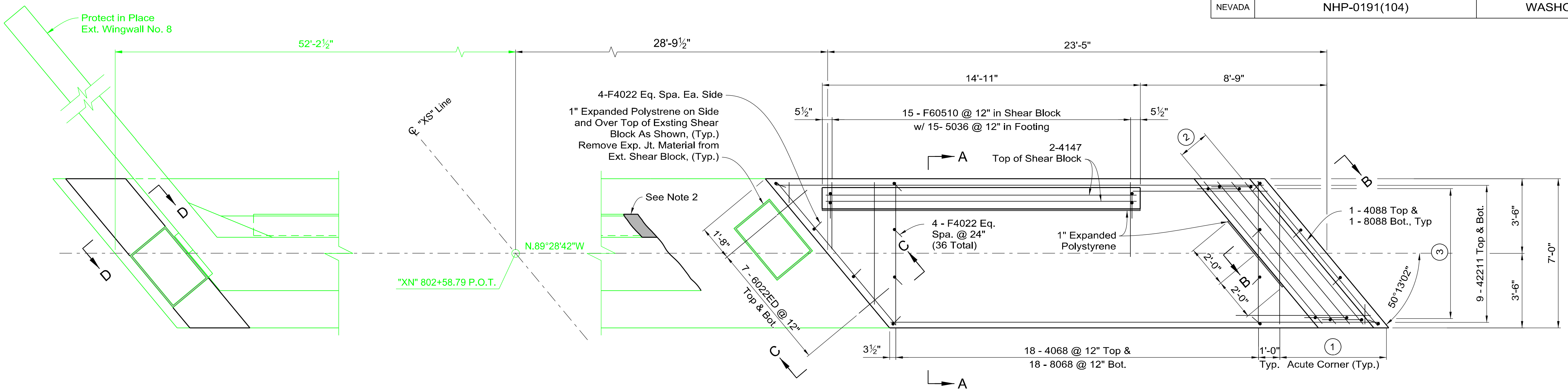
STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

CONCRETE SLOPE PAVING

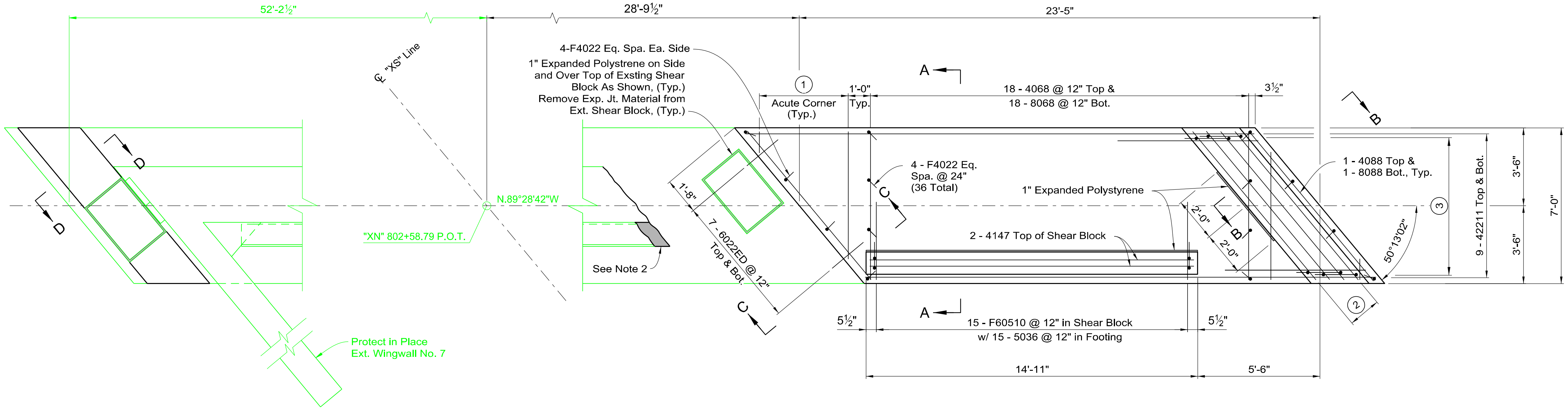
G-1748 N

HDR Engineering, Inc.
9805 Double R Boulevard, Suite 101
Reno, NV 89521-5917
PH: 775-337-4700 FAX: 775-337-4774

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	B453



PLAN - ABUTMENT 2S



PLAN - ABUTMENT 1S

① 1 Set 40510 to 4010 @ 12" Top (6 Bars/Set)
1 Set 80510 to 8010 @ 12" Bot (6 Bars/Set)

② 4 - 4088 @ 3 Layers (12 Bars Total), (See Section B-B)

③ 10 - Double F7070 Eq. Spa. (20 Total) &
10 - F7064 Eq. Spa.

NOTES:

1. See Abutment Footing Details sheet for Sections A-A, B-B, C-C and details not shown.
2. Partial removal of existing longitudinal shear block. Remove existing reinforcing at removal line & top of footing. Place expanded polystrene between remaining shear block and proposed abutment wall.

ORIGINAL CONTRACT: 2243
MODIFIED CONTRACT: 2983, DIST. 2 CONTRACT

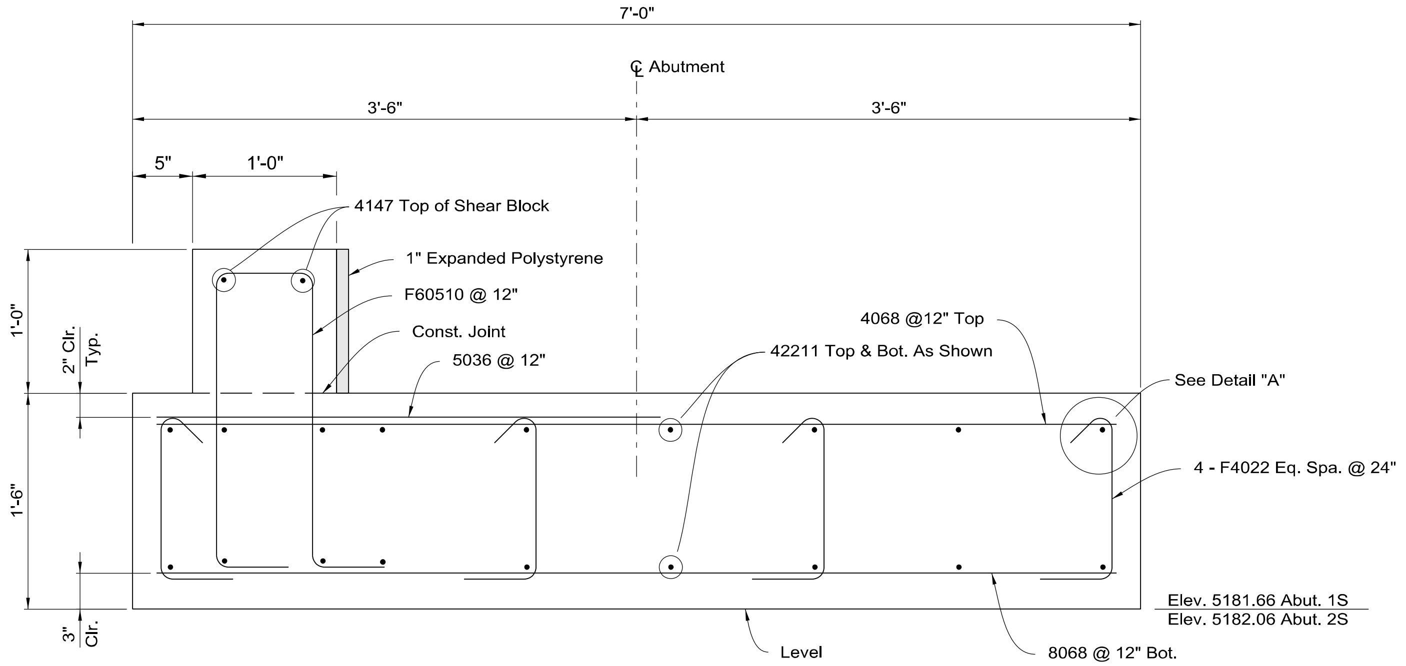
STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

ABUTMENT FOOTING PLAN
1S & 2S

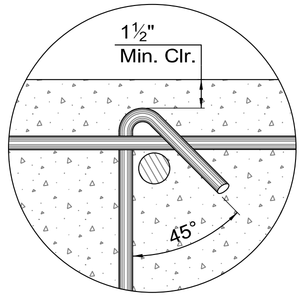
G-1748 S

HDR Engineering, Inc.
9805 Double R Boulevard, Suite 101
Reno, NV 89521-5917
PH: 775-337-4700 FAX: 775-337-4774

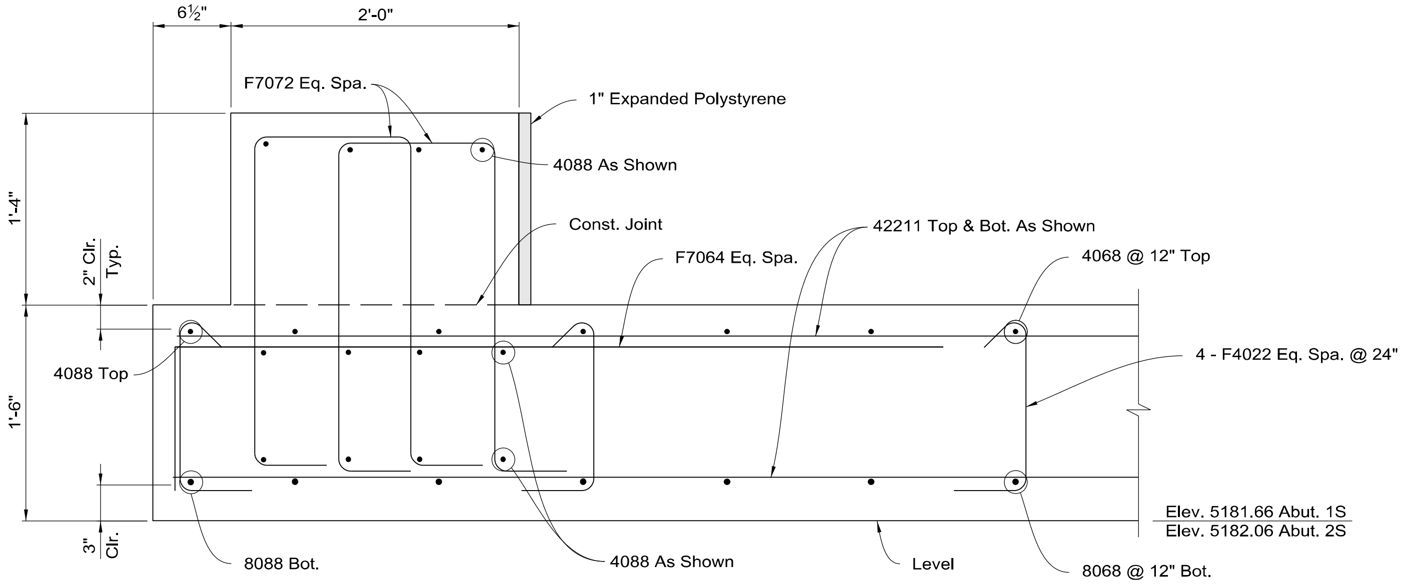
STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	B454



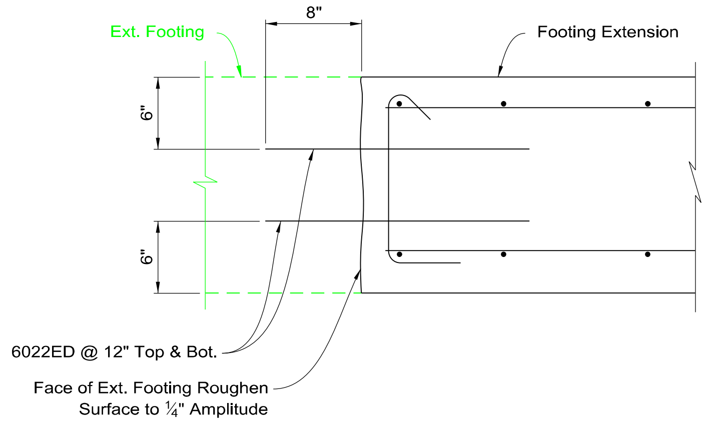
SECTION A-A



DETAIL "A"



SECTION B-B



SECTION C-C

ORIGINAL CONTRACT: 2243
MODIFIED CONTRACT: 2983, DIST. 2 CONTRACT

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

ABUTMENT FOOTING
DETAILS

G-1748 S

HDR Engineering, Inc.
9805 Double R Boulevard, Suite 101
Reno, NV 89521-5917
PH: 775-337-4700 FAX: 775-337-4774

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	B455

NOTES

1. See Abutment Details sheet for Sections A-A, B-B and details not shown.

∗ Removal of existing wingwall and portion of abutment wall. Protect in place existing reinforcing in abutment wall. Lap or embed into new wall. Abutment wall removal measured along abutment centerline.

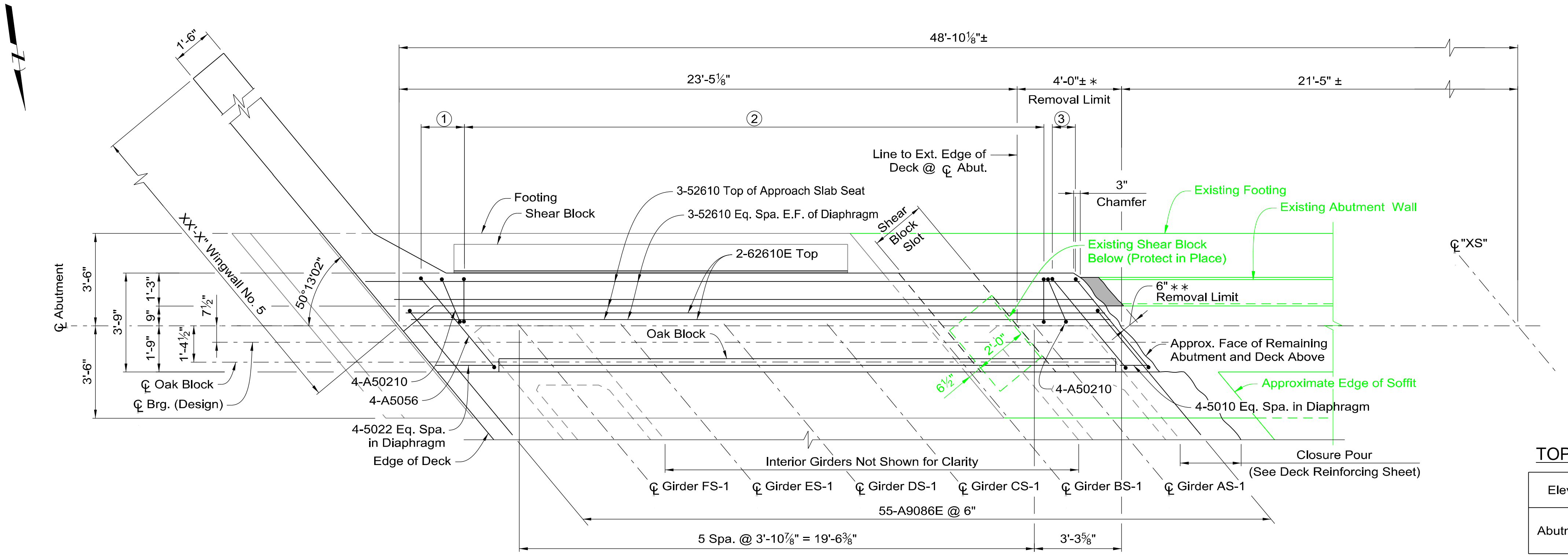
∗∗ Partial removal of existing longitudinal shear block. Remove existing reinforcing at removal line & top of footing. Place expanded polystyrene between remaining shear block and proposed abutment wall. Abutment shear block removal measured perpendicular to abutment wall removal line.

REINFORCING STEEL;

① 2 Spa. @ 9" Max. (Typ. Ea. End)

② 23 Groups of A5028 @ 12" (4 Bars/ Group) Eq. Spa. Vertically in Diaphragm (69-A5028 Total)

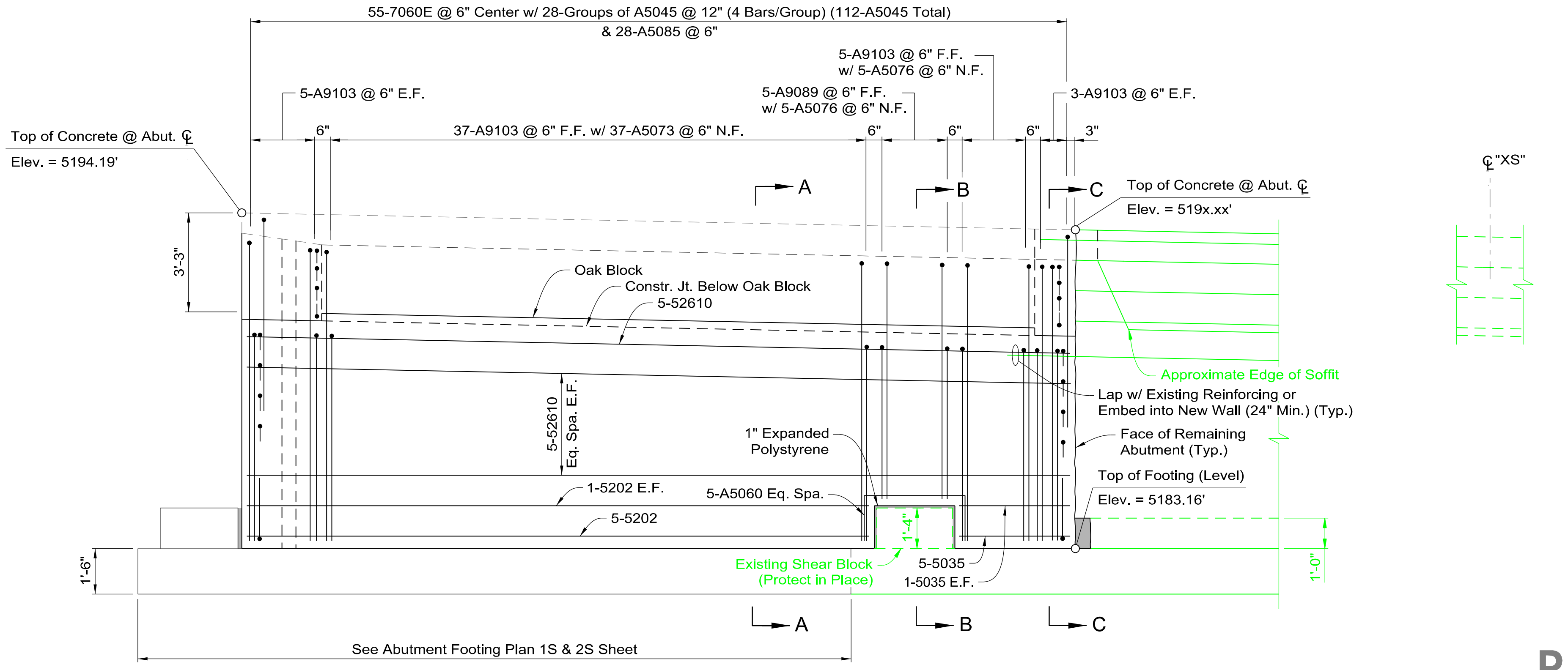
③ 2 Groups of A5056 (4 Bars/Group) Eq. Spa. Vertically in Diaphragm (6-A5056 Total)



PLAN

TOP OF WALL ELEVATION

Elevation	℄ Girder AS-1	℄ Girder BS-1	℄ Girder CS-1	℄ Girder DS-1	℄ Girder ES-1	℄ Girder FS-1
Abutment 1S						



ELEVATION

LOOKING BACK ON LINE NORMAL TO SKEW

ORIGINAL CONTRACT: 2243
MODIFIED CONTRACT: 2983, DIST. 2 CONTRACT

SHEET
IN
PROGRESS
90% PRELIMINARY
SUBJECT TO REVISION
09/02/2022

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

ABUTMENT 1S
PLAN & ELEVATION

G-1748 S

HDR Engineering, Inc.
9805 Double R Boulevard, Suite 101
Reno, NV 89521-5917
PH: 775-337-4700 FAX: 775-337-4774

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	B456

NOTES

1. See Abutment Details sheet for Sections A-A, B-B and details not shown.

∗ Removal of existing wingwall and portion of abutment wall. Protect in place existing reinforcing in abutment wall. Lap or embed into new wall. Abutment wall removal measured along abutment centerline.

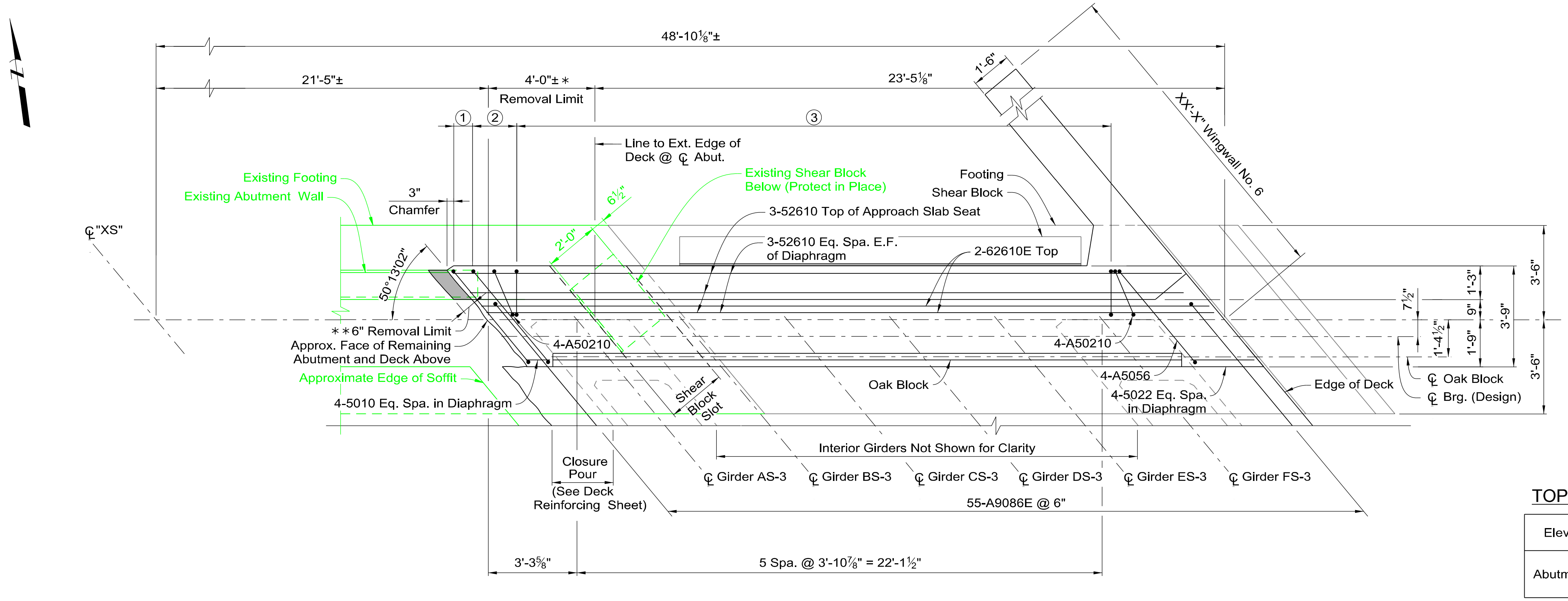
∗∗ Partial removal of existing longitudinal shear block. Remove existing reinforcing at removal line & top of footing. Place expanded polystyrene between remaining shear block and proposed abutment wall. Abutment shear block removal measured perpedicular to abutment wall removal line.

REINFORCING STEEL;

① 2 Groups of A5056 (4 Bars/Group) Eq. Spa. Vertically in Diaphragm (6-A5056 Total)

② 2 Spa. @ 9" Max. (Typ. Ea. End)

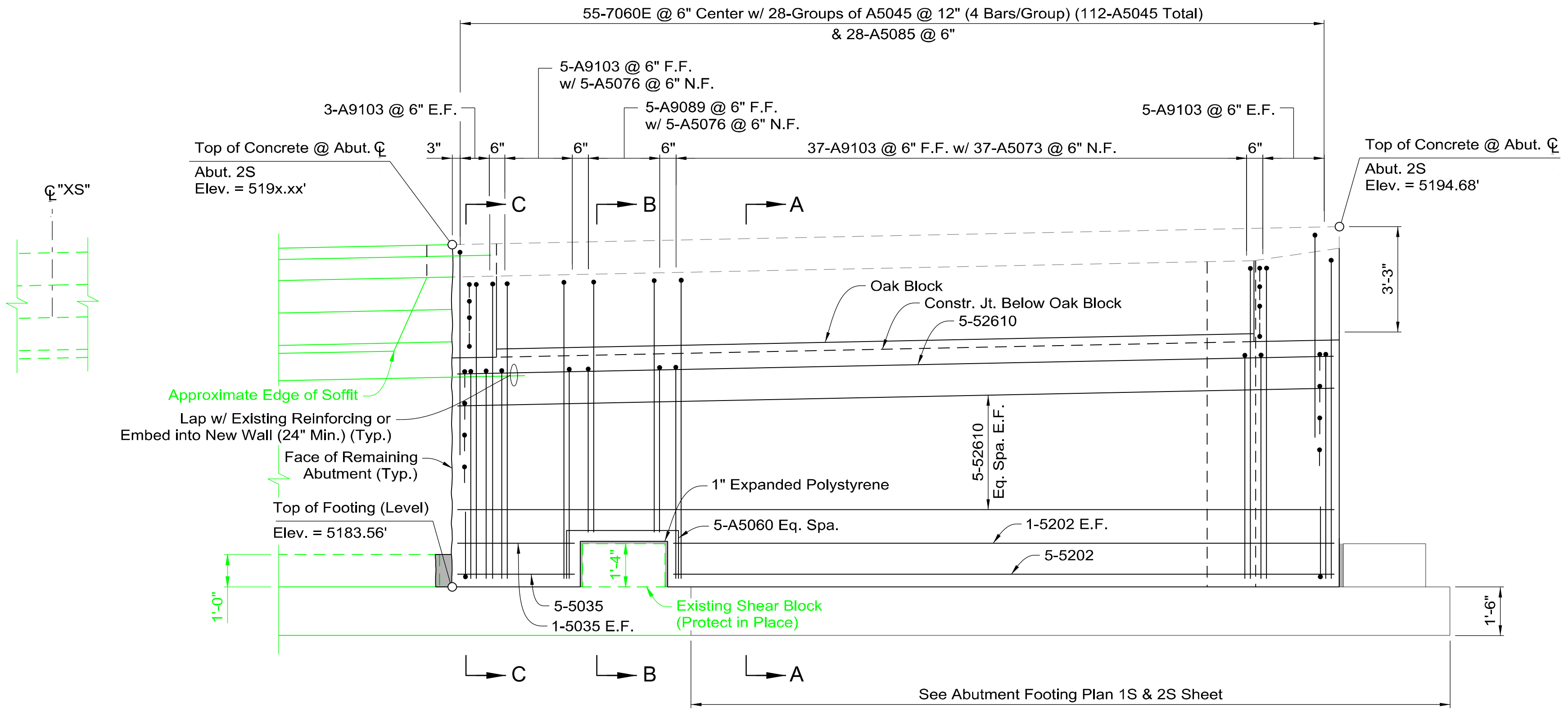
③ 23 Groups of A5028 @ 12" (4 Bars/ Group) Eq. Spa. Vertically in Diaphragm (92-A5028 Total)



PLAN

TOP OF WALL ELEVATION

Elevation	℄ Girder AS-3	℄ Girder BS-3	℄ Girder CS-3	℄ Girder DS-3	℄ Girder ES-1	℄ Girder FS-1
Abutment 2S						



ELEVATION

LOOKING AHEAD ON LINE NORMAL TO SKEW

SHEET IN PROGRESS

90% PRELIMINARY

SUBJECT TO REVISION

09/02/2022

ORIGINAL CONTRACT: 2243
MODIFIED CONTRACT: 2983, DIST. 2 CONTRACT

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

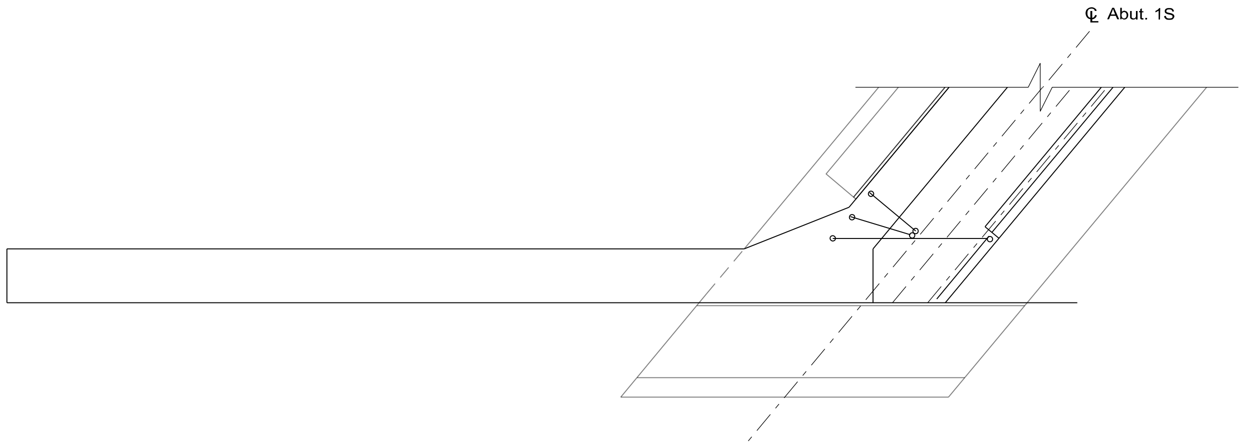
ABUTMENT 2S
PLAN & ELEVATION

G-1748 S

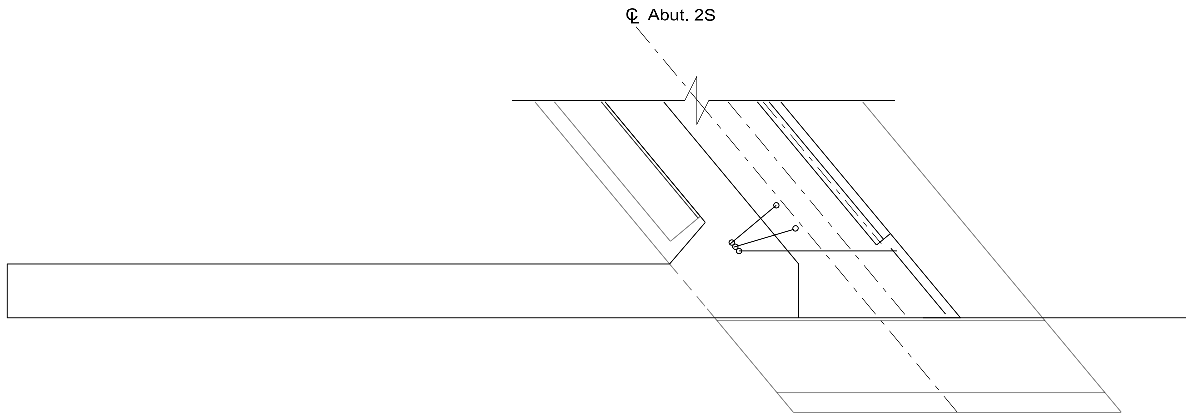
HDR Engineering, Inc.

9805 Double R Boulevard, Suite 101
Reno, NV 89521-5917
PH: 775-337-4700 FAX: 775-337-4774

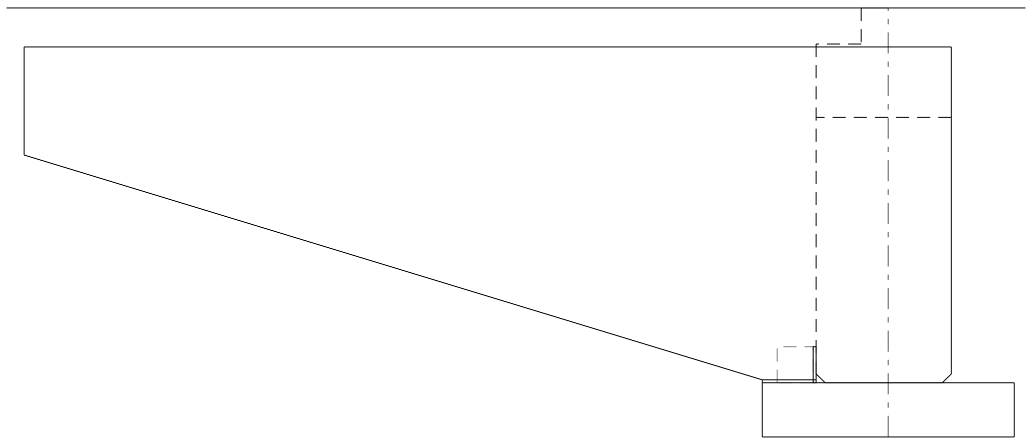
STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	B458



PLAN

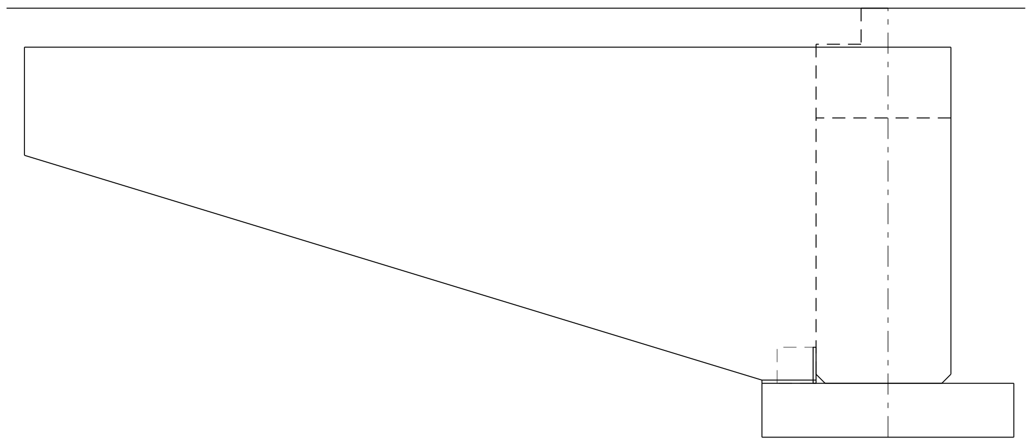


PLAN



ELEVATION

WINGWALL NO. 5



ELEVATION

WINGWALL NO. 6

ORIGINAL CONTRACT: 2243
MODIFIED CONTRACT: 2983, DIST. 2 CONTRACT

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

WINGWALL PLAN & ELEVATION

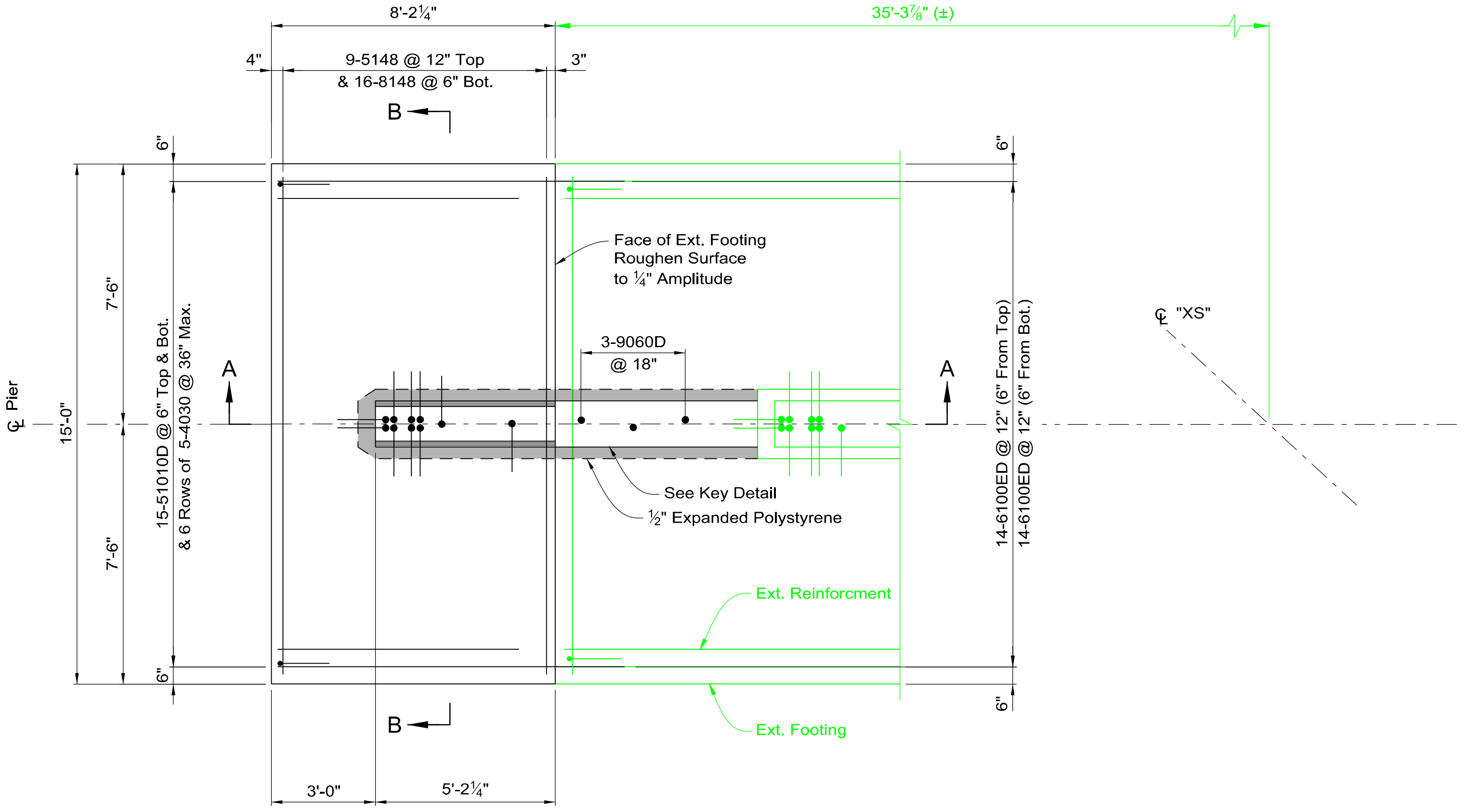
G-1748 S

HDR Engineering, Inc.
9805 Double R Boulevard, Suite 101
Reno, NV 89521-5917
PH: 775-337-4700 FAX: 775-337-4774

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	B459

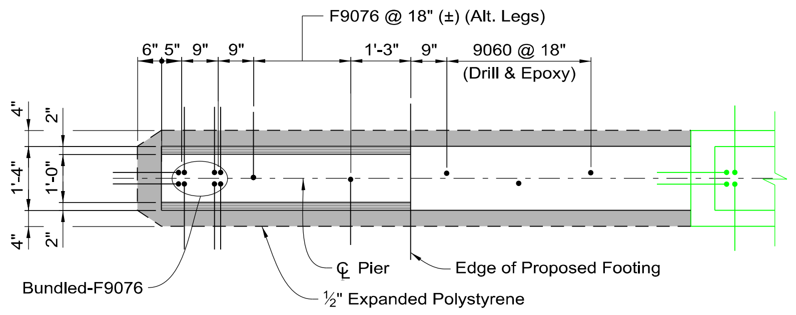
NOTES:

1. For pier wall details not shown, See Pier Plan & Elevation sheets.

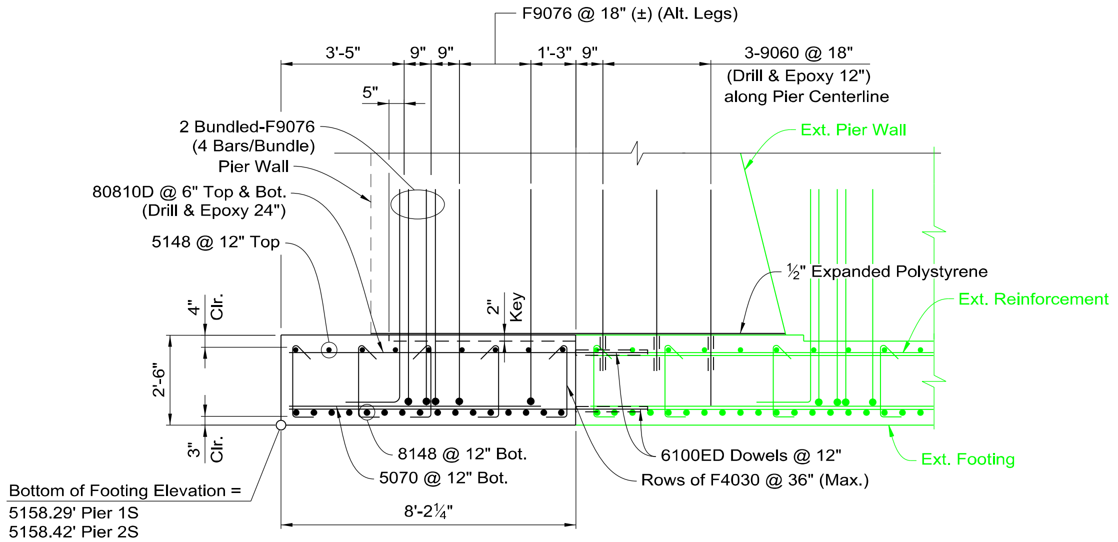


PLAN 1S

PIER 1S SHOWN,
PIER 2S SIMILAR

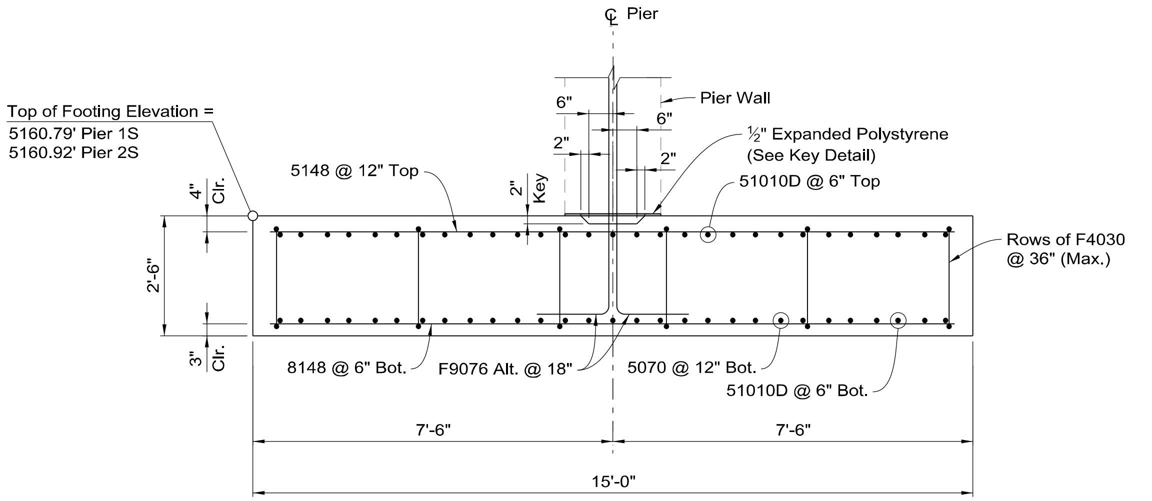


KEY DETAIL



SECTION A-A

PIER 1S SHOWN,
PIER 2S SIMILAR



SECTION B-B

PIER 1S SHOWN,
PIER 2S SIMILAR

ORIGINAL CONTRACT: 2243
MODIFIED CONTRACT: 2983, DIST. 2 CONTRACT

SHEET
IN
PROGRESS

90% PRELIMINARY
SUBJECT TO REVISION
09/02/2022

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

PIER 1S & 2S WEST
FOOTING DETAILS
PLAN & SECTIONS

G-1748 S

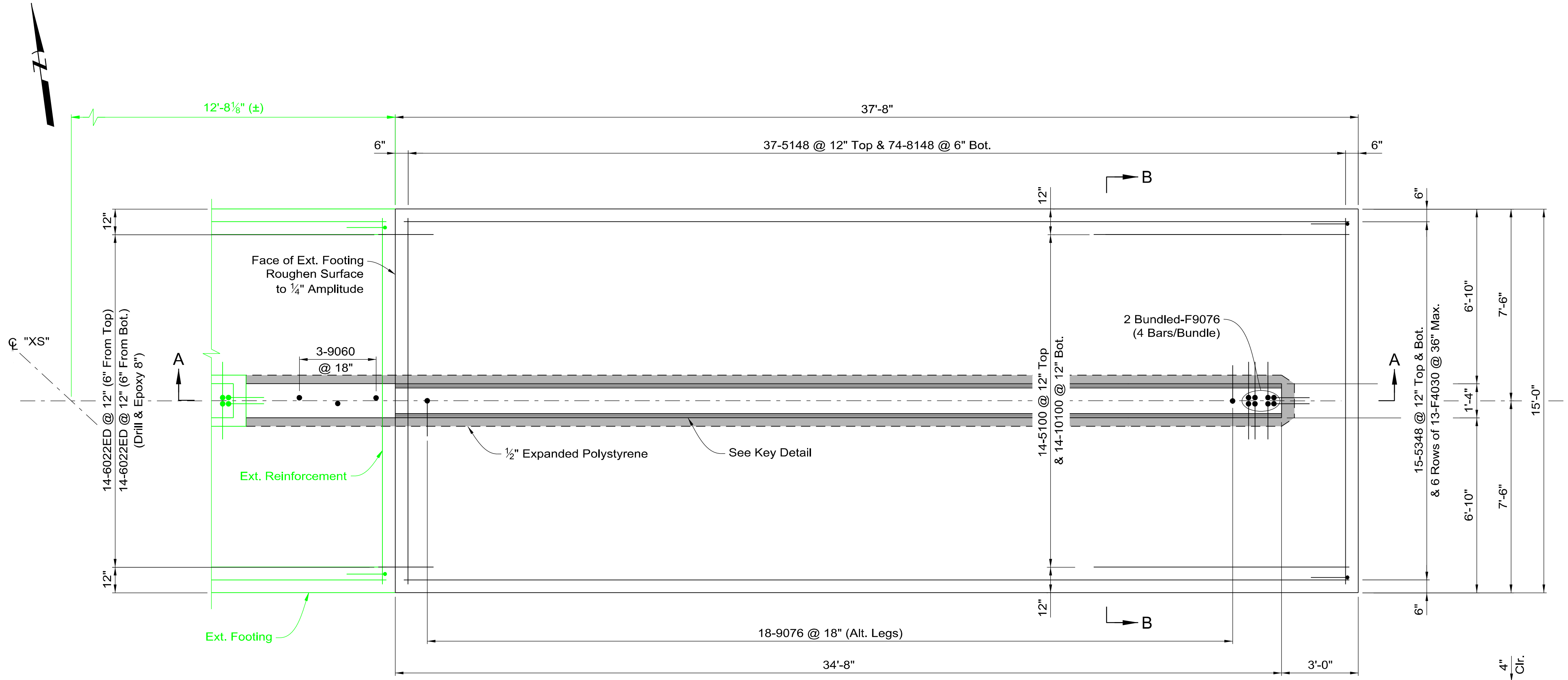
HDR Engineering, Inc.

9805 Double R Boulevard, Suite 101
Reno, NV 89521-5917
PH: 775-337-4700 FAX: 775-337-4774

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	B460

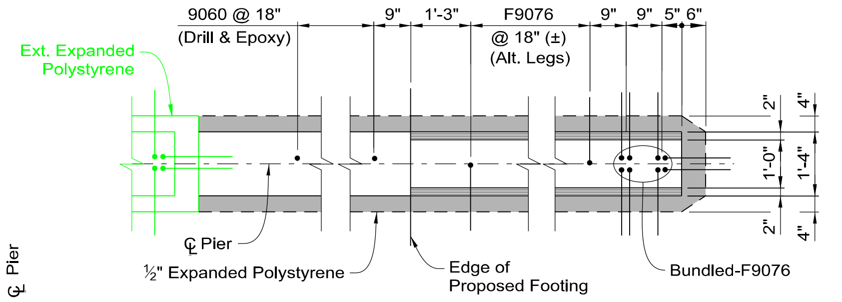
NOTES:

1. For pier wall details not shown, See Pier Plan & Elevation sheets.

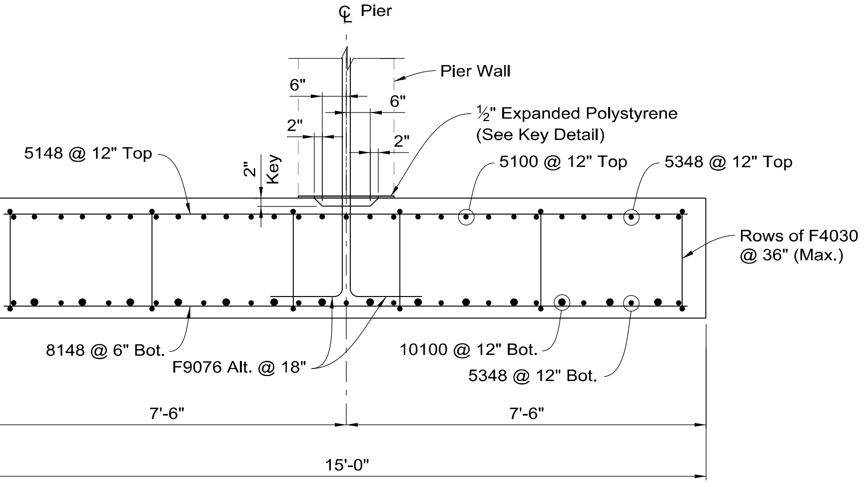


PLAN 1S

PIER 1S SHOWN,
PIER 2S SIMILAR

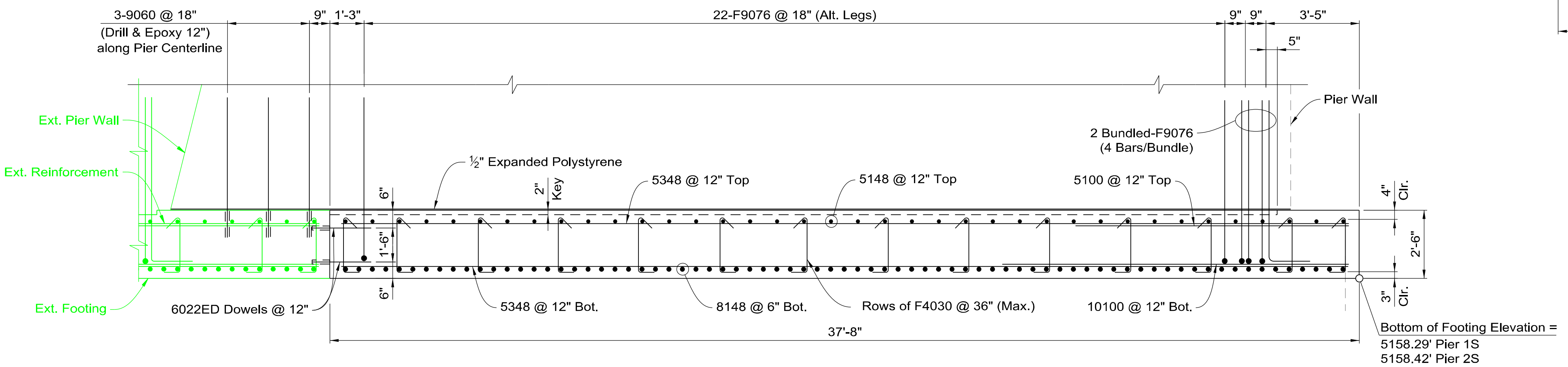


KEY DETAIL



SECTION B-B

Pier 1S Shown,
Pier 2S Similar



SECTION A-A

PIER 1S SHOWN,
PIER 2S SIMILAR

ORIGINAL CONTRACT: 2243
MODIFIED CONTRACT: 2983, DIST. 2 CONTRACT

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

PIER 1S & 2S EAST
FOOTING DETAILS
PLAN & SECTIONS

G-1748 S

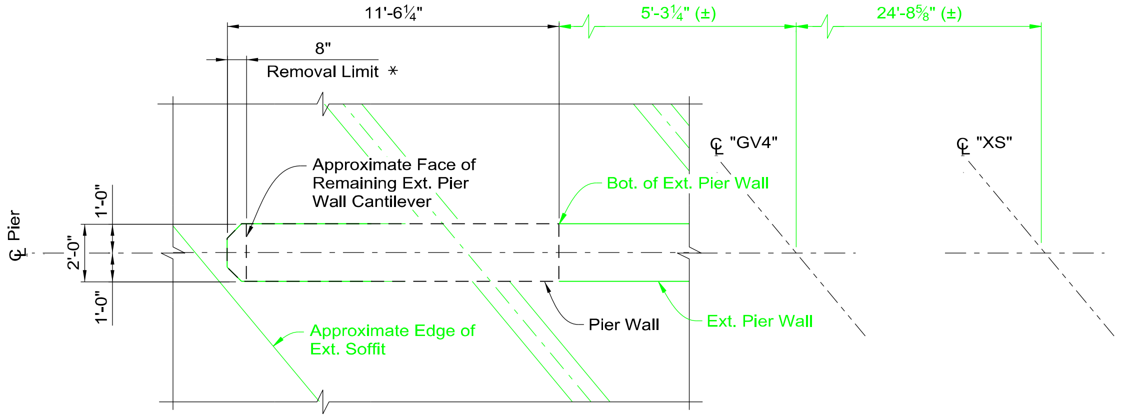
HDR Engineering, Inc.
9805 Double R Boulevard, Suite 101
Reno, NV 89521-5917
PH: 775-337-4700 FAX: 775-337-4774

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	B461

NOTES

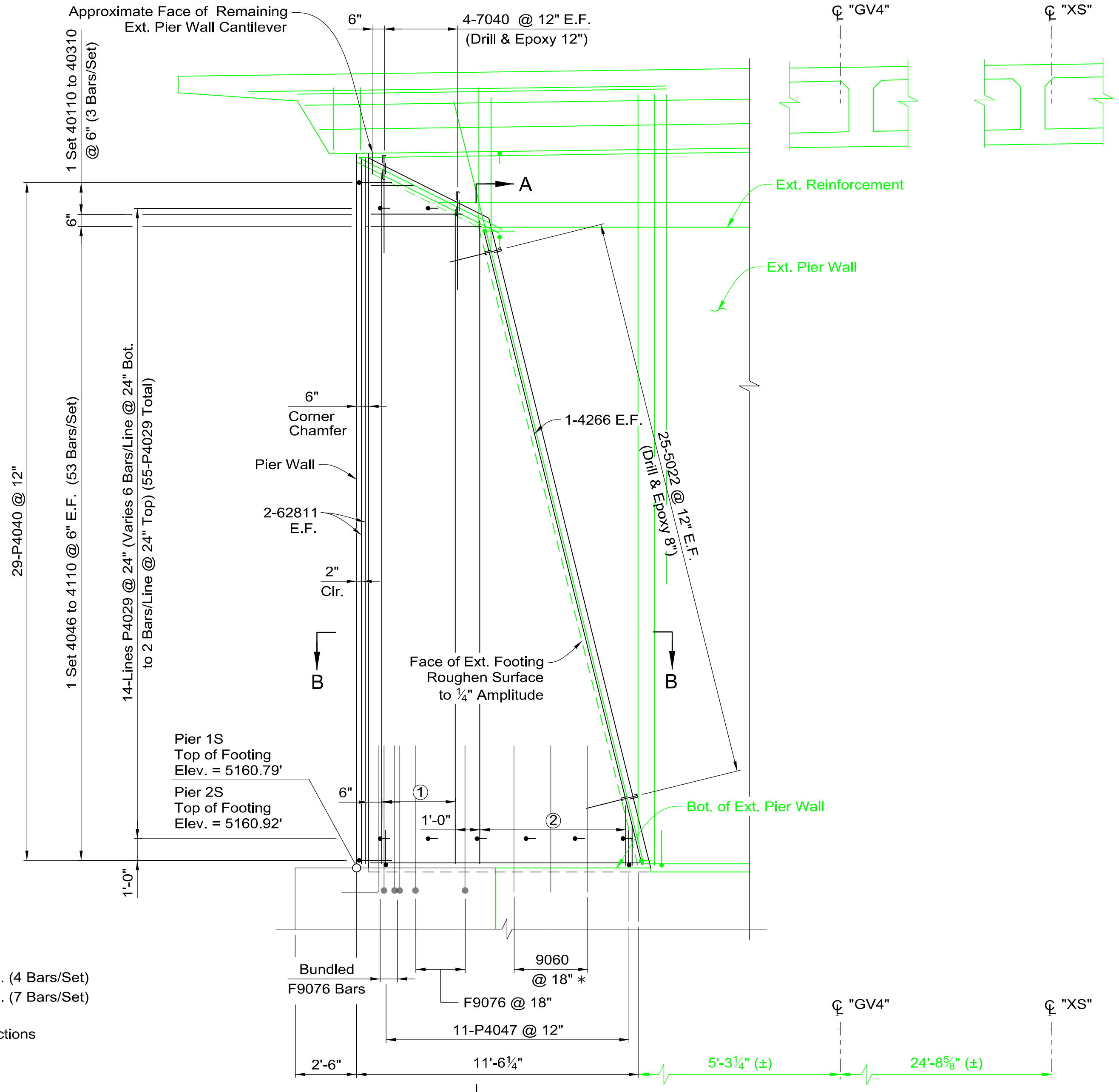
1. Pier wall reinforcing and details apply to Pier 1S and Pier 2S.

∗ Partial removal of the existing cantilever. Protect in place existing reinforcing in cantilever and embed into new wall.



PLAN 1S

PIER 1S SHOWN, PIER 2S SIMILAR



ELEVATION 1S

PIER 1S SHOWN, PIER 2S SIMILAR
LOOKING AHEAD ON LINE NORMAL TO SKEW

REINFORCING NOTES:

① 1 Set 7269 to 7283 @ 12" E.F. (4 Bars/Set)
② 1 Set 5025 to 5263 @ 12" E.F. (7 Bars/Set)

∗ See Footing Details Plan & Sections sheet for 9060 & F9076 bars

90% PRELIMINARY

SUBJECT TO REVISION
09/02/2022

ORIGINAL CONTRACT: 2243
MODIFIED CONTRACT: 2983, DIST. 2 CONTRACT

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

PIER 1S & 2S WEST
PLAN & ELEVATION

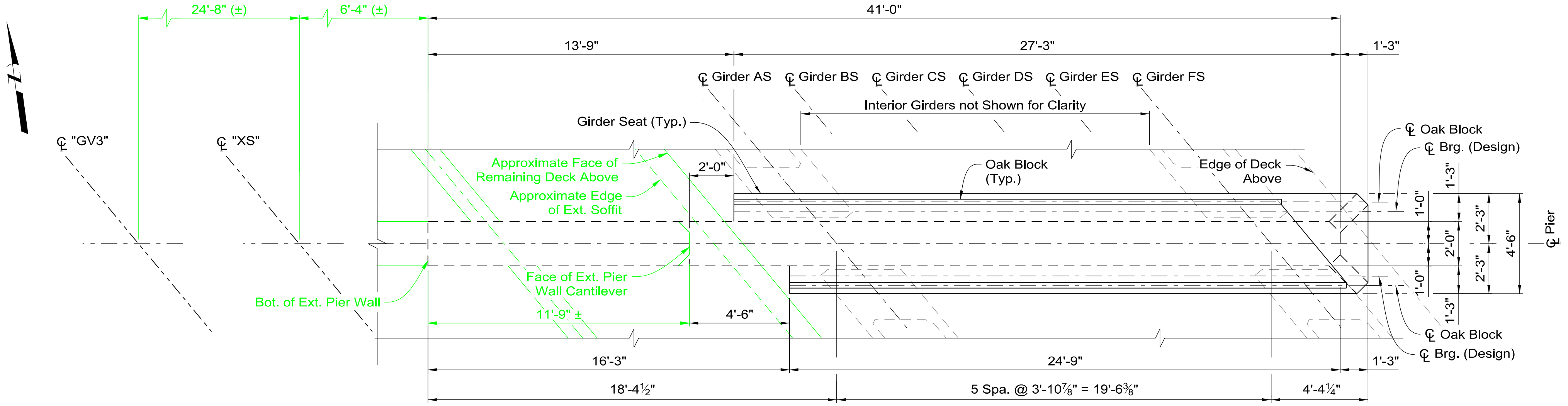
G-1748 S

HDR Engineering, Inc.
9805 Double R Boulevard, Suite 101
Reno, NV 89521-5917
PH: 775-337-4700 FAX: 775-337-4774

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	B462

NOTES

1. Pier wall reinforcing and details apply to Pier 1S and Pier 2S.

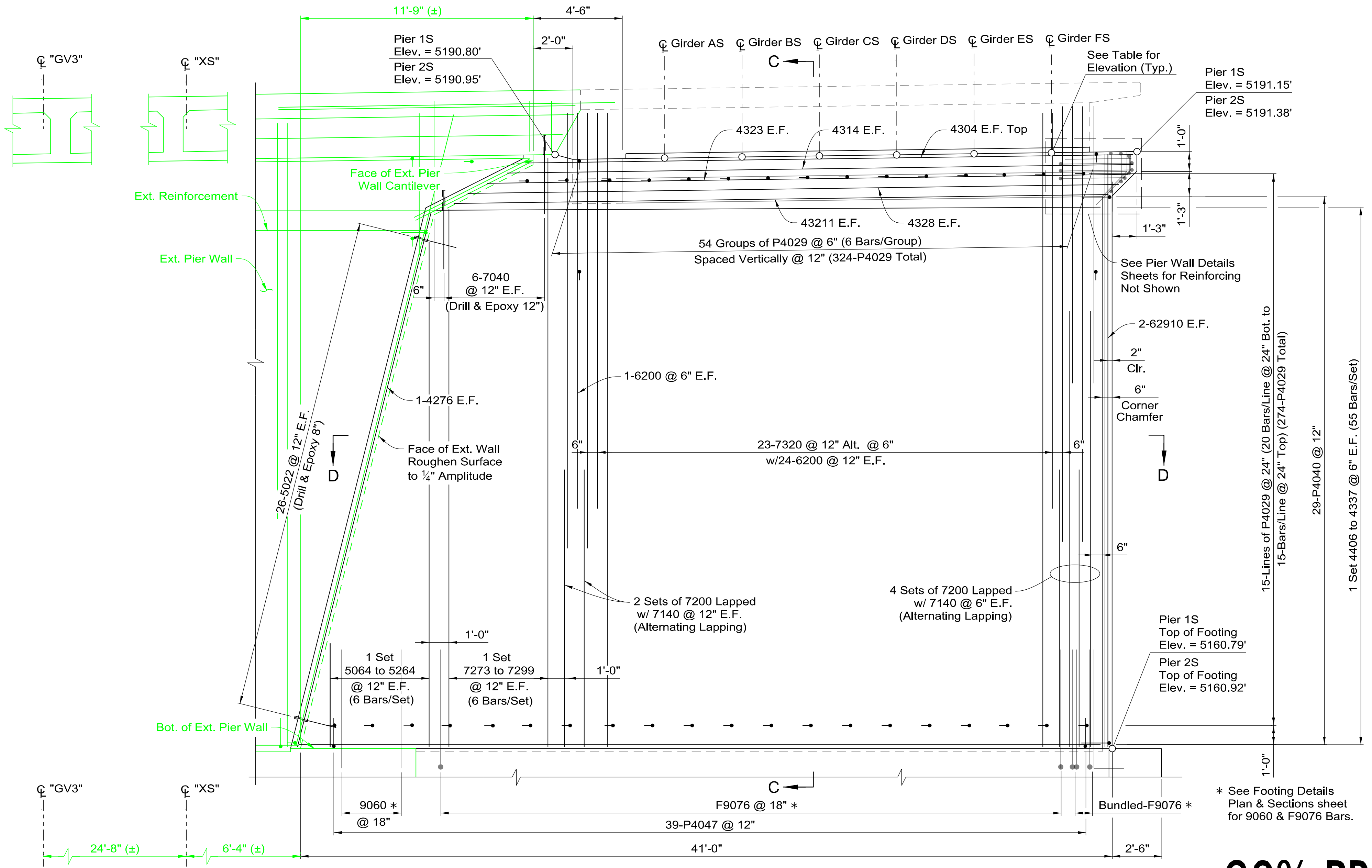


PLAN 1S

PIER 1S SHOWN, PIER 2S SIMILAR

TOP OF WALL ELEVATION

Elevation	℄ Girder AS	℄ Girder BS	℄ Girder CS	℄ Girder DS	℄ Girder ES	℄ Girder FS
Pier 1S						
Pier 2S						



∗ See Footing Details Plan & Sections sheet for 9060 & F9076 Bars.

ELEVATION 1S

PIER 1S SHOWN, PIER 2S SIMILAR
LOOKING AHEAD ON LINE NORMAL TO SKEW

ORIGINAL CONTRACT: 2243
MODIFIED CONTRACT: 2983, DIST. 2 CONTRACT

90% PRELIMINARY

SUBJECT TO REVISION
09/02/2022

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

PIER 1S & 2S EAST
PLAN & ELEVATION

G-1748 S

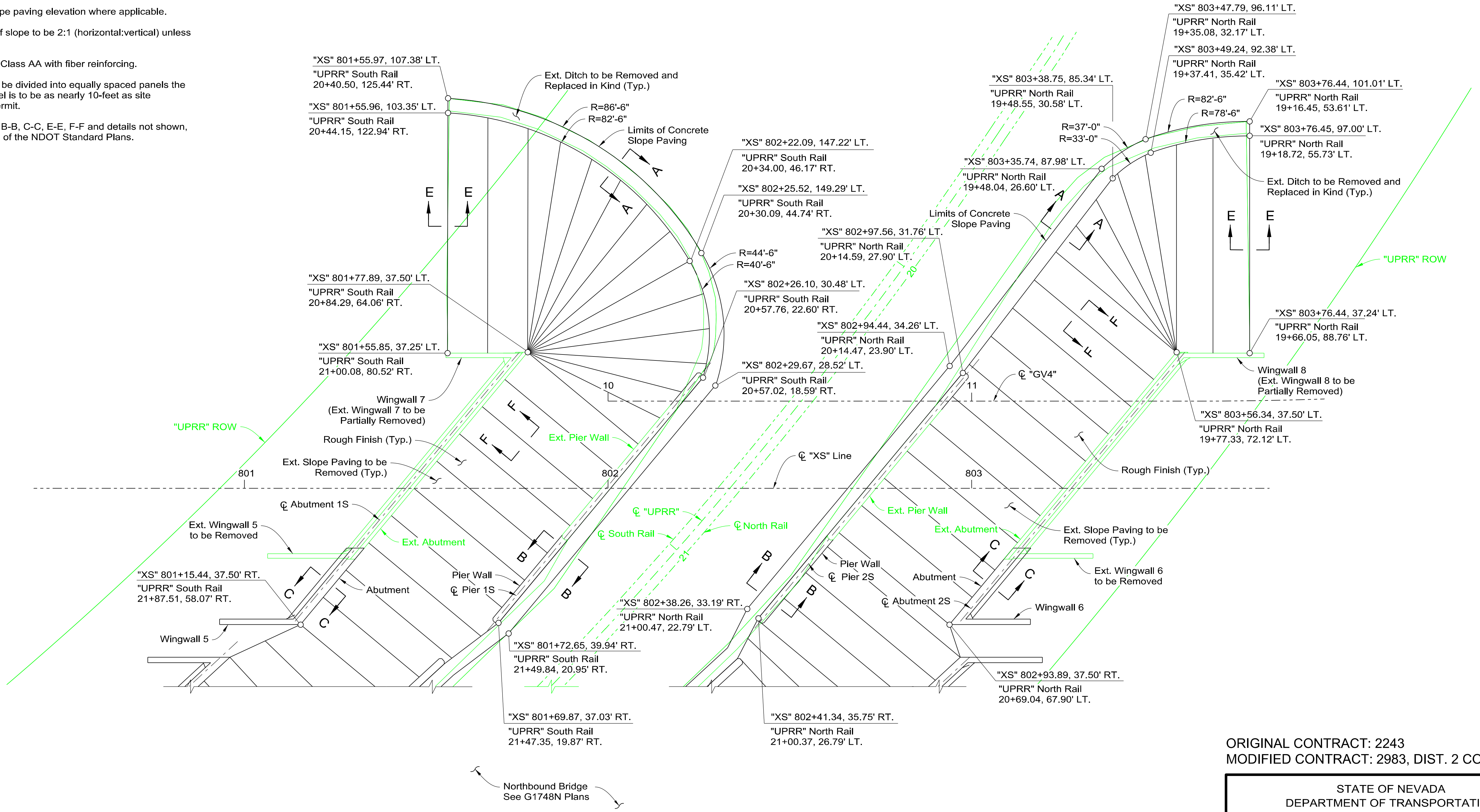
HDR Engineering, Inc.

9805 Double R Boulevard, Suite 101
Reno, NV 89521-5917
PH: 775-337-4700 FAX: 775-337-4774

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	B483

NOTES:

1. Match existing slope paving elevation where applicable.
2. Maximum grade of slope to be 2:1 (horizontal:vertical) unless noted otherwise.
3. Concrete shall be Class AA with fiber reinforcing.
4. Slope paving is to be divided into equally spaced panels the width of each panel is to be as nearly 10-feet as site dimensions will permit.
5. For Sections A-A, B-B, C-C, E-E, F-F and details not shown, see Drawing SP-1 of the NDOT Standard Plans.



PLAN

ORIGINAL CONTRACT: 2243
MODIFIED CONTRACT: 2983, DIST. 2 CONTRACT

90% PRELIMINARY
SUBJECT TO REVISION
09/02/2022

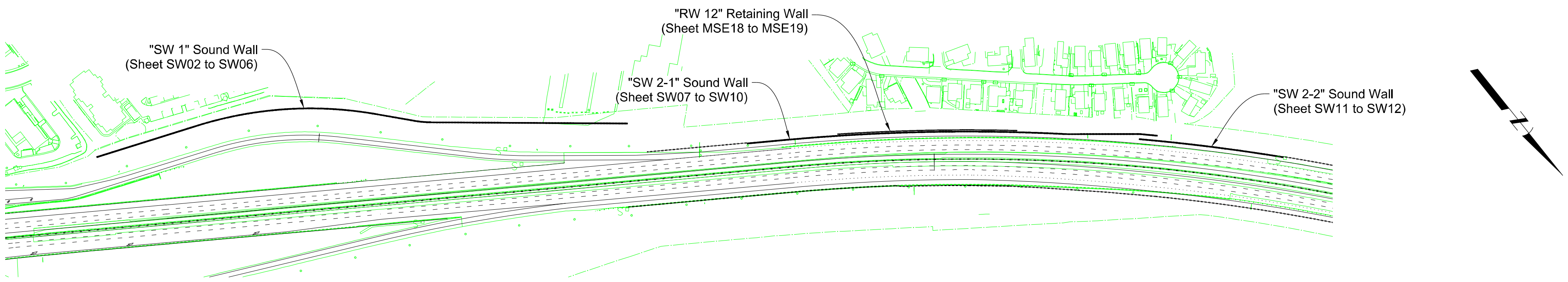
STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

CONCRETE SLOPE PAVING

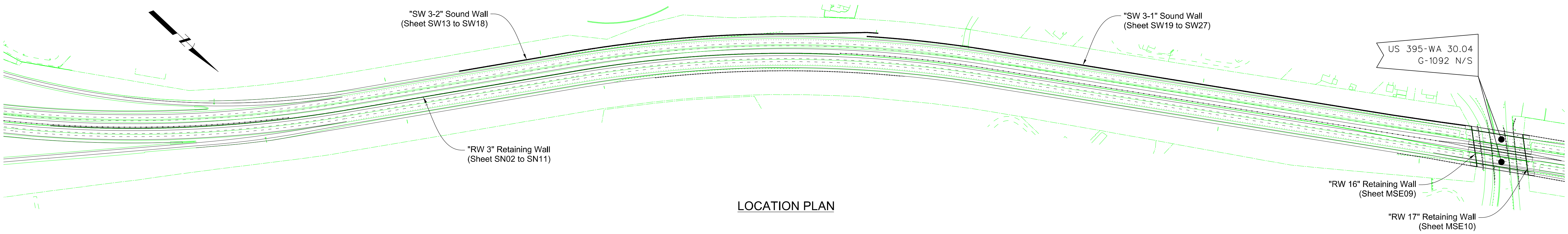
G-1748 S

HDR Engineering, Inc.
9805 Double R Boulevard, Suite 101
Reno, NV 89521-5917
PH: 775-337-4700 FAX: 775-337-4774

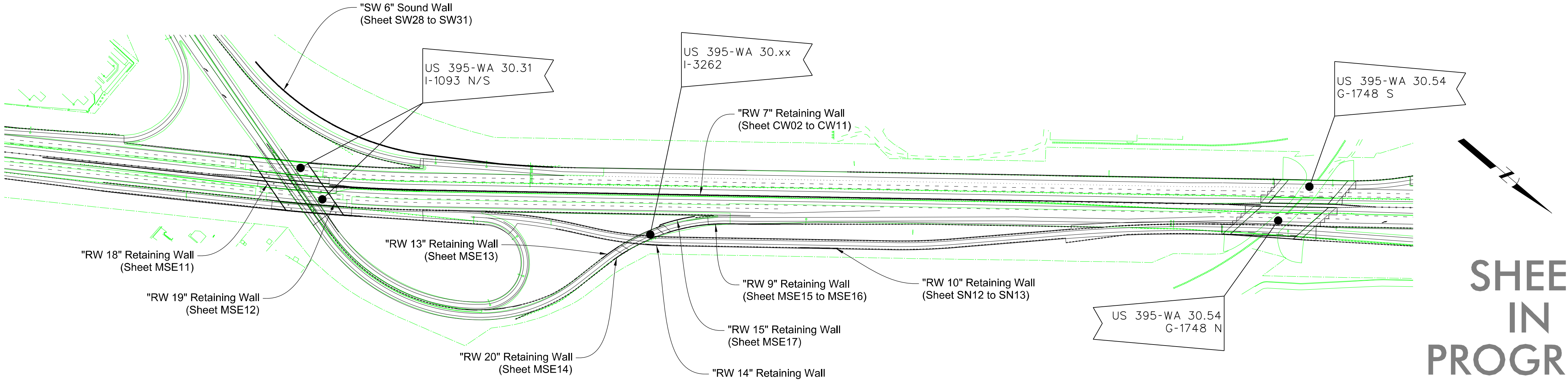
STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	MSE01



LOCATION PLAN



LOCATION PLAN



LOCATION PLAN

SHEET
IN
PROGRESS
90% PRELIMINARY
SUBJECT TO REVISION
09/02/2022

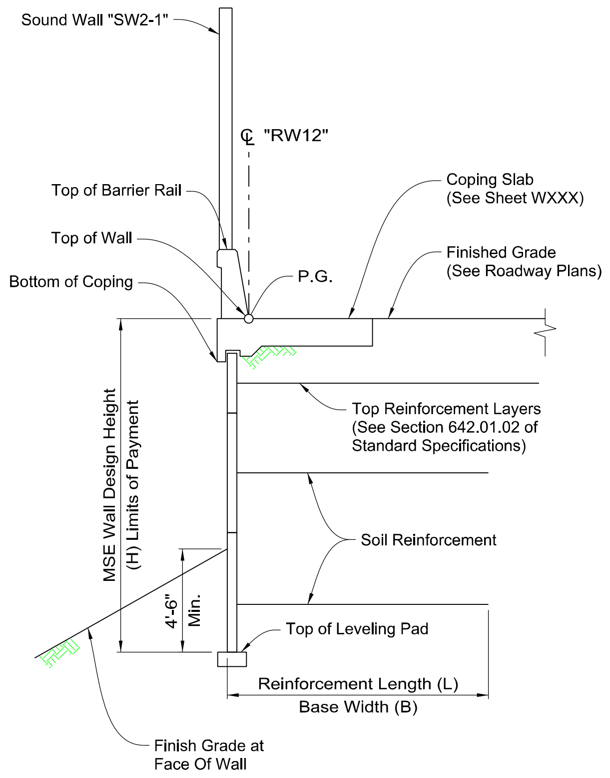
STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

WALL LOCATION PLAN

HDR Engineering, Inc.

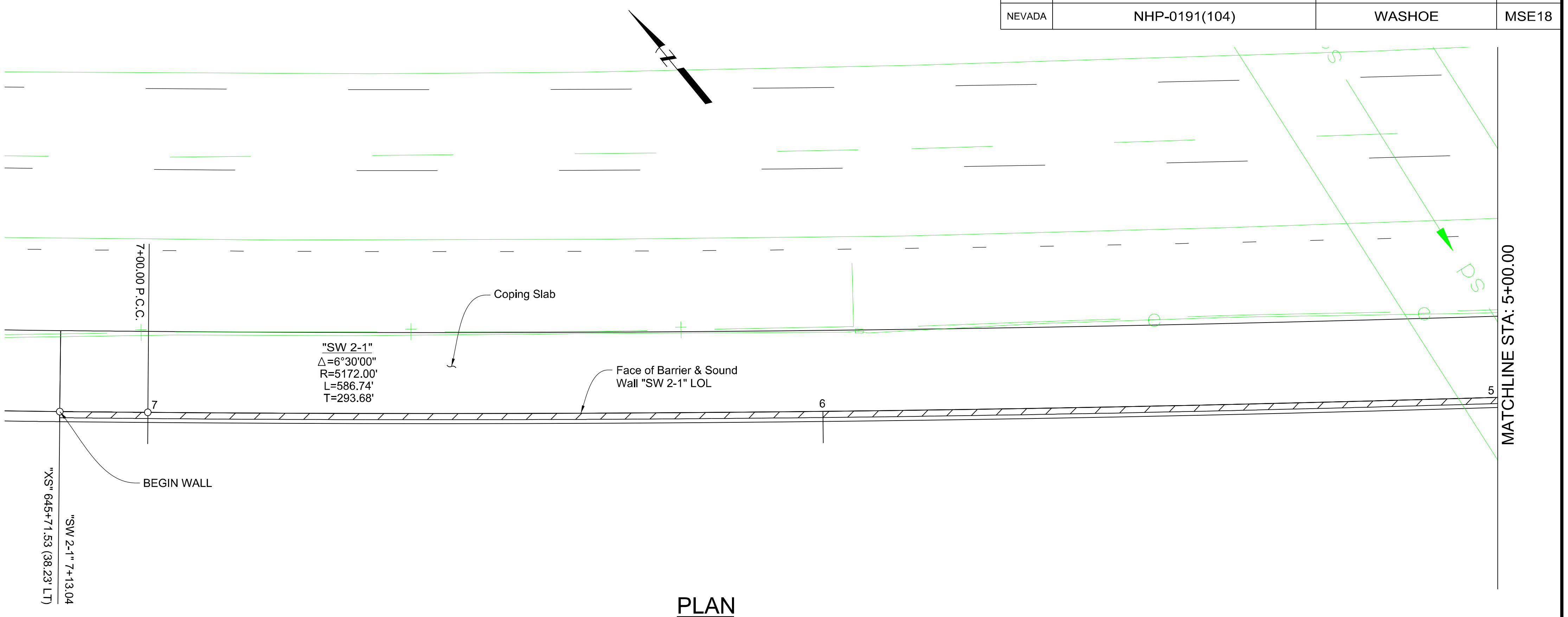
9805 Double R Boulevard, Suite 101
Reno, NV 89521-5917
PH: 775-337-4700 FAX: 775-337-4774

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	MSE18

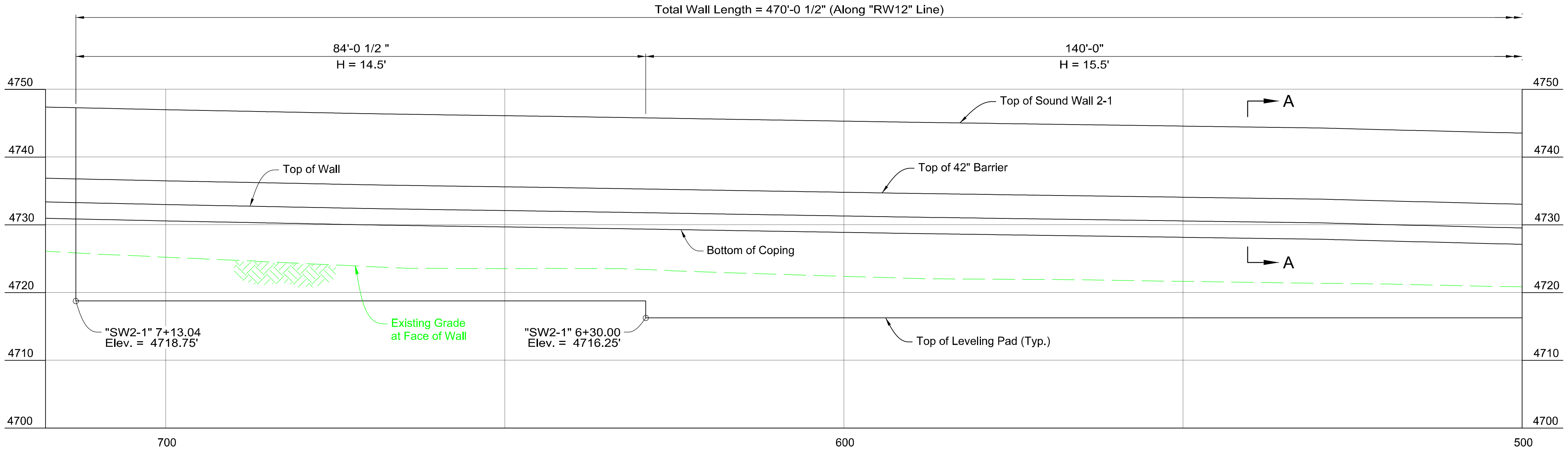


TYPICAL SECTION

LOOKING BACK ON LINE



PLAN



DEVELOPED ELEVATION

MSE WALL SCHEDULE

Max. Wall Design Height (H)	Min. Reinforcement Length (L)
< 10'-0"	8'-0"
10'-0"	8'-0"
12'-0"	9'-0"
14'-0"	10'-0"
16'-0"	12'-0"
18'-0"	13'-0"
20'-0"	14'-0"
22'-0"	16'-0"
24'-0"	17'-0"
26'-0"	19'-0"
28'-0"	20'-0"
30'-0"	21'-0"
32'-0"	23'-0"
34'-0"	24'-0"

SHEET
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90% PRELIMINARY

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09/02/2022

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

RETAINING WALL "RW12"
PLAN AND ELEVATION 1

HDR Engineering, Inc.

9805 Double R Boulevard, Suite 101
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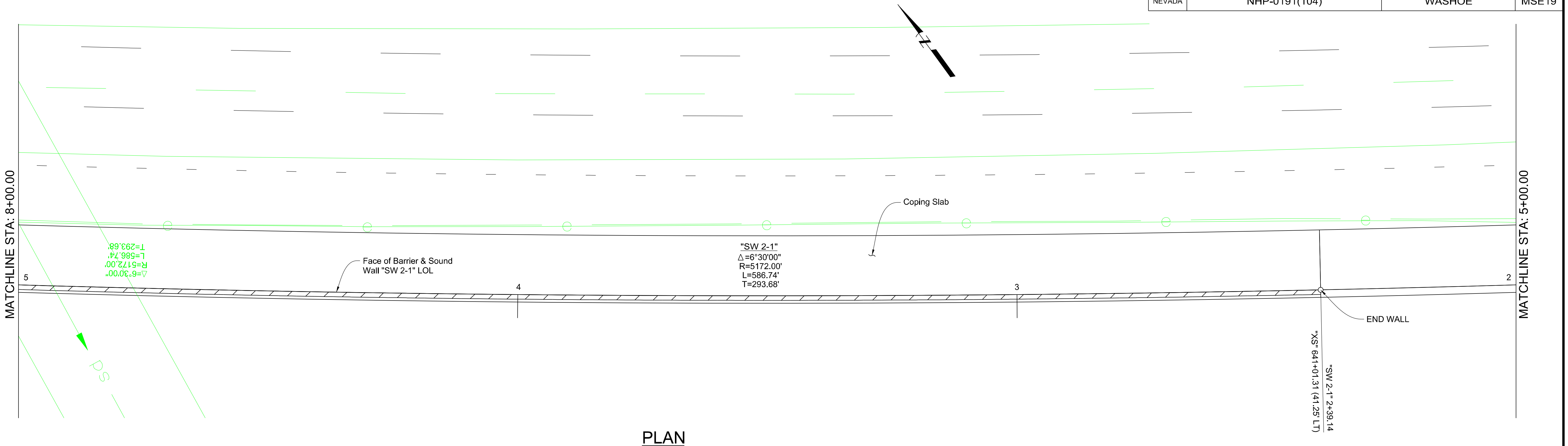
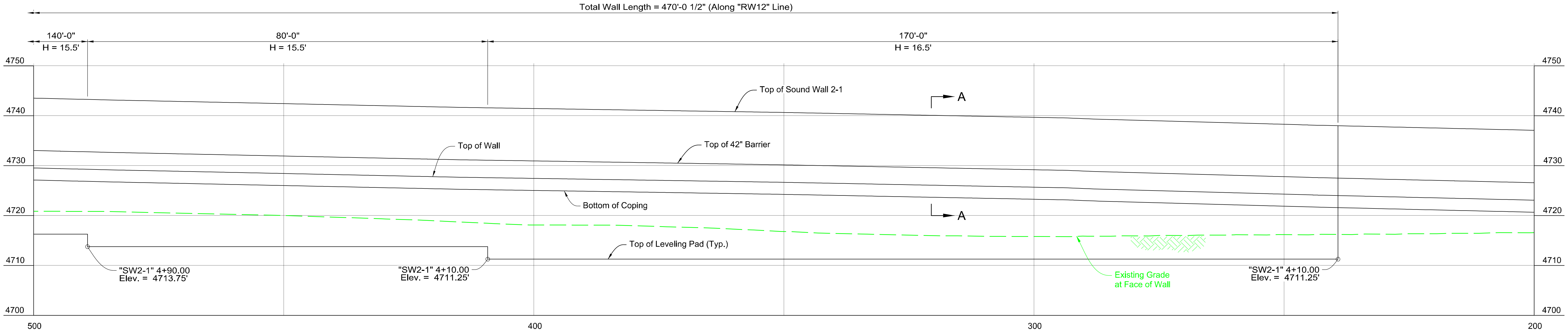
STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	MSE19



PLAN



DEVELOPED ELEVATION

SHEET
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09/02/2022

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

RETAINING WALL "RW12"
PLAN AND ELEVATION 2

HDR Engineering, Inc.
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GENERAL NOTES:

1. Existing grade, top of shotcrete wall, and bottom of shotcrete wall elevations are provided on drawings. However, these drawings may not accurately represent field conditions. The Contractor is required to conduct necessary field investigations to verify all controlling measurements (dimensions, elevations and bearings) prior to ordering materials, preparing shop drawings or starting any construction. Submit all information to the engineer, identify those measurements that deviate substantially from the plans and that will impact the new construction for resolution by the engineer. No direct payment will be made for obtaining field measurements.
2. All nail lengths and nail bar sizes shall be in accordance with schedules and details shown herein.
3. For shotcrete wall reinforcing requirements, see sheets SN09 & SN10.
4. For nail inclination requirements, see sheet SN09.
5. All materials, workmanship and construction shall be in accordance with contract documents.
6. The contractor is responsible for field locating all utilities.
7. The contractor is responsible for providing and maintaining stable slopes above and below the soil nail walls. Soil in back of wall that is disturbed by sloughing or construction shall be carfully removed and replaced with lean concrete at no direct payment.
8. No general excavation open cuts steeper than 1.5H:1V shall be made within 10 ft. Of the face of the soil nail walls without approval of the geotechnical engineer.
9. The soil nail wall designed as a part of these plans is permanent and is designed to resist all lateral earth pressures.
10. Proof and verification tests shall be conducted in accordance with section 644 of the special. The allowable pullout resistance qd (50% of ultimate) for testing purposes will be as shown on sheets SN09.
11. There are no drainage provisions specified herein for the temporary wall. Temporary drainage control is the responsibility of the contractor.

DESIGN REQUIREMENTS:

1. Design Specifications: AASHTO LRFD Bridge Design Specifications, Ninth Edition, 2020
2. See Geotechnical Design Memo.
3. The following factors of safety were applied to the above parameters:
   STATIC ANALYSIS: F.S. C = 1.5, F.S.Qd = 2.0, F.S. nh = 1.35, F.S.fy = 1.80
4. Live Load: Retaining walls shall be designed for a live load surcharge pressure per AASHTO LRFD Article 3.11.6.4.
5. Seismic Load: Design based on AASHTO Response Spectra for Site Class C and Seismic Performance Zone 4. Peak Ground Acceleration Coefficient = 0.5, Ss = 1.25, S1 =0.5 from Figure 12.3-H of the NDOT Structures Manual.

SEQUENCE OF CONSTRUCTION:

1. The soil nail Contractor shall locate all utilities (existing and new) and existing foundations in the vicinity of the wall to confirm adequate clearance. If a conflict is encountered, contact the Engineer to evaluate the wall design as required.
2. Excavation to the final temporary face, defined as the back of the structural shotcrete facing, shall use procedures which: (1) prevent over-excavation; (2) prevent ground loss, swelling, air slaking, or mass loosening; (3) prevent loss of support for completed portions of the wall or existing roadway; (4) prevent gain or loss of soil moisture at the face; and (5) prevent damage to existing roadway, structures and utilities.
3. Walls shall be built from the top down in accordance with the staged excavation lifts. Lifts are not to exceed 5 feet in height without the installation of the soil nails and shotcrete facing.
4. Soil nails shall be installed at the locations and to the lengths and inclinations shown in these Plans.
5. Installation of production soil nails shall not be permitted in any soil unit before successful pre-production verification testing of sacrificial soil nails is completed in that unit and approved by the Engineer. Verification test soil nails shall be installed using the same equipment, methods, soil nail inclination, and drill hole diameter as for the production soil nails. Pre-production verification tests shall be performed in accordance with the Verification Testing section of these Plans and the Specifications. Locations of verification test nails shall be selected by the soil nail Contractor based on the encountered soil units and approved by the Engineer.
6. Construction of the soil nail wall may require the excavation face of the soil nail wall to be stabilized. The soil nail Contractor is responsible for developing and constructing the soil stabilization system to facilitate construction of the soil nail wall.
7. The following wall construction sequence for each excavation lift shall be completed prior to initiating work on the next excavation lift unless otherwise approved by the Engineer:
   - 7.1 Excavate to rough grade.
   - 7.2 Perform soil nail verification tests as required.
   - 7.3 Trim to final wall face excavation line or stabilizing berm (if used). Employ additional stabilization methods if caving soils are encountered. Stabilization methods may include flash coating with shotcrete or constructing a stabilizing berm.
   - 7.4 Install soil nails. Trim stabilizing berm (if used) to final wall face excavation line.
   - 7.5 Install geocomposite drain strips.
   - 7.6 Place reinforcing steel and apply shotcrete. Excavation with exposed wall face shall not be left unstabilized at the end of the work shift unless approved by the Engineer.
   - 7.7 Perform soil nail proof tests in accordance with the Proof Testing section of these Plans and the Specifications after the nail grout and shotcrete have attained their specified strengths.
8. Soil nail Contractor shall coordinate with the fascia Contractor for construction of the CIP concrete fascia wall.

SOIL NAIL INSTALLATION:

1. VERIFICATION: Dimensions and locations of future structures shall be verified prior to fabrication and installation of any structural member. Engineer shall be notified of any discrepancies in dimensions.
2. SOIL NAIL TOLERANCES: Nail head plan location < 6 inches not cumulative, orientation < 3 degrees
3. Minimum soil nail drill hole diameter is 6 inches.
4. QUALITY CONTROL: A systematic program of observation shall be conducted during the project execution to determine the effect of construction on adjacent soil nails in order to protect them from damage.

INSPECTION AND MONITORING:

1. The contractor shall provide inspection, material testing, and surveying and monitoring of soil nail wall installation.
2. Drilling contractor shall take photographs to document conditions of adjacent existing structures, walls, street pavements, utilities, etc. prior to commencement of work.
3. Daily observations shall be made of conditions above the soil nail wall for signs of ground movement such as new cracks in structures, increased size of existing cracks, or separation of joints in structures, foundations, streets or paved and unpaved surfaces.
4. Monitoring of ground settlement and soil nail wall movement shall be through survey with instruments provided by the contractor at least twice per week until the completion of the soil nail wall, and twice per week afterwards. The above monitoring frequencies may be revised after engineer has examined the survey data and evaluated the performance of the soil nail wall. The number and locations of survey points required shall be determined by engineer. Monitoring data shall be transmitted on a weekly basis.
5. Should signs of ground movement or sudden increase of ground settlement or soil nail wall movement be detected, the contractor shall immediately notify engineer.

RECORDS:

1. Prepare and submit to the engineer full-length installation records for each installed nail, submit within 24 hours of installation the following: nail head elevation; drill hole diameter; unusual drilling condition; soil stratigraphy; top elevation of strongly cemented soils or bedrock; occurrence of groundwater; bar size; number and location of centralizers; drilling methods; and other useful data.

MATERIALS:

1. Proportion initial shotcrete facing to have a minimum 28-day compressive strength of 4000 psi. use type V cement. final/finished concrete facing shall have a 28-day compressive strength of 4000 psi.
2. Proportion nail grout to have a minimum 3-day compressive strength of 1500psi and a minimum 28-day compressive strength of 3000 psi. use type v cement
3. Bearing plate/headed concrete anchor assembly steel shall be in accordance with AASHTO M183/ASTM A36.
4. Conventional nail bars shall be grade 75 deformed bars in accordance with ASTM A615 with double corrosion protection.
5. Horizontal waler splices shall have laps centered around midspan between nails, and shall be staggered at least 40 bar diameters.
6. Tolerances for concrete and fabricating and placing reinforcement shall conform to applicable ACI requirements.
7. Notes and details on this sheet apply to all drawings unless otherwise noted.
8. Reinforcing bars shall be ASTM A706 grade 60.
9. Welded wire reinforcing shall be ASTM A1064 grade 60.
10. Coupling hex nuts & other accessories shall be in accordance with nail bar manufacturer's specifications.

VERIFICATION TESTING:

1. Verification testing shall be performed in accordance with subsection 644.03.08 of the standard specifications.
2. Submit detailed records of proposed methods for testing as specified below prior to beginning tests. Include drawings and details to clearly describe methods. Submit calibration reports and data for each test jack, pressure gauge and master pressure gauge (calibrated as a unit) to be used. Calibration reports shall not be older than 90 days. Testing shall be complete within a lift prior to advancing the excavation to the next lift.
3. Maximum test load shall not exceed 80 percent of the guaranteed ultimate tensile strength (guts) of conventional nail bars. For grade 75, no. 8 bar, maximum test load is 47.5 kips.

PROOF TESTING:

1. Proof testing shall be performed in accordance with subsection 644.03.09 of the standard specifications.

SHEET INDEX

SHEET	DESCRIPTION
SN01	Soil Nail Wall General Notes & Quantities
SN02	Soil Nail Wall "RW3" Plan and Elevation 1
SN03	Soil Nail Wall "RW3" Plan and Elevation 2
SN04	Soil Nail Wall "RW3" Plan and Elevation 3
SN05	Soil Nail Wall "RW3" Plan and Elevation 4
SN06	Soil Nail Wall "RW3" Plan and Elevation 5
SN07	Soil Nail Wall "RW3" Plan and Elevation 6
SN08	Soil Nail Wall "RW3" Plan and Elevation 7
SN09	Soil Nail Wall "RW3" Plan and Elevation 8
SN10	Soil Nail Wall "RW3" Details 1
SN11	Soil Nail Wall "RW3" Details 2
SN12	Soil Nail Wall "RW10" Plan and Elevation
SN13	Soil Nail Wall "RW10" Details 1

QUANTITIES - Soil Nail Walls

ITEM NO.	ITEM DESCRIPTION	UNIT	RW3	RW10	Total
206 0110	STRUCTURE EXCAVATION	CU.YD.	9,105	0	9,105
207 0110	GRANULAR BACKFILL	CU.YD.	372	0	372
502 0950	CLASS AA CONCRETE, MODIFIED (MAJOR)	CU.YD.	2,017	22	2,039
502 1010	CLASS EA CONCRETE, MODIFIED (MAJOR)	CU.YD.	287	0	287
505 0100	REINFORCING STEEL	POUND	74,502	4,625	79,127
505 0120	REINFORCING STEEL (EPOXY COATED)	POUND	224,758	0	224,758
506 0820	PEDESTRIAN RAIL, TYPE X	LIN.FT.	0	81	81
610 0050	GEOTEXTILE (CLASS 1)	SQ.YD.	478	18	496
644 0100	SOIL NAIL	LIN.FT.	14,375	375	14,750
644 0120	VERIFICATION TEST	EA	53	2	55
660 0995	PNEUMATICALLY PLACED CONCRETE MORTOR (4-INCH)	SQ.YD.	2,381	67	2,448

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

SOIL NAIL WALL
GENERAL NOTES
& QUANTITIES

HDR Engineering, Inc.
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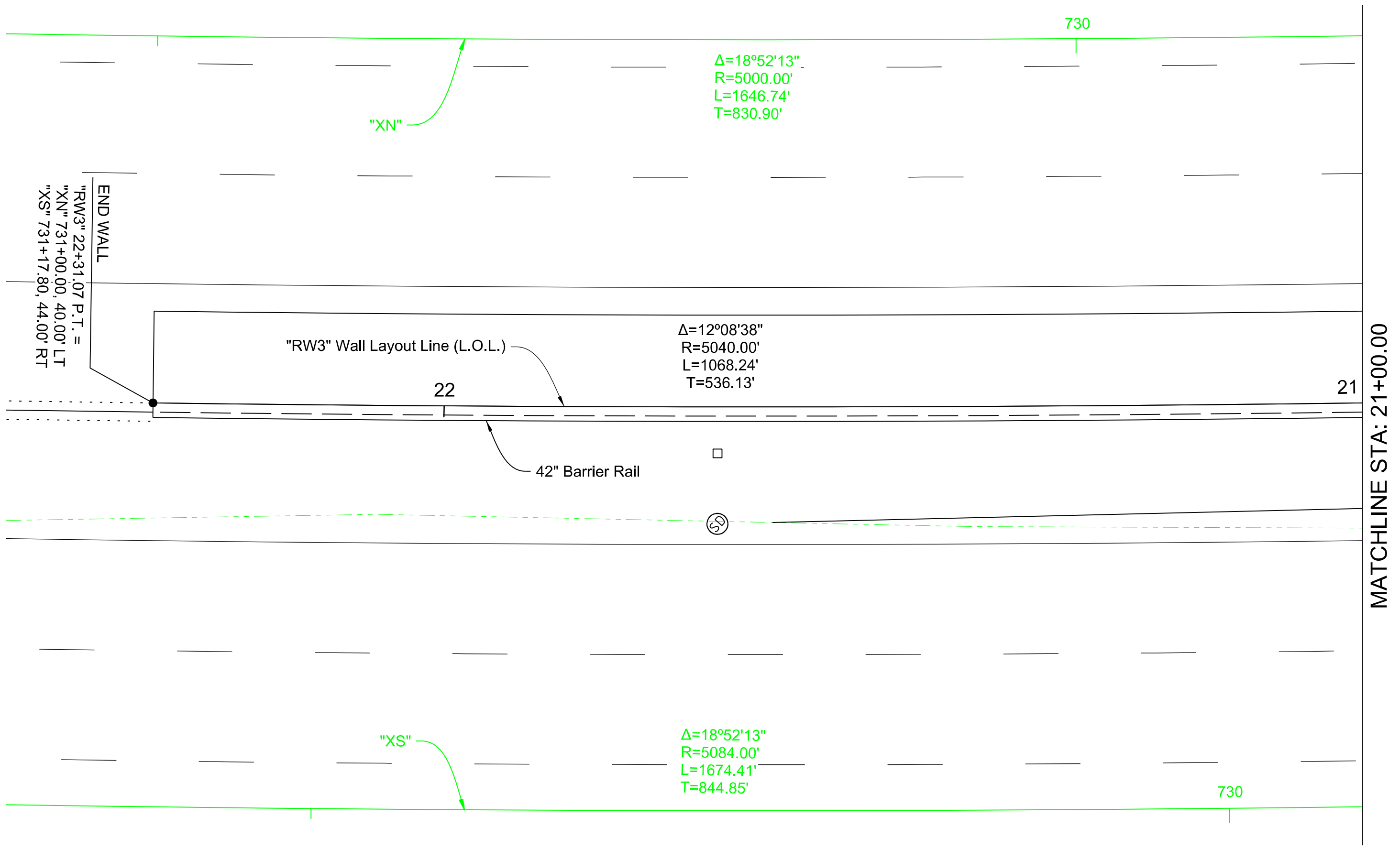
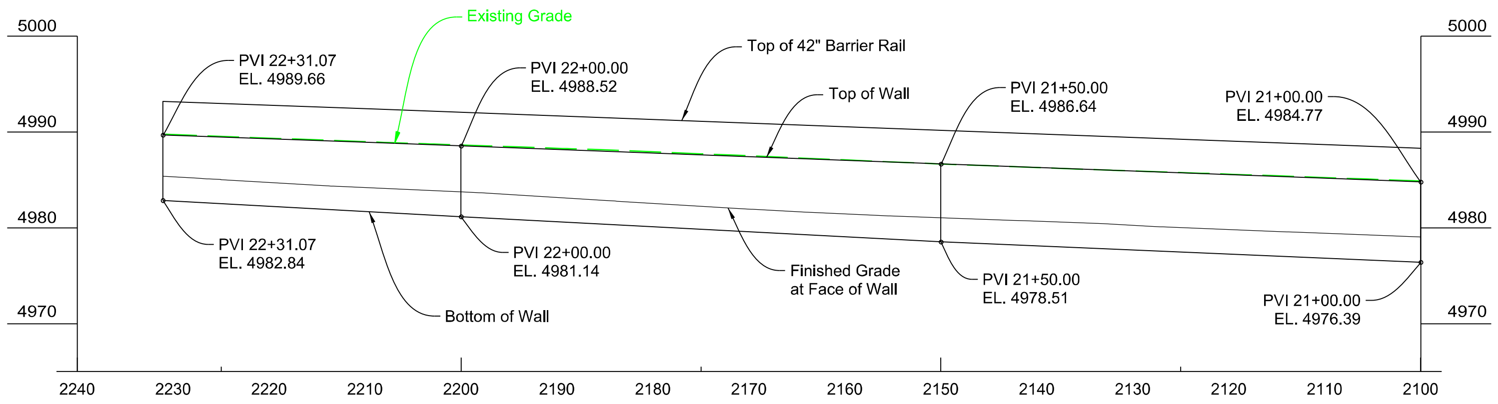
STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	SN02



PLAN



ELEVATION

SHEET
IN
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90% PRELIMINARY
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09/02/2022

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

SOIL NAIL WALL "RW3"
PLAN AND ELEVATION 1

HDR Engineering, Inc.
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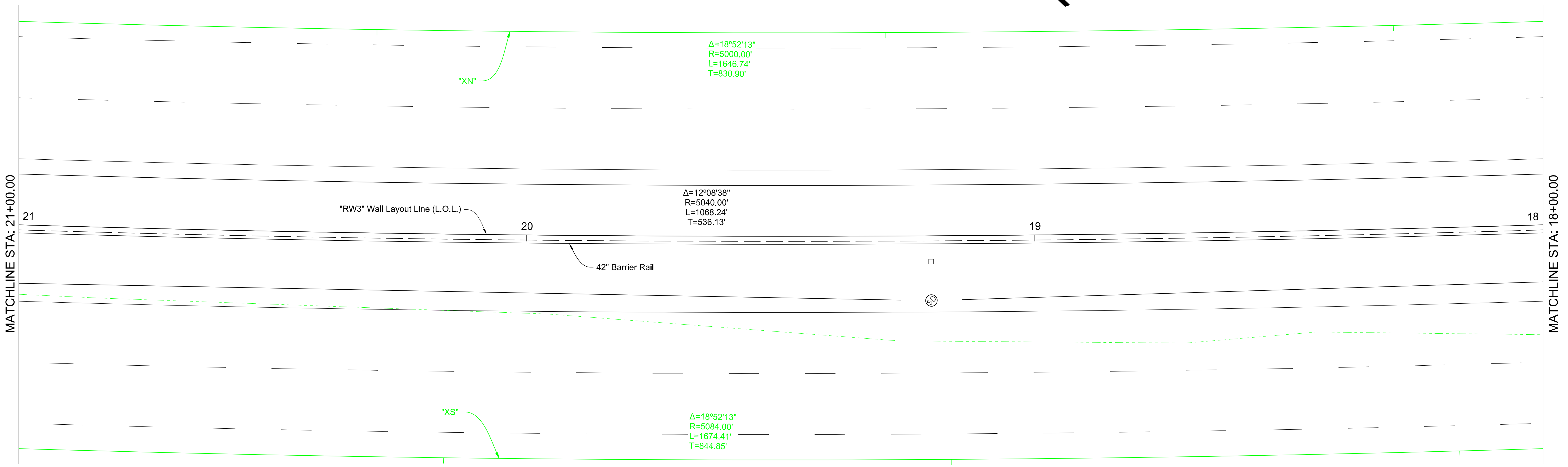
STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	SN03



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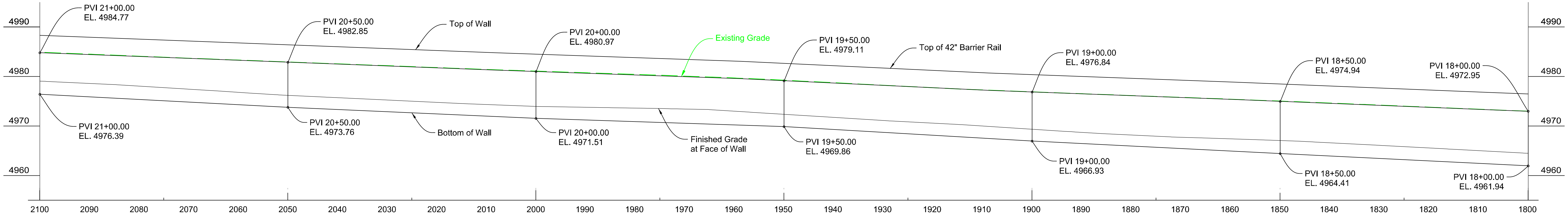

ELEVATION

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09/02/2022

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

SOIL NAIL WALL "RW3"
PLAN AND ELEVATION 2

HDR Engineering, Inc.

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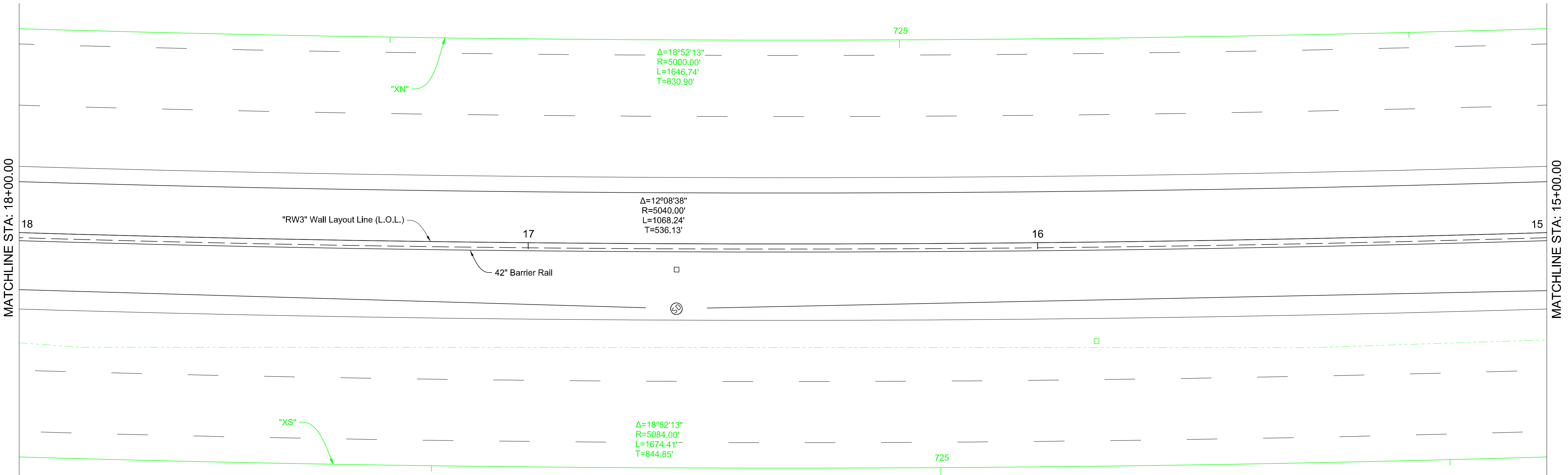
STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	SN04



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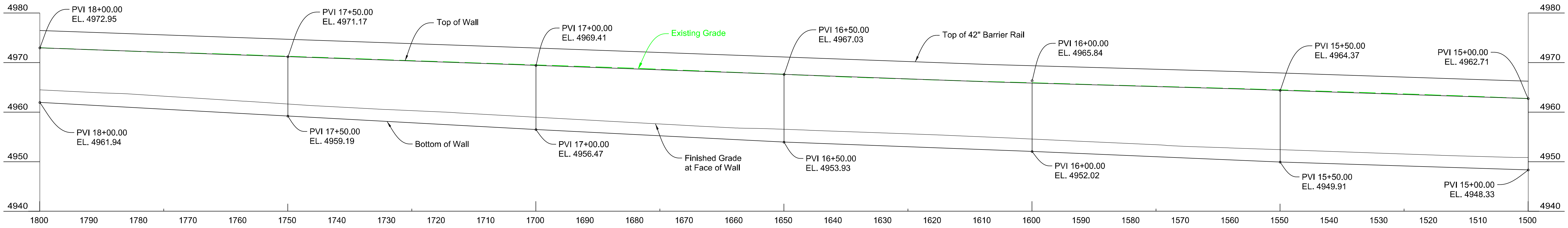

ELEVATION

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

SOIL NAIL WALL "RW3"
PLAN AND ELEVATION 3

HDR Engineering, Inc.
9805 Double R Boulevard, Suite 101
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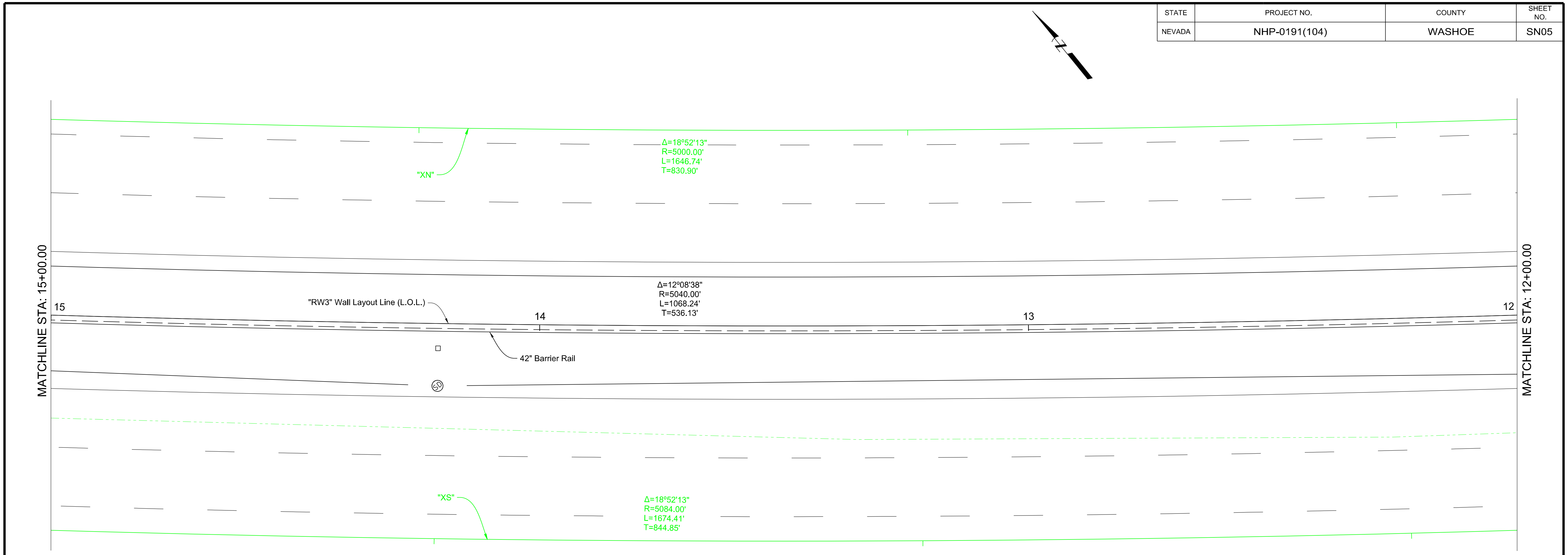
PH: 775-337-4700 FAX: 775-337-4774

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	SN05



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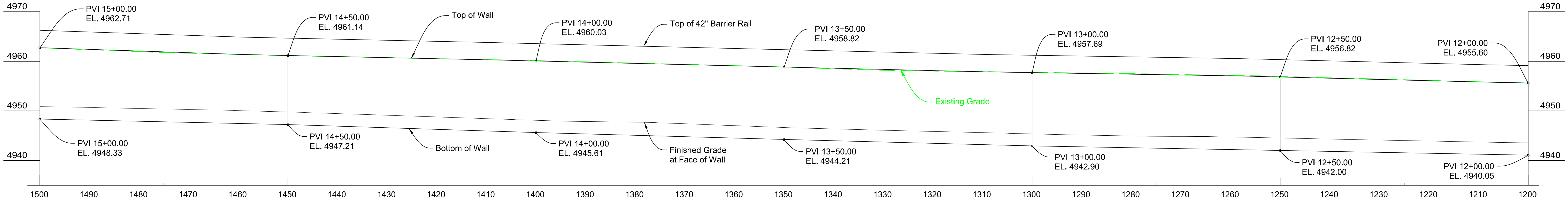

ELEVATION

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09/02/2022

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

SOIL NAIL WALL "RW3"
PLAN AND ELEVATION 4

HDR Engineering, Inc.
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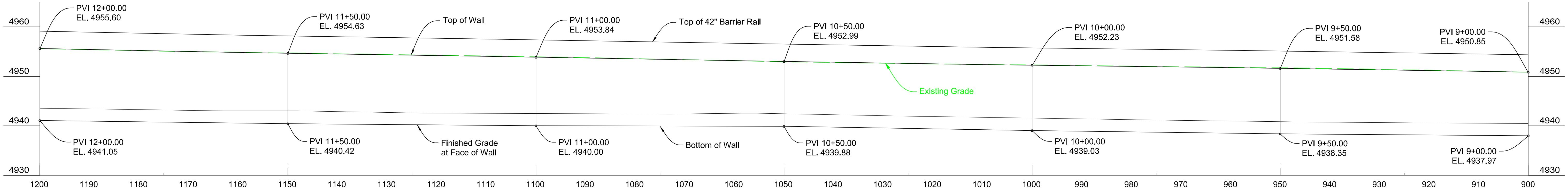
STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	SN06

PLAN



ELEVATION

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90% PRELIMINARY
SUBJECT TO REVISION
09/02/2022

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

SOIL NAIL WALL "RW3"
PLAN AND ELEVATION 5

HDR Engineering, Inc.
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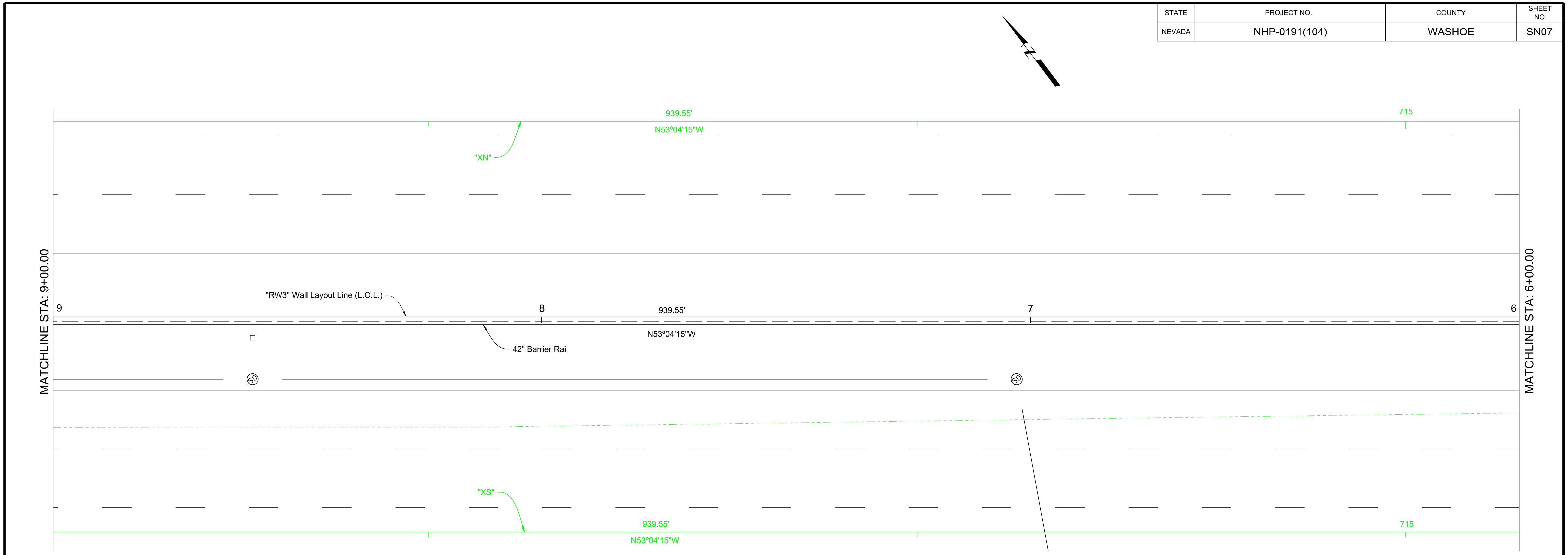
STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	SN07



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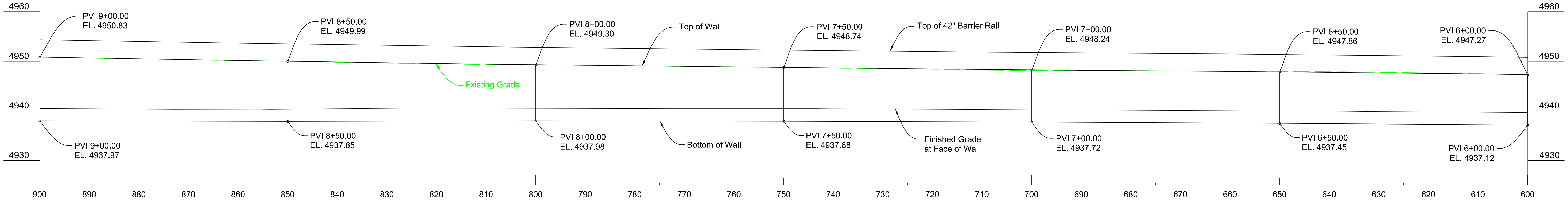

ELEVATION

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

SOIL NAIL WALL "RW3"
PLAN AND ELEVATION 6

HDR Engineering, Inc.
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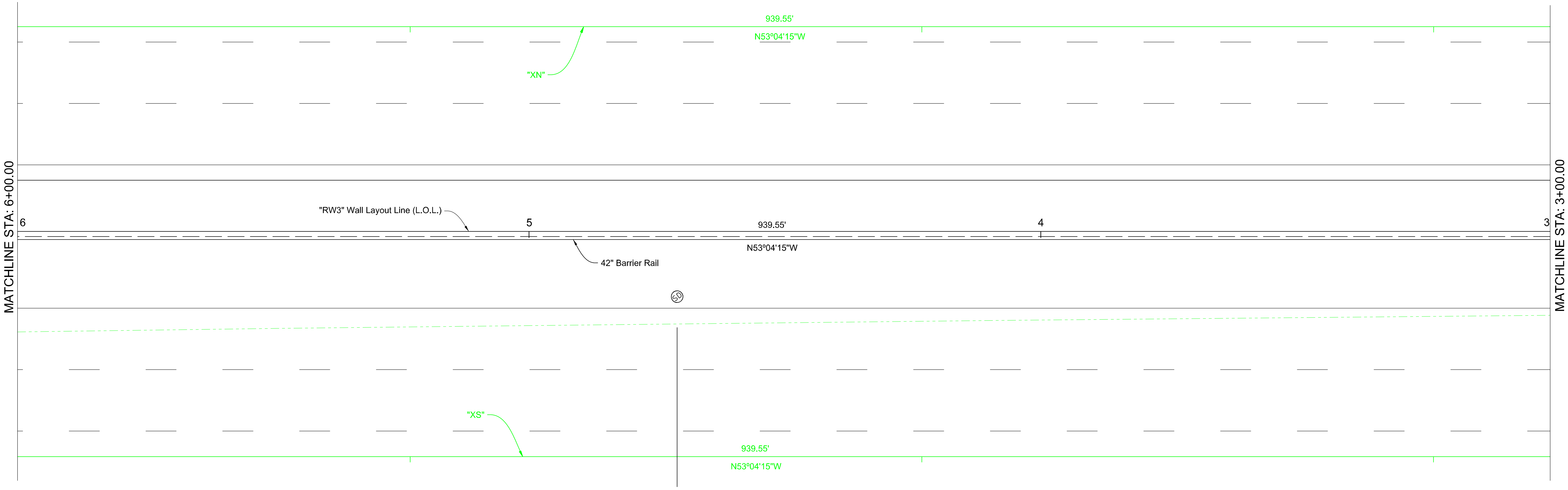
PH: 775-337-4700 FAX: 775-337-4774

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	SN08



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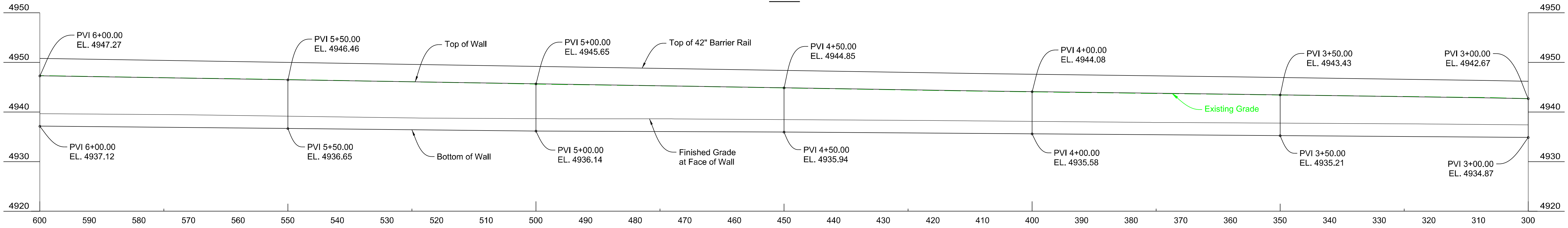


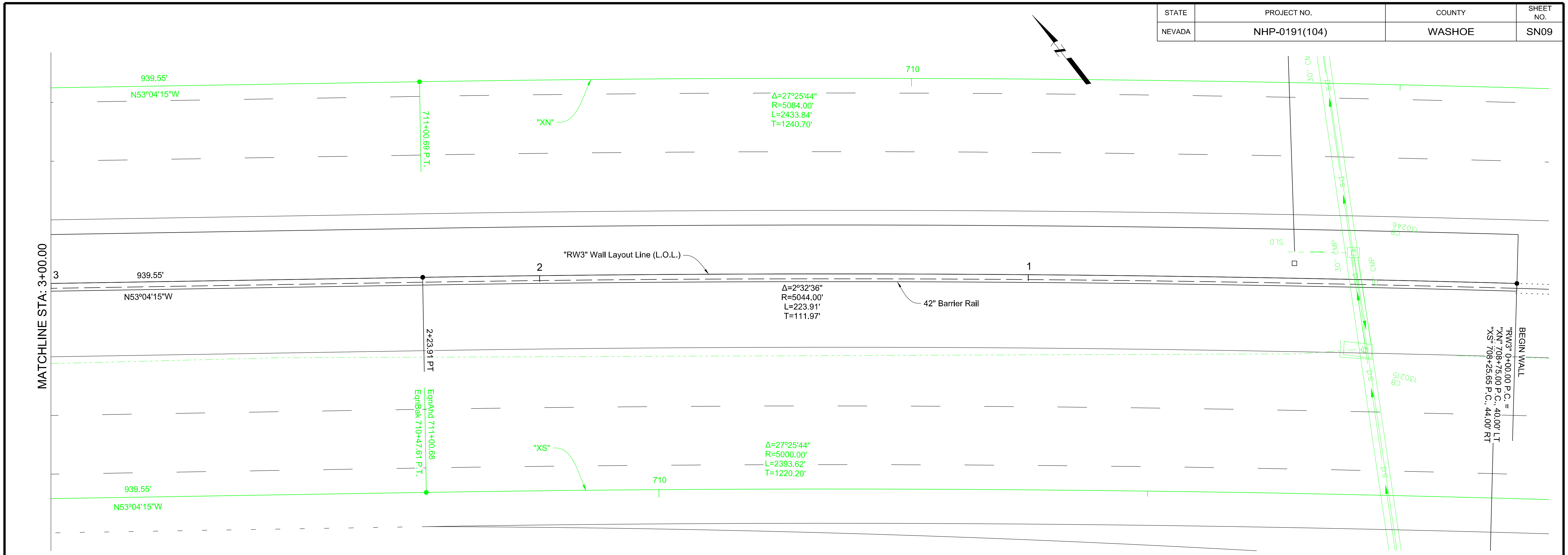
ELEVATION

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

SOIL NAIL WALL "RW3"
PLAN AND ELEVATION 7

HDR Engineering, Inc.
9805 Double R Boulevard, Suite 101
Reno, NV 89521-5917
PH: 775-337-4700 FAX: 775-337-4774

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	SN09



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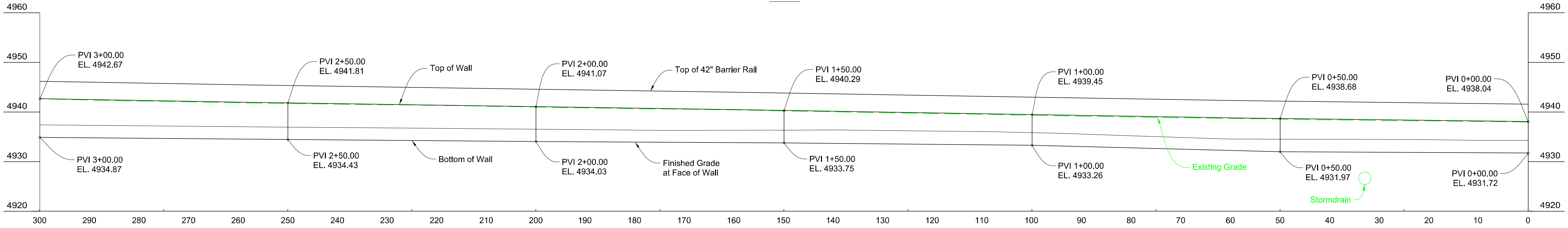

ELEVATION

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09/02/2022

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

SOIL NAIL WALL "RW3"
PLAN AND ELEVATION 8

HDR Engineering, Inc.
9805 Double R Boulevard, Suite 101
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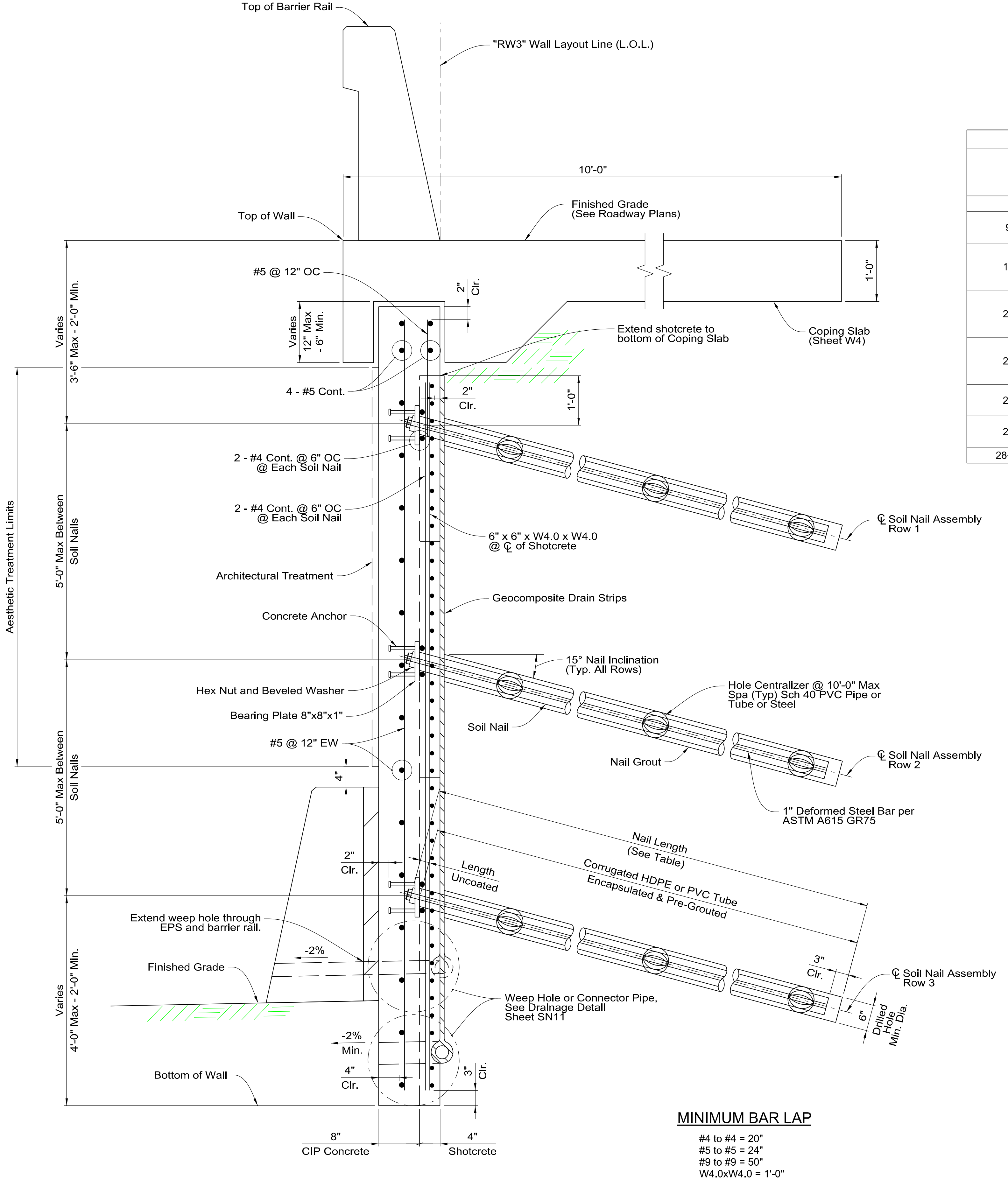
PH: 775-337-4700 FAX: 775-337-4774

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	SN10

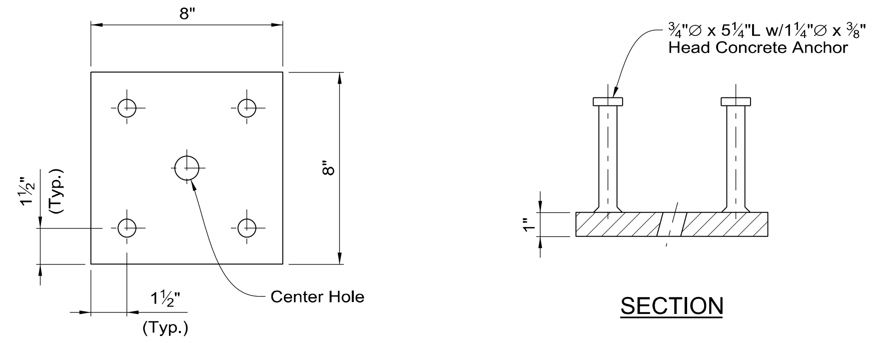


SOIL NAIL WALL TYPICAL SECTION

MINIMUM BAR LAP

#4 to #4 = 20"
#5 to #5 = 24"
#9 to #9 = 50"
W4.0xW4.0 = 1'-0"

Soil Nail Wall - Soil Nail Layout & Schedule									
Wall Station	Wall Height (ft)	No. of Nail Rows	Depth to Top Row (below FG @ TOW) (ft)	Nail Row Vertical Spacing (ft)	Nail Column Horizontal Spacing (ft)	Nail Row No.	Nail Length (ft)	Nail Inclination (Below Horizontal) (degrees)	Allowable Pullout Resistance, Qd (kips/ft)
0+00 to 9+00	4.6 to 7.0	1	1/2 H	-	5	1	10	15	2.26
9+00 to 14+50	7.0 to 11.5	2	2.5	5	5	1	15	15	2.26
						2	10	15	2.26
14+50 to 21+00	11.5 to 14.0	3	2	5	5	1	15	15	2.26
						2	15	15	2.26
						3	10	15	2.26
21+00 to 22+00	13.7 to 12.8	3	2	5	5	1	20	15	2.26
						2	15	15	2.26
						3	10	15	2.26
22+00 to 23+00	12.8 to 12	3	2	5	5	1	15	15	2.26
						2	15	15	2.26
						3	10	15	2.26
23+00 to 24+00	12 to 10	2	3	5	5	1	20	15	2.26
						2	15	15	2.26
24+00 to 28+00	10 to 6.4	2	2	5	5	1	15	15	2.26
						2	10	15	2.26
28+00 to 29+02.46	6.4 to 4.7	1	1/2 H	-	5	1	15	15	2.26



PLAN

SECTION

BEARING PLATE ASSEMBLY

Plate ASTM A36
Concrete Anchor ASTM A108 Type A Grade 60

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

SOIL NAIL WALL "RW3"
DETAILS 1

HDR Engineering, Inc.
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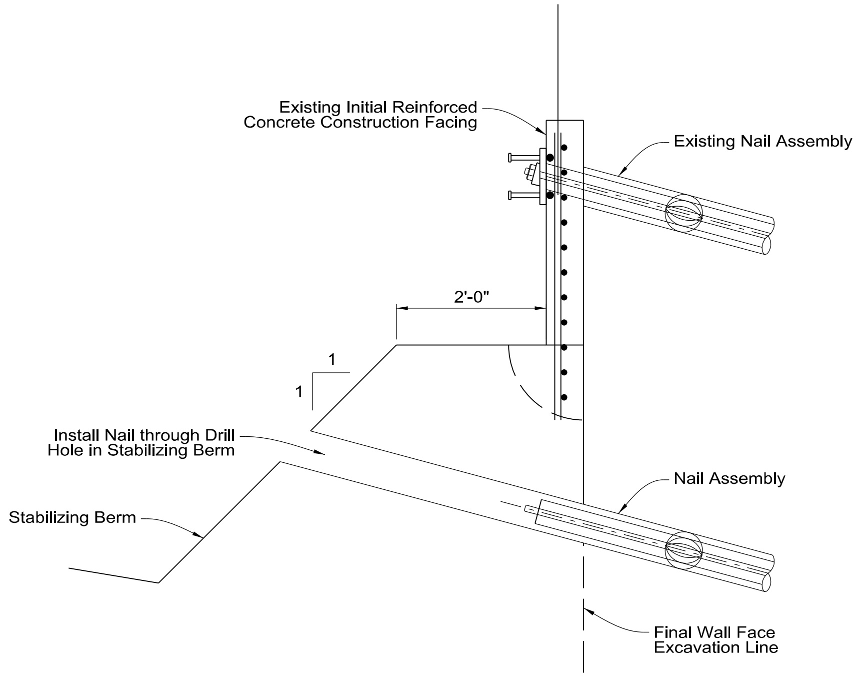
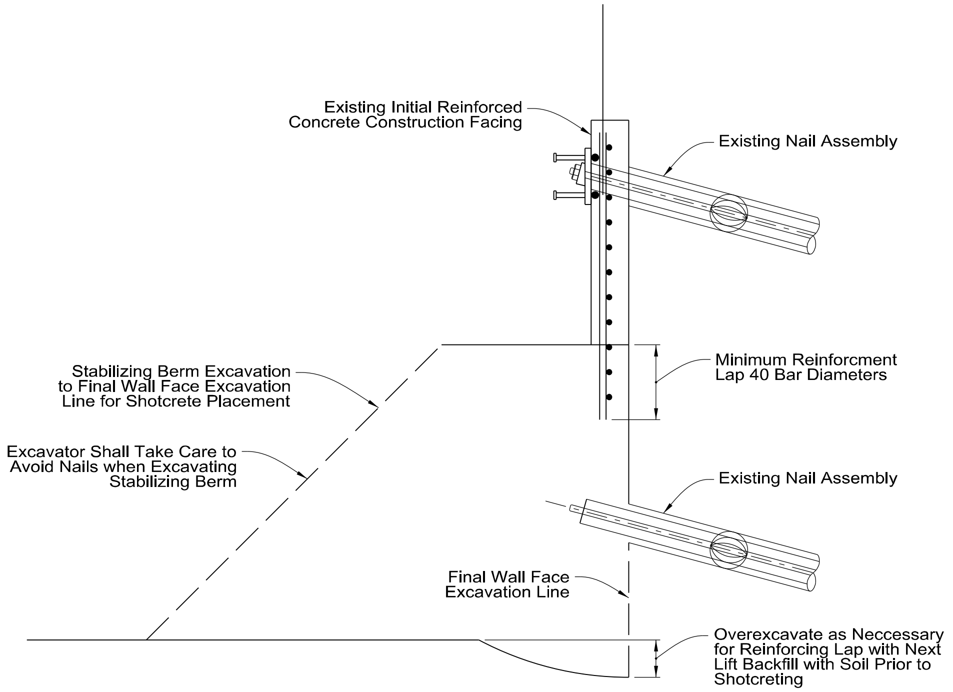
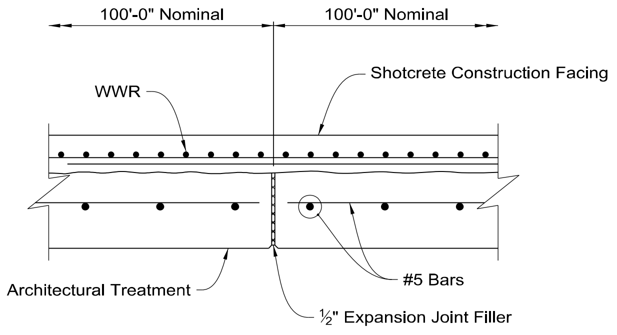
STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	SN11



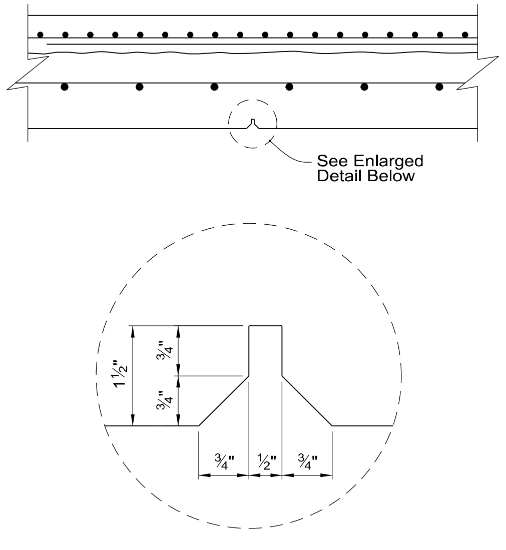
NAIL INSTALLATION THROUGH TEMPORARY STABILIZING BERM (CONTRACTOR OPTION)



EXCAVATION OF TEMPORARY STABILIZING BERM FOR SHOTCRETE PLACEMENT (CONTRACTOR OPTION)

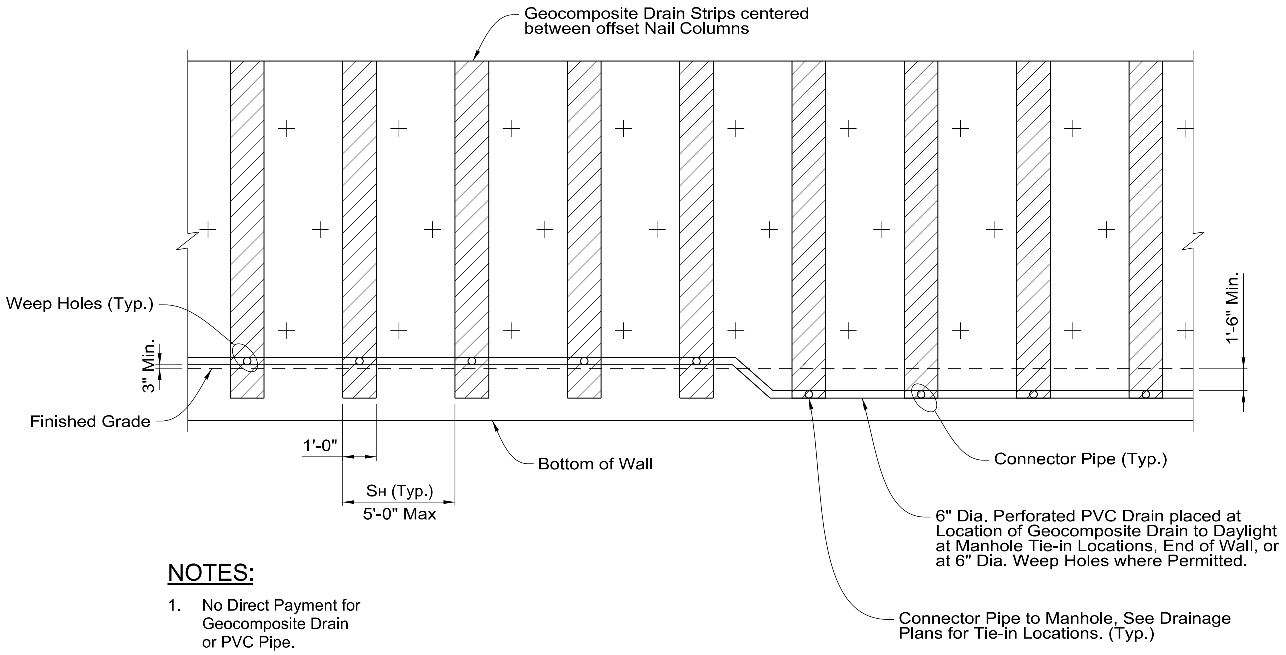


EXPANSION JOINT



CONTRACTION JOINT

(Mid-point Between Expansion Joints)



NOTES:

1. No Direct Payment for Geocomposite Drain or PVC Pipe.

GEOCOMPOSITE DRAIN STRIP DETAIL

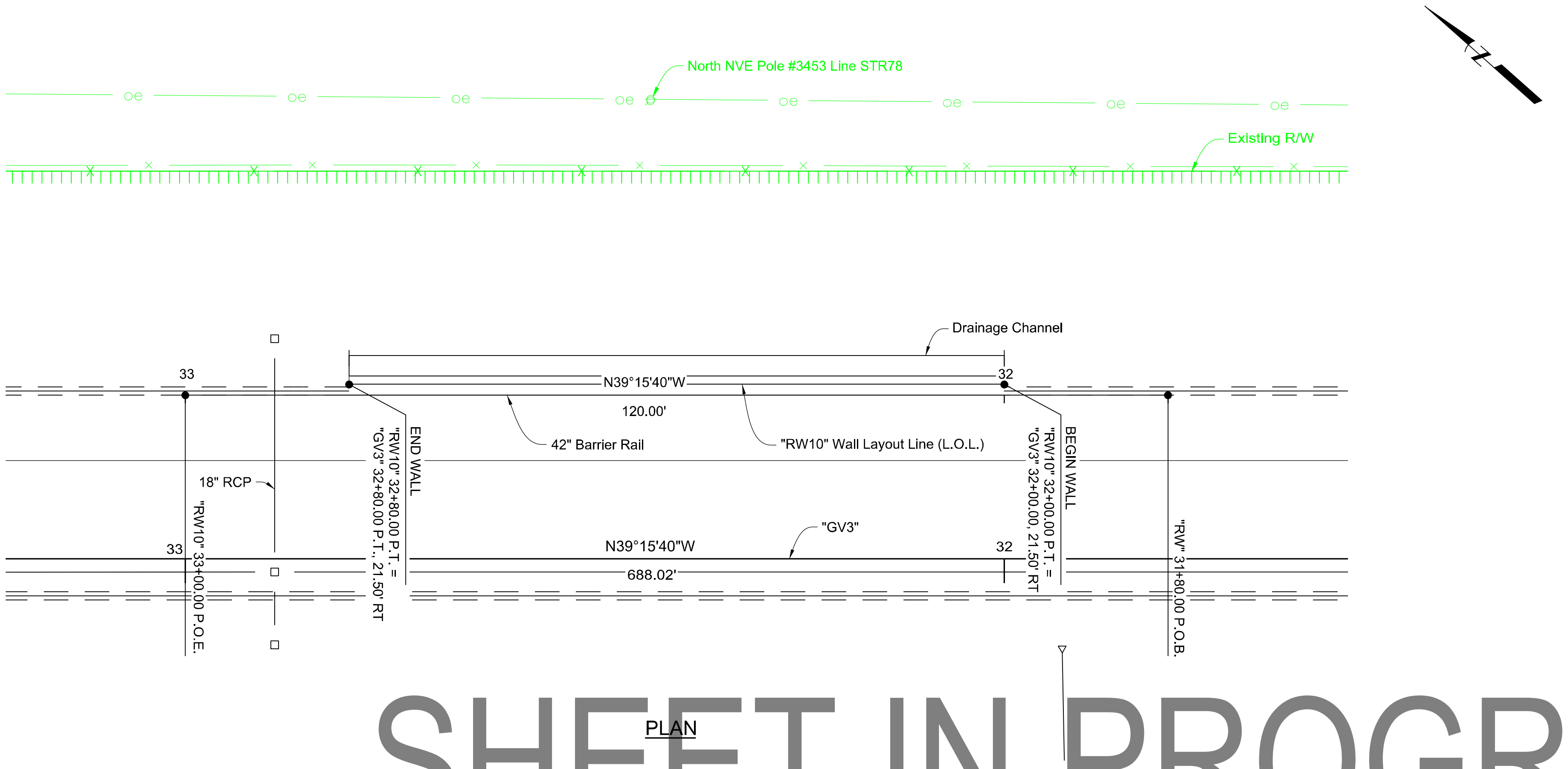
Weepholes Permitted: "RW3" 22+32 to "RW3" 8+59

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

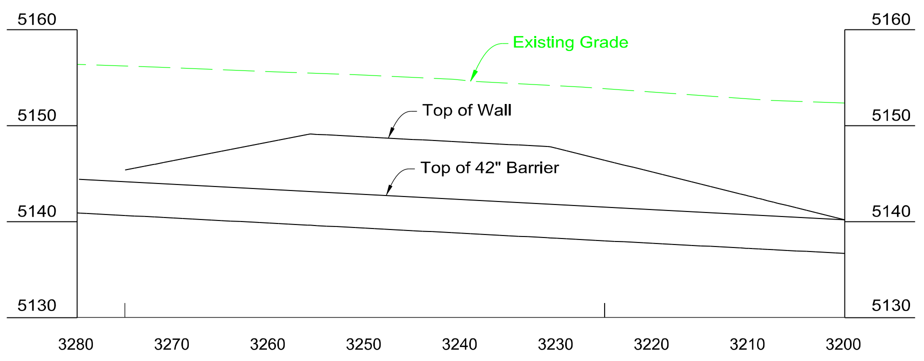
SOIL NAIL WALL "RW3"
DETAILS 2

HDR
HDR Engineering, Inc.
9805 Double R Boulevard, Suite 101
Reno, NV 89521-5917
PH: 775-337-4700 FAX: 775-337-4774

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	SN12



PLAN



ELEVATION

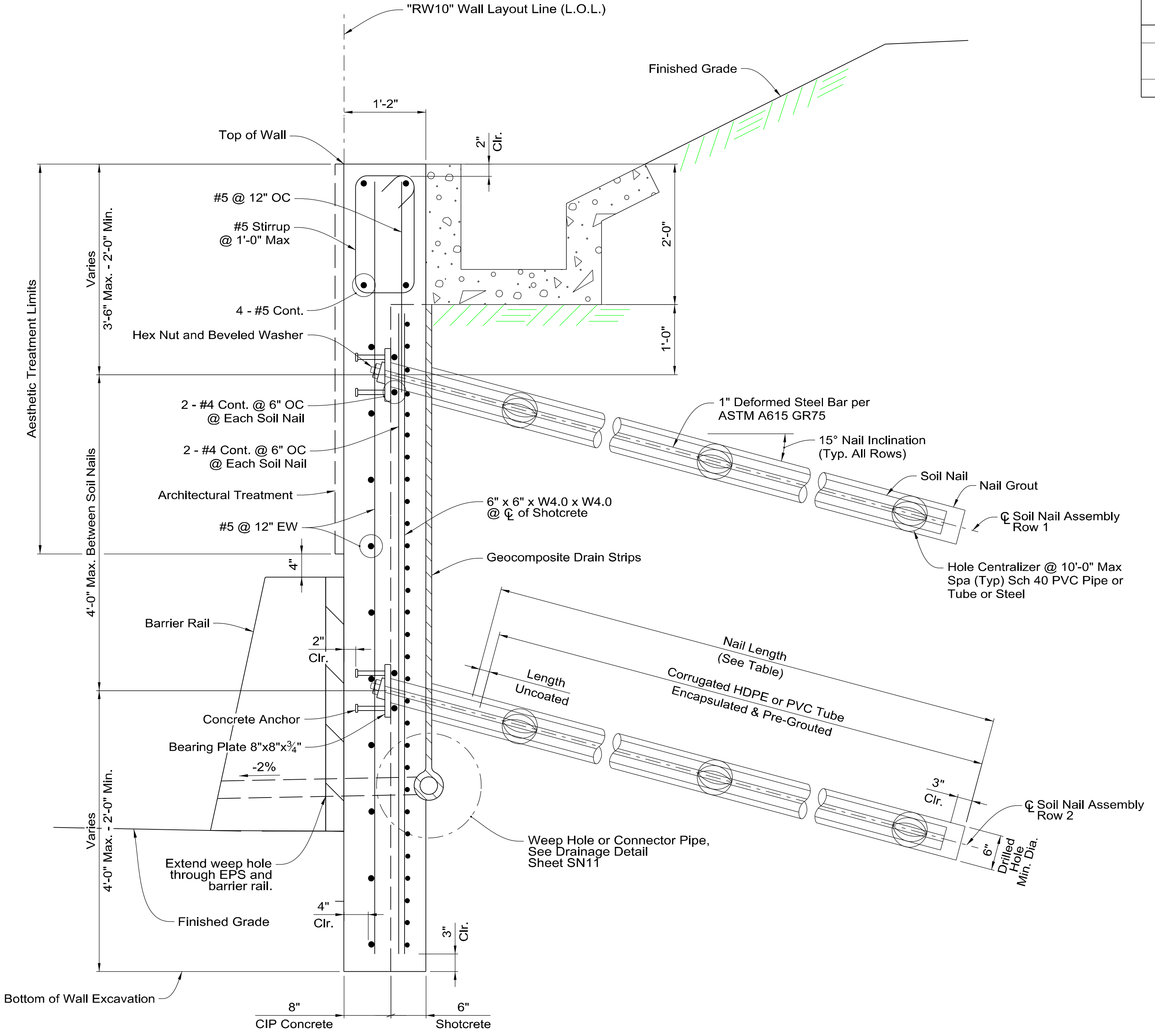
STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

SOIL NAIL WALL "RW10"
PLAN AND ELEVATION

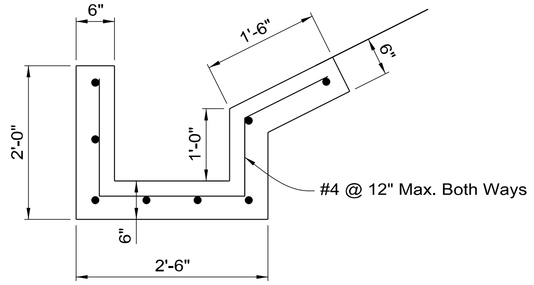
HDR Engineering, Inc.
9805 Double R Boulevard, Suite 101
Reno, NV 89521-5917
PH: 775-337-4700 FAX: 775-337-4774

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	SN13

Soil Nail Wall RW10 - Soil Nail Layout & Schedule									
Wall Station	Wall Height H (ft)	No. of Nail Rows	Depth to Top Row (below FG @ TOW) (ft)	Nail Row Vertical Spacing (ft)	Nail Column Horizontal Spacing (ft)	Nail Row No.	Nail Length (ft)	Nail Inclination (Below Horizontal) (degrees)	Allowable Pullout Resistance, Qd (kips/ft)
32+00 to 32+13	6.0 and Less	1	1/2 H	Varies	4	1	10	15	2.26
32+13 to 32+70	6.0 to 9.5	2	3.5 to 2	4	4	1	15	15	2.26
						2	10	15	2.26
32+70 to 32+80	6.0 and Less	1	1/2 H	Varies	4	1	10	15	2.26



SOIL NAIL WALL TYPICAL SECTION



DRAINAGE CHANNEL DETAIL

MINIMUM BAR LAP

#4 to #4 = 20"
#5 to #5 = 24"
#9 to #9 = 50"
W4.0xW4.0 = 1'-0"

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

SOIL NAIL WALL "RW10"
DETAILS 1

HDR Engineering, Inc.
9805 Double R Boulevard, Suite 101
Reno, NV 89521-5917
PH: 775-337-4700 FAX: 775-337-4774

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	CW01

GENERAL NOTES:

1. Design Specifications: AASHTO LRFD Bridge Design Specifications, Ninth Edition, 2020.
2. Construction Specifications: State of Nevada Department of Transportation “Standard Specifications for Road and Bridge Construction, 2014”except as noted below.
3. Loading: Live load surcharge due to 2-feet of earth. Seismic acceleration = 0.5g, where ½ the Peak Ground Acceleration is used in the Design.
4. Concrete: All concrete shall be Class DA Modified (Major) with f'c = 4500 psi at 28 days, unless noted otherwise.
5. Reinforcing Steel: All reinforcing steel to be ASTM A706 Grade 60.
6. Plan Dimensions: All plan dimensions shown are measured horizontally or vertically, and are based on an assumed 60 °F unless noted otherwise.
7. Elevations and roadway profile information in these plans are approximate and are based on Contract XXXX, adjusted to the survey datum for this project. Contractor to verify elevations shown prior to construction to ensure a smooth roadway profile at top and/or bottom of wall can be attained. Any discrepancies shall be brought to the attention of the Engineer prior to construction.
8. Incidental Items: All items shown or noted on the plans which are not specifically bid items are considered incidental items. The cost of furnishing all such items will not be paid for directly, but shall be included in the unit price bid for other items unless otherwise noted.
9. Structural Excavation & Granular Backfill Limits: For limits of structural excavation and granular backfill, refer to NDOT Standard Drawing EB-4. Any temporary shoring required to maintain traffic, protect utilities, or as otherwise needed shall conform to the Design and Construction Specifications of these General Notes. Contractor to submit a plan outlining construction procedures, shoring requirements, and design to the engineer for review and approval prior to proceeding with the work.
10. Foundations: The walls and their foundations were designed using the soil information provided in the Geotechnical Engineering Report “XXXXXX”.

SHEET INDEX

SHEET	DESCRIPTION
CW01	Cantilevered Wall General Notes & Quantities
CW02	Retaining Wall "RW7" Plan and Elevation 1
CW03	Retaining Wall "RW7" Plan and Elevation 2
CW04	Retaining Wall "RW7" Plan and Elevation 3
CW05	Retaining Wall "RW7" Plan and Elevation 4
CW06	Retaining Wall "RW7" Plan and Elevation 5
CW07	Retaining Wall "RW7" Plan and Elevation 6
CW08	Retaining Wall "RW7" Plan and Elevation 7
CW09	Retaining Wall "RW7" Plan and Elevation 8
CW10	Retaining Wall "RW7" Details 1
CW11	Retaining Wall "RW7" Details 2
CW12	Retaining Wall "RW14" Plan and Elevation
CW13	Retaining Wall "RW14" Details

STANDARD BAR LAPS

Bar Size	Uncoated (in)	Epoxy Coated (in)
#4	20	24
#5	24	30
#6	30	34
#7	38	45
#8	48	57
#9	60	72
#10	74	88
#11	90	108

QUANTITIES

ITEM NO.	ITEM DESCRIPTION	UNIT	RW7	RW14	Total
206 0110	STRUCTURE EXCAVATION	CUYD	9,862	0	9,862
207 0110	GRANULAR BACKFILL	CUYD	11,224	0	11,224
502 0950	CLASS AA CONCRETE, MODIFIED (MAJOR)	CUYD	2,374	23	2,397
502 1010	CLASS EA CONCRETE, MODIFIED (MAJOR)	CUYD	282	0	282
505 0100	REINFORCING STEEL	POUND	344,712	3,292	348,004
505 0120	REINFORCING STEEL (EPOXY COATED)	POUND	54,590	0	54,590

SHEET
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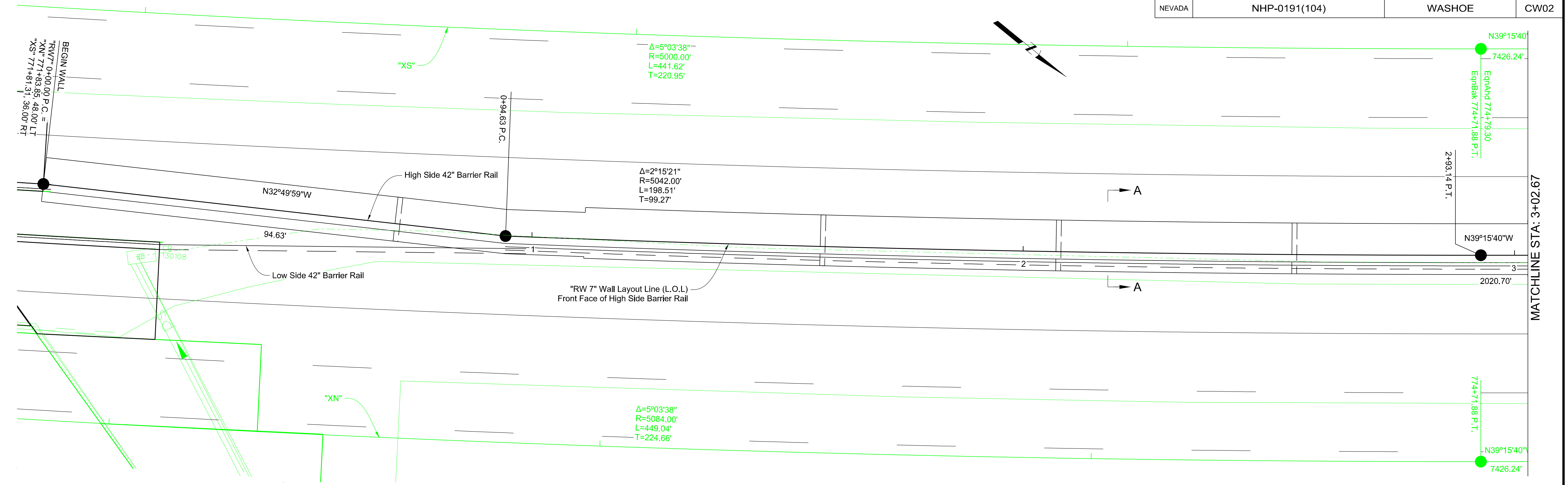
STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

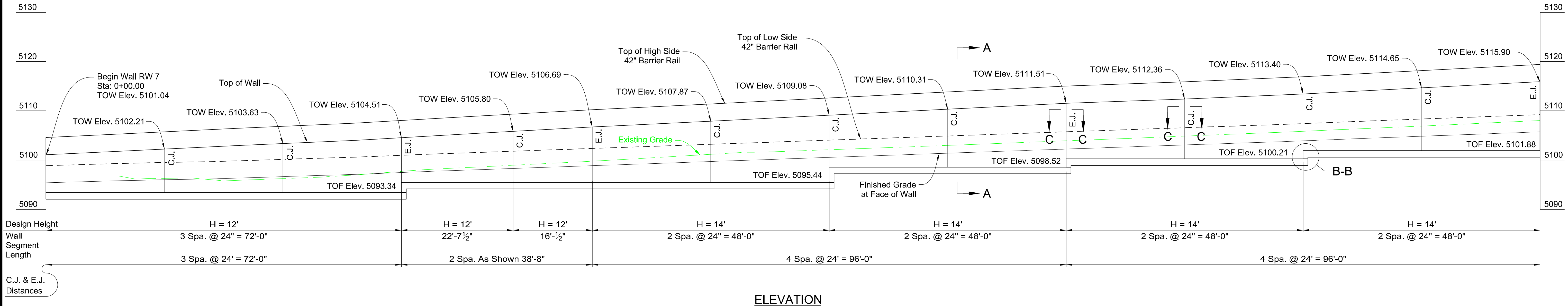
CANTILEVERED WALL
GENERAL NOTES
& QUANTITIES

HDR Engineering, Inc.
9805 Double R Boulevard, Suite 101
Reno, NV 89521-5917
PH: 775-337-4700 FAX: 775-337-4774

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	CW02



PLAN



ELEVATION

NOTES:

1. Top of wall elevations are approximate, elevations shall match the finished roadway surface at wall face.
2. Refer to NDOT Standard Plans Sheet CW-1 for Section A-A, CW-4 thru CW-6 for Section B-B, Section C-C, and other details not shown. Wall dimensions and reinforcing are to be provided per the Design Heights herein.
3. The Stem Haunch For Barrier Rail detail on Sheet CW-4 shall have a vertical face not of 1'-0", but of 1'-3" minimum to match the roadway section. All reinforcing bars extending into the barrier rail shall be epoxy coated.

SHEET
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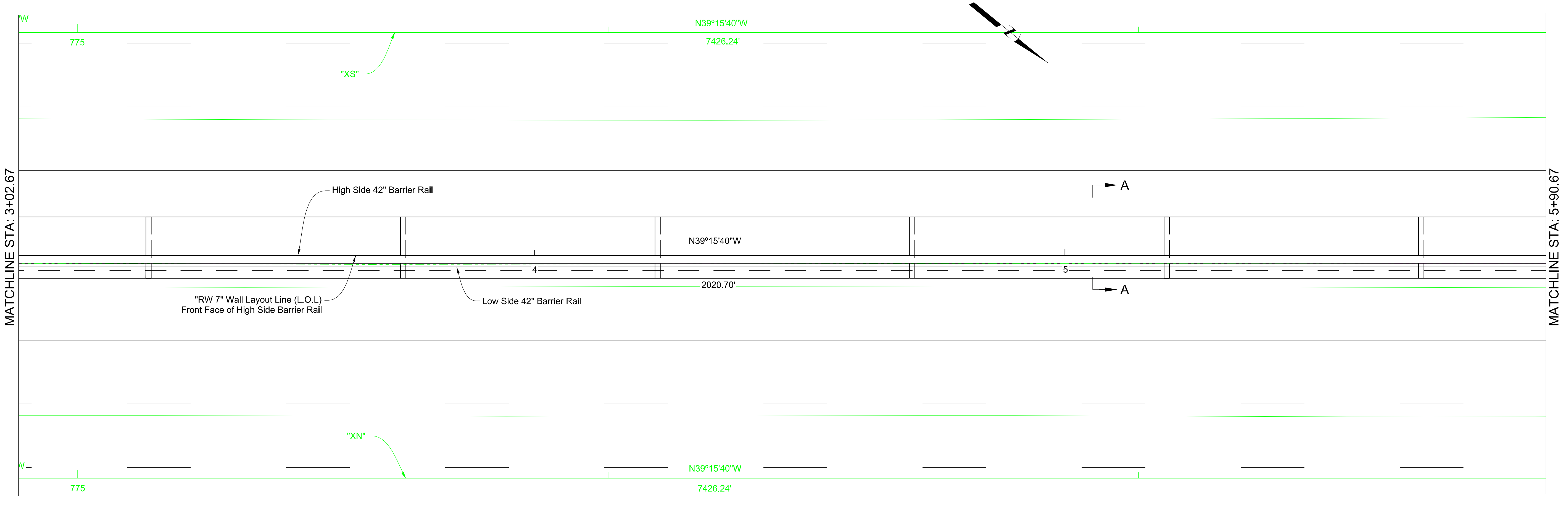
09/02/2022

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

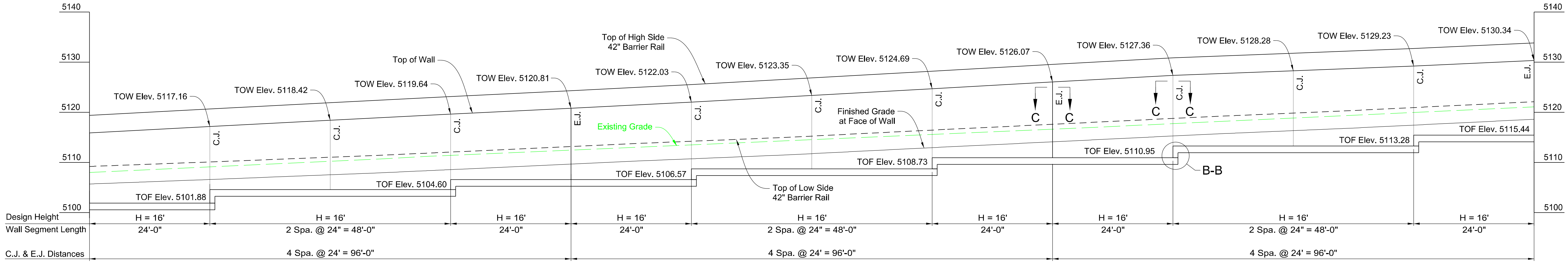
RETAINING WALL "RW7"
PLAN AND ELEVATION 1

HDR Engineering, Inc.
9805 Double R Boulevard, Suite 101
Reno, NV 89521-5917
PH: 775-337-4700 FAX: 775-337-4774

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	CW03



PLAN



ELEVATION

NOTES:

1. Top of wall elevations are approximate, elevations shall match the finished roadway surface at wall face.
2. Refer to NDOT Standard Plans Sheet CW-1 for Section A-A, CW-4 thru CW-6 for Section B-B, Section C-C, and other details not shown. Wall dimensions and reinforcing are to be provided per the Design Heights herein.
3. The Stem Haunch For Barrier Rail detail on Sheet CW-4 shall have a vertical face not of 1'-0", but of 1'-3" minimum to match the roadway section. All reinforcing bars extending into the barrier rail shall be epoxy coated.

SHEET
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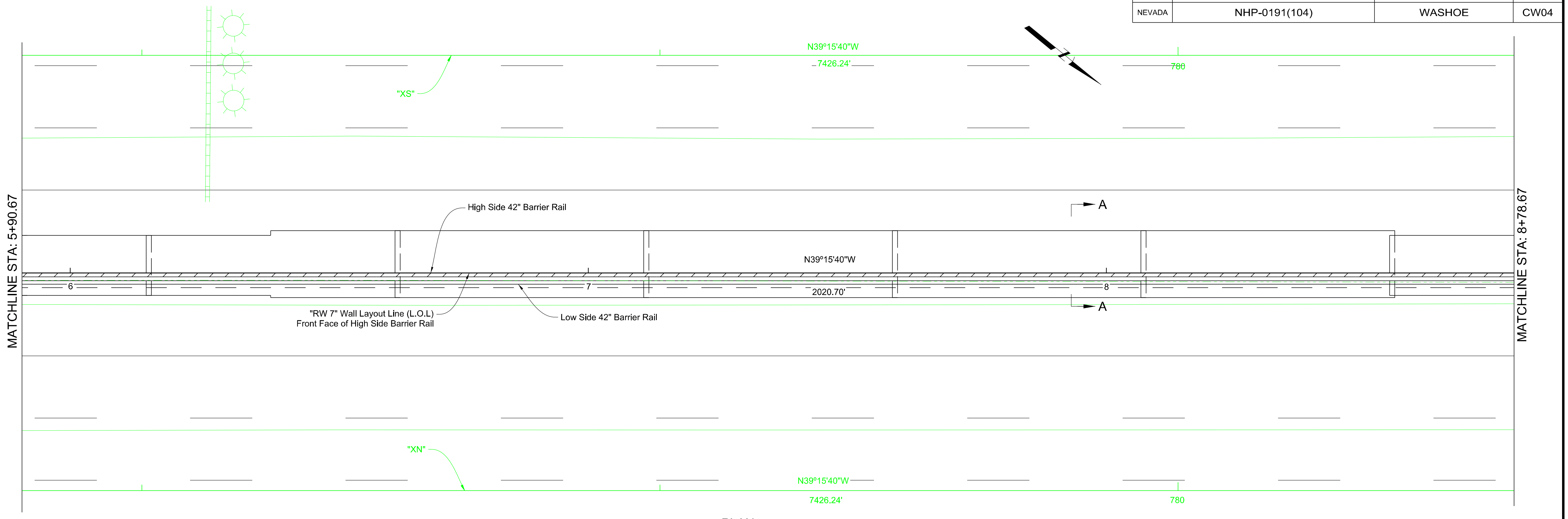
STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

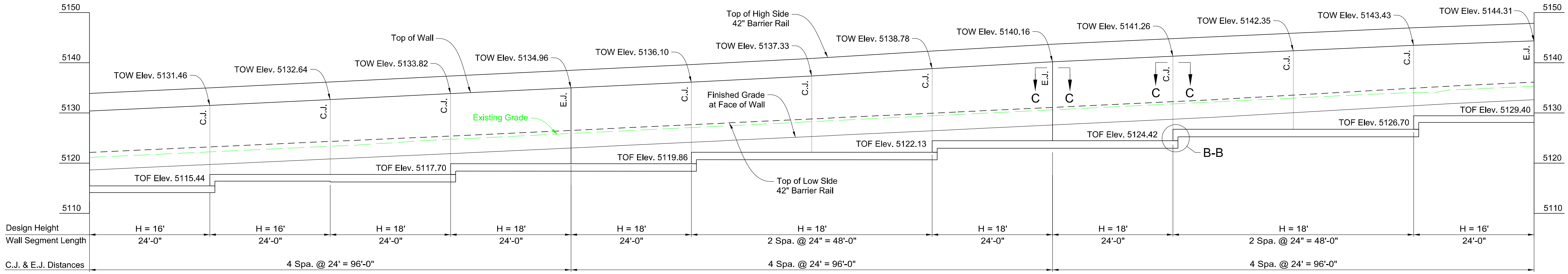
RETAINING WALL "RW7"
PLAN AND ELEVATION 2

HDR Engineering, Inc.
9805 Double R Boulevard, Suite 101
Reno, NV 89521-5917
PH: 775-337-4700 FAX: 775-337-4774

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	CW04



PLAN



ELEVATION

NOTES:

1. Top of wall elevations are approximate, elevations shall match the finished roadway surface at wall face.
2. Refer to NDOT Standard Plans Sheet CW-1 for Section A-A, CW-4 thru CW-6 for Section B-B, Section C-C, and other details not shown. Wall dimensions and reinforcing are to be provided per the Design Heights herein.
3. The Stem Haunch For Barrier Rail detail on Sheet CW-4 shall have a vertical face not of 1'-0", but of 1'-3" minimum to match the roadway section. All reinforcing bars extending into the barrier rail shall be epoxy coated.

SHEET
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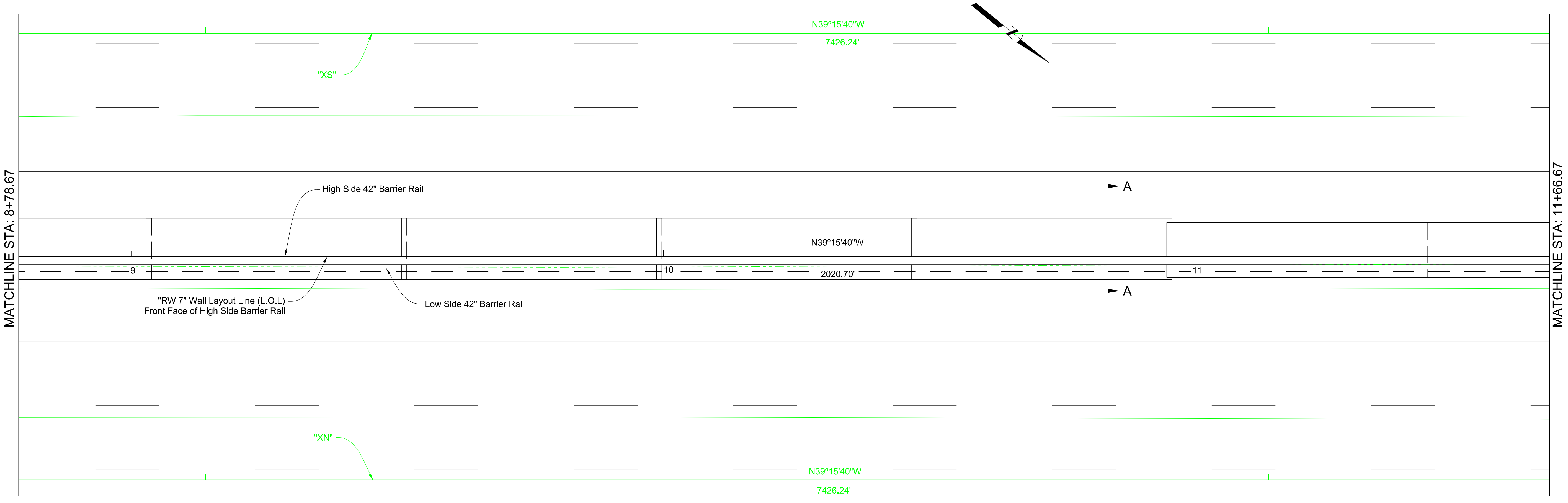
STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

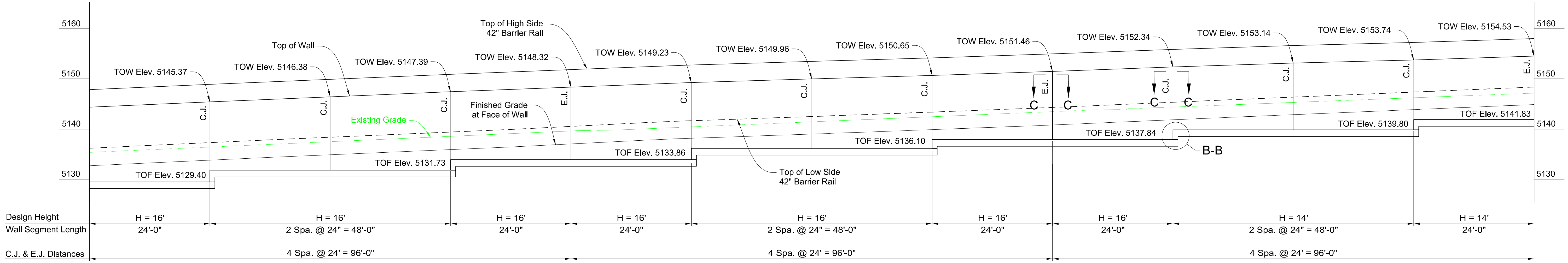
RETAINING WALL "RW7"
PLAN AND ELEVATION 3

HDR Engineering, Inc.
9805 Double R Boulevard, Suite 101
Reno, NV 89521-5917
PH: 775-337-4700 FAX: 775-337-4774

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	CW05



PLAN



ELEVATION

NOTES:

1. Top of wall elevations are approximate, elevations shall match the finished roadway surface at wall face.
2. Refer to NDOT Standard Plans Sheet CW-1 for Section A-A, CW-4 thru CW-6 for Section B-B, Section C-C, and other details not shown. Wall dimensions and reinforcing are to be provided per the Design Heights herein.
3. The Stem Haunch For Barrier Rail detail on Sheet CW-4 shall have a vertical face not of 1'-0", but of 1'-3" minimum to match the roadway section. All reinforcing bars extending into the barrier rail shall be epoxy coated.

SHEET
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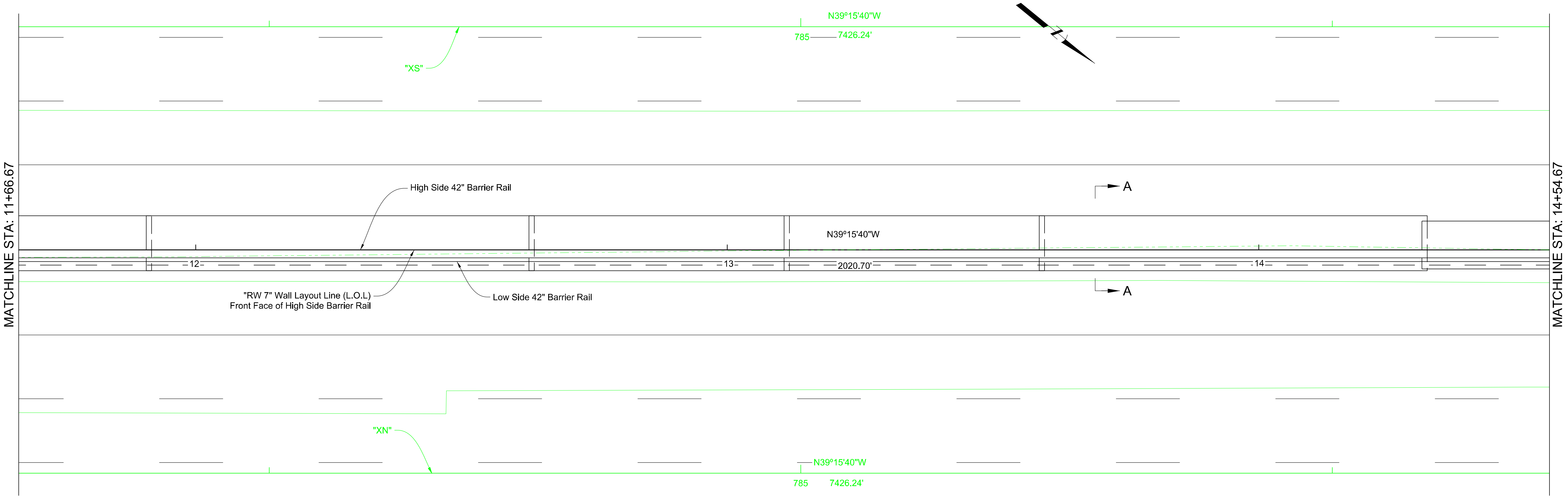
STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

RETAINING WALL "RW7"
PLAN AND ELEVATION 4

HDR
HDR Engineering, Inc.

9805 Double R Boulevard, Suite 101
Reno, NV 89521-5917
PH: 775-337-4700 FAX: 775-337-4774

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	CW06



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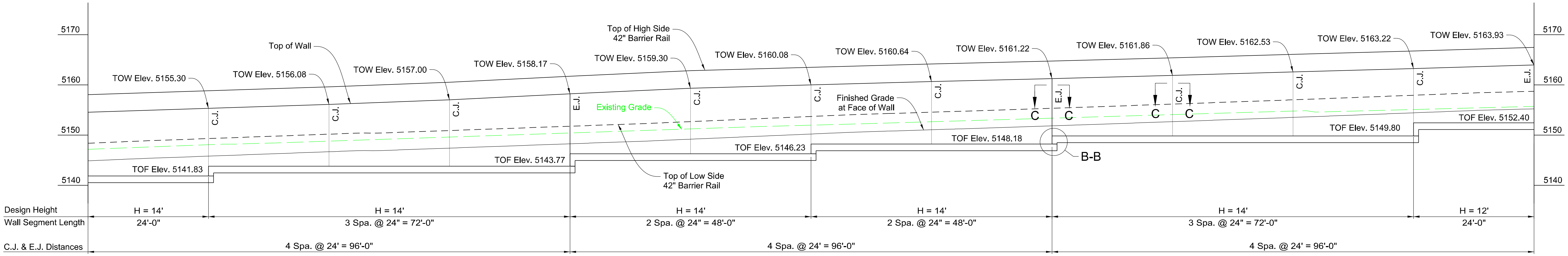


ELEVATION

NOTES:

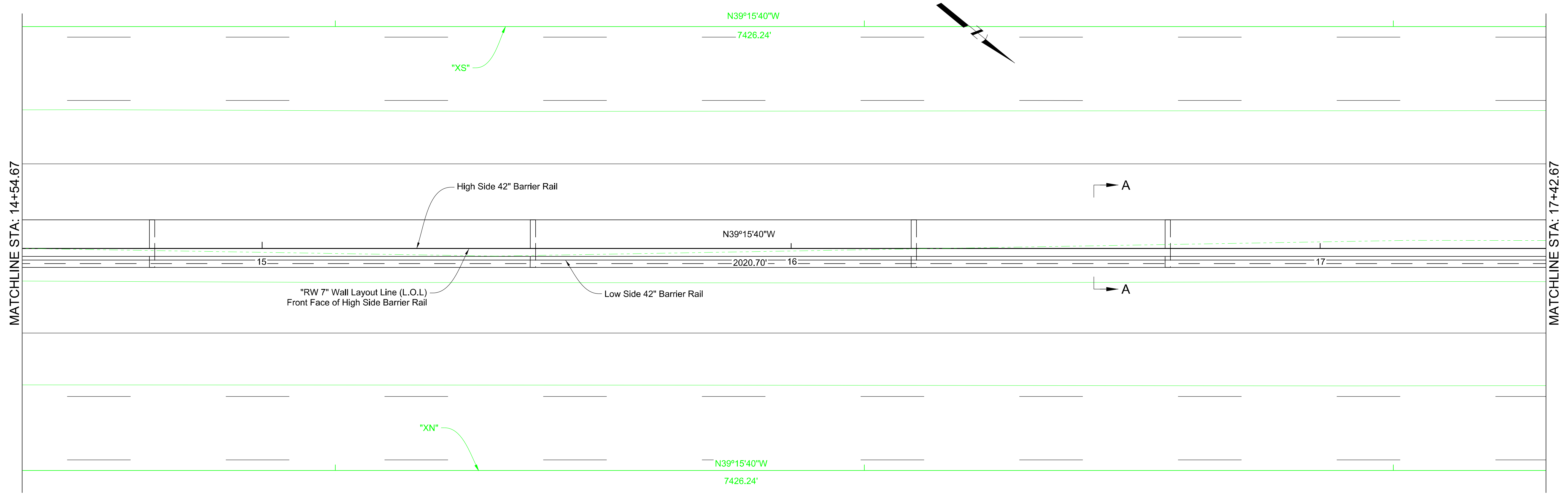
1. Top of wall elevations are approximate, elevations shall match the finished roadway surface at wall face.
2. Refer to NDOT Standard Plans Sheet CW-1 for Section A-A, CW-4 thru CW-6 for Section B-B, Section C-C, and other details not shown. Wall dimensions and reinforcing are to be provided per the Design Heights herein.
3. The Stem Haunch For Barrier Rail detail on Sheet CW-4 shall have a vertical face not of 1'-0", but of 1'-3" minimum to match the roadway section. All reinforcing bars extending into the barrier rail shall be epoxy coated.

