Geotechnical Data Report
I-15 Truck Climbing Lanes
Southbound MP CL 70.7 to CL 71.9
Clark County, Nevada

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April 20, 2022
NewFields Project No. 475.0464.001

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Attention: **David Dodson, P.E.**
Division Manager, Transportation

Re: **Geotechnical Data Report**
I-15 Truck Climbing Lanes
Southbound MP CL 70.7 to CL 71.9
Clark County, Nevada

This submittal presents the Geotechnical Data Report for the I-15 Truck Climbing Lane, southbound MP CL 70.7 to CL 71.9 project in Clark County, Nevada. The report presents a summary of the geotechnical site characteristics, laboratory test results, and general recommendations for use in Atkins' engineering design efforts.

If you have any questions or require additional information, please contact the undersigned.

Sincerely,

NewFields Mining Design & Technical Services

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1. INTRODUCTION

This report presents the results of the geotechnical field investigation and testing program performed for the Interstate-15 (I-15) Truck Climbing Lane, Southbound MP CL 70.7 to CL 71.9 project located in Clark County, Nevada. The project site consists of the widening to the inside median of southbound I-15 for the construction of a truck climbing lane between the mileposts CL 70.7 and CL 71.9. The general location of the site is presented on Figure 01, Vicinity Map, Appendix A. Site plans showing the sections of the alignment and approximate soil boring, are presented on Figures 02 through 05, Site Plans, Appendix A.

1.1 Overview

The I-15 Truck Climbing Lane Southbound MP CL 64.4 to CL 66.1 project is an improvement for the I-15 Corridor, north of Las Vegas. I-15 Southbound will be widened from two to three lanes between the milemarkers stated above, with a distance of approximately 1.2 miles. A large quadruple 10 ft x 6 ft Reinforced Concrete Box (RCB) identified as Structures B-690S, is located at MP 71.79. The structure will need to be extended with the widening. There is an established median flowline ditch that conveys flows to drop inlets along the median. As southbound is widened to the median to make width for the truck climbing lane to the outside, a new median ditch flowline will need to be re-established and new drop inlets will need to be placed to provide median drainage.

1.2 Objectives and Scope

The objectives and scope of this program were presented in NewFields' Proposal No. 21PR-031, dated July 19, 2021. In general, the objectives include:

- Performing high-level geologic mapping and reconnaissance;
- Geotechnical exploration to characterizing the subsurface conditions;
- Laboratory testing;
- Provide slope stability recommendations for embankment slopes;
- Providing general recommendations regarding the reuse potential of on-site materials.

2. SITE SETTING

2.1 Geologic Setting

Regional Geology

Las Vegas is located in a broad north-south valley within the Basin and Range geomorphic province. The valley was formed by a southwest-northeast extension and northwest-southeast

elongation that created a structural low between block faulted mountain ranges. The valley is surrounded with the Spring Mountains to the west-southwest, the Sheep and Las Vegas Ranges to the northeast, and Frenchman Mountain to the east-southeast.

The valley is filled with deep accumulations of coalescing alluvium, fluvial, spring, and lakebed deposits of the Quaternary and Tertiary periods. The coarser grained deposits are generally located near the base of the mountains becoming progressively finer towards the middle of the valley. Sediments are on the order of 10,000 to 13,000 feet deep (Page et. Al., 2005).

Site Geology

The *Preliminary geologic map of the Lake Mead 30' x 60' quadrangle, Clark County, Nevada, and Mohave County, Arizona* (Beard L.S., 2007) indicates the project corridor is underlain by alluvial deposits of the from Holocene epoch through the late Pleistocene epoch and two separate calcrete (caliche) deposits, one from the Lower Pleistocene to upper Pliocene and a second from the lower Pliocene epoch. The alluvial deposits consist of channel/sidestream alluvium of poorly sorted silt, clay, sand, and pebble- to boulder-gravel. The calcrete deposits consist of strongly to moderately cemented calcareous soils approximately 15 to 30 feet in thickness. To the east and west of I-15, the interstate cuts through a valley surrounded by paleozoic limestone ridges of the Bird Springs and Monte Cristo formations. Both of these formations consist primarily of carbonate limestones beginning from the south end the project limits through approximate Sta. 278+00. The basal unit of this zone that subdivides the Bird Springs Formation and Monte Cristo are beds of quartzite, sandstone, shale, and very silty limestone held within the Bird Springs formation (Ebanks 1965).

The *USDA Web Soil Survey* (2022) indicates the near surface materials along the project alignment are comprised of gravelly to sandy loams derived from limestone, dolomite, and sandstone, and sedimentary rock.

2.2 Seismicity and Faulting

Southern Nevada is considered to have a high risk of seismicity, largely due to its proximity to the Sierra Nevada fault zone. The Sierra Nevada fault zone is a series of north-south trending faults, separating the Sierra Nevada Province from the Great Basin Province, west of Las Vegas, and is prone to major quakes.

Based on a review of the *Quaternary Fault and Fold Database of the United States* (USGS, 2021) no Holocene faults (evidence of displacement during the last 10,000 years) have been mapped transecting the project site. Quaternary faults in the vicinity of the project site include the California Wash fault located approximately 8 miles east of the project site. The approximate

location of these fault lineaments relative to the project location are shown on Figure 06 in Appendix A.

3. FIELD INVESTIGATION

NewFields conducted a geotechnical field investigation from January through March 2022 as described in the *Proposal for Geotechnical Investigation* (NewFields, 2021). Our field program included high-level geologic mapping and reconnaissance, logging, and sampling of fourteen geotechnical borings along the proposed I-15 Truck Climbing lanes southbound MP CL 70.7 to 71.9 project corridor, and laboratory testing.

All exploration locations were cleared for underground utilities through USA North 811. Details of the geotechnical site investigation are described in the following sections.

3.1 High-Level Geologic Mapping

A site reconnaissance and high-level geologic mapping was performed by a NewFields engineer on January 13, 2022. The *Preliminary Geologic Map of the Lake Mead 30' x 60' Quadrangle, Clark County, Nevada, and Mohave County, Arizona* (Beard L.S., 2007) was used as the base map. The various geologic units noted on the map were verified in the field, logged, and photographed.

The high-level geologic mapping generally agrees with the base map. Site soils generally consist of clayey gravel with sand to clayey sand with gravel. The majority of materials were visually estimated to have approximately 25% fines or less and judged to be of low to medium plasticity. Gravels were noted as subrounded to angular and less than 2 to 3 inches in diameter. Between Station 237+00 and 268+00, calcrete was exposed in the cut slopes. From approximately Station 237+00 to 246+00, the calcrete was qualitatively logged as moderately cemented. Between Station 246+00 to 268+00, the calcrete was noted as strongly cemented. Results of the high-level geologic mapping are presented in Figures 07 through 10 in Appendix A, along with project stationing. The high-level geologic maps provided in Appendix A should not be used as an indicator of excavability.

During our field reconnaissance, the roadway surface was visually examined for signs of distress, such as excessive cracking and undulations. No areas of atypical distress were noted. However west and north of the project site, considerable undulations were noted on I-15 and Las Vegas Boulevard. The cause for these undulations is unknown. During our field reconnaissance, the roadway surface was visually examined for signs of distress, such as excessive cracking and undulations. Two areas of undulations were noted. The first is an approximately 50-foot section of northbound I-15 near MP 71, close to the existing drainage culvert that crosses beneath I-15. The second is southbound I-15 at approximately MP 71.2, near an existing drainage channel.

Several areas of undulations were also noted on Las Vegas Boulevard approximately 0.5 miles to the west, and on I-15 approximately 0.5 south of the project limits. The cause for these undulations are unknown at this time. However, given the proximity of the culvert and the drainage channel near the areas of noted undulations, it is likely that these undulations could be attributed to under compacted trench backfill and/or drainage issues.

3.2 Soil Borings

The geotechnical investigation consisted of fourteen soil borings performed from March 9 through 11, 2022. The approximate boring locations are presented in Figures 02 through 05, Appendix A. Borings were advanced by Terra Contracting using a Mobile B-29 truck mounted drill rig equipped with 8" diameter hollow stem augers. Ground surface elevations were estimated from Clark County's OpenWeb GIS website and are presented on the boring logs. Boring locations, coordinates, and depths are summarized in Table 1.

Table 1: Summary of Geotechnical Exploration Locations

Boring	Station	Offset	Latitude	Longitude	Exploration Depth (feet)
21-BH-19	"XW" 238+02	RT 50 ft	36.46205	-114.83317	6.5
21-BH-20	"XW" 242+55	RT 52 ft	36.46299	-114.83217	6.5
21-BH-21	"XW" 247+14	RT 50 ft	36.46397	-114.83117	6.5
21-BH-22	"XW" 251+69	RT 50 ft	36.46492	-114.83018	6.5
21-BH-23	"XW" 256+20	RT 48 ft	36.46587	-114.82919	6.5
21-BH-24	"XW" 260+80	RT 51 ft	36.46683	-114.82818	6.5
21-BH-25	"XW" 265+32	RT 57 ft	36.46776	-114.82717	6.5
21-BH-26	"XW" 269+93	RT 56 ft	36.46869	-114.82611	6.5
21-BH-27	"XW" 274+57	RT 53 ft	36.46958	-114.82500	6.5
21-BH-28	"XW" 279+09	RT 55 ft	36.47040	-114.82385	6.5
21-BH-29	"XW" 283+72	RT 57 ft	36.47119	-114.82264	6.5
21-BH-30	"XW" 288+98	RT 59 ft	36.47205	-114.82119	31.5
21-BH-31	"XW" 293+64	RT 56 ft	36.47276	-114.81990	6.5
21-BH-32	"XW" 296+44	RT 63 ft	36.47321	-114.81895	6.5

NewFields logged stratigraphy, material characteristics, and other pertinent field observations and collected geotechnical soil samples. Soils were classified in general accordance with the Unified Soil Classification System (USCS) as described in ASTM D2487 and D2488.

Geotechnical samples were collected using a standard penetration test (SPT) split spoon (1.38-inch inside diameter; ASTM D1586) at the surface and a depth of 5-foot, except for boring 21-BH-30. At location 21-BH-30, a sampling interval of 2.5 feet in the upper 10 feet, and 5 feet thereafter was used. Split spoon samplers were driven using a 140-pound automatic hammer with an approximate drop of 30 inches until a maximum penetration of 18 inches was achieved, when possible.

The number of blows required to drive the sampler the final 12 inches of the 18-inch drive were recorded on the field logs. Blow counts presented on the final boring logs (Appendix B) are raw field values and have not been corrected for sampler type, overburden pressures, and hammer efficiency.

Bulk samples were collected of auger cuttings, and placed into plastic buckets, sealed, and labeled. Split spoon sampled were also placed into plastic bags, sealed, and labeled. Upon completion of sampling activities, the borings were backfilled in accordance with *2016 Nevada Revised Statutes* (NRS) 534.4371.

Following a review of initial boring logs, geotechnical laboratory tests were assigned to specific samples. In an effort to expedite the project, geotechnical samples for testing were transferred to Aztech's geotechnical laboratory in Las Vegas, Nevada. Aztech is AASHTO accredited in all geotechnical tests performed.

An exploration key and geotechnical boring logs are included in Appendix B.

4. LABORATORY TESTING

4.1 Geotechnical Laboratory Testing

Laboratory testing was performed on representative geotechnical samples encountered during the field investigation to aid in the classification of site soils and to determine material properties.

The following geotechnical tests were performed:

- Particle Size Analysis (NDOT T-206);
- Atterberg Limits (NDOT T-210, T-211, and T-212);
- R-Value Tests (NDOT T-115D);
- Proctor Test (NDOT T-108D).

Laboratory test results are summarized in Table 1 as presented in Appendix C. Individual laboratory results are provided in Appendix C.

4.2 Chemical Laboratory Testing

Chemical tests were performed on five samples collected during NewFields' investigation. Chemical tests were performed to evaluate corrosion potential and potential for sulfate attack on concrete.

The following chemical tests were performed by Sims & Associates in Las Vegas, Nevada:

- pH (AASHTO T289/NDOT T238A);
- Resistivity (AASHTO T288/NDOT T235B);
- Chloride (AASHTO T291B);
- Soluble Sulfate (AASHTO T290B).

The sample boring, depth, and chemical test results are summarized in Table 2 below. Chemical test results are provided in Appendix C.

Table 2: Chemical Testing Sample Locations and Results

Boring Location	Depth (feet)	Soil pH	Min. Resistivity (Ω-cm)	Chloride (ppm)	Soluble Sulfate (ppm)
21-BH-19	5.0-6.5	8.93	1,500	56	100
21-BH-21	0.0-5.0	8.81	784	61	500
21-BH-28	0.0-1.5	8.58	850	58	300
21-BH-30	5.0-6.5	9.19	1,200	171	400
21-BH-32	5.0-6.5	8.37	4,700	1,126	800

5. GEOTECHNICAL CHARACTERIZATION

5.1 Subsurface Conditions

Site soils generally consist of medium dense to very dense clayey or silty gravel with sand to clayey sand with gravel. Clayey gravel was generally medium to high plasticity based on laboratory testing. Gravels were noted as subrounded to angular and less than 2 to 3 inches in diameter. High plasticity fat clay with sand was encountered in boring 21-BH-30 at a depth of 15 feet extending to the maximum depth explored of 31.5 feet. The clay was estimated to have a consistency of stiff to hard based on blow count measurements.

Between Station 237+00 and 268+00, calcrete was exposed in the cut slopes. From approximately Station 237+00 to 246+00, the calcrete was qualitatively logged as moderately cemented. Between Station 246+00 to 268+00, the calcrete was noted as strongly cemented. Therefore, difficult excavation should be anticipated.

Gypsiferous soils were noted in the form of gypsum crystals near approximately Station 246+00. Gypsiferous deposits typically occur throughout the Las Vegas Valley at shallow depths (upper 5 feet). Gypsum is susceptible to rapid dissolution when saturated and is therefore noticeably absent in washes due to its solubility.

5.2 Groundwater

Groundwater was not encountered to the maximum depth explored of 31.5 feet below existing ground surface. A review of the Nevada Division of Water Resources Well Database indicates groundwater in the site vicinity is in excess of 400 feet below ground surface (NDWR Water Level Dashboard Feb 2022).

6. RESULTS AND INTERPRETATIONS

The following sections present the findings of our field investigation and laboratory testing program for the project and provides general earthwork recommendations.

6.1 Cut and Embankment Slope Stability

To allow for the construction of truck climbing lanes on I-15, the roadway embankment will need to be widened up to approximately 16 feet, which will require cut slopes of up to 2:1 (H:V) for the NB embankment slope. Based on the typical sections presented on the 60% design plans, it appears the existing embankments are generally constructed at an inclination of 2:1 (H:V) or flatter and based on observations appears to be globally stable, with slope performance impacted only by surficial raveling, rills and shallow erosion gullies that require on-going maintenance.

Slope stability of proposed embankment slopes were evaluated for both static and pseudostatic loading conditions using the Bishop method and computer software SLIDE by Rocscience Inc. The critical section modeled consisted of a 2:1 (H:V) maximum slope up to 10 feet in height. A traffic surcharge of 250 psf was modeled at a distance of 2 feet from edge of slope to account for vehicular live loads. A friction angle of 34 degrees was used in the stability model based on blow count correlations presented in FHWA GEC No. 5 (2007). Surficial failures less than 5 feet in depth were neglected and not considered in the global slope stability analyses.

To represent a pseudostatic loading condition, the slope stability model used a horizontal seismic acceleration coefficient (k_h) of 0.1 based on one-half the peak ground acceleration as obtained from the USGS Design Maps calculator. This value was greater than the minimum presented in the *NDOT Structures Manual* (NDOT, 2008).

Since the widening will support I-15, which serves as a vital north-south thoroughfare through the Nevada, we have considered the roadway embankment slopes to be of critical importance to the highway system and per *AASHTO LRFD Bridge Design Specifications, Article 11.6.2.3* a resistance factor of 0.65 should be applied to the evaluation of overall stability of earth slopes. The applied resistance factor is equivalent to a factor of safety of 1.5 from the allowable stress design (ASD) design methodology. The *LRFD Seismic Analysis and Design of Transportation Geotechnical Features and Structural Foundations Reference Manual* (FHWA, 2011), Section 6.2.2 recommends a minimum Factor of Safety of 1.1 for pseudostatic (seismic) analyses.

The stability results for the modeled conditions exceed the minimum factors for safety for static and pseudostatic conditions and are therefore considered to be globally stable. Graphical outputs of the slope stability analyses are provided in Appendix D.

6.2 Reinforced Concrete Box Design

The existing reinforced concrete box will be widened approximately 10.5 feet into the inside median and new wingwalls constructed. Wing walls will vary in height from 6.3 feet to 10.4 feet with an overall length of 12.3 feet and have a foundation width of approximately 4.5 feet. The strength and service limit state bearing resistance for both elements were designed in accordance with *AASHTO LRFD Bridge Design Specifications* (2020) as outlined in the following subsections. An embedment depth of 1 foot was assumed for bearing resistance calculations.

6.2.1 Strength and Extreme Limit Bearing Resistance

Nominal bearing resistance for the RCB extension and wing walls under the strength and extreme limit states was calculated using Equation 10.6.3.1.1-1, *AASHTO LRFD Bridge Design Specifications* (2020). A resistance factor of 0.45 per Table 10.5.5.2.2-1, *AASHTO LRFD Bridge Design Specifications* (2020) was applied to the nominal bearing resistance value to calculate the factored strength bearing resistance. A resistance factor of 1.0 was used in determining the extreme limit bearing resistance. Factored bearing resistance values for are summarized Table 3.

Table 3: Factored Strength Limit State Bearing Resistances

Structure	Strength Limit I Bearing Resistance (ksf)	Extreme Limit Bearing Resistance (ksf)
RCB Extension	4.20	9.34
Wing Walls	2.57	5.70

Supporting calculations are provided in Appendix E.

6.2.2 Service Limit State Bearing Resistance

Settlement of the RCB and wing walls were estimated based on the dimensions shown on Sheets B1and B2 of the 60% plans. To estimate settlement, the elastic modulus values presented in Table 5 were used with a Boussinesq vertical stress distribution in the program SETTLE3. The depth of the soil profile used in the model to assess potential settlement was developed following guidance for stress influence and test hole depths provided in Section 10.4.2, *AASHTO LRFD Bridge Design Specifications* (2020).

Per Section 10.5.5 of the *AASHTO LRFD Bridge Design Specifications* (2020) a resistance factor of 1.0 should be used for the service limit state. Therefore, the nominal bearing resistance is equal to the factored extreme limit bearing resistance. No further reduction was applied.

The equivalent elastic modulus (E_s) for the various lithologies were estimated using field SPT blow counts corrected for overburden and hammer efficiency effects ($N1_{60}$) and compared against the equations for "Silts, Sandy Silts, slightly cohesive mixtures" and "sandy gravel and gravels" from Table C10.4.6.3-1, *AASHTO LRFD Bridge Design Specifications* (2020). The soil properties for service limit state settlement calculations are summarized in Table 4.

Table 4: Soil Properties for Service Limit State Settlement Calculations

Material Description	Method	Elevation (ft)	Total Unit Weight (pcf)	Young's Modulus Es (ksf)
Fill: Silty Gravel with Sand	Elastic Method using AASHTO LRFD Bridge Design Specifications, Table C10.4.6.3-1	Assumed Bottom of RCB Footing. 2086 to 2085	130	2,120
Clayey Gravel with Sand (Medium Dense)	Elastic Method using AASHTO LRFD Bridge Design Specifications, Table C10.4.6.3-1	2085 to 2079	130	2,000
Clay (CL-CH) (Stiff to Very Stiff)	Elastic Method using *AASHTO LRFD Bridge Design Specifications*, Table C10.4.6.3-1	2079-2058	120	1,000

Considering differential settlement would likely control the service limit bearing resistance for the proposed widening, we used a settlement threshold of 0.5 inches in determining the service limit state bearing resistance. Settlement calculations were analyzed for varying loads until a maximum settlement of 0.5 inches was obtained using the program SETTLE3 by Rocscience. A corresponding load of 2.4 ksf was determined to be the recommended service limit state bearing resistance for the proposed extension. Results of the SETTLE3 calculations are provided in Appendix F.

6.2.3 Lateral Earth Pressures

In accordance with Detail No. EB-4 of the NDOT Standard Plans (NDOT, 2020), granular backfill will be required around the RCB. A minimum of 18 inches will be required on the sides and a minimum of 12 inches of cover over the top of the RCB. Granular backfill is required to consist of natural sand or a mixture of sand with gravel, crushed gravel or stone complying with the requirements of the *Standard Specification for Road and Bridge Construction*, Section 704.03.11 (NDOT, 2014). Considering all borrow material will be required to have a minimum R-value of 45 or greater per Section 704.03.12 of the Standard Specifications for Road and Bridge Construction (NDOT, 2014), we have assumed an angle of internal shear resistance of 34 degrees for calculating lateral earth pressure coefficients. Sliding resistance between the base of shallow spread foundation and the soil beneath it is determined by the coefficient of friction (tan δ) between the bottom of footing and the soil. A value of 23 degrees was assumed for δ from AASHTO Table C.3.11.5.3-1. In the table, d for silty or clayey gravel ranges from 24 degrees to 29 degrees. The unfactored lateral earth pressure coefficients are provided in Table 5. Recommendations in Table 5 are for a vertical wall with level backfill behind the wall.

Table 5: Unfactored Lateral Earth Pressure Coefficients

Case	Condition	Earth Pressure Coefficient	Resultant Location [5]	Required Movement (D/H) [6]	Unit Weight (pcf)
Static	Active (K_A) [1]	0.26	H/3	0.002	125
	Passive (K_P) [2]	7.5		0.02	
	At-Rest (K_O) [3]	0.44		-	
Dynamic	K_{AE} [4] (Resultant)	0.3	0.6H	0.002	

Notes:
(1) ***AASHTO LRFD Bridge Design Specifications*, Equation 3.11.5.3-1.**
(2) ***AASHTO LRFD Bridge Design Specifications,* Figure 3.11.5.4-1.**
(3) ***AASHTO LRFD Bridge Design Specifications,* Equation 3.11.5.2-1.**
(4) ***AASHTO LRFD Bridge Design Specifications,* Equation A11.3.1-1.**
(5) **Resultant measured from bottom of wall.**
(6) **Movement at top of wall required to reach minimum active or maximum passive pressure by tilting or lateral translation based on Table C3.11.1-1 of *AASHTO LRFD Bridge Design Specifications* (2017) for medium dense sand.**

Lateral earth pressure coefficients provided in Table 5 do not include the forces of hydrostatic pressure behind the wall.

6.3 Drainage Considerations

The subgrade conditions encountered during the investigation indicate site soils are potentially expansive. Additionally, two areas of undulations were noted during the high-level geologic mapping program. The first is an approximately 50-foot section of northbound I-15 near MP 71, close to the existing drainage culvert that crosses beneath I-15. The second is southbound I-15 at approximately MP 71.2, near an existing drainage channel. Given the proximity of the culvert and the drainage channel near the areas of noted undulations, it is likely that these undulations could be attributed to under compacted trench backfill and/or drainage issues.

Undulations on the order of 6 to 12 inches have been reported immediately south of the project limits on I-15 near milepost 70. Considering the subgrade conditions encountered during the investigation indicate medium to high plasticity clayey gravels underlain by high plasticity fat clays, all surface drainage should be controlled and directed off-site. No ponding of stormwater or impoundment of water should be allowed on-site.

Paved drainage channels should be limited to the extent possible, as moisture can become trapped beneath the impermeable layer further exacerbating the potential expansion of the subgrade soils. We recommend drainage swales be constructed of properly placed compacted aggregate base which will as a “chocking” layer between surface water and the underlying clayey soils.

6.4 Reuse of On-Site Materials

Laboratory testing of the on-site soils do not meet the minimum R-Value ≥ 45 requirements for Borrow as outlined in Section 704.03.12 of the *Standard Specifications for Road and Bridge Construction* (NDOT, 2014). Most of the near surface soils consist of clayey gravels of medium to high plasticity. Additionally during the high level geologic field mapping highly gypsiferous soils were noted near surface. Due to the solubility concerns of these soils, in combination with low R-values any material generated from excavation should be considered unacceptable and disposed off-site.

While the materials are anticipated to be suitable for construction, surface drainage should be controlled. The project site is in an area where soluble soils have been noted. Should surface water be allowed to infiltrate into these soils, dissolution of the soluble soils and/or swell of potentially expansive soils could occur ultimately impacting the roadway surface in the form of undulations which could be similar to those noted on Las Vegas Boulevard to the west and north.

6.4.1 Concrete Reactivity

Soluble sulfate testing is used in evaluating the potential for sulfate attack against Portland cement concrete from external sources of sulfate (native soils leached by water placed against site concrete). Per the *Guide to Durable Concrete*, ACI 201.2R-08, Table 6.3 (ACI, 2008), sulfate concentrations greater than 150 ppm and less than 1500 ppm, are classified as a Class 1 severity of potential exposure.

Since most of the samples tested indicated sulfate concentrations greater than 150 but less than 1500 ppm, the use of Type V cement is recommended for concrete structures.

6.4.2 Corrosivity

Per Table 2-3 "Effect of Resistivity on Corrosion*" of Corrosion/Degradation of Soil Reinforcements for Mechanically Stabilized Earth Walls and Reinforced Soils Slopes*, FHWA-NHI-00-044 (FHWA, 2000), generally soils are considered "corrosive" when resistivity values are between 700 Ω-cm and 2000 Ω-cm. Since the use of buried metallic utilities such as pipes are not anticipated, corrosion potential is not considered to be a concern. However, if at a later time metallic pipes or other buried metallic elements are proposed, a corrosion engineer should review test results to determine if corrosion protection for metallic elements should be incorporated into the final design.

6.5 Fill Placement

Placement of embankment fills shall meet the requirements outlined in Section 203.03.15 of the *NDOT Standard Specifications for Road and Bridge Construction* (2014).

Prior to the placement of fill, vegetation and organic materials will be required to be cleared and grubbed from structural areas and removed from the site in accordance with Section 201 of the *NDOT Standard Specifications for Road and Bridge Construction* (2014). The majority of the areas that will receive have sparse vegetation growth as observed during our investigation, therefore clearing and grubbing is anticipated to be minor.

6.6 Benching

Where fill is to be placed on slopes steeper than 4:1 (H:V) or against existing embankments, the new fill should be continuously benched as the work is brought up in layers. Benching should be of sufficient width to permit placement and compaction efforts. Begin each horizontal cut along a line extending from the intersection of the original ground and the vertical sides of the previous cuts.

6.7 Temporary Excavations

All temporary excavations and temporary shoring should comply with OSHA safety regulations (29 CFR Part 1926, Subpart P, Excavations). Temporary shoring should be anticipated for excavations adjacent to existing structures and utilities and should be designed with the necessary rigidity to protect such structures in place and prevent excessive deflection, support imposed loads, and demonstrate compliance with OSHA regulations. Temporary excavations and shoring are the responsibility of the Contractor and should provide positive means to prevent settlement of structures located adjacent to the excavation.

7. LIMITATIONS

The recommendations contained in this report are based on field exploration, laboratory testing, research of pertinent maps and literature, and our understanding of the proposed construction. The soil data used in the preparation of this report are based on the field explorations performed at the locations referenced in the report. It is possible that variation in the soil conditions may exist between the locations explored. Therefore, if any soil conditions are encountered at the site that are different from those outlined in this report, NewFields should be immediately notified so that we may review and make supplementary recommendations if warranted.

This report has been prepared solely for the use of Atkins and NDOT for design of the I-15 Truck Climbing Lanes MP CL 70.7 to CL 71.9 Project. Our services were performed using generally accepted geotechnical engineering practice common to the area at the time of this report. No other warranties, either expressed or implied, are included or intended.

8. REFERENCES

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APPENDIX A
Figures

LEGEND

- BORING LOCATIONS (2022)

N W E S

0 600 1200
FEET

NewFields

PROJECT NUMBER	475.0464.002
LOCATION	CLARK COUNTY, NEVADA
DOCUMENT FILENAME	TCL POINTS.DWG
AREA	I-15
CLIENT	ATKINS
PROJECT	I-15 TRUCK CLIMBING LANE MP CL 70.7 TO 71.9
FIGURE TITLE	VICINITY MAP
FIGURE NUMBER	01
REVISION	-

S:\PROJECTS\0464\002-I-15 TCL MP 71.9 TO 70\7-DESIGN\FIGS\TCL_POINTS.DWG - Last saved by: AGONZALEZ on 4/20/2022

MATCH LINE SEE FIGURE 03

21-BH-22 (5')
STA "XW" 251+69
50' RIGHT

21-BH-21 (5')
STA "XW" 247+14
50' RIGHT

21-BH-20 (5')
STA "XW" 242+55
52' RIGHT

21-BH-19 (5')
STA "XW" 238+02
50' RIGHT

PROPOSED DITCH

250
245
240
235

FILL
CUT

LEGEND

- BORING LOCATIONS (2022)

N
W
E
S

0 60 120
FEET

NewFields

AREA	I-15
CLIENT	ATKINS
PROJECT	I-15 TRUCK CLIMBING LANE MP CL 70.7 TO 71.9
PROJECT NUMBER	475.0464.002
LOCATION	CLARK COUNTY, NEVADA
DOCUMENT FILENAME	TCL POINTS.DWG
FIGURE TITLE	SITE PLAN (1 OF 4)
FIGURE NUMBER	02
REVISION	-

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MATCH LINE SEE FIGURE 04

MATCH LINE SEE FIGURE 02

21-BH-26 (5')
STA "XW" 269+93
56' RIGHT

21-BH-25 (5')
STA "XW" 265+32
57' RIGHT

21-BH-24 (5')
STA "XW" 260+80
51' RIGHT

21-BH-23 (5')
STA "XW" 256+20
48' RIGHT

BEGIN MEDIAN GUARDRAIL
STA. 261+50

264+54.70 P.C.

270
265
260
255

CUT
FILL

4'
12'

LEGEND

- BORING LOCATIONS (2022)

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NewFields

PROJECT NUMBER	LOCATION	AREA	CLIENT
475.0464.002	CLARK COUNTY, NEVADA	I-15	ATKINS
DOCUMENT FILENAME		PROJECT	
TCL POINTS.DWG		I-15 TRUCK CLIMBING LANE MP CL 70.7 TO 71.9	
		FIGURE TITLE	FIGURE NUMBER / REVISION
		SITE PLAN (2 OF 4)	03 / -

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MATCH LINE SEE FIGURE 05

MATCH LINE SEE FIGURE 03

LEGEND

- BORING LOCATIONS (2022)

N W E S

0 60 120
FEET

NewFields

AREA	I-15
CLIENT	ATKINS
PROJECT	I-15 TRUCK CLIMBING LANE MP CL 70.7 TO 71.9
PROJECT NUMBER	475.0464.002
LOCATION	CLARK COUNTY, NEVADA
DOCUMENT FILENAME	TCL POINTS.DWG
FIGURE TITLE	SITE PLAN (3 OF 4)
FIGURE NUMBER	04
REVISION	-

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LEGEND

- BORING LOCATIONS (2022)

N W E S

0 60 120
FEET

NewFields	AREA: I-15	CLIENT: ATKINS	
	PROJECT: I-15 TRUCK CLIMBING LANE MP CL 70.7 TO 71.9		
PROJECT NUMBER: 475.0464.002	LOCATION: CLARK COUNTY, NEVADA		
DOCUMENT FILENAME: TCL POINTS.DWG	FIGURE TITLE: SITE PLAN (4 OF 4)	FIGURE NUMBER: 05	REVISION: -

S:\PROJECTS\0464.002\I-15 TCL LMP 71.9 TO 70.7\07-DESIGN\FIGS\TCL POINTS.DWG - Last saved by AGONZALEZ on 4/20/2022

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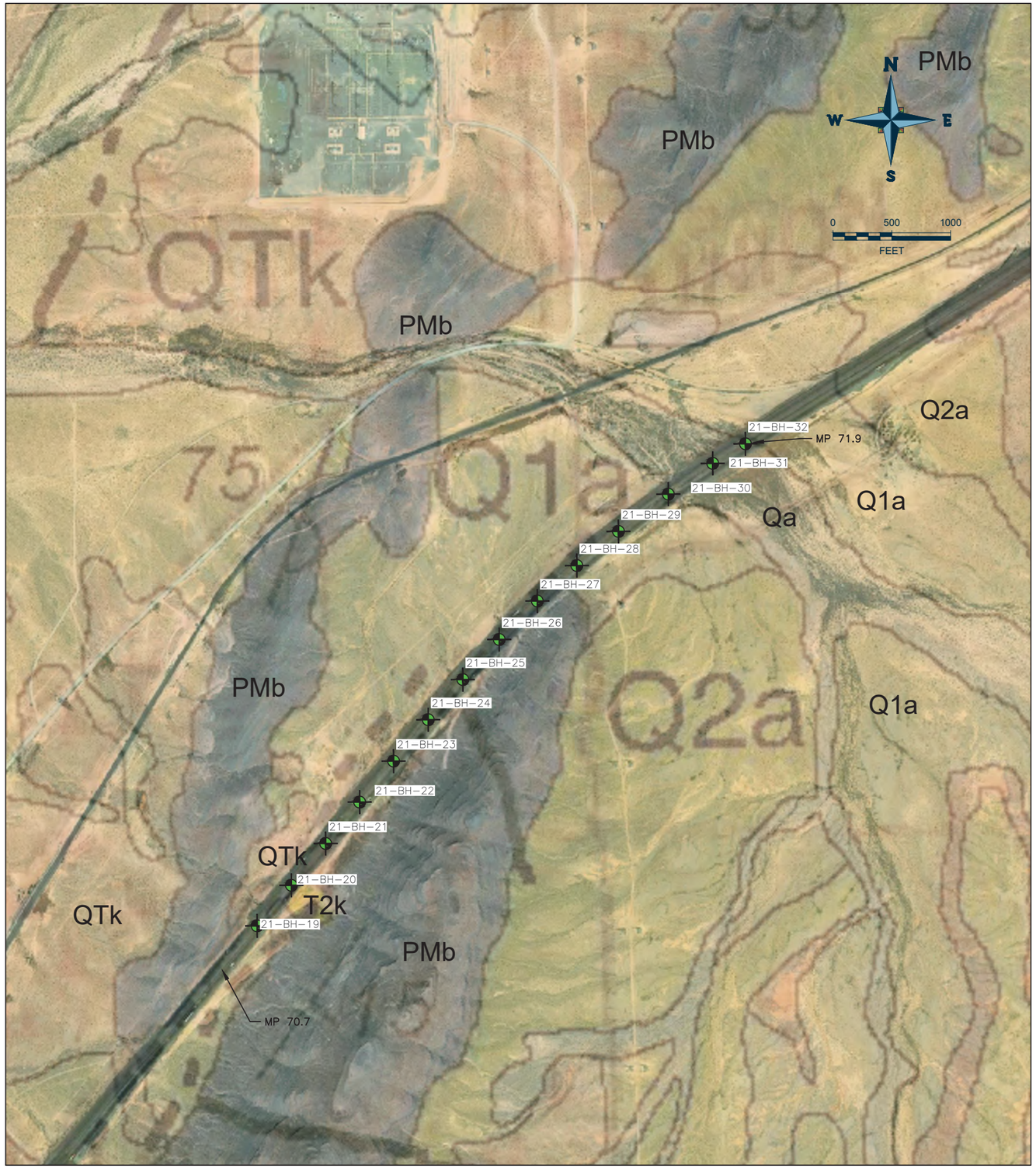
LEGEND:

- LATE QUATERNARY FAULTS (LESS THAN 130,000 YEARS)
- LATEST QUATERNARY FAULTS (LESS THAN 15,000 YEARS)

NewFields

PROJECT NUMBER	475.0464.002
LOCATION	CLARK COUNTY, NEVADA
DOCUMENT FILENAME	06 70.7 TO 71.9 FAULT MAP.DWG
AREA	I-15
CLIENT	ATKINS
PROJECT	I-15 TRUCK CLIMBING LANE MP CL 70.7 TO 71.9
FIGURE TITLE	QUATERNARY FAULTS MAP
FIGURE NUMBER	06
REVISION	-

S:\PROJECTS\0464.0001-I15 TCL MP 64.4 TO 68.1\07-DESIGN\FIGS\FIELD\MAPPING FIGS\PDR\V01\07 TO 71.9\06 70.7 TO 71.9 FAULT MAP.DWG - Last saved by: HWALSH on 4/20/2022



LEGEND:

PROPOSED BOREHOLE LOCATIONS

Q1a GEOLOGIC MAPPING UNIT

Af – Holocene Deposits – Artificial Fill

Qa – Holocene Deposits – Young Alluvium

QTa – Lower Pleistocene Deposits – Sidestream Alluvium

Q1a – Upper and Middle Pleistocene Deposits – Intermediate Aged Sidestream Alluvium