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

RETAINING WALL "RW7"
PLAN AND ELEVATION 5

HDR Engineering, Inc.
9805 Double R Boulevard, Suite 101
Reno, NV 89521-5917
PH: 775-337-4700 FAX: 775-337-4774

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	CW07



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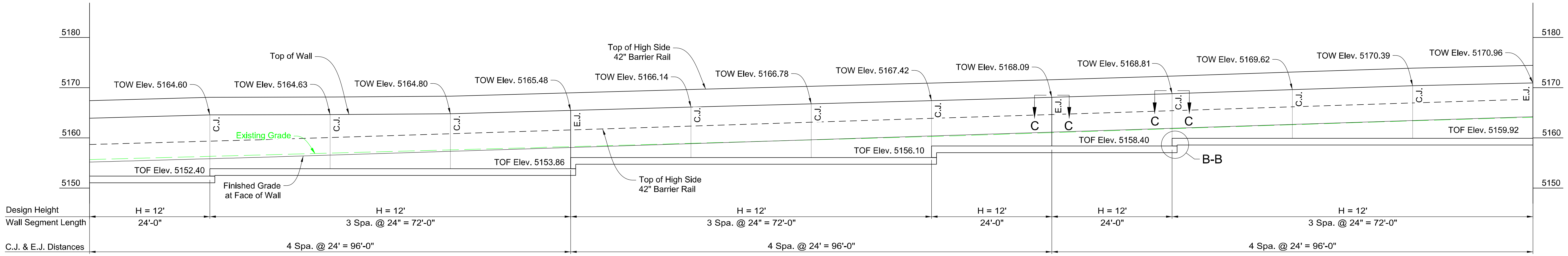

ELEVATION

NOTES:

1. Top of wall elevations are approximate, elevations shall match the finished roadway surface at wall face.
2. Refer to NDOT Standard Plans Sheet CW-1 for Section A-A, CW-4 thru CW-6 for Section B-B, Section C-C, and other details not shown. Wall dimensions and reinforcing are to be provided per the Design Heights herein.
3. The Stem Haunch For Barrier Rail detail on Sheet CW-4 shall have a vertical face not of 1'-0", but of 1'-3" minimum to match the roadway section. All reinforcing bars extending into the barrier rail shall be epoxy coated.

SHEET
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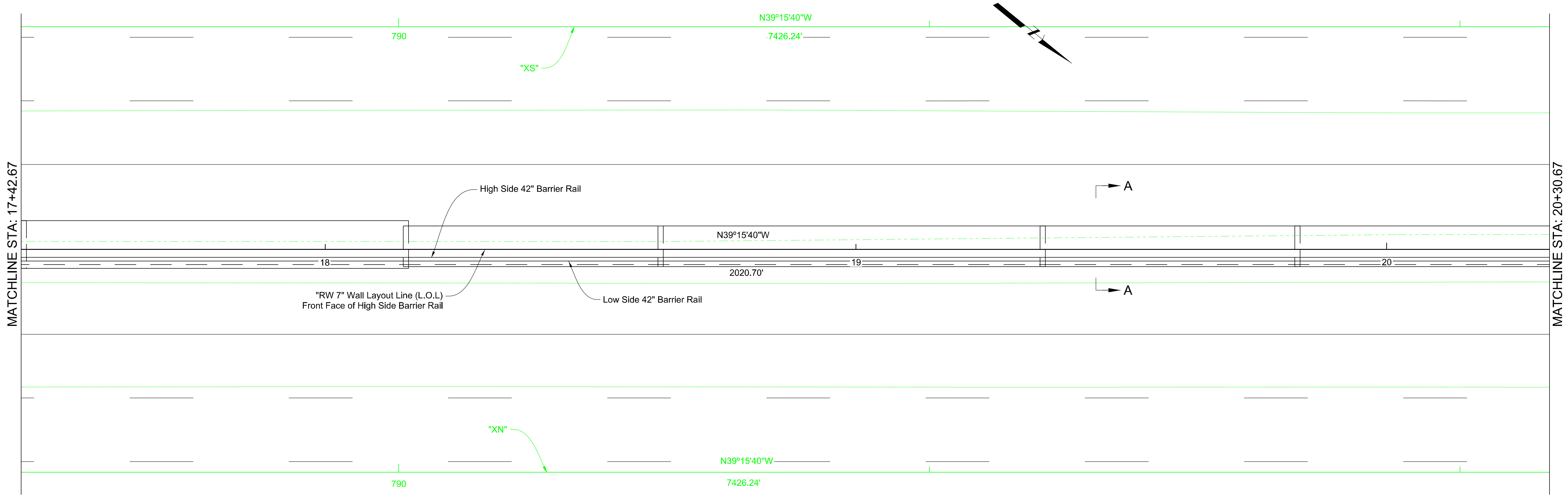
09/02/2022

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

RETAINING WALL "RW7"
PLAN AND ELEVATION 6

HDR Engineering, Inc.
9805 Double R Boulevard, Suite 101
Reno, NV 89521-5917
PH: 775-337-4700 FAX: 775-337-4774

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	CW08



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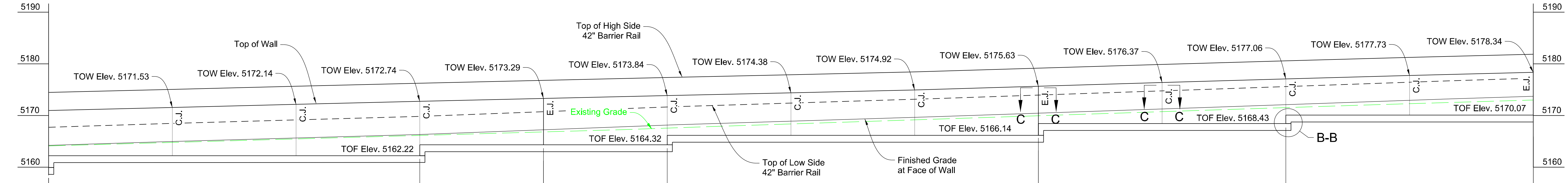

Design Height	H = 12'	H = 10'	H = 10'	H = 10'	H = 10'	H = 10'
Wall Segment Length	3 Spa. @ 24" = 72'-0"	24'-0"	24'-0"	3 Spa. @ 24" = 72'-0"	2 Spa. @ 24" = 48'-0"	2 Spa. @ 24" = 48'-0"
C.J. & E.J. Distances	4 Spa. @ 24' = 96'-0"		4 Spa. @ 24' = 96'-0"		4 Spa. @ 24' = 96'-0"	

ELEVATION

NOTES:

1. Top of wall elevations are approximate, elevations shall match the finished roadway surface at wall face.
2. Refer to NDOT Standard Plans Sheet CW-1 for Section A-A, CW-4 thru CW-6 for Section B-B, Section C-C, and other details not shown. Wall dimensions and reinforcing are to be provided per the Design Heights herein.
3. The Stem Haunch For Barrier Rail detail on Sheet CW-4 shall have a vertical face not of 1'-0", but of 1'-3" minimum to match the roadway section. All reinforcing bars extending into the barrier rail shall be epoxy coated.

SHEET
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PROGRESS
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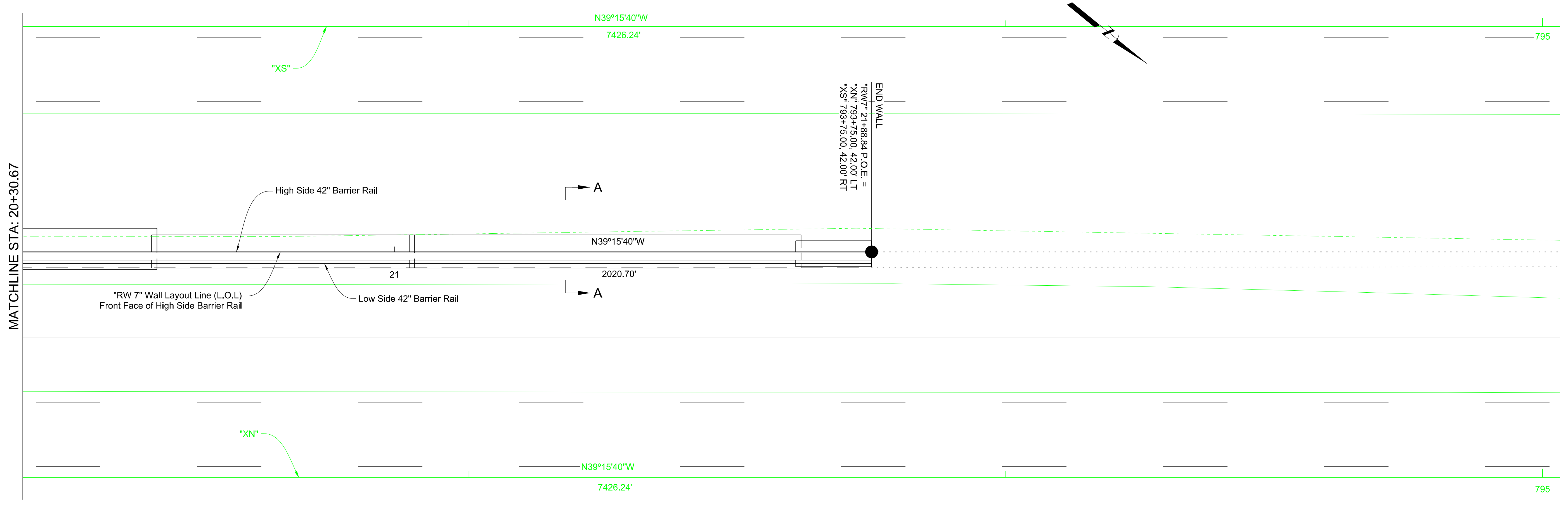
09/02/2022

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

RETAINING WALL "RW7"
PLAN AND ELEVATION 7

HDR Engineering, Inc.
9805 Double R Boulevard, Suite 101
Reno, NV 89521-5917
PH: 775-337-4700 FAX: 775-337-4774

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	CW09



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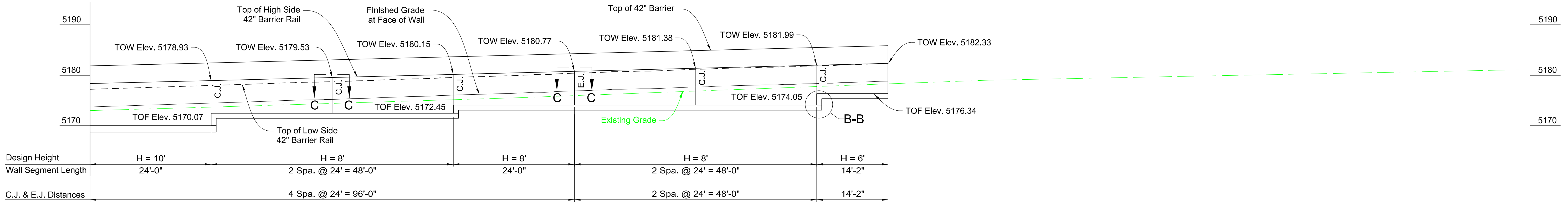

ELEVATION

NOTES:

1. Top of wall elevations are approximate, elevations shall match the finished roadway surface at wall face.
2. Refer to NDOT Standard Plans Sheet CW-1 for Section A-A, CW-4 thru CW-6 for Section B-B, Section C-C, and other details not shown. Wall dimensions and reinforcing are to be provided per the Design Heights herein.
3. The Stem Haunch For Barrier Rail detail on Sheet CW-4 shall have a vertical face not of 1'-0", but of 1'-3" minimum to match the roadway section. All reinforcing bars extending into the barrier rail shall be epoxy coated.

SHEET
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SUBJECT TO REVISION
09/02/2022

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

RETAINING WALL "RW7"
PLAN AND ELEVATION 8

HDR Engineering, Inc.
9805 Double R Boulevard, Suite 101
Reno, NV 89521-5917
PH: 775-337-4700 FAX: 775-337-4774

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	CW10

SHEET IN PROGRESS

90% PRELIMINARY
SUBJECT TO REVISION
09/02/2022

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

RETAINING WALL "RW7"
DETAILS 1

HDR Engineering, Inc.
9805 Double R Boulevard, Suite 101
Reno, NV 89521-5917
PH: 775-337-4700 FAX: 775-337-4774

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	CW11

SHEET IN PROGRESS

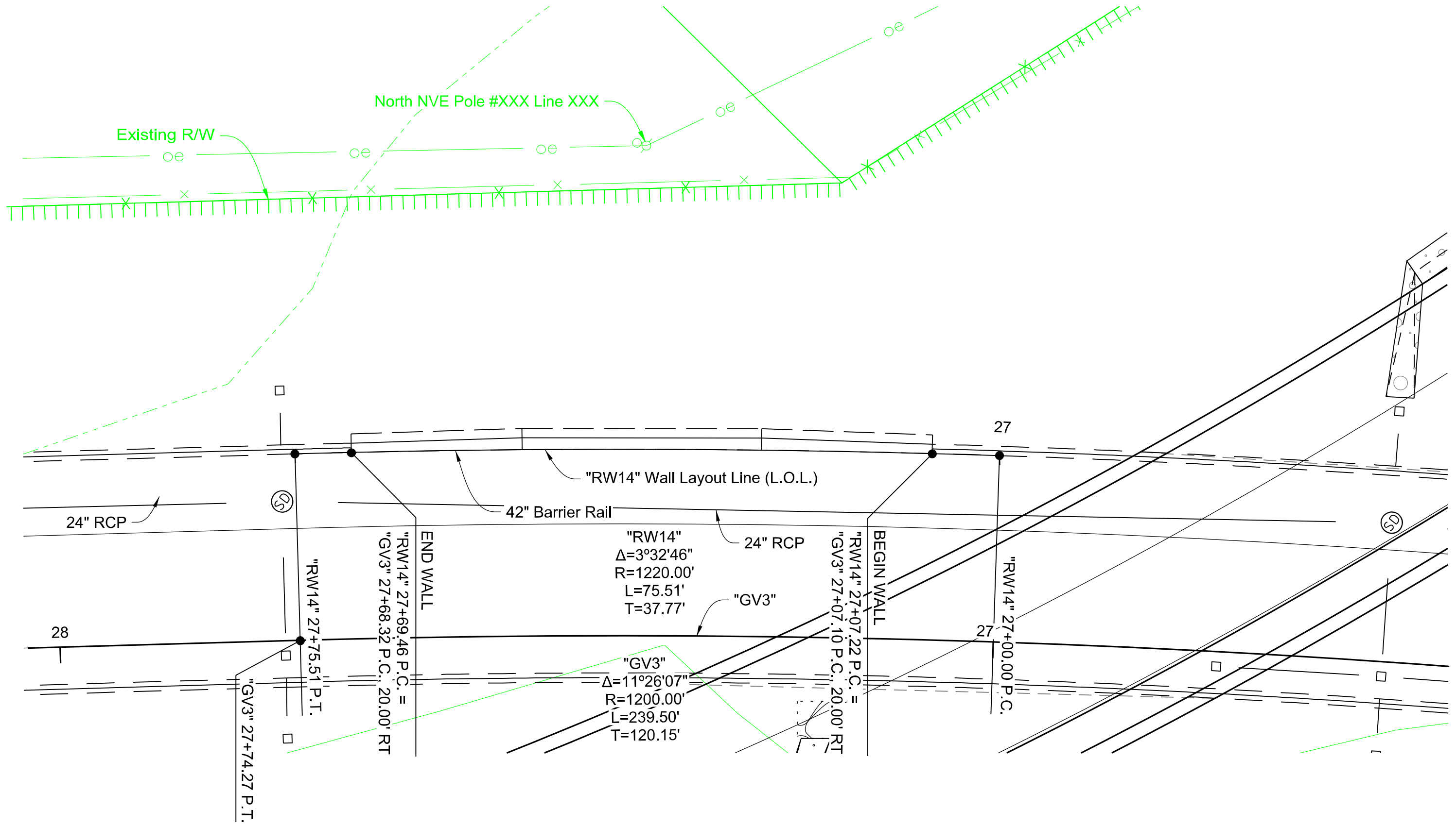
90% PRELIMINARY
SUBJECT TO REVISION
09/02/2022

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

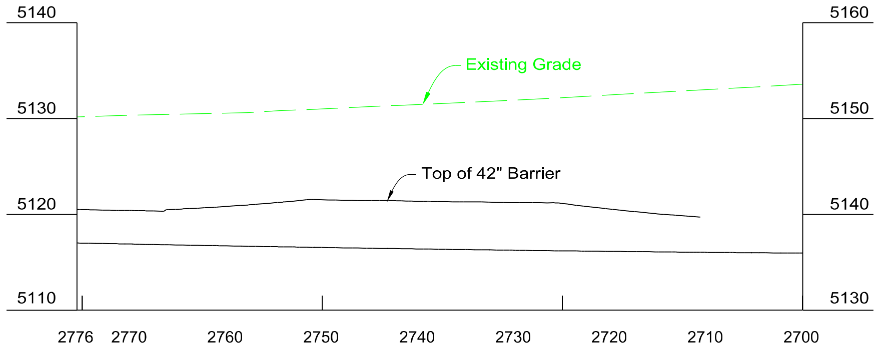
RETAINING WALL "RW7"
DETAILS 2

HDR Engineering, Inc.
9805 Double R Boulevard, Suite 101
Reno, NV 89521-5917
PH: 775-337-4700 FAX: 775-337-4774

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	CW12



PLAN



ELEVATION

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STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

RETAINING WALL "RW14"
PLAN AND ELEVATION

HDR Engineering, Inc.
9805 Double R Boulevard, Suite 101
Reno, NV 89521-5917
PH: 775-337-4700 FAX: 775-337-4774

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	NHP-0191(104)	WASHOE	CW13

SHEET IN PROGRESS

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09/02/2022

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

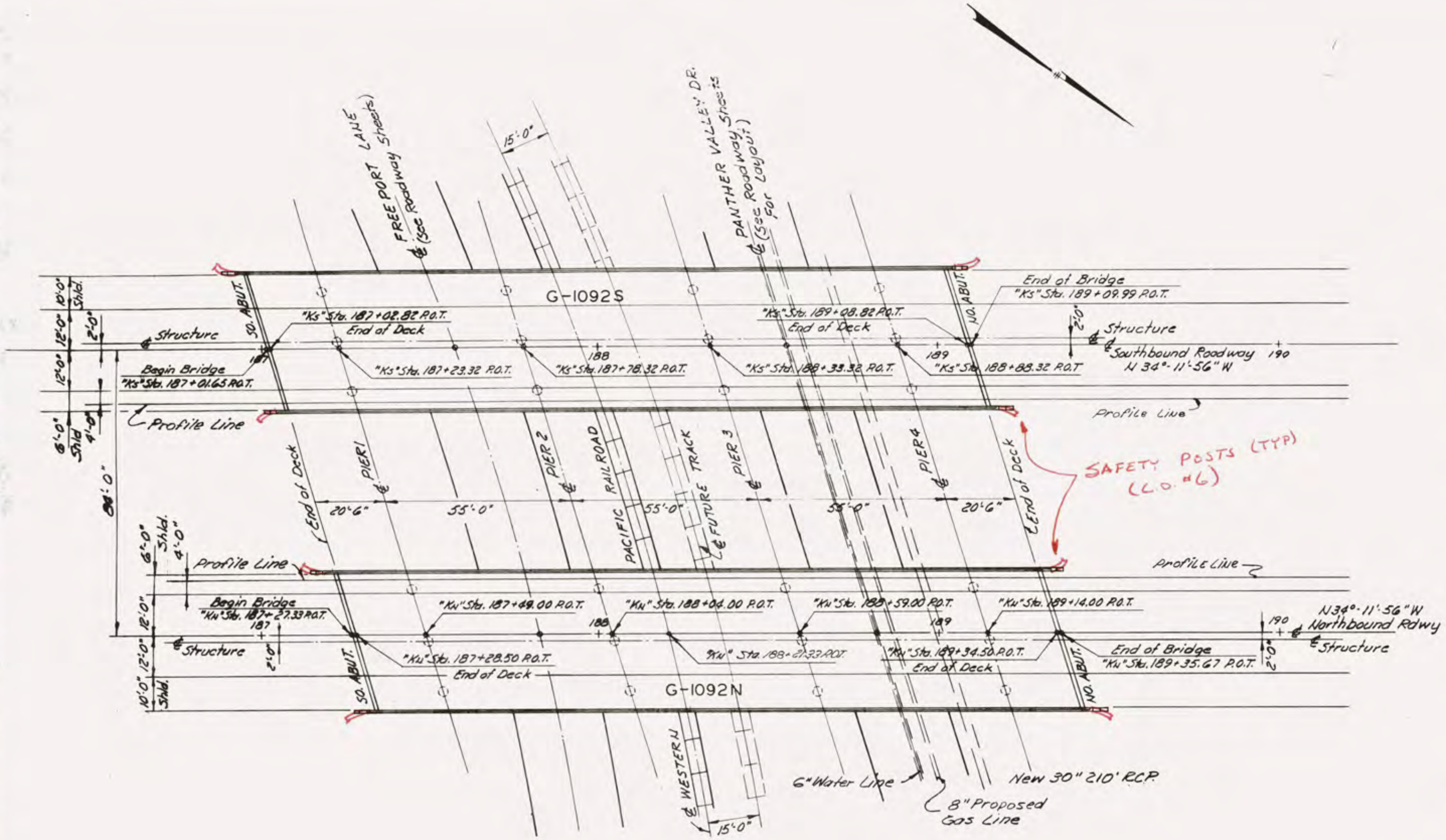
RETAINING WALL "RW14"
DETAILS

HDR Engineering, Inc.
9805 Double R Boulevard, Suite 101
Reno, NV 89521-5917
PH: 775-337-4700 FAX: 775-337-4774

APPENDIX C

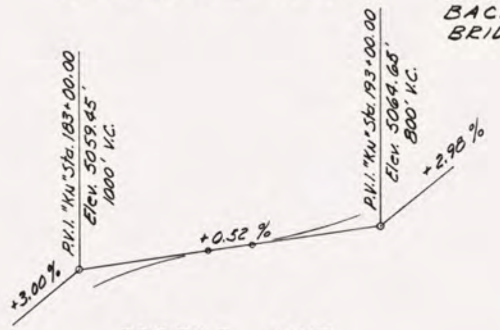
Select As-Built Plans for Bridges G-1092N&S and G-1748N&S

FED. ROAD REG. NO.	STATE	PROJECT NO.	COUNTY	CONTROL SECTION	STATE ROUTE	SHEET NO.	TOTAL SHEETS
7	NEVADA	F-009-1(7)	WASHOE	31-063		B24	

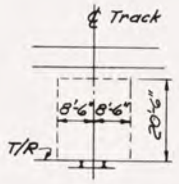


PLAN

PROFILE LINE
SOUTHBOUND ROADWAY



PROFILE LINE
NORTHBOUND ROADWAY



RAILROAD FALSEWORK
CLEARANCE DIAGRAM

SUMMARY OF QUANTITIES

	CONCRETE CU. YDS.		REINFORCING STEEL LBS.	
	1092-N	1092-S	1092-N	1092-S
PIER FOOTINGS	47.2	47.2	10,946.8	10,946.8
PIER COLUMNS	94.3	94.3	34,777.5	34,777.5
ABUTMENTS	37.3	37.6	2,788.5	2,795.0
DECK SLAB, CAPS GIRDER & DIAPH.	433.7	433.7	153,994.1	153,994.1
PARAPETS	24.8	24.8	1,107.8	1,107.8
PEDESTALS	35.6	35.6	2,677.9	2,677.9
	672.9	673.2	206292.6	206292.6

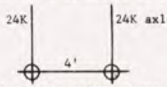
	1091-N.	1091-S.
STRUCTURE EXCAVATION	450.0 Cu. Yds.	450.0 Cu. Yds.
BACKFILL	519.0 Cu. Yds.	519.0 Cu. Yds.
BRIDGE RAIL-TYPE H	427.0 Lin. Ft.	427.0 Lin. Ft.

— GENERAL NOTES —

DESIGN SPECIFICATIONS: AASHO "Standard Specifications for highway bridges, 1961," and "Interim Specifications through 1963."

CONSTRUCTION SPECIFICATIONS: "State of Nevada Department of Highways "Standard Specifications for Road and Bridge construction 1961," except as noted below, and in the special provisions for this contract.

LIVE LOAD: Standard HS 20-44 or Alternate Loading



CONCRETE: All concrete in the substructure shall be Class AA. All concrete in the superstructure shall be Class DA.

REINFORCING STEEL: All reinforcing steel to be intermediate or hard grade. Dimensions are to center of Bar unless otherwise noted. Bar sizes (3) to (9) are indicated by the first number in the Mark, ten (10) or larger by the first two numbers. Spiral reinforcement shall conform to AASHO designation M32 or ASTM A-82

CAMBER: The camber shall be as shown on the plans.

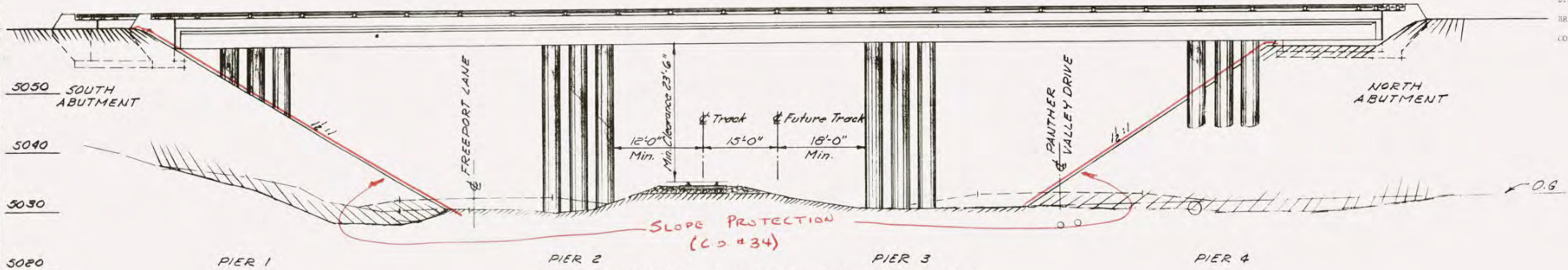
FALSEWORK & FORMS: Falsework supporting the main carrying members of all continuous structures shall not be removed from any span until all spans are cured.

SPREAD FOOTINGS: Maximum bearing value for pier footings 6,000 lbs. per sq.ft.

BRIDGE RAILING: Bridge railing to be Bridge Rail Type H.

CONSTRUCTION TYPE CODE: X5.1.

BRIDGE DEPARTMENT	BY	DATE	CHECKED BY	DATE
DESIGN				
DRAWING	*			
TRACING	*			



ELEVATION NORMAL TO ROADWAY

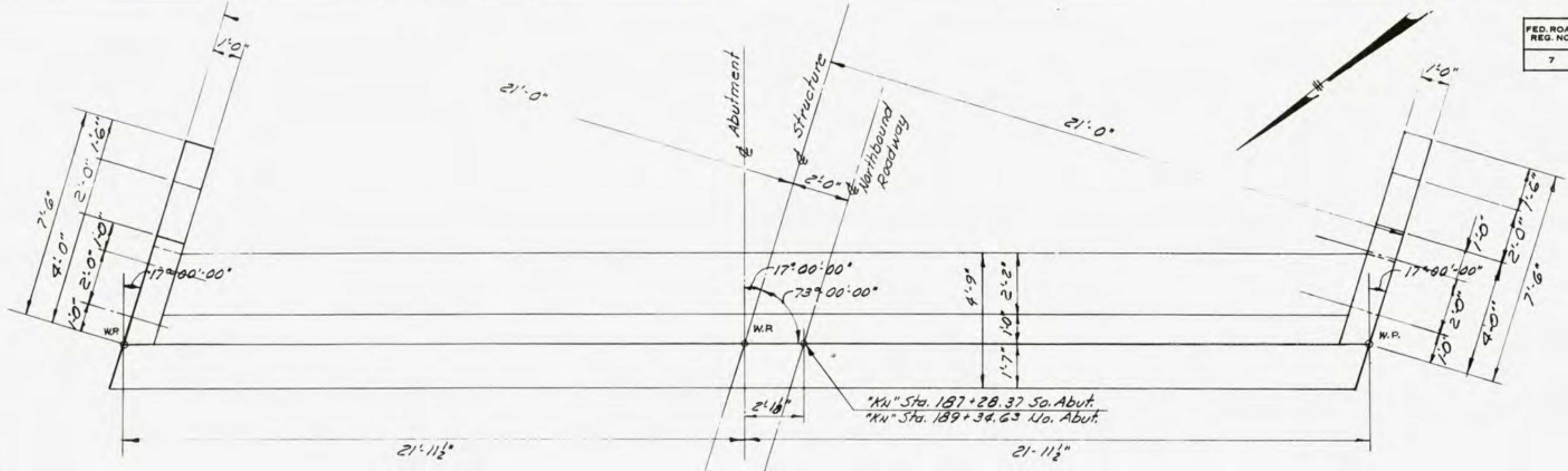
STATE OF NEVADA
DEPARTMENT OF HIGHWAYS

G-1092N & G-1092S

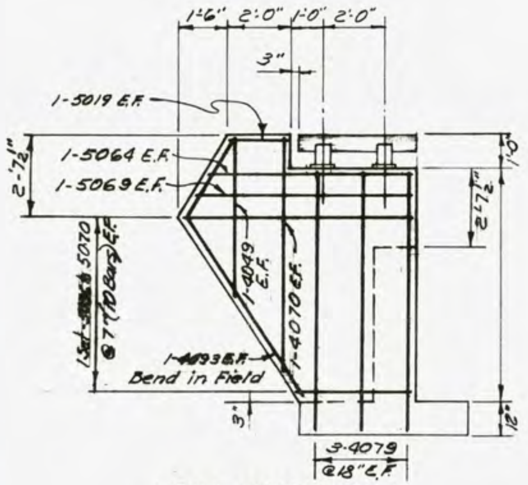
PANTHER VALLEY OVERPASS
GENERAL PLAN

DIETZGEN 197-M DURAVEL

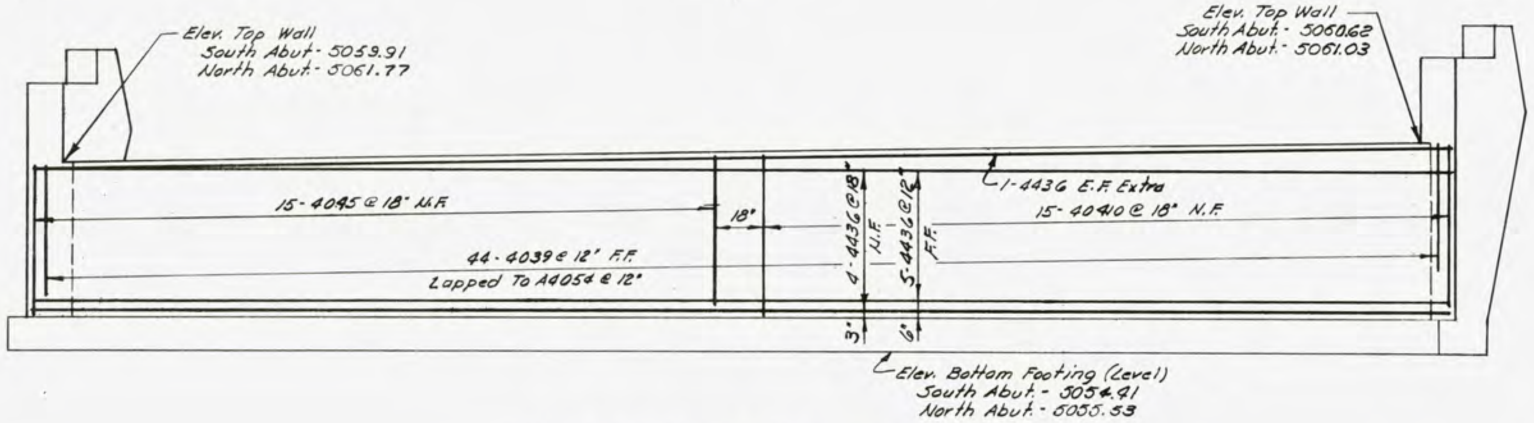
FED. ROAD REG. NO.	STATE	PROJECT NO.	COUNTY	CONTROL SECTION	STATE ROUTE	SHEET NO.	TOTAL SHEETS
7	NEVADA	F-009-1(7)	WASHOE	31-063		825	



PLAN

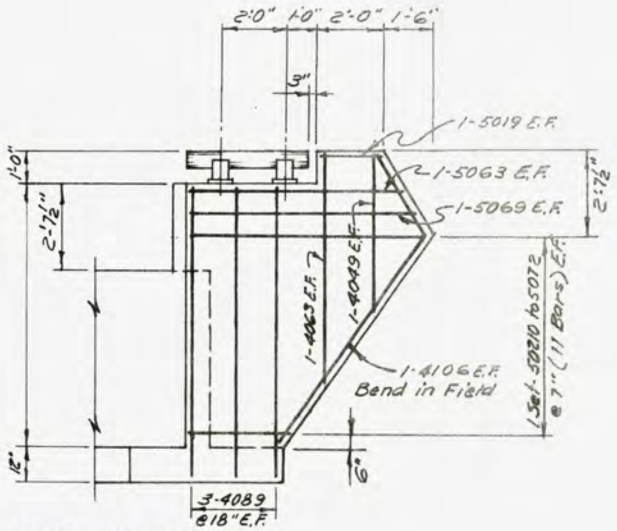


LOW WINGWALL

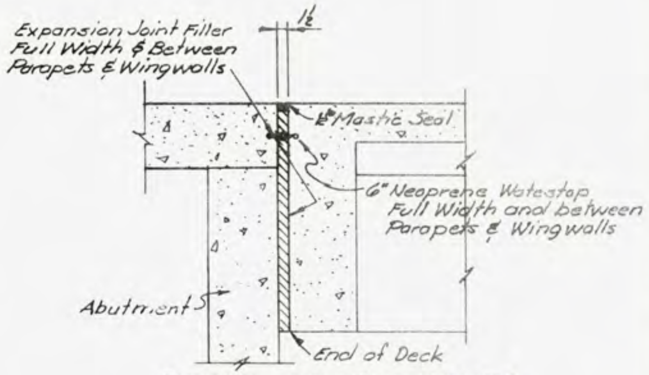


ELEVATION – SOUTH ABUTMENT

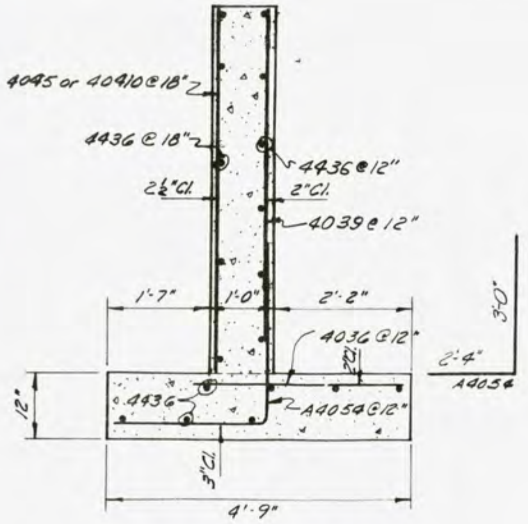
(North Abutment Opposite Hand)



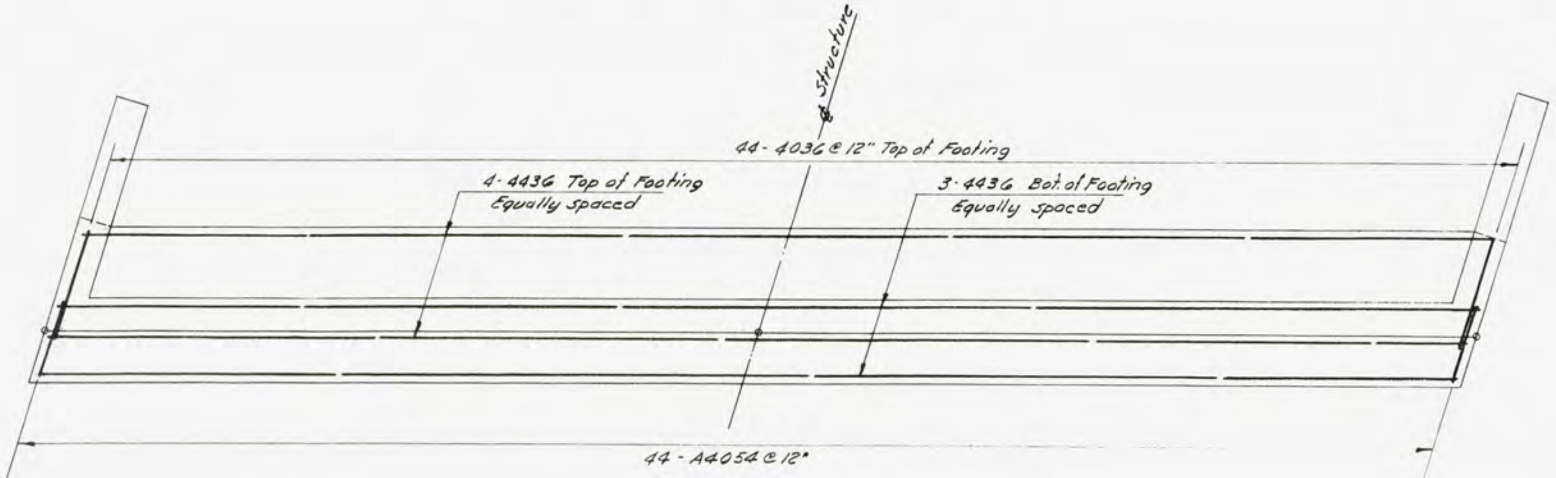
HIGH WINGWALL



DETAIL AT ABUTMENTS



TYPICAL SECTION



FOOTING REINFORCING

BRIDGE DEPARTMENT

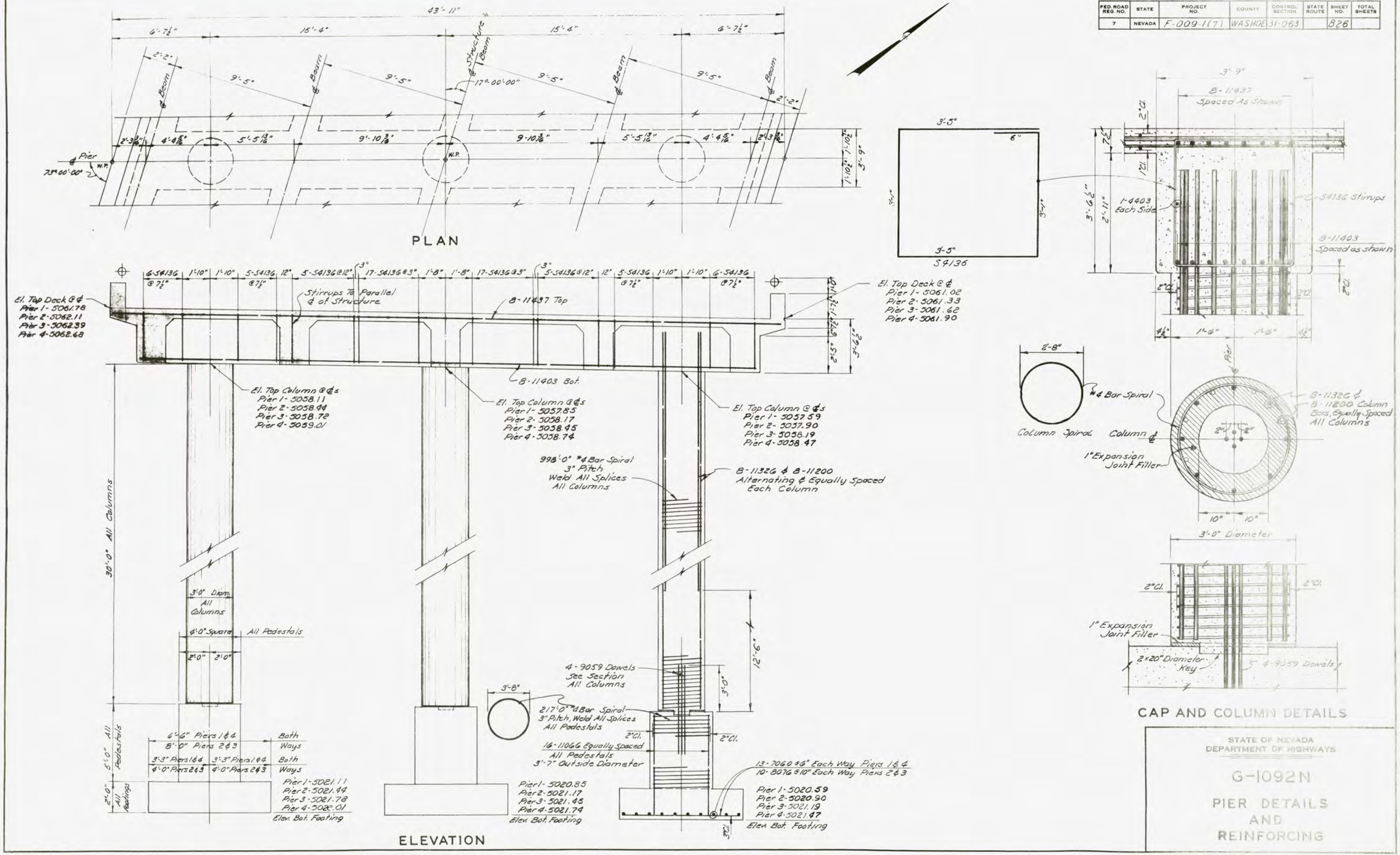
	BY	DATE	CHECKED BY	DATE
DESIGN				
DRAWING	*			
TRACING	*			

STATE OF NEVADA
DEPARTMENT OF HIGHWAYS

G-1092N

ABUTMENT DETAILS
AND
REINFORCING

FED. ROAD REG. NO.	STATE	PROJECT NO.	COUNTY	CONTROL SECTION	STATE ROUTE	SHEET NO.	TOTAL SHEETS
7	NEVADA	F-009-1(7)	WASHOE	31-063		B26	



STATE OF NEVADA
DEPARTMENT OF HIGHWAYS

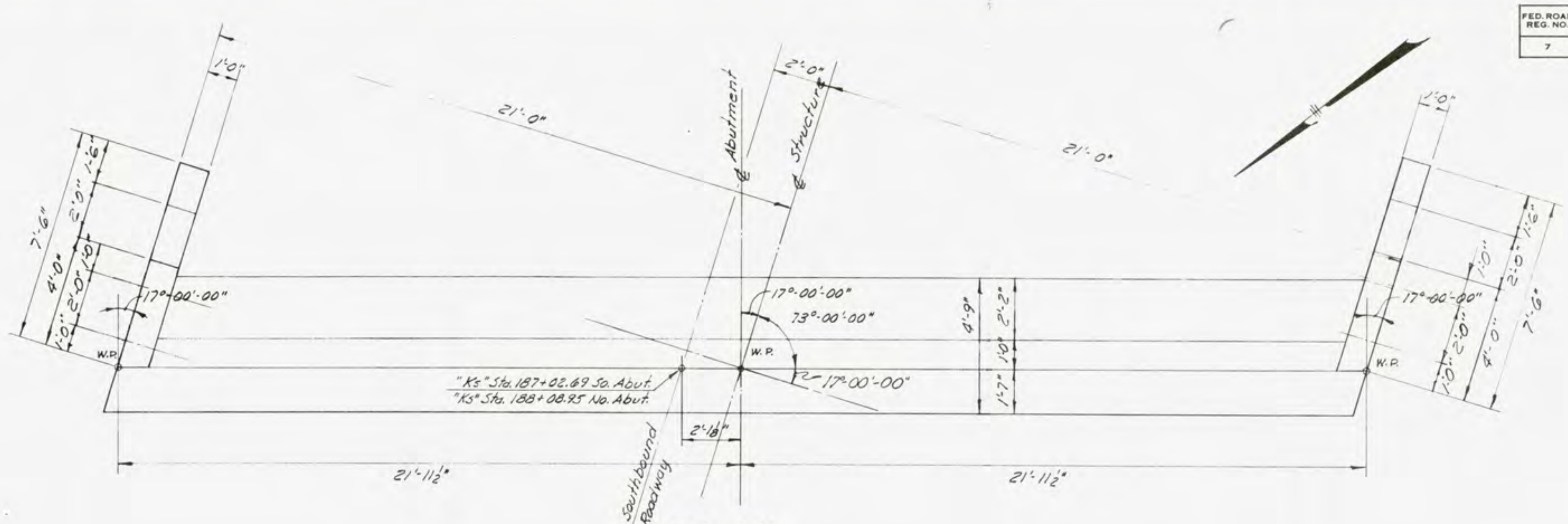
G-1092N

PIER DETAILS
AND
REINFORCING

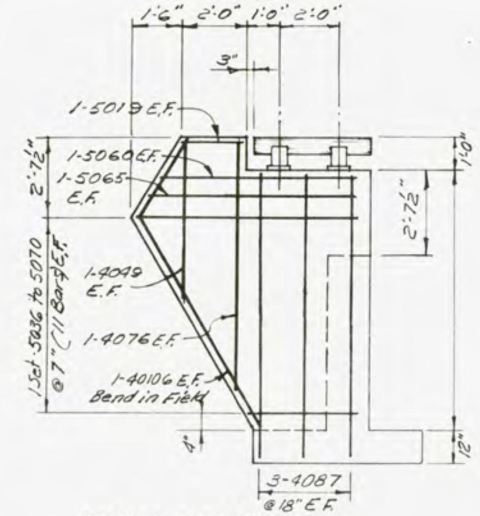
BRIDGE DEPARTMENT	BY	DATE	CHECKED BY	DATE
DESIGN				
DRAWING	✱			
TRACING	✱			

DIETZGEN 197-M DURAVEL

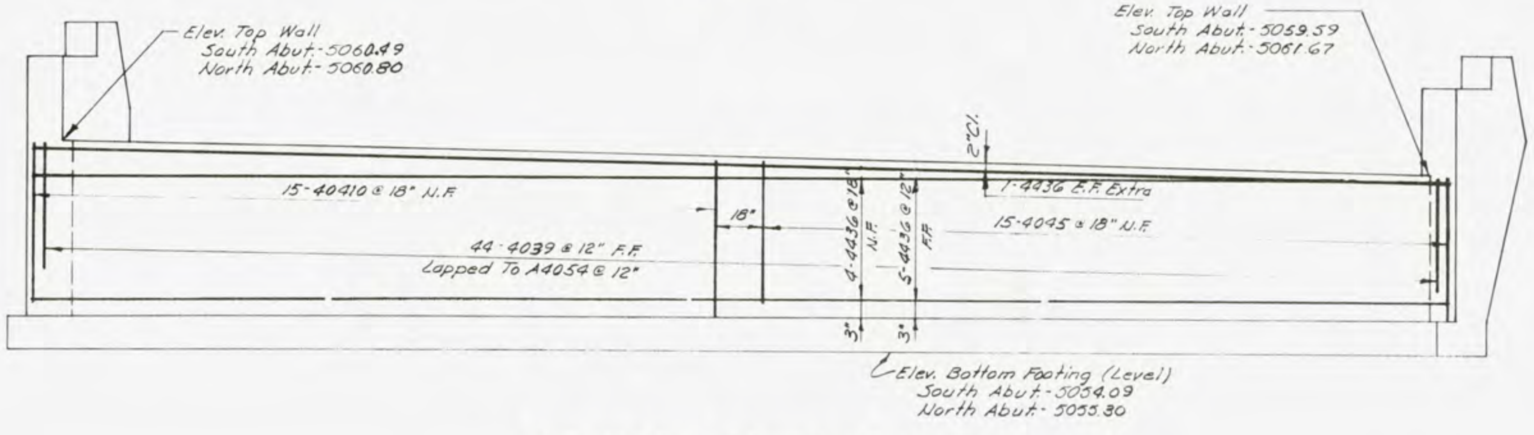
FED. ROAD REG. NO.	STATE	PROJECT NO.	COUNTY	CONTROL SECTION	STATE ROUTE	SHEET NO.	TOTAL SHEETS
7	NEVADA	I-J09-1(7)	WASHOE	31-063		827	



PLAN

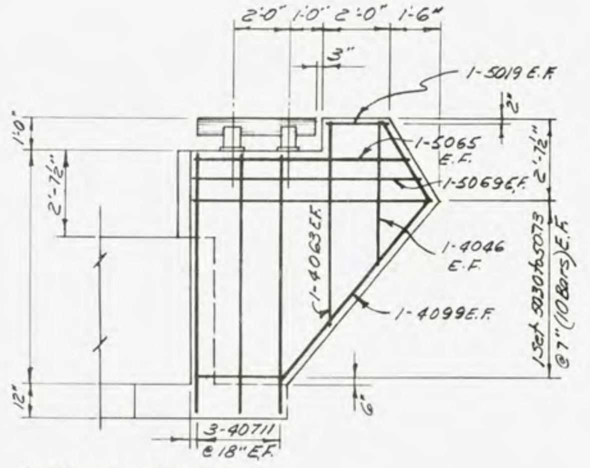


HIGH WINGWALL

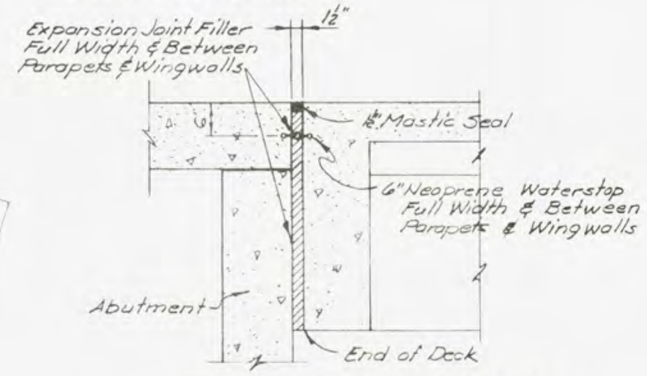


ELEVATION - SOUTH ABUTMENT

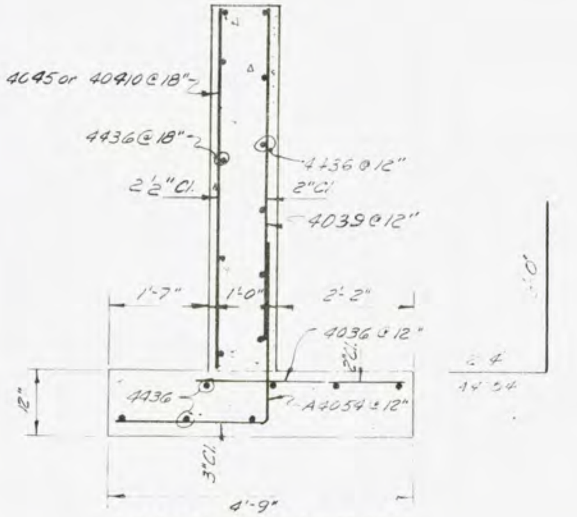
(North Abutment Opposite Hand)



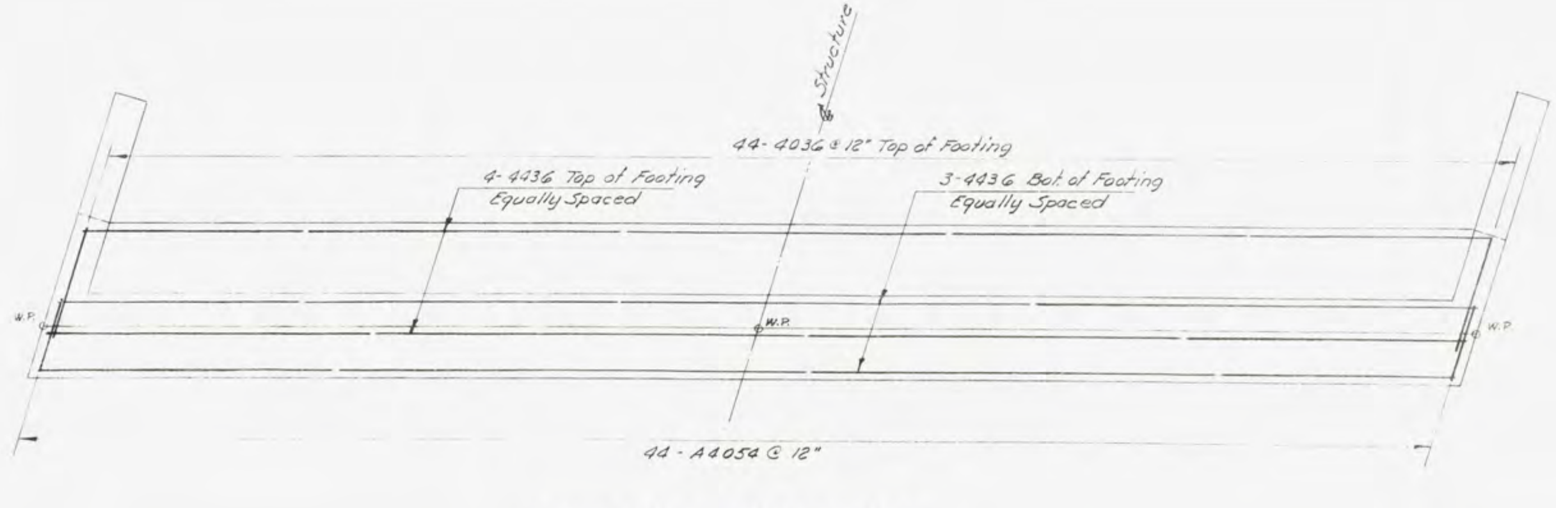
LOW WINGWALL



DETAIL AT ABUTMENTS



TYPICAL SECTION



FOOTING REINFORCING

BRIDGE DEPARTMENT	BY	DATE	CHECKED BY	DATE
DESIGN	✱			
DRAWING	✱			
TRACING				

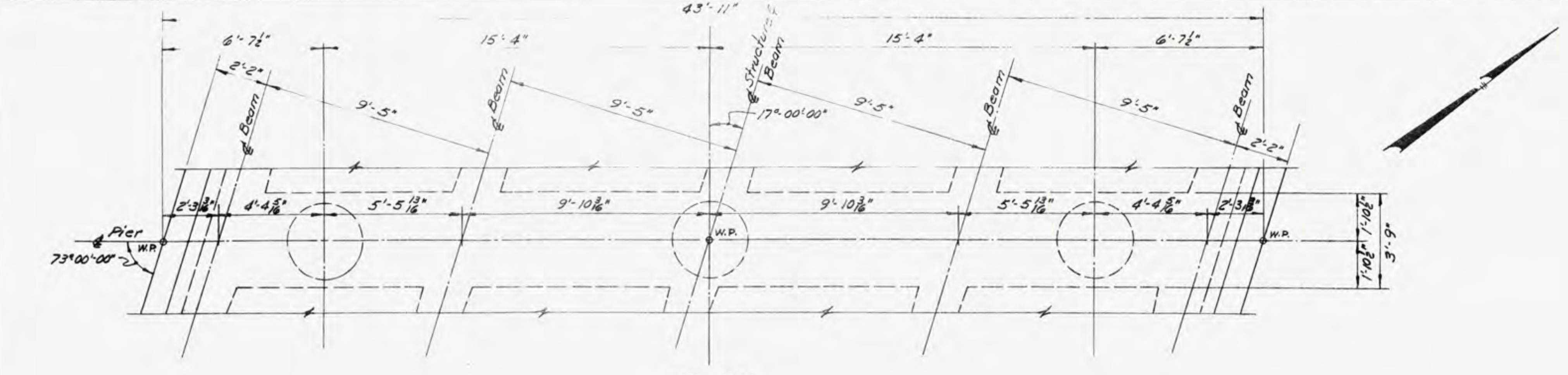
STATE OF NEVADA
DEPARTMENT OF HIGHWAYS

G-1092S

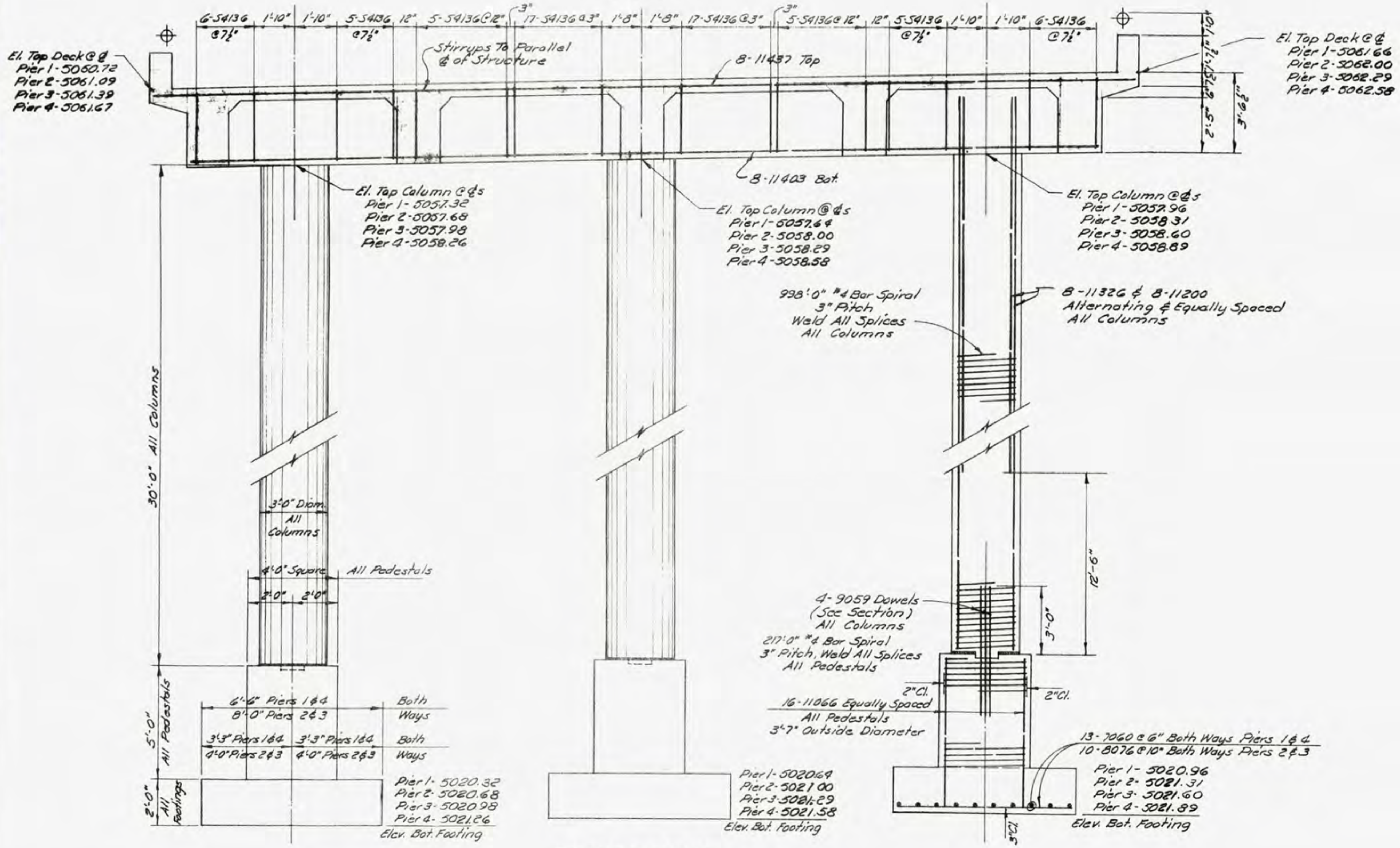
ABUTMENT DETAILS
AND
REINFORCING

DIETZGEN 197-H DURAVEL

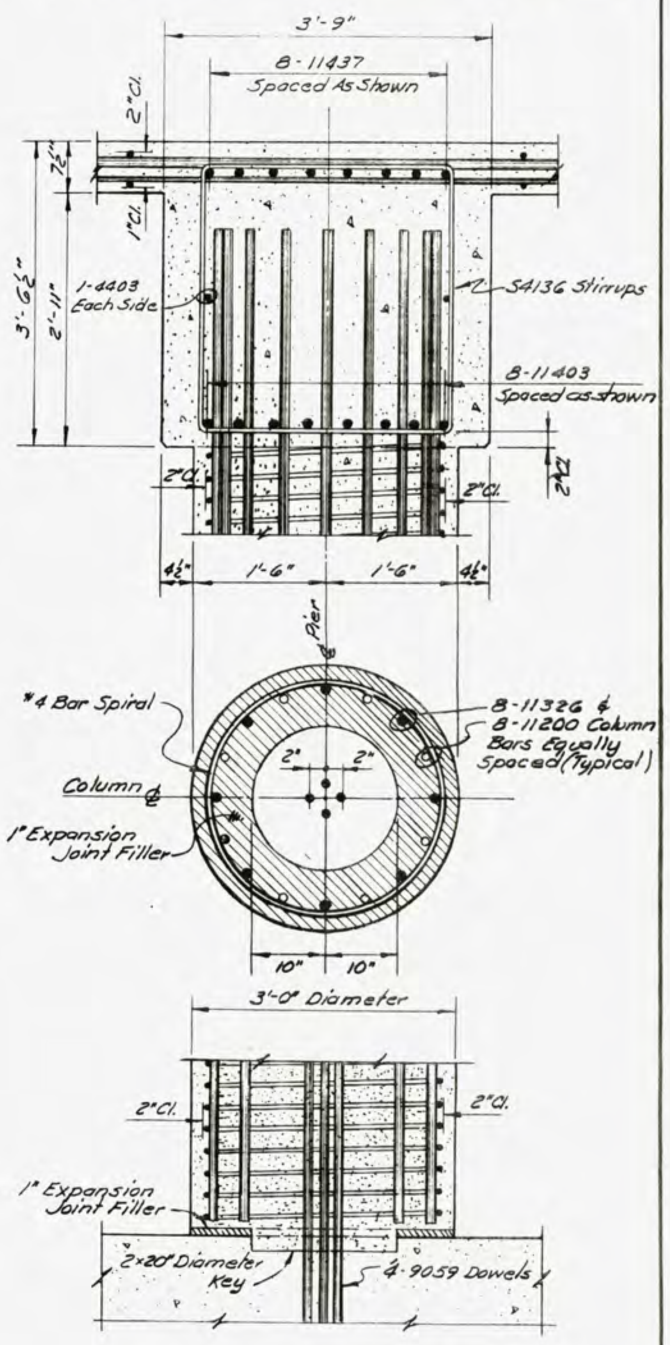
FED. ROAD REG. NO.	STATE	PROJECT NO.	COUNTY	CONTROL SECTION	STATE ROUTE	SHEET NO.	TOTAL SHEETS
7	NEVADA	F-009-1(7)	WASHOE	31-063		B28	



PLAN



ELEVATION



CAP AND COLUMN DETAILS

STATE OF NEVADA
DEPARTMENT OF HIGHWAYS

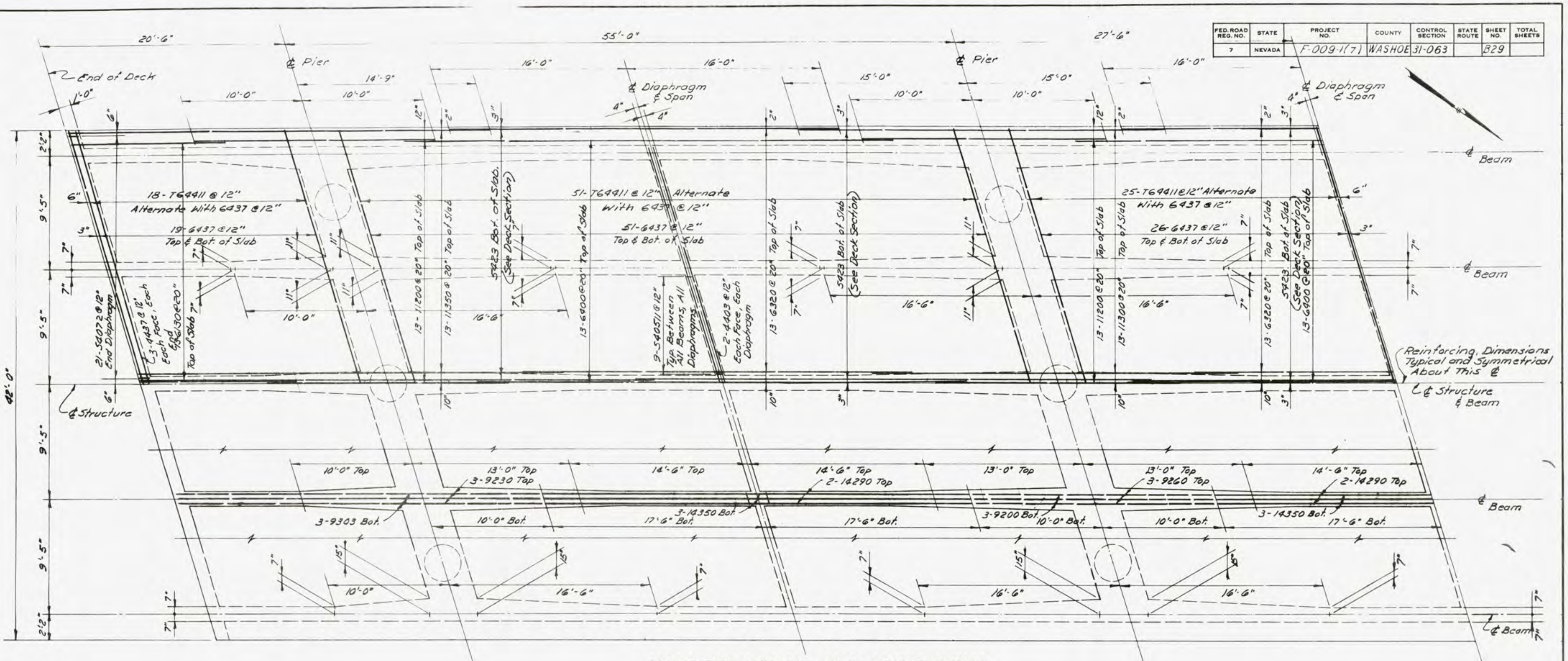
G-1092 S

PIER DETAILS
AND
REINFORCING

BRIDGE DEPARTMENT

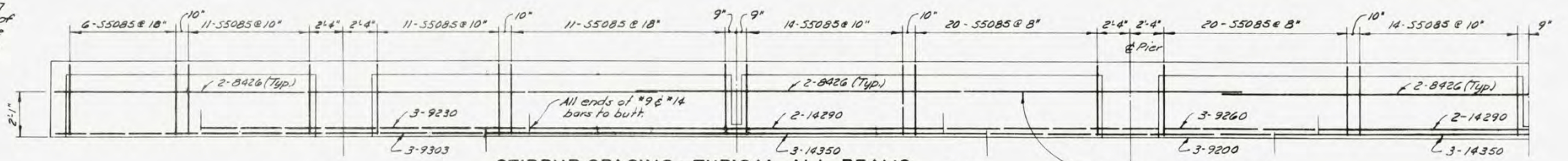
	BY	DATE	CHECKED BY	DATE
DESIGN				
DRAWING	✱			
TRACING	✱			

FED. ROAD REG. NO.	STATE	PROJECT NO.	COUNTY	CONTROL SECTION	STATE ROUTE	SHEET NO.	TOTAL SHEETS
7	NEVADA	F-009-1(7)	WASHOE	31-063		B29	



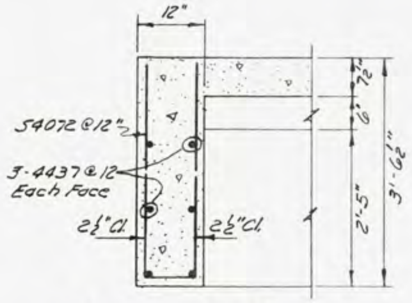
HALF DECK PLAN AND REINFORCING

—NOTE—
The Contractor May Use 6437 Top & Bottom @ 12" In Lieu of Truss Bars Provided There Is No Additional Cost To The Highway Department.

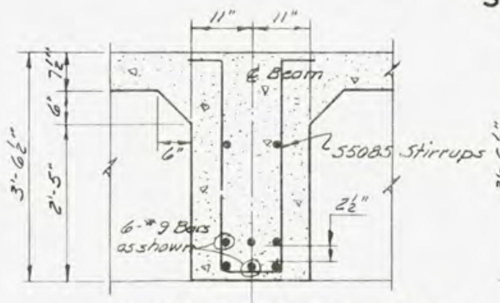


STIRRUP SPACING - TYPICAL ALL BEAMS

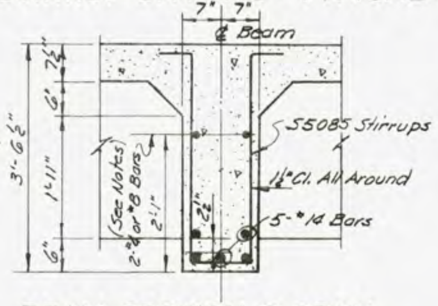
*#4 Bars May Be Substituted If The Deck and Beams are Poured Monolithically



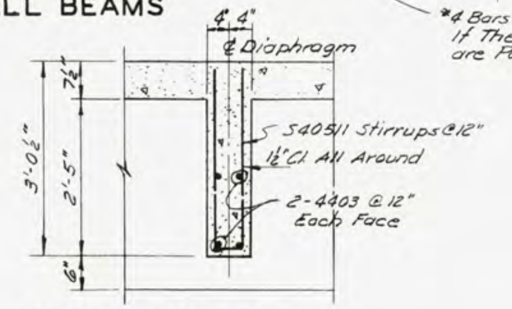
END OF DECK



BEAM SECTION AT PIER



BEAM SECTION ℄ SPAN



DIAPHRAGM SECTION

STATE OF NEVADA
DEPARTMENT OF HIGHWAYS

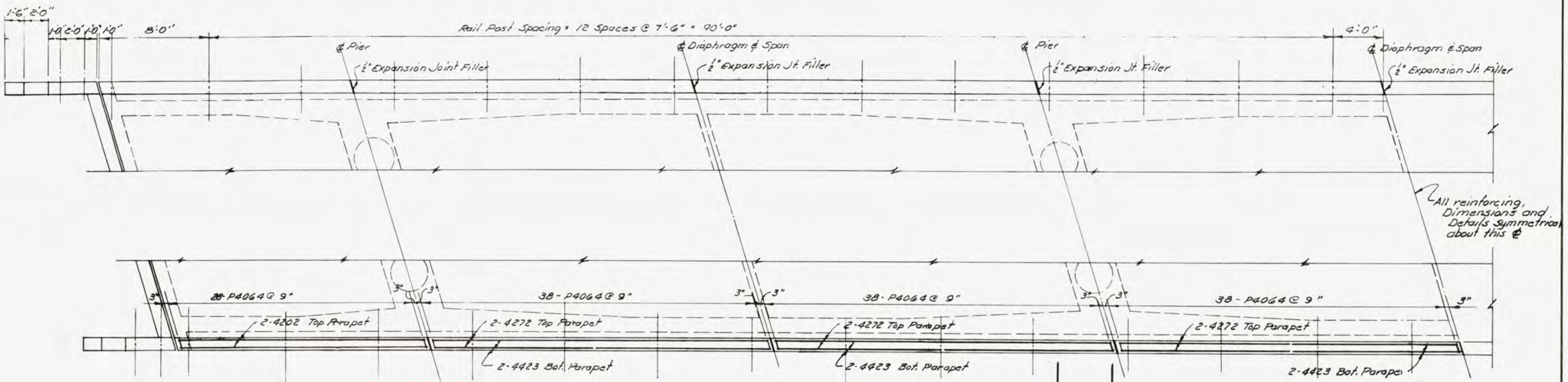
G-1092N & G-1092S

DECK DETAILS
AND
REINFORCING

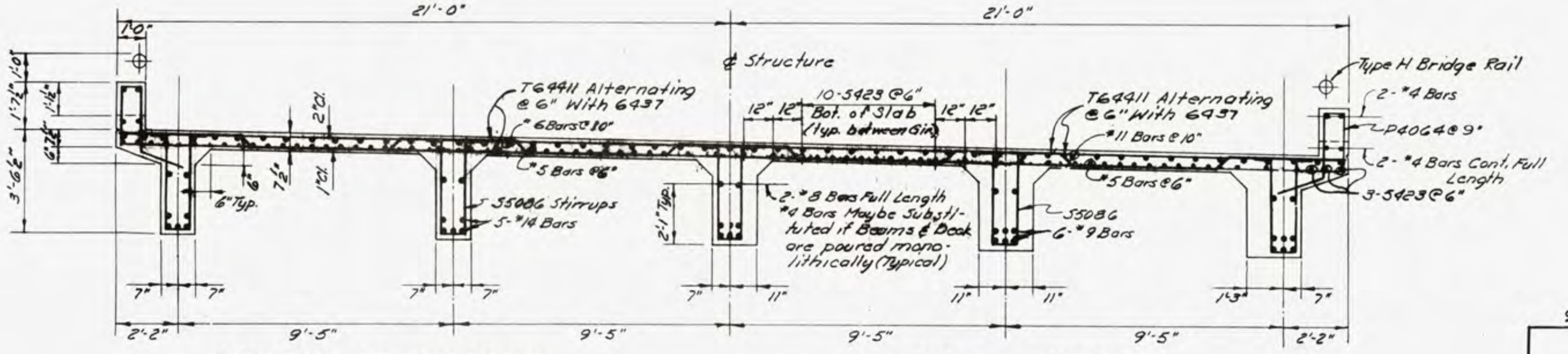
BRIDGE DEPARTMENT

	BY	DATE	CHECKED BY	DATE
DESIGN				
DRAWING	**			
TRACING				

FED. ROAD REG. NO.	STATE	PROJECT NO.	COUNTY	CONTROL SECTION	STATE ROUTE	SHEET NO.	TOTAL SHEETS
7	NEVADA	F-009-1(7)	WASHOE	31-063		B30	



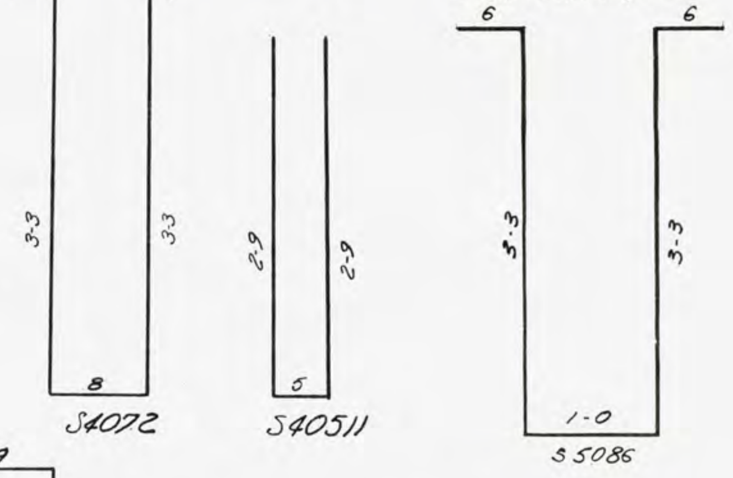
PARAPET PLAN AND REINFORCING

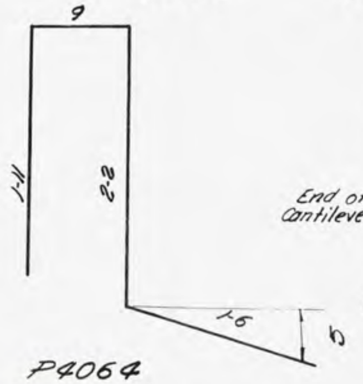


SECTION AT MIDSPAN

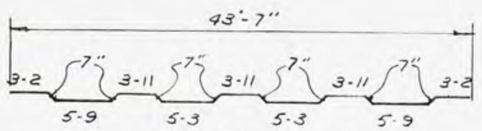
SECTION AT PIERS

DECK SECTIONS

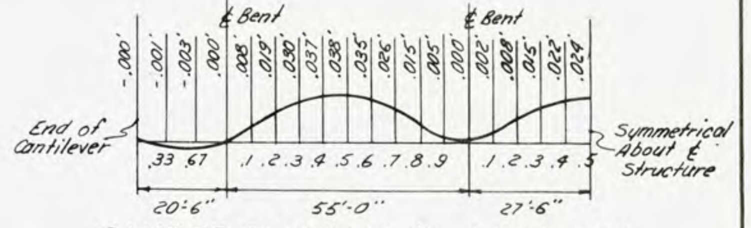




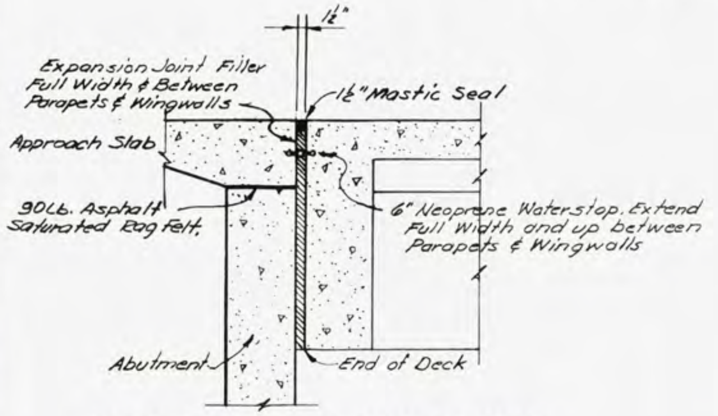
P4064



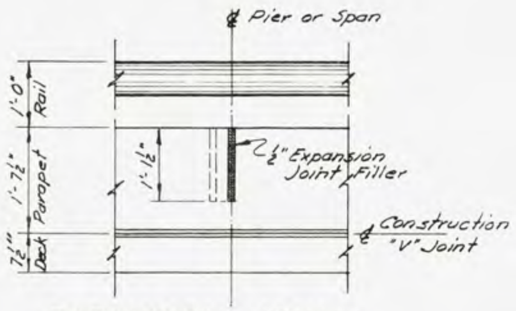
T-64911



CAMBER DIAGRAM (Dead Load Only)



DECK DETAIL AT ABUTMENTS



EXPANSION JOINT DETAIL

CONSTRUCTION "V" JOINT

BRIDGE DEPARTMENT

	BY	DATE	CHECKED BY	DATE
DESIGN				
DRAWING	*			
TRACING	*			

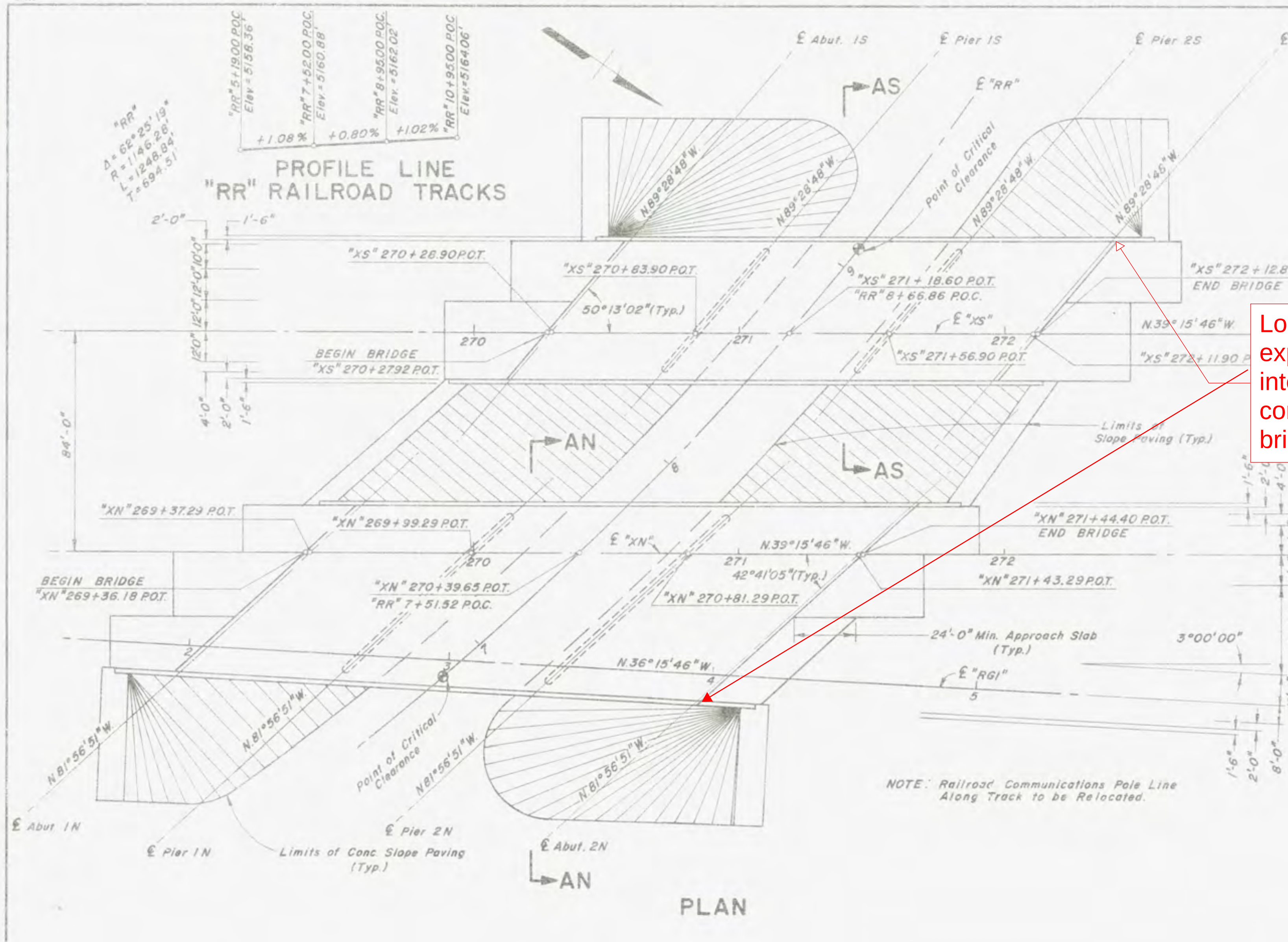
STATE OF NEVADA
DEPARTMENT OF HIGHWAYS

G-1092N & G-1092S

DECK DETAILS
AND
REINFORCING

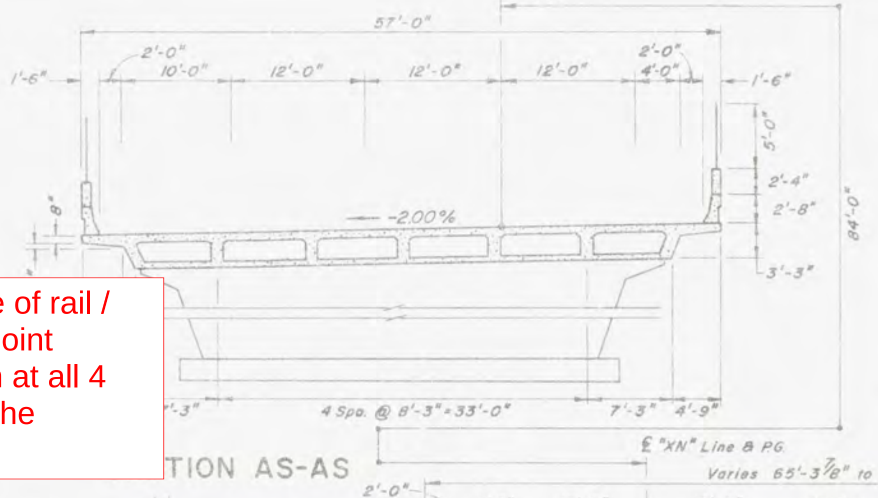
FED. RD. REG. NO.	STATE	PROJECT NO.	COUNTY	SHEET NO.
9	NEVADA	F-395-2(11)	WASHOE	B-33

PBNBS-33



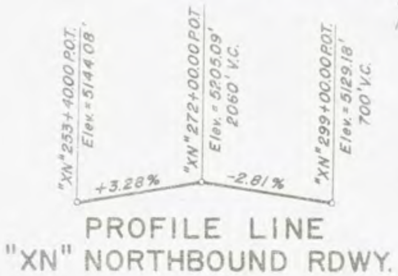
PLAN

Locate face of rail / expansion joint intersection at all 4 corners of the bridges.

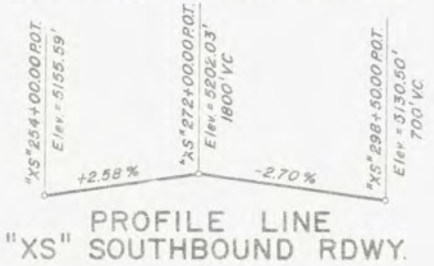


SECTION AS-AS

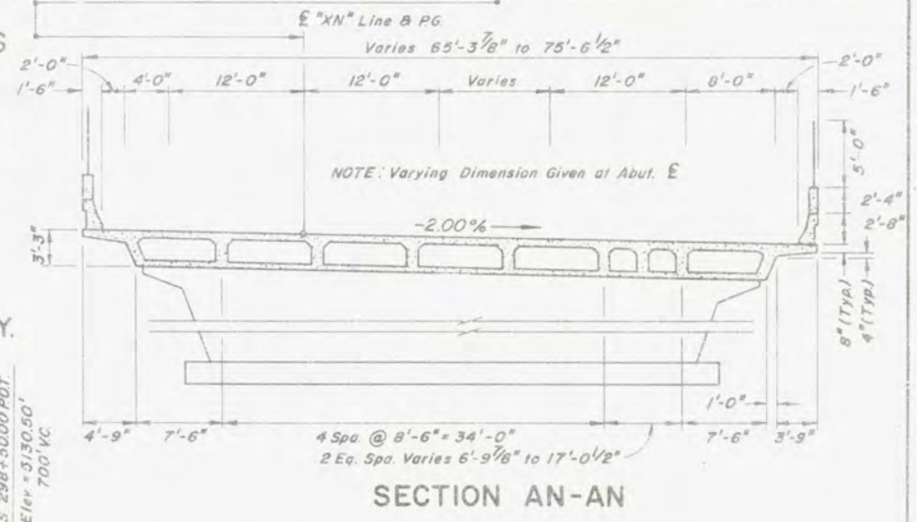
LOCATION SKETCH



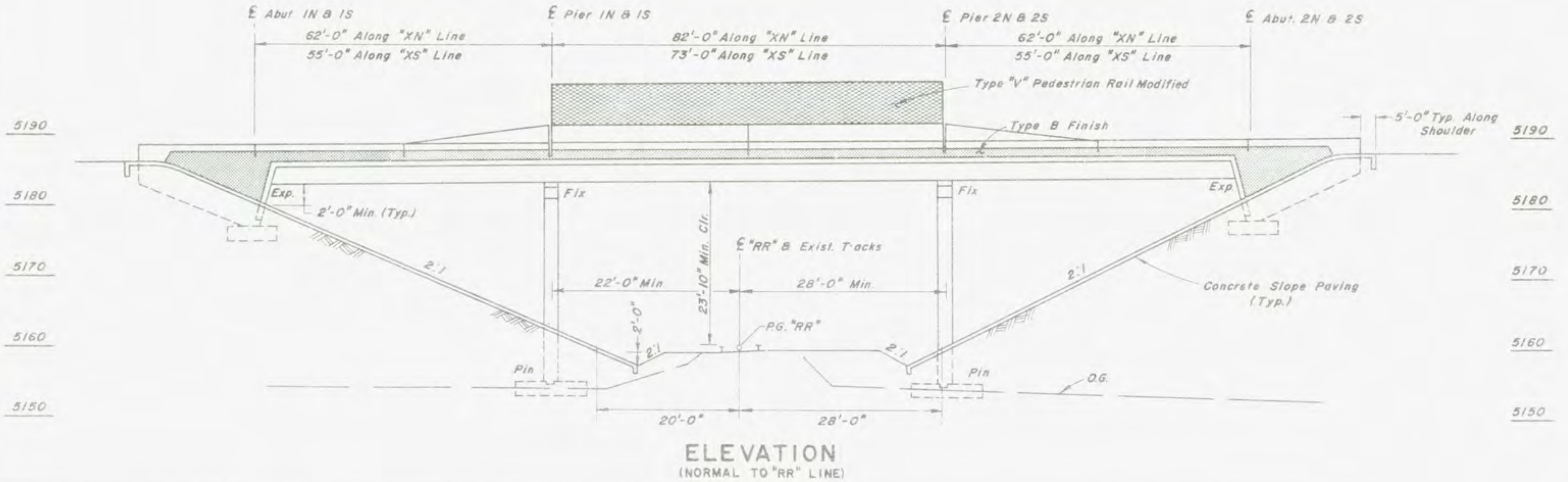
PROFILE LINE "XN" NORTHBOUND RDWY.



PROFILE LINE "XS" SOUTHBOUND RDWY.



SECTION AN-AN



ELEVATION
(NORMAL TO "RR" LINE)

STRUCTURAL DESIGN DIVISION

DESIGN	BY: PONTE	✓	BY: STEPONOWICZ
DRAWING	BY: NAPIER	✓	BY: PONTE
QUANTITIES	BY: PONTE	✓	BY: BELLFI

APPROVED
Edwin L. McGuire
PRINCIPAL BRIDGE DESIGN ENGINEER
Floyd T. Marconi
ASSISTANT CHIEF BRIDGE ENGINEER
Rodney C. Johnson
CHIEF BRIDGE ENGINEER

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

US 395-WA 30.54
PANTHER BRANCH
U.P.R.R. GRADE SEPARATION

G-1748 N & S

FED. RD. REG. NO.	STATE	PROJECT NO.	COUNTY	SHEET NO.
9	NEVADA	F-395-2(11)	WASHOE	B-34

PBN&S-34

-GENERAL NOTES-

1) DESIGN SPECIFICATIONS: AASHTO "STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES, 1983" AND "INTERIM SPECIFICATIONS THROUGH 1985" AND AASHTO "GUIDE SPECIFICATIONS FOR SEISMIC DESIGN OF HIGHWAY BRIDGES, 1983."

2) CONSTRUCTION SPECIFICATIONS: STATE OF NEVADA DEPARTMENT OF TRANSPORTATION "STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION, 1986," EXCEPT AS NOTED BELOW AND IN THE SPECIAL PROVISIONS FOR THIS CONTRACT.

3) LIVE LOAD: STANDARD HS20-44. OVERLOAD DESIGN BASED ON CALIFORNIA "STANDARD PERMIT DESIGN VEHICLES." (MAXIMUM ALLOWABLE OVERLOAD: "P13" TRUCK.)

4) CONCRETE: ALL CONCRETE TO BE CLASS AA MODIFIED (MAJOR) OR CLASS EA MODIFIED (MAJOR). SEE PRESTRESSING NOTES AND CONCRETE CLASSIFICATION DIAGRAM FOR ULTIMATE COMPRESSIVE CONCRETE STRENGTHS AND PLACEMENT LOCATIONS.

5) REINFORCING STEEL: ALL REINFORCING STEEL TO BE ASTM A615 GRADE 60. DIMENSIONS RELATING TO BAR SPACING ARE CENTER TO CENTER. BENDING DIMENSIONS ARE FROM OUT TO OUT OF THE BARS. BAR SIZES THREE (3) TO NINE (9) ARE INDICATED BY THE FIRST NUMBER OF THE MARK, TEN (10) OR LARGER BY THE FIRST TWO NUMBERS. THE LENGTH OF BAR SIZES FOUR (4) AND FIVE (5), WHEN CONSIDERED AS BARS TO CONTROL TEMPERATURE, SHRINKAGE, AND DISTRIBUTION STRESSES BY THE BRIDGE ENGINEER, MAY BE ADJUSTED BY THE CONTRACTOR UPON CONCURRENCE AND APPROVAL OF THE ENGINEER. BAR MARKS ENDING WITH THE LETTER "E" INDICATES THAT THE BAR SHALL HAVE AN EPOXY COATING.

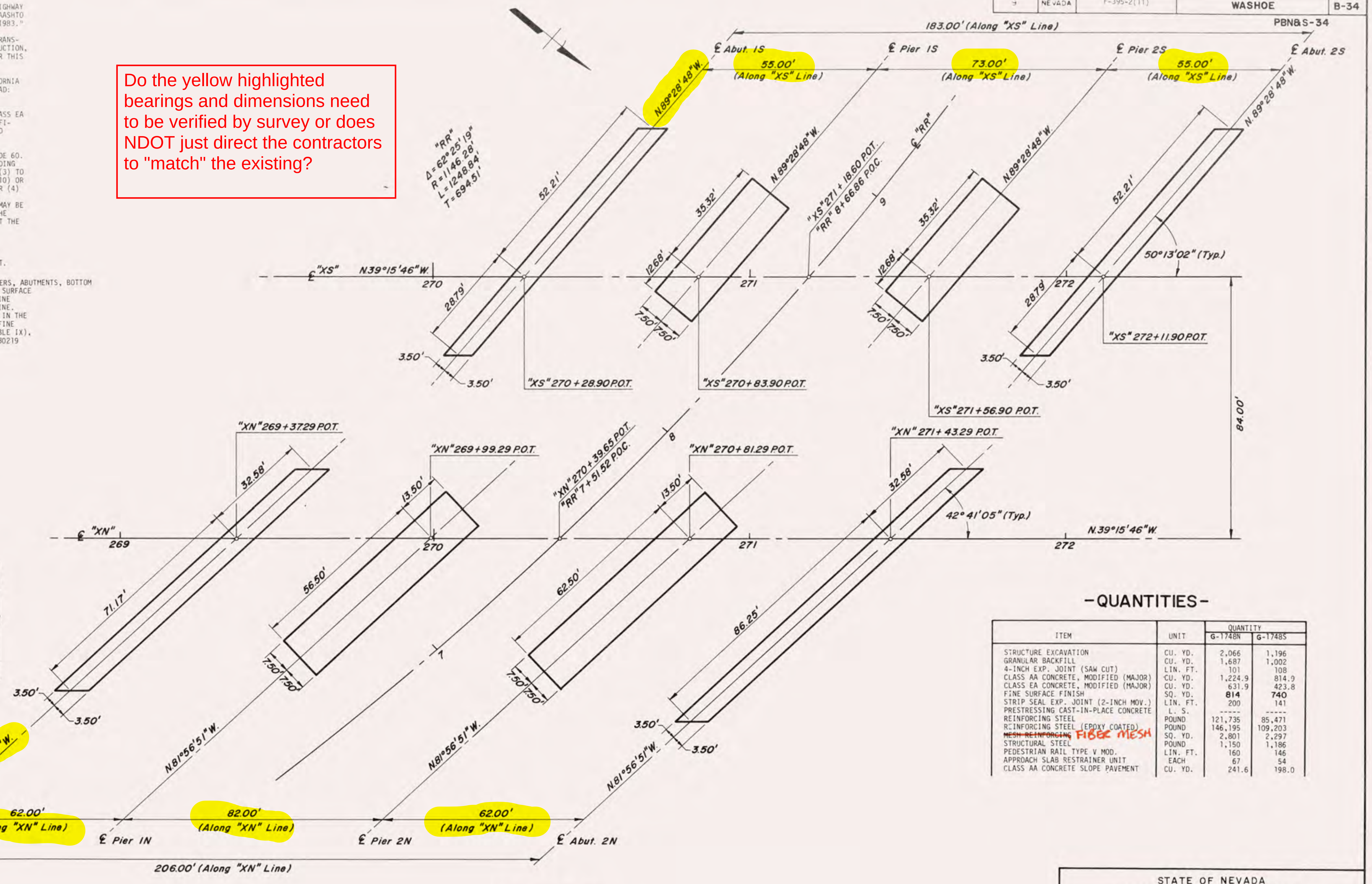
6) CAMBER: THE CAMBER SHALL BE AS SHOWN ON THE PLANS.

7) SPREAD FOOTINGS: MAXIMUM BEARING VALUE EQUALS 1.5 TONS/SQ. FT. FOR ALL FOOTINGS.

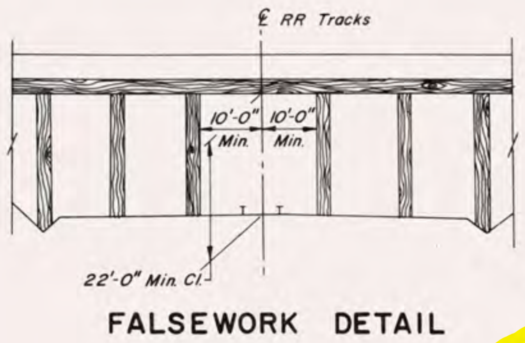
8) FINE SURFACE FINISH: ALL EXPOSED CONCRETE SURFACES EXCEPT PIERS, ABUTMENTS, BOTTOM SURFACE OF SOFFIT AND TOP SURFACE OF DECK SLAB, SHALL BE FINE SURFACE FINISHED. ALL SURFACES IN CONTACT WITH THE GROUND SHALL BE FINE SURFACE FINISHED TO A POINT 1'-0" BELOW THE FINISHED GROUND LINE. FINE SURFACE FINISH B SHALL BE APPLIED TO THE AREAS SPECIFIED IN THE PLANS; ALL OTHER AREAS SHALL RECEIVE FINE SURFACE FINISH A. FINE SURFACE FINISH A SHALL CONFORM TO FEDERAL COLOR NO. 37875 (TABLE IX), AND FINE SURFACE FINISH B SHALL CONFORM TO FEDERAL COLOR NO. 30219 (TABLE II) AS SHOWN IN FEDERAL STANDARD NO. 595a.

9) CONSTRUCTION TYPE CODE: X181.

Do the yellow highlighted bearings and dimensions need to be verified by survey or does NDOT just direct the contractors to "match" the existing?



GEOMETRICS



FALSEWORK DETAIL

-QUANTITIES-

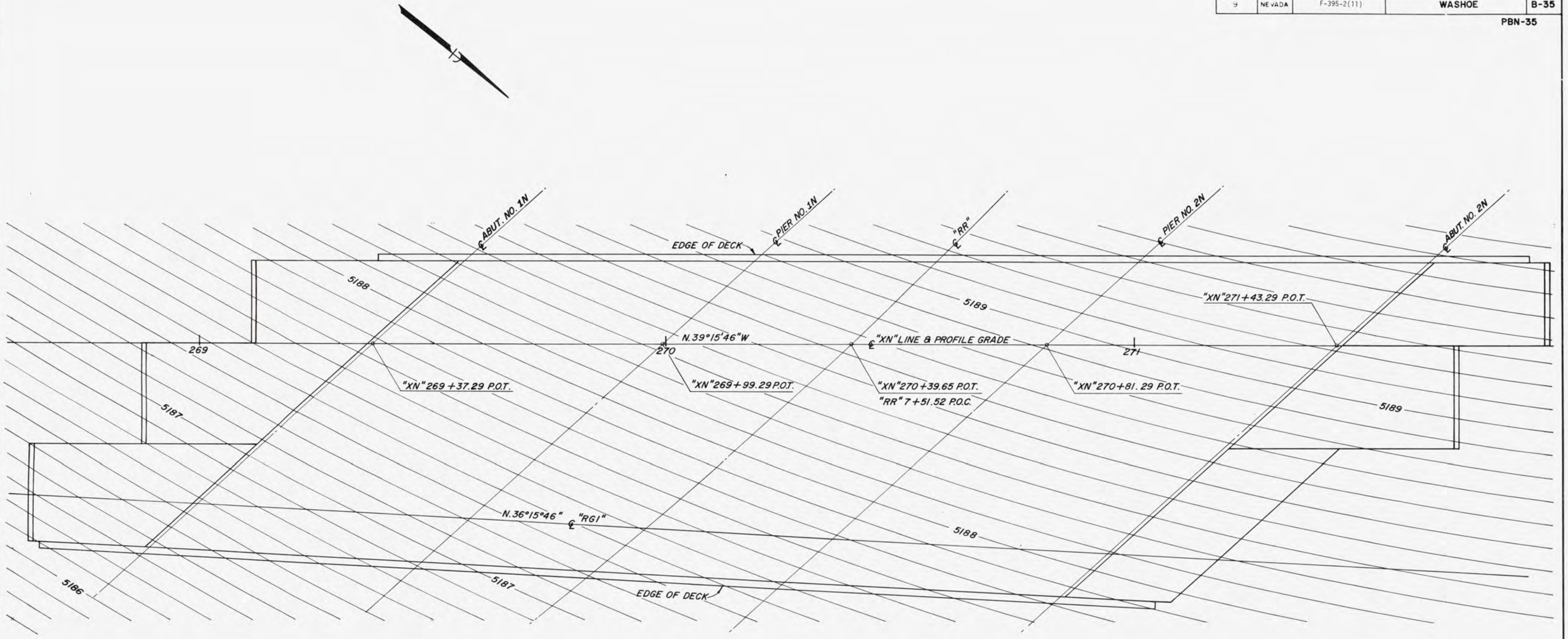
ITEM	UNIT	QUANTITY G-1748N	QUANTITY G-1748S
STRUCTURE EXCAVATION	CU. YD.	2,066	1,196
GRANULAR BACKFILL	CU. YD.	1,687	1,002
4-INCH EXP. JOINT (SAW CUT)	LIN. FT.	101	108
CLASS AA CONCRETE, MODIFIED (MAJOR)	CU. YD.	1,224.9	814.9
CLASS EA CONCRETE, MODIFIED (MAJOR)	CU. YD.	631.9	423.8
FINE SURFACE FINISH	SQ. YD.	814	740
STRIP SEAL EXP. JOINT (2-INCH MOV.)	LIN. FT.	200	141
PRESTRESSING CAST-IN-PLACE CONCRETE	L. S.	-----	-----
REINFORCING STEEL	POUND	121,735	85,471
REINFORCING STEEL (EPOXY COATED)	POUND	146,195	109,203
~~MESH REINFORCING~~ FIBER MESH	SQ. YD.	2,801	2,297
STRUCTURAL STEEL	POUND	1,150	1,186
PEDESTRIAN RAIL TYPE V MOD.	LIN. FT.	160	146
APPROACH SLAB RESTRAINER UNIT	EACH	67	54
CLASS AA CONCRETE SLOPE PAVEMENT	CU. YD.	241.6	198.0

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

US 395-WA 30.54
GEOMETRICS,
GENERAL NOTES,
& QUANTITIES
G-1748 N&S

FED RD REG NO	STATE	PROJECT NO	COUNTY	SHEET NO
9	NEVADA	F-395-2(11)	WASHOE	B-35

PBN-35



DECK CONTOURS

NOTE: CONTOURS SHOWN ARE BASED ON "XN" PROFILE GRADE ELEVATIONS

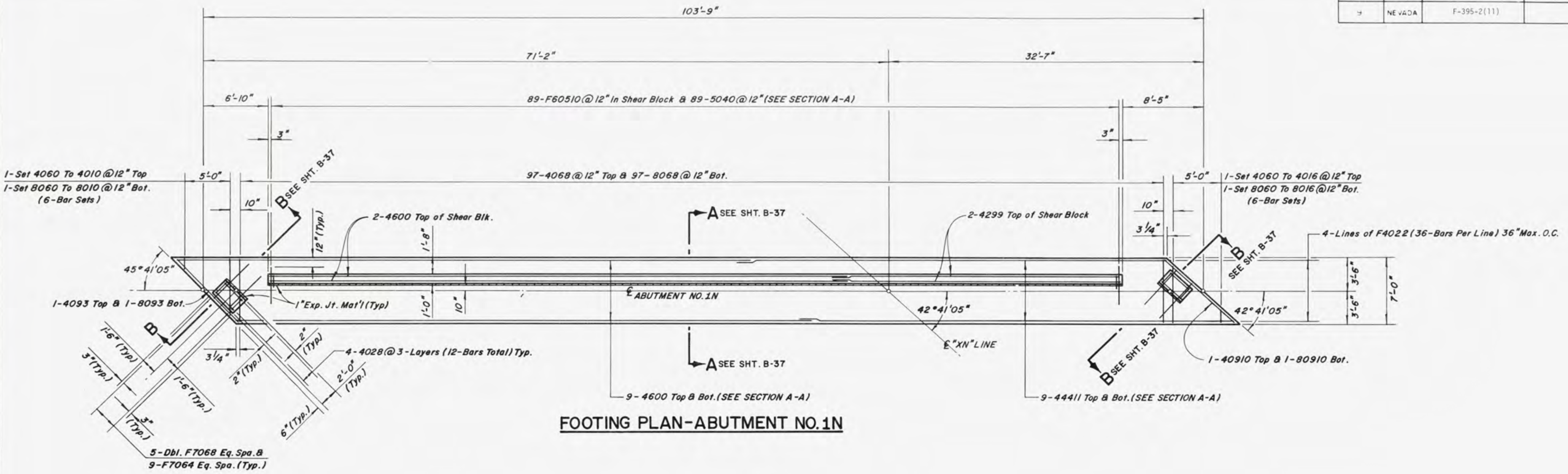
STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

US 395-WA 30.54
DECK CONTOURS

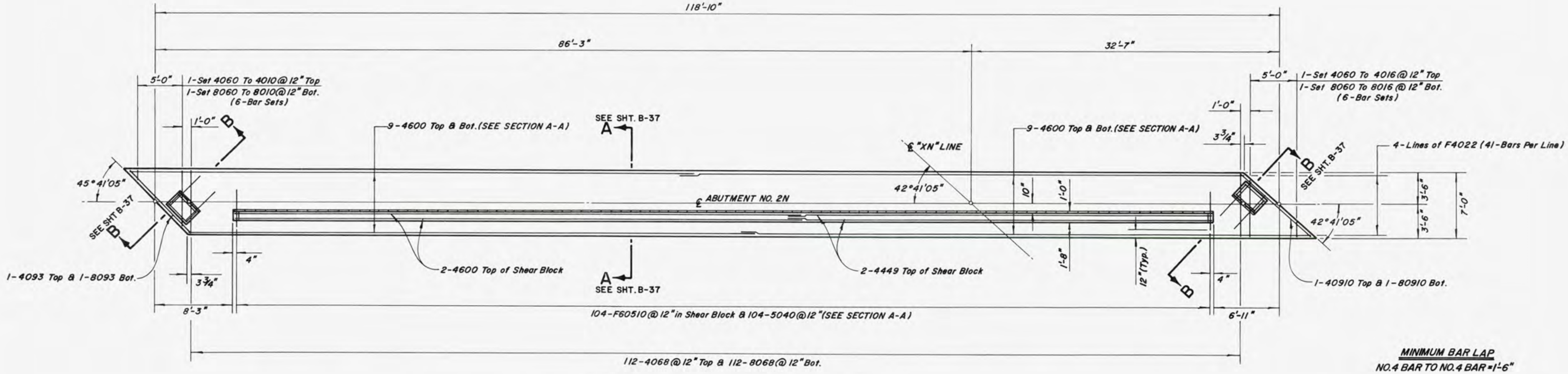
G-1748N

FED. RD. REG. NO.	STATE	PROJECT NO.	COUNTY	SHEET NO.
9	NEVADA	F-395-2(11)	WASHOE	B-36

PBN-36



FOOTING PLAN-ABUTMENT NO. 1N



FOOTING PLAN-ABUTMENT NO. 2N

NOTE: FOR GUIDE BLOCK DIMENSIONS & REINF. SEE ABUT. FOOTING NO. 1N

MINIMUM BAR LAP
NO. 4 BAR TO NO. 4 BAR = 1'-6"

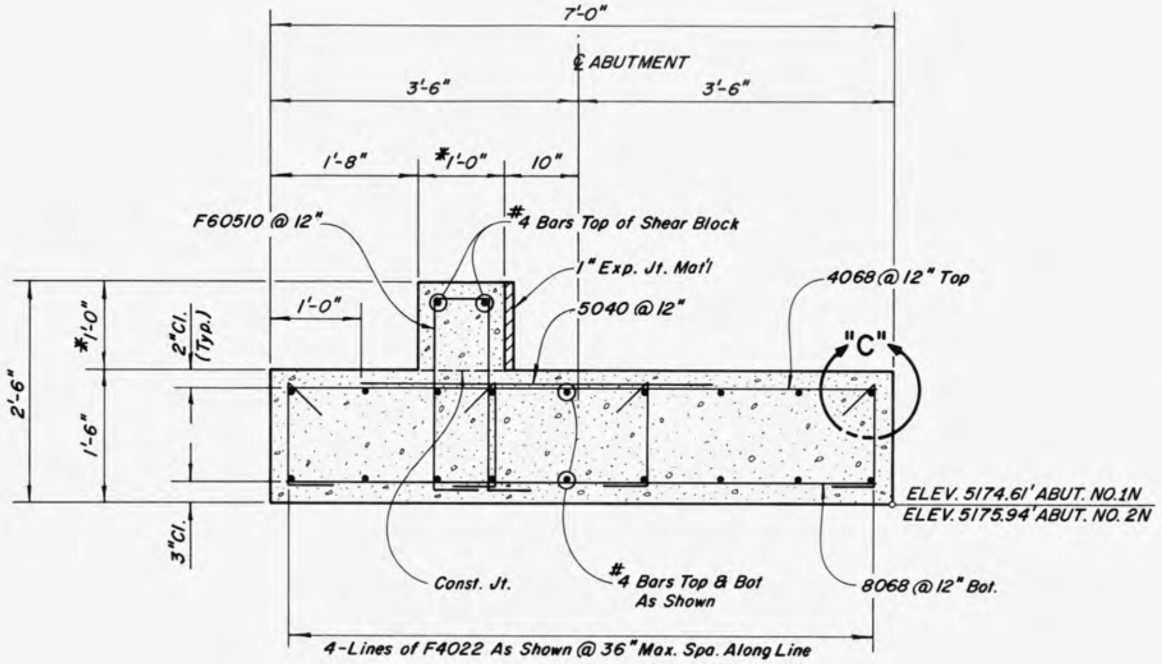
STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

US 395-WA 30.54
ABUTMENT FOOTINGS

G-1748N

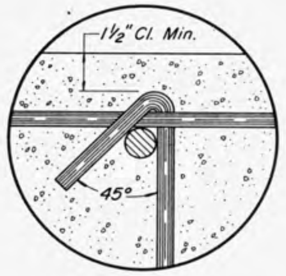
FED. RD. REG. NO.	STATE	PROJECT NO.	COUNTY	SHEET NO.
9	NEVADA	F-395-2(11)	WASHOE	B-37

PBN-37

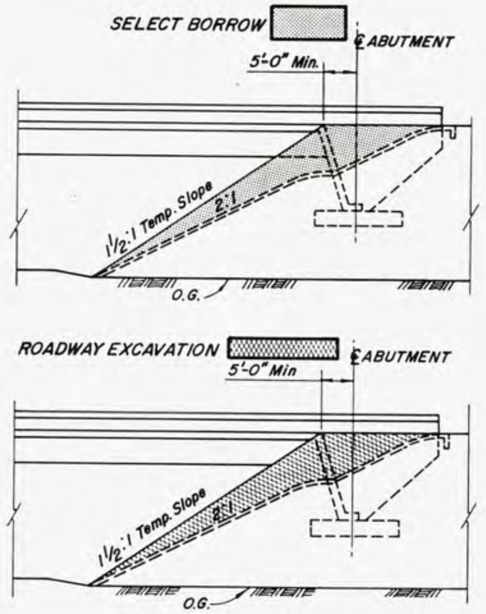


SECTION A-A

*SHEAR BLOCK NOT TO BE PLACED UNTIL STRESSING IS COMPLETED

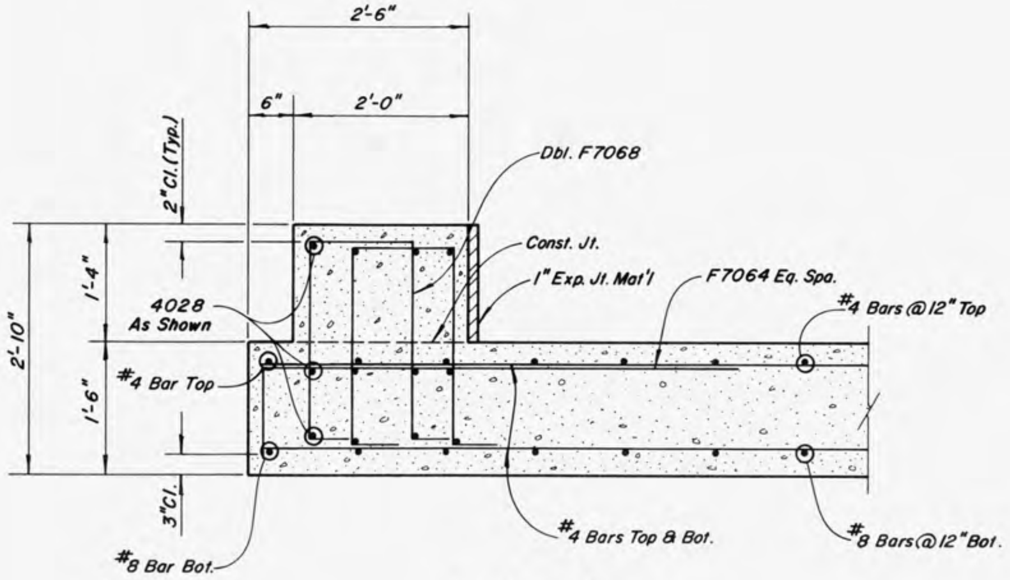


DETAIL "C"



TEMPORARY FILL ELEVATIONS

NOTES:
1. CONSTRUCT TEMPORARY FILL
2. TEMPORARY FILL TO BE IN PLACE FOR 30 DAYS PRIOR TO CONSTRUCTION OF THE ABUTMENT FOOTINGS
3. TEMPORARY FILL TO BE PAID FOR AS ROADWAY ITEMS.



SECTION B-B

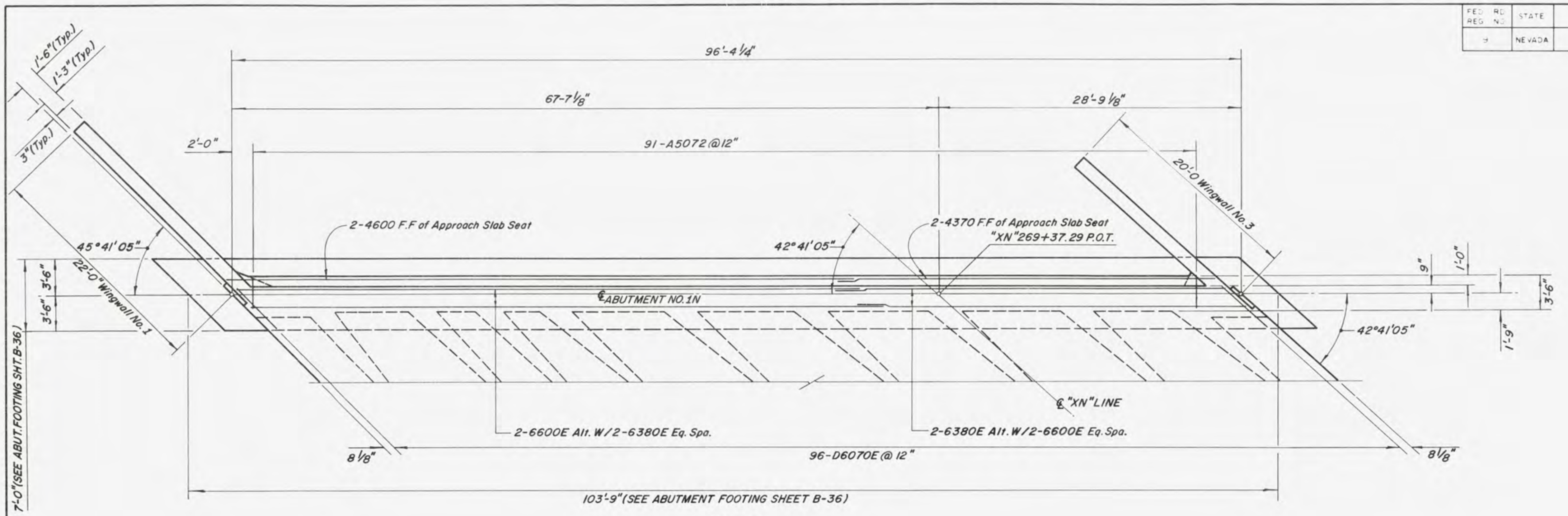
STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

US 395-WA 30.54
ABUTMENT FOOTING DETAILS & TEMPORARY FILL ELEVS.

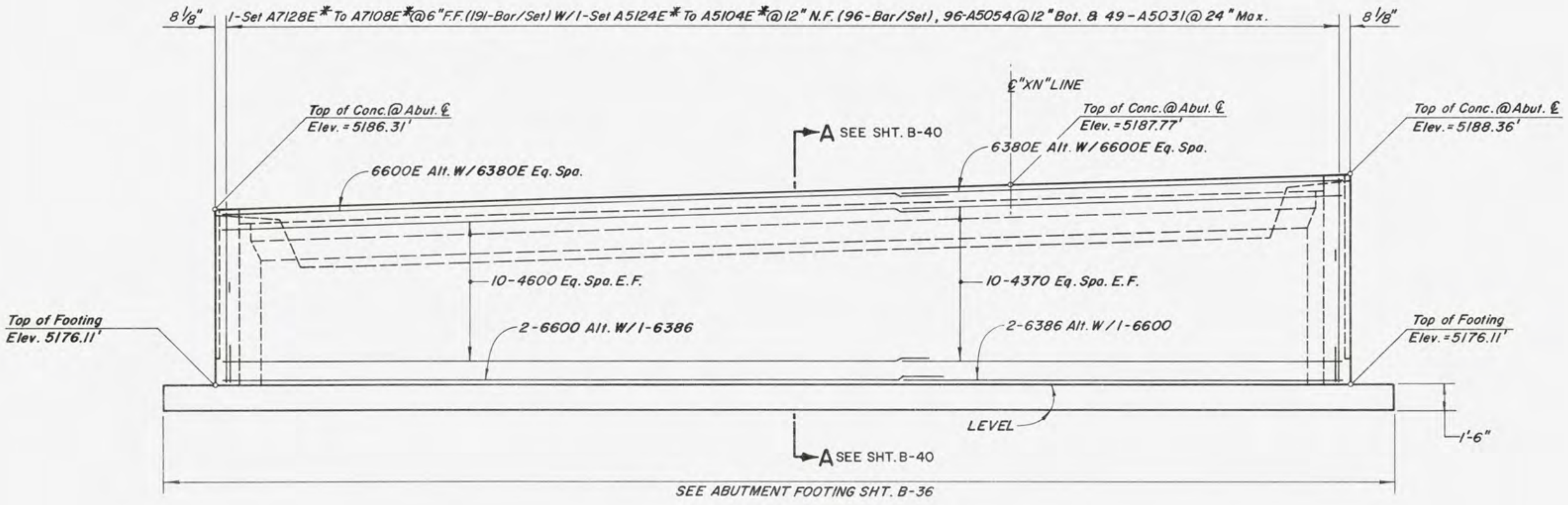
G-1748N

FED RD REG NO	STATE	PROJECT NO	COUNTY	SHEET NO
9	NEVADA	F-395-2(11)	WASHOE	B-38

PBN-38



PLAN



ELEVATION

(ABUTMENT 1N LOOKING BACK ON LINE)

* EPOXY COAT TOP LEG OF BAR AND 1'-0" DOWN VERTICAL LEG. THE ENTIRE BAR MAY BE COATED AT THE CONTRACTORS EXPENSE.

MINIMUM BAR LAP

NO.4 BAR TO NO.4 BAR = 1'-6"
NO.6 BAR TO NO.6 BAR = 2'-6"

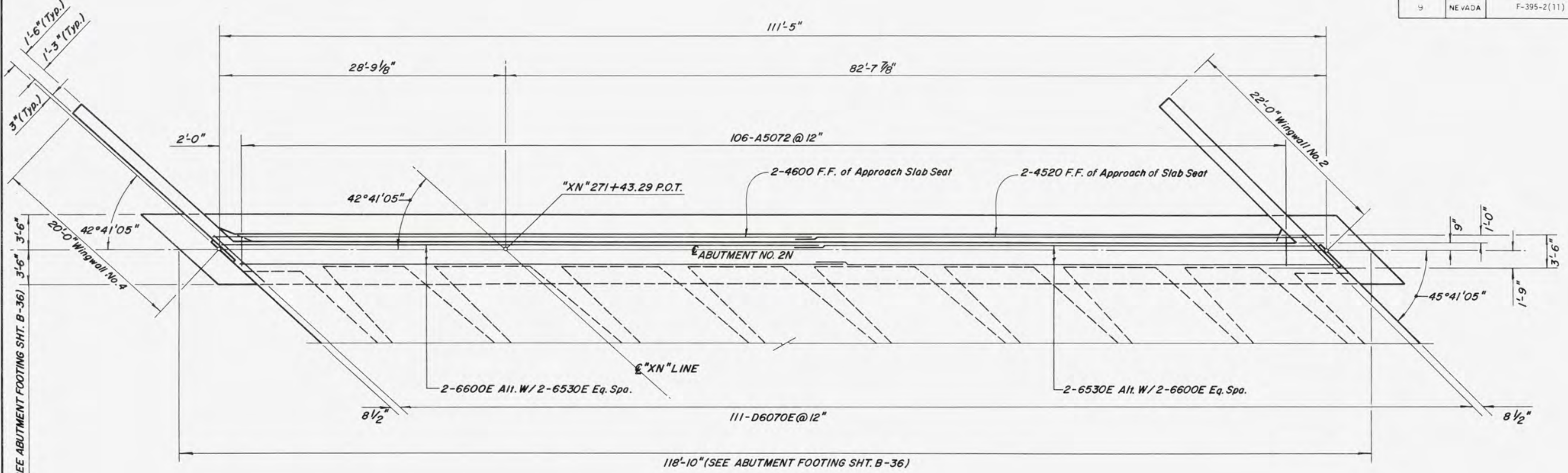
STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

US 395-WA 30.54
ABUTMENT NO.1N

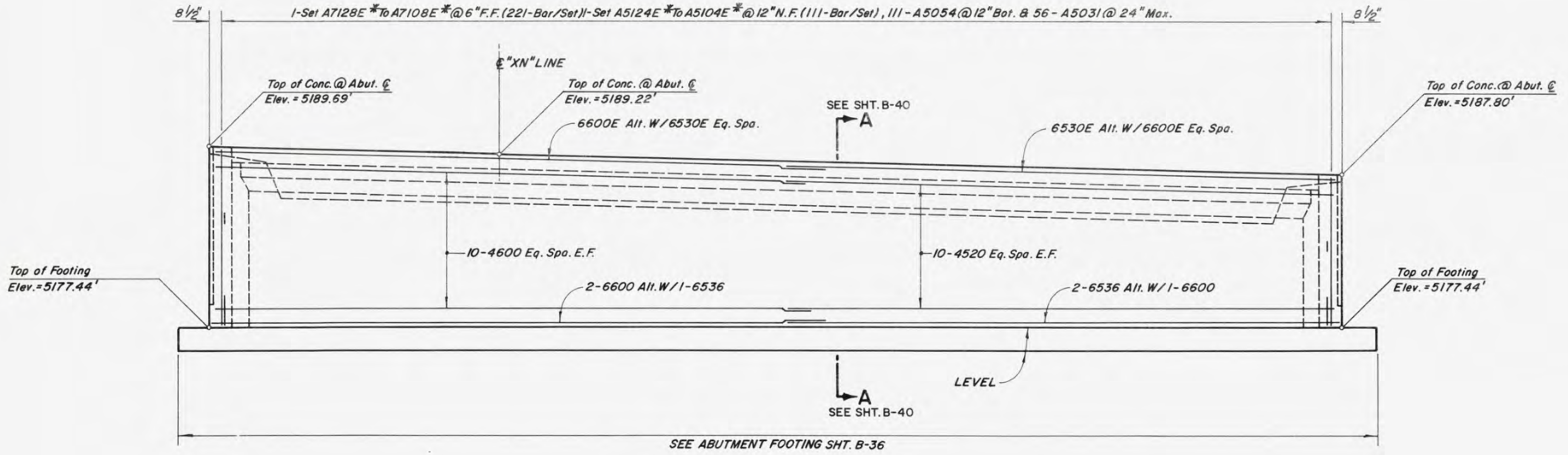
G-1748N

FED RD REG NO	STATE	PROJECT NO	COUNTY	SHEET NO
9	NEVADA	F-395-2(11)	WASHOE	B-39

PBN-39



PLAN



ELEVATION

(ABUTMENT 2N LOOKING AHEAD ON LINE)

* EPOXY COAT TOP LEG OF BAR AND 1'-0" DOWN VERTICAL LEG. THE ENTIRE BAR MAY BE COATED AT THE CONTRACTORS EXPENSE.

MINIMUM BAR LAP

NO. 4 BAR TO NO. 4 BAR = 1'-6"
NO. 6 BAR TO NO. 6 BAR = 2'-6"

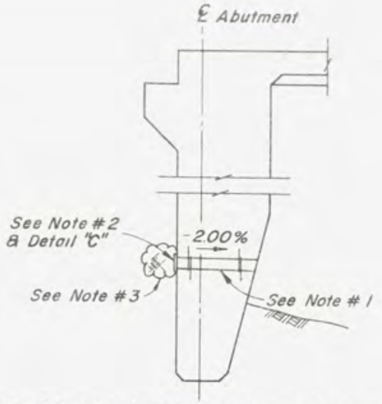
STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

US 395-WA 30.54
ABUTMENT NO. 2N

G-1748N

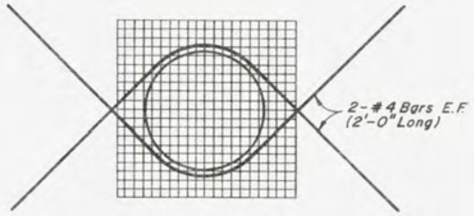
FED. RD. REG. NO.	STATE	PROJECT NO.	COUNTY	SHEET NO.
9	NEVADA	F-395-2(11)	WASHOE	B-40

PBN-40

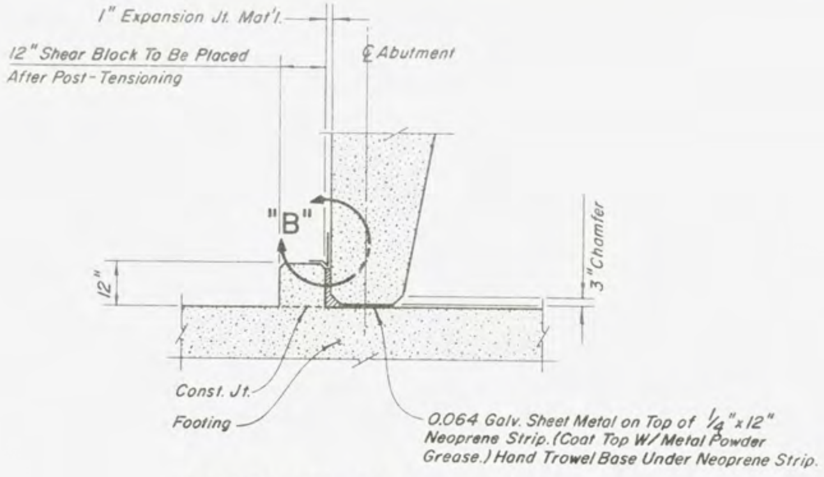


ABUTMENT WEEPHOLE DETAIL

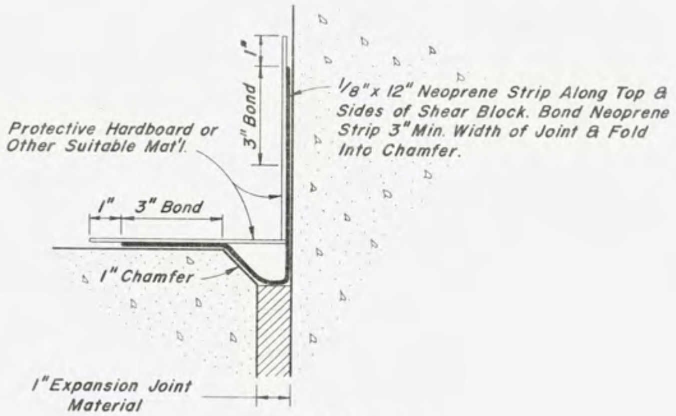
NOTES:
1. 4" Dia. Drains at 15'-0"± Ctrs. Located 3"± Above Finished Grade.
2. 6" Sq. Aluminum or Galvanized Steel Wire Mesh Hardware Cloth. (Min. Wire Dia. 0.03")
3. 1 Cu. Ft. of Pervious Backfill Material In A Burlap Sack Securely Tied



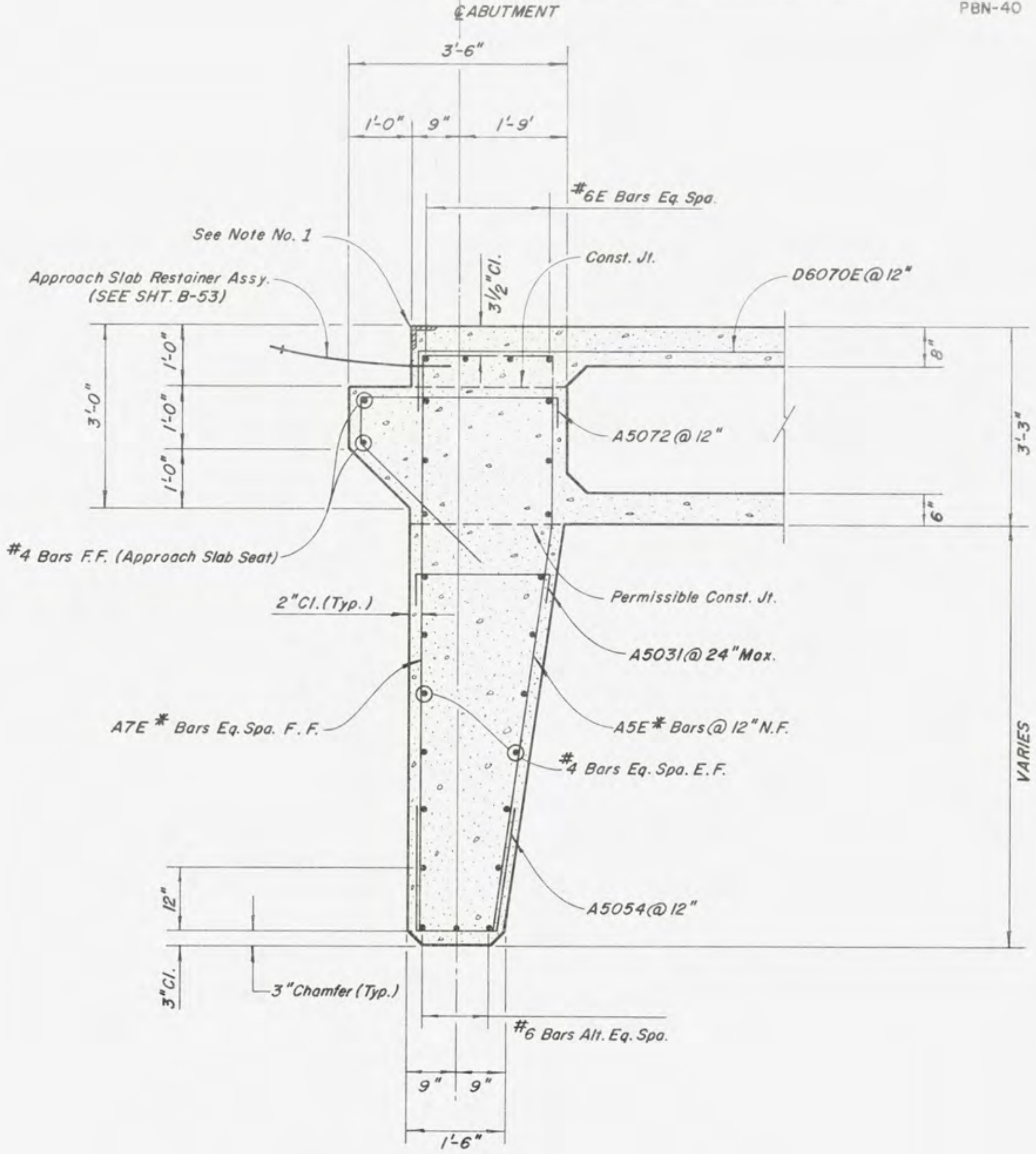
DETAIL "C"



ABUTMENT SEAT DETAIL



DETAIL "B"



SECTION A-A

NOTES:
1. SUPPORT ASSEMBLIES FOR STRIP SEAL EXPANSION JOINTS. SHALL BE INSTALLED BEFORE TOP SLAB OF STRUCTURE IS POURED.
2. BUNDLE VERTICAL ABUTMENT STEM BARS AT GIRDER STEM LOCATIONS, AS REQUIRED TO CLEAR PRESTRESSING DUCTS.

* EPOXY COAT TOP LEG OF BAR & 1'-0" DOWN VERT. LEG. THE ENTIRE BAR MAY BE EPOXY COATED AT THE CONTRACTORS EXPENSE.

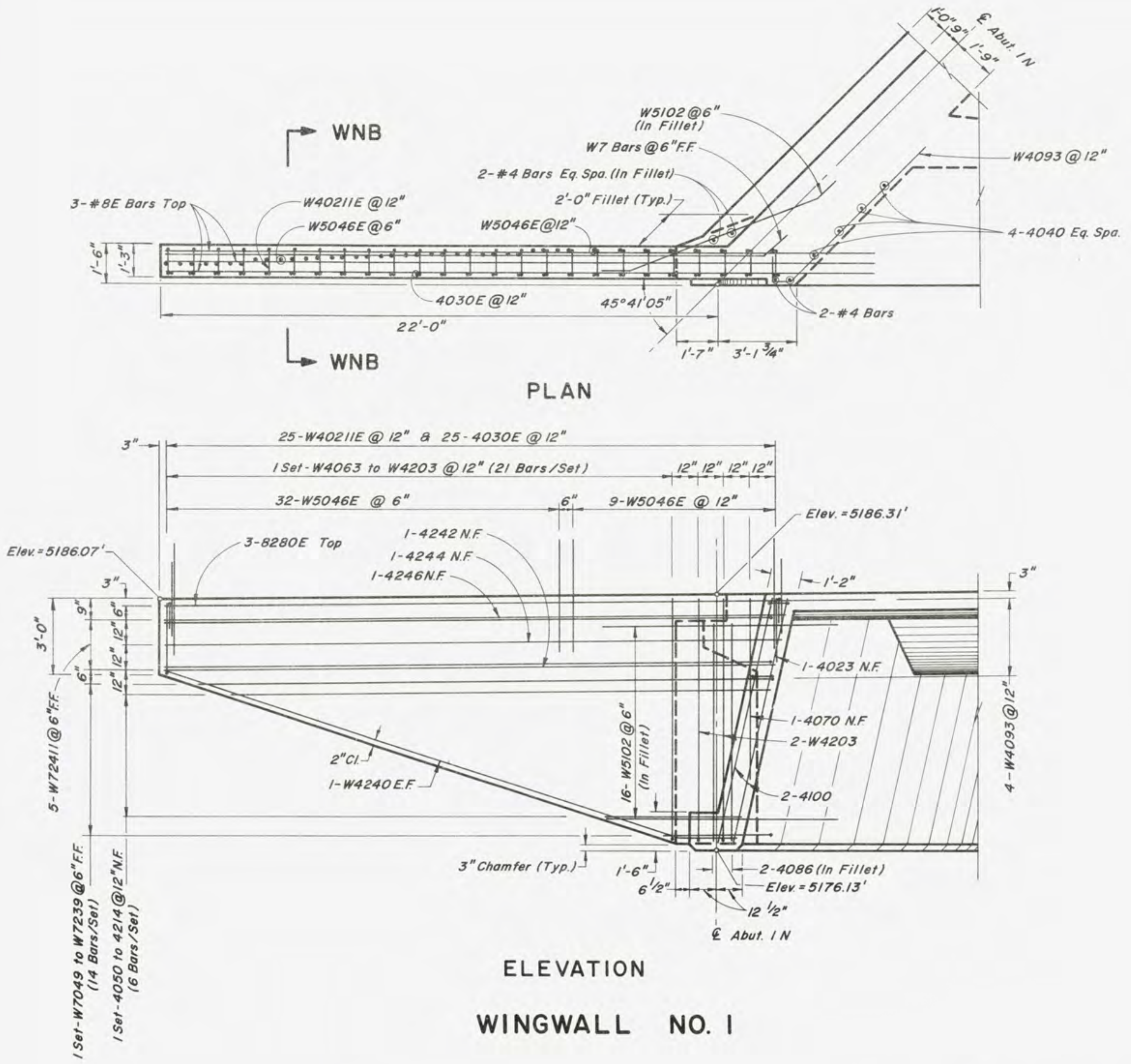
STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

US 395-WA 30.54
ABUTMENT DETAILS

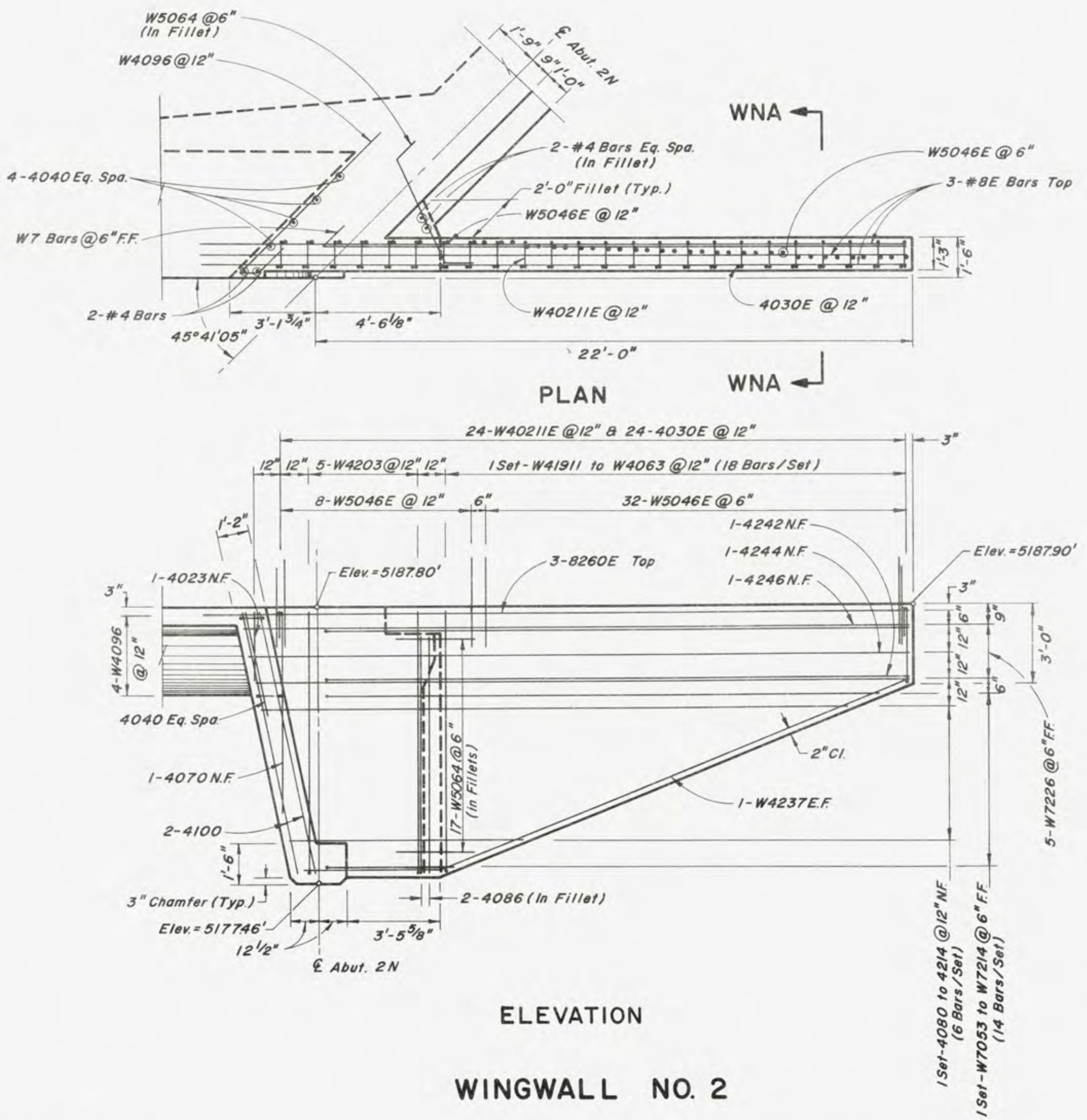
G-1748N

FED. RD. REG. NO.	STATE	PROJECT NO.	COUNTY	SHEET NO.
9	NEVADA	F-395-2(11)	WASHOE	B-41

PBN-41

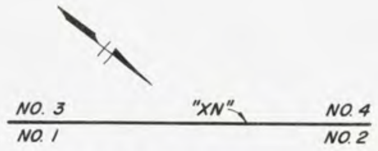


WINGWALL NO. 1



WINGWALL NO. 2

FOR SEC. WNA-WNA & WNB-WNB
SEE SHT. B-42



WINGWALL PATTERN

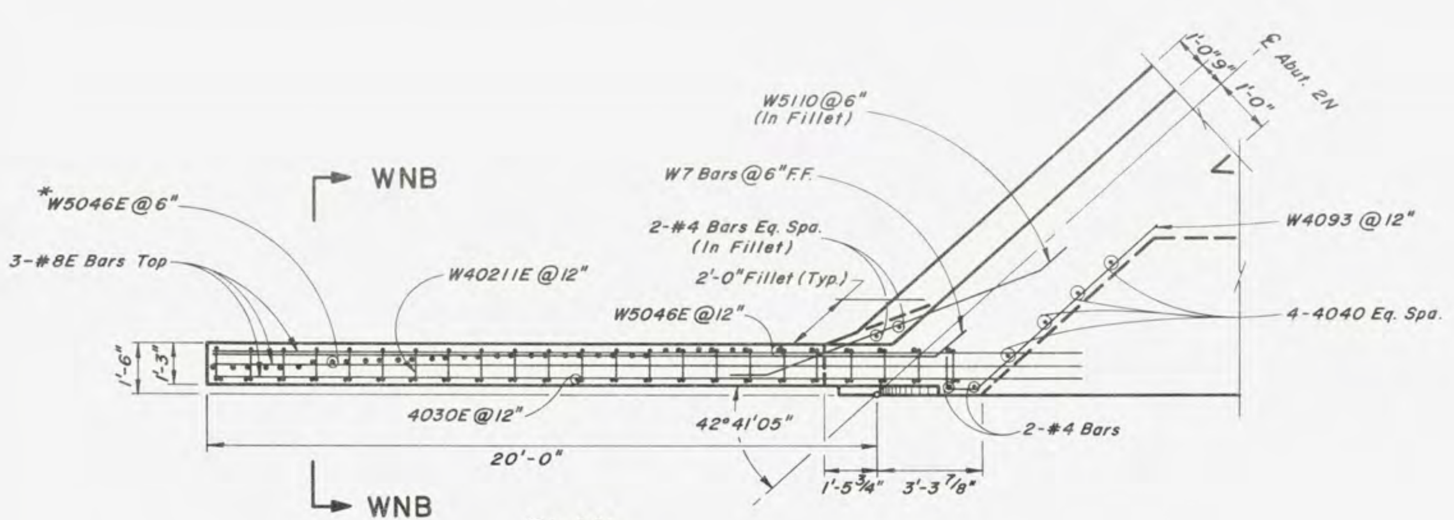
STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

US 395-WA 30.54
WINGWALL DETAILS
(NO. 1 & NO. 2)

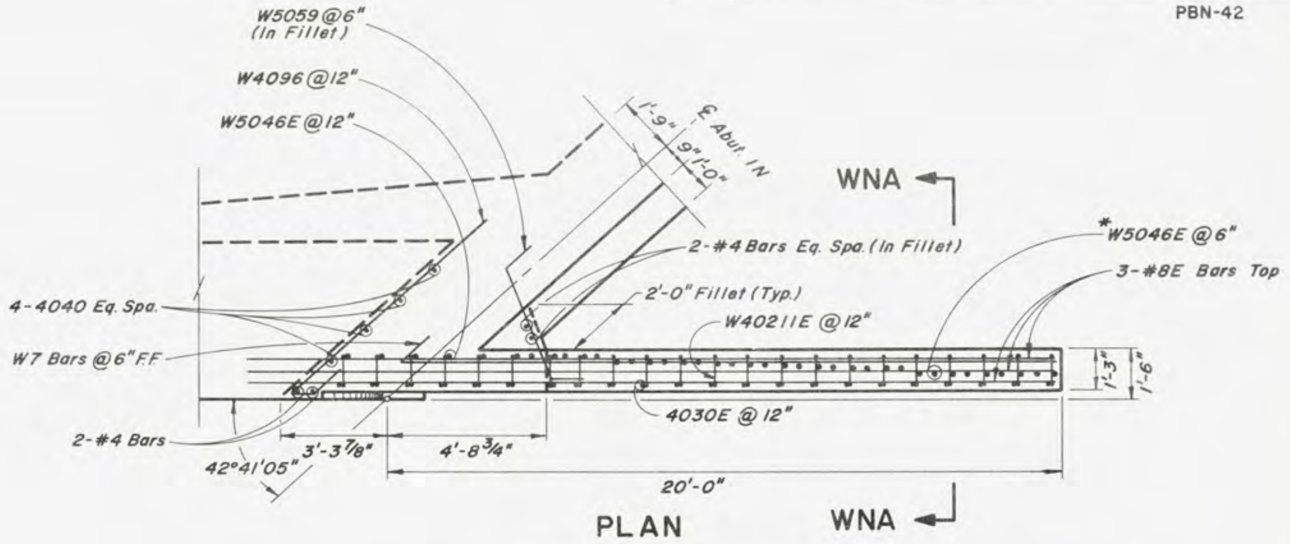
G-1748 N

FED. RD. REG. NO.	STATE	PROJECT NO.	COUNTY	SHEET NO.
9	NEVADA	F-395-2(11)	WASHOE	B-42

PBN-42



PLAN



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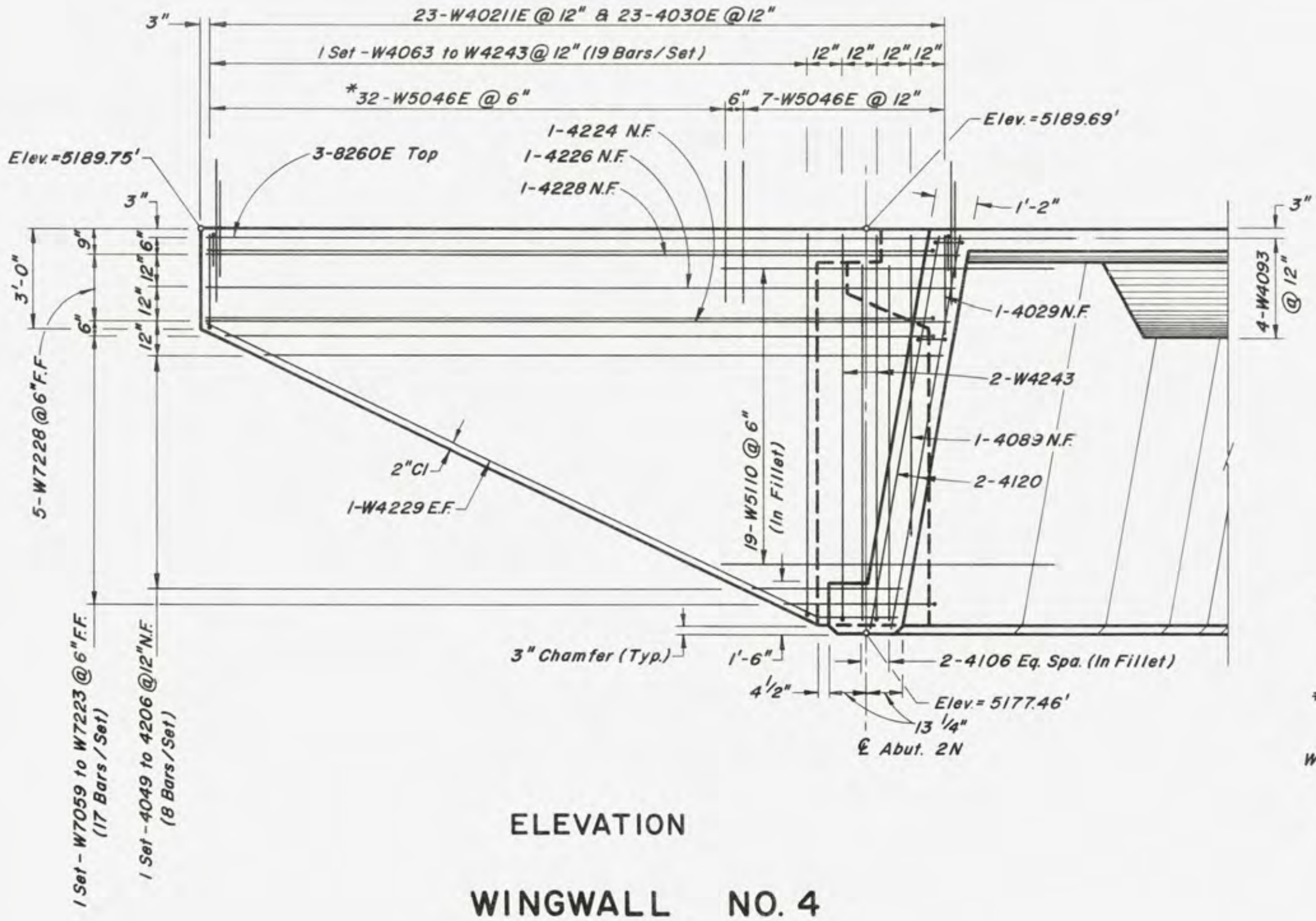
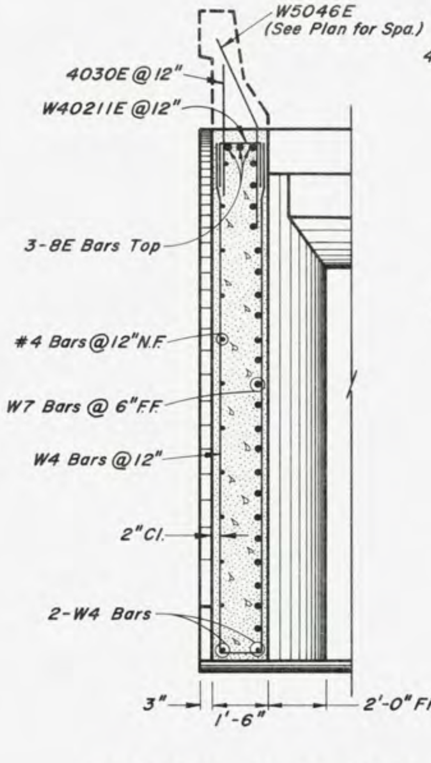
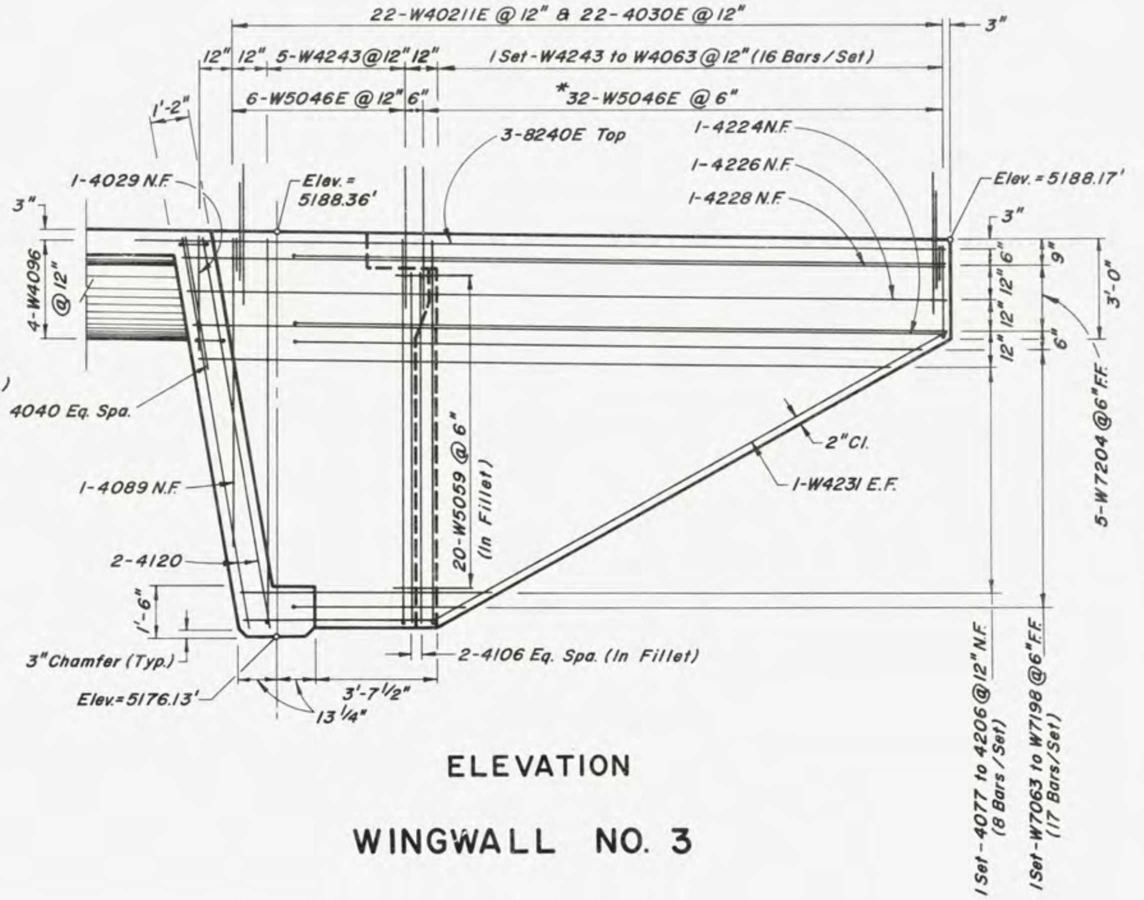


ELEVATION

WINGWALL NO. 4



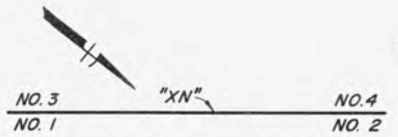
SECTION WNA-WNA
(WNB-WNB OPPOSITE HAND)



ELEVATION

WINGWALL NO. 3

* ADJUST LOCATIONS TO FIT GUARDRAIL-BRIDGE RAIL CONNECTION SEE STD. PLANS SHT. R-8.2.4



WINGWALL PATTERN

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

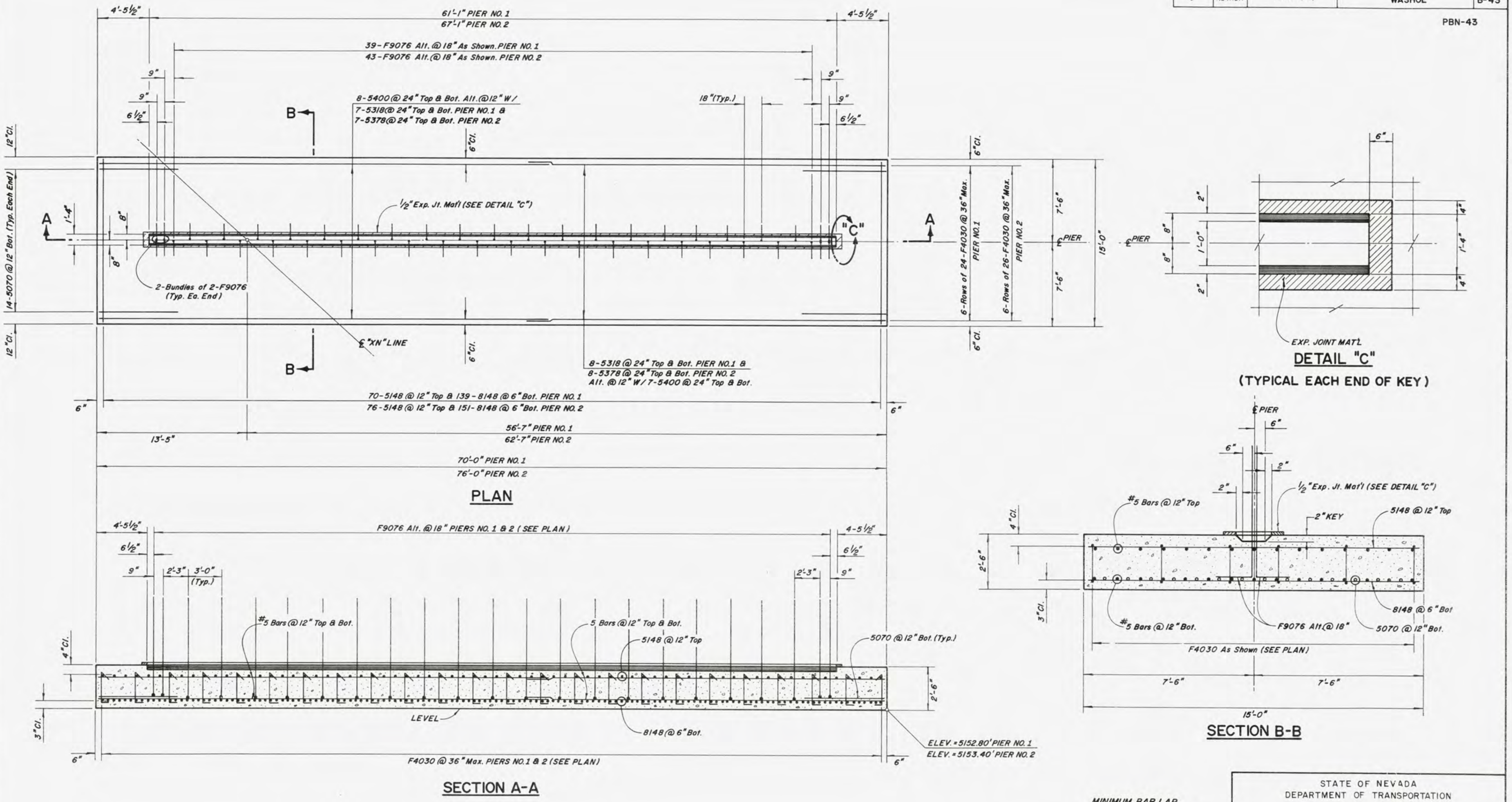
US 395-WA 30.54

WINGWALL DETAILS
(NO. 3 & NO. 4)

G-1748 N

FED. RD. REG. NO.	STATE	PROJECT NO.	COUNTY	SHEET NO.
9	NEVADA	F-395-2(11)	WASHOE	B-43

PBN-43



PLAN

DETAIL "C"

(TYPICAL EACH END OF KEY)

SECTION B-B

SECTION A-A

MINIMUM BAR LAP
NO. 5 BAR TO NO. 5 BAR = 2'-0"

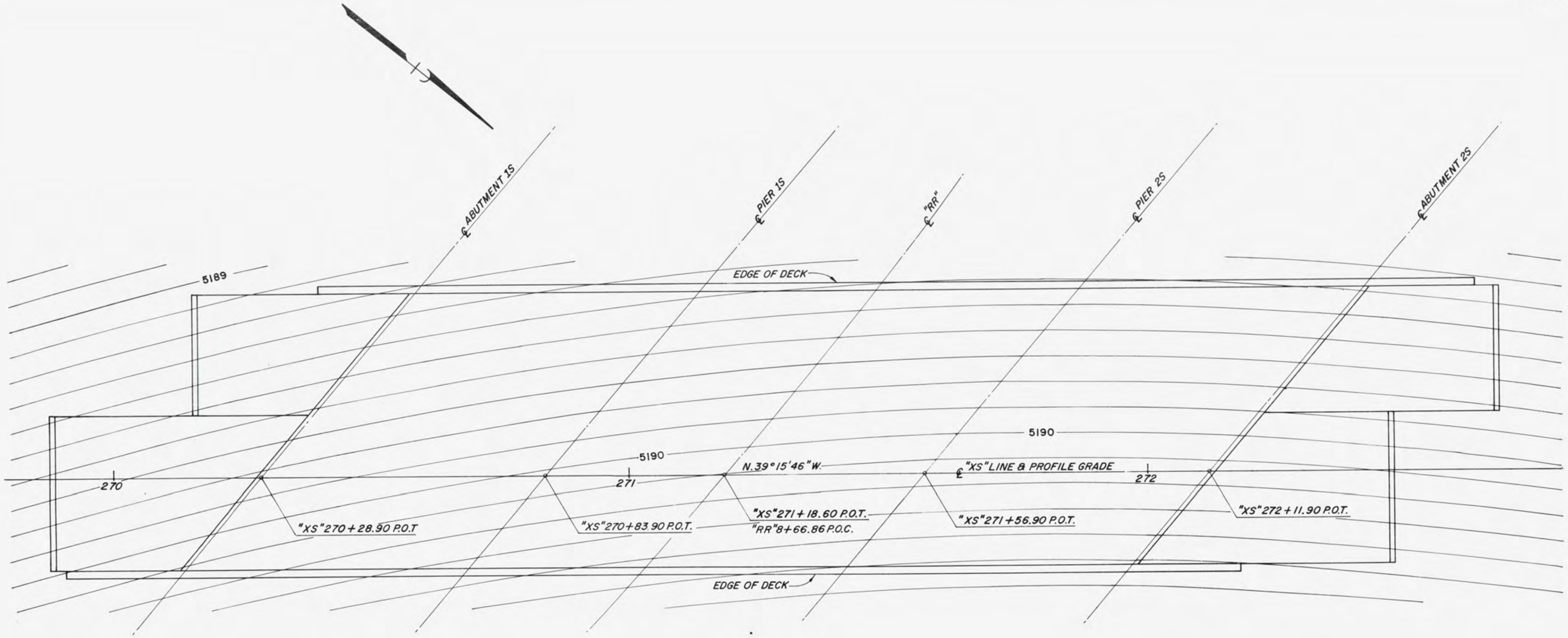
STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

US 395-WA 30.54
PIER FOOTING DETAILS

G-1748N

FED RD REG NO	STATE	PROJECT NO	COUNTY	SHEET NO
9	NEVADA	F-395-2(11)	WASHOE	B-60

PBS-60



DECK CONTOURS

NOTE: CONTOURS SHOWN ARE BASED ON PROFILE GRADE ELEVATIONS

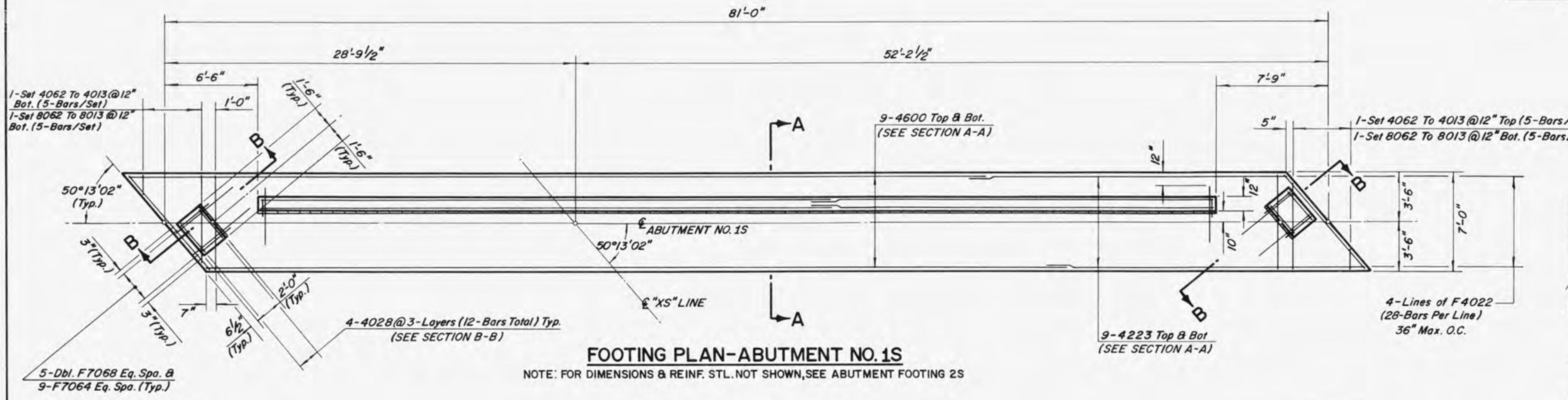
STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

US 395-WA 30.54
DECK CONTOURS

G-1748S

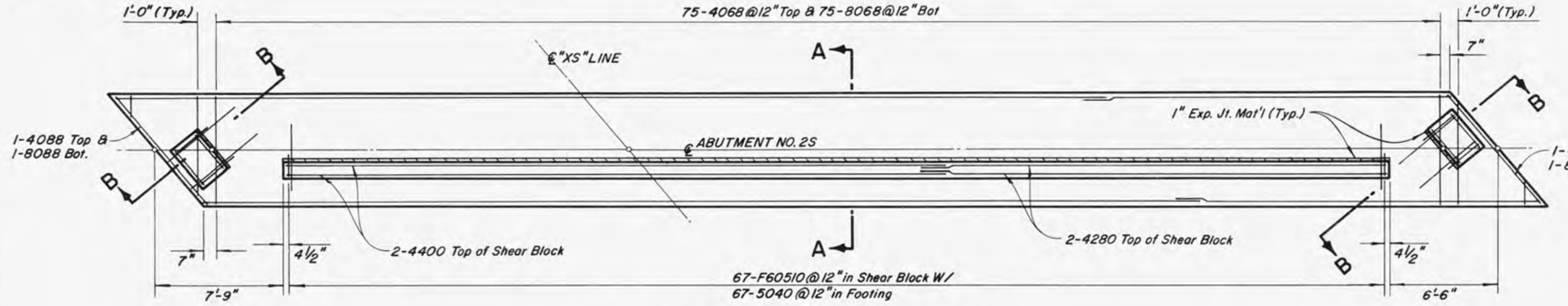
FED. RD. REG. NO.	STATE	PROJECT NO.	COUNTY	SHEET NO.
9	NEVADA	F-395-2(11)	**WASHOE**	**B-61**

PBS-61



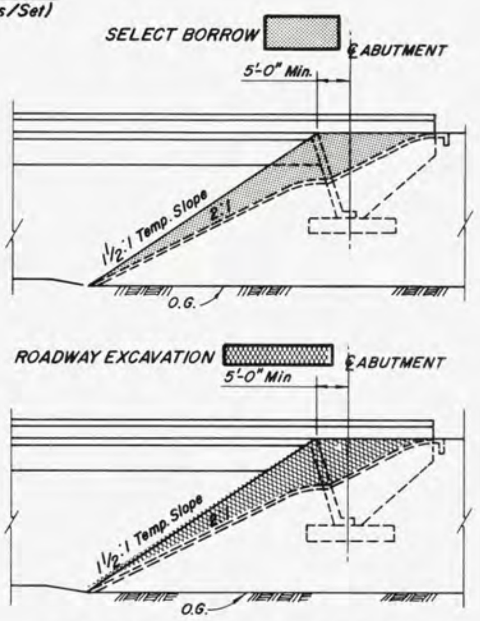
FOOTING PLAN-ABUTMENT NO. 1S

NOTE: FOR DIMENSIONS & REINF. STL. NOT SHOWN, SEE ABUTMENT FOOTING 2S



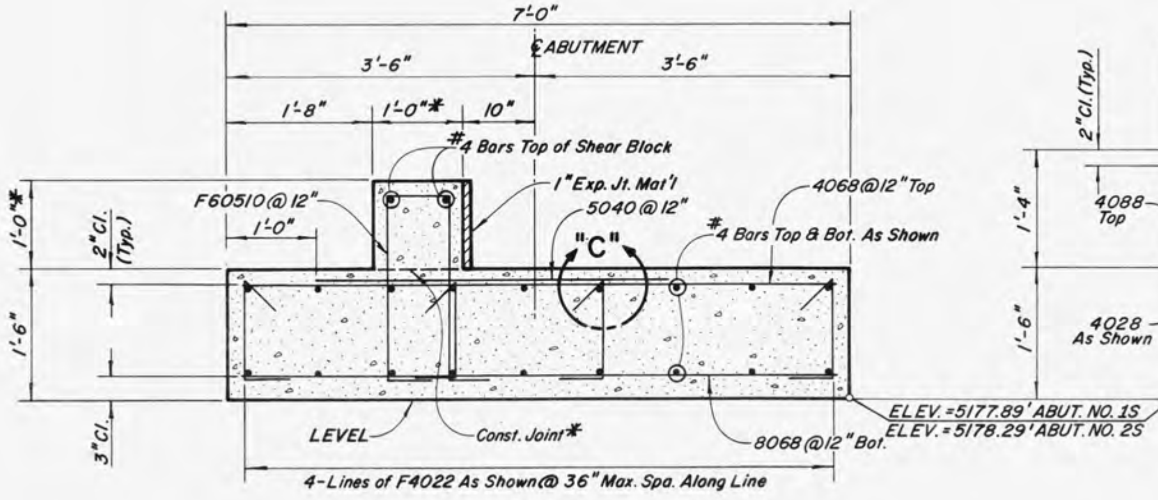
FOOTING PLAN-ABUTMENT NO. 2S

NOTE: FOR DIMENSIONS & REINF. STL. NOT SHOWN, SEE ABUTMENT FOOTING 1S



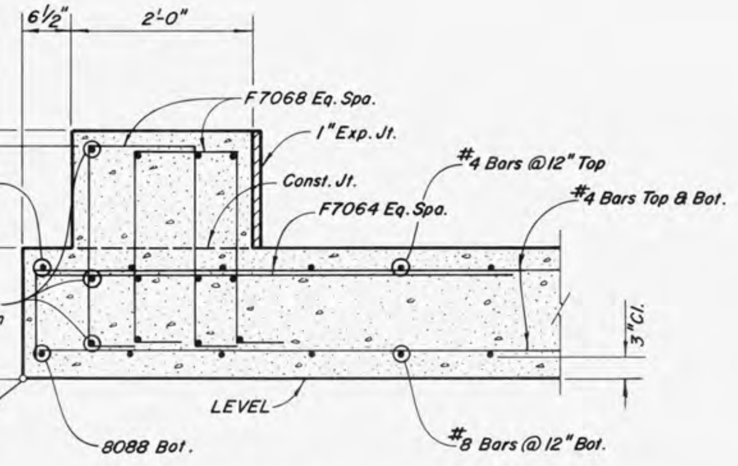
TEMPORARY FILL ELEVATIONS

NOTES:
1. CONSTRUCT TEMPORARY FILL
2. TEMPORARY FILL TO BE IN PLACE FOR 30 DAYS PRIOR TO CONSTRUCTION OF THE ABUTMENT FOOTINGS
3. TEMPORARY FILL TO BE PAID FOR AS ROADWAY ITEMS.

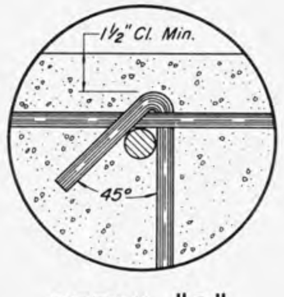


SECTION A-A

*SHEAR BLOCK NOT TO BE PLACED UNTILL STRESSING IS COMPLETED



SECTION B-B



DETAIL "C"

MINIMUM BAR LAP

NO. 4 BAR TO NO. 4 BAR = 1'-6"

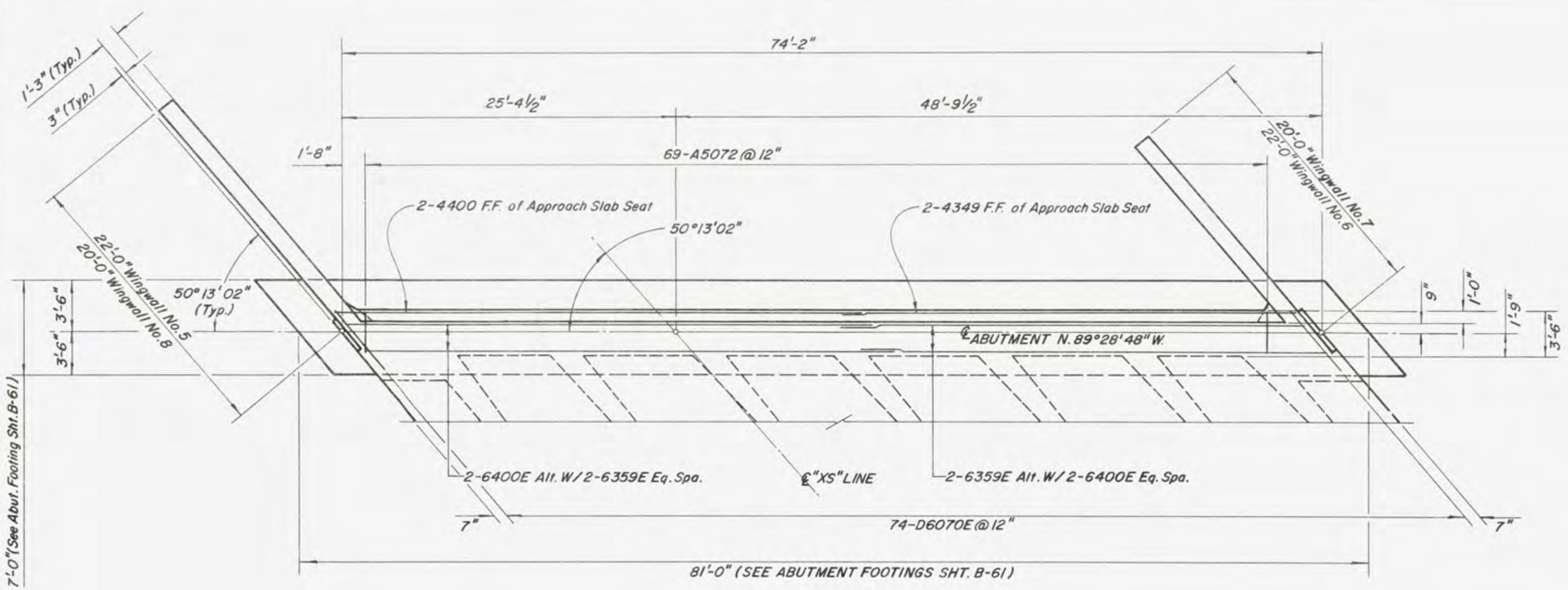
STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

US 395-WA 30.54
ABUTMENT FOOTINGS
& TEMP. FILL ELEVS.

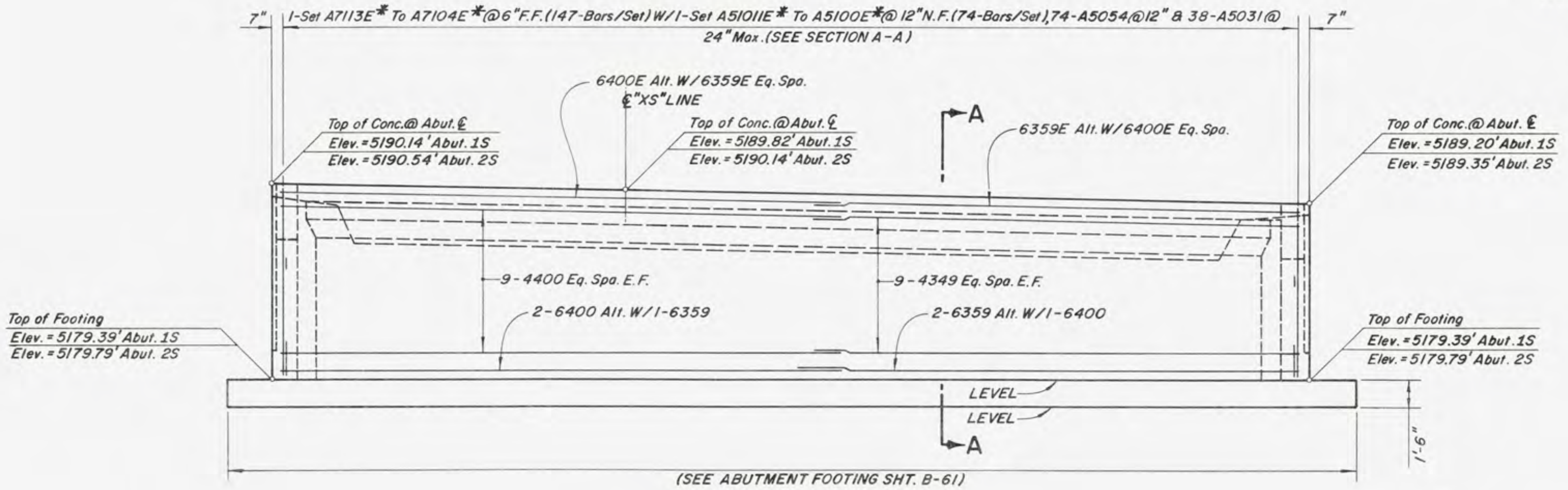
G-1748S

FED. RD. REG. NO.	STATE	PROJECT NO.	COUNTY	SHEET NO.
9	NEVADA	F-395-2(11)	WASHOE	B-62

PBS-62



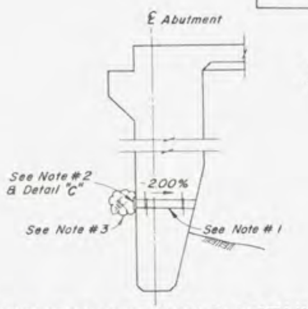
PLAN



ELEVATION

ABUTMENT 1S LOOKING BACK ON LINE
(ABUTMENT 2S OPPOSITE HAND)

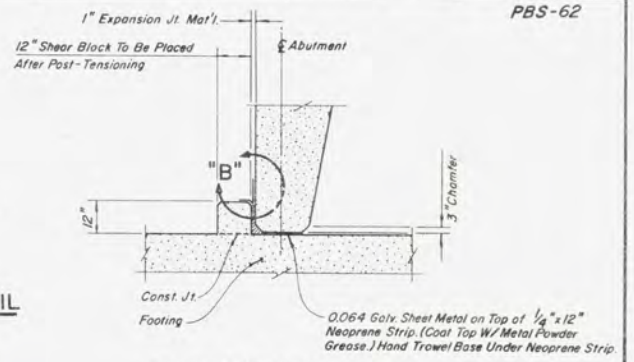
* EPOXY COAT TOP LEG OF BAR & 1'-0" DOWN VERT. LEG.
THE ENTIRE BAR MAY BE COATED AT THE CONTRACTORS EXPENSE.



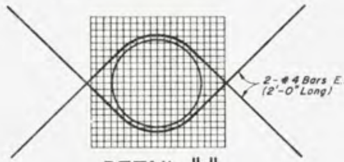
ABUTMENT WEEPHOLE DETAIL

NOTES:

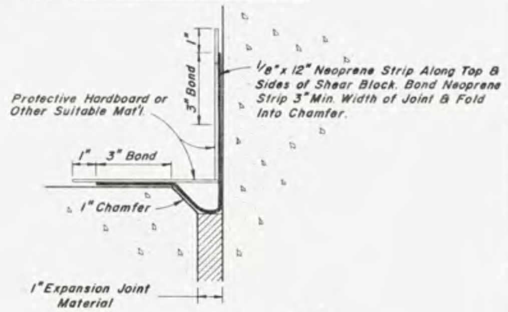
1. 4" Dia. Drains at 15'-0" ± Ctrs. Located 3" ± Above Finished Grade.
2. 6" Sq. Aluminum or Galvanized Steel Wire Mesh Hardware Cloth. (Min. Wire Dia. 0.03")
3. 1 Cu. Ft. of Pervious Backfill Material In A Burlap Sack Securely Tied.



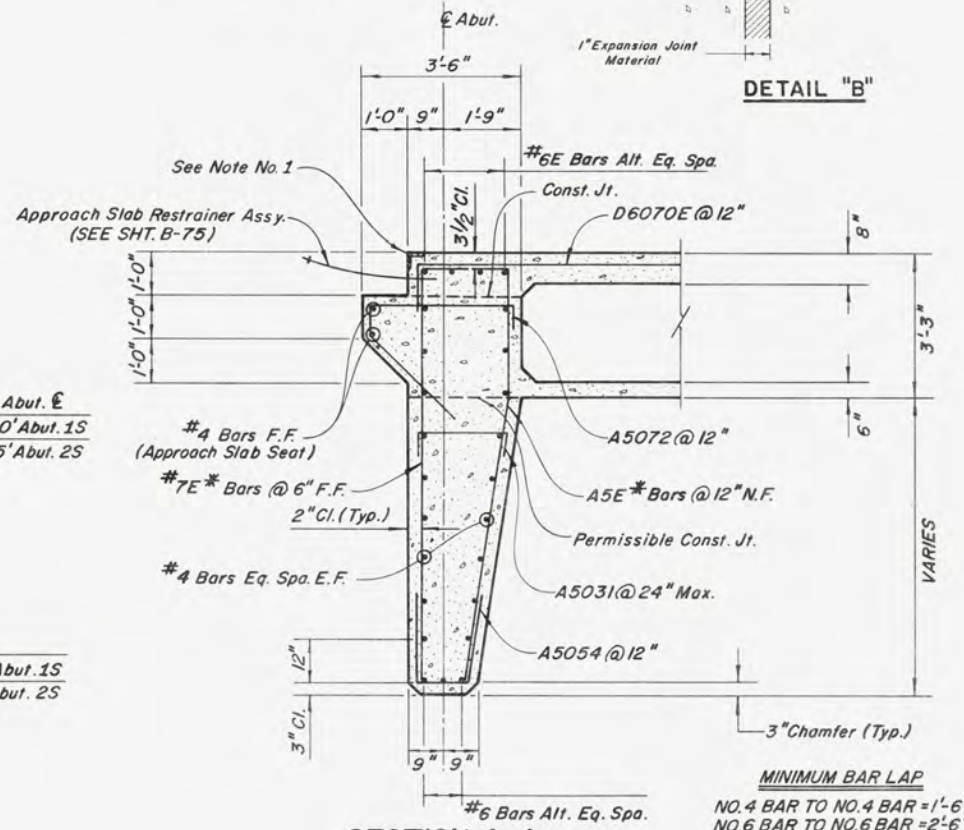
ABUTMENT SEAT DETAIL



DETAIL "C"



DETAIL "B"



SECTION A-A

MINIMUM BAR LAP
NO. 4 BAR TO NO. 4 BAR = 1'-6"
NO. 6 BAR TO NO. 6 BAR = 2'-6"

NOTES:

1. SUPPORT ASSEMBLIES FOR STRIP SEAL EXPANSION JOINTS. SHALL BE INSTALLED BEFORE TOP SLAB OF STRUCTURE IS POURED.
2. BUNDLE VERTICAL ABUTMENT STEM BARS AT GIRDER STEM LOCATIONS, AS REQUIRED TO CLEAR PRESTRESSING DUCTS.