Q2a – Middle to Lower Pleistocene Deposits – Older Sidestream Alluvium

Qp – Holocene and Pleistocene Deposits – Playa Deposits

QTk – Lower Pleistocene to Upper Pliocene Deposits – Calcrete Deposits

T2k – Lower Pliocene Deposits – Calcrete Deposits

Tmf – Upper Miocene Deposits – Muddy Creek Formation: Fine Grained Facies, Siltstone and Sandstone

Mm – Lower and Upper Mississippian Deposits – Monte Cristo Group : Limestone

PMb – Lower Permian to Upper Mississippian Deposits – Bird Springs Formation: Sandstones,Shale, Quartzite, Limestone

U.S. Geological Survey
Open-File Report 2007-1010
Preliminary Geologic Map of the Lake Mead 30' X 60' Quadrangle, Clark County, Nevada, and Mohave County, Arizona
L.S. Beard, R.E. Anderson, D.L. Block, R.G. Bohannon, R.J. Brady, S.B. Castor, E.M. Duebendorfer, J.E. Faulds, T.J. Felger, K.A. Howard, M.A. Kuntz, and V.S. Williams, 2007

NewFields

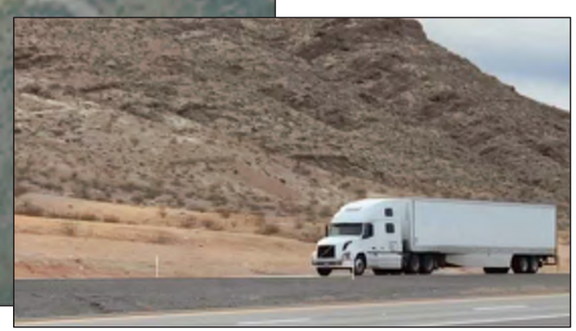
PROJECT NUMBER 475.0464.002	LOCATION CLARK COUNTY, NEVADA	AREA I-15	CLIENT ATKINS
DOCUMENT FILENAME 02 70.7 TO 71.9 OVERVIEW.DWG		PROJECT I-15 TRUCK CLIMBING LANE MP CL 70.7 TO 71.9	
		FIGURE TITLE GEOLOGIC MAP	FIGURE NUMBER 07 / REVISION -

S:\PROJECTS\0464.001 I-15 TCL MP 64.4 TO 69.1\07-DESIGN\FIGS\FIELDMAPPING FIGS\REVISED 70.7 TO 71.9\02 70.7 TO 71.9 OVERVIEW.DWG - Last saved by HWALSH on 4/20/2022

Clayey Sand with Gravel (SC), light brown, dry, fine to coarse sand, fine rounded gravel, moderately cemented with gypsum

Calcrete, whiteish pink, moderately cemented, dry, nonplastic, fine to coarse sand, fine subangular gravel

Clayey Gravel with Sand (GC), reddish brown, dry, low plasticity, fine and coarse sand, fine and coarse angular gravel, with cobbles, desiccation cracking



Northbound I-15 undulation

Erosion along northbound I-15 cutslope

LEGEND:

PROPOSED BOREHOLE LOCATIONS

Q1a GEOLOGIC MAPPING UNIT

Af – Holocene Deposits – Artificial Fill

Qa – Holocene Deposits – Young Alluvium

QTa – Lower Pleistocene Deposits – Sidestream Alluvium

Q1a – Upper and Middle Pleistocene Deposits – Intermediate Aged Sidestream Alluvium

Q2a – Middle to Lower Pleistocene Deposits – Older Sidestream Alluvium

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QTk – Lower Pleistocene to Upper Pliocene Deposits – Calcrete Deposits

T2k – Lower Pliocene Deposits – Calcrete Deposits

Tmf – Upper Miocene Deposits – Muddy Creek Formation: Fine Grained Facies, Siltstone and Sandstone

Mm – Lower and Upper Mississippian Deposits – Monte Cristo Group : Limestone

PMb – Lower Permian to Upper Mississippian Deposits – Bird Springs Formation: Sandstones,Shale, Quartzite, Limestone

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U.S. Geological Survey
Open-File Report 2007-1010
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L.S. Beard, R.E. Anderson, D.L. Block, R.G. Bohannon, R.J. Brady, S.B. Castor, E.M. Duebendorfer, J.E. Faulds, T.J. Felger, K.A. Howard, M.A. Kuntz, and V.S. Williams, 2007

NewFields

PROJECT NUMBER 475.0464.002	LOCATION CLARK COUNTY, NEVADA
DOCUMENT FILENAME 03 70.7 TO 71.9 AREA_1.DWG	
AREA I-15	CLIENT ATKINS
PROJECT I-15 TRUCK CLIMBING LANE MP CL 70.7 TO 71.9	
FIGURE TITLE HIGH LEVEL GEOLOGIC MAPPING	
FIGURE NUMBER 08	REVISION -

S:\PROJECTS\0464.001 I-15 TCL MP 64.4 TO 69.1\07-DESIGN\FIGS\FIELDMAPPING FIGS\REVISED\03 TO 71.9\03 70.7 TO 71.9 AREA_1.DWG - Last saved by: MWALSH on 4/20/2022

Calcrete, tannish white, moderately to strongly cemented subangular to angular gravels and cobbles, fine and coarse gravel

Silty Gravel with Sand (GM), reddish brown, dry, nonplastic, fine sand, fine and coarse subangular to angular gravel, with cobbles

LEGEND:

PROPOSED BOREHOLE LOCATIONS

Q1a GEOLOGIC MAPPING UNIT

Af – Holocene Deposits – Artificial Fill

Qa – Holocene Deposits – Young Alluvium

QTa – Lower Pleistocene Deposits – Sidestream Alluvium

Q1a – Upper and Middle Pleistocene Deposits – Intermediate Aged Sidestream Alluvium

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QTk – Lower Pleistocene to Upper Pliocene Deposits – Calcrete Deposits

T2k – Lower Pliocene Deposits – Calcrete Deposits

Tmf – Upper Miocene Deposits – Muddy Creek Formation: Fine Grained Facies, Siltstone and Sandstone

Mm – Lower and Upper Mississippian Deposits – Monte Cristo Group : Limestone

PMb – Lower Permian to Upper Mississippian Deposits – Bird Springs Formation: Sandstones,Shale, Quartzite, Limestone

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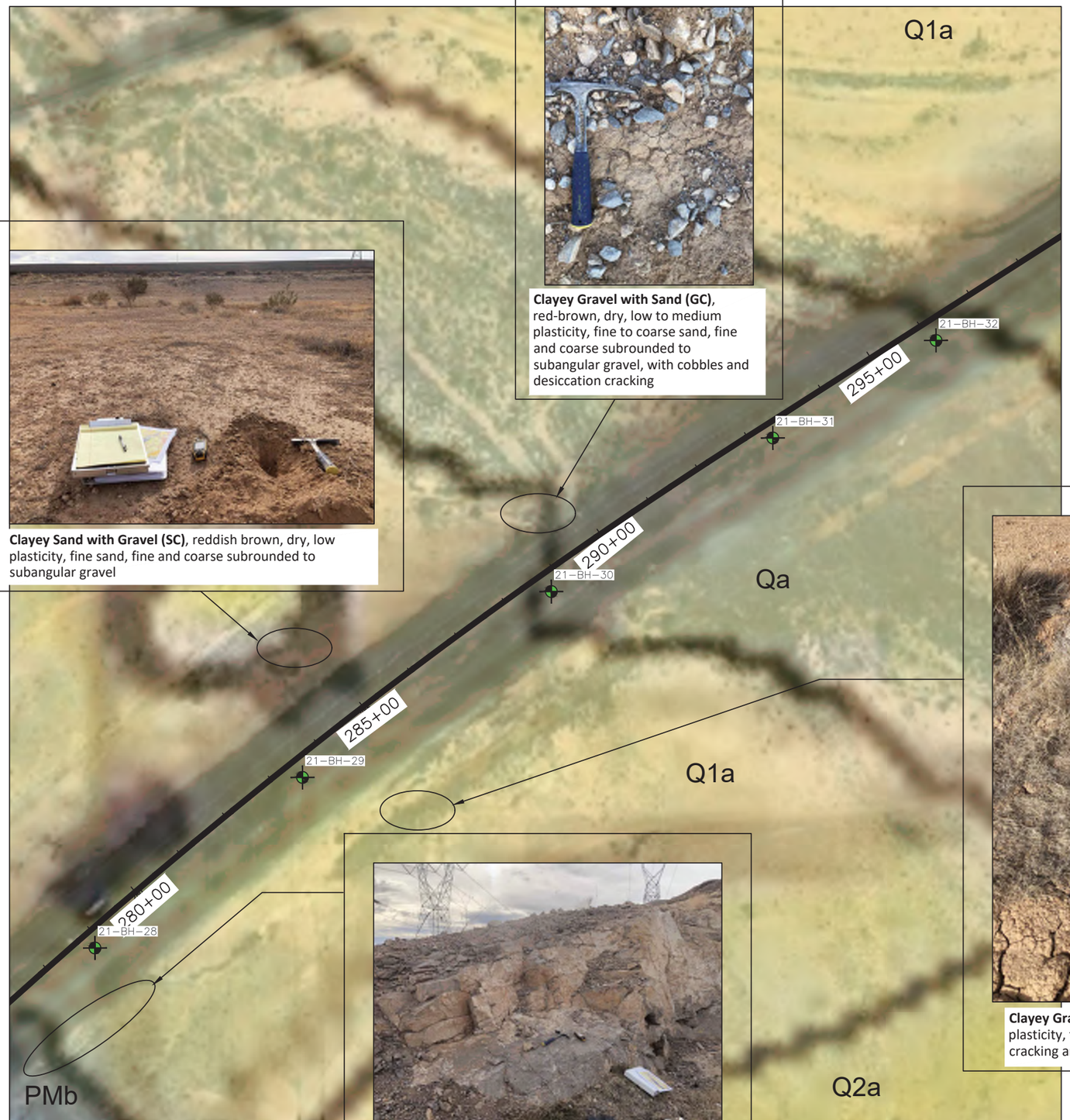
NewFields

PROJECT NUMBER	475.0464.002
LOCATION	CLARK COUNTY, NEVADA
DOCUMENT FILENAME	04 70.7 TO 71.9 AREA_2.DWG
AREA	I-15
CLIENT	ATKINS
PROJECT	I-15 TRUCK CLIMBING LANE MP CL 70.7 TO 71.9
FIGURE TITLE	HIGH LEVEL GEOLOGIC MAPPING
FIGURE NUMBER	09
REVISION	-



Clayey Gravel with Sand (GC), red-brown, dry, low to medium plasticity, fine to coarse sand, fine and coarse subrounded to subangular gravel, with cobbles and desiccation cracking

Clayey Sand with Gravel (SC), reddish brown, dry, low plasticity, fine sand, fine and coarse subrounded to subangular gravel

Clayey Gravel with Sand (GC), light brown, dry, low plasticity, fine sand, trace fine gravel, desiccation cracking and animal burrowing disturbances

Bird Springs Formation: **Quartzite**, grey-white, massive, jointed and fractured, R4, with calcite infill (contact exposed in cut face)

LEGEND:

PROPOSED BOREHOLE LOCATIONS

Q1a GEOLOGIC MAPPING UNIT

Af – Holocene Deposits – Artificial Fill

Qa – Holocene Deposits – Young Alluvium

QTa – Lower Pleistocene Deposits – Sidestream Alluvium

Q1a – Upper and Middle Pleistocene Deposits – Intermediate Aged Sidestream Alluvium

Q2a – Middle to Lower Pleistocene Deposits – Older Sidestream Alluvium

Qp – Holocene and Pleistocene Deposits – Playa Deposits

QTk – Lower Pleistocene to Upper Pliocene Deposits – Calcrete Deposits

T2k – Lower Pliocene Deposits – Calcrete Deposits

Tmf – Upper Miocene Deposits – Muddy Creek Formation: Fine Grained Facies, Siltstone and Sandstone

Mm – Lower and Upper Mississippian Deposits – Monte Cristo Group : Limestone

PMb – Lower Permian to Upper Mississippian Deposits – Bird Springs Formation: Sandstones, Shale, Quartzite, Limestone

N

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0 100 200

FEET

U.S. Geological Survey
Open-File Report 2007-1010
Preliminary Geologic Map of the Lake Mead 30' X 60' Quadrangle, Clark County, Nevada, and Mohave County, Arizona
L.S. Beard, R.E. Anderson, D.L. Block, R.G. Bohannon, R.J. Brady, S.B. Castor, E.M. Duebendorfer, J.E. Faulds, T.J. Felger, K.A. Howard, M.A. Kuntz, and V.S. Williams, 2007

NewFields

PROJECT NUMBER	475.0464.002
LOCATION	CLARK COUNTY, NEVADA
DOCUMENT FILENAME	05 70.7 TO 71.9 AREA_3.DWG
AREA	I-15
CLIENT	ATKINS
PROJECT	I-15 TRUCK CLIMBING LANE MP CL 70.7 TO 71.9
FIGURE TITLE	HIGH LEVEL GEOLOGIC MAPPING
FIGURE NUMBER	10
REVISION	-

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APPENDIX B
Exploration Key
Boring Logs

NewFields

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.)			
GRAVELS More than 50% of coarse fraction larger than No. 4 sieve size	Clean Gravels (Less than 5% fines)	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
SANDS 50% or more of coarse fraction smaller than No. 4 sieve size	Clean Sands (Less than 5% fines)	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

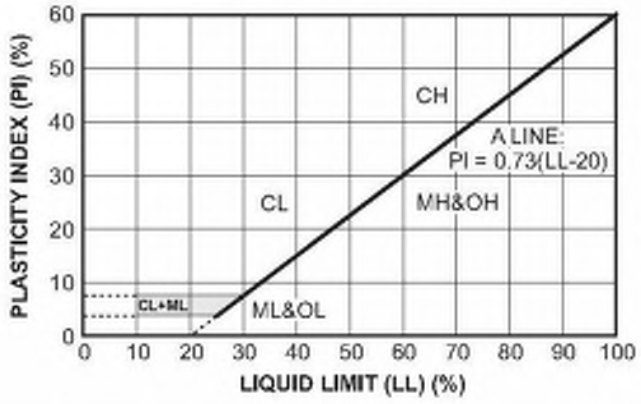
LABORATORY CLASSIFICATION CRITERIA

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



BORING KEY

NewFields

Symbol Description

Soil Samplers


Standard Penetration Test
(1 3/8 in. dia. ASTM D1586)


Modified California Sampler
(2.5 in. dia. ASTM D3550)


Undisturbed Thin Wall Shelby Tube

Groundwater Symbols


Water Encountered During Drilling


Water Encountered After Drilling

NFWE — No Free Water Encountered

Moisture Condition

Dry	Absence of moisture; dusty; dry to touch
Moist	Damp but no visible water
Wet	Visible free water; usually below water table

Plasticity

None	A 1⁄8-in. (3-mm) thread cannot be rolled at any water content	PI = 0
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit	1 < PI < 10
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit	10 < PI < 20
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be refolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.	20 < PI < 40

Particle Size Reference

Component	Particle Size Range
Boulders	12”
Cobbles	12” – 3”
Gravels	
Coarse	3” – ¾”
Fine	¾” – No. 4 (4.75mm)
Sand	
Coarse	No. 4 (4.75mm) – No. 10 (2mm)
Medium	No. 10 (2mm) – No. 40 (0.42mm)
Fine	No. 40 (0.42mm) – No. 200 (0.075mm)
Silt & Clay	< No. 200

Apparent Density of Coarse-Grained Soils

Apparent Density	SPT (# blows/ft)	Mod. Cal. Sampler
Very Loose	< 4	< 6
Loose	4 - 10	6 - 15
Medium Dense	10 - 30	15 - 45
Dense	30-50	45 - 75
Very Dense	> 50	> 75

Consistency of Fine-Grained Soils

Consistency	SPT (# blows/ft)	Mod. Cal. Sampler
Very Soft	< 2	< 3
Soft	2 - 4	3 - 6
Medium Stiff	4 - 8	6 - 12
Stiff	8 - 15	12 - 23
Very Stiff	15 - 30	23 - 45
Hard	> 30	> 45

Angularity of Coarse-Grained Particles

Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces
Sub-Angular	Edges more rounded
Sub-Rounded	Particles have nearly plane sides but have well-rounded corners and edges
Rounded	Particles have smooth, curved sides and no edges

Cementation

Weak	Crumbles with little finger pressure
Moderate	Crumbles with considerable finger pressure
Strong	Will not break with finger pressure

21-BH-19

NewFields

CLIENT Atkins
PROJECT NAME I-15 Truck Climbing Lanes MP 70.7 to 71.9
PROJECT NUMBER 475.0464.002
PROJECT LOCATION Clark County, Nevada
DATE STARTED 03/10/22 **COMPLETED** 03/10/22
GROUND ELEVATION 2180 ft **HOLE SIZE** 8 inch
DRILLING CONTRACTOR Terra Drilling, Mobile B-29
COORDINATES ():
DRILLING METHOD Hollow Stem Auger
LATITUDE 36.46205 **LONGITUDE** -114.83317
LOGGED BY R. Berg **CHECKED BY** J. Ruzicka
DEPTH TO WATER (FT BGS) no free water encountered
NOTES Station "XW" 238+02 Offset 50 ft RT

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
2180	0		Surface Description: Clear ground										
			Clayey Gravel with Sand (GC), light brown, dry, medium to high plasticity, fine to coarse sand, fine and coarse gravel up to 2" dia., effervescent	SPT	8-12-10 (22)	10							bulk sample 0-5'
				GB				40	20	60	19	21	R-value=12
2175	5		gravel coarser with depth up to 3" dia.										
			Cemented Soils, white, dry, nonplastic, fine sand, effervescent	SPT	16-48-35 (83)	10							
			BOH = 6.5'										

NewFields

21-BH-20

CLIENT Atkins
PROJECT NAME I-15 Truck Climbing Lanes MP 70.7 to 71.9
PROJECT NUMBER 475.0464.002
PROJECT LOCATION Clark County, Nevada
DATE STARTED 03/10/22 **COMPLETED** 03/10/22
GROUND ELEVATION 2176 ft **HOLE SIZE** 8 inch
DRILLING CONTRACTOR Terra Drilling, Mobile B-29
COORDINATES ():
DRILLING METHOD Hollow Stem Auger
LATITUDE 36.46299 **LONGITUDE** -114.83217
LOGGED BY R. Berg **CHECKED BY** J. Ruzicka
DEPTH TO WATER (FT BGS) no free water encountered
NOTES Station "XW" 242+55 Offset 52 ft RT