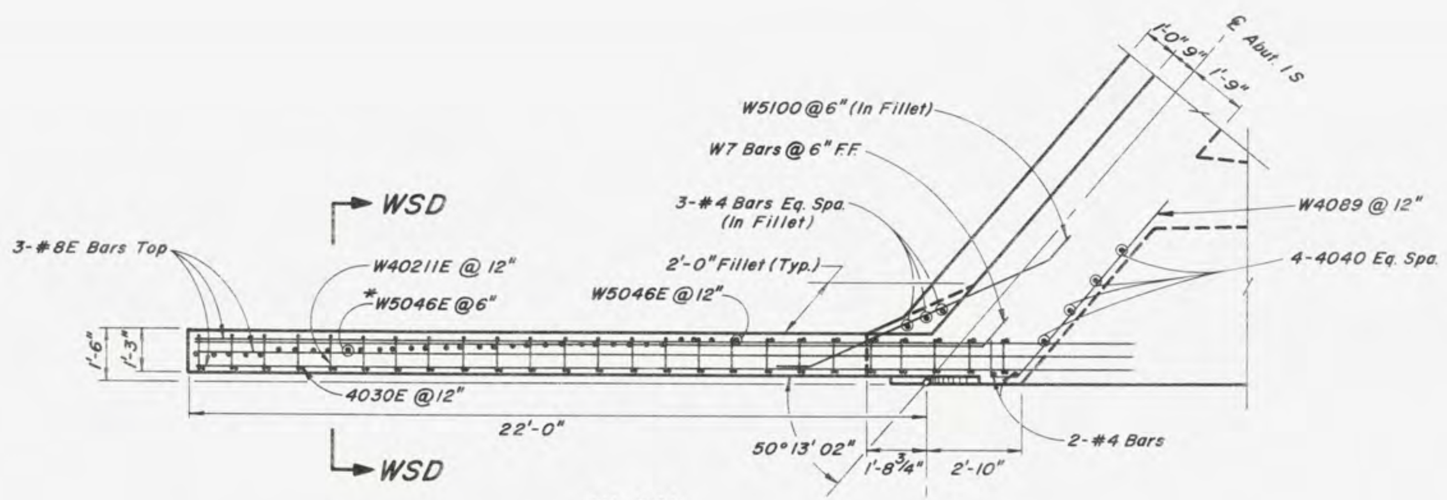
STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

US 395-WA 30.54
ABUTMENTS 1S & 2S

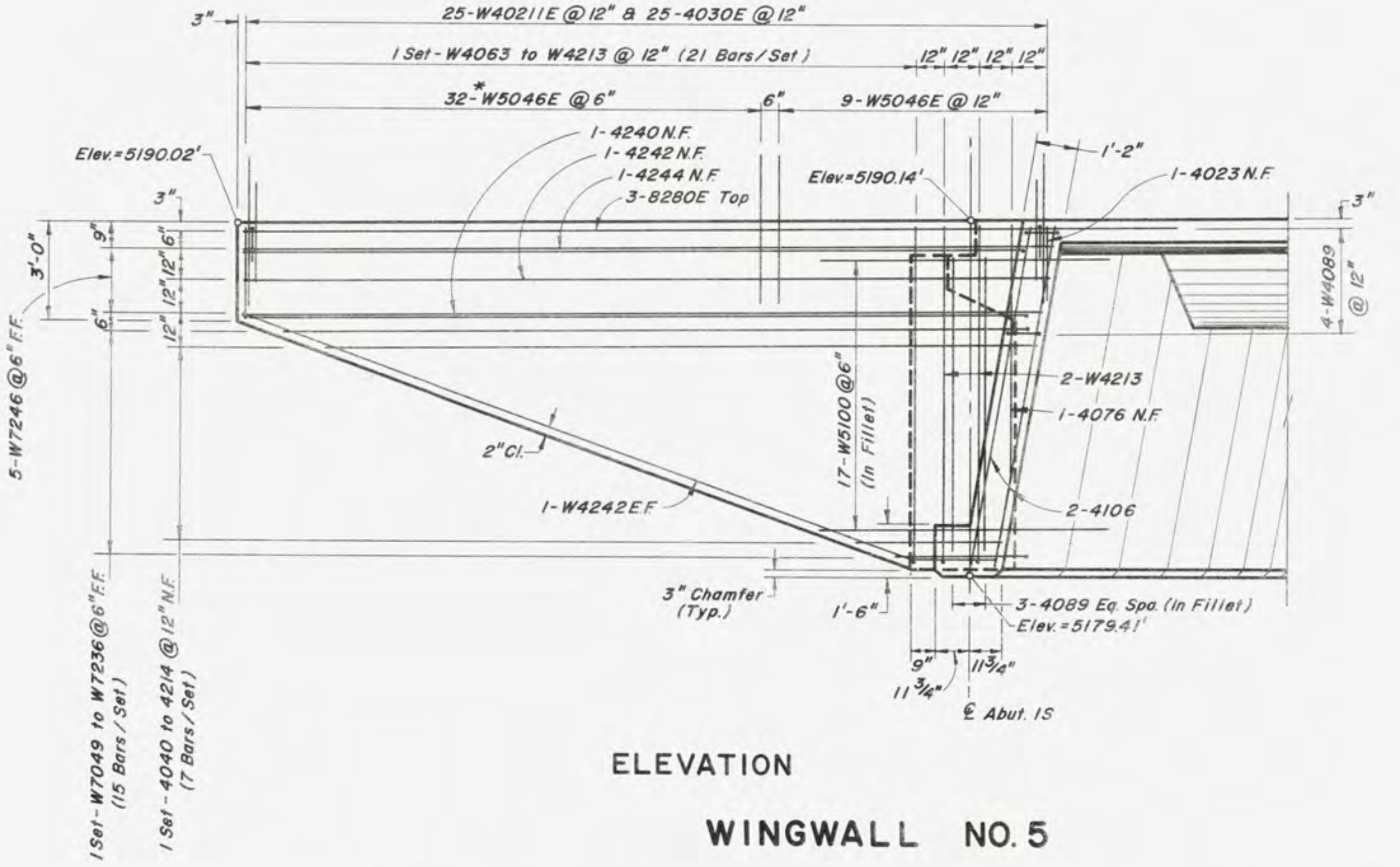
G-1748 S

FED. RD. REG. NO.	STATE	PROJECT NO.	COUNTY	SHEET NO.
9	NEVADA	F-395-2(11)	WASHOE	B-63

PBS-63

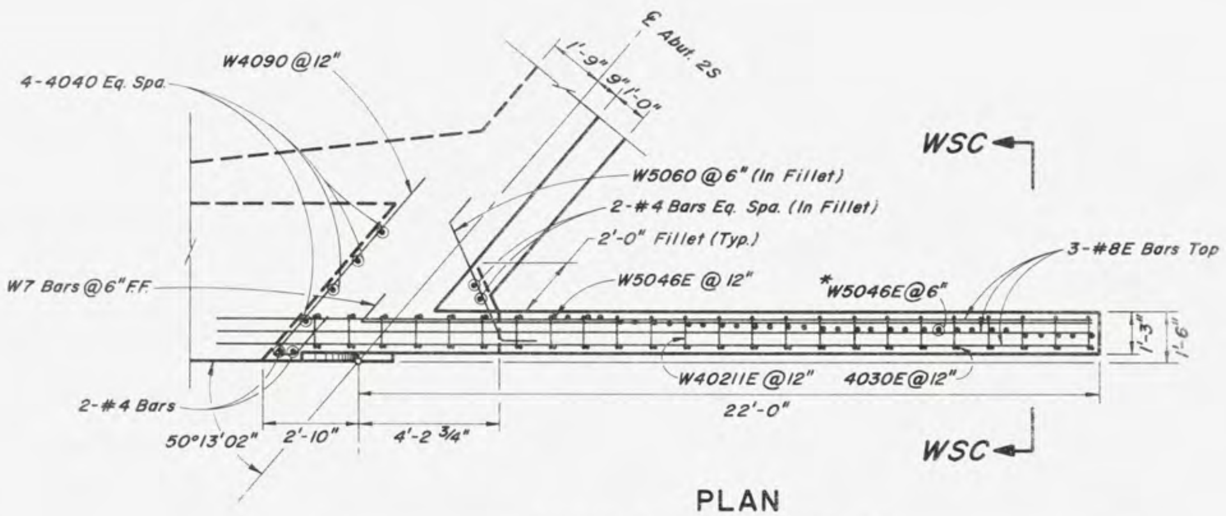


PLAN

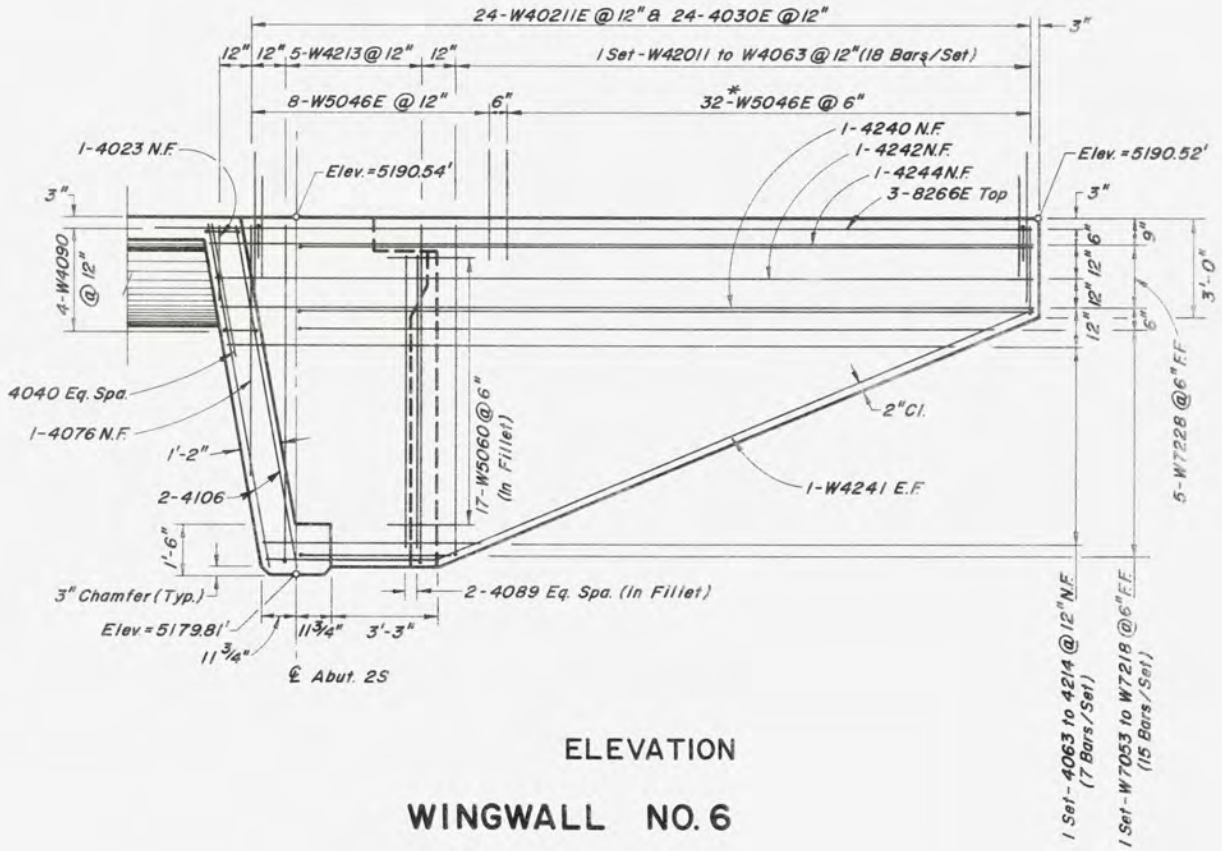


ELEVATION

WINGWALL NO. 5



PLAN



ELEVATION

WINGWALL NO. 6

*ADJUST LOCATIONS TO FIT GUARDRAIL - BRIDGE RAIL CONNECTION SEE STD. PLANS SHT. R-8.2.4

FOR SEC. WSC-WSC & WSD-WSD SEE SHT. B-64

WINGWALL PATTERN

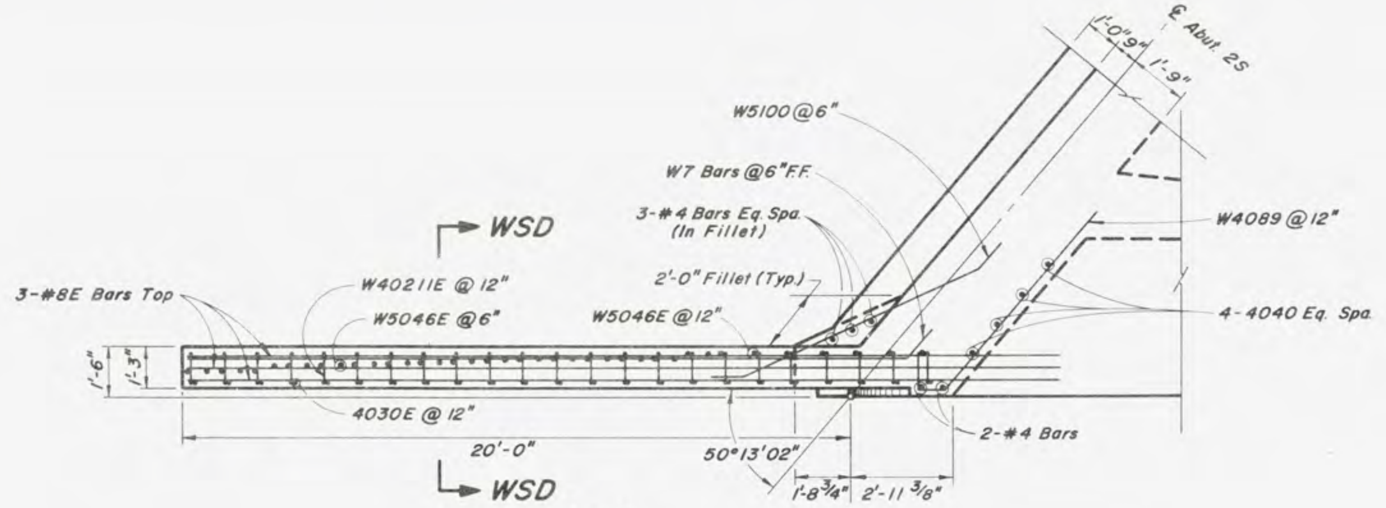
STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

US 395-WA 30.54
WINGWALL DETAILS
(NO. 5 & NO. 6)

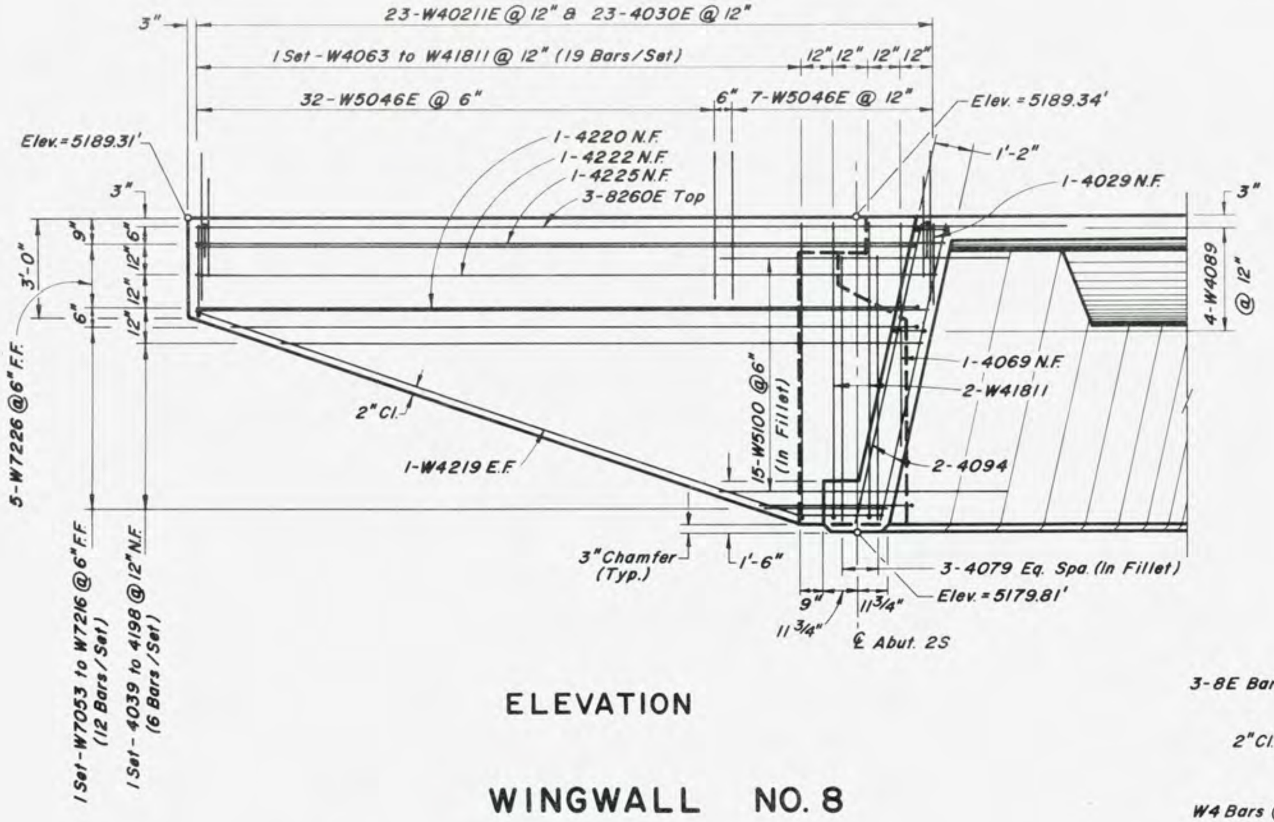
G-1748S

FED RD REG NO	STATE	PROJECT NO	COUNTY	SHEET NO
9	NEVADA	F-395-2(11)	WASHOE	B-64

PBS-64

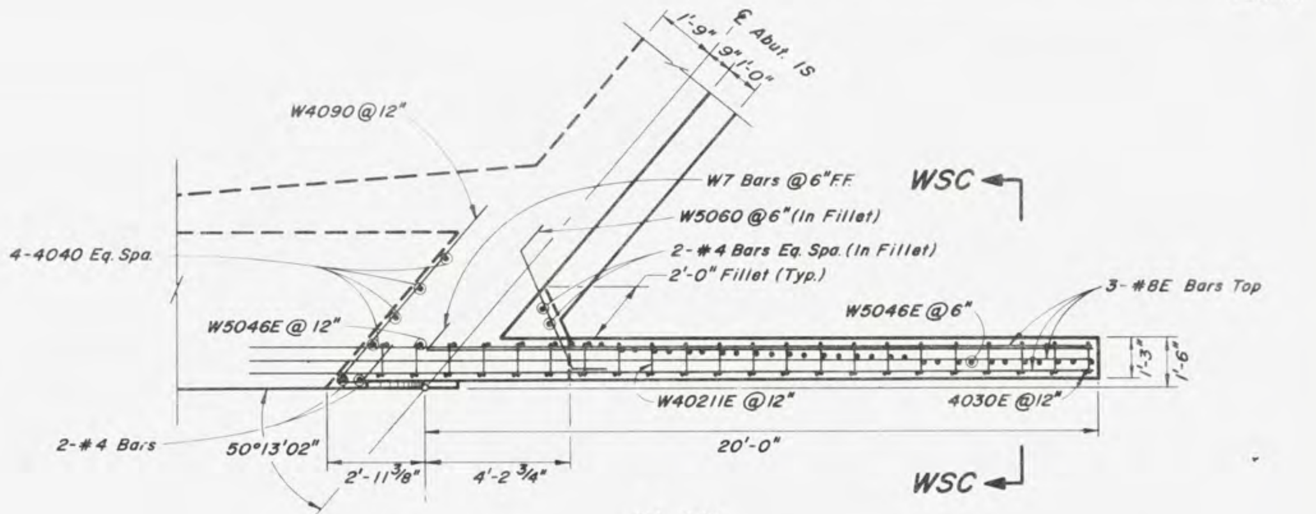


PLAN

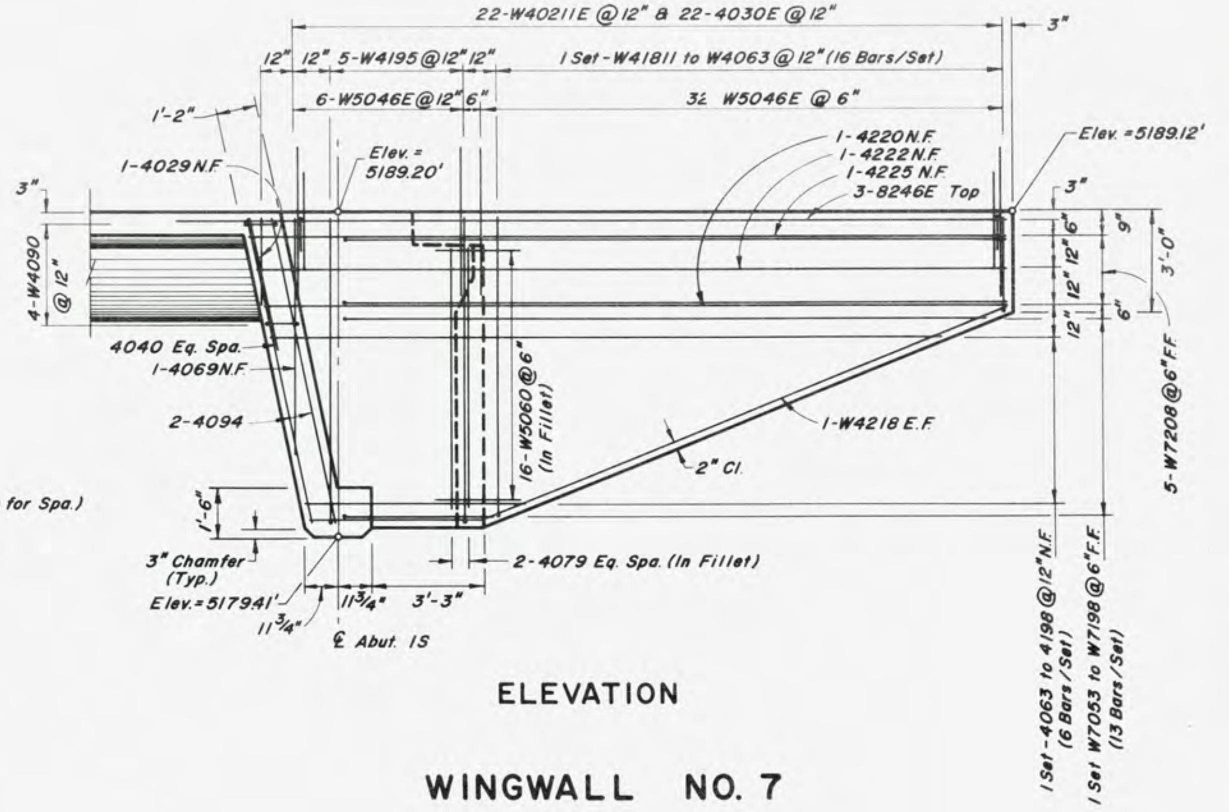


ELEVATION

WINGWALL NO. 8

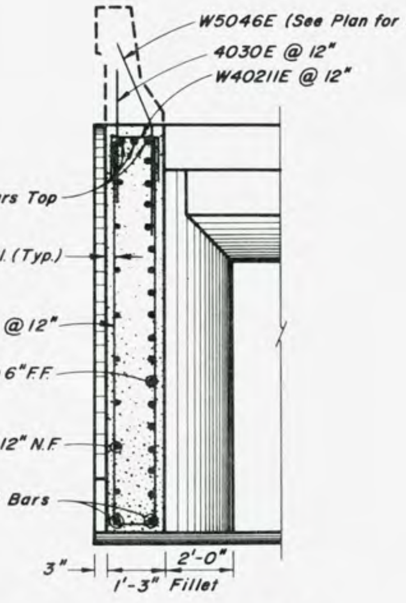


PLAN



ELEVATION

WINGWALL NO. 7



SECTION WSC-WSC

(WSD-WSD OPPOSITE HAND)

WINGWALL PATTERN

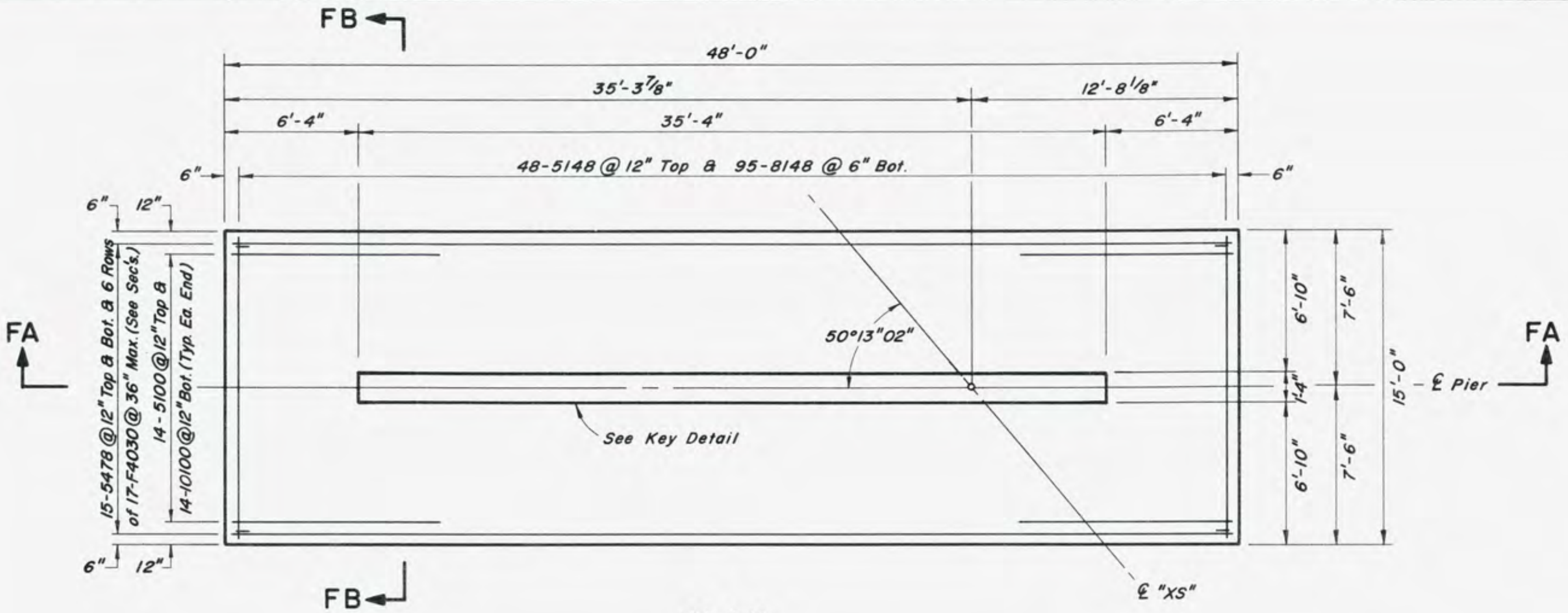
STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

US 395-WA 30.54
WINGWALL DETAILS
(NO. 7 & NO. 8)

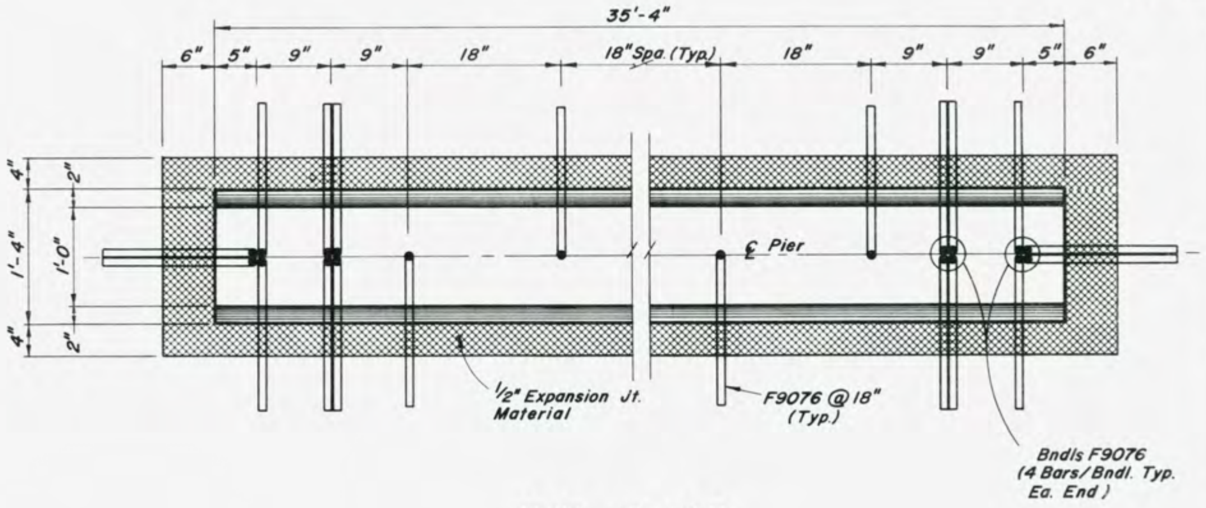
G-1748S

FED. RD. REG. NO.	STATE	PROJECT NO.	COUNTY	SHEET NO.
9	NEVADA	F-395-2(11)	WASHOE	B-65

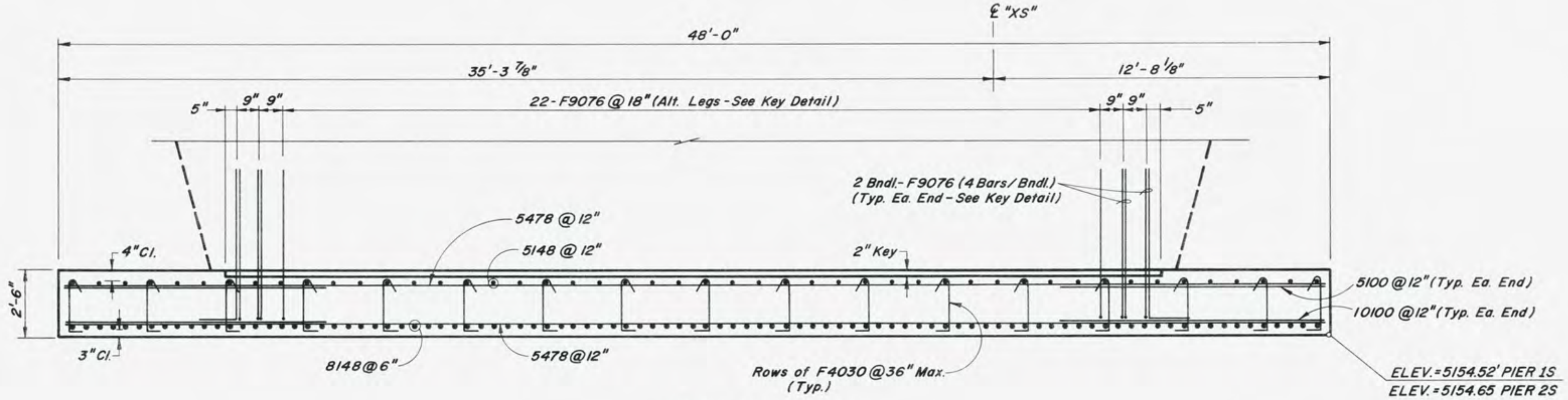
PBS-65



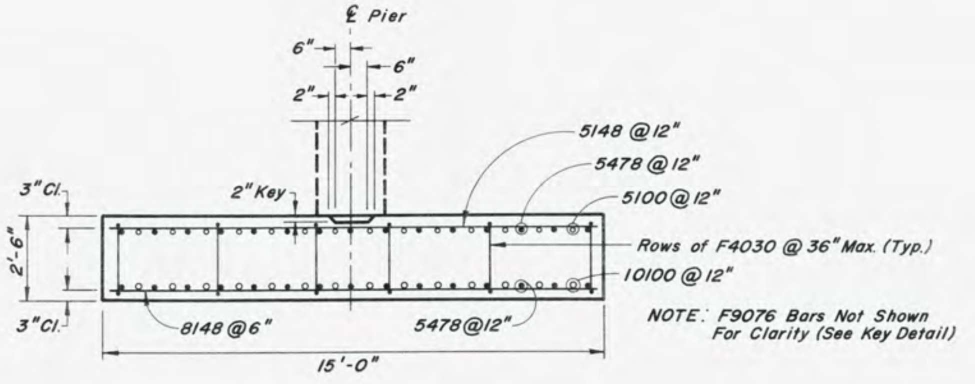
PLAN



KEY DETAIL
(PLAN)



SECTION FA-FA



NOTE: F9076 Bars Not Shown For Clarity (See Key Detail)

SECTION FB-FB

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

US 395-WA 30.54
PIER FOOTING DETAILS

G-1478S

APPENDIX D

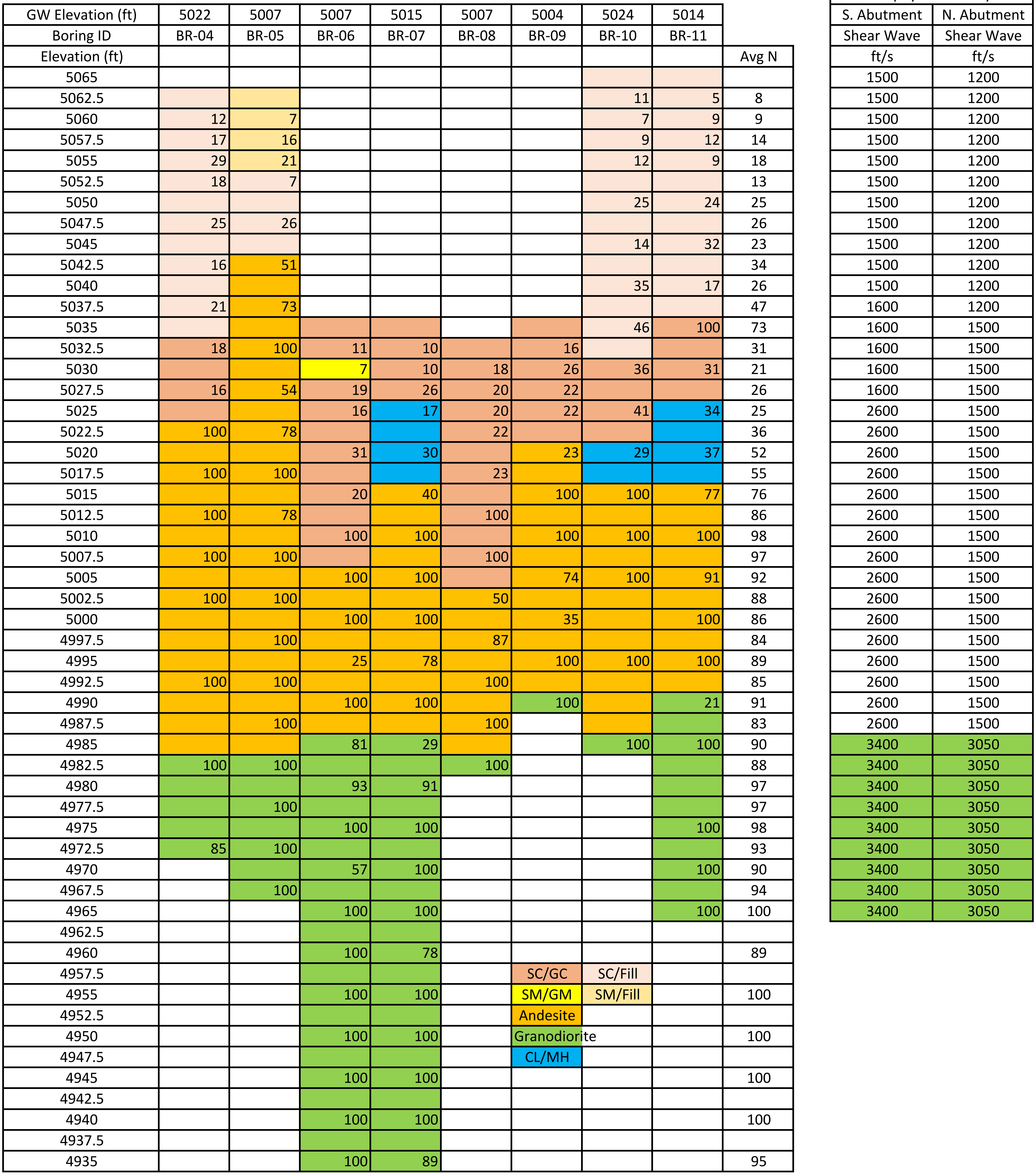
Geotechnical Profiles for Bridges and Retaining Walls, Tables D-1 to D-9

Lateral Soil Parameters for Bridge G-1092, Table D-10

Table D-1 : Bridge G-1092 Subsurface Profile
Phase 1B: US395 North Valleys
Washoe County, Nevada

Bridge G-1092N	**South Abutment**	**Pier 1**	**Pier 2**	**Pier 3**	**Pier 4**	**North Abutment**
BOF Elevation (ft)	5054.4	5020.8	5021.2	5021.5	5021.7	5055.5
Exist. Footing Dim. (ft)	44'x5'	6.5'x6.5'	8'x8'	8'x8'	6.5'x6.5'	44'x5'
Prop. Footing Dim. (ft)	75'x5'	6.5'x6.5'	8'x8'	8'x8'	6.5'x6.5'	75'x5'

Bridge G-1092S	**South Abutment**	**Pier 1**	**Pier 2**	**Pier 3**	**Pier 4**	**North Abutment**
BOF Elevation (ft)	5054.1	5020.6	5020.9	5021.3	5021.6	5055.3
Exist. Footing Dim. (ft)	44'x5'	6.5'x6.5'	8'x8'	8'x8'	6.5'x6.5'	44'x5'
Prop. Footing Dim. (ft)	75'x5'	6.5'x6.5'	8'x8'	8'x8'	6.5'x6.5'	75'x5'



										Geophysical Surveys	
GW Elevation (ft)	5022	5007	5007	5015	5007	5004	5024	5014		S. Abutment	N. Abutment
Boring ID	BR-04	BR-05	BR-06	BR-07	BR-08	BR-09	BR-10	BR-11		Shear Wave	Shear Wave
Elevation (ft)									Avg N	ft/s	ft/s
5065										1500	1200
5062.5							11	5	8	1500	1200
5060	12	7					7	9	9	1500	1200
5057.5	17	16					9	12	14	1500	1200
5055	29	21					12	9	18	1500	1200
5052.5	18	7							13	1500	1200
5050							25	24	25	1500	1200
5047.5	25	26							26	1500	1200
5045							14	32	23	1500	1200
5042.5	16	51							34	1500	1200
5040							35	17	26	1500	1200
5037.5	21	73							47	1600	1200
5035							46	100	73	1600	1500
5032.5	18	100	11	10		16			31	1600	1500
5030			7	10	18	26	36	31	21	1600	1500
5027.5	16	54	19	26	20	22			26	1600	1500
5025			16	17	20	22	41	34	25	2600	1500
5022.5	100	78			22				36	2600	1500
5020			31	30		23	29	37	52	2600	1500
5017.5	100	100			23				55	2600	1500
5015			20	40		100	100	77	76	2600	1500
5012.5	100	78			100				86	2600	1500
5010			100	100		100	100	100	98	2600	1500
5007.5	100	100			100				97	2600	1500
5005			100	100		74	100	91	92	2600	1500
5002.5	100	100			50				88	2600	1500
5000			100	100		35		100	86	2600	1500
4997.5		100			87				84	2600	1500
4995			25	78		100	100	100	89	2600	1500
4992.5	100	100			100				85	2600	1500
4990			100	100		100		21	91	2600	1500
4987.5		100			100				83	2600	1500
4985			81	29			100	100	90	3400	3050
4982.5	100	100			100				88	3400	3050
4980			93	91					97	3400	3050
4977.5		100							97	3400	3050
4975			100	100				100	98	3400	3050
4972.5	85	100							93	3400	3050
4970			57	100				100	90	3400	3050
4967.5		100							94	3400	3050
4965			100	100				100	100	3400	3050
4962.5											
4960			100	78					89		
4957.5						SC/GC	SC/Fill				
4955			100	100		SM/GM	SM/Fill		100		
4952.5						Andesite					
4950			100	100		Granodiorite			100		
4947.5						CL/MH					
4945			100	100					100		
4942.5											
4940			100	100					100		
4937.5											
4935			100	89					95		

Table D-2 : Bridge G-1748 Subsurface Profile
Phase 1B: US395 North Valleys
Washoe County, Nevada

Bridge G-1748N	S. Abutment	Pier 1	Pier 2	N. Abutment
BOF Elevation (ft)	5174.6	5152.8	5153.4	5175.9
Exist. Footing Dim. (ft)	104'x7'	70'x15'	76'x15'	119'x7'
Prop. Footing Dim. (ft)	122'x7'	96.5'x15'	102.5'x15'	137'x7'
Bridge G-1748S	S. Abutment	Pier 1	Pier 2	N. Abutment
BOF Elevation (ft)	5177.9	5154.5	5154.6	5178.3
Exist. Footing Dim. (ft)	81'x7'	48'x15'	48'x15'	81'x7'
Prop. Footing Dim. (ft)	92'x7'	66'x15'	66'x15'	92'x7'

						Geophysical Surveys	
GW Elevation (ft)	5111	5138	5102	NE		S. Abutment	N. Abutment
Boring ID	BR-20	BR-21	BR-22	BR-23		Shear Wave	Shear Wave
Elevation (ft)					Avg. N	ft/s	ft/s
5192.5							1000
5190			26	30			1000
5187.5	51		26	27	30		1000
5185	27	32	14	41	31		1000
5182.5	23	47	31	27	29		1000
5180	31	15			30		1000
5177.5		20	31	41	28		1000
5175	28				32		1000
5172.5		26	35	42	31		1000
5170	23				32		1000
5167.5		40	27	29	34		1000
5165	53				36		1000
5162.5		36	29	35	37	1650	1000
5160	33				31	1650	1000
5157.5		34	26	26	44	1650	1550
5155	100				57	1650	1550
5152.5		100	13	100	83	2200	1550
5150	100				86	2200	1550
5147.5		100	89	100	98	2200	1800
5145	100				88	2200	1800
5142.5		100	30	100	78	2200	1800
5140	61				77	2200	1800
5137.5		100	48	100	69	2200	1800
5135	38				76	2200	1800
5132.5		100	69		60	2200	3250
5130	32				75	2200	3250
5127.5		100	76		61	2200	3250
5125	36				78	2200	3250
5122.5			100		56	2200	3250
5120	33				83	2200	3250
5117.5		100	100		78	2750	3250
5115					100	2750	3250
5112.5			100		64	2750	3250
5110	28				76	2750	3250
5107.5			100		64	2750	3250
5105					88	2750	3250
5102.5			76		60	2750	3250
5100	44				73	2750	3250
5097.5			100		72	2750	3250
5095					64	2750	3250
5092.5			28		64	2750	3250
5090	100				64	2750	
5087.5						2750	
5085	SC/GC	SC/Fill				2750	
5082.5	SM/GM	SM/Fill				2750	
5080	Andesite					2750	
5077.5	Granodiorite					2750	
5075	CL/MH					2750	

Table D-3 : Retaining Walls RW1 and RW2 Subsurface Profiles
Phase 1B: US395 North Valleys
Washoe County, Nevada

Profile:	RW1A		RW1B											
Wall	Retaining Wall 1													
Wall								Retaining Wall 2						
GW Elev.												4649		
	RW1-01	RW1-02	SW1-01	RW1-03	SW1-02	RW1-04	SW1-03	RW1-05	RW2-07	SW1-04	RW1-06	RW2-08	SW1-05	SW1-06
Elevation														
4690														
4687.5														34
4685														38
4682.5														39
4680														73
4677.5												29	17	
4675												45	40	100
4672.5											48	76	38	
4670										100	100	34	31	100
4667.5									43	100	100			
4665									31	100	100	100	100	49
4662.5								26	58	100				
4660							47	19	27		100	100	100	
4657.5							37	36						
4655							27	65	24		38	41	100	
4652.5						31	23							
4650						37		34	100		100	100		
4647.5					44	39	27							
4645					100	65		43	51		100			
4642.5				20	82		23							
4640				22	100	100		100	59					
4637.5			76	16			31							
4635		18	100	22	100	100		100						
4632.5		12	100											
4630		19	100	85	100	100								
4627.5		13												
4625	16		100	39	100	100								
4622.5	15	15												
4620	21			33										
4617.5	24	100												
4615				100										
4612.5	17	100												
4610														
4607.5	13	100				SC/GC	SC/Fill							
4605						SM/GM	SM/Fill							
4602.5	22					Andesite								
4600						Granodiorite								
4597.5	47					CL/CH								
4595														

Table D-4 : Retaining Walls RW3, RW4 and RW5 Subsurface Profiles
Phase 1B: US395 North Valleys
Washoe County, Nevada

Profile	RW3A																RW3B								RW3C						
Wall	Retaining Wall 3																														
Wall																	Retaining Wall 4														
Wall																		Retaining Wall 5													
Seis. Line																											Line 732				
GW Elev.																	4903	4921		4918	4916							4957			
Boring ID	RW3-09	RW3-10	RW3-11	RW3-12	RW3-13	RW3-14	RW3-15	RW3-16	SW3-11	RW3-17	SW3-12	RW3-18	SW3-13	RW3-19	SW3-14	RW3-20	RW4-26	RW5-28	RW3-21	RW4-27	RW5-29	SW3-15	RW3-22	SW4-19	SW3-16	RW3-23	SW3-17	RW3-24	SW4-21	SW5-33	RW3-25
Elevation																															
5000																															
4997.5																															
4995																														38	100
4992.5																														58	100
4990																													100	65	100
4987.5																													100	100	100
4985																											45	23	100	100	
4982.5																											100	100	100		100
4980																											65	24		100	
4977.5																											100	65			100
4975																								65	41		100			100	
4972.5																								100	100	99		100			100
4970																							27	52	100	100	100			100	
4967.5																							10	31	100	100		100			
4965																							18		100	47	100				51
4962.5																					16	10	17	52				100			
4960																					17	15			100	100	100				
4957.5																15		34			84	43	30	55				100			
4955																22		24		23	24	28			100						
4952.5																31		18	8	15			20	100							
4950																38	11	23	42	16	37	44									
4947.5												17					11		17	100			100								
4945								33				13				100	76	31	23		100	100									
4942.5								38				14		10			91			20			61								
4940								28				13	30	53	26	65		100	32		19	100									
4937.5						15		22			21		12	66	30		18			39											
4935					19	17			36	41	5	22	9	21	35	100		100	11		27										
4932.5				86	22	14	49	35	18	24	8		12		30		36			36											
4930				51	24	12	68		22	35	6	27	46	92		100		100	13		22										
4927.5			100	97	17		100	39	30	49	14				41		71			20											
4925			100	44		24	44		24			35	43	60				100	13		47										
4922.5		100	100		10			98		57	30				100		47			23											
4920		100	100	100		100	100		23			62	64	45				28			68										
4917.5		100			100			100		25	51				100		100			25											
4915	23	100	100	71		71	36		28				48	40				100			100										
4912.5	33	100			100					29	100						100			25											
4910	100		100	100		68	81		100									100			100										
4907.5	18	100			100					26			SC/GC	SC/Fill			100			100											
4905			100	100			100						SM/GM	SM/Fill																	
4902.5	45	100											Andesite				100			45											
4900			100										Granodiorite																		
4897.5	100	100											CL/CH				100			59											
4895																															
4892.5	100	100															100														
4890																															
4887.5	100																														
4885																															

Table D-5 : Retaining Wall RW6 Subsurface Profile
Phase 1B: US395 North Valleys
Washoe County, Nevada

Wall			Retaining Wall 6					
Seis. Line	Panther UPRR Overpass North					Panther Valley South		
GW Elev.	5024	5014					5041	5023
Boring ID	BR-10	BR-11	RW6-30	RW6-31	RW6-32	RW6-33	BR-12	BR-13
Elevation								
5090								
5087.5								
5085								15
5082.5							36	13
5080							47	9
5077.5						100	12	16
5075						40	9	
5072.5					45	47		5
5070					100	27	18	
5067.5					26			22
5065				28	46	100	17	
5062.5			60	36				20
5060	11	5	31	100	18	22	20	
5057.5	8	9	51	60				15
5055	9	12	30		23	15	51	
5052.5	12	9		26				21
5050			18		28	23	85	
5047.5	25	24		20				100
5045			77		77		57	
5042.5	14	32		26				96
5040			24				26	
5037.5	35	17		38				66
5035			24				43	
5032.5	46	74						79
5030							96	
5027.5	36	31						92
5025							77	
5022.5	41	34						100
5020							43	
5017.5	29	37						100
5015							100	
5012.5	100	77						100
5010							61	
5007.5	100	100						100
5005								
5002.5	100	91						
5000					SC/GC	SC/Fill		
4997.5		100			SM/GM	SM/Fill		
4995					Andesite			
4992.5	100	100			Granodiorite			
4990					CL/CH			
4987.5		21						
4985								
4982.5	100	84						

Table D-6 : Retaining Walls RW7, RW9 and RW10 Subsurface Profiles
Phase 1B: US395 North Valleys
Washoe County, Nevada

Profile	RW7A				RW7B												RW7C					
Wall	Retaining Wall 7																					
Wall								Retaining Wall 9						RW 10								
Seis. Line	Panther Valley Int. North						Braid Ramp												UPRR Branch South			
GW Elev.	5036				5117		5087	5071	5114												5111	5138
Boring ID	BR-16	BR-17	RW7-34	RW7-35	RW7-36	RW7-37	BR-18	BR-19	RW7-38	RW7-39	RW9-51	RW9-52	RW7-40	RW10-53	RW7-41	RW7-42	RW7-43	RW7-44	RW7-45	RW7-46	BR-20	BR-21
Elevation																						
5195																						
5192.5																						
5190																						
5187.5																					51	
5185																				26	27	32
5182.5																			30	33	23	47
5180																			23	24	31	15
5177.5																		20	26	23		20
5175																		100	25		28	
5172.5																	15	22		33		26
5170																	8	45	13		23	
5167.5																	13			38		40
5165																33	100	30	22		53	
5162.5																33				25		36
5160															13	100	100	40	100		33	
5157.5															46	100				100		34
5155													20	67	42		100	91	100		100	
5152.5													88		69	100	100	71				100
5150												24	100	59							100	
5147.5												72	91	61	100	100						100
5145										49	14	100		75							100	
5142.5										78	100	53	100		100	100						100
5140										100	78	53		65							61	
5137.5									17	100	39				100	100						100
5135								17	70		72	100	100	100							38	
5132.5								16	100	100					100							100
5130						25		24	100		29	100		78							32	
5127.5						100	11	82		100												100
5125						100	9	65	100		46	90		100							36	
5122.5						100	4															
5120					55		91	96	100		16	65									33	
5117.5					21	100				100												100
5115					100		24	98	52		67											
5112.5					100	100																
5110							17	75	100												28	
5107.5				14	100	100																
5105				15			48	65														
5102.5				36	100	100								SC/GC	SC/Fill							
5100			37	32			91	100						SM/GM	SM/Fill						44	
5097.5			38		100									Andesite								
5095			31	21			100	100						Granodiorite								
5092.5	5	7	34		100									CL/CH								
5090	6	16		100			100	100														
5087.5	6	11	41																			
5085	12	15		100			100	100														
5082.5			34																			
5080	15	11		100			100	100														
5077.5			75																			
5075	20	26					100	100														
5072.5			100																			
5070	24	17																				
5067.5																						
5065	65	66																				
5062.5																						
5060	100	86																				
5057.5																						
5055	100	100																				
5052.5																						
5050	100	58																				
5047.5																						
5045	98	76																				

Table D-7 : Retaining Wall RW8 Subsurface Profile
Phase 1B: US395 North Valleys
Washoe County, Nevada

Wall	Retaining Wall 8			
Seis. Line	Panther Val. Int. North			
Boring ID	RW8-47	RW8-48	RW8-49	RW8-50
Elevation				
5110				10
5107.5				38
5105				14
5102.5				27
5100				21
5097.5			23	
5095			97	67
5092.5			100	
5090			65	95
5087.5		18	98	
5085		16		67
5082.5		36	100	
5080		47		100
5077.5	32	47	84	
5075	63			
5072.5	51	41	65	
5070	50			
5067.5	100	40		
5065				
5062.5	100	78		
5060				
5057.5	100	97	SC/GC	SC/Fill
5055			SM/GM	SM/Fill
5052.5	100		Andesite	
5050			Granodiorite	
5047.5	100		CL/CH	

Table D-8 : Retaining Wall RW11 Subsurface Profile
Phase 1B: US395 North Valleys
Washoe County, Nevada

Profile	RW11A															RW11B								
Wall		Retaining Wall 11																						
Seis. Line																							Lemon Valley South	
GW Elev.																							5071	5080
Boring ID	SW9-68	RW11-54	SW9-69	RW11-55	RW11-56	SW9-70	RW11-57	RW11-58	SW10-71	RW11-59	SW10-72	RW11-60	SW10-73	RW11-61	SW10-74	RW11-62	SW10-75	RW11-63	SW10-76	RW11-64	RW11-65	RW11-66	BR-28	BR-29
Elevation																								
5155																								
5152.5																								
5150		16																						
5147.5	8	8																						
5145	18	20	26	20																				
5142.5	31	25	19	43																				
5140	32		25	25	14	18																		
5137.5		32	23	29	24	27																		
5135	30				34	22																		
5132.5		25	31	29	34	73																		
5130	25						11																	
5127.5		33	29	36	32	41	13																	
5125	30						57	16														27	22	
5122.5		44	26	32	33	47	47	7			18	33		48	17		10			13		28	32	28
5120								12	38	18	25	34	22	46	11		16		14	10	26	46	44	18
5117.5				37	100	35	35	11	38	12	21	31	23	41	14	23	22	18	46	33	34	39	24	25
5115									22	21	27	36	21	37	12	10	28	11	51	33	86		23	23
5112.5					100		39	24	27	6			78			15		11	78		62	40		
5110											30	37		35	38	25	38	26		100			17	25
5107.5							42	33	100	9			78						60		30	36		
5105											33	26		36	44	39	31	46		47			18	20
5102.5							49	16	33	7			78						32		33	40		
5100											32	29		34	37	65	26	25		45			21	25
5097.5								30	100	46			78						31		32	40		
5095												29		29		47		37		28			17	25
5092.5										36											23			
5090																41		44					15	26
5087.5																								
5085													SC/GC	SC/Fill									20	44
5082.5													SM/GM	SM/Fill										
5080													Andesite										22	36
5077.5													Granodiorite											
5075													CL/CH										23	42
5072.5																								
5070																							35	34
5067.5																								
5065																							38	67
5062.5																								
5060																							45	65
5057.5																								
5055																							38	85
5052.5																								
5050																							27	100
5047.5																								
5045																							47	100
5042.5																								
5040																							100	100
5037.5																								
5035																							36	100
5032.5																								
5030																							100	100
5027.5																								
5025																							100	66

Table D-9 : Retaining Wall RW12 Subsurface Profile

Phase 1B: US395 North Valleys

Washoe County, Nevada

Wall		Retaining Wall 12						
Seis. Line							Line 651	
GW Elev.		4677						
Boring ID	SW2-07	RW12-67	RW12-68	RW12-69	RW12-70	SW2-08	SW2-09	SW2-10
Elevation								
4745								
4742.5								
4740								38
4737.5							17	25
4735							22	53
4732.5						20	100	50
4730					21	17	100	
4727.5				20	27	17		100
4725				20	17	17	100	
4722.5			18	24	31			100
4720		13	14	46		71		
4717.5		25	22		33			100
4715		9	20	83		100		
4712.5	13	23			100			
4710	65		35	62		100		
4707.5	30	19			14			
4705	17		27	22				
4702.5		30			27			
4700	18		19	40				
4697.5		15			100			
4695	33		14	29				
4692.5		20			100			
4690	100		17	44			SC/GC	SC/Fill
4687.5		59			74		SM/GM	SM/Fill
4685			31	50			Andesite	
4682.5		23			100		Granodiorite	
4680			53	100			CL/CH	
4677.5		100			100			
4675			20	100				
4672.5		100			26			
4670			20	25				
4667.5		90						
4665			53					
4662.5		100						

Table D-10
Panther Valley UPRR Overpass G-1092
Phase 1B: US 395 North Valleys

Geotechnical Lateral Soil Parameters

Date: 10/20/2020
Structure Name: US395-WA30.04 Panther Valley UPRR Overpass
Structure Number: G-1092
EA Number:

Boring Log: BR-04 to BR-11
Support ID: Piers 1, 2, 3 and 4
Engineer: Sterling Crandell

Lateral Soil Profile

THESE COLUMNS ARE FOR INFORMATIONAL USE ONLY					THESE COLUMNS ARE THE DIRECT INPUT FOR STRAIN WEDGE													THIS IS USED FOR LPILE	
Layer Number	Elevation (ft)	N (B/Ft)	N_{60} (B/Ft)	USCS	Soil Type	Layer Thickness (ft)	Eff. Unit Weight (pcf)	Friction Angle	e50	Liquefaction	S_u Top* (psf)	S_u Bottom* (psf)	Cohesion** (psf)	Corrected Blowcounts	Fines %	Sand Grains	Eff. Stress-Mid Point (psf)	K_{static} (pci)	$K_{dynamic}$ (pci)
1	5,030.00	20	20	SC	Sand (Reese)	10.0	125	34	0.700		--	--	--				625.0	90.0	
2	5,020.00	30	30	SC	Sand (Reese)	2.5	125	34	0.700		--	--	--				1,406.3	90.0	
3	5,017.50	88	88	Andesite	Sand (Reese)	5.5	130	38	0.450		--	--	--				1,920.0	125.0	
4	5,012.00	88	88	Andesite	Sand (Reese)	27.0	68	38	0.450		--	--	--				3,195.5	125.0	
5	4,985.00	95	95	Granodiorite	Sand (Reese)	45.0	73	40	0.450		--	--	--				5,756.0	125.0	

🟧	Recommended PY model for Lpile; will be converted to either "Sand", "Clay", "C-Phi", or "Rock" for SWM
▩	These inputs only used when liquefaction considered; you can leave blank
🟨	K values are used in Lpile. It can be helpful to provide these in case engineer or independent checker wants to do a P-Y Analysis (Lpile)

* Su is taken to be undrained shear strength

** Cohesion is taken as the intercept of the Mohr-Coulomb failure envelope with the vertical axis

Note: Lateral Resistance Should be Neglected to the Bottom of Permanent and Isolation Casings

APPENDIX E

Spread Footing Design Recommendations for Bridges G-1092N&S and G-1748N&S

Figures E-1 to E-9

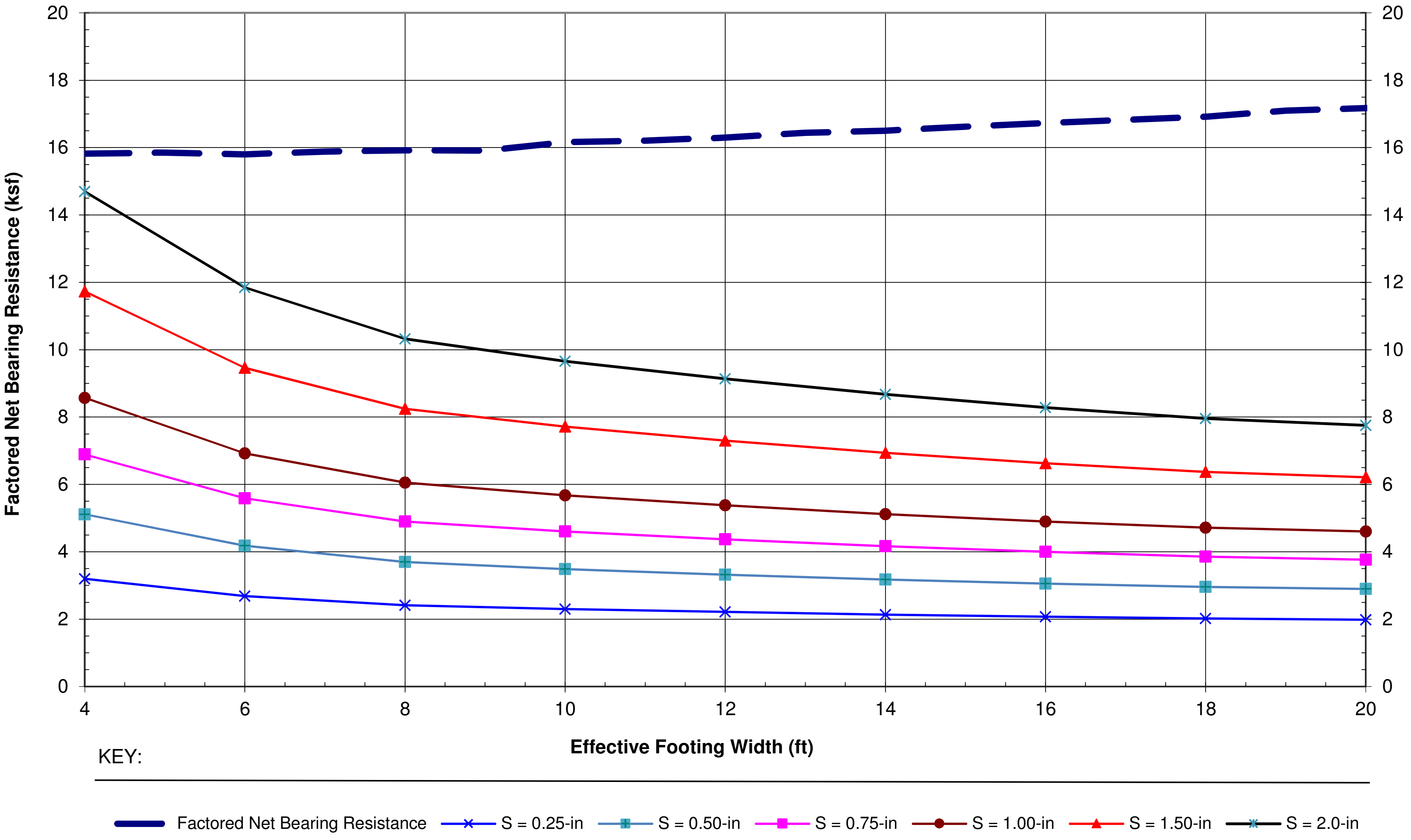


Figure E-1a: **Bearing Resistance Chart, Abutment Spread Footings, Bridges 1092N & 1092S**
Effective Footing Length = 75 ft; Bearing Elevation at 5055 feet or lower. **Depth of embedment Df = 6 ft.**
S = Immediate Settlement

Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

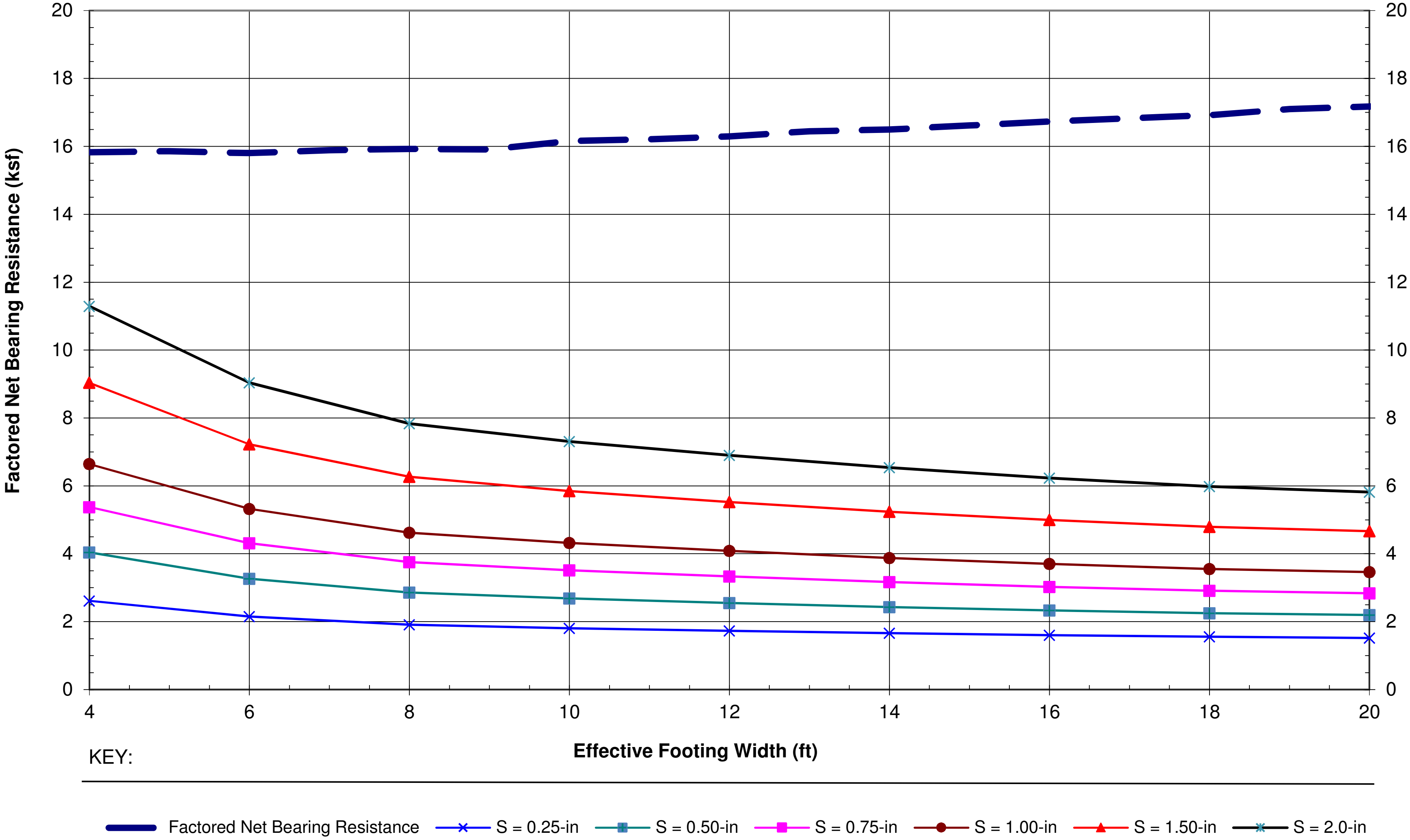


Figure E-1b: **Bearing Resistance Chart, Abutment Spread Footings, Bridges 1092N & 1092S**
Effective Footing Length = 75 ft; Bearing Elevation at 5055 feet or lower. **Depth of embedment Df = 6 ft.**
S = Total (Immediate plus long-term) Settlement

Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

Figure
E-1b

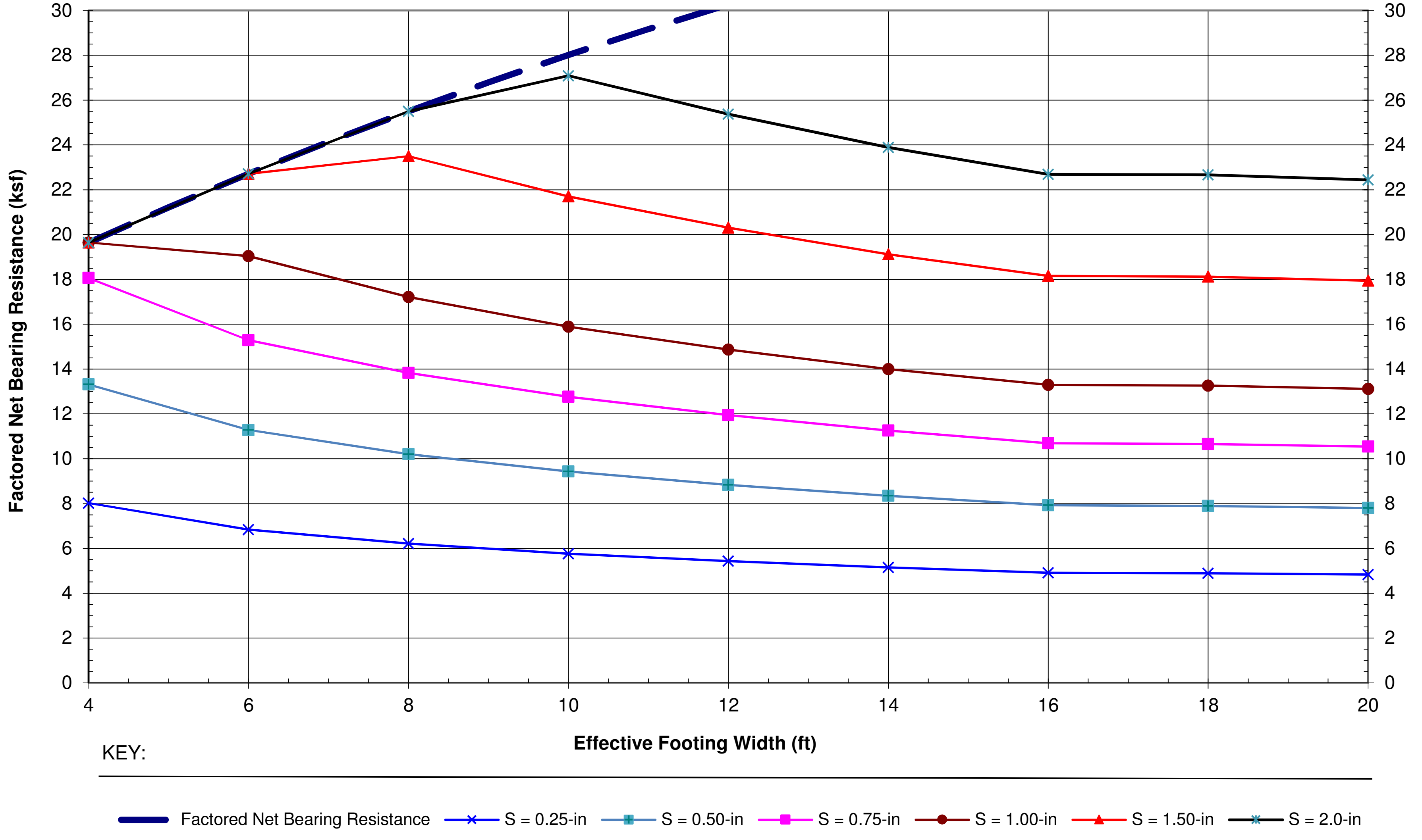


Figure E-2a: **Bearing Resistance Chart, Piers 1 and 4, Bridges 1092N & 1092S**
Effective Footing Length = 6.5 ft; Bearing Elevation at 5021 feet or lower. **Depth of embedment Df = 8 ft.**
S = Immediate Settlement

Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

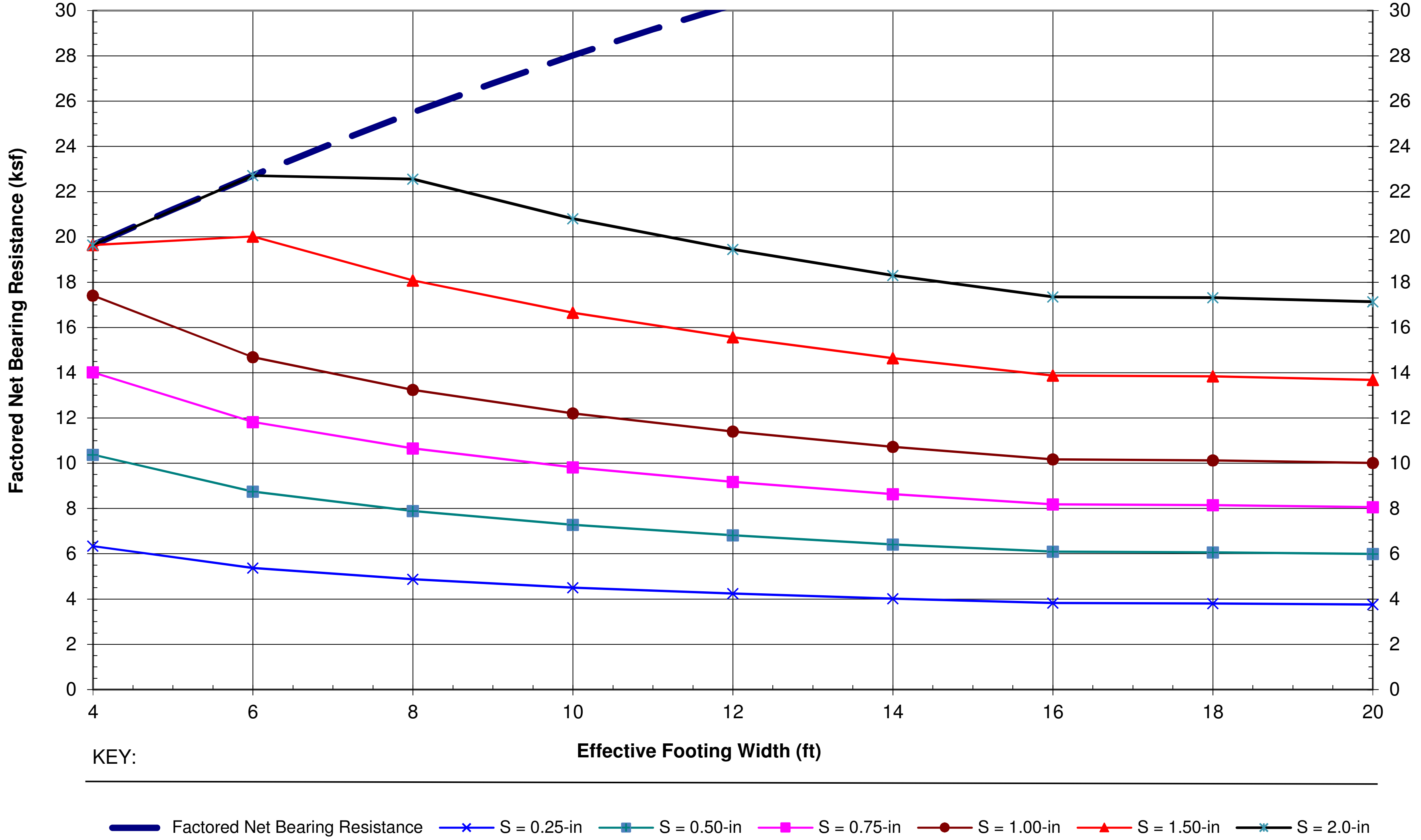


Figure E-2b: **Bearing Resistance Chart, Piers 1 and 4, Bridges 1092N & 1092S**
Effective Footing Length = 6.5 ft; Bearing Elevation at 5021 feet or lower. **Depth of embedment Df = 8 ft.**
S = Total (Immediate plus long-term) Settlement

Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

Figure
E-2b

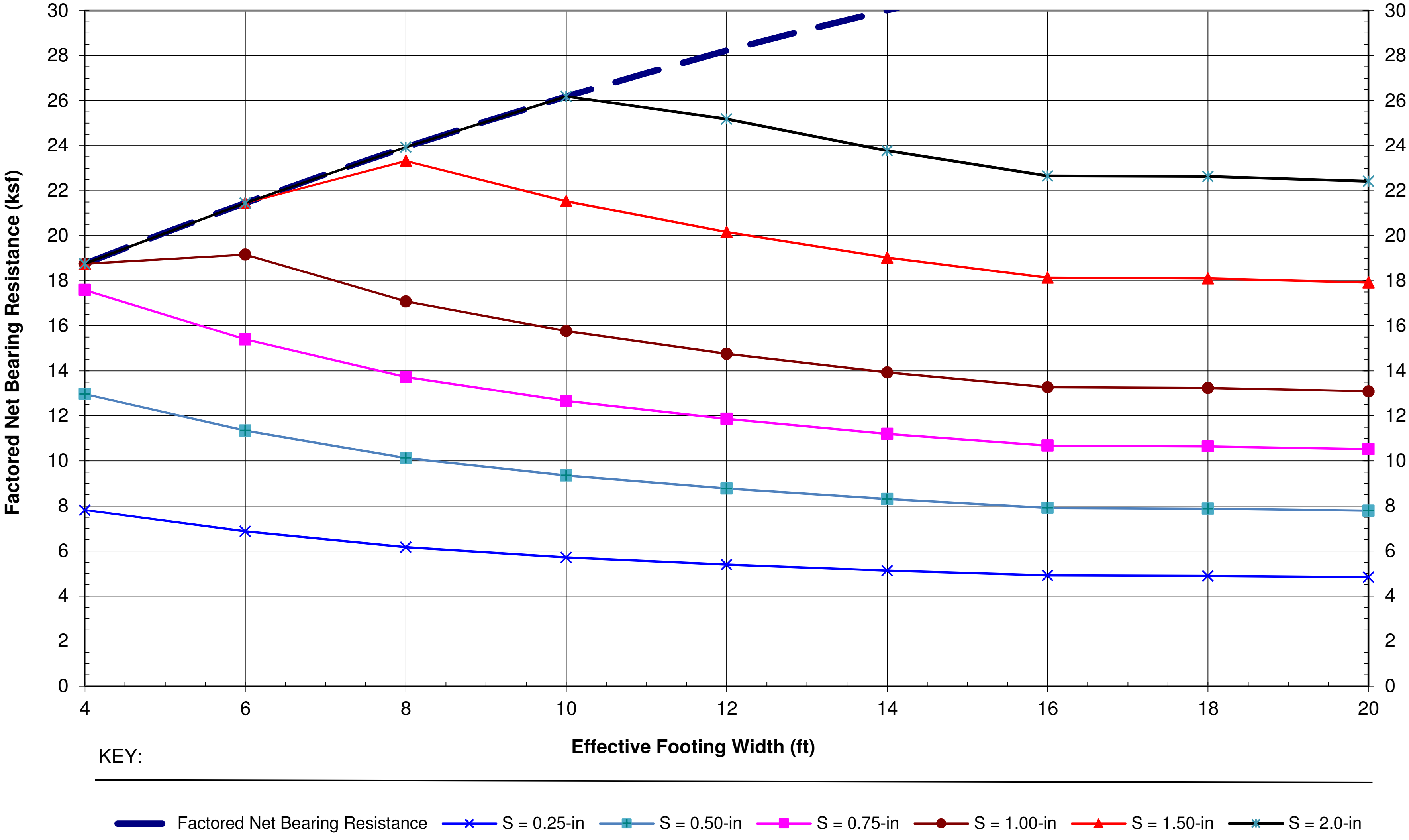


Figure E-3a: **Bearing Resistance Chart, Piers 2 and 3, Bridges 1092N & 1092S**
Effective Footing Length = 8 ft; Bearing Elevation at 5021 feet or lower. **Depth of embedment Df = 8 ft.**
S = Immediate Settlement

Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

Figure
E-3a

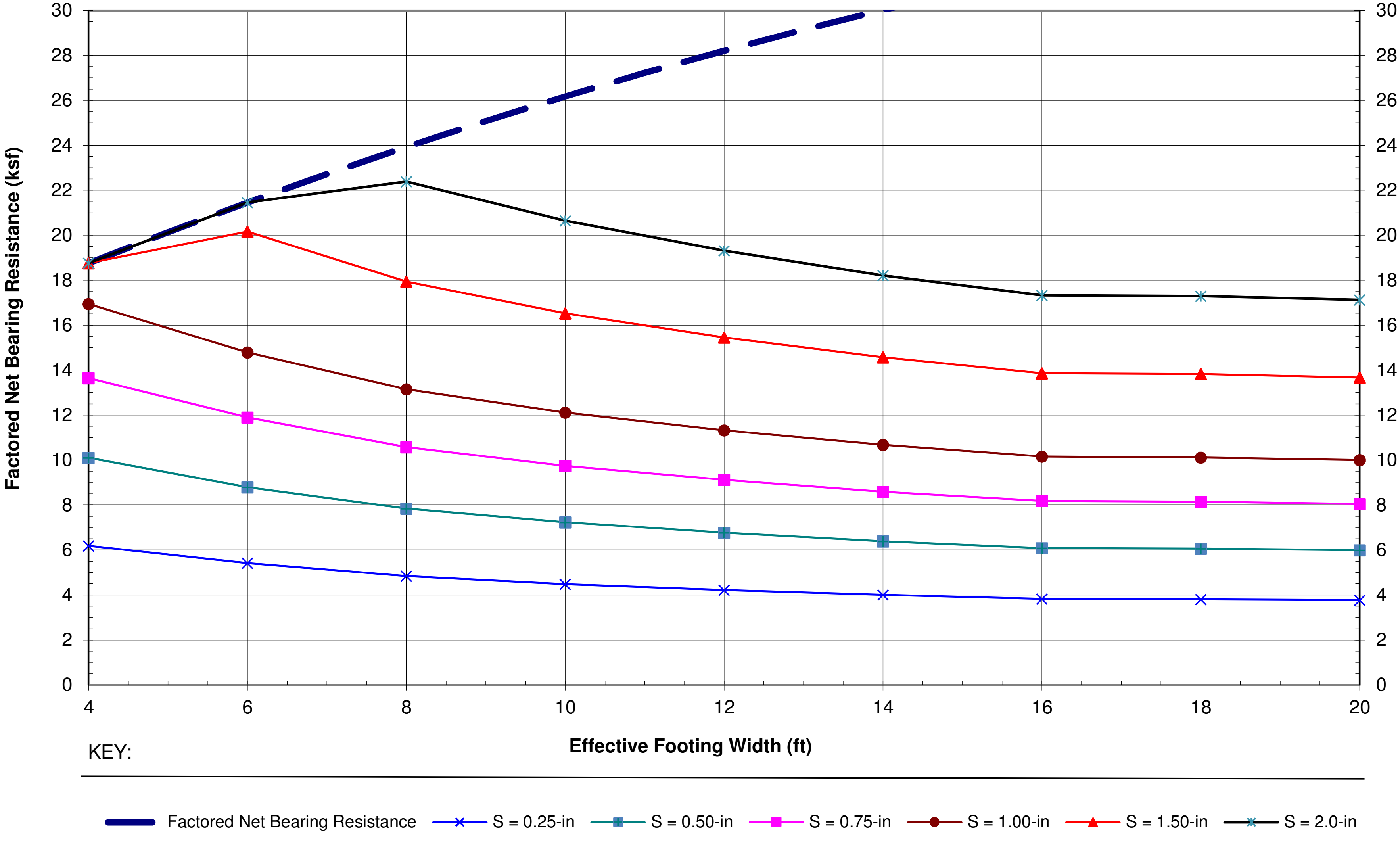


Figure E-3b: **Bearing Resistance Chart, Piers 2 and 3, Bridges 1092N & 1092S**
Effective Footing Length = 8 ft; Bearing Elevation at 5021 feet or lower. **Depth of embedment Df = 8 ft.**
S = Total (Immediate plus long-term) Settlement

Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

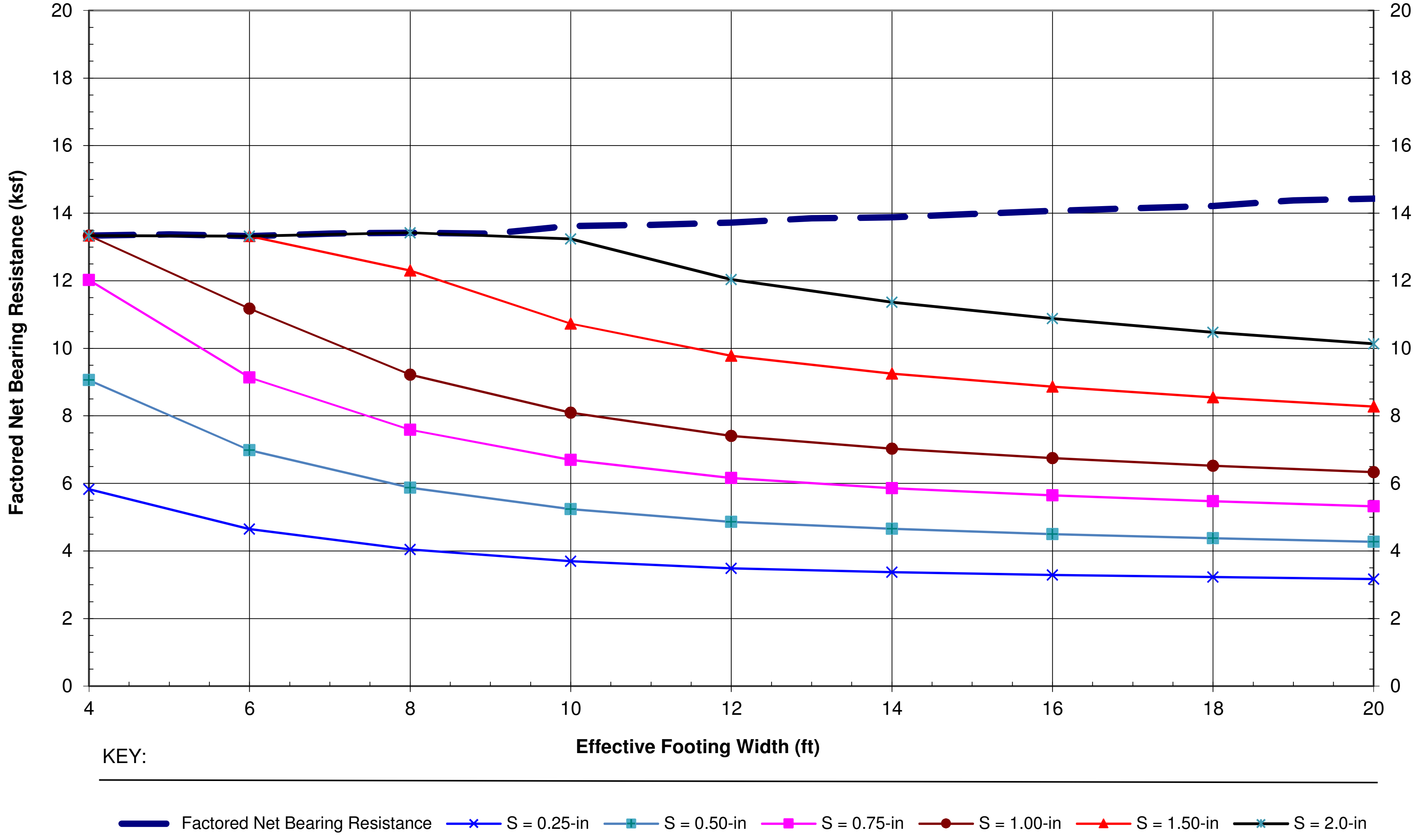


Figure E-4a: **Bearing Resistance Chart, Abutment 1, Bridge 1748N**
Effective Footing Length = 122 ft; Bearing Elevation at 5175 feet or lower. **Depth of embedment Df = 5 ft.**
S = Immediate Settlement

Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

Figure
E-4a

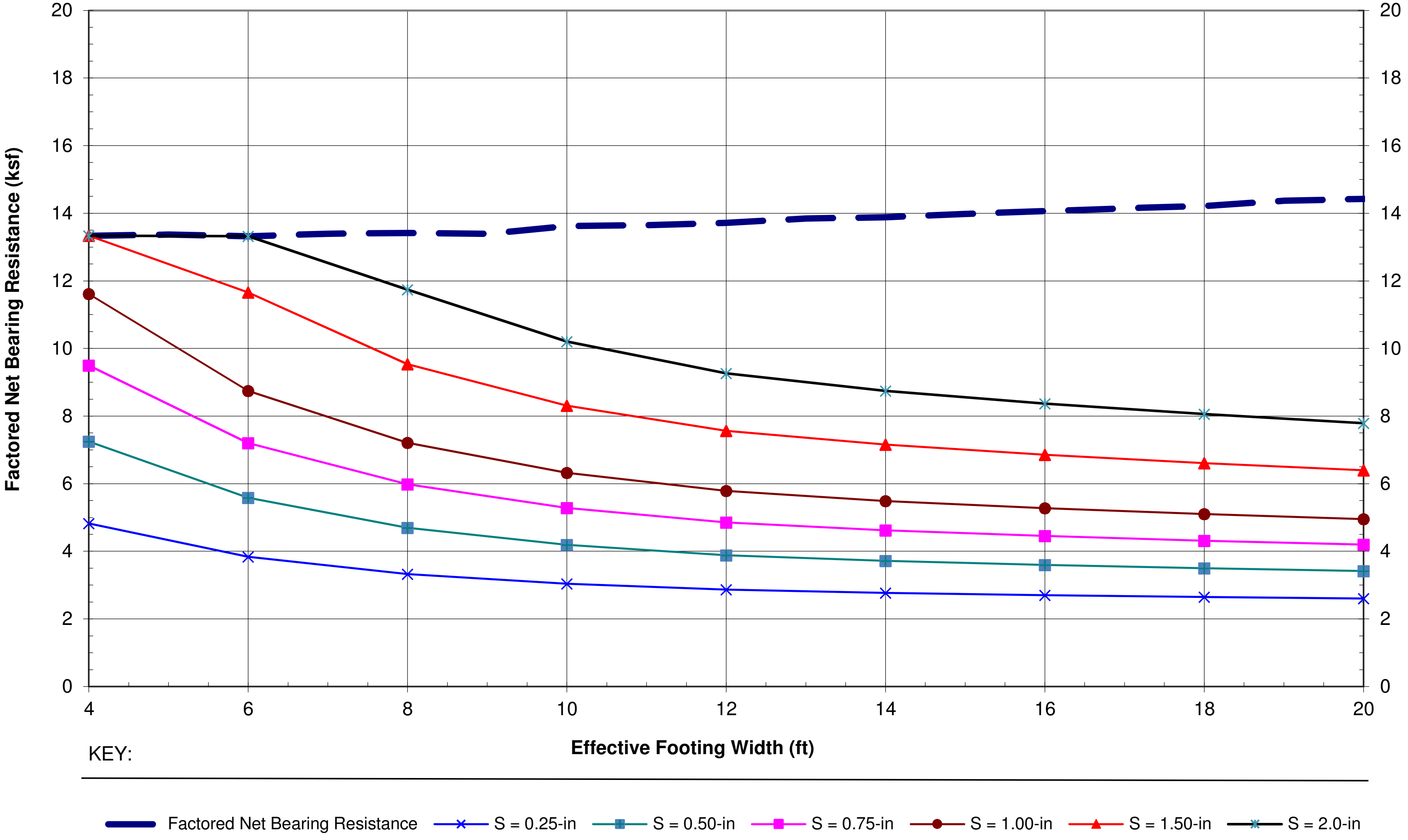


Figure E-4b: **Bearing Resistance Chart, Abutment 1, Bridge 1748N**
Effective Footing Length = 122 ft; Bearing Elevation at 5175 feet or lower. **Depth of embedment Df = 5 ft.**
S = Total (Immediate plus long-term) Settlement

Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

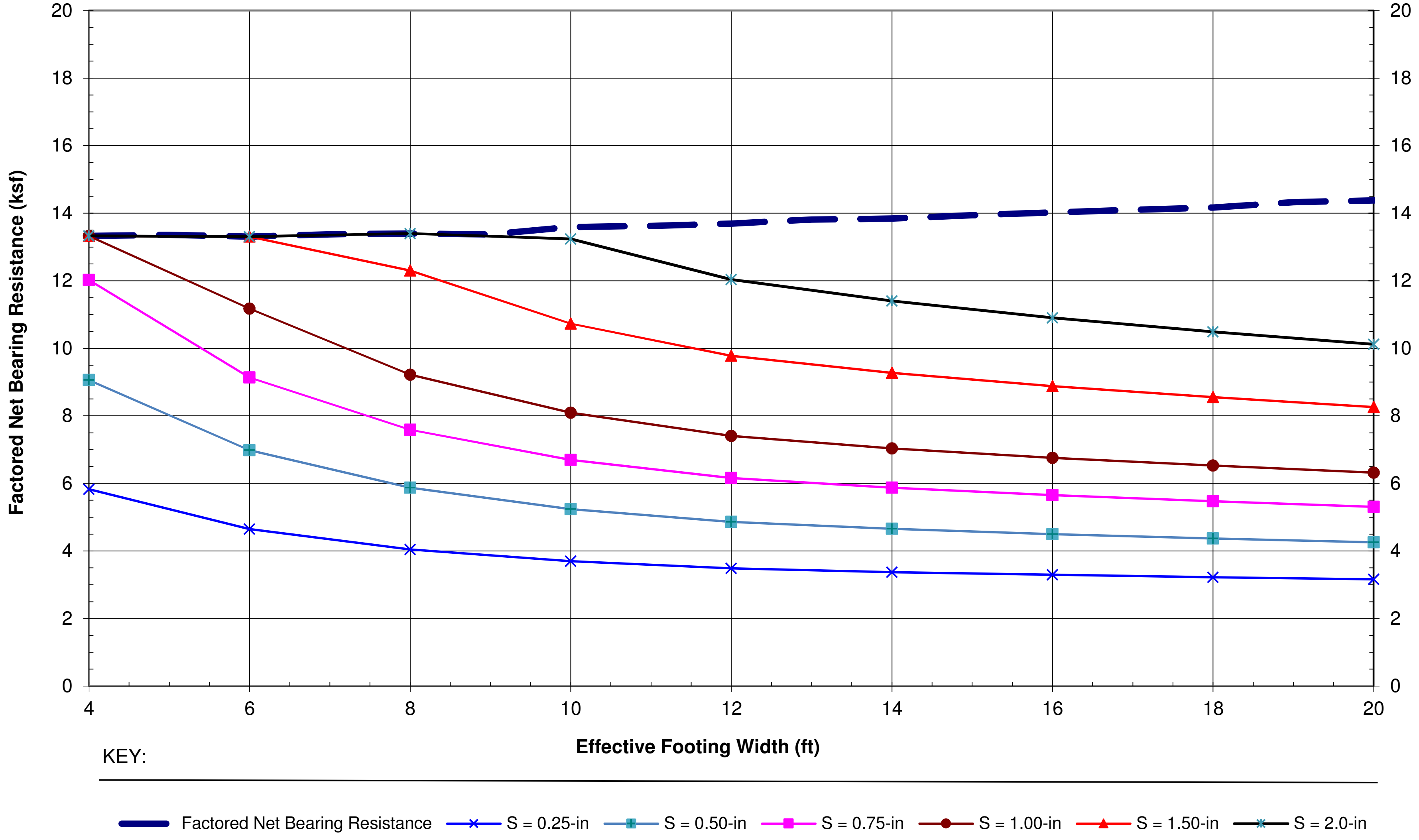


Figure E-5a: **Bearing Resistance Chart, Abutment 2, Bridge 1748N**
Effective Footing Length = 137 ft; Bearing Elevation at 5175 feet or lower. **Depth of embedment Df = 5 ft.**
S = Immediate Settlement

Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

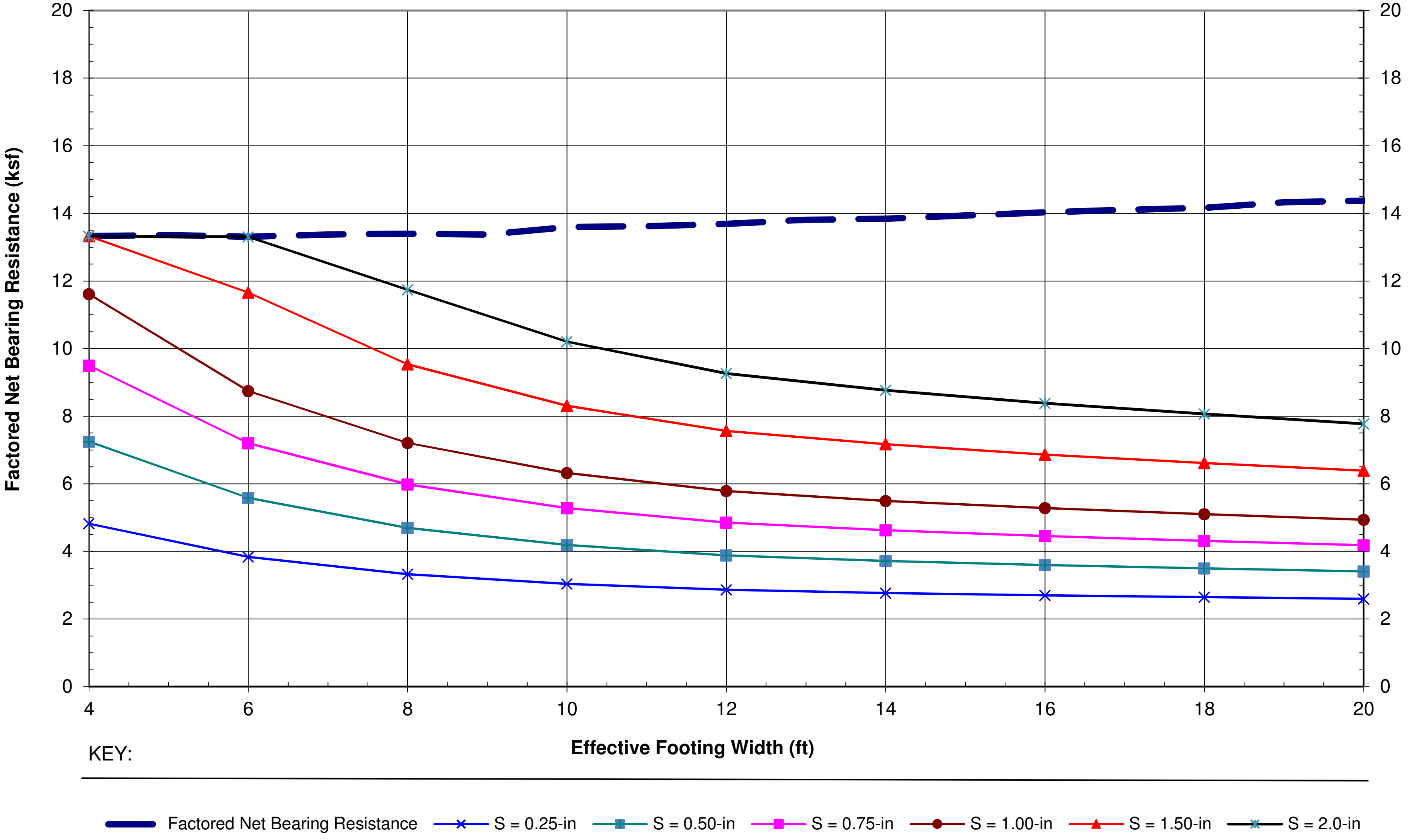


Figure E-5b: **Bearing Resistance Chart, Abutment 2, Bridge 1748N**
Effective Footing Length = 137 ft; Bearing Elevation at 5175 feet or lower. **Depth of embedment Df = 5 ft.**
S = Total (Immediate plus long-term) Settlement

Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

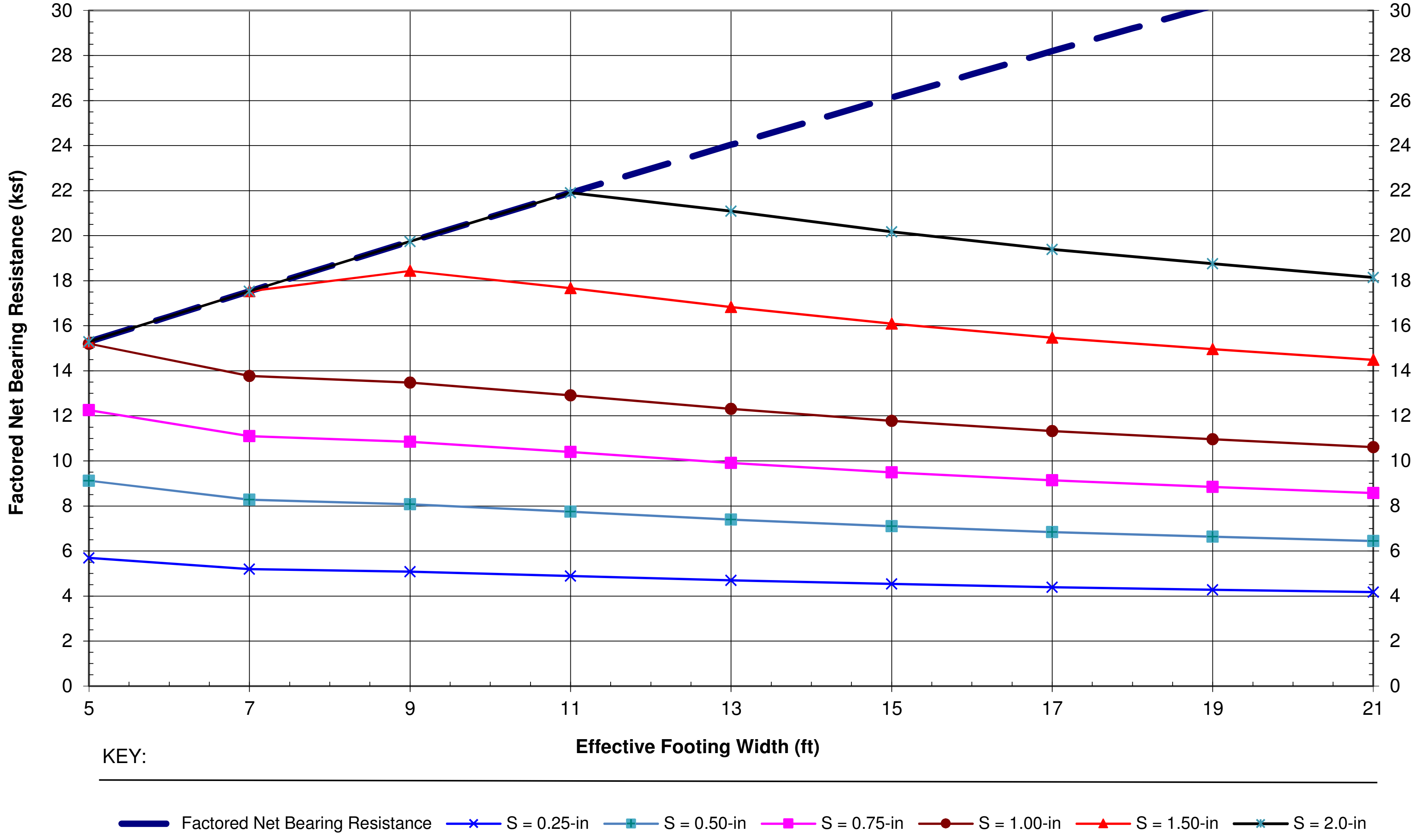


Figure E-6a: **Bearing Resistance Chart, Pier 1, Bridge 1748N**
Effective Footing Length = 96.5 ft; Bearing Elevation at 5153 feet or lower. **Depth of embedment Df = 6 ft.**
S = Immediate Settlement

Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

Figure
E-6a

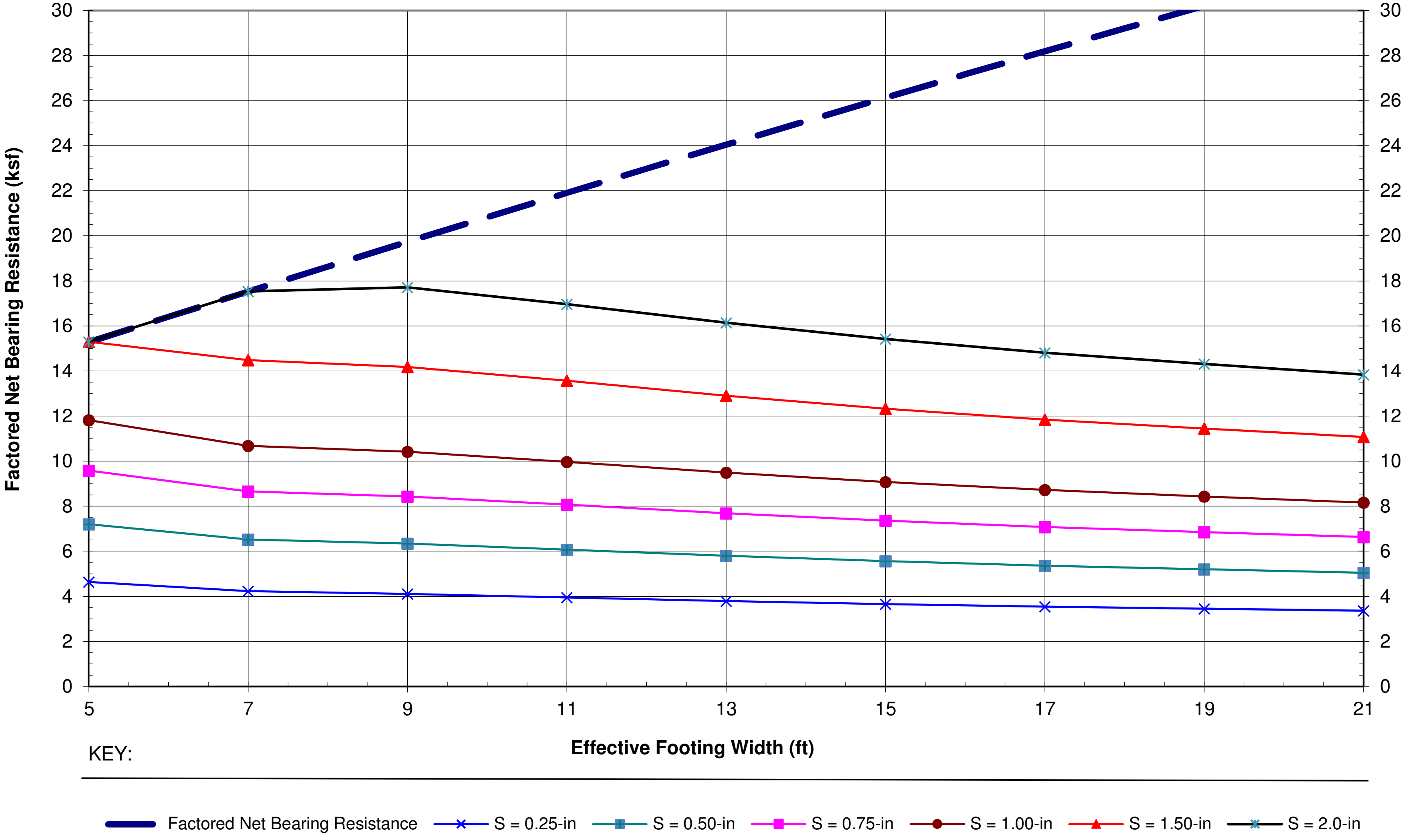


Figure E-6b: **Bearing Resistance Chart, Pier 1, Bridge 1748N**
Effective Footing Length = 96.5 ft; Bearing Elevation at 5153 feet or lower. **Depth of embedment Df = 6 ft.**
S = Total (Immediate plus long-term) Settlement

Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

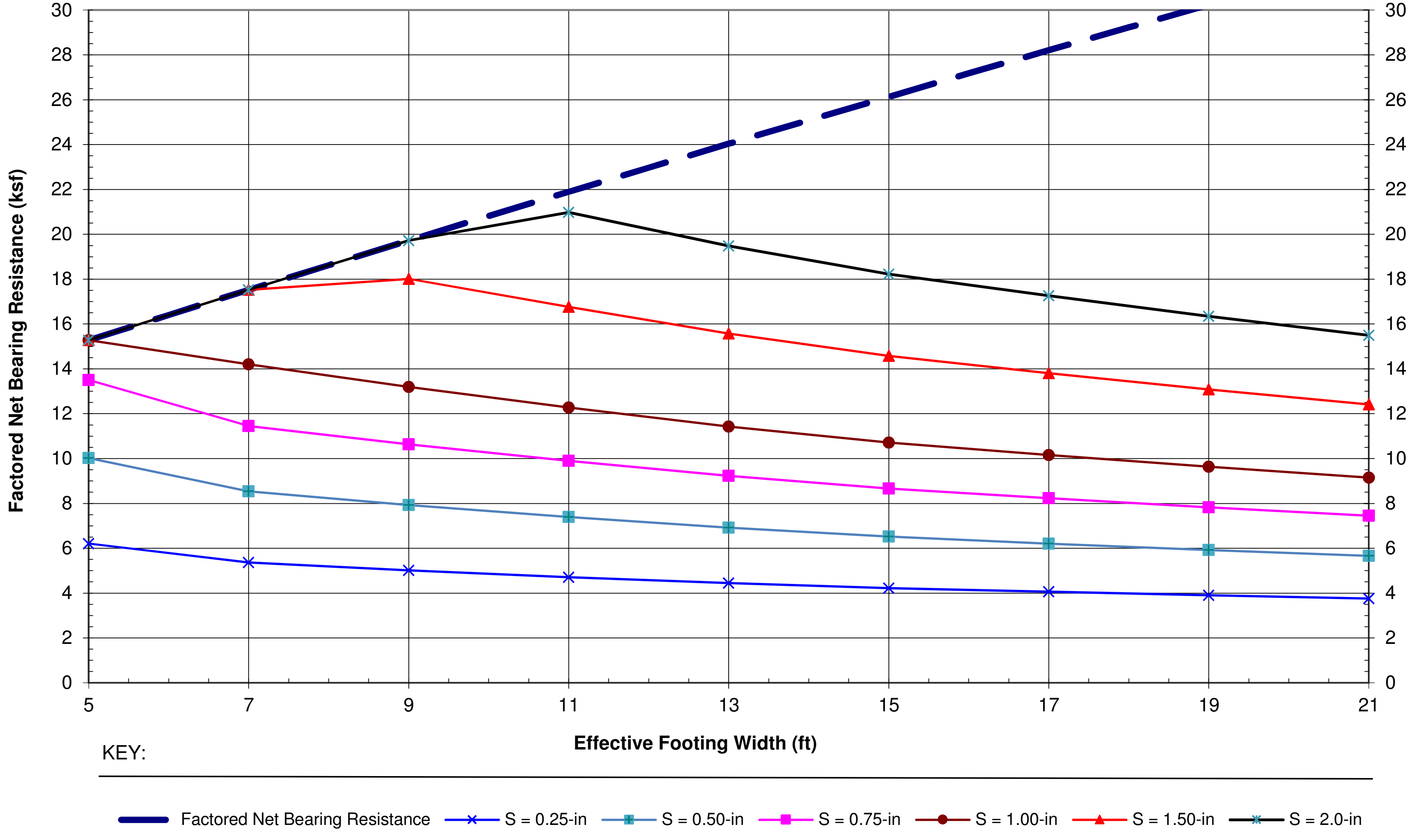


Figure E-7a: **Bearing Resistance Chart, Pier 2, Bridge 1748N**
Effective Footing Length = 102.5 ft; Bearing Elevation at 5153 feet or lower. **Depth of embedment Df = 6 ft.**
S = Immediate Settlement

Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

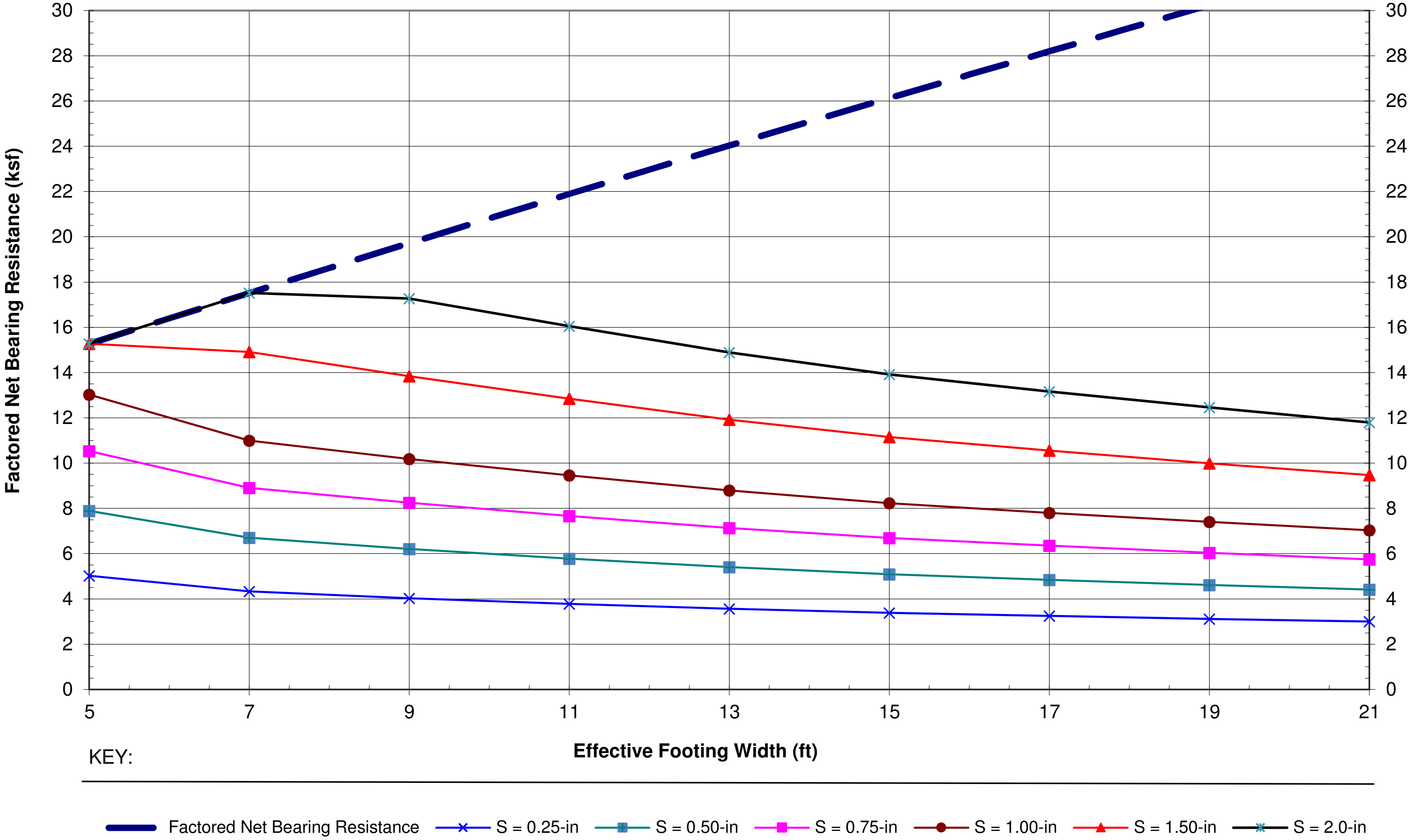


Figure E-7b: **Bearing Resistance Chart, Pier 2, Bridge 1748N**
Effective Footing Length = 102.5 ft; Bearing Elevation at 5153 feet or lower. **Depth of embedment Df = 6 ft.**
S = Total (Immediate plus long-term) Settlement

Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

US 395 North Valleys Project
Bridge 1748S

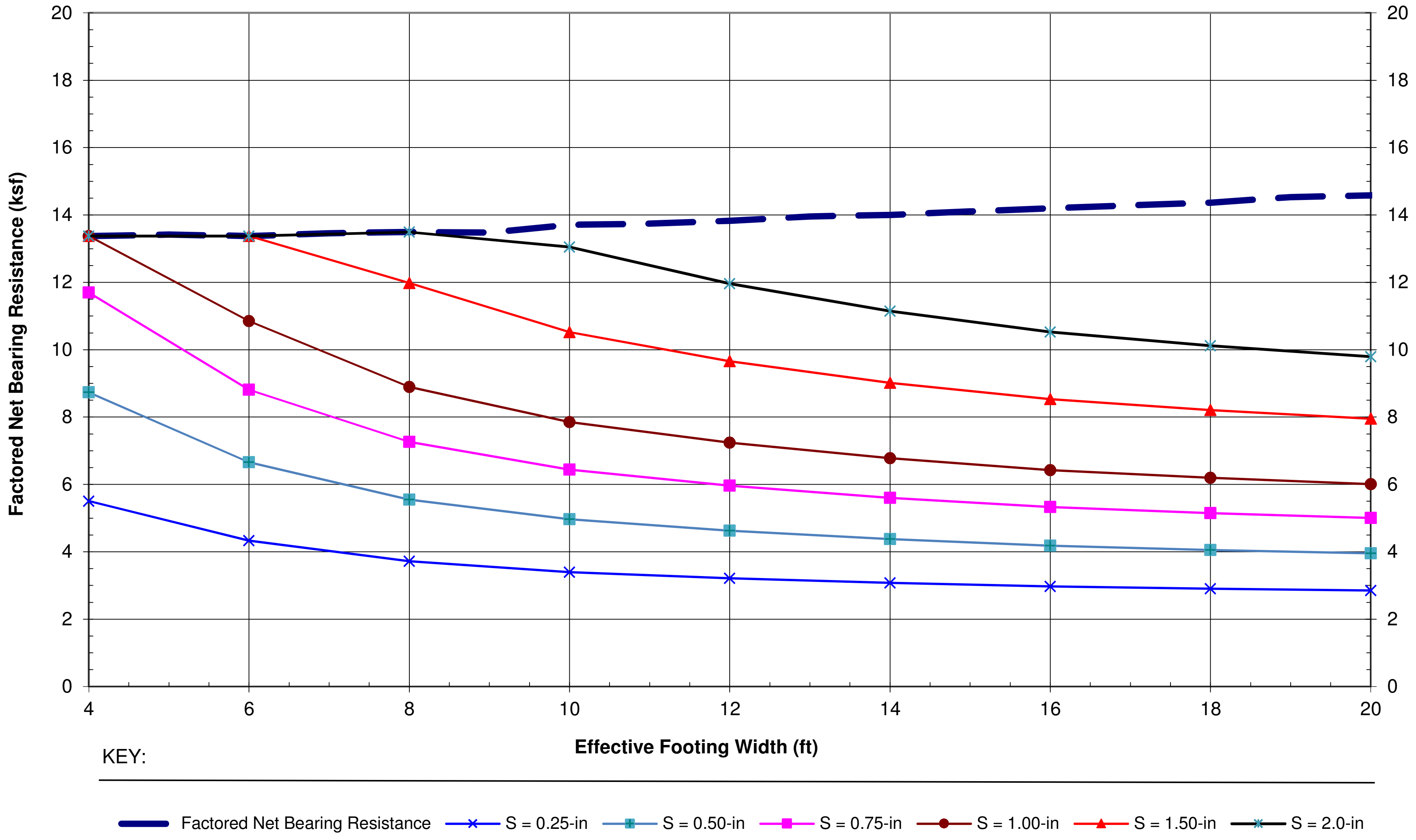


Figure E-8a: **Bearing Resistance Chart, Abutments 1 and 2, Bridge 1748S**
Effective Footing Length = 92 ft; Bearing Elevation at 5178 feet or lower. **Depth of embedment Df = 5 ft.**
S = Immediate Settlement

Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

Figure
E-8a

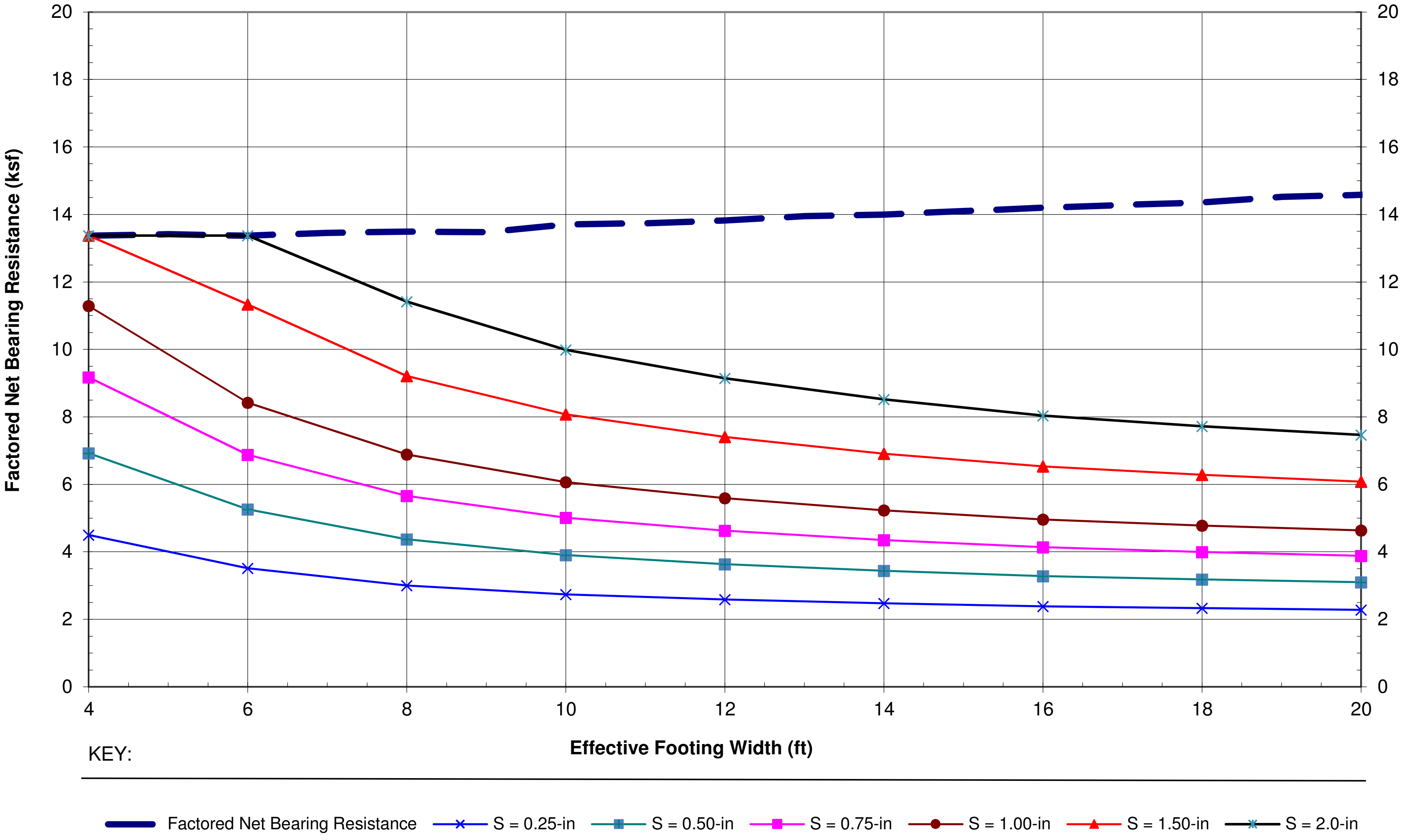


Figure E-8b: **Bearing Resistance Chart, Abutments 1 and 2, Bridge 1748S**
Effective Footing Length = 92 ft; Bearing Elevation at 5178 feet or lower. **Depth of embedment Df = 5 ft.**
S = Total (Immediate plus long-term) Settlement

Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

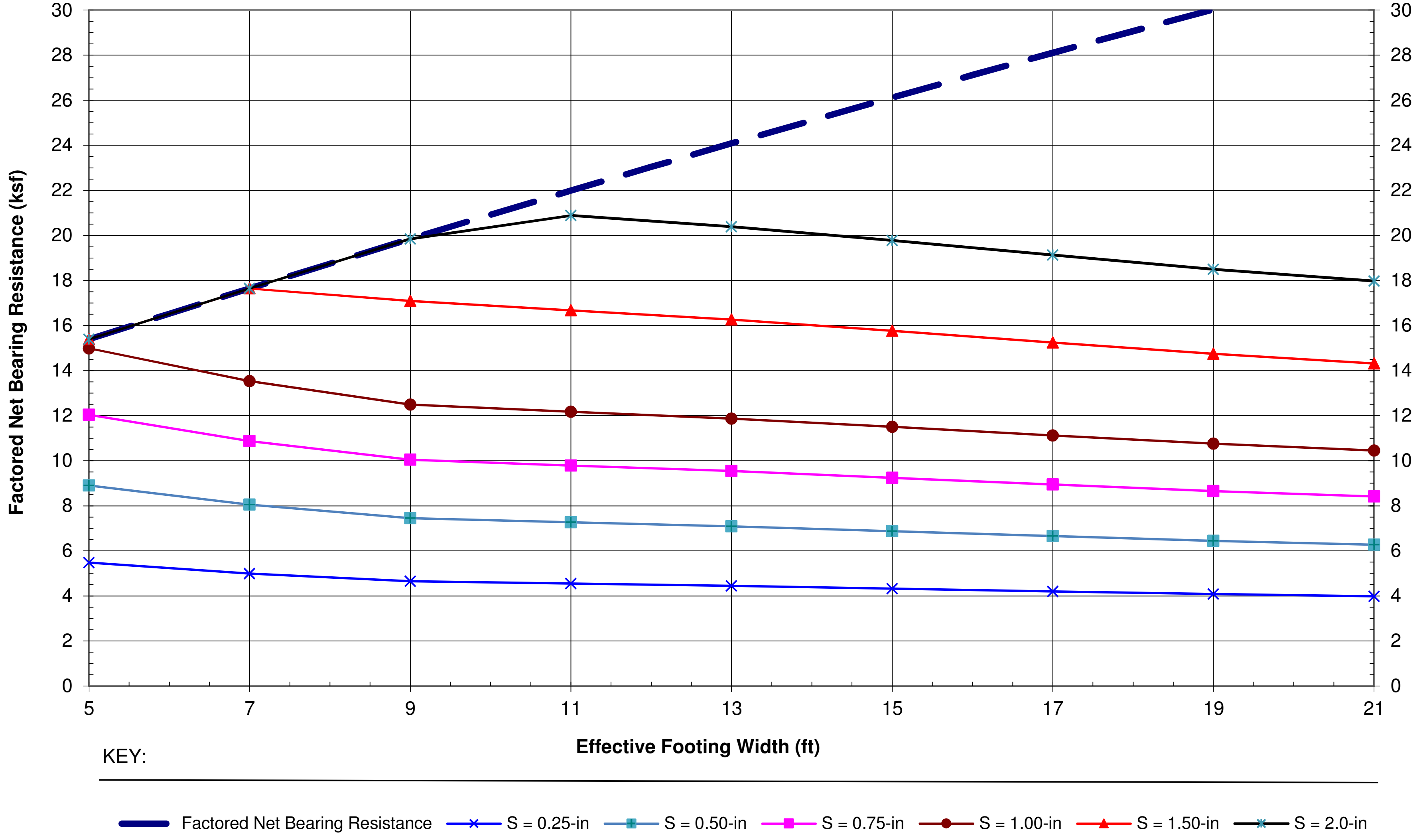


Figure E-9a: **Bearing Resistance Chart, Piers 1 and 2, Bridge 1748S**
Effective Footing Length = 66 ft; Bearing Elevation at 5155 feet or lower. **Depth of embedment Df = 6 ft.**
S = Immediate Settlement

Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

US 395 North Valleys Project
Bridge 1748S

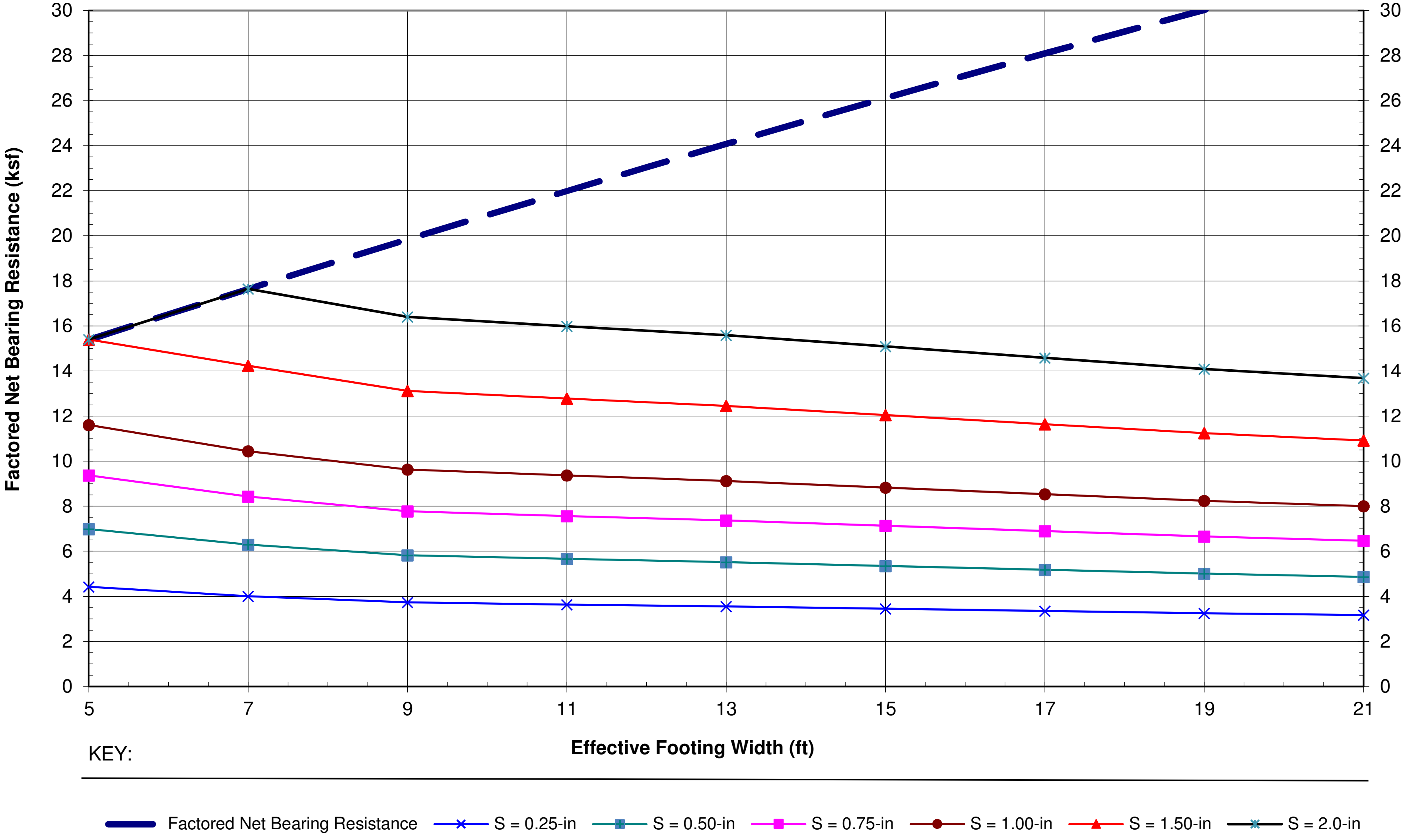


Figure E-9b: **Bearing Resistance Chart, Piers 1 and 2, Bridge 1748S**
Effective Footing Length = 66 ft; Bearing Elevation at 5155 feet or lower. **Depth of embedment Df = 6 ft.**
S = Total (Immediate plus long-term) Settlement

Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

Figure
E-9b

APPENDIX F

Spread Footing Design Recommendations for Retaining Walls RW1 to RW12

Figures F-1 to F-16

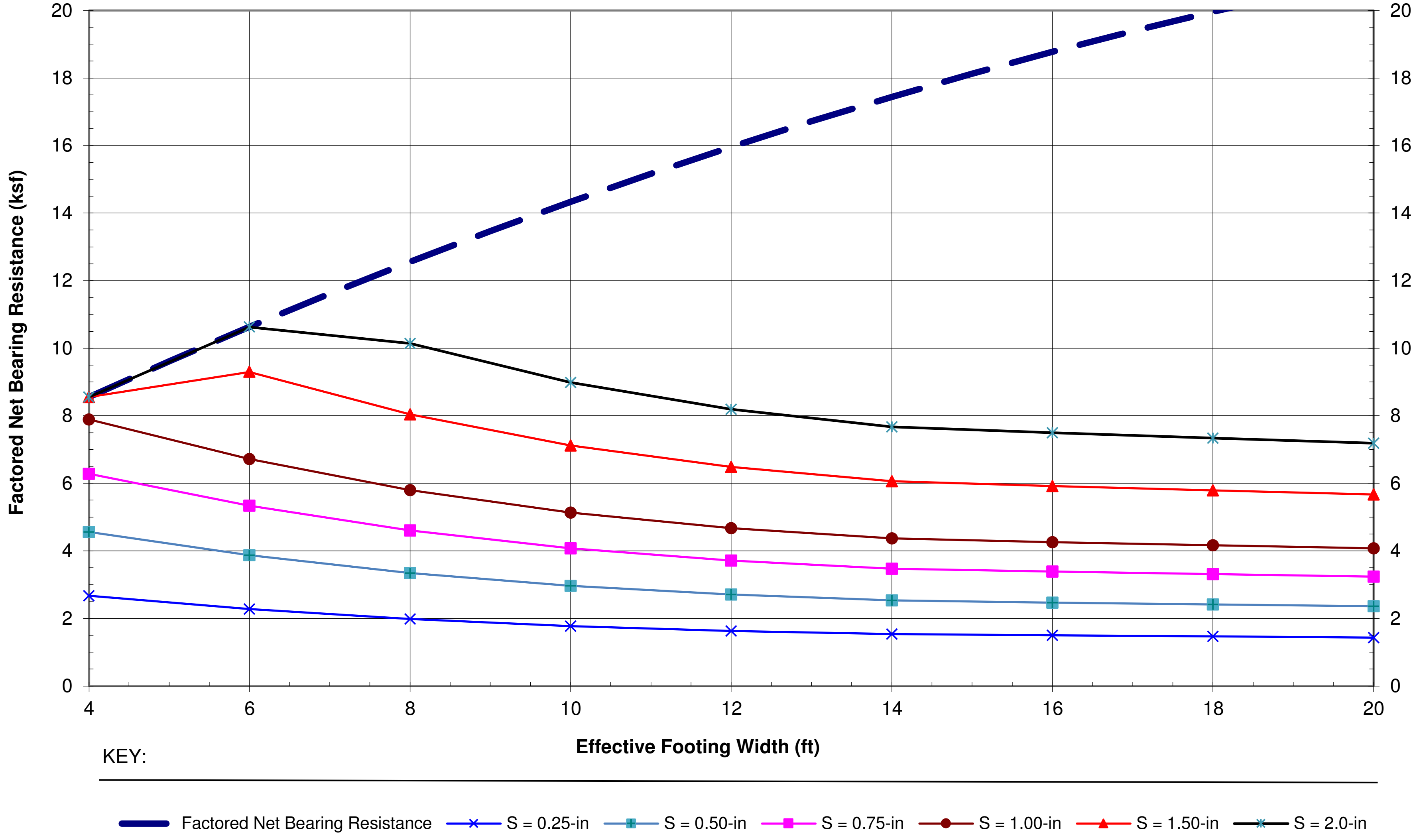


Figure F-1a: **Bearing Resistance Chart, Profile RW1A, Retaining Wall 1**
Effective Footing Length = 24 ft; Bearing Elevation at 4630 feet or lower. **Depth of embedment Df = 2.5 ft.**
S = Immediate Settlement

Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

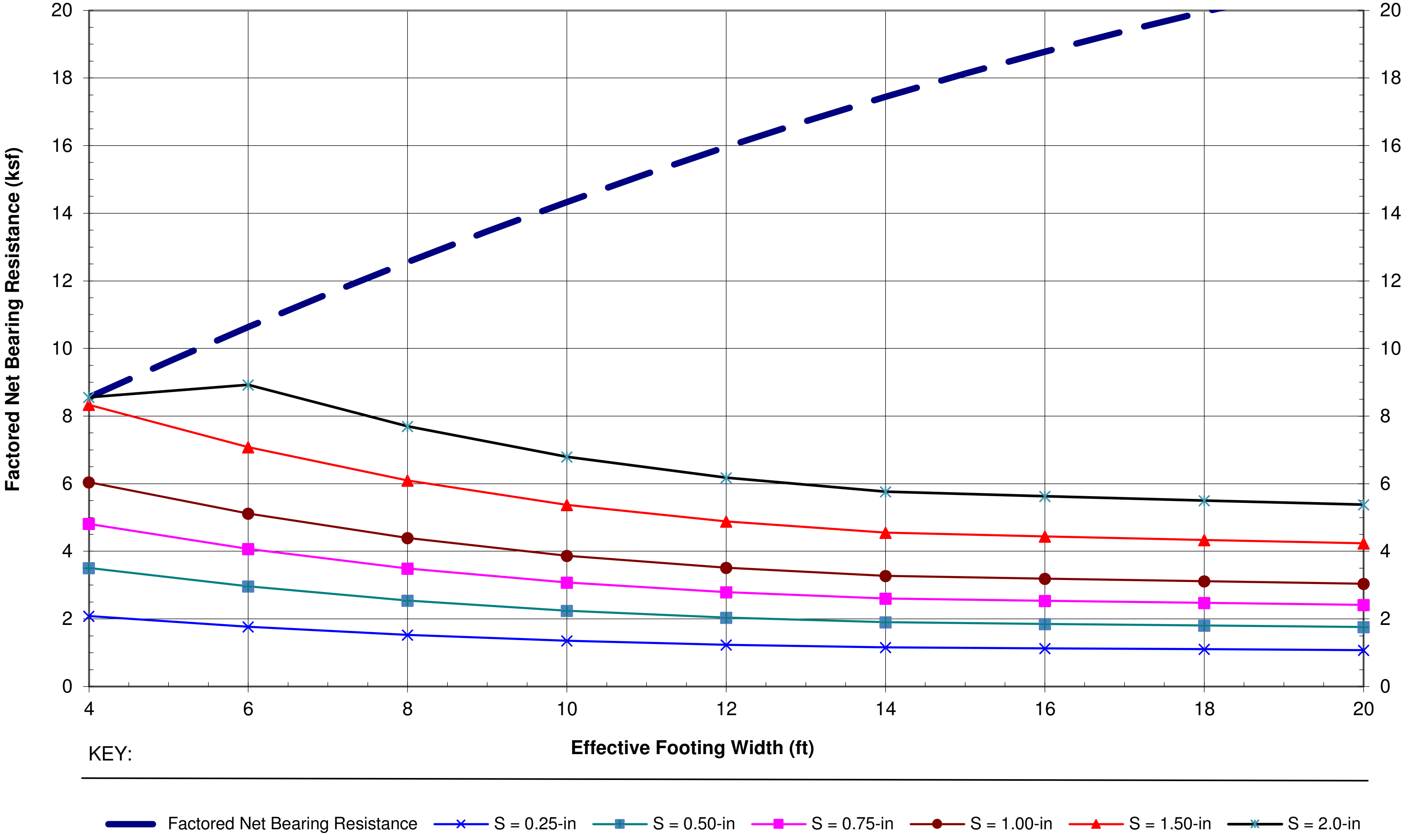


Figure F-1b: **Bearing Resistance Chart, Profile RW1A, Retaining Wall 1**
Effective Footing Length = 24 ft; Bearing Elevation at 4630 feet or lower. **Depth of embedment Df = 2.5 ft.**
S = Total (Immediate plus long-term) Settlement

Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

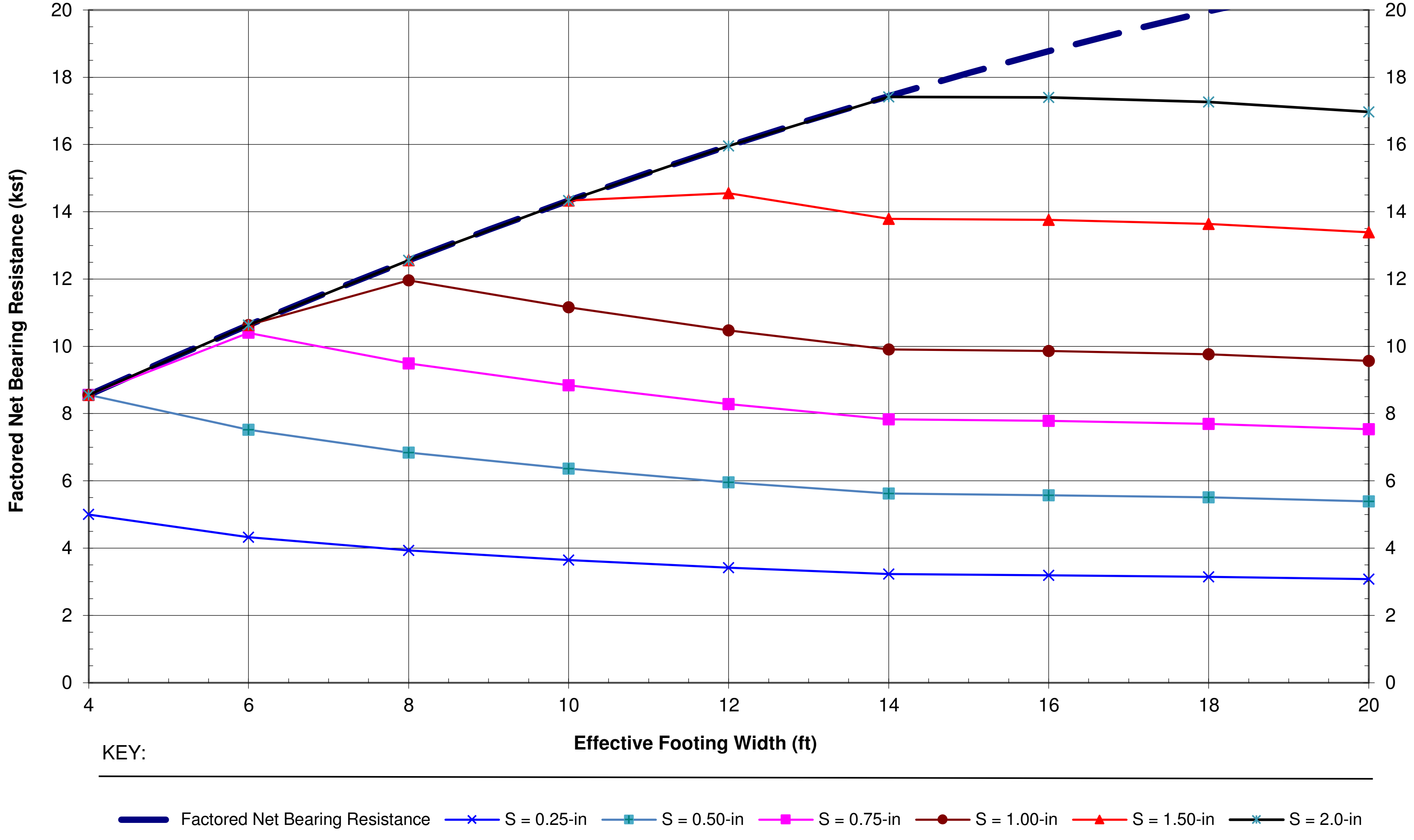


Figure F-2a: **Bearing Resistance Chart, Profile RW1B, Retaining Walls 1 & 2**
Effective Footing Length = 24 ft; Bearing Elevation at 4660 feet or lower. **Depth of embedment Df = 2.5 ft.**
S = Immediate Settlement

Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

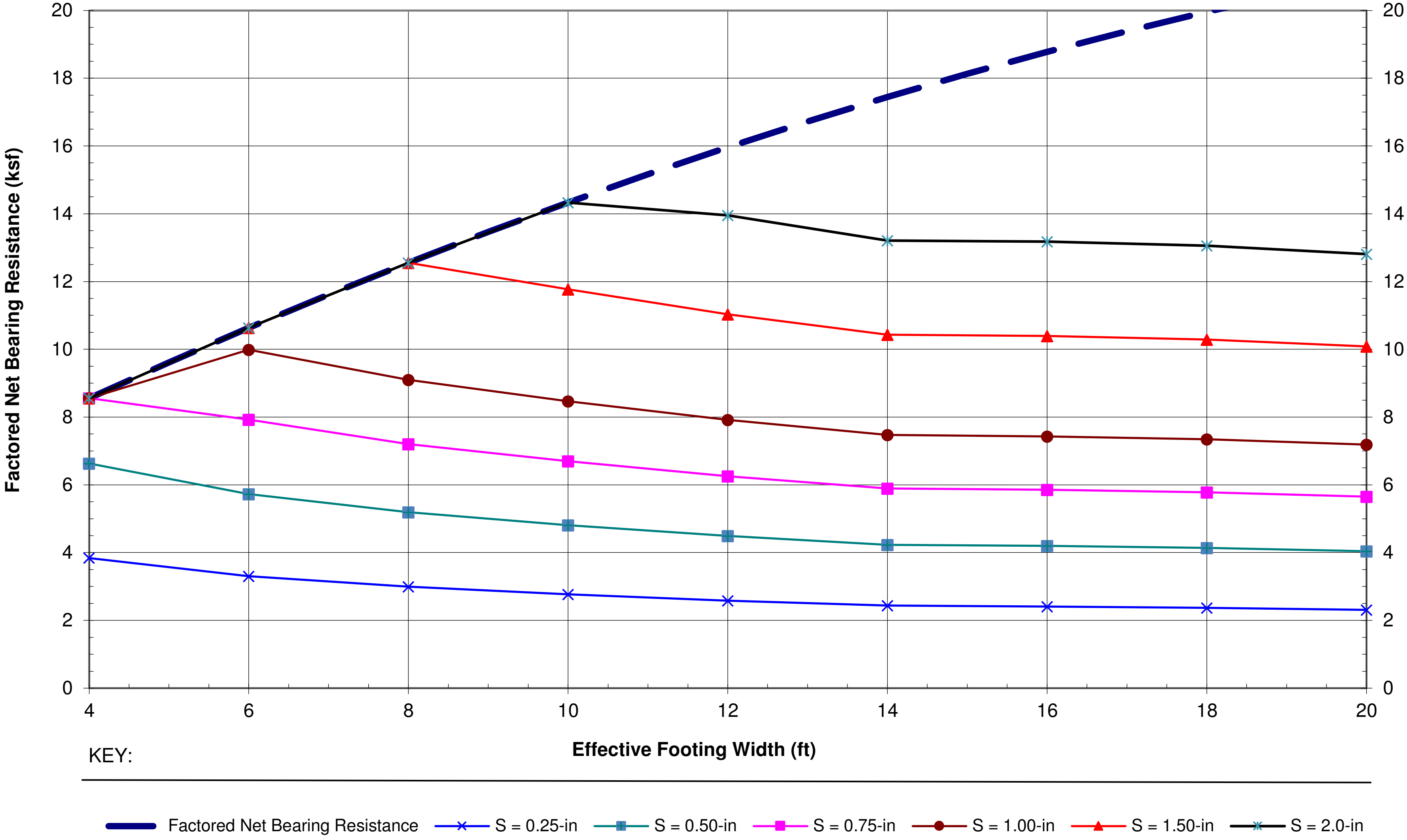


Figure F-2b: **Bearing Resistance Chart, Profile RW1B, Retaining Walls 1 & 2**
Effective Footing Length = 24 ft; Bearing Elevation at 4660 feet or lower. **Depth of embedment Df = 2.5 ft.**
S = Total (Immediate plus long-term) Settlement

Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

Figure
F-2b

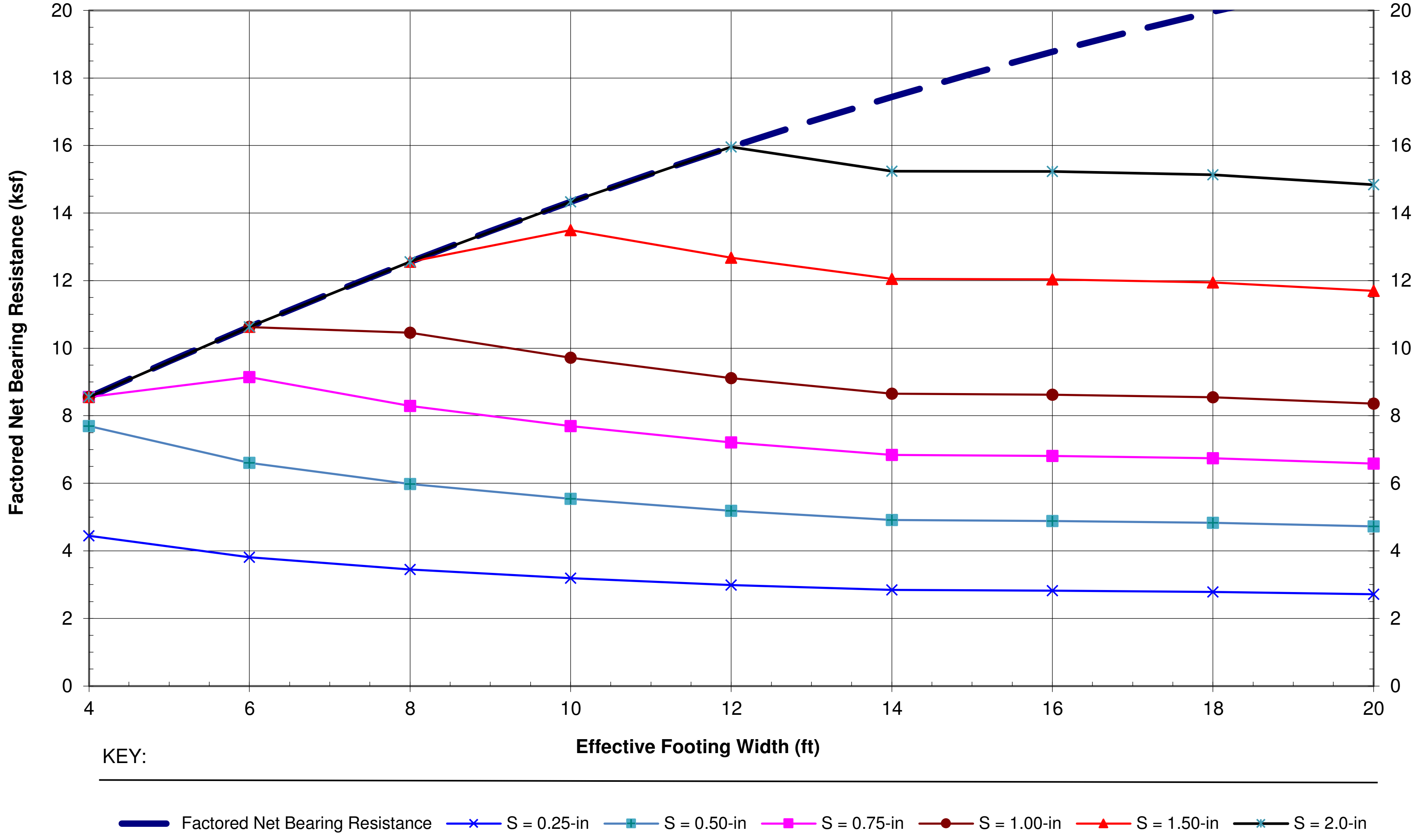


Figure F-3a: **Bearing Resistance Chart, Profile RW3A, Retaining Wall 3**
Effective Footing Length = 24 ft; Bearing Elevation at 4935 feet or lower. **Depth of embedment Df = 2.5 ft.**
S = Immediate Settlement

Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

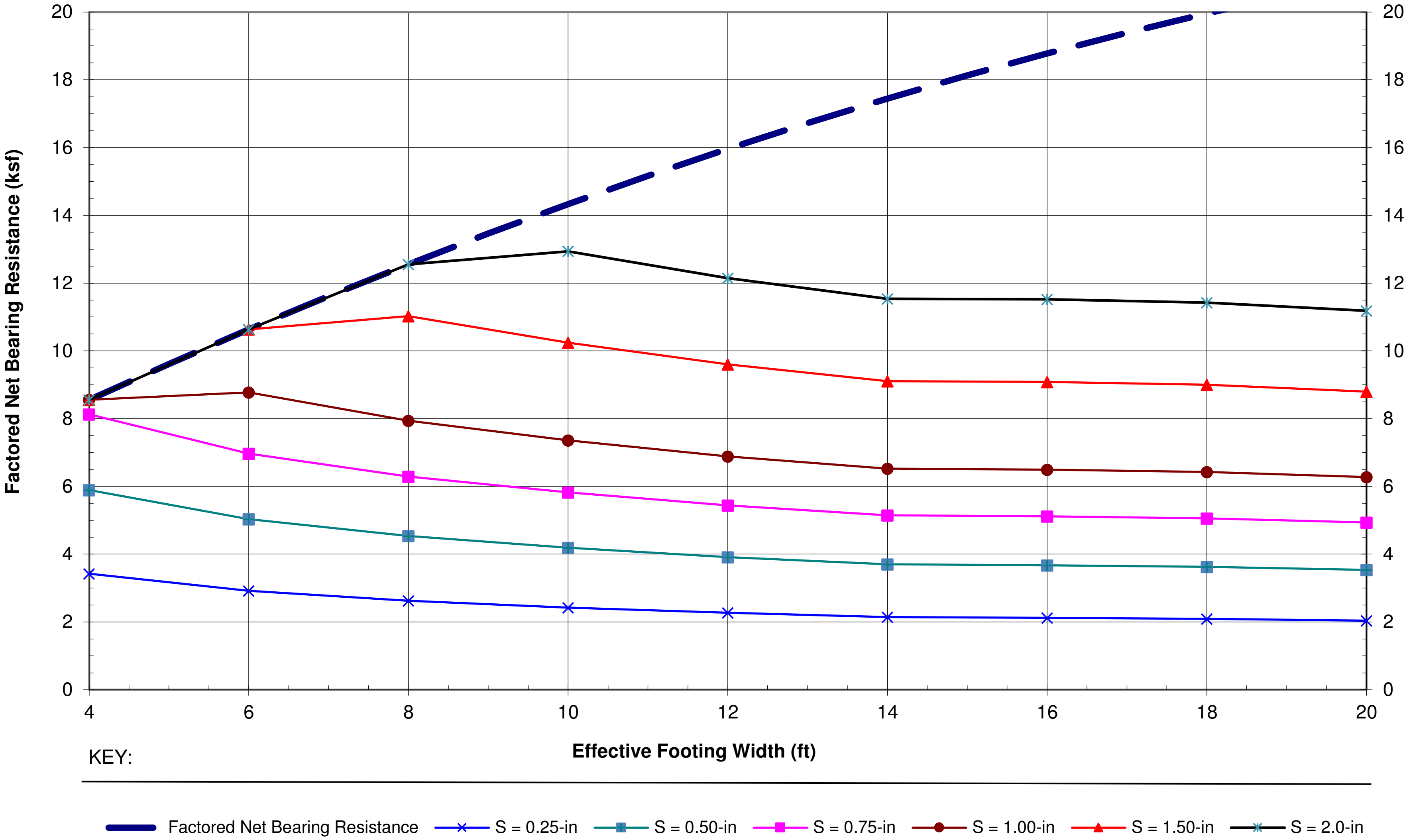


Figure F-3b: **Bearing Resistance Chart, Profile RW3A, Retaining Wall 3**
Effective Footing Length = 24 ft; Bearing Elevation at 4935 feet or lower. **Depth of embedment Df = 2.5 ft.**
S = Total (Immediate plus long-term) Settlement

Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

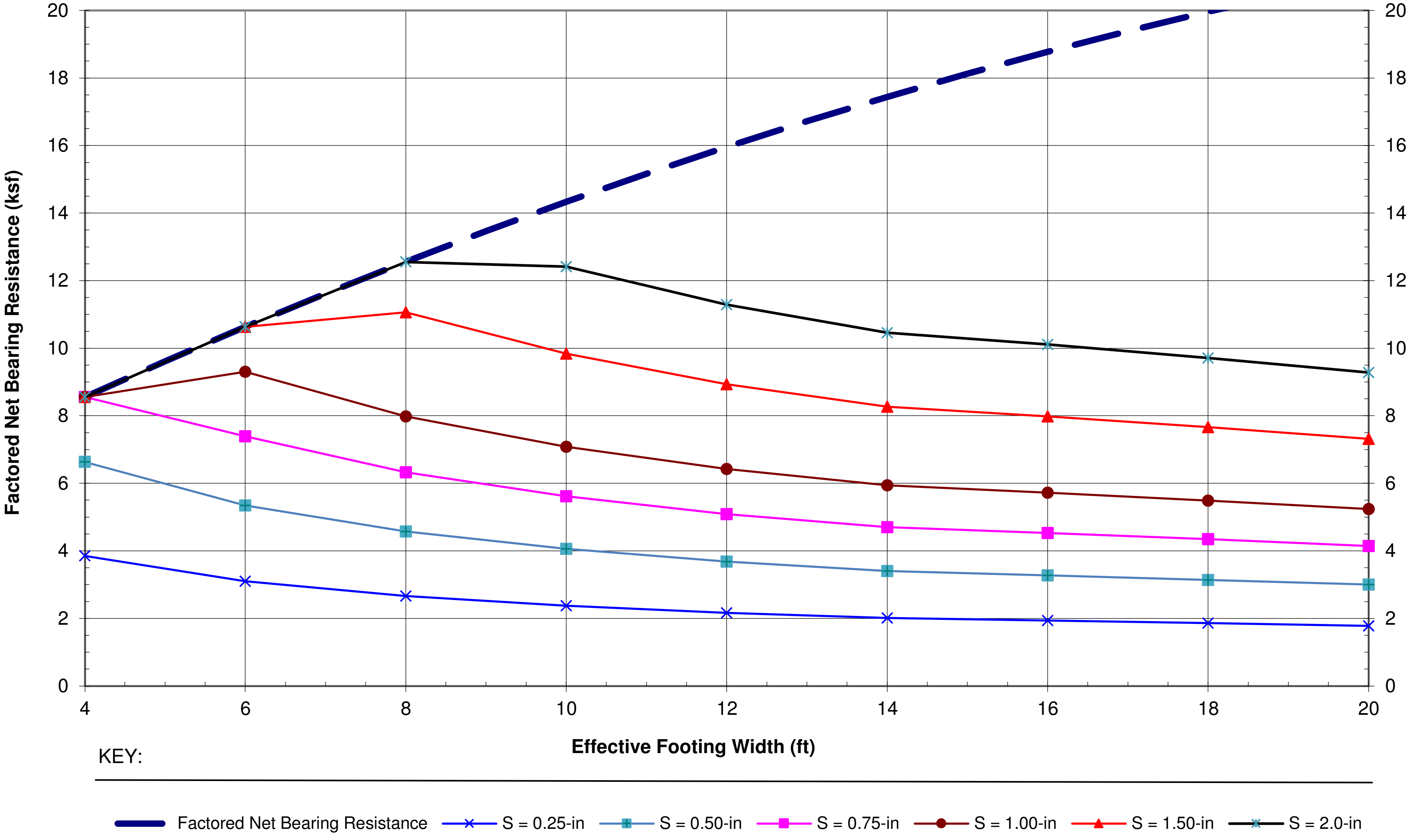


Figure F-4a: **Bearing Resistance Chart, Profile RW3B, Retaining Walls 3, 4 & 5**
Effective Footing Length = 24 ft; Bearing Elevation at 4965 feet or lower. **Depth of embedment Df = 2.5 ft.**
S = Immediate Settlement

Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

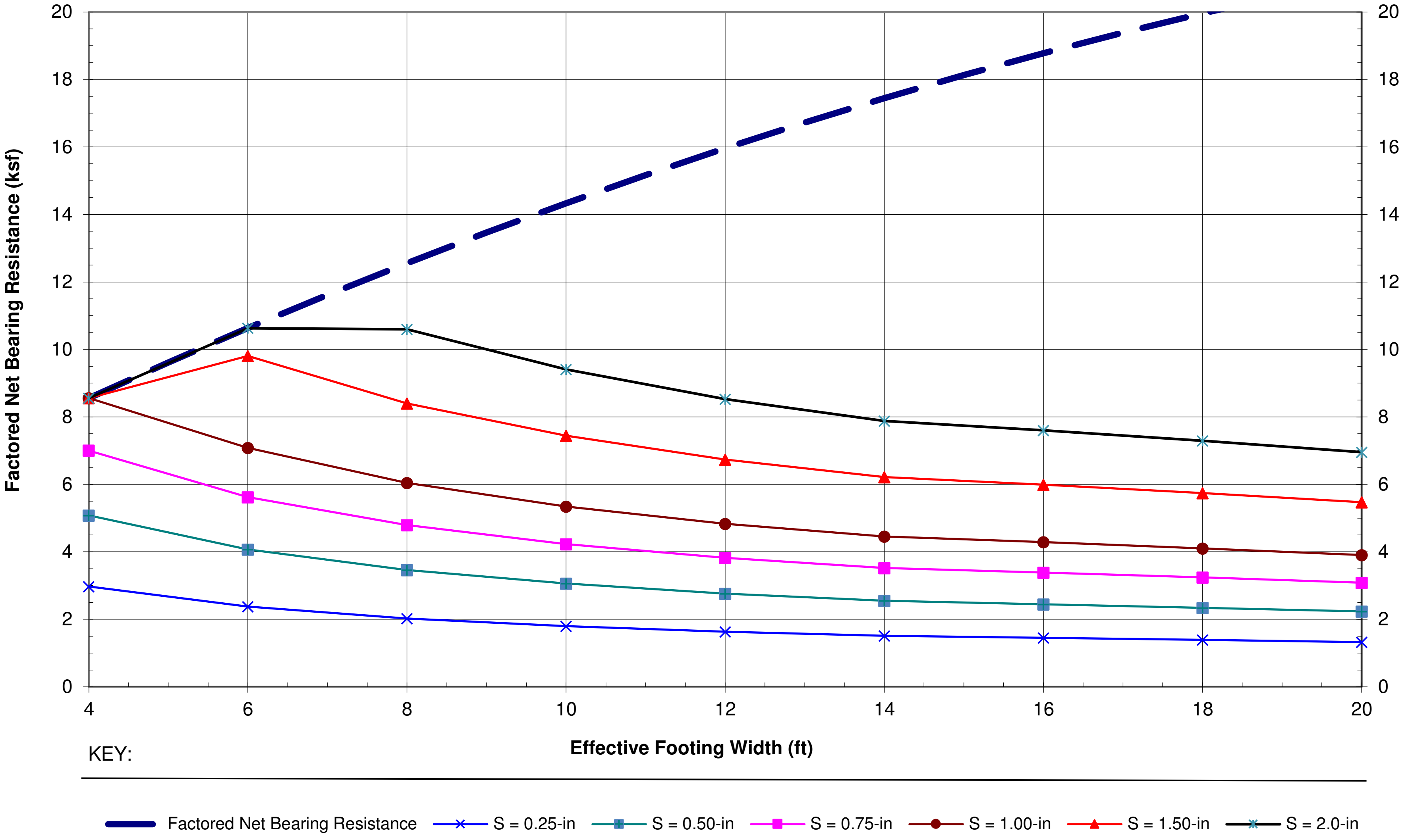


Figure F-4b: **Bearing Resistance Chart, Profile RW3B, Retaining Walls 3, 4 & 5**
Effective Footing Length = 24 ft; Bearing Elevation at 4965 feet or lower. **Depth of embedment Df = 2.5 ft.**
S = Total (Immediate plus long-term) Settlement

Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

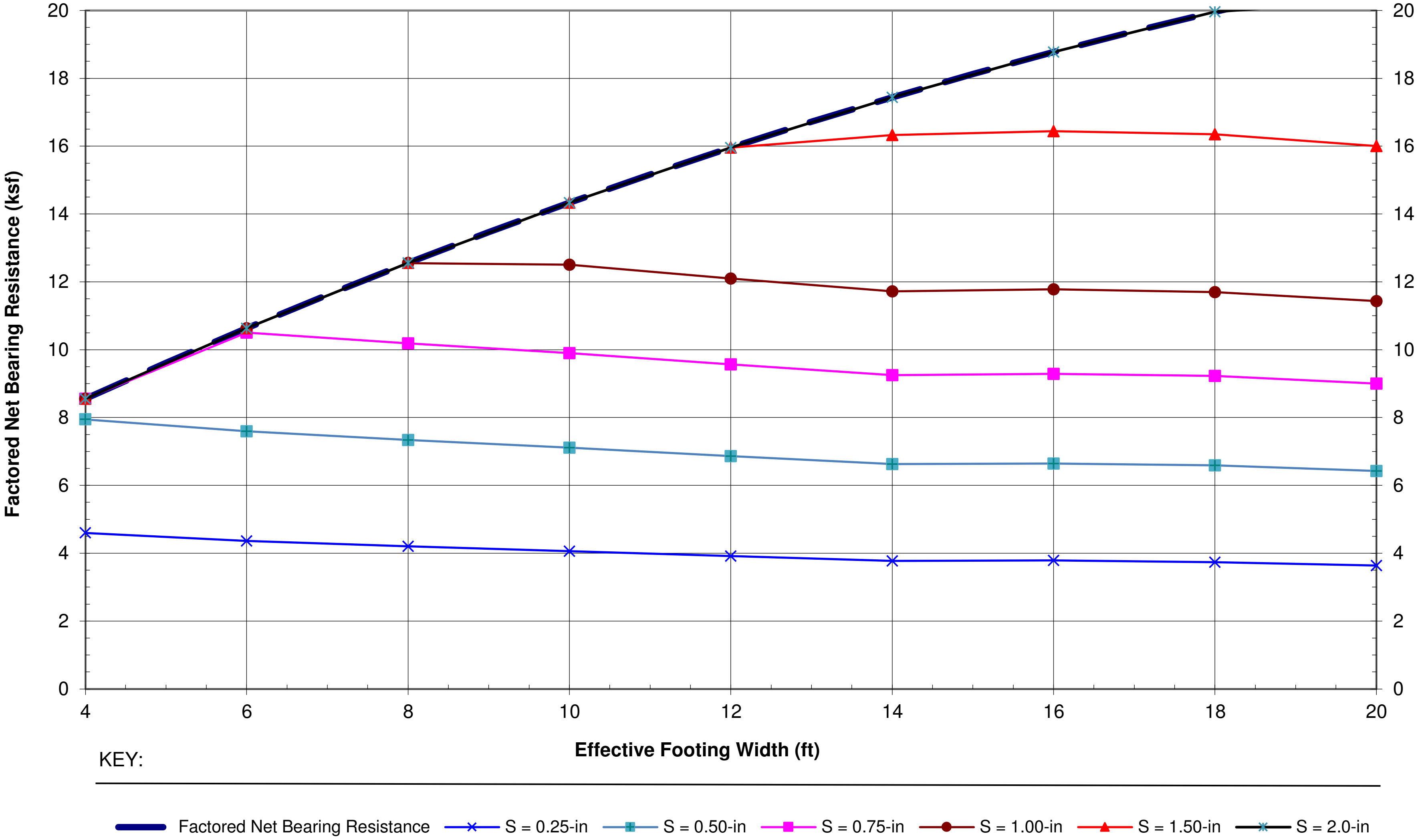


Figure F-5a: **Bearing Resistance Chart, Profile RW3C, Retaining Wall 3**
Effective Footing Length = 24 ft; Bearing Elevation at 4990 feet or lower. **Depth of embedment Df = 2.5 ft.**
S = Immediate Settlement

Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

Figure
F-5a

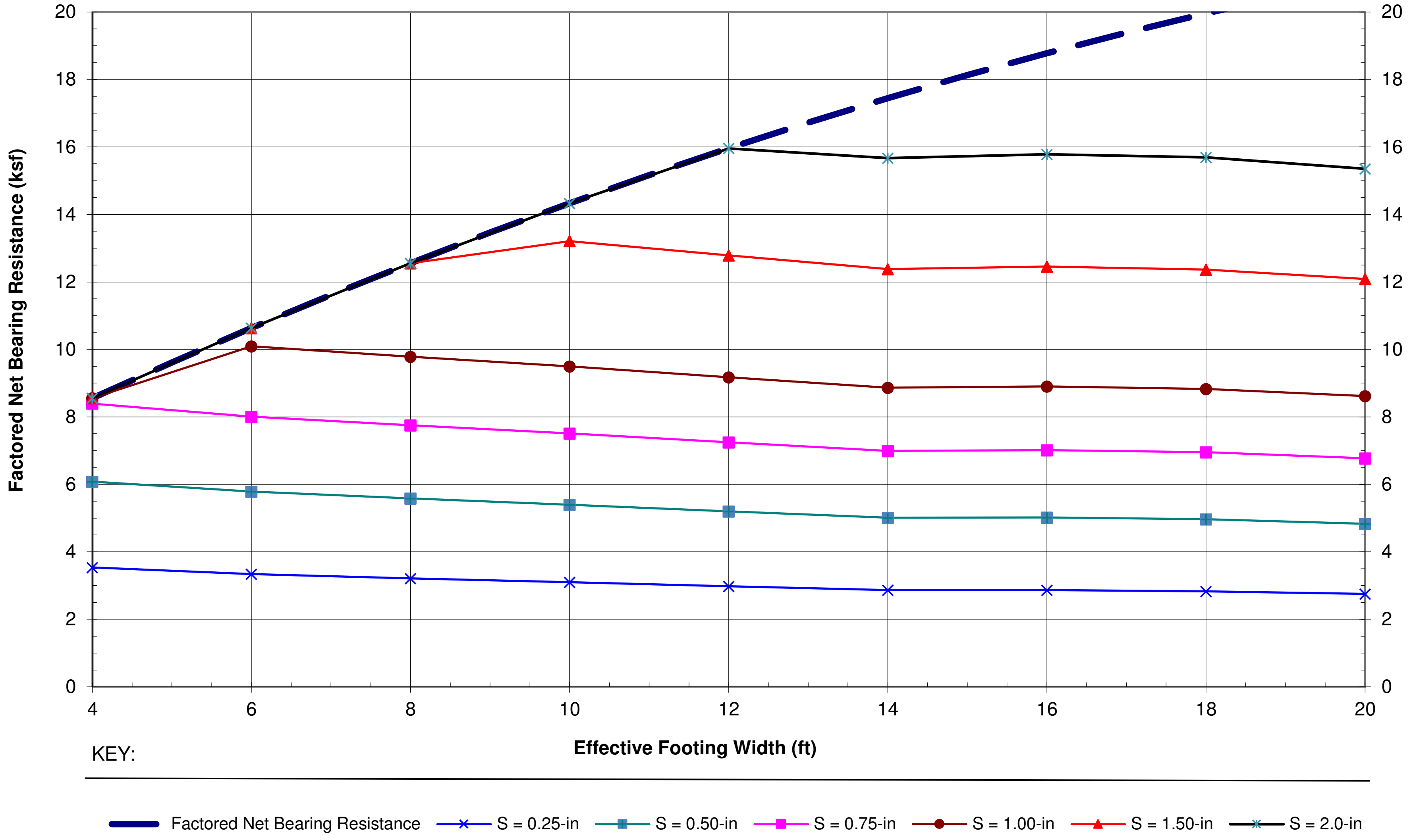


Figure F-5b: **Bearing Resistance Chart, Profile RW3C, Retaining Wall 3**
Effective Footing Length = 24 ft; Bearing Elevation at 4990 feet or lower. **Depth of embedment Df = 2.5 ft.**
S = Total (Immediate plus long-term) Settlement

Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

Figure
F-5b

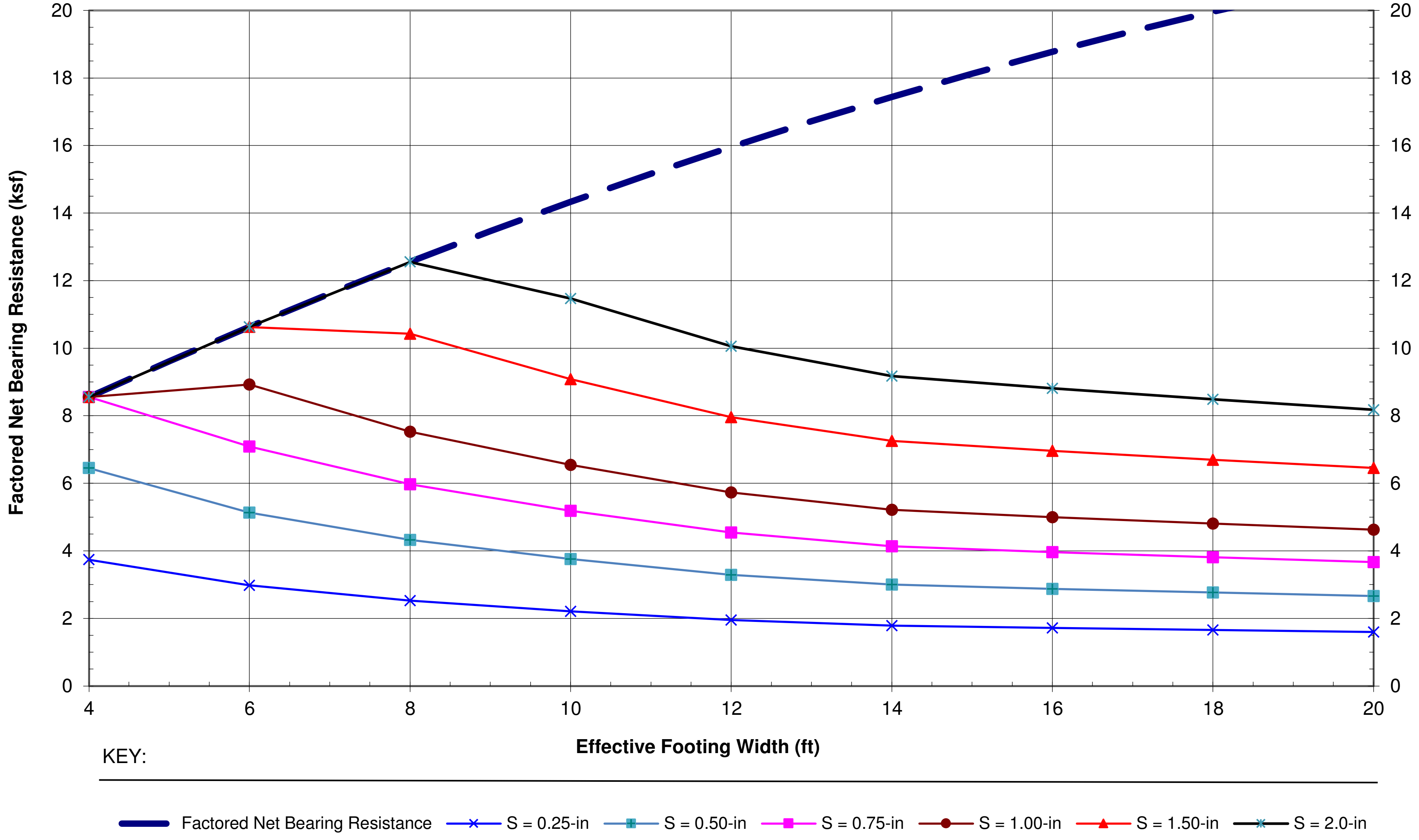


Figure F-6a: **Bearing Resistance Chart, Profile Boring RW4-27, Retaining Wall 4**
Effective Footing Length = 24 ft; Bearing Elevation at 4925 feet or lower. **Depth of embedment Df = 2.5 ft.**
S = Immediate Settlement

Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

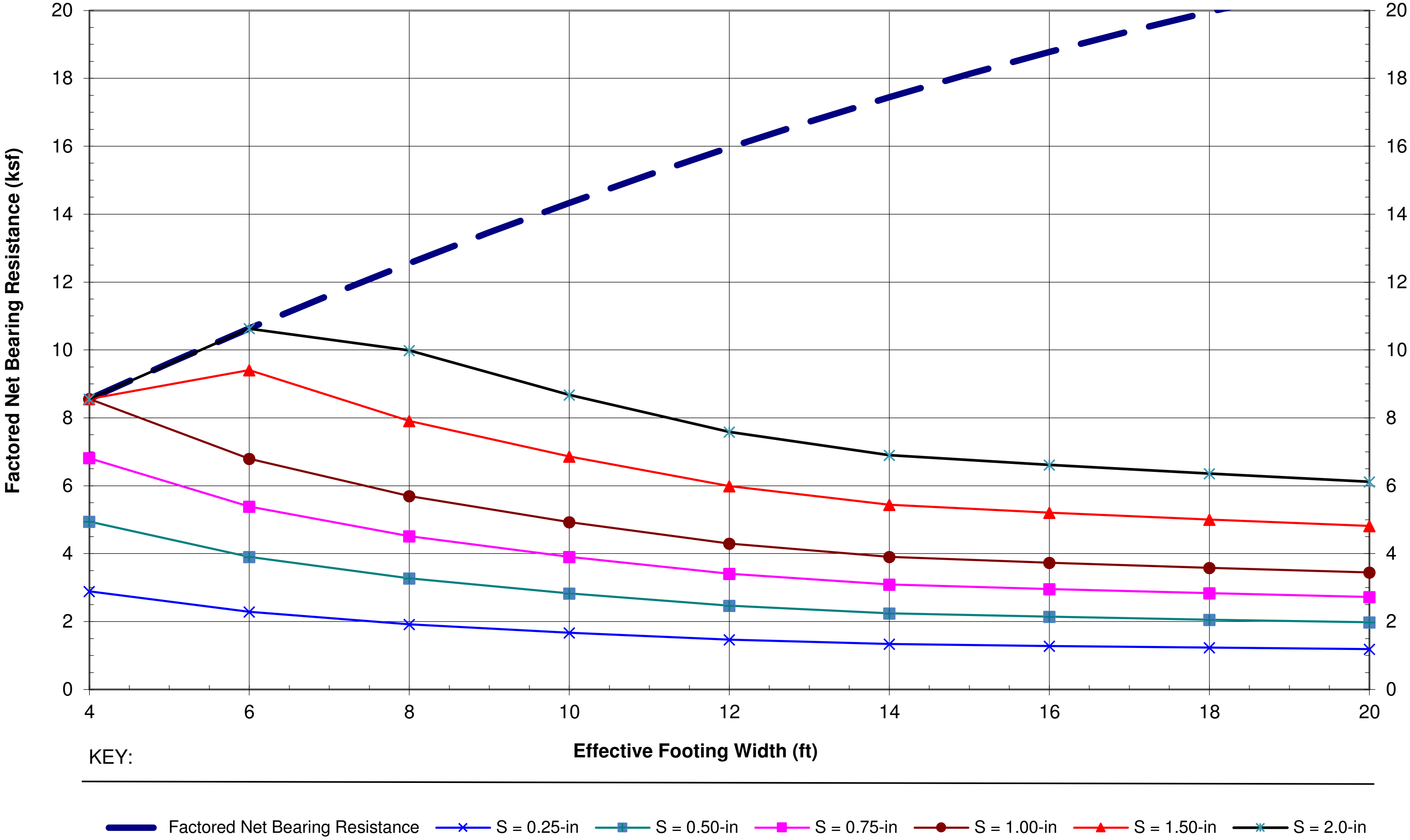


Figure F-6b: **Bearing Resistance Chart, Profile Boring RW4-27, Retaining Wall 4**
Effective Footing Length = 24 ft; Bearing Elevation at 4925 feet or lower. **Depth of embedment Df = 2.5 ft.**
S = Total (Immediate plus long-term) Settlement

Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

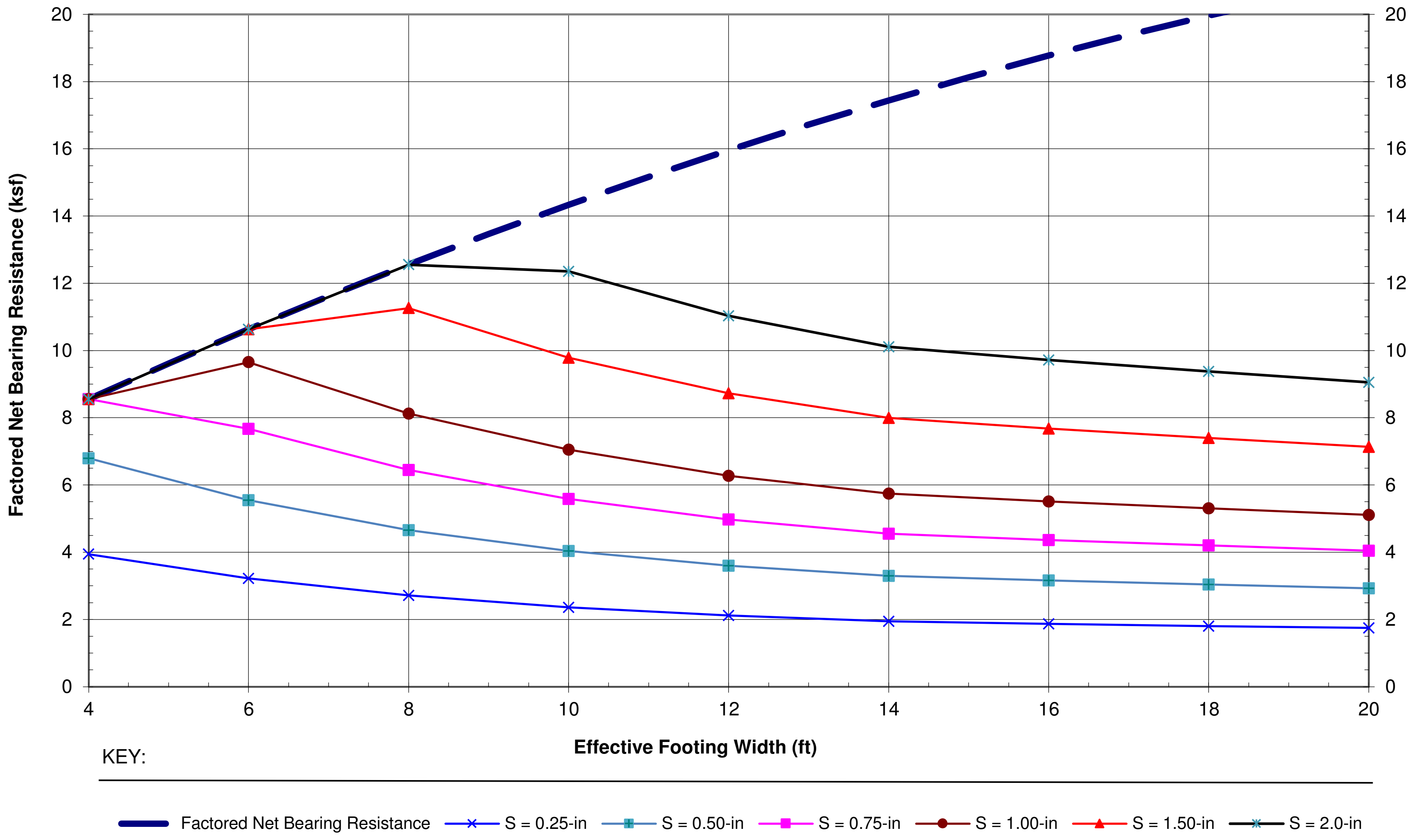


Figure F-7a: **Bearing Resistance Chart, Profile Boring RW5-29, Retaining Wall 5**
Effective Footing Length = 24 ft; Bearing Elevation at 4940 feet or lower. **Depth of embedment Df = 2.5 ft.**
S = Immediate Settlement

Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

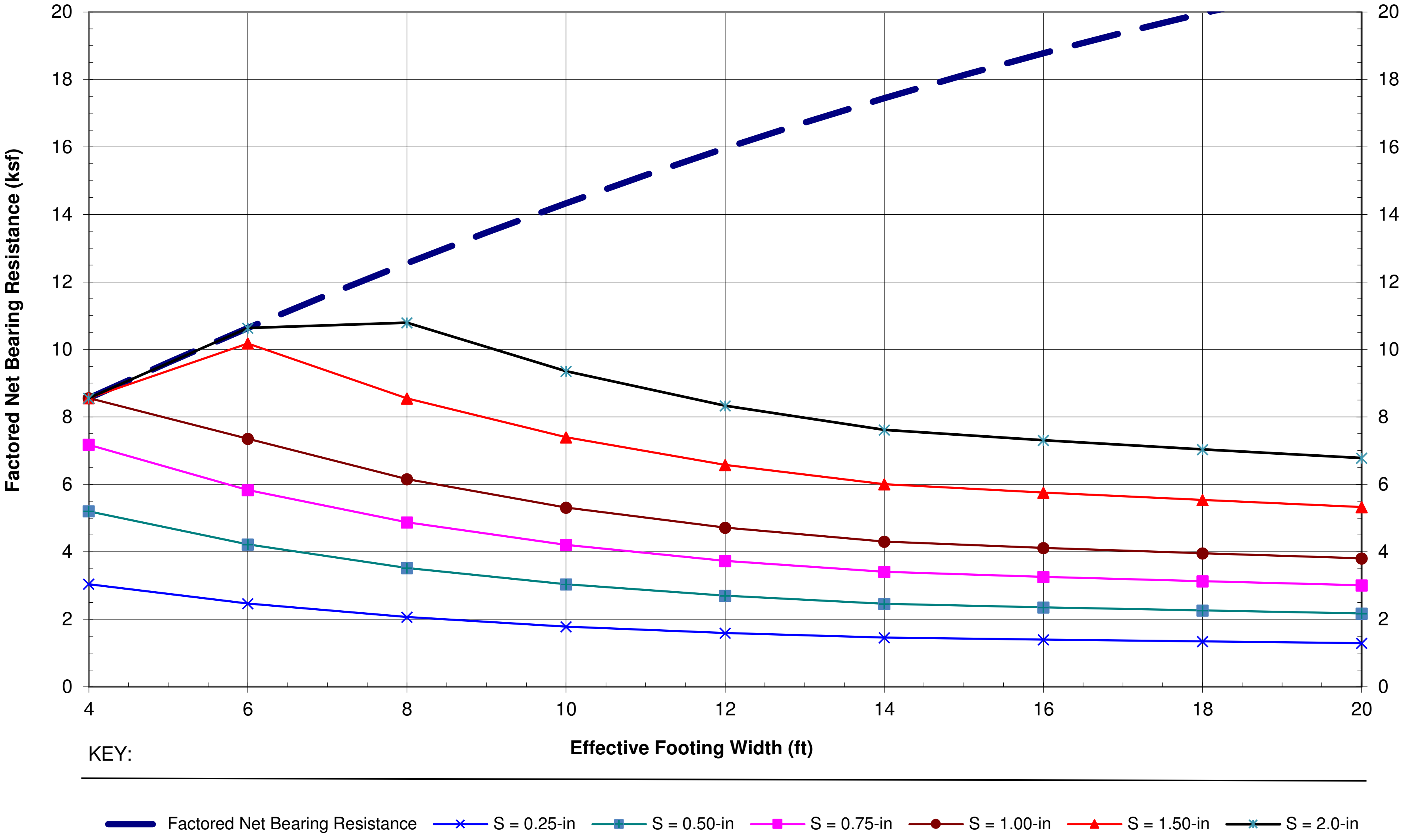


Figure F-7b: **Bearing Resistance Chart, Profile Boring RW5-29, Retaining Wall 5**
Effective Footing Length = 24 ft; Bearing Elevation at 4940 feet or lower. **Depth of embedment Df = 2.5 ft.**
S = Total (Immediate plus long-term) Settlement

Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

Figure
F-7b

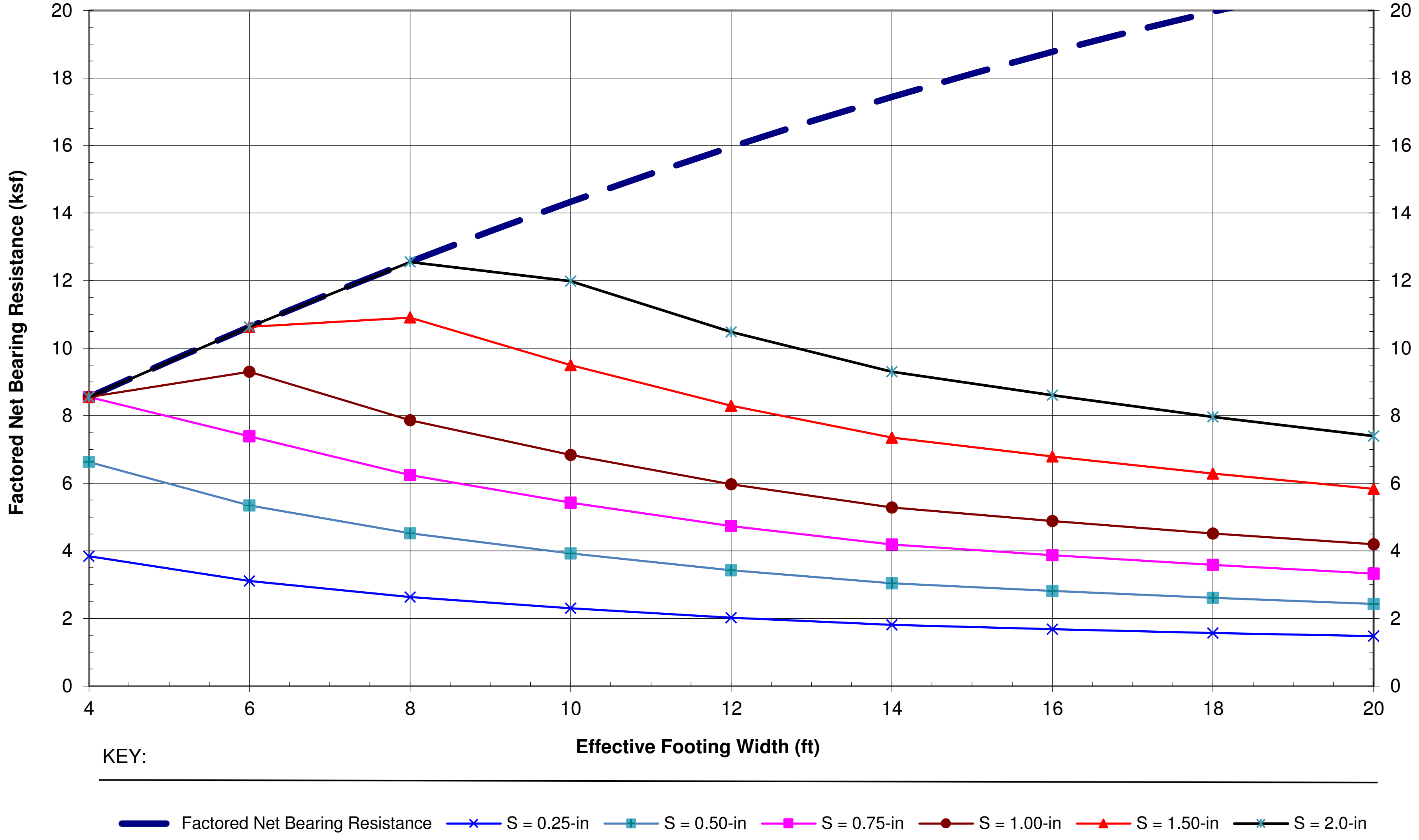


Figure F-8a: **Bearing Resistance Chart, Profile RW6, Retaining Wall 6**
Effective Footing Length = 24 ft; Bearing Elevation at 5070 feet or lower. **Depth of embedment Df = 2.5 ft.**
S = Immediate Settlement

Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

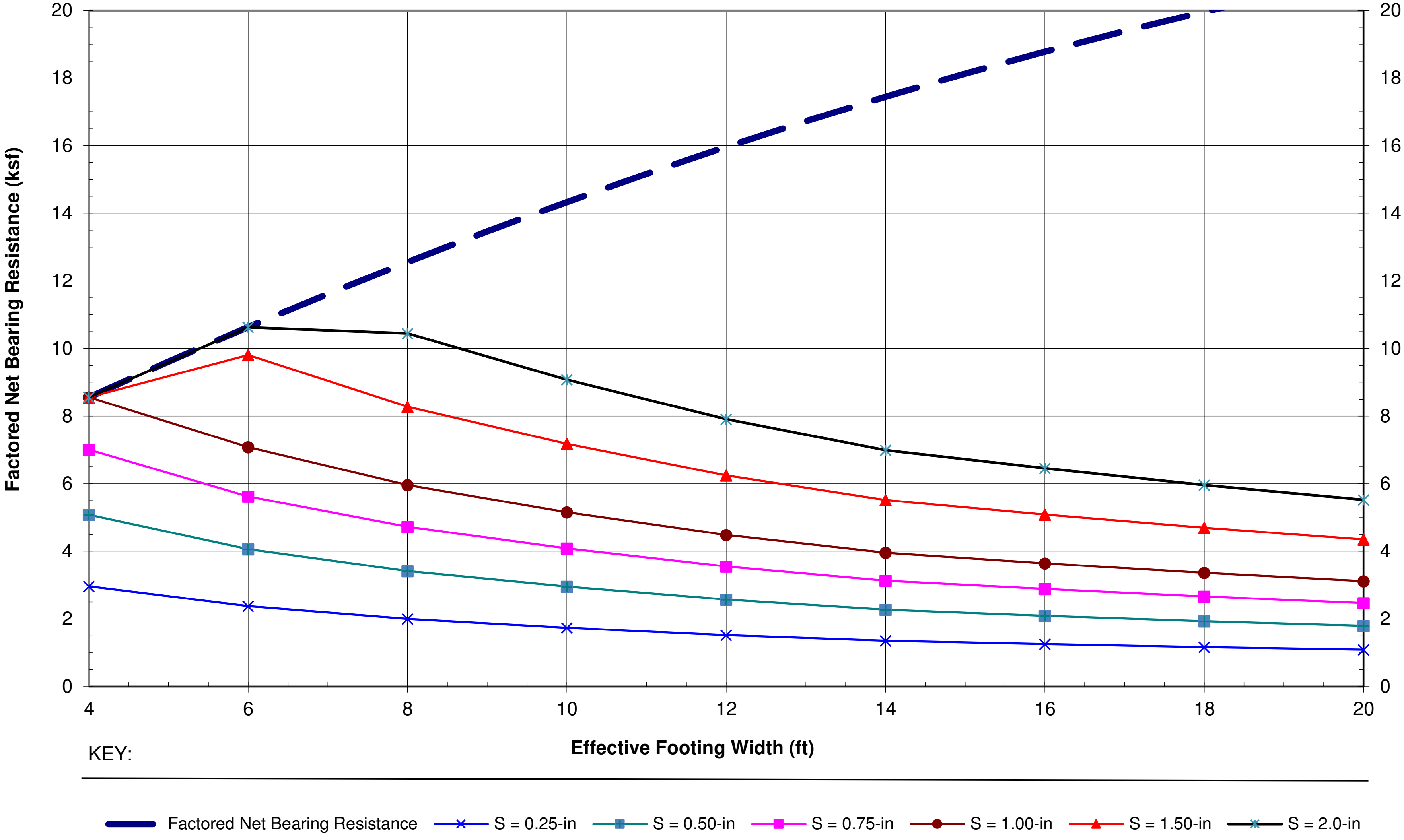


Figure F-8b: **Bearing Resistance Chart, Profile RW6, Retaining Wall 6**
Effective Footing Length = 24 ft; Bearing Elevation at 5070 feet or lower. **Depth of embedment Df = 2.5 ft.**
S = Total (Immediate plus long-term) Settlement

Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

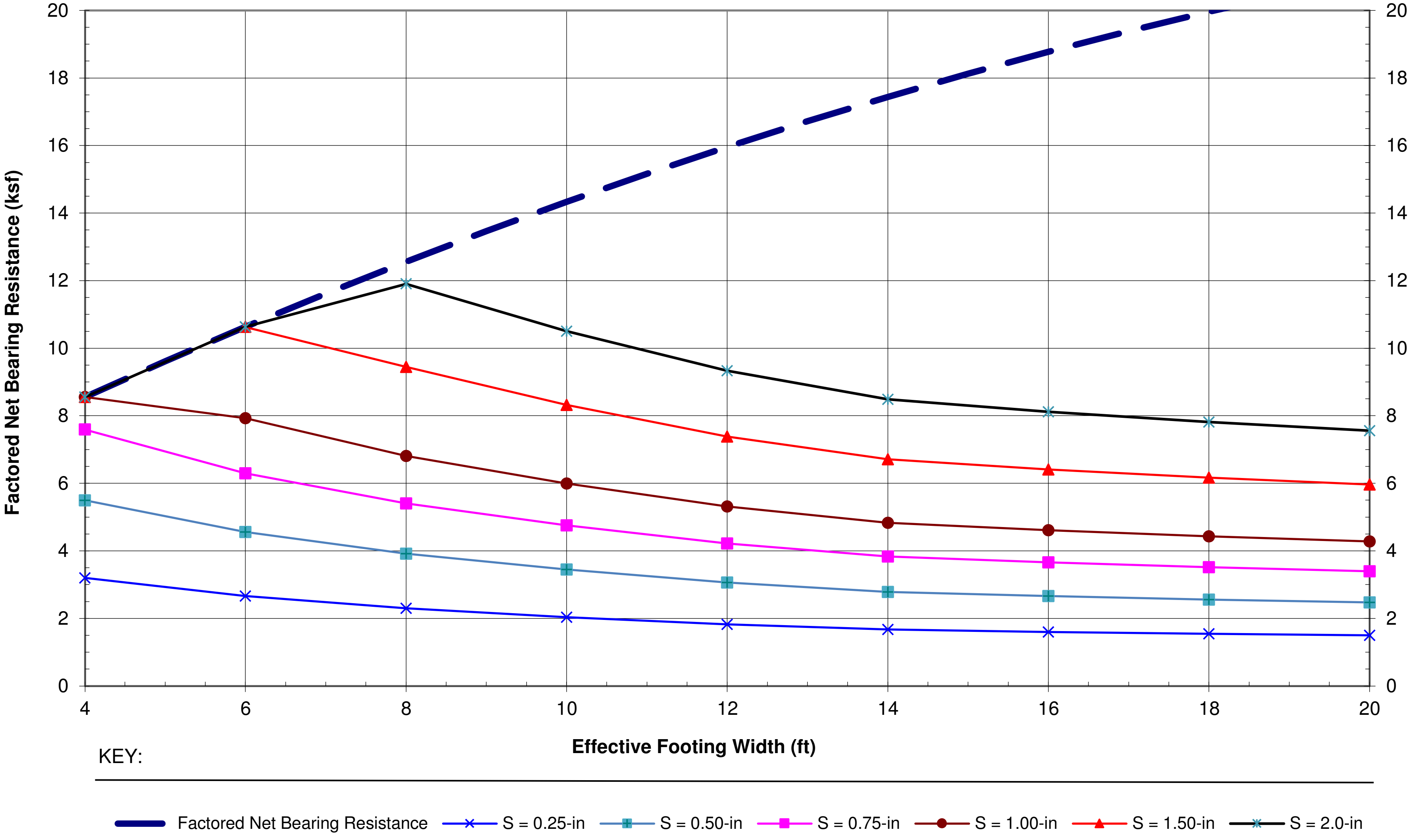


Figure F-9a: **Bearing Resistance Chart, Profile RW7A, Retaining Wall 7**
Effective Footing Length = 24 ft; Bearing Elevation at 5100 feet or lower. **Depth of embedment Df = 2.5 ft.**
S = Immediate Settlement

Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

Figure
F-9a

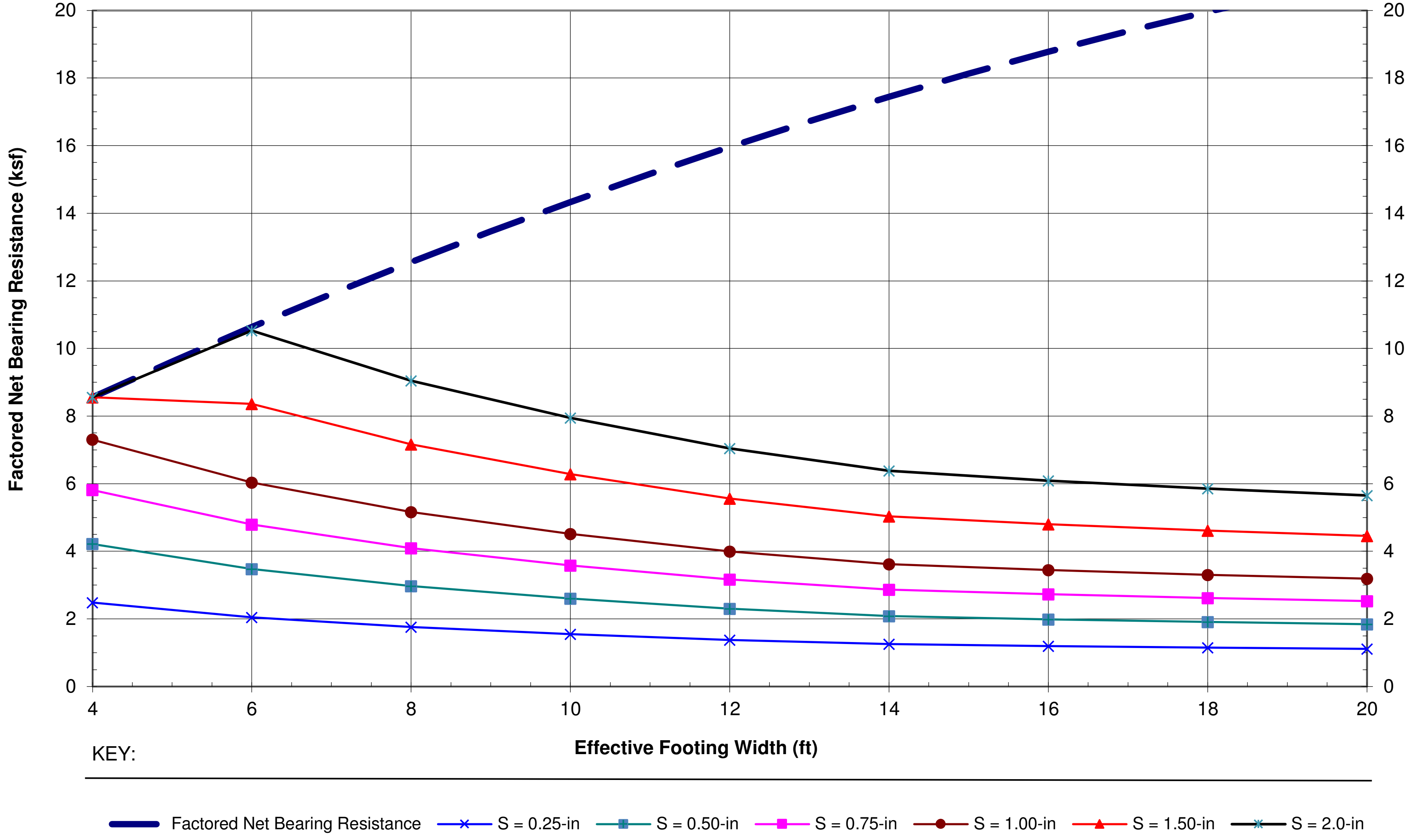


Figure F-9b: **Bearing Resistance Chart, Profile RW7A, Retaining Wall 7**
Effective Footing Length = 24 ft; Bearing Elevation at 5100 feet or lower. **Depth of embedment Df = 2.5 ft.**
S = Total (Immediate plus long-term) Settlement

Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

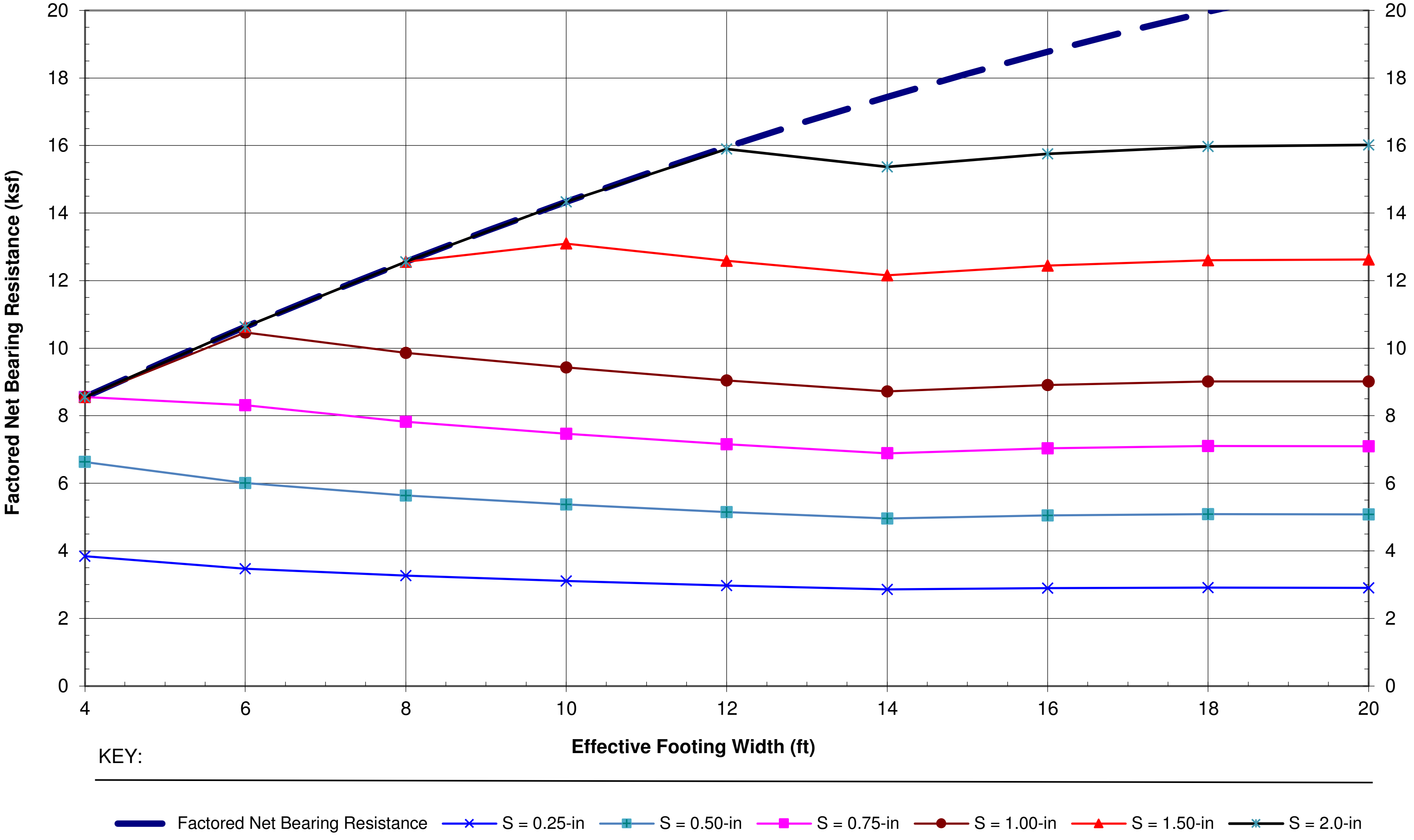


Figure F-10a: **Bearing Resistance Chart, Profile RW7B, Retaining Walls 7, 9 & 10**
Effective Footing Length = 24 ft; Bearing Elevation at 5150 feet or lower. **Depth of embedment Df = 2.5 ft.**
S = Immediate Settlement

Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

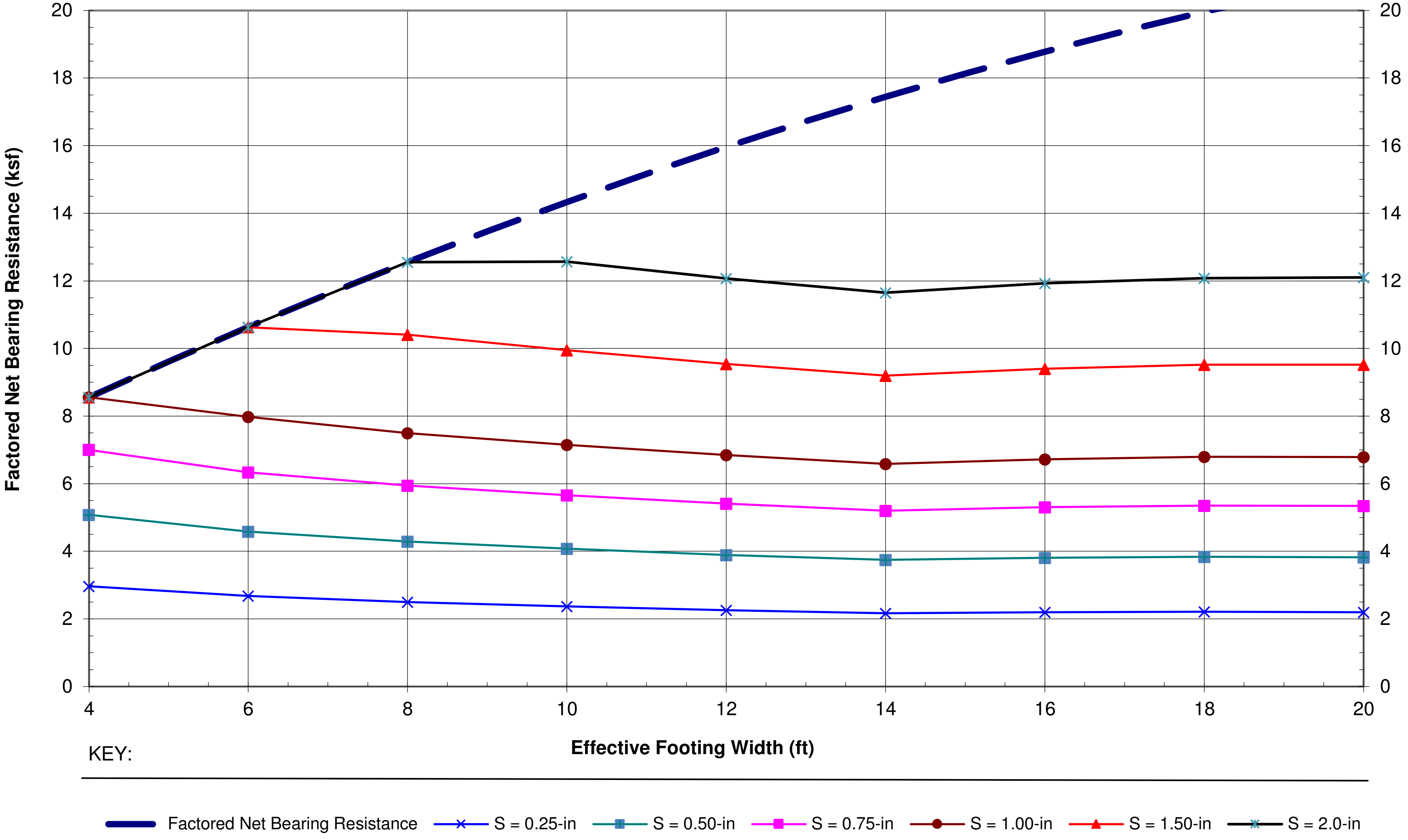


Figure F-10b: **Bearing Resistance Chart, Profile RW7B, Retaining Walls 7, 9 & 10**
Effective Footing Length = 24 ft; Bearing Elevation at 5150 feet or lower. **Depth of embedment Df = 2.5 ft.**
S = Total (Immediate plus long-term) Settlement

Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

Figure
F-10b

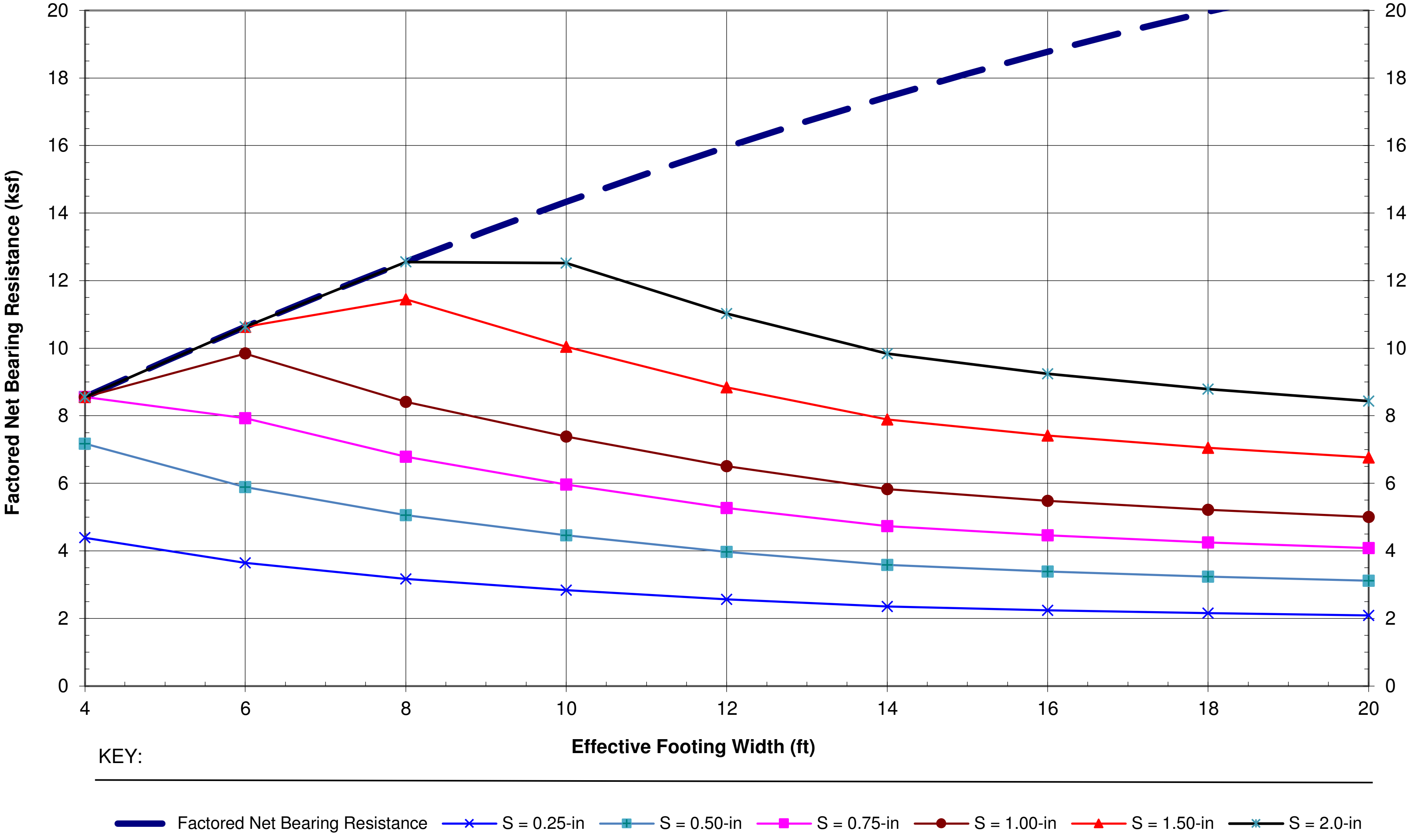


Figure F-11a: **Bearing Resistance Chart, Profile RW7C, Retaining Wall 7**
Effective Footing Length = 24 ft; Bearing Elevation at 5180 feet or lower. **Depth of embedment Df = 2.5 ft.**
S = Immediate Settlement

Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

Figure
F-11a

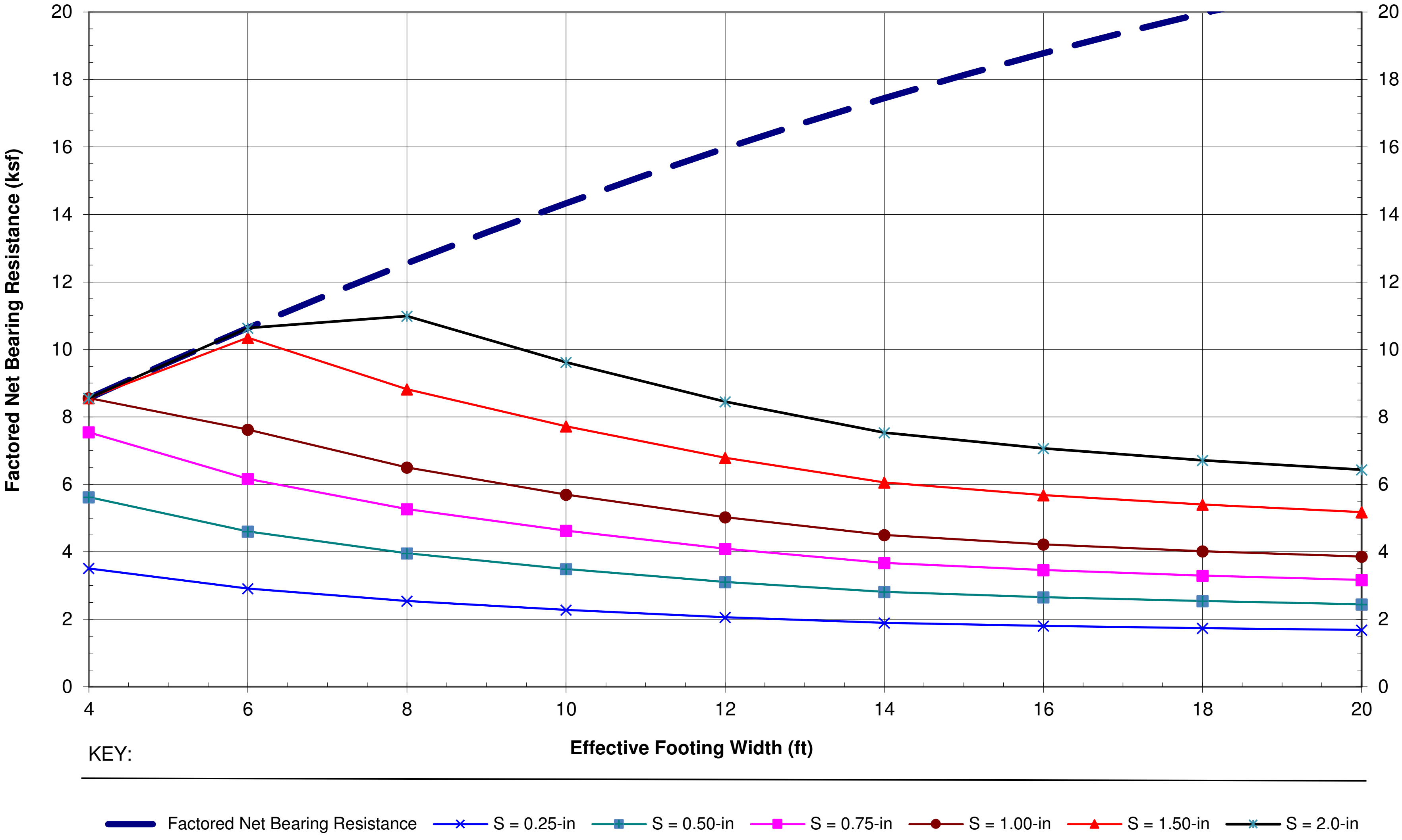


Figure F-11b: **Bearing Resistance Chart, Profile RW7C, Retaining Wall 7**
Effective Footing Length = 24 ft; Bearing Elevation at 5180 feet or lower. **Depth of embedment Df = 2.5 ft.**
S = Total (Immediate plus long-term) Settlement

Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

Figure
F-11b

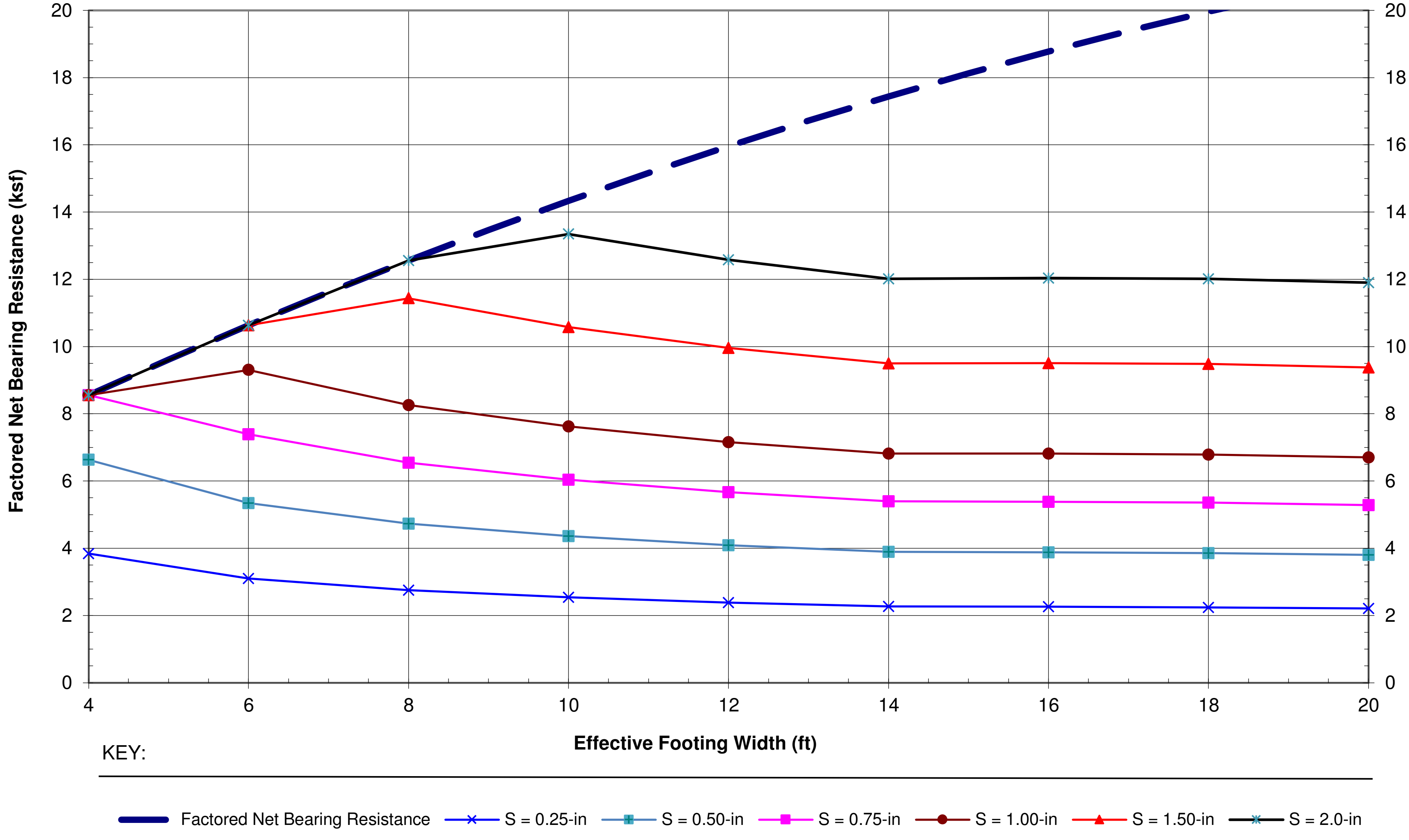


Figure F-12a: **Bearing Resistance Chart, Profile RW8, Retaining Wall 8**
Effective Footing Length = 24 ft; Bearing Elevation at 5095 feet or lower. **Depth of embedment Df = 2.5 ft.**
S = Immediate Settlement

Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

Figure
F-12a

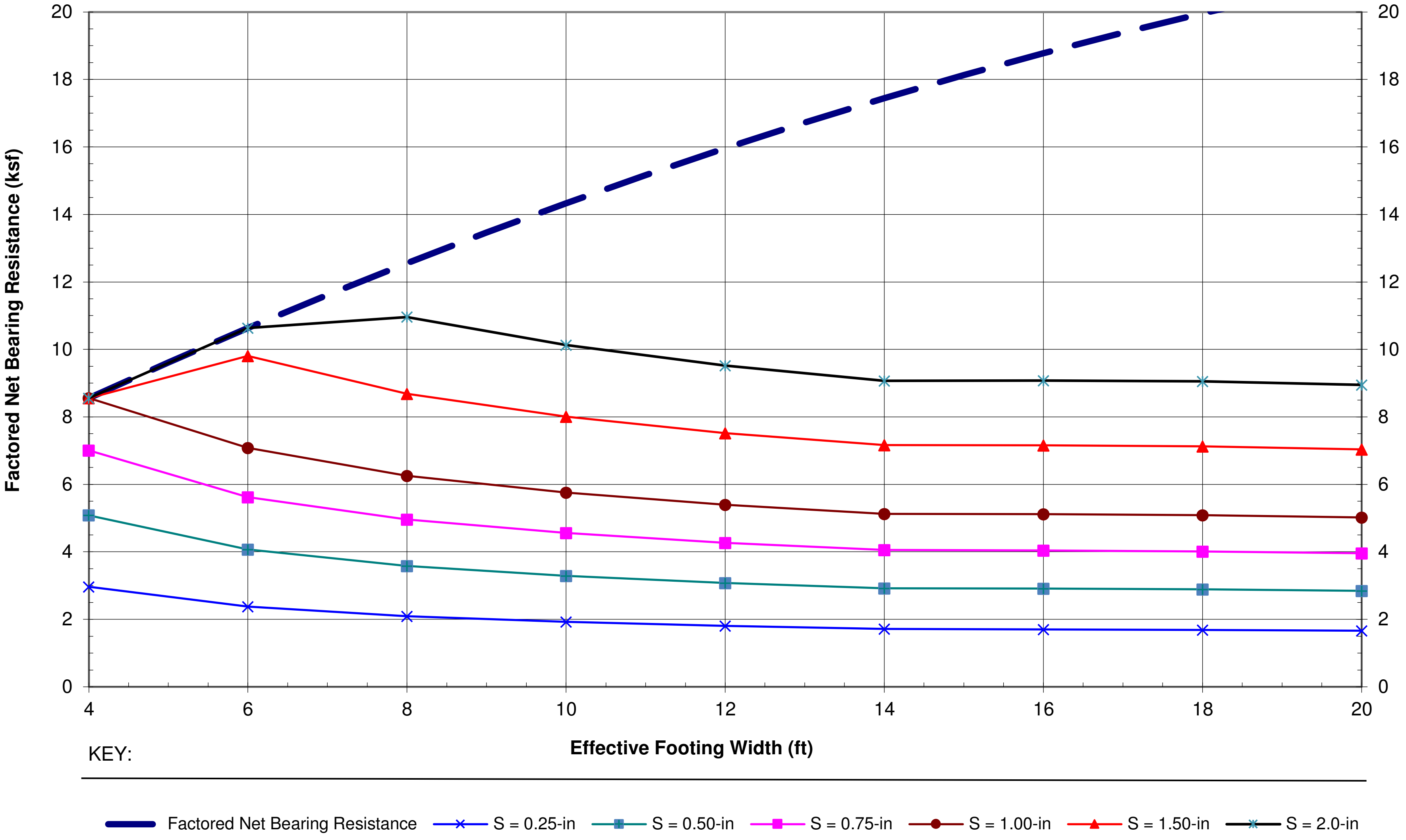


Figure F-12b: **Bearing Resistance Chart, Profile RW8, Retaining Wall 8**
Effective Footing Length = 24 ft; Bearing Elevation at 5095 feet or lower. **Depth of embedment Df = 2.5 ft.**
S = Total (Immediate plus long-term) Settlement

Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

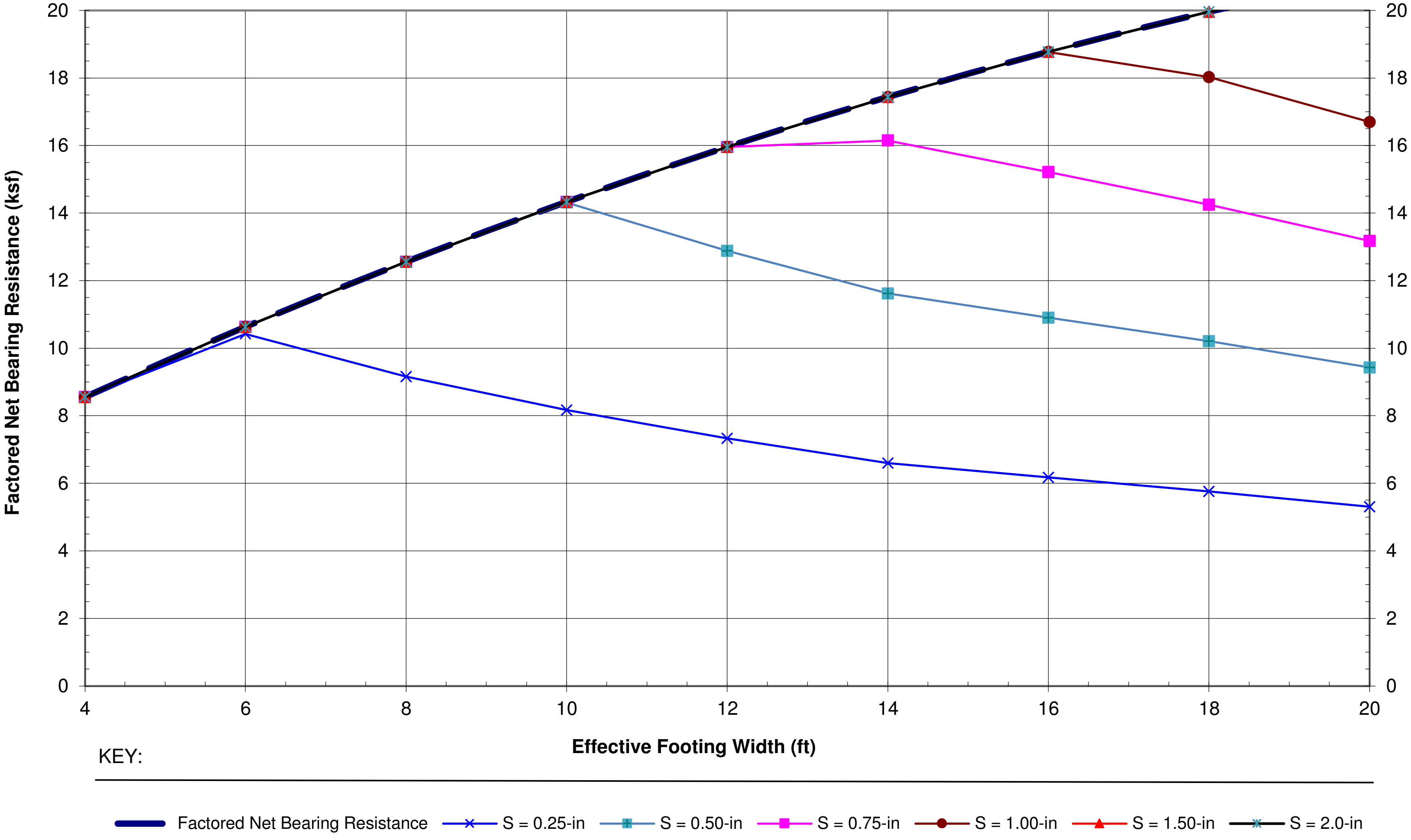


Figure F-13a: **Bearing Resistance Chart, Profile RW7B, Retaining Wall 10**
Effective Footing Length = 24 ft; Bearing Elevation at 5140 feet or lower. **Depth of embedment Df = 2.5 ft.**
S = Immediate Settlement

Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

Figure
F-13a

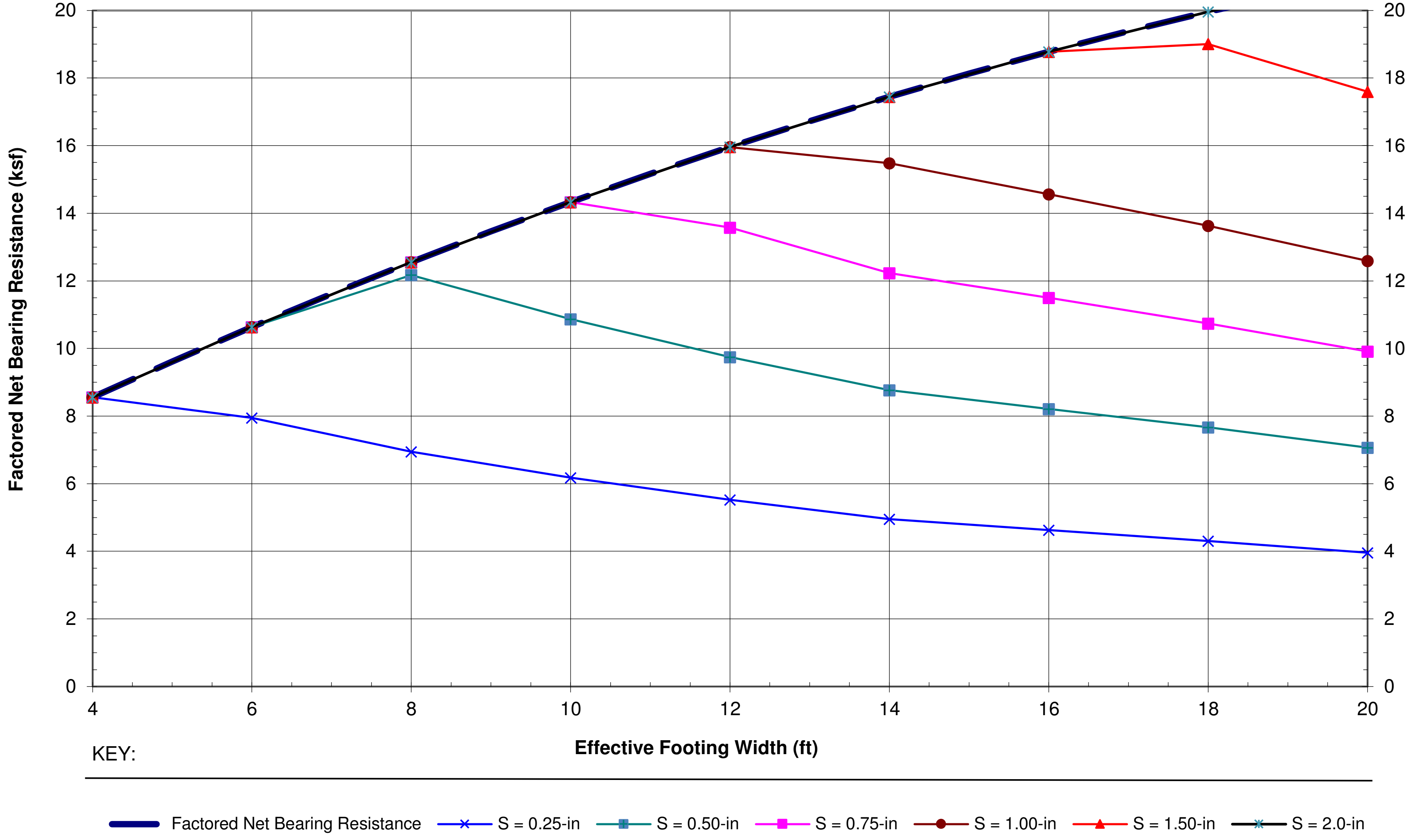


Figure F-13b: **Bearing Resistance Chart, Profile RW7B, Retaining Wall 10**
Effective Footing Length = 24 ft; Bearing Elevation at 5140 feet or lower. **Depth of embedment Df = 2.5 ft.**
S = Total (Immediate plus long-term) Settlement

Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

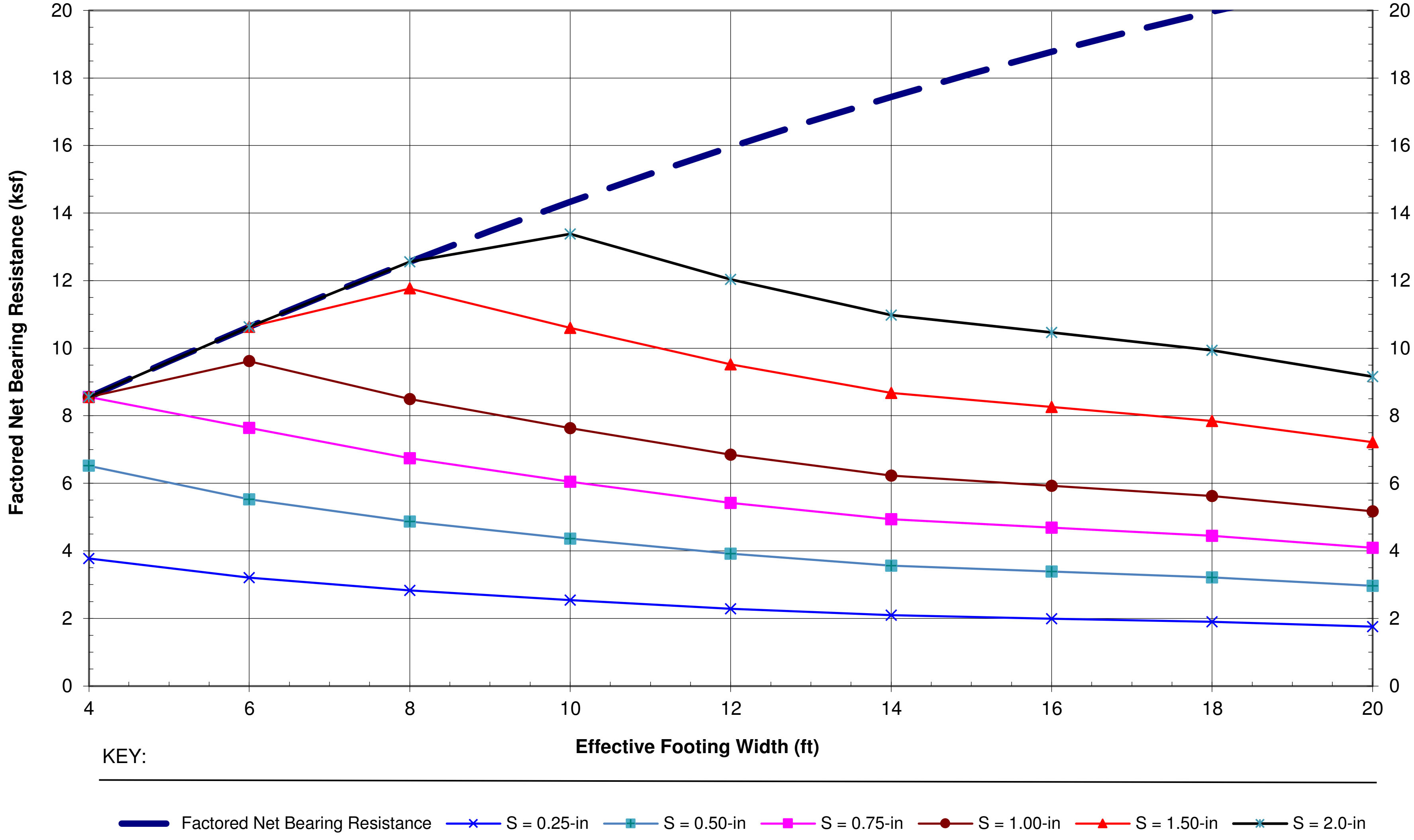


Figure F-14a: **Bearing Resistance Chart, Profile RW11A, Retaining Wall 11**
Effective Footing Length = 24 ft; Bearing Elevation at 5130 feet or lower. **Depth of embedment Df = 2.5 ft.**
S = Immediate Settlement

Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

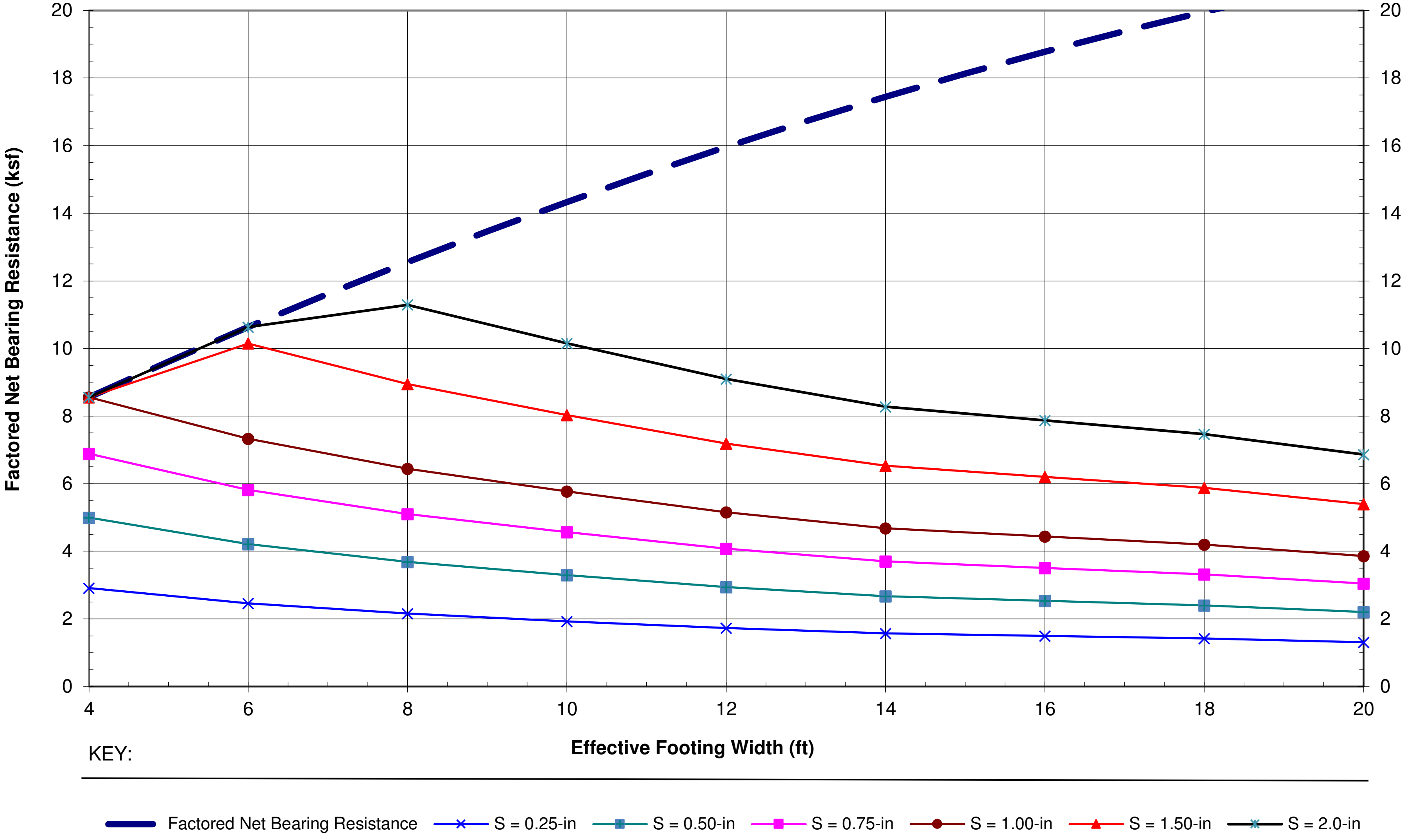


Figure F-14b: Bearing Resistance Chart, Profile RW11A, Retaining Wall 11
Effective Footing Length = 24 ft; Bearing Elevation at 5130 feet or lower. Depth of embedment Df = 2.5 ft.
S = Total (Immediate plus long-term) Settlement

Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

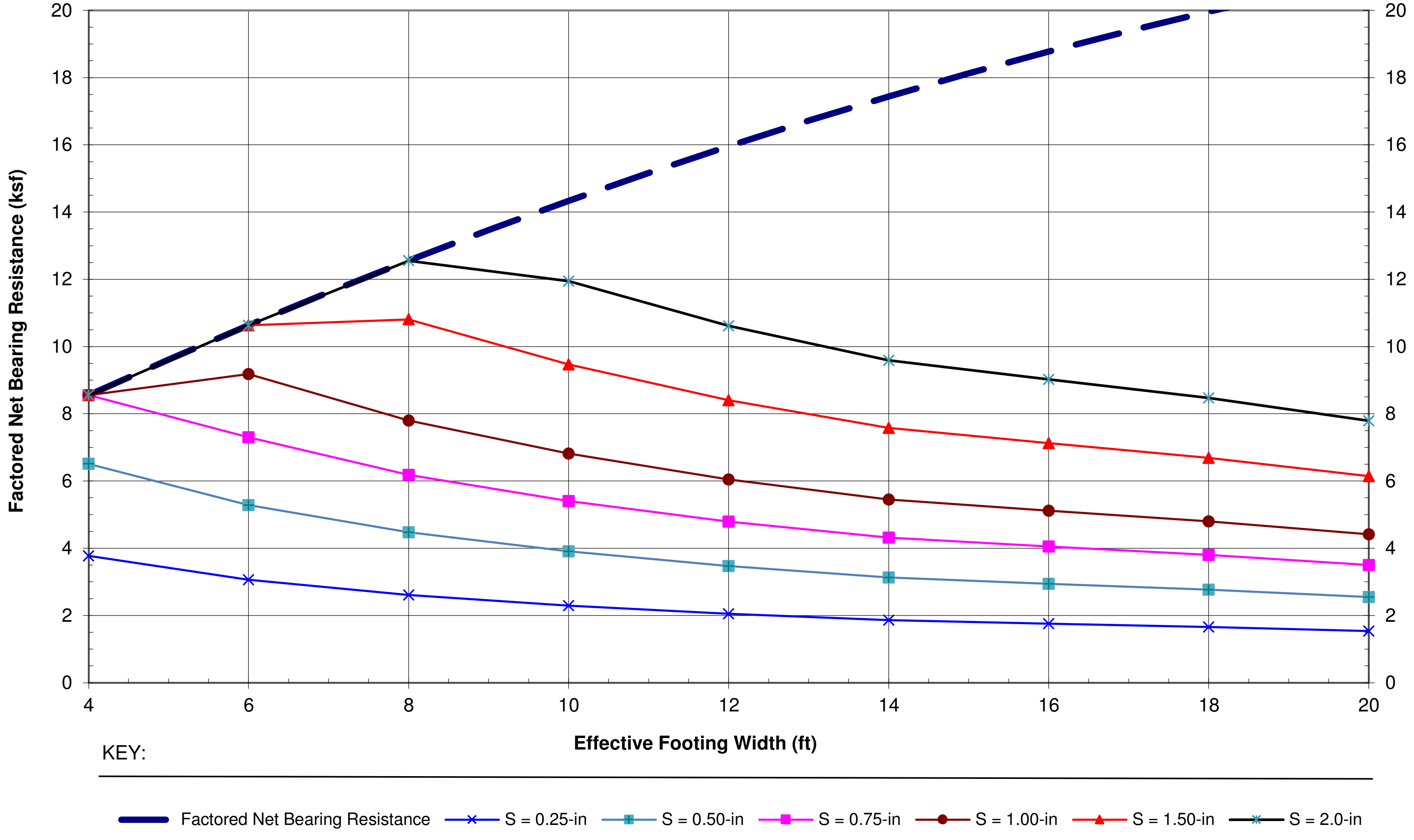


Figure F-15a: **Bearing Resistance Chart, Profile RW11B, Retaining Wall 11**
Effective Footing Length = 24 ft; Bearing Elevation at 5122.5 feet or lower. **Depth of embedment Df = 2.5 ft.**
S = Immediate Settlement

Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

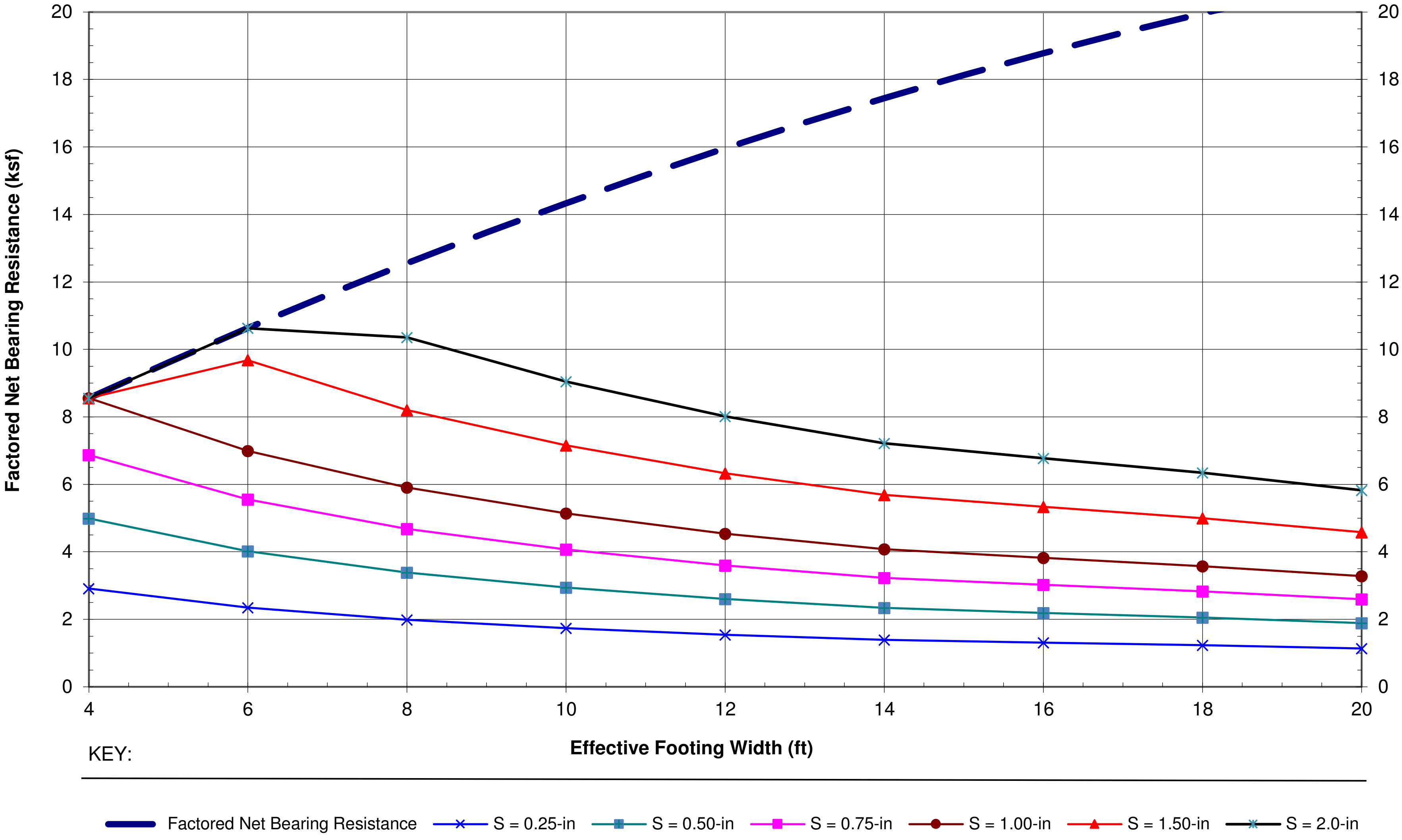


Figure F-15b: **Bearing Resistance Chart, Profile RW11B, Retaining Wall 11**
Effective Footing Length = 24 ft; Bearing Elevation at 5122.5 feet or lower. **Depth of embedment Df = 2.5 ft.**
S = Total (Immediate plus long-term) Settlement

Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

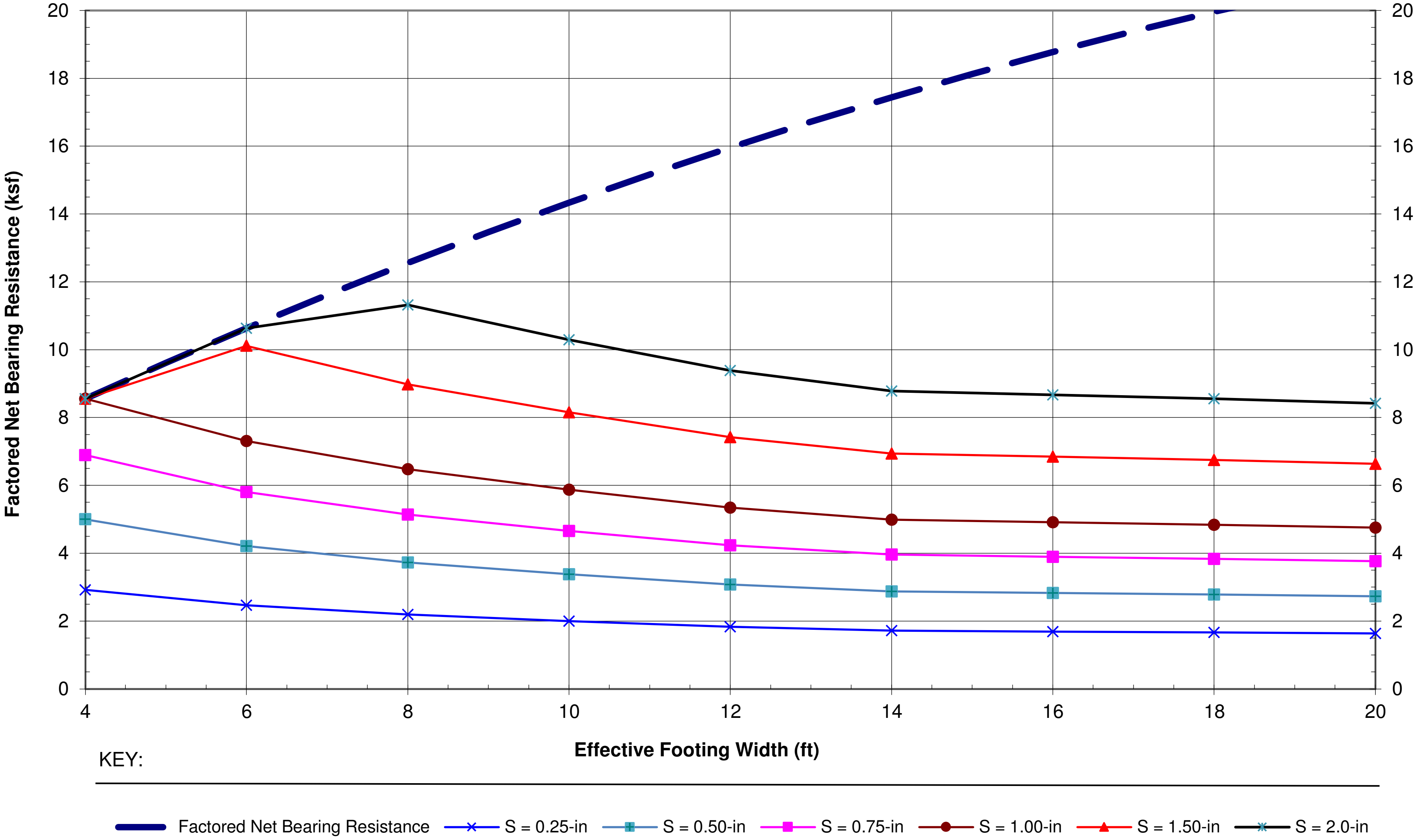


Figure F-16a: **Bearing Resistance Chart, Profile RW12, Retaining Wall 12**
Effective Footing Length = 24 ft; Bearing Elevation at 4710 feet or lower. **Depth of embedment Df = 2.5 ft.**
S = Immediate Settlement

Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

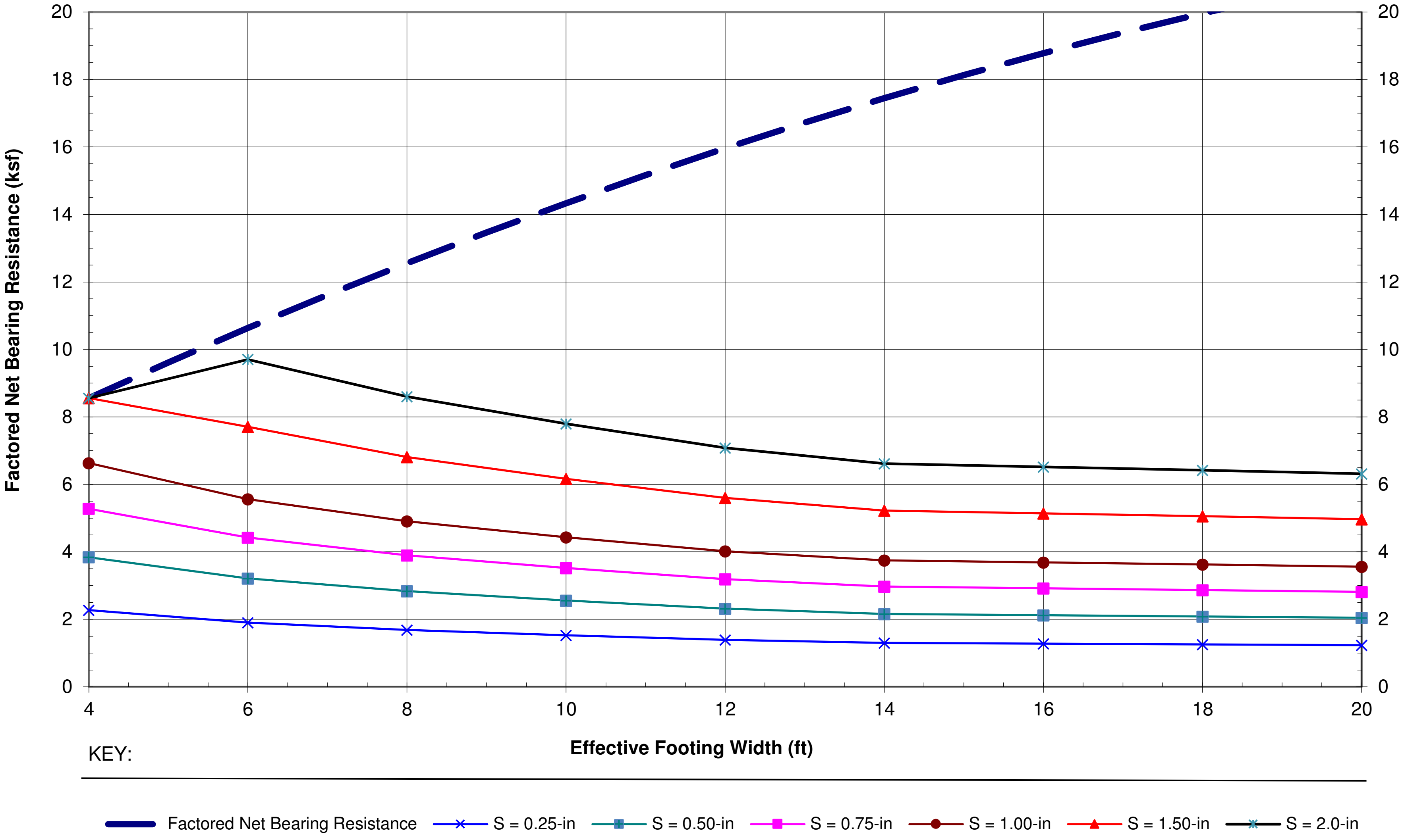


Figure F-16b: **Bearing Resistance Chart, Profile RW12, Retaining Wall 12**
Effective Footing Length = 24 ft; Bearing Elevation at 4710 feet or lower. **Depth of embedment Df = 2.5 ft.**
S = Total (Immediate plus long-term) Settlement

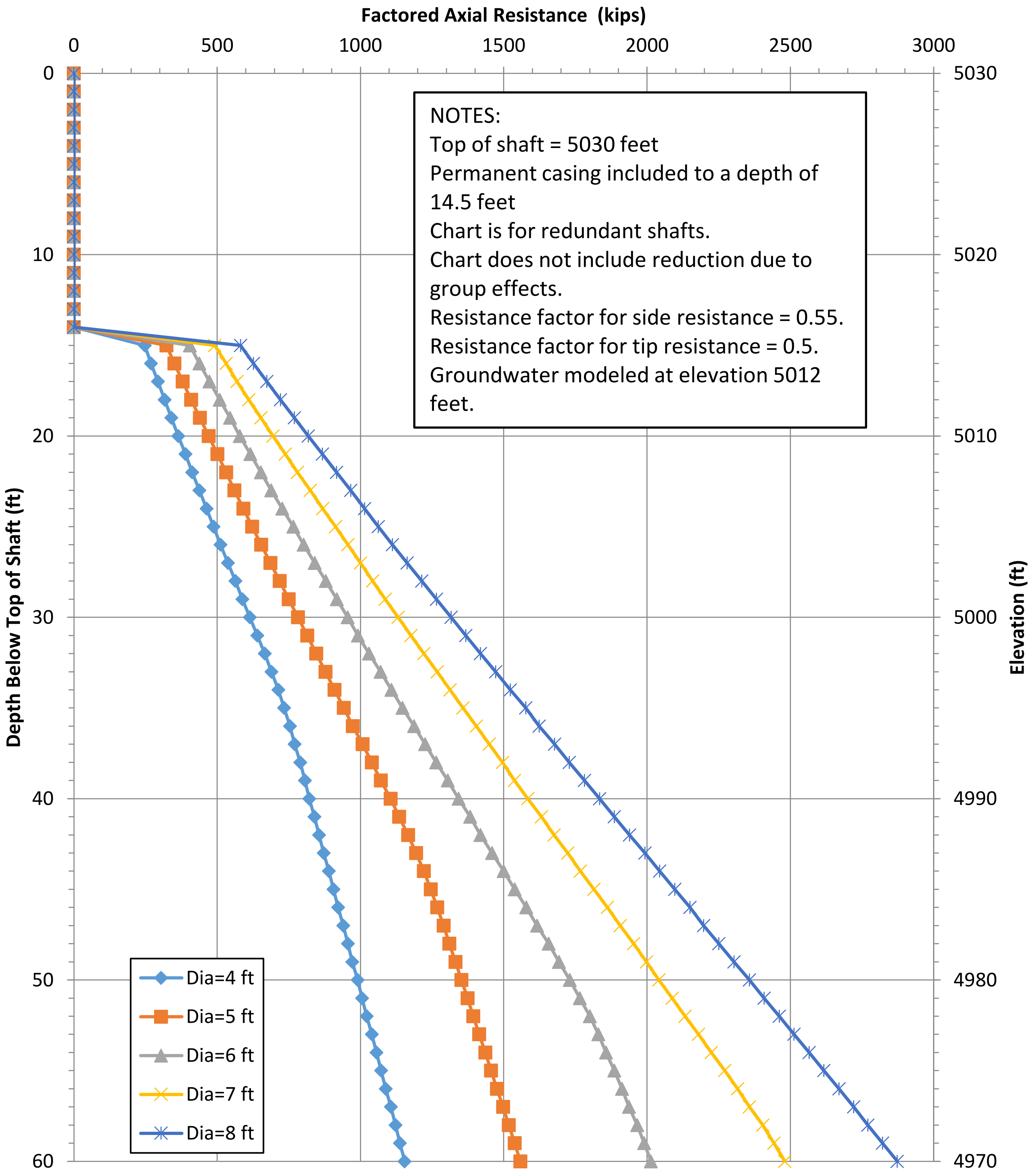
Notes: Capacity and settlements presented above are based on +/-20% of listed dimensions and embedment depth.
Chart incorporates effect of proximity to slope, if applicable.

APPENDIX G

Drilled Shaft Design Recommendations for Bridge G-1092N&S

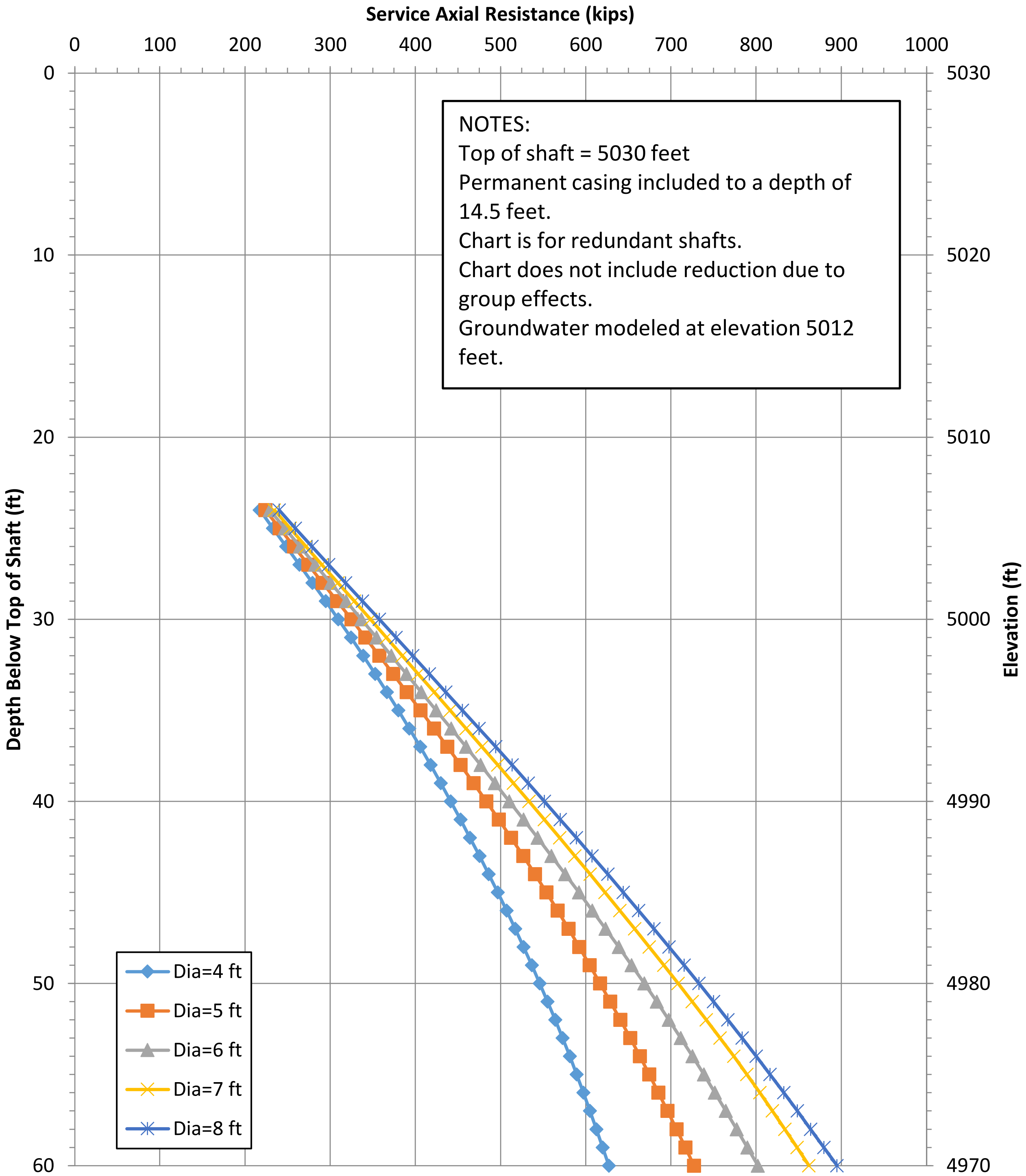
Figures G-1 to G-2

Figure G-1
US 395 - WA 30.04
Panther Valley UPRR Overpass G-1092
Piers 1 and 4
Factored Axial Resistance of Drilled Shafts



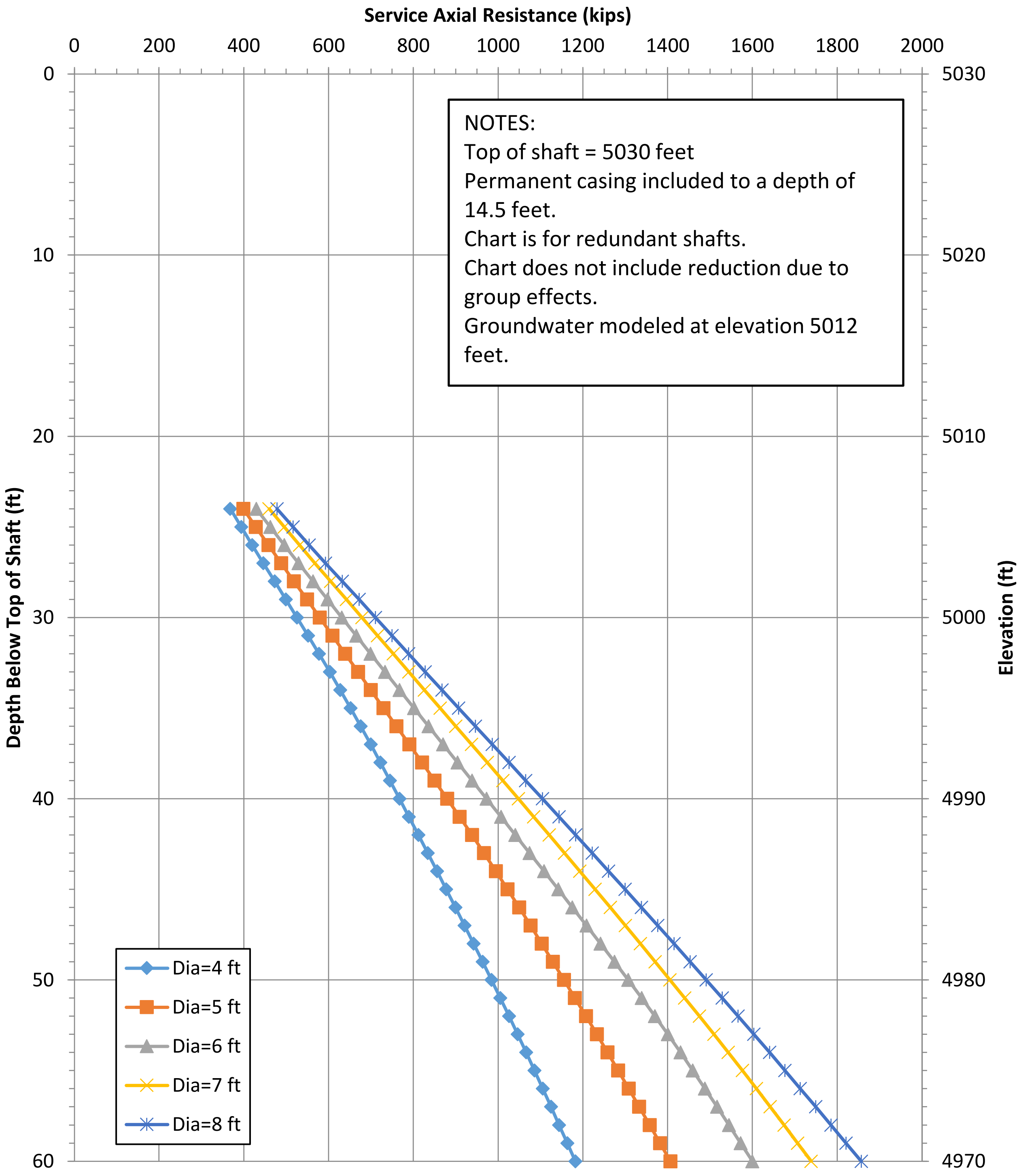
NOTES:
Top of shaft = 5030 feet
Permanent casing included to a depth of 14.5 feet
Chart is for redundant shafts.
Chart does not include reduction due to group effects.
Resistance factor for side resistance = 0.55.
Resistance factor for tip resistance = 0.5.
Groundwater modeled at elevation 5012 feet.

Figure G-1A
US 395 - WA 30.04
Panther Valley UPRR Overpass G-1092
Piers 1 and 4
Service Axial Load for 0.1 inch Settlement



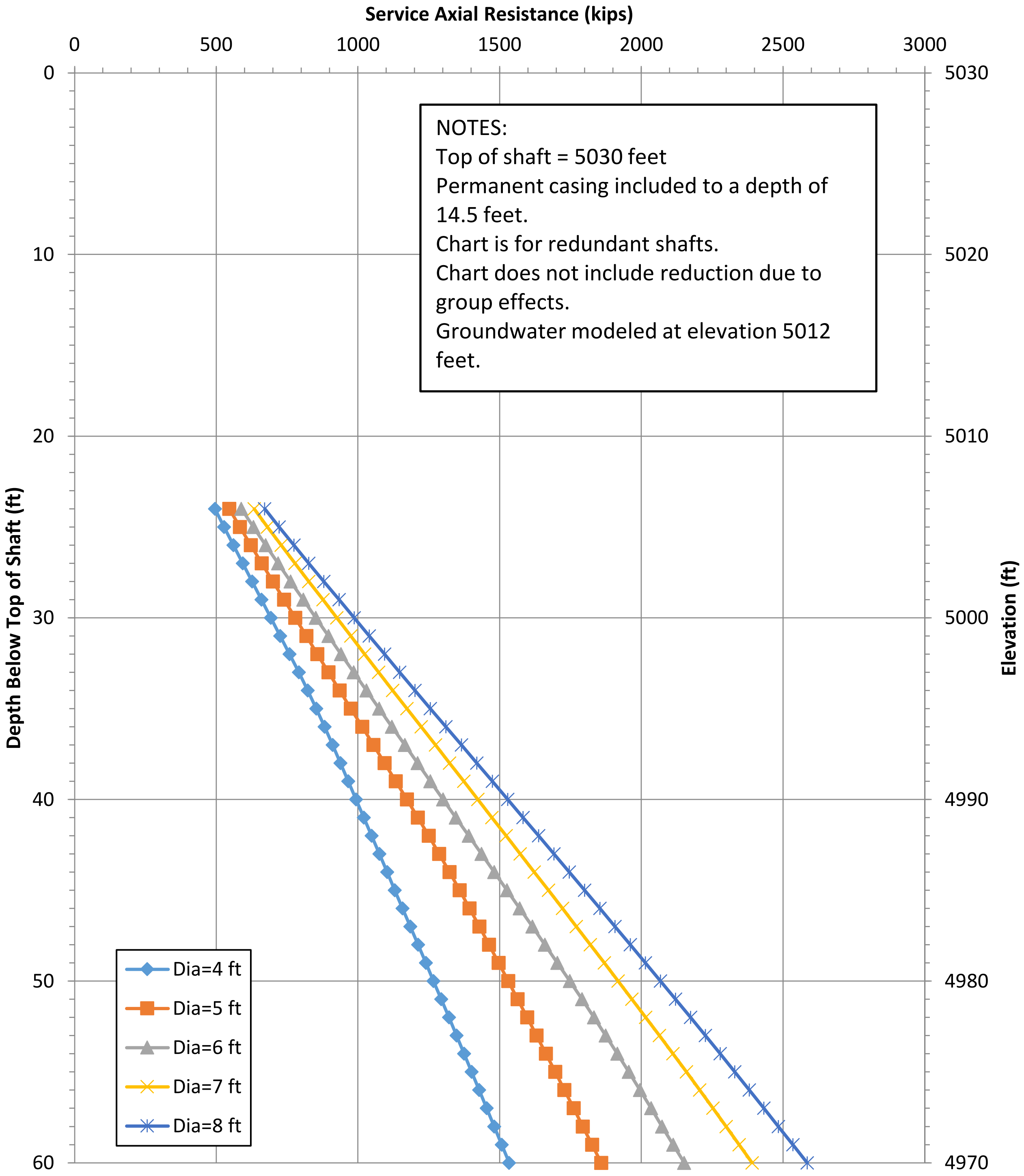
NOTES:
Top of shaft = 5030 feet
Permanent casing included to a depth of 14.5 feet.
Chart is for redundant shafts.
Chart does not include reduction due to group effects.
Groundwater modeled at elevation 5012 feet.

Figure G-1B
US 395 - WA 30.04
Panther Valley UPRR Overpass G-1092
Piers 1 and 4
Service Axial Load for 0.25 inch Settlement



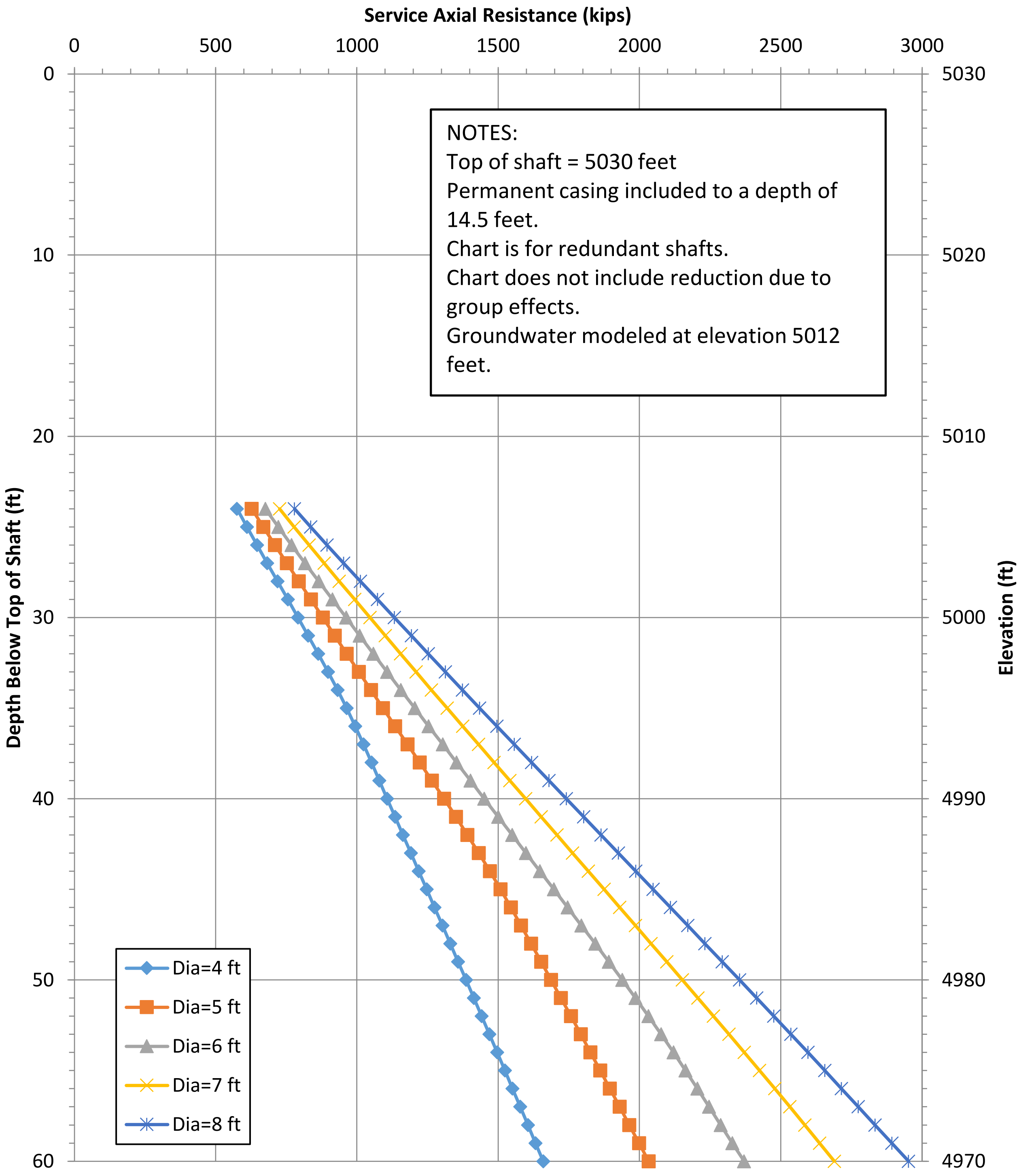
NOTES:
Top of shaft = 5030 feet
Permanent casing included to a depth of 14.5 feet.
Chart is for redundant shafts.
Chart does not include reduction due to group effects.
Groundwater modeled at elevation 5012 feet.

Figure G-1C
US 395 - WA 30.04
Panther Valley UPRR Overpass G-1092
Piers 1 and 4
Service Axial Load for 0.5 inch Settlement



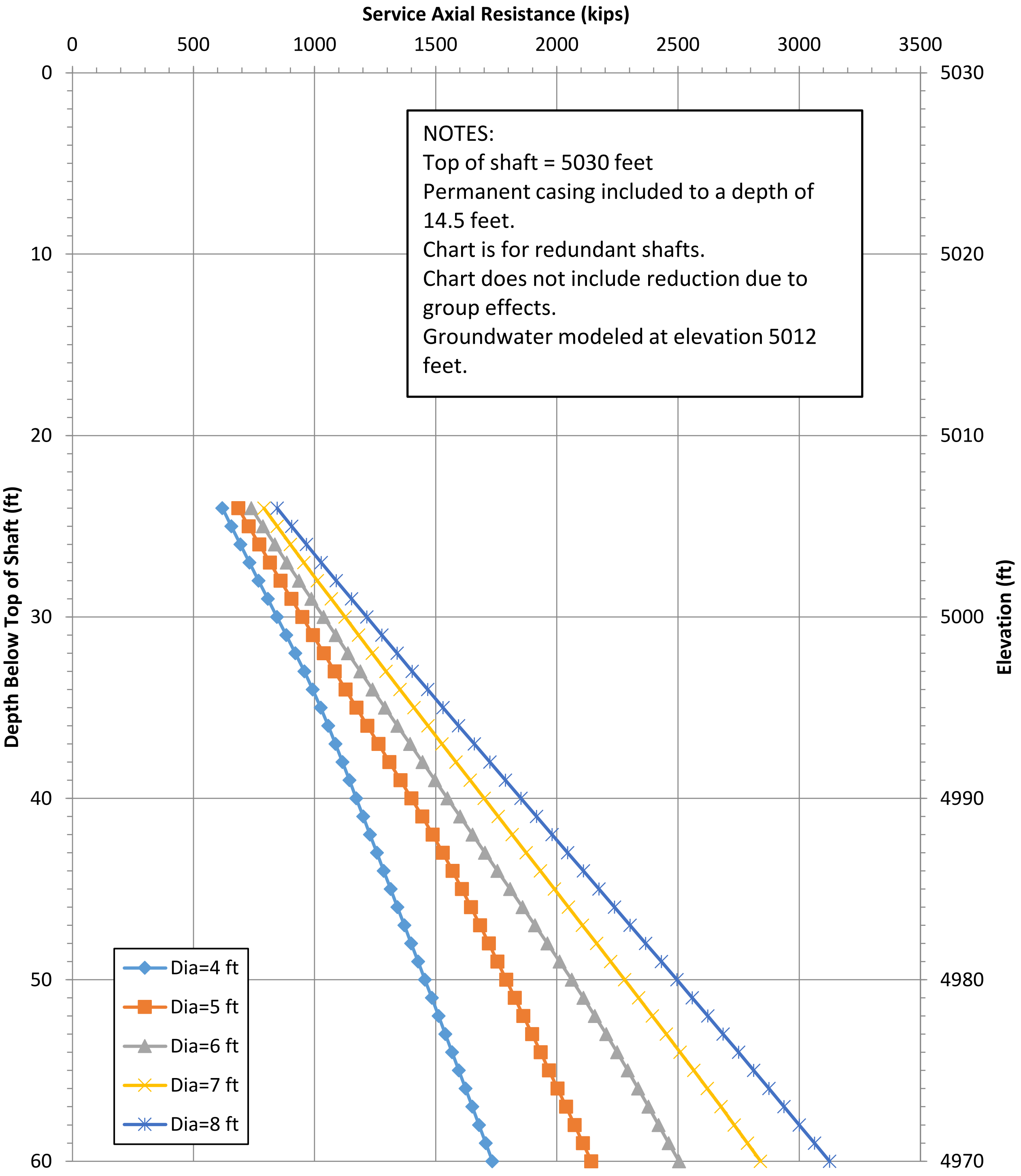
NOTES:
Top of shaft = 5030 feet
Permanent casing included to a depth of 14.5 feet.
Chart is for redundant shafts.
Chart does not include reduction due to group effects.
Groundwater modeled at elevation 5012 feet.

Figure G-1D
US 395 - WA 30.04
Panther Valley UPRR Overpass G-1092
Piers 1 and 4
Service Axial Load for 0.75 inch Settlement



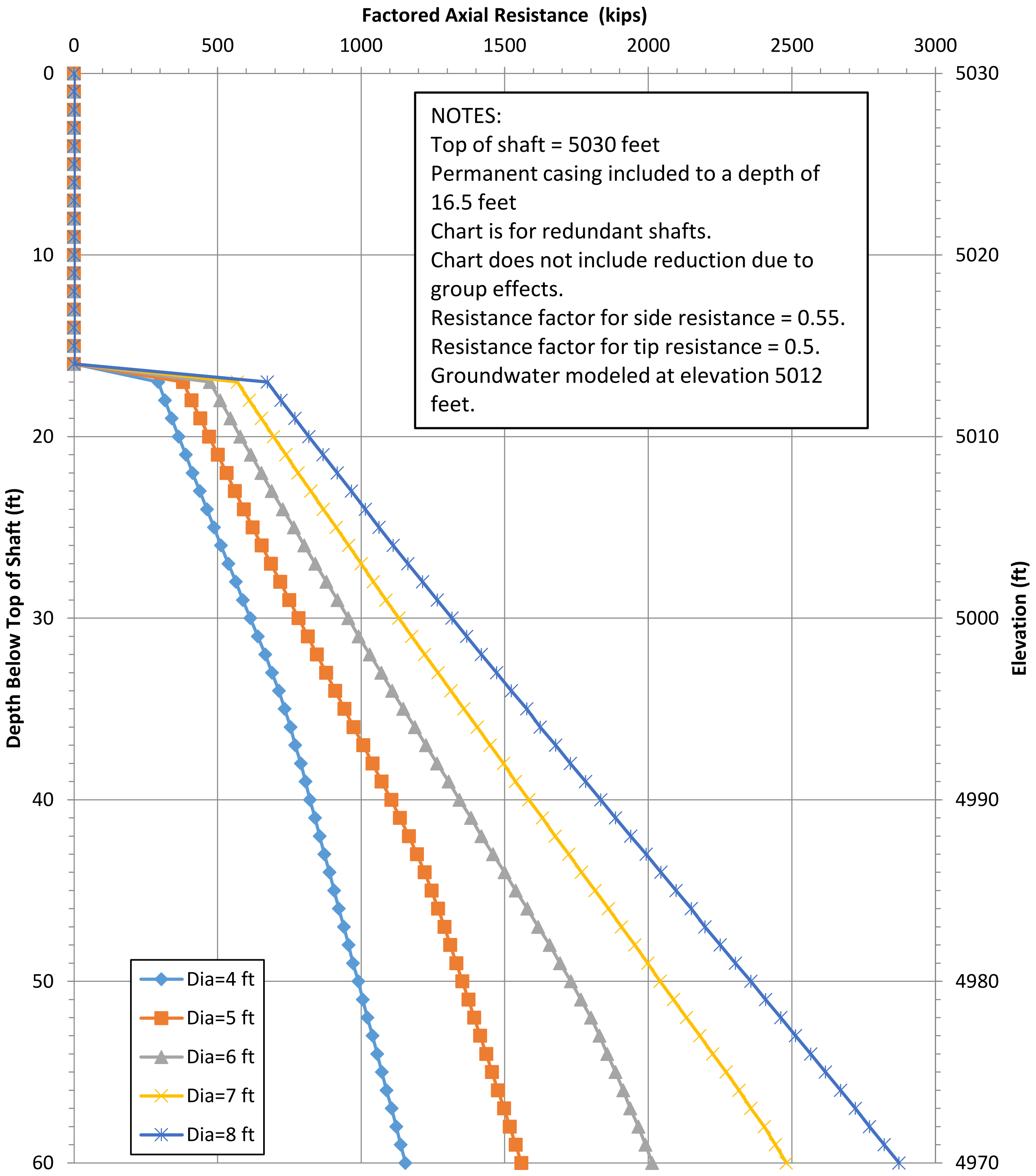
NOTES:
Top of shaft = 5030 feet
Permanent casing included to a depth of 14.5 feet.
Chart is for redundant shafts.
Chart does not include reduction due to group effects.
Groundwater modeled at elevation 5012 feet.

Figure G-1E
US 395 - WA 30.04
Panther Valley UPRR Overpass G-1092
Piers 1 and 4
Service Axial Load for 1.00 inch Settlement



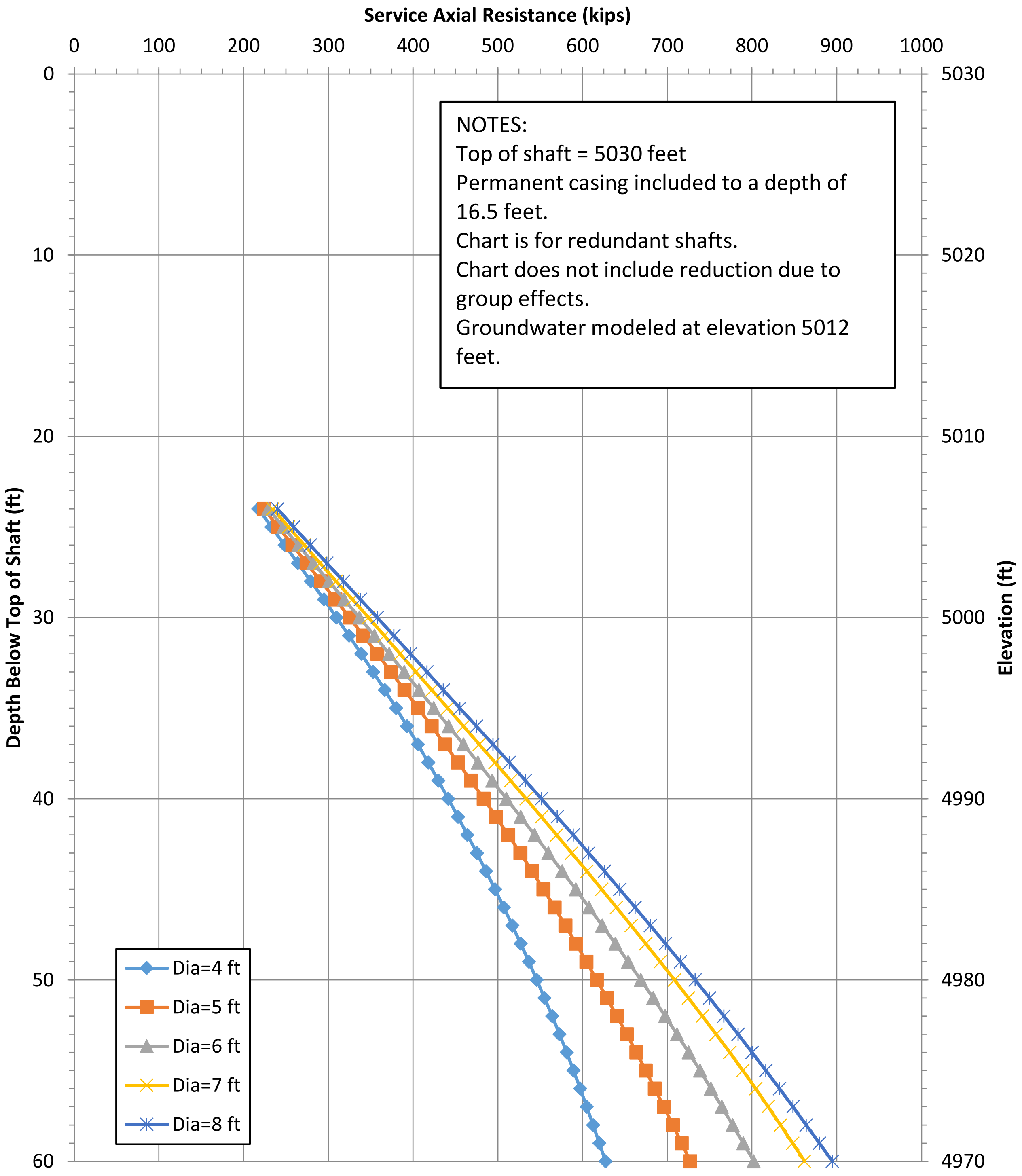
NOTES:
Top of shaft = 5030 feet
Permanent casing included to a depth of 14.5 feet.
Chart is for redundant shafts.
Chart does not include reduction due to group effects.
Groundwater modeled at elevation 5012 feet.

Figure G-2
US 395 - WA 30.04
Panther Valley UPRR Overpass G-1092
Piers 2 and 3
Factored Axial Resistance of Drilled Shafts



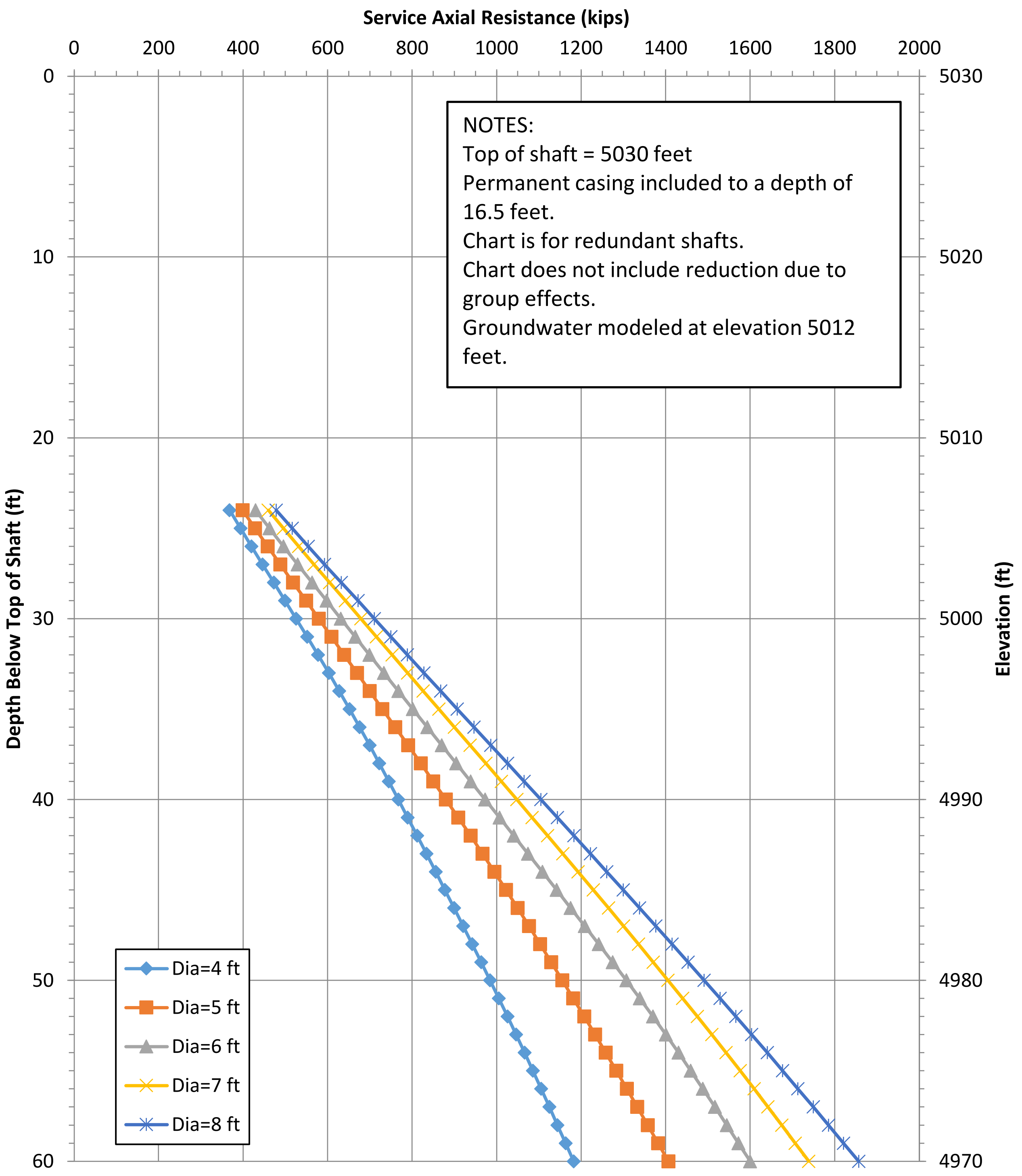
NOTES:
Top of shaft = 5030 feet
Permanent casing included to a depth of 16.5 feet
Chart is for redundant shafts.
Chart does not include reduction due to group effects.
Resistance factor for side resistance = 0.55.
Resistance factor for tip resistance = 0.5.
Groundwater modeled at elevation 5012 feet.

Figure G-2A
US 395 - WA 30.04
Panther Valley UPRR Overpass G-1092
Piers 2 and 3
Service Axial Load for 0.1 inch Settlement



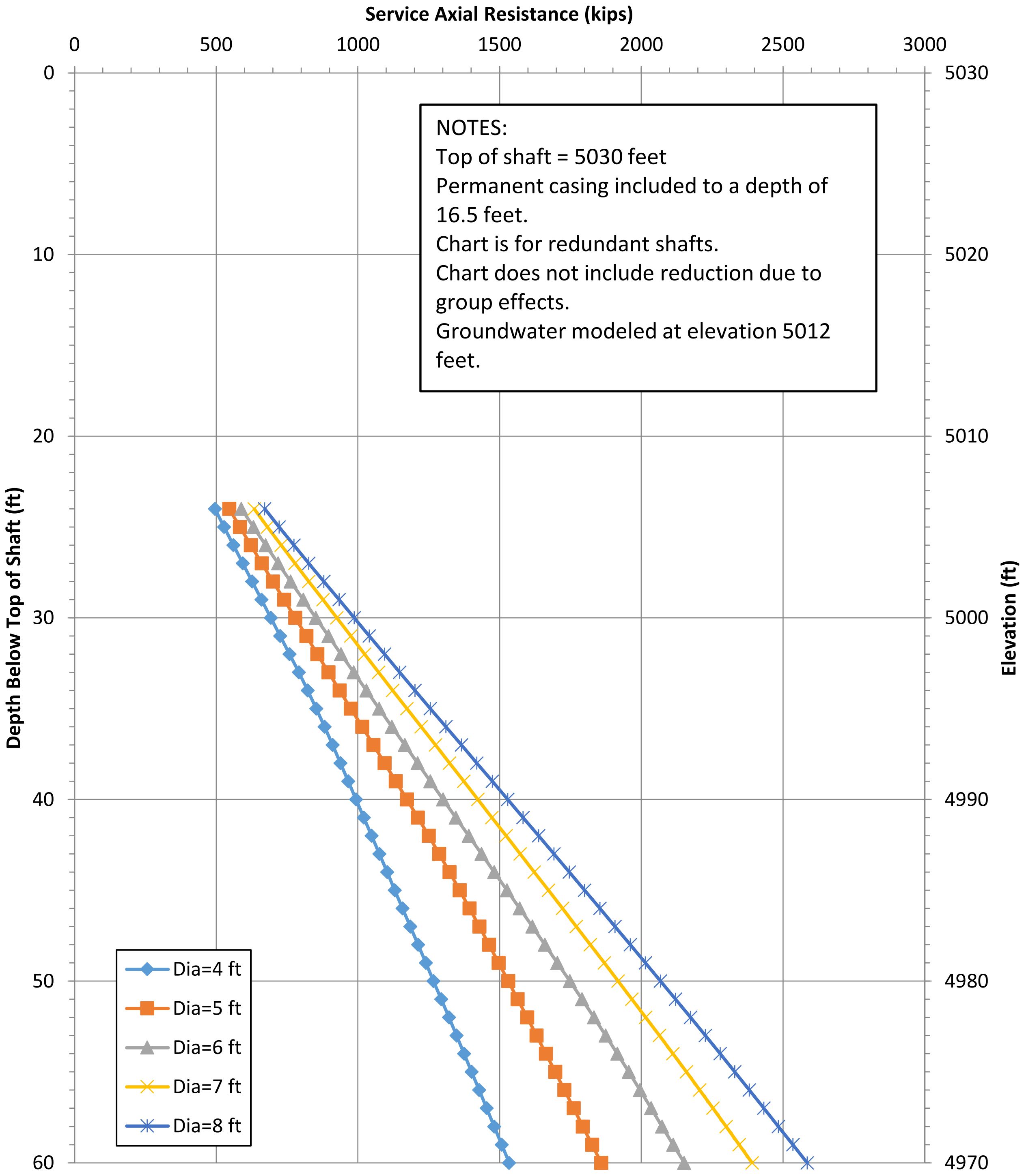
NOTES:
Top of shaft = 5030 feet
Permanent casing included to a depth of 16.5 feet.
Chart is for redundant shafts.
Chart does not include reduction due to group effects.
Groundwater modeled at elevation 5012 feet.

Figure G-2B
US 395 - WA 30.04
Panther Valley UPRR Overpass G-1092
Piers 2 and 3
Service Axial Load for 0.25 inch Settlement



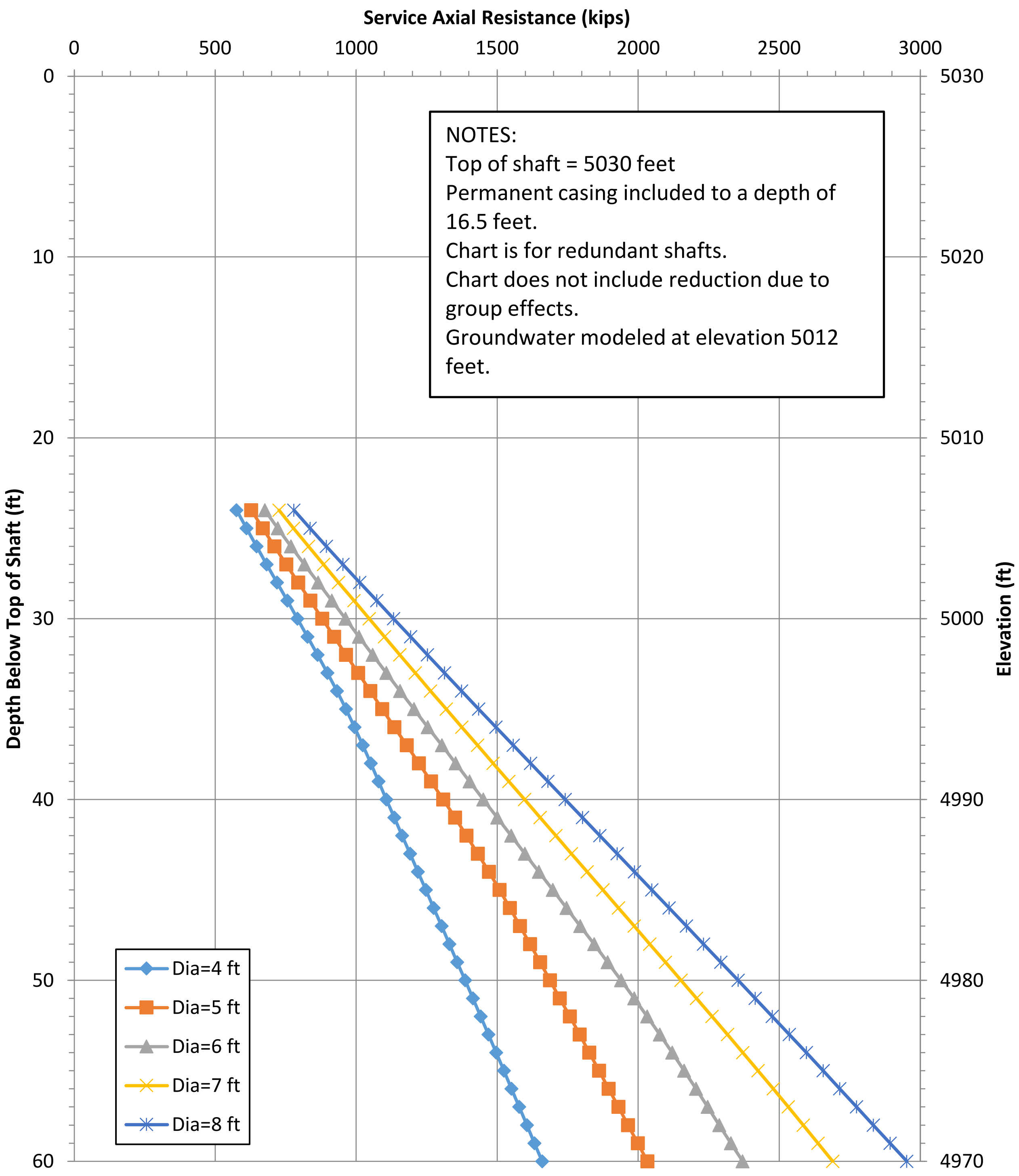
NOTES:
Top of shaft = 5030 feet
Permanent casing included to a depth of 16.5 feet.
Chart is for redundant shafts.
Chart does not include reduction due to group effects.
Groundwater modeled at elevation 5012 feet.

Figure G-2C
US 395 - WA 30.04
Panther Valley UPRR Overpass G-1092
Piers 2 and 3
Service Axial Load for 0.5 inch Settlement



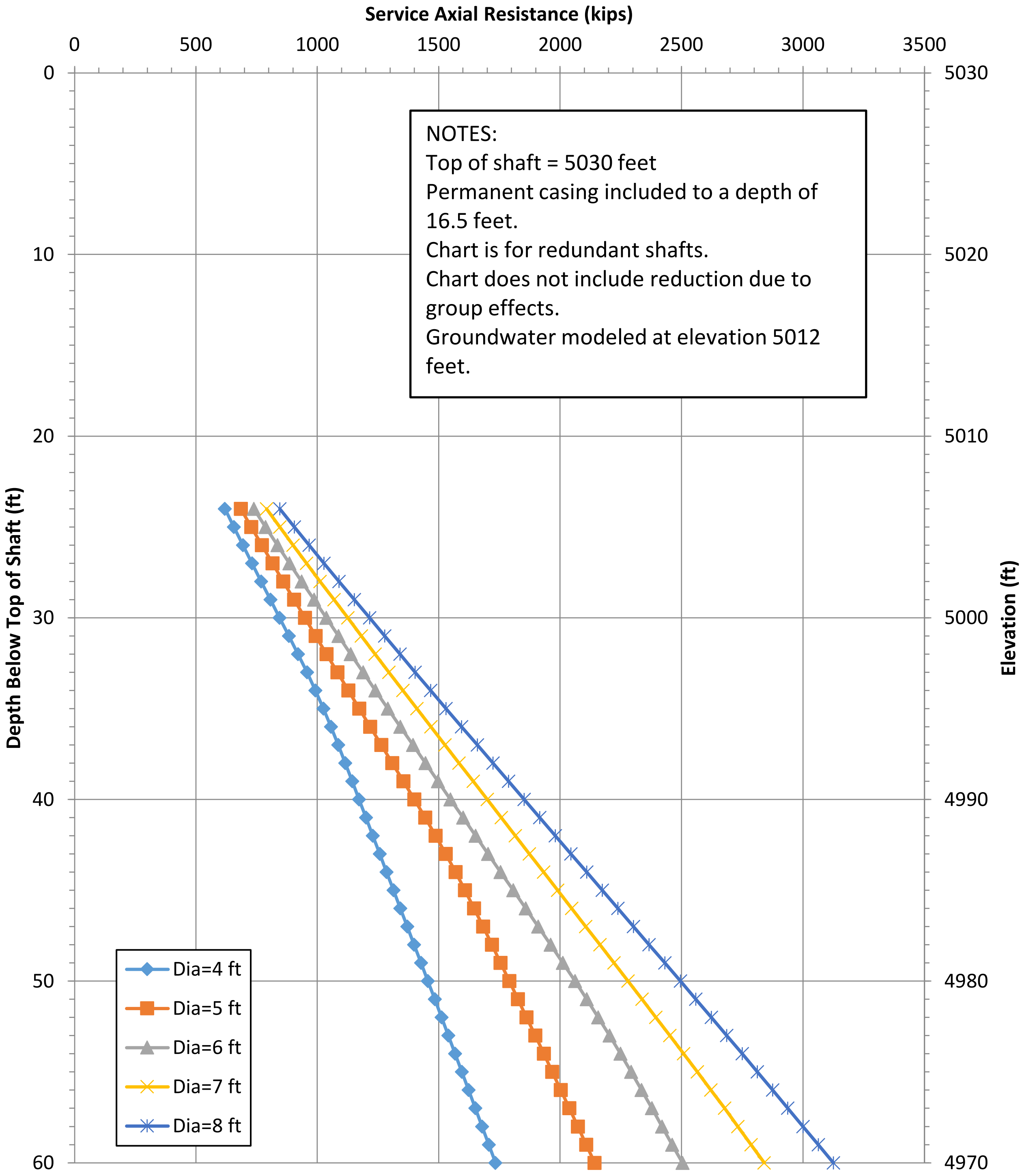
NOTES:
Top of shaft = 5030 feet
Permanent casing included to a depth of 16.5 feet.
Chart is for redundant shafts.
Chart does not include reduction due to group effects.
Groundwater modeled at elevation 5012 feet.

Figure G-2D
US 395 - WA 30.04
Panther Valley UPRR Overpass G-1092
Piers 2 and 3
Service Axial Load for 0.75 inch Settlement



NOTES:
Top of shaft = 5030 feet
Permanent casing included to a depth of 16.5 feet.
Chart is for redundant shafts.
Chart does not include reduction due to group effects.
Groundwater modeled at elevation 5012 feet.

Figure G-2E
US 395 - WA 30.04
Panther Valley UPRR Overpass G-1092
Piers 2 and 3
Service Axial Load for 1.00 inch Settlement



NOTES:
Top of shaft = 5030 feet
Permanent casing included to a depth of 16.5 feet.
Chart is for redundant shafts.
Chart does not include reduction due to group effects.
Groundwater modeled at elevation 5012 feet.

APPENDIX H

Soil Nail Walls RW3, RW10 & RW14

Table H-1
Us 395 North Valleys
Washoe County, Nevada

Soil Nail Wall RW3 - Soil Nail Layout & Schedule

Wall Station	Wall Height H (ft)	No. of Nail Rows	Depth to Top Row (below FG @ TOW) (ft)	Nail Row Vertical Spacing (ft)	Nail Column Horizontal Spacing (ft)	Nail Row No.	Nail Length (ft)	Nail Inclination (Below Horizontal) (degrees)	Allowable Pullout Resistance, Qd (kips/ft)
0+00 to 2+00	6.3 to 7.0	1	3	NA	5	1	10	15	1.13
2+00 to 7+60	7.0 to 11	2	3	2 to 5	5	1	15	15	1.13
						2	10	15	1.13
7+60 to 15+00	11 to 14.8	3	3	2.5 to 4.4	5	1	15	15	1.13
						2	15	15	1.13
						3	10	15	1.13
15+00 to 17+10	12.8 to 14.5	3	3	3.4 to 4.25	4	1	20	15	1.13
						2	15	15	1.13
						3	10	15	1.13
17+10 to 18+00	12.8 to 11	3	3	2.5 to 3.4	5	1	15	15	1.13
						2	15	15	1.13
						3	10	15	1.13
18+00 to 18+90	11 to 10	2	3	4 to 5	4.5	1	15	15	1.13
						2	15	15	1.13
18+90 to 22+31.07	10 to 6.8	2	3	2 to 4	5	1	15	15	1.13
						2	10	15	1.13

Table H-2
Us 395 North Valleys
Washoe County, Nevada

Soil Nail Wall RW10 - Soil Nail Layout & Schedule

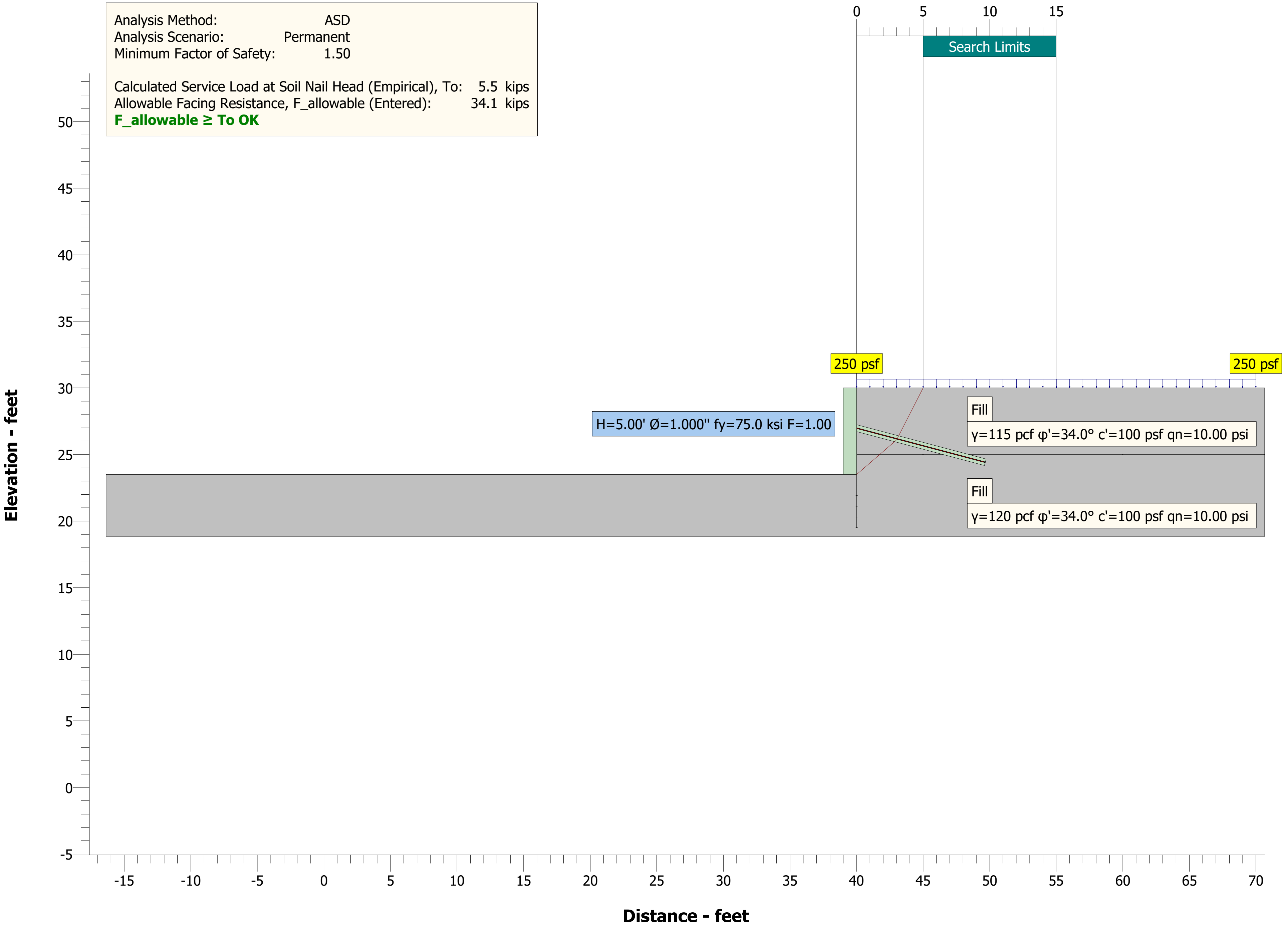
Wall Station	Wall Height H (ft)	No. of Nail Rows	Depth to Top Row (below FG @ TOW) (ft)	Nail Row Vertical Spacing (ft)	Nail Column Horizontal Spacing (ft)	Nail Row No.	Nail Length (ft)	Nail Inclination (Below Horizontal) (degrees)	Allowable Pullout Resistance, Qd (kips/ft)
32+05 to 32+13	5 to 7.7	1	3	NA	4	1	15	15	1.13
32+17 to 32+65	9 to 11.4	2	3	4	4	1	15	15	1.13
						2	10	15	1.13
32+69 to 32+77	7.8 to 5	1	3	NA	4	1	15	15	1.13

Table H-3
Us 395 North Valleys
Washoe County, Nevada

Soil Nail Wall RW14 - Soil Nail Layout & Schedule									
Wall Station	Wall Height H (ft)	No. of Nail Rows	Depth to Top Row (below FG @ TOW) (ft)	Nail Row Vertical Spacing (ft)	Nail Column Horizontal Spacing (ft)	Nail Row No.	Nail Length (ft)	Nail Inclination (Below Horizontal) (degrees)	Allowable Pullout Resistance, Qd (kips/ft)
27+17 to 27+25	5 to 7.4	1	3	NA	4	1	10	15	1.13
27+29 to 27+49	8.2 to 8.25	2	3	3	4	1	10	15	1.13
						2	10	15	1.13
27+53 to 27+61	7.7 to 5	1	3	NA	4	1	10	15	1.13

Figure H-1

Snail Version 2.2.2 - US 395 RW3 Sta 150 13:53:36 on 11/15/22

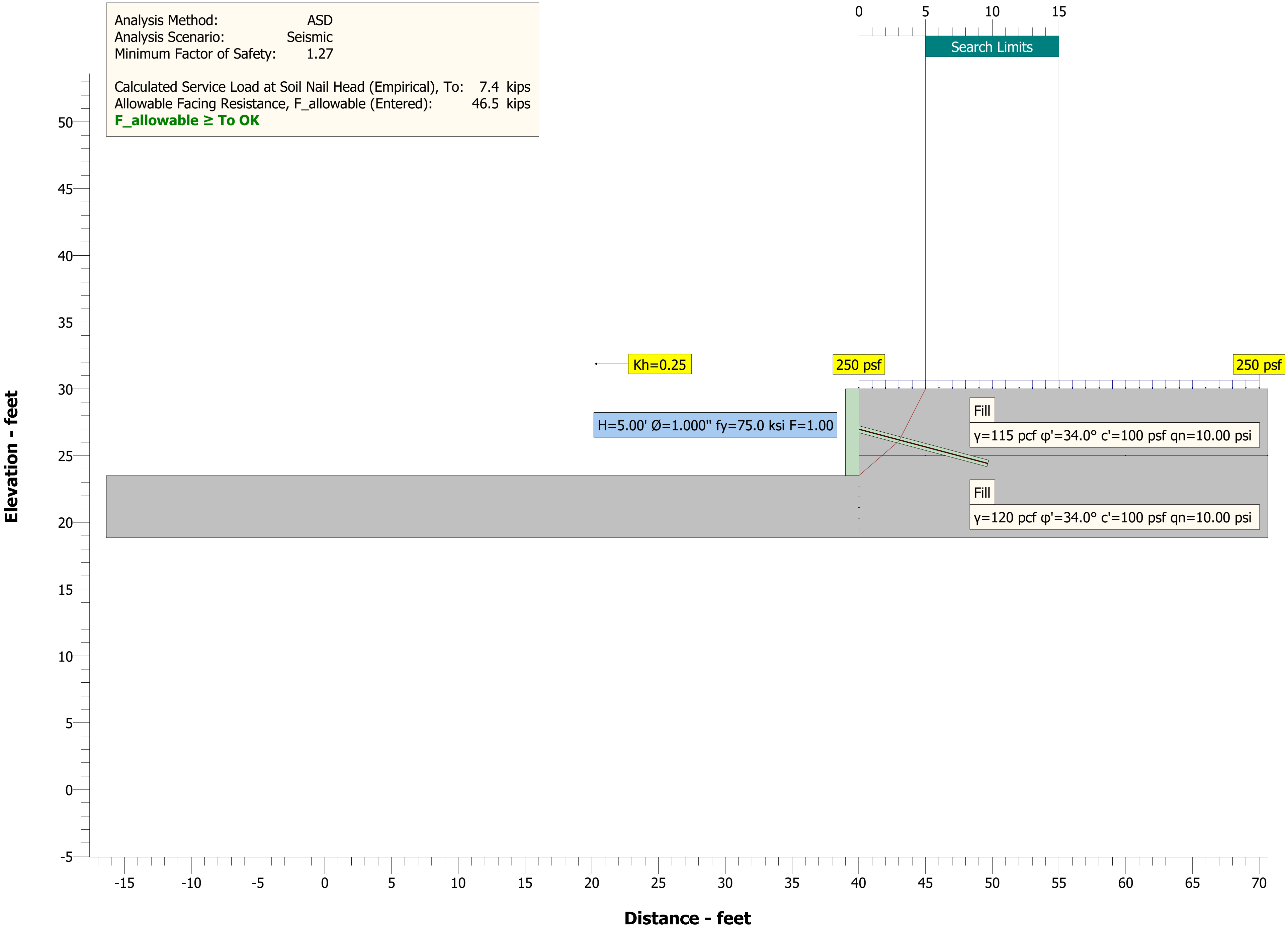


Analysis Method: ASD
Analysis Scenario: Permanent
Minimum Factor of Safety: 1.50

Calculated Service Load at Soil Nail Head (Empirical), To: 5.5 kips
Allowable Facing Resistance, F_allowable (Entered): 34.1 kips
F_allowable ≥ To OK

Figure H-2

Snail Version 2.2.2 - US 395 RW3 Sta 150 Seismic 13:57:40 on 11/15/22

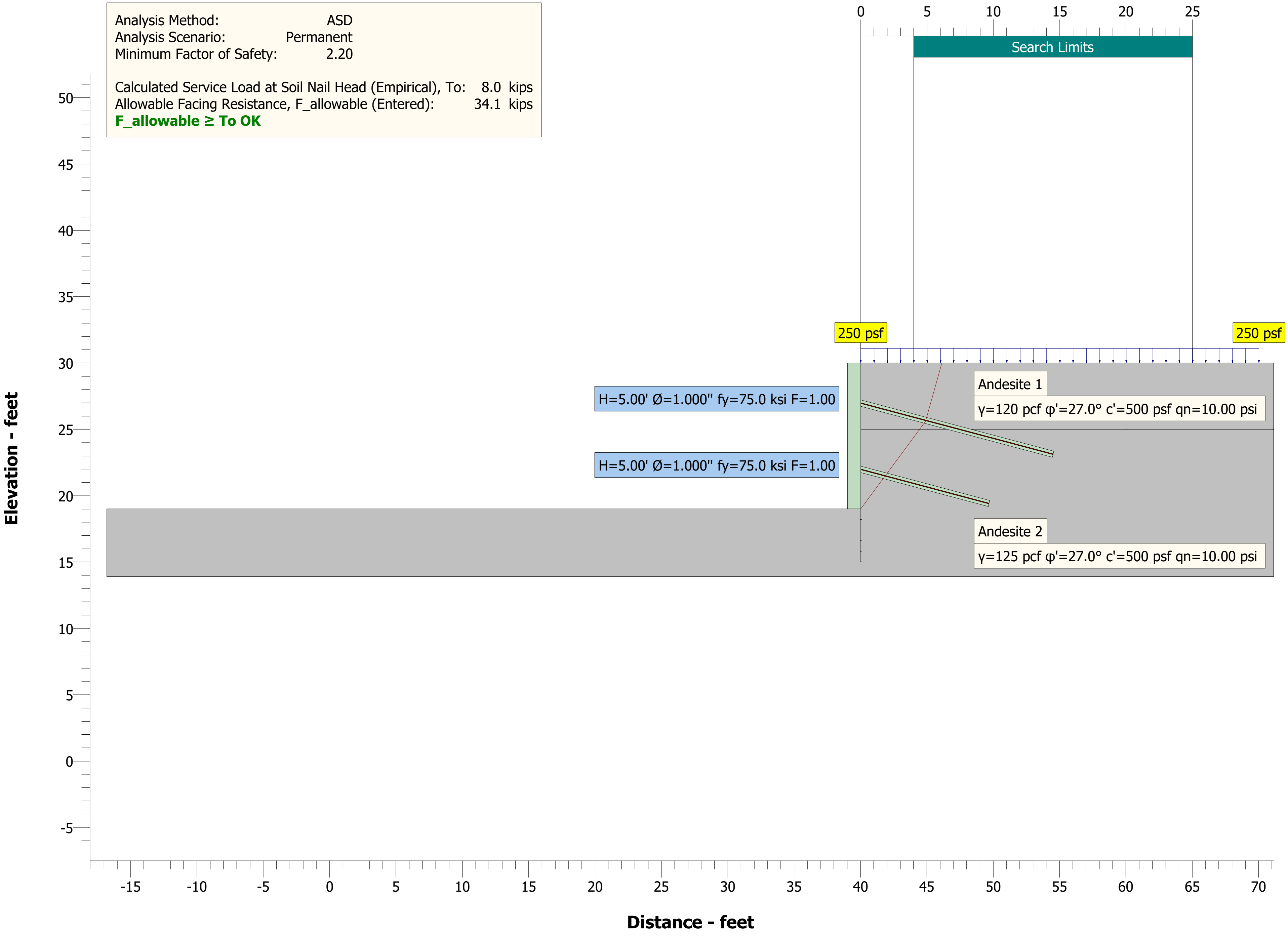


Analysis Method: ASD
Analysis Scenario: Seismic
Minimum Factor of Safety: 1.27

Calculated Service Load at Soil Nail Head (Empirical), To: 7.4 kips
Allowable Facing Resistance, F_allowable (Entered): 46.5 kips
F_allowable ≥ To OK

Figure H-3

Snail Version 2.2.2 - US 395 RW3 Sta 760 15:12:29 on 11/15/22

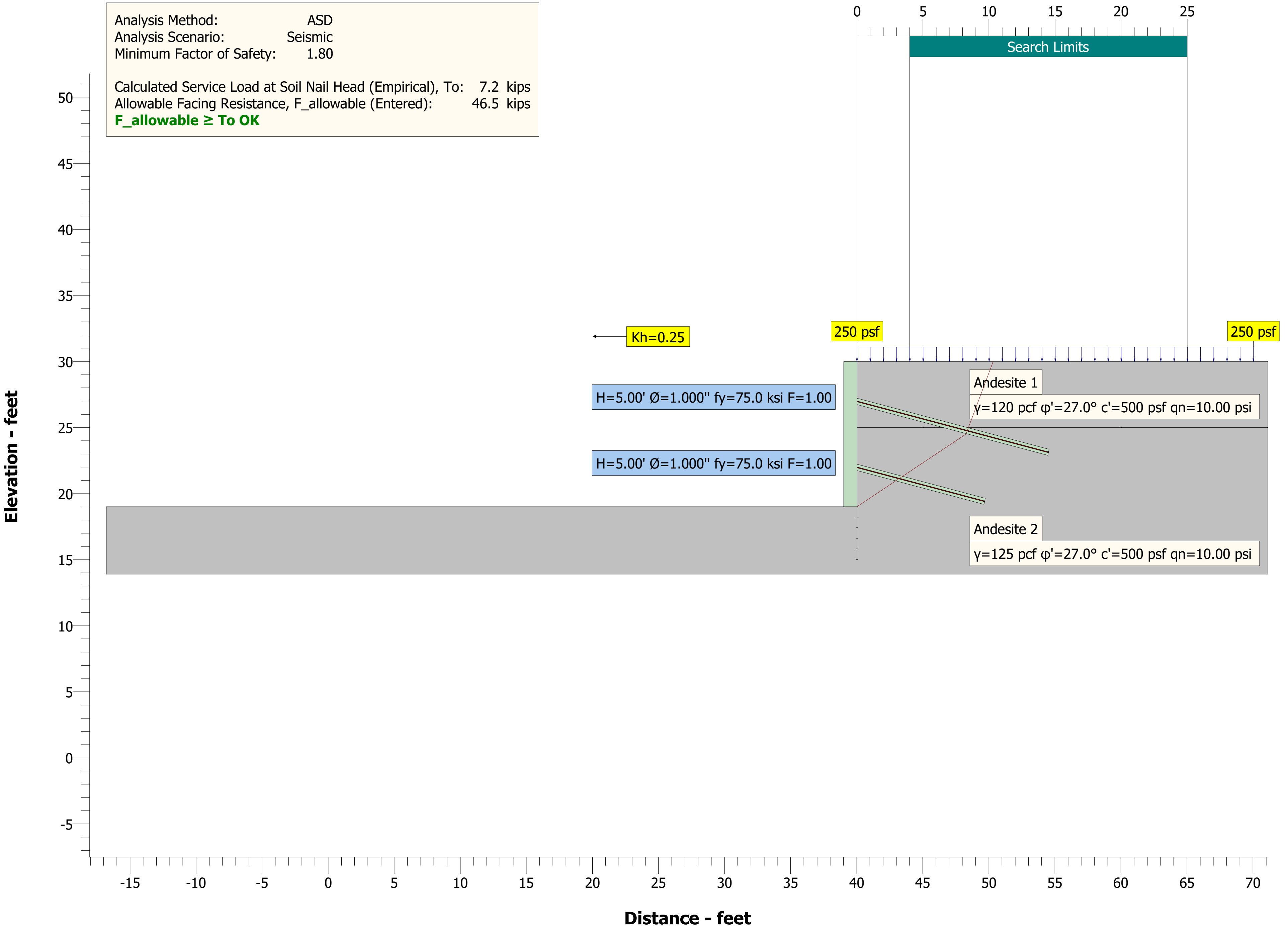


Analysis Method: ASD
Analysis Scenario: Permanent
Minimum Factor of Safety: 2.20

Calculated Service Load at Soil Nail Head (Empirical), To: 8.0 kips
Allowable Facing Resistance, F_allowable (Entered): 34.1 kips
F_allowable ≥ To OK

Figure H-4

Snail Version 2.2.2 - US 395 RW3 Sta 760 Seismic 15:18:58 on 11/15/22

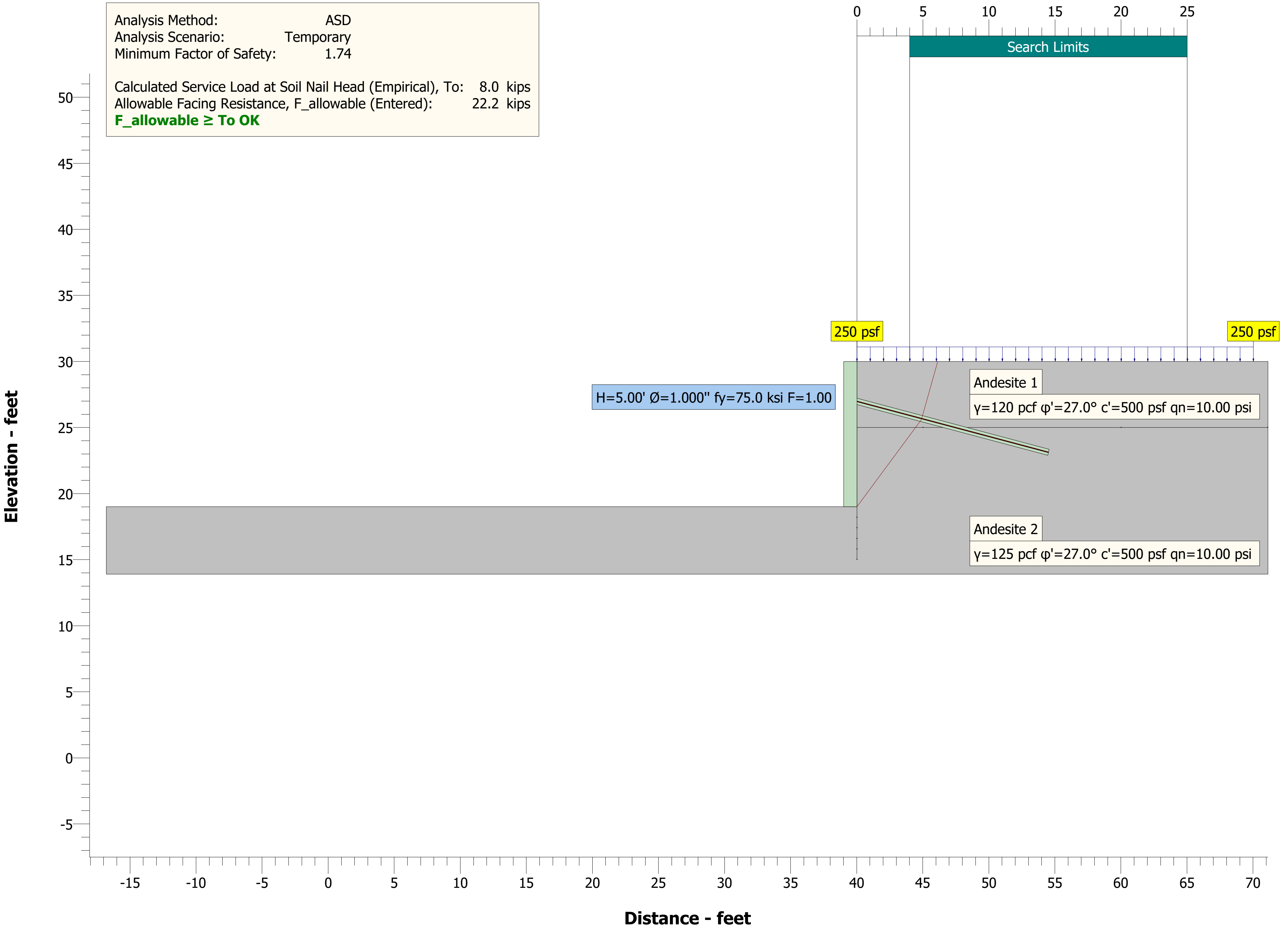


Analysis Method: ASD
Analysis Scenario: Seismic
Minimum Factor of Safety: 1.80

Calculated Service Load at Soil Nail Head (Empirical), To: 7.2 kips
Allowable Facing Resistance, F_allowable (Entered): 46.5 kips
F_allowable ≥ To OK

Figure H-5

Snail Version 2.2.2 - US 395 RW3 Sta 760 Temp 15:16:52 on 11/15/22

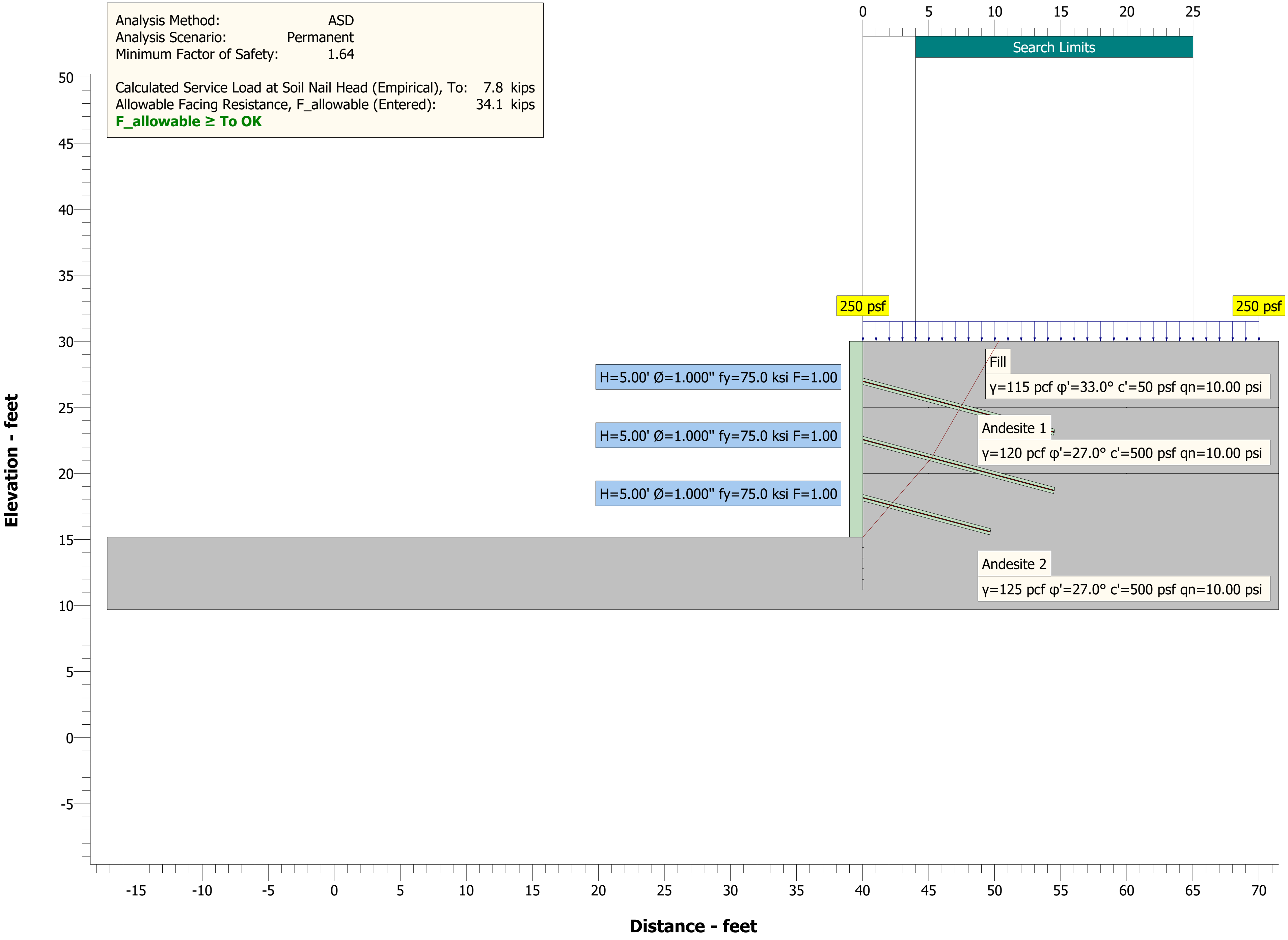


Analysis Method: ASD
Analysis Scenario: Temporary
Minimum Factor of Safety: 1.74

Calculated Service Load at Soil Nail Head (Empirical), To: 8.0 kips
Allowable Facing Resistance, F_allowable (Entered): 22.2 kips
F_allowable ≥ To OK

Figure H-6

Snail Version 2.2.2 - US 395 RW3 Sta 1250 Max Height 11:34:33 on 11/14/22

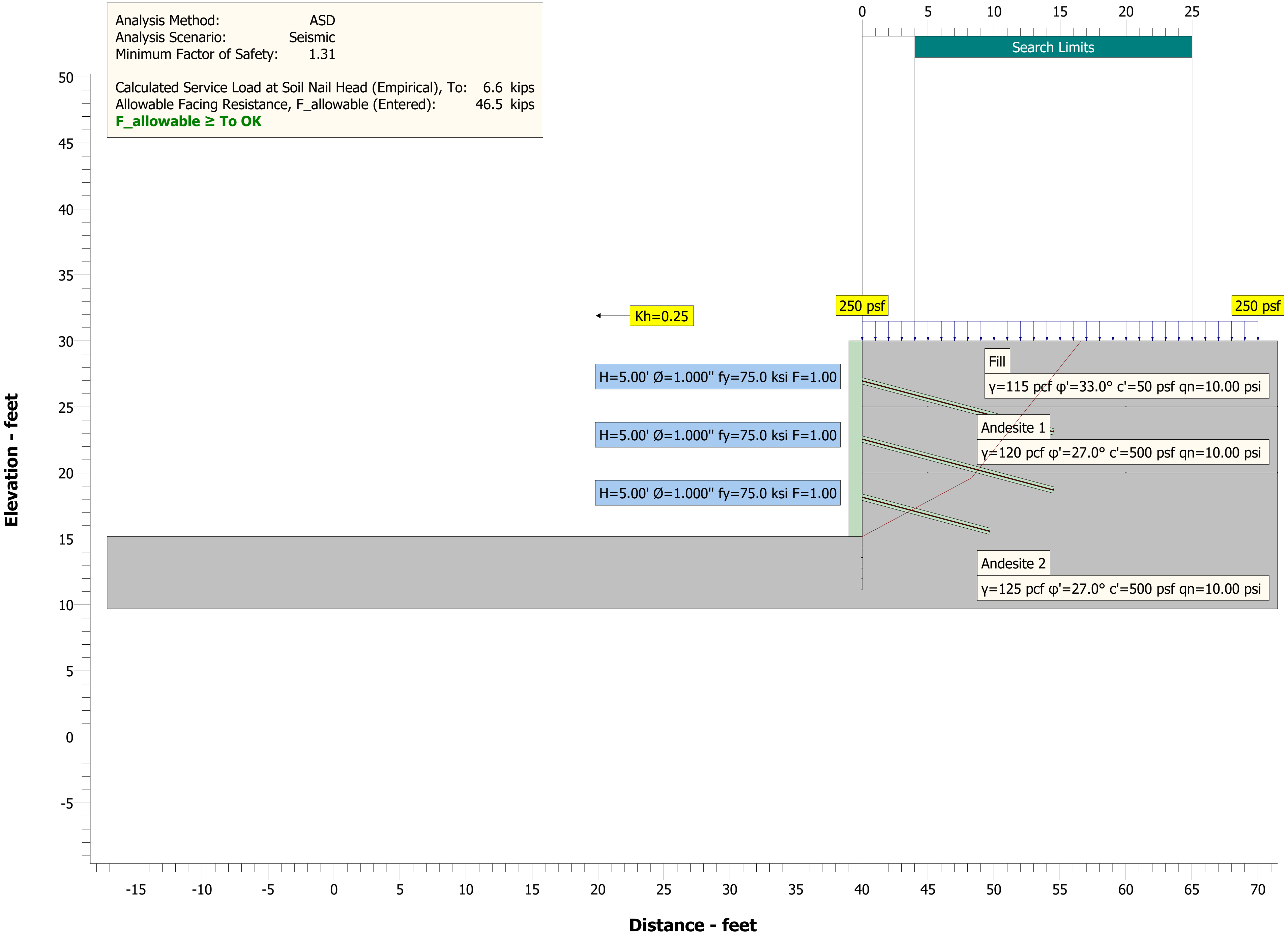


Analysis Method: ASD
Analysis Scenario: Permanent
Minimum Factor of Safety: 1.64

Calculated Service Load at Soil Nail Head (Empirical), To: 7.8 kips
Allowable Facing Resistance, F_allowable (Entered): 34.1 kips
F_allowable ≥ To OK

Figure H-7

Snail Version 2.2.2 - US 395 RW3 Sta 1250 Max Height Seismic 11:47:50 on 11/14/22

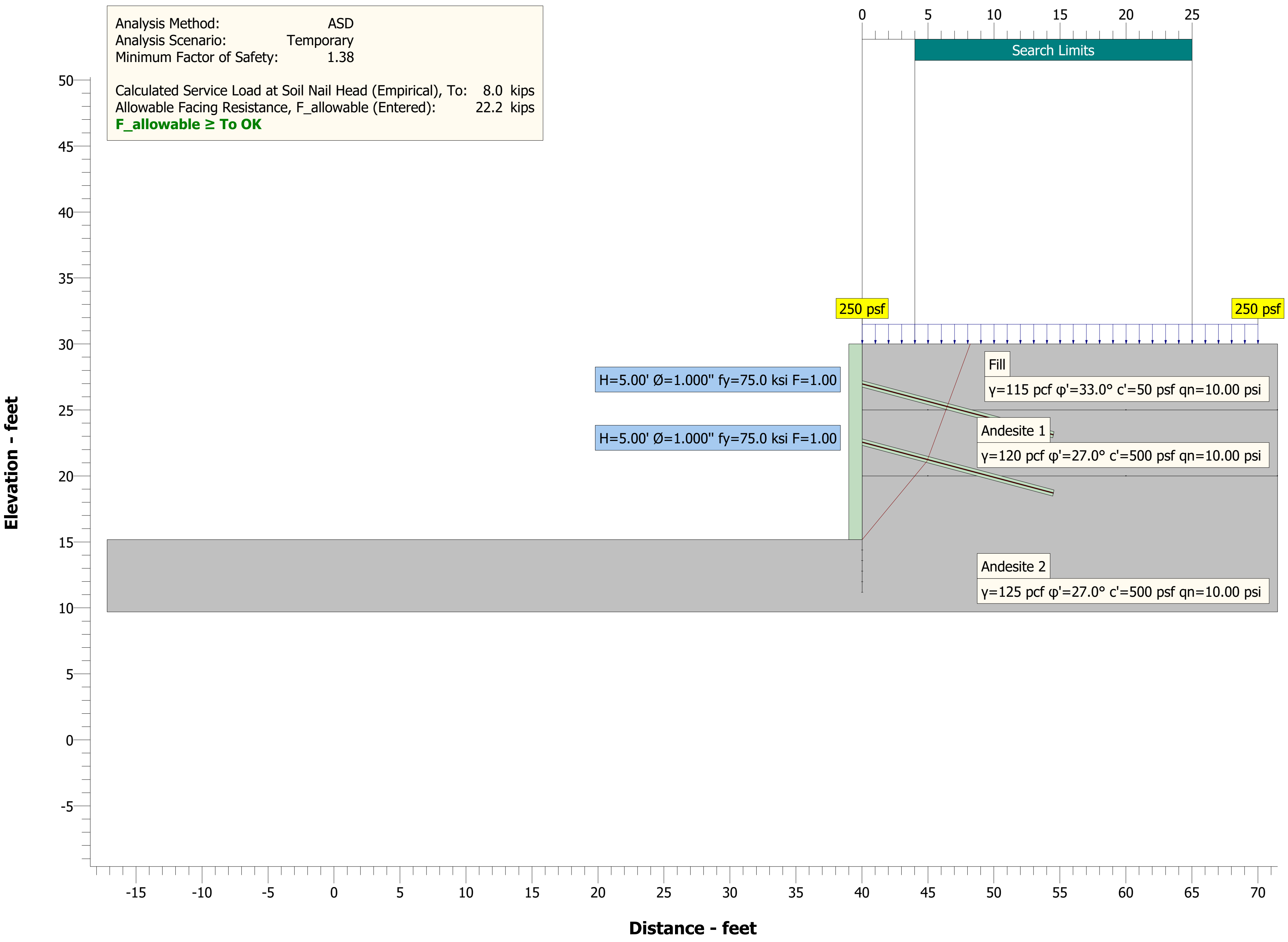


Analysis Method: ASD
Analysis Scenario: Seismic
Minimum Factor of Safety: 1.31

Calculated Service Load at Soil Nail Head (Empirical), To: 6.6 kips
Allowable Facing Resistance, F_allowable (Entered): 46.5 kips
F_allowable ≥ To OK

Figure H-8

Snail Version 2.2.2 - US 395 RW3 Sta 1250 Max Height Temp 11:55:18 on 11/14/22

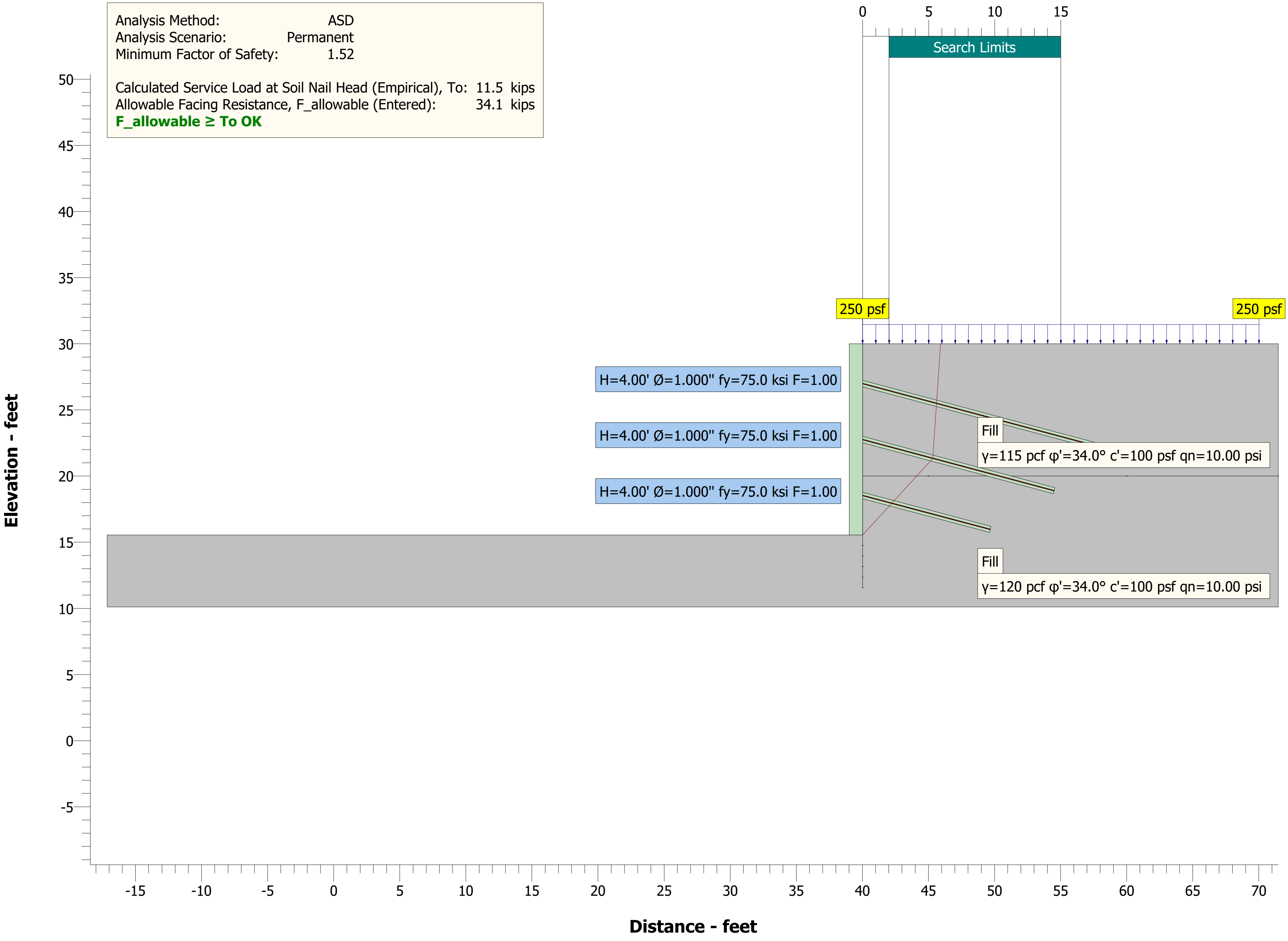


Analysis Method: ASD
Analysis Scenario: Temporary
Minimum Factor of Safety: 1.38

Calculated Service Load at Soil Nail Head (Empirical), To: 8.0 kips
Allowable Facing Resistance, F_allowable (Entered): 22.2 kips
F_allowable ≥ To OK

Figure H-9

Snail Version 2.2.2 - US 395 RW3 Sta 1550 14:02:57 on 11/14/22



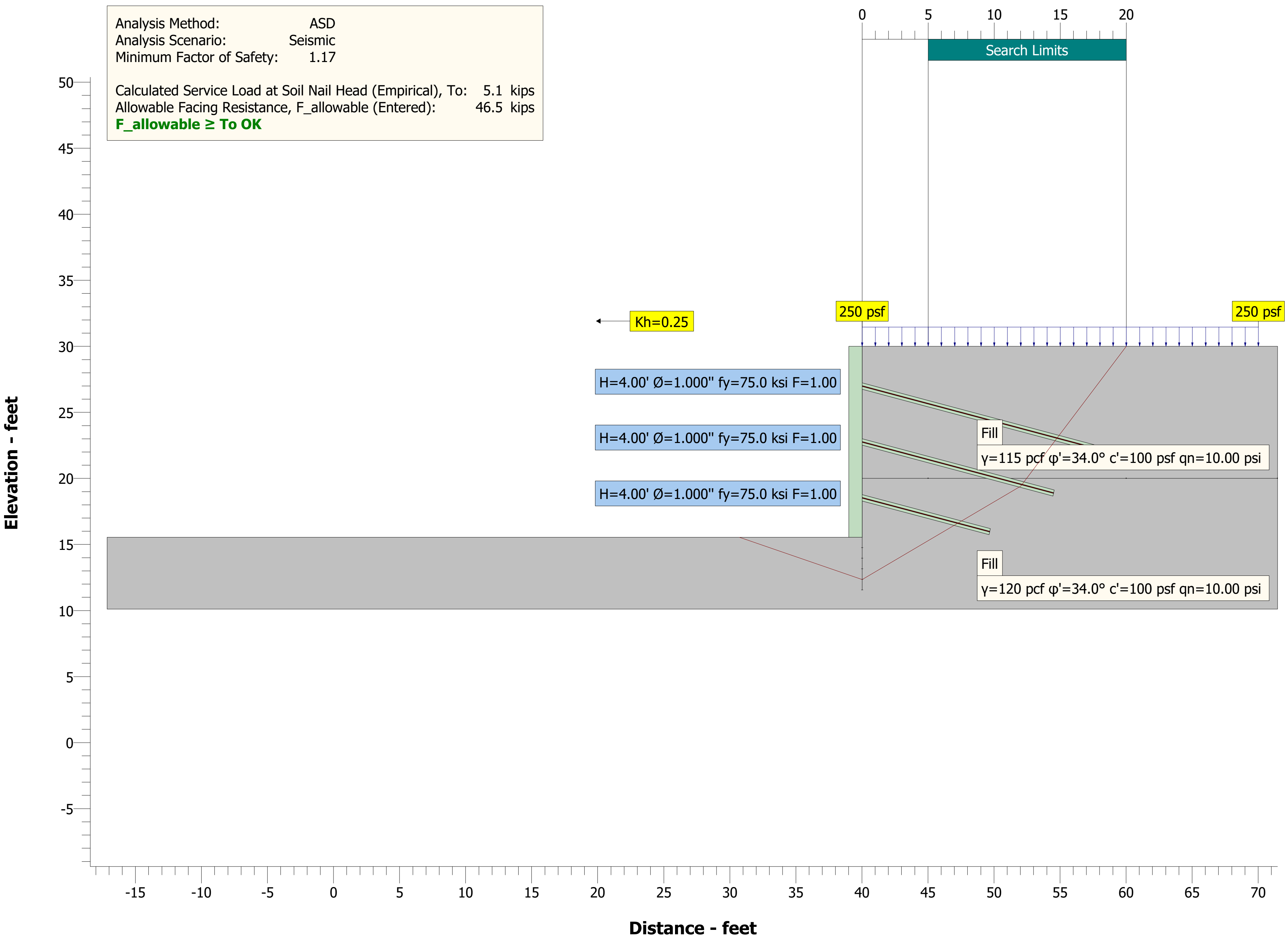
Analysis Method: ASD
Analysis Scenario: Permanent
Minimum Factor of Safety: 1.52

Calculated Service Load at Soil Nail Head (Empirical), To: 11.5 kips
Allowable Facing Resistance, F_allowable (Entered): 34.1 kips
F_allowable ≥ To OK

Figure H-10

Snail Version 2.2.2 - US 395 RW3 Sta 1550 Seismic

14:09:05 on 11/14/22



Analysis Method: ASD
Analysis Scenario: Seismic
Minimum Factor of Safety: 1.17

Calculated Service Load at Soil Nail Head (Empirical), To: 5.1 kips
Allowable Facing Resistance, F_allowable (Entered): 46.5 kips
F_allowable ≥ To OK

Figure H-11

Snail Version 2.2.2 - US 395 RW3 Sta 1550 Temp — 14:12:19 on 11/14/22

Analysis Method: ASD
Analysis Scenario: Temporary
Minimum Factor of Safety: 1.21

Calculated Service Load at Soil Nail Head (Empirical), To: 11.5 kips
Allowable Facing Resistance, F_allowable (Entered): 22.2 kips
F_allowable ≥ To OK

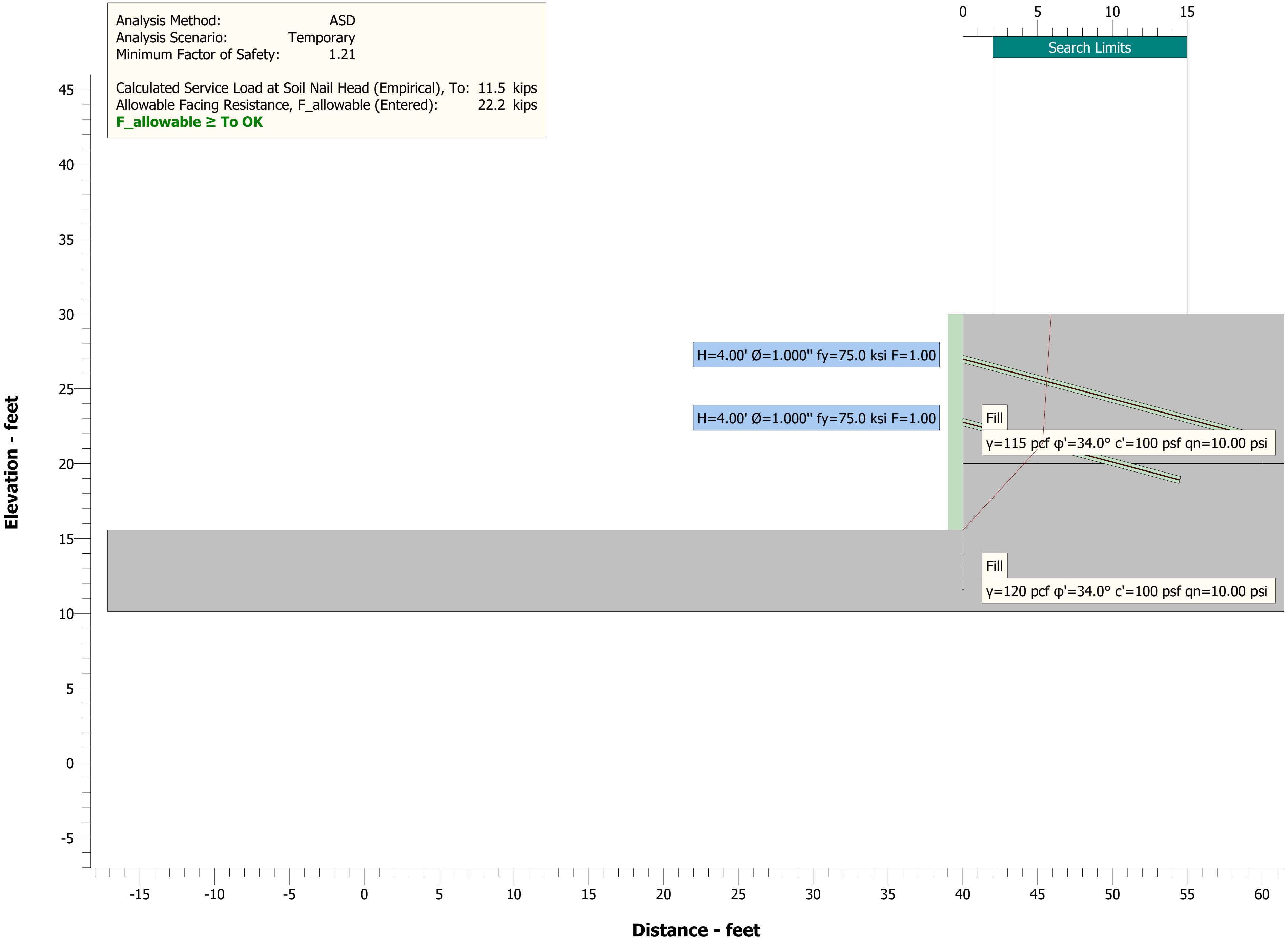
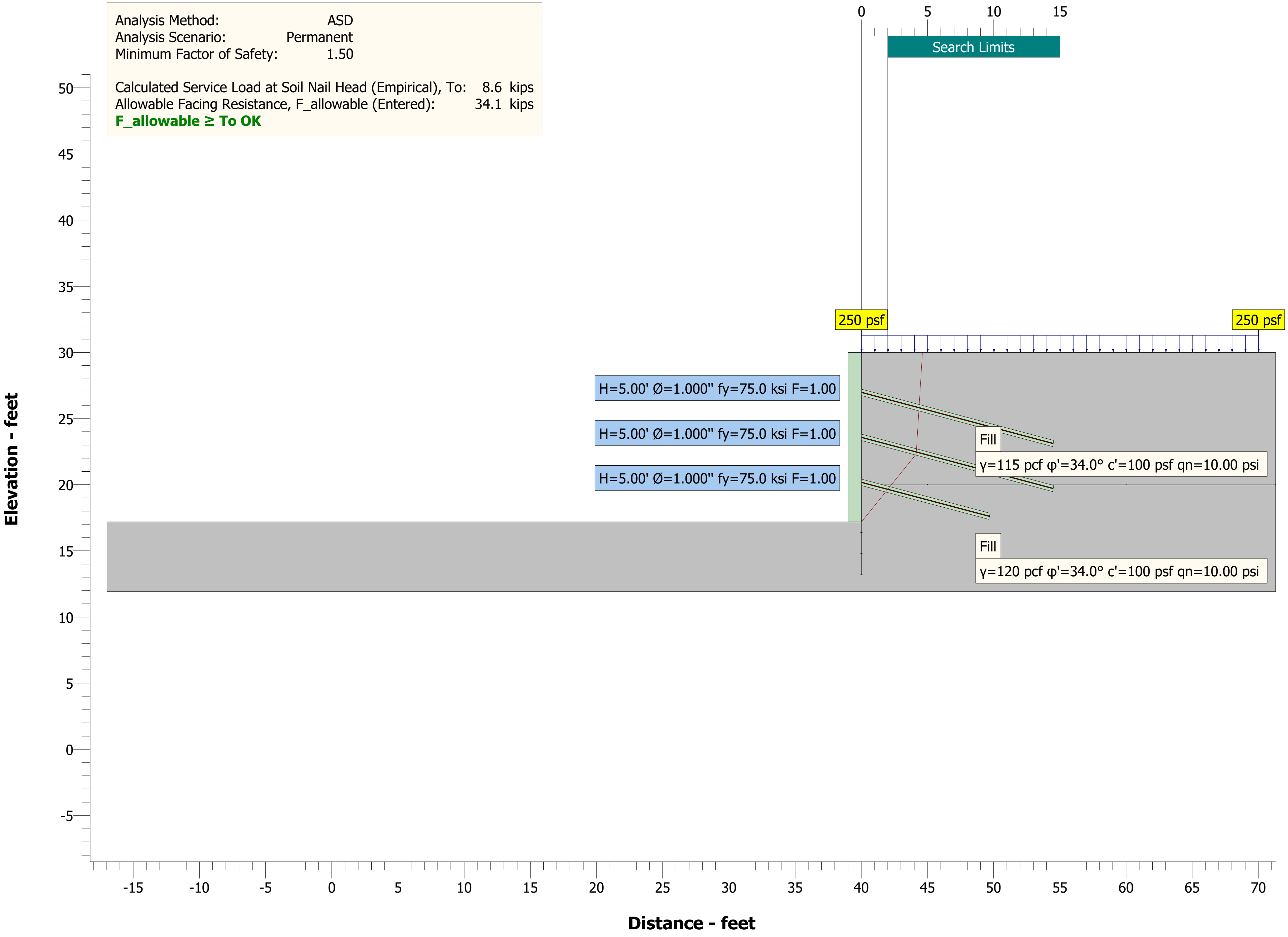


Figure H-12

Snail Version 2.2.2 - US 395 RW3 Sta 1710 21:57:06 on 11/14/22

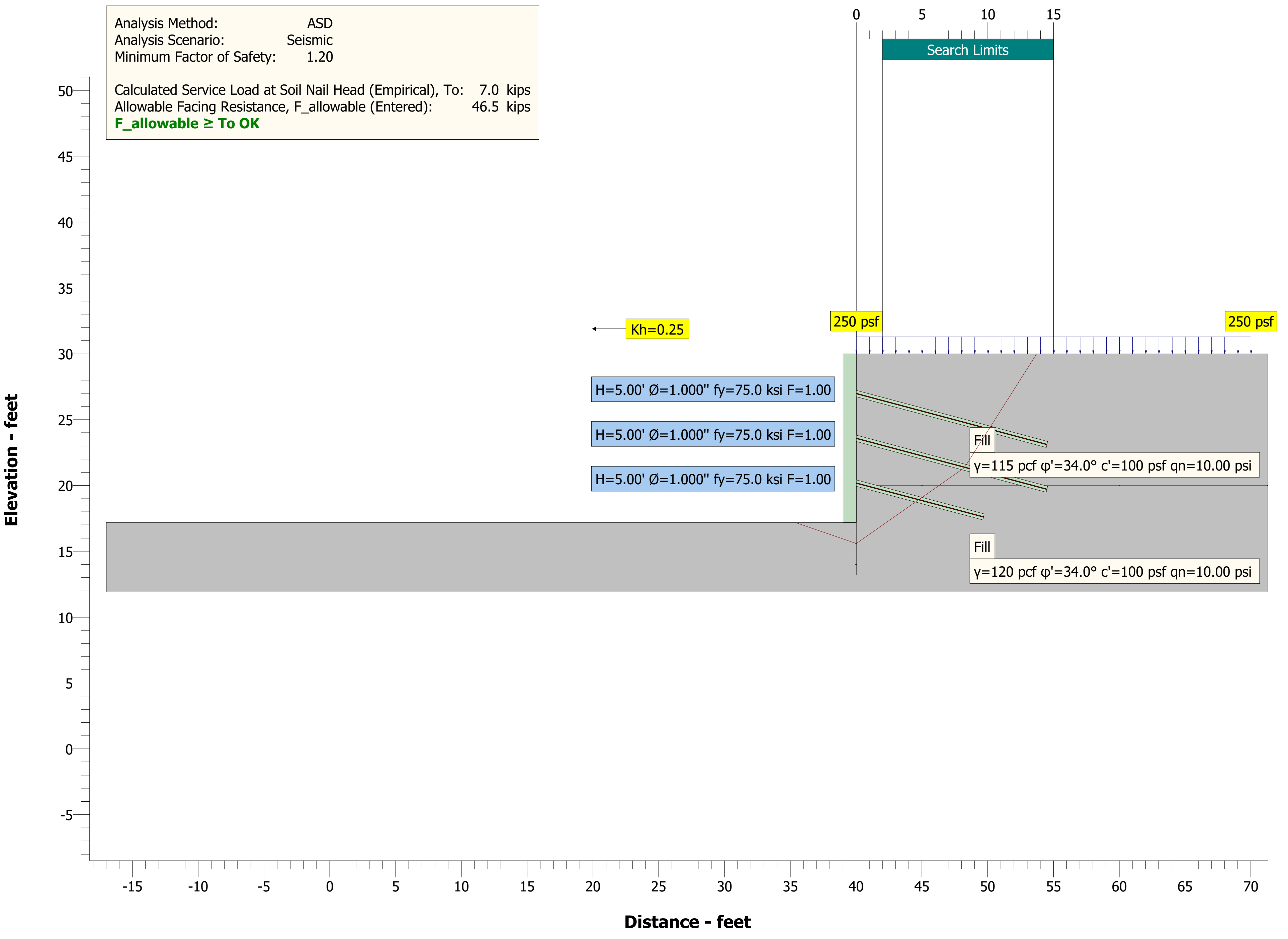


Analysis Method: ASD
Analysis Scenario: Permanent
Minimum Factor of Safety: 1.50

Calculated Service Load at Soil Nail Head (Empirical), To: 8.6 kips
Allowable Facing Resistance, F_allowable (Entered): 34.1 kips
F_allowable ≥ To OK