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		Surface Description: Clear ground										
2175			**2" Aggregate Base**										
			Clayey Gravel with Sand (GC), brown to red, slight moist, medium to high plasticity, fine to coarse sand, fine and coarse gravel up to 1.5" dia., effervessive	SPT	5-8-9 (17)	16							bulk sample 0-5'
				GB				36	20	68	15	17	R-value=15
	5												
2170				SPT	10-21-38 (59)	18							
			Clayey Sand (SC), yellow to white, fine sand, cemented nodules										
			BOH = 6.5'										

NewFields

21-BH-21

CLIENT Atkins
PROJECT NAME I-15 Truck Climbing Lanes MP 70.7 to 71.9
PROJECT NUMBER 475.0464.002
PROJECT LOCATION Clark County, Nevada
DATE STARTED 03/10/22 **COMPLETED** 03/10/22
GROUND ELEVATION 2170 ft **HOLE SIZE** 8 inch
DRILLING CONTRACTOR Terra Drilling, Mobile B-29
COORDINATES ():
DRILLING METHOD Hollow Stem Auger
LATITUDE 36.46397 **LONGITUDE** -114.83117
LOGGED BY R. Berg **CHECKED BY** J. Ruzicka
DEPTH TO WATER (FT BGS) no free water encountered
NOTES Station "XW" 247+14 Offset 50 ft RT

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
2170	0		Surface Description: Clear ground										
			Clayey Gravel with Sand (GC), light brown, slightly moist, medium plasticity, fine to coarse sand, fine and coarse gravel up to 1.5" dia., effervescent	SPT	4-4-8 (12)	8							bulk sample 0-5'
			gravel coarser with depth	GB				28	13	55	25	20	R-value=20
2165	5		**Cemented Soils**, dry, low plasticity, fine sand, effervescent	SPT	17-39-25 (64)	16							
			BOH = 6.5'										

NewFields

21-BH-22

CLIENT Atkins
PROJECT NAME I-15 Truck Climbing Lanes MP 70.7 to 71.9
PROJECT NUMBER 475.0464.002
PROJECT LOCATION Clark County, Nevada
DATE STARTED 03/10/22 **COMPLETED** 03/10/22
GROUND ELEVATION 2166 ft **HOLE SIZE** 8 inch
DRILLING CONTRACTOR Terra Drilling, Mobile B-29
COORDINATES ():
DRILLING METHOD Hollow Stem Auger
LATITUDE 36.46492 **LONGITUDE** -114.83018
LOGGED BY R. Berg **CHECKED BY** J. Ruzicka
DEPTH TO WATER (FT BGS) no free water encountered
NOTES Station "XW" 251+69 Offset 50 ft RT

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		Surface Description: Clear ground										
2165			**FILL: Silty Gravel with Sand (GM)**, light brown, slightly moist, nonplastic, fine to coarse sand, fine and coarse gravel up to 2" dia., effervescent	SPT	10-10-24 (34)	5							rock in shoe, pulverized rock in sample
				GB				25	NP	62	24	14	R-value=30
	5												
2160			**Clayey Sand with Gravel (SC)**, red brown, slightly moist, fine to coarse sand, fine and coarse gravel up to 2" dia., cemented veining	SPT	4-6-10 (16)	9							rock in shoe
			BOH = 6.5'										

21-BH-23

NewFields

CLIENT Atkins
PROJECT NAME I-15 Truck Climbing Lanes MP 70.7 to 71.9
PROJECT NUMBER 475.0464.002
PROJECT LOCATION Clark County, Nevada
DATE STARTED 03/10/22 **COMPLETED** 03/10/22
GROUND ELEVATION 2160 ft **HOLE SIZE** 8 inch
DRILLING CONTRACTOR Terra Drilling, Mobile B-29
COORDINATES ():
DRILLING METHOD Hollow Stem Auger
LATITUDE 36.46587 **LONGITUDE** -114.82919
LOGGED BY R. Berg **CHECKED BY** J. Ruzicka
DEPTH TO WATER (FT BGS) no free water encountered
NOTES Station "XW" 256+20 Offset 48 ft RT

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
2160	0		Surface Description: Weeds and road base										
			FILL: Silty Gravel with Sand (GM), light red brown, dry, nonplastic, fine to coarse sand, fine and coarse subrounded gravel up to 3" dia., effervescent	SPT	7-8-14 (22)	10							bulk sample 0-5'
				GB				38	NP	51	27	22	R-value=18
2155	5		**Clayey Sand with Gravel (SC)**, brown red, slightly moist, low plasticity, fine to coarse sand, fine gravel up to 1/8" dia., cemented veins	SPT	5-6-7 (13)	10							
			BOH = 6.5'										

21-BH-24

NewFields

CLIENT Atkins
PROJECT NAME I-15 Truck Climbing Lanes MP 70.7 to 71.9
PROJECT NUMBER 475.0464.002
PROJECT LOCATION Clark County, Nevada
DATE STARTED 03/10/22 **COMPLETED** 03/10/22
GROUND ELEVATION 2152 ft **HOLE SIZE** 8 inch
DRILLING CONTRACTOR Terra Drilling, Mobile B-29
COORDINATES ():
DRILLING METHOD Hollow Stem Auger
LATITUDE 36.46683 **LONGITUDE** -114.82818
LOGGED BY R. Berg **CHECKED BY** J. Ruzicka
DEPTH TO WATER (FT BGS) no free water encountered
NOTES Station "XW" 260+80 Offset 51 ft RT

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		Surface Description: Light grasses and weeds										
2150			**FILL: Clayey Gravel with Sand (GC)**, light red, dry, medium plasticity, fine to coarse sand, fine and coarse subrounded gravel up to 2.5" dia., effervescent	SPT	11-14-15 (29)	8							bulk sample 0-5'
				GB				39	16	65	19	16	R-value=35
	5		**Clayey Gravel with Sand (GC)**, red, slightly moist, fine to coarse sand, fine and coarse subangular to subrounded gravel up to 2" dia., mechanically fractured, cemented veins	SPT	5-6-10 (16)	10							
			BOH = 6.5'										

21-BH-25

NewFields

CLIENT Atkins
PROJECT NAME I-15 Truck Climbing Lanes MP 70.7 to 71.9
PROJECT NUMBER 475.0464.002
PROJECT LOCATION Clark County, Nevada
DATE STARTED 03/10/22 **COMPLETED** 03/10/22
GROUND ELEVATION 2148 ft **HOLE SIZE** 8 inch
DRILLING CONTRACTOR Terra Drilling, Mobile B-29
COORDINATES ():
DRILLING METHOD Hollow Stem Auger
LATITUDE 36.46776 **LONGITUDE** -114.82717
LOGGED BY R. Berg **CHECKED BY** J. Ruzicka
DEPTH TO WATER (FT BGS) no free water encountered
NOTES Station "XW" 265+32 Offset 57 ft RT

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		Surface Description: Light grasses and weeds										
			2" Aggregate Base	SPT	10-9-10 (19)	10							bulk sample 0-5'
2145			**FILL: Clayey Gravel with Sand (GC)**, light brown, dry, high plasticity, fine to coarse sand, fine and coarse subrounded up to 3" dia., effervessive	GB				42	22	68	15	17	R-value=24
	5		light red	SPT	10-18-25 (43)	12							
			BOH = 6.5'										

NewFields

21-BH-26
PAGE 1 OF 1

CLIENT Atkins
PROJECT NAME I-15 Truck Climbing Lanes MP 70.7 to 71.9
PROJECT NUMBER 475.0464.002
PROJECT LOCATION Clark County, Nevada
DATE STARTED 03/10/22 **COMPLETED** 03/10/22
GROUND ELEVATION 2142 ft **HOLE SIZE** 8 inch
DRILLING CONTRACTOR Terra Drilling, Mobile B-59
COORDINATES ():
DRILLING METHOD Hollow Stem Auger
LATITUDE 36.46869 **LONGITUDE** -114.82611
LOGGED BY R. Berg **CHECKED BY** J. Ruzicka
DEPTH TO WATER (FT BGS) no free water encountered
NOTES Station "XW" 269+93 Offset 56 ft RT

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		Surface Description: Weeds										
2140			**FILL: Clayey Gravel with Sand (GC)**, light brown, dry, medium plasticity, fine to coarse sand, fine and coarse subangular gravel, effervessive	SPT	10-20-13 (33)	8							rock in shoe bulk sample 0-5'
				GB				34	14	72	15	13	R-value=34
	5		light red	SPT	12-18-15 (33)	10							
			BOH = 6.5'										

21-BH-27

NewFields

CLIENT Atkins
PROJECT NAME I-15 Truck Climbing Lanes MP 70.7 to 71.9
PROJECT NUMBER 475.0464.002
PROJECT LOCATION Clark County, Nevada
DATE STARTED 03/09/22 **COMPLETED** 03/09/22
GROUND ELEVATION 2130 ft **HOLE SIZE** 8 inch
DRILLING CONTRACTOR Terra Drilling, Mobile B-59
COORDINATES ():
DRILLING METHOD Hollow Stem Auger
LATITUDE 36.46958 **LONGITUDE** -114.82500
LOGGED BY R. Berg **CHECKED BY** J. Ruzicka
DEPTH TO WATER (FT BGS) no free water encountered
NOTES Station "XW" 274+57 Offset 53 ft RT

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
2130	0		Surface Description: Light grasses and weeds										
			FILL: Clayey Gravel (GC), light brown to red, dry, medium plasticity, fine to coarse sand, fine and coarse rounded gravel up to 3" dia., mechanically fractured	SPT	9-11-9 (20)	9							bulk sample 0-5'
				GB				32	12	54	18	28	R-value=21
2125	5			SPT	9-16-20 (36)	0							

BOH = 6.5'

NewFields

21-BH-28

CLIENT Atkins
PROJECT NAME I-15 Truck Climbing Lanes MP 70.7 to 71.9
PROJECT NUMBER 475.0464.002
PROJECT LOCATION Clark County, Nevada
DATE STARTED 03/09/22 **COMPLETED** 03/09/22
GROUND ELEVATION 2114 ft **HOLE SIZE** 8 inch
DRILLING CONTRACTOR Terra Drilling, Mobile B-59
COORDINATES ():
DRILLING METHOD Hollow Stem Auger
LATITUDE 36.47040 **LONGITUDE** -114.82385
LOGGED BY R. Berg **CHECKED BY** J. Ruzicka
DEPTH TO WATER (FT BGS) no free water encountered
NOTES Station "XW" 279+09 Offset 55 ft RT

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		Surface Description: light grasses										
			FILL: Clayey Gravel with Sand (GC), light brown, dry, medium plasticity, fine to coarse sand, fine and coarse rounded gravel up to 1.5" dia., mechanically fractured	SPT	5-12-14 (26)	10							bulk sample 0-5'
2110				GB				32	11	56	31	13	R-value=57
	5		**Cemented Soils**, white, dry, low plasticity, fine to coarse sand, weakly cemented	SPT	7-11-11 (22)	10							
			Lean Clay with Sand (CL), light brown, slightly moist, medium plasticity										
			BOH = 6.5'										

NewFields

21-BH-29

CLIENT Atkins
PROJECT NAME I-15 Truck Climbing Lanes MP 70.7 to 71.9
PROJECT NUMBER 475.0464.002
PROJECT LOCATION Clark County, Nevada
DATE STARTED 03/09/22 **COMPLETED** 03/09/22
GROUND ELEVATION 2098 ft **HOLE SIZE** 8 inch
DRILLING CONTRACTOR Terra Drilling, Mobile B-59
COORDINATES ():
DRILLING METHOD Hollow Stem Auger
LATITUDE 36.47119 **LONGITUDE** -114.82264
LOGGED BY R. Berg **CHECKED BY** J. Ruzicka
DEPTH TO WATER (FT BGS) no free water encountered
NOTES Station "XW" 283+72 Offset 57 ft RT

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		Surface Description: Clear ground										
2095			**FILL: Clayey Gravel with Sand (GC)**, light brown to red, dry, high plasticity, fine to coarse sand, fine and coarse angular gravel up to 2" dia., mechanically fractured, effervesive	SPT	8-7-7 (14)	9							bulk sample 0-5'
				GB				51	25	32	25	43	R-value=20
	5			SPT	7-10-8 (18)	9							rock in shoe
			BOH = 6.5'										

21-BH-30

NewFields

CLIENT Atkins
PROJECT NAME I-15 Truck Climbing Lanes MP 70.7 to 71.9
PROJECT NUMBER 475.0464.002
PROJECT LOCATION Clark County, Nevada
DATE STARTED 03/09/22 **COMPLETED** 03/09/22
GROUND ELEVATION 2088 ft **HOLE SIZE** 8 inch
DRILLING CONTRACTOR Terra Drilling, Mobile B-59
COORDINATES ():
DRILLING METHOD Hollow Stem Auger
LATITUDE 36.47205 **LONGITUDE** -114.82119
LOGGED BY R. Berg **CHECKED BY** J. Ruzicka
DEPTH TO WATER (FT BGS) no free water encountered
NOTES Station "XW" 288+98 Offset 59 ft RT

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		Surface Description: Clear ground and tumbleweeds										
			FILL: Clayey Gravel with Sand (GC), red slightly moist, medium plasticity, fine to coarse sand, fine subangular gravel, effervescent	GB				33	13	41	35	24	bulk sample 0-5' R-value=28
2085				SPT	4-5-3 (8)	8							
	5		**FILL: Clayey Gravel with Sand (GC)**, gray, slightly moist, low to medium plasticity, fine to coarse sand, fine and coarse subrounded gravel, mechanically fractured, effervesive, weakly cemented	SPT	8-10-4 (14)	8							
2080			**FILL: Silty Gravel with Sand (GM)**, red, moist, nonplastic, fine to coarse sand, fine and coarse angular gravel, mechanically fractured, effervescent	SPT	10-26-31 (57)	9		NV	NP	46	32	22	
	10		**Clayey Gravel with Sand (GC)**, brown, slightly moist to moist, high plasticity, fine to coarse sand, trace gypsum	SPT	6-12-7 (19)	17							
2075				GB				48	25	63	18	19	bulk sample 10-15', MDD = 117.1 pcf, OMC = 11.8%
	15		**Fat Clay with Sand (CH)**, red brown, moist, high plasticity	SPT	5-7-7 (14)	18							
2070													
	20		slightly moist	SPT	5-12-20 (32)	18							
2065			fine sand										
	25			SPT	8-8-7 (15)	18		50	24	0	7	93	
2060													
	30		slightly moist, trace sand, slightly effervescent	SPT	6-9-18 (27)	18							
			BOH = 31.5'										

NewFields

21-BH-31

CLIENT Atkins
PROJECT NAME I-15 Truck Climbing Lanes MP 70.7 to 71.9
PROJECT NUMBER 475.0464.002
PROJECT LOCATION Clark County, Nevada
DATE STARTED 03/09/22 **COMPLETED** 03/09/22
GROUND ELEVATION 2088 ft **HOLE SIZE** 8 inch
DRILLING CONTRACTOR Terra Drilling, Mobile B-29
COORDINATES ():
DRILLING METHOD Hollow Stem Auger
LATITUDE 36.47276 **LONGITUDE** -114.81990
LOGGED BY R. Berg **CHECKED BY** J. Ruzicka
DEPTH TO WATER (FT BGS) no free water encountered
NOTES Station "XW" 293+64 Offset 56 ft RT

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		Surface Description: Grasses and weeds											
2085			**FILL: Clayey Gravel with Sand (GC)**, light brown, dry, medium plasticity, fine to coarse sand, fine and coarse subrounded gravel up to 2.5" dia., effervessive		SPT	13-28-31 (59)	9							bulk sample 0-5'
					GB				40	15	44	33	23	R-value=28
	5		**Clayey Gravel with Sand (GC)**, red, slightly moist, low to medium plasticity, fine to coarse sand, fine and coarse subrounded gravel up to 2" dia., cemented veining		SPT	4-5-7 (12)	10							
			BOH = 6.5'											

21-BH-32

NewFields

CLIENT Atkins
PROJECT NAME I-15 Truck Climbing Lanes MP 70.7 to 71.9
PROJECT NUMBER 475.0464.002
PROJECT LOCATION Clark County, Nevada
DATE STARTED 03/09/22 **COMPLETED** 03/09/22
GROUND ELEVATION 2088 ft **HOLE SIZE** 8 inch
DRILLING CONTRACTOR Terra Drilling, Mobile B-29
COORDINATES ():
DRILLING METHOD Hollow Stem Auger
LATITUDE 36.47321 **LONGITUDE** -114.81895
LOGGED BY R. Berg **CHECKED BY** J. Ruzicka
DEPTH TO WATER (FT BGS) no free water encountered
NOTES Station "XW" 296+44 Offset 63 ft RT

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		Surface Description: Clear ground										
			2" Aggregate Base	SPT	6-18-17 (35)	11							bulk sample 0-5'
2085			**Clayey Sand with Gravel (SC)**, light brown to red, dry, medium plasticity, fine to coarse sand, fine and coarse gravel up to 2.5" dia., mechanically fractured	GB				17	11	23	44	33	R-value=20
	5			SPT	4-3-7 (10)	8							rock in shoe
			BOH = 6.5'										

APPENDIX C
Laboratory Testing

NewFields

I-15 Truck Climbing Lanes Southbound MP CL 70.7 to CL 71.9
Laboratory Summary

NewFields Project No. 475.0464.002

Boring Location	Depth (feet bgs)	USCS Group Name	USCS Group Symbol	GRAIN SIZE DISTRIBUTION (% PASSING)														ATTERBERG LIMITS					Chemical Results					R-Value
				GRAVEL							SAND							FINES											
				3.0"	2.0"	1.5"	1.0"	0.75"	0.5"	0.375"	#4	#8	#16	#30	#50	#100	#200	LIQUID LIMIT	PLASTIC LIMIT	PLASTIC INDEX	Optimum Moisture Content	Maximum Dry Density (pcf)	pH	Soluble Sulfate (%)	Soluble Sulfates (ppm)	Chloride (ppm)	Resistivity (ohm-cm)	
21-BH-19	5.0-6.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.93	0.01	100.0	56.0	1500.0	
21-BH-19	0.0-5.0	Clayey Gravel with Sand	GC	100	100	95	87	75	62	55	40	35	32	29	27	25	21	40	20	20	-	-	-	-	-	-	-	12
21-BH-20	0.0-5.0	Clayey Gravel with Sand	GC	100	100	100	93	86	67	55	32	28	25	23	21	19	17.0	36	16	20	-	-	-	-	-	-	-	15
21-BH-21	0.0-5.0	Clayey Gravel with Sand	GC	100	100	99	91	89	79	71	45	37	31	28	25	23	20	28	15	13	-	-	8.81	0.05	500.0	61.0	784.0	20
21-BH-22	0.0-5.0	Silty Gravel with Sand	GM	100	100	98	92	86	73	63	38	31	26	23	21	18	14	25	NP	NP	-	-	-	-	-	-	-	30
21-BH-23	0.0-5.0	Silty Gravel with Sand	GM	100	100	93	89	82	75	70	49	42	37	33	31	27	22	38	NP	NP	-	-	-	-	-	-	-	18
21-BH-24	0.0-5.0	Clayey Gravel with Sand	GC	100	100	99	90	83	67	58	35	28	25	23	21	19	16.0	39	23	16	-	-	-	-	-	-	-	35
21-BH-25	0.0-5.0	Clayey Gravel with Sand	GC	100	100	94	90	81	67	57	32	27	24	22	21	19	17	42	20	22	-	-	-	-	-	-	-	24
21-BH-26a	0.0-5.0	Clayey Gravel with Sand	GC	100	100	90	81	71	52	43	28	24	21	19	18	16	13	34	20	14	-	-	-	-	-	-	-	34
21-BH-27	0.0-5.0	Clayey Gravel with Sand	GC	100	100	98	96	91	85	80	46	42	38	36	34	32	28	32	20	12	-	-	-	-	-	-	-	21
21-BH-28	0.0-5.0	Clayey Gravel with Sand	GC	100	100	94	89	80	71	63	44	34	29	25	22	18	13	32	21	11	-	-	-	-	-	-	-	57
21-BH-28	0.0-1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.58	0.03	300.0	58.0	850.0	-
21-BH-29	0.0-5.0	Clayey Gravel with Sand	GC	100	100	100	98	94	87	83	68	63	59	55	51	47	43.0	51	26	25	-	-	-	-	-	-	-	20
21-BH-30	10.0-15.0	Clayey Gravel with Sand	GC	100	100	100	98	98	76	64	37	34	31	29	26	22	19	48	23	25	11.8	117.1	-	-	-	-	-	-
21-BH-30	0.0-5.0	Clayey Gravel with Sand	GC	100	100	97	93	88	81	76	59	50	43	38	34	29	24	33	20	13	-	-	-	-	-	-	-	28
21-BH-30	25.0-26.5	Lean Clay	CL	100	100	100	100	100	100	100	100	100	99	97	95	94	93	50	26	24	-	-	-	-	-	-	-	-
21-BH-30	7.5-9.0	Silty Gravel with Sand	GM	100	100	100	100	94	77	71	54	44	38	33	30	27	22.0	NV	NP	NP	-	-	-	-	-	-	-	-
21-BH-30	5.0-6.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9.19	0.04	400.0	171.0	1200.0	-
21-BH-31	0.0-5.0	Clayey Gravel with Sand	GC	100	93	91	84	82	78	73	56	46	40	35	31	28	23	40	25	15	-	-	-	-	-	-	-	28
21-BH-32	0.0-5.0	Clayey Sand with Gravel	SC	100	100	100	99	98	93	89	77	66	57	50	45	40	33	28	17	11	-	-	-	-	-	-	-	20
21-BH-32	5.0-6.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.37	0.08	800.0	1126.0	4700.0	-

- Indicates test was not performed

AZTECH
INSPECTIONS & TESTING

SUMMARY REPORT OF SOIL AND AGGREGATE TESTS

		Revised On:	***3/25/22***
Client:	NewFields	Date of Report:	3/24/22
	1301 N. McCarran Blvd Ste. 101	Aztech Project No.:	NEFX-003
	Sparks, NV 89431	Laboratory No.:	79723
Attention:	Mr. Jesse Ruzicka	Sample No.:	51
		Client Project No.:	475.0464.002
		Page:	1 of 2

Project Name:	I-15 TCL 70.7 to 71.9	Soil Symbol:	GC
Sample Location:	21-BH-19, Sample Depth *0.0'-5.0'*	Date Sampled:	-
Material Type:	Bulk	Date Received:	3/14/22
Soil Classification:	Clayey Gravel with Sand	Sampled By:	Client

SOIL AND AGGREGATE PROPERTIES

	Test Method	Results	Specifications	Pass or Fail
Liquid Limit, LL	NDOT T210	40		
Plastic Limit, PL	NDOT T211	20		
Plasticity Index, PI	NDOT T212	20		
R-Value	NDOT T115	12		

SIEVE ANALYSIS - AASHTO T27, T11

Sieve Size	Percent Passing	Specification Limits Min.	Max.	Pass or Fail
2"	100			
1 1/2"	95			
1"	87			
3/4"	75			
1/2"	62			
3/8"	55			
#4	40			
#8	35			
#16	32			
#30	29			
#50	27			
#100	25			
#200	21			

Comments: R-Value graph on page 2.

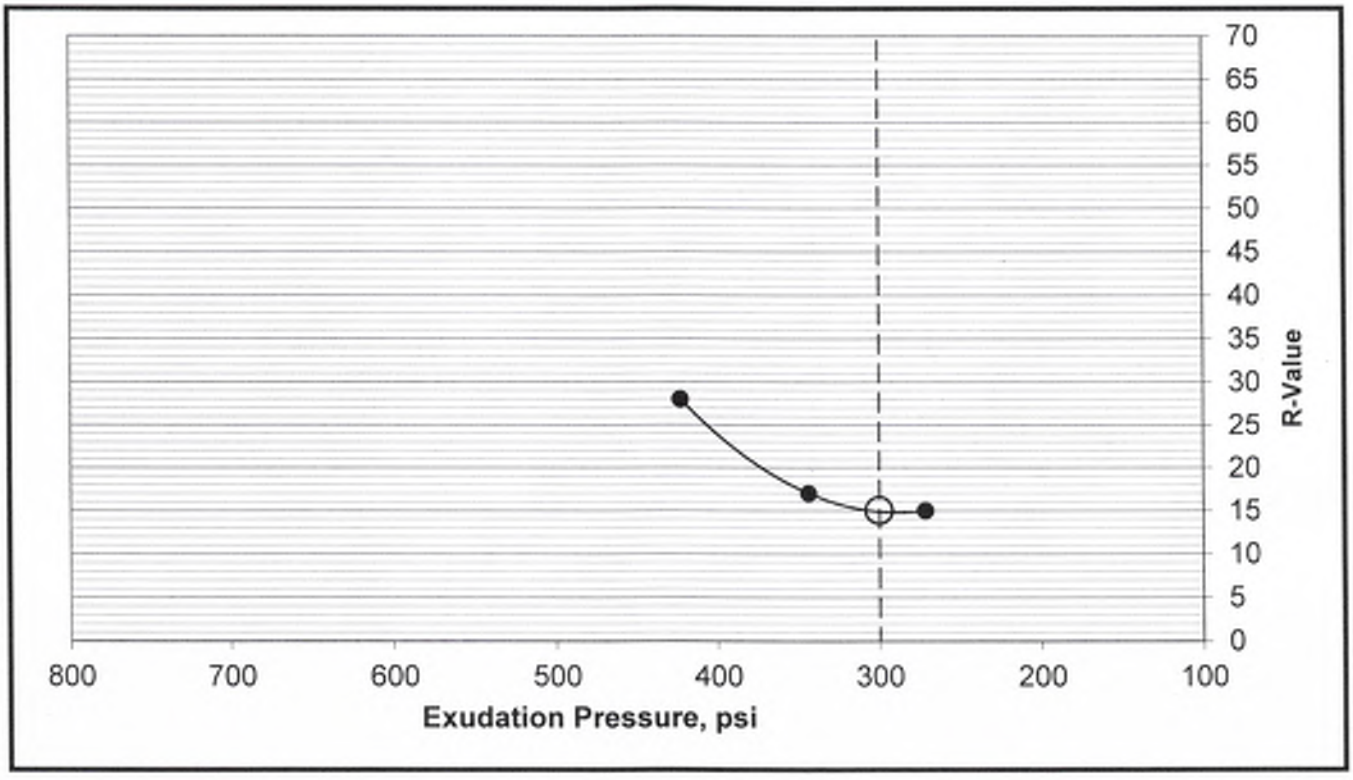
Reviewed By: Jesse Ruzicka

Date: 3-25-2022

AZTECH
INSPECTIONS & TESTING

RESISTANCE R-VALUE
NDOT T115

Client:	NewFields 1301 N. McCarran Blvd Ste. 101 Sparks, NV 89431 Mr. Jesse Ruzicka	Date of Report: Project Number: Sample Number: Page	3/24/22 NEFX-003 79723 2 of 2
Project: Sample Location: Material Use:	I-15 TCL 70.7 to 71.9 21-BH-19, Sample Depth *0.0'-5.0'* Bulk	Date Sampled: Date Received: Sampled By:	- 3/14/22 Client



Comments:

Reviewed By: Jesse Ruzicka

Date: 3-25-2022

AZTECH
INSPECTIONS & TESTING

SUMMARY REPORT OF SOIL AND AGGREGATE TESTS

		Revised On:	***3/25/22***
Client:	NewFields	Date of Report:	3/24/22
	1301 N. McCarran Blvd Ste. 101	Aztech Project No.:	NEFX-003
	Sparks, NV 89431	Laboratory No.:	79724
Attention:	Mr. Jesse Ruzicka	Sample No.:	48
		Client Project No.:	475.0464.002
		Page:	1 of 2

Project Name:	I-15 TCL 70.7 to 71.9	Soil Symbol:	GC
Sample Location:	21-BH-20, Sample Depth *0.0'-5.0'*	Date Sampled:	-
Material Type:	Bulk	Date Received:	3/14/22
Soil Classification:	Clayey Gravel with Sand	Sampled By:	Client

SOIL AND AGGREGATE PROPERTIES

	Test Method	Results	Specifications	Pass or Fail
Liquid Limit, LL	NDOT T210	36		
Plastic Limit, PL	NDOT T211	16		
Plasticity Index, PI	NDOT T212	20		
R-Value	NDOT T115	15		

SIEVE ANALYSIS - AASHTO T27, T11

Sieve Size	Percent Passing	Specification Limits Min.	Specification Limits Max.	Pass or Fail
2"				
1 1/2"	100			
1"	93			
3/4"	86			
1/2"	67			
3/8"	55			
#4	32			
#8	28			
#16	25			
#30	23			
#50	21			
#100	19			
#200	17			

Comments: R-Value graph on page 2.

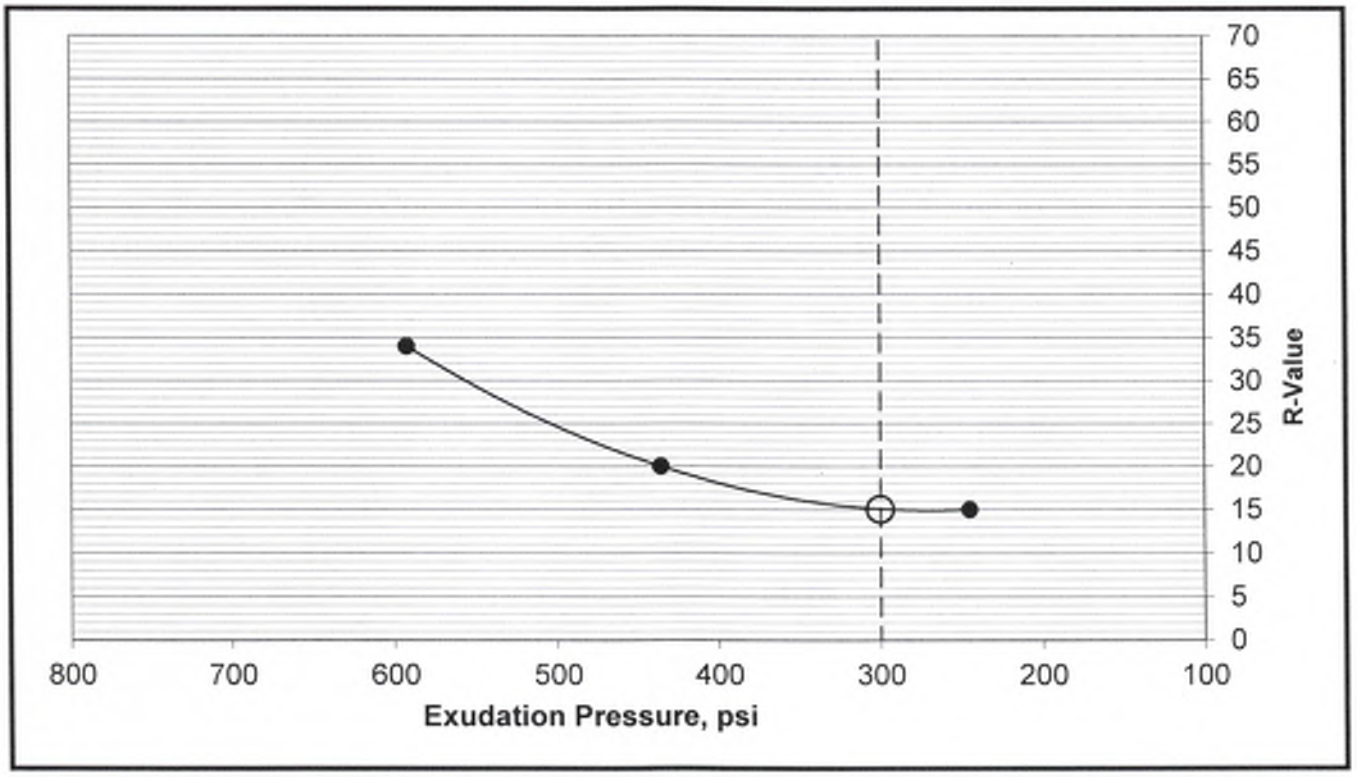
Reviewed By: Jeo Pin

Date: 3-25-2022

AZTECH
INSPECTIONS & TESTING

RESISTANCE R-VALUE
NDOT T115

Client:	NewFields 1301 N. McCarran Blvd Ste. 101 Sparks, NV 89431 Mr. Jesse Ruzicka	Date of Report: Project Number: Sample Number: Page	3/24/22 NEFX-003 79724 2 of 2
Project: Sample Location: Material Use:	I-15 TCL 70.7 to 71.9 21-BH-20, Sample Depth *0.0'-5.0'* Bulk	Date Sampled: Date Received: Sampled By:	- 3/14/22 Client



Comments:

Reviewed By: Leo Rios

Date: 3-25-2022

AZTECH
INSPECTIONS & TESTING

SUMMARY REPORT OF SOIL AND AGGREGATE TESTS

		Revised On:	***3/25/22***
Client:	NewFields	Date of Report:	3/24/22
	1301 N. McCarran Blvd Ste. 101	Aztech Project No.:	NEFX-003
	Sparks, NV 89431	Laboratory No.:	79725
Attention:	Mr. Jesse Ruzicka	Sample No.:	45
		Client Project No.:	475.0464.002
		Page:	1 of 2

Project Name:	I-15 TCL 70.7 to 71.9	Soil Symbol:	GC
Sample Location:	21-BH-21, Sample Depth *0.0'-5.0'*	Date Sampled:	-
Material Type:	Bulk	Date Received:	3/14/22
Soil Classification:	Clayey Gravel with Sand	Sampled By:	Client

SOIL AND AGGREGATE PROPERTIES

	Test Method	Results	Specifications	Pass or Fail
Liquid Limit, LL	NDOT T210	28		
Plastic Limit, PL	NDOT T211	15		
Plasticity Index, PI	NDOT T212	13		
R-Value	NDOT T115	20		
Resistivity, ohm-cm	AASHTO T288	784		
pH Value	*AASHTO T289	8.81		
Soluble Sulfate, %	*AASHTO T290B	0.05		
Chloride Content, ppm	*AASHTO T291A	61		

SIEVE ANALYSIS - AASHTO T27, T11

Sieve Size	Percent Passing	Specification Limits Min.	Max.	Pass or Fail
2"	100			
1 1/2"	99			
1"	91			
3/4"	89			
1/2"	79			
3/8"	71			
#4	45			
#8	37			
#16	31			
#30	28			
#50	25			
#100	23			
#200	20			

Comments: R-Value graph on page 2.
*Testing performed by Sims & Associates, LLC.

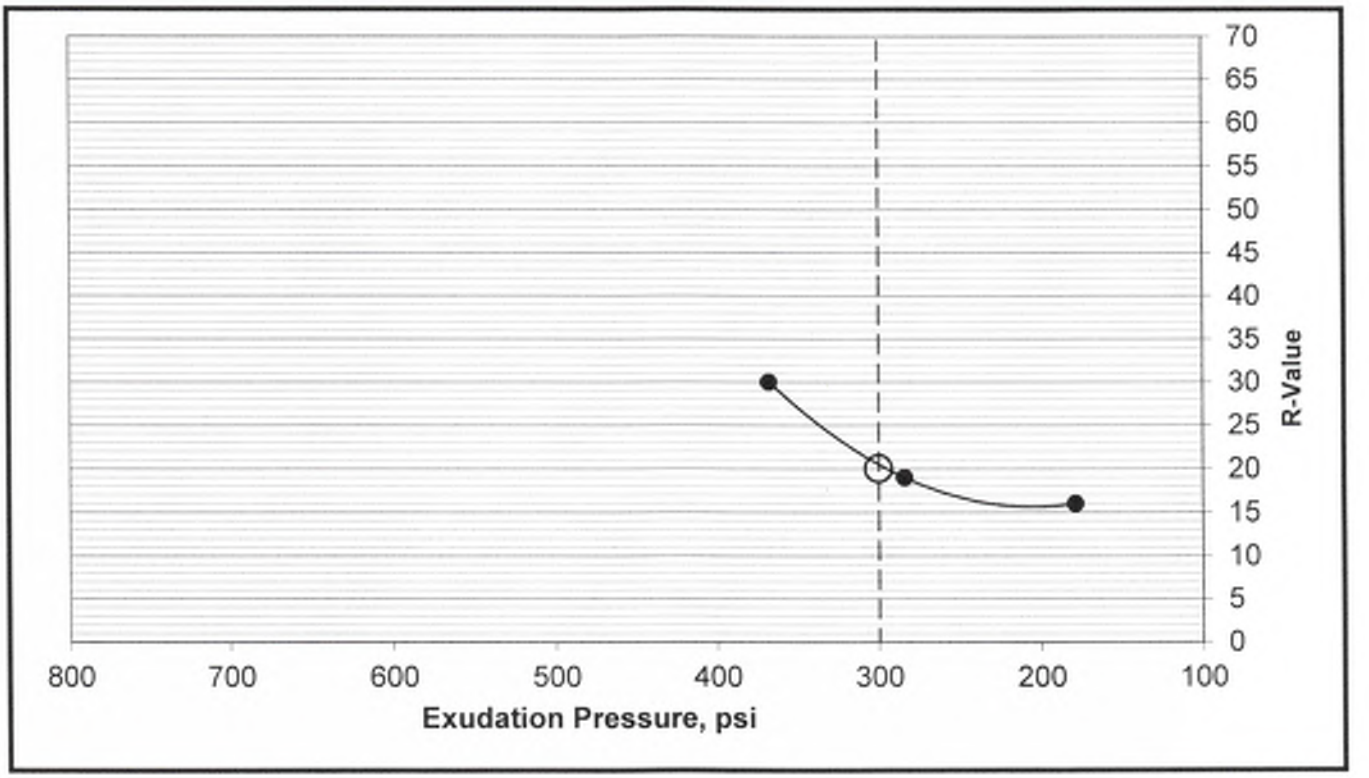
Reviewed By: Leo Rios

Date: 3-25-2022

AZTECH
INSPECTIONS & TESTING

RESISTANCE R-VALUE
NDOT T115

Client:	NewFields 1301 N. McCarran Blvd Ste. 101 Sparks, NV 89431 Mr. Jesse Ruzicka	Date of Report: Project Number: Sample Number: Page	3/24/22 NEFX-003 79725 2 of 2
Project: Sample Location: Material Use:	I-15 TCL 70.7 to 71.9 21-BH-21 Sample Depth *0.0'-5.0'* Bulk	Date Sampled: Date Received: Sampled By:	- 3/14/22 Client



Comments: _____

Reviewed By: _____

Date: _____

AZTECH
INSPECTIONS & TESTING

SUMMARY REPORT OF SOIL AND AGGREGATE TESTS

		Revised On:	***3/25/22***
Client:	NewFields	Date of Report:	3/24/22
	1301 N. McCarran Blvd Ste. 101	Aztech Project No.:	NEFX-003
	Sparks, NV 89431	Laboratory No.:	79726
Attention:	Mr. Jesse Ruzicka	Sample No.:	42
		Client Project No.:	475.0464.002
		Page:	1 of 2

Project Name:	I-15 TCL 70.7 to 71.9	Soil Symbol:	GM
Sample Location:	21-BH-22, Sample Depth *0.0'-5.0'*	Date Sampled:	-
Material Type:	Bulk	Date Received:	3/14/22
Soil Classification:	Silty Gravel with Sand	Sampled By:	Client

SOIL AND AGGREGATE PROPERTIES

	Test Method	Results	Specifications	Pass or Fail
Liquid Limit, LL	NDOT T210	25		
Plastic Limit, PL	NDOT T211	NP		
Plasticity Index, PI	NDOT T212	NP		
R-Value	NDOT T115	30		

SIEVE ANALYSIS - AASHTO T27, T11

Sieve Size	Percent Passing	Specification Limits Min.	Specification Limits Max.	Pass or Fail
2"	100			
1 1/2"	98			
1"	92			
3/4"	86			
1/2"	73			
3/8"	63			
#4	38			
#8	31			
#16	26			
#30	23			
#50	21			
#100	18			
#200	14			

Comments: R-Value graph on page 2.