Figure H-13

Snail Version 2.2.2 - US 395 RW3 Sta 1710 Seismic — 21:59:52 on 11/14/22

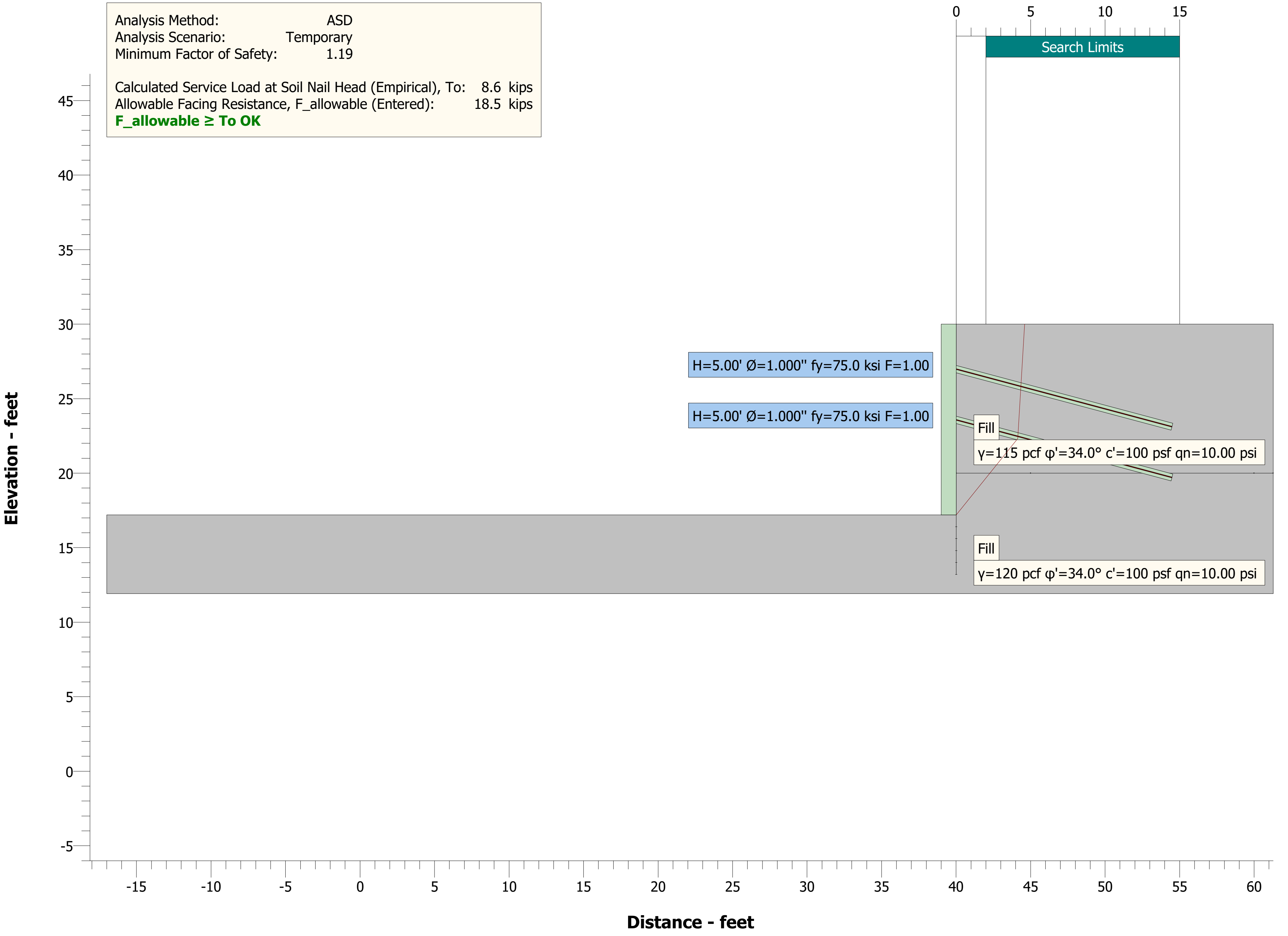


Analysis Method: ASD
Analysis Scenario: Seismic
Minimum Factor of Safety: 1.20

Calculated Service Load at Soil Nail Head (Empirical), To: 7.0 kips
Allowable Facing Resistance, F_allowable (Entered): 46.5 kips
F_allowable ≥ To OK

Figure H-14

Snail Version 2.2.2 - US 395 RW3 Sta 1710 Temp 22:07:39 on 11/14/22



Analysis Method: ASD
Analysis Scenario: Temporary
Minimum Factor of Safety: 1.19

Calculated Service Load at Soil Nail Head (Empirical), To: 8.6 kips
Allowable Facing Resistance, F_allowable (Entered): 18.5 kips
F_allowable ≥ To OK

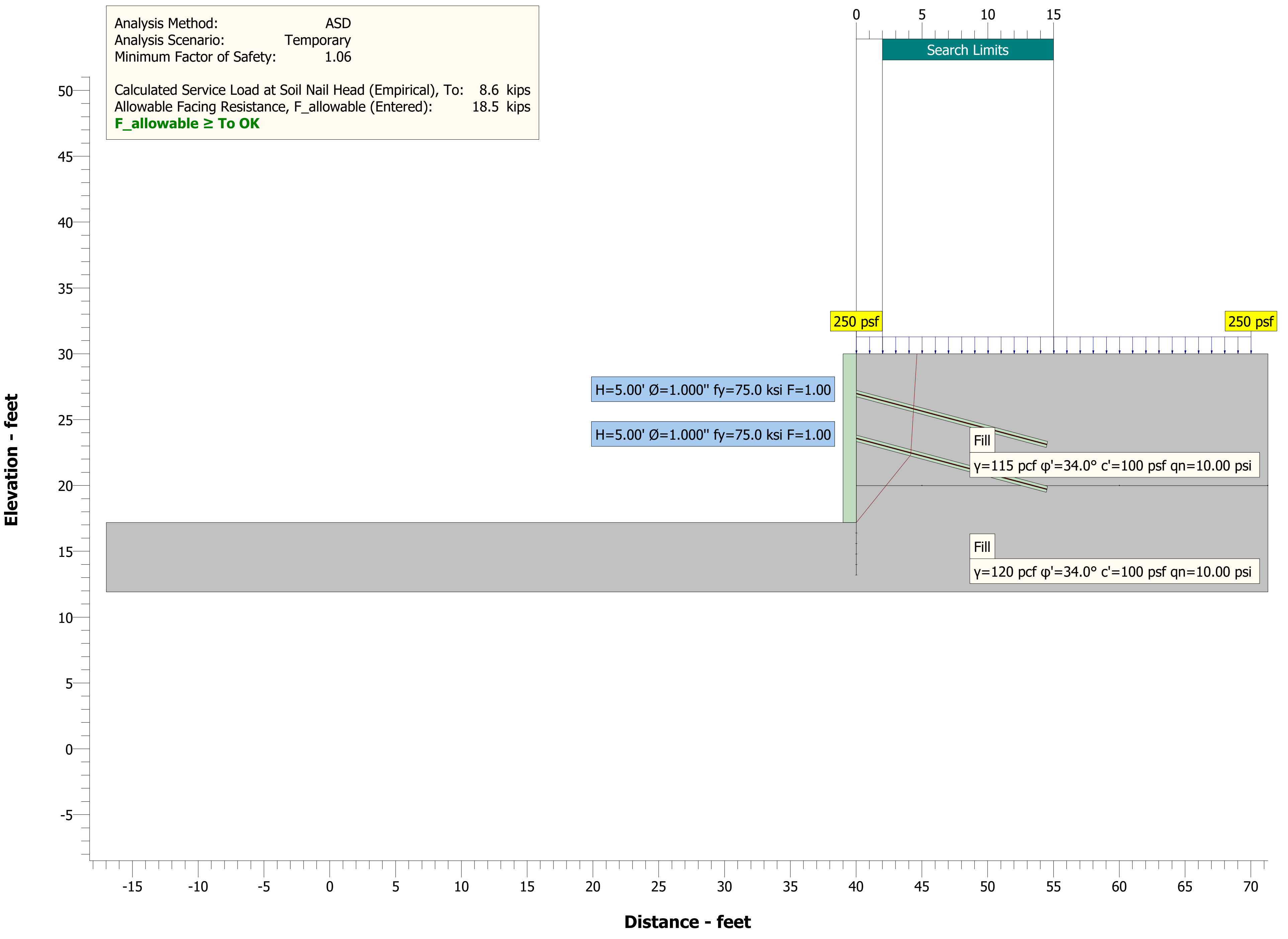
H=5.00' Ø=1.000" fy=75.0 ksi F=1.00
H=5.00' Ø=1.000" fy=75.0 ksi F=1.00

Fill
γ=115 pcf φ'=34.0° c'=100 psf qn=10.00 psi

Fill
γ=120 pcf φ'=34.0° c'=100 psf qn=10.00 psi

Figure H-15

Snail Version 2.2.2 - US 395 RW3 Sta 1710 Temp 22:05:40 on 11/14/22

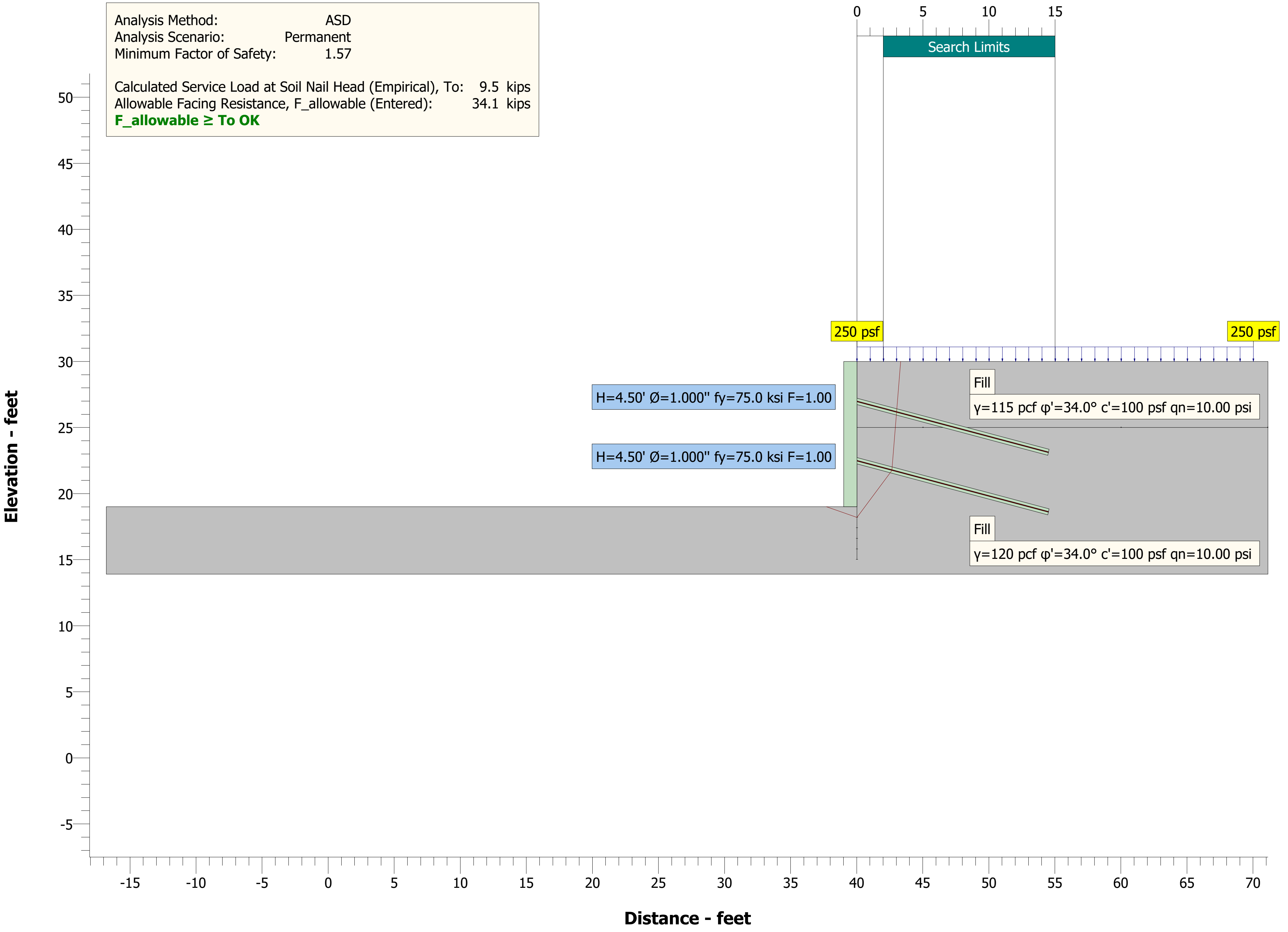


Analysis Method: ASD
Analysis Scenario: Temporary
Minimum Factor of Safety: 1.06

Calculated Service Load at Soil Nail Head (Empirical), To: 8.6 kips
Allowable Facing Resistance, F_allowable (Entered): 18.5 kips
F_allowable ≥ To OK

Figure H-16

Snail Version 2.2.2 - US 395 RW3 Sta 1800 18:46:47 on 11/14/22



Analysis Method: ASD
Analysis Scenario: Permanent
Minimum Factor of Safety: 1.57

Calculated Service Load at Soil Nail Head (Empirical), To: 9.5 kips
Allowable Facing Resistance, F_allowable (Entered): 34.1 kips
F_allowable ≥ To OK

Figure H-17

Snail Version 2.2.2 - US 395 RW3 Sta 1800 Seismic

18:50:40 on 11/14/22

Analysis Method: ASD
Analysis Scenario: Seismic
Minimum Factor of Safety: 1.32

Calculated Service Load at Soil Nail Head (Empirical), To: 12.3 kips
Allowable Facing Resistance, F_allowable (Entered): 46.5 kips
F_allowable ≥ To OK

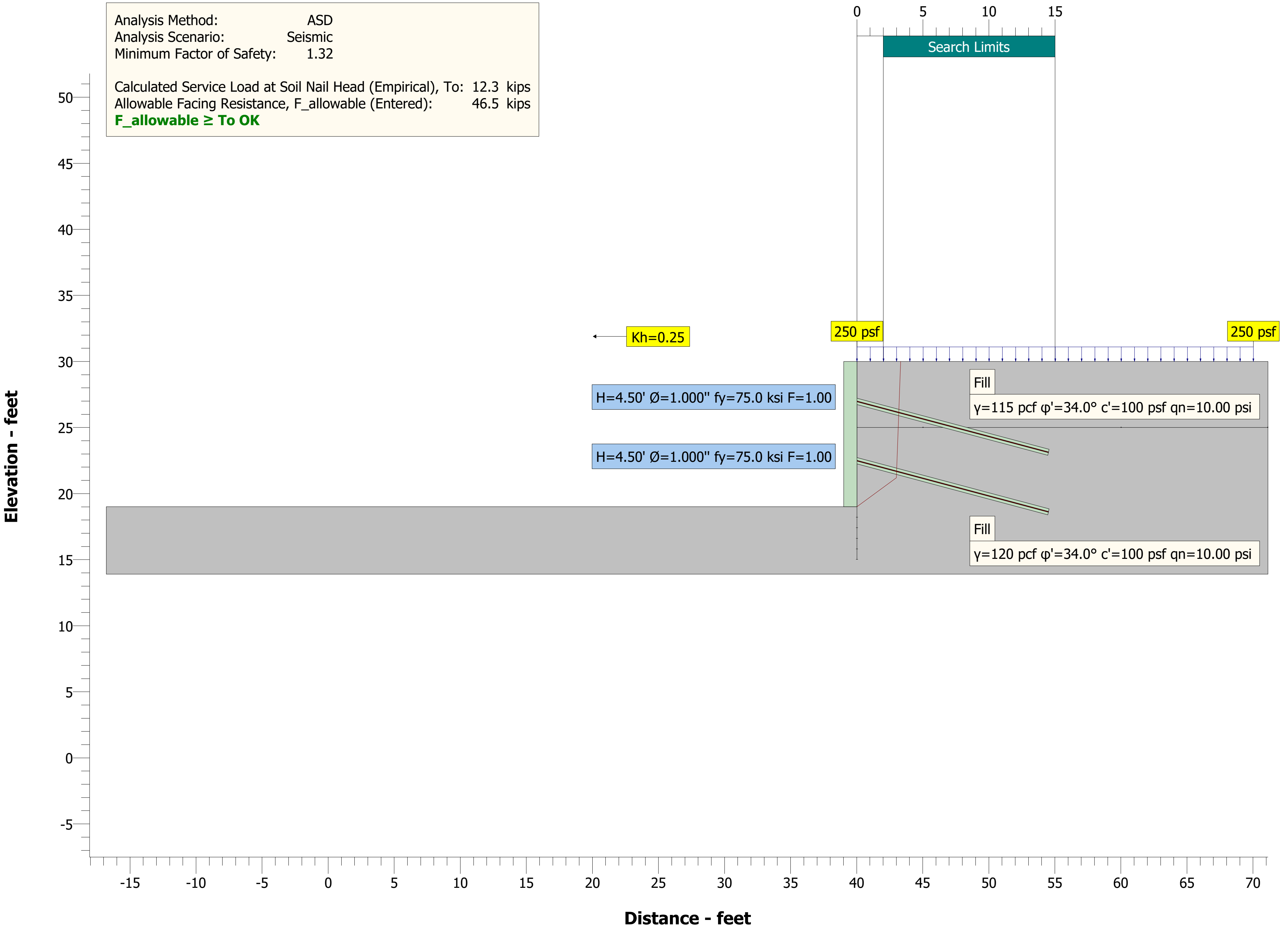
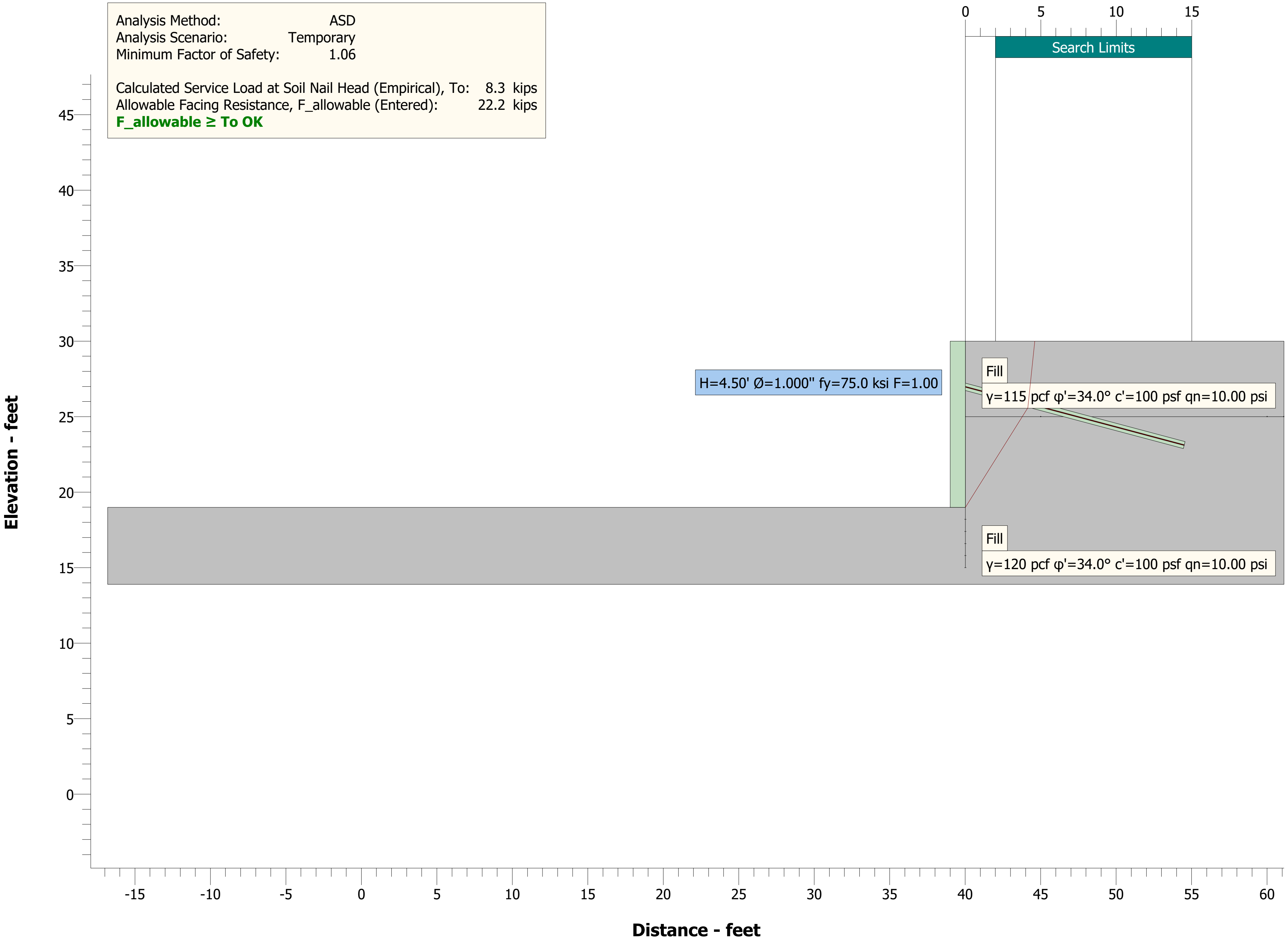


Figure H-18

Snail Version 2.2.2 - US 395 RW3 Sta 1800 Temp 18:56:29 on 11/14/22



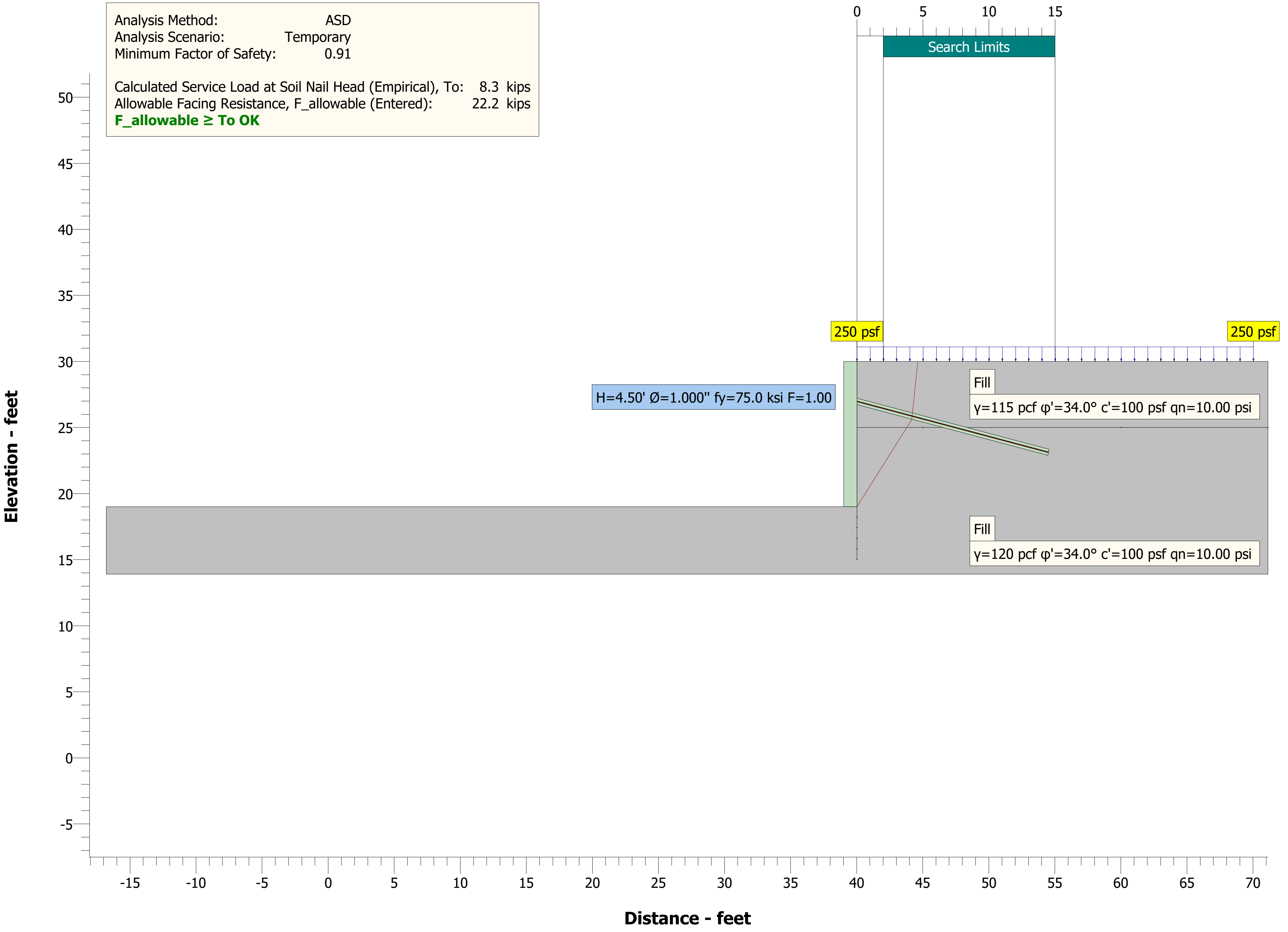
Analysis Method:	ASD
Analysis Scenario:	Temporary
Minimum Factor of Safety:	1.06

Calculated Service Load at Soil Nail Head (Empirical), To:	8.3	kips
Allowable Facing Resistance, F_allowable (Entered):	22.2	kips

F_allowable ≥ To OK

Figure H-19

Snail Version 2.2.2 - US 395 RW3 Sta 1800 Temp 18:53:09 on 11/14/22

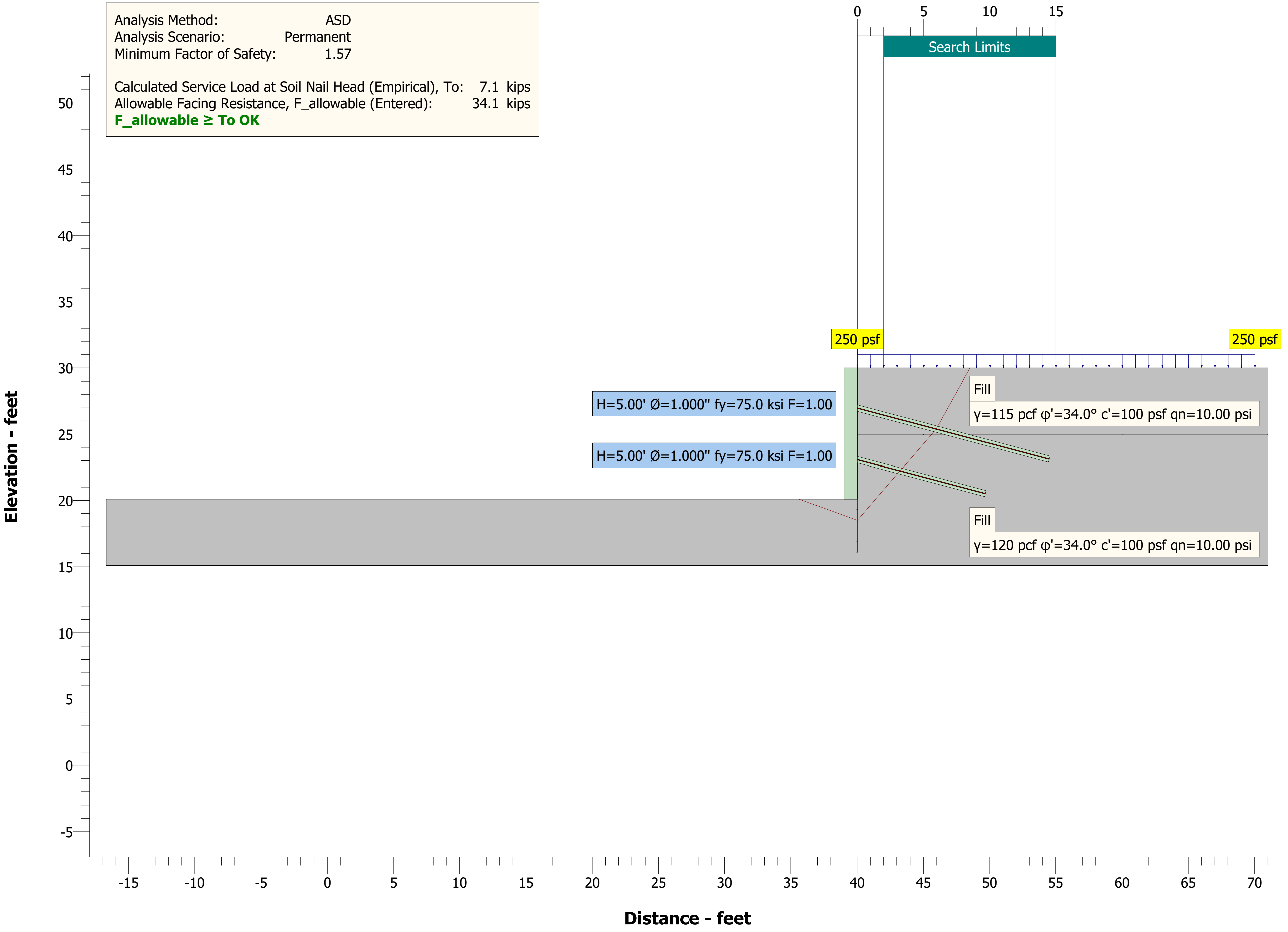


Analysis Method: ASD
Analysis Scenario: Temporary
Minimum Factor of Safety: 0.91

Calculated Service Load at Soil Nail Head (Empirical), To: 8.3 kips
Allowable Facing Resistance, F_allowable (Entered): 22.2 kips
F_allowable ≥ To OK

Figure H-20

Snail Version 2.2.2 - US 395 RW3 Sta 1900 15:42:20 on 11/14/22

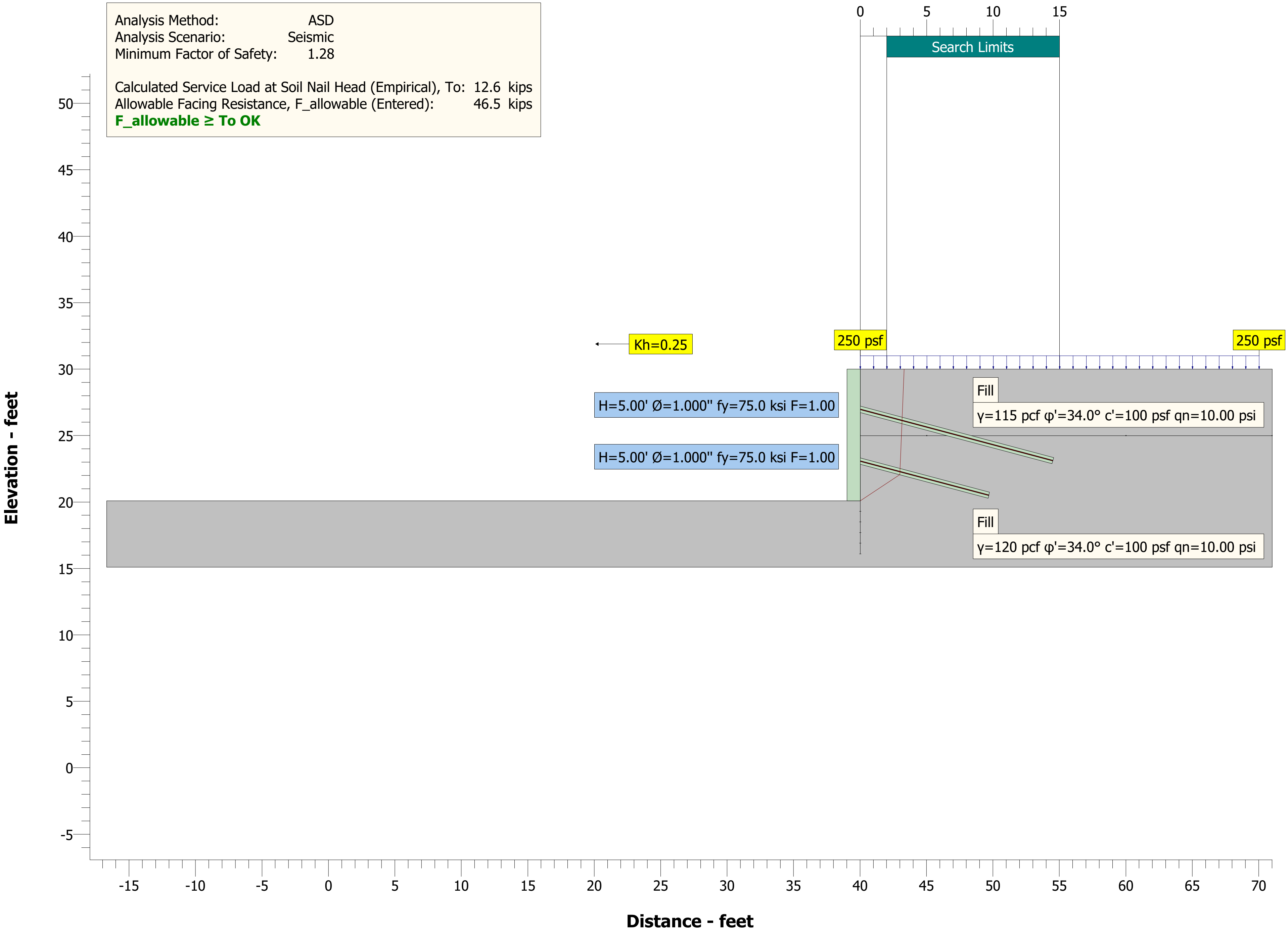


Analysis Method: ASD
Analysis Scenario: Permanent
Minimum Factor of Safety: 1.57

Calculated Service Load at Soil Nail Head (Empirical), To: 7.1 kips
Allowable Facing Resistance, F_allowable (Entered): 34.1 kips
F_allowable ≥ To OK

Figure H-21

Snail Version 2.2.2 - US 395 RW3 Sta 1900 Seismic 15:44:56 on 11/14/22

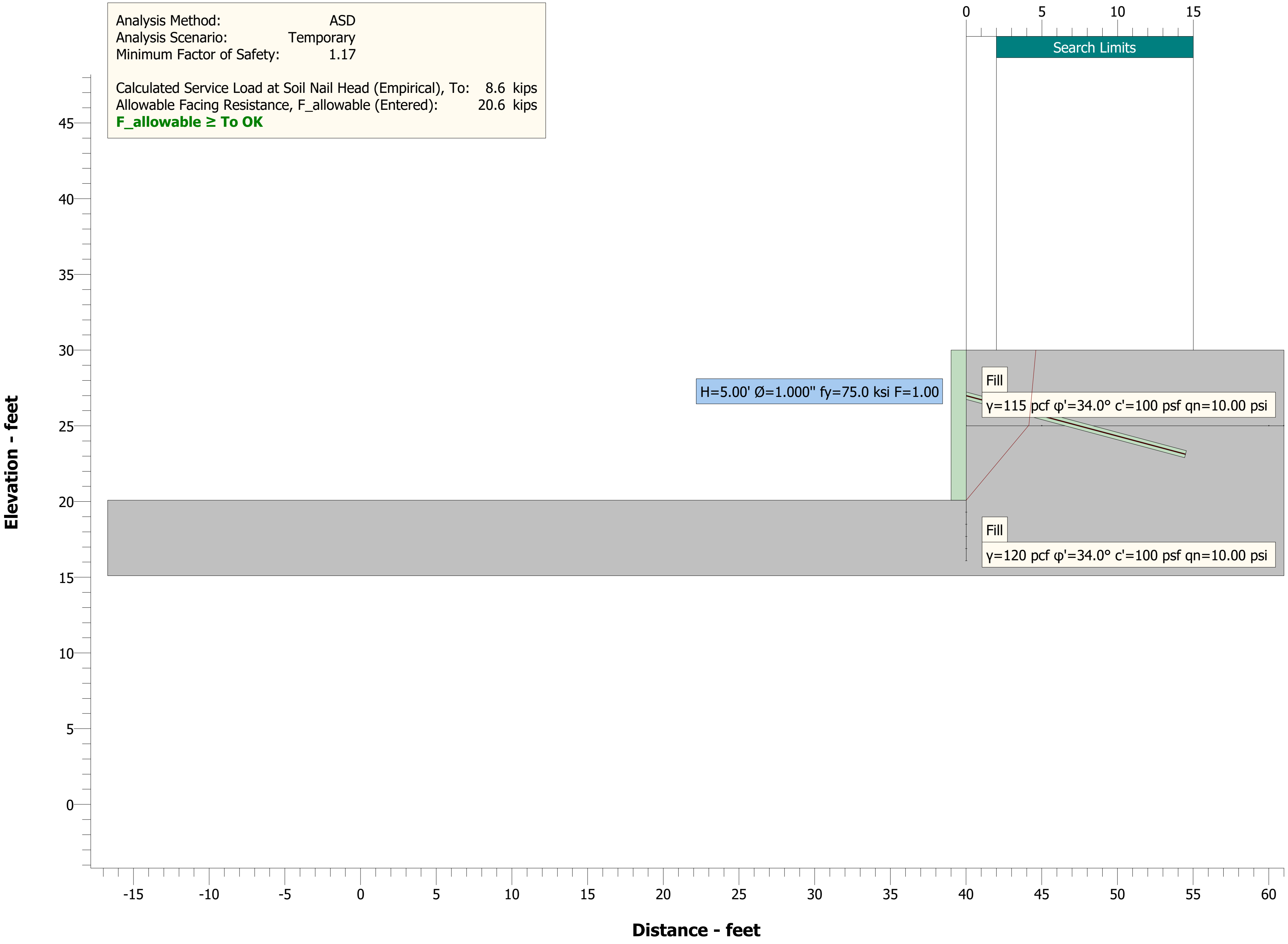


Analysis Method: ASD
Analysis Scenario: Seismic
Minimum Factor of Safety: 1.28

Calculated Service Load at Soil Nail Head (Empirical), To: 12.6 kips
Allowable Facing Resistance, F_allowable (Entered): 46.5 kips
F_allowable ≥ To OK

Figure H-22

Snail Version 2.2.2 - US 395 RW3 Sta 1900 Temp 15:50:36 on 11/14/22



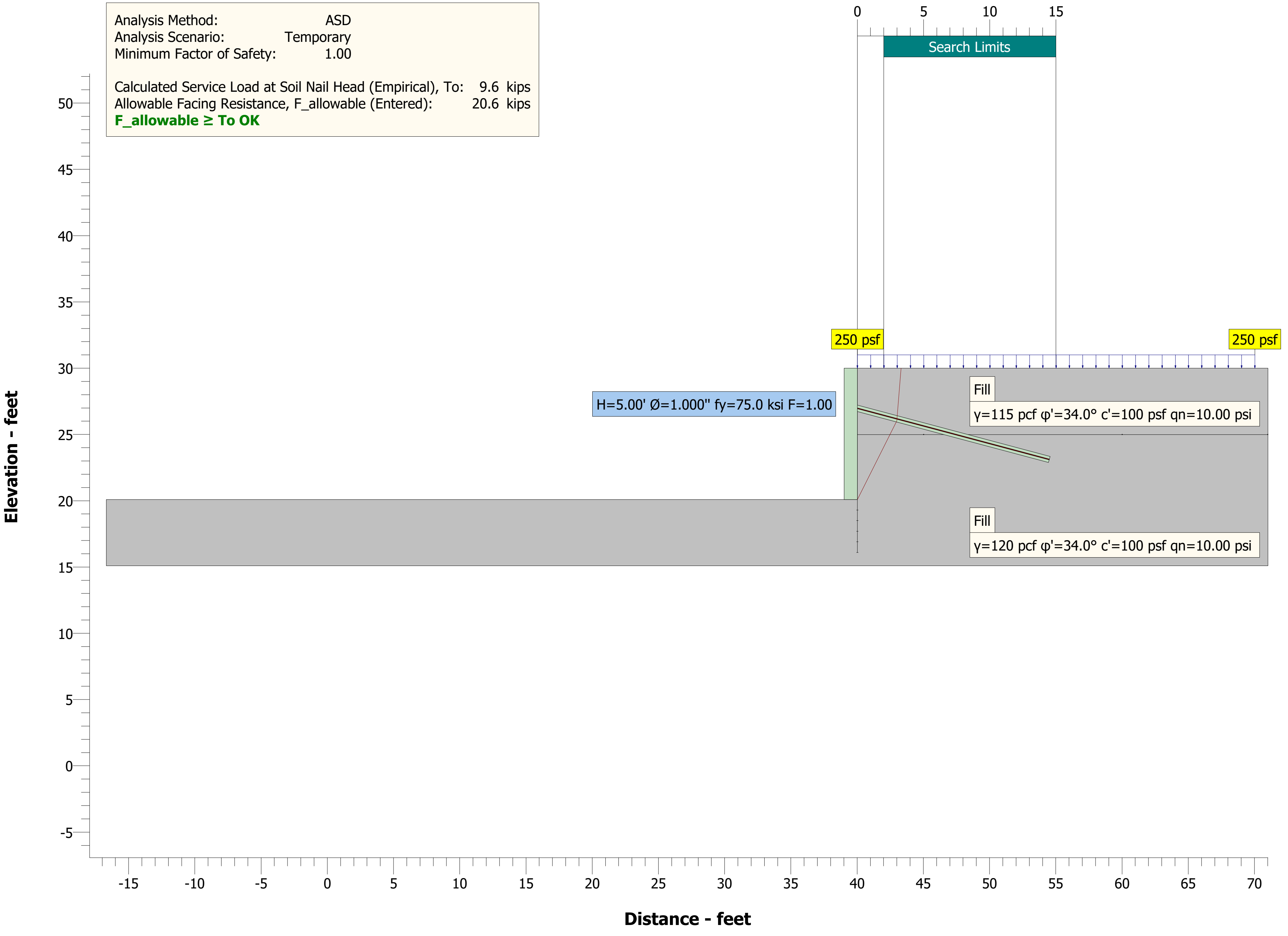
Analysis Method: ASD
Analysis Scenario: Temporary
Minimum Factor of Safety: 1.17

Calculated Service Load at Soil Nail Head (Empirical), To: 8.6 kips
Allowable Facing Resistance, F_allowable (Entered): 20.6 kips
F_allowable ≥ To OK

Figure H-23

Snail Version 2.2.2 - US 395 RW3 Sta 1900 Temp

15:48:24 on 11/14/22



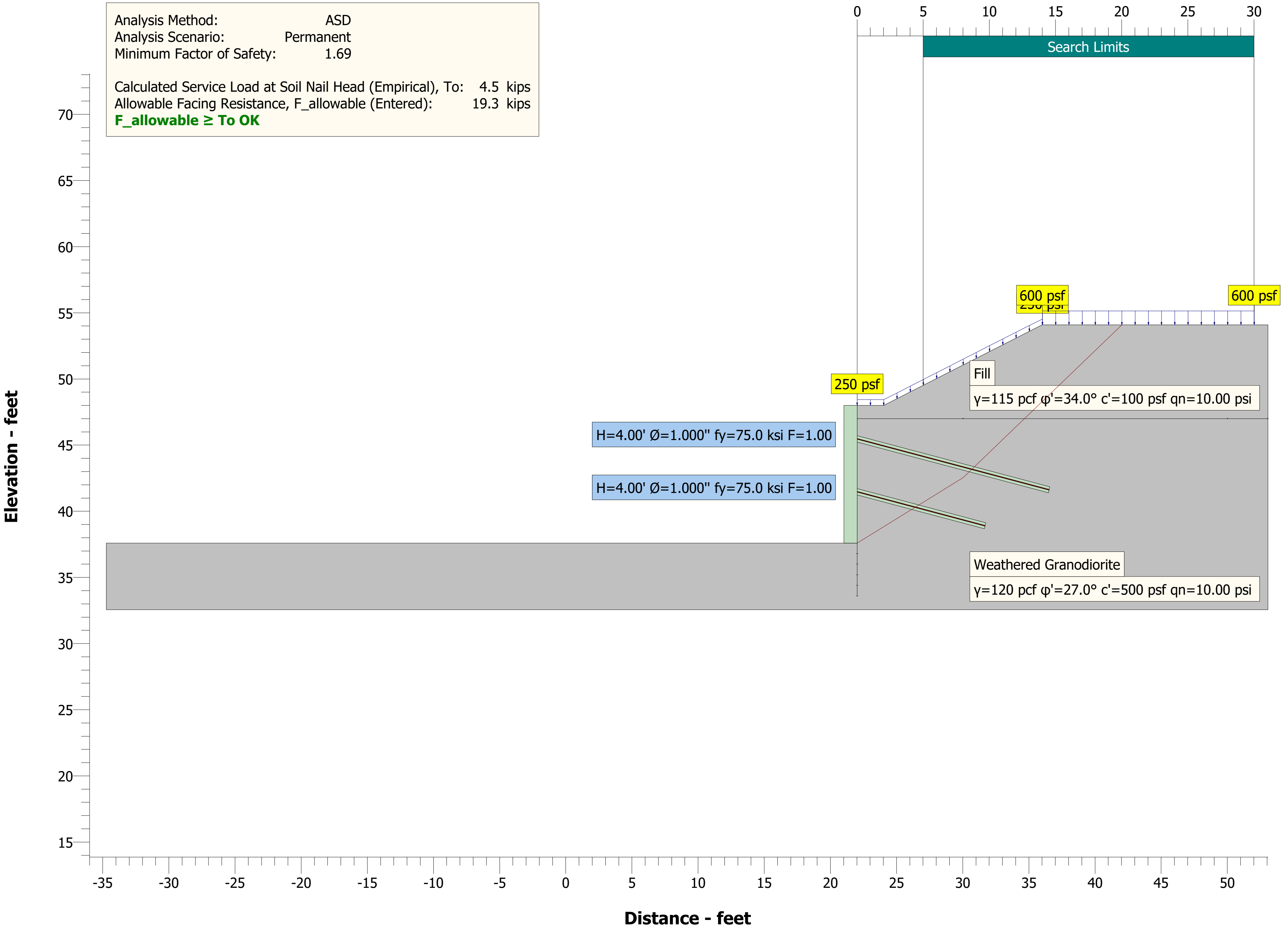
Analysis Method: ASD
Analysis Scenario: Temporary
Minimum Factor of Safety: 1.00

Calculated Service Load at Soil Nail Head (Empirical), To: 9.6 kips
Allowable Facing Resistance, F_allowable (Entered): 20.6 kips
F_allowable ≥ To OK

Figure H-24

Snail Version 2.2.2 - US 395 RW10 Full Height Perm

11:15:22 on 11/01/22

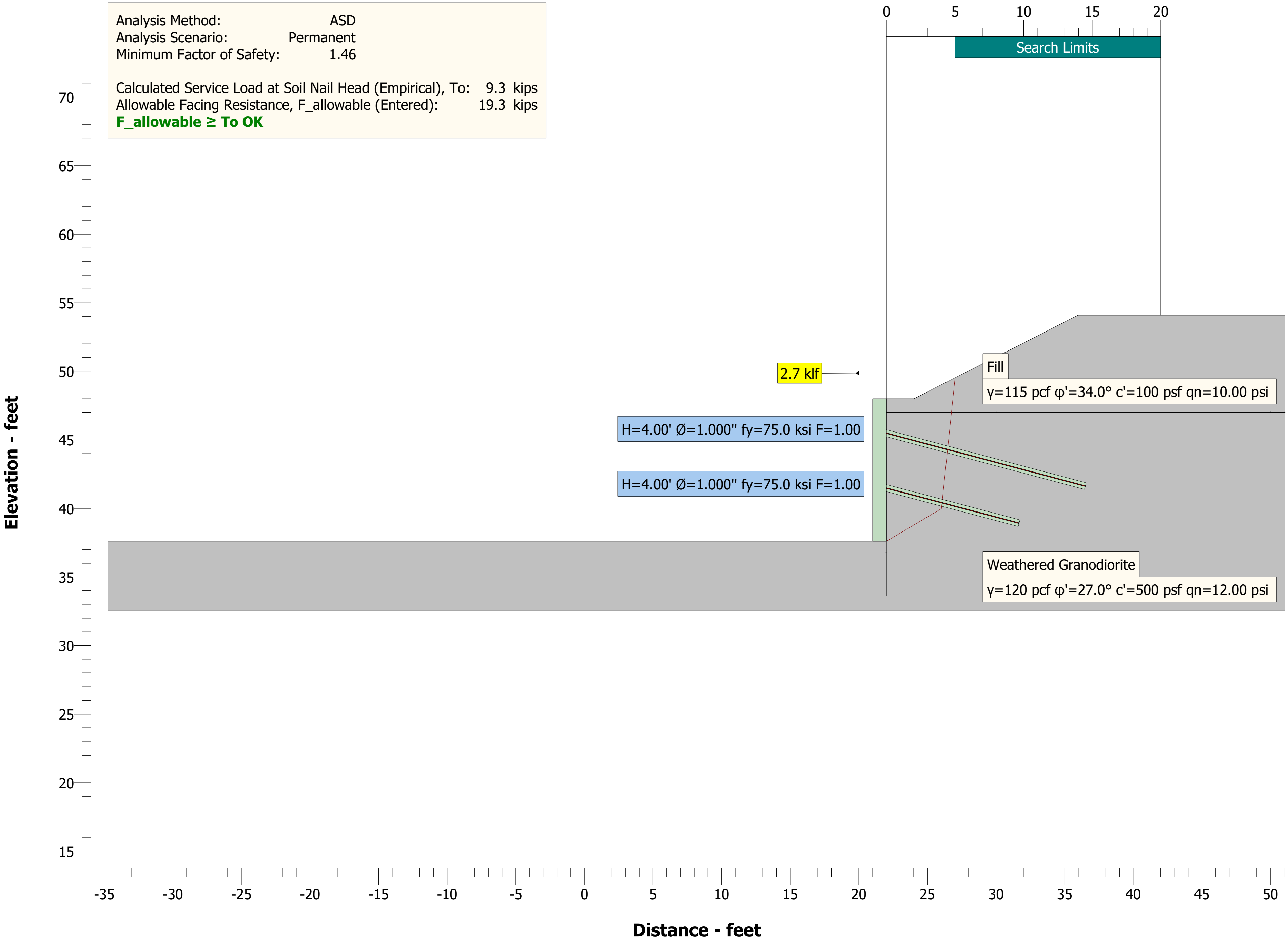


Analysis Method: ASD
Analysis Scenario: Permanent
Minimum Factor of Safety: 1.69

Calculated Service Load at Soil Nail Head (Empirical), To: 4.5 kips
Allowable Facing Resistance, F_allowable (Entered): 19.3 kips
F_allowable ≥ To OK

Figure H-25

Snail Version 2.2.2 - US 395 RW10 Full Height Pole Load 11:20:53 on 11/01/22



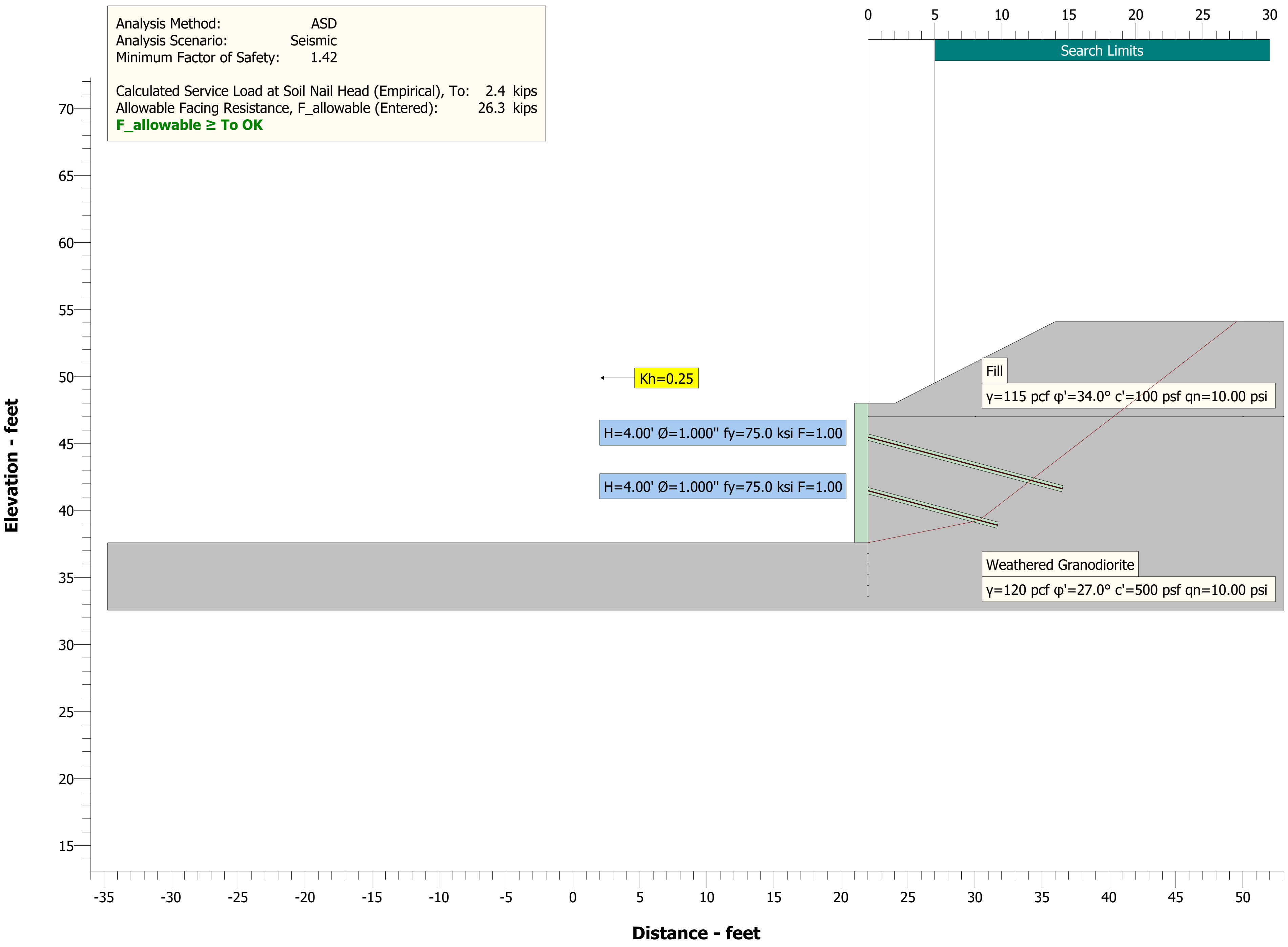
Analysis Method: ASD
Analysis Scenario: Permanent
Minimum Factor of Safety: 1.46

Calculated Service Load at Soil Nail Head (Empirical), To: 9.3 kips
Allowable Facing Resistance, F_allowable (Entered): 19.3 kips
F_allowable ≥ To OK

Figure H-26

Snail Version 2.2.2 - US 395 RW10 Full Height Seismic

11:26:27 on 11/01/22

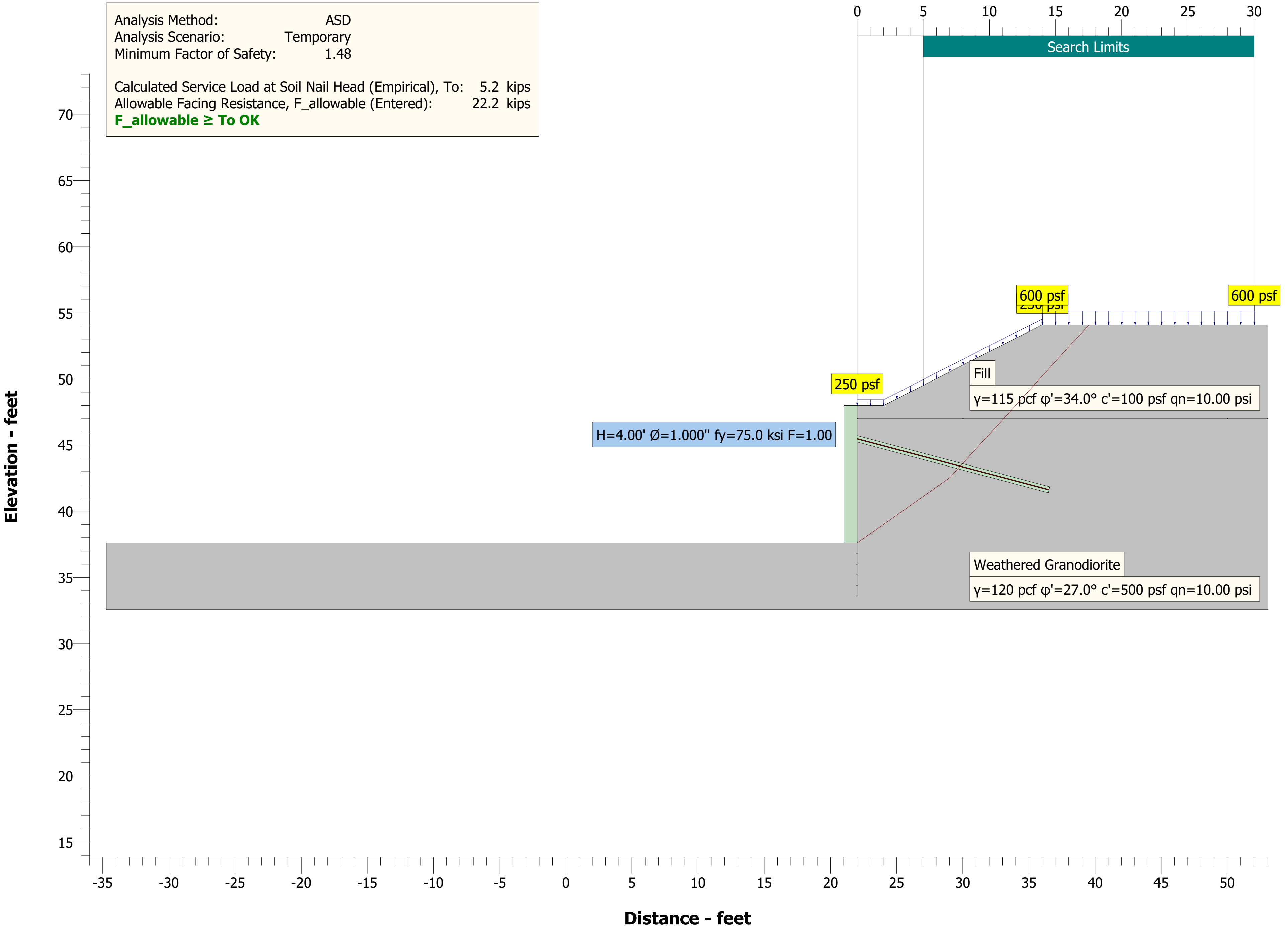


Analysis Method: ASD
Analysis Scenario: Seismic
Minimum Factor of Safety: 1.42

Calculated Service Load at Soil Nail Head (Empirical), To: 2.4 kips
Allowable Facing Resistance, F_allowable (Entered): 26.3 kips
F_allowable ≥ To OK

Figure H-27

Snail Version 2.2.2 - US 395 RW10 Full Height Temp   11:32:08 on 11/01/22

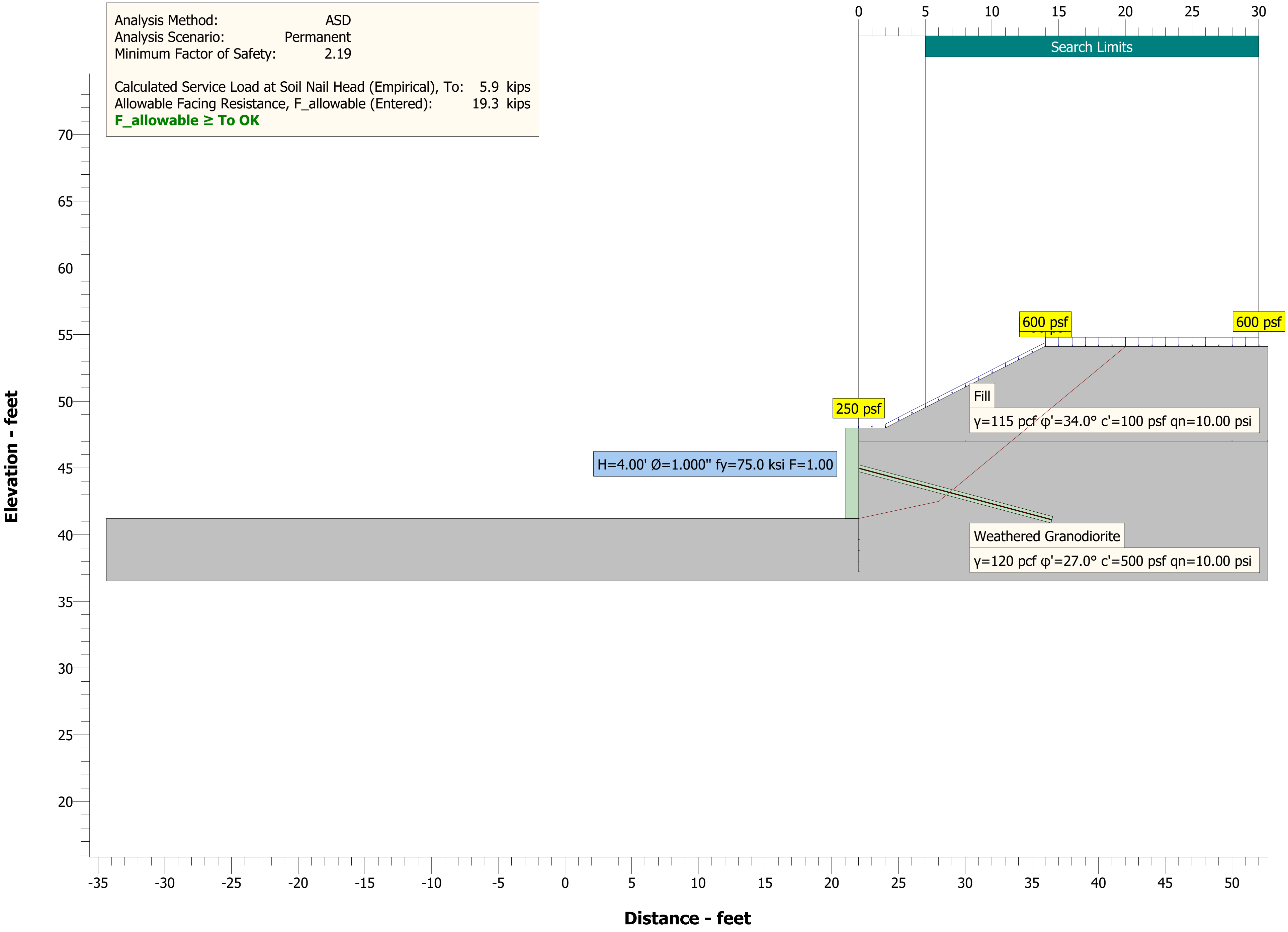


Analysis Method: ASD
Analysis Scenario: Temporary
Minimum Factor of Safety: 1.48

Calculated Service Load at Soil Nail Head (Empirical), To: 5.2 kips
Allowable Facing Resistance, F_allowable (Entered): 22.2 kips
F_allowable ≥ To OK

Figure H-28

Snail Version 2.2.2 - US 395 RW10 Single Row Perm 12:10:16 on 11/01/22

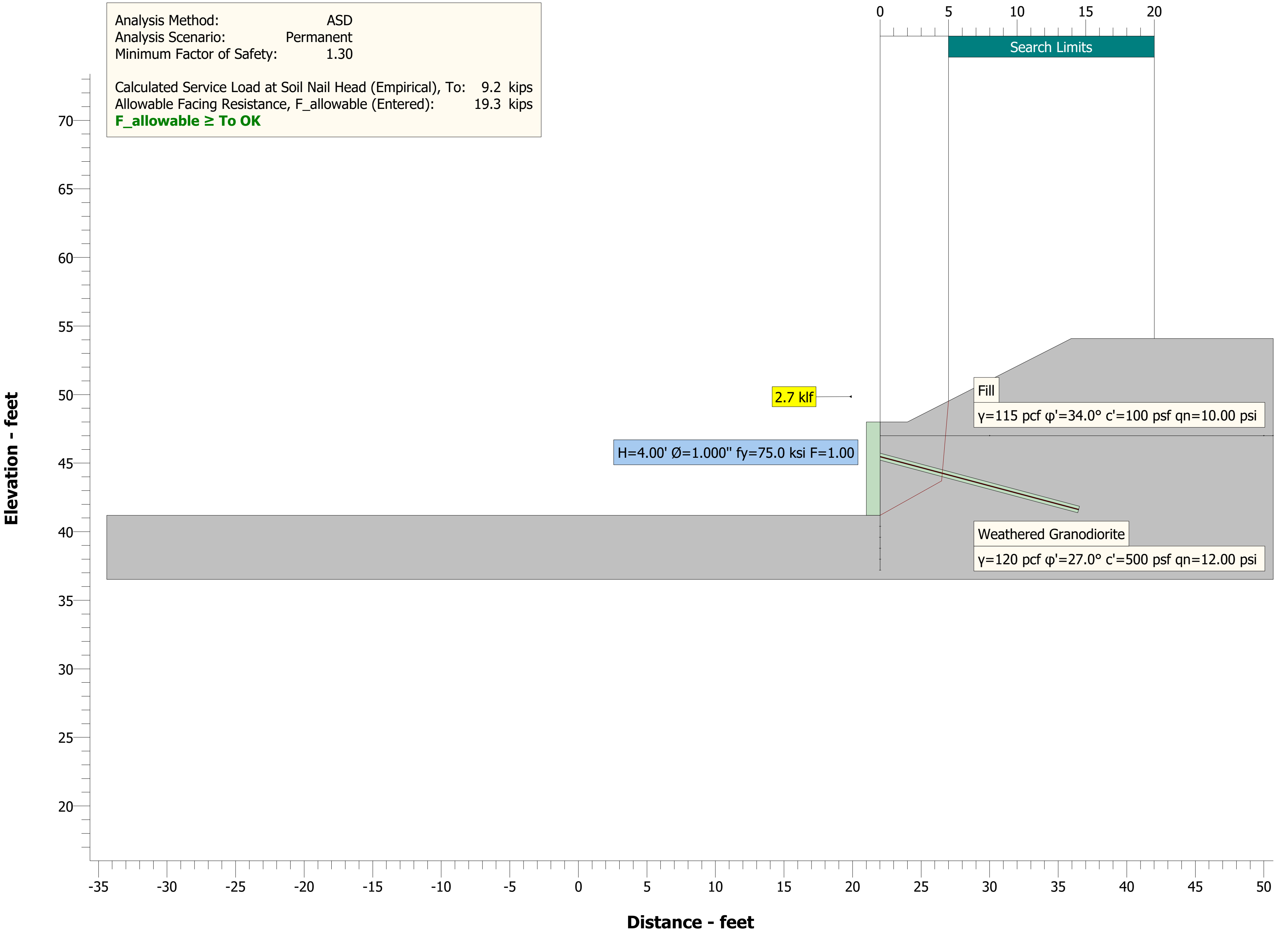


Analysis Method: ASD
Analysis Scenario: Permanent
Minimum Factor of Safety: 2.19

Calculated Service Load at Soil Nail Head (Empirical), To: 5.9 kips
Allowable Facing Resistance, F_allowable (Entered): 19.3 kips
F_allowable ≥ To OK

Figure H-29

Snail Version 2.2.2 - US 395 RW10 Single Row Pole Load 12:06:44 on 11/01/22



Analysis Method: ASD
Analysis Scenario: Permanent
Minimum Factor of Safety: 1.30

Calculated Service Load at Soil Nail Head (Empirical), To: 9.2 kips
Allowable Facing Resistance, F_allowable (Entered): 19.3 kips
F_allowable ≥ To OK

Figure H-30

Snail Version 2.2.2 - US 395 RW10 Single Row Seismic 12:04:41 on 11/01/22

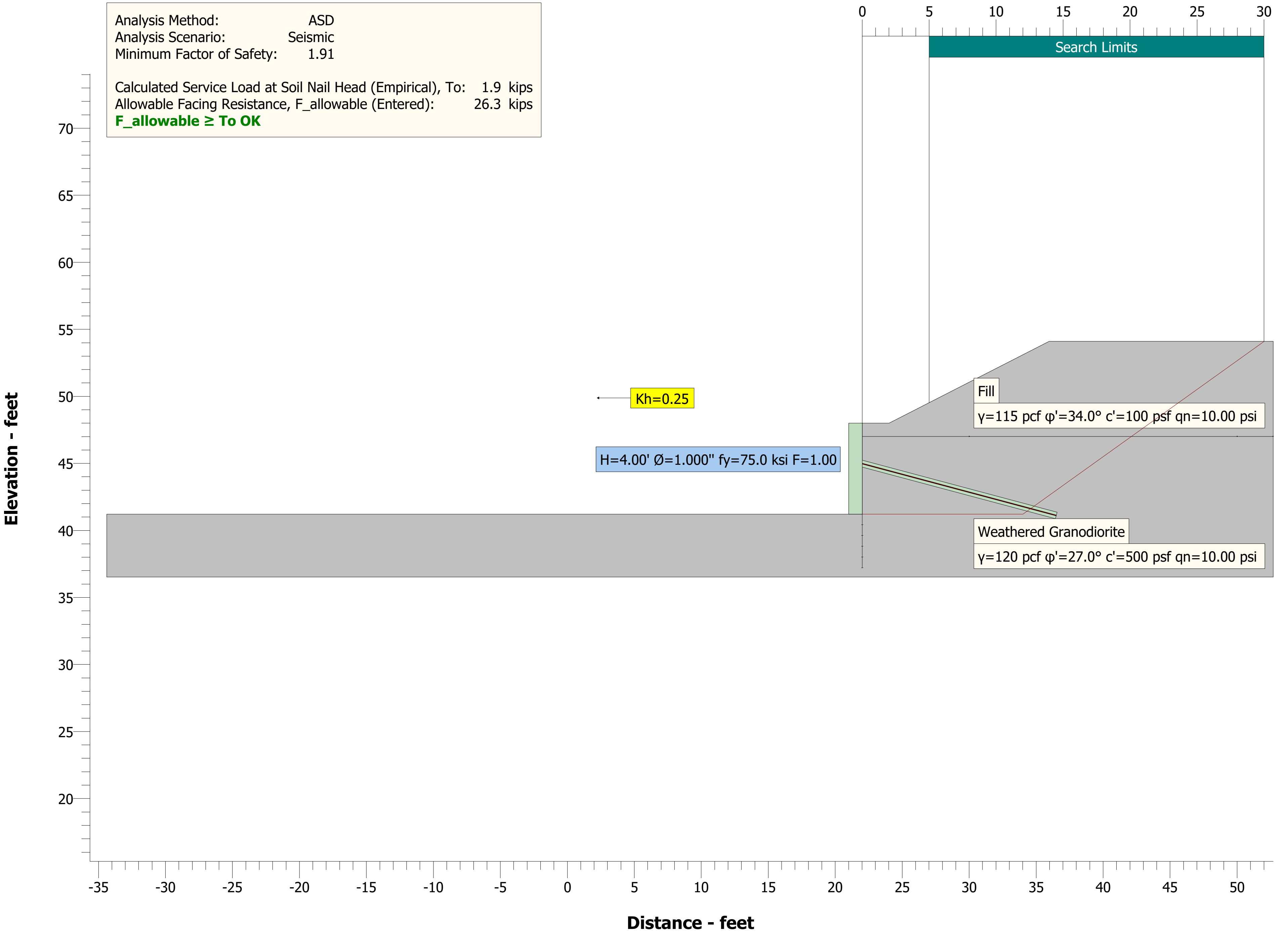
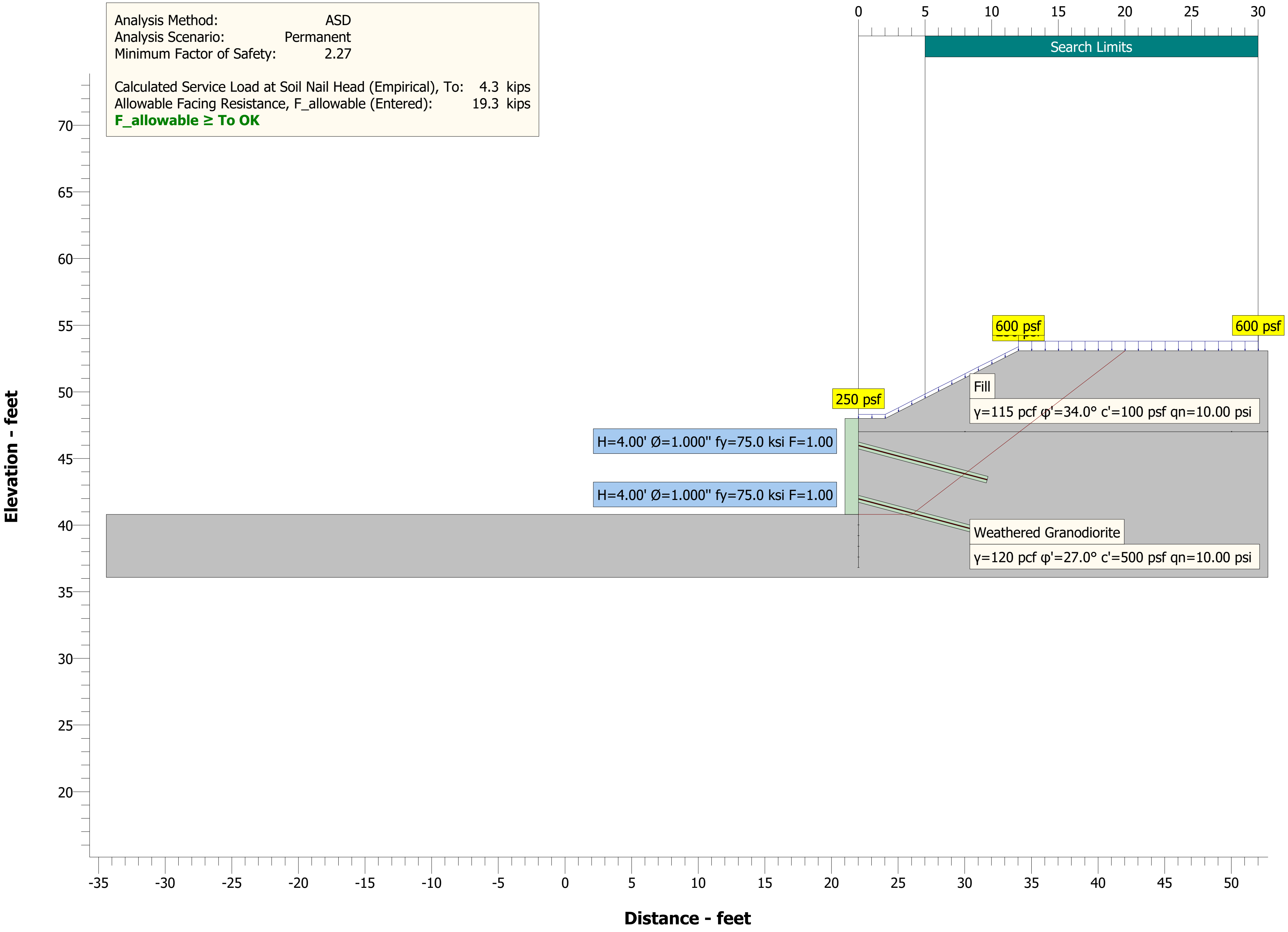


Figure H-31

Snail Version 2.2.2 - US 395 RW14 Full Height Perm 10:59:49 on 11/02/22

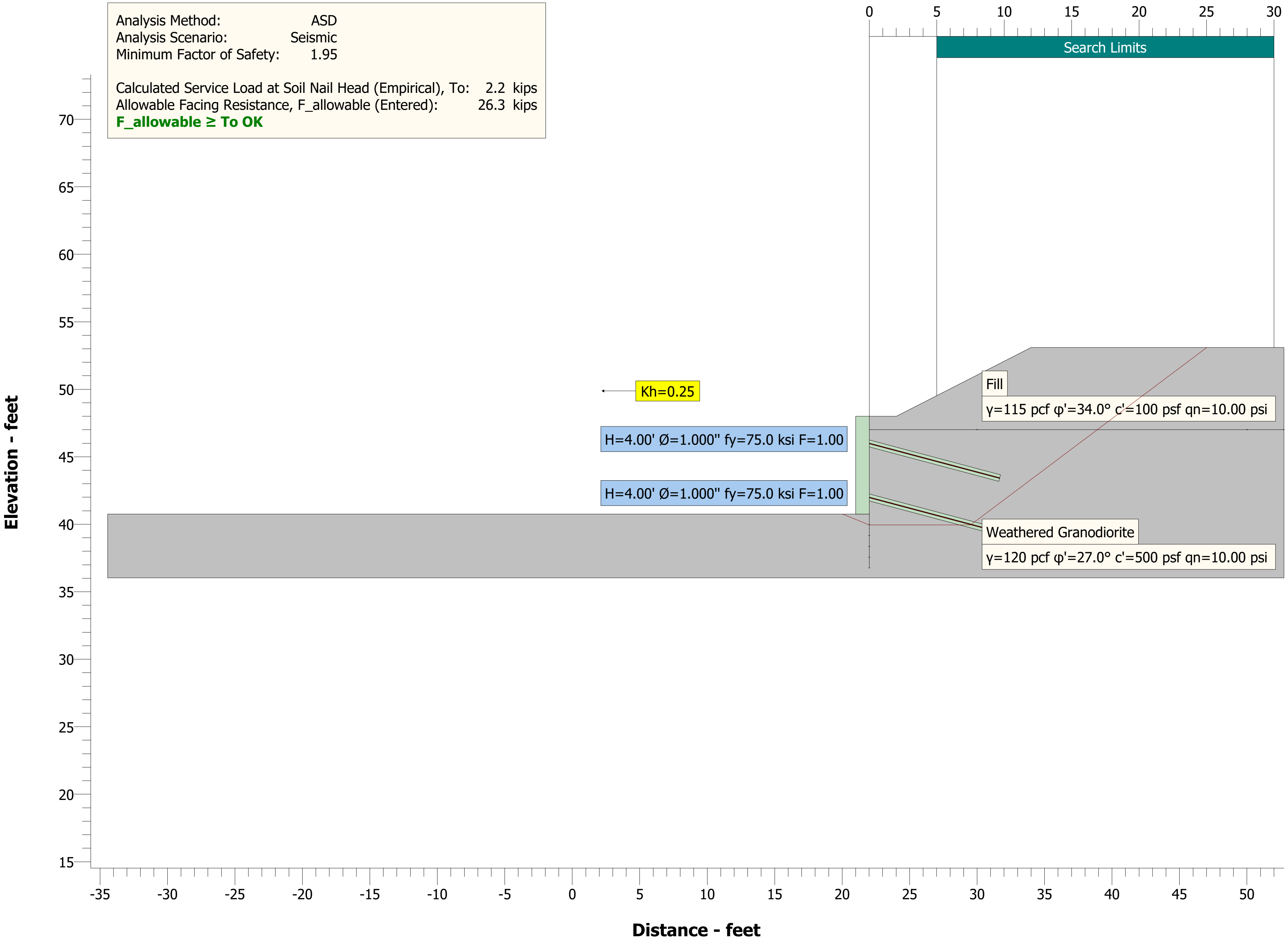


Analysis Method: ASD
Analysis Scenario: Permanent
Minimum Factor of Safety: 2.27

Calculated Service Load at Soil Nail Head (Empirical), To: 4.3 kips
Allowable Facing Resistance, F_allowable (Entered): 19.3 kips
F_allowable ≥ To OK

Figure H-32

Snail Version 2.2.2 - US 395 RW14 Full Height Seismic 10:27:50 on 11/02/22



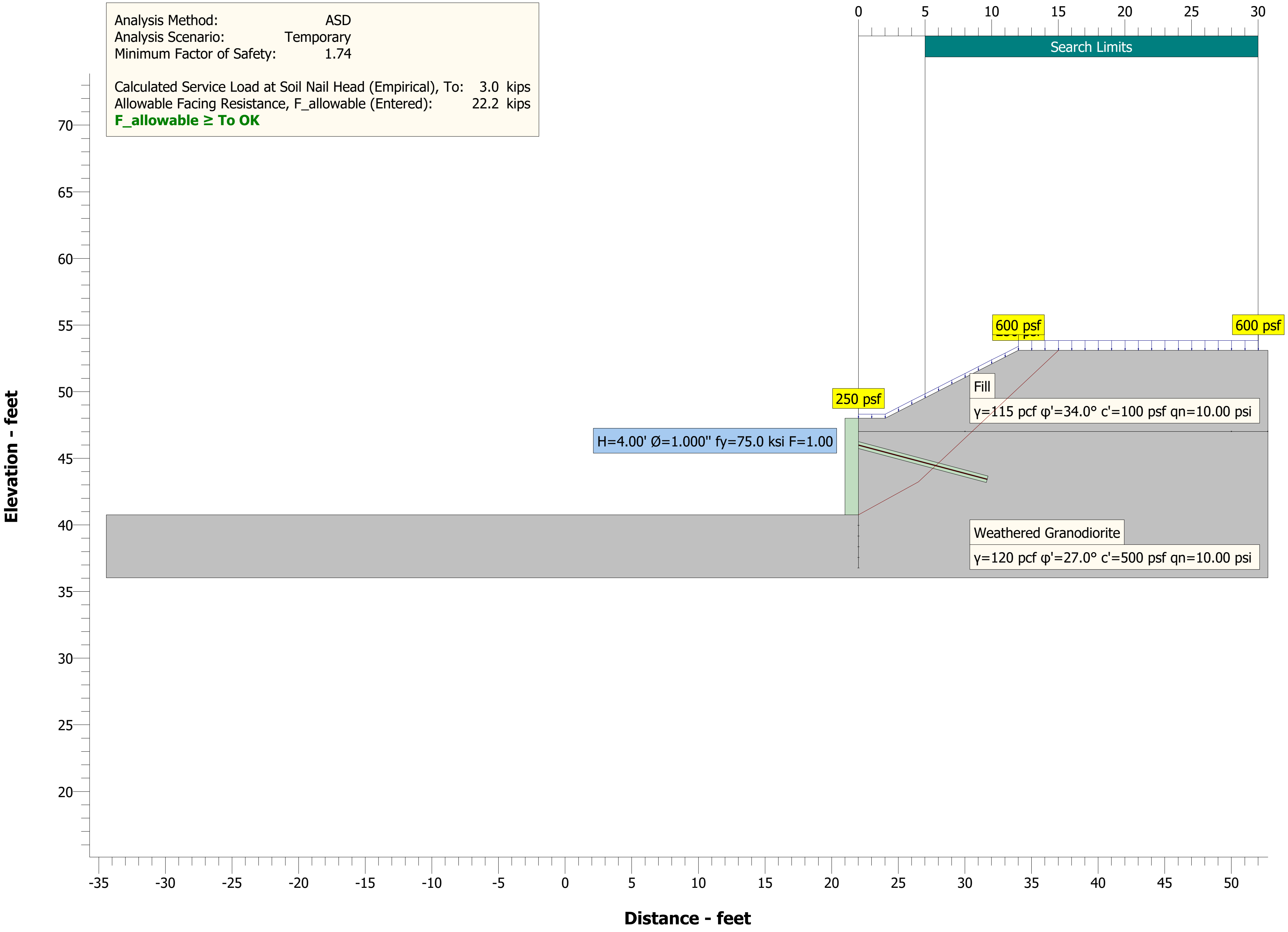
Analysis Method:	ASD
Analysis Scenario:	Seismic
Minimum Factor of Safety:	1.95

Calculated Service Load at Soil Nail Head (Empirical), To:	2.2 kips
Allowable Facing Resistance, F_allowable (Entered):	26.3 kips

F_allowable ≥ To OK

Figure H-33

Snail Version 2.2.2 - US 395 RW14 Full Height Temp 11:06:51 on 11/02/22



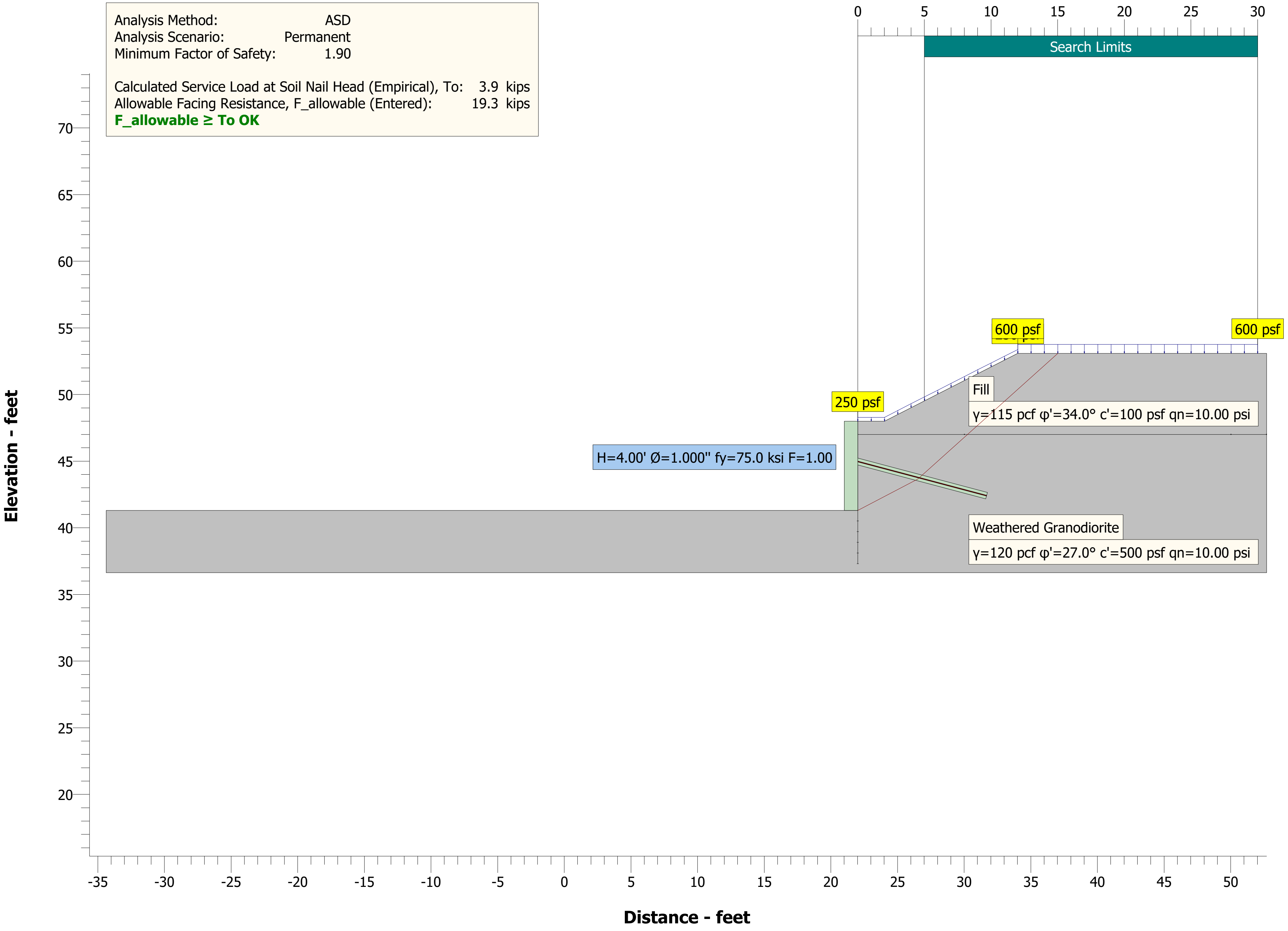
Analysis Method: ASD
Analysis Scenario: Temporary
Minimum Factor of Safety: 1.74

Calculated Service Load at Soil Nail Head (Empirical), To: 3.0 kips
Allowable Facing Resistance, F_allowable (Entered): 22.2 kips
F_allowable ≥ To OK

Figure H-34

Snail Version 2.2.2 - US 395 RW14 Single Row

11:10:31 on 11/02/22

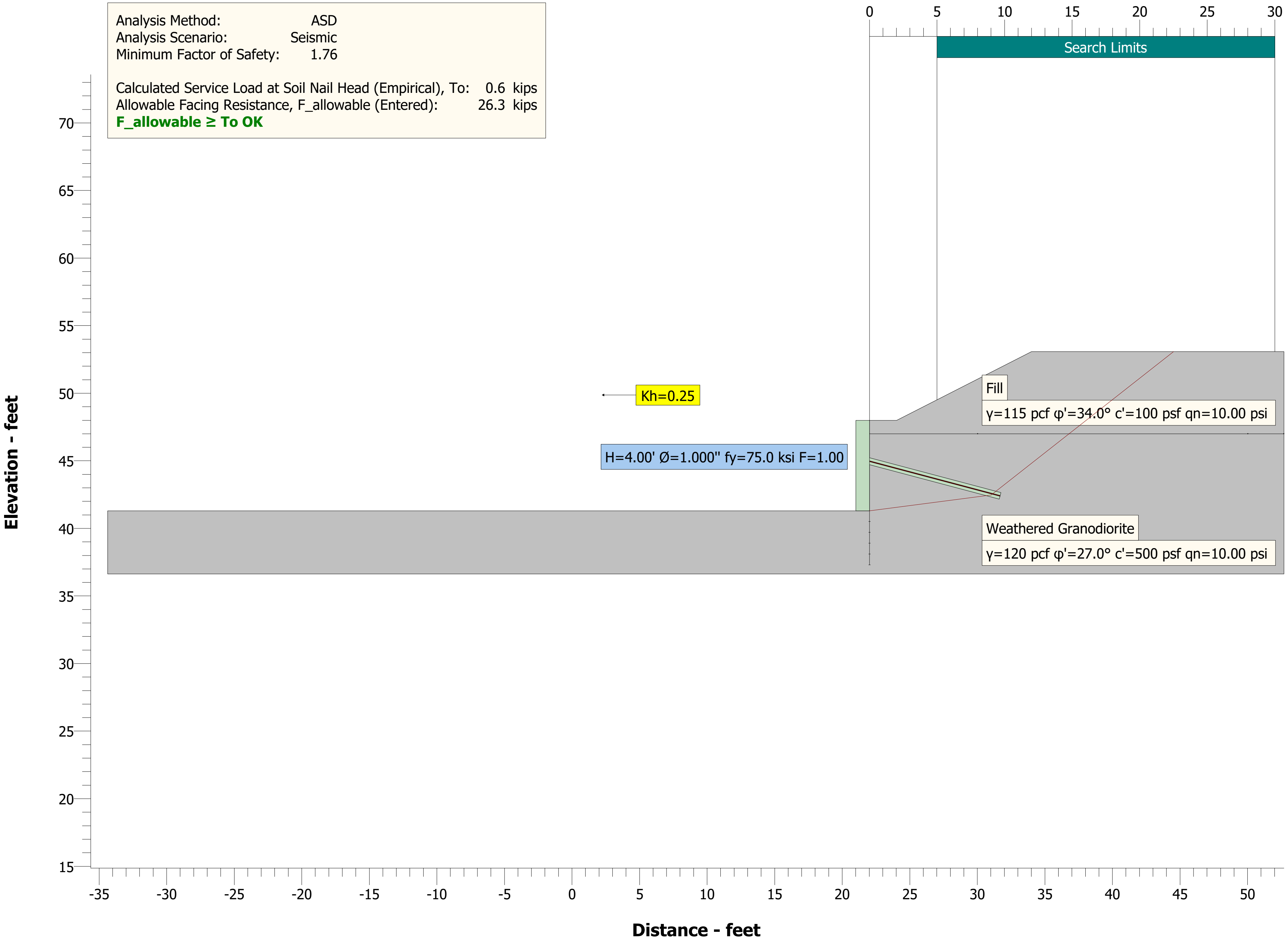


Analysis Method: ASD
Analysis Scenario: Permanent
Minimum Factor of Safety: 1.90

Calculated Service Load at Soil Nail Head (Empirical), To: 3.9 kips
Allowable Facing Resistance, F_allowable (Entered): 19.3 kips
F_allowable ≥ To OK