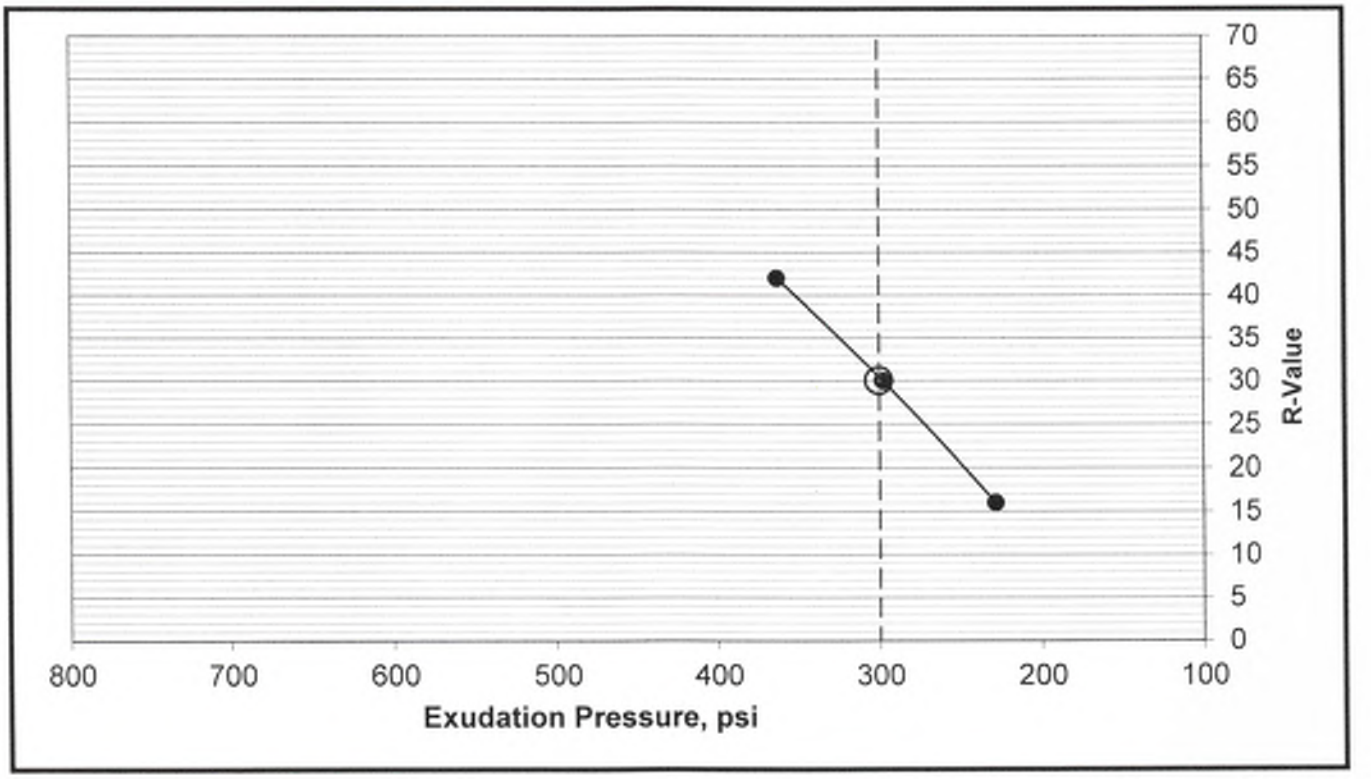
Reviewed By: Leo Pico

Date: 3-25-2022

AZTECH
INSPECTIONS & TESTING

RESISTANCE R-VALUE
NDOT T115

Client:	NewFields 1301 N. McCarran Blvd Ste. 101 Sparks, NV 89431 Mr. Jesse Ruzicka	Date of Report: Project Number: Sample Number: Page	3/24/22 NEFX-003 79726 2 of 2
Project: Sample Location: Material Use:	I-15 TCL 70.7 to 71.9 21-BH-22, Sample Depth *0.0'-5.0'* Bulk	Date Sampled: Date Received: Sampled By:	- 3/14/22 Client



Comments: _____

Reviewed By: Jesse Ruzicka

Date: 3-25-2022

AZTECH
INSPECTIONS & TESTING

SUMMARY REPORT OF SOIL AND AGGREGATE TESTS

		Revised On:	***3/25/22***
Client:	NewFields	Date of Report:	3/24/22
	1301 N. McCarran Blvd Ste. 101	Aztech Project No.:	NEFX-003
	Sparks, NV 89431	Laboratory No.:	79727
Attention:	Mr. Jesse Ruzicka	Sample No.:	39
		Client Project No.:	475.0464.002
		Page:	1 of 2

Project Name:	I-15 TCL 70.7 to 71.9	Soil Symbol:	GM
Sample Location:	21-BH-23, Sample Depth *0.0'-5.0'*	Date Sampled:	-
Material Type:	Bulk	Date Received:	3/14/22
Soil Classification:	Silty Gravel with Sand	Sampled By:	Client

SOIL AND AGGREGATE PROPERTIES

	Test Method	Results	Specifications	Pass or Fail
Liquid Limit, LL	NDOT T210	38		
Plastic Limit, PL	NDOT T211	NP		
Plasticity Index, PI	NDOT T212	NP		
R-Value	NDOT T115	18		

SIEVE ANALYSIS - AASHTO T27, T11

Sieve Size	Percent Passing	Specification Limits Min.	Specification Limits Max.	Pass or Fail
2"	100			
1 1/2"	93			
1"	89			
3/4"	82			
1/2"	75			
3/8"	70			
#4	49			
#8	42			
#16	37			
#30	33			
#50	31			
#100	27			
#200	22			

Comments: R-Value graph on page 2.

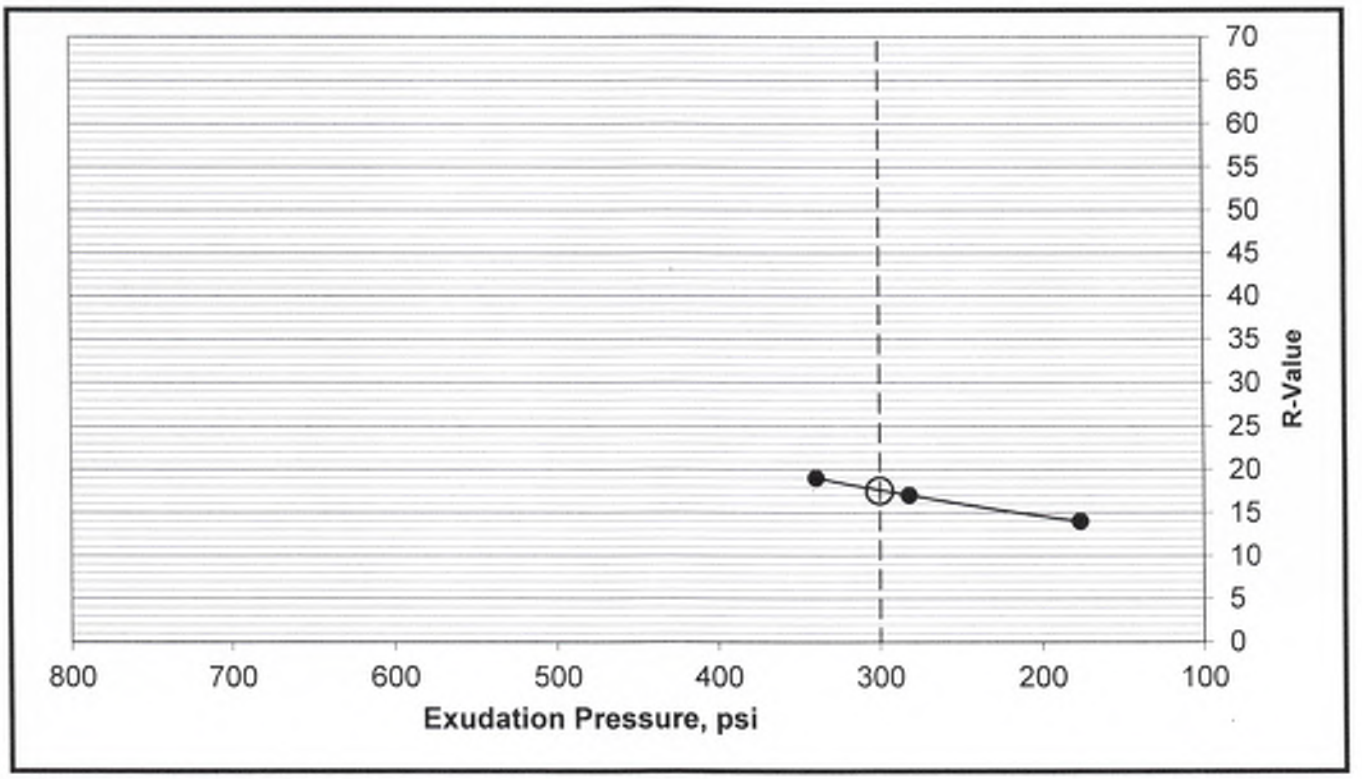
Reviewed By: Jesse Ruzicka

Date: 3-25-2022

AZTECH
INSPECTIONS & TESTING

RESISTANCE R-VALUE
NDOT T115

Client:	NewFields 1301 N. McCarran Blvd Ste. 101 Sparks, NV 89431 Mr. Jesse Ruzicka	Date of Report: Project Number: Sample Number: Page	3/24/22 NEFX-003 79727 2 of 2
Project: Sample Location: Material Use:	I-15 TCL 70.7 to 71.9 21-BH-23, Sample Depth *0.0'-5.0'* Bulk	Date Sampled: Date Received: Sampled By:	- 3/14/22 Client



Comments:

Reviewed By: Jesse Ruzicka

Date: 3-25-2022

AZTECH
INSPECTIONS & TESTING

SUMMARY REPORT OF SOIL AND AGGREGATE TESTS

		Revised On:	***3/25/22***
Client:	NewFields	Date of Report:	3/24/22
	1301 N. McCarran Blvd Ste. 101	Aztech Project No.:	NEFX-003
	Sparks, NV 89431	Laboratory No.:	79728
Attention:	Mr. Jesse Ruzicka	Sample No.:	36
		Client Project No.:	475.0464.002
		Page:	1 of 2

Project Name:	I-15 TCL 70.7 to 71.9	Soil Symbol:	GC
Sample Location:	21-BH-24, Sample Depth *0.0'-5.0'*	Date Sampled:	-
Material Type:	Bulk	Date Received:	3/14/22
Soil Classification:	Clayey Gravel with Sand	Sampled By:	Client

SOIL AND AGGREGATE PROPERTIES

	Test Method	Results	Specifications	Pass or Fail
Liquid Limit, LL	NDOT T210	39		
Plastic Limit, PL	NDOT T211	23		
Plasticity Index, PI	NDOT T212	16		
R-Value	NDOT T115	35		

SIEVE ANALYSIS - AASHTO T27, T11

Sieve Size	Percent Passing	Specification Limits Min.	Max.	Pass or Fail
2"	100			
1 1/2"	99			
1"	90			
3/4"	83			
1/2"	67			
3/8"	58			
#4	35			
#8	28			
#16	25			
#30	23			
#50	21			
#100	19			
#200	16			

Comments: R-Value graph on page 2.

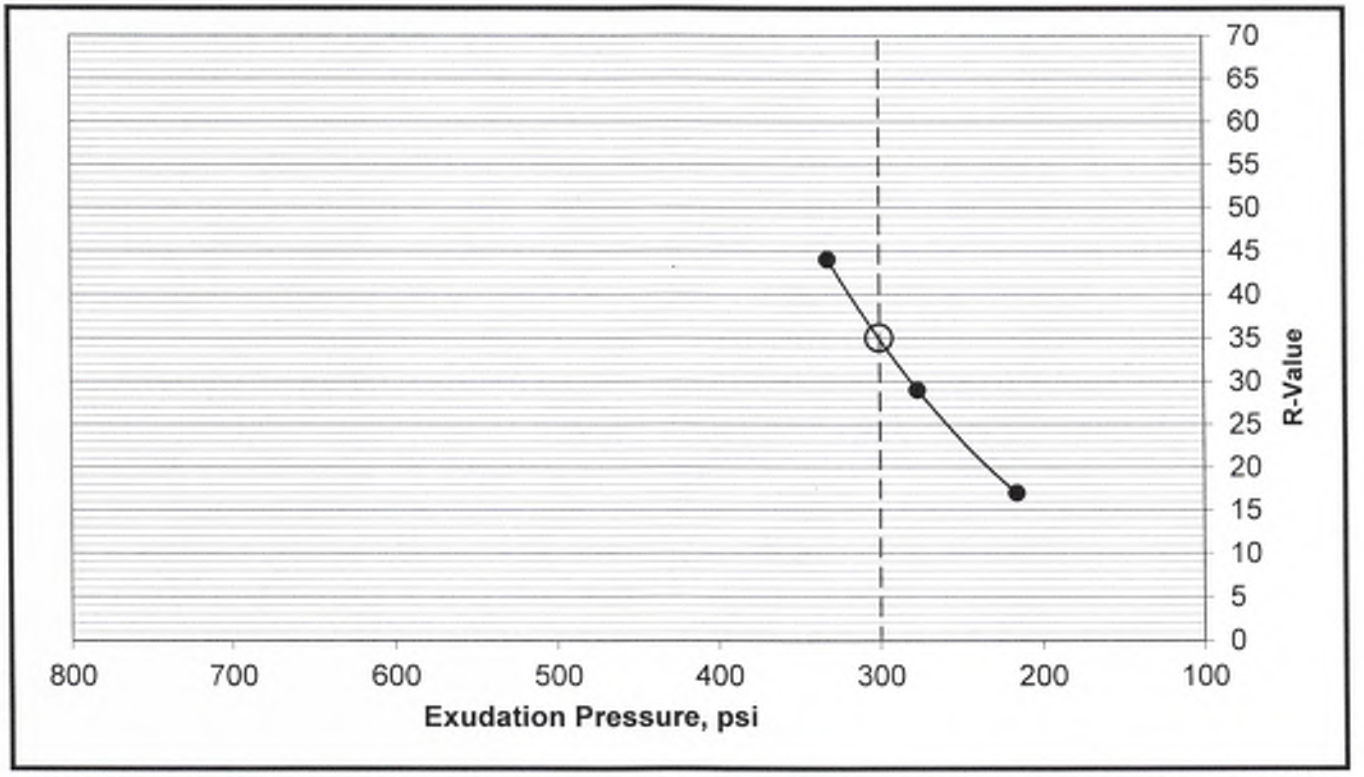
Reviewed By: Jesse Ruzicka

Date: 3-25-2022

AZTECH
INSPECTIONS & TESTING

RESISTANCE R-VALUE
NDOT T115

Client:	NewFields 1301 N. McCarran Blvd Ste. 101 Sparks, NV 89431 Mr. Jesse Ruzicka	Date of Report: Project Number: Sample Number: Page	3/24/22 NEFX-003 79728 2 of 2
Project: Sample Location: Material Use:	I-15 TCL 70.7 to 71.9 21-BH-24, Sample Depth *0.0'-5.0'* Bulk	Date Sampled: Date Received: Sampled By:	- 3/14/22 Client



Comments:

Reviewed By: Jesse Ruiz

Date: 3-25-2022

AZTECH
INSPECTIONS & TESTING

SUMMARY REPORT OF SOIL AND AGGREGATE TESTS

		Revised On:	***3/25/22***
Client:	NewFields	Date of Report:	3/24/22
	1301 N. McCarran Blvd Ste. 101	Aztech Project No.:	NEFX-003
	Sparks, NV 89431	Laboratory No.:	79729
Attention:	Mr. Jesse Ruzicka	Sample No.:	33
		Client Project No.:	475.0464.002
		Page:	1 of 2

Project Name:	I-15 TCL 70.7 to 71.9	Soil Symbol:	GC
Sample Location:	21-BH-25, Sample Depth *0.0'-5.0'*	Date Sampled:	-
Material Type:	Bulk	Date Received:	3/14/22
Soil Classification:	Clayey Gravel with Sand	Sampled By:	Client

SOIL AND AGGREGATE PROPERTIES

	Test Method	Results	Specifications	Pass or Fail
Liquid Limit, LL	NDOT T210	42		
Plastic Limit, PL	NDOT T211	20		
Plasticity Index, PI	NDOT T212	22		
R-Value	NDOT T115	24		

SIEVE ANALYSIS - AASHTO T27, T11

Sieve Size	Percent Passing	Specification Limits Min.	Specification Limits Max.	Pass or Fail
2"	100			
1 1/2"	94			
1"	90			
3/4"	81			
1/2"	67			
3/8"	57			
#4	32			
#8	27			
#16	24			
#30	22			
#50	21			
#100	19			
#200	17			

Comments: R-Value graph on page 2.