Figure H-35

Snail Version 2.2.2 - US 395 RW14 Single Row Seismic 11:15:26 on 11/02/22



Analysis Method: ASD
Analysis Scenario: Seismic
Minimum Factor of Safety: 1.76

Calculated Service Load at Soil Nail Head (Empirical), To: 0.6 kips
Allowable Facing Resistance, F_allowable (Entered): 26.3 kips
F_allowable ≥ To OK

```
======================================================================================================
                                               Snail

                                           Version: 2.2.2

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======================================================================================================
                                          File Information
======================================================================================================

File Name: US 395 RW3 Sta 150.snz
Run Date:  11/15/22
Run Time:  13:53:36

======================================================================================================
                                        Project Information
======================================================================================================

Description:    RW3
Location:       US 395
EA:
Project ID:
Wall No.:
Structure No.:
Station:
Engineer:       STC
                Designer

Comments:


======================================================================================================
                                              Geometry
======================================================================================================

Layout:

Reference Point:

At: Top of Wall
Distance From Origin:       40.00 feet
Elevation Above Origin:     30.00 feet

Wall Dimensions:

Wall Height:        6.50 feet
Facing Angle:      90.00 degrees
Facing Batter:     0.000 :12 H:V
```

```
Ground Surface:

Number of lines that define the ground surface above the wall: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Number of lines that define the ground surface in front of the toe: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Soil Layers:

Number of Layers: 2

Layers Below the Top Layer:

Coordinates of the Top of the Layer: feet

             Point 1         Point 1         Point 2         Point 2
Layer       Distance       Elevation        Distance       Elevation
--------------------------------------------------------------------
2              45.00           25.00           60.00           25.00

Ground Water:

Include Ground Water: No

======================================================================================================
                                             Soil Nails
======================================================================================================

Dimensions and Properties:

Maximum Vertical Spacing:               5.00 feet
Number of Soil Nail Rows:                  1
Soil Nail Design Parameters:               Varying

      Soil Nail       Inclination   Vertical   Horizontal      Nail Bar   Nail Bar Yield       Bond
         Length   From Horizontal    Spacing    Spacing H    Diameter Ø      Strength fy   Strength
No.        feet           degrees       feet         feet        inches              ksi   Factor F
---------------------------------------------------------------------------------------------------
1         10.00                15       3.00         5.00         1.000             75.0       1.00

Facing Resistance:
```

```
                                     Temporary   Permanent     Seismic
ASD Allowable Facing Resistance:          20.6        34.1        46.5 kips

======================================================================================================
                                          Soil Properties
======================================================================================================

                                        Unit Weight  Friction Angle        Cohesion
                                                  γ              φ'              c'
Layer  Description                              pcf         degrees             psf
-----------------------------------------------------------------------------------
1      Fill                                     115            34.0             100
2      Fill                                     120            34.0             100

======================================================================================================
                                               Loads
======================================================================================================

Applied Loads:

Seismic:

Horizontal Seismic Coefficient Kh0.25:

External Load:

Apply external load: No

Surcharges:

Apply surcharges:    Yes

           Distance from Top of Wall            Load            Load
               Begin             End           Begin             End
No.             feet            feet             psf             psf
--------------------------------------------------------------------
1               0.00           30.00             250             250

======================================================================================================
                                         Factors of Safety
======================================================================================================

                    Temporary   Permanent     Seismic
Pullout (Distal):        2.00        2.00        1.50
Pullout (Proximal):      2.00        2.00        1.50
Nail Bar Yield:          1.80        1.80        1.35

======================================================================================================
                                           Search Options
======================================================================================================
```

```
Search Limits:

Begin:      5.00 feet
End:       15.00 feet

Below Toe Searches (BTS):

Perform below Toe Search:       Yes
Number of BTS Points:             5
BTS Depth:                     4.00 feet
Interface Friction
Reduction Factor:              0.33

Advanced Search Options:

Use Advanced Search Options:     Yes
Inclination of Interslice Force: Use Average Failure Angle

======================================================================================================
                                               Results
======================================================================================================

Analysis:

Method:          ASD
Scenario:  Permanent

Factor of Safety:

Minimum:                  1.50
Found at Search Point:       1
Found at Grid Point:        35
Found at Search Level:       Toe of the wall

Load at Soil Nail Head:

Calculated Service Load at Soil Nail Head (Empirical), To:     5.5 kips
Allowable Facing Resistance, F_allowable (Entered):           34.1 kips
F_allowable ≥ To OK

Nominal Pullout Resistance:

                    Nominal Pullout Resistance
Layer  Description                         klf
----------------------------------------------
    1  Fill                              2.262
    2  Fill                              2.262

Results by Search Level:

** Indicates Minimum Factor of Safety
```

```
Search Level: At the toe of the wall  Facing Design Force = 5.5 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower     |       Upper         |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
   ** 1      1.50       5.00     40.91      3.97     62.85      4.38       1      9.9   Pullout

      2      1.65       6.00     40.91      3.97     52.43      4.92       1      9.8   Pullout

      3      1.78       7.00     34.85      3.41     47.29      6.19       1      9.3   Pullout

      4      1.88       8.00     31.36      3.75     43.47      6.61       1      8.8   Pullout

      5      1.99       9.00     28.44      4.09     40.12      7.06       1      8.2   Pullout

      6      2.10      10.00     25.99      4.45     37.17      7.53       1      7.7   Pullout

      7      2.22      11.00     23.90      4.81     34.58      8.02       1      7.3   Pullout

      8      2.33      12.00     22.11      5.18     32.29      8.52       1      6.8   Pullout

      9      2.44      13.00     20.56      5.55     30.26      9.03       1      6.4   Pullout

     10      2.56      14.00     19.20      5.93     28.44      9.55       1      6.0   Pullout

     11      2.71      15.00     16.11      4.68     26.35     11.72       1      5.7   Pullout

Search Level: 0.80 feet below the toe of the wall  Facing Design Force = 5.4 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower     |       Upper         |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      1.67       5.00     44.23      4.19     65.46      4.82       1      9.6   Pullout

      2      1.71       6.00     39.05      4.64     61.28      4.99       1      8.7   Pullout

      3      1.76       7.00     34.81      5.12     57.41      5.20       1      7.9   Pullout

      4      1.83       8.00     36.13      4.95     47.60      5.93       1      8.1   Pullout

      5      1.90       9.00     32.98      5.36     44.23      6.28       1      7.5   Pullout
```

```
      6      1.97      10.00     30.29      5.79     41.22      6.65       1      6.9   Pullout

      7      2.08      11.00     26.46      4.91     37.75      8.35       1      6.5   Pullout

      8      2.16      12.00     24.53      5.28     35.36      8.83       1      6.0   Pullout

      9      2.24      13.00     22.84      5.64     33.23      9.32       1      5.5   Pullout

     10      2.33      14.00     21.36      6.01     31.31      9.83       1      5.0   Pullout

     11      2.42      15.00     20.05      6.39     29.59     10.35       1      4.6   Pullout

Search Level: 1.60 feet below the toe of the wall  Facing Design Force = 5.1 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      1.86       5.00     49.17      5.35     69.68      4.32       1      9.1   Pullout

      2      1.89       6.00     48.37      5.42     59.35      4.71       1      9.0   Pullout

      3      1.92       7.00     42.79      4.77     54.24      5.99       1      8.4   Pullout

      4      1.94       8.00     39.01      5.15     50.54      6.29       1      7.6   Pullout

      5      1.97       9.00     35.75      5.55     47.20      6.62       1      7.0   Pullout

      6      2.02      10.00     32.94      5.96     44.19      6.97       1      6.3   Pullout

      7      2.07      11.00     30.50      6.38     41.47      7.34       1      5.7   Pullout

      8      2.12      12.00     28.37      6.82     39.01      7.72       1      5.1   Pullout

      9      2.19      13.00     26.49      7.26     36.79      8.12       1      4.5   Pullout

     10      2.27      14.00     30.05     16.17      0.00      0.00       1      5.4   Pullout

     11      2.34      15.00     28.37     17.05      0.00      0.00       1      5.0   Pullout

Search Level: 2.40 feet below the toe of the wall  Facing Design Force = 4.0 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
```

```
------------------------------------------------------------------------------------------------------
      1      5.10       5.00      0.00      2.50     74.31      9.24       1      8.6   Pullout

      2      2.23       6.00     56.01     10.73      0.00      0.00       1      9.4   Pullout

      3      2.17       7.00     51.82     11.32      0.00      0.00       1      8.7   Pullout

      4      2.08       8.00     42.83      6.55     54.28      5.48       1      7.1   Pullout

      5      2.12       9.00     38.35      5.74     49.88      6.98       1      6.5   Pullout

      6      2.14      10.00     35.45      6.14     46.88      7.32       1      5.8   Pullout

      7      2.17      11.00     32.91      6.55     44.15      7.67       1      5.2   Pullout

      8      2.20      12.00     30.68      6.98     41.67      8.03       1      4.5   Pullout

      9      2.24      13.00     28.71      7.41     39.40      8.41       1      3.9   Pullout

     10      2.29      14.00     26.96      7.85     37.34      8.80       1      3.3   Pullout

     11      2.34      15.00     30.68     17.44      0.00      0.00       1      4.2   Pullout

Search Level: 3.20 feet below the toe of the wall  Facing Design Force = 2.9 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes               |       Reinforcement        |
|       |         |          |------------------------------------------|----------------------------|
|       | Minimum | Distance |        Lower        |       Upper        |       |        |           |
|       | Factor  | From Toe |------------------------------------------|       |        | Controlling|
|Search |   of    | of Wall  |  Angle   |  Length  |  Angle   |  Length  |       | Stress | Resistance |
|Point  | Safety  |   feet   | degrees  |   feet   | degrees  |   feet   | Level |  ksi   | Failure Mode|
------------------------------------------------------------------------------------------------------
      1       N/A       5.00      0.00      1.00     67.59     10.49       1      9.3   Pullout

      2     20.02       6.00      0.00      5.40     86.46      9.72       1      5.9   Pullout

      3      6.22       7.00      0.00      4.20     73.90     10.10       1      5.9   Pullout

      4      5.87       8.00      0.00      4.80     71.74     10.21       1      4.8   Pullout

      5      3.38       9.00     23.32      9.80     90.00      5.82       1      1.0   Pullout

      6      2.56      10.00     34.18     12.09    -90.00      2.91       1      3.9   Pullout

      7      2.36      11.00     38.44     14.04    -90.00      0.97       1      5.0   Pullout

      8      2.32      12.00     38.95     15.43      0.00      0.00       1      5.1   Pullout

      9      2.34      13.00     36.73     16.22      0.00      0.00       1      4.6   Pullout

     10      2.37      14.00     34.72     17.03      0.00      0.00       1      4.0   Pullout
```

```
     11      2.40      15.00     32.89     17.86      0.00      0.00       1      3.5   Pullout

Search Level: 4.00 feet below the toe of the wall  Facing Design Force = 1.1 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      2.91       5.00     46.40      5.80     80.98      6.38       1      7.9   Pullout

      2       N/A       6.00      9.93      6.09    -90.00      9.45       1      5.5   Pullout

      3       N/A       7.00      0.00      0.70     59.04     12.25       1      7.7   Pullout

      4       N/A       8.00      0.00      0.80     55.56     12.73       1      6.9   Pullout

      5     23.22       9.00      0.00      8.10     85.10     10.54       1      1.7   Pullout

      6      5.94      10.00      0.00      6.00     69.15     11.24       1      2.4   Pullout

      7      4.78      11.00     15.98     11.44    -90.00      7.35       1      0.0   Pullout

      8      3.29      12.00     23.63     13.10     90.00      5.25       1      0.0   Pullout

      9      2.99      13.00     25.86     14.45     90.00      4.20       1      0.0   Pullout

     10      2.80      14.00     27.70     15.81     90.00      3.15       1      0.3   Pullout

     11      2.57      15.00     32.21     17.73    -90.00      1.05       1      1.9   Pullout


======================================================================================================
                                           END OF REPORT
======================================================================================================
```

```
======================================================================================================
                                               Snail

                                           Version: 2.2.2

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======================================================================================================
                                          File Information
======================================================================================================

File Name: US 395 RW3 Sta 150 Seismic.snz
Run Date:  11/15/22
Run Time:  13:57:40

======================================================================================================
                                        Project Information
======================================================================================================

Description:    RW3
Location:       US 395
EA:
Project ID:
Wall No.:
Structure No.:
Station:
Engineer:       STC
                Designer

Comments:


======================================================================================================
                                              Geometry
======================================================================================================

Layout:

Reference Point:

At: Top of Wall
Distance From Origin:       40.00 feet
Elevation Above Origin:     30.00 feet

Wall Dimensions:

Wall Height:         6.50 feet
Facing Angle:       90.00 degrees
Facing Batter:      0.000 :12 H:V
```

```
Ground Surface:

Number of lines that define the ground surface above the wall: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Number of lines that define the ground surface in front of the toe: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Soil Layers:

Number of Layers: 2

Layers Below the Top Layer:

Coordinates of the Top of the Layer: feet

             Point 1         Point 1         Point 2         Point 2
Layer       Distance       Elevation        Distance       Elevation
--------------------------------------------------------------------
2              45.00           25.00           60.00           25.00

Ground Water:

Include Ground Water: No

======================================================================================================
                                             Soil Nails
======================================================================================================

Dimensions and Properties:

Maximum Vertical Spacing:               5.00 feet
Number of Soil Nail Rows:                  1
Soil Nail Design Parameters:               Varying

      Soil Nail       Inclination   Vertical   Horizontal      Nail Bar   Nail Bar Yield       Bond
         Length   From Horizontal    Spacing    Spacing H    Diameter Ø      Strength fy   Strength
No.        feet           degrees       feet         feet        inches              ksi   Factor F
---------------------------------------------------------------------------------------------------
1         10.00                15       3.00         5.00         1.000             75.0       1.00

Facing Resistance:
```

```
                                     Temporary   Permanent     Seismic
ASD Allowable Facing Resistance:          20.6        34.1        46.5 kips

======================================================================================================
                                          Soil Properties
======================================================================================================

                                        Unit Weight  Friction Angle        Cohesion
                                                  γ              φ'             c'
Layer  Description                              pcf         degrees             psf
-----------------------------------------------------------------------------------
1      Fill                                     115            34.0             100
2      Fill                                     120            34.0             100

======================================================================================================
                                               Loads
======================================================================================================

Applied Loads:

Seismic:

Horizontal Seismic Coefficient Kh0.25:

External Load:

Apply external load: No

Surcharges:

Apply surcharges:    Yes

           Distance from Top of Wall            Load            Load
               Begin             End           Begin             End
No.             feet            feet             psf             psf
--------------------------------------------------------------------
1               0.00           30.00             250             250

======================================================================================================
                                         Factors of Safety
======================================================================================================

                    Temporary   Permanent     Seismic
Pullout (Distal):        2.00        2.00        1.50
Pullout (Proximal):      2.00        2.00        1.50
Nail Bar Yield:          1.80        1.80        1.35

======================================================================================================
                                           Search Options
======================================================================================================
```

```
Search Limits:

Begin:      5.00 feet
End:       15.00 feet

Below Toe Searches (BTS):

Perform below Toe Search:       Yes
Number of BTS Points:             5
BTS Depth:                     4.00 feet
Interface Friction
Reduction Factor:              0.33

Advanced Search Options:

Use Advanced Search Options:     Yes
Inclination of Interslice Force: Use Average Failure Angle

======================================================================================================
                                               Results
======================================================================================================

Analysis:

Method:          ASD
Scenario:    Seismic

Factor of Safety:

Minimum:                  1.27
Found at Search Point:       1
Found at Grid Point:        35
Found at Search Level:       Toe of the wall

Load at Soil Nail Head:

Calculated Service Load at Soil Nail Head (Empirical), To:     7.4 kips
Allowable Facing Resistance, F_allowable (Entered):           46.5 kips
F_allowable ≥ To OK

Nominal Pullout Resistance:

                    Nominal Pullout Resistance
Layer  Description                         klf
----------------------------------------------
    1  Fill                              2.262
    2  Fill                              2.262

Results by Search Level:

** Indicates Minimum Factor of Safety
```

```
Search Level: At the toe of the wall  Facing Design Force = 7.4 kips (Clouterre)
-------------------------------------------------------------------------------------------------------
|       |         |          |            Failure Planes             |         Reinforcement          |
|       |         |          |---------------------------------------|--------------------------------|
|       | Minimum | Distance |       Lower        |      Upper       |       |        |               |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling   |
|Search |   of    | of Wall  |  Angle  |  Length  |  Angle  | Length |       | Stress | Resistance    |
|Point  | Safety  |   feet   | degrees |   feet   | degrees |  feet  | Level |  ksi   | Failure Mode  |
-------------------------------------------------------------------------------------------------------
    ** 1      1.27       5.00     40.91      3.97     62.85      4.38       1     13.2   Pullout

       2      1.33       6.00     28.44      4.09     62.19      5.14       1     11.5   Pullout

       3      1.38       7.00     24.91      4.63     58.39      5.34       1     10.4   Pullout

       4      1.43       8.00     22.11      5.18     54.88      5.56       1      9.3   Pullout

       5      1.47       9.00     19.86      5.74     51.65      5.80       1      8.3   Pullout

       6      1.54      10.00     21.31      5.37     42.30      6.76       1      8.9   Pullout

       7      1.58      11.00     19.52      5.84     39.60      7.14       1      8.1   Pullout

       8      1.63      12.00     12.23      6.14     40.91      7.94       1      6.2   Pullout

       9      1.66      13.00     11.31      6.63     38.66      8.32       1      5.4   Pullout

      10      1.69      14.00     10.52      7.12     36.61      8.72       1      4.6   Pullout

      11      1.72      15.00      9.83      7.61     34.74      9.13       1      3.9   Pullout

Search Level: 0.80 feet below the toe of the wall  Facing Design Force = 5.7 kips (Clouterre)
-------------------------------------------------------------------------------------------------------
|       |         |          |            Failure Planes             |         Reinforcement          |
|       |         |          |---------------------------------------|--------------------------------|
|       | Minimum | Distance |       Lower        |      Upper       |       |        |               |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling   |
|Search |   of    | of Wall  |  Angle  |  Length  |  Angle  | Length |       | Stress | Resistance    |
|Point  | Safety  |   feet   | degrees |   feet   | degrees |  feet  | Level |  ksi   | Failure Mode  |
-------------------------------------------------------------------------------------------------------
       1      1.30       5.00     32.98      5.36     83.49      4.41       1     10.2   Pullout

       2      1.32       6.00     31.31      5.62     74.68      4.54       1      9.6   Pullout

       3      1.35       7.00     30.79      5.70     64.39      4.86       1      9.4   Pullout

       4      1.39       8.00     31.31      5.62     53.85      5.42       1      9.5   Pullout

       5      1.44       9.00     25.95      5.00     48.63      6.81       1      9.0   Pullout
```

```
      6       1.46      10.00      23.65       5.46      45.62       7.15        1        8.1   Pullout

      7       1.49      11.00      21.71       5.92      42.90       7.51        1        7.2   Pullout

      8       1.51      12.00      20.05       6.39      40.42       7.88        1        6.4   Pullout

      9       1.54      13.00      18.62       6.86      38.17       8.27        1        5.6   Pullout

     10       1.56      14.00      17.37       7.33      36.13       8.67        1        4.8   Pullout

     11       1.59      15.00      16.28       7.81      34.27       9.08        1        4.1   Pullout

Search Level: 1.60 feet below the toe of the wall  Facing Design Force = 4.3 kips (Clouterre)
-------------------------------------------------------------------------------------------------------
|       |         |          |           Failure Planes              |       Reinforcement           |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |        Lower        |      Upper      |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle   | Length   |  Angle   | Length |       | Stress | Resistance   |
|Point  | Safety  |  feet    | degrees  |  feet    | degrees  |  feet  | Level |  ksi   | Failure Mode |
-------------------------------------------------------------------------------------------------------
      1       1.53       5.00      39.01       5.15      78.37       4.96        1       10.9   Pullout

      2       1.51       6.00      34.02       5.79      76.13       5.01        1        9.4   Pullout

      3       1.49       7.00      33.47       5.87      66.63       5.29        1        9.0   Pullout

      4       1.49       8.00      30.05       6.47      63.72       5.42        1        7.8   Pullout

      5       1.49       9.00      30.96       6.30      53.47       6.05        1        8.0   Pullout

      6       1.49      10.00      28.37       6.82      50.54       6.29        1        6.9   Pullout

      7       1.50      11.00      26.15       7.35      47.84       6.56        1        5.9   Pullout

      8       1.53      12.00      22.05       6.47      43.38       8.26        1        5.5   Pullout

      9       1.55      13.00      20.50       6.94      41.10       8.63        1        4.7   Pullout

     10       1.56      14.00      19.14       7.41      39.01       9.01        1        3.8   Pullout

     11       1.58      15.00      17.95       7.88      37.09       9.40        1        3.0   Pullout

Search Level: 2.40 feet below the toe of the wall  Facing Design Force = 2.4 kips (Clouterre)
-------------------------------------------------------------------------------------------------------
|       |         |          |           Failure Planes              |       Reinforcement           |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |        Lower        |      Upper      |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle   | Length   |  Angle   | Length |       | Stress | Resistance   |
|Point  | Safety  |  feet    | degrees  |  feet    | degrees  |  feet  | Level |  ksi   | Failure Mode |
```

```
------------------------------------------------------------------------------------------------------
      1      4.03       5.00      0.00      3.50     80.43      9.03       1     10.7   Pullout

      2      1.91       6.00     56.01     10.73      0.00      0.00       1     12.5   Pullout

      3      1.79       7.00     48.85     10.64     90.00      0.89       1     10.9   Pullout

      4      1.65       8.00     42.83      6.55     54.28      5.48       1      9.5   Pullout

      5      1.60       9.00     33.40      6.47     56.01      6.44       1      7.5   Pullout

      6      1.58      10.00     30.68      6.98     53.17      6.67       1      6.4   Pullout

      7      1.57      11.00     28.34      7.50     50.51      6.92       1      5.3   Pullout

      8      1.57      12.00     26.31      8.03     48.05      7.18       1      4.3   Pullout

      9      1.57      13.00     24.53      8.57     45.76      7.45       1      3.3   Pullout

     10      1.58      14.00     22.97      9.12     43.64      7.74       1      2.4   Pullout

     11      1.60      15.00     25.39      8.30     35.45      9.21       1      3.6   Pullout

Search Level: 3.20 feet below the toe of the wall  Facing Design Force = 0.4 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |            Failure Planes             |        Reinforcement        |
|       |         |          |---------------------------------------|-----------------------------|
|       | Minimum | Distance |        Lower        |      Upper      |       |        |            |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling|
|Search |   of    | of Wall  |  Angle   | Length   |  Angle   | Length   |       | Stress | Resistance |
|Point  | Safety  |   feet   | degrees  |  feet    | degrees  |  feet    | Level |  ksi   | Failure Mode|
------------------------------------------------------------------------------------------------------
      1       N/A       5.00      0.00      1.00     67.59     10.49       1     12.5   Pullout

      2       N/A       6.00      0.00      0.60     60.90     11.10       1     11.7   Pullout

      3      3.43       7.00     15.49      7.26     90.00      7.76       1      5.3   Pullout

      4      2.54       8.00     19.99      8.51     90.00      6.79       1      3.3   Pullout

      5      2.09       9.00     23.32      9.80     90.00      5.82       1      1.3   Pullout

      6      1.86      10.00     30.20     11.57    -90.00      3.88       1      3.5   Pullout

      7      1.76      11.00     35.20     13.46    -90.00      1.94       1      5.5   Pullout

      8      1.73      12.00     36.04     14.84     90.00      0.97       1      5.8   Pullout

      9      1.67      13.00     30.83      7.57     41.84      8.72       1      4.4   Pullout

     10      1.66      14.00     24.79      9.25     46.10      8.08       1      1.6   Pullout
```

```
    11       1.66      15.00     23.32      9.80     44.13      8.36       1      0.7   Pullout

Search Level: 4.00 feet below the toe of the wall  Facing Design Force = 0.7 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement         |
|       |         |          |---------------------------------------|------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
     1        N/A       5.00      0.00      0.50     66.80     11.42       1     12.6   Pullout

     2        N/A       6.00      0.00      0.60     62.78     11.81       1     11.4   Pullout

     3        N/A       7.00      0.00      1.40     61.93     11.90       1      9.8   Pullout

     4        N/A       8.00      0.00      2.40     61.93     11.90       1      8.1   Pullout

     5       3.14       9.00     13.13      9.24     90.00      8.40       1      1.3   Pullout

     6       3.03      10.00     11.86     10.22    -90.00      8.40       1      0.0   Pullout

     7       2.55      11.00     15.98     11.44    -90.00      7.35       1      0.0   Pullout

     8       2.26      12.00     19.29     12.71     90.00      6.30       1      0.0   Pullout

     9       1.92      13.00     25.86     14.45     90.00      4.20       1      0.0   Pullout

    10       1.84      14.00     27.70     15.81     90.00      3.15       1      0.4   Pullout

    11       1.80      15.00     29.25     17.19    -90.00      2.10       1      1.2   Pullout


======================================================================================================
                                           END OF REPORT
======================================================================================================
```

```
======================================================================================================
                                               Snail

                                           Version: 2.2.2

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======================================================================================================
                                          File Information
======================================================================================================

File Name: US 395 RW3 Sta 760.snz
Run Date:  11/15/22
Run Time:  15:12:29

======================================================================================================
                                        Project Information
======================================================================================================

Description:    RW3
Location:       US 395
EA:
Project ID:
Wall No.:
Structure No.:
Station:
Engineer:       STC
                Designer

Comments:


======================================================================================================
                                              Geometry
======================================================================================================

Layout:

Reference Point:

At: Top of Wall
Distance From Origin:       40.00 feet
Elevation Above Origin:     30.00 feet

Wall Dimensions:

Wall Height:       11.00 feet
Facing Angle:      90.00 degrees
Facing Batter:     0.000 :12 H:V
```

```
Ground Surface:

Number of lines that define the ground surface above the wall: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Number of lines that define the ground surface in front of the toe: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Soil Layers:

Number of Layers: 2

Layers Below the Top Layer:

Coordinates of the Top of the Layer: feet

             Point 1         Point 1         Point 2         Point 2
Layer       Distance       Elevation        Distance       Elevation
--------------------------------------------------------------------
2              45.00           25.00           60.00           25.00

Ground Water:

Include Ground Water: No

======================================================================================================
                                             Soil Nails
======================================================================================================

Dimensions and Properties:

Maximum Vertical Spacing:               4.41 feet
Number of Soil Nail Rows:                  2
Soil Nail Design Parameters:               Varying

      Soil Nail       Inclination   Vertical   Horizontal      Nail Bar   Nail Bar Yield       Bond
         Length   From Horizontal    Spacing    Spacing H    Diameter Ø      Strength fy   Strength
No.        feet           degrees       feet         feet        inches              ksi   Factor F
---------------------------------------------------------------------------------------------------
1         15.00                15       3.00         5.00         1.000             75.0       1.00
2         10.00                15       5.00         5.00         1.000             75.0       1.00

Facing Resistance:
```

```
                                     Temporary   Permanent     Seismic
ASD Allowable Facing Resistance:          22.2        34.1        46.5 kips

======================================================================================================
                                          Soil Properties
======================================================================================================

                                        Unit Weight  Friction Angle        Cohesion
                                                  γ              φ'              c'
Layer  Description                              pcf         degrees             psf
-----------------------------------------------------------------------------------
1      Andesite 1                               120            27.0             500
2      Andesite 2                               125            27.0             500

======================================================================================================
                                               Loads
======================================================================================================

Applied Loads:

Seismic:

Horizontal Seismic Coefficient Kh0.25:

External Load:

Apply external load: No

Surcharges:

Apply surcharges:    Yes

           Distance from Top of Wall            Load            Load
               Begin             End           Begin             End
No.             feet            feet             psf             psf
--------------------------------------------------------------------
1               0.00           30.00             250             250

======================================================================================================
                                         Factors of Safety
======================================================================================================

                    Temporary   Permanent     Seismic
Pullout (Distal):        2.00        2.00        1.50
Pullout (Proximal):      2.00        2.00        1.50
Nail Bar Yield:          1.80        1.80        1.35

======================================================================================================
                                           Search Options
======================================================================================================
```

```
Search Limits:

Begin:      4.00 feet
End:       25.00 feet

Below Toe Searches (BTS):

Perform below Toe Search:      Yes
Number of BTS Points:            5
BTS Depth:                     4.00 feet
Interface Friction
Reduction Factor:              0.33

Advanced Search Options:

Use Advanced Search Options:     Yes
Inclination of Interslice Force: Use Average Failure Angle

======================================================================================================
                                               Results
======================================================================================================

Analysis:

Method:          ASD
Scenario:  Permanent

Factor of Safety:

Minimum:                  2.20
Found at Search Point:       2
Found at Grid Point:        46
Found at Search Level:       Toe of the wall

Load at Soil Nail Head:

Calculated Service Load at Soil Nail Head (Empirical), To:     8.0 kips
Allowable Facing Resistance, F_allowable (Entered):           34.1 kips
F_allowable ≥ To OK

Nominal Pullout Resistance:

                    Nominal Pullout Resistance
Layer  Description                         klf
----------------------------------------------
    1  Andesite 1                        2.262
    2  Andesite 2                        2.262

Results by Search Level:
```

```
** Indicates Minimum Factor of Safety

Search Level: At the toe of the wall  Facing Design Force = 8.0 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      2.30       4.00     61.39      7.52     84.81      4.42       1     16.2   Pullout
                                                                           2     12.3   Pullout

   ** 2      2.20       6.10     53.52      8.21     74.50      4.57       1     14.3   Pullout
                                                                           2     11.6   Pullout

      3      2.25       8.20     43.78      7.95     65.90      6.03       1     12.5   Pullout
                                                                           2     10.8   Pullout

      4      2.30      10.30     37.34      9.07     60.67      6.31       1     10.4   Pullout
                                                                           2     10.1   Pullout

      5      2.40      12.40     36.47      9.25     47.96      7.41       1     10.0   Pullout
                                                                           2     10.0   Pullout

      6      2.50      14.50     32.30     10.29     43.48      7.99       1      8.4   Pullout
                                                                           2      9.4   Pullout

      7      2.65      16.60     27.93      9.39     38.49     10.60       1      7.3   Pullout
                                                                           2      8.8   Pullout

      8      2.78      18.70     25.20     10.33     35.22     11.44       1      6.0   Pullout
                                                                           2      8.3   Pullout

      9      2.91      20.80     14.81      4.30     30.75     19.36       1      5.4   Pullout
                                                                           2      6.8   Pullout

     10      3.05      22.90     13.51      4.71     28.39     20.82       1      4.3   Pullout
                                                                           2      6.3   Pullout

     11      3.18      25.00     12.41      5.12     26.34     22.32       1      3.3   Pullout
                                                                           2      5.9   Pullout

Search Level: 0.80 feet below the toe of the wall  Facing Design Force = 7.5 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
```

```
|Point  | Safety  |   feet   | degrees |  feet  | degrees |  feet   | Level |  ksi   |Failure Mode |
----------------------------------------------------------------------------------------------------
      1      2.76       4.00     63.05      7.94     85.16      4.74      1     16.1  Pullout
                                                                          2     11.9  Pullout

      2      2.46       6.10     52.21      8.96     82.64      4.76      1     13.4  Pullout
                                                                          2     10.8  Pullout

      3      2.50       8.20     45.79      8.23     67.37      6.39      1     12.3  Pullout
                                                                          2     10.0  Pullout

      4      2.48      10.30     39.29      9.32     62.36      6.66      1     10.2  Pullout
                                                                          2      9.2  Pullout

      5      2.50      12.40     32.39      4.41     47.40     12.82      1     10.1  Pullout
                                                                          2      8.4  Pullout

      6      2.55      14.50     28.48      4.95     42.92     13.86      1      8.6  Pullout
                                                                          2      7.6  Pullout

      7      2.63      16.60     25.36      5.51     39.09     14.97      1      7.1  Pullout
                                                                          2      6.8  Pullout

      8      2.74      18.70     26.79     10.47     37.13     11.73      1      5.4  Pullout
                                                                          2      7.1  Pullout

      9      2.84      20.80     24.41     11.42     34.25     12.58      1      4.1  Pullout
                                                                          2      6.6  Pullout

     10      2.95      22.90     22.40     12.38     31.73     13.46      1      2.8  Pullout
                                                                          2      6.1  Pullout

     11      3.06      25.00     20.69     13.36     29.53     14.37      1      1.7  Pullout
                                                                          2      5.6  Pullout

Search Level: 1.60 feet below the toe of the wall  Facing Design Force = 5.2 kips (Clouterre)
----------------------------------------------------------------------------------------------------
|       |         |          |            Failure Planes            |        Reinforcement         |
|       |         |          |--------------------------------------|------------------------------|
|       | Minimum | Distance |      Lower       |       Upper       |       |        |             |
|       | Factor  | From Toe |--------------------------------------|       |        |Controlling  |
|Search |   of    | of Wall  |  Angle  | Length |  Angle  | Length  |       | Stress |Resistance   |
|Point  | Safety  |   feet   | degrees |  feet  | degrees |  feet   | Level |  ksi   |Failure Mode |
----------------------------------------------------------------------------------------------------
      1      3.11       4.00     53.47      4.70     82.25      8.90      1     16.4  Pullout
                                                                          2     10.2  Pullout

      2      2.76       6.10     54.01      9.34     83.10      5.08      1     13.3  Pullout
                                                                          2     10.2  Pullout

      3      2.63       8.20     45.69     10.56     80.76      5.11      1     10.6  Pullout
```

```
                                                                           2      9.1   Pullout

      4      2.63      10.30     46.36     10.45     58.49      5.91       1     10.8   Pullout
                                                                           2      9.2   Pullout

      5      2.63      12.40     40.26      9.75     51.79      8.02       1      9.2   Pullout
                                                                           2      8.2   Pullout

      6      2.64      14.50     35.91     10.74     47.37      8.56       1      7.6   Pullout
                                                                           2      7.5   Pullout

      7      2.68      16.60     32.32     11.79     43.50      9.15       1      6.0   Pullout
                                                                           2      6.8   Pullout

      8      2.74      18.70     29.31     12.87     40.11      9.78       1      4.5   Pullout
                                                                           2      6.1   Pullout

      9      2.81      20.80     21.99      6.73     34.70     17.71       1      3.9   Pullout
                                                                           2      4.5   Pullout

     10      2.89      22.90     20.14      7.32     32.16     18.94       1      2.6   Pullout
                                                                           2      3.8   Pullout

     11      2.97      25.00     18.57      7.91     29.94     20.20       1      1.5   Pullout
                                                                           2      3.1   Pullout

Search Level: 2.40 feet below the toe of the wall  Facing Design Force = 4.8 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      3.50       4.00     51.48      5.14     85.13      9.41       1     16.1   Pullout
                                                                           2      9.6   Pullout

      2      3.03       6.10     55.67      9.74     83.51      5.39       1     13.3   Pullout
                                                                           2      9.8   Pullout

      3      2.84       8.20     47.45     10.91     81.30      5.42       1     10.5   Pullout
                                                                           2      8.5   Pullout

      4      2.75      10.30     44.30     11.51     68.98      5.74       1      9.2   Pullout
                                                                           2      7.9   Pullout

      5      2.73      12.40     42.81     11.83     55.24      6.52       1      8.6   Pullout
                                                                           2      7.7   Pullout

      6      2.73      14.50     37.60     10.98     49.12      8.86       1      7.2   Pullout
```

```
                                                                            2      6.6   Pullout

      7      2.74      16.60      33.93      12.00      45.26       9.43       1      5.5   Pullout
                                                                            2      5.8   Pullout

      8      2.77      18.70      30.84      13.07      41.85      10.04       1      4.0   Pullout
                                                                            2      5.1   Pullout

      9      2.82      20.80      28.23      14.16      38.84      10.68       1      2.5   Pullout
                                                                            2      4.4   Pullout

     10      2.88      22.90      26.00      15.29      36.18      11.35       1      1.1   Pullout
                                                                            2      3.7   Pullout

     11      2.95      25.00      24.07      16.43      33.82      12.04       1      0.0   Pullout
                                                                            2      3.1   Pullout

Search Level: 3.20 feet below the toe of the wall  Facing Design Force = 2.9 kips (Clouterre)
-------------------------------------------------------------------------------------------------------
|       |         |          |            Failure Planes            |          Reinforcement         |
|       |         |          |--------------------------------------|--------------------------------|
|       | Minimum | Distance |        Lower       |      Upper      |        |         |             |
|       | Factor  | From Toe |--------------------------------------|        |         | Controlling |
|Search |   of    | of Wall  |  Angle   | Length |  Angle  | Length |        |  Stress | Resistance  |
|Point  | Safety  |   feet   | degrees  |  feet  | degrees |  feet  |  Level |   ksi   | Failure Mode|
-------------------------------------------------------------------------------------------------------
      1      4.16       4.00      72.16      10.44      79.37       4.33       1     16.7   Pullout
                                                                            2     11.7   Pullout

      2      3.74       6.10      66.75      15.45       0.00       0.00       1     15.2   Pullout
                                                                            2     10.8   Pullout

      3      3.33       8.20      60.00      16.40       0.00       0.00       1     13.3   Pullout
                                                                            2      9.8   Pullout

      4      3.09      10.30      54.05      17.54       0.00       0.00       1     11.5   Pullout
                                                                            2      8.8   Pullout

      5      2.86      12.40      44.47      12.16      56.78       6.79       1      8.4   Pullout
                                                                            2      7.0   Pullout

      6      2.83      14.50      39.22      11.23      50.76       9.17       1      6.9   Pullout
                                                                            2      5.9   Pullout

      7      2.81      16.60      35.48      12.23      46.92       9.72       1      5.2   Pullout
                                                                            2      5.0   Pullout

      8      2.82      18.70      32.33      13.28      43.51      10.31       1      3.5   Pullout
                                                                            2      4.1   Pullout

      9      2.85      20.80      29.64      14.36      40.48      10.94       1      2.0   Pullout
```

```
                                                                             2      3.4   Pullout

     10      2.89      22.90     27.33     15.47     37.78     11.59        1      0.5   Pullout
                                                                             2      2.6   Pullout

     11      2.95      25.00     23.07     10.87     33.53     17.99        1      0.0   Pullout
                                                                             2      1.1   Pullout

Search Level: 4.00 feet below the toe of the wall  Facing Design Force = 1.8 kips (Clouterre)
-----------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes             |          Reinforcement         |
|       |         |          |----------------------------------------|--------------------------------|
|       | Minimum | Distance |        Lower        |       Upper      |       |        |                |
|       | Factor  | From Toe |----------------------------------------|       |        | Controlling    |
|Search |   of    | of Wall  |  Angle  |  Length  |  Angle  |  Length |       | Stress | Resistance     |
|Point  | Safety  |   feet   | degrees |   feet   | degrees |   feet  | Level |  ksi   | Failure Mode   |
-----------------------------------------------------------------------------------------------------
      1      4.84       4.00     75.07     15.52      0.00      0.00        1     17.1   Pullout
                                                                             2     11.8   Pullout

      2       N/A       6.10      0.00      1.22     71.98     15.77        1     14.6   Pullout
                                                                             2      9.6   Pullout

      3     11.20       8.20      0.00      5.74     80.69     15.20        1     10.6   Pullout
                                                                             2      4.6   Pullout

      4      6.31      10.30      0.00      5.15     71.05     15.86        1      8.9   Pullout
                                                                             2      4.1   Pullout

      5      4.22      12.40      0.00      3.72     59.94     17.33        1      7.8   Pullout
                                                                             2      4.4   Pullout

      6      3.24      14.50      0.00      1.45     48.98     19.88        1      7.2   Pullout
                                                                             2      5.3   Pullout

      7      2.90      16.60     36.98     12.47     48.48     10.02        1      4.8   Pullout
                                                                             2      4.2   Pullout

      8      2.89      18.70     33.76     13.50     45.08     10.59        1      3.1   Pullout
                                                                             2      3.3   Pullout

      9      2.89      20.80     31.00     14.56     42.03     11.20        1      1.5   Pullout
                                                                             2      2.4   Pullout

     10      2.92      22.90     28.63     15.65     39.31     11.84        1      0.0   Pullout
                                                                             2      1.6   Pullout

     11      2.97      25.00     24.23     10.97     34.99     18.31        1      0.0   Pullout
                                                                             2      0.0   Pullout
```

```
=======================================================================================================
                                           END OF REPORT
=======================================================================================================
```

```
======================================================================================================
                                               Snail

                                           Version: 2.2.2

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======================================================================================================
                                          File Information
======================================================================================================

File Name: US 395 RW3 Sta 760 Seismic.snz
Run Date:  11/15/22
Run Time:  15:18:58

======================================================================================================
                                        Project Information
======================================================================================================

Description:    RW3
Location:       US 395
EA:
Project ID:
Wall No.:
Structure No.:
Station:
Engineer:       STC
                Designer

Comments:


======================================================================================================
                                              Geometry
======================================================================================================

Layout:

Reference Point:

At: Top of Wall
Distance From Origin:       40.00 feet
Elevation Above Origin:     30.00 feet

Wall Dimensions:

Wall Height:       11.00 feet
Facing Angle:      90.00 degrees
Facing Batter:     0.000 :12 H:V
```

```
Ground Surface:

Number of lines that define the ground surface above the wall: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Number of lines that define the ground surface in front of the toe: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Soil Layers:

Number of Layers: 2

Layers Below the Top Layer:

Coordinates of the Top of the Layer: feet

             Point 1         Point 1         Point 2         Point 2
Layer       Distance       Elevation        Distance       Elevation
--------------------------------------------------------------------
2              45.00           25.00           60.00           25.00

Ground Water:

Include Ground Water: No

======================================================================================================
                                             Soil Nails
======================================================================================================

Dimensions and Properties:

Maximum Vertical Spacing:               4.41 feet
Number of Soil Nail Rows:                  2
Soil Nail Design Parameters:               Varying

      Soil Nail       Inclination   Vertical   Horizontal      Nail Bar   Nail Bar Yield       Bond
         Length   From Horizontal    Spacing    Spacing H    Diameter Ø      Strength fy   Strength
No.        feet           degrees       feet         feet        inches              ksi   Factor F
---------------------------------------------------------------------------------------------------
1         15.00                15       3.00         5.00         1.000             75.0       1.00
2         10.00                15       5.00         5.00         1.000             75.0       1.00

Facing Resistance:
```

```
                                     Temporary   Permanent     Seismic
ASD Allowable Facing Resistance:          22.2        34.1        46.5 kips

======================================================================================================
                                          Soil Properties
======================================================================================================

                                        Unit Weight  Friction Angle        Cohesion
                                                  γ              φ'              c'
Layer  Description                              pcf         degrees             psf
-----------------------------------------------------------------------------------
1      Andesite 1                               120            27.0             500
2      Andesite 2                               125            27.0             500

======================================================================================================
                                               Loads
======================================================================================================

Applied Loads:

Seismic:

Horizontal Seismic Coefficient Kh0.25:

External Load:

Apply external load: No

Surcharges:

Apply surcharges:    Yes

           Distance from Top of Wall            Load            Load
               Begin             End           Begin             End
No.             feet            feet             psf             psf
--------------------------------------------------------------------
1               0.00           30.00             250             250

======================================================================================================
                                         Factors of Safety
======================================================================================================

                    Temporary   Permanent     Seismic
Pullout (Distal):        2.00        2.00        1.50
Pullout (Proximal):      2.00        2.00        1.50
Nail Bar Yield:          1.80        1.80        1.35

======================================================================================================
                                           Search Options
======================================================================================================
```

```
Search Limits:

Begin:      4.00 feet
End:       25.00 feet

Below Toe Searches (BTS):

Perform below Toe Search:      Yes
Number of BTS Points:            5
BTS Depth:                     4.00 feet
Interface Friction
Reduction Factor:              0.33

Advanced Search Options:

Use Advanced Search Options:     Yes
Inclination of Interslice Force: Use Average Failure Angle

======================================================================================================
                                               Results
======================================================================================================

Analysis:

Method:          ASD
Scenario:    Seismic

Factor of Safety:

Minimum:                  1.80
Found at Search Point:       4
Found at Grid Point:        42
Found at Search Level:       Toe of the wall

Load at Soil Nail Head:

Calculated Service Load at Soil Nail Head (Empirical), To:     7.2 kips
Allowable Facing Resistance, F_allowable (Entered):           46.5 kips
F_allowable ≥ To OK

Nominal Pullout Resistance:

                    Nominal Pullout Resistance
Layer  Description                         klf
----------------------------------------------
    1  Andesite 1                        2.262
    2  Andesite 2                        2.262

Results by Search Level:
```

```
** Indicates Minimum Factor of Safety

Search Level: At the toe of the wall  Facing Design Force = 7.2 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      1.96       4.00     38.16      3.56     82.24      8.88       1     21.9   Pullout
                                                                           2     13.6   Pullout

      2      1.88       6.10     45.05      7.77     83.67      5.53       1     17.7   Pullout
                                                                           2     14.5   Pullout

      3      1.81       8.20     36.70      9.20     81.52      5.56       1     14.0   Pullout
                                                                           2     13.3   Pullout

   ** 4      1.80      10.30     33.72      9.91     69.47      5.87       1     12.2   Pullout
                                                                           2     12.8   Pullout

      5      1.82      12.40     32.36     10.28     55.93      6.64       1     11.3   Pullout
                                                                           2     12.6   Pullout

      6      1.87      14.50     26.83      9.75     48.69      8.79       1      9.7   Pullout
                                                                           2     11.5   Pullout

      7      1.88      16.60     23.83     10.89     44.83      9.36       1      7.5   Pullout
                                                                           2     10.8   Pullout

      8      1.91      18.70     21.41     12.05     41.42      9.98       1      5.5   Pullout
                                                                           2     10.2   Pullout

      9      1.93      20.80     10.00      6.34     34.21     17.61       1      5.4   Pullout
                                                                           2      6.3   Pullout

     10      1.95      22.90      9.10      6.96     31.70     18.84       1      3.8   Pullout
                                                                           2      5.4   Pullout

     11      2.00      25.00      6.28     10.06     33.43     17.97       1      0.0   Pullout
                                                                           2      3.4   Pullout

Search Level: 0.80 feet below the toe of the wall  Facing Design Force = 5.8 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
```

```
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      2.41        4.00     33.25      4.30     87.57      9.45       1     21.2  Pullout
                                                                            2     12.0  Pullout

      2      2.13        6.10     52.21      8.96     82.64      4.76       1     17.8  Pullout
                                                                            2     14.4  Pullout

      3      2.02        8.20     38.64      9.45     82.09      5.96       1     13.9  Pullout
                                                                            2     12.1  Pullout

      4      1.95       10.30     35.60     10.13     70.75      6.25       1     12.0  Pullout
                                                                            2     11.5  Pullout

      5      1.91       12.40     30.74     11.54     67.20      6.40       1      8.9  Pullout
                                                                            2     10.4  Pullout

      6      1.90       14.50     30.17     11.74     53.60      7.33       1      8.4  Pullout
                                                                            2     10.3  Pullout

      7      1.92       16.60     25.36     11.02     46.84      9.71       1      6.9  Pullout
                                                                            2      9.0  Pullout

      8      1.91       18.70     22.82     12.17     43.43     10.30       1      4.7  Pullout
                                                                            2      8.2  Pullout

      9      1.92       20.80     20.72     13.34     40.40     10.92       1      2.7  Pullout
                                                                            2      7.5  Pullout

     10      1.94       22.90     18.96     14.53     37.70     11.58       1      0.7  Pullout
                                                                            2      6.8  Pullout

     11      1.96       25.00      8.94      7.59     31.25     20.47       1      1.1  Pullout
                                                                            2      2.9  Pullout

Search Level: 1.60 feet below the toe of the wall  Facing Design Force = 3.1 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower     |       Upper         |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      2.70        4.00     53.47      4.70     82.25      8.90       1     21.9  Pullout
                                                                            2     13.6  Pullout

      2      2.39        6.10     54.01      9.34     83.10      5.08       1     17.8  Pullout
                                                                            2     13.6  Pullout

      3      2.15        8.20     45.69     10.56     80.76      5.11       1     14.1  Pullout
```

```
                                                                           2      12.1   Pullout

      4      2.10      10.30     34.20     11.21     80.72      6.38       1      10.1   Pullout
                                                                           2       9.6   Pullout

      5      2.02      12.40     32.42     11.75     68.51      6.77       1       8.6   Pullout
                                                                           2       9.1   Pullout

      6      1.98      14.50     28.51     13.20     65.28      6.94       1       5.6   Pullout
                                                                           2       7.9   Pullout

      7      1.94      16.60     28.47     13.22     51.68      8.03       1       5.5   Pullout
                                                                           2       7.9   Pullout

      8      1.94      18.70     18.62      7.89     41.94     15.08       1       5.3   Pullout
                                                                           2       4.2   Pullout

      9      1.94      20.80     21.99     13.46     42.26     11.24       1       1.9   Pullout
                                                                           2       5.6   Pullout

     10      1.94      22.90     20.14     14.64     39.53     11.88       1       0.0   Pullout
                                                                           2       4.8   Pullout

     11      1.95      25.00     14.14     10.31     33.90     18.07       1       0.0   Pullout
                                                                           2       1.6   Pullout

Search Level: 2.40 feet below the toe of the wall  Facing Design Force = 0.3 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      2.96       4.00     51.48      5.14     85.13      9.41       1      21.5   Pullout
                                                                           2      12.8   Pullout

      2      2.63       6.10     55.67      9.74     83.51      5.39       1      17.7   Pullout
                                                                           2      13.0   Pullout

      3      2.34       8.20     47.45     10.91     81.30      5.42       1      14.0   Pullout
                                                                           2      11.3   Pullout

      4      2.23      10.30     35.86     11.44     81.26      6.78       1      10.0   Pullout
                                                                           2       8.4   Pullout

      5      2.13      12.40     34.04     11.97     69.69      7.14       1       8.4   Pullout
                                                                           2       7.8   Pullout

      6      2.06      14.50     30.01     13.40     66.60      7.30       1       5.3   Pullout
```

```
                                                                           2      6.5   Pullout

      7      2.01     16.60     29.97     13.41     53.38      8.35       1      5.0   Pullout
                                                                           2      6.5   Pullout

      8      1.97     18.70     27.11     14.71     50.06      8.74       1      2.5   Pullout
                                                                           2      5.4   Pullout

      9      1.96     20.80     24.71     16.03     47.04      9.16       1      0.4   Pullout
                                                                           2      4.5   Pullout

     10      1.96     22.90     16.31      9.54     37.96     17.43       1      0.6   Pullout
                                                                           2      0.5   Pullout

     11      1.97     25.00     15.00     10.35     35.55     18.44       1      0.0   Pullout
                                                                           2      0.0   Pullout

Search Level: 3.20 feet below the toe of the wall  Facing Design Force = 0.0 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      3.89      4.00     72.16     10.44     79.37      4.33       1     22.3   Pullout
                                                                           2     15.5   Pullout

      2      3.48      6.10     66.75     15.45      0.00      0.00       1     20.2   Pullout
                                                                           2     14.5   Pullout

      3      2.99      8.20     60.00     16.40      0.00      0.00       1     17.7   Pullout
                                                                           2     13.0   Pullout

      4      2.67     10.30     54.05     17.54      0.00      0.00       1     15.3   Pullout
                                                                           2     11.7   Pullout

      5      2.31     12.40     44.47     12.16     56.78      6.79       1     11.2   Pullout
                                                                           2      9.3   Pullout

      6      2.15     14.50     34.97     12.39     58.51      8.33       1      7.2   Pullout
                                                                           2      6.5   Pullout

      7      2.08     16.60     31.43     13.62     54.95      8.67       1      4.5   Pullout
                                                                           2      5.2   Pullout

      8      2.03     18.70     28.48     14.89     51.69      9.05       1      2.0   Pullout
                                                                           2      4.0   Pullout

      9      2.00     20.80     26.00     16.20     48.69      9.45       1      0.0   Pullout
```

```
                                                                 2       2.9   Pullout

    10      1.99      22.90      20.41      12.22      40.96      15.16      1       0.0   Pullout
                                                                 2       0.0   Pullout

    11      2.01      25.00      20.74      16.04      40.43      13.14      1       0.0   Pullout
                                                                 2       0.1   Pullout

Search Level: 4.00 feet below the toe of the wall  Facing Design Force = 0.2 kips (Clouterre)
-------------------------------------------------------------------------------------------
|       |        |         |             Failure Planes            |      Reinforcement       |
|       |        |         |---------------------------------------|--------------------------|
|       | Minimum| Distance|       Lower       |       Upper       |      |       |           |
|       | Factor | From Toe|---------------------------------------|      |       | Controlling |
|Search |   of   | of Wall |  Angle  | Length  |  Angle  | Length  |      | Stress| Resistance|
|Point  | Safety |  feet   | degrees |  feet   | degrees |  feet   | Level|  ksi  | Failure Mode|
-------------------------------------------------------------------------------------------
     1       N/A       4.00       0.00       0.40      76.51      15.43      1      22.7   Pullout
                                                                 2      15.3   Pullout

     2       N/A       6.10       0.00       0.61      69.90      15.97      1      19.7   Pullout
                                                                 2      13.5   Pullout

     3       N/A       8.20       0.00       0.82      63.80      16.72      1      17.0   Pullout
                                                                 2      11.7   Pullout

     4      5.42      10.30       0.00       8.24      82.18      15.14      1       9.8   Pullout
                                                                 2       1.6   Pullout

     5      3.53      12.40       0.00       6.20      67.54      16.23      1       8.8   Pullout
                                                                 2       2.9   Pullout

     6      2.62      14.50       0.00       2.90      52.28      18.96      1       8.7   Pullout
                                                                 2       5.5   Pullout

     7      2.22      16.60      24.31      18.22      90.00       7.50      1       0.0   Pullout
                                                                 2       0.0   Pullout

     8      2.10      18.70      29.31      21.45      90.00       4.50      1       0.0   Pullout
                                                                 2       2.4   Pullout

     9      2.05      20.80      25.68      13.85      47.25      12.26      1       0.1   Pullout
                                                                 2       0.6   Pullout

    10      2.04      22.90      25.07      17.70      47.51      10.17      1       0.0   Pullout
                                                                 2       0.3   Pullout

    11      2.05      25.00      24.23      10.97      34.99      18.31      1       0.0   Pullout
                                                                 2       0.0   Pullout
```

```
======================================================================================================
                                           END OF REPORT
======================================================================================================
```

```
======================================================================================================
                                               Snail

                                           Version: 2.2.2

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======================================================================================================
                                          File Information
======================================================================================================

File Name: US 395 RW3 Sta 760 Temp.snz
Run Date:  11/15/22
Run Time:  15:16:52

======================================================================================================
                                        Project Information
======================================================================================================

Description:    RW3
Location:       US 395
EA:
Project ID:
Wall No.:
Structure No.:
Station:
Engineer:       STC
                Designer

Comments:


======================================================================================================
                                              Geometry
======================================================================================================

Layout:

Reference Point:

At: Top of Wall
Distance From Origin:       40.00 feet
Elevation Above Origin:     30.00 feet

Wall Dimensions:

Wall Height:       11.00 feet
Facing Angle:      90.00 degrees
Facing Batter:     0.000 :12 H:V
```

```
Ground Surface:

Number of lines that define the ground surface above the wall: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Number of lines that define the ground surface in front of the toe: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Soil Layers:

Number of Layers: 2

Layers Below the Top Layer:

Coordinates of the Top of the Layer: feet

             Point 1         Point 1         Point 2         Point 2
Layer       Distance       Elevation        Distance       Elevation
--------------------------------------------------------------------
2              45.00           25.00           60.00           25.00

Ground Water:

Include Ground Water: No

======================================================================================================
                                             Soil Nails
======================================================================================================

Dimensions and Properties:

Maximum Vertical Spacing:               4.41 feet
Number of Soil Nail Rows:                  1
Soil Nail Design Parameters:               Varying

      Soil Nail       Inclination   Vertical   Horizontal      Nail Bar   Nail Bar Yield       Bond
         Length   From Horizontal    Spacing    Spacing H    Diameter Ø      Strength fy   Strength
No.        feet           degrees       feet         feet        inches              ksi   Factor F
---------------------------------------------------------------------------------------------------
1         15.00                15       3.00         5.00         1.000             75.0       1.00

Facing Resistance:
```

```
                                     Temporary   Permanent     Seismic
ASD Allowable Facing Resistance:          22.2        34.1        46.5 kips

======================================================================================================
                                          Soil Properties
======================================================================================================

                                        Unit Weight  Friction Angle        Cohesion
                                                  γ              φ'              c'
Layer  Description                              pcf         degrees             psf
-----------------------------------------------------------------------------------
1      Andesite 1                               120            27.0             500
2      Andesite 2                               125            27.0             500

======================================================================================================
                                               Loads
======================================================================================================

Applied Loads:

Seismic:

Horizontal Seismic Coefficient Kh0.25:

External Load:

Apply external load: No

Surcharges:

Apply surcharges:    Yes

           Distance from Top of Wall           Load            Load
               Begin            End           Begin             End
No.             feet           feet             psf             psf
--------------------------------------------------------------------
1               0.00          30.00             250             250

======================================================================================================
                                         Factors of Safety
======================================================================================================

                    Temporary   Permanent     Seismic
Pullout (Distal):        2.00        2.00        1.50
Pullout (Proximal):      2.00        2.00        1.50
Nail Bar Yield:          1.80        1.80        1.35

======================================================================================================
                                           Search Options
======================================================================================================
```

```
Search Limits:

Begin:      4.00 feet
End:       25.00 feet

Below Toe Searches (BTS):

Perform below Toe Search:       Yes
Number of BTS Points:             5
BTS Depth:                     4.00 feet
Interface Friction
Reduction Factor:              0.33

Advanced Search Options:

Use Advanced Search Options:     Yes
Inclination of Interslice Force: Use Average Failure Angle

======================================================================================================
                                               Results
======================================================================================================

Analysis:

Method:          ASD
Scenario:  Temporary

Factor of Safety:

Minimum:                  1.74
Found at Search Point:       2
Found at Grid Point:        46
Found at Search Level:       Toe of the wall

Load at Soil Nail Head:

Calculated Service Load at Soil Nail Head (Empirical), To:     8.0 kips
Allowable Facing Resistance, F_allowable (Entered):           22.2 kips
F_allowable ≥ To OK

Nominal Pullout Resistance:

                    Nominal Pullout Resistance
Layer  Description                         klf
----------------------------------------------
    1  Andesite 1                        2.262
    2  Andesite 2                        2.262

Results by Search Level:

** Indicates Minimum Factor of Safety
```

```
Search Level: At the toe of the wall  Facing Design Force = 8.0 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |         Reinforcement         |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      1.83       4.00     56.79      6.57     85.84      5.51       1     16.1   Pullout

   ** 2      1.74       6.10     53.52      8.21     74.50      4.57       1     14.3   Pullout

      3      1.78       8.20     43.78      7.95     65.90      6.03       1     12.5   Pullout

      4      1.86      10.30     37.34      9.07     60.67      6.31       1     10.4   Pullout

      5      1.97      12.40     36.47      9.25     47.96      7.41       1     10.0   Pullout

      6      2.08      14.50     32.30     10.29     43.48      7.99       1      8.4   Pullout

      7      2.24      16.60     27.93      9.39     38.49     10.60       1      7.3   Pullout

      8      2.38      18.70     25.20     10.33     35.22     11.44       1      6.0   Pullout

      9      2.53      20.80     22.93     11.29     32.40     12.32       1      4.8   Pullout

     10      2.68      22.90     21.02     12.27     29.96     13.22       1      3.6   Pullout

     11      2.83      25.00     19.39     13.25     27.83     14.14       1      2.5   Pullout
```

```
Search Level: 0.80 feet below the toe of the wall  Facing Design Force = 7.5 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |         Reinforcement         |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      2.33       4.00     58.61      6.91     86.12      5.91       1     16.0   Pullout

      2      2.06       6.10     52.21      8.96     82.64      4.76       1     13.4   Pullout

      3      2.10       8.20     45.79      8.23     67.37      6.39       1     12.3   Pullout

      4      2.11      10.30     39.29      9.32     62.36      6.66       1     10.2   Pullout

      5      2.16      12.40     38.42      9.50     49.95      7.71       1      9.6   Pullout
```

```
      6      2.23      14.50     34.14     10.51      45.49      8.27       1      8.0   Pullout

      7      2.33      16.60     30.64     11.58      41.62      8.88       1      6.5   Pullout

      8      2.45      18.70     26.79     10.47      37.13     11.73       1      5.4   Pullout

      9      2.57      20.80     24.41     11.42      34.25     12.58       1      4.1   Pullout

     10      2.69      22.90     22.40     12.38      31.73     13.46       1      2.8   Pullout

     11      2.82      25.00     20.69     13.36      29.53     14.37       1      1.7   Pullout

Search Level: 1.60 feet below the toe of the wall  Facing Design Force = 5.9 kips (Clouterre)
-------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes             |        Reinforcement          |
|       |         |          |----------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower        |      Upper        |       |        |              |
|       | Factor  | From Toe |----------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  | Angle   | Length   |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   |degrees  |  feet    | Level |  ksi   | Failure Mode |
-------------------------------------------------------------------------------------------------------
      1      2.78       4.00     64.54      8.37      85.46      5.06       1     16.1   Pullout

      2      2.40       6.10     54.01      9.34      83.10      5.08       1     13.3   Pullout

      3      2.31       8.20     45.69     10.56      80.76      5.11       1     10.6   Pullout

      4      2.33      10.30     46.36     10.45      58.49      5.91       1     10.8   Pullout

      5      2.34      12.40     40.26      9.75      51.79      8.02       1      9.2   Pullout

      6      2.38      14.50     35.91     10.74      47.37      8.56       1      7.6   Pullout

      7      2.44      16.60     32.32     11.79      43.50      9.15       1      6.0   Pullout

      8      2.52      18.70     29.31     12.87      40.11      9.78       1      4.5   Pullout

      9      2.63      20.80     26.79     13.98      37.13     10.44       1      3.1   Pullout

     10      2.72      22.90     24.63     15.12      34.52     11.12       1      1.9   Pullout

     11      2.82      25.00     22.78     16.27      32.21     11.82       1      0.8   Pullout

Search Level: 2.40 feet below the toe of the wall  Facing Design Force = 4.8 kips (Clouterre)
-------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes             |        Reinforcement          |
|       |         |          |----------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower        |      Upper        |       |        |              |
|       | Factor  | From Toe |----------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  | Angle   | Length   |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   |degrees  |  feet    | Level |  ksi   | Failure Mode |
```

```
------------------------------------------------------------------------------------------------------
      1      3.18       4.00     65.88      8.81     85.73      5.37       1     16.1   Pullout

      2      2.80       6.10     58.74      9.41     77.18      5.50       1     14.0   Pullout

      3      2.56       8.20     47.45     10.91     81.30      5.42       1     10.5   Pullout

      4      2.50      10.30     44.30     11.51     68.98      5.74       1      9.2   Pullout

      5      2.50      12.40     42.81     11.83     55.24      6.52       1      8.6   Pullout

      6      2.52      14.50     37.60     10.98     49.12      8.86       1      7.2   Pullout

      7      2.56      16.60     33.93     12.00     45.26      9.43       1      5.5   Pullout

      8      2.61      18.70     30.84     13.07     41.85     10.04       1      4.0   Pullout

      9      2.68      20.80     28.23     14.16     38.84     10.68       1      2.5   Pullout

     10      2.76      22.90     26.00     15.29     36.18     11.35       1      1.1   Pullout

     11      2.85      25.00     24.07     16.43     33.82     12.04       1      0.0   Pullout

Search Level: 3.20 feet below the toe of the wall  Facing Design Force = 3.8 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes             |       Reinforcement           |
|       |         |          |----------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower        |       Upper       |       |        |              |
|       | Factor  | From Toe |----------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  |  Length  |  Angle  |  Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |   feet   | degrees |   feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1     25.05       4.00      0.00      3.60     88.39     14.21       1     15.8   Pullout

      2      9.24       6.10      0.00      3.66     80.25     14.41       1     13.6   Pullout

      3      5.41       8.20      0.00      3.28     70.89     15.03       1     11.8   Pullout

      4      2.85      10.30     54.05     17.54      0.00      0.00       1     11.5   Pullout

      5      2.67      12.40     44.47     12.16     56.78      6.79       1      8.4   Pullout

      6      2.67      14.50     39.22     11.23     50.76      9.17       1      6.9   Pullout

      7      2.67      16.60     35.48     12.23     46.92      9.72       1      5.2   Pullout

      8      2.71      18.70     32.33     13.28     43.51     10.31       1      3.5   Pullout

      9      2.75      20.80     29.64     14.36     40.48     10.94       1      2.0   Pullout

     10      2.81      22.90     27.33     15.47     37.78     11.59       1      0.5   Pullout
```

```
     11      2.88      25.00     29.60     28.75      0.00      0.00       1      1.6   Pullout

Search Level: 4.00 feet below the toe of the wall  Facing Design Force = 1.8 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1       N/A       4.00      0.00      0.40     76.51     15.43       1     17.0   Pullout

      2       N/A       6.10      0.00      0.61     69.90     15.97       1     14.8   Pullout

      3     16.16       8.20      0.00      6.56     83.76     15.09       1     10.2   Pullout

      4      6.20      10.30      0.00      5.15     71.05     15.86       1      8.9   Pullout

      5      4.74      12.40      0.00      4.96     63.62     16.74       1      7.2   Pullout

      6      3.10      14.50      0.00      1.45     48.98     19.88       1      7.2   Pullout

      7      2.81      16.60     42.10     22.37      0.00      0.00       1      6.3   Pullout

      8      2.80      18.70     33.76     13.50     45.08     10.59       1      3.1   Pullout

      9      2.83      20.80     31.72     17.12     43.88      8.66       1      1.4   Pullout

     10      2.87      22.90     29.31     18.38     41.13      9.12       1      0.0   Pullout

     11      2.92      25.00     30.96     29.15      0.00      0.00       1      1.0   Pullout


======================================================================================================
                                           END OF REPORT
======================================================================================================
```

```
======================================================================================================
                                               Snail

                                           Version: 2.2.2

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======================================================================================================
                                          File Information
======================================================================================================

File Name: US 395 RW3 Sta 1250 Max Height.snz
Run Date:  11/14/22
Run Time:  11:34:33

======================================================================================================
                                        Project Information
======================================================================================================

Description:    RW3
Location:       US 395
EA:
Project ID:
Wall No.:
Structure No.:
Station:
Engineer:       STC
                Designer

Comments:


======================================================================================================
                                              Geometry
======================================================================================================

Layout:

Reference Point:

At: Top of Wall
Distance From Origin:       40.00 feet
Elevation Above Origin:     30.00 feet

Wall Dimensions:

Wall Height:       14.82 feet
Facing Angle:      90.00 degrees
Facing Batter:     0.000 :12 H:V
```

```
Ground Surface:

Number of lines that define the ground surface above the wall: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Number of lines that define the ground surface in front of the toe: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Soil Layers:

Number of Layers: 3

Layers Below the Top Layer:

Coordinates of the Top of the Layer: feet

             Point 1         Point 1         Point 2         Point 2
Layer       Distance       Elevation        Distance       Elevation
--------------------------------------------------------------------
2              45.00           25.00           60.00           25.00
3              45.00           20.00           60.00           20.00

Ground Water:

Include Ground Water: No

======================================================================================================
                                             Soil Nails
======================================================================================================

Dimensions and Properties:

Maximum Vertical Spacing:               5.00 feet
Number of Soil Nail Rows:                  3
Soil Nail Design Parameters:               Varying

      Soil Nail       Inclination   Vertical   Horizontal      Nail Bar   Nail Bar Yield       Bond
         Length   From Horizontal    Spacing    Spacing H    Diameter Ø      Strength fy   Strength
No.        feet           degrees       feet         feet        inches              ksi   Factor F
---------------------------------------------------------------------------------------------------
1         15.00                15       3.00         5.00         1.000             75.0       1.00
2         15.00                15       4.41         5.00         1.000             75.0       1.00
3         10.00                15       4.41         5.00         1.000             75.0       1.00
```

```
Facing Resistance:

                                     Temporary   Permanent     Seismic
ASD Allowable Facing Resistance:          22.2        34.1        46.5 kips

======================================================================================================
                                          Soil Properties
======================================================================================================

                                        Unit Weight  Friction Angle        Cohesion
                                                  γ              φ'              c'
Layer  Description                              pcf         degrees             psf
-----------------------------------------------------------------------------------
1      Fill                                     115            33.0              50
2      Andesite 1                               120            27.0             500
3      Andesite 2                               125            27.0             500

======================================================================================================
                                               Loads
======================================================================================================

Applied Loads:

Seismic:

Horizontal Seismic Coefficient Kh0.25:

External Load:

Apply external load: No

Surcharges:

Apply surcharges:    Yes

           Distance from Top of Wall            Load            Load
               Begin             End           Begin             End
No.             feet            feet             psf             psf
--------------------------------------------------------------------
1               0.00           30.00             250             250

======================================================================================================
                                         Factors of Safety
======================================================================================================

                    Temporary   Permanent     Seismic
Pullout (Distal):        2.00        2.00        1.50
Pullout (Proximal):      2.00        2.00        1.50
Nail Bar Yield:          1.80        1.80        1.35
```

```
======================================================================================================
                                           Search Options
======================================================================================================

Search Limits:

Begin:      4.00 feet
End:       25.00 feet

Below Toe Searches (BTS):

Perform below Toe Search:       Yes
Number of BTS Points:             5
BTS Depth:                     4.00 feet
Interface Friction
Reduction Factor:              0.33

Advanced Search Options:

Use Advanced Search Options:     Yes
Inclination of Interslice Force: Use Average Failure Angle

======================================================================================================
                                               Results
======================================================================================================

Analysis:

Method:          ASD
Scenario:  Permanent

Factor of Safety:

Minimum:                  1.64
Found at Search Point:       4
Found at Grid Point:        34
Found at Search Level:       Toe of the wall

Load at Soil Nail Head:

Calculated Service Load at Soil Nail Head (Empirical), To:     7.8 kips
Allowable Facing Resistance, F_allowable (Entered):           34.1 kips
F_allowable ≥ To OK

Nominal Pullout Resistance:

                    Nominal Pullout Resistance
Layer  Description                         klf
----------------------------------------------
    1  Fill                              2.262
    2  Andesite 1                        2.262
```

```
    3  Andesite 2                        2.262

Results by Search Level:

** Indicates Minimum Factor of Safety

Search Level: At the toe of the wall  Facing Design Force = 7.8 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes             |         Reinforcement          |
|       |         |          |----------------------------------------|--------------------------------|
|       | Minimum | Distance |         Lower       |       Upper      |        |        |                |
|       | Factor  | From Toe |----------------------------------------|        |        | Controlling    |
|Search |   of    | of Wall  |  Angle   | Length   |  Angle  | Length  |        | Stress | Resistance     |
|Point  | Safety  |   feet   | degrees  |  feet    | degrees |  feet   | Level  |  ksi   | Failure Mode   |
------------------------------------------------------------------------------------------------------
      1      1.79       4.00     58.73      6.94     87.43      8.90       1      15.9   Pullout
                                                                           2      16.2   Pullout
                                                                           3      12.1   Pullout

      2      1.68       6.10     50.54      7.68     82.19      8.98       1      13.4   Pullout
                                                                           2      14.3   Pullout
                                                                           3      11.4   Pullout

      3      1.64       8.20     50.31      7.70     69.75      9.48       1      12.0   Pullout
                                                                           2      14.2   Pullout
                                                                           3      11.4   Pullout

   ** 4      1.64      10.30     49.02      7.85     59.92     10.28       1      10.5   Pullout
                                                                           2      13.8   Pullout
                                                                           3      11.2   Pullout

      5      1.64      12.40     41.87      6.66     54.35     12.77       1       8.8   Pullout
                                                                           2      12.7   Pullout
                                                                           3      10.6   Pullout

      6      1.68      14.50     37.47      7.31     50.02     13.54       1       7.0   Pullout
                                                                           2      11.5   Pullout
                                                                           3      10.1   Pullout

      7      1.72      16.60     33.81      7.99     46.17     14.38       1       5.3   Pullout
                                                                           2      10.4   Pullout
                                                                           3       9.6   Pullout

      8      1.77      18.70     38.40     23.86      0.00      0.00       1       5.0   Pullout
                                                                           2      11.2   Pullout
                                                                           3      10.2   Pullout

      9      1.83      20.80     35.47     25.54      0.00      0.00       1       3.6   Pullout
                                                                           2      10.3   Pullout
                                                                           3       9.8   Pullout
```

```
     10      1.90      22.90     32.91     27.28      0.00      0.00       1      2.3   Pullout
                                                                           2      9.5   Pullout
                                                                           3      9.5   Pullout

     11      1.97      25.00     30.66     29.06      0.00      0.00       1      1.1   Pullout
                                                                           2      8.8   Pullout
                                                                           3      9.2   Pullout

Search Level: 0.80 feet below the toe of the wall  Facing Design Force = 6.0 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      2.15       4.00     60.05      7.21     87.56      9.38       1     15.9   Pullout
                                                                           2     16.2   Pullout
                                                                           3     11.6   Pullout

      2      1.96       6.10     52.01      7.93     82.58      9.45       1     13.4   Pullout
                                                                           2     14.2   Pullout
                                                                           3     10.7   Pullout

      3      1.87       8.20     47.43      8.48     75.29      9.69       1     11.3   Pullout
                                                                           2     12.9   Pullout
                                                                           3     10.2   Pullout

      4      1.80      10.30     45.31      8.79     66.27     10.24       1      9.6   Pullout
                                                                           2     12.2   Pullout
                                                                           3     10.0   Pullout

      5      1.78      12.40     45.22      8.80     56.51     11.24       1      8.4   Pullout
                                                                           2     12.1   Pullout
                                                                           3     10.0   Pullout

      6      1.78      14.50     40.76      9.57     52.28     11.85       1      6.6   Pullout
                                                                           2     10.8   Pullout
                                                                           3      9.4   Pullout

      7      1.82      16.60     35.21      8.13     47.67     14.79       1      5.0   Pullout
                                                                           2      9.8   Pullout
                                                                           3      8.6   Pullout

      8      1.85      18.70     39.87     24.37      0.00      0.00       1      4.5   Pullout
                                                                           2     10.5   Pullout
                                                                           3      9.3   Pullout

      9      1.89      20.80     36.91     26.01      0.00      0.00       1      3.1   Pullout
                                                                           2      9.6   Pullout
```

```
                                                                           3      8.8   Pullout

     10      1.93      22.90     34.30     27.72      0.00      0.00       1      1.8   Pullout
                                                                           2      8.7   Pullout
                                                                           3      8.4   Pullout

     11      1.99      25.00     32.00     29.48      0.00      0.00       1      0.5   Pullout
                                                                           2      7.9   Pullout
                                                                           3      8.1   Pullout

Search Level: 1.60 feet below the toe of the wall  Facing Design Force = 5.0 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |   feet  | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      2.48       4.00     61.27      7.49     87.68      9.86       1     15.9   Pullout
                                                                           2     16.1   Pullout
                                                                           3     11.1   Pullout

      2      2.23       6.10     53.39      8.18     82.94      9.93       1     13.3   Pullout
                                                                           2     14.1   Pullout
                                                                           3     10.2   Pullout

      3      2.09       8.20     48.85      8.72     75.98     10.15       1     11.2   Pullout
                                                                           2     12.7   Pullout
                                                                           3      9.5   Pullout

      4      1.98      10.30     46.74      9.02     67.31     10.68       1      9.5   Pullout
                                                                           2     11.9   Pullout
                                                                           3      9.2   Pullout

      5      1.93      12.40     46.65      9.03     57.82     11.64       1      8.2   Pullout
                                                                           2     11.7   Pullout
                                                                           3      9.2   Pullout

      6      1.90      14.50     42.17      9.78     53.65     12.23       1      6.3   Pullout
                                                                           2     10.3   Pullout
                                                                           3      8.6   Pullout

      7      1.90      16.60     38.36     10.58     49.89     12.88       1      4.5   Pullout
                                                                           2      9.0   Pullout
                                                                           3      7.9   Pullout

      8      1.93      18.70     33.37      8.96     45.69     16.06       1      3.0   Pullout
                                                                           2      8.0   Pullout
                                                                           3      7.0   Pullout
```

```
      9      1.95      20.80     38.29     26.50      0.00      0.00       1      2.7   Pullout
                                                                           2      8.9   Pullout
                                                                           3      7.9   Pullout

     10      1.98      22.90     35.64     28.18      0.00      0.00       1      1.3   Pullout
                                                                           2      8.0   Pullout
                                                                           3      7.4   Pullout

     11      2.02      25.00     33.30     29.91      0.00      0.00       1      0.0   Pullout
                                                                           2      7.1   Pullout
                                                                           3      7.0   Pullout

Search Level: 2.40 feet below the toe of the wall  Facing Design Force = 4.0 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes             |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      2.71       4.00     67.31      9.33     87.34      8.62       1     15.9   Pullout
                                                                           2     16.2   Pullout
                                                                           3     11.4   Pullout

      2      2.47       6.10     51.44      8.81     86.62     10.35       1     12.9   Pullout
                                                                           2     13.3   Pullout
                                                                           3      9.1   Pullout

      3      2.30       8.20     50.20      8.97     76.61     10.62       1     11.1   Pullout
                                                                           2     12.6   Pullout
                                                                           3      8.9   Pullout

      4      2.16      10.30     48.10      9.25     68.26     11.12       1      9.3   Pullout
                                                                           2     11.7   Pullout
                                                                           3      8.6   Pullout

      5      2.08      12.40     48.01      9.27     59.03     12.05       1      8.0   Pullout
                                                                           2     11.4   Pullout
                                                                           3      8.6   Pullout

      6      2.03      14.50     43.53     10.00     54.94     12.62       1      6.0   Pullout
                                                                           2      9.9   Pullout
                                                                           3      7.8   Pullout

      7      2.01      16.60     39.69     10.79     51.22     13.25       1      4.2   Pullout
                                                                           2      8.5   Pullout
                                                                           3      7.1   Pullout

      8      2.00      18.70     36.38     11.61     47.86     13.93       1      2.4   Pullout
                                                                           2      7.2   Pullout
```

```
                                                                           3      6.4   Pullout

      9      2.01      20.80     33.52     12.47     44.81     14.66       1      0.7   Pullout
                                                                           2      5.9   Pullout
                                                                           3      5.7   Pullout

     10      2.04      22.90     36.94     28.65      0.00      0.00       1      0.8   Pullout
                                                                           2      7.3   Pullout
                                                                           3      6.5   Pullout

     11      2.07      25.00     34.56     30.36      0.00      0.00       1      0.0   Pullout
                                                                           2      6.3   Pullout
                                                                           3      6.0   Pullout

Search Level: 3.20 feet below the toe of the wall  Facing Design Force = 3.0 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      3.11       4.00     70.45      9.56     84.93      9.05       1     16.2   Pullout
                                                                           2     16.7   Pullout
                                                                           3     11.4   Pullout

      2      2.73       6.10     64.64      9.97     78.52      9.19       1     13.8   Pullout
                                                                           2     15.1   Pullout
                                                                           3     10.5   Pullout

      3      2.53       8.20     61.36     10.27     70.00      9.59       1     11.9   Pullout
                                                                           2     14.1   Pullout
                                                                           3     10.0   Pullout

      4      2.34      10.30     56.85     15.07     69.14      5.79       1      9.2   Pullout
                                                                           2     12.8   Pullout
                                                                           3      9.3   Pullout

      5      2.23      12.40     49.30      9.51     60.17     12.46       1      7.8   Pullout
                                                                           2     11.1   Pullout
                                                                           3      7.9   Pullout

      6      2.15      14.50     44.83     10.22     56.16     13.02       1      5.8   Pullout
                                                                           2      9.6   Pullout
                                                                           3      7.1   Pullout

      7      2.11      16.60     40.97     10.99     52.49     13.63       1      3.9   Pullout
                                                                           2      8.1   Pullout
                                                                           3      6.3   Pullout
```

```
       8      2.09      18.70      37.63      11.81      49.15      14.29          1       2.1   Pullout
                                                                                   2       6.7   Pullout
                                                                                   3       5.5   Pullout

       9      2.09      20.80      34.73      12.65      46.11      15.00          1       0.4   Pullout
                                                                                   2       5.4   Pullout
                                                                                   3       4.8   Pullout

      10      2.10      22.90      38.20      29.14       0.00       0.00          1       0.4   Pullout
                                                                                   2       6.6   Pullout
                                                                                   3       5.6   Pullout

      11      2.13      25.00      35.78      30.82       0.00       0.00          1       0.0   Pullout
                                                                                   2       5.6   Pullout
                                                                                   3       5.1   Pullout

Search Level: 4.00 feet below the toe of the wall  Facing Design Force = 2.7 kips (Clouterre)
-------------------------------------------------------------------------------------------------------
|        |         |          |             Failure Planes              |          Reinforcement          |
|        |         |          |-----------------------------------------|---------------------------------|
|        | Minimum | Distance |        Lower        |       Upper       |        |        |               |
|        | Factor  | From Toe |-----------------------------------------|        |        |  Controlling  |
|Search  |   of    | of Wall  |  Angle   | Length   |  Angle  | Length  |        | Stress |  Resistance   |
|Point   | Safety  |   feet   | degrees  |  feet    | degrees |  feet   | Level  |  ksi   |  Failure Mode |
-------------------------------------------------------------------------------------------------------
       1      3.89       4.00      76.71      17.40      90.00       1.88          1      16.4   Pullout
                                                                                   2      17.8   Pullout
                                                                                   3      12.1   Pullout

       2     10.21       6.10       0.00       4.27      84.45      18.91          1      13.2   Pullout
                                                                                   2      13.8   Pullout
                                                                                   3       7.2   Pullout

       3      7.49       8.20       0.00       4.92      80.11      19.10          1      10.7   Pullout
                                                                                   2      11.8   Pullout
                                                                                   3       5.7   Pullout

       4      5.49      10.30       0.00       5.15      74.70      19.51          1       8.4   Pullout
                                                                                   2      10.1   Pullout
                                                                                   3       4.6   Pullout

       5      3.54      12.40      24.48      13.62     -90.00      13.17          1       3.1   Pullout
                                                                                   2       3.1   Pullout
                                                                                   3       0.0   Pullout

       6      2.30      14.50      49.44      22.30      90.00       1.88          1       5.2   Pullout
                                                                                   2       9.8   Pullout
                                                                                   3       7.1   Pullout

       7      2.24      16.60      48.59      25.09       0.00       0.00          1       4.8   Pullout
                                                                                   2       9.5   Pullout
```

```
                                                                           3      7.0   Pullout

      8      2.18      18.70     38.84     12.00     50.38     14.66       1      1.8   Pullout
                                                                           2      6.3   Pullout
                                                                           3      4.7   Pullout

      9      2.17      20.80     35.90     12.84     47.36     15.35       1      0.0   Pullout
                                                                           2      4.9   Pullout
                                                                           3      3.9   Pullout

     10      2.17      22.90     39.42     29.64      0.00      0.00       1      0.0   Pullout
                                                                           2      6.0   Pullout
                                                                           3      4.8   Pullout

     11      2.19      25.00     36.97     31.29      0.00      0.00       1      0.0   Pullout
                                                                           2      4.9   Pullout
                                                                           3      4.2   Pullout


======================================================================================================
                                           END OF REPORT
======================================================================================================
```

```
========================================================================================================
                                                Snail

                                            Version: 2.2.2

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========================================================================================================
                                           File Information
========================================================================================================

File Name: US 395 RW3 Sta 1250 Max Height Seismic.snz
Run Date:  11/14/22
Run Time:  11:47:50

========================================================================================================
                                         Project Information
========================================================================================================

Description:    RW3
Location:       US 395
EA:
Project ID:
Wall No.:
Structure No.:
Station:
Engineer:       STC
                Designer

Comments:


========================================================================================================
                                               Geometry
========================================================================================================

Layout:

Reference Point:

At: Top of Wall
Distance From Origin:       40.00 feet
Elevation Above Origin:     30.00 feet

Wall Dimensions:

Wall Height:       14.82 feet
Facing Angle:      90.00 degrees
Facing Batter:     0.000 :12 H:V
```

```
Ground Surface:

Number of lines that define the ground surface above the wall: 1

         Angle  Distance
No.    degrees      feet
------------------------
1           0

Number of lines that define the ground surface in front of the toe: 1

         Angle  Distance
No.    degrees      feet
------------------------
1           0

Soil Layers:

Number of Layers: 3

Layers Below the Top Layer:

Coordinates of the Top of the Layer: feet

             Point 1         Point 1         Point 2         Point 2
Layer       Distance       Elevation        Distance       Elevation
--------------------------------------------------------------------
2              45.00           25.00           60.00           25.00
3              45.00           20.00           60.00           20.00

Ground Water:

Include Ground Water: No

======================================================================================================
                                             Soil Nails
======================================================================================================

Dimensions and Properties:

Maximum Vertical Spacing:               5.00 feet
Number of Soil Nail Rows:                  3
Soil Nail Design Parameters:               Varying

      Soil Nail       Inclination   Vertical   Horizontal      Nail Bar   Nail Bar Yield        Bond
         Length   From Horizontal    Spacing    Spacing H    Diameter Ø      Strength fy    Strength
No.        feet           degrees       feet         feet        inches              ksi    Factor F
---------------------------------------------------------------------------------------------------
1         15.00                15       3.00         5.00         1.000             75.0        1.00
2         15.00                15       4.41         5.00         1.000             75.0        1.00
3         10.00                15       4.41         5.00         1.000             75.0        1.00
```

```
Facing Resistance:

                                     Temporary   Permanent      Seismic
ASD Allowable Facing Resistance:          22.2        34.1         46.5 kips

=======================================================================================================
                                          Soil Properties
=======================================================================================================

                                        Unit Weight  Friction Angle        Cohesion
                                                  γ              φ'              c'
Layer  Description                              pcf         degrees             psf
-----------------------------------------------------------------------------------
1      Fill                                     115            33.0              50
2      Andesite 1                               120            27.0             500
3      Andesite 2                               125            27.0             500

=======================================================================================================
                                               Loads
=======================================================================================================

Applied Loads:

Seismic:

Horizontal Seismic Coefficient Kh0.25:

External Load:

Apply external load: No

Surcharges:

Apply surcharges:    Yes

           Distance from Top of Wall            Load            Load
               Begin             End           Begin             End
No.             feet            feet             psf             psf
--------------------------------------------------------------------
1               0.00           30.00             250             250

=======================================================================================================
                                         Factors of Safety
=======================================================================================================

                    Temporary   Permanent     Seismic
Pullout (Distal):        2.00        2.00        1.50
Pullout (Proximal):      2.00        2.00        1.50
Nail Bar Yield:          1.80        1.80        1.35
```

```
======================================================================================================
                                           Search Options
======================================================================================================

Search Limits:

Begin:      4.00 feet
End:       25.00 feet

Below Toe Searches (BTS):

Perform below Toe Search:       Yes
Number of BTS Points:             5
BTS Depth:                     4.00 feet
Interface Friction
Reduction Factor:              0.33

Advanced Search Options:

Use Advanced Search Options:     Yes
Inclination of Interslice Force: Use Average Failure Angle

======================================================================================================
                                               Results
======================================================================================================

Analysis:

Method:          ASD
Scenario:    Seismic

Factor of Safety:

Minimum:                  1.31
Found at Search Point:       7
Found at Grid Point:        28
Found at Search Level:       Toe of the wall

Load at Soil Nail Head:

Calculated Service Load at Soil Nail Head (Empirical), To:     6.6 kips
Allowable Facing Resistance, F_allowable (Entered):           46.5 kips
F_allowable ≥ To OK

Nominal Pullout Resistance:

                    Nominal Pullout Resistance
Layer  Description                         klf
----------------------------------------------
    1  Fill                              2.262
    2  Andesite 1                        2.262
```

```
    3  Andesite 2                       2.262

Results by Search Level:

** Indicates Minimum Factor of Safety

Search Level: At the toe of the wall  Facing Design Force = 6.6 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower         |       Upper     |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
| Search|   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      1.63       4.00     58.73      6.94     87.43      8.90       1     21.2   Pullout
                                                                           2     21.6   Pullout
                                                                           3     16.1   Pullout

      2      1.41       6.10     47.20      8.08     86.08      8.91       1     17.3   Pullout
                                                                           2     17.9   Pullout
                                                                           3     14.8   Pullout

      3      1.44       8.20     50.31      7.70     69.75      9.48       1     16.0   Pullout
                                                                           2     18.9   Pullout
                                                                           3     15.2   Pullout

      4      1.37      10.30     35.73      7.61     68.34     11.16       1     12.4   Pullout
                                                                           2     15.6   Pullout
                                                                           3     13.2   Pullout

      5      1.33      12.40     35.64      7.63     59.14     12.09       1     10.6   Pullout
                                                                           2     15.1   Pullout
                                                                           3     13.1   Pullout

      6      1.31      14.50     31.52      8.50     55.05     12.66       1      8.0   Pullout
                                                                           2     13.2   Pullout
                                                                           3     12.4   Pullout

   ** 7      1.31      16.60     28.18      9.42     51.34     13.29       1      5.6   Pullout
                                                                           2     11.3   Pullout
                                                                           3     11.8   Pullout

      8      1.31      18.70     30.73      8.70     42.76     15.28       1      5.0   Pullout
                                                                           2     12.3   Pullout
                                                                           3     12.3   Pullout

      9      1.32      20.80     28.12      9.43     39.74     16.23       1      3.0   Pullout
                                                                           2     10.9   Pullout
                                                                           3     11.8   Pullout
```

```
     10      1.33      22.90     17.93      4.81     36.06     22.66       1      1.5   Pullout
                                                                          2     10.3   Pullout
                                                                          3      9.5   Pullout

     11      1.35      25.00     16.51      5.22     33.70     24.04       1      0.0   Pullout
                                                                          2      9.1   Pullout
                                                                          3      8.9   Pullout

Search Level: 0.80 feet below the toe of the wall  Facing Design Force = 5.7 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  | Angle   | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      1.94       4.00     60.05      7.21     87.56      9.38       1     21.2   Pullout
                                                                          2     21.6   Pullout
                                                                          3     15.4   Pullout

      2      1.65       6.10     48.70      8.32     86.28      9.39       1     17.3   Pullout
                                                                          2     17.8   Pullout
                                                                          3     13.8   Pullout

      3      1.54       8.20     43.61      9.06     80.08      9.51       1     14.2   Pullout
                                                                          2     15.7   Pullout
                                                                          3     13.0   Pullout

      4      1.46      10.30     40.91      9.54     71.75      9.87       1     11.8   Pullout
                                                                          2     14.5   Pullout
                                                                          3     12.5   Pullout

      5      1.46      12.40     37.08      7.77     60.45     12.57       1     10.3   Pullout
                                                                          2     14.7   Pullout
                                                                          3     11.8   Pullout

      6      1.41      14.50     40.76      9.57     52.28     11.85       1      8.7   Pullout
                                                                          2     14.4   Pullout
                                                                          3     12.5   Pullout

      7      1.39      16.60     29.45      9.53     52.80     13.73       1      5.1   Pullout
                                                                          2     10.7   Pullout
                                                                          3     10.1   Pullout

      8      1.37      18.70     26.62     10.46     49.47     14.39       1      2.7   Pullout
                                                                          2      8.8   Pullout
                                                                          3      9.4   Pullout

      9      1.37      20.80     29.39      9.55     41.22     16.59       1      2.4   Pullout
                                                                          2     10.0   Pullout
```

```
                                                                           3     10.1   Pullout

     10      1.37      22.90     27.09     10.29     38.51     17.56       1      0.4   Pullout
                                                                           2      8.6   Pullout
                                                                           3      9.5   Pullout

     11      1.39      25.00     25.11     11.04     36.09     18.56       1      0.0   Pullout
                                                                           2      7.2   Pullout
                                                                           3      8.9   Pullout

Search Level: 1.60 feet below the toe of the wall  Facing Design Force = 4.4 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------||------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      2.17       4.00     42.37      4.87     88.26     13.14       1     21.1   Pullout
                                                                           2     21.4   Pullout
                                                                           3     12.0   Pullout

      2      1.87       6.10     50.11      8.56     86.46      9.87       1     17.2   Pullout
                                                                           2     17.8   Pullout
                                                                           3     13.0   Pullout

      3      1.69       8.20     41.67      9.88     85.24      9.89       1     13.3   Pullout
                                                                           2     14.1   Pullout
                                                                           3     11.3   Pullout

      4      1.61      10.30     38.56     10.54     78.19     10.07       1     10.6   Pullout
                                                                           2     12.3   Pullout
                                                                           3     10.6   Pullout

      5      1.53      12.40     37.11     10.88     69.32     10.53       1      8.5   Pullout
                                                                           2     11.5   Pullout
                                                                           3     10.3   Pullout

      6      1.48      14.50     37.05     10.90     59.51     11.43       1      6.9   Pullout
                                                                           2     11.4   Pullout
                                                                           3     10.3   Pullout

      7      1.47      16.60     38.36     10.58     49.89     12.88       1      6.0   Pullout
                                                                           2     12.0   Pullout
                                                                           3     10.6   Pullout

      8      1.44      18.70     27.78     10.57     50.87     14.82       1      2.3   Pullout
                                                                           2      8.1   Pullout
                                                                           3      7.7   Pullout
```

```
      9       1.42      20.80     25.35     11.51     47.86     15.50      1       0.0   Pullout
                                                                           2       6.2   Pullout
                                                                           3       6.9   Pullout

     10       1.42      22.90     28.27     10.40     39.91     17.91      1       0.0   Pullout
                                                                           2       7.7   Pullout
                                                                           3       7.9   Pullout

     11       1.43      25.00     26.23     11.15     37.46     18.90      1       0.0   Pullout
                                                                           2       6.2   Pullout
                                                                           3       7.2   Pullout

Search Level: 2.40 feet below the toe of the wall  Facing Design Force = 4.0 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1       2.47       4.00     67.31      9.33     87.34      8.62      1      21.2   Pullout
                                                                           2      21.6   Pullout
                                                                           3      15.2   Pullout

      2       2.08       6.10     51.44      8.81     86.62     10.35      1      17.2   Pullout
                                                                           2      17.7   Pullout
                                                                           3      12.2   Pullout

      3       1.90       8.20     46.40      9.51     80.98     10.46      1      14.1   Pullout
                                                                           2      15.4   Pullout
                                                                           3      11.1   Pullout

      4       1.74      10.30     39.89     10.74     78.73     10.54      1      10.5   Pullout
                                                                           2      12.2   Pullout
                                                                           3       9.5   Pullout

      5       1.65      12.40     38.43     11.08     70.20     10.98      1       8.3   Pullout
                                                                           2      11.2   Pullout
                                                                           3       9.1   Pullout

      6       1.59      14.50     34.16     12.27     67.17     11.21      1       5.2   Pullout
                                                                           2       8.5   Pullout
                                                                           3       7.9   Pullout

      7       1.53      16.60     34.67     12.11     57.27     12.28      1       3.9   Pullout
                                                                           2       8.7   Pullout
                                                                           3       8.0   Pullout

      8       1.51      18.70     36.38     11.61     47.86     13.93      1       3.2   Pullout
                                                                           2       9.6   Pullout
```

```
                                                                           3      8.5   Pullout

      9      1.48      20.80     33.52     12.47     44.81     14.66       1      1.0   Pullout
                                                                           2      7.9   Pullout
                                                                           3      7.7   Pullout

     10      1.47      22.90     26.63      7.68     40.68     21.14       1      0.0   Pullout
                                                                           2      7.2   Pullout
                                                                           3      5.3   Pullout

     11      1.47      25.00     27.32     11.26     38.79     19.24       1      0.0   Pullout
                                                                           2      5.3   Pullout
                                                                           3      5.5   Pullout

Search Level: 3.20 feet below the toe of the wall  Facing Design Force = 2.6 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  | Angle   | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level | ksi    | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      2.71       4.00     68.22      9.70     87.46      9.02       1     21.2   Pullout
                                                                           2     21.6   Pullout
                                                                           3     14.8   Pullout

      2      2.47       6.10     64.64      9.97     78.52      9.19       1     18.4   Pullout
                                                                           2     20.1   Pullout
                                                                           3     14.0   Pullout

      3      2.27       8.20     61.36     10.27     70.00      9.59       1     15.9   Pullout
                                                                           2     18.8   Pullout
                                                                           3     13.3   Pullout

      4      2.02      10.30     50.77     16.29     90.00      5.41       1      8.8   Pullout
                                                                           2     14.7   Pullout
                                                                           3     10.9   Pullout

      5      1.84      12.40     41.09     16.45    -90.00      7.21       1      4.2   Pullout
                                                                           2     10.3   Pullout
                                                                           3      8.4   Pullout

      6      1.69      14.50     39.64     11.30     61.79     12.27       1      6.4   Pullout
                                                                           2     10.5   Pullout
                                                                           3      8.0   Pullout

      7      1.62      16.60     35.89     12.29     58.45     12.69       1      3.6   Pullout
                                                                           2      8.2   Pullout
                                                                           3      6.8   Pullout
```

```
      8       1.57      18.70     32.72     13.34     55.32     13.15      1       0.9  Pullout
                                                                           2       6.0  Pullout
                                                                           3       5.7  Pullout

      9       1.54      20.80     30.01     14.41     52.42     13.64      1       0.0  Pullout
                                                                           2       3.9  Pullout
                                                                           3       4.6  Pullout

     10       1.52      22.90     32.19     13.53     43.36     15.75      1       0.0  Pullout
                                                                           2       5.5  Pullout
                                                                           3       5.5  Pullout

     11       1.52      25.00     29.97     14.43     40.86     16.53      1       0.0  Pullout
                                                                           2       3.9  Pullout
                                                                           3       4.6  Pullout

Search Level: 4.00 feet below the toe of the wall  Facing Design Force = 1.8 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1       3.53       4.00     74.18      5.87     79.68     13.39      1      22.3  Pullout
                                                                           2      23.8  Pullout
                                                                           3      15.7  Pullout

      2       3.09       6.10     72.04     19.78      0.00      0.00      1      19.4  Pullout
                                                                           2      22.0  Pullout
                                                                           3      15.1  Pullout

      3        N/A       8.20      0.00      0.82     68.59     20.22      1      16.2  Pullout
                                                                           2      19.3  Pullout
                                                                           3      12.8  Pullout

      4       4.18      10.30      0.00      7.21     80.68     19.07      1      10.1  Pullout
                                                                           2      11.5  Pullout
                                                                           3       3.3  Pullout

      5       3.56      12.40      8.63     12.54    -90.00     16.94      1       4.2  Pullout
                                                                           2       4.2  Pullout
                                                                           3       0.0  Pullout

      6       1.81      14.50     42.26     19.59     90.00      5.65      1       2.1  Pullout
                                                                           2       9.5  Pullout
                                                                           3       7.4  Pullout

      7       1.74      16.60     38.44     21.19     90.00      5.65      1       0.0  Pullout
                                                                           2       7.4  Pullout
```

```
                                                                           3      6.1   Pullout

      8      1.66      18.70     38.84     12.00     50.38     14.66       1      2.4   Pullout
                                                                           2      8.4   Pullout
                                                                           3      6.2   Pullout

      9      1.61      20.80     31.10     14.57     53.62     14.03       1      0.0   Pullout
                                                                           2      3.3   Pullout
                                                                           3      3.2   Pullout

     10      1.59      22.90     28.72     15.67     50.95     14.54       1      0.0   Pullout
                                                                           2      1.2   Pullout
                                                                           3      2.1   Pullout

     11      1.57      25.00     31.06     14.59     42.09     16.85       1      0.0   Pullout
                                                                           2      3.0   Pullout
                                                                           3      3.2   Pullout


======================================================================================================
                                           END OF REPORT
======================================================================================================
```

```
======================================================================================================
                                               Snail

                                           Version: 2.2.2

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======================================================================================================
                                          File Information
======================================================================================================

File Name: US 395 RW3 Sta 1250 Max Height Temp.snz
Run Date:  11/14/22
Run Time:  11:55:18

======================================================================================================
                                        Project Information
======================================================================================================

Description:    RW3
Location:       US 395
EA:
Project ID:
Wall No.:
Structure No.:
Station:
Engineer:       STC
                Designer

Comments:


======================================================================================================
                                              Geometry
======================================================================================================

Layout:

Reference Point:

At: Top of Wall
Distance From Origin:       40.00 feet
Elevation Above Origin:     30.00 feet

Wall Dimensions:

Wall Height:       14.82 feet
Facing Angle:      90.00 degrees
Facing Batter:     0.000 :12 H:V
```

```
Ground Surface:

Number of lines that define the ground surface above the wall: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Number of lines that define the ground surface in front of the toe: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Soil Layers:

Number of Layers: 3

Layers Below the Top Layer:

Coordinates of the Top of the Layer: feet

             Point 1         Point 1         Point 2         Point 2
Layer       Distance       Elevation        Distance       Elevation
--------------------------------------------------------------------
2              45.00           25.00           60.00           25.00
3              45.00           20.00           60.00           20.00

Ground Water:

Include Ground Water: No

======================================================================================================
                                             Soil Nails
======================================================================================================

Dimensions and Properties:

Maximum Vertical Spacing:               4.41 feet
Number of Soil Nail Rows:                  2
Soil Nail Design Parameters:               Varying

       Soil Nail       Inclination   Vertical   Horizontal      Nail Bar   Nail Bar Yield       Bond
          Length   From Horizontal    Spacing    Spacing H    Diameter Ø      Strength fy   Strength
No.         feet           degrees       feet         feet        inches              ksi   Factor F
----------------------------------------------------------------------------------------------------
1          15.00                15       3.00         5.00         1.000             75.0       1.00
2          15.00                15       4.41         5.00         1.000             75.0       1.00
```

```
Facing Resistance:

                                     Temporary   Permanent     Seismic
ASD Allowable Facing Resistance:          22.2        34.1        46.5 kips

======================================================================================================
                                          Soil Properties
======================================================================================================

                                        Unit Weight  Friction Angle        Cohesion
                                                  γ              φ'              c'
Layer  Description                              pcf         degrees             psf
-----------------------------------------------------------------------------------
1      Fill                                     115            33.0              50
2      Andesite 1                               120            27.0             500
3      Andesite 2                               125            27.0             500

======================================================================================================
                                               Loads
======================================================================================================

Applied Loads:

Seismic:

Horizontal Seismic Coefficient Kh0.25:

External Load:

Apply external load: No

Surcharges:

Apply surcharges:    Yes

           Distance from Top of Wall            Load            Load
               Begin             End           Begin             End
No.             feet            feet             psf             psf
--------------------------------------------------------------------
1               0.00           30.00             250             250

======================================================================================================
                                         Factors of Safety
======================================================================================================

                    Temporary   Permanent     Seismic
Pullout (Distal):        2.00        2.00        1.50
Pullout (Proximal):      2.00        2.00        1.50
Nail Bar Yield:          1.80        1.80        1.35

======================================================================================================
```

```
                                           Search Options
======================================================================================================

Search Limits:

Begin:      4.00 feet
End:       25.00 feet

Below Toe Searches (BTS):

Perform below Toe Search:       Yes
Number of BTS Points:             5
BTS Depth:                     4.00 feet
Interface Friction
Reduction Factor:              0.33

Advanced Search Options:

Use Advanced Search Options:     Yes
Inclination of Interslice Force: Use Average Failure Angle

======================================================================================================
                                               Results
======================================================================================================

Analysis:

Method:          ASD
Scenario:  Temporary

Factor of Safety:

Minimum:                  1.38
Found at Search Point:       3
Found at Grid Point:        35
Found at Search Level:       Toe of the wall

Load at Soil Nail Head:

Calculated Service Load at Soil Nail Head (Empirical), To:     8.0 kips
Allowable Facing Resistance, F_allowable (Entered):          22.2 kips
F_allowable ≥ To OK

Nominal Pullout Resistance:

                    Nominal Pullout Resistance
Layer  Description                         klf
----------------------------------------------
    1  Fill                              2.262
    2  Andesite 1                        2.262
    3  Andesite 2                        2.262
```

```
Results by Search Level:

** Indicates Minimum Factor of Safety

Search Level: At the toe of the wall  Facing Design Force = 8.0 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      1.48       4.00     58.73      6.94     87.43      8.90       1     15.9   Pullout
                                                                           2     16.2   Pullout

      2      1.39       6.10     50.54      7.68     82.19      8.98       1     13.4   Pullout
                                                                           2     14.3   Pullout

   ** 3      1.38       8.20     50.31      7.70     69.75      9.48       1     12.0   Pullout
                                                                           2     14.2   Pullout

      4      1.40      10.30     49.02      7.85     59.92     10.28       1     10.5   Pullout
                                                                           2     13.8   Pullout

      5      1.41      12.40     41.87      6.66     54.35     12.77       1      8.8   Pullout
                                                                           2     12.7   Pullout

      6      1.46      14.50     37.47      7.31     50.02     13.54       1      7.0   Pullout
                                                                           2     11.5   Pullout

      7      1.51      16.60     41.76     22.25      0.00      0.00       1      6.4   Pullout
                                                                           2     12.1   Pullout

      8      1.57      18.70     38.40     23.86      0.00      0.00       1      5.0   Pullout
                                                                           2     11.2   Pullout

      9      1.64      20.80     35.47     25.54      0.00      0.00       1      3.6   Pullout
                                                                           2     10.3   Pullout

     10      1.71      22.90     32.91     27.28      0.00      0.00       1      2.3   Pullout
                                                                           2      9.5   Pullout

     11      1.78      25.00     30.66     29.06      0.00      0.00       1      1.1   Pullout
                                                                           2      8.8   Pullout

Search Level: 0.80 feet below the toe of the wall  Facing Design Force = 6.8 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
```

```
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      1.87       4.00     60.05      7.21     87.56      9.38       1     15.9   Pullout
                                                                           2     16.2   Pullout

      2      1.70       6.10     52.01      7.93     82.58      9.45       1     13.4   Pullout
                                                                           2     14.2   Pullout

      3      1.64       8.20     47.43      8.48     75.29      9.69       1     11.3   Pullout
                                                                           2     12.9   Pullout

      4      1.59      10.30     45.31      8.79     66.27     10.24       1      9.6   Pullout
                                                                           2     12.2   Pullout

      5      1.58      12.40     45.22      8.80     56.51     11.24       1      8.4   Pullout
                                                                           2     12.1   Pullout

      6      1.60      14.50     40.76      9.57     52.28     11.85       1      6.6   Pullout
                                                                           2     10.8   Pullout

      7      1.65      16.60     35.21      8.13     47.67     14.79       1      5.0   Pullout
                                                                           2      9.8   Pullout

      8      1.68      18.70     39.87     24.37      0.00      0.00       1      4.5   Pullout
                                                                           2     10.5   Pullout

      9      1.73      20.80     36.91     26.01      0.00      0.00       1      3.1   Pullout
                                                                           2      9.6   Pullout

     10      1.78      22.90     34.30     27.72      0.00      0.00       1      1.8   Pullout
                                                                           2      8.7   Pullout

     11      1.84      25.00     32.00     29.48      0.00      0.00       1      0.5   Pullout
                                                                           2      7.9   Pullout

Search Level: 1.60 feet below the toe of the wall  Facing Design Force = 5.8 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |         Reinforcement         |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      2.21       4.00     61.27      7.49     87.68      9.86       1     15.9   Pullout
                                                                           2     16.1   Pullout

      2      1.99       6.10     53.39      8.18     82.94      9.93       1     13.3   Pullout
```

```
                                                                            2     14.1   Pullout

      3      1.88       8.20     48.85      8.72     75.98     10.15        1     11.2   Pullout
                                                                            2     12.7   Pullout

      4      1.80      10.30     46.74      9.02     67.31     10.68        1      9.5   Pullout
                                                                            2     11.9   Pullout

      5      1.76      12.40     46.65      9.03     57.82     11.64        1      8.2   Pullout
                                                                            2     11.7   Pullout

      6      1.75      14.50     42.17      9.78     53.65     12.23        1      6.3   Pullout
                                                                            2     10.3   Pullout

      7      1.76      16.60     38.36     10.58     49.89     12.88        1      4.5   Pullout
                                                                            2      9.0   Pullout

      8      1.79      18.70     41.29     24.89      0.00      0.00        1      4.1   Pullout
                                                                            2      9.9   Pullout

      9      1.82      20.80     38.29     26.50      0.00      0.00        1      2.7   Pullout
                                                                            2      8.9   Pullout

     10      1.86      22.90     35.64     28.18      0.00      0.00        1      1.3   Pullout
                                                                            2      8.0   Pullout

     11      1.90      25.00     33.30     29.91      0.00      0.00        1      0.0   Pullout
                                                                            2      7.1   Pullout

Search Level: 2.40 feet below the toe of the wall  Facing Design Force = 4.8 kips (Clouterre)
-------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes             |        Reinforcement          |
|       |         |          |----------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower        |      Upper        |       |        |              |
|       | Factor  | From Toe |----------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  |  Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |   feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
-------------------------------------------------------------------------------------------------------
      1      2.51       4.00     67.31      9.33     87.34      8.62        1     15.9   Pullout
                                                                            2     16.2   Pullout

      2      2.25       6.10     51.44      8.81     86.62     10.35        1     12.9   Pullout
                                                                            2     13.3   Pullout

      3      2.11       8.20     50.20      8.97     76.61     10.62        1     11.1   Pullout
                                                                            2     12.6   Pullout

      4      1.99      10.30     48.10      9.25     68.26     11.12        1      9.3   Pullout
                                                                            2     11.7   Pullout

      5      1.93      12.40     48.01      9.27     59.03     12.05        1      8.0   Pullout
```

```
                                                                          2      11.4   Pullout

      6      1.90      14.50     43.53     10.00     54.94     12.62      1       6.0   Pullout
                                                                          2       9.9   Pullout

      7      1.89      16.60     39.69     10.79     51.22     13.25      1       4.2   Pullout
                                                                          2       8.5   Pullout

      8      1.90      18.70     36.38     11.61     47.86     13.93      1       2.4   Pullout
                                                                          2       7.2   Pullout

      9      1.92      20.80     39.62     27.00      0.00      0.00      1       2.3   Pullout
                                                                          2       8.3   Pullout

     10      1.94      22.90     36.94     28.65      0.00      0.00      1       0.8   Pullout
                                                                          2       7.3   Pullout

     11      1.98      25.00     34.56     30.36      0.00      0.00      1       0.0   Pullout
                                                                          2       6.3   Pullout

Search Level: 3.20 feet below the toe of the wall  Facing Design Force = 3.8 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes             |       Reinforcement           |
|       |         |          |----------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper        |       |        |              |
|       | Factor  | From Toe |----------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length   |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet    | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      3.10       4.00     72.74      9.44     82.41      9.09      1      16.4   Pullout
                                                                          2      17.3   Pullout

      2      2.69       6.10     67.89      9.73     74.85      9.33      1      14.3   Pullout
                                                                          2      15.9   Pullout

      3      2.44       8.20     60.37     16.58    -90.00      3.60      1      10.5   Pullout
                                                                          2      13.8   Pullout

      4      2.25      10.30     57.58     19.21     90.00      1.80      1       9.4   Pullout
                                                                          2      13.0   Pullout

      5      2.10      12.40     49.30      9.51     60.17     12.46      1       7.8   Pullout
                                                                          2      11.1   Pullout

      6      2.04      14.50     44.83     10.22     56.16     13.02      1       5.8   Pullout
                                                                          2       9.6   Pullout

      7      2.01      16.60     40.97     10.99     52.49     13.63      1       3.9   Pullout
                                                                          2       8.1   Pullout

      8      2.01      18.70     37.63     11.81     49.15     14.29      1       2.1   Pullout
```

```
                                                                           2      6.7   Pullout

      9      2.01      20.80     40.90     27.52      0.00      0.00       1      1.9   Pullout
                                                                           2      7.7   Pullout

     10      2.02      22.90     38.20     29.14      0.00      0.00       1      0.4   Pullout
                                                                           2      6.6   Pullout

     11      2.06      25.00     35.78     30.82      0.00      0.00       1      0.0   Pullout
                                                                           2      5.6   Pullout

Search Level: 4.00 feet below the toe of the wall  Facing Design Force = 4.0 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1       N/A       4.00      0.00      0.80     80.35     19.09       1     16.6   Pullout
                                                                           2     17.7   Pullout

      2     20.05       6.10      0.00      5.49     88.14     18.83       1     12.7   Pullout
                                                                           2     12.9   Pullout

      3      9.58       8.20      0.00      5.74     82.55     18.98       1     10.4   Pullout
                                                                           2     11.2   Pullout

      4      6.74      10.30      0.00      6.18     77.65     19.27       1      8.0   Pullout
                                                                           2      9.4   Pullout

      5      3.53      12.40      0.00      3.72     65.24     20.73       1      7.0   Pullout
                                                                           2      9.7   Pullout

      6      2.23      14.50     46.08     20.90     90.00      3.76       1      3.5   Pullout
                                                                           2      8.6   Pullout

      7      2.15      16.60     48.59     25.09      0.00      0.00       1      4.8   Pullout
                                                                           2      9.5   Pullout

      8      2.11      18.70     38.84     12.00     50.38     14.66       1      1.8   Pullout
                                                                           2      6.3   Pullout

      9      2.11      20.80     42.14     28.05      0.00      0.00       1      1.5   Pullout
                                                                           2      7.1   Pullout

     10      2.11      22.90     39.42     29.64      0.00      0.00       1      0.0   Pullout
                                                                           2      6.0   Pullout

     11      2.14      25.00     36.97     31.29      0.00      0.00       1      0.0   Pullout
```

```
                                                                              2      4.9   Pullout

==========================================================================================================
                                            END OF REPORT
==========================================================================================================
```

```
======================================================================================================
                                               Snail

                                           Version: 2.2.2

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======================================================================================================
                                          File Information
======================================================================================================

File Name: US 395 RW3 Sta 1550.snz
Run Date:  11/14/22
Run Time:  14:02:57

======================================================================================================
                                        Project Information
======================================================================================================

Description:    RW3
Location:       US 395
EA:
Project ID:
Wall No.:
Structure No.:
Station:
Engineer:       STC
                Designer

Comments:


======================================================================================================
                                              Geometry
======================================================================================================

Layout:

Reference Point:

At: Top of Wall
Distance From Origin:       40.00 feet
Elevation Above Origin:     30.00 feet

Wall Dimensions:

Wall Height:       14.46 feet
Facing Angle:      90.00 degrees
Facing Batter:     0.000 :12 H:V
```

```
Ground Surface:

Number of lines that define the ground surface above the wall: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Number of lines that define the ground surface in front of the toe: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Soil Layers:

Number of Layers: 2

Layers Below the Top Layer:

Coordinates of the Top of the Layer: feet

             Point 1         Point 1         Point 2         Point 2
Layer       Distance       Elevation        Distance       Elevation
--------------------------------------------------------------------
2              45.00           20.00           60.00           20.00

Ground Water:

Include Ground Water: No

======================================================================================================
                                             Soil Nails
======================================================================================================

Dimensions and Properties:

Maximum Vertical Spacing:               5.00 feet
Number of Soil Nail Rows:                  3
Soil Nail Design Parameters:               Varying

      Soil Nail       Inclination   Vertical   Horizontal      Nail Bar   Nail Bar Yield       Bond
         Length   From Horizontal    Spacing    Spacing H    Diameter Ø      Strength fy   Strength
No.        feet           degrees       feet         feet        inches              ksi   Factor F
---------------------------------------------------------------------------------------------------
1         20.00                15       3.00         4.00         1.000             75.0       1.00
2         15.00                15       4.23         4.00         1.000             75.0       1.00
3         10.00                15       4.23         4.00         1.000             75.0       1.00
```

```
Facing Resistance:

                                     Temporary   Permanent     Seismic
ASD Allowable Facing Resistance:          22.2        34.1        46.5 kips

======================================================================================================
                                          Soil Properties
======================================================================================================

                                        Unit Weight  Friction Angle        Cohesion
                                                  γ              φ'              c'
Layer  Description                              pcf         degrees             psf
-----------------------------------------------------------------------------------
1      Fill                                     115            34.0             100
2      Fill                                     120            34.0             100

======================================================================================================
                                               Loads
======================================================================================================

Applied Loads:

Seismic:

Horizontal Seismic Coefficient Kh0.25:

External Load:

Apply external load: No

Surcharges:

Apply surcharges:    Yes

           Distance from Top of Wall            Load            Load
               Begin            End            Begin             End
No.             feet            feet             psf             psf
--------------------------------------------------------------------
1               0.00           30.00             250             250

======================================================================================================
                                         Factors of Safety
======================================================================================================

                    Temporary   Permanent     Seismic
Pullout (Distal):        2.00        2.00        1.50
Pullout (Proximal):      2.00        2.00        1.50
Nail Bar Yield:          1.80        1.80        1.35

======================================================================================================
                                           Search Options
```

```
======================================================================================================

Search Limits:

Begin:      2.00 feet
End:       15.00 feet

Below Toe Searches (BTS):

Perform below Toe Search:       Yes
Number of BTS Points:             5
BTS Depth:                     4.00 feet
Interface Friction
Reduction Factor:              0.33

Advanced Search Options:

Use Advanced Search Options:     Yes
Inclination of Interslice Force: Use Average Failure Angle

======================================================================================================
                                               Results
======================================================================================================

Analysis:

Method:          ASD
Scenario:  Permanent

Factor of Safety:

Minimum:                  1.52
Found at Search Point:       4
Found at Grid Point:        38
Found at Search Level:       Toe of the wall

Load at Soil Nail Head:

Calculated Service Load at Soil Nail Head (Empirical), To:    11.5 kips
Allowable Facing Resistance, F_allowable (Entered):           34.1 kips
F_allowable ≥ To OK

Nominal Pullout Resistance:

                    Nominal Pullout Resistance
Layer  Description                         klf
----------------------------------------------
    1  Fill                              2.262
    2  Fill                              2.262

Results by Search Level:
```

```
** Indicates Minimum Factor of Safety

Search Level: At the toe of the wall  Facing Design Force = 11.5 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      1.92       2.00     72.71      6.06     88.68      8.68       1     25.9   Pullout
                                                                           2     18.9   Pullout
                                                                           3     13.1   Pullout

      2      1.65       3.30     62.82      6.50     87.82      8.68       1     24.1   Pullout
                                                                           2     17.1   Pullout
                                                                           3     12.4   Pullout

      3      1.54       4.60     54.41      7.11     86.97      8.69       1     22.3   Pullout
                                                                           2     15.4   Pullout
                                                                           3     11.7   Pullout

   ** 4      1.52       5.90     47.45      7.85     86.11      8.70       1     20.5   Pullout
                                                                           2     13.7   Pullout
                                                                           3     11.1   Pullout

      5      1.59       7.20     48.93      7.67     76.02      8.94       1     19.8   Pullout
                                                                           2     14.1   Pullout
                                                                           3     11.2   Pullout

      6      1.66       8.50     48.60      7.71     68.60      9.32       1     18.9   Pullout
                                                                           2     14.0   Pullout
                                                                           3     11.2   Pullout

      7      1.71       9.80     44.53     12.37     80.38      5.87       1     15.5   Pullout
                                                                           2     13.0   Pullout
                                                                           3     10.8   Pullout

      8      1.74      11.10     40.97     13.23     79.14      5.89       1     13.9   Pullout
                                                                           2     12.1   Pullout
                                                                           3     10.5   Pullout

      9      1.76      12.40     41.17     13.18     66.79      6.29       1     13.9   Pullout
                                                                           2     12.2   Pullout
                                                                           3     10.5   Pullout

     10      1.82      13.70     32.35      8.11     55.91     12.22       1     14.1   Pullout
                                                                           2     10.5   Pullout
                                                                           3      9.4   Pullout
```

```
     11      1.85     15.00     35.87      7.40     48.36     13.54        1     14.0   Pullout
                                                                            2     11.3   Pullout
                                                                            3      9.9   Pullout

Search Level: 0.80 feet below the toe of the wall  Facing Design Force = 11.5 kips (Clouterre)
---------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes           |        Reinforcement         |
|       |         |          |--------------------------------------|------------------------------|
|       | Minimum | Distance |      Lower          |      Upper     |       |        |             |
|       | Factor  | From Toe |--------------------------------------|       |        | Controlling |
| Search|   of    | of Wall  |  Angle  | Length  |  Angle  | Length |       | Stress | Resistance  |
| Point | Safety  |   feet   | degrees |  feet   | degrees |  feet  | Level |  ksi   | Failure Mode|
---------------------------------------------------------------------------------------------------------
      1      1.78      2.00     59.47      3.54     89.06     12.21        1     25.9   Pullout
                                                                            2     18.8   Pullout
                                                                            3     11.7   Pullout

      2      1.65      3.30     49.14      4.04     86.91     12.23        1     24.2   Pullout
                                                                            2     17.3   Pullout
                                                                            3     10.5   Pullout

      3      1.57      4.60     55.85      7.38     87.13      9.17        1     22.3   Pullout
                                                                            2     15.4   Pullout
                                                                            3     11.1   Pullout

      4      1.53      5.90     48.98      8.09     86.31      9.17        1     20.4   Pullout
                                                                            2     13.6   Pullout
                                                                            3     10.4   Pullout

      5      1.54      7.20     46.66      8.39     81.06      9.27        1     19.2   Pullout
                                                                            2     12.9   Pullout
                                                                            3     10.1   Pullout

      6      1.56      8.50     41.91      9.14     79.48      9.31        1     17.5   Pullout
                                                                            2     11.4   Pullout
                                                                            3      9.5   Pullout

      7      1.57      9.80     41.66      9.18     72.20      9.62        1     16.7   Pullout
                                                                            2     11.3   Pullout
                                                                            3      9.5   Pullout

      8      1.60     11.10     42.51      9.03     64.13     10.18        1     16.1   Pullout
                                                                            2     11.6   Pullout
                                                                            3      9.6   Pullout

      9      1.66     12.40     42.71     13.50     67.89      6.59        1     13.8   Pullout
                                                                            2     11.5   Pullout
                                                                            3      9.6   Pullout

     10      1.67     13.70     41.70      9.18     53.20     11.43        1     14.6   Pullout
```

```
                                                                            2      11.3   Pullout
                                                                            3       9.5   Pullout

     11     1.71     15.00     41.09     13.93     53.60      7.58          1      12.9   Pullout
                                                                            2      11.1   Pullout
                                                                            3       9.4   Pullout

Search Level: 1.60 feet below the toe of the wall  Facing Design Force = 9.3 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes              |         Reinforcement          |
|       |         |          |---------------------------------------|--------------------------------|
|       | Minimum | Distance |        Lower        |       Upper       |       |        |               |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling   |
|Search |   of    | of Wall  |  Angle   |  Length  |  Angle   | Length  |       | Stress | Resistance    |
|Point  | Safety  |   feet   | degrees  |   feet   | degrees  |  feet   | Level |  ksi   | Failure Mode  |
------------------------------------------------------------------------------------------------------
      1     1.96      2.00     60.73      3.68     89.11     12.85          1      25.9   Pullout
                                                                            2      18.8   Pullout
                                                                            3      11.7   Pullout

      2     1.80      3.30     47.24      4.37     88.53     12.85          1      24.0   Pullout
                                                                            2      17.0   Pullout
                                                                            3       9.9   Pullout

      3     1.66      4.60     57.20      7.64     87.27      9.65          1      22.2   Pullout
                                                                            2      15.3   Pullout
                                                                            3      10.6   Pullout

      4     1.60      5.90     50.42      8.33     86.50      9.65          1      20.4   Pullout
                                                                            2      13.6   Pullout
                                                                            3       9.8   Pullout

      5     1.59      7.20     48.12      8.63     81.50      9.74          1      19.1   Pullout
                                                                            2      12.8   Pullout
                                                                            3       9.4   Pullout

      6     1.59      8.50     43.37      9.35     80.00      9.78          1      17.5   Pullout
                                                                            2      11.3   Pullout
                                                                            3       8.7   Pullout

      7     1.59      9.80     43.12      9.40     73.03     10.07          1      16.6   Pullout
                                                                            2      11.1   Pullout
                                                                            3       8.7   Pullout

      8     1.60     11.10     43.97      9.25     65.26     10.61          1      15.9   Pullout
                                                                            2      11.3   Pullout
                                                                            3       8.8   Pullout

      9     1.60     12.40     40.81      9.83     62.76     10.84          1      14.6   Pullout
                                                                            2      10.2   Pullout
                                                                            3       8.3   Pullout
```

```
     10      1.61      13.70      38.01      10.43      60.37      11.09       1     13.3   Pullout
                                                                               2      9.2   Pullout
                                                                               3      7.9   Pullout

     11      1.64      15.00      40.58       9.88      52.11      12.21       1     13.2   Pullout
                                                                               2     10.0   Pullout
                                                                               3      8.3   Pullout

Search Level: 2.40 feet below the toe of the wall  Facing Design Force = 7.3 kips (Clouterre)
-----------------------------------------------------------------------------------------------------
|       |         |          |              Failure Planes              |          Reinforcement           |
|       |         |          |------------------------------------------|----------------------------------|
|       | Minimum | Distance |         Lower       |        Upper       |       |        |                 |
|       | Factor  | From Toe |------------------------------------------|       |        | Controlling     |
|Search |   of    | of Wall  |  Angle  |  Length   |  Angle  |  Length  |       | Stress | Resistance      |
|Point  | Safety  |   feet   | degrees |   feet    | degrees |   feet   | Level |  ksi   | Failure Mode    |
-----------------------------------------------------------------------------------------------------
      1      2.18       2.00      61.91       3.82      89.15      13.49       1     25.9   Pullout
                                                                               2     18.8   Pullout
                                                                               3     11.7   Pullout

      2      1.93       3.30      70.59       8.94      87.76       8.44       1     24.1   Pullout
                                                                               2     17.1   Pullout
                                                                               3     11.8   Pullout

      3      1.73       4.60      63.85       9.39      86.88       8.44       1     22.3   Pullout
                                                                               2     15.4   Pullout
                                                                               3     10.9   Pullout

      4      1.71       5.90      51.78       8.58      86.66      10.13       1     20.4   Pullout
                                                                               2     13.6   Pullout
                                                                               3      9.2   Pullout

      5      1.68       7.20      49.50       8.87      81.90      10.22       1     19.1   Pullout
                                                                               2     12.7   Pullout
                                                                               3      8.8   Pullout

      6      1.66       8.50      44.76       9.58      80.46      10.26       1     17.4   Pullout
                                                                               2     11.2   Pullout
                                                                               3      8.0   Pullout

      7      1.65       9.80      44.51       9.62      73.80      10.53       1     16.5   Pullout
                                                                               2     11.0   Pullout
                                                                               3      8.0   Pullout

      8      1.64      11.10      45.36       9.48      66.30      11.05       1     15.7   Pullout
                                                                               2     11.0   Pullout
                                                                               3      8.1   Pullout

      9      1.63      12.40      42.19      10.04      63.88      11.27       1     14.4   Pullout
```

```
                                                                           2      9.9   Pullout
                                                                           3      7.5   Pullout

     10      1.63      13.70     39.37     10.63     61.56     11.50       1     13.1   Pullout
                                                                           2      8.9   Pullout
                                                                           3      7.0   Pullout

     11      1.63      15.00     36.85     11.25     59.33     11.76       1     11.8   Pullout
                                                                           2      7.8   Pullout
                                                                           3      6.5   Pullout

Search Level: 3.20 feet below the toe of the wall  Facing Design Force = 5.8 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      2.30       2.00     71.24      5.60     89.07     12.36       1     25.9   Pullout
                                                                           2     18.8   Pullout
                                                                           3     11.7   Pullout

      2      1.99       3.30     60.73      6.07     88.47     12.37       1     24.0   Pullout
                                                                           2     17.0   Pullout
                                                                           3     10.0   Pullout

      3      1.87       4.60     64.88      9.75     87.02      8.84       1     22.3   Pullout
                                                                           2     15.4   Pullout
                                                                           3     10.6   Pullout

      4      1.75       5.90     58.98     10.30     86.18      8.85       1     20.5   Pullout
                                                                           2     13.7   Pullout
                                                                           3      9.6   Pullout

      5      1.72       7.20     56.88     10.54     80.74      8.95       1     19.2   Pullout
                                                                           2     13.0   Pullout
                                                                           3      9.3   Pullout

      6      1.75       8.50     58.25     14.54     80.89      5.37       1     17.3   Pullout
                                                                           2     13.3   Pullout
                                                                           3      9.5   Pullout

      7      1.73       9.80     50.23     13.79     82.10      7.13       1     15.3   Pullout
                                                                           2     11.0   Pullout
                                                                           3      8.1   Pullout

      8      1.71      11.10     46.69     14.56     81.07      7.15       1     13.6   Pullout
                                                                           2      9.9   Pullout
                                                                           3      7.4   Pullout
```

```
      9      1.69      12.40     43.52     10.26     64.92     11.70       1     14.2   Pullout
                                                                           2      9.7   Pullout
                                                                           3      6.8   Pullout

     10      1.68      13.70     44.03     15.24     68.80      7.58       1     11.9   Pullout
                                                                           2      9.0   Pullout
                                                                           3      6.9   Pullout

     11      1.67      15.00     41.45     16.01     66.99      7.67       1     10.4   Pullout
                                                                           2      8.1   Pullout
                                                                           3      6.4   Pullout

Search Level: 4.00 feet below the toe of the wall  Facing Design Force = 5.8 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes             |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  | Angle   | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      2.53       2.00     72.00      5.82     89.11     12.92       1     25.9   Pullout
                                                                           2     18.8   Pullout
                                                                           3     11.7   Pullout

      2      2.19       3.30     61.80      6.28     88.54     12.93       1     24.0   Pullout
                                                                           2     17.0   Pullout
                                                                           3      9.9   Pullout

      3      2.03       4.60     65.84     10.12     87.15      9.24       1     22.3   Pullout
                                                                           2     15.4   Pullout
                                                                           3     10.2   Pullout

      4      1.89       5.90     60.09     10.65     86.34      9.25       1     20.4   Pullout
                                                                           2     13.6   Pullout
                                                                           3      9.2   Pullout

      5      1.80       7.20     54.93     11.28     85.54      9.26       1     18.6   Pullout
                                                                           2     11.9   Pullout
                                                                           3      8.2   Pullout

      6      1.79       8.50     53.62     11.46     79.57      9.39       1     17.5   Pullout
                                                                           2     11.4   Pullout
                                                                           3      8.0   Pullout

      7      1.78       9.80     53.38     11.50     72.33      9.69       1     16.7   Pullout
                                                                           2     11.3   Pullout
                                                                           3      7.9   Pullout

      8      1.78      11.10     47.95     14.92     81.45      7.47       1     13.5   Pullout
```

```
                                                                           2      9.4   Pullout
                                                                           3      6.8   Pullout

      9      1.76      12.40     48.15     14.87     71.44      7.79       1     13.2   Pullout
                                                                           2      9.5   Pullout
                                                                           3      6.9   Pullout

     10      1.74      13.70     45.30     15.58     69.64      7.88       1     11.7   Pullout
                                                                           2      8.5   Pullout
                                                                           3      6.2   Pullout

     11      1.73      15.00     42.71     16.33     67.89      7.97       1     10.3   Pullout
                                                                           2      7.5   Pullout
                                                                           3      5.6   Pullout


======================================================================================================
                                           END OF REPORT
======================================================================================================
```

```
======================================================================================================
                                               Snail

                                           Version: 2.2.2

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======================================================================================================
                                          File Information
======================================================================================================

File Name: US 395 RW3 Sta 1550 Seismic.snz
Run Date:  11/14/22
Run Time:  14:09:05

======================================================================================================
                                        Project Information
======================================================================================================

Description:    RW3
Location:       US 395
EA:
Project ID:
Wall No.:
Structure No.:
Station:
Engineer:       STC
                Designer

Comments:


======================================================================================================
                                              Geometry
======================================================================================================

Layout:

Reference Point:

At: Top of Wall
Distance From Origin:       40.00 feet
Elevation Above Origin:     30.00 feet

Wall Dimensions:

Wall Height:       14.46 feet
Facing Angle:      90.00 degrees
Facing Batter:     0.000 :12 H:V
```

```
Ground Surface:

Number of lines that define the ground surface above the wall: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Number of lines that define the ground surface in front of the toe: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Soil Layers:

Number of Layers: 2

Layers Below the Top Layer:

Coordinates of the Top of the Layer: feet

             Point 1         Point 1         Point 2         Point 2
Layer       Distance       Elevation        Distance       Elevation
--------------------------------------------------------------------
2              45.00           20.00           60.00           20.00

Ground Water:

Include Ground Water: No

======================================================================================================
                                             Soil Nails
======================================================================================================

Dimensions and Properties:

Maximum Vertical Spacing:               5.00 feet
Number of Soil Nail Rows:                  3
Soil Nail Design Parameters:               Varying

      Soil Nail       Inclination   Vertical   Horizontal      Nail Bar   Nail Bar Yield        Bond
         Length   From Horizontal    Spacing    Spacing H    Diameter Ø      Strength fy    Strength
No.        feet           degrees       feet         feet        inches              ksi    Factor F
----------------------------------------------------------------------------------------------------
1         20.00                15       3.00         4.00         1.000             75.0        1.00
2         15.00                15       4.23         4.00         1.000             75.0        1.00
3         10.00                15       4.23         4.00         1.000             75.0        1.00
```

```
Facing Resistance:

                                     Temporary   Permanent     Seismic
ASD Allowable Facing Resistance:          22.2        34.1        46.5 kips

=======================================================================================================
                                          Soil Properties
=======================================================================================================

                                        Unit Weight  Friction Angle        Cohesion
                                                  γ              φ'              c'
Layer  Description                              pcf         degrees             psf
-----------------------------------------------------------------------------------
1      Fill                                     115            34.0             100
2      Fill                                     120            34.0             100

=======================================================================================================
                                               Loads
=======================================================================================================

Applied Loads:

Seismic:

Horizontal Seismic Coefficient Kh0.25:

External Load:

Apply external load: No

Surcharges:

Apply surcharges:    Yes

           Distance from Top of Wall            Load            Load
               Begin             End           Begin             End
No.             feet            feet             psf             psf
--------------------------------------------------------------------
1               0.00           30.00             250             250

=======================================================================================================
                                         Factors of Safety
=======================================================================================================

                    Temporary   Permanent     Seismic
Pullout (Distal):        2.00        2.00        1.50
Pullout (Proximal):      2.00        2.00        1.50
Nail Bar Yield:          1.80        1.80        1.35

=======================================================================================================
                                           Search Options
```

```
======================================================================================================

Search Limits:

Begin:      5.00 feet
End:       20.00 feet

Below Toe Searches (BTS):

Perform below Toe Search:       Yes
Number of BTS Points:             5
BTS Depth:                     4.00 feet
Interface Friction
Reduction Factor:              0.33

Advanced Search Options:

Use Advanced Search Options:     Yes
Inclination of Interslice Force: Use Average Failure Angle

======================================================================================================
                                               Results
======================================================================================================

Analysis:

Method:          ASD
Scenario:    Seismic

Factor of Safety:

Minimum:                  1.17
Found at Search Point:      11
Found at Grid Point:        35
Found at Search Level:    3.20 feet below the toe of the wall

Load at Soil Nail Head:

Calculated Service Load at Soil Nail Head (Empirical), To:     5.1 kips
Allowable Facing Resistance, F_allowable (Entered):           46.5 kips
F_allowable ≥ To OK

Nominal Pullout Resistance:

                    Nominal Pullout Resistance
Layer  Description                         klf
----------------------------------------------
    1  Fill                              2.262
    2  Fill                              2.262

Results by Search Level:
```

```
** Indicates Minimum Factor of Safety

Search Level: At the toe of the wall  Facing Design Force = 6.5 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      1.38       5.00     52.12      7.33     86.70      8.69       1     29.0   Pullout
                                                                           2     19.8   Pullout
                                                                           3     15.4   Pullout

      2      1.37       6.50     48.04      7.78     81.48      8.77       1     26.8   Pullout
                                                                           2     18.4   Pullout
                                                                           3     14.9   Pullout

      3      1.42       8.00     31.07      8.41     85.48     10.15       1     23.3   Pullout
                                                                           2     14.3   Pullout
                                                                           3     12.3   Pullout

      4      1.41       9.50     29.72      8.75     79.37     10.30       1     21.5   Pullout
                                                                           2     13.4   Pullout
                                                                           3     12.1   Pullout

      5      1.39      11.00     41.23     13.16     79.23      5.89       1     18.7   Pullout
                                                                           2     16.2   Pullout
                                                                           3     14.0   Pullout

      6      1.38      12.50     26.37      9.77     69.67     10.79       1     17.8   Pullout
                                                                           2     11.0   Pullout
                                                                           3     11.4   Pullout

      7      1.37      14.00     27.31      9.45     61.05     11.57       1     17.0   Pullout
                                                                           2     11.5   Pullout
                                                                           3     11.6   Pullout

      8      1.35      15.50     25.01     10.26     58.51     11.87       1     15.1   Pullout
                                                                           2      9.9   Pullout
                                                                           3     11.1   Pullout

      9      1.34      17.00     23.04     11.08     56.11     12.19       1     13.2   Pullout
                                                                           2      8.3   Pullout
                                                                           3     10.6   Pullout

     10      1.35      18.50     25.13     10.22     47.58     13.71       1     13.2   Pullout
                                                                           2      9.8   Pullout
                                                                           3     11.1   Pullout
```

```
     11      1.34      20.00     23.45     10.90     45.35     14.23       1     11.6   Pullout
                                                                           2      8.6   Pullout
                                                                           3     10.7   Pullout

Search Level: 0.80 feet below the toe of the wall  Facing Design Force = 6.2 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      1.40       5.00     53.60      7.58     86.88      9.17       1     28.9   Pullout
                                                                           2     19.8   Pullout
                                                                           3     14.6   Pullout

      2      1.27       6.50     46.22      8.45     85.94      9.18       1     26.1   Pullout
                                                                           2     17.1   Pullout
                                                                           3     13.4   Pullout

      3      1.27       8.00     43.64      8.84     80.09      9.29       1     24.2   Pullout
                                                                           2     16.0   Pullout
                                                                           3     13.0   Pullout

      4      1.29       9.50     42.55      9.03     72.71      9.59       1     22.7   Pullout
                                                                           2     15.5   Pullout
                                                                           3     12.8   Pullout

      5      1.31      11.00     42.76     13.48     79.79      6.20       1     18.6   Pullout
                                                                           2     15.4   Pullout
                                                                           3     12.9   Pullout

      6      1.27      12.50     39.14     14.51     78.43      6.23       1     16.0   Pullout
                                                                           2     14.0   Pullout
                                                                           3     12.2   Pullout

      7      1.29      14.00     28.59      9.57     62.34     12.06       1     16.7   Pullout
                                                                           2     11.0   Pullout
                                                                           3      9.9   Pullout

      8      1.27      15.50     26.21     10.37     59.87     12.35       1     14.7   Pullout
                                                                           2      9.4   Pullout
                                                                           3      9.3   Pullout

      9      1.26      17.00     24.17     11.18     57.52     12.66       1     12.8   Pullout
                                                                           2      7.7   Pullout
                                                                           3      8.7   Pullout

     10      1.26      18.50     26.33     10.32     49.11     14.13       1     12.7   Pullout
```

```
                                                                            2      9.1   Pullout
                                                                            3      9.3   Pullout

     11      1.25      20.00     24.60     11.00      46.89     14.63       1     11.1   Pullout
                                                                            2      7.8   Pullout
                                                                            3      8.8   Pullout

Search Level: 1.60 feet below the toe of the wall  Facing Design Force = 5.9 kips (Clouterre)
-------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes             |        Reinforcement          |
|       |         |          |----------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower     |        Upper         |       |        |              |
|       | Factor  | From Toe |----------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle   | Length   |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees  |  feet    | Level |  ksi   | Failure Mode |
-------------------------------------------------------------------------------------------------------
      1      1.40       5.00     35.52      5.53      87.77     12.86       1     28.8   Pullout
                                                                            2     19.5   Pullout
                                                                            3     10.2   Pullout

      2      1.32       6.50     47.68      8.69      86.14      9.66       1     26.1   Pullout
                                                                            2     17.1   Pullout
                                                                            3     12.5   Pullout

      3      1.24       8.00     41.74      9.65      85.26      9.67       1     23.3   Pullout
                                                                            2     14.4   Pullout
                                                                            3     11.3   Pullout

      4      1.21       9.50     36.92     10.69      84.37      9.68       1     20.6   Pullout
                                                                            2     11.8   Pullout
                                                                            3     10.2   Pullout

      5      1.21      11.00     36.13     10.90      77.14      9.88       1     19.1   Pullout
                                                                            2     11.3   Pullout
                                                                            3     10.0   Pullout

      6      1.22      12.50     36.29     10.85      68.74     10.34       1     18.0   Pullout
                                                                            2     11.4   Pullout
                                                                            3     10.1   Pullout

      7      1.21      14.00     37.41     15.86      77.71      6.57       1     13.3   Pullout
                                                                            2     11.8   Pullout
                                                                            3     10.3   Pullout

      8      1.23      15.50     37.85     15.70      64.24      7.13       1     13.7   Pullout
                                                                            2     12.0   Pullout
                                                                            3     10.5   Pullout

      9      1.23      17.00     30.56     15.79      67.05      8.72       1     10.3   Pullout
                                                                            2      8.4   Pullout
                                                                            3      8.5   Pullout
```

```
     10      1.21      18.50     27.51     10.43     50.55     14.56       1     12.3   Pullout
                                                                           2      8.4   Pullout
                                                                           3      7.6   Pullout

     11      1.20      20.00     25.73     11.10     48.35     15.05       1     10.6   Pullout
                                                                           2      7.0   Pullout
                                                                           3      7.0   Pullout

Search Level: 2.40 feet below the toe of the wall  Facing Design Force = 7.4 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      1.53       5.00     36.85      5.62     87.88     13.50       1     28.8   Pullout
                                                                           2     19.5   Pullout
                                                                           3     10.2   Pullout

      2      1.38       6.50     49.06      8.93     86.32     10.14       1     26.1   Pullout
                                                                           2     17.0   Pullout
                                                                           3     11.6   Pullout

      3      1.30       8.00     43.13      9.87     85.48     10.15       1     23.3   Pullout
                                                                           2     14.3   Pullout
                                                                           3     10.3   Pullout

      4      1.25       9.50     38.27     10.89     84.64     10.16       1     20.5   Pullout
                                                                           2     11.7   Pullout
                                                                           3      9.0   Pullout

      5      1.23      11.00     34.26     11.98     83.80     10.18       1     17.8   Pullout
                                                                           2      9.1   Pullout
                                                                           3      7.9   Pullout

      6      1.22      12.50     34.00     12.06     76.12     10.42       1     16.5   Pullout
                                                                           2      8.8   Pullout
                                                                           3      7.8   Pullout

      7      1.20      14.00     34.53     11.90     67.45     10.95       1     15.6   Pullout
                                                                           2      9.1   Pullout
                                                                           3      8.0   Pullout

      8      1.21      15.50     35.95     11.49     58.50     11.86       1     15.1   Pullout
                                                                           2      9.9   Pullout
                                                                           3      8.4   Pullout

      9      1.18      17.00     33.47     12.23     56.09     12.19       1     13.2   Pullout
```

```
                                                                           2      8.4   Pullout
                                                                           3      7.6   Pullout

     10      1.20      18.50     29.67     17.03     66.30      9.21       1      7.8   Pullout
                                                                           2      5.9   Pullout
                                                                           3      6.4   Pullout

     11      1.19      20.00     29.34     13.77     51.66     12.90       1      9.5   Pullout
                                                                           2      5.7   Pullout
                                                                           3      6.3   Pullout

Search Level: 3.20 feet below the toe of the wall  Facing Design Force = 5.1 kips (Clouterre)
--------------------------------------------------------------------------------------------------------
|       |         |          |            Failure Planes              |           Reinforcement        |
|       |         |          |----------------------------------------|--------------------------------|
|       | Minimum | Distance |       Lower         |      Upper       |       |        |               |
|       | Factor  | From Toe |----------------------------------------|       |        | Controlling   |
|Search |   of    | of Wall  |  Angle   | Length   |  Angle  | Length  |       | Stress | Resistance    |
|Point  | Safety  |   feet   | degrees  |  feet    | degrees |  feet   | Level |  ksi   | Failure Mode  |
--------------------------------------------------------------------------------------------------------
      1      1.63       5.00     63.00      9.91     86.76      8.84       1     28.9   Pullout
                                                                           2     19.8   Pullout
                                                                           3     13.7   Pullout

      2      1.44       6.50     56.48     10.59     85.79      8.85       1     26.2   Pullout
                                                                           2     17.2   Pullout
                                                                           3     12.3   Pullout

      3      1.38       8.00     44.45     10.09     85.68     10.63       1     23.3   Pullout
                                                                           2     14.3   Pullout
                                                                           3      9.3   Pullout

      4      1.32       9.50     39.56     11.09     84.88     10.64       1     20.5   Pullout
                                                                           2     11.6   Pullout
                                                                           3      7.9   Pullout

      5      1.29      11.00     35.51     12.16     84.07     10.65       1     17.7   Pullout
                                                                           2      9.0   Pullout
                                                                           3      6.6   Pullout

      6      1.26      12.50     35.24     12.24     76.73     10.89       1     16.4   Pullout
                                                                           2      8.6   Pullout
                                                                           3      6.6   Pullout

      7      1.24      14.00     40.06     16.46     78.79      7.20       1     13.1   Pullout
                                                                           2     10.1   Pullout
                                                                           3      8.1   Pullout

      8      1.21      15.50     37.22     17.52     77.63      7.23       1     10.5   Pullout
                                                                           2      8.6   Pullout
                                                                           3      7.2   Pullout
```

```
      9      1.20      17.00     30.69     13.84     64.30     11.76       1     11.0   Pullout
                                                                           2      5.0   Pullout
                                                                           3      4.9   Pullout

     10      1.19      18.50     32.47     13.16     55.07     12.92       1     10.9   Pullout
                                                                           2      6.3   Pullout
                                                                           3      5.6   Pullout

  ** 11      1.17      20.00     30.48     13.92     52.95     13.28       1      9.1   Pullout
                                                                           2      4.8   Pullout
                                                                           3      4.8   Pullout

Search Level: 4.00 feet below the toe of the wall  Facing Design Force = 3.6 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      1.64       5.00     50.90      7.14     87.79     12.93       1     28.8   Pullout
                                                                           2     19.5   Pullout
                                                                           3     10.2   Pullout

      2      1.55       6.50     57.63     10.93     85.97      9.25       1     26.1   Pullout
                                                                           2     17.1   Pullout
                                                                           3     11.7   Pullout

      3      1.42       8.00     52.04     11.71     85.05      9.26       1     23.4   Pullout
                                                                           2     14.5   Pullout
                                                                           3     10.2   Pullout

      4      1.43       9.50     44.17     10.60     80.27     11.24       1     21.3   Pullout
                                                                           2     13.1   Pullout
                                                                           3      8.0   Pullout

      5      1.40      11.00     48.21     14.86     81.53      7.47       1     18.2   Pullout
                                                                           2     12.7   Pullout
                                                                           3      9.2   Pullout

      6      1.34      12.50     40.16     11.45     71.30     11.69       1     17.5   Pullout
                                                                           2     10.5   Pullout
                                                                           3      6.7   Pullout

      7      1.30      14.00     37.00     12.27     69.23     11.85       1     15.2   Pullout
                                                                           2      8.5   Pullout
                                                                           3      5.6   Pullout

      8      1.27      15.50     34.24     13.12     67.23     12.01       1     13.0   Pullout
```

```
                                                                           2      6.5   Pullout
                                                                           3      4.5   Pullout

      9      1.24      17.00     31.82     14.00     65.28     12.19       1     10.8   Pullout
                                                                           2      4.6   Pullout
                                                                           3      3.5   Pullout

     10      1.22      18.50     36.81     18.49     63.39      8.26       1      8.6   Pullout
                                                                           2      6.8   Pullout
                                                                           3      5.5   Pullout

     11      1.20      20.00     34.69     19.46     61.56      8.40       1      6.5   Pullout
                                                                           2      5.6   Pullout
                                                                           3      4.7   Pullout


======================================================================================================
                                           END OF REPORT
======================================================================================================
```

```
======================================================================================================
                                               Snail

                                           Version: 2.2.2

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======================================================================================================
                                          File Information
======================================================================================================

File Name: US 395 RW3 Sta 1550 Temp.snz
Run Date:  11/14/22
Run Time:  14:12:19

======================================================================================================
                                        Project Information
======================================================================================================

Description:    RW3
Location:       US 395
EA:
Project ID:
Wall No.:
Structure No.:
Station:
Engineer:       STC
                Designer

Comments:


======================================================================================================
                                              Geometry
======================================================================================================

Layout:

Reference Point:

At: Top of Wall
Distance From Origin:       40.00 feet
Elevation Above Origin:     30.00 feet

Wall Dimensions:

Wall Height:       14.46 feet
Facing Angle:      90.00 degrees
Facing Batter:     0.000 :12 H:V
```

```
Ground Surface:

Number of lines that define the ground surface above the wall: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Number of lines that define the ground surface in front of the toe: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Soil Layers:

Number of Layers: 2

Layers Below the Top Layer:

Coordinates of the Top of the Layer: feet

             Point 1         Point 1         Point 2         Point 2
Layer       Distance       Elevation        Distance       Elevation
--------------------------------------------------------------------
2              45.00           20.00           60.00           20.00

Ground Water:

Include Ground Water: No

======================================================================================================
                                             Soil Nails
======================================================================================================

Dimensions and Properties:

Maximum Vertical Spacing:               5.00 feet
Number of Soil Nail Rows:                  2
Soil Nail Design Parameters:               Varying

      Soil Nail       Inclination   Vertical   Horizontal      Nail Bar   Nail Bar Yield       Bond
         Length   From Horizontal    Spacing    Spacing H    Diameter Ø      Strength fy   Strength
No.        feet           degrees       feet         feet        inches              ksi   Factor F
---------------------------------------------------------------------------------------------------
1         20.00                15       3.00         4.00         1.000             75.0       1.00
2         15.00                15       4.23         4.00         1.000             75.0       1.00

Facing Resistance:
```

```
                                     Temporary   Permanent     Seismic
ASD Allowable Facing Resistance:          22.2        34.1        46.5 kips

======================================================================================================
                                          Soil Properties
======================================================================================================

                                        Unit Weight  Friction Angle        Cohesion
                                                  γ              φ'              c'
Layer  Description                              pcf         degrees             psf
-----------------------------------------------------------------------------------
1      Fill                                     115            34.0             100
2      Fill                                     120            34.0             100

======================================================================================================
                                               Loads
======================================================================================================

Applied Loads:

Seismic:

Horizontal Seismic Coefficient Kh0.25:

External Load:

Apply external load: No

Surcharges:

Apply surcharges: No

======================================================================================================
                                         Factors of Safety
======================================================================================================

                    Temporary   Permanent     Seismic
Pullout (Distal):        2.00        2.00        1.50
Pullout (Proximal):      2.00        2.00        1.50
Nail Bar Yield:          1.80        1.80        1.35

======================================================================================================
                                           Search Options
======================================================================================================

Search Limits:

Begin:      2.00 feet
End:       15.00 feet
```

```
Below Toe Searches (BTS):

Perform below Toe Search:       Yes
Number of BTS Points:             5
BTS Depth:                     4.00 feet
Interface Friction
Reduction Factor:              0.33

Advanced Search Options:

Use Advanced Search Options:     Yes
Inclination of Interslice Force: Use Average Failure Angle

======================================================================================================
                                               Results
======================================================================================================

Analysis:

Method:          ASD
Scenario:  Temporary

Factor of Safety:

Minimum:                  1.21
Found at Search Point:       4
Found at Grid Point:        38
Found at Search Level:       Toe of the wall

Load at Soil Nail Head:

Calculated Service Load at Soil Nail Head (Empirical), To:    11.5 kips
Allowable Facing Resistance, F_allowable (Entered):           22.2 kips
F_allowable ≥ To OK

Nominal Pullout Resistance:

                    Nominal Pullout Resistance
Layer  Description                         klf
----------------------------------------------
    1  Fill                              2.262
    2  Fill                              2.262

Results by Search Level:

** Indicates Minimum Factor of Safety

Search Level: At the toe of the wall  Facing Design Force = 11.5 kips (Clouterre)
------------------------------------------------------------------------------------------------------
│       │         │          │             Failure Planes             │        Reinforcement          │
│       │         │          │---------------------------------------│-------------------------------│
```

```
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  | Angle   | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      1.62       2.00     67.47      4.70     88.87     10.12       1     25.9   Pullout
                                                                           2     18.8   Pullout

      2      1.34       3.30     62.82      6.50     87.82      8.68       1     24.1   Pullout
                                                                           2     17.1   Pullout

      3      1.22       4.60     54.41      7.11     86.97      8.69       1     22.3   Pullout
                                                                           2     15.4   Pullout

   ** 4      1.21       5.90     47.45      7.85     86.11      8.70       1     20.5   Pullout
                                                                           2     13.7   Pullout

      5      1.35       7.20     48.93      7.67     76.02      8.94       1     19.8   Pullout
                                                                           2     14.1   Pullout

      6      1.48       8.50     48.60      7.71     68.60      9.32       1     18.9   Pullout
                                                                           2     14.0   Pullout

      7      1.51       9.80     44.53     12.37     80.38      5.87       1     15.5   Pullout
                                                                           2     13.0   Pullout

      8      1.55      11.10     40.97     13.23     79.14      5.89       1     13.9   Pullout
                                                                           2     12.1   Pullout

      9      1.63      12.40     41.17     13.18     66.79      6.29       1     13.9   Pullout
                                                                           2     12.2   Pullout

     10      1.69      13.70     32.35      8.11     55.91     12.22       1     14.1   Pullout
                                                                           2     10.5   Pullout

     11      1.73      15.00     30.05      8.66     53.46     12.60       1     12.9   Pullout
                                                                           2      9.6   Pullout

Search Level: 0.80 feet below the toe of the wall  Facing Design Force = 11.5 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  | Angle   | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      1.77       2.00     68.54      4.92     88.93     10.68       1     25.9   Pullout
                                                                           2     18.8   Pullout

      2      1.47       3.30     64.05      6.79     87.94      9.16       1     24.1   Pullout
```

```
                                                                           2      17.1   Pullout

      3      1.33       4.60      55.85       7.38      87.13       9.17       1      22.3   Pullout
                                                                           2      15.4   Pullout

      4      1.30       5.90      48.98       8.09      86.31       9.17       1      20.4   Pullout
                                                                           2      13.6   Pullout

      5      1.32       7.20      43.29       8.90      85.50       9.18       1      18.6   Pullout
                                                                           2      11.9   Pullout

      6      1.38       8.50      41.91       9.14      79.48       9.31       1      17.5   Pullout
                                                                           2      11.4   Pullout

      7      1.43       9.80      41.66       9.18      72.20       9.62       1      16.7   Pullout
                                                                           2      11.3   Pullout

      8      1.51      11.10      42.51       9.03      64.13      10.18       1      16.1   Pullout
                                                                           2      11.6   Pullout

      9      1.55      12.40      39.37      14.44      78.52       6.23       1      12.1   Pullout
                                                                           2      10.6   Pullout

     10      1.60      13.70      39.88      14.28      65.83       6.69       1      12.4   Pullout
                                                                           2      10.8   Pullout

     11      1.68      15.00      31.40       8.79      54.93      13.05       1      12.6   Pullout
                                                                           2       9.1   Pullout

Search Level: 1.60 feet below the toe of the wall  Facing Design Force = 11.4 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |            Failure Planes             |         Reinforcement         |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |        Lower        |      Upper      |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      1.97       2.00      69.52       5.14      88.98      11.24       1      25.9   Pullout
                                                                           2      18.8   Pullout

      2      1.64       3.30      65.19       7.08      88.04       9.64       1      24.1   Pullout
                                                                           2      17.1   Pullout

      3      1.49       4.60      57.20       7.64      87.27       9.65       1      22.2   Pullout
                                                                           2      15.3   Pullout

      4      1.43       5.90      50.42       8.33      86.50       9.65       1      20.4   Pullout
                                                                           2      13.6   Pullout

      5      1.44       7.20      44.75       9.12      85.73       9.66       1      18.6   Pullout
```

```
                                                                           2     11.9   Pullout

      6      1.47       8.50      43.37      9.35     80.00      9.78       1     17.5   Pullout
                                                                           2     11.3   Pullout

      7      1.51       9.80      39.33     10.14     78.50      9.83       1     15.8   Pullout
                                                                           2      9.8   Pullout

      8      1.53      11.10      39.58     10.08     70.94     10.20       1     15.1   Pullout
                                                                           2      9.9   Pullout

      9      1.57      12.40      36.51     10.80     68.89     10.33       1     13.6   Pullout
                                                                           2      8.6   Pullout

     10      1.59      13.70      38.01     10.43     60.37     11.09       1     13.3   Pullout
                                                                           2      9.2   Pullout

     11      1.63      15.00      38.76     15.39     64.97      7.09       1     10.8   Pullout
                                                                           2      9.3   Pullout

Search Level: 2.40 feet below the toe of the wall  Facing Design Force = 10.4 kips (Clouterre)
-------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  | Angle   | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
-------------------------------------------------------------------------------------------------------
      1      2.19       2.00      75.06      6.98     88.87     10.12       1     25.9   Pullout
                                                                           2     18.8   Pullout

      2      1.83       3.30      66.23      7.37     88.13     10.12       1     24.1   Pullout
                                                                           2     17.1   Pullout

      3      1.63       4.60      63.85      9.39     86.88      8.44       1     22.3   Pullout
                                                                           2     15.4   Pullout

      4      1.59       5.90      51.78      8.58     86.66     10.13       1     20.4   Pullout
                                                                           2     13.6   Pullout

      5      1.58       7.20      46.14      9.35     85.93     10.14       1     18.6   Pullout
                                                                           2     11.8   Pullout

      6      1.60       8.50      44.76      9.58     80.46     10.26       1     17.4   Pullout
                                                                           2     11.2   Pullout

      7      1.62       9.80      40.70     10.34     79.04     10.30       1     15.7   Pullout
                                                                           2      9.7   Pullout

      8      1.63      11.10      40.96     10.29     71.78     10.65       1     14.9   Pullout
```

```
                                                                           2      9.7   Pullout

      9      1.64      12.40     42.19     15.06     79.58      6.86       1     12.0   Pullout
                                                                           2      9.4   Pullout

     10      1.66      13.70     39.37     15.95     78.52      6.88       1     10.3   Pullout
                                                                           2      8.4   Pullout

     11      1.67      15.00     40.13     15.70     66.02      7.38       1     10.6   Pullout
                                                                           2      8.7   Pullout

Search Level: 3.20 feet below the toe of the wall  Facing Design Force = 11.5 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes              |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       |  Minimum| Distance |       Lower       |       Upper       |       |        |              |
|       |  Factor | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  |  Safety |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      2.42       2.00     75.71      7.29     88.92     10.60       1     25.9   Pullout
                                                                           2     18.8   Pullout

      2      2.04       3.30     67.20      7.66     88.22     10.60       1     24.1   Pullout
                                                                           2     17.1   Pullout

      3      1.82       4.60     64.88      9.75     87.02      8.84       1     22.3   Pullout
                                                                           2     15.4   Pullout

      4      1.70       5.90     58.98     10.30     86.18      8.85       1     20.5   Pullout
                                                                           2     13.7   Pullout

      5      1.71       7.20     56.88     10.54     80.74      8.95       1     19.2   Pullout
                                                                           2     13.0   Pullout

      6      1.75       8.50     46.09      9.81     80.89     10.73       1     17.3   Pullout
                                                                           2     11.1   Pullout

      7      1.75       9.80     50.23     13.79     82.10      7.13       1     15.3   Pullout
                                                                           2     11.0   Pullout

      8      1.73      11.10     46.69     14.56     81.07      7.15       1     13.6   Pullout
                                                                           2      9.9   Pullout

      9      1.73      12.40     43.52     15.39     80.04      7.17       1     11.9   Pullout
                                                                           2      8.8   Pullout

     10      1.73      13.70     40.68     16.26     79.03      7.20       1     10.2   Pullout
                                                                           2      7.8   Pullout

     11      1.74      15.00     41.45     16.01     66.99      7.67       1     10.4   Pullout
```

```
                                                                                   2      8.1   Pullout

Search Level: 4.00 feet below the toe of the wall  Facing Design Force = 5.8 kips (Clouterre)
-----------------------------------------------------------------------------------------------------
|       |         |          |            Failure Planes             |       Reinforcement           |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |        Lower        |      Upper      |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
| Search|   of    | of Wall  |  Angle   | Length   |  Angle  | Length |       | Stress | Resistance   |
| Point | Safety  |   feet   | degrees  |  feet    | degrees |  feet  | Level |  ksi   | Failure Mode |
-----------------------------------------------------------------------------------------------------
      1      2.67       2.00      76.30       7.60     88.97     11.08       1     25.9   Pullout
                                                                             2     18.8   Pullout

      2      2.26       3.30      72.16       9.70     87.95      9.24       1     24.1   Pullout
                                                                             2     17.1   Pullout

      3      2.02       4.60      65.84      10.12     87.15      9.24       1     22.3   Pullout
                                                                             2     15.4   Pullout

      4      1.98       5.90      62.92      10.37     82.72      9.31       1     20.8   Pullout
                                                                             2     14.4   Pullout

      5      1.99       7.20      61.36      10.52     76.83      9.48       1     19.7   Pullout
                                                                             2     13.9   Pullout

      6      1.91       8.50      57.19      10.98     74.56      9.58       1     18.2   Pullout
                                                                             2     12.6   Pullout

      7      1.85       9.80      53.38      11.50     72.33      9.69       1     16.7   Pullout
                                                                             2     11.3   Pullout

      8      1.88      11.10      43.54      10.72     73.27     11.57       1     14.7   Pullout
                                                                             2      9.3   Pullout

      9      1.85      12.40      48.15      14.87     71.44      7.79       1     13.2   Pullout
                                                                             2      9.5   Pullout

     10      1.83      13.70      45.30      15.58     69.64      7.88       1     11.7   Pullout
                                                                             2      8.5   Pullout

     11      1.82      15.00      42.71      16.33     67.89      7.97       1     10.3   Pullout
                                                                             2      7.5   Pullout


=====================================================================================================
                                          END OF REPORT
=====================================================================================================
```

```
======================================================================================================
                                               Snail

                                           Version: 2.2.2

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======================================================================================================
                                          File Information
======================================================================================================

File Name: US 395 RW3 Sta 1710.snz
Run Date:  11/14/22
Run Time:  21:57:06

======================================================================================================
                                        Project Information
======================================================================================================

Description:    RW3
Location:       US 395
EA:
Project ID:
Wall No.:
Structure No.:
Station:
Engineer:       STC
                Designer

Comments:


======================================================================================================
                                              Geometry
======================================================================================================

Layout:

Reference Point:

At: Top of Wall
Distance From Origin:       40.00 feet
Elevation Above Origin:     30.00 feet

Wall Dimensions:

Wall Height:       12.80 feet
Facing Angle:      90.00 degrees
Facing Batter:     0.000 :12 H:V
```

```
Ground Surface:

Number of lines that define the ground surface above the wall: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Number of lines that define the ground surface in front of the toe: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Soil Layers:

Number of Layers: 2

Layers Below the Top Layer:

Coordinates of the Top of the Layer: feet

             Point 1         Point 1         Point 2         Point 2
Layer       Distance       Elevation        Distance       Elevation
--------------------------------------------------------------------
2              45.00           20.00           60.00           20.00

Ground Water:

Include Ground Water: No

======================================================================================================
                                             Soil Nails
======================================================================================================

Dimensions and Properties:

Maximum Vertical Spacing:               5.00 feet
Number of Soil Nail Rows:                  3
Soil Nail Design Parameters:               Varying

      Soil Nail       Inclination   Vertical   Horizontal      Nail Bar   Nail Bar Yield       Bond
         Length   From Horizontal    Spacing    Spacing H    Diameter Ø      Strength fy   Strength
No.        feet           degrees       feet         feet        inches              ksi   Factor F
---------------------------------------------------------------------------------------------------
1         15.00                15       3.00         5.00         1.000             75.0       1.00
2         15.00                15       3.40         5.00         1.000             75.0       1.00
3         10.00                15       3.40         5.00         1.000             75.0       1.00
```

```
Facing Resistance:

                                     Temporary   Permanent     Seismic
ASD Allowable Facing Resistance:          18.5        34.1        46.5 kips

======================================================================================================
                                          Soil Properties
======================================================================================================

                                        Unit Weight  Friction Angle        Cohesion
                                                  γ              φ'              c'
Layer  Description                              pcf         degrees             psf
-----------------------------------------------------------------------------------
1      Fill                                     115            34.0             100
2      Fill                                     120            34.0             100

======================================================================================================
                                               Loads
======================================================================================================

Applied Loads:

Seismic:

Horizontal Seismic Coefficient Kh0.25:

External Load:

Apply external load: No

Surcharges:

Apply surcharges:    Yes

           Distance from Top of Wall            Load            Load
               Begin             End           Begin             End
No.             feet            feet             psf             psf
--------------------------------------------------------------------
1               0.00           30.00             250             250

======================================================================================================
                                         Factors of Safety
======================================================================================================

                    Temporary   Permanent     Seismic
Pullout (Distal):        2.00        2.00        1.50
Pullout (Proximal):      2.00        2.00        1.50
Nail Bar Yield:          1.80        1.80        1.35

======================================================================================================
                                           Search Options
```

```
======================================================================================================

Search Limits:

Begin:      2.00 feet
End:       15.00 feet

Below Toe Searches (BTS):

Perform below Toe Search:       Yes
Number of BTS Points:             5
BTS Depth:                     4.00 feet
Interface Friction
Reduction Factor:              0.33

Advanced Search Options:

Use Advanced Search Options:     Yes
Inclination of Interslice Force: Use Average Failure Angle

======================================================================================================
                                               Results
======================================================================================================

Analysis:

Method:          ASD
Scenario:  Permanent

Factor of Safety:

Minimum:                  1.50
Found at Search Point:       3
Found at Grid Point:        38
Found at Search Level:       Toe of the wall

Load at Soil Nail Head:

Calculated Service Load at Soil Nail Head (Empirical), To:     8.6 kips
Allowable Facing Resistance, F_allowable (Entered):           34.1 kips
F_allowable ≥ To OK

Nominal Pullout Resistance:

                    Nominal Pullout Resistance
Layer  Description                         klf
----------------------------------------------
    1  Fill                              2.262
    2  Fill                              2.262

Results by Search Level:
```

```
** Indicates Minimum Factor of Safety

Search Level: At the toe of the wall  Facing Design Force = 8.6 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |       Reinforcement           |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      1.62       2.00     58.00      3.02     87.76     10.25       1     18.8   Pullout
                                                                           2     19.0   Pullout
                                                                           3     12.0   Pullout

      2      1.57       3.30     59.88      5.92     87.54      7.69       1     16.9   Pullout
                                                                           2     17.1   Pullout
                                                                           3     12.2   Pullout

   ** 3      1.50       4.60     51.04      6.58     86.57      7.69       1     15.1   Pullout
                                                                           2     15.4   Pullout
                                                                           3     11.4   Pullout

      4      1.51       5.90     47.33      6.96     81.27      7.77       1     13.8   Pullout
                                                                           2     14.6   Pullout
                                                                           3     11.1   Pullout

      5      1.57       7.20     49.84      6.70     69.44      8.20       1     13.4   Pullout
                                                                           2     15.1   Pullout
                                                                           3     11.3   Pullout

      6      1.64       8.50     50.31      6.65     61.04      8.78       1     12.7   Pullout
                                                                           2     15.2   Pullout
                                                                           3     11.4   Pullout

      7      1.68       9.80     38.09      6.23     61.33     10.21       1     11.0   Pullout
                                                                           2     13.4   Pullout
                                                                           3     10.1   Pullout

      8      1.69      11.10     40.86      5.87     53.38     11.16       1     10.6   Pullout
                                                                           2     13.7   Pullout
                                                                           3     10.5   Pullout

      9      1.72      12.40     37.75      6.27     50.30     11.65       1      9.5   Pullout
                                                                           2     13.0   Pullout
                                                                           3     10.1   Pullout

     10      1.75      13.70     35.02      6.69     47.47     12.16       1      8.5   Pullout
                                                                           2     12.2   Pullout
                                                                           3      9.8   Pullout
```

```
    11     1.78      15.00     32.62      7.12     44.87     12.70       1      7.5  Pullout
                                                                           2     11.5  Pullout
                                                                           3      9.5  Pullout

Search Level: 0.80 feet below the toe of the wall  Facing Design Force = 7.8 kips (Clouterre)
------------------------------------------------------------------------------------------------------
│       │         │          │             Failure Planes            │        Reinforcement          │
│       │         │          │---------------------------------------│-------------------------------│
│       │ Minimum │ Distance │       Lower       │       Upper       │       │        │              │
│       │ Factor  │ From Toe │---------------------------------------│       │        │ Controlling  │
│Search │   of    │ of Wall  │  Angle  │ Length  │  Angle  │ Length  │       │ Stress │ Resistance   │
│Point  │ Safety  │   feet   │ degrees │  feet   │ degrees │  feet   │ Level │  ksi   │ Failure Mode │
------------------------------------------------------------------------------------------------------
     1     1.75       2.00     56.51      3.26     88.95     10.88       1     18.7  Pullout
                                                                           2     18.8  Pullout
                                                                           3     11.7  Pullout

     2     1.65       3.30     45.86      3.79     86.53     10.90       1     17.0  Pullout
                                                                           2     17.3  Pullout
                                                                           3     10.4  Pullout

     3     1.55       4.60     52.73      6.84     86.77      8.17       1     15.1  Pullout
                                                                           2     15.4  Pullout
                                                                           3     10.8  Pullout

     4     1.54       5.90     49.05      7.20     81.77      8.24       1     13.8  Pullout
                                                                           2     14.5  Pullout
                                                                           3     10.4  Pullout

     5     1.53       7.20     47.19      7.42     75.17      8.44       1     12.7  Pullout
                                                                           2     13.9  Pullout
                                                                           3     10.2  Pullout

     6     1.54       8.50     42.44      8.06     72.65      8.55       1     11.2  Pullout
                                                                           2     12.7  Pullout
                                                                           3      9.6  Pullout

     7     1.55       9.80     42.77      8.01     64.34      9.05       1     10.6  Pullout
                                                                           2     12.7  Pullout
                                                                           3      9.7  Pullout

     8     1.57      11.10     39.24      4.30     54.47     13.37       1     10.4  Pullout
                                                                           2     13.4  Pullout
                                                                           3      9.3  Pullout

     9     1.59      12.40     36.17      4.61     51.42     13.92       1      9.3  Pullout
                                                                           2     12.6  Pullout
                                                                           3      8.8  Pullout

    10     1.64      13.70     36.67      6.83     49.19     12.58       1      8.1  Pullout
```

```
                                                                            2    11.7   Pullout
                                                                            3     8.8   Pullout

     11      1.67      15.00     34.22      7.26     46.61     13.10        1     7.1   Pullout
                                                                            2    11.0   Pullout
                                                                            3     8.4   Pullout

Search Level: 1.60 feet below the toe of the wall  Facing Design Force = 7.0 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      1.99       2.00     58.00      3.40     89.01     11.52        1    18.7   Pullout
                                                                            2    18.8   Pullout
                                                                            3    11.7   Pullout

      2      1.81       3.30     62.72      6.48     87.81      8.65        1    16.9   Pullout
                                                                            2    17.1   Pullout
                                                                            3    11.3   Pullout

      3      1.67       4.60     54.29      7.09     86.95      8.65        1    15.1   Pullout
                                                                            2    15.3   Pullout
                                                                            3    10.3   Pullout

      4      1.63       5.90     50.67      7.45     82.22      8.72        1    13.7   Pullout
                                                                            2    14.4   Pullout
                                                                            3     9.8   Pullout

      5      1.60       7.20     48.81      7.65     75.96      8.91        1    12.6   Pullout
                                                                            2    13.8   Pullout
                                                                            3     9.5   Pullout

      6      1.59       8.50     44.07      8.28     73.56      9.01        1    11.1   Pullout
                                                                            2    12.5   Pullout
                                                                            3     8.9   Pullout

      7      1.58       9.80     44.41      8.23     65.60      9.49        1    10.4   Pullout
                                                                            2    12.4   Pullout
                                                                            3     8.9   Pullout

      8      1.58      11.10     40.86      8.81     62.80      9.71        1     9.1   Pullout
                                                                            2    11.4   Pullout
                                                                            3     8.3   Pullout

      9      1.59      12.40     42.89      8.46     54.34     10.63        1     8.8   Pullout
                                                                            2    11.8   Pullout
                                                                            3     8.7   Pullout
```

```
     10      1.60      13.70     40.06      8.95     51.59     11.03       1      7.7   Pullout
                                                                           2     11.0   Pullout
                                                                           3      8.2   Pullout

     11      1.61      15.00     37.52      9.46     49.04     11.44       1      6.6   Pullout
                                                                           2     10.2   Pullout
                                                                           3      7.8   Pullout

Search Level: 2.40 feet below the toe of the wall  Facing Design Force = 5.9 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      2.12       2.00     68.46      4.90     88.92     10.64       1     18.7   Pullout
                                                                           2     18.8   Pullout
                                                                           3     11.7   Pullout

      2      1.84       3.30     56.92      5.44     88.22     10.65       1     16.9   Pullout
                                                                           2     17.0   Pullout
                                                                           3     10.0   Pullout

      3      1.74       4.60     61.42      8.65     86.54      7.61       1     15.1   Pullout
                                                                           2     15.4   Pullout
                                                                           3     10.6   Pullout

      4      1.76       5.90     52.18      7.70     82.63      9.20       1     13.7   Pullout
                                                                           2     14.3   Pullout
                                                                           3      9.2   Pullout

      5      1.71       7.20     50.34      7.90     76.68      9.37       1     12.5   Pullout
                                                                           2     13.6   Pullout
                                                                           3      8.9   Pullout

      6      1.68       8.50     45.62      8.51     74.38      9.47       1     11.0   Pullout
                                                                           2     12.3   Pullout
                                                                           3      8.2   Pullout

      7      1.65       9.80     45.96      8.46     66.74      9.93       1     10.2   Pullout
                                                                           2     12.2   Pullout
                                                                           3      8.2   Pullout

      8      1.64      11.10     42.39      9.02     64.04     10.14       1      8.9   Pullout
                                                                           2     11.1   Pullout
                                                                           3      7.6   Pullout

      9      1.63      12.40     44.44      8.68     55.79     11.03       1      8.5   Pullout
```

```
                                                                           2     11.4   Pullout
                                                                           3      8.0   Pullout

     10      1.63      13.70     41.59      9.16     53.09     11.41       1      7.4   Pullout
                                                                           2     10.6   Pullout
                                                                           3      7.4   Pullout

     11      1.63      15.00     39.03      9.65     50.57     11.81       1      6.3   Pullout
                                                                           2      9.7   Pullout
                                                                           3      6.9   Pullout

Search Level: 3.20 feet below the toe of the wall  Facing Design Force = 5.2 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      2.38       2.00     69.44      5.13     88.98     11.20       1     18.7   Pullout
                                                                           2     18.8   Pullout
                                                                           3     11.7   Pullout

      2      2.07       3.30     58.25      5.64     88.31     11.20       1     16.8   Pullout
                                                                           2     17.0   Pullout
                                                                           3      9.9   Pullout

      3      1.91       4.60     62.64      9.01     86.71      8.01       1     15.1   Pullout
                                                                           2     15.4   Pullout
                                                                           3     10.2   Pullout

      4      1.80       5.90     56.43      9.60     85.78      8.02       1     13.3   Pullout
                                                                           2     13.7   Pullout
                                                                           3      9.2   Pullout

      5      1.76       7.20     54.25      9.86     79.80      8.13       1     12.1   Pullout
                                                                           2     13.0   Pullout
                                                                           3      8.8   Pullout

      6      1.78       8.50     48.48      6.41     69.22     11.98       1     11.6   Pullout
                                                                           2     13.4   Pullout
                                                                           3      7.9   Pullout

      7      1.74       9.80     53.68      9.93     63.90      8.91       1     10.6   Pullout
                                                                           2     12.8   Pullout
                                                                           3      8.7   Pullout

      8      1.72      11.10     47.23      6.54     59.26     13.03       1      9.6   Pullout
                                                                           2     12.2   Pullout
                                                                           3      7.6   Pullout
```

```
      9      1.70      12.40     44.06      6.90     56.41     13.45       1      8.4   Pullout
                                                                           2     11.3   Pullout
                                                                           3      6.9   Pullout

     10      1.69      13.70     43.06      9.37     54.49     11.79       1      7.1   Pullout
                                                                           2     10.2   Pullout
                                                                           3      6.7   Pullout

     11      1.69      15.00     40.48      9.86     52.00     12.18       1      6.0   Pullout
                                                                           2      9.3   Pullout
                                                                           3      6.2   Pullout

Search Level: 4.00 feet below the toe of the wall  Facing Design Force = 5.0 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes             |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      2.66       2.00     70.35      5.35     89.03     11.76       1     18.7   Pullout
                                                                           2     18.8   Pullout
                                                                           3     11.7   Pullout

      2      2.35       3.30     70.53      8.91     87.75      8.41       1     16.9   Pullout
                                                                           2     17.1   Pullout
                                                                           3     11.0   Pullout

      3      2.17       4.60     66.34      9.17     83.75      8.45       1     15.4   Pullout
                                                                           2     16.0   Pullout
                                                                           3     10.3   Pullout

      4      2.08       5.90     63.82      9.36     78.10      8.58       1     14.2   Pullout
                                                                           2     15.2   Pullout
                                                                           3      9.9   Pullout

      5      2.04       7.20     62.78      9.45     71.08      8.88       1     13.2   Pullout
                                                                           2     14.8   Pullout
                                                                           3      9.7   Pullout

      6      1.94       8.50     58.74      9.83     67.96      9.06       1     11.8   Pullout
                                                                           2     13.7   Pullout
                                                                           3      9.0   Pullout

      7      1.86       9.80     55.01     10.25     64.98      9.27       1     10.5   Pullout
                                                                           2     12.6   Pullout
                                                                           3      8.2   Pullout

      8      1.81      11.10     51.59     10.72     62.14      9.50       1      9.2   Pullout
```

```
                                                                           2     11.5   Pullout
                                                                           3      7.6   Pullout

      9      1.80      12.40     48.47     11.22     59.44      9.76       1      7.9   Pullout
                                                                           2     10.5   Pullout
                                                                           3      6.9   Pullout

     10      1.78      13.70     44.45      9.60     55.80     12.19       1      6.9   Pullout
                                                                           2      9.8   Pullout
                                                                           3      6.0   Pullout

     11      1.77      15.00     41.86     10.07     53.35     12.56       1      5.7   Pullout
                                                                           2      8.9   Pullout
                                                                           3      5.4   Pullout


======================================================================================================
                                           END OF REPORT
======================================================================================================
```

```
======================================================================================================
                                               Snail

                                           Version: 2.2.2

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======================================================================================================
                                          File Information
======================================================================================================

File Name: US 395 RW3 Sta 1710 Seismic.snz
Run Date:  11/14/22
Run Time:  21:59:52

======================================================================================================
                                        Project Information
======================================================================================================

Description:    RW3
Location:       US 395
EA:
Project ID:
Wall No.:
Structure No.:
Station:
Engineer:       STC
                Designer

Comments:


======================================================================================================
                                              Geometry
======================================================================================================

Layout:

Reference Point:

At: Top of Wall
Distance From Origin:       40.00 feet
Elevation Above Origin:     30.00 feet

Wall Dimensions:

Wall Height:       12.80 feet
Facing Angle:      90.00 degrees
Facing Batter:     0.000 :12 H:V
```

```
Ground Surface:

Number of lines that define the ground surface above the wall: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Number of lines that define the ground surface in front of the toe: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Soil Layers:

Number of Layers: 2

Layers Below the Top Layer:

Coordinates of the Top of the Layer: feet

             Point 1         Point 1         Point 2         Point 2
Layer       Distance       Elevation        Distance       Elevation
--------------------------------------------------------------------
2              45.00           20.00           60.00           20.00

Ground Water:

Include Ground Water: No

======================================================================================================
                                             Soil Nails
======================================================================================================

Dimensions and Properties:

Maximum Vertical Spacing:               5.00 feet
Number of Soil Nail Rows:                  3
Soil Nail Design Parameters:               Varying

      Soil Nail       Inclination   Vertical   Horizontal      Nail Bar   Nail Bar Yield       Bond
         Length   From Horizontal    Spacing    Spacing H    Diameter Ø      Strength fy   Strength
No.        feet           degrees       feet         feet        inches              ksi   Factor F
---------------------------------------------------------------------------------------------------
1         15.00                15       3.00         5.00         1.000             75.0       1.00
2         15.00                15       3.40         5.00         1.000             75.0       1.00
3         10.00                15       3.40         5.00         1.000             75.0       1.00
```

```
Facing Resistance:

                                     Temporary   Permanent     Seismic
ASD Allowable Facing Resistance:          18.5        34.1        46.5 kips

======================================================================================================
                                          Soil Properties
======================================================================================================

                                        Unit Weight  Friction Angle        Cohesion
                                                  γ              φ'              c'
Layer  Description                              pcf         degrees             psf
-----------------------------------------------------------------------------------
1      Fill                                     115            34.0             100
2      Fill                                     120            34.0             100

======================================================================================================
                                               Loads
======================================================================================================

Applied Loads:

Seismic:

Horizontal Seismic Coefficient Kh0.25:

External Load:

Apply external load: No

Surcharges:

Apply surcharges:    Yes

           Distance from Top of Wall            Load            Load
               Begin             End           Begin             End
No.             feet            feet             psf             psf
--------------------------------------------------------------------
1               0.00           30.00             250             250

======================================================================================================
                                         Factors of Safety
======================================================================================================

                    Temporary   Permanent     Seismic
Pullout (Distal):        2.00        2.00        1.50
Pullout (Proximal):      2.00        2.00        1.50
Nail Bar Yield:          1.80        1.80        1.35

======================================================================================================
                                           Search Options
```

```
======================================================================================================

Search Limits:

Begin:      2.00 feet
End:       15.00 feet

Below Toe Searches (BTS):

Perform below Toe Search:       Yes
Number of BTS Points:             5
BTS Depth:                     4.00 feet
Interface Friction
Reduction Factor:              0.33

Advanced Search Options:

Use Advanced Search Options:     Yes
Inclination of Interslice Force: Use Average Failure Angle

======================================================================================================
                                               Results
======================================================================================================

Analysis:

Method:          ASD
Scenario:    Seismic

Factor of Safety:

Minimum:                  1.20
Found at Search Point:      10
Found at Grid Point:        35
Found at Search Level:    1.60 feet below the toe of the wall

Load at Soil Nail Head:

Calculated Service Load at Soil Nail Head (Empirical), To:     7.0 kips
Allowable Facing Resistance, F_allowable (Entered):           46.5 kips
F_allowable ≥ To OK

Nominal Pullout Resistance:

                    Nominal Pullout Resistance
Layer  Description                         klf
----------------------------------------------
    1  Fill                              2.262
    2  Fill                              2.262

Results by Search Level:
```

```
** Indicates Minimum Factor of Safety

Search Level: At the toe of the wall  Facing Design Force = 10.9 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes             |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      1.56       2.00     58.00      3.02     87.76     10.25       1     25.1   Pullout
                                                                           2     25.4   Pullout
                                                                           3     16.0   Pullout

      2      1.52       3.30     59.88      5.92     87.54      7.69       1     22.6   Pullout
                                                                           2     22.9   Pullout
                                                                           3     16.2   Pullout

      3      1.33       4.60     51.04      6.58     86.57      7.69       1     20.2   Pullout
                                                                           2     20.6   Pullout
                                                                           3     15.2   Pullout

      4      1.31       5.90     47.33      6.96     81.27      7.77       1     18.4   Pullout
                                                                           2     19.4   Pullout
                                                                           3     14.8   Pullout

      5      1.40       7.20     33.69      6.92     80.87      9.07       1     16.0   Pullout
                                                                           2     17.0   Pullout
                                                                           3     12.8   Pullout

      6      1.38       8.50     32.84      7.08     74.11      9.32       1     14.7   Pullout
                                                                           2     16.5   Pullout
                                                                           3     12.7   Pullout

      7      1.37       9.80     29.24      7.86     71.84      9.43       1     12.7   Pullout
                                                                           2     14.7   Pullout
                                                                           3     12.0   Pullout

      8      1.35      11.10     29.97      7.69     63.64     10.00       1     11.9   Pullout
                                                                           2     14.9   Pullout
                                                                           3     12.1   Pullout

      9      1.34      12.40     27.30      8.37     61.03     10.24       1     10.2   Pullout
                                                                           2     13.5   Pullout
                                                                           3     11.6   Pullout

     10      1.33      13.70     25.04      9.07     58.55     10.50       1      8.5   Pullout
                                                                           2     12.1   Pullout
                                                                           3     11.1   Pullout
```

```
     11      1.33      15.00     23.11      9.78     56.19     10.78       1      6.9   Pullout
                                                                           2     10.7   Pullout
                                                                           3     10.6   Pullout

Search Level: 0.80 feet below the toe of the wall  Facing Design Force = 8.9 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      1.61       2.00     56.51      3.26     88.95     10.88       1     25.0   Pullout
                                                                           2     25.1   Pullout
                                                                           3     15.6   Pullout

      2      1.36       3.30     42.48      4.03     88.26     10.89       1     22.5   Pullout
                                                                           2     22.7   Pullout
                                                                           3     13.3   Pullout

      3      1.31       4.60     36.47      4.58     85.17     10.92       1     20.4   Pullout
                                                                           2     20.9   Pullout
                                                                           3     11.9   Pullout

      4      1.26       5.90     45.69      7.60     85.87      8.18       1     17.7   Pullout
                                                                           2     18.2   Pullout
                                                                           3     13.4   Pullout

      5      1.21       7.20     40.01      8.46     84.96      8.19       1     15.3   Pullout
                                                                           2     15.9   Pullout
                                                                           3     12.4   Pullout

      6      1.26       8.50     42.44      8.06     72.65      8.55       1     14.9   Pullout
                                                                           2     16.9   Pullout
                                                                           3     12.8   Pullout

      7      1.26       9.80     34.76      4.77     61.61     12.37       1     14.6   Pullout
                                                                           2     17.8   Pullout
                                                                           3     11.4   Pullout

      8      1.29      11.10     31.49      7.81     65.00     10.50       1     11.7   Pullout
                                                                           2     14.5   Pullout
                                                                           3     10.6   Pullout

      9      1.27      12.40     36.17      4.61     51.42     13.92       1     12.4   Pullout
                                                                           2     16.9   Pullout
                                                                           3     11.7   Pullout

     10      1.26      13.70     30.78      7.97     54.26     11.73       1      9.6   Pullout
```

```
                                                                           2     13.6   Pullout
                                                                           3     10.5   Pullout

     11      1.25      15.00     28.55      8.54     51.77     12.12       1      8.1   Pullout
                                                                           2     12.5   Pullout
                                                                           3      9.9   Pullout

Search Level: 1.60 feet below the toe of the wall  Facing Design Force = 7.0 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes           |        Reinforcement          |
|       |         |          |---------------------------------------|------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      1.80       2.00     58.00      3.40     89.01     11.52       1     24.9   Pullout
                                                                           2     25.1   Pullout
                                                                           3     15.6   Pullout

      2      1.53       3.30     44.12      4.14     88.36     11.52       1     22.5   Pullout
                                                                           2     22.7   Pullout
                                                                           3     13.2   Pullout

      3      1.44       4.60     34.82      5.04     87.71     11.53       1     20.0   Pullout
                                                                           2     20.3   Pullout
                                                                           3     10.9   Pullout

      4      1.33       5.90     47.33      7.83     86.09      8.66       1     17.7   Pullout
                                                                           2     18.1   Pullout
                                                                           3     12.4   Pullout

      5      1.27       7.20     41.63      8.67     85.24      8.67       1     15.3   Pullout
                                                                           2     15.8   Pullout
                                                                           3     11.3   Pullout

      6      1.24       8.50     36.98      9.58     84.38      8.68       1     12.9   Pullout
                                                                           2     13.6   Pullout
                                                                           3     10.2   Pullout

      7      1.22       9.80     36.30      9.73     77.22      8.86       1     11.7   Pullout
                                                                           2     13.2   Pullout
                                                                           3     10.1   Pullout

      8      1.21      11.10     36.55      9.67     68.92      9.26       1     10.9   Pullout
                                                                           2     13.2   Pullout
                                                                           3     10.1   Pullout

      9      1.22      12.40     37.75      9.41     60.14      9.96       1     10.4   Pullout
                                                                           2     13.8   Pullout
                                                                           3     10.4   Pullout
```

```
  ** 10      1.20      13.70     35.02     10.04     57.62     10.23       1      8.8   Pullout
                                                                           2     12.4   Pullout
                                                                           3      9.8   Pullout

     11      1.20      15.00     25.64      6.66     52.00     14.62       1      8.0   Pullout
                                                                           2     12.4   Pullout
                                                                           3      7.1   Pullout

Search Level: 2.40 feet below the toe of the wall  Facing Design Force = 5.9 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      1.95       2.00     68.46      4.90     88.92     10.64       1     25.0   Pullout
                                                                           2     25.1   Pullout
                                                                           3     15.6   Pullout

      2      1.58       3.30     56.92      5.44     88.22     10.65       1     22.5   Pullout
                                                                           2     22.7   Pullout
                                                                           3     13.3   Pullout

      3      1.54       4.60     61.42      8.65     86.54      7.61       1     20.2   Pullout
                                                                           2     20.6   Pullout
                                                                           3     14.1   Pullout

      4      1.43       5.90     48.87      8.07     86.30      9.14       1     17.7   Pullout
                                                                           2     18.1   Pullout
                                                                           3     11.6   Pullout

      5      1.35       7.20     43.18      8.89     85.49      9.15       1     15.2   Pullout
                                                                           2     15.8   Pullout
                                                                           3     10.3   Pullout

      6      1.30       8.50     38.48      9.77     84.68      9.16       1     12.9   Pullout
                                                                           2     13.5   Pullout
                                                                           3      9.1   Pullout

      7      1.28       9.80     37.79      9.92     77.87      9.33       1     11.6   Pullout
                                                                           2     13.0   Pullout
                                                                           3      8.9   Pullout

      8      1.26      11.10     34.40     10.76     76.32      9.39       1      9.4   Pullout
                                                                           2     11.0   Pullout
                                                                           3      7.9   Pullout

      9      1.23      12.40     35.01     10.60     67.81      9.85       1      8.8   Pullout
```

```
                                                                               2     11.3   Pullout
                                                                               3      8.1   Pullout

     10      1.22      13.70     32.37      11.35      65.74      10.00        1      6.9   Pullout
                                                                               2      9.6   Pullout
                                                                               3      7.3   Pullout

     11      1.21      15.00     34.04      10.86      56.66      10.92        1      6.8   Pullout
                                                                               2     10.6   Pullout
                                                                               3      7.8   Pullout

Search Level: 3.20 feet below the toe of the wall  Facing Design Force = 5.6 kips (Clouterre)
-----------------------------------------------------------------------------------------------------------
|       |         |          |              Failure Planes              |          Reinforcement          |
|       |         |          |------------------------------------------|---------------------------------|
|       | Minimum | Distance |       Lower        |        Upper        |        |        |               |
|       | Factor  | From Toe |------------------------------------------|        |        |  Controlling  |
|Search |   of    | of Wall  |  Angle  |  Length  |  Angle   |  Length  |        | Stress | Resistance    |
|Point  | Safety  |   feet   | degrees |   feet   | degrees  |   feet   | Level  |  ksi   | Failure Mode  |
-----------------------------------------------------------------------------------------------------------
      1      2.15       2.00     69.44       5.13      88.98      11.20        1     24.9   Pullout
                                                                               2     25.1   Pullout
                                                                               3     15.6   Pullout

      2      1.77       3.30     58.25       5.64      88.31      11.20        1     22.5   Pullout
                                                                               2     22.7   Pullout
                                                                               3     13.3   Pullout

      3      1.57       4.60     49.22       6.34      87.65      11.21        1     20.0   Pullout
                                                                               2     20.3   Pullout
                                                                               3     10.9   Pullout

      4      1.50       5.90     45.48       6.73      83.99      11.26        1     18.0   Pullout
                                                                               2     18.7   Pullout
                                                                               3      9.8   Pullout

      5      1.45       7.20     43.60       6.96      79.09      11.41        1     16.3   Pullout
                                                                               2     17.5   Pullout
                                                                               3      9.2   Pullout

      6      1.41       8.50     43.26       9.34      79.96       9.75        1     13.7   Pullout
                                                                               2     14.8   Pullout
                                                                               3      9.0   Pullout

      7      1.36       9.80     39.23      10.12      78.46       9.80        1     11.5   Pullout
                                                                               2     12.8   Pullout
                                                                               3      7.8   Pullout

      8      1.32      11.10     35.78      10.95      76.98       9.85        1      9.3   Pullout
                                                                               2     10.8   Pullout
                                                                               3      6.7   Pullout
```

```
      9       1.29      12.40     36.40     10.78     68.82     10.30        1      8.6   Pullout
                                                                             2     10.9   Pullout
                                                                             3      6.9   Pullout

     10       1.27      13.70     33.72     11.53     66.82     10.44        1      6.7   Pullout
                                                                             2      9.3   Pullout
                                                                             3      6.0   Pullout

     11       1.25      15.00     35.42     11.04     58.00     11.32        1      6.5   Pullout
                                                                             2     10.1   Pullout
                                                                             3      6.6   Pullout

Search Level: 4.00 feet below the toe of the wall  Facing Design Force = 5.4 kips (Clouterre)
--------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes             |          Reinforcement          |
|       |         |          |----------------------------------------|---------------------------------|
|       | Minimum | Distance |       Lower        |      Upper        |       |         |              |
|       | Factor  | From Toe |----------------------------------------|       |         |  Controlling |
|Search |   of    | of Wall  |  Angle   | Length  |  Angle  | Length  |       |  Stress | Resistance   |
|Point  | Safety  |   feet   | degrees  |  feet   | degrees |  feet   | Level |   ksi   | Failure Mode |
--------------------------------------------------------------------------------------------------------
      1       2.36       2.00     70.35      5.35     89.03     11.76        1     24.9   Pullout
                                                                             2     25.1   Pullout
                                                                             3     15.6   Pullout

      2       1.96       3.30     59.49      5.85     88.39     11.76        1     22.5   Pullout
                                                                             2     22.6   Pullout
                                                                             3     13.2   Pullout

      3       1.82       4.60     63.76      9.36     86.87      8.41        1     20.1   Pullout
                                                                             2     20.5   Pullout
                                                                             3     13.1   Pullout

      4       1.72       5.90     60.67      9.64     82.00      8.48        1     18.3   Pullout
                                                                             2     19.2   Pullout
                                                                             3     12.4   Pullout

      5       1.67       7.20     59.04      9.80     75.58      8.67        1     16.8   Pullout
                                                                             2     18.5   Pullout
                                                                             3     12.0   Pullout

      6       1.55       8.50     54.69     10.29     73.11      8.78        1     14.8   Pullout
                                                                             2     16.7   Pullout
                                                                             3     10.9   Pullout

      7       1.56       9.80     55.01     10.25     64.98      9.27        1     14.0   Pullout
                                                                             2     16.8   Pullout
                                                                             3     11.0   Pullout

      8       1.43      11.10     42.24      7.50     64.74     13.00        1     11.7   Pullout
```

```
                                                                           2     14.5   Pullout
                                                                           3      7.8   Pullout

      9      1.37       12.40      42.09      10.03      63.80      11.23       1      9.6   Pullout
                                                                           2     12.6   Pullout
                                                                           3      7.3   Pullout

     10      1.33       13.70      39.27      10.62      61.47      11.47       1      7.9   Pullout
                                                                           2     11.1   Pullout
                                                                           3      6.4   Pullout

     11      1.30       15.00      36.75      11.23      59.24      11.73       1      6.1   Pullout
                                                                           2      9.6   Pullout
                                                                           3      5.5   Pullout


======================================================================================================
                                           END OF REPORT
======================================================================================================
```

```
======================================================================================================
                                               Snail

                                           Version: 2.2.2

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======================================================================================================
                                          File Information
======================================================================================================

File Name: US 395 RW3 Sta 1710 Temp.snz
Run Date:  11/14/22
Run Time:  22:07:39

======================================================================================================
                                        Project Information
======================================================================================================

Description:    RW3
Location:       US 395
EA:
Project ID:
Wall No.:
Structure No.:
Station:
Engineer:       STC
                Designer

Comments:


======================================================================================================
                                              Geometry
======================================================================================================

Layout:

Reference Point:

At: Top of Wall
Distance From Origin:       40.00 feet
Elevation Above Origin:     30.00 feet

Wall Dimensions:

Wall Height:       12.80 feet
Facing Angle:      90.00 degrees
Facing Batter:     0.000 :12 H:V
```

```
Ground Surface:

Number of lines that define the ground surface above the wall: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Number of lines that define the ground surface in front of the toe: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Soil Layers:

Number of Layers: 2

Layers Below the Top Layer:

Coordinates of the Top of the Layer: feet

             Point 1         Point 1         Point 2         Point 2
Layer       Distance       Elevation        Distance       Elevation
--------------------------------------------------------------------
2              45.00           20.00           60.00           20.00

Ground Water:

Include Ground Water: No

======================================================================================================
                                             Soil Nails
======================================================================================================

Dimensions and Properties:

Maximum Vertical Spacing:               5.00 feet
Number of Soil Nail Rows:                  2
Soil Nail Design Parameters:               Varying

      Soil Nail       Inclination   Vertical   Horizontal      Nail Bar   Nail Bar Yield       Bond
         Length   From Horizontal    Spacing    Spacing H    Diameter Ø      Strength fy   Strength
No.        feet           degrees       feet         feet        inches              ksi   Factor F
---------------------------------------------------------------------------------------------------
1         15.00                15       3.00         5.00         1.000             75.0       1.00
2         15.00                15       3.40         5.00         1.000             75.0       1.00

Facing Resistance:
```

```
                                     Temporary   Permanent     Seismic
ASD Allowable Facing Resistance:          18.5        34.1        46.5 kips

======================================================================================================
                                          Soil Properties
======================================================================================================

                                        Unit Weight  Friction Angle        Cohesion
                                                  γ              φ'              c'
Layer  Description                              pcf         degrees             psf
-----------------------------------------------------------------------------------
1      Fill                                     115            34.0             100
2      Fill                                     120            34.0             100

======================================================================================================
                                               Loads
======================================================================================================

Applied Loads:

Seismic:

Horizontal Seismic Coefficient Kh0.25:

External Load:

Apply external load: No

Surcharges:

Apply surcharges: No

======================================================================================================
                                         Factors of Safety
======================================================================================================

                    Temporary   Permanent     Seismic
Pullout (Distal):        2.00        2.00        1.50
Pullout (Proximal):      2.00        2.00        1.50
Nail Bar Yield:          1.80        1.80        1.35

======================================================================================================
                                           Search Options
======================================================================================================

Search Limits:

Begin:      2.00 feet
End:       15.00 feet
```

```
Below Toe Searches (BTS):

Perform below Toe Search:       Yes
Number of BTS Points:             5
BTS Depth:                     4.00 feet
Interface Friction
Reduction Factor:              0.33

Advanced Search Options:

Use Advanced Search Options:     Yes
Inclination of Interslice Force: Use Average Failure Angle

=======================================================================================================
                                               Results
=======================================================================================================

Analysis:

Method:          ASD
Scenario:  Temporary

Factor of Safety:

Minimum:                  1.19
Found at Search Point:       3
Found at Grid Point:        38
Found at Search Level:       Toe of the wall

Load at Soil Nail Head:

Calculated Service Load at Soil Nail Head (Empirical), To:     8.6 kips
Allowable Facing Resistance, F_allowable (Entered):           18.5 kips
F_allowable ≥ To OK

Nominal Pullout Resistance:

                    Nominal Pullout Resistance
Layer  Description                         klf
----------------------------------------------
    1  Fill                               2.262
    2  Fill                               2.262

Results by Search Level:

** Indicates Minimum Factor of Safety

Search Level: At the toe of the wall  Facing Design Force = 8.6 kips (Clouterre)
-------------------------------------------------------------------------------------------------------
│       │         │           │            Failure Planes                │       Reinforcement          │
│       │         │           │---------------------------------------│-------------------------------│
```

```
|       | Minimum  | Distance  |        Lower        |        Upper        |       |        |                   |
|       | Factor   | From Toe  |-------------------------------------------|       |        | Controlling       |
|Search |   of     | of Wall   |  Angle   |  Length  |  Angle   |  Length  |       | Stress | Resistance        |
|Point  | Safety   |  feet     | degrees  |   feet   | degrees  |   feet   | Level |  ksi   | Failure Mode      |
--------------------------------------------------------------------------------------------------------------
      1      1.53        2.00      64.89       4.24      88.72       8.96       1     18.7   Pullout
                                                                               2     18.8   Pullout

      2      1.26        3.30      59.88       5.92      87.54       7.69       1     16.9   Pullout
                                                                               2     17.1   Pullout

   ** 3      1.19        4.60      51.04       6.58      86.57       7.69       1     15.1   Pullout
                                                                               2     15.4   Pullout

      4      1.24        5.90      47.33       6.96      81.27       7.77       1     13.8   Pullout
                                                                               2     14.6   Pullout

      5      1.40        7.20      49.84       6.70      69.44       8.20       1     13.4   Pullout
                                                                               2     15.1   Pullout

      6      1.49        8.50      36.98       6.38      69.22       9.58       1     11.6   Pullout
                                                                               2     13.4   Pullout

      7      1.54        9.80      38.09       6.23      61.33      10.21       1     11.0   Pullout
                                                                               2     13.4   Pullout

      8      1.58       11.10      34.68       6.75      58.23      10.54       1      9.8   Pullout
                                                                               2     12.5   Pullout

      9      1.63       12.40      31.77       7.29      55.32      10.90       1      8.6   Pullout
                                                                               2     11.6   Pullout

     10      1.68       13.70      35.02       6.69      47.47      12.16       1      8.5   Pullout
                                                                               2     12.2   Pullout

     11      1.72       15.00      32.62       7.12      44.87      12.70       1      7.5   Pullout
                                                                               2     11.5   Pullout

Search Level: 0.80 feet below the toe of the wall  Facing Design Force = 8.6 kips (Clouterre)
--------------------------------------------------------------------------------------------------------------
|       |          |           |              Failure Planes                  |           Reinforcement           |
|       |          |           |----------------------------------------------|-----------------------------------|
|       | Minimum  | Distance  |        Lower        |        Upper           |       |        |                   |
|       | Factor   | From Toe  |----------------------------------------------|       |        | Controlling       |
|Search |   of     | of Wall   |  Angle   |  Length  |  Angle   |  Length     |       | Stress | Resistance        |
|Point  | Safety   |  feet     | degrees  |   feet   | degrees  |   feet      | Level |  ksi   | Failure Mode      |
--------------------------------------------------------------------------------------------------------------
      1      1.73        2.00      66.19       4.46      88.80       9.52       1     18.7   Pullout
                                                                               2     18.8   Pullout

      2      1.43        3.30      61.37       6.20      87.69       8.17       1     16.9   Pullout
```

```
                                                                           2      17.1   Pullout

      3      1.33       4.60     52.73      6.84     86.77      8.17       1      15.1   Pullout
                                                                           2      15.4   Pullout

      4      1.33       5.90     45.69      7.60     85.87      8.18       1      13.3   Pullout
                                                                           2      13.6   Pullout

      5      1.38       7.20     43.36      7.92     79.99      8.29       1      12.1   Pullout
                                                                           2      13.0   Pullout

      6      1.42       8.50     42.44      8.06     72.65      8.55       1      11.2   Pullout
                                                                           2      12.7   Pullout

      7      1.48       9.80     42.77      8.01     64.34      9.05       1      10.6   Pullout
                                                                           2      12.7   Pullout

      8      1.57      11.10     44.43      7.77     55.78      9.87       1      10.2   Pullout
                                                                           2      13.1   Pullout

      9      1.58      12.40     41.26      8.25     52.77     10.25       1       9.1   Pullout
                                                                           2      12.3   Pullout

     10      1.64      13.70     36.67      6.83     49.19     12.58       1       8.1   Pullout
                                                                           2      11.7   Pullout

     11      1.67      15.00     34.22      7.26     46.61     13.10       1       7.1   Pullout
                                                                           2      11.0   Pullout

Search Level: 1.60 feet below the toe of the wall  Facing Design Force = 7.6 kips (Clouterre)
-------------------------------------------------------------------------------------------------------
|       |         |           |            Failure Planes             |        Reinforcement          |
|       |         |           |---------------------------------------|-------------------------------|
|       | Minimum | Distance  |      Lower        |      Upper        |       |        |              |
|       | Factor  | From Toe  |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall   | Angle   | Length  | Angle   | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet    |degrees  |  feet   |degrees  |  feet   | Level |  ksi   | Failure Mode |
-------------------------------------------------------------------------------------------------------
      1      1.98       2.00     72.65      6.03     88.68      8.64       1      18.7   Pullout
                                                                           2      18.9   Pullout

      2      1.65       3.30     62.72      6.48     87.81      8.65       1      16.9   Pullout
                                                                           2      17.1   Pullout

      3      1.52       4.60     54.29      7.09     86.95      8.65       1      15.1   Pullout
                                                                           2      15.3   Pullout

      4      1.50       5.90     47.33      7.83     86.09      8.66       1      13.3   Pullout
                                                                           2      13.6   Pullout

      5      1.52       7.20     45.00      8.15     80.54      8.76       1      12.0   Pullout
```

```
                                                                           2     12.8   Pullout

      6      1.54       8.50     44.07      8.28     73.56      9.01       1     11.1   Pullout
                                                                           2     12.5   Pullout

      7      1.56       9.80     40.02      8.96     71.21      9.13       1      9.6   Pullout
                                                                           2     11.2   Pullout

      8      1.58      11.10     40.86      8.81     62.80      9.71       1      9.1   Pullout
                                                                           2     11.4   Pullout

      9      1.60      12.40     37.75      9.41     60.14      9.96       1      7.8   Pullout
                                                                           2     10.3   Pullout

     10      1.63      13.70     35.02     10.04     57.62     10.23       1      6.6   Pullout
                                                                           2      9.3   Pullout

     11      1.65      15.00     37.52      9.46     49.04     11.44       1      6.6   Pullout
                                                                           2     10.2   Pullout

Search Level: 2.40 feet below the toe of the wall  Facing Design Force = 8.6 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |              Failure Planes             |         Reinforcement       |
|       |         |          |---------------------------------------|-----------------------------|
|       | Minimum | Distance |         Lower       |       Upper     |       |        |            |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling|
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode|
------------------------------------------------------------------------------------------------------
      1      2.25       2.00     73.51      6.34     88.74      9.12       1     18.7   Pullout
                                                                           2     18.8   Pullout

      2      1.88       3.30     68.66      8.16     87.51      7.61       1     16.9   Pullout
                                                                           2     17.1   Pullout

      3      1.68       4.60     61.42      8.65     86.54      7.61       1     15.1   Pullout
                                                                           2     15.4   Pullout

      4      1.68       5.90     48.87      8.07     86.30      9.14       1     13.2   Pullout
                                                                           2     13.6   Pullout

      5      1.68       7.20     46.55      8.38     81.03      9.23       1     12.0   Pullout
                                                                           2     12.7   Pullout

      6      1.68       8.50     45.62      8.51     74.38      9.47       1     11.0   Pullout
                                                                           2     12.3   Pullout

      7      1.69       9.80     41.55      9.17     72.13      9.58       1      9.5   Pullout
                                                                           2     11.0   Pullout

      8      1.69      11.10     42.39      9.02     64.04     10.14       1      8.9   Pullout
```

```
                                                                           2     11.1   Pullout

      9      1.70      12.40     39.26      9.61     61.46     10.38       1      7.6   Pullout
                                                                           2     10.0   Pullout

     10      1.71      13.70     36.49     10.22     59.00     10.64       1      6.3   Pullout
                                                                           2      8.9   Pullout

     11      1.72      15.00     39.03      9.65     50.57     11.81       1      6.3   Pullout
                                                                           2      9.7   Pullout

Search Level: 3.20 feet below the toe of the wall  Facing Design Force = 7.3 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      2.54       2.00     74.29      6.65     88.81      9.60       1     18.7   Pullout
                                                                           2     18.8   Pullout

      2      2.12       3.30     69.63      8.53     87.64      8.01       1     16.9   Pullout
                                                                           2     17.1   Pullout

      3      1.90       4.60     62.64      9.01     86.71      8.01       1     15.1   Pullout
                                                                           2     15.4   Pullout

      4      1.86       5.90     59.46      9.29     81.61      8.09       1     13.8   Pullout
                                                                           2     14.5   Pullout

      5      1.79       7.20     54.25      9.86     79.80      8.13       1     12.1   Pullout
                                                                           2     13.0   Pullout

      6      1.85       8.50     47.09      8.74     75.13      9.93       1     10.9   Pullout
                                                                           2     12.1   Pullout

      7      1.84       9.80     43.01      9.38     72.97     10.04       1      9.4   Pullout
                                                                           2     10.8   Pullout

      8      1.82      11.10     43.86      9.24     65.18     10.58       1      8.7   Pullout
                                                                           2     10.8   Pullout

      9      1.82      12.40     40.70      9.81     62.68     10.81       1      7.4   Pullout
                                                                           2      9.7   Pullout

     10      1.81      13.70     43.06      9.37     54.49     11.79       1      7.1   Pullout
                                                                           2     10.2   Pullout

     11      1.81      15.00     40.48      9.86     52.00     12.18       1      6.0   Pullout
```

```
                                                                           2       9.3  Pullout

Search Level: 4.00 feet below the toe of the wall  Facing Design Force = 5.0 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      2.84       2.00      75.01      6.96     88.86     10.08      1      18.7  Pullout
                                                                           2      18.8  Pullout

      2      2.68       3.30      74.62      8.71     83.28      8.46      1      17.3  Pullout
                                                                           2      17.9  Pullout

      3      2.84       4.60      74.69     17.42      0.00      0.00      1      16.4  Pullout
                                                                           2      17.6  Pullout

      4      2.58       5.90      70.65     17.81      0.00      0.00      1      15.0  Pullout
                                                                           2      16.6  Pullout

      5      5.63       7.20       0.00      3.60     77.91     17.18      1      12.4  Pullout
                                                                           2      13.4  Pullout

      6      3.39       8.50       0.00      1.70     67.96     18.12      1      11.8  Pullout
                                                                           2      13.7  Pullout

      7      2.16       9.80      59.74     19.45      0.00      0.00      1      11.2  Pullout
                                                                           2      13.8  Pullout

      8      2.02      11.10      50.45     17.43    -90.00      3.36      1       7.7  Pullout
                                                                           2      11.1  Pullout

      9      1.99      12.40      47.31     18.29     90.00      3.36      1       6.4  Pullout
                                                                           2      10.1  Pullout

     10      1.94      13.70      44.45      9.60     55.80     12.19      1       6.9  Pullout
                                                                           2       9.8  Pullout

     11      1.92      15.00      43.83     14.56     56.19      8.09      1       5.2  Pullout
                                                                           2       9.0  Pullout


======================================================================================================
                                           END OF REPORT
======================================================================================================
```

```
======================================================================================================
                                               Snail

                                           Version: 2.2.2

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======================================================================================================
                                          File Information
======================================================================================================

File Name: US 395 RW3 Sta 1710 Temp.snz
Run Date:  11/14/22
Run Time:  22:05:40

======================================================================================================
                                        Project Information
======================================================================================================

Description:    RW3
Location:       US 395
EA:
Project ID:
Wall No.:
Structure No.:
Station:
Engineer:       STC
                Designer

Comments:


======================================================================================================
                                              Geometry
======================================================================================================

Layout:

Reference Point:

At: Top of Wall
Distance From Origin:       40.00 feet
Elevation Above Origin:     30.00 feet

Wall Dimensions:

Wall Height:       12.80 feet
Facing Angle:      90.00 degrees
Facing Batter:     0.000 :12 H:V
```

```
Ground Surface:

Number of lines that define the ground surface above the wall: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Number of lines that define the ground surface in front of the toe: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Soil Layers:

Number of Layers: 2

Layers Below the Top Layer:

Coordinates of the Top of the Layer: feet

             Point 1         Point 1         Point 2         Point 2
Layer       Distance       Elevation        Distance       Elevation
--------------------------------------------------------------------
2              45.00           20.00           60.00           20.00

Ground Water:

Include Ground Water: No

======================================================================================================
                                             Soil Nails
======================================================================================================

Dimensions and Properties:

Maximum Vertical Spacing:               5.00 feet
Number of Soil Nail Rows:                  2
Soil Nail Design Parameters:               Varying

      Soil Nail       Inclination   Vertical   Horizontal      Nail Bar   Nail Bar Yield       Bond
         Length   From Horizontal    Spacing    Spacing H    Diameter Ø      Strength fy   Strength
No.        feet           degrees       feet         feet        inches              ksi   Factor F
---------------------------------------------------------------------------------------------------
1         15.00                15       3.00         5.00         1.000             75.0       1.00
2         15.00                15       3.40         5.00         1.000             75.0       1.00

Facing Resistance:
```

```
                                     Temporary   Permanent     Seismic
ASD Allowable Facing Resistance:          18.5        34.1        46.5 kips

======================================================================================================
                                          Soil Properties
======================================================================================================

                                        Unit Weight  Friction Angle        Cohesion
                                                  γ              φ'              c'
Layer  Description                             pcf         degrees             psf
-----------------------------------------------------------------------------------
1      Fill                                     115            34.0             100
2      Fill                                     120            34.0             100

======================================================================================================
                                               Loads
======================================================================================================

Applied Loads:

Seismic:

Horizontal Seismic Coefficient Kh0.25:

External Load:

Apply external load: No

Surcharges:

Apply surcharges:    Yes

           Distance from Top of Wall            Load            Load
               Begin            End            Begin             End
No.             feet            feet             psf             psf
--------------------------------------------------------------------
1               0.00           30.00             250             250

======================================================================================================
                                         Factors of Safety
======================================================================================================

                    Temporary   Permanent     Seismic
Pullout (Distal):        2.00        2.00        1.50
Pullout (Proximal):      2.00        2.00        1.50
Nail Bar Yield:          1.80        1.80        1.35

======================================================================================================
                                           Search Options
======================================================================================================
```

```
Search Limits:

Begin:      2.00 feet
End:       15.00 feet

Below Toe Searches (BTS):

Perform below Toe Search:       Yes
Number of BTS Points:             5
BTS Depth:                     4.00 feet
Interface Friction
Reduction Factor:              0.33

Advanced Search Options:

Use Advanced Search Options:     Yes
Inclination of Interslice Force: Use Average Failure Angle

======================================================================================================
                                               Results
======================================================================================================

Analysis:

Method:          ASD
Scenario:  Temporary

Factor of Safety:

Minimum:                  1.06
Found at Search Point:       3
Found at Grid Point:        38
Found at Search Level:       Toe of the wall

Load at Soil Nail Head:

Calculated Service Load at Soil Nail Head (Empirical), To:      8.6 kips
Allowable Facing Resistance, F_allowable (Entered):           18.5 kips
F_allowable ≥ To OK

Nominal Pullout Resistance:

                    Nominal Pullout Resistance
Layer  Description                         klf
----------------------------------------------
    1  Fill                              2.262
    2  Fill                              2.262

Results by Search Level:
```

```
** Indicates Minimum Factor of Safety

Search Level: At the toe of the wall  Facing Design Force = 8.6 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      1.36       2.00     64.89      4.24     88.72      8.96       1     18.7   Pullout
                                                                           2     18.8   Pullout

      2      1.11       3.30     59.88      5.92     87.54      7.69       1     16.9   Pullout
                                                                           2     17.1   Pullout

   ** 3      1.06       4.60     51.04      6.58     86.57      7.69       1     15.1   Pullout
                                                                           2     15.4   Pullout

      4      1.10       5.90     47.33      6.96     81.27      7.77       1     13.8   Pullout
                                                                           2     14.6   Pullout

      5      1.17       7.20     49.84      6.70     69.44      8.20       1     13.4   Pullout
                                                                           2     15.1   Pullout

      6      1.25       8.50     50.31      6.65     61.04      8.78       1     12.7   Pullout
                                                                           2     15.2   Pullout

      7      1.29       9.80     44.41      5.49     56.73     10.72       1     11.7   Pullout
                                                                           2     14.5   Pullout

      8      1.32      11.10     40.86      5.87     53.38     11.16       1     10.6   Pullout
                                                                           2     13.7   Pullout

      9      1.36      12.40     37.75      6.27     50.30     11.65       1      9.5   Pullout
                                                                           2     13.0   Pullout

     10      1.41      13.70     35.02      6.69     47.47     12.16       1      8.5   Pullout
                                                                           2     12.2   Pullout

     11      1.46      15.00     32.62      7.12     44.87     12.70       1      7.5   Pullout
                                                                           2     11.5   Pullout

Search Level: 0.80 feet below the toe of the wall  Facing Design Force = 8.6 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
```

```
|Point  | Safety  |   feet   | degrees |   feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
-------------------------------------------------------------------------------------------------------
      1      1.55       2.00     71.69      5.73     88.60      8.16       1      18.7   Pullout
                                                                           2      18.9   Pullout

      2      1.27       3.30     61.37      6.20     87.69      8.17       1      16.9   Pullout
                                                                           2      17.1   Pullout

      3      1.19       4.60     52.73      6.84     86.77      8.17       1      15.1   Pullout
                                                                           2      15.4   Pullout

      4      1.20       5.90     49.05      7.20     81.77      8.24       1      13.8   Pullout
                                                                           2      14.5   Pullout

      5      1.22       7.20     47.19      7.42     75.17      8.44       1      12.7   Pullout
                                                                           2      13.9   Pullout

      6      1.24       8.50     46.85      7.46     67.38      8.84       1      11.9   Pullout
                                                                           2      13.8   Pullout

      7      1.26       9.80     42.77      8.01     64.34      9.05       1      10.6   Pullout
                                                                           2      12.7   Pullout

      8      1.31      11.10     44.43      7.77     55.78      9.87       1      10.2   Pullout
                                                                           2      13.1   Pullout

      9      1.33      12.40     41.26      8.25     52.77     10.25       1       9.1   Pullout
                                                                           2      12.3   Pullout

     10      1.39      13.70     36.67      6.83     49.19     12.58       1       8.1   Pullout
                                                                           2      11.7   Pullout

     11      1.43      15.00     34.22      7.26     46.61     13.10       1       7.1   Pullout
                                                                           2      11.0   Pullout

Search Level: 1.60 feet below the toe of the wall  Facing Design Force = 7.7 kips (Clouterre)
-------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes             |        Reinforcement          |
|       |         |          |----------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower        |       Upper       |       |        |              |
|       | Factor  | From Toe |----------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  |  Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |   feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
-------------------------------------------------------------------------------------------------------
      1      1.78       2.00     72.65      6.03     88.68      8.64       1      18.7   Pullout
                                                                           2      18.9   Pullout

      2      1.47       3.30     62.72      6.48     87.81      8.65       1      16.9   Pullout
                                                                           2      17.1   Pullout

      3      1.36       4.60     54.29      7.09     86.95      8.65       1      15.1   Pullout
```

```
                                                                           2     15.3   Pullout

      4      1.34       5.90      50.67       7.45      82.22       8.72       1     13.7   Pullout
                                                                           2     14.4   Pullout

      5      1.34       7.20      48.81       7.65      75.96       8.91       1     12.6   Pullout
                                                                           2     13.8   Pullout

      6      1.34       8.50      48.48       7.69      68.52       9.28       1     11.7   Pullout
                                                                           2     13.5   Pullout

      7      1.35       9.80      44.41       8.23      65.60       9.49       1     10.4   Pullout
                                                                           2     12.4   Pullout

      8      1.37      11.10      40.86       8.81      62.80       9.71       1      9.1   Pullout
                                                                           2     11.4   Pullout

      9      1.38      12.40      42.89       8.46      54.34      10.63       1      8.8   Pullout
                                                                           2     11.8   Pullout

     10      1.40      13.70      40.06       8.95      51.59      11.03       1      7.7   Pullout
                                                                           2     11.0   Pullout

     11      1.43      15.00      37.52       9.46      49.04      11.44       1      6.6   Pullout
                                                                           2     10.2   Pullout

Search Level: 2.40 feet below the toe of the wall  Facing Design Force = 6.8 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      2.04       2.00      73.51       6.34      88.74       9.12       1     18.7   Pullout
                                                                           2     18.8   Pullout

      2      1.67       3.30      68.66       8.16      87.51       7.61       1     16.9   Pullout
                                                                           2     17.1   Pullout

      3      1.49       4.60      61.42       8.65      86.54       7.61       1     15.1   Pullout
                                                                           2     15.4   Pullout

      4      1.51       5.90      52.18       7.70      82.63       9.20       1     13.7   Pullout
                                                                           2     14.3   Pullout

      5      1.49       7.20      50.34       7.90      76.68       9.37       1     12.5   Pullout
                                                                           2     13.6   Pullout

      6      1.47       8.50      50.01       7.94      69.56       9.73       1     11.6   Pullout
```

```
                                                                           2     13.3   Pullout

      7      1.46       9.80     45.96      8.46     66.74      9.93       1     10.2   Pullout
                                                                           2     12.2   Pullout

      8      1.46      11.10     47.61      8.23     58.68     10.68       1      9.7   Pullout
                                                                           2     12.4   Pullout

      9      1.46      12.40     44.44      8.68     55.79     11.03       1      8.5   Pullout
                                                                           2     11.4   Pullout

     10      1.47      13.70     41.59      9.16     53.09     11.41       1      7.4   Pullout
                                                                           2     10.6   Pullout

     11      1.49      15.00     39.03      9.65     50.57     11.81       1      6.3   Pullout
                                                                           2      9.7   Pullout

Search Level: 3.20 feet below the toe of the wall  Facing Design Force = 6.2 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |   Angle  | Length |   Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees  |  feet   | degrees  |  feet  | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      2.31       2.00     74.29      6.65     88.81      9.60       1     18.7   Pullout
                                                                           2     18.8   Pullout

      2      1.90       3.30     69.63      8.53     87.64      8.01       1     16.9   Pullout
                                                                           2     17.1   Pullout

      3      1.70       4.60     62.64      9.01     86.71      8.01       1     15.1   Pullout
                                                                           2     15.4   Pullout

      4      1.64       5.90     59.46      9.29     81.61      8.09       1     13.8   Pullout
                                                                           2     14.5   Pullout

      5      1.57       7.20     54.25      9.86     79.80      8.13       1     12.1   Pullout
                                                                           2     13.0   Pullout

      6      1.62       8.50     51.45      8.18     70.50     10.18       1     11.5   Pullout
                                                                           2     13.1   Pullout

      7      1.58       9.80     53.68      9.93     63.90      8.91       1     10.6   Pullout
                                                                           2     12.8   Pullout

      8      1.58      11.10     49.07      8.47     59.97     11.09       1      9.5   Pullout
                                                                           2     12.0   Pullout

      9      1.56      12.40     45.91      8.91     57.15     11.43       1      8.3   Pullout
```

```
                                                                           2     11.1   Pullout

     10      1.57      13.70     43.06      9.37     54.49     11.79       1      7.1   Pullout
                                                                           2     10.2   Pullout

     11      1.57      15.00     40.48      9.86     52.00     12.18       1      6.0   Pullout
                                                                           2      9.3   Pullout

Search Level: 4.00 feet below the toe of the wall  Facing Design Force = 5.0 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      2.59       2.00     75.01      6.96     88.86     10.08       1     18.7   Pullout
                                                                           2     18.8   Pullout

      2      2.35       3.30     74.62      8.71     83.28      8.46       1     17.3   Pullout
                                                                           2     17.9   Pullout

      3      2.19       4.60     71.81      8.84     77.65      8.60       1     16.0   Pullout
                                                                           2     17.1   Pullout

      4      2.09       5.90     68.68     16.23     90.00      1.68       1     14.3   Pullout
                                                                           2     16.1   Pullout

      5      1.95       7.20     64.54     16.75    -90.00      1.68       1     12.9   Pullout
                                                                           2     15.1   Pullout

      6      1.85       8.50     60.66     17.35     90.00      1.68       1     11.5   Pullout
                                                                           2     14.0   Pullout

      7      1.72       9.80     55.01     10.25     64.98      9.27       1     10.5   Pullout
                                                                           2     12.6   Pullout

      8      1.68      11.10     51.59     10.72     62.14      9.50       1      9.2   Pullout
                                                                           2     11.5   Pullout

      9      1.68      12.40     48.47     11.22     59.44      9.76       1      7.9   Pullout
                                                                           2     10.5   Pullout

     10      1.67      13.70     44.45      9.60     55.80     12.19       1      6.9   Pullout
                                                                           2      9.8   Pullout

     11      1.67      15.00     43.83     14.56     56.19      8.09       1      5.2   Pullout
                                                                           2      9.0   Pullout
```

```
======================================================================================================
                                           END OF REPORT
======================================================================================================
```

```
================================================================================
                                     Snail

                                 Version: 2.2.2

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================================================================================
                                File Information
================================================================================

File Name: US 395 RW3 Sta 1800.snz
Run Date:  11/14/22
Run Time:  18:46:47

================================================================================
                              Project Information
================================================================================

Description:    RW3
Location:       US 395
EA:
Project ID:
Wall No.:
Structure No.:
Station:
Engineer:       STC
                Designer

Comments:


================================================================================
                                    Geometry
================================================================================

Layout:

Reference Point:

At: Top of Wall
Distance From Origin:       40.00 feet
Elevation Above Origin:     30.00 feet

Wall Dimensions:

Wall Height:       11.00 feet
Facing Angle:      90.00 degrees
Facing Batter:     0.000 :12 H:V
```

```
Ground Surface:

Number of lines that define the ground surface above the wall: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Number of lines that define the ground surface in front of the toe: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Soil Layers:

Number of Layers: 2

Layers Below the Top Layer:

Coordinates of the Top of the Layer: feet

             Point 1         Point 1         Point 2         Point 2
Layer       Distance       Elevation        Distance       Elevation
--------------------------------------------------------------------
2              45.00           25.00           60.00           25.00

Ground Water:

Include Ground Water: No

======================================================================================================
                                             Soil Nails
======================================================================================================

Dimensions and Properties:

Maximum Vertical Spacing:               4.00 feet
Number of Soil Nail Rows:                  2
Soil Nail Design Parameters:               Varying

      Soil Nail       Inclination   Vertical   Horizontal      Nail Bar   Nail Bar Yield       Bond
         Length   From Horizontal    Spacing    Spacing H    Diameter Ø      Strength fy   Strength
No.        feet           degrees       feet         feet        inches              ksi   Factor F
---------------------------------------------------------------------------------------------------
1         15.00                15       3.00         4.50         1.000             75.0       1.00
2         15.00                15       4.50         4.50         1.000             75.0       1.00

Facing Resistance:
```

```
                                     Temporary   Permanent     Seismic
ASD Allowable Facing Resistance:          22.2        34.1        46.5 kips

======================================================================================================
                                          Soil Properties
======================================================================================================

                                        Unit Weight  Friction Angle        Cohesion
                                                  γ              φ'              c'
Layer  Description                              pcf         degrees             psf
-----------------------------------------------------------------------------------
1      Fill                                     115            34.0             100
2      Fill                                     120            34.0             100

======================================================================================================
                                               Loads
======================================================================================================

Applied Loads:

Seismic:

Horizontal Seismic Coefficient Kh0.25:

External Load:

Apply external load: No

Surcharges:

Apply surcharges:    Yes

           Distance from Top of Wall            Load            Load
               Begin             End           Begin             End
No.             feet            feet             psf             psf
--------------------------------------------------------------------
1               0.00           30.00             250             250

======================================================================================================
                                         Factors of Safety
======================================================================================================

                    Temporary   Permanent     Seismic
Pullout (Distal):        2.00        2.00        1.50
Pullout (Proximal):      2.00        2.00        1.50
Nail Bar Yield:          1.80        1.80        1.35

======================================================================================================
                                           Search Options
======================================================================================================
```

```
Search Limits:

Begin:      2.00 feet
End:       15.00 feet

Below Toe Searches (BTS):

Perform below Toe Search:       Yes
Number of BTS Points:             5
BTS Depth:                     4.00 feet
Interface Friction
Reduction Factor:              0.33

Advanced Search Options:

Use Advanced Search Options:     Yes
Inclination of Interslice Force: Use Average Failure Angle

======================================================================================================
                                               Results
======================================================================================================

Analysis:

Method:          ASD
Scenario:  Permanent

Factor of Safety:

Minimum:                  1.57
Found at Search Point:       2
Found at Grid Point:        31
Found at Search Level:    0.80 feet below the toe of the wall

Load at Soil Nail Head:

Calculated Service Load at Soil Nail Head (Empirical), To:     9.5 kips
Allowable Facing Resistance, F_allowable (Entered):           34.1 kips
F_allowable ≥ To OK

Nominal Pullout Resistance:

                    Nominal Pullout Resistance
Layer  Description                         klf
----------------------------------------------
    1  Fill                              2.262
    2  Fill                              2.262

Results by Search Level:
```

```
** Indicates Minimum Factor of Safety

Search Level: At the toe of the wall  Facing Design Force = 10.2 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |         Reinforcement         |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      1.62        2.00     50.71      2.84     88.70      8.80       1     18.7  Pullout
                                                                            2     18.9  Pullout

      2      1.62        3.30     43.60      3.19     83.58      8.86       1     17.3  Pullout
                                                                            2     18.0  Pullout

      3      1.66        4.60     38.56      3.53     78.19      8.99       1     16.0  Pullout
                                                                            2     17.3  Pullout

      4      1.71        5.90     36.71      3.68     71.47      9.28       1     14.9  Pullout
                                                                            2     17.0  Pullout

      5      1.77        7.20     37.38      3.62     63.85      9.80       1     14.1  Pullout
                                                                            2     17.0  Pullout

      6      1.82        8.50     32.91      4.05     59.91     10.17       1     12.9  Pullout
                                                                            2     16.2  Pullout

      7      1.88        9.80     29.30      4.50     56.25     10.58       1     11.7  Pullout
                                                                            2     15.5  Pullout

      8      1.95       11.10     26.36      4.96     52.88     11.04       1     10.7  Pullout
                                                                            2     14.9  Pullout

      9      2.02       12.40     30.60      4.32     45.39     12.36       1     10.5  Pullout
                                                                            2     15.7  Pullout

     10      2.09       13.70     28.16      4.66     42.54     13.02       1      9.6  Pullout
                                                                            2     15.2  Pullout

     11      2.15       15.00     26.05      5.01     39.97     13.70       1      8.7  Pullout
                                                                            2     14.8  Pullout

Search Level: 0.80 feet below the toe of the wall  Facing Design Force = 9.5 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |         Reinforcement         |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
```

```
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      1.71       2.00    63.05      3.97    88.61      8.26       1     18.7   Pullout
                                                                           2     18.9   Pullout

   ** 2      1.57       3.30    53.29      4.42    85.43      8.29       1     17.1   Pullout
                                                                           2     17.7   Pullout

      3      1.62       4.60    52.06      4.49    77.44      8.46       1     16.1   Pullout
                                                                           2     17.5   Pullout

      4      1.76       5.90    38.66      3.78    72.65      9.89       1     14.8   Pullout
                                                                           2     16.7   Pullout

      5      1.77       7.20    39.33      3.72    65.41     10.38       1     13.9   Pullout
                                                                           2     16.6   Pullout

      6      1.79       8.50    34.77      4.14    61.62     10.73       1     12.6   Pullout
                                                                           2     15.8   Pullout

      7      1.82       9.80    38.76      3.77    54.00     11.67       1     12.1   Pullout
                                                                           2     16.2   Pullout

      8      1.85      11.10    35.33      4.08    50.54     12.23       1     11.1   Pullout
                                                                           2     15.6   Pullout

      9      1.89      12.40    32.39      4.41    47.40     12.82       1     10.1   Pullout
                                                                           2     15.0   Pullout

     10      1.93      13.70    29.87      4.74    44.55     13.46       1      9.1   Pullout
                                                                           2     14.5   Pullout

     11      1.98      15.00    27.67      5.08    41.96     14.12       1      8.2   Pullout
                                                                           2     14.0   Pullout

Search Level: 1.60 feet below the toe of the wall  Facing Design Force = 8.6 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |   feet  | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      1.96       2.00    64.54      4.19    88.70      8.82       1     18.7   Pullout
                                                                           2     18.9   Pullout

      2      1.74       3.30    51.84      4.81    87.86      8.83       1     16.9   Pullout
                                                                           2     17.1   Pullout

      3      1.72       4.60    45.77      5.28    84.05      8.87       1     15.4   Pullout
```

```
                                                                               2      16.1    Pullout

       4      1.72        5.90       42.47        5.60       78.65        9.00         1      14.1    Pullout
                                                                               2      15.4    Pullout

       5      1.72        7.20       41.19        5.74       71.92        9.28         1      13.1    Pullout
                                                                               2      15.1    Pullout

       6      1.74        8.50       41.65        5.69       64.27        9.79         1      12.3    Pullout
                                                                               2      15.1    Pullout

       7      1.79        9.80       43.96        5.45       56.31       10.60         1      11.7    Pullout
                                                                               2      15.5    Pullout

       8      1.80       11.10       40.41        5.83       52.94       11.05         1      10.6    Pullout
                                                                               2      14.9    Pullout

       9      1.87       12.40       34.11        4.49       49.27       13.30         1       9.7    Pullout
                                                                               2      14.4    Pullout

      10      1.89       13.70       31.51        4.82       46.43       13.91         1       8.7    Pullout
                                                                               2      13.8    Pullout

      11      1.92       15.00       29.25        5.16       43.83       14.56         1       7.8    Pullout
                                                                               2      13.2    Pullout

Search Level: 2.40 feet below the toe of the wall  Facing Design Force = 7.5 kips (Clouterre)
----------------------------------------------------------------------------------------------------
|       |         |          |              Failure Planes             |       Reinforcement         |
|       |         |          |-----------------------------------------|-----------------------------|
|       | Minimum | Distance |         Lower       |        Upper      |       |        |             |
|       | Factor  | From Toe |-----------------------------------------|       |        | Controlling |
|Search |   of    | of Wall  |  Angle   | Length   |  Angle   | Length  |       | Stress | Resistance  |
|Point  | Safety  |   feet   | degrees  |  feet    | degrees  |  feet   | Level |  ksi   | Failure Mode|
----------------------------------------------------------------------------------------------------
       1      2.19        2.00       71.44        5.65       88.58        8.04         1      18.7    Pullout
                                                                               2      18.9    Pullout

       2      1.99        3.30       53.54        5.00       87.99        9.39         1      16.9    Pullout
                                                                               2      17.1    Pullout

       3      1.93        4.60       47.53        5.45       84.40        9.43         1      15.3    Pullout
                                                                               2      16.0    Pullout

       4      1.90        5.90       44.23        5.76       79.32        9.55         1      14.0    Pullout
                                                                               2      15.2    Pullout

       5      1.87        7.20       42.94        5.90       72.93        9.81         1      13.0    Pullout
                                                                               2      14.9    Pullout

       6      1.85        8.50       43.41        5.85       65.63       10.30         1      12.1    Pullout
```

```
                                                                           2     14.8   Pullout

      7      1.84       9.80     39.37      6.34     62.42     10.58       1     10.8   Pullout
                                                                           2     13.9   Pullout

      8      1.85      11.10     35.92      6.85     59.39     10.90       1      9.6   Pullout
                                                                           2     13.0   Pullout

      9      1.86      12.40     39.02      6.38     51.58     11.97       1      9.3   Pullout
                                                                           2     13.7   Pullout

     10      1.87      13.70     36.26      6.80     48.77     12.47       1      8.2   Pullout
                                                                           2     13.0   Pullout

     11      1.89      15.00     33.82      7.22     46.19     13.00       1      7.2   Pullout
                                                                           2     12.3   Pullout

Search Level: 3.20 feet below the toe of the wall  Facing Design Force = 7.1 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      2.46       2.00     72.42      5.96     88.66      8.52       1     18.7   Pullout
                                                                           2     18.9   Pullout

      2      2.11       3.30     62.40      6.41     87.78      8.53       1     16.9   Pullout
                                                                           2     17.2   Pullout

      3      2.00       4.60     57.06      6.77     83.84      8.57       1     15.4   Pullout
                                                                           2     16.1   Pullout

      4      2.03       5.90     58.07      6.69     74.52      8.84       1     14.6   Pullout
                                                                           2     16.3   Pullout

      5      2.03       7.20     52.75     10.70     82.78      5.73       1     11.8   Pullout
                                                                           2     15.3   Pullout

      6      1.99       8.50     45.07      6.02     66.85     10.81       1     11.9   Pullout
                                                                           2     14.5   Pullout

      7      1.97       9.80     41.00      6.49     63.76     11.08       1     10.6   Pullout
                                                                           2     13.6   Pullout

      8      1.95      11.10     43.82      6.15     56.18     11.96       1     10.1   Pullout
                                                                           2     13.9   Pullout

      9      1.94      12.40     40.66      6.54     53.19     12.42       1      9.0   Pullout
```

```
                                                                           2     13.2   Pullout

     10      1.94      13.70      37.86      6.94      50.41      12.90       1      7.9   Pullout
                                                                           2     12.4   Pullout

     11      1.94      15.00      35.38      7.36      47.84      13.41       1      6.9   Pullout
                                                                           2     11.8   Pullout

Search Level: 4.00 feet below the toe of the wall  Facing Design Force = 6.3 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower     |       Upper         |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |   feet  | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      2.75       2.00      73.30      6.26      88.73       9.00       1     18.7   Pullout
                                                                           2     18.9   Pullout

      2      2.67       3.30      71.74      6.32      81.66       9.10       1     17.5   Pullout
                                                                           2     18.4   Pullout

      3      2.53       4.60      69.03      6.43      75.67       9.29       1     16.3   Pullout
                                                                           2     17.9   Pullout

      4      2.49       5.90      66.39     14.73      90.00       1.50       1     14.6   Pullout
                                                                           2     17.2   Pullout

      5      2.34       7.20      61.93     15.30     -90.00       1.50       1     13.3   Pullout
                                                                           2     16.4   Pullout

      6      2.23       8.50      57.81     15.95      90.00       1.50       1     12.0   Pullout
                                                                           2     15.6   Pullout

      7      2.06       9.80      50.76      7.75      61.44      10.25       1     11.0   Pullout
                                                                           2     14.2   Pullout

      8      2.02      11.10      47.23      8.17      58.34      10.57       1      9.8   Pullout
                                                                           2     13.3   Pullout

      9      2.03      12.40      46.04     12.50      58.20       7.06       1      8.1   Pullout
                                                                           2     13.0   Pullout

     10      2.02      13.70      43.18     13.15      55.59       7.27       1      6.9   Pullout
                                                                           2     12.3   Pullout

     11      2.02      15.00      40.60     13.83      53.13       7.50       1      5.8   Pullout
                                                                           2     11.7   Pullout
```

```
=======================================================================================================
                                           END OF REPORT
=======================================================================================================
```

```
======================================================================================================
                                               Snail

                                           Version: 2.2.2

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======================================================================================================
                                          File Information
======================================================================================================

File Name: US 395 RW3 Sta 1800 Seismic.snz
Run Date:  11/14/22
Run Time:  18:50:40

======================================================================================================
                                        Project Information
======================================================================================================

Description:    RW3
Location:       US 395
EA:
Project ID:
Wall No.:
Structure No.:
Station:
Engineer:       STC
                Designer

Comments:


======================================================================================================
                                              Geometry
======================================================================================================

Layout:

Reference Point:

At: Top of Wall
Distance From Origin:       40.00 feet
Elevation Above Origin:     30.00 feet

Wall Dimensions:

Wall Height:       11.00 feet
Facing Angle:      90.00 degrees
Facing Batter:     0.000 :12 H:V
```

```
Ground Surface:

Number of lines that define the ground surface above the wall: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Number of lines that define the ground surface in front of the toe: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Soil Layers:

Number of Layers: 2

Layers Below the Top Layer:

Coordinates of the Top of the Layer: feet

             Point 1         Point 1         Point 2         Point 2
Layer       Distance       Elevation        Distance       Elevation
--------------------------------------------------------------------
2              45.00           25.00           60.00           25.00

Ground Water:

Include Ground Water: No

======================================================================================================
                                             Soil Nails
======================================================================================================

Dimensions and Properties:

Maximum Vertical Spacing:               4.00 feet
Number of Soil Nail Rows:                  2
Soil Nail Design Parameters:               Varying

      Soil Nail       Inclination   Vertical   Horizontal      Nail Bar   Nail Bar Yield       Bond
         Length   From Horizontal    Spacing    Spacing H    Diameter Ø      Strength fy   Strength
No.        feet           degrees       feet         feet        inches              ksi   Factor F
---------------------------------------------------------------------------------------------------
1         15.00                15       3.00         4.50         1.000             75.0       1.00
2         15.00                15       4.50         4.50         1.000             75.0       1.00

Facing Resistance:
```

```
                                     Temporary   Permanent     Seismic
ASD Allowable Facing Resistance:          22.2        34.1        46.5 kips

======================================================================================================
                                          Soil Properties
======================================================================================================

                                        Unit Weight  Friction Angle        Cohesion
                                                  γ              φ'              c'
Layer  Description                              pcf         degrees             psf
-----------------------------------------------------------------------------------
1      Fill                                     115            34.0             100
2      Fill                                     120            34.0             100

======================================================================================================
                                               Loads
======================================================================================================

Applied Loads:

Seismic:

Horizontal Seismic Coefficient Kh0.25:

External Load:

Apply external load: No

Surcharges:

Apply surcharges:    Yes

           Distance from Top of Wall            Load            Load
               Begin             End           Begin             End
No.             feet            feet             psf             psf
--------------------------------------------------------------------
1               0.00           30.00             250             250

======================================================================================================
                                         Factors of Safety
======================================================================================================

                    Temporary   Permanent     Seismic
Pullout (Distal):        2.00        2.00        1.50
Pullout (Proximal):      2.00        2.00        1.50
Nail Bar Yield:          1.80        1.80        1.35

======================================================================================================
                                           Search Options
======================================================================================================
```

```
Search Limits:

Begin:      2.00 feet
End:       15.00 feet

Below Toe Searches (BTS):

Perform below Toe Search:       Yes
Number of BTS Points:             5
BTS Depth:                     4.00 feet
Interface Friction
Reduction Factor:              0.33

Advanced Search Options:

Use Advanced Search Options:     Yes
Inclination of Interslice Force: Use Average Failure Angle

======================================================================================================
                                               Results
======================================================================================================

Analysis:

Method:          ASD
Scenario:    Seismic

Factor of Safety:

Minimum:                  1.32
Found at Search Point:       2
Found at Grid Point:        25
Found at Search Level:       Toe of the wall

Load at Soil Nail Head:

Calculated Service Load at Soil Nail Head (Empirical), To:    12.3 kips
Allowable Facing Resistance, F_allowable (Entered):           46.5 kips
F_allowable ≥ To OK

Nominal Pullout Resistance:

                    Nominal Pullout Resistance
Layer  Description                         klf
----------------------------------------------
    1  Fill                              2.262
    2  Fill                              2.262

Results by Search Level:
```

```
** Indicates Minimum Factor of Safety

Search Level: At the toe of the wall  Facing Design Force = 12.3 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes              |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower     |       Upper     |        |        |             |
|       | Factor  | From Toe |---------------------------------------|        |        | Controlling |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |        | Stress | Resistance  |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level  |  ksi   | Failure Mode|
------------------------------------------------------------------------------------------------------
      1      1.48       2.00     50.71      2.84     88.70      8.80       1     25.0   Pullout
                                                                           2     25.2   Pullout

   ** 2      1.32       3.30     36.53      3.70     87.85      8.81       1     22.5   Pullout
                                                                           2     22.9   Pullout

      3      1.33       4.60     27.99      4.69     87.01      8.81       1     20.1   Pullout
                                                                           2     20.6   Pullout

      4      1.38       5.90     24.99      5.21     82.36      8.88       1     18.3   Pullout
                                                                           2     19.4   Pullout

      5      1.41       7.20     26.99      4.85     71.88      9.26       1     17.4   Pullout
                                                                           2     20.1   Pullout

      6      1.45       8.50     27.37      4.79     64.22      9.77       1     16.4   Pullout
                                                                           2     20.2   Pullout

      7      1.51       9.80     29.30      4.50     56.25     10.58       1     15.7   Pullout
                                                                           2     20.7   Pullout

      8      1.51      11.10     26.36      4.96     52.88     11.04       1     14.2   Pullout
                                                                           2     19.8   Pullout

      9      1.62      12.40     30.60      4.32     45.39     12.36       1     14.0   Pullout
                                                                           2     20.9   Pullout

     10      1.61      13.70     28.16      4.66     42.54     13.02       1     12.8   Pullout
                                                                           2     20.3   Pullout

     11      1.61      15.00     26.05      5.01     39.97     13.70       1     11.6   Pullout
                                                                           2     19.7   Pullout

Search Level: 0.80 feet below the toe of the wall  Facing Design Force = 12.7 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes              |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower     |       Upper     |        |        |             |
|       | Factor  | From Toe |---------------------------------------|        |        | Controlling |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |        | Stress | Resistance  |
```

```
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1       1.61       2.00     63.05      3.97     88.61      8.26      1      25.0  Pullout
                                                                           2      25.2  Pullout

      2       1.40       3.30     53.29      4.42     85.43      8.29      1      22.8  Pullout
                                                                           2      23.5  Pullout

      3       1.43       4.60     29.69      4.77     87.21      9.45      1      20.1  Pullout
                                                                           2      20.5  Pullout

      4       1.44       5.90     29.75      4.76     79.38      9.60      1      18.7  Pullout
                                                                           2      20.3  Pullout

      5       1.44       7.20     28.65      4.92     73.03      9.87      1      17.3  Pullout
                                                                           2      19.8  Pullout

      6       1.44       8.50     24.83      5.62     70.19     10.03      1      15.4  Pullout
                                                                           2      18.3  Pullout

      7       1.43       9.80     25.72      5.44     62.57     10.64      1      14.4  Pullout
                                                                           2      18.5  Pullout

      8       1.43      11.10     23.04      6.03     59.55     10.95      1      12.8  Pullout
                                                                           2      17.3  Pullout

      9       1.42      12.40     20.84      6.63     56.70     11.29      1      11.2  Pullout
                                                                           2      16.2  Pullout

     10       1.42      13.70     19.01      7.25     54.03     11.66      1       9.6  Pullout
                                                                           2      15.1  Pullout

     11       1.43      15.00     21.47      6.45     46.37     13.04      1       9.6  Pullout
                                                                           2      16.4  Pullout

Search Level: 1.60 feet below the toe of the wall  Facing Design Force = 10.4 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |   feet  | degrees |   feet  | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1       1.81       2.00     64.54      4.19     88.70      8.82      1      25.0  Pullout
                                                                           2      25.2  Pullout

      2       1.49       3.30     51.84      4.81     87.86      8.83      1      22.5  Pullout
                                                                           2      22.9  Pullout

      3       1.36       4.60     42.40      5.61     87.02      8.83      1      20.1  Pullout
```

```
                                                                           2     20.5   Pullout

      4      1.35       5.90     38.69      6.05     82.38      8.90       1     18.2   Pullout
                                                                           2     19.4   Pullout

      5      1.40       7.20     41.19      5.74     71.92      9.28       1     17.4   Pullout
                                                                           2     20.1   Pullout

      6      1.43       8.50     41.65      5.69     64.27      9.79       1     16.4   Pullout
                                                                           2     20.2   Pullout

      7      1.47       9.80     27.22      5.51     64.08     11.21       1     14.1   Pullout
                                                                           2     18.0   Pullout

      8      1.45      11.10     29.58      5.11     56.55     12.08       1     13.4   Pullout
                                                                           2     18.4   Pullout

      9      1.43      12.40     26.93      5.56     53.57     12.53       1     11.9   Pullout
                                                                           2     17.4   Pullout

     10      1.42      13.70     24.70      6.03     50.80     13.01       1     10.4   Pullout
                                                                           2     16.4   Pullout

     11      1.41      15.00     22.78      6.51     48.24     13.51       1      9.0   Pullout
                                                                           2     15.5   Pullout

Search Level: 2.40 feet below the toe of the wall  Facing Design Force = 8.1 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes             |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      2.02       2.00     71.44      5.65     88.58      8.04       1     25.0   Pullout
                                                                           2     25.2   Pullout

      2      1.68       3.30     53.54      5.00     87.99      9.39       1     22.5   Pullout
                                                                           2     22.8   Pullout

      3      1.53       4.60     44.16      5.77     87.19      9.39       1     20.1   Pullout
                                                                           2     20.5   Pullout

      4      1.47       5.90     37.13      6.66     86.40      9.40       1     17.6   Pullout
                                                                           2     18.2   Pullout

      5      1.45       7.20     34.91      7.02     81.27      9.49       1     15.9   Pullout
                                                                           2     17.3   Pullout

      6      1.43       8.50     34.04      7.18     74.79      9.72       1     14.6   Pullout
```

```
                                                                           2     16.8   Pullout

      7      1.41       9.80     30.37      7.95     72.60      9.83       1     12.6   Pullout
                                                                           2     15.1   Pullout

      8      1.39      11.10     31.12      7.78     64.67     10.38       1     11.7   Pullout
                                                                           2     15.5   Pullout

      9      1.39      12.40     32.96      7.39     56.54     11.24       1     11.2   Pullout
                                                                           2     16.2   Pullout

     10      1.38      13.70     30.41      7.94     53.86     11.61       1      9.7   Pullout
                                                                           2     15.1   Pullout

     11      1.41      15.00     33.82      7.22     46.19     13.00       1      9.6   Pullout
                                                                           2     16.5   Pullout

Search Level: 3.20 feet below the toe of the wall  Facing Design Force = 7.2 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes             |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        |  Controlling |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress |  Resistance  |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   |  Failure Mode |
------------------------------------------------------------------------------------------------------
      1      2.24       2.00     72.42      5.96     88.66      8.52       1     25.0   Pullout
                                                                           2     25.2   Pullout

      2      1.83       3.30     62.40      6.41     87.78      8.53       1     22.5   Pullout
                                                                           2     22.9   Pullout

      3      1.70       4.60     57.06      6.77     83.84      8.57       1     20.5   Pullout
                                                                           2     21.5   Pullout

      4      1.65       5.90     42.07      6.36     83.23     10.01       1     18.1   Pullout
                                                                           2     19.1   Pullout

      5      1.60       7.20     40.21      6.60     77.74     10.17       1     16.5   Pullout
                                                                           2     18.3   Pullout

      6      1.55       8.50     35.60      7.32     75.61     10.26       1     14.4   Pullout
                                                                           2     16.6   Pullout

      7      1.52       9.80     35.92      7.26     68.48     10.69       1     13.3   Pullout
                                                                           2     16.5   Pullout

      8      1.48      11.10     32.61      7.91     65.93     10.89       1     11.5   Pullout
                                                                           2     15.0   Pullout

      9      1.46      12.40     29.80      8.57     63.48     11.11       1      9.7   Pullout
```

```
                                                                            2     13.6   Pullout

     10      1.44      13.70     31.88      8.07     55.43      12.07       1      9.3   Pullout
                                                                            2     14.5   Pullout

     11      1.42      15.00     29.60      8.63     52.97      12.45       1      7.7   Pullout
                                                                            2     13.4   Pullout

Search Level: 4.00 feet below the toe of the wall  Facing Design Force = 6.8 kips (Clouterre)
-------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes             |        Reinforcement          |
|       |         |          |----------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper        |       |        |              |
|       | Factor  | From Toe |----------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle   | Length |   Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees  |  feet  | degrees  |  feet   | Level |  ksi   | Failure Mode |
-------------------------------------------------------------------------------------------------------
      1      2.46       2.00     73.30      6.26     88.73       9.00       1     25.0   Pullout
                                                                            2     25.2   Pullout

      2      2.14       3.30     66.25      6.56     85.81       9.02       1     22.8   Pullout
                                                                            2     23.4   Pullout

      3      2.13       4.60     65.30      6.60     78.45       9.19       1     21.3   Pullout
                                                                            2     23.0   Pullout

      4      2.09       5.90     63.82      6.69     71.85       9.47       1     19.8   Pullout
                                                                            2     22.5   Pullout

      5      1.91       7.20     59.04      7.00     68.20       9.69       1     18.0   Pullout
                                                                            2     21.3   Pullout

      6      1.78       8.50     54.69      7.35     64.72       9.95       1     16.3   Pullout
                                                                            2     20.1   Pullout

      7      1.69       9.80     50.76      7.75     61.44      10.25       1     14.6   Pullout
                                                                            2     18.9   Pullout

      8      1.61      11.10     47.23      8.17     58.34      10.57       1     13.0   Pullout
                                                                            2     17.8   Pullout

      9      1.55      12.40     35.97      7.66     59.44      12.19       1     10.6   Pullout
                                                                            2     15.1   Pullout

     10      1.51      13.70     33.30      8.20     56.88      12.54       1      8.9   Pullout
                                                                            2     13.9   Pullout

     11      1.48      15.00     30.96      8.75     54.46      12.90       1      7.3   Pullout
                                                                            2     12.7   Pullout
```

```
========================================================================
                              END OF REPORT
========================================================================
```

```
=====================================================================================
                                       Snail

                                   Version: 2.2.2

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=====================================================================================
                                  File Information
=====================================================================================

File Name: US 395 RW3 Sta 1800 Temp.snz
Run Date:  11/14/22
Run Time:  18:56:29

=====================================================================================
                                Project Information
=====================================================================================

Description:    RW3
Location:       US 395
EA:
Project ID:
Wall No.:
Structure No.:
Station:
Engineer:       STC
                Designer

Comments:


=====================================================================================
                                      Geometry
=====================================================================================

Layout:

Reference Point:

At: Top of Wall
Distance From Origin:       40.00 feet
Elevation Above Origin:     30.00 feet

Wall Dimensions:

Wall Height:       11.00 feet
Facing Angle:      90.00 degrees
Facing Batter:     0.000 :12 H:V
```

```
Ground Surface:

Number of lines that define the ground surface above the wall: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Number of lines that define the ground surface in front of the toe: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Soil Layers:

Number of Layers: 2

Layers Below the Top Layer:

Coordinates of the Top of the Layer: feet

             Point 1         Point 1         Point 2         Point 2
Layer       Distance       Elevation        Distance       Elevation
--------------------------------------------------------------------
2              45.00           25.00           60.00           25.00

Ground Water:

Include Ground Water: No

======================================================================================================
                                             Soil Nails
======================================================================================================

Dimensions and Properties:

Maximum Vertical Spacing:               4.00 feet
Number of Soil Nail Rows:                  1
Soil Nail Design Parameters:               Varying

      Soil Nail       Inclination   Vertical   Horizontal      Nail Bar   Nail Bar Yield       Bond
         Length   From Horizontal    Spacing    Spacing H    Diameter Ø      Strength fy   Strength
No.        feet           degrees       feet         feet        inches              ksi   Factor F
---------------------------------------------------------------------------------------------------
1         15.00                15       3.00         4.50         1.000             75.0       1.00

Facing Resistance:
```

```
                                     Temporary   Permanent     Seismic
ASD Allowable Facing Resistance:          22.2        34.1        46.5 kips

======================================================================================================
                                          Soil Properties
======================================================================================================

                                        Unit Weight  Friction Angle        Cohesion
                                                  γ              φ'              c'
Layer  Description                            pcf         degrees             psf
-----------------------------------------------------------------------------------
1      Fill                                   115            34.0             100
2      Fill                                   120            34.0             100

======================================================================================================
                                               Loads
======================================================================================================

Applied Loads:

Seismic:

Horizontal Seismic Coefficient Kh0.25:

External Load:

Apply external load: No

Surcharges:

Apply surcharges: No

======================================================================================================
                                         Factors of Safety
======================================================================================================

                    Temporary   Permanent     Seismic
Pullout (Distal):        2.00        2.00        1.50
Pullout (Proximal):      2.00        2.00        1.50
Nail Bar Yield:          1.80        1.80        1.35

======================================================================================================
                                           Search Options
======================================================================================================

Search Limits:

Begin:      2.00 feet
End:       15.00 feet

Below Toe Searches (BTS):
```

```
Perform below Toe Search:       Yes
Number of BTS Points:             5
BTS Depth:                     4.00 feet
Interface Friction
Reduction Factor:              0.33

Advanced Search Options:

Use Advanced Search Options:     Yes
Inclination of Interslice Force: Use Average Failure Angle

======================================================================================================
                                               Results
======================================================================================================

Analysis:

Method:          ASD
Scenario:  Temporary

Factor of Safety:

Minimum:                  1.06
Found at Search Point:       3
Found at Grid Point:        47
Found at Search Level:       Toe of the wall

Load at Soil Nail Head:

Calculated Service Load at Soil Nail Head (Empirical), To:      8.3 kips
Allowable Facing Resistance, F_allowable (Entered):           22.2 kips
F_allowable ≥ To OK

Nominal Pullout Resistance:

                    Nominal Pullout Resistance
Layer  Description                         klf
----------------------------------------------
    1  Fill                              2.262
    2  Fill                              2.262

Results by Search Level:

** Indicates Minimum Factor of Safety

Search Level: At the toe of the wall  Facing Design Force = 8.3 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes             |       Reinforcement          |
|       |         |          |----------------------------------------|------------------------------|
|       | Minimum | Distance |       Lower        |      Upper        |       |        |             |
```

```
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      1.37       2.00     67.75      4.75     88.27      6.60       1     18.8   Pullout

      2      1.14       3.30     61.63      6.25     86.57      5.51       1     17.0   Pullout

   ** 3      1.06       4.60     57.90      7.79     84.03      4.42       1     15.4   Pullout

      4      1.13       5.90     46.01      7.65     83.88      5.53       1     13.5   Pullout

      5      1.21       7.20     43.68      7.96     75.33      5.69       1     12.7   Pullout

      6      1.30       8.50     38.97      8.75     72.83      5.76       1     11.2   Pullout

      7      1.38       9.80     38.72      8.79     61.87      6.24       1     10.9   Pullout

      8      1.45      11.10     35.29      9.52     58.81      6.43       1      9.7   Pullout

      9      1.54      12.40     32.36     10.28     55.93      6.64       1      8.5   Pullout

     10      1.61      13.70     33.79      9.89     45.10      7.76       1      9.0   Pullout

     11      1.68      15.00     31.43     10.55     42.51      8.14       1      8.1   Pullout

Search Level: 0.80 feet below the toe of the wall  Facing Design Force = 7.3 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |         Reinforcement          |
|       |         |          |---------------------------------------|--------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      1.66       2.00     69.13      5.05     88.38      7.08       1     18.8   Pullout

      2      1.37       3.30     63.28      6.61     86.80      5.91       1     17.0   Pullout

      3      1.26       4.60     59.68      8.20     84.43      4.74       1     15.3   Pullout

      4      1.23       5.90     53.13      8.85     82.88      4.76       1     13.6   Pullout

      5      1.30       7.20     50.87      9.13     73.03      4.93       1     12.9   Pullout

      6      1.38       8.50     40.95      9.00     73.93      6.14       1     11.0   Pullout

      7      1.44       9.80     40.70      9.05     63.51      6.59       1     10.7   Pullout

      8      1.49      11.10     37.21      9.76     60.56      6.77       1      9.4   Pullout
```

```
      9       1.55      12.40      38.42       9.50      49.95       7.71         1        9.6   Pullout

     10       1.60      13.70      35.67      10.12      47.11       8.05         1        8.6   Pullout

     11       1.66      15.00      33.25      10.76      44.52       8.41         1        7.6   Pullout

Search Level: 1.60 feet below the toe of the wall  Facing Design Force = 6.4 kips (Clouterre)
---------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes              |       Reinforcement        |
|       |         |          |-----------------------------------------|----------------------------|
|       | Minimum | Distance |        Lower        |       Upper       |       |        |           |
|       | Factor  | From Toe |-----------------------------------------|       |        | Controlling |
|Search |   of    | of Wall  |  Angle   | Length   |  Angle  | Length  |       | Stress | Resistance  |
|Point  | Safety  |   feet   | degrees  |  feet    | degrees |  feet   | Level |  ksi   | Failure Mode |
---------------------------------------------------------------------------------------------------
      1       1.99       2.00      70.35       5.35      88.49       7.56         1       18.8   Pullout

      2       1.65       3.30      64.76       6.96      87.00       6.31         1       17.0   Pullout

      3       1.50       4.60      61.29       8.62      84.79       5.06         1       15.3   Pullout

      4       1.43       5.90      54.92       9.24      83.32       5.07         1       13.6   Pullout

      5       1.42       7.20      49.40       9.96      81.87       5.09         1       11.9   Pullout

      6       1.47       8.50      48.03      10.17      71.36       5.32         1       11.4   Pullout

      7       1.55       9.80      47.78      10.21      59.74       5.83         1       11.2   Pullout

      8       1.59      11.10      39.04      10.00      62.14       7.13         1        9.2   Pullout

      9       1.63      12.40      40.26       9.75      51.79       8.02         1        9.2   Pullout

     10       1.66      13.70      37.47      10.36      48.98       8.35         1        8.2   Pullout

     11       1.70      15.00      34.99      10.99      46.40       8.70         1        7.2   Pullout

Search Level: 2.40 feet below the toe of the wall  Facing Design Force = 6.4 kips (Clouterre)
---------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes              |       Reinforcement        |
|       |         |          |-----------------------------------------|----------------------------|
|       | Minimum | Distance |        Lower        |       Upper       |       |        |           |
|       | Factor  | From Toe |-----------------------------------------|       |        | Controlling |
|Search |   of    | of Wall  |  Angle   | Length   |  Angle  | Length  |       | Stress | Resistance  |
|Point  | Safety  |   feet   | degrees  |  feet    | degrees |  feet   | Level |  ksi   | Failure Mode |
---------------------------------------------------------------------------------------------------
      1       2.34       2.00      71.44       5.65      88.58       8.04         1       18.7   Pullout

      2       1.94       3.30      66.09       7.33      87.18       6.71         1       17.0   Pullout

      3       1.75       4.60      62.76       9.04      85.10       5.38         1       15.3   Pullout
```

```
      4      1.65       5.90     56.56      9.64     83.72      5.39       1     13.5   Pullout

      5      1.62       7.20     51.13     10.33     82.35      5.41       1     11.8   Pullout

      6      1.62       8.50     46.42     11.10     80.99      5.43       1     10.1   Pullout

      7      1.65       9.80     45.72     11.23     69.91      5.71       1      9.8   Pullout

      8      1.70      11.10     45.98     11.18     58.15      6.31       1      9.8   Pullout

      9      1.72      12.40     42.81     11.83     55.24      6.52       1      8.6   Pullout

     10      1.76      13.70     39.18     10.60     50.72      8.66       1      7.8   Pullout

     11      1.79      15.00     36.67     11.22     48.16      8.99       1      6.8   Pullout

Search Level: 3.20 feet below the toe of the wall  Facing Design Force = 4.5 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      2.89       2.00     79.74     10.10     87.31      4.26       1     18.9   Pullout

      2      2.91       3.30     76.92     14.58      0.00      0.00       1     17.9   Pullout

      3      7.31       4.60      0.00      2.76     82.62     14.32       1     15.5   Pullout

      4      4.80       5.90     14.97      5.50     87.36     12.79       1     13.1   Pullout

      5      3.59       7.20     30.61      8.37    -90.00      9.94       1     10.9   Pullout

      6      2.06       8.50     59.10     16.55      0.00      0.00       1     13.0   Pullout

      7      1.95       9.80     52.52     16.10     90.00      1.42       1     11.0   Pullout

      8      1.86      11.10     47.64     11.53     59.62      6.58       1      9.6   Pullout

      9      1.86      12.40     44.47     12.16     56.78      6.79       1      8.4   Pullout

     10      1.86      13.70     41.62     12.83     54.11      7.01       1      7.2   Pullout

     11      1.91      15.00     38.27     11.46     49.80      9.30       1      6.4   Pullout

Search Level: 4.00 feet below the toe of the wall  Facing Design Force = 3.4 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
```

```
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1       N/A       2.00      0.00      0.20     83.16     15.11       1     19.2   Pullout

      2       N/A       3.30      0.00      0.33     78.80     15.29       1     17.8   Pullout

      3       N/A       4.60      0.00      0.46     74.57     15.56       1     16.4   Pullout

      4       N/A       5.90      0.00      1.18     72.53     15.73       1     14.8   Pullout

      5     12.43       7.20      0.00      5.76     84.52     15.07       1     11.6   Pullout

      6      6.71       8.50      0.00      5.10     77.23     15.38       1     10.6   Pullout

      7      3.70       9.80     24.66     10.78     90.00     10.50       1      7.0   Pullout

      8      2.89      11.10     28.39     12.62    -90.00      9.00       1      5.1   Pullout

      9      2.22      12.40     35.97     15.32     90.00      6.00       1      3.6   Pullout

     10      2.07      13.70     41.22     18.21    -90.00      3.00       1      6.0   Pullout

     11      2.05      15.00     41.99     20.18     90.00      1.50       1      6.3   Pullout


======================================================================================================
                                           END OF REPORT
======================================================================================================
```

```
======================================================================================================
                                               Snail

                                           Version: 2.2.2

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======================================================================================================
                                          File Information
======================================================================================================

File Name: US 395 RW3 Sta 1800 Temp.snz
Run Date:  11/14/22
Run Time:  18:53:09

======================================================================================================
                                        Project Information
======================================================================================================

Description:    RW3
Location:       US 395
EA:
Project ID:
Wall No.:
Structure No.:
Station:
Engineer:       STC
                Designer

Comments:


======================================================================================================
                                              Geometry
======================================================================================================

Layout:

Reference Point:

At: Top of Wall
Distance From Origin:       40.00 feet
Elevation Above Origin:     30.00 feet

Wall Dimensions:

Wall Height:       11.00 feet
Facing Angle:      90.00 degrees
Facing Batter:     0.000 :12 H:V
```

```
Ground Surface:

Number of lines that define the ground surface above the wall: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Number of lines that define the ground surface in front of the toe: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Soil Layers:

Number of Layers: 2

Layers Below the Top Layer:

Coordinates of the Top of the Layer: feet

             Point 1         Point 1         Point 2         Point 2
Layer       Distance       Elevation        Distance       Elevation
--------------------------------------------------------------------
2              45.00           25.00           60.00           25.00

Ground Water:

Include Ground Water: No

======================================================================================================
                                             Soil Nails
======================================================================================================

Dimensions and Properties:

Maximum Vertical Spacing:               4.00 feet
Number of Soil Nail Rows:                  1
Soil Nail Design Parameters:               Varying

      Soil Nail       Inclination   Vertical   Horizontal      Nail Bar   Nail Bar Yield       Bond
         Length   From Horizontal    Spacing    Spacing H    Diameter Ø      Strength fy   Strength
No.        feet           degrees       feet         feet        inches              ksi   Factor F
---------------------------------------------------------------------------------------------------
1         15.00                15       3.00         4.50         1.000             75.0       1.00

Facing Resistance:
```

```
                                     Temporary   Permanent     Seismic
ASD Allowable Facing Resistance:          22.2        34.1        46.5 kips

======================================================================================================
                                          Soil Properties
======================================================================================================

                                        Unit Weight  Friction Angle        Cohesion
                                                  γ              φ'              c'
Layer  Description                             pcf         degrees             psf
-----------------------------------------------------------------------------------
1      Fill                                    115            34.0             100
2      Fill                                    120            34.0             100

======================================================================================================
                                               Loads
======================================================================================================

Applied Loads:

Seismic:

Horizontal Seismic Coefficient Kh0.25:

External Load:

Apply external load: No

Surcharges:

Apply surcharges:    Yes

           Distance from Top of Wall            Load            Load
               Begin             End           Begin             End
No.             feet            feet             psf             psf
--------------------------------------------------------------------
1               0.00           30.00             250             250

======================================================================================================
                                         Factors of Safety
======================================================================================================

                    Temporary   Permanent     Seismic
Pullout (Distal):        2.00        2.00        1.50
Pullout (Proximal):      2.00        2.00        1.50
Nail Bar Yield:          1.80        1.80        1.35

======================================================================================================
                                           Search Options
======================================================================================================
```

```
Search Limits:

Begin:      2.00 feet
End:       15.00 feet

Below Toe Searches (BTS):

Perform below Toe Search:       Yes
Number of BTS Points:             5
BTS Depth:                     4.00 feet
Interface Friction
Reduction Factor:              0.33

Advanced Search Options:

Use Advanced Search Options:     Yes
Inclination of Interslice Force: Use Average Failure Angle

======================================================================================================
                                               Results
======================================================================================================

Analysis:

Method:          ASD
Scenario:  Temporary

Factor of Safety:

Minimum:                  0.91
Found at Search Point:       3
Found at Grid Point:        47
Found at Search Level:       Toe of the wall

Load at Soil Nail Head:

Calculated Service Load at Soil Nail Head (Empirical), To:     8.3 kips
Allowable Facing Resistance, F_allowable (Entered):           22.2 kips
F_allowable ≥ To OK

Nominal Pullout Resistance:

                    Nominal Pullout Resistance
Layer  Description                         klf
----------------------------------------------
    1  Fill                              2.262
    2  Fill                              2.262

Results by Search Level:

** Indicates Minimum Factor of Safety
```

```
Search Level: At the toe of the wall  Facing Design Force = 8.3 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      1.18       2.00     67.75      4.75     88.27      6.60       1     18.8   Pullout

      2      0.97       3.30     61.63      6.25     86.57      5.51       1     17.0   Pullout

   ** 3      0.91       4.60     57.90      7.79     84.03      4.42       1     15.4   Pullout

      4      0.97       5.90     54.43      8.11     74.99      4.56       1     14.5   Pullout

      5      1.05       7.20     47.50      7.46     68.56      5.91       1     13.5   Pullout

      6      1.11       8.50     42.75      8.10     65.13      6.06       1     12.2   Pullout

      7      1.18       9.80     43.09      8.05     54.52      6.75       1     12.0   Pullout

      8      1.24      11.10     39.55      8.64     51.09      7.07       1     11.0   Pullout

      9      1.31      12.40     36.47      9.25     47.96      7.41       1     10.0   Pullout

     10      1.38      13.70     33.79      9.89     45.10      7.76       1      9.0   Pullout

     11      1.46      15.00     31.43     10.55     42.51      8.14       1      8.1   Pullout

Search Level: 0.80 feet below the toe of the wall  Facing Design Force = 7.3 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      1.44       2.00     69.13      5.05     88.38      7.08       1     18.8   Pullout

      2      1.18       3.30     63.28      6.61     86.80      5.91       1     17.0   Pullout

      3      1.08       4.60     59.68      8.20     84.43      4.74       1     15.3   Pullout

      4      1.07       5.90     53.13      8.85     82.88      4.76       1     13.6   Pullout

      5      1.11       7.20     50.87      9.13     73.03      4.93       1     12.9   Pullout
```

```
      6      1.17       8.50     49.96      9.25     61.62      5.36       1     12.6   Pullout
      7      1.23       9.80     45.10      8.33     56.40      7.08       1     11.7   Pullout
      8      1.27      11.10     41.54      8.90     53.04      7.38       1     10.6   Pullout
      9      1.32      12.40     38.42      9.50     49.95      7.71       1      9.6   Pullout
     10      1.38      13.70     35.67     10.12     47.11      8.05       1      8.6   Pullout
     11      1.44      15.00     38.19     19.09      0.00      0.00       1      9.2   Pullout
Search Level: 1.60 feet below the toe of the wall  Facing Design Force = 7.3 kips (Clouterre)
-------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes             |         Reinforcement         |
|       |         |          |----------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower        |      Upper        |       |        |              |
|       | Factor  | From Toe |----------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  |  Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |   feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
-------------------------------------------------------------------------------------------------------
      1      1.75       2.00     70.35      5.35     88.49      7.56       1     18.8   Pullout
      2      1.43       3.30     64.76      6.96     87.00      6.31       1     17.0   Pullout
      3      1.29       4.60     61.29      8.62     84.79      5.06       1     15.3   Pullout
      4      1.24       5.90     54.92      9.24     83.32      5.07       1     13.6   Pullout
      5      1.25       7.20     49.40      9.96     81.87      5.09       1     11.9   Pullout
      6      1.27       8.50     48.03     10.17     71.36      5.32       1     11.4   Pullout
      7      1.31       9.80     47.78     10.21     59.74      5.83       1     11.2   Pullout
      8      1.35      11.10     43.41      9.17     54.83      7.71       1     10.3   Pullout
      9      1.39      12.40     40.26      9.75     51.79      8.02       1      9.2   Pullout
     10      1.43      13.70     37.47     10.36     48.98      8.35       1      8.2   Pullout
     11      1.47      15.00     40.03     19.59      0.00      0.00       1      8.7   Pullout
Search Level: 2.40 feet below the toe of the wall  Facing Design Force = 6.4 kips (Clouterre)
-------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes             |         Reinforcement         |
|       |         |          |----------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower        |      Upper        |       |        |              |
|       | Factor  | From Toe |----------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  |  Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |   feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
```

```
------------------------------------------------------------------------------------------------------
      1      2.07       2.00     71.44      5.65     88.58      8.04       1     18.7   Pullout

      2      1.69       3.30     66.09      7.33     87.18      6.71       1     17.0   Pullout

      3      1.51       4.60     62.76      9.04     85.10      5.38       1     15.3   Pullout

      4      1.44       5.90     56.56      9.64     83.72      5.39       1     13.5   Pullout

      5      1.41       7.20     51.13     10.33     82.35      5.41       1     11.8   Pullout

      6      1.42       8.50     49.78     10.53     72.40      5.62       1     11.2   Pullout

      7      1.43       9.80     45.72     11.23     69.91      5.71       1      9.8   Pullout

      8      1.45      11.10     45.98     11.18     58.15      6.31       1      9.8   Pullout

      9      1.47      12.40     42.81     11.83     55.24      6.52       1      8.6   Pullout

     10      1.52      13.70     44.37     19.16      0.00      0.00       1      9.2   Pullout

     11      1.54      15.00     41.78     20.11      0.00      0.00       1      8.2   Pullout

Search Level: 3.20 feet below the toe of the wall  Facing Design Force = 5.1 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |         Reinforcement          |
|       |         |          |---------------------------------------|--------------------------------|
|       | Minimum | Distance |        Lower       |       Upper      |       |        |               |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling   |
|Search |   of    | of Wall  |  Angle   | Length  |  Angle  | Length |       | Stress | Resistance    |
|Point  | Safety  |   feet   | degrees  |  feet   | degrees |  feet  | Level |  ksi   | Failure Mode  |
------------------------------------------------------------------------------------------------------
      1      2.52       2.00     79.74     10.10     87.31      4.26       1     18.9   Pullout

      2      2.37       3.30     76.92     14.58      0.00      0.00       1     17.9   Pullout

      3      2.05       4.60     72.05     14.93      0.00      0.00       1     16.6   Pullout

      4      1.86       5.90     67.44     15.38      0.00      0.00       1     15.4   Pullout

      5      1.73       7.20     60.60     14.67    -90.00      1.42       1     13.4   Pullout

      6      1.61       8.50     55.07     10.39     65.82      6.23       1     12.1   Pullout

      7      1.59       9.80     51.16     10.94     62.63      6.40       1     10.8   Pullout

      8      1.58      11.10     47.64     11.53     59.62      6.58       1      9.6   Pullout

      9      1.59      12.40     44.47     12.16     56.78      6.79       1      8.4   Pullout

     10      1.61      13.70     41.62     12.83     54.11      7.01       1      7.2   Pullout
```

```
     11      1.64      15.00     43.43     20.66      0.00      0.00       1      7.9   Pullout

Search Level: 4.00 feet below the toe of the wall  Facing Design Force = 3.7 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1       N/A       2.00      0.00      0.20     83.16     15.11       1     19.2   Pullout

      2       N/A       3.30      0.00      0.33     78.80     15.29       1     17.8   Pullout

      3       N/A       4.60      0.00      0.46     74.57     15.56       1     16.4   Pullout

      4     11.17       5.90      0.00      4.72     85.50     15.05       1     13.3   Pullout

      5      7.78       7.20      0.00      5.04     81.81     15.15       1     11.9   Pullout

      6      3.31       8.50     27.90      9.62     90.00     10.50       1      8.9   Pullout

      7      2.21       9.80     37.43     12.34     90.00      7.50       1      7.0   Pullout

      8      1.80      11.10     47.23     16.35    -90.00      3.00       1      8.3   Pullout

      9      1.75      12.40     50.42     19.46      0.00      0.00       1      9.5   Pullout

     10      1.73      13.70     43.18     13.15     55.59      7.27       1      6.9   Pullout

     11      1.74      15.00     40.60     13.83     53.13      7.50       1      5.8   Pullout


======================================================================================================
                                           END OF REPORT
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```

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======================================================================================================
                                               Snail

                                           Version: 2.2.2

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======================================================================================================
                                          File Information
======================================================================================================

File Name: US 395 RW3 Sta 1900.snz
Run Date:  11/14/22
Run Time:  15:42:20

======================================================================================================
                                        Project Information
======================================================================================================

Description:    RW3
Location:       US 395
EA:
Project ID:
Wall No.:
Structure No.:
Station:
Engineer:       STC
                Designer

Comments:


======================================================================================================
                                              Geometry
======================================================================================================

Layout:

Reference Point:

At: Top of Wall
Distance From Origin:       40.00 feet
Elevation Above Origin:     30.00 feet

Wall Dimensions:

Wall Height:        9.91 feet
Facing Angle:      90.00 degrees
Facing Batter:     0.000 :12 H:V
```

```
Ground Surface:

Number of lines that define the ground surface above the wall: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Number of lines that define the ground surface in front of the toe: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Soil Layers:

Number of Layers: 2

Layers Below the Top Layer:

Coordinates of the Top of the Layer: feet

             Point 1         Point 1         Point 2         Point 2
Layer       Distance       Elevation        Distance       Elevation
--------------------------------------------------------------------
2              45.00           25.00           60.00           25.00

Ground Water:

Include Ground Water: No

====================================================================================================
                                             Soil Nails
====================================================================================================

Dimensions and Properties:

Maximum Vertical Spacing:                5.00 feet
Number of Soil Nail Rows:                   2
Soil Nail Design Parameters:                Varying

      Soil Nail       Inclination   Vertical   Horizontal      Nail Bar   Nail Bar Yield       Bond
         Length   From Horizontal    Spacing    Spacing H    Diameter Ø      Strength fy   Strength
No.        feet           degrees       feet         feet        inches              ksi   Factor F
---------------------------------------------------------------------------------------------------
1         15.00                15       3.00         5.00         1.000             75.0       1.00
2         10.00                15       3.90         5.00         1.000             75.0       1.00

Facing Resistance:
```

```
                                     Temporary   Permanent     Seismic
ASD Allowable Facing Resistance:          20.6        34.1        46.5 kips

======================================================================================================
                                          Soil Properties
======================================================================================================

                                        Unit Weight  Friction Angle        Cohesion
                                                  γ              φ'              c'
Layer  Description                              pcf         degrees             psf
-----------------------------------------------------------------------------------
1      Fill                                     115            34.0             100
2      Fill                                     120            34.0             100

======================================================================================================
                                               Loads
======================================================================================================

Applied Loads:

Seismic:

Horizontal Seismic Coefficient Kh0.25:

External Load:

Apply external load: No

Surcharges:

Apply surcharges:    Yes

           Distance from Top of Wall            Load            Load
               Begin             End           Begin             End
No.             feet            feet             psf             psf
--------------------------------------------------------------------
1               0.00           30.00             250             250

======================================================================================================
                                         Factors of Safety
======================================================================================================

                    Temporary   Permanent     Seismic
Pullout (Distal):        2.00        2.00        1.50
Pullout (Proximal):      2.00        2.00        1.50
Nail Bar Yield:          1.80        1.80        1.35

======================================================================================================
                                           Search Options
======================================================================================================
```

```
Search Limits:

Begin:      2.00 feet
End:       15.00 feet

Below Toe Searches (BTS):

Perform below Toe Search:       Yes
Number of BTS Points:             5
BTS Depth:                     4.00 feet
Interface Friction
Reduction Factor:              0.33

Advanced Search Options:

Use Advanced Search Options:     Yes
Inclination of Interslice Force: Use Average Failure Angle

======================================================================================================
                                               Results
======================================================================================================

Analysis:

Method:          ASD
Scenario:  Permanent

Factor of Safety:

Minimum:                  1.57
Found at Search Point:       6
Found at Grid Point:        45
Found at Search Level:    1.60 feet below the toe of the wall

Load at Soil Nail Head:

Calculated Service Load at Soil Nail Head (Empirical), To:     7.1 kips
Allowable Facing Resistance, F_allowable (Entered):           34.1 kips
F_allowable ≥ To OK

Nominal Pullout Resistance:

                    Nominal Pullout Resistance
Layer  Description                         klf
----------------------------------------------
    1  Fill                              2.262
    2  Fill                              2.262

Results by Search Level:
```

```
** Indicates Minimum Factor of Safety

Search Level: At the toe of the wall  Facing Design Force = 10.5 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      1.58       2.00     47.76      2.68     88.56      7.93       1     18.8   Pullout
                                                                           2     11.7   Pullout

      2      1.58       3.30     45.03      2.80     80.55      8.04       1     17.6   Pullout
                                                                           2     11.3   Pullout

      3      1.60       4.60     40.75      3.04     73.82      8.25       1     16.4   Pullout
                                                                           2     10.8   Pullout

      4      1.64       5.90     40.03      3.08     65.94      8.68       1     15.5   Pullout
                                                                           2     10.6   Pullout

      5      1.68       7.20     34.54      3.50     61.41      9.03       1     14.4   Pullout
                                                                           2      9.9   Pullout

      6      1.75       8.50     30.24      3.94     57.25      9.43       1     13.2   Pullout
                                                                           2      9.2   Pullout

      7      1.81       9.80     33.99      3.55     49.13     10.48       1     12.9   Pullout
                                                                           2      9.8   Pullout

      8      1.87      11.10     30.76      3.88     45.58     11.10       1     12.0   Pullout
                                                                           2      9.3   Pullout

      9      1.95      12.40     28.05      4.22     42.41     11.76       1     11.1   Pullout
                                                                           2      8.8   Pullout

     10      2.08      13.70     30.06      7.91     40.96      9.07       1      9.9   Pullout
                                                                           2      9.1   Pullout

     11      2.16      15.00     27.86      8.48     38.41      9.57       1      9.1   Pullout
                                                                           2      8.8   Pullout

Search Level: 0.80 feet below the toe of the wall  Facing Design Force = 8.6 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
```

```
|Point   | Safety  |    feet    | degrees  |   feet   | degrees  |   feet   | Level  |   ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      1.68       2.00     60.74      3.68     88.47      7.50       1     18.8   Pullout
                                                                           2     11.7   Pullout

      2      1.67       3.30     58.36      3.77     80.02      7.61       1     17.7   Pullout
                                                                           2     11.4   Pullout

      3      1.60       4.60     57.21      7.64     83.87      4.31       1     15.4   Pullout
                                                                           2     11.3   Pullout

      4      1.62       5.90     53.70      7.97     74.60      4.44       1     14.6   Pullout
                                                                           2     10.9   Pullout

      5      1.69       7.20     46.74      7.35     68.03      5.77       1     13.5   Pullout
                                                                           2     10.1   Pullout

      6      1.71       8.50     41.99      8.00     64.54      5.93       1     12.3   Pullout
                                                                           2      9.5   Pullout

      7      1.74       9.80     36.08      3.64     51.32     10.98       1     12.5   Pullout
                                                                           2      9.2   Pullout

      8      1.78      11.10     32.75      3.96     47.80     11.57       1     11.6   Pullout
                                                                           2      8.6   Pullout

      9      1.83      12.40     29.93      4.29     44.63     12.20       1     10.6   Pullout
                                                                           2      8.1   Pullout

     10      1.88      13.70     27.53      4.63     41.78     12.86       1      9.7   Pullout
                                                                           2      7.5   Pullout

     11      1.94      15.00     25.45      4.98     39.21     13.55       1      8.9   Pullout
                                                                           2      7.1   Pullout

Search Level: 1.60 feet below the toe of the wall  Facing Design Force = 7.1 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|        |         |           |           Failure Planes             |        Reinforcement          |
|        |         |           |--------------------------------------|-------------------------------|
|        | Minimum | Distance  |      Lower        |      Upper       |       |         |             |
|        | Factor  | From Toe  |--------------------------------------|       |         | Controlling |
|Search  |   of    | of Wall   |  Angle   | Length  |  Angle   | Length |       | Stress  | Resistance  |
|Point   | Safety  |   feet    | degrees  |  feet   | degrees  |  feet  | Level |   ksi   | Failure Mode|
------------------------------------------------------------------------------------------------------
      1      1.98       2.00     62.47      3.89     88.58      8.06       1     18.7   Pullout
                                                                           2     11.7   Pullout

      2      1.80       3.30     49.30      4.55     87.66      8.06       1     16.9   Pullout
                                                                           2     10.0   Pullout

      3      1.75       4.60     59.06      8.05     84.30      4.63       1     15.4   Pullout
```

```
                                                                           2     10.9   Pullout

      4      1.68       5.90     52.44      8.71     82.70      4.64       1     13.7   Pullout
                                                                           2     10.0   Pullout

      5      1.69       7.20     50.17      8.99     72.63      4.82       1     13.0   Pullout
                                                                           2      9.7   Pullout

   ** 6      1.57       8.50     49.25      9.12     61.02      5.26       1     12.7   Pullout
                                                                           2      9.6   Pullout

      7      1.74       9.80     41.38      5.22     53.88      9.97       1     12.1   Pullout
                                                                           2      8.5   Pullout

      8      1.78      11.10     40.83      8.80     52.35      7.27       1     10.7   Pullout
                                                                           2      8.3   Pullout

      9      1.81      12.40     37.72      9.41     49.24      7.60       1      9.7   Pullout
                                                                           2      7.8   Pullout

     10      1.84      13.70     35.00     10.03     46.40      7.95       1      8.7   Pullout
                                                                           2      7.3   Pullout

     11      1.88      15.00     32.60     10.68     43.81      8.31       1      7.8   Pullout
                                                                           2      6.8   Pullout

Search Level: 2.40 feet below the toe of the wall  Facing Design Force = 6.4 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |                               |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      2.31       2.00     64.02      4.11     88.67      8.62       1     18.7   Pullout
                                                                           2     11.7   Pullout

      2      2.07       3.30     51.19      4.74     87.81      8.62       1     16.9   Pullout
                                                                           2      9.9   Pullout

      3      1.94       4.60     60.73      8.47     84.66      4.95       1     15.3   Pullout
                                                                           2     10.5   Pullout

      4      1.84       5.90     54.29      9.10     83.17      4.96       1     13.6   Pullout
                                                                           2      9.5   Pullout

      5      1.80       7.20     48.74      9.83     81.68      4.98       1     11.9   Pullout
                                                                           2      8.7   Pullout

      6      1.79       8.50     47.37     10.04     70.95      5.21       1     11.4   Pullout
```

```
                                                                           2       8.4   Pullout

      7      1.82       9.80     47.12     10.08     59.16      5.73       1      11.3   Pullout
                                                                           2       8.4   Pullout

      8      1.83      11.10     39.75      5.78     52.30     10.89       1      10.8   Pullout
                                                                           2       7.3   Pullout

      9      1.84      12.40     36.67      6.18     49.19     11.38       1       9.7   Pullout
                                                                           2       6.6   Pullout

     10      1.86      13.70     33.98      6.61     46.35     11.91       1       8.7   Pullout
                                                                           2       5.9   Pullout

     11      1.89      15.00     31.61      7.05     43.76     12.46       1       7.8   Pullout
                                                                           2       5.3   Pullout

Search Level: 3.20 feet below the toe of the wall  Facing Design Force = 5.5 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |            Failure Planes             |         Reinforcement         |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      2.56       2.00     71.06      5.54     88.54      7.87       1      18.8   Pullout
                                                                           2      11.7   Pullout

      2      2.39       3.30     69.32      8.41     86.40      5.25       1      17.0   Pullout
                                                                           2      11.2   Pullout

      3      2.31       4.60     66.32      5.73     73.70      8.20       1      16.5   Pullout
                                                                           2      10.8   Pullout

      4      2.13       5.90     60.64      6.02     69.44      8.40       1      15.1   Pullout
                                                                           2       9.9   Pullout

      5      2.04       7.20     57.35      9.34     67.61      5.67       1      13.6   Pullout
                                                                           2       9.3   Pullout

      6      1.97       8.50     52.90      9.86     64.07      5.83       1      12.3   Pullout
                                                                           2       8.6   Pullout

      7      1.91       9.80     45.10     11.11     69.51      5.60       1       9.8   Pullout
                                                                           2       7.1   Pullout

      8      1.91      11.10     45.35     11.06     57.58      6.21       1       9.9   Pullout
                                                                           2       7.2   Pullout

      9      1.93      12.40     41.38      9.92     52.89      8.22       1       9.0   Pullout
```

```
                                                                           2        6.3   Pullout

     10      1.93      13.70      38.57      10.51      50.10       8.54       1        8.0   Pullout
                                                                           2        5.7   Pullout

     11      1.94      15.00      36.07      11.13      47.53       8.89       1        6.9   Pullout
                                                                           2        5.1   Pullout

Search Level: 4.00 feet below the toe of the wall  Facing Design Force = 4.3 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      3.41       2.00      80.67       9.87      84.53       4.19       1       19.1   Pullout
                                                                           2       12.8   Pullout

      2       N/A       3.30       0.00       0.33      77.95      14.22       1       17.8   Pullout
                                                                           2       11.8   Pullout

      3       N/A       4.60       0.00       0.46      73.43      14.51       1       16.5   Pullout
                                                                           2       10.9   Pullout

      4     10.85       5.90       0.00       4.72      85.15      13.96       1       13.4   Pullout
                                                                           2        6.7   Pullout

      5      6.32       7.20       0.00       4.32      78.30      14.21       1       12.3   Pullout
                                                                           2        6.2   Pullout

      6      3.85       8.50      26.15       9.47      90.00       9.74       1        8.9   Pullout
                                                                           2        1.7   Pullout

      7      2.97       9.80      29.59      11.27      90.00       8.35       1        7.0   Pullout
                                                                           2        1.9   Pullout

      8      2.09      11.10      51.41      17.80       0.00       0.00       1       10.9   Pullout
                                                                           2        7.5   Pullout

      9      2.06      12.40      48.29      18.63       0.00       0.00       1        9.9   Pullout
                                                                           2        6.9   Pullout

     10      2.02      13.70      40.24      10.77      51.77       8.85       1        7.6   Pullout
                                                                           2        5.0   Pullout

     11      2.03      15.00      37.70      11.37      49.22       9.19       1        6.6   Pullout
                                                                           2        4.4   Pullout
```

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==========================================================================================
                                     END OF REPORT
==========================================================================================
```

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======================================================================================================
                                               Snail

                                           Version: 2.2.2

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======================================================================================================
                                          File Information
======================================================================================================

File Name: US 395 RW3 Sta 1900 Seismic.snz
Run Date:  11/14/22
Run Time:  15:44:56

======================================================================================================
                                        Project Information
======================================================================================================

Description:    RW3
Location:       US 395
EA:
Project ID:
Wall No.:
Structure No.:
Station:
Engineer:       STC
                Designer

Comments:


======================================================================================================
                                              Geometry
======================================================================================================

Layout:

Reference Point:

At: Top of Wall
Distance From Origin:       40.00 feet
Elevation Above Origin:     30.00 feet

Wall Dimensions:

Wall Height:        9.91 feet
Facing Angle:      90.00 degrees
Facing Batter:     0.000 :12 H:V
```

```
Ground Surface:

Number of lines that define the ground surface above the wall: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Number of lines that define the ground surface in front of the toe: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Soil Layers:

Number of Layers: 2

Layers Below the Top Layer:

Coordinates of the Top of the Layer: feet

             Point 1         Point 1         Point 2         Point 2
Layer       Distance       Elevation        Distance       Elevation
--------------------------------------------------------------------
2              45.00           25.00           60.00           25.00

Ground Water:

Include Ground Water: No

======================================================================================================
                                             Soil Nails
======================================================================================================

Dimensions and Properties:

Maximum Vertical Spacing:               5.00 feet
Number of Soil Nail Rows:                  2
Soil Nail Design Parameters:               Varying

      Soil Nail       Inclination   Vertical   Horizontal      Nail Bar   Nail Bar Yield       Bond
         Length   From Horizontal    Spacing    Spacing H    Diameter Ø      Strength fy   Strength
No.        feet           degrees       feet         feet        inches              ksi   Factor F
---------------------------------------------------------------------------------------------------
1         15.00                15       3.00         5.00         1.000             75.0       1.00
2         10.00                15       3.90         5.00         1.000             75.0       1.00

Facing Resistance:
```

```
                                     Temporary   Permanent     Seismic
ASD Allowable Facing Resistance:          20.6        34.1        46.5 kips

======================================================================================================
                                          Soil Properties
======================================================================================================

                                        Unit Weight  Friction Angle        Cohesion
                                                  γ              φ'              c'
Layer  Description                              pcf         degrees             psf
-----------------------------------------------------------------------------------
1      Fill                                     115            34.0             100
2      Fill                                     120            34.0             100

======================================================================================================
                                               Loads
======================================================================================================

Applied Loads:

Seismic:

Horizontal Seismic Coefficient Kh0.25:

External Load:

Apply external load: No

Surcharges:

Apply surcharges:    Yes

           Distance from Top of Wall            Load            Load
               Begin             End           Begin             End
No.             feet            feet             psf             psf
--------------------------------------------------------------------
1               0.00           30.00             250             250

======================================================================================================
                                         Factors of Safety
======================================================================================================

                    Temporary   Permanent     Seismic
Pullout (Distal):        2.00        2.00        1.50
Pullout (Proximal):      2.00        2.00        1.50
Nail Bar Yield:          1.80        1.80        1.35

======================================================================================================
                                           Search Options
======================================================================================================
```

```
Search Limits:

Begin:      2.00 feet
End:       15.00 feet

Below Toe Searches (BTS):

Perform below Toe Search:       Yes
Number of BTS Points:             5
BTS Depth:                     4.00 feet
Interface Friction
Reduction Factor:              0.33

Advanced Search Options:

Use Advanced Search Options:     Yes
Inclination of Interslice Force: Use Average Failure Angle

======================================================================================================
                                               Results
======================================================================================================

Analysis:

Method:          ASD
Scenario:    Seismic

Factor of Safety:

Minimum:                  1.28
Found at Search Point:       2
Found at Grid Point:        25
Found at Search Level:       Toe of the wall

Load at Soil Nail Head:

Calculated Service Load at Soil Nail Head (Empirical), To:    12.6 kips
Allowable Facing Resistance, F_allowable (Entered):           46.5 kips
F_allowable ≥ To OK

Nominal Pullout Resistance:

                    Nominal Pullout Resistance
Layer  Description                         klf
----------------------------------------------
    1  Fill                              2.262
    2  Fill                              2.262

Results by Search Level:
```

```
** Indicates Minimum Factor of Safety

Search Level: At the toe of the wall  Facing Design Force = 12.6 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      1.40       2.00     47.76      2.68     88.56      7.93       1     25.0   Pullout
                                                                           2     15.6   Pullout

   ** 2      1.28       3.30     33.72      3.57     87.62      7.93       1     22.6   Pullout
                                                                           2     13.3   Pullout

      3      1.31       4.60     28.31      4.18     83.38      7.98       1     20.6   Pullout
                                                                           2     11.9   Pullout

      4      1.34       5.90     29.24      4.06     73.42      8.27       1     19.6   Pullout
                                                                           2     12.1   Pullout

      5      1.36       7.20     28.84      4.11     65.58      8.71       1     18.5   Pullout
                                                                           2     12.0   Pullout

      6      1.40       8.50     36.08      8.41     71.06      5.24       1     15.2   Pullout
                                                                           2     13.2   Pullout

      7      1.45       9.80     35.84      8.46     59.32      5.76       1     15.0   Pullout
                                                                           2     13.2   Pullout

      8      1.48      11.10     27.03      8.72     60.75      6.81       1     12.5   Pullout
                                                                           2     11.5   Pullout

      9      1.49      12.40     28.05      4.22     42.41     11.76       1     14.8   Pullout
                                                                           2     11.8   Pullout

     10      1.49      13.70     19.88     11.65     65.26      6.55       1      7.0   Pullout
                                                                           2      9.7   Pullout

     11      1.51      15.00     20.68     11.22     52.88      7.46       1      7.8   Pullout
                                                                           2      9.9   Pullout

Search Level: 0.80 feet below the toe of the wall  Facing Design Force = 6.6 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
```

```
|Point  | Safety  |   feet   | degrees |  feet  | degrees |  feet   | Level |  ksi   | Failure Mode |
-----------------------------------------------------------------------------------------------------
      1      1.55      2.00     60.74      3.68     88.47      7.50       1    25.0    Pullout
                                                                          2    15.6    Pullout

      2      1.45      3.30     35.80      3.66     87.80      8.57       1    22.5    Pullout
                                                                          2    13.2    Pullout

      3      1.43      4.60     33.63      3.87     80.85      8.68       1    21.0    Pullout
                                                                          2    12.6    Pullout

      4      1.38      5.90     45.24      7.54     83.71      5.39       1    18.0    Pullout
                                                                          2    13.3    Pullout

      5      1.34      7.20     39.57      8.41     82.34      5.40       1    15.8    Pullout
                                                                          2    12.3    Pullout

      6      1.33      8.50     34.99      9.34     80.98      5.42       1    13.5    Pullout
                                                                          2    11.4    Pullout

      7      1.33      9.80     34.33      9.49     69.90      5.70       1    13.0    Pullout
                                                                          2    11.2    Pullout

      8      1.35     11.10     34.57      9.44     58.13      6.31       1    13.1    Pullout
                                                                          2    11.3    Pullout

      9      1.31     12.40     19.06      6.56     54.11     10.58       1    11.8    Pullout
                                                                          2     6.9    Pullout

     10      1.36     13.70     21.35      5.88     46.19     11.87       1    11.7    Pullout
                                                                          2     8.0    Pullout

     11      1.37     15.00     19.65      6.37     43.59     12.43       1    10.4    Pullout
                                                                          2     7.2    Pullout

Search Level: 1.60 feet below the toe of the wall  Facing Design Force = 9.5 kips (Clouterre)
-----------------------------------------------------------------------------------------------------
|       |         |          |            Failure Planes            |        Reinforcement          |
|       |         |          |--------------------------------------|-------------------------------|
|       | Minimum | Distance |      Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |--------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  | Angle   | Length | Angle   | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet  | degrees |  feet   | Level |  ksi   | Failure Mode |
-----------------------------------------------------------------------------------------------------
      1      1.79      2.00     62.47      3.89     88.58      8.06       1    25.0    Pullout
                                                                          2    15.6    Pullout

      2      1.48      3.30     49.30      4.55     87.66      8.06       1    22.6    Pullout
                                                                          2    13.3    Pullout

      3      1.38      4.60     39.83      5.39     86.73      8.07       1    20.1    Pullout
```

```
                                                                           2     11.0   Pullout

      4      1.37       5.90     39.90      5.38     77.61      8.25       1     19.0   Pullout
                                                                           2     11.0   Pullout

      5      1.39       7.20     41.61      8.67     82.87      5.80       1     15.7   Pullout
                                                                           2     11.3   Pullout

      6      1.29       8.50     49.25      9.12     61.02      5.26       1     17.0   Pullout
                                                                           2     12.8   Pullout

      7      1.34       9.80     36.28      9.73     71.19      6.08       1     12.8   Pullout
                                                                           2     10.1   Pullout

      8      1.33      11.10     32.95     10.58     68.91      6.17       1     10.9   Pullout
                                                                           2      9.2   Pullout

      9      1.33      12.40     30.12     11.47     66.69      6.27       1      9.0   Pullout
                                                                           2      8.4   Pullout

     10      1.33      13.70     30.97     11.18     54.47      7.07       1      9.5   Pullout
                                                                           2      8.6   Pullout

     11      1.36      15.00     27.09     10.11     49.02      9.15       1      8.8   Pullout
                                                                           2      7.4   Pullout

Search Level: 2.40 feet below the toe of the wall  Facing Design Force = 4.2 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      2.05       2.00     64.02      4.11     88.67      8.62       1     25.0   Pullout
                                                                           2     15.6   Pullout

      2      1.71       3.30     51.19      4.74     87.81      8.62       1     22.5   Pullout
                                                                           2     13.2   Pullout

      3      1.57       4.60     41.73      5.55     86.95      8.63       1     20.1   Pullout
                                                                           2     10.9   Pullout

      4      1.52       5.90     38.04      5.99     82.20      8.70       1     18.3   Pullout
                                                                           2      9.7   Pullout

      5      1.44       7.20     48.74      9.83     81.68      4.98       1     15.9   Pullout
                                                                           2     11.6   Pullout

      6      1.43       8.50     38.82      9.82     82.14      6.21       1     13.3   Pullout
```

```
                                                                           2      9.2   Pullout

      7      1.40       9.80     34.91     10.76     80.95      6.23       1     11.0   Pullout
                                                                           2      8.1   Pullout

      8      1.38      11.10     34.73     10.80     70.17      6.54       1     10.6   Pullout
                                                                           2      8.0   Pullout

      9      1.36      12.40     31.82     11.67     68.06      6.64       1      8.7   Pullout
                                                                           2      7.1   Pullout

     10      1.35      13.70     32.69     11.40     56.27      7.40       1      9.1   Pullout
                                                                           2      7.4   Pullout

     11      1.34      15.00     30.38     12.17     53.83      7.62       1      7.5   Pullout
                                                                           2      6.6   Pullout

Search Level: 3.20 feet below the toe of the wall  Facing Design Force = 4.0 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
| Search|   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      2.28       2.00     71.06      5.54     88.54      7.87       1     25.0   Pullout
                                                                           2     15.6   Pullout

      2      1.96       3.30     63.28      5.87     85.21      7.89       1     22.9   Pullout
                                                                           2     13.9   Pullout

      3      1.93       4.60     62.24      5.93     76.84      8.08       1     21.5   Pullout
                                                                           2     13.6   Pullout

      4      1.74       5.90     55.98      6.33     73.30      8.21       1     19.6   Pullout
                                                                           2     12.2   Pullout

      5      1.75       7.20     57.35      9.34     67.61      5.67       1     18.1   Pullout
                                                                           2     12.4   Pullout

      6      1.59       8.50     42.78      5.79     65.15     10.11       1     16.2   Pullout
                                                                           2      9.8   Pullout

      7      1.52       9.80     43.70      9.49     65.84      7.18       1     13.8   Pullout
                                                                           2      9.1   Pullout

      8      1.46      11.10     40.15     10.17     63.07      7.35       1     12.0   Pullout
                                                                           2      8.1   Pullout

      9      1.43      12.40     37.06     10.88     60.43      7.54       1     10.3   Pullout
```

```
                                                                           2      7.1   Pullout

     10      1.40      13.70     34.35     11.62     57.91      7.74       1      8.7   Pullout
                                                                           2      6.2   Pullout

     11      1.39      15.00     31.98     12.38     55.53      7.95       1      7.1   Pullout
                                                                           2      5.4   Pullout

Search Level: 4.00 feet below the toe of the wall  Facing Design Force = 4.9 kips (Clouterre)
-----------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
-----------------------------------------------------------------------------------------------------
      1      2.67       2.00     73.96      5.79     87.26      8.36       1     25.2   Pullout
                                                                           2     15.9   Pullout

      2      2.63       3.30     74.83     10.09     81.01      4.22       1     23.4   Pullout
                                                                           2     15.7   Pullout

      3      2.50       4.60     71.70     14.65      0.00      0.00       1     22.2   Pullout
                                                                           2     15.0   Pullout

      4       N/A       5.90      0.00      0.59     69.11     14.89       1     20.2   Pullout
                                                                           2     13.3   Pullout

      5      4.72       7.20      0.00      6.48     87.04     13.93       1     15.0   Pullout
                                                                           2      5.8   Pullout

      6      2.40       8.50     26.15      9.47     90.00      9.74       1     11.9   Pullout
                                                                           2      2.3   Pullout

      7      1.80       9.80     35.36     12.02     90.00      6.95       1      9.3   Pullout
                                                                           2      4.9   Pullout

      8      1.63      11.10     41.26     14.77    -90.00      4.17       1      9.9   Pullout
                                                                           2      7.0   Pullout

      9      1.58      12.40     41.91     16.66     90.00      2.78       1     10.2   Pullout
                                                                           2      7.2   Pullout

     10      1.52      13.70     39.09      8.83     50.62     10.80       1     10.5   Pullout
                                                                           2      6.3   Pullout

     11      1.47      15.00     37.70     11.37     49.22      9.19       1      8.8   Pullout
                                                                           2      5.8   Pullout
```

```
==========================================================================================
                                      END OF REPORT
==========================================================================================
```

```
======================================================================================================
                                               Snail

                                           Version: 2.2.2

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======================================================================================================
                                          File Information
======================================================================================================

File Name: US 395 RW3 Sta 1900 Temp.snz
Run Date:  11/14/22
Run Time:  15:50:36

======================================================================================================
                                        Project Information
======================================================================================================

Description:    RW3
Location:       US 395
EA:
Project ID:
Wall No.:
Structure No.:
Station:
Engineer:       STC
                Designer

Comments:


======================================================================================================
                                              Geometry
======================================================================================================

Layout:

Reference Point:

At: Top of Wall
Distance From Origin:       40.00 feet
Elevation Above Origin:     30.00 feet

Wall Dimensions:

Wall Height:        9.91 feet
Facing Angle:      90.00 degrees
Facing Batter:     0.000 :12 H:V
```

```
Ground Surface:

Number of lines that define the ground surface above the wall: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Number of lines that define the ground surface in front of the toe: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Soil Layers:

Number of Layers: 2

Layers Below the Top Layer:

Coordinates of the Top of the Layer: feet

             Point 1         Point 1         Point 2         Point 2
Layer       Distance       Elevation        Distance       Elevation
--------------------------------------------------------------------
2              45.00           25.00           60.00           25.00

Ground Water:

Include Ground Water: No

======================================================================================================
                                             Soil Nails
======================================================================================================

Dimensions and Properties:

Maximum Vertical Spacing:               5.00 feet
Number of Soil Nail Rows:                  1
Soil Nail Design Parameters:               Varying

      Soil Nail       Inclination   Vertical   Horizontal      Nail Bar   Nail Bar Yield       Bond
         Length   From Horizontal    Spacing    Spacing H    Diameter Ø      Strength fy   Strength
No.        feet           degrees       feet         feet        inches              ksi   Factor F
---------------------------------------------------------------------------------------------------
1         15.00                15       3.00         5.00         1.000             75.0       1.00

Facing Resistance:
```

```
                                     Temporary   Permanent     Seismic
ASD Allowable Facing Resistance:          20.6        34.1        46.5 kips

======================================================================================================
                                          Soil Properties
======================================================================================================

                                        Unit Weight  Friction Angle        Cohesion
                                                  γ              φ'              c'
Layer  Description                              pcf         degrees             psf
-----------------------------------------------------------------------------------
1      Fill                                     115            34.0             100
2      Fill                                     120            34.0             100

======================================================================================================
                                               Loads
======================================================================================================

Applied Loads:

Seismic:

Horizontal Seismic Coefficient Kh0.25:

External Load:

Apply external load: No

Surcharges:

Apply surcharges: No

======================================================================================================
                                         Factors of Safety
======================================================================================================

                    Temporary   Permanent     Seismic
Pullout (Distal):        2.00        2.00        1.50
Pullout (Proximal):      2.00        2.00        1.50
Nail Bar Yield:          1.80        1.80        1.35

======================================================================================================
                                           Search Options
======================================================================================================

Search Limits:

Begin:      2.00 feet
End:       15.00 feet

Below Toe Searches (BTS):
```

```
Perform below Toe Search:       Yes
Number of BTS Points:             5
BTS Depth:                     4.00 feet
Interface Friction
Reduction Factor:              0.33

Advanced Search Options:

Use Advanced Search Options:     Yes
Inclination of Interslice Force: Use Average Failure Angle

======================================================================================================
                                               Results
======================================================================================================

Analysis:

Method:          ASD
Scenario:  Temporary

Factor of Safety:

Minimum:                  1.17
Found at Search Point:       3
Found at Grid Point:        43
Found at Search Level:       Toe of the wall

Load at Soil Nail Head:

Calculated Service Load at Soil Nail Head (Empirical), To:     8.6 kips
Allowable Facing Resistance, F_allowable (Entered):           20.6 kips
F_allowable ≥ To OK

Nominal Pullout Resistance:

                    Nominal Pullout Resistance
Layer  Description                         klf
----------------------------------------------

    1  Fill                              2.262
    2  Fill                              2.262

Results by Search Level:

** Indicates Minimum Factor of Safety

Search Level: At the toe of the wall  Facing Design Force = 8.6 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes             |       Reinforcement           |
|       |         |          |----------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower        |       Upper       |       |        |              |
```

```
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  | Angle   | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      1.41       2.00     65.58      4.35     88.07      5.95       1     18.8   Pullout

      2      1.20       3.30     59.06      5.78     86.19      4.97       1     17.1   Pullout

   ** 3      1.17       4.60     50.12      6.46     84.70      4.98       1     15.3   Pullout

      4      1.24       5.90     43.02      7.26     83.21      4.99       1     13.6   Pullout

      5      1.35       7.20     37.40      8.16     81.73      5.01       1     11.9   Pullout

      6      1.46       8.50     36.08      8.41     71.06      5.24       1     11.4   Pullout

      7      1.57       9.80     35.84      8.46     59.32      5.76       1     11.3   Pullout

      8      1.71      11.10     36.65      8.30     48.14      6.65       1     11.5   Pullout

      9      1.83      12.40     32.59      7.36     43.80      8.59       1     10.8   Pullout

     10      1.92      13.70     30.06      7.91     40.96      9.07       1      9.9   Pullout

     11      2.00      15.00     27.86      8.48     38.41      9.57       1      9.1   Pullout

Search Level: 0.80 feet below the toe of the wall  Facing Design Force = 8.6 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  | Angle   | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      1.73       2.00     67.21      4.65     88.22      6.43       1     18.8   Pullout

      2      1.46       3.30     60.99      6.12     86.47      5.37       1     17.0   Pullout

      3      1.35       4.60     57.21      7.64     83.87      4.31       1     15.4   Pullout

      4      1.40       5.90     45.24      7.54     83.71      5.39       1     13.5   Pullout

      5      1.47       7.20     42.91      7.86     74.95      5.55       1     12.7   Pullout

      6      1.54       8.50     38.22      8.66     72.39      5.62       1     11.2   Pullout

      7      1.61       9.80     37.98      8.70     61.23      6.11       1     11.0   Pullout

      8      1.68      11.10     34.57      9.44     58.13      6.31       1      9.8   Pullout
```

```
      9      1.76      12.40     31.67     10.20     55.21      6.52       1      8.6   Pullout

     10      1.83      13.70     33.08      9.81     44.34      7.66       1      9.2   Pullout

     11      1.93      15.00     29.74      8.64     40.59      9.88       1      8.5   Pullout

Search Level: 1.60 feet below the toe of the wall  Facing Design Force = 7.1 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  | Angle   | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   |degrees  |  feet   |degrees  |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      2.09       2.00     68.65      4.94     88.34      6.91       1     18.8   Pullout

      2      1.75       3.30     62.70      6.48     86.72      5.76       1     17.0   Pullout

      3      1.61       4.60     59.06      8.05     84.30      4.63       1     15.4   Pullout

      4      1.55       5.90     52.44      8.71     82.70      4.64       1     13.7   Pullout

      5      1.62       7.20     50.17      8.99     72.63      4.82       1     13.0   Pullout

      6      1.52       8.50     49.25      9.12     61.02      5.26       1     12.7   Pullout

      7      1.73       9.80     39.99      8.95     62.94      6.46       1     10.8   Pullout

      8      1.78      11.10     36.53      9.67     59.95      6.65       1      9.5   Pullout

      9      1.83      12.40     37.72      9.41     49.24      7.60       1      9.7   Pullout

     10      1.88      13.70     35.00     10.03     46.40      7.95       1      8.7   Pullout

     11      1.93      15.00     32.60     10.68     43.81      8.31       1      7.8   Pullout

Search Level: 2.40 feet below the toe of the wall  Facing Design Force = 6.4 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  | Angle   | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   |degrees  |  feet   |degrees  |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      2.47       2.00     69.92      5.24     88.45      7.39       1     18.8   Pullout

      2      2.08       3.30     68.10      7.96     86.17      4.94       1     17.1   Pullout

      3      2.01       4.60     63.52      8.25     79.42      5.01       1     15.9   Pullout
```

```
      4      1.89       5.90     57.42      8.77     76.52      5.06       1     14.3   Pullout

      5      1.83       7.20     52.05      9.37     73.70      5.13       1     12.9   Pullout

      6      1.81       8.50     47.37     10.04     70.95      5.21       1     11.4   Pullout

      7      1.89       9.80     47.12     10.08     59.16      5.73       1     11.3   Pullout

      8      1.92      11.10     38.39      9.91     61.59      7.00       1      9.3   Pullout

      9      1.95      12.40     39.60      9.66     51.14      7.90       1      9.4   Pullout

     10      1.97      13.70     36.83     10.27     48.32      8.24       1      8.3   Pullout

     11      2.01      15.00     34.37     10.90     45.73      8.60       1      7.3   Pullout

Search Level: 3.20 feet below the toe of the wall  Facing Design Force = 5.1 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      3.43       2.00     79.91      7.99     83.47      5.28       1     19.2   Pullout

      2       N/A       3.30      0.00      0.33     77.24     13.44       1     17.9   Pullout

      3     11.81       4.60      0.00      3.68     85.99     13.14       1     15.2   Pullout

      4      7.16       5.90      0.00      3.54     79.80     13.32       1     14.0   Pullout

      5      4.07       7.20     28.65      8.20     90.00      9.18       1     10.9   Pullout

      6      3.06       8.50     31.67      9.99     90.00      7.87       1      8.9   Pullout

      7      2.17       9.80     46.94     14.35     90.00      2.62       1     10.3   Pullout

      8      2.14      11.10     46.75     16.20    -90.00      1.31       1     10.3   Pullout

      9      2.09      12.40     41.38      9.92     52.89      8.22       1      9.0   Pullout

     10      2.10      13.70     38.57     10.51     50.10      8.54       1      8.0   Pullout

     11      2.12      15.00     36.07     11.13     47.53      8.89       1      6.9   Pullout

Search Level: 4.00 feet below the toe of the wall  Facing Design Force = 3.1 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
```

```
|       |         |         |---------------------------------------|------------------------------|
|       | Minimum | Distance|        Lower       |      Upper       |       |        |                |
|       | Factor  | From Toe|---------------------------------------|       |        | Controlling    |
|Search |   of    | of Wall | Angle   | Length   | Angle   | Length  |       | Stress | Resistance     |
|Point  | Safety  |   feet  | degrees |  feet    | degrees |  feet   | Level |  ksi   | Failure Mode   |
-------------------------------------------------------------------------------------------------------
      1       N/A      2.00      0.00       0.20     82.63     14.03       1     19.3   Pullout

      2       N/A      3.30      0.00       0.66     79.25     14.16       1     17.7   Pullout

      3       N/A      4.60      0.00       1.38     76.97     14.28       1     16.1   Pullout

      4       N/A      5.90      0.00       1.18     71.26     14.69       1     14.9   Pullout

      5     20.23      7.20      0.00       6.48     87.04     13.93       1     11.2   Pullout

      6     12.69      8.50      0.00       6.80     83.03     14.01       1      9.9   Pullout

      7      6.40      9.80     15.85      10.19     90.00     11.13       1      7.0   Pullout

      8      3.21     11.10     26.62      12.42    -90.00      8.35       1      5.1   Pullout

      9      2.73     12.40     29.29      14.22     90.00      6.95       1      3.1   Pullout

     10      2.38     13.70     35.40      16.81     90.00      4.17       1      5.0   Pullout

     11      2.31     15.00     36.57      18.68    -90.00      2.78       1      5.5   Pullout


=======================================================================================================
                                            END OF REPORT
=======================================================================================================
```

```
======================================================================================================
                                               Snail

                                           Version: 2.2.2

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======================================================================================================
                                          File Information
======================================================================================================

File Name: US 395 RW3 Sta 1900 Temp.snz
Run Date:  11/14/22
Run Time:  15:48:24

======================================================================================================
                                        Project Information
======================================================================================================

Description:    RW3
Location:       US 395
EA:
Project ID:
Wall No.:
Structure No.:
Station:
Engineer:       STC
                Designer

Comments:


======================================================================================================
                                              Geometry
======================================================================================================

Layout:

Reference Point:

At: Top of Wall
Distance From Origin:       40.00 feet
Elevation Above Origin:     30.00 feet

Wall Dimensions:

Wall Height:        9.91 feet
Facing Angle:      90.00 degrees
Facing Batter:     0.000 :12 H:V
```

```
Ground Surface:

Number of lines that define the ground surface above the wall: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Number of lines that define the ground surface in front of the toe: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Soil Layers:

Number of Layers: 2

Layers Below the Top Layer:

Coordinates of the Top of the Layer: feet

             Point 1         Point 1         Point 2         Point 2
Layer       Distance       Elevation        Distance       Elevation
--------------------------------------------------------------------
2              45.00           25.00           60.00           25.00

Ground Water:

Include Ground Water: No

======================================================================================================
                                             Soil Nails
======================================================================================================

Dimensions and Properties:

Maximum Vertical Spacing:               5.00 feet
Number of Soil Nail Rows:                  1
Soil Nail Design Parameters:               Varying

      Soil Nail       Inclination   Vertical   Horizontal      Nail Bar   Nail Bar Yield       Bond
         Length   From Horizontal    Spacing    Spacing H    Diameter Ø      Strength fy   Strength
No.        feet           degrees       feet         feet        inches              ksi   Factor F
---------------------------------------------------------------------------------------------------
1         15.00                15       3.00         5.00         1.000             75.0       1.00

Facing Resistance:
```

```
                                     Temporary   Permanent     Seismic
ASD Allowable Facing Resistance:          20.6        34.1        46.5 kips

======================================================================================================
                                          Soil Properties
======================================================================================================

                                        Unit Weight  Friction Angle        Cohesion
                                                  γ              φ'              c'
Layer  Description                              pcf         degrees             psf
-----------------------------------------------------------------------------------
1      Fill                                     115            34.0             100
2      Fill                                     120            34.0             100

======================================================================================================
                                               Loads
======================================================================================================

Applied Loads:

Seismic:

Horizontal Seismic Coefficient Kh0.25:

External Load:

Apply external load: No

Surcharges:

Apply surcharges:    Yes

           Distance from Top of Wall            Load            Load
               Begin             End           Begin             End
No.             feet            feet             psf             psf
--------------------------------------------------------------------
1               0.00           30.00             250             250

======================================================================================================
                                         Factors of Safety
======================================================================================================

                    Temporary   Permanent     Seismic
Pullout (Distal):        2.00        2.00        1.50
Pullout (Proximal):      2.00        2.00        1.50
Nail Bar Yield:          1.80        1.80        1.35

======================================================================================================
                                           Search Options
======================================================================================================
```

```
Search Limits:

Begin:      2.00 feet
End:       15.00 feet

Below Toe Searches (BTS):

Perform below Toe Search:       Yes
Number of BTS Points:             5
BTS Depth:                     4.00 feet
Interface Friction
Reduction Factor:              0.33

Advanced Search Options:

Use Advanced Search Options:     Yes
Inclination of Interslice Force: Use Average Failure Angle

======================================================================================================
                                               Results
======================================================================================================

Analysis:

Method:          ASD
Scenario:  Temporary

Factor of Safety:

Minimum:                  1.00
Found at Search Point:       2
Found at Grid Point:        47
Found at Search Level:       Toe of the wall

Load at Soil Nail Head:

Calculated Service Load at Soil Nail Head (Empirical), To:     9.6 kips
Allowable Facing Resistance, F_allowable (Entered):           20.6 kips
F_allowable ≥ To OK

Nominal Pullout Resistance:

                    Nominal Pullout Resistance
Layer  Description                         klf
----------------------------------------------
    1  Fill                              2.262
    2  Fill                              2.262

Results by Search Level:

** Indicates Minimum Factor of Safety
```

```
Search Level: At the toe of the wall  Facing Design Force = 9.6 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes             |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      1.19       2.00     65.58      4.35     88.07      5.95       1     18.8   Pullout

   ** 2      1.00       3.30     63.46      6.65     85.24      3.98       1     17.2   Pullout

      3      1.01       4.60     50.12      6.46     84.70      4.98       1     15.3   Pullout

      4      1.08       5.90     46.39      6.84     76.61      5.09       1     14.3   Pullout

      5      1.16       7.20     44.51      7.07     66.45      5.41       1     13.7   Pullout

      6      1.23       8.50     39.79      7.74     62.77      5.57       1     12.5   Pullout

      7      1.32       9.80     40.12      7.69     51.65      6.32       1     12.5   Pullout

      8      1.40      11.10     36.65      8.30     48.14      6.65       1     11.5   Pullout

      9      1.50      12.40     32.59      7.36     43.80      8.59       1     10.8   Pullout

     10      1.59      13.70     30.06      7.91     40.96      9.07       1      9.9   Pullout

     11      1.67      15.00     33.45     17.98      0.00      0.00       1     10.5   Pullout

Search Level: 0.80 feet below the toe of the wall  Facing Design Force = 8.6 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes             |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      1.49       2.00     67.21      4.65     88.22      6.43       1     18.8   Pullout

      2      1.23       3.30     65.20      7.08     85.60      4.30       1     17.1   Pullout

      3      1.14       4.60     57.21      7.64     83.87      4.31       1     15.4   Pullout

      4      1.18       5.90     53.70      7.97     74.60      4.44       1     14.6   Pullout

      5      1.25       7.20     46.74      7.35     68.03      5.77       1     13.5   Pullout
```

```
      6      1.30       8.50      41.99       8.00      64.54       5.93       1     12.3   Pullout

      7      1.35       9.80      42.33       7.95      53.80       6.64       1     12.1   Pullout

      8      1.41      11.10      38.80       8.55      50.34       6.96       1     11.1   Pullout

      9      1.48      12.40      35.75       9.17      47.19       7.30       1     10.1   Pullout

     10      1.54      13.70      33.08       9.81      44.34       7.66       1      9.2   Pullout

     11      1.62      15.00      35.53      18.43       0.00       0.00       1      9.9   Pullout

Search Level: 1.60 feet below the toe of the wall  Facing Design Force = 7.1 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |    feet  | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      1.82       2.00      72.63       6.03      88.01       5.76       1     18.8   Pullout

      2      1.50       3.30      66.73       7.52      85.90       4.62       1     17.1   Pullout

      3      1.37       4.60      59.06       8.05      84.30       4.63       1     15.4   Pullout

      4      1.33       5.90      52.44       8.71      82.70       4.64       1     13.7   Pullout

      5      1.36       7.20      50.17       8.99      72.63       4.82       1     13.0   Pullout

      6      1.27       8.50      49.25       9.12      61.02       5.26       1     12.7   Pullout

      7      1.45       9.80      44.39       8.23      55.74       6.96       1     11.8   Pullout

      8      1.49      11.10      40.83       8.80      52.35       7.27       1     10.7   Pullout

      9      1.53      12.40      37.72       9.41      49.24       7.60       1      9.7   Pullout

     10      1.58      13.70      35.00      10.03      46.40       7.95       1      8.7   Pullout

     11      1.64      15.00      37.50      18.91       0.00       0.00       1      9.3   Pullout

Search Level: 2.40 feet below the toe of the wall  Facing Design Force = 6.7 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |    feet  | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
```

```
---------------------------------------------------------------------------------------------------------
      1      2.16        2.00     73.70      6.41      88.14      6.16       1     18.8   Pullout

      2      1.78        3.30     68.10      7.96      86.17      4.94       1     17.1   Pullout

      3      1.61        4.60     60.73      8.47      84.66      4.95       1     15.3   Pullout

      4      1.54        5.90     54.29      9.10      83.17      4.96       1     13.6   Pullout

      5      1.53        7.20     48.74      9.83      81.68      4.98       1     11.9   Pullout

      6      1.54        8.50     47.37     10.04      70.95      5.21       1     11.4   Pullout

      7      1.56        9.80     47.12     10.08      59.16      5.73       1     11.3   Pullout

      8      1.60       11.10     42.74      9.07      54.20      7.59       1     10.4   Pullout

      9      1.63       12.40     39.60      9.66      51.14      7.90       1      9.4   Pullout

     10      1.67       13.70     36.83     10.27      48.32      8.24       1      8.3   Pullout

     11      1.70       15.00     39.38     19.40       0.00      0.00       1      8.9   Pullout

Search Level: 3.20 feet below the toe of the wall  Facing Design Force = 6.2 kips (Clouterre)
---------------------------------------------------------------------------------------------------------
|       |         |           |             Failure Planes              |        Reinforcement         |
|       |         |           |-----------------------------------------|------------------------------|
|       | Minimum | Distance  |        Lower        |       Upper       |        |        |            |
|       | Factor  | From Toe  |-----------------------------------------|        |        | Controlling|
|Search |   of    | of Wall   |  Angle   | Length   |  Angle  | Length  |        | Stress | Resistance |
|Point  | Safety  |   feet    | degrees  |  feet    | degrees |  feet   | Level  |  ksi   |Failure Mode|
---------------------------------------------------------------------------------------------------------
      1      2.87        2.00     79.91      7.99      83.47      5.28       1     19.2   Pullout

      2     10.69        3.30      0.00      2.64      87.12     13.13       1     17.0   Pullout

      3      6.47        4.60      0.00      2.76      82.01     13.24       1     15.6   Pullout

      4      3.53        5.90      0.00      1.77      72.52     13.75       1     14.8   Pullout

      5      1.87        7.20     61.23     14.96       0.00      0.00       1     14.4   Pullout

      6      1.81        8.50     57.04     15.62       0.00      0.00       1     13.3   Pullout

      7      1.72        9.80     48.91     10.44      60.72      6.01       1     11.1   Pullout

      8      1.72       11.10     45.35     11.06      57.58      6.21       1      9.9   Pullout

      9      1.75       12.40     41.38      9.92      52.89      8.22       1      9.0   Pullout

     10      1.77       13.70     43.74     18.96       0.00      0.00       1      9.3   Pullout
```

```
     11      1.79      15.00     41.15     19.92      0.00      0.00       1      8.4   Pullout

Search Level: 4.00 feet below the toe of the wall  Facing Design Force = 5.0 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1       N/A       2.00      0.00      0.20     82.63     14.03       1     19.3   Pullout

      2       N/A       3.30      0.00      0.33     77.95     14.22       1     17.8   Pullout

      3       N/A       4.60      0.00      0.46     73.43     14.51       1     16.5   Pullout

      4     17.75       5.90      0.00      5.31     87.57     13.92       1     13.1   Pullout

      5     11.18       7.20      0.00      5.76     84.09     13.98       1     11.6   Pullout

      6      5.70       8.50     18.12      8.94     90.00     11.13       1      8.9   Pullout

      7      2.86       9.80     29.59     11.27     90.00      8.35       1      7.0   Pullout

      8      2.18      11.10     36.94     13.89    -90.00      5.56       1      5.7   Pullout

      9      1.92      12.40     45.27     17.62     90.00      1.39       1      8.9   Pullout

     10      1.89      13.70     45.44     19.52      0.00      0.00       1      8.9   Pullout

     11      1.90      15.00     42.84     20.46      0.00      0.00       1      8.0   Pullout


======================================================================================================
                                           END OF REPORT
======================================================================================================
```

```
======================================================================================================
                                               Snail

                                           Version: 2.2.2

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======================================================================================================
                                          File Information
======================================================================================================

File Name: US 395 RW10 Full Height Perm.snz
Run Date:  11/01/22
Run Time:  11:15:22

======================================================================================================
                                        Project Information
======================================================================================================

Description:    RW10
Location:       US 395
EA:
Project ID:
Wall No.:
Structure No.:
Station:
Engineer:       STC
                Designer

Comments:


======================================================================================================
                                              Geometry
======================================================================================================

Layout:

Reference Point:

At: Top of Wall
Distance From Origin:       22.00 feet
Elevation Above Origin:     48.00 feet

Wall Dimensions:

Wall Height:       10.40 feet
Facing Angle:      90.00 degrees
Facing Batter:     0.000 :12 H:V
```

```
Ground Surface:

Number of lines that define the ground surface above the wall: 3

         Angle  Distance
No.    degrees      feet
------------------------
1            0      2.00
2           27     13.42
3            0

Number of lines that define the ground surface in front of the toe: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Soil Layers:

Number of Layers: 2

Layers Below the Top Layer:

Coordinates of the Top of the Layer: feet

             Point 1         Point 1         Point 2         Point 2
Layer       Distance       Elevation        Distance       Elevation
--------------------------------------------------------------------
2                 30.00           47.00           50.00           47.00

Ground Water:

Include Ground Water: No

======================================================================================================
                                             Soil Nails
======================================================================================================

Dimensions and Properties:

Maximum Vertical Spacing:               4.00 feet
Number of Soil Nail Rows:                  2
Soil Nail Design Parameters:               Varying

      Soil Nail       Inclination   Vertical   Horizontal      Nail Bar   Nail Bar Yield       Bond
         Length   From Horizontal    Spacing    Spacing H    Diameter Ø      Strength fy   Strength
No.        feet           degrees       feet         feet        inches              ksi   Factor F
---------------------------------------------------------------------------------------------------
1         15.00                15       2.50         4.00         1.000             75.0       1.00
2         10.00                15       4.00         4.00         1.000             75.0       1.00
```

```
Facing Resistance:

                                     Temporary   Permanent     Seismic
ASD Allowable Facing Resistance:          22.2        19.3        26.3 kips

======================================================================================================
                                          Soil Properties
======================================================================================================

                                        Unit Weight  Friction Angle        Cohesion
                                                  γ              φ'              c'
Layer  Description                              pcf         degrees             psf
-----------------------------------------------------------------------------------
1      Fill                                     115            34.0             100
2      Weathered Granodiorite                   120            27.0             500

======================================================================================================
                                               Loads
======================================================================================================

Applied Loads:

Seismic:

Horizontal Seismic Coefficient Kh0.25:

External Load:

Apply external load: No

Surcharges:

Apply surcharges:    Yes

           Distance from Top of Wall            Load            Load
               Begin             End           Begin             End
No.             feet            feet             psf             psf
--------------------------------------------------------------------
1               0.00           14.00             250             250
2              14.00           30.00             600             600

======================================================================================================
                                         Factors of Safety
======================================================================================================

                    Temporary   Permanent     Seismic
Pullout (Distal):        2.00        2.00        1.50
Pullout (Proximal):      2.00        2.00        1.50
Nail Bar Yield:          1.80        1.80        1.35
```

```
=======================================================================================================
                                           Search Options
=======================================================================================================

Search Limits:

Begin:      5.00 feet
End:       30.00 feet

Below Toe Searches (BTS):

Perform below Toe Search:       Yes
Number of BTS Points:             5
BTS Depth:                     4.00 feet
Interface Friction
Reduction Factor:              0.33

Advanced Search Options:

Use Advanced Search Options:     Yes
Inclination of Interslice Force: Use Average Failure Angle

=======================================================================================================
                                               Results
=======================================================================================================

Analysis:

Method:          ASD
Scenario:  Permanent

Factor of Safety:

Minimum:                  1.69
Found at Search Point:       7
Found at Grid Point:        27
Found at Search Level:       Toe of the wall

Load at Soil Nail Head:

Calculated Service Load at Soil Nail Head (Empirical), To:     4.5 kips
Allowable Facing Resistance, F_allowable (Entered):           19.3 kips
F_allowable ≥ To OK

Nominal Pullout Resistance:

                    Nominal Pullout Resistance
Layer  Description                         klf
----------------------------------------------
    1  Fill                              2.262
    2  Weathered Granodiorite            2.262
```

```
Results by Search Level:

** Indicates Minimum Factor of Safety

Search Level: At the toe of the wall  Facing Design Force = 4.5 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      2.26       5.00     38.49      3.83     78.16      9.75       1      15.7  Pullout
                                                                           2       9.7  Pullout

      2      2.07       7.50     35.15      4.59     70.45     11.21       1      14.0  Pullout
                                                                           2       8.7  Pullout

      3      1.99      10.00     43.98      4.17     58.85     13.53       1      13.9  Pullout
                                                                           2       9.8  Pullout

      4      1.93      12.50     37.09      7.84     60.45     12.67       1      11.2  Pullout
                                                                           2       8.7  Pullout

      5      1.80      15.00     28.80      3.42     51.05     19.09       1      11.7  Pullout
                                                                           2       8.5  Pullout

      6      1.70      17.50     35.25      8.57     47.71     15.61       1      10.0  Pullout
                                                                           2       8.4  Pullout

   ** 7      1.69      20.00     31.74      9.41     43.89     16.65       1       8.7  Pullout
                                                                           2       7.8  Pullout

      8      1.71      22.50     20.13      4.79     39.51     23.33       1       8.0  Pullout
                                                                           2       6.3  Pullout

      9      1.75      25.00     12.40      7.68     40.30     22.95       1       4.8  Pullout
                                                                           2       2.9  Pullout

     10      1.79      27.50     11.31      8.41     37.64     24.31       1       3.5  Pullout
                                                                           2       2.0  Pullout

     11      1.86      30.00     10.38      9.15     35.25     25.72       1       2.3  Pullout
                                                                           2       1.5  Pullout

Search Level: 0.80 feet below the toe of the wall  Facing Design Force = 2.5 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
```

```
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  | Angle   | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      2.57       5.00     51.85      4.86     77.35      9.13       1     15.8   Pullout
                                                                           2      9.9   Pullout

      2      2.36       7.50     49.40      9.22     77.91      7.16       1     12.6   Pullout
                                                                           2      9.5   Pullout

      3      2.20      10.00     37.37      5.03     63.85     13.61       1     12.7   Pullout
                                                                           2      8.1   Pullout

      4      2.04      12.50     33.51      6.00     60.47     15.22       1     11.2   Pullout
                                                                           2      6.9   Pullout

      5      1.91      15.00     37.54      5.68     52.80     17.37       1     11.1   Pullout
                                                                           2      7.7   Pullout

      6      1.82      17.50     30.66     10.17     54.14     14.94       1      7.5   Pullout
                                                                           2      6.3   Pullout

      7      1.77      20.00     32.96      9.53     45.25     17.04       1      8.1   Pullout
                                                                           2      6.8   Pullout

      8      1.76      22.50     24.76     12.39     47.10     16.53       1      4.3   Pullout
                                                                           2      4.8   Pullout

      9      1.79      25.00     22.54     13.53     44.08     17.40       1      2.8   Pullout
                                                                           2      4.1   Pullout

     10      1.83      27.50     17.45     11.53     39.98     21.53       1      2.1   Pullout
                                                                           2      2.4   Pullout

     11      1.87      30.00     10.88      9.16     36.54     26.14       1      1.4   Pullout
                                                                           2      0.2   Pullout

Search Level: 1.60 feet below the toe of the wall  Facing Design Force = 3.3 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  | Angle   | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      2.88       5.00     45.42      5.70     83.97      9.52       1     15.0   Pullout
                                                                           2      8.4   Pullout

      2      2.60       7.50     47.64     10.02     84.21      7.44       1     11.5   Pullout
```

```
                                                                            2      8.4   Pullout

      3      2.44      10.00     42.57       9.51     72.72     10.10      1     10.7   Pullout
                                                                            2      7.5   Pullout

      4      2.23      12.50     42.78      10.22     64.35     11.55      1     10.1   Pullout
                                                                            2      7.5   Pullout

      5      2.06      15.00     31.09       7.01     58.13     17.04      1      9.3   Pullout
                                                                            2      5.2   Pullout

      6      1.91      17.50     34.58       6.38     49.76     18.96      1      9.2   Pullout
                                                                            2      6.1   Pullout

      7      1.84      20.00     31.09       7.01     45.95     20.14      1      7.8   Pullout
                                                                            2      5.1   Pullout

      8      1.82      22.50     28.20       7.66     42.58     21.39      1      6.4   Pullout
                                                                            2      4.2   Pullout

      9      1.83      25.00     23.47      13.63     45.38     17.79      1      2.1   Pullout
                                                                            2      2.7   Pullout

     10      1.85      27.50     18.21      11.58     41.26     21.95      1      1.4   Pullout
                                                                            2      0.7   Pullout

     11      1.89      30.00     16.78      12.53     38.80     23.10      1      0.0   Pullout
                                                                            2      0.0   Pullout

Search Level: 2.40 feet below the toe of the wall  Facing Design Force = 2.3 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      3.28       5.00     62.37       9.70     85.02      5.75      1     14.8   Pullout
                                                                            2     10.1   Pullout

      2      2.84       7.50     49.13      10.32     84.51      7.84      1     11.4   Pullout
                                                                            2      7.8   Pullout

      3      2.64      10.00     43.96       9.72     73.50     10.56      1     10.5   Pullout
                                                                            2      6.8   Pullout

      4      2.40      12.50     44.07      10.44     65.34     11.98      1      9.8   Pullout
                                                                            2      6.8   Pullout

      5      2.18      15.00     40.02      11.75     62.11     12.83      1      8.0   Pullout
```

```
                                                                           2      5.9   Pullout

      6      2.03      17.50     40.82     11.56     52.34     14.32       1      8.2   Pullout
                                                                           2      6.1   Pullout

      7      1.93      20.00     37.08     12.53     48.58     15.12       1      6.6   Pullout
                                                                           2      5.2   Pullout

      8      1.90      22.50     26.74     12.60     49.61     17.36       1      3.2   Pullout
                                                                           2      2.2   Pullout

      9      1.89      25.00     26.74      8.40     40.82     23.12       1      4.5   Pullout
                                                                           2      2.5   Pullout

     10      1.89      27.50     24.61      9.07     38.14     24.47       1      3.2   Pullout
                                                                           2      1.7   Pullout

     11      1.92      30.00     22.77      9.76     35.74     25.87       1      2.0   Pullout
                                                                           2      0.8   Pullout

Search Level: 3.20 feet below the toe of the wall  Facing Design Force = 1.1 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  | Angle   | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      4.23       5.00     69.84     14.50    -90.00      1.51       1     16.1   Pullout
                                                                           2     10.9   Pullout

      2      3.56       7.50     65.43     18.04      0.00      0.00       1     14.9   Pullout
                                                                           2     10.1   Pullout

      3      2.93      10.00     54.73     17.32    -90.00      3.54       1     11.8   Pullout
                                                                           2      8.1   Pullout

      4      2.59      12.50     48.67      7.57     60.52     15.24       1     11.2   Pullout
                                                                           2      6.9   Pullout

      5      2.31      15.00     41.19     11.96     63.08     13.25       1      7.6   Pullout
                                                                           2      5.1   Pullout

      6      2.12      17.50     36.88     13.13     59.36     13.73       1      5.6   Pullout
                                                                           2      4.0   Pullout

      7      2.02      20.00     38.23     12.73     49.76     15.48       1      6.1   Pullout
                                                                           2      4.4   Pullout

      8      1.97      22.50     35.00     13.73     46.41     16.31       1      4.6   Pullout
```

```
                                                                            2      3.5   Pullout

      9      1.95      25.00     25.30     13.83     47.80     18.61        1      1.0   Pullout
                                                                            2      0.1   Pullout

     10      1.94      27.50     28.24     12.49     39.88     21.50        1      2.2   Pullout
                                                                            2      1.3   Pullout

     11      1.96      30.00     26.21     13.38     37.45     22.67        1      0.9   Pullout
                                                                            2      0.5   Pullout

Search Level: 4.00 feet below the toe of the wall  Facing Design Force = 0.6 kips (Clouterre)
-------------------------------------------------------------------------------------------------------
|       |         |          |              Failure Planes            |        Reinforcement          |
|       |         |          |----------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower        |       Upper       |       |        |              |
|       | Factor  | From Toe |----------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle   | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees  |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
-------------------------------------------------------------------------------------------------------
      1       N/A       5.00      0.00      1.00     75.90     16.42        1     16.0   Pullout
                                                                            2     10.2   Pullout

      2     14.32       7.50      0.00      6.00     85.02     17.27        1     11.3   Pullout
                                                                            2      4.7   Pullout

      3      7.25      10.00      0.00      6.00     77.79     18.90        1      9.5   Pullout
                                                                            2      3.5   Pullout

      4      5.17      12.50      0.00      6.25     72.44     20.72        1      7.8   Pullout
                                                                            2      2.4   Pullout

      5      2.53      15.00     43.72     20.76    -90.00      6.15        1      7.1   Pullout
                                                                            2      4.8   Pullout

      6      2.31      17.50     46.50     25.42     90.00      2.05        1      8.2   Pullout
                                                                            2      5.5   Pullout

      7      2.10      20.00     34.34     14.53     56.95     14.67        1      3.3   Pullout
                                                                            2      2.0   Pullout

      8      2.04      22.50     31.27     15.79     53.80     15.24        1      1.4   Pullout
                                                                            2      0.9   Pullout

      9      2.01      25.00     33.26     14.95     44.53     17.53        1      2.5   Pullout
                                                                            2      1.7   Pullout

     10      1.99      27.50     30.80     16.01     41.80     18.45        1      1.1   Pullout
                                                                            2      0.8   Pullout

     11      2.01      30.00     28.66     17.09     39.34     19.40        1      0.0   Pullout
```

```
                                                                            2      0.0   Pullout

========================================================================================================
                                            END OF REPORT
========================================================================================================
```

```
======================================================================================================
                                               Snail

                                           Version: 2.2.2

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======================================================================================================
                                          File Information
======================================================================================================

File Name: US 395 RW10 Full Height Pole Load.snz
Run Date:  11/01/22
Run Time:  11:20:53

======================================================================================================
                                        Project Information
======================================================================================================

Description:    RW10
Location:       US 395
EA:
Project ID:
Wall No.:
Structure No.:
Station:
Engineer:       STC
                Designer

Comments:


======================================================================================================
                                              Geometry
======================================================================================================

Layout:

Reference Point:

At: Top of Wall
Distance From Origin:       22.00 feet
Elevation Above Origin:     48.00 feet

Wall Dimensions:

Wall Height:       10.40 feet
Facing Angle:      90.00 degrees
Facing Batter:     0.000 :12 H:V
```

```
Ground Surface:

Number of lines that define the ground surface above the wall: 3

         Angle  Distance
No.    degrees      feet
------------------------
1            0      2.00
2           27     13.42
3            0

Number of lines that define the ground surface in front of the toe: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Soil Layers:

Number of Layers: 2

Layers Below the Top Layer:

Coordinates of the Top of the Layer: feet

             Point 1         Point 1         Point 2         Point 2
Layer       Distance       Elevation        Distance       Elevation
--------------------------------------------------------------------
2              30.00           47.00           50.00           47.00

Ground Water:

Include Ground Water: No

======================================================================================================
                                             Soil Nails
======================================================================================================

Dimensions and Properties:

Maximum Vertical Spacing:               4.00 feet
Number of Soil Nail Rows:                  2
Soil Nail Design Parameters:               Varying

      Soil Nail       Inclination   Vertical   Horizontal      Nail Bar   Nail Bar Yield       Bond
         Length   From Horizontal    Spacing    Spacing H    Diameter Ø      Strength fy   Strength
No.        feet           degrees       feet         feet        inches              ksi   Factor F
---------------------------------------------------------------------------------------------------
1         15.00                15       2.50         4.00         1.000             75.0       1.00
2         10.00                15       4.00         4.00         1.000             75.0       1.00
```

```
Facing Resistance:

                                     Temporary   Permanent     Seismic
ASD Allowable Facing Resistance:          22.2        19.3        26.3 kips

======================================================================================================
                                          Soil Properties
======================================================================================================

                                        Unit Weight  Friction Angle        Cohesion
                                                  γ              φ'              c'
Layer  Description                              pcf         degrees             psf
-----------------------------------------------------------------------------------
1      Fill                                     115            34.0             100
2      Weathered Granodiorite                   120            27.0             500

======================================================================================================
                                               Loads
======================================================================================================

Applied Loads:

Seismic:

Horizontal Seismic Coefficient Kh0.25:

External Load:

Apply external load:    Yes
Load:                   2.7 klf
Angle:                 -180 degrees

Surcharges:

Apply surcharges: No

======================================================================================================
                                         Factors of Safety
======================================================================================================

                    Temporary   Permanent     Seismic
Pullout (Distal):        2.00        2.00        1.50
Pullout (Proximal):      2.00        2.00        1.50
Nail Bar Yield:          1.80        1.80        1.35

======================================================================================================
                                           Search Options
======================================================================================================

Search Limits:
```

```
Begin:      5.00 feet
End:       20.00 feet

Below Toe Searches (BTS):

Perform below Toe Search:       Yes
Number of BTS Points:             5
BTS Depth:                     4.00 feet
Interface Friction
Reduction Factor:              0.33

Advanced Search Options:

Use Advanced Search Options:     Yes
Inclination of Interslice Force: Use Average Failure Angle

======================================================================================================
                                               Results
======================================================================================================

Analysis:

Method:          ASD
Scenario:  Permanent

Factor of Safety:

Minimum:                  1.46
Found at Search Point:       1
Found at Grid Point:        24
Found at Search Level:       Toe of the wall

Load at Soil Nail Head:

Calculated Service Load at Soil Nail Head (Empirical), To:     9.3 kips
Allowable Facing Resistance, F_allowable (Entered):           19.3 kips
F_allowable ≥ To OK

Nominal Pullout Resistance:

                    Nominal Pullout Resistance
Layer  Description                         klf
----------------------------------------------
    1  Fill                              2.262
    2  Weathered Granodiorite            2.714

Results by Search Level:

** Indicates Minimum Factor of Safety
```

```
Search Level: At the toe of the wall  Facing Design Force = 9.3 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
   ** 1      1.46       5.00      30.81      4.66     84.02      9.60      1      18.0  Pullout
                                                                           2      10.0  Pullout

      2      1.52       6.50      33.06      4.65     75.64     10.48      1      17.1  Pullout
                                                                           2      10.2  Pullout

      3      1.56       8.00      33.94      4.82     69.62     11.48      1      16.3  Pullout
                                                                           2      10.0  Pullout

      4      1.63       9.50      36.82      4.75     63.39     12.73      1      15.9  Pullout
                                                                           2      10.5  Pullout

      5      1.68      11.00      24.42      3.62     60.28     15.53      1      15.1  Pullout
                                                                           2      10.0  Pullout

      6      1.67      12.50      22.78      4.07     58.31     16.66      1      14.2  Pullout
                                                                           2       9.3  Pullout

      7      1.65      14.00      21.44      4.51     56.57     17.79      1      13.3  Pullout
                                                                           2       8.6  Pullout

      8      1.64      15.50      19.53      4.93     53.84     18.39      1      12.1  Pullout
                                                                           2       7.9  Pullout

      9      1.64      17.00      17.92      5.36     51.28     19.02      1      11.0  Pullout
                                                                           2       7.1  Pullout

     10      1.64      18.50      16.55      5.79     48.90     19.70      1      10.0  Pullout
                                                                           2       6.4  Pullout

     11      1.66      20.00      15.37      6.22     46.68     20.40      1       8.9  Pullout
                                                                           2       5.7  Pullout

Search Level: 0.80 feet below the toe of the wall  Facing Design Force = 4.2 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
```

```
      1      1.95       5.00     32.47      4.74     84.39     10.23       1      17.9   Pullout
                                                                           2       9.9   Pullout

      2      1.95       6.50     30.67      5.29     79.76     10.97       1      16.3   Pullout
                                                                           2       8.9   Pullout

      3      1.93       8.00     30.71      5.58     74.33     11.85       1      15.2   Pullout
                                                                           2       8.4   Pullout

      4      1.90       9.50     32.31      5.62     68.43     12.92       1      14.6   Pullout
                                                                           2       8.5   Pullout

      5      1.86      11.00     29.86      6.34     66.47     13.77       1      13.2   Pullout
                                                                           2       7.4   Pullout

      6      1.86      12.50     33.51      6.00     60.47     15.22       1      13.4   Pullout
                                                                           2       8.3   Pullout

      7      1.90      14.00     22.38      4.54     57.80     18.39       1      12.8   Pullout
                                                                           2       8.0   Pullout

      8      1.85      15.50     20.40      4.96     55.12     18.97       1      11.6   Pullout
                                                                           2       7.1   Pullout

      9      1.82      17.00     18.73      5.39     52.60     19.59       1      10.4   Pullout
                                                                           2       6.3   Pullout

     10      1.80      18.50     17.31      5.81     50.24     20.25       1       9.3   Pullout
                                                                           2       5.5   Pullout

     11      1.80      20.00     16.08      6.24     48.03     20.93       1       8.2   Pullout
                                                                           2       4.8   Pullout

Search Level: 1.60 feet below the toe of the wall  Facing Design Force = 3.6 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes             |        Reinforcement           |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      2.21       5.00     42.05      6.06     86.98      9.48       1      17.5   Pullout
                                                                           2       9.2   Pullout

      2      2.33       6.50     47.71      5.80     75.43     10.34       1      17.1   Pullout
                                                                           2      10.2   Pullout

      3      2.26       8.00     46.28     10.42     83.94      7.57       1      13.0   Pullout
                                                                           2       9.8   Pullout
```

```
      4      2.22       9.50      33.67       5.71      69.43      13.52       1      14.3   Pullout
                                                                           2       8.1   Pullout

      5      2.14      11.00      31.10       6.42      67.49      14.36       1      12.9   Pullout
                                                                           2       7.0   Pullout

      6      2.08      12.50      29.04       7.15      65.76      15.22       1      11.6   Pullout
                                                                           2       5.8   Pullout

      7      2.04      14.00      32.87       6.67      59.87      16.73       1      12.0   Pullout
                                                                           2       6.9   Pullout

      8      1.97      15.50      30.27       7.18      57.28      17.20       1      10.7   Pullout
                                                                           2       6.0   Pullout

      9      1.92      17.00      28.02       7.70      54.83      17.71       1       9.5   Pullout
                                                                           2       5.1   Pullout

     10      1.94      18.50      30.40      10.72      53.86      15.68       1       7.6   Pullout
                                                                           2       5.8   Pullout

     11      1.92      20.00      24.34       8.78      50.34      18.80       1       7.1   Pullout
                                                                           2       3.6   Pullout

Search Level: 2.40 feet below the toe of the wall  Facing Design Force = 3.3 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      3.16       5.00      59.82       4.97      76.01      10.34       1      19.2   Pullout
                                                                           2      12.3   Pullout

      2      3.05       6.50      58.91       8.81      75.51       7.79       1      17.1   Pullout
                                                                           2      11.4   Pullout

      3      2.80       8.00      54.77       9.71      73.16       8.28       1      15.5   Pullout
                                                                           2      10.6   Pullout

      4      2.51       9.50      46.39       6.89      67.79      12.57       1      14.8   Pullout
                                                                           2       8.8   Pullout

      5      2.41      11.00      42.09      10.38      72.45      10.94       1      11.5   Pullout
                                                                           2       7.7   Pullout

      6      2.30      12.50      35.98      12.36      77.07      11.17       1       7.9   Pullout
                                                                           2       5.9   Pullout
```

```
      7      2.22      14.00     37.64     12.38     69.67     12.09       1      8.3   Pullout
                                                                           2      6.4   Pullout

      8      2.16      15.50     31.36      7.26     58.40     17.75       1     10.2   Pullout
                                                                           2      5.4   Pullout

      9      2.04      17.00     36.53     12.69     59.04     13.22       1      7.7   Pullout
                                                                           2      6.1   Pullout

     10      2.05      18.50     27.05      8.31     53.71     18.75       1      7.7   Pullout
                                                                           2      3.5   Pullout

     11      2.01      20.00     25.28      8.85     51.55     19.30       1      6.5   Pullout
                                                                           2      2.5   Pullout

Search Level: 3.20 feet below the toe of the wall  Facing Design Force = 2.7 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1       N/A       5.00      0.00      0.50     73.44     15.78       1     19.6   Pullout
                                                                           2     13.0   Pullout

      2       N/A       6.50      0.00      1.30     71.88     16.72       1     17.8   Pullout
                                                                           2     11.3   Pullout

      3      6.00       8.00      0.00      6.40     84.51     16.73       1     12.9   Pullout
                                                                           2      4.9   Pullout

      4      3.76       9.50      0.00      3.80     71.88     18.33       1     13.7   Pullout
                                                                           2      7.2   Pullout

      5      3.94      11.00      0.00      5.50     73.17     19.00       1     11.3   Pullout
                                                                           2      4.6   Pullout

      6      2.66      12.50     46.70     18.23    -90.00      5.69       1     11.0   Pullout
                                                                           2      7.7   Pullout

      7      2.51      14.00     40.16     18.32    -90.00      7.88       1      8.1   Pullout
                                                                           2      5.9   Pullout

      8      2.43      15.50     41.65     20.74     90.00      5.91       1      8.8   Pullout
                                                                           2      6.3   Pullout

      9      2.32      17.00     37.68      6.44     52.93     19.74       1     10.3   Pullout
                                                                           2      6.1   Pullout
```

```
     10      2.18      18.50     35.36     13.61     57.94     13.94        1      5.8   Pullout
                                                                            2      4.3   Pullout

     11      2.14      20.00     30.57     11.61     54.04     17.03        1      5.3   Pullout
                                                                            2      2.5   Pullout

Search Level: 4.00 feet below the toe of the wall  Facing Design Force = 3.3 kips (Clouterre)
-------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes              |          Reinforcement         |
|       |         |          |-----------------------------------------|--------------------------------|
|       | Minimum | Distance |        Lower        |       Upper       |       |        |               |
|       | Factor  | From Toe |-----------------------------------------|       |        | Controlling   |
| Search|   of    | of Wall  |  Angle   |  Length  |  Angle  |  Length |       | Stress | Resistance    |
|Point  | Safety  |   feet   | degrees  |   feet   | degrees |   feet  | Level |  ksi   | Failure Mode  |
-------------------------------------------------------------------------------------------------------
      1       N/A       5.00      0.00      0.50     74.23     16.55        1     19.5   Pullout
                                                                            2     12.7   Pullout

      2       N/A       6.50      0.00      1.30     72.70     17.48        1     17.7   Pullout
                                                                            2     11.1   Pullout

      3       N/A       8.00      0.00      1.60     69.87     18.59        1     16.2   Pullout
                                                                            2     10.0   Pullout

      4       N/A       9.50      0.00      0.95     64.86     20.13        1     15.5   Pullout
                                                                            2      9.9   Pullout

      5      6.94      11.00      0.00      8.80     83.39     19.11        1      8.3   Pullout
                                                                            2      0.4   Pullout

      6      6.93      12.50      0.00     10.00     82.79     19.91        1      6.0   Pullout
                                                                            2      0.0   Pullout

      7      3.93      14.00      0.00      7.00     71.14     21.66        1      7.8   Pullout
                                                                            2      1.4   Pullout

      8      3.73      15.50      0.00      7.75     69.29     21.91        1      6.0   Pullout
                                                                            2      0.0   Pullout

      9      2.47      17.00     35.88     20.98     90.00      8.20        1      4.4   Pullout
                                                                            2      3.0   Pullout

     10      2.41      18.50     37.79     23.41     90.00      6.15        1      5.5   Pullout
                                                                            2      3.7   Pullout

     11      2.36      20.00     39.34     25.86     90.00      4.10        1      6.3   Pullout
                                                                            2      4.3   Pullout


=======================================================================================================
                                           END OF REPORT
```

```
========================================================================================
```

```
=====================================================================================================
                                               Snail

                                           Version: 2.2.2

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=====================================================================================================
                                          File Information
=====================================================================================================

File Name: US 395 RW10 Full Height Seismic.snz
Run Date:  11/01/22
Run Time:  11:26:27

=====================================================================================================
                                        Project Information
=====================================================================================================

Description:    RW3
Location:       US 395
EA:
Project ID:
Wall No.:
Structure No.:
Station:
Engineer:       STC
                Designer

Comments:


=====================================================================================================
                                              Geometry
=====================================================================================================

Layout:

Reference Point:

At: Top of Wall
Distance From Origin:       22.00 feet
Elevation Above Origin:     48.00 feet

Wall Dimensions:

Wall Height:       10.40 feet
Facing Angle:      90.00 degrees
Facing Batter:     0.000 :12 H:V
```

```
Ground Surface:

Number of lines that define the ground surface above the wall: 3

         Angle  Distance
No.    degrees      feet
------------------------
1            0      2.00
2           27     13.42
3            0

Number of lines that define the ground surface in front of the toe: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Soil Layers:

Number of Layers: 2

Layers Below the Top Layer:

Coordinates of the Top of the Layer: feet

             Point 1         Point 1         Point 2         Point 2
Layer       Distance       Elevation        Distance       Elevation
--------------------------------------------------------------------
2              30.00           47.00           50.00           47.00

Ground Water:

Include Ground Water: No

======================================================================================================
                                             Soil Nails
======================================================================================================

Dimensions and Properties:

Maximum Vertical Spacing:               4.00 feet
Number of Soil Nail Rows:                  2
Soil Nail Design Parameters:               Varying

      Soil Nail       Inclination   Vertical   Horizontal      Nail Bar   Nail Bar Yield       Bond
         Length   From Horizontal    Spacing    Spacing H    Diameter Ø      Strength fy   Strength
No.        feet           degrees       feet         feet        inches              ksi   Factor F
---------------------------------------------------------------------------------------------------
1         15.00                15       2.50         4.00         1.000             75.0       1.00
2         10.00                15       4.00         4.00         1.000             75.0       1.00
```

```
Facing Resistance:

                                     Temporary   Permanent      Seismic
ASD Allowable Facing Resistance:           22.2        19.3        26.3 kips

=======================================================================================================
                                          Soil Properties
=======================================================================================================

                                        Unit Weight  Friction Angle         Cohesion
                                                  γ              φ'               c'
Layer  Description                              pcf         degrees              psf
------------------------------------------------------------------------------------
1      Fill                                     115            34.0              100
2      Weathered Granodiorite                   120            27.0              500

=======================================================================================================
                                               Loads
=======================================================================================================

Applied Loads:

Seismic:

Horizontal Seismic Coefficient Kh0.25:

External Load:

Apply external load: No

Surcharges:

Apply surcharges: No

=======================================================================================================
                                         Factors of Safety
=======================================================================================================

                    Temporary   Permanent     Seismic
Pullout (Distal):        2.00        2.00        1.50
Pullout (Proximal):      2.00        2.00        1.50
Nail Bar Yield:          1.80        1.80        1.35

=======================================================================================================
                                           Search Options
=======================================================================================================

Search Limits:

Begin:      5.00 feet
```

```
End:       30.00 feet

Below Toe Searches (BTS):

Perform below Toe Search:       Yes
Number of BTS Points:             5
BTS Depth:                     4.00 feet
Interface Friction
Reduction Factor:              0.33

Advanced Search Options:

Use Advanced Search Options:     Yes
Inclination of Interslice Force: Use Average Failure Angle

======================================================================================================
                                               Results
======================================================================================================

Analysis:

Method:          ASD
Scenario:    Seismic

Factor of Safety:

Minimum:                  1.42
Found at Search Point:      10
Found at Grid Point:        11
Found at Search Level:       Toe of the wall

Load at Soil Nail Head:

Calculated Service Load at Soil Nail Head (Empirical), To:     2.4 kips
Allowable Facing Resistance, F_allowable (Entered):           26.3 kips
F_allowable ≥ To OK

Nominal Pullout Resistance:

                    Nominal Pullout Resistance
Layer  Description                         klf
----------------------------------------------
    1  Fill                              2.262
    2  Weathered Granodiorite            2.262

Results by Search Level:

** Indicates Minimum Factor of Safety

Search Level: At the toe of the wall  Facing Design Force = 2.4 kips (Clouterre)
------------------------------------------------------------------------------------------------------
```

```
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      2.05       5.00     27.93      5.09     87.00      9.56       1     19.4   Pullout
                                                                           2     10.2   Pullout

      2      2.03       7.50     30.40      5.22     74.14     10.98       1     17.7   Pullout
                                                                           2     10.2   Pullout

      3      2.07      10.00     28.50      9.10     78.84     10.33       1     12.4   Pullout
                                                                           2      9.6   Pullout

      4      1.86      12.50     28.37      9.94     71.22     11.65       1     10.9   Pullout
                                                                           2      9.6   Pullout

      5      1.70      15.00     25.23     11.61     68.71     12.39       1      7.8   Pullout
                                                                           2      8.7   Pullout

      6      1.58      17.50     25.23     11.61     58.77     13.50       1      7.8   Pullout
                                                                           2      8.7   Pullout

      7      1.50      20.00     11.65      8.17     51.05     19.09       1      7.5   Pullout
                                                                           2      3.2   Pullout

      8      1.46      22.50     13.73      6.95     43.30     21.64       1      8.1   Pullout
                                                                           2      5.1   Pullout

      9      1.43      25.00     12.40      7.68     40.30     22.95       1      6.3   Pullout
                                                                           2      3.9   Pullout

  ** 10      1.42      27.50     11.31      8.41     37.64     24.31       1      4.7   Pullout
                                                                           2      2.7   Pullout

     11      1.43      30.00     10.38      9.15     35.25     25.72       1      3.1   Pullout
                                                                           2      2.0   Pullout

Search Level: 0.80 feet below the toe of the wall  Facing Design Force = 1.0 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      2.51       5.00     29.50      5.17     87.19     10.20       1     19.4   Pullout
                                                                           2     10.2   Pullout
```

```
       2      2.30       7.50     25.02      6.62     82.37     11.30       1     15.8  Pullout
                                                                            2      7.2  Pullout

       3      2.09      10.00     34.17     10.88     83.77      9.22       1     10.9  Pullout
                                                                            2      9.3  Pullout

       4      1.99      12.50     26.40     11.16     77.82     11.85       1      8.5  Pullout
                                                                            2      7.0  Pullout

       5      1.80      15.00     26.29     11.71     69.61     12.91       1      7.5  Pullout
                                                                            2      6.9  Pullout

       6      1.67      17.50     26.29     11.71     59.96     13.98       1      7.2  Pullout
                                                                            2      6.9  Pullout

       7      1.58      20.00     23.38     13.07     56.54     14.51       1      4.6  Pullout
                                                                            2      5.9  Pullout

       8      1.53      22.50     17.09     11.77     50.88     17.83       1      3.5  Pullout
                                                                            2      3.0  Pullout

       9      1.50      25.00     12.98      7.70     41.65     23.42       1      5.4  Pullout
                                                                            2      2.6  Pullout

      10      1.47      27.50     11.84      8.43     38.96     24.75       1      3.6  Pullout
                                                                            2      1.4  Pullout

      11      1.45      30.00     10.88      9.16     36.54     26.14       1      1.9  Pullout
                                                                            2      0.2  Pullout

Search Level: 1.60 feet below the toe of the wall  Facing Design Force = 0.0 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
       1      2.63       5.00     42.05      6.06     86.98      9.48       1     19.4  Pullout
                                                                            2     10.2  Pullout

       2      2.60       7.50     47.64     10.02     84.21      7.44       1     15.3  Pullout
                                                                            2     11.2  Pullout

       3      2.25      10.00     35.55     11.06     84.08      9.70       1     10.8  Pullout
                                                                            2      8.1  Pullout

       4      2.08      12.50     24.83      8.26     70.19     14.75       1     11.3  Pullout
                                                                            2      4.3  Pullout
```

```
      5      1.90      15.00      19.89      15.95     -90.00      12.66         1       0.0   Pullout
                                                                              2       1.8   Pullout

      6      1.76      17.50      27.34      11.82      61.07      14.47         1       6.7   Pullout
                                                                              2       5.3   Pullout

      7      1.65      20.00      24.34      13.17      57.72      14.98         1       4.0   Pullout
                                                                              2       4.0   Pullout

      8      1.59      22.50      17.83      11.82      52.14      18.33         1       2.8   Pullout
                                                                              2       0.7   Pullout

      9      1.54      25.00      19.89      10.63      43.98      20.84         1       3.8   Pullout
                                                                              2       1.8   Pullout

     10      1.51      27.50      18.21      11.58      41.26      21.95         1       1.8   Pullout
                                                                              2       0.9   Pullout

     11      1.49      30.00      16.78      12.53      38.80      23.10         1       0.0   Pullout
                                                                              2       0.0   Pullout

Search Level: 2.40 feet below the toe of the wall  Facing Design Force = 0.0 kips (Clouterre)
-----------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes              |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |        Lower        |      Upper        |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle   | Length   |  Angle   | Length |       | Stress | Resistance   |
|Point  | Safety  |  feet    | degrees  |  feet    | degrees  |  feet  | Level |  ksi   | Failure Mode |
-----------------------------------------------------------------------------------------------------
      1      3.29       5.00      50.85       5.54      81.50      10.14         1      20.4   Pullout
                                                                              2      11.9   Pullout

      2      2.90       7.50      46.13       6.49      74.64      11.33         1      17.6   Pullout
                                                                              2      10.0   Pullout

      3      2.57      10.00      29.36       6.88      73.50      14.08         1      14.0   Pullout
                                                                              2       6.6   Pullout

      4      2.17      12.50      35.98      12.36      77.07      11.17         1       8.8   Pullout
                                                                              2       6.6   Pullout

      5      1.96      15.00      26.74      16.80     -90.00      11.34         1       2.3   Pullout
                                                                              2       3.0   Pullout

      6      1.84      17.50      23.36      19.06      90.00      11.34         1       0.0   Pullout
                                                                              2       1.3   Pullout

      7      1.73      20.00      25.28      13.27      58.83      15.46         1       3.5   Pullout
                                                                              2       2.3   Pullout
```

```
      8      1.65      22.50     22.77     14.64     55.76     16.00       1      0.8   Pullout
                                                                           2      1.0   Pullout

      9      1.60      25.00     20.70     10.69     45.22     21.29       1      2.9   Pullout
                                                                           2      0.0   Pullout

     10      1.57      27.50     22.40     14.87     43.89     19.08       1      0.0   Pullout
                                                                           2      0.8   Pullout

     11      1.56      30.00     17.48     12.58     40.02     23.50       1      0.0   Pullout
                                                                           2      0.0   Pullout

Search Level: 3.20 feet below the toe of the wall  Facing Design Force = 0.8 kips (Clouterre)
-------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes             |        Reinforcement           |
|       |         |          |----------------------------------------|--------------------------------|
|       | Minimum | Distance |       Lower       |       Upper        |        |       |               |
|       | Factor  | From Toe |----------------------------------------|        |       | Controlling   |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length   |        | Stress| Resistance    |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet    | Level  |  ksi  | Failure Mode  |
-------------------------------------------------------------------------------------------------------
      1      4.61       5.00     67.55      6.55     74.60      9.42       1     21.6   Pullout
                                                                           2     14.0   Pullout

      2      4.11       7.50     63.07     16.56    -90.00      1.64       1     18.9   Pullout
                                                                           2     12.9   Pullout

      3      3.68      10.00     60.50     20.31      0.00      0.00       1     18.0   Pullout
                                                                           2     12.3   Pullout

      4      2.53      12.50     46.70     18.23    -90.00      5.69       1     12.2   Pullout
                                                                           2      8.6   Pullout

      5      2.01      15.00     27.71     16.94    -90.00     11.82       1      1.0   Pullout
                                                                           2      1.4   Pullout

      6      1.90      17.50     29.36     20.08     90.00      9.85       1      2.2   Pullout
                                                                           2      2.2   Pullout

      7      1.80      20.00     26.21     13.38     59.87     15.94       1      3.0   Pullout
                                                                           2      0.6   Pullout

      8      1.72      22.50     26.57     17.61     60.26     13.61       1      0.1   Pullout
                                                                           2      0.8   Pullout

      9      1.66      25.00     25.30     13.83     47.80     18.61       1      1.3   Pullout
                                                                           2      0.1   Pullout

     10      1.63      27.50     23.25     14.97     45.07     19.47       1      0.0   Pullout
                                                                           2      0.0   Pullout
```

```
     11      1.62      30.00     23.64      9.82     36.88     26.25       1      1.6   Pullout
                                                                           2      0.0   Pullout

Search Level: 4.00 feet below the toe of the wall  Facing Design Force = 0.1 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1       N/A       5.00      0.00      2.00     79.33     16.21       1     20.8   Pullout
                                                                           2     12.6   Pullout

      2       N/A       7.50      0.00      0.75     68.58     18.48       1     19.1   Pullout
                                                                           2     12.3   Pullout

      3       N/A      10.00      0.00      1.00     64.03     20.55       1     16.8   Pullout
                                                                           2     10.7   Pullout

      4      4.33      12.50      0.00      8.75     79.25     20.10       1      8.0   Pullout
                                                                           2      0.0   Pullout

      5      2.57      15.00     15.28     15.55    -90.00     16.39       1      0.0   Pullout
                                                                           2      0.0   Pullout

      6      1.95      17.50     30.35     20.28     90.00     10.25       1      1.1   Pullout
                                                                           2      0.8   Pullout

      7      1.89      20.00     31.58     23.48     90.00      8.20       1      2.0   Pullout
                                                                           2      1.4   Pullout

      8      1.81      22.50     28.66     25.64     90.00      8.20       1      0.0   Pullout
                                                                           2      0.0   Pullout

      9      1.72      25.00     28.66     17.09     50.88     15.85       1      0.0   Pullout
                                                                           2      0.0   Pullout

     10      1.71      27.50     26.42     18.42     48.18     16.50       1      0.0   Pullout
                                                                           2      0.0   Pullout

     11      1.68      30.00     27.13     13.48     38.55     23.02       1      0.2   Pullout
                                                                           2      0.0   Pullout


======================================================================================================
                                           END OF REPORT
======================================================================================================
```

```
======================================================================================================
                                               Snail

                                           Version: 2.2.2

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======================================================================================================
                                          File Information
======================================================================================================

File Name: US 395 RW10 Full Height Temp.snz
Run Date:  11/01/22
Run Time:  11:32:08

======================================================================================================
                                        Project Information
======================================================================================================

Description:    RW10
Location:       US 395
EA:
Project ID:
Wall No.:
Structure No.:
Station:
Engineer:       STC
                Designer

Comments:


======================================================================================================
                                              Geometry
======================================================================================================

Layout:

Reference Point:

At: Top of Wall
Distance From Origin:       22.00 feet
Elevation Above Origin:     48.00 feet

Wall Dimensions:

Wall Height:       10.40 feet
Facing Angle:      90.00 degrees
Facing Batter:     0.000 :12 H:V
```

```
Ground Surface:

Number of lines that define the ground surface above the wall: 3

         Angle  Distance
No.    degrees      feet
------------------------
1            0      2.00
2           27     13.42
3            0

Number of lines that define the ground surface in front of the toe: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Soil Layers:

Number of Layers: 2

Layers Below the Top Layer:

Coordinates of the Top of the Layer: feet

             Point 1         Point 1         Point 2         Point 2
Layer       Distance       Elevation        Distance       Elevation
--------------------------------------------------------------------
2              30.00           47.00           50.00           47.00

Ground Water:

Include Ground Water: No

======================================================================================================
                                             Soil Nails
======================================================================================================

Dimensions and Properties:

Maximum Vertical Spacing:               4.00 feet
Number of Soil Nail Rows:                  1
Soil Nail Design Parameters:               Varying

      Soil Nail       Inclination   Vertical   Horizontal      Nail Bar   Nail Bar Yield       Bond
         Length   From Horizontal    Spacing    Spacing H    Diameter Ø      Strength fy   Strength
No.        feet           degrees       feet         feet        inches              ksi   Factor F
---------------------------------------------------------------------------------------------------
1         15.00                15       2.50         4.00         1.000             75.0       1.00
```

```
Facing Resistance:

                                     Temporary   Permanent     Seismic
ASD Allowable Facing Resistance:          22.2        19.3        26.3 kips

=======================================================================================================
                                          Soil Properties
=======================================================================================================

                                        Unit Weight  Friction Angle        Cohesion
                                                  γ              φ'              c'
Layer  Description                              pcf         degrees             psf
-----------------------------------------------------------------------------------
1      Fill                                     115            34.0             100
2      Weathered Granodiorite                   120            27.0             500

=======================================================================================================
                                               Loads
=======================================================================================================

Applied Loads:

Seismic:

Horizontal Seismic Coefficient Kh0.25:

External Load:

Apply external load: No

Surcharges:

Apply surcharges:    Yes

           Distance from Top of Wall            Load            Load
               Begin             End           Begin             End
No.             feet            feet             psf             psf
--------------------------------------------------------------------
1               0.00           14.00             250             250
2              14.00           30.00             600             600

=======================================================================================================
                                         Factors of Safety
=======================================================================================================

                    Temporary   Permanent     Seismic
Pullout (Distal):        2.00        2.00        1.50
Pullout (Proximal):      2.00        2.00        1.50
Nail Bar Yield:          1.80        1.80        1.35

=======================================================================================================
```

```
                                           Search Options
======================================================================================================

Search Limits:

Begin:      5.00 feet
End:       30.00 feet

Below Toe Searches (BTS):

Perform below Toe Search:       Yes
Number of BTS Points:             5
BTS Depth:                     4.00 feet
Interface Friction
Reduction Factor:              0.33

Advanced Search Options:

Use Advanced Search Options:     Yes
Inclination of Interslice Force: Use Average Failure Angle

======================================================================================================
                                               Results
======================================================================================================

Analysis:

Method:          ASD
Scenario:  Temporary

Factor of Safety:

Minimum:                  1.48
Found at Search Point:       6
Found at Grid Point:        27
Found at Search Level:       Toe of the wall

Load at Soil Nail Head:

Calculated Service Load at Soil Nail Head (Empirical), To:     5.2 kips
Allowable Facing Resistance, F_allowable (Entered):           22.2 kips
F_allowable ≥ To OK

Nominal Pullout Resistance:

                    Nominal Pullout Resistance
Layer  Description                         klf
----------------------------------------------
    1  Fill                              2.262
    2  Weathered Granodiorite            2.262
```

```
Results by Search Level:

** Indicates Minimum Factor of Safety

Search Level: At the toe of the wall  Facing Design Force = 5.2 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      1.68       5.00     52.97      7.47     85.21      5.99       1     14.8   Pullout

      2      1.66       7.50     45.17      7.45     74.14      8.23       1     13.3   Pullout

      3      1.59      10.00     43.98      8.34     65.27      9.56       1     12.3   Pullout

      4      1.58      12.50     43.38      6.88     55.77     13.33       1     12.6   Pullout

      5      1.51      15.00     39.51      7.78     52.06     14.64       1     11.4   Pullout

   ** 6      1.48      17.50     35.25      8.57     47.71     15.61       1     10.0   Pullout

      7      1.50      20.00     31.74      9.41     43.89     16.65       1      8.7   Pullout

      8      1.55      22.50     28.80     10.27     40.54     17.76       1      7.5   Pullout

      9      1.61      25.00     26.33     11.16     37.58     18.93       1      6.3   Pullout

     10      1.69      27.50     24.22     12.06     34.98     20.14       1      5.2   Pullout

     11      1.77      30.00     20.13      9.59     32.14     24.80       1      4.5   Pullout

Search Level: 0.80 feet below the toe of the wall  Facing Design Force = 4.2 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      2.14       5.00     54.74      7.79     85.51      6.38       1     14.8   Pullout

      2      1.94       7.50     49.40      9.22     77.91      7.16       1     12.6   Pullout

      3      1.87      10.00     45.52      8.56     66.42     10.00       1     12.1   Pullout

      4      1.77      12.50     41.43     10.00     63.27     11.12       1     10.4   Pullout
```

```
      5      1.71      15.00     40.85      7.93     53.37     15.08       1     10.9   Pullout

      6      1.63      17.50     36.54      8.71     49.06     16.02       1      9.4   Pullout

      7      1.62      20.00     32.96      9.53     45.25     17.04       1      8.1   Pullout

      8      1.64      22.50     29.96     10.39     41.88     18.13       1      6.8   Pullout

      9      1.68      25.00     27.42     11.27     38.90     19.28       1      5.5   Pullout

     10      1.73      27.50     25.25     12.16     36.27     20.46       1      4.4   Pullout

     11      1.80      30.00     23.38     13.07     33.92     21.69       1      3.2   Pullout

Search Level: 1.60 feet below the toe of the wall  Facing Design Force = 3.2 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      2.53       5.00     61.00      9.28     84.72      5.43       1     14.9   Pullout

      2      2.24       7.50     47.64     10.02     84.21      7.44       1     11.5   Pullout

      3      2.14      10.00     46.98      8.79     67.48     10.44       1     11.8   Pullout

      4      1.99      12.50     42.78     10.22     64.35     11.55       1     10.1   Pullout

      5      1.87      15.00     43.98     10.42     55.36     13.19       1     10.2   Pullout

      6      1.78      17.50     37.79      8.86     50.34     16.45       1      8.9   Pullout

      7      1.74      20.00     34.16      9.67     46.54     17.45       1      7.5   Pullout

      8      1.73      22.50     31.09     10.51     43.17     18.51       1      6.1   Pullout

      9      1.75      25.00     28.49     11.38     40.18     19.63       1      4.8   Pullout

     10      1.79      27.50     26.26     12.27     37.51     20.80       1      3.6   Pullout

     11      1.85      30.00     24.34     13.17     35.13     22.01       1      2.4   Pullout

Search Level: 2.40 feet below the toe of the wall  Facing Design Force = 2.9 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
```

```
|        | Factor   | From Toe  |---------------------------------------|        |        | Controlling    |
|Search  |   of     | of Wall   |  Angle   | Length  |  Angle   | Length  |        | Stress | Resistance     |
|Point   | Safety   |  feet     | degrees  |  feet   | degrees  |  feet   | Level  |  ksi   | Failure Mode   |
-----------------------------------------------------------------------------------------------------------
      1      3.06       5.00      65.05      9.48      80.10      5.82       1      15.5    Pullout

      2      2.61       7.50      56.06      9.40      73.91      8.12       1      13.3    Pullout

      3      2.38      10.00      48.37      9.03      68.45     10.89       1      11.6    Pullout

      4      2.19      12.50      44.07     10.44      65.34     11.98       1       9.8    Pullout

      5      2.03      15.00      40.02     11.75      62.11     12.83       1       8.0    Pullout

      6      1.90      17.50      40.82     11.56      52.34     14.32       1       8.2    Pullout

      7      1.84      20.00      37.08     12.53      48.58     15.12       1       6.6    Pullout

      8      1.83      22.50      32.20     10.64      44.41     18.90       1       5.5    Pullout

      9      1.83      25.00      29.54     11.49      41.40     20.00       1       4.2    Pullout

     10      1.86      27.50      27.26     12.37      38.71     21.15       1       2.9    Pullout

     11      1.90      30.00      25.28     13.27      36.31     22.34       1       1.6    Pullout

Search Level: 3.20 feet below the toe of the wall  Facing Design Force = 2.4 kips (Clouterre)
-----------------------------------------------------------------------------------------------------------
|        |          |           |            Failure Planes             |          Reinforcement          |
|        |          |           |---------------------------------------|---------------------------------|
|        | Minimum  | Distance  |        Lower       |      Upper       |        |        |                |
|        | Factor   | From Toe  |---------------------------------------|        |        | Controlling    |
|Search  |   of     | of Wall   |  Angle   | Length  |  Angle   | Length  |        | Stress | Resistance     |
|Point   | Safety   |  feet     | degrees  |  feet   | degrees  |  feet   | Level  |  ksi   | Failure Mode   |
-----------------------------------------------------------------------------------------------------------
      1     15.49       5.00       0.00      4.00      86.22     15.16       1      14.7    Pullout

      2      6.53       7.50       0.00      3.75      77.12     16.83       1      12.8    Pullout

      3      4.08      10.00       0.00      3.00      68.40     19.01       1      11.6    Pullout

      4      2.44      12.50      50.49     19.65     -90.00      3.79       1      10.4    Pullout

      5      2.19      15.00      41.19     11.96      63.08     13.25       1       7.6    Pullout

      6      2.03      17.50      42.00     11.77      53.48     14.70       1       7.7    Pullout

      7      1.95      20.00      38.23     12.73      49.76     15.48       1       6.1    Pullout

      8      1.91      22.50      35.00     13.73      46.41     16.31       1       4.6    Pullout
```

```
      9      1.91      25.00     32.22     14.77     43.39     17.20       1      3.2   Pullout

     10      1.92      27.50     29.81     15.85     40.67     18.13       1      1.9   Pullout

     11      1.95      30.00     26.21     13.38     37.45     22.67       1      0.9   Pullout

Search Level: 4.00 feet below the toe of the wall  Facing Design Force = 1.3 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1       N/A       5.00      0.00      0.50     74.23     16.55       1     16.2   Pullout

      2     24.48       7.50      0.00      6.75     87.50     17.22       1     10.9   Pullout

      3      9.33      10.00      0.00      7.00     80.78     18.72       1      8.8   Pullout

      4      5.13      12.50      0.00      6.25     72.44     20.72       1      7.8   Pullout

      5      2.88      15.00     28.66     17.09    -90.00     12.30       1      0.0   Pullout

      6      2.21      17.50     46.50     25.42     90.00      2.05       1      8.2   Pullout

      7      2.06      20.00     39.34     12.93     50.88     15.85       1      5.7   Pullout

      8      2.00      22.50     36.08     13.92     47.54     16.67       1      4.1   Pullout

      9      1.98      25.00     33.26     14.95     44.53     17.53       1      2.5   Pullout

     10      1.98      27.50     30.80     16.01     41.80     18.45       1      1.1   Pullout

     11      2.01      30.00     28.66     17.09     39.34     19.40       1      0.0   Pullout


======================================================================================================
                                           END OF REPORT
======================================================================================================
```

```
==================================================================================================
                                               Snail

                                           Version: 2.2.2

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==================================================================================================
                                          File Information
==================================================================================================

File Name: US 395 RW10 Single Row Perm.snz
Run Date:  11/01/22
Run Time:  12:10:16

==================================================================================================
                                        Project Information
==================================================================================================

Description:    RW10
Location:       US 395
EA:
Project ID:
Wall No.:
Structure No.:
Station:
Engineer:       STC
                Designer

Comments:


==================================================================================================
                                              Geometry
==================================================================================================

Layout:

Reference Point:

At: Top of Wall
Distance From Origin:       22.00 feet
Elevation Above Origin:     48.00 feet

Wall Dimensions:

Wall Height:        6.80 feet
Facing Angle:      90.00 degrees
Facing Batter:     0.000 :12 H:V
```

```
Ground Surface:

Number of lines that define the ground surface above the wall: 3

         Angle  Distance
No.    degrees      feet
------------------------
1            0      2.00
2           27     13.42
3            0

Number of lines that define the ground surface in front of the toe: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Soil Layers:

Number of Layers: 2

Layers Below the Top Layer:

Coordinates of the Top of the Layer: feet

             Point 1         Point 1         Point 2         Point 2
Layer       Distance       Elevation        Distance       Elevation
--------------------------------------------------------------------
2              30.00           47.00           50.00           47.00

Ground Water:

Include Ground Water: No

======================================================================================================
                                             Soil Nails
======================================================================================================

Dimensions and Properties:

Maximum Vertical Spacing:               4.00 feet
Number of Soil Nail Rows:                  1
Soil Nail Design Parameters:               Varying

      Soil Nail       Inclination   Vertical   Horizontal      Nail Bar   Nail Bar Yield       Bond
         Length   From Horizontal    Spacing    Spacing H    Diameter Ø      Strength fy   Strength
No.        feet           degrees       feet         feet        inches              ksi   Factor F
---------------------------------------------------------------------------------------------------
1         15.00                15       3.00         4.00         1.000             75.0       1.00
```

```
Facing Resistance:

                                     Temporary   Permanent     Seismic
ASD Allowable Facing Resistance:          22.2        19.3        26.3 kips

======================================================================================================
                                          Soil Properties
======================================================================================================

                                        Unit Weight  Friction Angle        Cohesion
                                                  γ              φ'              c'
Layer  Description                              pcf         degrees             psf
-----------------------------------------------------------------------------------
1      Fill                                     115            34.0             100
2      Weathered Granodiorite                   120            27.0             500

======================================================================================================
                                               Loads
======================================================================================================

Applied Loads:

Seismic:

Horizontal Seismic Coefficient Kh0.25:

External Load:

Apply external load: No

Surcharges:

Apply surcharges:    Yes

           Distance from Top of Wall            Load            Load
               Begin             End           Begin             End
No.             feet            feet             psf             psf
--------------------------------------------------------------------
1               0.00           14.00             250             250
2              14.00           30.00             600             600

======================================================================================================
                                         Factors of Safety
======================================================================================================

                    Temporary   Permanent     Seismic
Pullout (Distal):        2.00        2.00        1.50
Pullout (Proximal):      2.00        2.00        1.50
Nail Bar Yield:          1.80        1.80        1.35

======================================================================================================
```

```
                                           Search Options
======================================================================================================

Search Limits:

Begin:      5.00 feet
End:       30.00 feet

Below Toe Searches (BTS):

Perform below Toe Search:       Yes
Number of BTS Points:             5
BTS Depth:                     4.00 feet
Interface Friction
Reduction Factor:              0.33

Advanced Search Options:

Use Advanced Search Options:     Yes
Inclination of Interslice Force: Use Average Failure Angle

======================================================================================================
                                               Results
======================================================================================================

Analysis:

Method:          ASD
Scenario:  Permanent

Factor of Safety:

Minimum:                  2.19
Found at Search Point:       7
Found at Grid Point:        11
Found at Search Level:       Toe of the wall

Load at Soil Nail Head:

Calculated Service Load at Soil Nail Head (Empirical), To:     5.9 kips
Allowable Facing Resistance, F_allowable (Entered):           19.3 kips
F_allowable ≥ To OK

Nominal Pullout Resistance:

                    Nominal Pullout Resistance
Layer  Description                         klf
----------------------------------------------
    1  Fill                              2.262
    2  Weathered Granodiorite            2.262
```

```
Results by Search Level:

** Indicates Minimum Factor of Safety

Search Level: At the toe of the wall  Facing Design Force = 5.9 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes                |         Reinforcement         |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      2.58       5.00     35.52      4.30     75.57      6.02       1     16.3   Pullout

      2      2.72       7.50     27.12      4.21     63.98      8.55       1     15.4   Pullout

      3      2.53      10.00     28.54      4.55     55.41     10.57       1     15.2   Pullout

      4      2.38      12.50     25.92      5.56     52.35     12.28       1     14.1   Pullout

      5      2.27      15.00     29.81      5.19     44.49     14.72       1     14.9   Pullout

      6      2.21      17.50     13.80      5.41     43.45     16.87       1     12.4   Pullout

   ** 7      2.19      20.00     12.13      6.14     39.65     18.18       1     11.4   Pullout

      8      2.22      22.50     10.81      6.87     36.38     19.56       1     10.5   Pullout

      9      2.29      25.00      9.75      7.61     33.55     21.00       1      9.6   Pullout

     10      2.37      27.50      8.88      8.35     31.08     22.48       1      8.8   Pullout

     11      2.46      30.00      8.15      9.09     28.92     23.99       1      8.0   Pullout

Search Level: 0.80 feet below the toe of the wall  Facing Design Force = 6.3 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes                |         Reinforcement         |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      3.10       5.00     46.21      5.06     74.69      5.68       1     16.4   Pullout

      2      2.98       7.50     34.74      5.48     67.61      7.88       1     14.7   Pullout

      3      2.90      10.00     30.28      4.63     57.29     11.10       1     14.7   Pullout

      4      2.67      12.50     27.38      5.63     54.10     12.79       1     13.5   Pullout
```

```
      5      2.44      15.00     24.53      6.60     50.59     14.18       1     12.4   Pullout

      6      2.32      17.50     27.55      5.92     41.80     16.43       1     13.2   Pullout

      7      2.27      20.00     24.53      6.60     38.04     17.78       1     12.3   Pullout

      8      2.30      22.50     22.08      7.28     34.82     19.18       1     11.5   Pullout

      9      2.33      25.00     10.35      7.62     35.15     21.40       1      8.5   Pullout

     10      2.39      27.50      9.42      8.36     32.63     22.86       1      7.6   Pullout

     11      2.46      30.00      6.51     12.08     34.40     21.81       1      3.7   Pullout

Search Level: 1.60 feet below the toe of the wall  Facing Design Force = 4.2 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes             |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      3.48       5.00     41.43      6.00     85.20      5.98       1     14.9   Pullout

      2      3.39       7.50     36.75      5.62     69.07      8.40       1     14.5   Pullout

      3      3.06      10.00     31.96      7.07     65.39      9.61       1     12.6   Pullout

      4      2.94      12.50     28.81      5.71     55.71     13.31       1     13.0   Pullout

      5      2.65      15.00     25.78      6.66     52.18     14.68       1     11.8   Pullout

      6      2.44      17.50     22.49      7.58     47.84     15.64       1     10.5   Pullout

      7      2.35      20.00     19.92      8.51     44.01     16.69       1      9.2   Pullout

      8      2.33      22.50     17.85      9.46     40.66     17.80       1      8.1   Pullout

      9      2.39      25.00     10.94      7.64     36.70     21.83       1      7.6   Pullout

     10      2.42      27.50      9.96      8.38     34.12     23.25       1      6.6   Pullout

     11      2.48      30.00      9.15      9.12     31.85     24.72       1      5.6   Pullout

Search Level: 2.40 feet below the toe of the wall  Facing Design Force = 3.1 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes             |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
```

```
|       | Factor  | From Toe |---------------------------------------|       |        |  Controlling  |
|Search |   of    | of Wall  |  Angle  |  Length |   Angle |  Length |       |  Stress|  Resistance   |
|Point  | Safety  |   feet   | degrees |   feet  |  degrees|   feet  |  Level|   ksi  |  Failure Mode |
-------------------------------------------------------------------------------------------------------
      1      9.95       5.00      0.00      3.00     79.44     10.91        1     15.7   Pullout

      2      4.22       7.50     55.23     13.15     90.00      1.20        1     16.2   Pullout

      3      3.68      10.00     50.07     15.58     90.00      1.33        1     15.3   Pullout

      4      3.05      12.50     34.93      7.62     58.47     11.95        1     12.2   Pullout

      5      2.85      15.00     27.01      6.73     53.66     15.19        1     11.3   Pullout

      6      2.59      17.50     23.60      7.64     49.36     16.12        1      9.8   Pullout

      7      2.47      20.00     20.92      8.56     45.55     17.14        1      8.5   Pullout

      8      2.42      22.50     18.77      9.51     42.18     18.22        1      7.3   Pullout

      9      2.42      25.00     17.01     10.46     39.20     19.36        1      6.1   Pullout

     10      2.44      27.50     15.54     11.42     36.56     20.54        1      4.9   Pullout

     11      2.51      30.00      9.64      9.13     33.24     25.11        1      4.5   Pullout

Search Level: 3.20 feet below the toe of the wall  Facing Design Force = 2.7 kips (Clouterre)
-------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |         Reinforcement          |
|       |         |          |---------------------------------------|--------------------------------|
|       | Minimum | Distance |       Lower       |        Upper      |       |        |               |
|       | Factor  | From Toe |---------------------------------------|       |        |  Controlling  |
|Search |   of    | of Wall  |  Angle  |  Length |   Angle |  Length |       |  Stress|  Resistance   |
|Point  | Safety  |   feet   | degrees |   feet  |  degrees|   feet  |  Level|   ksi  |  Failure Mode |
-------------------------------------------------------------------------------------------------------
      1       N/A       5.00      0.00      1.00     70.87     12.20        1     16.9   Pullout

      2     14.74       7.50      0.00      6.00     83.32     12.89        1     11.7   Pullout

      3      6.31      10.00      0.00      5.00     70.45     14.94        1     11.4   Pullout

      4      3.76      12.50     36.38     15.53     90.00      6.14        1     11.2   Pullout

      5      3.12      15.00     44.00     20.85     90.00      1.61        1     13.1   Pullout

      6      2.71      17.50     34.59      8.50     47.01     15.40        1     10.8   Pullout

      7      2.57      20.00     31.11      9.34     43.19     16.46        1      9.6   Pullout

      8      2.52      22.50     19.68      9.56     43.64     18.65        1      6.5   Pullout
```

```
      9      2.50      25.00     17.84     10.51     40.64     19.77       1      5.2   Pullout

     10      2.50      27.50     16.31     11.46     37.96     20.93       1      4.0   Pullout

     11      2.53      30.00     15.01     12.42     35.57     22.13       1      2.9   Pullout

Search Level: 4.00 feet below the toe of the wall  Facing Design Force = 1.6 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1       N/A       5.00      0.00      0.50     69.95     13.12       1     17.1   Pullout

      2       N/A       7.50      0.00      1.50     66.20     14.87       1     15.0   Pullout

      3     24.65      10.00      0.00      9.00     86.16     14.91       1      7.7   Pullout

      4      8.89      12.50      0.00      8.75     76.93     16.58       1      6.8   Pullout

      5      3.55      15.00     34.05     18.10     90.00      6.76       1      9.3   Pullout

      6      3.17      17.50      0.00      3.50     50.35     21.94       1      9.4   Pullout

      7      2.72      20.00     22.90      8.68     48.40     18.07       1      7.2   Pullout

      8      2.60      22.50     29.38     10.33     41.22     17.95       1      7.8   Pullout

      9      2.57      25.00     26.88     11.21     38.25     19.10       1      6.6   Pullout

     10      2.57      27.50     17.07     11.51     39.32     21.33       1      3.2   Pullout

     11      2.58      30.00     15.72     12.47     36.90     22.51       1      1.9   Pullout


======================================================================================================
                                           END OF REPORT
======================================================================================================
```

```
======================================================================================================
                                               Snail

                                           Version: 2.2.2

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======================================================================================================
                                          File Information
======================================================================================================

File Name: US 395 RW10 Single Row Pole Load.snz
Run Date:  11/01/22
Run Time:  12:06:44

======================================================================================================
                                        Project Information
======================================================================================================

Description:    RW10
Location:       US 395
EA:
Project ID:
Wall No.:
Structure No.:
Station:
Engineer:       STC
                Designer

Comments:


======================================================================================================
                                              Geometry
======================================================================================================

Layout:

Reference Point:

At: Top of Wall
Distance From Origin:       22.00 feet
Elevation Above Origin:     48.00 feet

Wall Dimensions:

Wall Height:        6.80 feet
Facing Angle:      90.00 degrees
Facing Batter:     0.000 :12 H:V
```

```
Ground Surface:

Number of lines that define the ground surface above the wall: 3

         Angle  Distance
No.    degrees      feet
------------------------
1            0      2.00
2           27     13.42
3            0

Number of lines that define the ground surface in front of the toe: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Soil Layers:

Number of Layers: 2

Layers Below the Top Layer:

Coordinates of the Top of the Layer: feet

             Point 1         Point 1         Point 2         Point 2
Layer       Distance       Elevation        Distance       Elevation
--------------------------------------------------------------------
2              30.00           47.00           50.00           47.00

Ground Water:

Include Ground Water: No

======================================================================================================
                                             Soil Nails
======================================================================================================

Dimensions and Properties:

Maximum Vertical Spacing:               4.00 feet
Number of Soil Nail Rows:                  1
Soil Nail Design Parameters:               Varying

      Soil Nail       Inclination   Vertical   Horizontal      Nail Bar   Nail Bar Yield       Bond
         Length   From Horizontal    Spacing    Spacing H    Diameter Ø      Strength fy   Strength
No.        feet           degrees       feet         feet        inches              ksi   Factor F
---------------------------------------------------------------------------------------------------
1         15.00                15       2.50         4.00         1.000             75.0       1.00
```

```
Facing Resistance:

                                     Temporary   Permanent     Seismic
ASD Allowable Facing Resistance:          22.2        19.3        26.3 kips

======================================================================================================
                                          Soil Properties
======================================================================================================

                                        Unit Weight  Friction Angle        Cohesion
                                                  γ               φ'              c'
Layer  Description                             pcf         degrees             psf
-----------------------------------------------------------------------------------
1      Fill                                     115            34.0             100
2      Weathered Granodiorite                   120            27.0             500

======================================================================================================
                                               Loads
======================================================================================================

Applied Loads:

Seismic:

Horizontal Seismic Coefficient Kh0.25:

External Load:

Apply external load:    Yes
Load:                   2.7 klf
Angle:                 -180 degrees

Surcharges:

Apply surcharges: No

======================================================================================================
                                         Factors of Safety
======================================================================================================

                    Temporary   Permanent     Seismic
Pullout (Distal):        2.00        2.00        1.50
Pullout (Proximal):      2.00        2.00        1.50
Nail Bar Yield:          1.80        1.80        1.35

======================================================================================================
                                           Search Options
======================================================================================================

Search Limits:
```

```
Begin:      5.00 feet
End:       20.00 feet

Below Toe Searches (BTS):

Perform below Toe Search:       Yes
Number of BTS Points:             5
BTS Depth:                     4.00 feet
Interface Friction
Reduction Factor:              0.33

Advanced Search Options:

Use Advanced Search Options:     Yes
Inclination of Interslice Force: Use Average Failure Angle

======================================================================================================
                                               Results
======================================================================================================

Analysis:

Method:          ASD
Scenario:  Permanent

Factor of Safety:

Minimum:                  1.30
Found at Search Point:       1
Found at Grid Point:        32
Found at Search Level:       Toe of the wall

Load at Soil Nail Head:

Calculated Service Load at Soil Nail Head (Empirical), To:     9.2 kips
Allowable Facing Resistance, F_allowable (Entered):           19.3 kips
F_allowable ≥ To OK

Nominal Pullout Resistance:

                    Nominal Pullout Resistance
Layer  Description                         klf
----------------------------------------------
    1  Fill                              2.262
    2  Weathered Granodiorite            2.714

Results by Search Level:

** Indicates Minimum Factor of Safety

Search Level: At the toe of the wall  Facing Design Force = 9.2 kips (Clouterre)
```

```
----------------------------------------------------------------------------------------------------------
|       |         |          |            Failure Planes              |          Reinforcement          |
|       |         |          |----------------------------------------|---------------------------------|
|       | Minimum | Distance |       Lower        |      Upper        |       |        |                |
|       | Factor  | From Toe |----------------------------------------|       |        | Controlling    |
|Search |   of    | of Wall  |  Angle   | Length  |  Angle  | Length  |       | Stress | Resistance     |
|Point  | Safety  |  feet    | degrees  |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode   |
----------------------------------------------------------------------------------------------------------
   ** 1     1.30       5.00     29.04      5.15     85.10      5.85       1     17.8   Pullout

      2     1.44       6.50     27.68      5.87     78.46      6.50       1     16.6   Pullout

      3     1.59       8.00     31.64      5.64     65.12      7.61       1     17.3   Pullout

      4     1.70       9.50     24.10      5.20     60.80      9.73       1     16.6   Pullout

      5     1.75      11.00     22.49      5.95     58.88     10.64       1     15.6   Pullout

      6     1.78      12.50     21.25      6.71     57.26     11.56       1     14.5   Pullout

      7     1.83      14.00     24.72      6.17     50.84     13.30       1     15.6   Pullout

      8     1.84      15.50     22.58      6.71     47.96     13.89       1     14.8   Pullout

      9     1.92      17.00     14.19      5.26     44.28     16.62       1     14.4   Pullout

     10     1.95      18.50     13.08      5.70     41.86     17.39       1     13.6   Pullout

     11     2.00      20.00     12.13      6.14     39.65     18.18       1     12.9   Pullout

Search Level: 0.80 feet below the toe of the wall  Facing Design Force = 9.2 kips (Clouterre)
----------------------------------------------------------------------------------------------------------
|       |         |          |            Failure Planes              |          Reinforcement          |
|       |         |          |----------------------------------------|---------------------------------|
|       | Minimum | Distance |       Lower        |      Upper        |       |        |                |
|       | Factor  | From Toe |----------------------------------------|       |        | Controlling    |
|Search |   of    | of Wall  |  Angle   | Length  |  Angle  | Length  |       | Stress | Resistance     |
|Point  | Safety  |  feet    | degrees  |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode   |
----------------------------------------------------------------------------------------------------------
      1     1.86       5.00     39.06      5.80     84.79      5.50       1     17.8   Pullout

      2     2.00       6.50     29.72      5.99     79.37      7.05       1     16.4   Pullout

      3     2.04       8.00     26.54      7.15     77.90      7.63       1     14.4   Pullout

      4     2.10       9.50     31.01      6.65     64.58      8.85       1     15.6   Pullout

      5     2.17      11.00     23.90      6.02     60.57     11.19       1     15.0   Pullout

      6     2.15      12.50     22.51      6.77     58.90     12.10       1     14.0   Pullout
```

```
      7      2.13      14.00     21.37      7.52     57.42     13.00       1     12.9   Pullout

      8      2.12      15.50     19.46      8.22     54.72     13.42       1     11.8   Pullout

      9      2.12      17.00     17.86      8.93     52.19     13.87       1     10.6   Pullout

     10      2.14      18.50     20.31      7.89     44.62     15.59       1     12.1   Pullout

     11      2.16      20.00     18.90      8.46     42.39     16.25       1     11.3   Pullout

Search Level: 1.60 feet below the toe of the wall  Facing Design Force = 5.3 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      3.46       5.00     58.86      5.80     68.06      5.35       1     20.5   Pullout

      2      3.03       6.50      0.00      1.95     66.95     11.62       1     18.8   Pullout

      3      2.71       8.00     43.67      6.64     65.04      7.58       1     17.3   Pullout

      4      2.47       9.50     28.87      7.59     71.58      9.02       1     13.8   Pullout

      5      2.46      11.00     30.55      7.66     64.17     10.10       1     13.9   Pullout

      6      2.49      12.50     23.75      6.83     60.40     12.65       1     13.4   Pullout

      7      2.44      14.00     22.49      7.58     58.88     13.54       1     12.4   Pullout

      8      2.39      15.50     20.51      8.27     56.24     13.95       1     11.1   Pullout

      9      2.36      17.00     18.83      8.98     53.75     14.38       1      9.9   Pullout

     10      2.35      18.50     21.39      7.95     46.25     16.05       1     11.3   Pullout

     11      2.34      20.00     19.92      8.51     44.01     16.69       1     10.4   Pullout

Search Level: 2.40 feet below the toe of the wall  Facing Design Force = 4.9 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1       N/A       5.00      0.00      0.50     67.25     11.63       1     20.6   Pullout
```

```
      2        N/A       6.50      0.00      0.65     63.02     12.90        1     19.5   Pullout

      3       5.06       8.00      0.00      6.40     82.56     12.36        1     13.3   Pullout

      4       3.81       9.50      0.00      4.75     69.96     13.86        1     14.2   Pullout

      5       3.39      11.00     36.94     13.76     90.00      5.51        1     14.2   Pullout

      6       3.18      12.50      0.00      3.75     58.98     16.98        1     13.9   Pullout

      7       2.92      14.00     17.33     10.27     71.05     12.93        1      7.8   Pullout

      8       2.61      15.50     30.62      9.01     54.10     13.22        1     12.0   Pullout

      9       2.59      17.00     19.79      9.03     55.21     14.90        1      9.3   Pullout

     10       2.55      18.50     22.46      8.01     47.78     16.52        1     10.5   Pullout

     11       2.52      20.00     20.92      8.56     45.55     17.14        1      9.5   Pullout

Search Level: 3.20 feet below the toe of the wall  Facing Design Force = 4.5 kips (Clouterre)
---------------------------------------------------------------------------------------------------
|       |         |          |            Failure Planes             |        Reinforcement        |
|       |         |          |---------------------------------------|-----------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |            |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling|
| Search|   of    | of Wall  |  Angle  |  Length |  Angle  |  Length |       | Stress | Resistance |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   |Failure Mode|
---------------------------------------------------------------------------------------------------
      1        N/A       5.00      0.00      1.00     70.87     12.20        1     20.0   Pullout

      2        N/A       6.50      0.00      0.65     64.55     13.61        1     19.2   Pullout

      3        N/A       8.00      0.00      2.40     66.79     14.21        1     16.9   Pullout

      4        N/A       9.50      0.00      0.95     58.26     16.25        1     17.3   Pullout

      5       7.45      11.00      0.00      9.90     85.69     14.63        1      7.6   Pullout

      6       5.13      12.50      0.00      8.75     76.27     15.80        1      8.2   Pullout

      7       3.53      14.00     24.69     15.41    -90.00      9.66        1      7.5   Pullout

      8       3.20      15.50     31.92     18.26    -90.00      6.44        1     10.9   Pullout

      9       3.06      17.00     33.53     20.39     90.00      4.83        1     11.5   Pullout

     10       2.85      18.50      0.00      3.70     47.40     21.86        1     10.7   Pullout

     11       2.69      20.00     21.92      8.62     47.01     17.60        1      8.8   Pullout
```

```
Search Level: 4.00 feet below the toe of the wall  Facing Design Force = 4.5 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      4.29       5.00     31.65      4.70     84.21      9.91       1     17.9   Pullout

      2      4.15       6.50     38.86      4.17     72.76     10.97       1     17.6   Pullout

      3      3.73       8.00     30.00      8.31     85.29      9.73       1     12.7   Pullout

      4       N/A       9.50      0.00      2.85     65.54     16.06       1     15.4   Pullout

      5      3.52      11.00     29.23      6.30     65.92     13.48       1     13.4   Pullout

      6       N/A      12.50      0.00      3.75     61.55     18.37       1     13.0   Pullout

      7      9.02      14.00      0.00     12.60     85.26     16.95       1      2.7   Pullout

      8      3.25      15.50     37.34     19.50    -90.00      5.07       1     11.5   Pullout

      9      3.39      17.00     26.42     18.98     90.00      8.45       1      6.5   Pullout

     10      3.25      18.50     28.72     21.09     90.00      6.76       1      7.7   Pullout

     11      3.11      20.00     30.59     23.23     90.00      5.07       1      8.6   Pullout


======================================================================================================
                                           END OF REPORT
======================================================================================================
```

```
======================================================================================================
                                               Snail

                                           Version: 2.2.2

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======================================================================================================
                                          File Information
======================================================================================================

File Name: US 395 RW10 Single Row Seismic.snz
Run Date:  11/01/22
Run Time:  12:04:41

======================================================================================================
                                        Project Information
======================================================================================================

Description:    RW10
Location:       US 395
EA:
Project ID:
Wall No.:
Structure No.:
Station:
Engineer:       STC
                Designer

Comments:


======================================================================================================
                                              Geometry
======================================================================================================

Layout:

Reference Point:

At: Top of Wall
Distance From Origin:       22.00 feet
Elevation Above Origin:     48.00 feet

Wall Dimensions:

Wall Height:        6.80 feet
Facing Angle:      90.00 degrees
Facing Batter:     0.000 :12 H:V
```

```
Ground Surface:

Number of lines that define the ground surface above the wall: 3

         Angle  Distance
No.    degrees      feet
------------------------
1            0      2.00
2           27     13.42
3            0

Number of lines that define the ground surface in front of the toe: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Soil Layers:

Number of Layers: 2

Layers Below the Top Layer:

Coordinates of the Top of the Layer: feet

             Point 1         Point 1         Point 2         Point 2
Layer       Distance       Elevation        Distance       Elevation
--------------------------------------------------------------------
2              30.00           47.00           50.00           47.00

Ground Water:

Include Ground Water: No

=====================================================================================================
                                             Soil Nails
=====================================================================================================

Dimensions and Properties:

Maximum Vertical Spacing:                4.00 feet
Number of Soil Nail Rows:                   1
Soil Nail Design Parameters:                Varying

      Soil Nail       Inclination   Vertical   Horizontal      Nail Bar   Nail Bar Yield       Bond
         Length   From Horizontal    Spacing    Spacing H    Diameter Ø      Strength fy   Strength
No.        feet           degrees       feet         feet        inches              ksi   Factor F
---------------------------------------------------------------------------------------------------
1         15.00                15       3.00         4.00         1.000             75.0       1.00
```

```
Facing Resistance:

                                     Temporary   Permanent     Seismic
ASD Allowable Facing Resistance:          22.2        19.3        26.3 kips

======================================================================================================
                                          Soil Properties
======================================================================================================

                                        Unit Weight  Friction Angle        Cohesion
                                                  γ             φ'              c'
Layer  Description                              pcf        degrees             psf
------------------------------------------------------------------------------------
1      Fill                                     115           34.0             100
2      Weathered Granodiorite                   120           27.0             500

======================================================================================================
                                               Loads
======================================================================================================

Applied Loads:

Seismic:

Horizontal Seismic Coefficient Kh0.25:

External Load:

Apply external load: No

Surcharges:

Apply surcharges: No

======================================================================================================
                                         Factors of Safety
======================================================================================================

                    Temporary   Permanent     Seismic
Pullout (Distal):        2.00        2.00        1.50
Pullout (Proximal):      2.00        2.00        1.50
Nail Bar Yield:          1.80        1.80        1.35

======================================================================================================
                                           Search Options
======================================================================================================

Search Limits:

Begin:      5.00 feet
End:       30.00 feet
```

```
Below Toe Searches (BTS):

Perform below Toe Search:       Yes
Number of BTS Points:             5
BTS Depth:                      4.00 feet
Interface Friction
Reduction Factor:               0.33

Advanced Search Options:

Use Advanced Search Options:     Yes
Inclination of Interslice Force: Use Average Failure Angle

=====================================================================================================
                                               Results
=====================================================================================================

Analysis:

Method:          ASD
Scenario:    Seismic

Factor of Safety:

Minimum:                   1.91
Found at Search Point:       11
Found at Grid Point:          4
Found at Search Level:       Toe of the wall

Load at Soil Nail Head:

Calculated Service Load at Soil Nail Head (Empirical), To:     1.9 kips
Allowable Facing Resistance, F_allowable (Entered):           26.3 kips
F_allowable ≥ To OK

Nominal Pullout Resistance:

                    Nominal Pullout Resistance
Layer  Description                         klf
----------------------------------------------
    1  Fill                              2.262
    2  Weathered Granodiorite            2.262

Results by Search Level:

** Indicates Minimum Factor of Safety

Search Level: At the toe of the wall  Facing Design Force = 1.9 kips (Clouterre)
-----------------------------------------------------------------------------------------------------
|       |         |          |              Failure Planes              |        Reinforcement       |
```

```
|       |         |           |---------------------------------------|-------------------------------|
|       | Minimum | Distance  |      Lower        |      Upper        |       |        |              |
|       | Factor  | From Toe  |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall   | Angle   | Length  | Angle   | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet    |degrees  |  feet   |degrees  |  feet   | Level |  ksi   | Failure Mode |
-------------------------------------------------------------------------------------------------------
      1      2.36       5.00     29.04      5.15     85.10      5.85        1     19.8   Pullout

      2      2.62       7.50     15.88      7.02     84.42      7.72        1     15.4   Pullout

      3      2.56      10.00     19.93      6.38     65.31      9.58        1     16.9   Pullout

      4      2.54      12.50      9.20      7.60     65.43     12.02        1     13.4   Pullout

      5      2.27      15.00      9.75      7.61     57.12     13.82        1     13.3   Pullout

      6      2.07      17.50      8.38      8.84     52.98     14.53        1     11.2   Pullout

      7      1.99      20.00      9.16      8.10     44.04     16.69        1     12.3   Pullout

      8      1.92      22.50      8.15      9.09     40.68     17.80        1     10.7   Pullout

      9      1.95      25.00      0.00     10.00     40.68     19.78        1      6.9   Pullout

     10      1.92      27.50      0.00     11.00     38.00     20.94        1      5.3   Pullout

  ** 11      1.91      30.00      0.00     12.00     35.61     22.14        1      3.8   Pullout

Search Level: 0.80 feet below the toe of the wall  Facing Design Force = 2.5 kips (Clouterre)
-------------------------------------------------------------------------------------------------------
|       |         |           |             Failure Planes            |        Reinforcement          |
|       |         |           |---------------------------------------|-------------------------------|
|       | Minimum | Distance  |      Lower        |      Upper        |       |        |              |
|       | Factor  | From Toe  |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall   | Angle   | Length  | Angle   | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet    |degrees  |  feet   |degrees  |  feet   | Level |  ksi   | Failure Mode |
-------------------------------------------------------------------------------------------------------
      1      3.01       5.00     31.32      5.27     85.53      6.41        1     19.8   Pullout

      2      3.02       7.50     30.73      6.11     72.83      7.62        1     18.3   Pullout

      3      2.82      10.00     16.27      8.33     77.92      9.55        1     12.8   Pullout

      4      2.70      12.50     22.51      6.77     58.90     12.10        1     16.0   Pullout

      5      2.49      15.00     10.35      7.62     58.68     14.43        1     12.6   Pullout

      6      2.24      17.50      8.89      8.86     54.62     15.11        1     10.4   Pullout

      7      2.10      20.00      7.80     10.09     50.94     15.87        1      8.2   Pullout
```

```
      8      2.02      22.50      8.65      9.10     42.39     18.28       1      9.5   Pullout

      9      1.96      25.00      7.80     10.09     39.41     19.41       1      7.9   Pullout

     10      1.93      27.50      7.10     11.08     36.76     20.59       1      6.4   Pullout

     11      1.92      30.00      6.51     12.08     34.40     21.81       1      4.9   Pullout

Search Level: 1.60 feet below the toe of the wall  Facing Design Force = 1.8 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      3.69       5.00     44.80      5.64     80.47      6.04       1     20.7   Pullout

      2      3.13       7.50     26.47      7.54     84.54      7.88       1     15.3   Pullout

      3      3.14      10.00     19.62      7.43     73.27     10.42       1     14.3   Pullout

      4      2.78      12.50     17.45      9.17     71.18     11.62       1     11.2   Pullout

      5      2.49      15.00     17.85      9.46     62.64     13.05       1     10.8   Pullout

      6      2.30      17.50     18.33      9.22     52.96     14.53       1     11.2   Pullout

      7      2.23      20.00     10.27      8.13     47.39     17.72       1     10.2   Pullout

      8      2.11      22.50      9.15      9.12     44.01     18.77       1      8.4   Pullout

      9      2.04      25.00      8.25     10.10     41.01     19.88       1      6.7   Pullout

     10      2.00      27.50      7.51     11.10     38.33     21.03       1      5.1   Pullout

     11      1.97      30.00      6.89     12.09     35.93     22.23       1      3.5   Pullout

Search Level: 2.40 feet below the toe of the wall  Facing Design Force = 1.1 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      7.81       5.00      0.00      4.50     87.33     10.74       1     19.4   Pullout

      2      5.94       7.50      0.00      4.50     75.97     12.37       1     17.5   Pullout
```

```
      3      3.91      10.00     14.87      5.17     67.29     12.95       1     16.2   Pullout

      4      3.33      12.50     13.11      6.42     64.49     14.51       1     13.8   Pullout

      5      2.67      15.00     18.77      9.51     63.88     13.63       1     10.3   Pullout

      6      2.43      17.50     16.24     10.94     60.22     14.10       1      7.6   Pullout

      7      2.26      20.00     17.01     10.46     50.74     15.80       1      8.3   Pullout

      8      2.15      22.50     15.21     11.66     47.40     16.62       1      6.3   Pullout

      9      2.12      25.00      8.69     10.12     42.54     20.36       1      5.6   Pullout

     10      2.06      27.50      7.91     11.11     39.83     21.49       1      3.8   Pullout

     11      2.02      30.00      7.26     12.10     37.40     22.66       1      2.1   Pullout

Search Level: 3.20 feet below the toe of the wall  Facing Design Force = 0.0 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |            Failure Planes              |        Reinforcement         |
|       |         |          |----------------------------------------|--------------------------------|
|       | Minimum | Distance |       Lower       |       Upper        |       |        |              |
|       | Factor  | From Toe |----------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  |  Length  |  Angle  |  Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |   feet   | degrees |   feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1       N/A       5.00      0.00      0.50     68.68     12.38       1     23.0   Pullout

      2       N/A       7.50      0.00      0.75     62.20     14.47       1     21.1   Pullout

      3       N/A      10.00      0.00      1.00     57.41     16.71       1     19.5   Pullout

      4      3.41      12.50     31.55     14.67     90.00      7.68       1     13.0   Pullout

      5      3.00      15.00     28.21     17.02     90.00      8.05       1     11.5   Pullout

      6      2.75      17.50     28.89     19.99     90.00      6.44       1     11.8   Pullout

      7      2.38      20.00     17.84     10.51     52.16     16.30       1      7.5   Pullout

      8      2.25      22.50     15.97     11.70     48.85     17.10       1      5.4   Pullout

      9      2.16      25.00     14.44     12.91     45.85     17.94       1      3.3   Pullout

     10      2.11      27.50     13.17     14.12     43.12     18.84       1      1.3   Pullout

     11      2.08      30.00     12.11     15.34     40.64     19.77       1      0.0   Pullout

Search Level: 4.00 feet below the toe of the wall  Facing Design Force = 1.3 kips (Clouterre)
```

```
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1       N/A       5.00      0.00      0.50     69.95     13.12       1     22.7   Pullout

      2       N/A       7.50      0.00      1.50     66.20     14.87       1     20.0   Pullout

      3       N/A      10.00      0.00      1.00     58.83     17.39       1     19.0   Pullout

      4       N/A      12.50      0.00      1.25     55.14     19.68       1     17.6   Pullout

      5      3.97      15.00      6.43     15.09     90.00     15.20       1      0.0   Pullout

      6      2.80      17.50     21.11     18.76     90.00     10.14       1      5.1   Pullout

      7      2.61      20.00     30.59     23.23     90.00      5.07       1     10.8   Pullout

      8      2.49      22.50     27.72     25.42     90.00      5.07       1      9.3   Pullout

      9      2.25      25.00     15.12     12.95     47.23     18.41       1      2.4   Pullout

     10      2.18      27.50     13.80     14.16     44.50     19.28       1      0.3   Pullout

     11      2.14      30.00     15.72     12.47     36.90     22.51       1      2.6   Pullout


======================================================================================================
                                           END OF REPORT
======================================================================================================
```

```
======================================================================================================
                                               Snail

                                           Version: 2.2.2

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======================================================================================================
                                          File Information
======================================================================================================

File Name: US 395 RW14 Full Height Perm.snz
Run Date:  11/02/22
Run Time:  10:59:49

======================================================================================================
                                        Project Information
======================================================================================================

Description:    RW14
Location:       US 395
EA:
Project ID:
Wall No.:
Structure No.:
Station:
Engineer:       STC
                Designer

Comments:


======================================================================================================
                                              Geometry
======================================================================================================

Layout:

Reference Point:

At: Top of Wall
Distance From Origin:       22.00 feet
Elevation Above Origin:     48.00 feet

Wall Dimensions:

Wall Height:        7.20 feet
Facing Angle:      90.00 degrees
Facing Batter:     0.000 :12 H:V
```

```
Ground Surface:

Number of lines that define the ground surface above the wall: 3

         Angle  Distance
No.    degrees      feet
------------------------
1            0      2.00
2           27     11.20
3            0

Number of lines that define the ground surface in front of the toe: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Soil Layers:

Number of Layers: 2

Layers Below the Top Layer:

Coordinates of the Top of the Layer: feet

             Point 1         Point 1         Point 2         Point 2
Layer       Distance       Elevation        Distance       Elevation
--------------------------------------------------------------------
2              30.00           47.00           50.00           47.00

Ground Water:

Include Ground Water: No

======================================================================================================
                                             Soil Nails
======================================================================================================

Dimensions and Properties:

Maximum Vertical Spacing:               3.00 feet
Number of Soil Nail Rows:                  2
Soil Nail Design Parameters:               Varying

      Soil Nail       Inclination   Vertical   Horizontal      Nail Bar   Nail Bar Yield       Bond
         Length   From Horizontal    Spacing    Spacing H    Diameter Ø      Strength fy   Strength
No.        feet           degrees       feet         feet        inches              ksi   Factor F
---------------------------------------------------------------------------------------------------
1         10.00                15       2.00         4.00         1.000             75.0       1.00
2         10.00                15       4.00         4.00         1.000             75.0       1.00
```

```
Facing Resistance:

                                     Temporary   Permanent     Seismic
ASD Allowable Facing Resistance:          22.2        19.3        26.3 kips

======================================================================================================
                                          Soil Properties
======================================================================================================

                                        Unit Weight  Friction Angle        Cohesion
                                                  γ              φ'              c'
Layer  Description                              pcf         degrees             psf
-----------------------------------------------------------------------------------
1      Fill                                     115            34.0             100
2      Weathered Granodiorite                   120            27.0             500

======================================================================================================
                                               Loads
======================================================================================================

Applied Loads:

Seismic:

Horizontal Seismic Coefficient Kh0.25:

External Load:

Apply external load: No

Surcharges:

Apply surcharges:    Yes

           Distance from Top of Wall            Load            Load
               Begin             End           Begin             End
No.             feet            feet             psf             psf
--------------------------------------------------------------------
1               0.00           12.00             250             250
2              12.00           30.00             600             600

======================================================================================================
                                         Factors of Safety
======================================================================================================

                    Temporary   Permanent     Seismic
Pullout (Distal):        2.00        2.00        1.50
Pullout (Proximal):      2.00        2.00        1.50
Nail Bar Yield:          1.80        1.80        1.35
```

```
======================================================================================================
                                           Search Options
======================================================================================================

Search Limits:

Begin:      5.00 feet
End:       30.00 feet

Below Toe Searches (BTS):

Perform below Toe Search:       Yes
Number of BTS Points:             5
BTS Depth:                     4.00 feet
Interface Friction
Reduction Factor:              0.33

Advanced Search Options:

Use Advanced Search Options:     Yes
Inclination of Interslice Force: Use Average Failure Angle

======================================================================================================
                                               Results
======================================================================================================

Analysis:

Method:          ASD
Scenario:  Permanent

Factor of Safety:

Minimum:                  2.27
Found at Search Point:       7
Found at Grid Point:         2
Found at Search Level:       Toe of the wall

Load at Soil Nail Head:

Calculated Service Load at Soil Nail Head (Empirical), To:     4.3 kips
Allowable Facing Resistance, F_allowable (Entered):           19.3 kips
F_allowable ≥ To OK

Nominal Pullout Resistance:

                    Nominal Pullout Resistance
Layer  Description                         klf
----------------------------------------------
    1  Fill                              2.262
    2  Weathered Granodiorite            2.262
```

```
Results by Search Level:

** Indicates Minimum Factor of Safety

Search Level: At the toe of the wall  Facing Design Force = 4.3 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
| Search|   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      3.75       5.00     41.12      1.33     63.02      8.82       1     10.2   Pullout
                                                                           2     12.9   Pullout

      2      3.60       7.50     46.86      5.48     58.00      7.08       1      8.7   Pullout
                                                                           2     13.1   Pullout

      3      3.22      10.00     40.22      5.24     52.76      9.91       1      7.7   Pullout
                                                                           2     12.8   Pullout

      4      2.79      12.50     36.39      6.21     48.91     11.41       1      6.8   Pullout
                                                                           2     12.6   Pullout

      5      2.44      15.00      0.00      3.00     45.67     17.17       1      4.9   Pullout
                                                                           2      9.5   Pullout

      6      2.30      17.50      0.00      3.50     41.27     18.63       1      3.6   Pullout
                                                                           2      8.8   Pullout

   ** 7      2.27      20.00      0.00      4.00     37.52     20.17       1      2.5   Pullout
                                                                           2      8.3   Pullout

      8      2.40      22.50      0.00      2.25     31.24     23.68       1      3.2   Pullout
                                                                           2     10.0   Pullout

      9      2.46      25.00      0.00      5.00     31.56     23.47       1      0.4   Pullout
                                                                           2      7.7   Pullout

     10      2.55      27.50      0.00      5.50     29.18     25.20       1      0.0   Pullout
                                                                           2      7.7   Pullout

     11      2.66      30.00      0.00      3.00     24.47     29.66       1      0.9   Pullout
                                                                           2      9.1   Pullout

Search Level: 0.80 feet below the toe of the wall  Facing Design Force = 3.4 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
```

```
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |    of   | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      4.17       5.00     32.43      1.78     67.80      9.26       1      9.6   Pullout
                                                                           2     11.8   Pullout

      2      3.53       7.50     25.65      2.50     61.63     11.05       1      8.0   Pullout
                                                                           2     10.8   Pullout

      3      3.15      10.00     31.12      2.34     53.65     13.50       1      7.5   Pullout
                                                                           2     11.2   Pullout

      4      2.77      12.50     27.63      2.82     49.66     15.45       1      6.5   Pullout
                                                                           2     10.7   Pullout

      5      2.52      15.00     27.63      8.47     50.69     11.84       1      3.2   Pullout
                                                                           2     10.6   Pullout

      6      2.39      17.50      0.00      3.50     43.07     19.16       1      2.9   Pullout
                                                                           2      7.9   Pullout

      7      2.32      20.00      0.00      4.00     39.28     20.67       1      1.7   Pullout
                                                                           2      7.2   Pullout

      8      2.30      22.50      0.00      4.50     36.01     22.25       1      0.5   Pullout
                                                                           2      6.5   Pullout

      9      2.34      25.00      0.00      5.00     33.19     23.90       1      0.0   Pullout
                                                                           2      5.9   Pullout

     10      2.42      27.50      0.00      5.50     30.74     25.60       1      0.0   Pullout
                                                                           2      5.3   Pullout

     11      2.51      30.00      0.00      6.00     28.60     27.34       1      0.0   Pullout
                                                                           2      4.7   Pullout

Search Level: 1.60 feet below the toe of the wall  Facing Design Force = 3.8 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |    of   | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      4.15       5.00     39.57      3.24     73.17      8.63       1      9.0   Pullout
                                                                           2     10.6   Pullout

      2      3.93       7.50     27.28      2.53     63.31     11.69       1      7.7   Pullout
```

```
                                                                           2     10.4   Pullout

      3      3.38      10.00     40.64      7.91     62.63      8.70       1      5.4   Pullout
                                                                           2     10.7   Pullout

      4      2.95      12.50     20.32      4.00     55.00     15.26       1      4.9   Pullout
                                                                           2      8.5   Pullout

      5      2.56      15.00     17.15      4.71     49.96     16.32       1      3.4   Pullout
                                                                           2      7.5   Pullout

      6      2.42      17.50     21.64      3.77     41.75     18.77       1      3.4   Pullout
                                                                           2      8.6   Pullout

      7      2.36      20.00     19.14      4.23     37.99     20.30       1      2.3   Pullout
                                                                           2      8.0   Pullout

      8      2.35      22.50     17.15      4.71     34.77     21.91       1      1.2   Pullout
                                                                           2      7.4   Pullout

      9      2.37      25.00     15.52      5.19     32.00     23.58       1      0.1   Pullout
                                                                           2      6.8   Pullout

     10      2.44      27.50      0.00      5.50     32.26     26.02       1      0.0   Pullout
                                                                           2      4.0   Pullout

     11      2.51      30.00      0.00      6.00     30.05     27.73       1      0.0   Pullout
                                                                           2      3.4   Pullout

Search Level: 2.40 feet below the toe of the wall  Facing Design Force = 2.0 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower     |       Upper         |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      5.25       5.00     65.81     12.20      0.00      0.00       1      9.9   Pullout
                                                                           2     12.2   Pullout

      2      4.04       7.50     47.79      3.35     62.12     11.23       1      7.9   Pullout
                                                                           2     10.7   Pullout

      3      3.49      10.00     42.36      4.06     57.39     12.99       1      6.6   Pullout
                                                                           2      9.9   Pullout

      4      3.13      12.50     43.22      8.58     54.65     10.80       1      5.0   Pullout
                                                                           2     10.0   Pullout

      5      2.73      15.00     30.43      8.70     53.89     12.72       1      2.1   Pullout
```

```
                                                                    2      8.1   Pullout

       6      2.51      17.50      15.63       5.45      47.17      18.02       1      1.3   Pullout
                                                                    2      5.8   Pullout

       7      2.40      20.00      13.75       6.18      43.35      19.25       1      0.0   Pullout
                                                                    2      4.8   Pullout

       8      2.38      22.50      12.27       6.91      40.00      20.56       1      0.0   Pullout
                                                                    2      3.9   Pullout

       9      2.40      25.00      11.08       7.64      37.06      21.93       1      0.0   Pullout
                                                                    2      3.0   Pullout

      10      2.47      27.50      10.09       8.38      34.47      23.35       1      0.0   Pullout
                                                                    2      2.4   Pullout

      11      2.53      30.00       0.00       6.00      31.46      28.14       1      0.0   Pullout
                                                                    2      2.1   Pullout

Search Level: 3.20 feet below the toe of the wall  Facing Design Force = 2.8 kips (Clouterre)
-------------------------------------------------------------------------------------------
|      |        |         |           Failure Planes             |      Reinforcement         |
|      |        |         |--------------------------------------|----------------------------|
|      | Minimum| Distance|       Lower      |      Upper        |      |       |             |
|      | Factor | From Toe|--------------------------------------|      |       | Controlling |
|Search|   of   | of Wall |  Angle  | Length |  Angle  | Length  |      | Stress| Resistance  |
|Point | Safety |  feet   | degrees |  feet  | degrees |  feet   | Level|  ksi  | Failure Mode|
-------------------------------------------------------------------------------------------
       1       N/A       5.00       0.00       0.50      69.33      12.75       1      9.4   Pullout
                                                                    2     11.5   Pullout

       2     15.02       7.50       0.00       6.00      83.52      13.29       1      4.3   Pullout
                                                                    2      5.0   Pullout

       3      7.27      10.00       0.00       6.00      74.55      15.02       1      2.9   Pullout
                                                                    2      4.4   Pullout

       4      3.50      12.50      36.62      15.57      90.00       6.19       1      2.0   Pullout
                                                                    2      7.9   Pullout

       5      2.93      15.00      42.90      20.47      90.00       1.55       1      3.9   Pullout
                                                                    2      8.9   Pullout

       6      2.60      17.50      30.54      12.19      53.01      11.63       1      0.0   Pullout
                                                                    2      6.8   Pullout

       7      2.51      20.00      31.77      11.76      42.90      13.65       1      0.3   Pullout
                                                                    2      7.0   Pullout

       8      2.47      22.50      18.99       4.76      37.75      22.76       1      0.0   Pullout
```

```
                                                                           2     5.3   Pullout

      9      2.47      25.00     11.67      7.66     38.53     22.37       1     0.0   Pullout
                                                                           2     2.0   Pullout

     10      2.50      27.50     10.63      8.39     35.90     23.77       1     0.0   Pullout
                                                                           2     1.1   Pullout

     11      2.54      30.00      9.76      9.13     33.57     25.20       1     0.0   Pullout
                                                                           2     0.3   Pullout

Search Level: 4.00 feet below the toe of the wall  Facing Design Force = 2.1 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |            Failure Planes             |         Reinforcement         |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |      Lower        |      Upper        |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1       N/A       5.00      0.00      2.50     78.89     12.97       1     8.3   Pullout
                                                                           2     9.4   Pullout

      2       N/A       7.50      0.00      0.75     64.26     15.54       1     7.6   Pullout
                                                                           2    10.1   Pullout

      3       N/A      10.00      0.00      2.00     62.36     17.24       1     5.5   Pullout
                                                                           2     8.2   Pullout

      4     12.07      12.50      0.00     10.00     81.27     16.48       1     0.0   Pullout
                                                                           2     0.0   Pullout

      5      3.56      15.00     28.49     17.07     90.00      8.14       1     0.0   Pullout
                                                                           2     4.8   Pullout

      6      2.87      17.50     36.67     21.82     90.00      3.26       1     0.9   Pullout
                                                                           2     6.7   Pullout

      7      2.57      20.00     28.49      6.83     42.94     19.12       1     0.1   Pullout
                                                                           2     5.0   Pullout

      8      2.53      22.50     25.76      7.49     39.60     20.44       1     0.0   Pullout
                                                                           2     4.2   Pullout

      9      2.54      25.00     23.47      8.18     36.67     21.82       1     0.0   Pullout
                                                                           2     3.4   Pullout

     10      2.56      27.50      0.00      2.75     33.34     29.63       1     0.0   Pullout
                                                                           2     3.1   Pullout

     11      2.59      30.00      0.00      3.00     31.10     31.53       1     0.0   Pullout
```

```
                                                                         2      2.4   Pullout

======================================================================================================
                                          END OF REPORT
======================================================================================================
```

```
======================================================================================================
                                               Snail

                                           Version: 2.2.2

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======================================================================================================
                                          File Information
======================================================================================================

File Name: US 395 RW14 Full Height Seismic.snz
Run Date:  11/02/22
Run Time:  10:27:50

======================================================================================================
                                        Project Information
======================================================================================================

Description:    RW14
Location:       US 395
EA:
Project ID:
Wall No.:
Structure No.:
Station:
Engineer:       STC
                Designer

Comments:


======================================================================================================
                                              Geometry
======================================================================================================

Layout:

Reference Point:

At: Top of Wall
Distance From Origin:       22.00 feet
Elevation Above Origin:     48.00 feet

Wall Dimensions:

Wall Height:         7.25 feet
Facing Angle:       90.00 degrees
Facing Batter:      0.000 :12 H:V
```

```
Ground Surface:

Number of lines that define the ground surface above the wall: 3

         Angle  Distance
No.    degrees      feet
------------------------
1            0      2.00
2           27     11.20
3            0

Number of lines that define the ground surface in front of the toe: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Soil Layers:

Number of Layers: 2

Layers Below the Top Layer:

Coordinates of the Top of the Layer: feet

             Point 1         Point 1         Point 2         Point 2
Layer       Distance       Elevation        Distance       Elevation
--------------------------------------------------------------------
2              30.00           47.00           50.00           47.00

Ground Water:

Include Ground Water: No

======================================================================================================
                                             Soil Nails
======================================================================================================

Dimensions and Properties:

Maximum Vertical Spacing:               3.00 feet
Number of Soil Nail Rows:                  2
Soil Nail Design Parameters:               Varying

      Soil Nail       Inclination   Vertical   Horizontal      Nail Bar   Nail Bar Yield       Bond
         Length   From Horizontal    Spacing    Spacing H    Diameter Ø      Strength fy   Strength
No.        feet           degrees       feet         feet        inches              ksi   Factor F
---------------------------------------------------------------------------------------------------
1         10.00                15       2.00         4.00         1.000             75.0       1.00
2         10.00                15       4.00         4.00         1.000             75.0       1.00
```

```
Facing Resistance:

                                     Temporary   Permanent      Seismic
ASD Allowable Facing Resistance:          22.2        19.3         26.3 kips

======================================================================================================
                                          Soil Properties
======================================================================================================

                                        Unit Weight  Friction Angle        Cohesion
                                                  γ              φ'              c'
Layer  Description                              pcf         degrees             psf
-----------------------------------------------------------------------------------
1      Fill                                     115            34.0             100
2      Weathered Granodiorite                   120            27.0             500

======================================================================================================
                                               Loads
======================================================================================================

Applied Loads:

Seismic:

Horizontal Seismic Coefficient Kh0.25:

External Load:

Apply external load: No

Surcharges:

Apply surcharges: No

======================================================================================================
                                         Factors of Safety
======================================================================================================

                    Temporary   Permanent     Seismic
Pullout (Distal):        2.00        2.00        1.50
Pullout (Proximal):      2.00        2.00        1.50
Nail Bar Yield:          1.80        1.80        1.35

======================================================================================================
                                           Search Options
======================================================================================================

Search Limits:

Begin:      5.00 feet
```

```
End:       30.00 feet

Below Toe Searches (BTS):

Perform below Toe Search:       Yes
Number of BTS Points:             5
BTS Depth:                     4.00 feet
Interface Friction
Reduction Factor:              0.33

Advanced Search Options:

Use Advanced Search Options:     Yes
Inclination of Interslice Force: Use Average Failure Angle

======================================================================================================
                                               Results
======================================================================================================

Analysis:

Method:          ASD
Scenario:    Seismic

Factor of Safety:

Minimum:                  1.95
Found at Search Point:       9
Found at Grid Point:         3
Found at Search Level:    0.80 feet below the toe of the wall

Load at Soil Nail Head:

Calculated Service Load at Soil Nail Head (Empirical), To:     2.2 kips
Allowable Facing Resistance, F_allowable (Entered):           26.3 kips
F_allowable ≥ To OK

Nominal Pullout Resistance:

                    Nominal Pullout Resistance
Layer  Description                         klf
----------------------------------------------
    1  Fill                              2.262
    2  Weathered Granodiorite            2.262

Results by Search Level:

** Indicates Minimum Factor of Safety

Search Level: At the toe of the wall  Facing Design Force = 5.2 kips (Clouterre)
------------------------------------------------------------------------------------------------------
```

```
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      4.59       5.00      0.00      4.00     83.50      8.84       1     10.3   Pullout
                                                                           2     11.2   Pullout

      2      4.02       7.50      0.00      4.50     73.38     10.49       1      8.0   Pullout
                                                                           2     10.2   Pullout

      3      3.45      10.00      0.00      4.00     62.09     12.82       1      7.4   Pullout
                                                                           2     11.1   Pullout

      4      2.96      12.50      0.00      3.75     54.65     15.12       1      6.7   Pullout
                                                                           2     11.5   Pullout

      5      2.41      15.00      0.00      4.50     49.59     16.20       1      4.7   Pullout
                                                                           2     10.2   Pullout

      6      2.32      17.50      0.00      3.50     41.38     18.66       1      4.8   Pullout
                                                                           2     11.7   Pullout

      7      2.13      20.00      0.00      4.00     37.63     20.20       1      3.3   Pullout
                                                                           2     10.9   Pullout

      8      2.02      22.50      0.00      4.50     34.42     21.82       1      1.8   Pullout
                                                                           2     10.2   Pullout

      9      2.11      25.00      0.00      5.00     31.66     23.50       1      0.5   Pullout
                                                                           2      9.9   Pullout

     10      2.09      27.50      0.00      5.50     29.28     25.22       1      0.0   Pullout
                                                                           2      9.9   Pullout

     11      2.11      30.00      0.00      6.00     27.20     26.98       1      0.0   Pullout
                                                                           2      9.9   Pullout

Search Level: 0.80 feet below the toe of the wall  Facing Design Force = 2.2 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      4.00       5.00     13.47      4.11     83.38      8.68       1     10.4   Pullout
                                                                           2     11.2   Pullout
```

```
      2      4.07       7.50     19.89      3.19     65.26     10.75       1       9.8   Pullout
                                                                           2      13.1   Pullout

      3      3.68      10.00     22.01      3.24     57.32     12.97       1       8.8   Pullout
                                                                           2      13.2   Pullout

      4      3.01      12.50      0.00      6.25     64.55     14.55       1       3.1   Pullout
                                                                           2       6.5   Pullout

      5      2.48      15.00      0.00      6.00     55.58     15.92       1       2.2   Pullout
                                                                           2       6.8   Pullout

      6      2.20      17.50      0.00      7.00     51.36     16.82       1       0.0   Pullout
                                                                           2       5.1   Pullout

      7      2.05      20.00      0.00      6.00     43.17     19.20       1       0.0   Pullout
                                                                           2       6.5   Pullout

      8      1.98      22.50      0.00      6.75     39.83     20.51       1       0.0   Pullout
                                                                           2       5.3   Pullout

   ** 9      1.95      25.00      0.00      7.50     36.89     21.88       1       0.0   Pullout
                                                                           2       4.2   Pullout

     10      1.97      27.50      0.00      5.50     30.84     25.62       1       0.0   Pullout
                                                                           2       6.9   Pullout

     11      1.97      30.00      0.00      6.00     28.69     27.36       1       0.0   Pullout
                                                                           2       6.2   Pullout

Search Level: 1.60 feet below the toe of the wall  Facing Design Force = 0.2 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      4.65       5.00     12.99      4.62     86.94      9.35       1       9.8   Pullout
                                                                           2      10.2   Pullout

      2      4.00       7.50     12.51      5.38     77.89     10.73       1       7.0   Pullout
                                                                           2       8.7   Pullout

      3      3.38      10.00     14.50      5.16     66.74     12.66       1       6.0   Pullout
                                                                           2       9.1   Pullout

      4      2.92      12.50     15.57      5.19     59.12     14.61       1       5.0   Pullout
                                                                           2       9.1   Pullout
```

```
      5      2.62      15.00     17.21      4.71     50.06     16.36       1      4.5   Pullout
                                                                           2      9.9   Pullout

      6      2.32      17.50     14.87      5.43     45.67     17.53       1      2.5   Pullout
                                                                           2      8.7   Pullout

      7      2.17      20.00      0.00      6.00     44.87     19.75       1      0.0   Pullout
                                                                           2      5.3   Pullout

      8      2.07      22.50      0.00      6.75     41.50     21.03       1      0.0   Pullout
                                                                           2      4.0   Pullout

      9      2.02      25.00      0.00      7.50     38.53     22.37       1      0.0   Pullout
                                                                           2      2.7   Pullout

     10      1.99      27.50      0.00      8.25     35.90     23.76       1      0.0   Pullout
                                                                           2      1.5   Pullout

     11      1.97      30.00      0.00      9.00     33.57     25.20       1      0.0   Pullout
                                                                           2      0.4   Pullout

Search Level: 2.40 feet below the toe of the wall  Facing Design Force = 1.4 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |         Reinforcement         |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  | Angle   | Length  |       | Stress | Resistance   |
|Point  | Safety  |    feet  | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      6.69       5.00     39.98      5.22     82.72      7.89       1     10.5   Pullout
                                                                           2     12.6   Pullout

      2      5.62       7.50      0.00      3.75     73.24     13.00       1      8.1   Pullout
                                                                           2     10.3   Pullout

      3      3.71      10.00     34.46     12.13     90.00      6.86       1      3.3   Pullout
                                                                           2     11.6   Pullout

      4      3.04      12.50     25.24     13.82     90.00      8.84       1      0.0   Pullout
                                                                           2      9.4   Pullout

      5      2.61      15.00     11.12      7.64     60.51     15.24       1      0.2   Pullout
                                                                           2      4.1   Pullout

      6      2.34      17.50     11.89      7.15     51.63     16.91       1      0.0   Pullout
                                                                           2      4.9   Pullout

      7      2.20      20.00     10.44      8.13     47.86     17.88       1      0.0   Pullout
                                                                           2      3.3   Pullout
```

```
      8      2.13      22.50      12.31       6.91      40.10      20.59        1      0.0   Pullout
                                                                             2      5.1   Pullout

      9      2.07      25.00      11.12       7.64      37.15      21.96        1      0.0   Pullout
                                                                             2      4.0   Pullout

     10      2.05      27.50       0.00       8.25      37.43      24.24        1      0.0   Pullout
                                                                             2      0.0   Pullout

     11      2.03      30.00       0.00       6.00      31.55      28.16        1      0.0   Pullout
                                                                             2      2.7   Pullout

Search Level: 3.20 feet below the toe of the wall  Facing Design Force = 0.1 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes             |         Reinforcement          |
|       |         |          |----------------------------------------|--------------------------------|
|       | Minimum | Distance |        Lower        |       Upper      |       |        |                |
|       | Factor  | From Toe |----------------------------------------|       |        |  Controlling   |
|Search |   of    | of Wall  |  Angle   |  Length  |  Angle  |  Length  |       | Stress | Resistance     |
|Point  | Safety  |   feet   | degrees  |   feet   | degrees |   feet   | Level |  ksi   | Failure Mode   |
------------------------------------------------------------------------------------------------------
      1       N/A       5.00       0.00       1.50      73.71      12.48        1     11.9   Pullout
                                                                             2     14.0   Pullout

      2       N/A       7.50       0.00       1.50      65.64      14.55        1      9.8   Pullout
                                                                             2     13.0   Pullout

      3       N/A      10.00       0.00       1.00      58.22      17.09        1      8.6   Pullout
                                                                             2     12.8   Pullout

      4      3.91      12.50       7.08      12.60      90.00      13.98        1      0.0   Pullout
                                                                             2      0.0   Pullout

      5      2.75      15.00      27.38      16.89      90.00       7.77        1      0.0   Pullout
                                                                             2      7.9   Pullout

      6      2.56      17.50      31.86      20.60      90.00       4.66        1      0.3   Pullout
                                                                             2      9.3   Pullout

      7      2.32      20.00      10.99       8.15      49.36      18.42        1      0.0   Pullout
                                                                             2      2.3   Pullout

      8      2.21      22.50       9.79       9.13      46.00      19.44        1      0.0   Pullout
                                                                             2      0.6   Pullout

      9      2.14      25.00      11.70       7.66      38.62      22.40        1      0.0   Pullout
                                                                             2      2.6   Pullout

     10      2.10      27.50      10.66       8.39      35.99      23.79        1      0.0   Pullout
                                                                             2      1.4   Pullout
```

```
     11       2.06      30.00      9.79      9.13     33.66     25.23      1       0.0  Pullout
                                                                           2       0.3  Pullout

Search Level: 4.00 feet below the toe of the wall  Facing Design Force = 0.0 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1        N/A       5.00      0.00      0.50     70.60     13.55      1      12.4  Pullout
                                                                           2      14.9  Pullout

      2        N/A       7.50      0.00      1.50     66.88     15.28      1       9.5  Pullout
                                                                           2      12.5  Pullout

      3        N/A      10.00      0.00      1.00     59.58     17.77      1       8.2  Pullout
                                                                           2      12.2  Pullout

      4        N/A      12.50      0.00      1.25     55.44     19.83      1       6.4  Pullout
                                                                           2      11.0  Pullout

      5       3.25      15.00     12.29     15.35     90.00     13.07      1       0.0  Pullout
                                                                           2       0.0  Pullout

      6       2.70      17.50     20.47     18.68     90.00      9.80      1       0.0  Pullout
                                                                           2       2.9  Pullout

      7       2.49      20.00     29.76     23.04     90.00      4.90      1       0.0  Pullout
                                                                           2       6.8  Pullout

      8       2.35      22.50      0.00      4.50     42.22     24.31      1       0.0  Pullout
                                                                           2       3.4  Pullout

      9       2.22      25.00     12.29      7.68     40.03     22.86      1       0.0  Pullout
                                                                           2       1.4  Pullout

     10       2.16      27.50     11.20      8.41     37.37     24.22      1       0.0  Pullout
                                                                           2       0.1  Pullout

     11       2.13      30.00      0.00      6.00     34.24     29.03      1       0.0  Pullout
                                                                           2       0.0  Pullout


======================================================================================================
                                           END OF REPORT
======================================================================================================
```

```
======================================================================================================
                                               Snail

                                           Version: 2.2.2

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======================================================================================================
                                          File Information
======================================================================================================

File Name: US 395 RW14 Full Height Temp.snz
Run Date:  11/02/22
Run Time:  11:06:51

======================================================================================================
                                        Project Information
======================================================================================================

Description:    RW14
Location:       US 395
EA:
Project ID:
Wall No.:
Structure No.:
Station:
Engineer:       STC
                Designer

Comments:


======================================================================================================
                                              Geometry
======================================================================================================

Layout:

Reference Point:

At: Top of Wall
Distance From Origin:       22.00 feet
Elevation Above Origin:     48.00 feet

Wall Dimensions:

Wall Height:         7.25 feet
Facing Angle:       90.00 degrees
Facing Batter:      0.000 :12 H:V
```

```
Ground Surface:

Number of lines that define the ground surface above the wall: 3

         Angle  Distance
No.    degrees      feet
------------------------
1            0      2.00
2           27     11.20
3            0

Number of lines that define the ground surface in front of the toe: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Soil Layers:

Number of Layers: 2

Layers Below the Top Layer:

Coordinates of the Top of the Layer: feet

             Point 1         Point 1         Point 2         Point 2
Layer       Distance       Elevation        Distance       Elevation
--------------------------------------------------------------------
2              30.00           47.00           50.00           47.00

Ground Water:

Include Ground Water: No

======================================================================================================
                                             Soil Nails
======================================================================================================

Dimensions and Properties:

Maximum Vertical Spacing:               3.00 feet
Number of Soil Nail Rows:                  1
Soil Nail Design Parameters:               Varying

      Soil Nail       Inclination   Vertical   Horizontal      Nail Bar   Nail Bar Yield       Bond
         Length   From Horizontal    Spacing    Spacing H    Diameter Ø      Strength fy   Strength
No.        feet           degrees       feet         feet        inches              ksi   Factor F
---------------------------------------------------------------------------------------------------
1         10.00                15       2.00         4.00         1.000             75.0       1.00
```

```
Facing Resistance:

                                     Temporary   Permanent     Seismic
ASD Allowable Facing Resistance:          22.2        19.3        26.3 kips

======================================================================================================
                                          Soil Properties
======================================================================================================

                                        Unit Weight  Friction Angle         Cohesion
                                                  γ              φ'               c'
Layer  Description                              pcf         degrees              psf
------------------------------------------------------------------------------------
1      Fill                                     115            34.0              100
2      Weathered Granodiorite                   120            27.0              500

======================================================================================================
                                               Loads
======================================================================================================

Applied Loads:

Seismic:

Horizontal Seismic Coefficient Kh0.25:

External Load:

Apply external load: No

Surcharges:

Apply surcharges:    Yes

           Distance from Top of Wall            Load            Load
               Begin             End           Begin             End
No.             feet            feet             psf             psf
--------------------------------------------------------------------
1               0.00           12.00             250             250
2              12.00           30.00             600             600

======================================================================================================
                                         Factors of Safety
======================================================================================================

                    Temporary   Permanent     Seismic
Pullout (Distal):        2.00        2.00        1.50
Pullout (Proximal):      2.00        2.00        1.50
Nail Bar Yield:          1.80        1.80        1.35

======================================================================================================
```

```
                                           Search Options
======================================================================================================

Search Limits:

Begin:      5.00 feet
End:       30.00 feet

Below Toe Searches (BTS):

Perform below Toe Search:       Yes
Number of BTS Points:             5
BTS Depth:                     4.00 feet
Interface Friction
Reduction Factor:              0.33

Advanced Search Options:

Use Advanced Search Options:     Yes
Inclination of Interslice Force: Use Average Failure Angle

======================================================================================================
                                               Results
======================================================================================================

Analysis:

Method:          ASD
Scenario:  Temporary

Factor of Safety:

Minimum:                  1.74
Found at Search Point:       5
Found at Grid Point:        19
Found at Search Level:       Toe of the wall

Load at Soil Nail Head:

Calculated Service Load at Soil Nail Head (Empirical), To:     3.0 kips
Allowable Facing Resistance, F_allowable (Entered):          22.2 kips
F_allowable ≥ To OK

Nominal Pullout Resistance:

                    Nominal Pullout Resistance
Layer  Description                         klf
----------------------------------------------
    1  Fill                              2.262
    2  Weathered Granodiorite            2.262
```

```
Results by Search Level:

** Indicates Minimum Factor of Safety

Search Level: At the toe of the wall  Facing Design Force = 3.0 kips (Clouterre)
-------------------------------------------------------------------------------------------------------
|       |         |          |            Failure Planes             |         Reinforcement          |
|       |         |          |---------------------------------------|--------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |         |              |
|       | Factor  | From Toe |---------------------------------------|       |         | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress  | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |   ksi   | Failure Mode |
-------------------------------------------------------------------------------------------------------
      1      2.06       5.00     45.09      4.96     74.10      5.48       1      8.9   Pullout

      2      1.92       7.50     41.78      6.03     63.56      6.74       1      7.7   Pullout

      3      1.88      10.00     34.20      6.05     57.76      9.37       1      6.5   Pullout

      4      1.79      12.50     36.50      6.22     49.02     11.44       1      6.7   Pullout

   ** 5      1.74      15.00     28.73      5.13     43.22     14.41       1      5.7   Pullout

      6      1.77      17.50     25.17      5.80     38.85     15.73       1      4.7   Pullout

      7      1.84      20.00     22.35      6.49     35.18     17.13       1      3.7   Pullout

      8      1.92      22.50     15.33      9.33     36.17     16.72       1      0.4   Pullout

      9      2.03      25.00     18.21      7.90     29.42     20.09       1      1.8   Pullout

     10      2.14      27.50     16.65      8.61     27.14     21.63       1      1.0   Pullout

     11      2.25      30.00     15.33      9.33     25.17     23.20       1      0.2   Pullout

Search Level: 0.80 feet below the toe of the wall  Facing Design Force = 1.9 kips (Clouterre)
-------------------------------------------------------------------------------------------------------
|       |         |          |            Failure Planes             |         Reinforcement          |
|       |         |          |---------------------------------------|--------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |         |              |
|       | Factor  | From Toe |---------------------------------------|       |         | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress  | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |   ksi   | Failure Mode |
-------------------------------------------------------------------------------------------------------
      1      2.60       5.00     46.78      6.57     84.04      4.82       1      7.7   Pullout

      2      2.43       7.50     43.97      6.25     65.26      7.17       1      7.4   Pullout

      3      2.28      10.00     36.04      6.18     59.50      9.85       1      6.1   Pullout

      4      2.10      12.50     32.23      7.39     55.79     11.12       1      4.7   Pullout
```

```
      5      1.95      15.00     33.29      7.18     45.61     12.87       1      4.9   Pullout

      6      1.91      17.50     29.38      8.03     41.21     13.96       1      3.7   Pullout

      7      1.96      20.00     26.22      8.92     37.46     15.12       1      2.5   Pullout

      8      2.01      22.50     23.65      9.82     34.26     16.33       1      1.6   Pullout

      9      2.08      25.00     19.30      7.95     30.98     20.41       1      0.8   Pullout

     10      2.18      27.50     17.66      8.66     28.63     21.93       1      0.0   Pullout

     11      2.30      30.00     16.27      9.38     26.58     23.48       1      0.0   Pullout

Search Level: 1.60 feet below the toe of the wall  Facing Design Force = 0.9 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      3.29       5.00     56.00      6.26     73.88      5.40       1      8.9   Pullout

      2      2.86       7.50     46.01      6.48     66.78      7.61       1      7.1   Pullout

      3      2.55      10.00     40.75      7.92     62.72      8.73       1      5.4   Pullout

      4      2.38      12.50     39.90      6.52     52.44     12.30       1      5.7   Pullout

      5      2.15      15.00     34.87      7.31     47.30     13.27       1      4.3   Pullout

      6      2.07      17.50     30.85      8.15     42.89     14.33       1      3.0   Pullout

      7      2.06      20.00     27.59      9.03     39.11     15.46       1      1.7   Pullout

      8      2.09      22.50     24.91      9.92     35.85     16.66       1      0.6   Pullout

      9      2.15      25.00     22.69     10.84     33.04     17.89       1      0.0   Pullout

     10      2.25      27.50     18.67      8.71     30.08     22.24       1      0.0   Pullout

     11      2.35      30.00     17.21      9.42     27.96     23.78       1      0.0   Pullout

Search Level: 2.40 feet below the toe of the wall  Facing Design Force = 0.5 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
```

```
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  | Angle   | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1     16.66       5.00      0.00      4.00     84.89     11.22       1      7.6   Pullout

      2      6.42       7.50      0.00      3.75     73.24     13.00       1      6.0   Pullout

      3      2.96      10.00     47.68     14.85     90.00      2.75       1      6.1   Pullout

      4      2.60      12.50     43.32      8.59     54.74     10.83       1      5.0   Pullout

      5      2.35      15.00     36.38      7.45     48.89     13.69       1      3.7   Pullout

      6      2.23      17.50     32.27      8.28     44.49     14.72       1      2.3   Pullout

      7      2.18      20.00     28.92      9.14     40.68     15.82       1      1.0   Pullout

      8      2.19      22.50     27.65     12.70     38.16     14.31       1      0.0   Pullout

      9      2.25      25.00     23.85     10.93     34.51     18.20       1      0.0   Pullout

     10      2.32      27.50     21.89     11.85     32.01     19.46       1      0.0   Pullout

     11      2.41      30.00     18.13      9.47     29.31     24.08       1      0.0   Pullout

Search Level: 3.20 feet below the toe of the wall  Facing Design Force = 0.1 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  | Angle   | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1       N/A       5.00      0.00      1.50     73.71     12.48       1      8.9   Pullout

      2      3.70       7.50     57.52     12.57     74.20      2.75       1      7.5   Pullout

      3      7.14      10.00      0.00      6.00     74.61     15.07       1      2.8   Pullout

      4      3.58      12.50     26.43     13.96     90.00      9.32       1      0.0   Pullout

      5      2.59      15.00     42.99     20.51     90.00      1.55       1      3.9   Pullout

      6      2.36      17.50     35.38     10.73     46.81     12.78       1      1.5   Pullout

      7      2.29      20.00     31.86     11.77     42.99     13.67       1      0.2   Pullout

      8      2.30      22.50     28.91     12.85     39.64     14.61       1      0.0   Pullout
```

```
      9      2.34      25.00     24.99     11.03     35.94     18.53        1      0.0  Pullout

     10      2.40      27.50     22.96     11.95     33.39     19.76        1      0.0  Pullout

     11      2.47      30.00      0.00      3.00     29.91     31.15        1      0.0  Pullout

Search Level: 4.00 feet below the toe of the wall  Facing Design Force = 0.0 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |            Failure Planes             |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
| Search|   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1       N/A       5.00      0.00      0.50     70.60     13.55        1      9.3  Pullout

      2       N/A       7.50      0.00      0.75     64.34     15.59        1      7.5  Pullout

      3       N/A      10.00      0.00      1.00     59.58     17.77        1      6.1  Pullout

      4     12.07      12.50      0.00     10.00     81.30     16.52        1      0.0  Pullout

      5      3.84      15.00     10.29      9.15     67.80     15.88        1      0.0  Pullout

      6      2.77      17.50     33.16     20.90     90.00      4.90        1      0.0  Pullout

      7      2.47      20.00     39.24     25.82      0.00      0.00        1      1.7  Pullout

      8      2.40      22.50     30.15     13.01     41.06     14.92        1      0.0  Pullout

      9      2.43      25.00     26.11     11.14     37.32     18.86        1      0.0  Pullout

     10      2.48      27.50     24.01     12.04     34.72     20.07        1      0.0  Pullout

     11      2.53      30.00      0.00      3.00     31.17     31.56        1      0.0  Pullout


======================================================================================================
                                           END OF REPORT
======================================================================================================
```

```
======================================================================================================
                                               Snail

                                           Version: 2.2.2

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======================================================================================================
                                          File Information
======================================================================================================

File Name: US 395 RW14 Single Row.snz
Run Date:  11/02/22
Run Time:  11:10:31

======================================================================================================
                                        Project Information
======================================================================================================

Description:    RW14
Location:       US 395
EA:
Project ID:
Wall No.:
Structure No.:
Station:
Engineer:       STC
                Designer

Comments:


======================================================================================================
                                              Geometry
======================================================================================================

Layout:

Reference Point:

At: Top of Wall
Distance From Origin:       22.00 feet
Elevation Above Origin:     48.00 feet

Wall Dimensions:

Wall Height:        6.70 feet
Facing Angle:      90.00 degrees
Facing Batter:     0.000 :12 H:V
```

```
Ground Surface:

Number of lines that define the ground surface above the wall: 3

         Angle  Distance
No.    degrees      feet
------------------------
1            0      2.00
2           27     11.20
3            0

Number of lines that define the ground surface in front of the toe: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Soil Layers:

Number of Layers: 2

Layers Below the Top Layer:

Coordinates of the Top of the Layer: feet

             Point 1         Point 1         Point 2         Point 2
Layer       Distance       Elevation        Distance       Elevation
--------------------------------------------------------------------
2              30.00           47.00           50.00           47.00

Ground Water:

Include Ground Water: No

======================================================================================================
                                             Soil Nails
======================================================================================================

Dimensions and Properties:

Maximum Vertical Spacing:               3.00 feet
Number of Soil Nail Rows:                  1
Soil Nail Design Parameters:               Varying

      Soil Nail       Inclination   Vertical   Horizontal      Nail Bar   Nail Bar Yield       Bond
         Length   From Horizontal    Spacing    Spacing H    Diameter Ø      Strength fy   Strength
No.        feet           degrees       feet         feet        inches              ksi   Factor F
---------------------------------------------------------------------------------------------------
1         10.00                15       3.00         4.00         1.000             75.0       1.00
```

```
Facing Resistance:

                                     Temporary   Permanent     Seismic
ASD Allowable Facing Resistance:          22.2        19.3        26.3 kips

======================================================================================================
                                          Soil Properties
======================================================================================================

                                        Unit Weight  Friction Angle        Cohesion
                                                  γ              φ'              c'
Layer  Description                              pcf         degrees             psf
-----------------------------------------------------------------------------------
1      Fill                                     115            34.0             100
2      Weathered Granodiorite                   120            27.0             500

======================================================================================================
                                               Loads
======================================================================================================

Applied Loads:

Seismic:

Horizontal Seismic Coefficient Kh0.25:

External Load:

Apply external load: No

Surcharges:

Apply surcharges:    Yes

           Distance from Top of Wall            Load            Load
               Begin             End           Begin             End
No.             feet            feet             psf             psf
--------------------------------------------------------------------
1               0.00           12.00             250             250
2              12.00           30.00             600             600

======================================================================================================
                                         Factors of Safety
======================================================================================================

                    Temporary   Permanent     Seismic
Pullout (Distal):        2.00        2.00        1.50
Pullout (Proximal):      2.00        2.00        1.50
Nail Bar Yield:          1.80        1.80        1.35

======================================================================================================
```

```
                                           Search Options
======================================================================================================

Search Limits:

Begin:      5.00 feet
End:       30.00 feet

Below Toe Searches (BTS):

Perform below Toe Search:       Yes
Number of BTS Points:             5
BTS Depth:                     4.00 feet
Interface Friction
Reduction Factor:              0.33

Advanced Search Options:

Use Advanced Search Options:     Yes
Inclination of Interslice Force: Use Average Failure Angle

======================================================================================================
                                               Results
======================================================================================================

Analysis:

Method:          ASD
Scenario:  Permanent

Factor of Safety:

Minimum:                  1.90
Found at Search Point:       5
Found at Grid Point:        19
Found at Search Level:       Toe of the wall

Load at Soil Nail Head:

Calculated Service Load at Soil Nail Head (Empirical), To:     3.9 kips
Allowable Facing Resistance, F_allowable (Entered):           19.3 kips
F_allowable ≥ To OK

Nominal Pullout Resistance:

                    Nominal Pullout Resistance
Layer  Description                         klf
----------------------------------------------
    1  Fill                              2.262
    2  Weathered Granodiorite            2.262
```

```
Results by Search Level:

** Indicates Minimum Factor of Safety

Search Level: At the toe of the wall  Facing Design Force = 3.9 kips (Clouterre)
-------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement           |
|       |         |          |---------------------------------------|--------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |               |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling   |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance    |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode  |
-------------------------------------------------------------------------------------------------------
      1      2.33       5.00     39.45      3.89     70.85      6.10       1      9.7   Pullout

      2      2.23       7.50     43.54      4.14     55.92      8.03       1      9.9   Pullout

      3      2.12      10.00     35.69      3.69     50.92     11.11       1      9.2   Pullout

      4      2.00      12.50     32.15      4.43     47.14     12.86       1      8.4   Pullout

   ** 5      1.90      15.00     27.64      5.08     41.92     14.11       1      7.5   Pullout

      6      1.96      17.50     18.61      3.69     37.15     17.56       1      6.9   Pullout

      7      2.03      20.00     11.11      6.11     37.15     17.56       1      4.1   Pullout

      8      2.10      22.50      9.90      6.85     33.96     18.99       1      3.2   Pullout

      9      2.20      25.00      8.93      7.59     31.22     20.46       1      2.3   Pullout

     10      2.30      27.50      8.13      8.33     28.85     21.98       1      1.5   Pullout

     11      2.42      30.00      7.46      9.08     26.80     23.53       1      0.8   Pullout

Search Level: 0.80 feet below the toe of the wall  Facing Design Force = 2.0 kips (Clouterre)
-------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement           |
|       |         |          |---------------------------------------|--------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |               |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling   |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance    |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode  |
-------------------------------------------------------------------------------------------------------
      1      3.00       5.00     50.28      4.69     69.74      5.77       1      9.9   Pullout

      2      2.69       7.50     39.50      4.86     62.53      8.13       1      8.5   Pullout

      3      2.54      10.00     37.66      3.79     52.92     11.61       1      8.6   Pullout

      4      2.32      12.50     33.87      4.52     49.01     13.34       1      7.8   Pullout
```

```
      5      2.13      15.00     29.22      5.16     43.80     14.55       1      6.7   Pullout

      6      2.08      17.50     19.78      7.44     43.80     14.55       1      3.8   Pullout

      7      2.12      20.00     22.76      6.51     35.72     17.24       1      4.9   Pullout

      8      2.18      22.50     20.45      7.20     32.59     18.69       1      4.1   Pullout

      9      2.25      25.00      9.53      7.60     32.91     20.85       1      1.2   Pullout

     10      2.33      27.50      8.67      8.35     30.47     22.33       1      0.3   Pullout

     11      2.44      30.00      7.96      9.09     28.34     23.86       1      0.0   Pullout

Search Level: 1.60 feet below the toe of the wall  Facing Design Force = 1.0 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1      3.59       5.00     52.65      4.95     71.27      6.23       1      9.7   Pullout

      2      3.14       7.50     41.61      5.02     64.24      8.63       1      8.2   Pullout

      3      2.80      10.00     36.60      6.23     60.01     10.00       1      6.8   Pullout

      4      2.60      12.50     35.52      4.61     50.75     13.83       1      7.2   Pullout

      5      2.34      15.00     30.75      5.24     45.56     15.00       1      6.1   Pullout

      6      2.24      17.50     27.02      5.89     41.16     16.27       1      5.0   Pullout

      7      2.22      20.00     18.50      8.44     41.74     16.08       1      1.9   Pullout

      8      2.24      22.50     16.56      9.39     38.42     17.23       1      0.7   Pullout

      9      2.30      25.00     14.99     10.35     35.52     18.43       1      0.0   Pullout

     10      2.38      27.50     17.98      8.67     29.09     22.03       1      1.4   Pullout

     11      2.47      30.00     16.56      9.39     27.02     23.57       1      0.6   Pullout

Search Level: 2.40 feet below the toe of the wall  Facing Design Force = 0.2 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
```

```
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1     25.49       5.00      0.00      4.50     87.31     10.64       1      7.4   Pullout

      2      3.68       7.50     46.61      3.28     61.13     10.87       1      8.8   Pullout

      3      3.30      10.00     42.69     13.60     90.00      3.95       1      6.8   Pullout

      4      2.80      12.50     40.40      6.57     52.94     12.44       1      6.5   Pullout

      5      2.50      15.00     35.35      7.36     47.81     13.40       1      5.2   Pullout

      6      2.40      17.50     28.39      5.97     42.81     16.70       1      4.3   Pullout

      7      2.34      20.00     23.05     10.87     44.80     14.09       1      1.3   Pullout

      8      2.34      22.50     20.72     12.03     41.43     15.01       1      0.3   Pullout

      9      2.38      25.00     20.72      8.02     32.96     20.86       1      1.2   Pullout

     10      2.43      27.50     18.98      8.72     30.52     22.35       1      0.3   Pullout

     11      2.51      30.00      0.00      3.00     27.72     30.50       1      0.0   Pullout

Search Level: 3.20 feet below the toe of the wall  Facing Design Force = 0.8 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1       N/A       5.00      0.00      1.00     70.71     12.11       1      9.7   Pullout

      2       N/A       7.50      0.00      1.50     64.72     14.05       1      8.1   Pullout

      3      9.44      10.00      0.00      7.00     77.89     14.29       1      2.4   Pullout

      4      3.51      12.50     30.94     14.57     90.00      7.49       1      2.5   Pullout

      5      2.83      15.00     38.63     19.20     90.00      3.00       1      4.8   Pullout

      6      2.51      17.50     27.19      9.84     50.17     13.66       1      1.3   Pullout

      7      2.44      20.00     29.33      9.18     41.16     15.94       1      2.1   Pullout

      8      2.43      22.50     28.05     12.75     38.63     14.40       1      1.6   Pullout
```

```
      9      2.44      25.00     24.21     10.96     34.97     18.30       1      0.1   Pullout

     10      2.50      27.50      0.00      2.75     31.19     28.93       1      0.0   Pullout

     11      2.56      30.00      0.00      3.00     29.03     30.88       1      0.0   Pullout

Search Level: 4.00 feet below the toe of the wall  Facing Design Force = 0.1 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |            Failure Planes                 |         Reinforcement         |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       |  Factor | From Toe |---------------------------------------|       |        | Controlling  |
| Search|    of   | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress | Resistance   |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   | Failure Mode |
------------------------------------------------------------------------------------------------------
      1       N/A       5.00      0.00      0.50     69.80     13.03       1      9.9   Pullout

      2      4.29       7.50     56.32      8.11     66.04      7.39       1      7.9   Pullout

      3       N/A      10.00      0.00      1.00     58.66     17.30       1      7.1   Pullout

      4     12.19      12.50      0.00     10.00     81.00     15.98       1      0.0   Pullout

      5      3.45      15.00     27.75     16.95     90.00      7.89       1      0.0   Pullout

      6      2.96      17.50     32.27     20.70     90.00      4.74       1      1.6   Pullout

      7      2.63      20.00     38.28     25.48      0.00      0.00       1      3.5   Pullout

      8      2.51      22.50     27.75     10.17     39.30     17.45       1      0.2   Pullout

      9      2.53      25.00     25.34     11.06     36.38     18.63       1      0.0   Pullout

     10      2.57      27.50      0.00      2.75     32.53     29.36       1      0.0   Pullout

     11      2.62      30.00      0.00      3.00     30.31     31.28       1      0.0   Pullout


======================================================================================================
                                           END OF REPORT
======================================================================================================
```

```
======================================================================================================
                                               Snail

                                           Version: 2.2.2

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======================================================================================================
                                          File Information
======================================================================================================

File Name: US 395 RW14 Single Row Seismic.snz
Run Date:  11/02/22
Run Time:  11:15:26

======================================================================================================
                                        Project Information
======================================================================================================

Description:    RW14
Location:       US 395
EA:
Project ID:
Wall No.:
Structure No.:
Station:
Engineer:       STC
                Designer

Comments:


======================================================================================================
                                              Geometry
======================================================================================================

Layout:

Reference Point:

At: Top of Wall
Distance From Origin:       22.00 feet
Elevation Above Origin:     48.00 feet

Wall Dimensions:

Wall Height:        6.70 feet
Facing Angle:      90.00 degrees
Facing Batter:     0.000 :12 H:V
```

```
Ground Surface:

Number of lines that define the ground surface above the wall: 3

         Angle  Distance
No.    degrees      feet
------------------------
1            0      2.00
2           27     11.20
3            0

Number of lines that define the ground surface in front of the toe: 1

         Angle  Distance
No.    degrees      feet
------------------------
1            0

Soil Layers:

Number of Layers: 2

Layers Below the Top Layer:

Coordinates of the Top of the Layer: feet

             Point 1         Point 1         Point 2         Point 2
Layer       Distance       Elevation        Distance       Elevation
--------------------------------------------------------------------
2              30.00           47.00           50.00           47.00

Ground Water:

Include Ground Water: No

======================================================================================================
                                             Soil Nails
======================================================================================================

Dimensions and Properties:

Maximum Vertical Spacing:               3.00 feet
Number of Soil Nail Rows:                  1
Soil Nail Design Parameters:               Varying

      Soil Nail       Inclination   Vertical   Horizontal      Nail Bar   Nail Bar Yield       Bond
         Length   From Horizontal    Spacing    Spacing H    Diameter Ø      Strength fy   Strength
No.        feet           degrees       feet         feet        inches              ksi   Factor F
---------------------------------------------------------------------------------------------------
1         10.00                15       3.00         4.00         1.000             75.0       1.00
```

```
Facing Resistance:

                                     Temporary   Permanent     Seismic
ASD Allowable Facing Resistance:          22.2        19.3        26.3 kips

======================================================================================================
                                          Soil Properties
======================================================================================================

                                        Unit Weight  Friction Angle        Cohesion
                                                  γ              φ'              c'
Layer  Description                              pcf         degrees             psf
-----------------------------------------------------------------------------------
1      Fill                                     115            34.0             100
2      Weathered Granodiorite                   120            27.0             500

======================================================================================================
                                               Loads
======================================================================================================

Applied Loads:

Seismic:

Horizontal Seismic Coefficient Kh0.25:

External Load:

Apply external load: No

Surcharges:

Apply surcharges: No

======================================================================================================
                                         Factors of Safety
======================================================================================================

                    Temporary   Permanent     Seismic
Pullout (Distal):        2.00        2.00        1.50
Pullout (Proximal):      2.00        2.00        1.50
Nail Bar Yield:          1.80        1.80        1.35

======================================================================================================
                                           Search Options
======================================================================================================

Search Limits:

Begin:      5.00 feet
End:       30.00 feet
```

```
Below Toe Searches (BTS):

Perform below Toe Search:       Yes
Number of BTS Points:             5
BTS Depth:                     4.00 feet
Interface Friction
Reduction Factor:              0.33

Advanced Search Options:

Use Advanced Search Options:     Yes
Inclination of Interslice Force: Use Average Failure Angle

======================================================================================================
                                               Results
======================================================================================================

Analysis:

Method:          ASD
Scenario:    Seismic

Factor of Safety:

Minimum:                  1.76
Found at Search Point:       8
Found at Grid Point:        12
Found at Search Level:       Toe of the wall

Load at Soil Nail Head:

Calculated Service Load at Soil Nail Head (Empirical), To:     0.6 kips
Allowable Facing Resistance, F_allowable (Entered):           26.3 kips
F_allowable ≥ To OK

Nominal Pullout Resistance:

                    Nominal Pullout Resistance
Layer  Description                         klf
----------------------------------------------
    1  Fill                              2.262
    2  Weathered Granodiorite            2.262

Results by Search Level:

** Indicates Minimum Factor of Safety

Search Level: At the toe of the wall  Facing Design Force = 0.6 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |                    Failure Planes     |       Reinforcement         |
```

```
|        |          |           |----------------------------------------|---------------------------------|
|        | Minimum  | Distance  |        Lower        |       Upper      |                                 |
|        | Factor   | From Toe  |----------------------------------------|        |        |  Controlling   |
|Search  |   of     | of Wall   |  Angle   | Length   |  Angle  | Length |        | Stress |  Resistance    |
|Point   | Safety   |   feet    | degrees  |  feet    | degrees |  feet  | Level  |  ksi   |  Failure Mode  |
---------------------------------------------------------------------------------------------------------
      1      2.33        5.00     28.75       5.13      85.04     5.78       1      10.3    Pullout

      2      2.44        7.50     19.90       5.58      73.51     7.93       1       8.6    Pullout

      3      2.23       10.00     23.32       5.44      59.89     9.97       1       9.1    Pullout

      4      2.16       12.50     13.26       5.14      54.74    12.99       1       7.9    Pullout

      5      1.93       15.00     11.11       6.11      49.68    13.91       1       6.0    Pullout

      6      1.83       17.50      9.56       7.10      45.29    14.92       1       4.3    Pullout

      7      1.78       20.00      8.38       8.09      41.47    16.02       1       2.6    Pullout

   ** 8      1.76       22.50      7.46       9.08      38.16    17.17       1       1.1    Pullout

      9      1.78       25.00      6.72      10.07      35.26    18.37       1       0.1    Pullout

     10      1.80       27.50      8.13       8.33      28.85    21.98       1       2.0    Pullout

     11      1.82       30.00      7.46       9.08      26.80    23.53       1       1.0    Pullout

Search Level: 0.80 feet below the toe of the wall  Facing Design Force = 0.2 kips (Clouterre)
---------------------------------------------------------------------------------------------------------
|        |          |           |             Failure Planes             |          Reinforcement          |
|        |          |           |----------------------------------------|---------------------------------|
|        | Minimum  | Distance  |        Lower        |       Upper      |                                 |
|        | Factor   | From Toe  |----------------------------------------|        |        |  Controlling   |
|Search  |   of     | of Wall   |  Angle   | Length   |  Angle  | Length |        | Stress |  Resistance    |
|Point   | Safety   |   feet    | degrees  |  feet    | degrees |  feet  | Level  |  ksi   |  Failure Mode  |
---------------------------------------------------------------------------------------------------------
      1      3.07        5.00     31.04       5.25      85.48     6.34       1      10.2    Pullout

      2      2.92        7.50     34.48       5.46      67.41     7.81       1      10.1    Pullout

      3      2.60       10.00     21.10       6.43      66.64    10.09       1       6.8    Pullout

      4      2.31       12.50     21.94       6.74      58.17    11.85       1       6.5    Pullout

      5      2.13       15.00     22.76       6.51      48.21    13.50       1       6.7    Pullout

      6      1.98       17.50     19.78       7.44      43.80    14.55       1       5.1    Pullout

      7      1.92       20.00      8.94       8.10      43.35    16.50       1       1.5    Pullout
```

```
      8      1.88      22.50      7.96      9.09     40.00     17.62       1      0.0   Pullout

      9      1.87      25.00      9.53      7.60     32.91     20.85       1      1.6   Pullout

     10      1.86      27.50      8.67      8.35     30.47     22.33       1      0.4   Pullout

     11      1.88      30.00      0.00      6.00     27.67     27.10       1      0.0   Pullout

Search Level: 1.60 feet below the toe of the wall  Facing Design Force = 0.0 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress |Resistance    |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   |Failure Mode  |
------------------------------------------------------------------------------------------------------
      1      4.20       5.00     29.32      4.01     79.20      8.00       1     11.4   Pullout

      2      3.36       7.50     36.51      5.60     68.89      8.33       1      9.7   Pullout

      3      2.95      10.00     22.42      6.49     68.00     10.68       1      6.4   Pullout

      4      2.57      12.50     19.64      7.96     64.97     11.82       1      3.8   Pullout

      5      2.28      15.00     19.64      7.96     54.99     13.07       1      3.6   Pullout

      6      2.11      17.50     17.01      9.15     50.75     13.83       1      1.4   Pullout

      7      2.02      20.00     14.99     10.35     46.96     14.65       1      0.0   Pullout

      8      1.97      22.50     16.56      9.39     38.42     17.23       1      0.9   Pullout

      9      1.95      25.00     14.99     10.35     35.52     18.43       1      0.0   Pullout

     10      1.95      27.50      9.22      8.36     32.04     22.71       1      0.0   Pullout

     11      1.97      30.00      0.00      6.00     29.15     27.48       1      0.0   Pullout

Search Level: 2.40 feet below the toe of the wall  Facing Design Force = 0.0 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |             Failure Planes            |        Reinforcement          |
|       |         |          |---------------------------------------|-------------------------------|
|       | Minimum | Distance |       Lower       |       Upper       |       |        |              |
|       | Factor  | From Toe |---------------------------------------|       |        | Controlling  |
|Search |   of    | of Wall  |  Angle  | Length  |  Angle  | Length  |       | Stress |Resistance    |
|Point  | Safety  |   feet   | degrees |  feet   | degrees |  feet   | Level |  ksi   |Failure Mode  |
------------------------------------------------------------------------------------------------------
      1       N/A       5.00      0.00      1.00     69.38     11.36       1     13.2   Pullout

      2      6.63       7.50      0.00      6.00     82.82     12.00       1      6.2   Pullout
```

```
       3       4.13       10.00        7.51       10.09       90.00       11.86          1        0.0   Pullout

       4       2.74       12.50       24.41       13.73       90.00        8.51          1        2.4   Pullout

       5       2.54       15.00       25.31       16.59       90.00        7.09          1        2.8   Pullout

       6       2.27       17.50       17.96        9.20       52.37       14.33          1        0.6   Pullout

       7       2.16       20.00       19.53        8.49       43.40       16.52          1        1.5   Pullout

       8       2.08       22.50       17.50        9.44       40.05       17.64          1        0.0   Pullout

       9       2.06       25.00       15.84       10.39       37.11       18.81          1        0.0   Pullout

      10       2.05       27.50        0.00        5.50       32.81       26.18          1        0.0   Pullout

      11       2.03       30.00        0.00        3.00       27.72       30.50          1        0.0   Pullout

Search Level: 3.20 feet below the toe of the wall  Facing Design Force = 0.0 kips (Clouterre)
------------------------------------------------------------------------------------------------------
|       |         |          |              Failure Planes             |         Reinforcement          |
|       |         |          |-----------------------------------------|--------------------------------|
|       | Minimum | Distance |         Lower       |       Upper       |       |        |               |
|       | Factor  | From Toe |-----------------------------------------|       |        | Controlling   |
|Search |   of    | of Wall  |  Angle   | Length   |  Angle   | Length |       | Stress | Resistance    |
|Point  | Safety  |   feet   | degrees  |  feet    | degrees  |  feet  | Level |  ksi   | Failure Mode  |
------------------------------------------------------------------------------------------------------
       1        N/A        5.00        0.00        2.00       75.29       11.82          1       12.1   Pullout

       2        N/A        7.50        0.00        0.75       62.01       14.38          1       11.5   Pullout

       3        N/A       10.00        0.00        1.00       57.22       16.62          1       10.0   Pullout

       4       4.07       12.50        6.84       12.59       90.00       13.49          1        0.0   Pullout

       5       2.66       15.00       21.78       16.15       90.00        8.99          1        0.0   Pullout

       6       2.46       17.50       30.94       20.40       90.00        4.50          1        3.4   Pullout

       7       2.35       20.00       10.61        8.14       48.34       18.05          1        0.0   Pullout

       8       2.20       22.50       21.78       12.11       43.00       15.38          1        0.0   Pullout

       9       2.16       25.00       16.68       10.44       38.63       19.20          1        0.0   Pullout

      10       2.12       27.50        0.00        2.75       31.19       28.93          1        0.0   Pullout

      11       2.10       30.00        0.00        3.00       29.03       30.88          1        0.0   Pullout

Search Level: 4.00 feet below the toe of the wall  Facing Design Force = 0.0 kips (Clouterre)
```

```
---------------------------------------------------------------------------------------------------------
|       |         |          |              Failure Planes             |        Reinforcement           |
|       |         |          |-----------------------------------------|--------------------------------|
|       | Minimum | Distance |        Lower        |       Upper       |       |        |               |
|       | Factor  | From Toe |-----------------------------------------|       |        | Controlling   |
|Search |   of    | of Wall  |  Angle  |  Length   |  Angle  |  Length |       | Stress | Resistance    |
|Point  | Safety  |   feet   | degrees |   feet    | degrees |   feet  | Level |  ksi   | Failure Mode  |
---------------------------------------------------------------------------------------------------------
      1     6.24       5.00     61.40       4.18      70.69      9.07       1     13.0   Pullout

      2      N/A       7.50      0.00       3.75      74.48     14.01       1      8.3   Pullout

      3      N/A      10.00      0.00       1.00      58.66     17.30       1      9.5   Pullout

      4      N/A      12.50      0.00       1.25      54.52     19.38       1      8.0   Pullout

      5     4.08      15.00      6.01      15.08      90.00     14.21       1      0.0   Pullout

      6     2.71      17.50     19.84      18.60      90.00      9.47       1      0.0   Pullout

      7     2.48      20.00     25.34      22.13      90.00      6.31       1      0.0   Pullout

      8     2.34      22.50     29.30      25.80      90.00      3.16       1      0.7   Pullout

      9     2.25      25.00      0.00       2.50      35.05     27.48       1      0.0   Pullout

     10     2.20      27.50      0.00       2.75      32.53     29.36       1      0.0   Pullout

     11     2.18      30.00      0.00       3.00      30.31     31.28       1      0.0   Pullout


=========================================================================================================
                                           END OF REPORT
=========================================================================================================
```