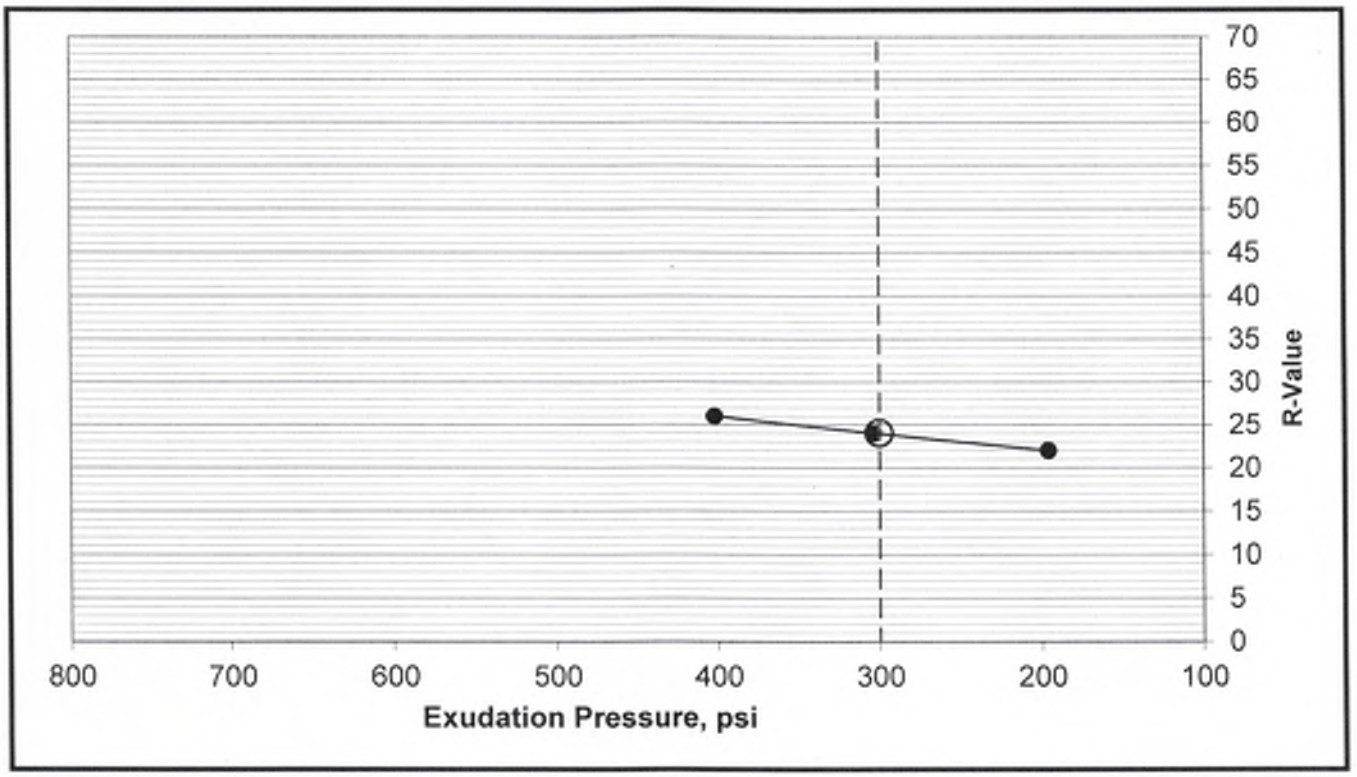
Reviewed By: Leo Rios

Date: 3-25-2022

AZTECH
INSPECTIONS & TESTING

RESISTANCE R-VALUE
NDOT T115

Client:	NewFields 1301 N. McCarran Blvd Ste. 101 Sparks, NV 89431 Mr. Jesse Ruzicka	Date of Report: Project Number: Sample Number: Page	3/24/22 NEFX-003 79729 2 of 2
Project:	I-15 TCL 70.7 to 71.9	Date Sampled:	-
Sample Location:	21-BH-25, Sample Depth 0.0'-5.0'	Date Received:	3/14/22
Material Use:	Bulk	Sampled By:	Client



Comments:

Reviewed By: Jesse Ruzicka

Date: 3-25-2022

AZTECH
INSPECTIONS & TESTING

SUMMARY REPORT OF SOIL AND AGGREGATE TESTS

		Revised On:	***3/25/22***
Client:	NewFields	Date of Report:	3/24/22
	1301 N. McCarran Blvd Ste. 101	Aztech Project No.:	NEFX-003
	Sparks, NV 89431	Laboratory No.:	79730
Attention:	Mr. Jesse Ruzicka	Sample No.:	30
		Client Project No.:	475.0464.002
		Page:	1 of 2

Project Name:	I-15 TCL 70.7 to 71.9	Soil Symbol:	GC
Sample Location:	21-BH-26A, Sample Depth *0.0'-5.0'*	Date Sampled:	-
Material Type:	Bulk	Date Received:	3/14/22
Soil Classification:	Clayey Gravel with Sand	Sampled By:	Client

SOIL AND AGGREGATE PROPERTIES

	Test Method	Results	Specifications	Pass or Fail
Liquid Limit, LL	NDOT T210	34		
Plastic Limit, PL	NDOT T211	20		
Plasticity Index, PI	NDOT T212	14		
R-Value	NDOT T115	34		

SIEVE ANALYSIS - AASHTO T27, T11

Sieve Size	Percent Passing	Specification Limits Min.	Max.	Pass or Fail
2"	100			
1 1/2"	90			
1"	81			
3/4"	71			
1/2"	52			
3/8"	43			
#4	28			
#8	24			
#16	21			
#30	19			
#50	18			
#100	16			
#200	13			

Comments: R-Value graph on page 2.

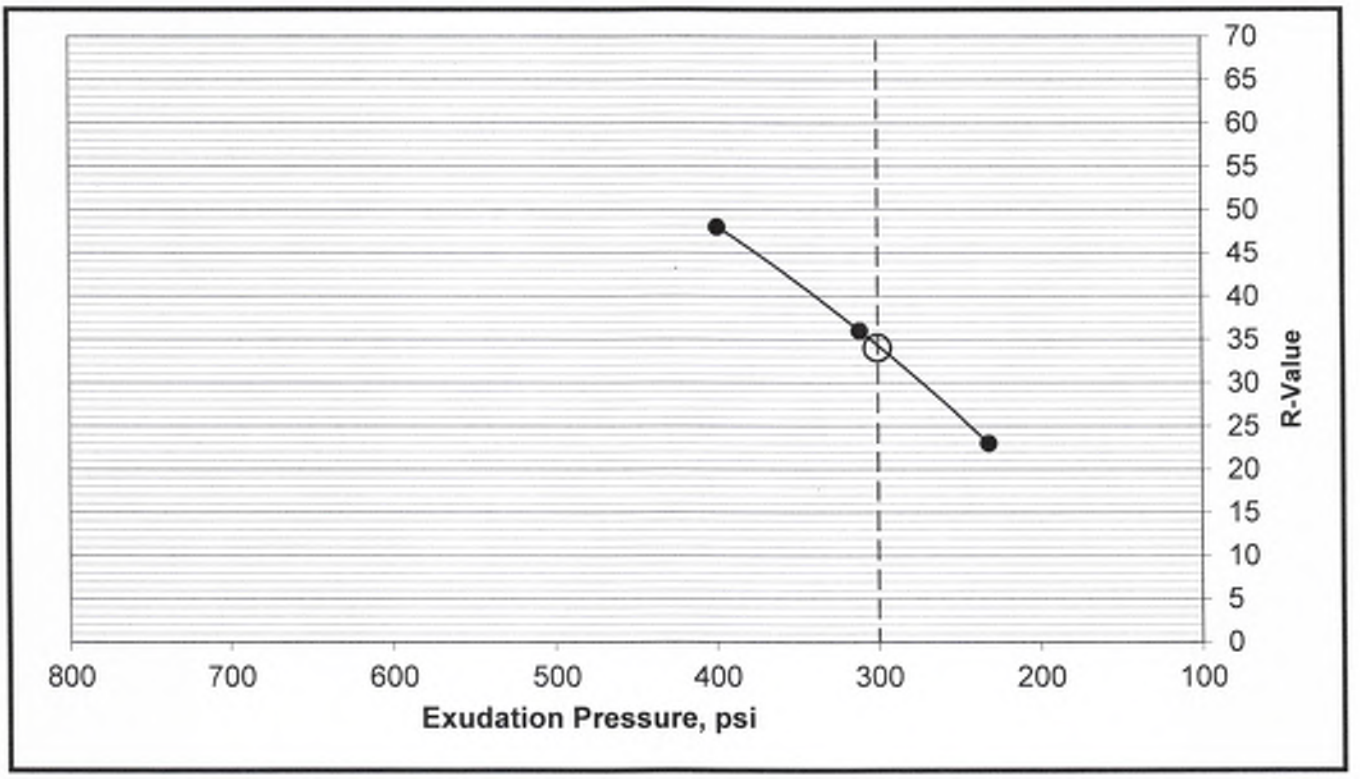
Reviewed By: Lee Price

Date: 3-25-2022

AZTECH
INSPECTIONS & TESTING

RESISTANCE R-VALUE
NDOT T115

Client:	NewFields 1301 N. McCarran Blvd Ste. 101 Sparks, NV 89431 Mr. Jesse Ruzicka	Date of Report: Project Number: Sample Number: Page	3/24/22 NEFX-003 79730 2 of 2
Project: Sample Location: Material Use:	I-15 TCL 70.7 to 71.9 21-BH-26A, Sample Depth *0.0'-5.0'* Bulk	Date Sampled: Date Received: Sampled By:	- 3/14/22 Client



Comments: _____

Reviewed By: Jesse Ruiz

Date: 3-25-2022

AZTECH
INSPECTIONS & TESTING

SUMMARY REPORT OF SOIL AND AGGREGATE TESTS

		Revised On:	***3/25/22***
Client:	NewFields	Date of Report:	3/24/22
	1301 N. McCarran Blvd Ste. 101	Aztech Project No.:	NEFX-003
	Sparks, NV 89431	Laboratory No.:	79731
Attention:	Mr. Jesse Ruzicka	Sample No.:	19
		Client Project No.:	475.0464.002
		Page:	1 of 2

Project Name:	I-15 TCL 70.7 to 71.9	Soil Symbol:	GC
Sample Location:	21-BH-27, Sample Depth *0.0'-5.0'*	Date Sampled:	-
Material Type:	Bulk	Date Received:	3/14/22
Soil Classification:	Clayey Gravel with Sand	Sampled By:	Client

SOIL AND AGGREGATE PROPERTIES

	Test Method	Results	Specifications	Pass or Fail
Liquid Limit, LL	NDOT T210	32		
Plastic Limit, PL	NDOT T211	20		
Plasticity Index, PI	NDOT T212	12		
R-Value	NDOT T115	21		

SIEVE ANALYSIS - AASHTO T27, T11

Sieve Size	Percent Passing	Specification Limits Min.	Specification Limits Max.	Pass or Fail
2"	100			
1 1/2"	98			
1"	96			
3/4"	91			
1/2"	85			
3/8"	80			
#4	46			
#8	42			
#16	38			
#30	36			
#50	34			
#100	32			
#200	28			

Comments: R-Value graph on page 2.

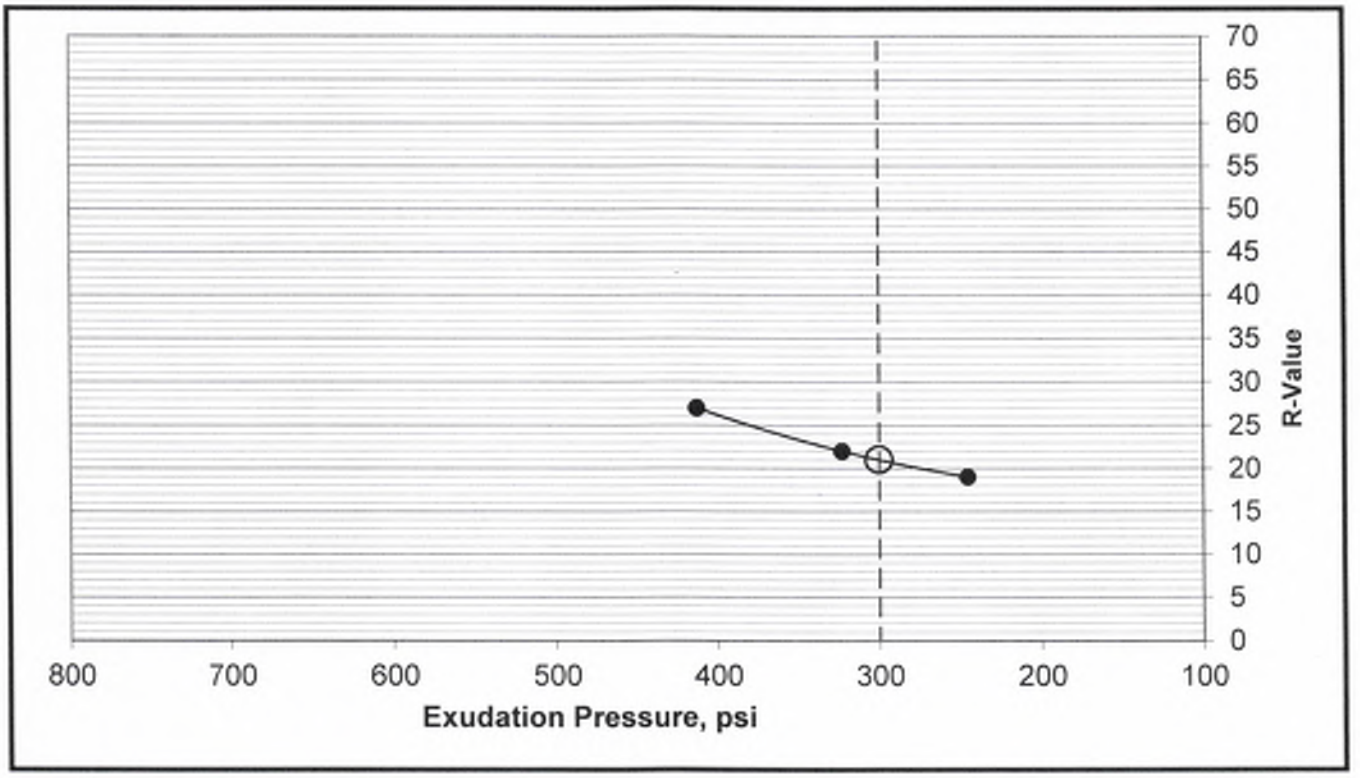
Reviewed By: Jesse Ruiz

Date: 3-25-2022

AZTECH
INSPECTIONS & TESTING

RESISTANCE R-VALUE
NDOT T115

Client:	NewFields 1301 N. McCarran Blvd Ste. 101 Sparks, NV 89431 Mr. Jesse Ruzicka	Date of Report: Project Number: Sample Number: Page	3/24/22 NEFX-003 79731 2 of 2
Project: Sample Location: Material Use:	I-15 TCL 70.7 to 71.9 21-BH-27, Sample Depth 0.0'-5.0' Bulk	Date Sampled: Date Received: Sampled By:	- 3/14/22 Client



Comments: _____

Reviewed By: Jesse Ruzicka

Date: 3-25-2022

AZTECH
INSPECTIONS & TESTING

SUMMARY REPORT OF SOIL AND AGGREGATE TESTS

		Revised On:	***3/25/22***
Client:	NewFields	Date of Report:	3/24/22
	1301 N. McCarran Blvd Ste. 101	Aztech Project No.:	NEFX-003
	Sparks, NV 89431	Laboratory No.:	79732
Attention:	Mr. Jesse Ruzicka	Sample No.:	16
		Client Project No.:	475.0464.002
		Page:	1 of 2

Project Name:	I-15 TCL 70.7 to 71.9	Soil Symbol:	GC
Sample Location:	21-BH-28, Sample Depth *0.0'-5.0'*	Date Sampled:	-
Material Type:	Bulk	Date Received:	3/14/22
Soil Classification:	Clayey Gravel with Sand	Sampled By:	Client

SOIL AND AGGREGATE PROPERTIES

	Test Method	Results	Specifications	Pass or Fail
Liquid Limit, LL	NDOT T210	32		
Plastic Limit, PL	NDOT T211	21		
Plasticity Index, PI	NDOT T212	11		
R-Value	NDOT T115	57		

SIEVE ANALYSIS - AASHTO T27, T11

Sieve Size	Percent Passing	Specification Limits Min.	Specification Limits Max.	Pass or Fail
2"	100			
1 1/2"	94			
1"	89			
3/4"	80			
1/2"	71			
3/8"	63			
#4	44			
#8	34			
#16	29			
#30	25			
#50	22			
#100	18			
#200	13			

Comments: R-Value graph on page 2.