APPENDIX I

MSE Wall RW12

AASHTO 2007-2010 (LRFD)
US 395

MSEW+: Update # 2022.20

PROJECT IDENTIFICATION

Title: US 395
Project Number: RW12
Client:
Designer: STC
Station Number: 2+80

Description:

Company's information:

Name:
Street:

,
Telephone #:
Fax #:
E-Mail:

File path and name: C:\Users\scrandel\OneDrive - HDR, Inc\Documents\MSEW Fi.....
.....2_Sta 280 Rev 2.BENp

Original date and time of creating this file: Tue Aug 23 12:16:07 2022

PROGRAM MODE: DESIGN
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

DESIGN DATA

DESIGN OBJECTIVES

Minimum Capacity Demand Ratio in pullout, CDR-po	1.00
Minimum Capacity Demand Ratio in direct sliding, CDR-sliding	1.00
Maximum allowable eccentricity ratio at each reinforcement level, e/L	0.2500
Minimum Capacity Demand Ratio in compound and overall failure, CDR-comp-static	1.30
Minimum Capacity Demand Ratio in compound and overall failure, CDR-comp-seismic	1.10

Prescribed minimum resistive length to prevent pullout, Le = 3.28 ft.
Prescribed minimum normalized length of each layer is: L/Hd = 0.70 --> L = 9.80 ft.
Prescribed minimum absolute total length of each layer is: L = 8.20 ft.

BEARING CAPACITY

Bearing capacity is controlled by general shear.

Maximum permissible eccentricity ratio (soil), e/L	0.2500
Min. Capacity Demand Ratio with respect to ultimate bearing capacity (Meyerhof approach)	1.00

Bearing capacity factors: Nc = 0.00 N γ= 14.00

SOIL DATA

REINFORCED SOIL

Unit weight, γ	135.0 lb/ft^3
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft^3
Design value of internal angle of friction, ϕ	35.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{\text{equiv.}}$	120.0 lb/ft^3
Equivalent internal angle of friction, $\phi_{\text{equiv.}}$	35.0 °
Equivalent cohesion, $c_{\text{equiv.}}$	150.0 lb/ft^2

Water table does not affect bearing capacity

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.2710 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

SEISMICITY (using AASHTO 2008-2010)

Peak ground acceleration coeff., A = PGA = 0.500 and Site Factor, Fpga = 1.000. Maximum ground acceleration coeff., As = 0.500
Design acceleration coefficient in Internal Stability: Kh = Am = 0.500
Design acceleration coefficient in External Stability: Kh_d = 0.249 => Kh = Am = 0.249
(Kh in External Stability is based on allowable displacement, d = 150 mm. using AASHTO 2008-2010 equation)

Kae (Kh > 0) = 0.4342 Kae (Kh = 0) = 0.2710 Δ Kae = 0.1633

DIRECT SLIDING / ECCENTRICITY

Seismic CDR is 100.0% of specified static CDR for direct sliding.
Maximum allowable eccentricity, e/L, under seismic conditions is: 0.4000

BEARING CAPACITY

Seismic CDR is 100.0% of specified static CDR for bearing capacity.
Maximum allowable eccentricity, e/L, under seismic conditions is: 0.4000

INTERNAL STABILITY

Seismic soil-metal strip friction coefficient, F* is 80.0% of its specified static value.
Seismic Capacity Demand Ratio in pullout, CDR-po, is 100.0% of its specified static value.
Seismic Capacity Demand Ratio, CDR-overall, is 100.0% of its specified static value.
The reduction of CDR pertains to metal strip strength and to connection strength for break mode of failure.

INPUT DATA: Metal strips
(Equally spaced single type reinforcement)

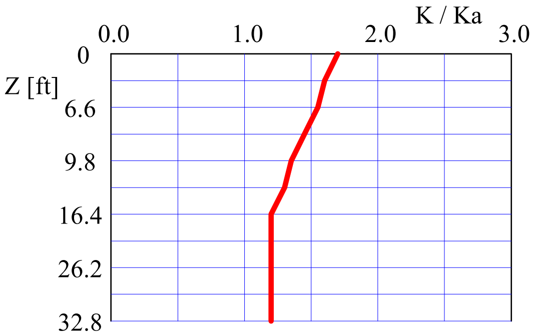
D A T A	Metal strip type #1	Metal strip type #2	Metal strip type #3	Metal strip type #4	Metal strip type #5
Yield strength of steel, Fy [kips/in ^{2}]	65.0	N/A	N/A	N/A	N/A
Strength reduction factor, FS	1.000	N/A	N/A	N/A	N/A
or: Fs = 1 / FS	1.000	N/A	N/A	N/A	N/A
Gross width of strip, b [in]	5.5	N/A	N/A	N/A	N/A
Vertical spacing, Sv [ft]	0.90	N/A	N/A	N/A	N/A
Design cross section area, Ac [in ^{2}]	0.500	N/A	N/A	N/A	N/A

Ribbed steel strips.
Uniformity Coefficient of reinforced soil, Cu = D60/D10 = 4.0

Friction angle along reinforcement-soil interface,	ρ				
@ the top	60.97	N/A	N/A	N/A	N/A
@ 19.7 ft or below	32.00	N/A	N/A	N/A	N/A
Pullout resistance factor, F*					
@ the top	1.80	N/A	N/A	N/A	N/A
@ 19.7 ft or below	0.62	N/A	N/A	N/A	N/A
Scale-effect correction factor, α	1.00	N/A	N/A	N/A	N/A

Variation of Lateral Earth Pressure Coefficient With Depth

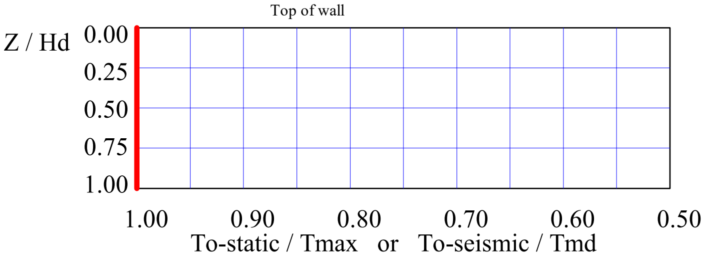
Z	K / Ka
0 ft	1.70
3.3 ft	1.60
6.6 ft	1.55
9.8 ft	1.45
13.1 ft	1.35
16.4 ft	1.30
19.7 ft	1.20



INPUT DATA: Facia and Connection (Design)

FACIA type: Segmental precast concrete panels.
Depth of panel is 1.31 ft. Horizontal distance to Center of Gravity of panel is 0.66 ft.
Average unit weight of panel is γ_f = 152.78 lb/ft ^{3}

Z / Hd	To-static / Tmax or To-seismic / Tmd
0.00	1.00
0.25	1.00
0.50	1.00
0.75	1.00
1.00	1.00



D A T A (for connection only)	Type #1	Type #2	Type #3	Type #4	Type #5
Product Name	---	N/A	N/A	N/A	N/A
Strength reduction at the connection, CRu = Fyc / Fy	0.90	N/A	N/A	N/A	N/A

INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd 14.00 [ft] { Embedded depth is E = 4.50 ft, and height above top of finished bottom grade is H = 9.50 ft }
Soil in front of the wall is inclined at 2H:1V. Hs = 6.56 ft.

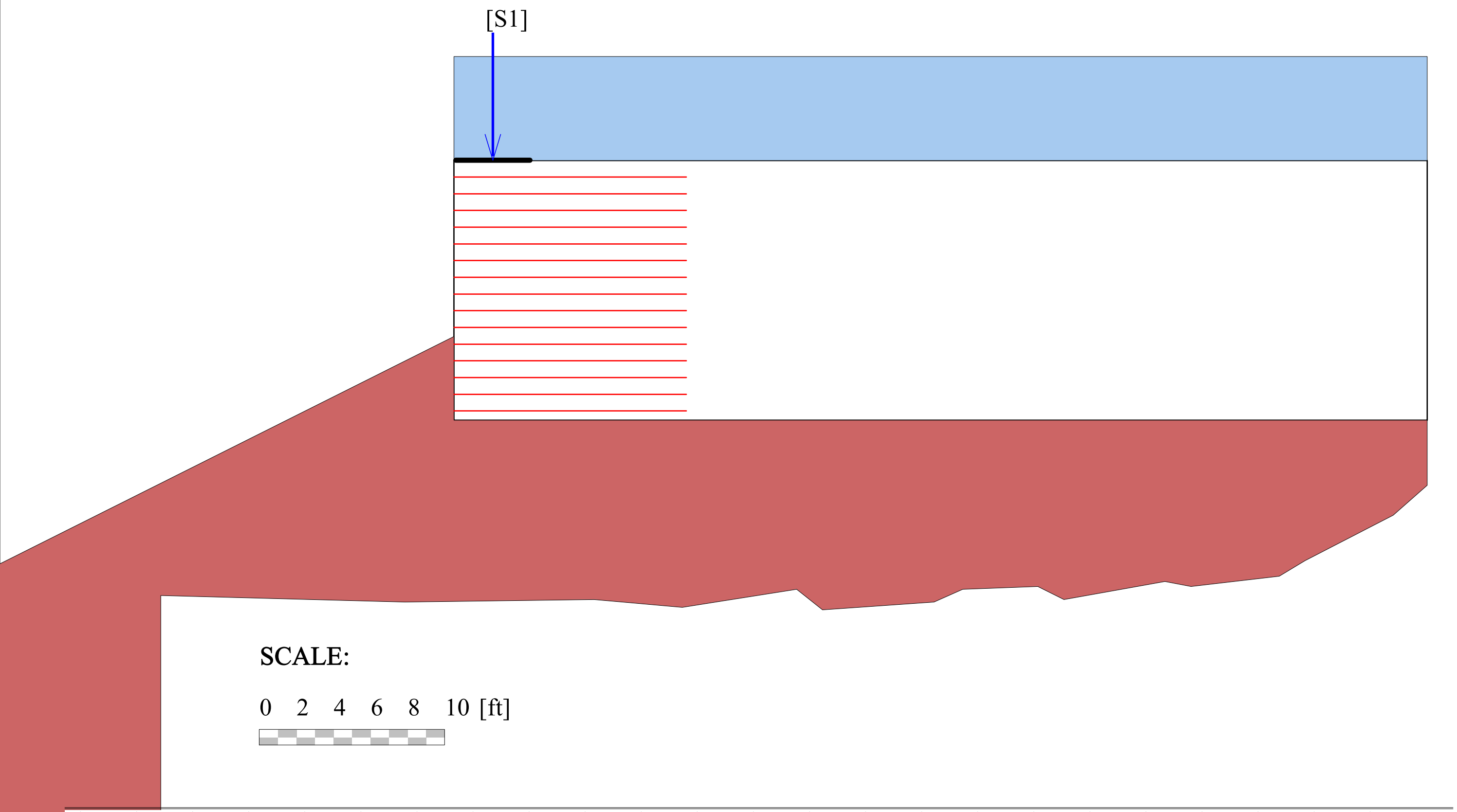
Batter, ω	0.0	[deg]	
Backslope, β	0.0	[deg]	
Backslope rise	0.0	[ft]	Broken back equivalent angle, I = 0.00° (see Fig. 25 in DEMO 82)

UNIFORM SURCHARGE

🟦 Uniformly distributed dead load is 0.0 [lb/ft ²], and live load is 250.0 [lb/ft ²]

OTHER EXTERNAL LOAD(S)
[S1] Strip Load, Pv-d = 2291.0 and Pv-l = 0.0 [lb/ft].
Footing width, b=4.0 [ft]. Distance of center of footing from wall face, d = 2.1 [ft] @ depth of 0.0 [ft] below soil surface.

DESIGNED REINFORCEMENT LAYOUT:



AASHTO 2007-2010 (LRFD) – Load and Resisting Factors

INTERNAL STABILITY

Load factor for vertical earth pressure, EV:	$\gamma_{p\text{-}EV}$	1.35	
Load factor for earthquake loads, EQ:	$\gamma_{p\text{-}EQ}$	1.00	
Load factor for live load surcharge, LS: (Same as in External Stability).	$\gamma_{p\text{-}LS}$	1.75	
Load factor for dead load surcharge, ES: (Same as in External Stability).	$\gamma_{p\text{-}ES}$	1.50	
Resistance factor for reinforcement tension	ϕ	Static	Combined static/seismic
Metal Strips:		0.75	1.00
Resistance factor for reinforcement tension in connectors	ϕ	Static	Combined static/seismic
Metal Strips:		0.75	1.00
Resistance factor for reinforcement pullout	ϕ	0.90	1.20

EXTERNAL STABILITY

Load factor for vertical earth pressure, EV			Static	Combined Static/Seismic	
	Sliding and Eccentricity	$\gamma_{p\text{-}EV}$	1.00	$\gamma_{p\text{-}EQ}$	1.00
	Bearing Capacity	$\gamma_{p\text{-}EV}$	1.35	$\gamma_{p\text{-}EQ}$	1.35

Load factor of active lateral earth pressure, EH	$\gamma_{p\text{-}EH}$	1.50
Load factor of active lateral earth pressure during earthquake (does not multiply P_{AE} and P_{IR}):	$(\gamma_{p\text{-}EH})_{EQ}$	1.50
Load factor for earthquake loads, EQ (multiplies P_{AE} and P_{IR}):	$\gamma_{p\text{-}EQ}$	1.00

Resistance factor for shear resistance along common interfaces			Static	Combined Static/Seismic
	Reinforced Soil and Foundation	ϕ_{τ}	1.00	1.00
	Reinforced Soil and Reinforcement	ϕ_{τ}	1.00	1.00
Resistance factor for bearing capacity of shallow foundation			Static	Combined Static/Seismic
		ϕ_{b}	0.65	0.65

REINFORCEMENT LAYOUT AND DESIGN CRITERIA

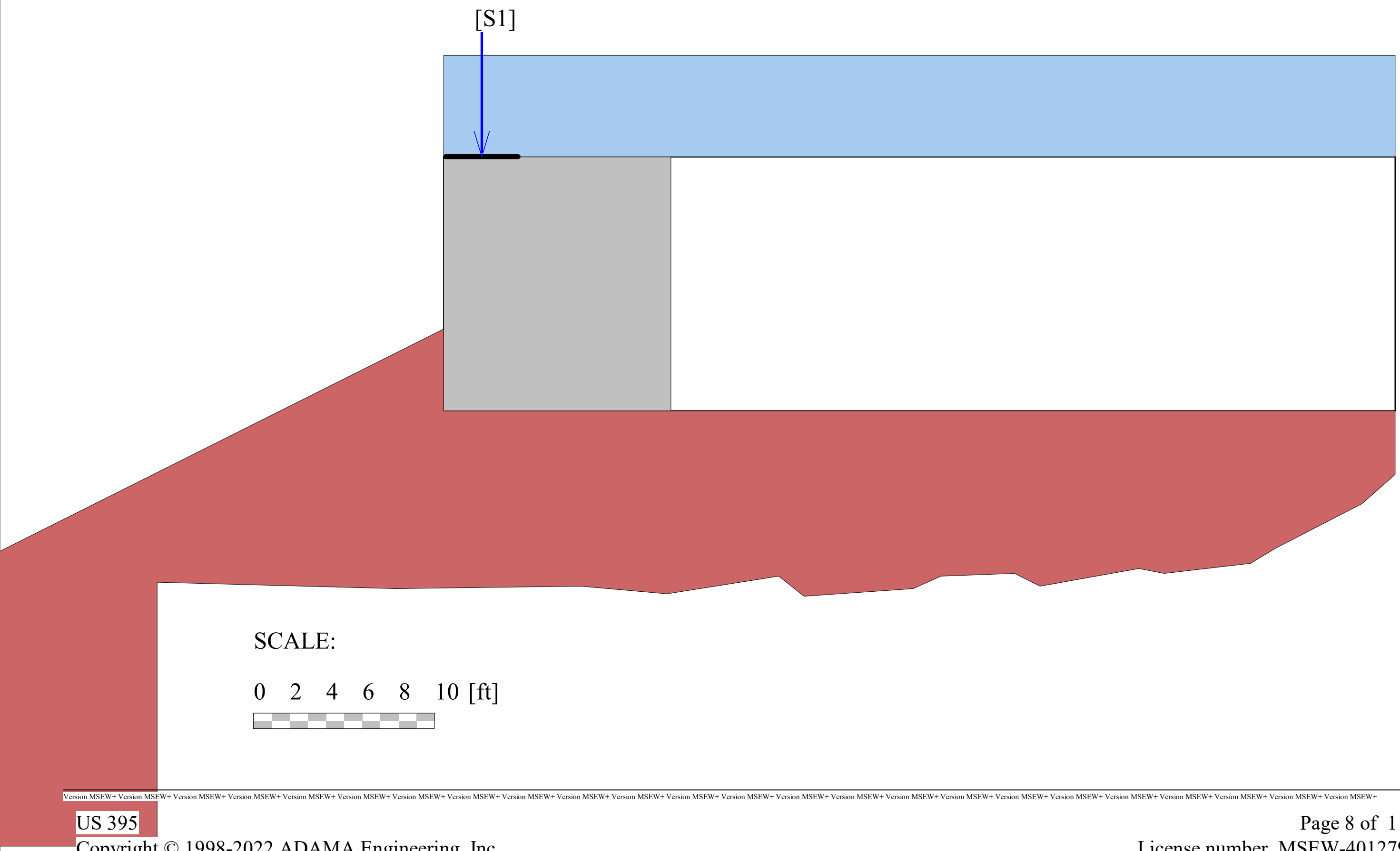
LEGEND:			
(1) Connection strength	√	Satisfactory
(2) Metal strip strength	⊗	Unsatisfactory
(3) Pullout resistance		
(4) Direct sliding		
(5) Eccentricity		

Bearing capacity: √
Foudation Interface: Direct sliding √ Eccentricity √

#	Metal Strip Elevation [ft]	Length [ft]	Type #	(1)	(2)	(3)	(4)	(5)
1	0.50	12.54	N/A	√	√	√	√	√
2	1.40	12.54	N/A	√	√	√	√	√
3	2.30	12.54	N/A	√	√	√	√	√
4	3.20	12.54	N/A	√	√	√	√	√
5	4.10	12.54	N/A	√	√	√	√	√
6	5.00	12.54	N/A	√	√	√	√	√
7	5.90	12.54	N/A	√	√	√	√	√
8	6.80	12.54	N/A	√	√	√	√	√
9	7.70	12.54	N/A	√	√	√	√	√
10	8.60	12.54	N/A	√	√	√	√	√
11	9.50	12.54	N/A	√	√	√	√	√
12	10.40	12.54	N/A	√	√	√	√	√
13	11.30	12.54	N/A	√	√	√	√	√
14	12.20	12.54	N/A	√	√	√	√	√
15	13.10	12.54	N/A	√	√	√	√	√

BEARING CAPACITY for DESIGNED LAYOUT

	STATIC	SEISMIC	UNITS
(Water table does not affect bearing capacity)			
Factored bearing resistance. q-n	5558	4727	[lb/ft ²]
Factored bearing load, σ_V	4019.1	4726	[lb/ft ²]
Eccentricity, e	1.18	1.94	[ft]
Eccentricity, e/L	0.094	0.155	
CDR calculated	1.38	1.00	
Base length	12.54	12.54	[ft]



DIRECT SLIDING for DESIGNED LAYOUT (for METAL STRIPS reinforcements)

Specified CDR-static = 1.000 and CDR-seismic = 1.000

Along reinforced and foundation soils interface: CDR-static = 2.722 and CDR-seismic = 1.638

#	Metal strip Elevation [ft]	Metal strip Length [ft]	CDR Static	CDR Seismic	Metal strip Type #	Product name
1	0.50	12.54	2.805	1.695	N/A	---
2	1.40	12.54	2.969	1.807	N/A	---
3	2.30	12.54	3.154	1.935	N/A	---
4	3.20	12.54	3.364	2.083	N/A	---
5	4.10	12.54	3.605	2.256	N/A	---
6	5.00	12.54	3.885	2.461	N/A	---
7	5.90	12.54	4.216	2.708	N/A	---
8	6.80	12.54	4.611	3.010	N/A	---
9	7.70	12.54	5.096	3.390	N/A	---
10	8.60	12.54	5.706	3.884	N/A	---
11	9.50	12.54	6.505	4.554	N/A	---
12	10.40	12.54	7.613	5.520	N/A	---
13	11.30	12.54	9.295	7.051	N/A	---
14	12.20	12.54	12.313	9.923	N/A	---
15	13.10	12.54	20.346	17.860	N/A	---

ECCENTRICITY for DESIGNED LAYOUT (for Simplified Method)

At interface with foundation: e/L static = 0.1334, e/L seismic = 0.2291; Overturning: CDR-static = 4.52, CDR-seismic = 2.36

#	Metal strip Elevation [ft]	Metal strip Length [ft]	e / L Static	e / L Seismic	Metal strip Type #	Product name
1	0.50	12.54	0.1280	0.2166	N/A	---
2	1.40	12.54	0.1189	0.1956	N/A	---
3	2.30	12.54	0.1108	0.1764	N/A	---
4	3.20	12.54	0.1035	0.1590	N/A	---
5	4.10	12.54	0.0973	0.1435	N/A	---
6	5.00	12.54	0.0923	0.1300	N/A	---
7	5.90	12.54	0.0885	0.1186	N/A	---
8	6.80	12.54	0.0863	0.1096	N/A	---
9	7.70	12.54	0.0858	0.1033	N/A	---
10	8.60	12.54	0.0876	0.1001	N/A	---
11	9.50	12.54	0.0925	0.1008	N/A	---
12	10.40	12.54	0.1018	0.1068	N/A	---
13	11.30	12.54	0.1179	0.1205	N/A	---
14	12.20	12.54	0.1463	0.1473	N/A	---
15	13.10	12.54	0.2008	0.2010	N/A	---

RESULTS for STRENGTH [Note: Actual CDR = (Yield stress) / (Actual stress)] For Simplified Method

Live Load included in calculating Tmax

#	Metal strip Elevation [ft]	Coverage ratio, Rc=b/Sh	Horizontal spacing, Sh [ft]	LTDS = (Fy·Ac·Rc) /(b·CDR) [lb/ft]	Static/Seismic Tmax [lb/ft]	Tmd [lb/ft]	Specified minimum CDR Static	Actual calculated CDR Static	Specified minimum CDR seismic	Actual calculated CDR seismic
1	0.50	0.458	1.000	24375.0	1569/1162	0.0 /258	1.000	15.536	1.000	22.883
2	1.40	0.458	1.000	24375.0	1437/1065	0.0 /247	1.000	16.957	1.000	24.781
3	2.30	0.458	1.000	24375.0	1395/1033	0.0 /235	1.000	17.473	1.000	25.618
4	3.20	0.458	1.000	24375.0	1350/1000	0.0 /224	1.000	18.050	1.000	26.547
5	4.10	0.458	1.000	24375.0	1304/966	0.0 /213	1.000	18.694	1.000	27.580
6	5.00	0.458	1.000	24375.0	1256/930	0.0 /201	1.000	19.414	1.000	28.731
7	5.90	0.458	1.000	24375.0	1206/893	0.0 /190	1.000	20.218	1.000	30.014
8	6.80	0.458	1.000	24375.0	1154/855	0.0 /178	1.000	21.115	1.000	31.447
9	7.70	0.458	1.000	24375.0	1098/814	0.0 /176	1.000	22.190	1.000	32.844
10	8.60	0.458	1.000	24375.0	1038/769	0.0 /176	1.000	23.486	1.000	34.405
11	9.50	0.458	1.000	24375.0	977/724	0.0 /176	1.000	24.940	1.000	36.119
12	10.40	0.458	1.000	24375.0	919/681	0.0 /176	1.000	26.517	1.000	37.934
13	11.30	0.458	1.000	24375.0	867/642	0.0 /176	1.000	28.106	1.000	39.718
14	12.20	0.458	1.000	24375.0	822/609	0.0 /176	1.000	29.669	1.000	41.433
15	13.10	0.458	1.000	24375.0	1168/865	0.0 /176	1.000	20.877	1.000	31.229

RESULTS for PULLOUT

Live Load included in calculating Tmax

NOTE: Live load is not included in calculating the overburden pressure used to assess pullout resistance.

#	Metal strip Elevation [ft]	Coverage Ratio Rc=b/Sh	Tmax [lb/ft]	Tmd [lb/ft]	Le (see NOTE)	La [ft]	Avail.Static Pullout, Pr [lb/ft]	Specified Static CDR	Actual Static CDR	Avail.Seism. Pullout, Pr [lb/ft]	Specified seismic CDR	Actual seismic CDR
1	0.50	0.458	0.0 /176	0.0 /176	12.24	0.30	20109.3	1.000	17.303	21449.9	1.000	15.103
2	1.40	0.458	0.0 /176	0.0 /176	11.70	0.84	19018.1	1.000	17.861	20286.0	1.000	15.468
3	2.30	0.458	0.0 /176	0.0 /176	11.16	1.38	17805.6	1.000	17.231	18992.7	1.000	14.971
4	3.20	0.458	0.0 /176	0.0 /176	10.62	1.92	16499.0	1.000	16.494	17598.9	1.000	14.375
5	4.10	0.458	0.0 /176	0.0 /176	10.08	2.46	15099.8	1.000	15.634	16106.5	1.000	13.668
6	5.00	0.458	0.0 /176	0.0 /176	9.54	3.00	13594.6	1.000	14.617	14500.9	1.000	12.819
7	5.90	0.458	0.0 /176	0.0 /176	9.00	3.54	12058.0	1.000	13.502	12861.8	1.000	11.878
8	6.80	0.458	0.0 /176	0.0 /176	8.46	4.08	10476.4	1.000	12.252	11174.9	1.000	10.813
9	7.70	0.458	0.0 /176	0.0 /176	8.34	4.20	9429.8	1.000	11.589	10058.5	1.000	10.165
10	8.60	0.458	0.0 /176	0.0 /176	8.34	4.20	8452.5	1.000	10.995	9016.0	1.000	9.545
11	9.50	0.458	0.0 /176	0.0 /176	8.34	4.20	7363.7	1.000	10.171	7854.6	1.000	8.729
12	10.40	0.458	0.0 /176	0.0 /176	8.34	4.20	6158.4	1.000	9.044	6569.0	1.000	7.667
13	11.30	0.458	0.0 /176	0.0 /176	8.34	4.20	4750.7	1.000	7.395	5067.4	1.000	6.193
14	12.20	0.458	0.0 /176	0.0 /176	8.34	4.20	3280.7	1.000	5.391	3499.4	1.000	4.461
15	13.10	0.458	0.0 /176	0.0 /176	8.34	4.20	1664.5	1.000	1.925	1775.5	1.000	1.706

RESULTS for CONNECTION (static conditions)

Live Load included in calculating Tmax

#	Metal strip Elevation [ft]	Coverage ratio Rc=b/Sh	Horizontal spacing, Sh [ft]	Connection force, To [lb/ft]	Reduction factor for connection break, CRu	Long-term connection strength,Tac (break criterion) [lb/ft]	Metal strip long-term strength, [lb/ft]	CDR connection break		CDR Metal strip strength		Product name
								Specified	Actual	Specified	Actual	
1	0.50	0.458	1.000	1162	0.90	1503137	1670153	1.00	1293.40	1.00	1437.12	---
2	1.40	0.458	1.000	1065	0.90	1503137	1670153	1.00	1411.65	1.00	1568.50	---
3	2.30	0.458	1.000	1033	0.90	1503137	1670153	1.00	1454.62	1.00	1616.25	---
4	3.20	0.458	1.000	1000	0.90	1503137	1670153	1.00	1502.64	1.00	1669.60	---
5	4.10	0.458	1.000	966	0.90	1503137	1670153	1.00	1556.29	1.00	1729.21	---
6	5.00	0.458	1.000	930	0.90	1503137	1670153	1.00	1616.21	1.00	1795.79	---
7	5.90	0.458	1.000	893	0.90	1503137	1670153	1.00	1683.13	1.00	1870.15	---
8	6.80	0.458	1.000	855	0.90	1503137	1670153	1.00	1757.83	1.00	1953.14	---
9	7.70	0.458	1.000	814	0.90	1503137	1670153	1.00	1847.32	1.00	2052.58	---
10	8.60	0.458	1.000	769	0.90	1503137	1670153	1.00	1955.23	1.00	2172.47	---
11	9.50	0.458	1.000	724	0.90	1503137	1670153	1.00	2076.24	1.00	2306.93	---
12	10.40	0.458	1.000	681	0.90	1503137	1670153	1.00	2207.53	1.00	2452.81	---
13	11.30	0.458	1.000	642	0.90	1503137	1670153	1.00	2339.81	1.00	2599.79	---
14	12.20	0.458	1.000	609	0.90	1503137	1670153	1.00	2469.99	1.00	2744.43	---
15	13.10	0.458	1.000	865	0.90	1503137	1670153	1.00	1738.03	1.00	1931.14	---

RESULTS for CONNECTION (seismic conditions)

Live Load included in calculating Tmax

#	Metal strip Elevation [ft]	Coverage ratio Rc=b/Sh	Horizontal spacing, Sh [ft]	Connection force, To [lb/ft]	Reduction factor for connection break, CRu	Long-term connection strength,Tac (break criterion) [lb/ft]	Metal strip long-term strength, [lb/ft]	CDR connection break		CDR Metal strip strength		Product name
								Specified	Actual	Specified	Actual	
1	0.50	0.458	1.000	1420	0.90	2004183	2226870	1.00	1411.16	1.00	1567.95	---
2	1.40	0.458	1.000	1312	0.90	2004183	2226870	1.00	1528.16	1.00	1697.95	---
3	2.30	0.458	1.000	1269	0.90	2004183	2226870	1.00	1579.76	1.00	1755.29	---
4	3.20	0.458	1.000	1224	0.90	2004183	2226870	1.00	1637.07	1.00	1818.96	---
5	4.10	0.458	1.000	1178	0.90	2004183	2226870	1.00	1700.79	1.00	1889.77	---
6	5.00	0.458	1.000	1131	0.90	2004183	2226870	1.00	1771.75	1.00	1968.61	---
7	5.90	0.458	1.000	1083	0.90	2004183	2226870	1.00	1850.89	1.00	2056.54	---
8	6.80	0.458	1.000	1033	0.90	2004183	2226870	1.00	1939.25	1.00	2154.72	---
9	7.70	0.458	1.000	990	0.90	2004183	2226870	1.00	2025.39	1.00	2250.43	---
10	8.60	0.458	1.000	945	0.90	2004183	2226870	1.00	2121.68	1.00	2357.42	---
11	9.50	0.458	1.000	900	0.90	2004183	2226870	1.00	2227.33	1.00	2474.81	---
12	10.40	0.458	1.000	857	0.90	2004183	2226870	1.00	2339.26	1.00	2599.18	---
13	11.30	0.458	1.000	818	0.90	2004183	2226870	1.00	2449.32	1.00	2721.46	---
14	12.20	0.458	1.000	784	0.90	2004183	2226870	1.00	2555.04	1.00	2838.93	---
15	13.10	0.458	1.000	1041	0.90	2004183	2226870	1.00	1925.81	1.00	2139.79	---

AASHTO 2007-2010 (LRFD)
US 395
MSEW+: Update # 2022.20

PROJECT IDENTIFICATION

Title:	US 395
Project Number:	RW12
Client:	
Designer:	STC
Station Number:	4+00

Description:

Company's information:

Name:
Street:

,
Telephone #:
Fax #:
E-Mail:

File path and name: C:\Users\scrandel\OneDrive - HDR, Inc\Documents\MSEW Fi.....
.....2_Sta 400 Rev 2.BENp

Original date and time of creating this file: Tue Aug 23 12:16:07 2022

PROGRAM MODE: DESIGN
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

DESIGN DATA

DESIGN OBJECTIVES

Minimum Capacity Demand Ratio in pullout, CDR-po	1.00
Minimum Capacity Demand Ratio in direct sliding, CDR-sliding	1.00
Maximum allowable eccentricity ratio at each reinforcement level, e/L	0.2500
Minimum Capacity Demand Ratio in compound and overall failure, CDR-comp-static	1.30
Minimum Capacity Demand Ratio in compound and overall failure, CDR-comp-seismic	1.10

Prescribed minimum resistive length to prevent pullout, Le = 3.28 ft.
Prescribed minimum normalized length of each layer is: L/Hd = 0.70 --> L = 11.55 ft.
Prescribed minimum absolute total length of each layer is: L = 8.20 ft.

BEARING CAPACITY

Bearing capacity is controlled by general shear.

Maximum permissible eccentricity ratio (soil), e/L	0.2500
Min. Capacity Demand Ratio with respect to ultimate bearing capacity (Meyerhof approach)	1.00

Bearing capacity factors: Nc = 0.00 $N\gamma = 14.00$

SOIL DATA

REINFORCED SOIL

Unit weight, γ	135.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	35.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{\text{equiv.}}$	120.0 lb/ft ^{3}
Equivalent internal angle of friction, $\phi_{\text{equiv.}}$	35.0 °
Equivalent cohesion, $c_{\text{equiv.}}$	150.0 lb/ft ^{2}

Water table does not affect bearing capacity

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.2710 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

SEISMICITY (using AASHTO 2008-2010)

Peak ground acceleration coeff., A = PGA = 0.500 and Site Factor, Fpga = 1.000. Maximum ground acceleration coeff., As = 0.500
Design acceleration coefficient in Internal Stability: Kh = Am = 0.500
Design acceleration coefficient in External Stability: Kh_d = 0.249 => Kh = Am = 0.249
(Kh in External Stability is based on allowable displacement, d = 150 mm. using AASHTO 2008-2010 equation)

Kae (Kh > 0) = 0.4342 Kae (Kh = 0) = 0.2710 Δ Kae = 0.1633

DIRECT SLIDING / ECCENTRICITY

Seismic CDR is 100.0% of specified static CDR for direct sliding.
Maximum allowable eccentricity, e/L, under seismic conditions is: 0.4000

BEARING CAPACITY

Seismic CDR is 100.0% of specified static CDR for bearing capacity.
Maximum allowable eccentricity, e/L, under seismic conditions is: 0.4000

INTERNAL STABILITY

Seismic soil-metal strip friction coefficient, F* is 80.0% of its specified static value.
Seismic Capacity Demand Ratio in pullout, CDR-po, is 100.0% of its specified static value.
Seismic Capacity Demand Ratio, CDR-overall, is 100.0% of its specified static value.
The reduction of CDR pertains to metal strip strength and to connection strength for break mode of failure.

INPUT DATA: Metal strips
(Equally spaced single type reinforcement)

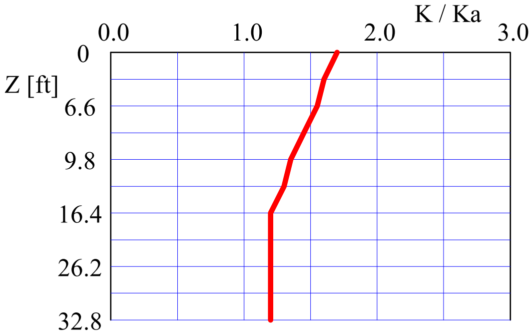
DATA	Metal strip type #1	Metal strip type #2	Metal strip type #3	Metal strip type #4	Metal strip type #5
Yield strength of steel, Fy [kips/in ^{2}]	65.0	N/A	N/A	N/A	N/A
Strength reduction factor, FS	1.000	N/A	N/A	N/A	N/A
or: Fs = 1 / FS	1.000	N/A	N/A	N/A	N/A
Gross width of strip, b [in]	5.0	N/A	N/A	N/A	N/A
Vertical spacing, Sv [ft]	1.00	N/A	N/A	N/A	N/A
Design cross section area, Ac [in ^{2}]	0.230	N/A	N/A	N/A	N/A

Ribbed steel strips.
Uniformity Coefficient of reinforced soil, Cu = D60/D10 = 4.0

Friction angle along reinforcement-soil interface,	ρ				
@ the top	60.97	N/A	N/A	N/A	N/A
@ 19.7 ft or below	32.00	N/A	N/A	N/A	N/A
Pullout resistance factor, F*					
@ the top	1.80	N/A	N/A	N/A	N/A
@ 19.7 ft or below	0.62	N/A	N/A	N/A	N/A
Scale-effect correction factor, α	1.00	N/A	N/A	N/A	N/A

Variation of Lateral Earth Pressure Coefficient With Depth

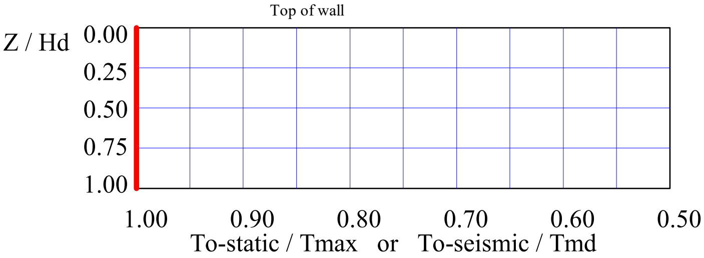
Z	K / Ka
0 ft	1.70
3.3 ft	1.60
6.6 ft	1.55
9.8 ft	1.45
13.1 ft	1.35
16.4 ft	1.30
19.7 ft	1.20



INPUT DATA: Facia and Connection (Design)

FACIA type: Segmental precast concrete panels.
Depth of panel is 1.31 ft. Horizontal distance to Center of Gravity of panel is 0.66 ft.
Average unit weight of panel is γ_f = 152.78 lb/ft ^{3}

Z / Hd	To-static / Tmax or To-seismic / Tmd
0.00	1.00
0.25	1.00
0.50	1.00
0.75	1.00
1.00	1.00



D A T A (for connection only)	Type #1	Type #2	Type #3	Type #4	Type #5
Product Name	---	N/A	N/A	N/A	N/A
Strength reduction at the connection, CRu = Fyc / Fy	0.90	N/A	N/A	N/A	N/A

INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd 16.50 [ft] { Embedded depth is E = 4.50 ft, and height above top of finished bottom grade is H = 12.00 ft }

Soil in front of the wall is inclined at 2H:1V. Hs = 6.56 ft.

Batter, ω	0.0	[deg]	
Backslope, β	0.0	[deg]	
Backslope rise	0.0	[ft]	Broken back equivalent angle, I = 0.00° (see Fig. 25 in DEMO 82)

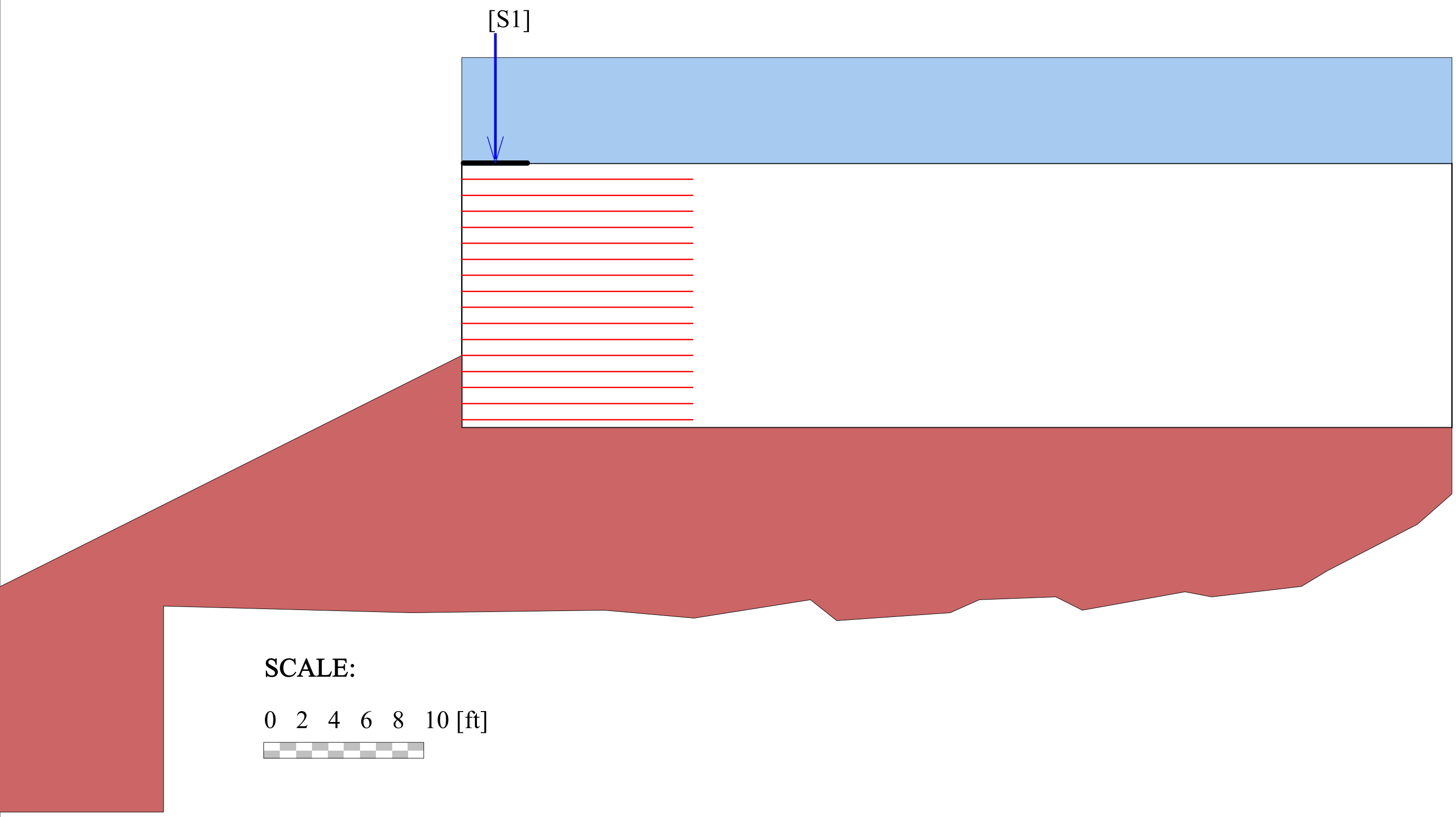
UNIFORM SURCHARGE

🟦 Uniformly distributed dead load is 0.0 [lb/ft^2], and live load is 250.0 [lb/ft^2]

OTHER EXTERNAL LOAD(S)

[S1] Strip Load, Pv-d = 2291.0 and Pv-l = 0.0 [lb/ft].
Footing width, b=4.0 [ft]. Distance of center of footing from wall face, d = 2.1 [ft] @ depth of 0.0 [ft] below soil surface.

DESIGNED REINFORCEMENT LAYOUT:



AASHTO 2007-2010 (LRFD) – Load and Resisting Factors

INTERNAL STABILITY

Load factor for vertical earth pressure, EV:	$\gamma_{p\text{-}EV}$	1.35	
Load factor for earthquake loads, EQ:	$\gamma_{p\text{-}EQ}$	1.00	
Load factor for live load surcharge, LS: (Same as in External Stability).	$\gamma_{p\text{-}LS}$	1.75	
Load factor for dead load surcharge, ES: (Same as in External Stability).	$\gamma_{p\text{-}ES}$	1.50	
Resistance factor for reinforcement tension	ϕ	Static	Combined static/seismic
Metal Strips:		0.75	1.00
Resistance factor for reinforcement tension in connectors	ϕ	Static	Combined static/seismic
Metal Strips:		0.75	1.00
Resistance factor for reinforcement pullout	ϕ	0.90	1.20

EXTERNAL STABILITY

Load factor for vertical earth pressure, EV		Static	Combined Static/Seismic	
Sliding and Eccentricity	$\gamma_{p\text{-}EV}$	1.00	$\gamma_{p\text{-}EQ}$	1.00
Bearing Capacity	$\gamma_{p\text{-}EV}$	1.35	$\gamma_{p\text{-}EQ}$	1.35

Load factor of active lateral earth pressure, EH	$\gamma_{p\text{-}EH}$	1.50
Load factor of active lateral earth pressure during earthquake (does not multiply P_{AE} and P_{IR}):	$(\gamma_{p\text{-}EH})_{EQ}$	1.50
Load factor for earthquake loads, EQ (multiplies P_{AE} and P_{IR}):	$\gamma_{p\text{-}EQ}$	1.00

Resistance factor for shear resistance along common interfaces		Static	Combined Static/Seismic
Reinforced Soil and Foundation	ϕ_{τ}	1.00	1.00
Reinforced Soil and Reinforcement	ϕ_{τ}	1.00	1.00
Resistance factor for bearing capacity of shallow foundation		Static	Combined Static/Seismic
	ϕ_{b}	0.65	0.65

REINFORCEMENT LAYOUT AND DESIGN CRITERIA

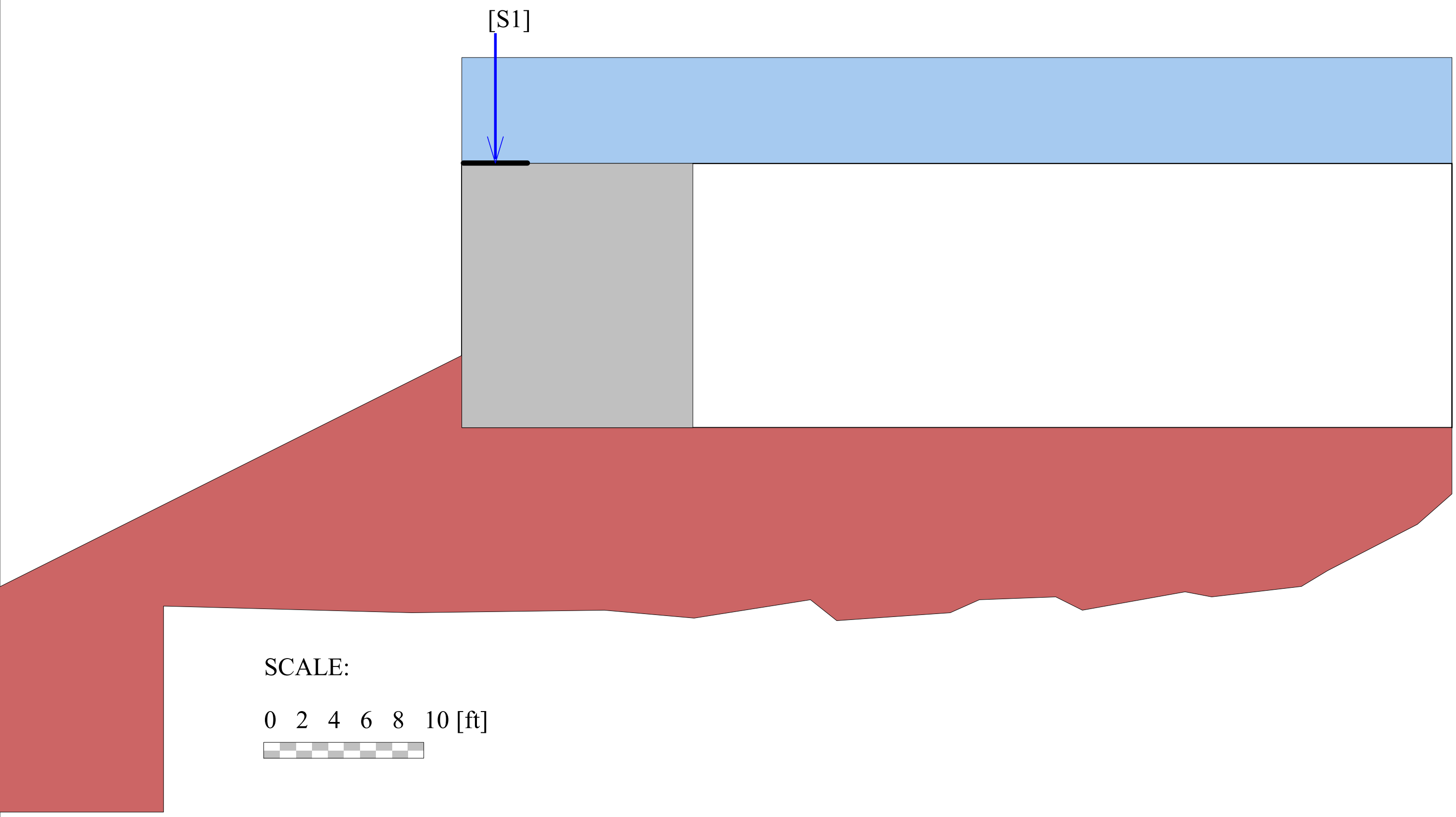
LEGEND: (1) Connection strength √ Satisfactory
(2) Metal strip strength ⊗ Unsatisfactory
(3) Pullout resistance
(4) Direct sliding
(5) Eccentricity

Bearing capacity: √
Foudation Interface: Direct sliding √ Eccentricity √

	Metal Strip							
#	Elevation [ft]	Length [ft]	Type #	(1)	(2)	(3)	(4)	(5)
1	0.50	14.43	N/A	√	√	√	√	√
2	1.50	14.43	N/A	√	√	√	√	√
3	2.50	14.43	N/A	√	√	√	√	√
4	3.50	14.43	N/A	√	√	√	√	√
5	4.50	14.43	N/A	√	√	√	√	√
6	5.50	14.43	N/A	√	√	√	√	√
7	6.50	14.43	N/A	√	√	√	√	√
8	7.50	14.43	N/A	√	√	√	√	√
9	8.50	14.43	N/A	√	√	√	√	√
10	9.50	14.43	N/A	√	√	√	√	√
11	10.50	14.43	N/A	√	√	√	√	√
12	11.50	14.43	N/A	√	√	√	√	√
13	12.50	14.43	N/A	√	√	√	√	√
14	13.50	14.43	N/A	√	√	√	√	√
15	14.50	14.43	N/A	√	√	√	√	√
16	15.50	14.43	N/A	√	√	√	√	√

BEARING CAPACITY for DESIGNED LAYOUT

	STATIC	SEISMIC	UNITS
(Water table does not affect bearing capacity)			
Factored bearing resistance. q-n	6435	5387	[lb/ft ²]
Factored bearing load, σ_V	4508.7	5386	[lb/ft ²]
Eccentricity, e	1.32	2.28	[ft]
Eccentricity, e/L	0.092	0.158	
CDR calculated	1.43	1.00	
Base length	14.43	14.43	[ft]



DIRECT SLIDING for DESIGNED LAYOUT (for METAL STRIPS reinforcements)

Specified CDR-static = 1.000 and CDR-seismic = 1.000

Along reinforced and foundation soils interface: CDR-static = 2.702 and CDR-seismic = 1.600

#	Metal strip Elevation [ft]	Metal strip Length [ft]	CDR Static	CDR Seismic	Metal strip Type #	Product name
1	0.50	14.43	2.772	1.647	N/A	---
2	1.50	14.43	2.925	1.748	N/A	---
3	2.50	14.43	3.096	1.864	N/A	---
4	3.50	14.43	3.289	1.995	N/A	---
5	4.50	14.43	3.508	2.147	N/A	---
6	5.50	14.43	3.760	2.324	N/A	---
7	6.50	14.43	4.052	2.533	N/A	---
8	7.50	14.43	4.395	2.784	N/A	---
9	8.50	14.43	4.805	3.091	N/A	---
10	9.50	14.43	5.305	3.477	N/A	---
11	10.50	14.43	5.933	3.975	N/A	---
12	11.50	14.43	6.749	4.648	N/A	---
13	12.50	14.43	7.868	5.611	N/A	---
14	13.50	14.43	9.540	7.119	N/A	---
15	14.50	14.43	12.470	9.898	N/A	---
16	15.50	14.43	20.002	17.362	N/A	---

ECCENTRICITY for DESIGNED LAYOUT (for Simplified Method)

At interface with foundation: e/L static = 0.1296, e/L seismic = 0.2322; Overturning: CDR-static = 4.50, CDR-seismic = 2.28

#	Metal strip Elevation [ft]	Metal strip Length [ft]	e / L Static	e / L Seismic	Metal strip Type #	Product name
1	0.50	14.43	0.1247	0.2210	N/A	---
2	1.50	14.43	0.1154	0.1997	N/A	---
3	2.50	14.43	0.1070	0.1800	N/A	---
4	3.50	14.43	0.0994	0.1620	N/A	---
5	4.50	14.43	0.0926	0.1456	N/A	---
6	5.50	14.43	0.0868	0.1310	N/A	---
7	6.50	14.43	0.0820	0.1182	N/A	---
8	7.50	14.43	0.0785	0.1074	N/A	---
9	8.50	14.43	0.0763	0.0988	N/A	---
10	9.50	14.43	0.0758	0.0927	N/A	---
11	10.50	14.43	0.0774	0.0895	N/A	---
12	11.50	14.43	0.0819	0.0901	N/A	---
13	12.50	14.43	0.0906	0.0956	N/A	---
14	13.50	14.43	0.1062	0.1089	N/A	---
15	14.50	14.43	0.1346	0.1357	N/A	---
16	15.50	14.43	0.1927	0.1929	N/A	---

RESULTS for STRENGTH [Note: Actual CDR = (Yield stress) / (Actual stress)] For Simplified Method

Live Load included in calculating Tmax

#	Metal strip Elevation [ft]	Coverage ratio, Rc=b/Sh	Horizontal spacing, Sh [ft]	LTDS = (Fy·Ac·Rc) /(b·CDR) [lb/ft]	Static/Seismic Tmax [lb/ft]	Tmd [lb/ft]	Specified minimum CDR Static	Actual calculated CDR Static	Specified minimum CDR seismic	Actual calculated CDR seismic
1	0.50	0.417	1.000	11212.5	1812/1342	0.0 /340	1.000	6.187	1.000	8.889
2	1.50	0.417	1.000	11212.5	1749/1295	0.0 /325	1.000	6.412	1.000	9.226
3	2.50	0.417	1.000	11212.5	1683/1246	0.0 /311	1.000	6.664	1.000	9.601
4	3.50	0.417	1.000	11212.5	1621/1201	0.0 /296	1.000	6.918	1.000	9.987
5	4.50	0.417	1.000	11212.5	1566/1160	0.0 /282	1.000	7.160	1.000	10.369
6	5.50	0.417	1.000	11212.5	1512/1120	0.0 /267	1.000	7.417	1.000	10.777
7	6.50	0.417	1.000	11212.5	1455/1077	0.0 /253	1.000	7.709	1.000	11.237
8	7.50	0.417	1.000	11212.5	1395/1033	0.0 /239	1.000	8.038	1.000	11.754
9	8.50	0.417	1.000	11212.5	1333/988	0.0 /228	1.000	8.410	1.000	12.300
10	9.50	0.417	1.000	11212.5	1269/940	0.0 /228	1.000	8.833	1.000	12.798
11	10.50	0.417	1.000	11212.5	1199/888	0.0 /228	1.000	9.353	1.000	13.399
12	11.50	0.417	1.000	11212.5	1123/832	0.0 /228	1.000	9.983	1.000	14.107
13	12.50	0.417	1.000	11212.5	1050/777	0.0 /228	1.000	10.684	1.000	14.873
14	13.50	0.417	1.000	11212.5	982/728	0.0 /228	1.000	11.413	1.000	15.646
15	14.50	0.417	1.000	11212.5	924/684	0.0 /228	1.000	12.136	1.000	16.390
16	15.50	0.417	1.000	11212.5	1303/965	0.0 /228	1.000	8.604	1.000	12.531

RESULTS for PULLOUT

Live Load included in calculating Tmax

NOTE: Live load is not included in calculating the overburden pressure used to assess pullout resistance.

#	Metal strip Elevation [ft]	Coverage Ratio Rc=b/Sh	Tmax [lb/ft]	Tmd [lb/ft]	Le (see NOTE)	La [ft]	Avail.Static Pullout, Pr [lb/ft]	Specified Static CDR	Actual Static CDR	Avail.Seism. Pullout, Pr [lb/ft]	Specified seismic CDR	Actual seismic CDR
1	0.50	0.417	0.0 /228	0.0 /228	14.13	0.30	20734.0	1.000	15.446	22116.3	1.000	13.150
2	1.50	0.417	0.0 /228	0.0 /228	13.53	0.90	19998.1	1.000	15.440	21331.3	1.000	13.165
3	2.50	0.417	0.0 /228	0.0 /228	12.93	1.50	19096.2	1.000	15.321	20369.2	1.000	13.082
4	3.50	0.417	0.0 /228	0.0 /228	12.33	2.10	18014.7	1.000	15.004	19215.6	1.000	12.837
5	4.50	0.417	0.0 /228	0.0 /228	11.73	2.70	16780.1	1.000	14.466	17898.8	1.000	12.414
6	5.50	0.417	0.0 /228	0.0 /228	11.13	3.30	15457.7	1.000	13.805	16488.3	1.000	11.886
7	6.50	0.417	0.0 /228	0.0 /228	10.53	3.90	13993.4	1.000	12.987	14926.3	1.000	11.219
8	7.50	0.417	0.0 /228	0.0 /228	9.93	4.50	12427.1	1.000	12.026	13255.6	1.000	10.422
9	8.50	0.417	0.0 /228	0.0 /228	9.48	4.95	11038.1	1.000	11.176	11773.9	1.000	9.687
10	9.50	0.417	0.0 /228	0.0 /228	9.48	4.95	10115.8	1.000	10.758	10790.2	1.000	9.237
11	10.50	0.417	0.0 /228	0.0 /228	9.48	4.95	9056.7	1.000	10.199	9660.4	1.000	8.658
12	11.50	0.417	0.0 /228	0.0 /228	9.48	4.95	7855.7	1.000	9.442	8379.4	1.000	7.907
13	12.50	0.417	0.0 /228	0.0 /228	9.48	4.95	6433.6	1.000	8.276	6862.5	1.000	6.827
14	13.50	0.417	0.0 /228	0.0 /228	9.48	4.95	4917.0	1.000	6.757	5244.8	1.000	5.489
15	14.50	0.417	0.0 /228	0.0 /228	9.48	4.95	3228.6	1.000	4.718	3443.8	1.000	3.775
16	15.50	0.417	0.0 /228	0.0 /228	9.48	4.95	1671.7	1.000	1.732	1783.2	1.000	1.495

RESULTS for CONNECTION (static conditions)

Live Load included in calculating Tmax

#	Metal strip Elevation [ft]	Coverage ratio Rc=b/Sh	Horizontal spacing, Sh [ft]	Connection force, To [lb/ft]	Reduction factor for connection break, CRu	Long-term connection strength,Tac (break criterion) [lb/ft]	Metal strip long-term strength, [lb/ft]	CDR connection break		CDR Metal strip strength		Product name
								Specified	Actual	Specified	Actual	
1	0.50	0.417	1.000	1342	0.90	691443	768270	1.00	515.11	1.00	572.35	---
2	1.50	0.417	1.000	1295	0.90	691443	768270	1.00	533.83	1.00	593.14	---
3	2.50	0.417	1.000	1246	0.90	691443	768270	1.00	554.76	1.00	616.40	---
4	3.50	0.417	1.000	1201	0.90	691443	768270	1.00	575.91	1.00	639.89	---
5	4.50	0.417	1.000	1160	0.90	691443	768270	1.00	596.09	1.00	662.32	---
6	5.50	0.417	1.000	1120	0.90	691443	768270	1.00	617.51	1.00	686.12	---
7	6.50	0.417	1.000	1077	0.90	691443	768270	1.00	641.74	1.00	713.04	---
8	7.50	0.417	1.000	1033	0.90	691443	768270	1.00	669.14	1.00	743.48	---
9	8.50	0.417	1.000	988	0.90	691443	768270	1.00	700.11	1.00	777.90	---
10	9.50	0.417	1.000	940	0.90	691443	768270	1.00	735.32	1.00	817.02	---
11	10.50	0.417	1.000	888	0.90	691443	768270	1.00	778.67	1.00	865.19	---
12	11.50	0.417	1.000	832	0.90	691443	768270	1.00	831.10	1.00	923.45	---
13	12.50	0.417	1.000	777	0.90	691443	768270	1.00	889.42	1.00	988.24	---
14	13.50	0.417	1.000	728	0.90	691443	768270	1.00	950.12	1.00	1055.69	---
15	14.50	0.417	1.000	684	0.90	691443	768270	1.00	1010.33	1.00	1122.59	---
16	15.50	0.417	1.000	965	0.90	691443	768270	1.00	716.32	1.00	795.91	---

RESULTS for CONNECTION (seismic conditions)

Live Load included in calculating Tmax

#	Metal strip Elevation [ft]	Coverage ratio Rc=b/Sh	Horizontal spacing, Sh [ft]	Connection force, To [lb/ft]	Reduction factor for connection break, CRu	Long-term connection strength,Tac (break criterion) [lb/ft]	Metal strip long-term strength, [lb/ft]	CDR connection break		CDR Metal strip strength		Product name
								Specified	Actual	Specified	Actual	
1	0.50	0.417	1.000	1682	0.90	921924	1024360	1.00	548.16	1.00	609.07	---
2	1.50	0.417	1.000	1620	0.90	921924	1024360	1.00	568.96	1.00	632.18	---
3	2.50	0.417	1.000	1557	0.90	921924	1024360	1.00	592.09	1.00	657.88	---
4	3.50	0.417	1.000	1497	0.90	921924	1024360	1.00	615.89	1.00	684.33	---
5	4.50	0.417	1.000	1442	0.90	921924	1024360	1.00	639.42	1.00	710.47	---
6	5.50	0.417	1.000	1387	0.90	921924	1024360	1.00	664.61	1.00	738.46	---
7	6.50	0.417	1.000	1330	0.90	921924	1024360	1.00	692.93	1.00	769.92	---
8	7.50	0.417	1.000	1272	0.90	921924	1024360	1.00	724.82	1.00	805.35	---
9	8.50	0.417	1.000	1215	0.90	921924	1024360	1.00	758.53	1.00	842.81	---
10	9.50	0.417	1.000	1168	0.90	921924	1024360	1.00	789.24	1.00	876.93	---
11	10.50	0.417	1.000	1116	0.90	921924	1024360	1.00	826.27	1.00	918.08	---
12	11.50	0.417	1.000	1060	0.90	921924	1024360	1.00	869.95	1.00	966.61	---
13	12.50	0.417	1.000	1005	0.90	921924	1024360	1.00	917.16	1.00	1019.06	---
14	13.50	0.417	1.000	956	0.90	921924	1024360	1.00	964.83	1.00	1072.04	---
15	14.50	0.417	1.000	912	0.90	921924	1024360	1.00	1010.71	1.00	1123.01	---
16	15.50	0.417	1.000	1193	0.90	921924	1024360	1.00	772.74	1.00	858.60	---

AASHTO 2007-2010 (LRFD)
US 395
MSEW+: Update # 2022.20

PROJECT IDENTIFICATION

Title:	US 395
Project Number:	RW12
Client:	
Designer:	STC
Station Number:	7+00

Description:

Company's information:

Name:
Street:

,
Telephone #:
Fax #:
E-Mail:

File path and name: C:\Users\scrandel\OneDrive - HDR, Inc\Documents\MSEW Fi.....
.....2_Sta 700 Rev 2.BENp

Original date and time of creating this file: Tue Aug 23 12:16:07 2022

PROGRAM MODE: DESIGN
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

DESIGN DATA

DESIGN OBJECTIVES

Minimum Capacity Demand Ratio in pullout, CDR-po	1.00
Minimum Capacity Demand Ratio in direct sliding, CDR-sliding	1.00
Maximum allowable eccentricity ratio at each reinforcement level, e/L	0.2500
Minimum Capacity Demand Ratio in compound and overall failure, CDR-comp-static	1.30
Minimum Capacity Demand Ratio in compound and overall failure, CDR-comp-seismic	1.10

Prescribed minimum resistive length to prevent pullout, Le = 3.28 ft.
Prescribed minimum normalized length of each layer is: L/Hd = 0.70 --> L = 9.80 ft.
Prescribed minimum absolute total length of each layer is: L = 8.20 ft.

BEARING CAPACITY

Bearing capacity is controlled by general shear.

Maximum permissible eccentricity ratio (soil), e/L	0.2500
Min. Capacity Demand Ratio with respect to ultimate bearing capacity (Meyerhof approach)	1.00

Bearing capacity factors: Nc = 0.00 N γ= 14.00

SOIL DATA

REINFORCED SOIL

Unit weight, γ	135.0 lb/ft ³
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft ³
Design value of internal angle of friction, ϕ	35.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{equiv.}$	120.0 lb/ft ³
Equivalent internal angle of friction, $\phi_{equiv.}$	35.0 °
Equivalent cohesion, $c_{equiv.}$	150.0 lb/ft ²

Water table does not affect bearing capacity

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.2710 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

SEISMICITY (using AASHTO 2008-2010)

Peak ground acceleration coeff., A = PGA = 0.500 and Site Factor, Fpga = 1.000. Maximum ground acceleration coeff., As = 0.500
Design acceleration coefficient in Internal Stability: Kh = Am = 0.500
Design acceleration coefficient in External Stability: Kh_d = 0.249 => Kh = Am = 0.249
(Kh in External Stability is based on allowable displacement, d = 150 mm. using AASHTO 2008-2010 equation)

Kae (Kh > 0) = 0.4342 Kae (Kh = 0) = 0.2710 Δ Kae = 0.1633

DIRECT SLIDING / ECCENTRICITY

Seismic CDR is 100.0% of specified static CDR for direct sliding.
Maximum allowable eccentricity, e/L, under seismic conditions is: 0.4000

BEARING CAPACITY

Seismic CDR is 100.0% of specified static CDR for bearing capacity.
Maximum allowable eccentricity, e/L, under seismic conditions is: 0.4000

INTERNAL STABILITY

Seismic soil-metal strip friction coefficient, F* is 80.0% of its specified static value.
Seismic Capacity Demand Ratio in pullout, CDR-po, is 100.0% of its specified static value.
Seismic Capacity Demand Ratio, CDR-overall, is 100.0% of its specified static value.
The reduction of CDR pertains to metal strip strength and to connection strength for break mode of failure.

INPUT DATA: Metal strips
(Equally spaced single type reinforcement)

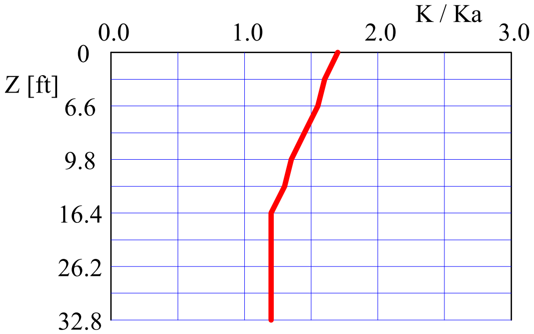
D A T A	Metal strip type #1	Metal strip type #2	Metal strip type #3	Metal strip type #4	Metal strip type #5
Yield strength of steel, Fy [kips/in ^{2}]	65.0	N/A	N/A	N/A	N/A
Strength reduction factor, FS	1.000	N/A	N/A	N/A	N/A
or: Fs = 1 / FS	1.000	N/A	N/A	N/A	N/A
Gross width of strip, b [in]	5.5	N/A	N/A	N/A	N/A
Vertical spacing, Sv [ft]	0.90	N/A	N/A	N/A	N/A
Design cross section area, Ac [in ^{2}]	0.500	N/A	N/A	N/A	N/A

Ribbed steel strips.
Uniformity Coefficient of reinforced soil, Cu = D60/D10 = 4.0

Friction angle along reinforcement-soil interface,	ρ				
@ the top	60.97	N/A	N/A	N/A	N/A
@ 19.7 ft or below	32.00	N/A	N/A	N/A	N/A
Pullout resistance factor, F*					
@ the top	1.80	N/A	N/A	N/A	N/A
@ 19.7 ft or below	0.62	N/A	N/A	N/A	N/A
Scale-effect correction factor, α	1.00	N/A	N/A	N/A	N/A

Variation of Lateral Earth Pressure Coefficient With Depth

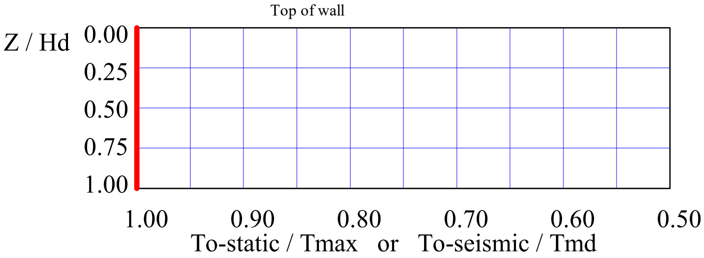
Z	K / Ka
0 ft	1.70
3.3 ft	1.60
6.6 ft	1.55
9.8 ft	1.45
13.1 ft	1.35
16.4 ft	1.30
19.7 ft	1.20



INPUT DATA: Facia and Connection (Design)

FACIA type: Segmental precast concrete panels.
Depth of panel is 1.31 ft. Horizontal distance to Center of Gravity of panel is 0.66 ft.
Average unit weight of panel is $\gamma_f = 152.78$ lb/ft ^{3}

Z / Hd	To-static / Tmax or To-seismic / Tmd
0.00	1.00
0.25	1.00
0.50	1.00
0.75	1.00
1.00	1.00



D A T A (for connection only)	Type #1	Type #2	Type #3	Type #4	Type #5
Product Name	---	N/A	N/A	N/A	N/A
Strength reduction at the connection, CRu = Fyc / Fy	0.90	N/A	N/A	N/A	N/A

INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd 14.00 [ft] { Embedded depth is E = 4.50 ft, and height above top of finished bottom grade is H = 9.50 ft }
Soil in front of the wall is inclined at 2H:1V. Hs = 6.56 ft.

Batter, ω	0.0	[deg]	
Backslope, β	0.0	[deg]	
Backslope rise	0.0	[ft]	Broken back equivalent angle, I = 0.00° (see Fig. 25 in DEMO 82)

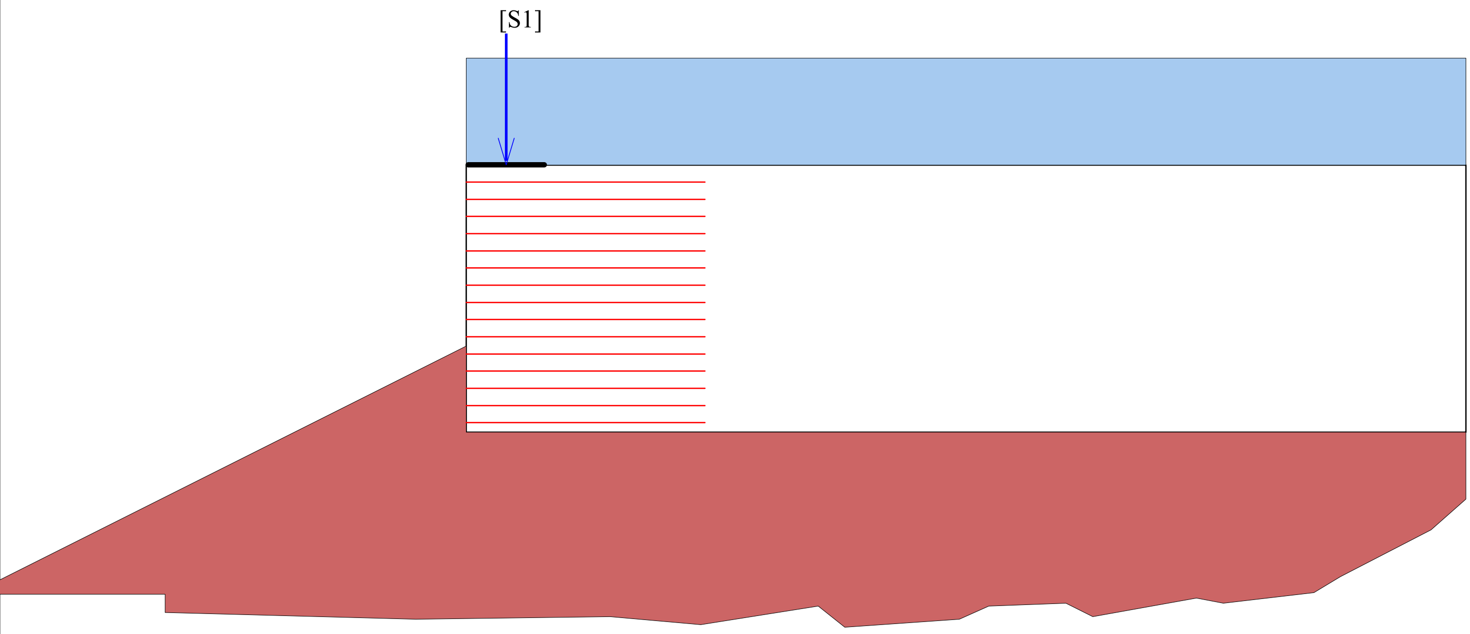
UNIFORM SURCHARGE

🟦 Uniformly distributed dead load is 0.0 [lb/ft ^{2}], and live load is 250.0 [lb/ft ^{2}]

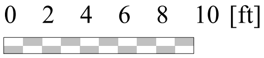
OTHER EXTERNAL LOAD(S)

[S1] Strip Load, Pv-d = 2291.0 and Pv-l = 0.0 [lb/ft].
Footing width, b=4.0 [ft]. Distance of center of footing from wall face, d = 2.1 [ft] @ depth of 0.0 [ft] below soil surface.

DESIGNED REINFORCEMENT LAYOUT:



SCALE:



AASHTO 2007-2010 (LRFD) – Load and Resisting Factors

INTERNAL STABILITY

Load factor for vertical earth pressure, EV:	$\gamma_{p\text{-}EV}$	1.35
Load factor for earthquake loads, EQ:	$\gamma_{p\text{-}EQ}$	1.00
Load factor for live load surcharge, LS: (Same as in External Stability).	$\gamma_{p\text{-}LS}$	1.75
Load factor for dead load surcharge, ES: (Same as in External Stability).	$\gamma_{p\text{-}ES}$	1.50

		Static	Combined static/seismic
Resistance factor for reinforcement tension	ϕ	Static	Combined static/seismic
Metal Strips:		0.75	1.00
Resistance factor for reinforcement tension in connectors	ϕ	Static	Combined static/seismic
Metal Strips:		0.75	1.00
Resistance factor for reinforcement pullout	ϕ	0.90	1.20

EXTERNAL STABILITY

Load factor for vertical earth pressure, EV		Static		Combined Static/Seismic
Sliding and Eccentricity	$\gamma_{p\text{-}EV}$	1.00	$\gamma_{p\text{-}EQ}$	1.00
Bearing Capacity	$\gamma_{p\text{-}EV}$	1.35	$\gamma_{p\text{-}EQ}$	1.35

Load factor of active lateral earth pressure, EH	$\gamma_{p\text{-}EH}$	1.50
Load factor of active lateral earth pressure during earthquake (does not multiply P_{AE} and P_{IR}):	$(\gamma_{p\text{-}EH})_{EQ}$	1.50
Load factor for earthquake loads, EQ (multiplies P_{AE} and P_{IR}):	$\gamma_{p\text{-}EQ}$	1.00

Resistance factor for shear resistance along common interfaces		Static	Combined Static/Seismic
Reinforced Soil and Foundation	ϕ_{τ}	1.00	1.00
Reinforced Soil and Reinforcement	ϕ_{τ}	1.00	1.00

Resistance factor for bearing capacity of shallow foundation		Static	Combined Static/Seismic
	ϕ_{b}	0.65	0.65

REINFORCEMENT LAYOUT AND DESIGN CRITERIA

LEGEND:
(1) Connection strength
(2) Metal strip strength
(3) Pullout resistance
(4) Direct sliding
(5) Eccentricity

√ Satisfactory
⊗ Unsatisfactory

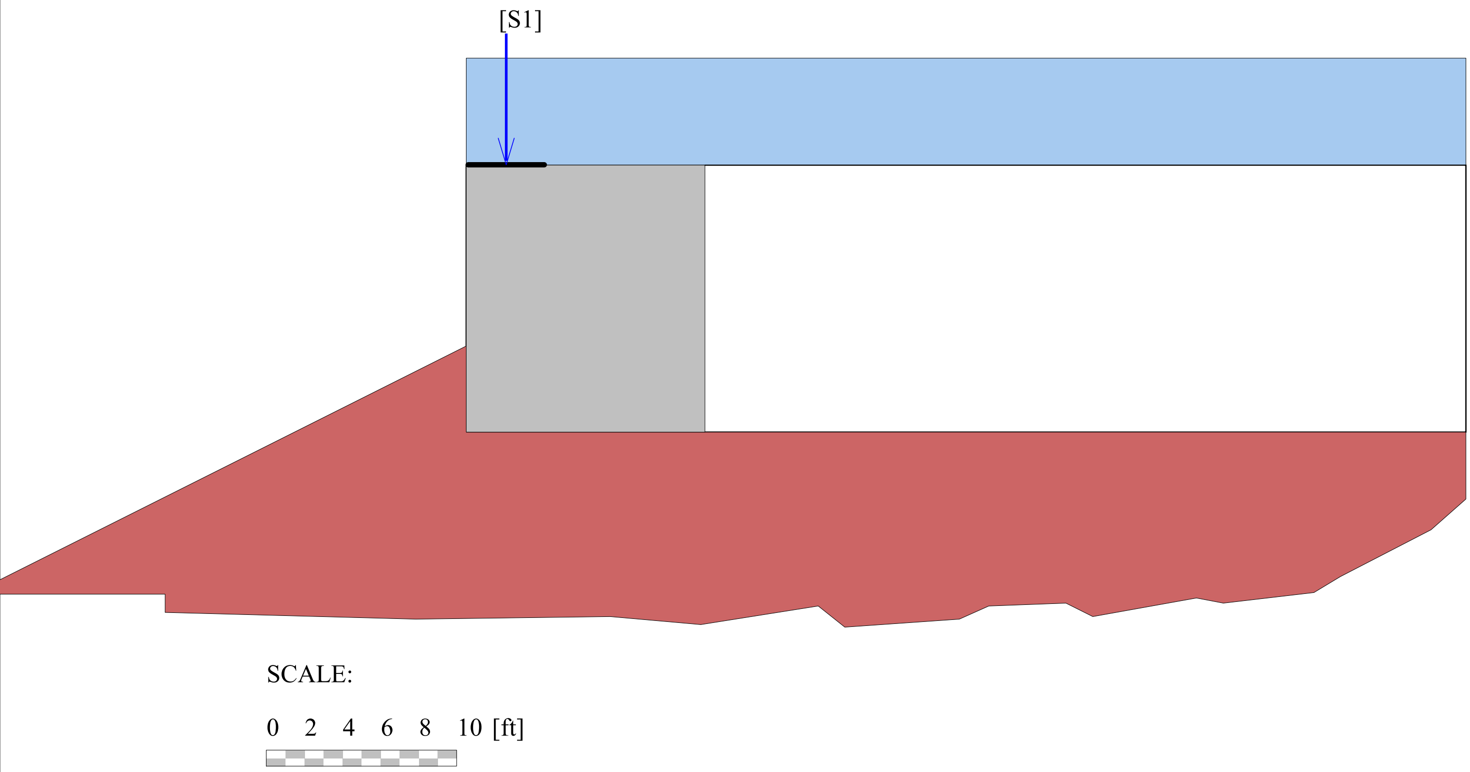
Bearing capacity: √
Foudation Interface: Direct sliding √ Eccentricity √

Metal Strip

#	Elevation [ft]	Length [ft]	Type #	(1)	(2)	(3)	(4)	(5)
1	0.50	12.54	N/A	√	√	√	√	√
2	1.40	12.54	N/A	√	√	√	√	√
3	2.30	12.54	N/A	√	√	√	√	√
4	3.20	12.54	N/A	√	√	√	√	√
5	4.10	12.54	N/A	√	√	√	√	√
6	5.00	12.54	N/A	√	√	√	√	√
7	5.90	12.54	N/A	√	√	√	√	√
8	6.80	12.54	N/A	√	√	√	√	√
9	7.70	12.54	N/A	√	√	√	√	√
10	8.60	12.54	N/A	√	√	√	√	√
11	9.50	12.54	N/A	√	√	√	√	√
12	10.40	12.54	N/A	√	√	√	√	√
13	11.30	12.54	N/A	√	√	√	√	√
14	12.20	12.54	N/A	√	√	√	√	√
15	13.10	12.54	N/A	√	√	√	√	√

BEARING CAPACITY for DESIGNED LAYOUT

	STATIC	SEISMIC	UNITS
(Water table does not affect bearing capacity)			
Factored bearing resistance. q-n	5558	4727	[lb/ft ²]
Factored bearing load, σ_V	4019.1	4726	[lb/ft ²]
Eccentricity, e	1.18	1.94	[ft]
Eccentricity, e/L	0.094	0.155	
CDR calculated	1.38	1.00	
Base length	12.54	12.54	[ft]



DIRECT SLIDING for DESIGNED LAYOUT (for METAL STRIPS reinforcements)

Specified CDR-static = 1.000 and CDR-seismic = 1.000

Along reinforced and foundation soils interface: CDR-static = 2.722 and CDR-seismic = 1.638

#	Metal strip Elevation [ft]	Metal strip Length [ft]	CDR Static	CDR Seismic	Metal strip Type #	Product name
1	0.50	12.54	2.805	1.695	N/A	---
2	1.40	12.54	2.969	1.807	N/A	---
3	2.30	12.54	3.154	1.935	N/A	---
4	3.20	12.54	3.364	2.083	N/A	---
5	4.10	12.54	3.605	2.256	N/A	---
6	5.00	12.54	3.885	2.461	N/A	---
7	5.90	12.54	4.216	2.708	N/A	---
8	6.80	12.54	4.611	3.010	N/A	---
9	7.70	12.54	5.096	3.390	N/A	---
10	8.60	12.54	5.706	3.884	N/A	---
11	9.50	12.54	6.505	4.554	N/A	---
12	10.40	12.54	7.613	5.520	N/A	---
13	11.30	12.54	9.295	7.051	N/A	---
14	12.20	12.54	12.313	9.923	N/A	---
15	13.10	12.54	20.346	17.860	N/A	---

ECCENTRICITY for DESIGNED LAYOUT (for Simplified Method)

At interface with foundation: e/L static = 0.1334, e/L seismic = 0.2291; Overturning: CDR-static = 4.52, CDR-seismic = 2.36

#	Metal strip Elevation [ft]	Metal strip Length [ft]	e / L Static	e / L Seismic	Metal strip Type #	Product name
1	0.50	12.54	0.1280	0.2166	N/A	---
2	1.40	12.54	0.1189	0.1956	N/A	---
3	2.30	12.54	0.1108	0.1764	N/A	---
4	3.20	12.54	0.1035	0.1590	N/A	---
5	4.10	12.54	0.0973	0.1435	N/A	---
6	5.00	12.54	0.0923	0.1300	N/A	---
7	5.90	12.54	0.0885	0.1186	N/A	---
8	6.80	12.54	0.0863	0.1096	N/A	---
9	7.70	12.54	0.0858	0.1033	N/A	---
10	8.60	12.54	0.0876	0.1001	N/A	---
11	9.50	12.54	0.0925	0.1008	N/A	---
12	10.40	12.54	0.1018	0.1068	N/A	---
13	11.30	12.54	0.1179	0.1205	N/A	---
14	12.20	12.54	0.1463	0.1473	N/A	---
15	13.10	12.54	0.2008	0.2010	N/A	---

RESULTS for STRENGTH [Note: Actual CDR = (Yield stress) / (Actual stress)] For Simplified Method

Live Load included in calculating Tmax

#	Metal strip Elevation [ft]	Coverage ratio, Rc=b/Sh	Horizontal spacing, Sh [ft]	LTDS = (Fy·Ac·Rc) /(b·CDR) [lb/ft]	Static/Seismic Tmax [lb/ft]	Tmd [lb/ft]	Specified minimum CDR Static	Actual calculated CDR Static	Specified minimum CDR seismic	Actual calculated CDR seismic
1	0.50	0.458	1.000	24375.0	1569/1162	0.0 /258	1.000	15.536	1.000	22.883
2	1.40	0.458	1.000	24375.0	1437/1065	0.0 /247	1.000	16.957	1.000	24.781
3	2.30	0.458	1.000	24375.0	1395/1033	0.0 /235	1.000	17.473	1.000	25.618
4	3.20	0.458	1.000	24375.0	1350/1000	0.0 /224	1.000	18.050	1.000	26.547
5	4.10	0.458	1.000	24375.0	1304/966	0.0 /213	1.000	18.694	1.000	27.580
6	5.00	0.458	1.000	24375.0	1256/930	0.0 /201	1.000	19.414	1.000	28.731
7	5.90	0.458	1.000	24375.0	1206/893	0.0 /190	1.000	20.218	1.000	30.014
8	6.80	0.458	1.000	24375.0	1154/855	0.0 /178	1.000	21.115	1.000	31.447
9	7.70	0.458	1.000	24375.0	1098/814	0.0 /176	1.000	22.190	1.000	32.844
10	8.60	0.458	1.000	24375.0	1038/769	0.0 /176	1.000	23.486	1.000	34.405
11	9.50	0.458	1.000	24375.0	977/724	0.0 /176	1.000	24.940	1.000	36.119
12	10.40	0.458	1.000	24375.0	919/681	0.0 /176	1.000	26.517	1.000	37.934
13	11.30	0.458	1.000	24375.0	867/642	0.0 /176	1.000	28.106	1.000	39.718
14	12.20	0.458	1.000	24375.0	822/609	0.0 /176	1.000	29.669	1.000	41.433
15	13.10	0.458	1.000	24375.0	1168/865	0.0 /176	1.000	20.877	1.000	31.229

RESULTS for PULLOUT

Live Load included in calculating Tmax

NOTE: Live load is not included in calculating the overburden pressure used to assess pullout resistance.

#	Metal strip Elevation [ft]	Coverage Ratio Rc=b/Sh	Tmax [lb/ft]	Tmd [lb/ft]	Le (see NOTE)	La [ft]	Avail.Static Pullout, Pr [lb/ft]	Specified Static CDR	Actual Static CDR	Avail.Seism. Pullout, Pr [lb/ft]	Specified seismic CDR	Actual seismic CDR
1	0.50	0.458	0.0 /176	0.0 /176	12.24	0.30	20109.3	1.000	17.303	21449.9	1.000	15.103
2	1.40	0.458	0.0 /176	0.0 /176	11.70	0.84	19018.1	1.000	17.861	20286.0	1.000	15.468
3	2.30	0.458	0.0 /176	0.0 /176	11.16	1.38	17805.6	1.000	17.231	18992.7	1.000	14.971
4	3.20	0.458	0.0 /176	0.0 /176	10.62	1.92	16499.0	1.000	16.494	17598.9	1.000	14.375
5	4.10	0.458	0.0 /176	0.0 /176	10.08	2.46	15099.8	1.000	15.634	16106.5	1.000	13.668
6	5.00	0.458	0.0 /176	0.0 /176	9.54	3.00	13594.6	1.000	14.617	14500.9	1.000	12.819
7	5.90	0.458	0.0 /176	0.0 /176	9.00	3.54	12058.0	1.000	13.502	12861.8	1.000	11.878
8	6.80	0.458	0.0 /176	0.0 /176	8.46	4.08	10476.4	1.000	12.252	11174.9	1.000	10.813
9	7.70	0.458	0.0 /176	0.0 /176	8.34	4.20	9429.8	1.000	11.589	10058.5	1.000	10.165
10	8.60	0.458	0.0 /176	0.0 /176	8.34	4.20	8452.5	1.000	10.995	9016.0	1.000	9.545
11	9.50	0.458	0.0 /176	0.0 /176	8.34	4.20	7363.7	1.000	10.171	7854.6	1.000	8.729
12	10.40	0.458	0.0 /176	0.0 /176	8.34	4.20	6158.4	1.000	9.044	6569.0	1.000	7.667
13	11.30	0.458	0.0 /176	0.0 /176	8.34	4.20	4750.7	1.000	7.395	5067.4	1.000	6.193
14	12.20	0.458	0.0 /176	0.0 /176	8.34	4.20	3280.7	1.000	5.391	3499.4	1.000	4.461
15	13.10	0.458	0.0 /176	0.0 /176	8.34	4.20	1664.5	1.000	1.925	1775.5	1.000	1.706

RESULTS for CONNECTION (static conditions)

Live Load included in calculating Tmax

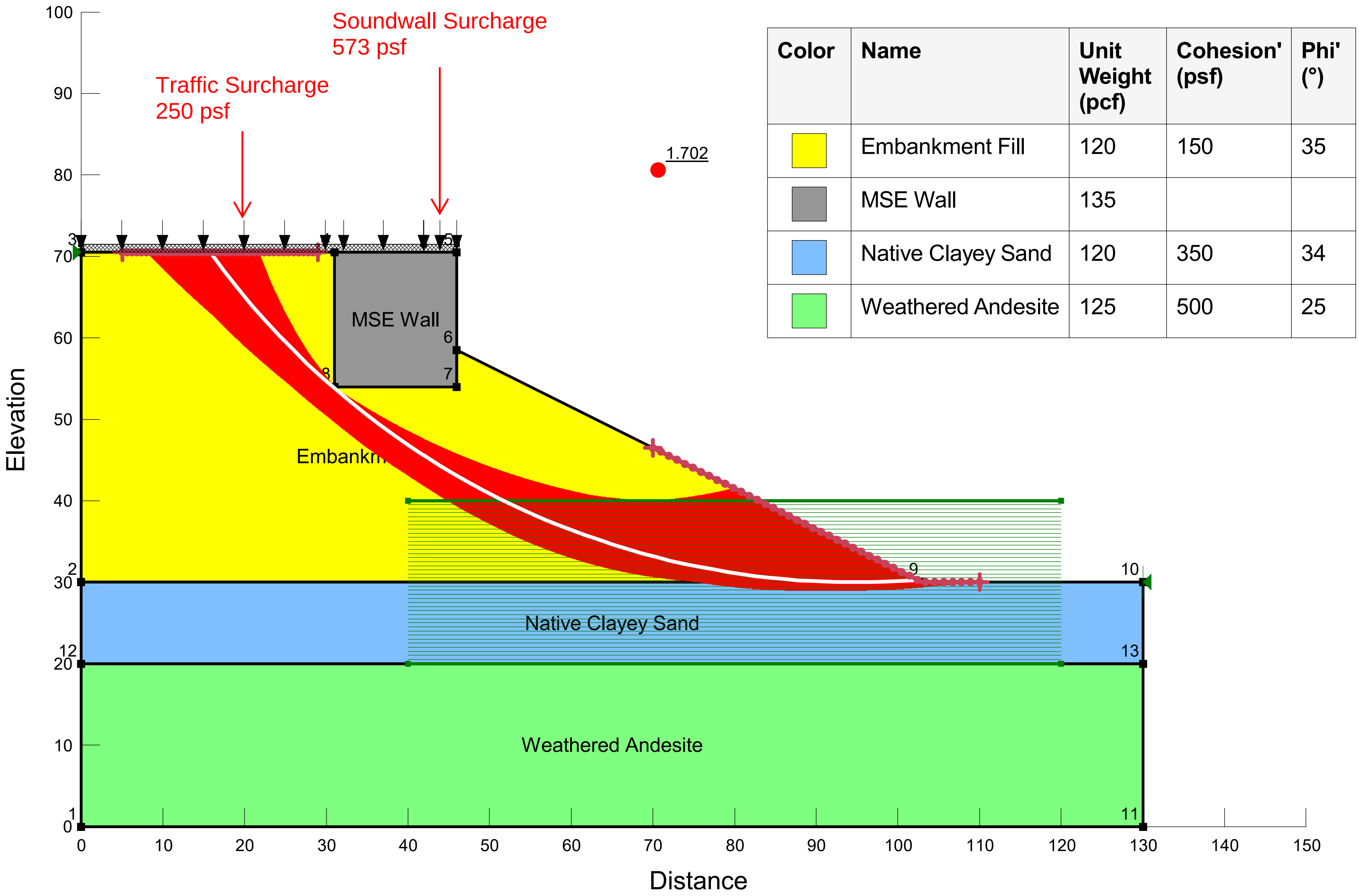
#	Metal strip Elevation [ft]	Coverage ratio Rc=b/Sh	Horizontal spacing, Sh [ft]	Connection force, To [lb/ft]	Reduction factor for connection break, CRu	Long-term connection strength,Tac (break criterion) [lb/ft]	Metal strip long-term strength, [lb/ft]	CDR connection break		CDR Metal strip strength		Product name
								Specified	Actual	Specified	Actual	
1	0.50	0.458	1.000	1162	0.90	1503137	1670153	1.00	1293.40	1.00	1437.12	---
2	1.40	0.458	1.000	1065	0.90	1503137	1670153	1.00	1411.65	1.00	1568.50	---
3	2.30	0.458	1.000	1033	0.90	1503137	1670153	1.00	1454.62	1.00	1616.25	---
4	3.20	0.458	1.000	1000	0.90	1503137	1670153	1.00	1502.64	1.00	1669.60	---
5	4.10	0.458	1.000	966	0.90	1503137	1670153	1.00	1556.29	1.00	1729.21	---
6	5.00	0.458	1.000	930	0.90	1503137	1670153	1.00	1616.21	1.00	1795.79	---
7	5.90	0.458	1.000	893	0.90	1503137	1670153	1.00	1683.13	1.00	1870.15	---
8	6.80	0.458	1.000	855	0.90	1503137	1670153	1.00	1757.83	1.00	1953.14	---
9	7.70	0.458	1.000	814	0.90	1503137	1670153	1.00	1847.32	1.00	2052.58	---
10	8.60	0.458	1.000	769	0.90	1503137	1670153	1.00	1955.23	1.00	2172.47	---
11	9.50	0.458	1.000	724	0.90	1503137	1670153	1.00	2076.24	1.00	2306.93	---
12	10.40	0.458	1.000	681	0.90	1503137	1670153	1.00	2207.53	1.00	2452.81	---
13	11.30	0.458	1.000	642	0.90	1503137	1670153	1.00	2339.81	1.00	2599.79	---
14	12.20	0.458	1.000	609	0.90	1503137	1670153	1.00	2469.99	1.00	2744.43	---
15	13.10	0.458	1.000	865	0.90	1503137	1670153	1.00	1738.03	1.00	1931.14	---

RESULTS for CONNECTION (seismic conditions)

Live Load included in calculating Tmax

#	Metal strip Elevation [ft]	Coverage ratio Rc=b/Sh	Horizontal spacing, Sh [ft]	Connection force, To [lb/ft]	Reduction factor for connection break, CRu	Long-term connection strength,Tac (break criterion) [lb/ft]	Metal strip long-term strength, [lb/ft]	CDR connection break		CDR Metal strip strength		Product name
								Specified	Actual	Specified	Actual	
1	0.50	0.458	1.000	1420	0.90	2004183	2226870	1.00	1411.16	1.00	1567.95	---
2	1.40	0.458	1.000	1312	0.90	2004183	2226870	1.00	1528.16	1.00	1697.95	---
3	2.30	0.458	1.000	1269	0.90	2004183	2226870	1.00	1579.76	1.00	1755.29	---
4	3.20	0.458	1.000	1224	0.90	2004183	2226870	1.00	1637.07	1.00	1818.96	---
5	4.10	0.458	1.000	1178	0.90	2004183	2226870	1.00	1700.79	1.00	1889.77	---
6	5.00	0.458	1.000	1131	0.90	2004183	2226870	1.00	1771.75	1.00	1968.61	---
7	5.90	0.458	1.000	1083	0.90	2004183	2226870	1.00	1850.89	1.00	2056.54	---
8	6.80	0.458	1.000	1033	0.90	2004183	2226870	1.00	1939.25	1.00	2154.72	---
9	7.70	0.458	1.000	990	0.90	2004183	2226870	1.00	2025.39	1.00	2250.43	---
10	8.60	0.458	1.000	945	0.90	2004183	2226870	1.00	2121.68	1.00	2357.42	---
11	9.50	0.458	1.000	900	0.90	2004183	2226870	1.00	2227.33	1.00	2474.81	---
12	10.40	0.458	1.000	857	0.90	2004183	2226870	1.00	2339.26	1.00	2599.18	---
13	11.30	0.458	1.000	818	0.90	2004183	2226870	1.00	2449.32	1.00	2721.46	---
14	12.20	0.458	1.000	784	0.90	2004183	2226870	1.00	2555.04	1.00	2838.93	---
15	13.10	0.458	1.000	1041	0.90	2004183	2226870	1.00	1925.81	1.00	2139.79	---

Station 4+00



Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
🟨	Embankment Fill	120	150	35
⬛	MSE Wall	135		
🟦	Native Clayey Sand	120	350	34
🟩	Weathered Andesite	125	500	25

SLOPE/W Analysis

File Information

- File Version: 10.01
- Created By: Crandell, Sterling
- Last Edited By: Crandell, Sterling
- Revision Number: 266
- Date: 01/20/2023
- Time: 09:51:26 AM
- Tool Version: 10.1.0.18696
- File Name: US 395 RW 12 Sta 400 Rev 2.gsz
- Directory: C:\Users\scrandel\OneDrive - HDR, Inc\Documents\SlopeW\
- Last Solved Date: 01/20/2023
- Last Solved Time: 09:51:41 AM

Project Settings

- Unit System: U.S. Customary Units

Analysis Settings

SLOPE/W Analysis

- Kind: SLOPE/W
- Method: Spencer
- Settings
  - PWP Conditions from: (none)
  - Unit Weight of Water: 62.430189 pcf
- Slip Surface
  - Direction of movement: Left to Right
  - Use Passive Mode: No
  - Slip Surface Option: Entry and Exit
  - Critical slip surfaces saved: 1
  - Optimize Critical Slip Surface Location: No
  - Tension Crack Option: (none)
- Distribution
  - F of S Calculation Option: Constant
- Advanced
  - Geometry Settings
    - Minimum Slip Surface Depth: 0.1 ft
    - Number of Slices: 50
  - Factor of Safety Convergence Settings
    - Maximum Number of Iterations: 100
    - Tolerable difference in F of S: 0.001
  - Solution Settings
    - Search Method: Root Finder
    - Tolerable difference between starting and converged F of S: 3
    - Maximum iterations to calculate converged lambda: 20
    - Max Absolute Lambda: 2

Materials

MSE Wall
Model: High Strength
Unit Weight: 135 pcf

Weathered Andesite
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 500 psf
Phi': 25 °
Phi-B: 0 °

Embankment Fill
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 150 psf
Phi': 35 °
Phi-B: 0 °

Native Clayey Sand
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 350 psf
Phi': 34 °
Phi-B: 0 °

Slip Surface Entry and Exit
Left Type: Range
Left-Zone Left Coordinate: (5, 70.5) ft
Left-Zone Right Coordinate: (29, 70.5) ft
Left-Zone Increment: 40
Right Type: Range
Right-Zone Left Coordinate: (70, 46.5) ft
Right-Zone Right Coordinate: (110, 30) ft
Right-Zone Increment: 40
Radius Increments: 40

Slip Surface Limits
Left Coordinate: (0, 70.5) ft
Right Coordinate: (130, 30) ft

Surcharge Loads

Surcharge Load 1
Surcharge (Unit Weight): 250 pcf
Direction: Vertical

Coordinates

	X	Y
	0 ft	71.5 ft
	41.9 ft	71.5 ft

Surcharge Load 2

Surcharge (Unit Weight): 573 pcf
Direction: Vertical

Coordinates

	X	Y
	42 ft	71.5 ft
	46 ft	71.5 ft

Geometry

Name: Default Geometry

Settings

View: 2D
Element Thickness: 1 ft

Points

	X	Y
Point 1	0 ft	0 ft
Point 2	0 ft	30 ft
Point 3	0 ft	70.5 ft
Point 4	31 ft	70.5 ft
Point 5	46 ft	70.5 ft
Point 6	46 ft	58.5 ft
Point 7	46 ft	54 ft
Point 8	31 ft	54 ft
Point 9	103 ft	30 ft
Point 10	130 ft	30 ft
Point 11	130 ft	0 ft
Point 12	0 ft	20 ft
Point 13	130 ft	20 ft

Regions

	Material	Points	Area
Region 1	Embankment Fill	3,4,8,7,6,9,2	2,427.8 ft²
Region 2	MSE Wall	4,5,6,7,8	247.5 ft²
Region 3	Weathered Andesite	12,13,11,1	2,600 ft²
Region 4	Native Clayey Sand	2,9,10,13,12	1,300 ft²

Slip Results

Slip Surfaces Analysed: 24690 of 68921 converged

Current Slip Surface

Slip Surface: 31,632
Factor of Safety: 1.702
Volume: 1,077.2874 ft³
Weight: 132,986.99 lbf
Resisting Moment: 10,404,733 lbf·ft
Activating Moment: 6,113,112.6 lbf·ft
Resisting Force: 93,907.194 lbf
Activating Force: 55,177.861 lbf
Slip Rank: 1 of 68,921 slip surfaces
Exit: (102.39032, 30.304841) ft
Entry: (15.8, 70.5) ft
Radius: 97.108087 ft
Center: (94.70187, 127.10809) ft

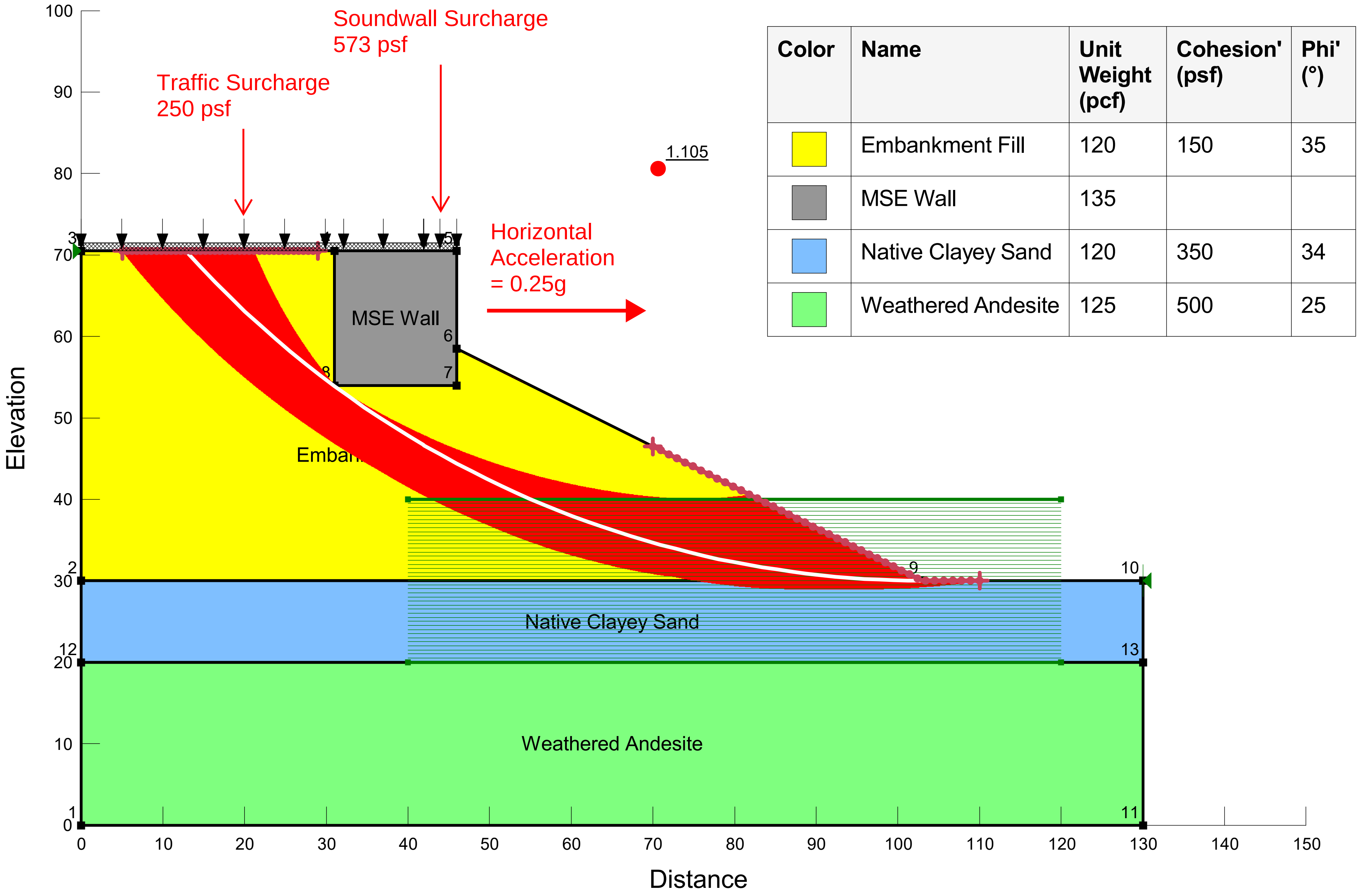
Slip Slices

	X	Y	PWP	Base Normal Stress	Frictional Strength	Cohesive Strength	Suction Strength	Base Material
Slice 1	16.644444 ft	69.358602 ft	0 psf	155.95217 psf	109.19888 psf	150 psf	0 psf	Embankment Fill
Slice 2	18.333333 ft	67.141783 ft	0 psf	305.12703 psf	213.65225 psf	150 psf	0 psf	Embankment Fill
Slice 3	20.022222 ft	65.05017 ft	0 psf	454.77444 psf	318.43649 psf	150 psf	0 psf	Embankment Fill
Slice 4	21.711111 ft	63.071455 ft	0 psf	604.56075 psf	423.31799 psf	150 psf	0 psf	Embankment Fill
Slice 5	23.4 ft	61.195445 ft	0 psf	754.22665 psf	528.11519 psf	150 psf	0 psf	Embankment Fill
Slice 6	25.088889 ft	59.41358 ft	0 psf	903.56884 psf	632.68571 psf	150 psf	0 psf	Embankment Fill
Slice 7	26.777778 ft	57.718593 ft	0 psf	1,052.4268 psf	736.91717 psf	150 psf	0 psf	Embankment Fill
Slice 8	28.466667 ft	56.10425 ft	0 psf	1,200.6731 psf	840.72033 psf	150 psf	0 psf	Embankment Fill
Slice 9	30.155556 ft	54.56516 ft	0 psf	1,348.2061 psf	944.02409 psf	150 psf	0 psf	Embankment Fill
Slice 10	31.908333 ft	53.043695 ft	0 psf	1,661.2283 psf	1,163.2046 psf	150 psf	0 psf	Embankment Fill
Slice 11	33.725 ft	51.540636 ft	0 psf	1,821.778 psf	1,275.6227 psf	150 psf	0 psf	Embankment Fill
Slice 12	35.541667 ft	50.109783 ft	0 psf	1,981.2183 psf	1,387.264 psf	150 psf	0 psf	Embankment Fill
Slice 13	37.358333 ft	48.747175 ft	0 psf	2,139.5092 psf	1,498.1005 psf	150 psf	0 psf	Embankment Fill
Slice 14	39.175 ft	47.449306 ft	0 psf	2,296.6208 psf	1,608.1112 psf	150 psf	0 psf	Embankment Fill
Slice 15	40.991667 ft	46.213057 ft	0 psf	2,452.5317 psf	1,717.2812 psf	150 psf	0 psf	Embankment Fill
Slice 16	41.95 ft	45.577619 ft	0 psf	2,352.3476 psf	1,647.1315 psf	150 psf	0 psf	Embankment Fill
Slice 17	43 ft	44.916229 ft	0 psf	2,861.9798 psf	2,003.9798 psf	150 psf	0 psf	Embankment Fill

Slice 18	45 ft	43.691364 ft	0 psf	3,035.7953 psf	2,125.6867 psf	150 psf	0 psf	Embankment Fill
Slice 19	46.869676 ft	42.603276 ft	0 psf	1,418.2846 psf	993.09354 psf	150 psf	0 psf	Embankment Fill
Slice 20	48.609029 ft	41.641987 ft	0 psf	1,453.8392 psf	1,017.9892 psf	150 psf	0 psf	Embankment Fill
Slice 21	50.348381 ft	40.726417 ft	0 psf	1,485.3754 psf	1,040.0711 psf	150 psf	0 psf	Embankment Fill
Slice 22	52.087734 ft	39.855126 ft	0 psf	1,512.8474 psf	1,059.3072 psf	150 psf	0 psf	Embankment Fill
Slice 23	53.827086 ft	39.026798 ft	0 psf	1,536.2047 psf	1,075.6621 psf	150 psf	0 psf	Embankment Fill
Slice 24	55.566439 ft	38.240232 ft	0 psf	1,555.3914 psf	1,089.0968 psf	150 psf	0 psf	Embankment Fill
Slice 25	57.305791 ft	37.494328 ft	0 psf	1,570.3461 psf	1,099.5682 psf	150 psf	0 psf	Embankment Fill
Slice 26	59.045144 ft	36.788077 ft	0 psf	1,581.0014 psf	1,107.0291 psf	150 psf	0 psf	Embankment Fill
Slice 27	60.784496 ft	36.120555 ft	0 psf	1,587.2834 psf	1,111.4278 psf	150 psf	0 psf	Embankment Fill
Slice 28	62.523849 ft	35.490917 ft	0 psf	1,589.1113 psf	1,112.7077 psf	150 psf	0 psf	Embankment Fill
Slice 29	64.263201 ft	34.898384 ft	0 psf	1,586.3968 psf	1,110.807 psf	150 psf	0 psf	Embankment Fill
Slice 30	66.002554 ft	34.342247 ft	0 psf	1,579.0437 psf	1,105.6583 psf	150 psf	0 psf	Embankment Fill
Slice 31	67.741906 ft	33.821853 ft	0 psf	1,566.9472 psf	1,097.1882 psf	150 psf	0 psf	Embankment Fill
Slice 32	69.481259 ft	33.336608 ft	0 psf	1,549.9933 psf	1,085.317 psf	150 psf	0 psf	Embankment Fill
Slice 33	71.220611 ft	32.885968 ft	0 psf	1,528.0578 psf	1,069.9576 psf	150 psf	0 psf	Embankment Fill
Slice 34	72.959964 ft	32.469438 ft	0 psf	1,501.0058 psf	1,051.0156 psf	150 psf	0 psf	Embankment Fill
Slice 35	74.699316 ft	32.086571 ft	0 psf	1,468.6904 psf	1,028.3881 psf	150 psf	0 psf	Embankment Fill
Slice 36	76.438669 ft	31.736959 ft	0 psf	1,430.9521 psf	1,001.9635 psf	150 psf	0 psf	Embankment Fill
Slice 37	78.178021 ft	31.42024 ft	0 psf	1,387.6172 psf	971.62001 psf	150 psf	0 psf	Embankment Fill
Slice 38	79.917374 ft	31.136086 ft	0 psf	1,338.4965 psf	937.22532 psf	150 psf	0 psf	Embankment Fill
Slice 39	81.656726 ft	30.88421 ft	0 psf	1,283.384 psf	898.63519 psf	150 psf	0 psf	Embankment Fill
Slice 40	83.396079 ft	30.664358 ft	0 psf	1,222.0554 psf	855.69238 psf	150 psf	0 psf	Embankment Fill
Slice 41	85.135431 ft	30.476311 ft	0 psf	1,154.2654 psf	808.22532 psf	150 psf	0 psf	Embankment Fill
Slice 42	86.874784 ft	30.319885 ft	0 psf	1,079.7463 psf	756.04653 psf	150 psf	0 psf	Embankment Fill
Slice 43	88.614136 ft	30.194926 ft	0 psf	998.20534 psf	698.9509 psf	150 psf	0 psf	Embankment Fill

Slice 44	90.353489 ft	30.101313 ft	0 psf	909.32146 psf	636.71374 psf	150 psf	0 psf	Embankment Fill
Slice 45	92.092841 ft	30.038954 ft	0 psf	812.74255 psf	569.08846 psf	150 psf	0 psf	Embankment Fill
Slice 46	93.832194 ft	30.007789 ft	0 psf	708.08152 psf	495.80402 psf	150 psf	0 psf	Embankment Fill
Slice 47	95.662926 ft	30.009512 ft	0 psf	588.59542 psf	412.13895 psf	150 psf	0 psf	Embankment Fill
Slice 48	97.585038 ft	30.047573 ft	0 psf	452.52953 psf	316.86459 psf	150 psf	0 psf	Embankment Fill
Slice 49	99.507149 ft	30.123738 ft	0 psf	304.75558 psf	213.39215 psf	150 psf	0 psf	Embankment Fill
Slice 50	101.42926 ft	30.238098 ft	0 psf	144.47772 psf	101.16439 psf	150 psf	0 psf	Embankment Fill

Station 4+00 Seismic



Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
🟨	Embankment Fill	120	150	35
⬛	MSE Wall	135		
🟦	Native Clayey Sand	120	350	34
🟩	Weathered Andesite	125	500	25

SLOPE/W Analysis

File Information

File Version: 10.01
Created By: Crandell, Sterling
Last Edited By: Crandell, Sterling
Revision Number: 262
Date: 01/20/2023
Time: 09:27:14 AM
Tool Version: 10.1.0.18696
File Name: US 395 RW 12 Sta 400 Seismic Rev 2.gsz
Directory: C:\Users\scrandel\OneDrive - HDR, Inc\Documents\SlopeW\
Last Solved Date: 01/20/2023
Last Solved Time: 09:27:46 AM

Project Settings

Unit System: U.S. Customary Units

Analysis Settings

SLOPE/W Analysis

- Kind: SLOPE/W
- Method: Spencer
- Settings
  - PWP Conditions from: (none)
  - Unit Weight of Water: 62.430189 pcf
- Slip Surface
  - Direction of movement: Left to Right
  - Use Passive Mode: No
  - Slip Surface Option: Entry and Exit
  - Critical slip surfaces saved: 1
  - Optimize Critical Slip Surface Location: No
  - Tension Crack Option: (none)
- Distribution
  - F of S Calculation Option: Constant
- Advanced
  - Geometry Settings
    - Minimum Slip Surface Depth: 0.1 ft
    - Number of Slices: 50
  - Factor of Safety Convergence Settings
    - Maximum Number of Iterations: 100
    - Tolerable difference in F of S: 0.001
  - Solution Settings
    - Search Method: Root Finder
    - Tolerable difference between starting and converged F of S: 3
    - Maximum iterations to calculate converged lambda: 20
    - Max Absolute Lambda: 2

Materials

MSE Wall

Model: High Strength
Unit Weight: 135 pcf

Weathered Andesite

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 500 psf
Phi': 25 °
Phi-B: 0 °

Embankment Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 150 psf
Phi': 35 °
Phi-B: 0 °

Native Clayey Sand

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 350 psf
Phi': 34 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Type: Range
Left-Zone Left Coordinate: (5, 70.5) ft
Left-Zone Right Coordinate: (29, 70.5) ft
Left-Zone Increment: 40
Right Type: Range
Right-Zone Left Coordinate: (70, 46.5) ft
Right-Zone Right Coordinate: (110, 30) ft
Right-Zone Increment: 40
Radius Increments: 40

Slip Surface Limits

Left Coordinate: (0, 70.5) ft
Right Coordinate: (130, 30) ft

Seismic Coefficients

Horz Seismic Coef.: 0.25

Surcharge Loads

Surcharge Load 1

Surcharge (Unit Weight): 250 pcf
Direction: Vertical

Coordinates

	X	Y
	0 ft	71.5 ft
	41.9 ft	71.5 ft

Surcharge Load 2

Surcharge (Unit Weight): 573 pcf
Direction: Vertical

Coordinates

	X	Y
	42 ft	71.5 ft
	46 ft	71.5 ft

Geometry

Name: Default Geometry

Settings

View: 2D
Element Thickness: 1 ft

Points

	X	Y
Point 1	0 ft	0 ft
Point 2	0 ft	30 ft
Point 3	0 ft	70.5 ft
Point 4	31 ft	70.5 ft
Point 5	46 ft	70.5 ft
Point 6	46 ft	58.5 ft
Point 7	46 ft	54 ft
Point 8	31 ft	54 ft
Point 9	103 ft	30 ft
Point 10	130 ft	30 ft
Point 11	130 ft	0 ft
Point 12	0 ft	20 ft
Point 13	130 ft	20 ft

Regions

	Material	Points	Area
Region 1	Embankment Fill	3,4,8,7,6,9,2	2,427.8 ft²
Region 2	MSE Wall	4,5,6,7,8	247.5 ft²
Region 3	Weathered Andesite	12,13,11,1	2,600 ft²

Region 4	Native Clayey Sand	2,9,10,13,12	1,300 ft²

Slip Results

Slip Surfaces Analysed: 23210 of 68921 converged

Current Slip Surface

Slip Surface: 23,268
Factor of Safety: 1.105
Volume: 1,028.3616 ft³
Weight: 127,115.9 lbf
Resisting Moment: 11,585,679 lbf·ft
Activating Moment: 10,488,957 lbf·ft
Resisting Force: 85,242.682 lbf
Activating Force: 77,152.162 lbf
Slip Rank: 1 of 68,921 slip surfaces
Exit: (102.99857, 30.000715) ft
Entry: (12.8, 70.5) ft
Radius: 121.62297 ft
Center: (103.41573, 151.62297) ft

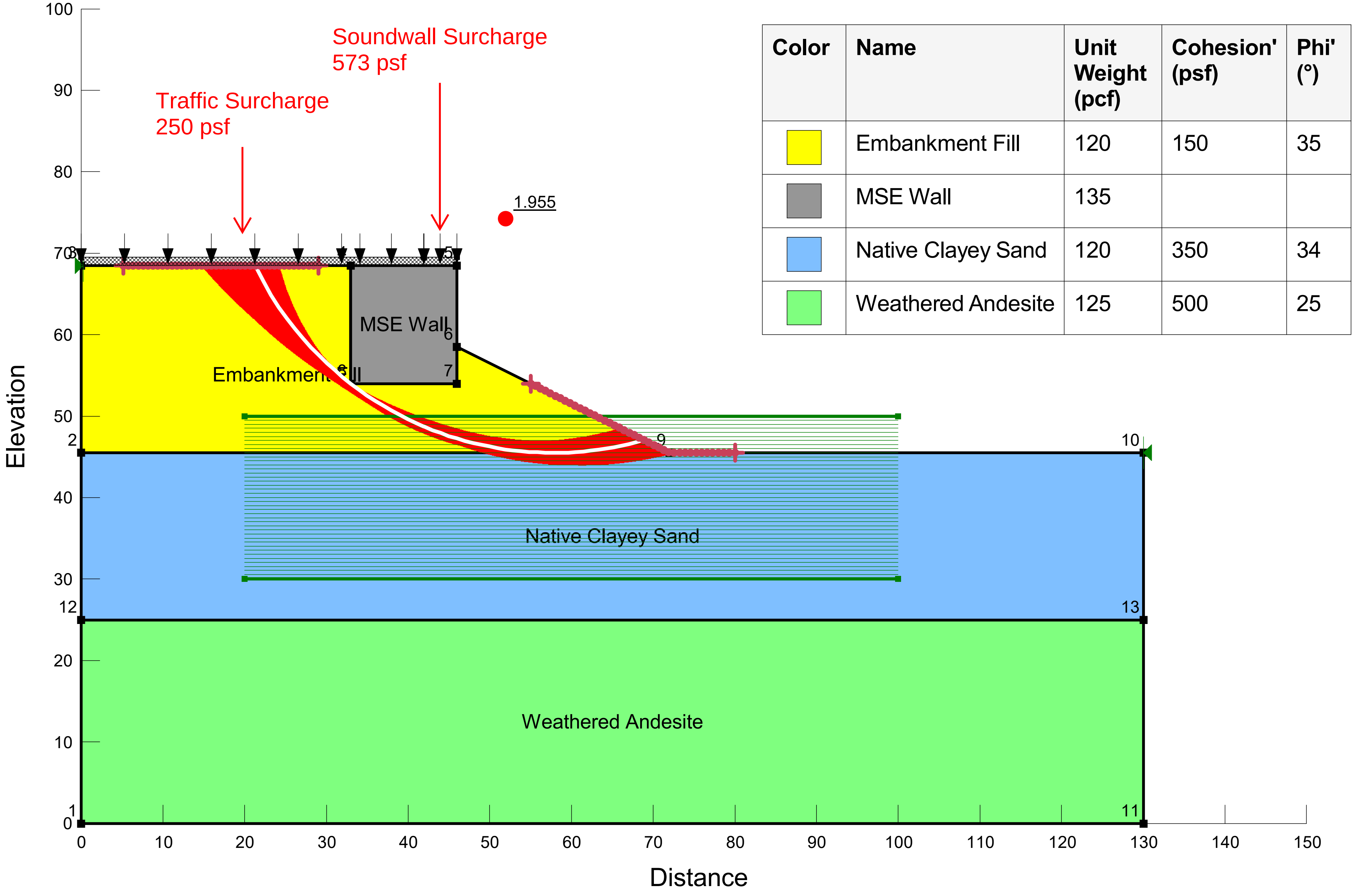
Slip Slices

	X	Y	PWP	Base Normal Stress	Frictional Strength	Cohesive Strength	Suction Strength	Base Material
Slice 1	13.71 ft	69.505904 ft	0 psf	147.41152 psf	103.21866 psf	150 psf	0 psf	Embankment Fill
Slice 2	15.53 ft	67.560422 ft	0 psf	252.34282 psf	176.69234 psf	150 psf	0 psf	Embankment Fill
Slice 3	17.35 ft	65.697549 ft	0 psf	359.09982 psf	251.4444 psf	150 psf	0 psf	Embankment Fill
Slice 4	19.17 ft	63.912015 ft	0 psf	467.56881 psf	327.39521 psf	150 psf	0 psf	Embankment Fill
Slice 5	20.99 ft	62.19918 ft	0 psf	577.65644 psf	404.47939 psf	150 psf	0 psf	Embankment Fill
Slice 6	22.81 ft	60.554939 ft	0 psf	689.28699 psf	482.64394 psf	150 psf	0 psf	Embankment Fill
Slice 7	24.63 ft	58.975635 ft	0 psf	802.40016 psf	561.84664 psf	150 psf	0 psf	Embankment Fill
Slice 8	26.45 ft	57.457998 ft	0 psf	916.94927 psf	642.05479 psf	150 psf	0 psf	Embankment Fill
Slice 9	28.27 ft	55.999089 ft	0 psf	1,032.8997 psf	723.24417 psf	150 psf	0 psf	Embankment Fill
Slice 10	30.09 ft	54.596257 ft	0 psf	1,150.2278 psf	805.39821 psf	150 psf	0 psf	Embankment Fill
Slice 11	31.908333 ft	53.248288 ft	0 psf	1,400.8367 psf	980.87644 psf	150 psf	0 psf	Embankment Fill
Slice 12	33.725 ft	51.952912 ft	0 psf	1,524.0249 psf	1,067.1337 psf	150 psf	0 psf	Embankment Fill
Slice 13	35.541667 ft	50.706866 ft	0 psf	1,648.6109 psf	1,154.3698 psf	150 psf	0 psf	Embankment Fill

Slice 14	37.358333 ft	49.508344 ft	0 psf	1,774.612 psf	1,242.5967 psf	150 psf	0 psf	Embankment Fill
Slice 15	39.175 ft	48.35569 ft	0 psf	1,902.0531 psf	1,331.8319 psf	150 psf	0 psf	Embankment Fill
Slice 16	40.991667 ft	47.247384 ft	0 psf	2,030.967 psf	1,422.0984 psf	150 psf	0 psf	Embankment Fill
Slice 17	41.95 ft	46.674852 ft	0 psf	1,912.8236 psf	1,339.3735 psf	150 psf	0 psf	Embankment Fill
Slice 18	43 ft	46.073177 ft	0 psf	2,420.3663 psf	1,694.7587 psf	150 psf	0 psf	Embankment Fill
Slice 19	45 ft	44.953155 ft	0 psf	2,572.4369 psf	1,801.2397 psf	150 psf	0 psf	Embankment Fill
Slice 20	46.890603 ft	43.938036 ft	0 psf	1,126.5729 psf	788.83482 psf	150 psf	0 psf	Embankment Fill
Slice 21	48.671808 ft	43.021611 ft	0 psf	1,157.2481 psf	810.31383 psf	150 psf	0 psf	Embankment Fill
Slice 22	50.453013 ft	42.141836 ft	0 psf	1,185.6368 psf	830.19179 psf	150 psf	0 psf	Embankment Fill
Slice 23	52.234219 ft	41.297833 ft	0 psf	1,211.6534 psf	848.40887 psf	150 psf	0 psf	Embankment Fill
Slice 24	54.015424 ft	40.488787 ft	0 psf	1,235.2072 psf	864.90143 psf	150 psf	0 psf	Embankment Fill
Slice 25	55.796629 ft	39.713939 ft	0 psf	1,256.2012 psf	879.60156 psf	150 psf	0 psf	Embankment Fill
Slice 26	57.577834 ft	38.972583 ft	0 psf	1,274.5316 psf	892.43661 psf	150 psf	0 psf	Embankment Fill
Slice 27	59.35904 ft	38.264063 ft	0 psf	1,290.0869 psf	903.32857 psf	150 psf	0 psf	Embankment Fill
Slice 28	61.140245 ft	37.587765 ft	0 psf	1,302.7473 psf	912.19351 psf	150 psf	0 psf	Embankment Fill
Slice 29	62.92145 ft	36.94312 ft	0 psf	1,312.3836 psf	918.94086 psf	150 psf	0 psf	Embankment Fill
Slice 30	64.702656 ft	36.329596 ft	0 psf	1,318.8556 psf	923.47266 psf	150 psf	0 psf	Embankment Fill
Slice 31	66.483861 ft	35.746699 ft	0 psf	1,322.0119 psf	925.68269 psf	150 psf	0 psf	Embankment Fill
Slice 32	68.265066 ft	35.193969 ft	0 psf	1,321.6874 psf	925.45549 psf	150 psf	0 psf	Embankment Fill
Slice 33	70.046271 ft	34.670979 ft	0 psf	1,317.7026 psf	922.66528 psf	150 psf	0 psf	Embankment Fill
Slice 34	71.827477 ft	34.177329 ft	0 psf	1,309.8613 psf	917.17472 psf	150 psf	0 psf	Embankment Fill
Slice 35	73.608682 ft	33.712653 ft	0 psf	1,297.9487 psf	908.83349 psf	150 psf	0 psf	Embankment Fill
Slice 36	75.389887 ft	33.276608 ft	0 psf	1,281.7296 psf	897.47671 psf	150 psf	0 psf	Embankment Fill
Slice 37	77.171093 ft	32.86888 ft	0 psf	1,260.9449 psf	882.92314 psf	150 psf	0 psf	Embankment Fill
Slice 38	78.952298 ft	32.489177 ft	0 psf	1,235.3096 psf	864.97311 psf	150 psf	0 psf	Embankment Fill
Slice 39	80.733503 ft	32.137232 ft	0 psf	1,204.5089 psf	843.40621 psf	150 psf	0 psf	Embankment Fill

Slice 40	82.514708 ft	31.8128 ft	0 psf	1,168.1944 psf	817.97854 psf	150 psf	0 psf	Embankment Fill
Slice 41	84.295914 ft	31.515659 ft	0 psf	1,125.98 psf	788.41972 psf	150 psf	0 psf	Embankment Fill
Slice 42	86.077119 ft	31.245606 ft	0 psf	1,077.4368 psf	754.42933 psf	150 psf	0 psf	Embankment Fill
Slice 43	87.858324 ft	31.002459 ft	0 psf	1,022.0869 psf	715.67293 psf	150 psf	0 psf	Embankment Fill
Slice 44	89.63953 ft	30.786057 ft	0 psf	959.39751 psf	671.77737 psf	150 psf	0 psf	Embankment Fill
Slice 45	91.420735 ft	30.596254 ft	0 psf	888.77291 psf	622.32549 psf	150 psf	0 psf	Embankment Fill
Slice 46	93.20194 ft	30.432927 ft	0 psf	809.54563 psf	566.84996 psf	150 psf	0 psf	Embankment Fill
Slice 47	94.983145 ft	30.295968 ft	0 psf	720.96644 psf	504.82614 psf	150 psf	0 psf	Embankment Fill
Slice 48	96.764351 ft	30.185289 ft	0 psf	622.19246 psf	435.66385 psf	150 psf	0 psf	Embankment Fill
Slice 49	98.545556 ft	30.100817 ft	0 psf	512.27353 psf	358.69779 psf	150 psf	0 psf	Embankment Fill
Slice 50	100.32676 ft	30.042497 ft	0 psf	390.13626 psf	273.17635 psf	150 psf	0 psf	Embankment Fill
Slice 51	102.10797 ft	30.010293 ft	0 psf	254.5655 psf	178.24868 psf	150 psf	0 psf	Embankment Fill

Station 7+00



Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
🟨	Embankment Fill	120	150	35
⬛	MSE Wall	135		
🟦	Native Clayey Sand	120	350	34
🟩	Weathered Andesite	125	500	25

SLOPE/W Analysis

File Information

File Version: 10.01
Created By: Crandell, Sterling
Last Edited By: Crandell, Sterling
Revision Number: 256
Date: 01/20/2023
Time: 09:56:45 AM
Tool Version: 10.1.0.18696
File Name: US 395 RW 12 Sta 700 Rev 2.gsz
Directory: C:\Users\scrandel\OneDrive - HDR, Inc\Documents\SlopeW\
Last Solved Date: 01/20/2023
Last Solved Time: 09:57:02 AM

Project Settings

Unit System: U.S. Customary Units

Analysis Settings

SLOPE/W Analysis

- Kind: SLOPE/W
- Method: Spencer
- Settings
  - PWP Conditions from: (none)
  - Unit Weight of Water: 62.430189 pcf
- Slip Surface
  - Direction of movement: Left to Right
  - Use Passive Mode: No
  - Slip Surface Option: Entry and Exit
  - Critical slip surfaces saved: 1
  - Optimize Critical Slip Surface Location: No
  - Tension Crack Option: (none)
- Distribution
  - F of S Calculation Option: Constant
- Advanced
  - Geometry Settings
    - Minimum Slip Surface Depth: 0.1 ft
    - Number of Slices: 50
  - Factor of Safety Convergence Settings
    - Maximum Number of Iterations: 100
    - Tolerable difference in F of S: 0.001
  - Solution Settings
    - Search Method: Root Finder
    - Tolerable difference between starting and converged F of S: 3
    - Maximum iterations to calculate converged lambda: 20
    - Max Absolute Lambda: 2

Materials

MSE Wall

Model: High Strength
Unit Weight: 135 pcf

Weathered Andesite

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 500 psf
Phi': 25 °
Phi-B: 0 °

Embankment Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 150 psf
Phi': 35 °
Phi-B: 0 °

Native Clayey Sand

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 350 psf
Phi': 34 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Type: Range
Left-Zone Left Coordinate: (5.17394, 68.5) ft
Left-Zone Right Coordinate: (29.02638, 68.5) ft
Left-Zone Increment: 40
Right Type: Range
Right-Zone Left Coordinate: (55, 54) ft
Right-Zone Right Coordinate: (80, 45.5) ft
Right-Zone Increment: 40
Radius Increments: 40

Slip Surface Limits

Left Coordinate: (0.20467618, 68.5) ft
Right Coordinate: (130, 45.5) ft

Surcharge Loads

Surcharge Load 1

Surcharge (Unit Weight): 250 pcf
Direction: Vertical

Coordinates

	X	Y
	0 ft	69.5 ft
	41.9 ft	69.5 ft

Surcharge Load 2

Surcharge (Unit Weight): 573 pcf
Direction: Vertical

Coordinates

	X	Y
	42 ft	69.5 ft
	46 ft	69.5 ft

Geometry

Name: Default Geometry

Settings

View: 2D
Element Thickness: 1 ft

Points

	X	Y
Point 1	0 ft	0 ft
Point 2	0 ft	45.5 ft
Point 3	0 ft	68.5 ft
Point 4	33 ft	68.5 ft
Point 5	46 ft	68.5 ft
Point 6	46 ft	58.5 ft
Point 7	46 ft	54 ft
Point 8	33 ft	54 ft
Point 9	72 ft	45.5 ft
Point 10	130 ft	45.5 ft
Point 11	130 ft	0 ft
Point 12	0 ft	25 ft
Point 13	130 ft	25 ft

Regions

	Material	Points	Area
Region 1	Embankment Fill	3,4,8,7,6,9,2	1,038.5 ft²
Region 2	MSE Wall	4,5,6,7,8	188.5 ft²
Region 3	Weathered Andesite	12,13,11,1	3,250 ft²
Region 4	Native Clayey Sand	2,9,10,13,12	2,665 ft²

Slip Results

Slip Surfaces Analysed: 24764 of 68921 converged

Current Slip Surface

Slip Surface: 46,340
Factor of Safety: 1.955
Volume: 491.71091 ft³
Weight: 61,832.809 lbf
Resisting Moment: 2,228,744.1 lbf·ft
Activating Moment: 1,139,939 lbf·ft
Resisting Force: 48,299.058 lbf
Activating Force: 24,712.292 lbf
Slip Rank: 1 of 68,921 slip surfaces
Exit: (68.889365, 47.055317) ft
Entry: (21.274337, 68.5) ft
Radius: 40.467828 ft
Center: (57.778036, 85.967828) ft

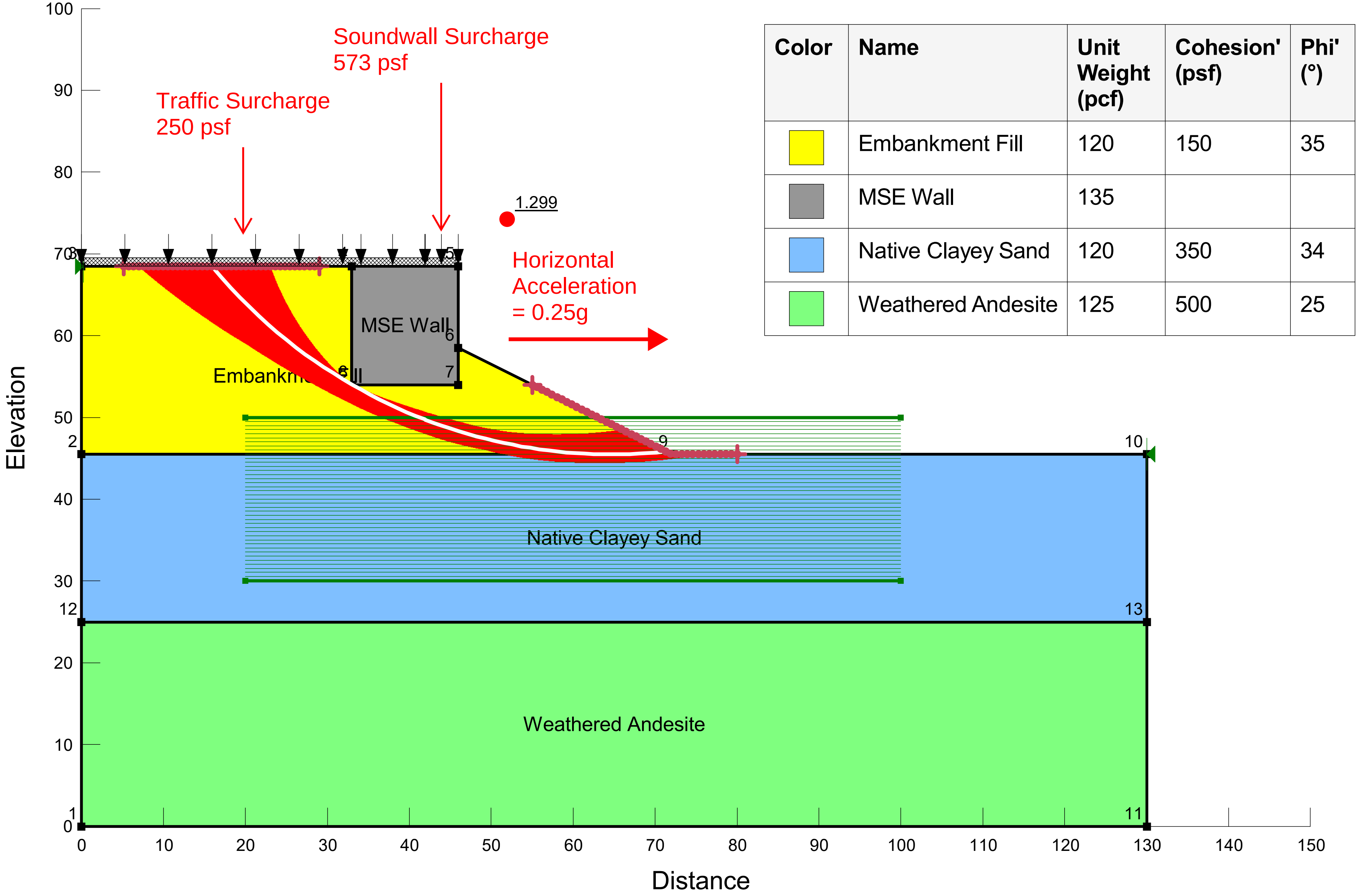
Slip Slices

	X	Y	PWP	Base Normal Stress	Frictional Strength	Cohesive Strength	Suction Strength	Base Material
Slice 1	21.762906 ft	67.544892 ft	0 psf	105.26119 psf	73.704676 psf	150 psf	0 psf	Embankment Fill
Slice 2	22.740045 ft	65.74336 ft	0 psf	221.86298 psf	155.35013 psf	150 psf	0 psf	Embankment Fill
Slice 3	23.717183 ft	64.13474 ft	0 psf	338.00355 psf	236.67263 psf	150 psf	0 psf	Embankment Fill
Slice 4	24.694322 ft	62.678505 ft	0 psf	453.02323 psf	317.21028 psf	150 psf	0 psf	Embankment Fill
Slice 5	25.671461 ft	61.347344 ft	0 psf	566.59311 psf	396.73277 psf	150 psf	0 psf	Embankment Fill
Slice 6	26.648599 ft	60.121779 ft	0 psf	678.54981 psf	475.12569 psf	150 psf	0 psf	Embankment Fill
Slice 7	27.625738 ft	58.987332 ft	0 psf	788.81881 psf	552.33688 psf	150 psf	0 psf	Embankment Fill
Slice 8	28.602876 ft	57.932887 ft	0 psf	897.37558 psf	628.34915 psf	150 psf	0 psf	Embankment Fill
Slice 9	29.580015 ft	56.949686 ft	0 psf	1,004.2245 psf	703.1656 psf	150 psf	0 psf	Embankment Fill
Slice 10	30.557154 ft	56.030684 ft	0 psf	1,109.3872 psf	776.80127 psf	150 psf	0 psf	Embankment Fill
Slice 11	31.534292 ft	55.170118 ft	0 psf	1,212.8949 psf	849.27818 psf	150 psf	0 psf	Embankment Fill
Slice 12	32.511431 ft	54.363201 ft	0 psf	1,314.7851 psf	920.62245 psf	150 psf	0 psf	Embankment Fill
Slice 13	33.494444 ft	53.601639 ft	0 psf	1,568.884 psf	1,098.5444 psf	150 psf	0 psf	Embankment Fill
Slice 14	34.483333 ft	52.882541 ft	0 psf	1,672.6306 psf	1,171.1885 psf	150 psf	0 psf	Embankment Fill
Slice 15	35.472222 ft	52.207725 ft	0 psf	1,774.7919 psf	1,242.7226 psf	150 psf	0 psf	Embankment Fill
Slice 16	36.461111 ft	51.574582 ft	0 psf	1,875.4254 psf	1,313.187 psf	150 psf	0 psf	Embankment Fill
Slice 17	37.45 ft	50.980844 ft	0 psf	1,974.5871 psf	1,382.6208 psf	150 psf	0 psf	Embankment Fill

Slice 18	38.438889 ft	50.424536 ft	0 psf	2,072.3313 psf	1,451.062 psf	150 psf	0 psf	Embankment Fill
Slice 19	39.427778 ft	49.903922 ft	0 psf	2,168.7114 psf	1,518.5481 psf	150 psf	0 psf	Embankment Fill
Slice 20	40.416667 ft	49.417475 ft	0 psf	2,263.7794 psf	1,585.1154 psf	150 psf	0 psf	Embankment Fill
Slice 21	41.405556 ft	48.963847 ft	0 psf	2,357.5871 psf	1,650.8002 psf	150 psf	0 psf	Embankment Fill
Slice 22	41.95 ft	48.72383 ft	0 psf	2,196.9223 psf	1,538.3016 psf	150 psf	0 psf	Embankment Fill
Slice 23	42.5 ft	48.498706 ft	0 psf	2,737.2357 psf	1,916.6331 psf	150 psf	0 psf	Embankment Fill
Slice 24	43.5 ft	48.106275 ft	0 psf	2,835.1043 psf	1,985.1614 psf	150 psf	0 psf	Embankment Fill
Slice 25	44.5 ft	47.744031 ft	0 psf	2,931.9 psf	2,052.9385 psf	150 psf	0 psf	Embankment Fill
Slice 26	45.5 ft	47.411122 ft	0 psf	3,027.6906 psf	2,120.0117 psf	150 psf	0 psf	Embankment Fill
Slice 27	46.490752 ft	47.109352 ft	0 psf	1,247.6226 psf	873.59473 psf	150 psf	0 psf	Embankment Fill
Slice 28	47.472255 ft	46.837553 ft	0 psf	1,248.5125 psf	874.21787 psf	150 psf	0 psf	Embankment Fill
Slice 29	48.453758 ft	46.592092 ft	0 psf	1,245.8764 psf	872.37204 psf	150 psf	0 psf	Embankment Fill
Slice 30	49.435261 ft	46.372479 ft	0 psf	1,239.6342 psf	868.00118 psf	150 psf	0 psf	Embankment Fill
Slice 31	50.416764 ft	46.178286 ft	0 psf	1,229.6937 psf	861.04082 psf	150 psf	0 psf	Embankment Fill
Slice 32	51.398267 ft	46.009141 ft	0 psf	1,215.95 psf	851.41739 psf	150 psf	0 psf	Embankment Fill
Slice 33	52.37977 ft	45.864728 ft	0 psf	1,198.2836 psf	839.0472 psf	150 psf	0 psf	Embankment Fill
Slice 34	53.361273 ft	45.74478 ft	0 psf	1,176.5589 psf	823.83543 psf	150 psf	0 psf	Embankment Fill
Slice 35	54.342776 ft	45.649079 ft	0 psf	1,150.6228 psf	805.67479 psf	150 psf	0 psf	Embankment Fill
Slice 36	55.324279 ft	45.577452 ft	0 psf	1,120.3021 psf	784.444 psf	150 psf	0 psf	Embankment Fill
Slice 37	56.305782 ft	45.529772 ft	0 psf	1,085.401 psf	760.00598 psf	150 psf	0 psf	Embankment Fill
Slice 38	57.287285 ft	45.505952 ft	0 psf	1,045.698 psf	732.20565 psf	150 psf	0 psf	Embankment Fill
Slice 39	58.241008 ft	45.505297 ft	0 psf	1,002.3269 psf	701.83687 psf	150 psf	0 psf	Embankment Fill
Slice 40	59.166952 ft	45.526495 ft	0 psf	955.36428 psf	668.95327 psf	150 psf	0 psf	Embankment Fill
Slice 41	60.092897 ft	45.568924 ft	0 psf	903.38938 psf	632.56006 psf	150 psf	0 psf	Embankment Fill
Slice 42	61.018841 ft	45.63265 ft	0 psf	846.09649 psf	592.44314 psf	150 psf	0 psf	Embankment Fill
Slice 43	61.944785 ft	45.717776 ft	0 psf	783.13826 psf	548.35931 psf	150 psf	0 psf	Embankment Fill

Slice 44	62.870729 ft	45.824438 ft	0 psf	714.11865 psf	500.03126 psf	150 psf	0 psf	Embankment Fill
Slice 45	63.796673 ft	45.952807 ft	0 psf	638.58436 psf	447.14158 psf	150 psf	0 psf	Embankment Fill
Slice 46	64.722617 ft	46.103093 ft	0 psf	556.01416 psf	389.32531 psf	150 psf	0 psf	Embankment Fill
Slice 47	65.648561 ft	46.275547 ft	0 psf	465.80585 psf	326.16077 psf	150 psf	0 psf	Embankment Fill
Slice 48	66.574505 ft	46.470458 ft	0 psf	367.25988 psf	257.15814 psf	150 psf	0 psf	Embankment Fill
Slice 49	67.500449 ft	46.68816 ft	0 psf	259.55889 psf	181.74509 psf	150 psf	0 psf	Embankment Fill
Slice 50	68.426393 ft	46.929036 ft	0 psf	141.74165 psf	99.24857 psf	150 psf	0 psf	Embankment Fill

Station 7+00 Seismic



Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
🟨	Embankment Fill	120	150	35
◼	MSE Wall	135		
🟦	Native Clayey Sand	120	350	34
🟩	Weathered Andesite	125	500	25

SLOPE/W Analysis

File Information

- File Version: 10.01
- Created By: Crandell, Sterling
- Last Edited By: Crandell, Sterling
- Revision Number: 252
- Date: 01/20/2023
- Time: 10:16:51 AM
- Tool Version: 10.1.0.18696
- File Name: US 395 RW 12 Sta 700 Seismic Rev 2.gsz
- Directory: C:\Users\scrandel\OneDrive - HDR, Inc\Documents\SlopeW\
- Last Solved Date: 01/20/2023
- Last Solved Time: 10:18:10 AM

Project Settings

- Unit System: U.S. Customary Units

Analysis Settings

SLOPE/W Analysis

- Kind: SLOPE/W
- Method: Spencer
- Settings
  - PWP Conditions from: (none)
  - Unit Weight of Water: 62.430189 pcf
- Slip Surface
  - Direction of movement: Left to Right
  - Use Passive Mode: No
  - Slip Surface Option: Entry and Exit
  - Critical slip surfaces saved: 1
  - Optimize Critical Slip Surface Location: No
  - Tension Crack Option: (none)
- Distribution
  - F of S Calculation Option: Constant
- Advanced
  - Geometry Settings
    - Minimum Slip Surface Depth: 0.1 ft
    - Number of Slices: 50
  - Factor of Safety Convergence Settings
    - Maximum Number of Iterations: 100
    - Tolerable difference in F of S: 0.001
  - Solution Settings
    - Search Method: Root Finder
    - Tolerable difference between starting and converged F of S: 3
    - Maximum iterations to calculate converged lambda: 20
    - Max Absolute Lambda: 2

Materials

MSE Wall

Model: High Strength
Unit Weight: 135 pcf

Weathered Andesite

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 500 psf
Phi': 25 °
Phi-B: 0 °

Embankment Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 150 psf
Phi': 35 °
Phi-B: 0 °

Native Clayey Sand

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 350 psf
Phi': 34 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Type: Range
Left-Zone Left Coordinate: (5.17394, 68.5) ft
Left-Zone Right Coordinate: (29.02638, 68.5) ft
Left-Zone Increment: 40
Right Type: Range
Right-Zone Left Coordinate: (55, 54) ft
Right-Zone Right Coordinate: (80, 45.5) ft
Right-Zone Increment: 40
Radius Increments: 40

Slip Surface Limits

Left Coordinate: (0.20467618, 68.5) ft
Right Coordinate: (130, 45.5) ft

Seismic Coefficients

Horz Seismic Coef.: 0.25

Surcharge Loads

Surcharge Load 1

Surcharge (Unit Weight): 250 pcf
Direction: Vertical

Coordinates

	X	Y
	0 ft	69.5 ft
	41.9 ft	69.5 ft

Surcharge Load 2

Surcharge (Unit Weight): 573 pcf
Direction: Vertical

Coordinates

	X	Y
	42 ft	69.5 ft
	46 ft	69.5 ft

Geometry

Name: Default Geometry

Settings

View: 2D
Element Thickness: 1 ft

Points

	X	Y
Point 1	0 ft	0 ft
Point 2	0 ft	45.5 ft
Point 3	0 ft	68.5 ft
Point 4	33 ft	68.5 ft
Point 5	46 ft	68.5 ft
Point 6	46 ft	58.5 ft
Point 7	46 ft	54 ft
Point 8	33 ft	54 ft
Point 9	72 ft	45.5 ft
Point 10	130 ft	45.5 ft
Point 11	130 ft	0 ft
Point 12	0 ft	25 ft
Point 13	130 ft	25 ft

Regions

	Material	Points	Area
Region 1	Embankment Fill	3,4,8,7,6,9,2	1,038.5 ft^2
Region 2	MSE Wall	4,5,6,7,8	188.5 ft^2
Region 3	Weathered Andesite	12,13,11,1	3,250 ft^2

Region 4	Native Clayey Sand	2,9,10,13,12	2,665 ft²

Slip Results

Slip Surfaces Analysed: 19677 of 68921 converged

Current Slip Surface

Slip Surface: 31,375
Factor of Safety: 1.299
Volume: 518.417 ft³
Weight: 65,037.431 lbf
Resisting Moment: 3,457,128.7 lbf·ft
Activating Moment: 2,661,076.2 lbf·ft
Resisting Force: 49,822.266 lbf
Activating Force: 38,359.189 lbf
Slip Rank: 1 of 68,921 slip surfaces
Exit: (71.304907, 45.847547) ft
Entry: (15.907538, 68.5) ft
Radius: 63.222387 ft
Center: (64.684887, 108.72239) ft

Slip Slices

	X	Y	PWP	Base Normal Stress	Frictional Strength	Cohesive Strength	Suction Strength	Base Material
Slice 1	16.477287 ft	67.828356 ft	0 psf	126.22746 psf	88.385422 psf	150 psf	0 psf	Embankment Fill
Slice 2	17.616784 ft	66.521256 ft	0 psf	196.16176 psf	137.35394 psf	150 psf	0 psf	Embankment Fill
Slice 3	18.756282 ft	65.283396 ft	0 psf	267.37443 psf	187.21759 psf	150 psf	0 psf	Embankment Fill
Slice 4	19.895779 ft	64.109001 ft	0 psf	339.76403 psf	237.90534 psf	150 psf	0 psf	Embankment Fill
Slice 5	21.035277 ft	62.993169 ft	0 psf	413.24787 psf	289.35928 psf	150 psf	0 psf	Embankment Fill
Slice 6	22.174774 ft	61.931705 ft	0 psf	487.76042 psf	341.53352 psf	150 psf	0 psf	Embankment Fill
Slice 7	23.314272 ft	60.920979 ft	0 psf	563.25151 psf	394.39295 psf	150 psf	0 psf	Embankment Fill
Slice 8	24.453769 ft	59.957832 ft	0 psf	639.6846 psf	447.91198 psf	150 psf	0 psf	Embankment Fill
Slice 9	25.593266 ft	59.039494 ft	0 psf	717.03529 psf	502.07352 psf	150 psf	0 psf	Embankment Fill
Slice 10	26.732764 ft	58.16352 ft	0 psf	795.28999 psf	556.86804 psf	150 psf	0 psf	Embankment Fill
Slice 11	27.872261 ft	57.327741 ft	0 psf	874.44486 psf	612.29288 psf	150 psf	0 psf	Embankment Fill
Slice 12	29.011759 ft	56.530224 ft	0 psf	954.50501 psf	668.35161 psf	150 psf	0 psf	Embankment Fill
Slice 13	30.151256 ft	55.769239 ft	0 psf	1,035.4839 psf	725.05363 psf	150 psf	0 psf	Embankment Fill

Slice 14	31.290754 ft	55.043231 ft	0 psf	1,117.4029 psf	782.41392 psf	150 psf	0 psf	Embankment Fill
Slice 15	32.430251 ft	54.350797 ft	0 psf	1,200.291 psf	840.45277 psf	150 psf	0 psf	Embankment Fill
Slice 16	33.565929 ft	53.692777 ft	0 psf	1,415.4959 psf	991.14088 psf	150 psf	0 psf	Embankment Fill
Slice 17	34.686726 ft	53.073639 ft	0 psf	1,502.6919 psf	1,052.1962 psf	150 psf	0 psf	Embankment Fill
Slice 18	35.79646 ft	52.48948 ft	0 psf	1,590.0814 psf	1,113.3869 psf	150 psf	0 psf	Embankment Fill
Slice 19	36.906195 ft	51.933014 ft	0 psf	1,678.6527 psf	1,175.4053 psf	150 psf	0 psf	Embankment Fill
Slice 20	38.015929 ft	51.403434 ft	0 psf	1,768.477 psf	1,238.3009 psf	150 psf	0 psf	Embankment Fill
Slice 21	39.125664 ft	50.900001 ft	0 psf	1,859.634 psf	1,302.1297 psf	150 psf	0 psf	Embankment Fill
Slice 22	40.235398 ft	50.422038 ft	0 psf	1,952.2128 psf	1,366.9541 psf	150 psf	0 psf	Embankment Fill
Slice 23	41.345133 ft	49.968922 ft	0 psf	2,046.3128 psf	1,432.8437 psf	150 psf	0 psf	Embankment Fill
Slice 24	41.95 ft	49.729233 ft	0 psf	1,868.3156 psf	1,308.2087 psf	150 psf	0 psf	Embankment Fill
Slice 25	42.5 ft	49.522591 ft	0 psf	2,447.489 psf	1,713.7503 psf	150 psf	0 psf	Embankment Fill
Slice 26	43.5 ft	49.157388 ft	0 psf	2,542.6408 psf	1,780.3762 psf	150 psf	0 psf	Embankment Fill
Slice 27	44.5 ft	48.811101 ft	0 psf	2,639.546 psf	1,848.23 psf	150 psf	0 psf	Embankment Fill
Slice 28	45.5 ft	48.483405 ft	0 psf	2,738.3314 psf	1,917.4003 psf	150 psf	0 psf	Embankment Fill
Slice 29	46.549556 ft	48.159602 ft	0 psf	1,056.2054 psf	739.56299 psf	150 psf	0 psf	Embankment Fill
Slice 30	47.648667 ft	47.841259 ft	0 psf	1,064.2489 psf	745.19509 psf	150 psf	0 psf	Embankment Fill
Slice 31	48.747778 ft	47.544317 ft	0 psf	1,070.0134 psf	749.23144 psf	150 psf	0 psf	Embankment Fill
Slice 32	49.846889 ft	47.268466 ft	0 psf	1,073.3703 psf	751.58198 psf	150 psf	0 psf	Embankment Fill
Slice 33	50.946 ft	47.013423 ft	0 psf	1,074.1761 psf	752.14622 psf	150 psf	0 psf	Embankment Fill
Slice 34	52.045111 ft	46.778932 ft	0 psf	1,072.2702 psf	750.81169 psf	150 psf	0 psf	Embankment Fill
Slice 35	53.144222 ft	46.564758 ft	0 psf	1,067.4722 psf	747.45209 psf	150 psf	0 psf	Embankment Fill
Slice 36	54.243333 ft	46.370694 ft	0 psf	1,059.5789 psf	741.92516 psf	150 psf	0 psf	Embankment Fill
Slice 37	55.342444 ft	46.196551 ft	0 psf	1,048.3609 psf	734.07019 psf	150 psf	0 psf	Embankment Fill
Slice 38	56.441555 ft	46.042163 ft	0 psf	1,033.5579 psf	723.70502 psf	150 psf	0 psf	Embankment Fill
Slice 39	57.540666 ft	45.907386 ft	0 psf	1,014.8742 psf	710.62259 psf	150 psf	0 psf	Embankment Fill

Slice 40	58.639777 ft	45.792092 ft	0 psf	991.97286 psf	694.58687 psf	150 psf	0 psf	Embankment Fill
Slice 41	59.738888 ft	45.696175 ft	0 psf	964.4683 psf	675.32797 psf	150 psf	0 psf	Embankment Fill
Slice 42	60.837999 ft	45.619546 ft	0 psf	931.91859 psf	652.53642 psf	150 psf	0 psf	Embankment Fill
Slice 43	61.93711 ft	45.562136 ft	0 psf	893.81551 psf	625.85636 psf	150 psf	0 psf	Embankment Fill
Slice 44	63.036221 ft	45.523891 ft	0 psf	849.573 psf	594.87742 psf	150 psf	0 psf	Embankment Fill
Slice 45	64.135332 ft	45.504777 ft	0 psf	798.51335 psf	559.12507 psf	150 psf	0 psf	Embankment Fill
Slice 46	65.236555 ft	45.504814 ft	0 psf	739.72685 psf	517.96232 psf	150 psf	0 psf	Embankment Fill
Slice 47	66.339892 ft	45.524075 ft	0 psf	672.25355 psf	470.717 psf	150 psf	0 psf	Embankment Fill
Slice 48	67.443229 ft	45.562615 ft	0 psf	595.11667 psf	416.70518 psf	150 psf	0 psf	Embankment Fill
Slice 49	68.546565 ft	45.620468 ft	0 psf	507.05354 psf	355.04271 psf	150 psf	0 psf	Embankment Fill
Slice 50	69.649902 ft	45.697689 ft	0 psf	406.58202 psf	284.69179 psf	150 psf	0 psf	Embankment Fill
Slice 51	70.753239 ft	45.794347 ft	0 psf	291.95708 psf	204.43055 psf	150 psf	0 psf	Embankment Fill