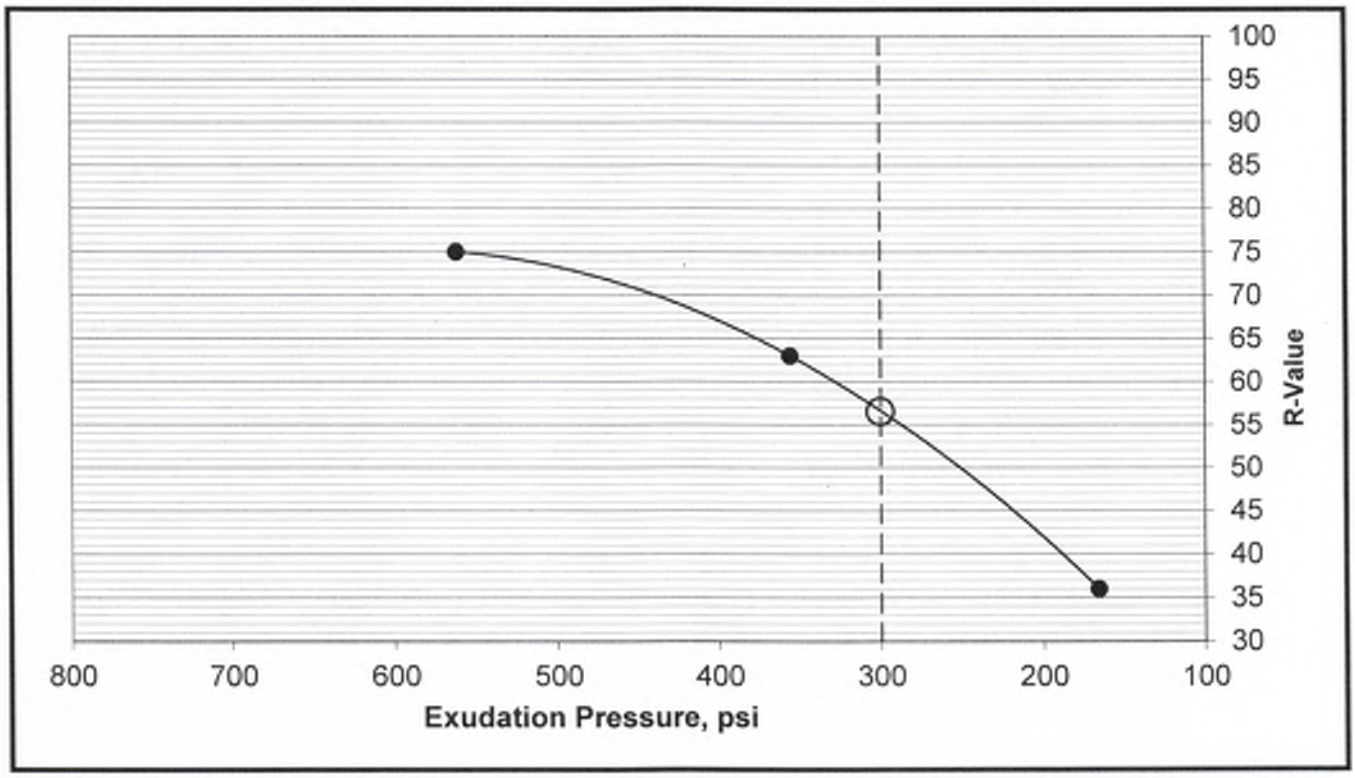
Reviewed By: Jesse Ruzicka

Date: 3-25-2022

AZTECH
INSPECTIONS & TESTING

RESISTANCE R-VALUE
NDOT T115

Client:	NewFields 1301 N. McCarran Blvd Ste. 101 Sparks, NV 89431 Mr. Jesse Ruzicka	Date of Report: Project Number: Sample Number: Page	3/24/22 NEFX-003 79732 2 of 2
Project: Sample Location: Material Use:	I-15 TCL 70.7 to 71.9 21-BH-28, Sample Depth *0.0'-5.0'* Bulk	Date Sampled: Date Received: Sampled By:	- 3/14/22 Client



Comments: _____

Reviewed By: Leo Rios

Date: 3-25-2022

AZTECH
INSPECTIONS & TESTING

SUMMARY REPORT OF SOIL AND AGGREGATE TESTS

		Revised On:	***3/25/22***
Client:	NewFields	Date of Report:	3/24/22
	1301 N. McCarran Blvd Ste. 101	Aztech Project No.:	NEFX-003
	Sparks, NV 89431	Laboratory No.:	79733
Attention:	Mr. Jesse Ruzicka	Sample No.:	14
		Client Project No.:	475.0464.002
		Page:	1 of 1

Project Name:	I-15 TCL 70.7 to 71.9	Soil Symbol:	-
Sample Location:	21-BH-28, Sample Depth *0.0'-1.5'*	Date Sampled:	-
Material Type:	Bulk	Date Received:	3/14/22
Soil Classification:	-	Sampled By:	Client

SOIL AND AGGREGATE PROPERTIES

	Test Method	Results	Specifications	Pass or Fail
Resistivity, ohm-cm	AASHTO T288	850		
pH Value	*AASHTO T289	8.58		
Soluble Sulfate, %	*AASHTO T290B	0.03		
Chloride Content, ppm	*AASHTO T291A	58		

SIEVE ANALYSIS - AASHTO T27, T11

Sieve Size	Percent Passing	Specification Limits Min.	Specification Limits Max.	Pass or Fail
2"				
1 1/2"				
1"				
3/4"				
1/2"				
3/8"				
#4				
#8				
#16				
#30				
#50				
#100				
#200				

Comments: *Testing performed by Sims & Associates, LLC.

Reviewed By: Leo Rios

Date: 3-25-2022

AZTECH
INSPECTIONS & TESTING

SUMMARY REPORT OF SOIL AND AGGREGATE TESTS

		Revised On:	***3/25/22***
Client:	NewFields	Date of Report:	3/24/22
	1301 N. McCarran Blvd Ste. 101	Aztech Project No.:	NEFX-003
	Sparks, NV 89431	Laboratory No.:	79734
Attention:	Mr. Jesse Ruzicka	Sample No.:	13
		Client Project No.:	475.0464.002
		Page:	1 of 2

Project Name:	I-15 TCL 70.7 to 71.9	Soil Symbol:	GC
Sample Location:	21-BH-29, Sample Depth *0.0'-5.0'*	Date Sampled:	-
Material Type:	Bulk	Date Received:	3/14/22
Soil Classification:	Clayey Gravel with Sand	Sampled By:	Client

SOIL AND AGGREGATE PROPERTIES

	Test Method	Results	Specifications	Pass or Fail
Liquid Limit, LL	NDOT T210	51		
Plastic Limit, PL	NDOT T211	26		
Plasticity Index, PI	NDOT T212	25		
R-Value	NDOT T115	20		

SIEVE ANALYSIS - AASHTO T27, T11

Sieve Size	Percent Passing	Specification Limits Min.	Specification Limits Max.	Pass or Fail
2"				
1 1/2"	100			
1"	98			
3/4"	94			
1/2"	87			
3/8"	83			
#4	68			
#8	63			
#16	59			
#30	55			
#50	51			
#100	47			
#200	43			

Comments: R-Value graph on page 2.

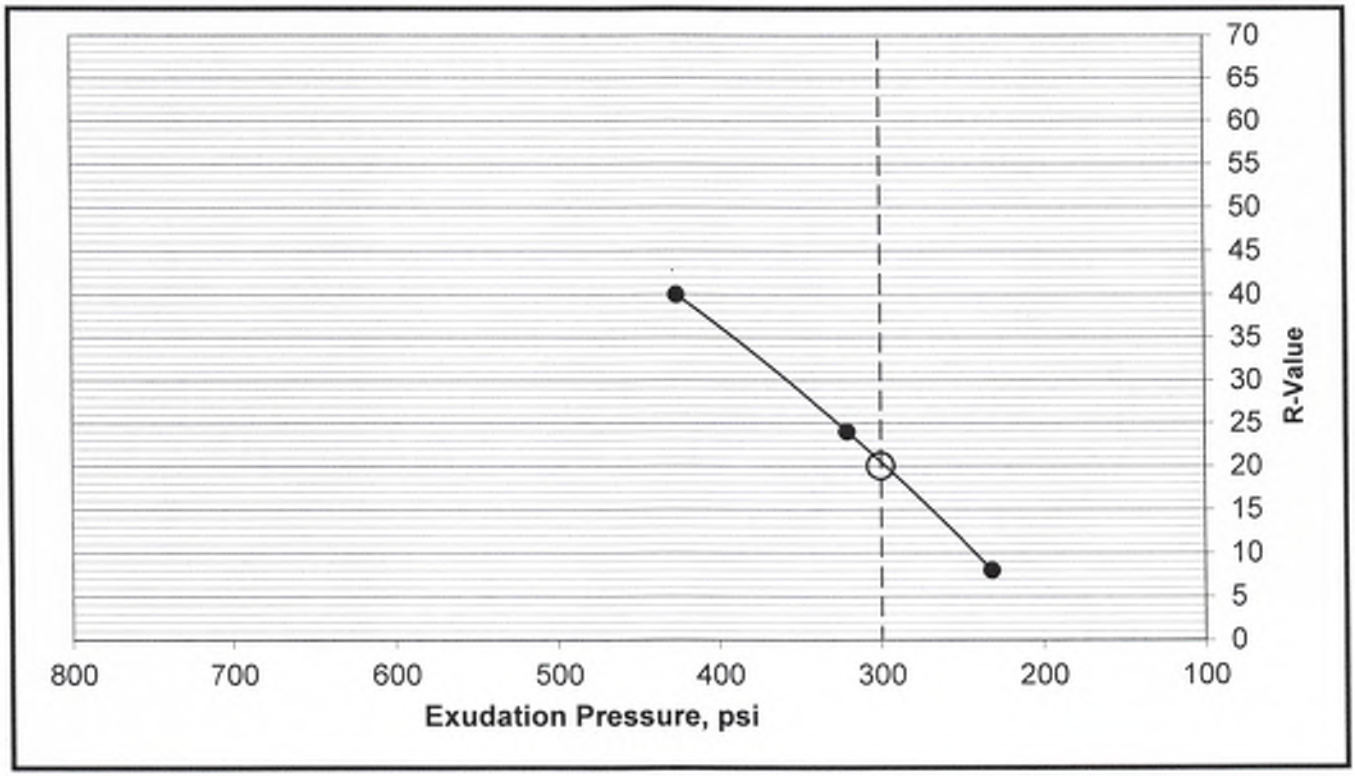
Reviewed By: Leo Pico

Date: 3-25-2022

AZTECH
INSPECTIONS & TESTING

RESISTANCE R-VALUE
NDOT T115

Client:	NewFields 1301 N. McCarran Blvd Ste. 101 Sparks, NV 89431 Mr. Jesse Ruzicka	Date of Report: Project Number: Sample Number: Page	3/24/22 NEFX-003 79734 2 of 2
Project: Sample Location: Material Use:	I-15 TCL 70.7 to 71.9 21-BH-29, Sample Depth 0.0'-5.0' Bulk	Date Sampled: Date Received: Sampled By:	- 3/14/22 Client



Comments: _____

Reviewed By: Jesse Ruiz

Date: 3-25-2022

AZTECH
INSPECTIONS & TESTING

SUMMARY REPORT OF SOIL AND AGGREGATE TESTS

		Revised On:	***3/25/22***
Client:	NewFields	Date of Report:	3/24/22
	1301 N. McCarran Blvd Ste. 101	Aztech Project No.:	NEFX-003
	Sparks, NV 89431	Laboratory No.:	79736
Attention:	Mr. Jesse Ruzicka	Sample No.:	9
		Client Project No.:	475.0464.002
		Page:	1 of 2

Project Name:	I-15 TCL 70.7 to 71.9	Soil Symbol:	GC
Sample Location:	21-BH-30, Sample Depth *0.0'-5.0'*	Date Sampled:	-
Material Type:	Bulk	Date Received:	3/14/22
Soil Classification:	Clayey Gravel with Sand	Sampled By:	Client

SOIL AND AGGREGATE PROPERTIES

	Test Method	Results	Specifications	Pass or Fail
Liquid Limit, LL	NDOT T210	33		
Plastic Limit, PL	NDOT T211	20		
Plasticity Index, PI	NDOT T212	13		
R-Value	NDOT T115	28		

SIEVE ANALYSIS - AASHTO T27, T11

Sieve Size	Percent Passing	Specification Limits Min.	Specification Limits Max.	Pass or Fail
2"	100			
1 1/2"	97			
1"	93			
3/4"	88			
1/2"	81			
3/8"	76			
#4	59			
#8	50			
#16	43			
#30	38			
#50	34			
#100	29			
#200	24			

Comments: R-Value graph on page 2.

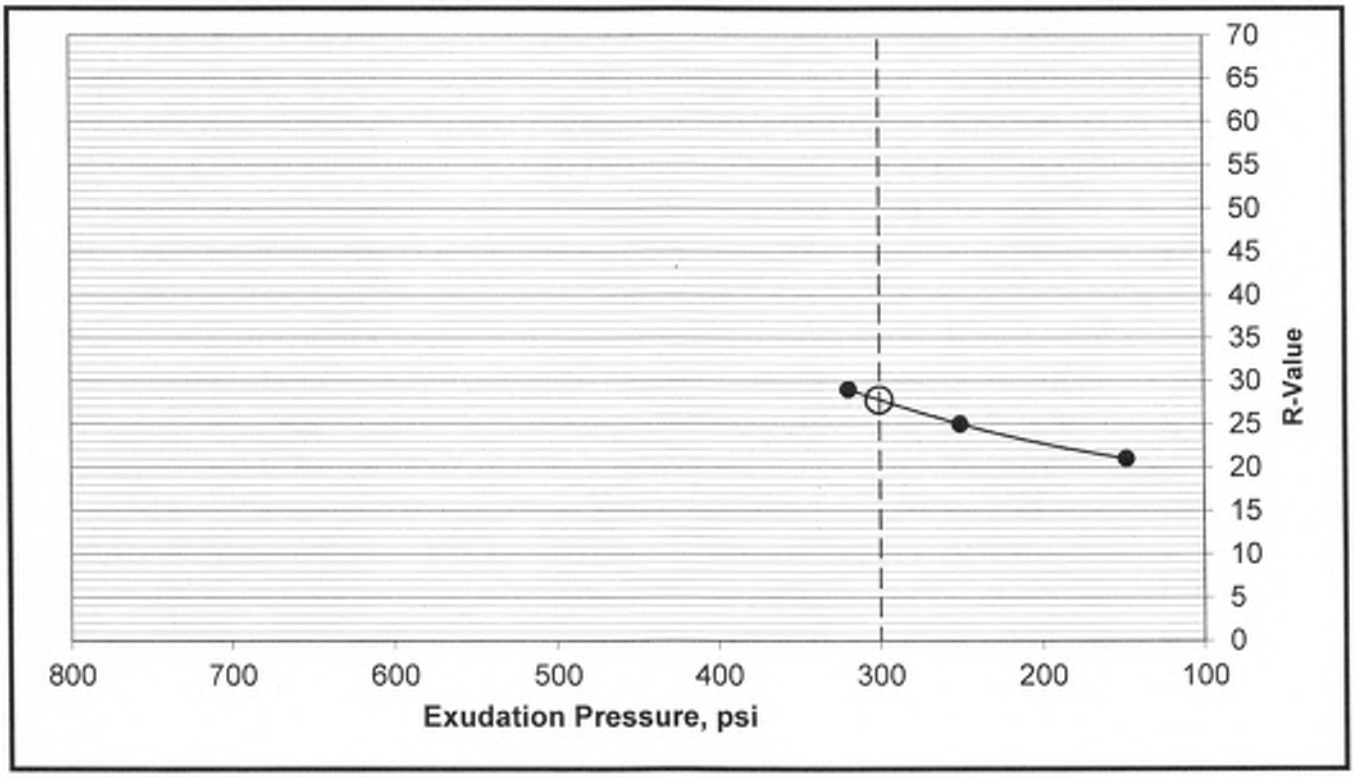
Reviewed By: Jesse Ruiz

Date: 3-25-2022

AZTECH
INSPECTIONS & TESTING

RESISTANCE R-VALUE
NDOT T115

Client:	NewFields 1301 N. McCarran Blvd Ste. 101 Sparks, NV 89431 Mr. Jesse Ruzicka	Date of Report: Project Number: Sample Number: Page	3/24/22 NEFX-003 79736 2 of 2
Project: Sample Location: Material Use:	I-15 TCL 70.7 to 71.9 21-BH-30, Sample Depth *0.0'-5.0'* Bulk	Date Sampled: Date Received: Sampled By:	- 3/14/22 Client



Comments: _____

Reviewed By: Jesse Ruzicka

Date: 3-25-2022

AZTECH
INSPECTIONS & TESTING

SUMMARY REPORT OF SOIL AND AGGREGATE TESTS

		Revised On:	***3/25/22***
Client:	NewFields	Date of Report:	3/24/22
	1301 N. McCarran Blvd Ste. 101	Aztech Project No.:	NEFX-003
	Sparks, NV 89431	Laboratory No.:	79737
Attention:	Mr. Jesse Ruzicka	Sample No.:	7
		Client Project No.:	475.0464.002
		Page:	1 of 1

Project Name:	I-15 TCL 70.7 to 71.9	Soil Symbol:	*CL-CH*
Sample Location:	21-BH-30, Sample Depth 25.0'-26.5'	Date Sampled:	-
Material Type:	Standard Penetration Test (SPT)	Date Received:	3/14/22
Soil Classification:	Lean Clay	Sampled By:	Client

SOIL AND AGGREGATE PROPERTIES

	Test Method	Results	Specifications	Pass or Fail
Liquid Limit, LL	NDOT T210	50		
Plastic Limit, PL	NDOT T211	26		
Plasticity Index, PI	NDOT T212	24		

SIEVE ANALYSIS - AASHTO T27, T11

Sieve Size	Percent Passing	Specification Limits Min.	Specification Limits Max.	Pass or Fail
2"				
1 1/2"				
1"				
3/4"				
1/2"				
3/8"				
#4				
#8	100			
#16	99			
#30	97			
#50	95			
#100	94			
#200	93			

Comments:

Reviewed By: Leo Pios

Date: 3-25-2022

AZTECH
INSPECTIONS & TESTING

SUMMARY REPORT OF SOIL AND AGGREGATE TESTS

		Revised On:	***3/25/22***
Client:	NewFields	Date of Report:	3/24/22
	1301 N. McCarran Blvd Ste. 101	Aztech Project No.:	NEFX-003
	Sparks, NV 89431	Laboratory No.:	79740
Attention:	Mr. Jesse Ruzicka	Sample No.:	27
		Client Project No.:	475.0464.002
		Page:	1 of 2

Project Name:	I-15 TCL 70.7 to 71.9	Soil Symbol:	GC
Sample Location:	21-BH-31, Sample Depth *0.0'-5.0'*	Date Sampled:	-
Material Type:	Bulk	Date Received:	3/14/22
Soil Classification:	Clayey Gravel with Sand	Sampled By:	Client

SOIL AND AGGREGATE PROPERTIES

	Test Method	Results	Specifications	Pass or Fail
Liquid Limit, LL	NDOT T210	40		
Plastic Limit, PL	NDOT T211	25		
Plasticity Index, PI	NDOT T212	15		
R-Value	NDOT T115	28		

SIEVE ANALYSIS - AASHTO T27, T11

Sieve Size	Percent Passing	Specification Limits Min.	Max.	Pass or Fail
3"	100			
2"	93			
1 1/2"	91			
1"	84			
3/4"	82			
1/2"	78			
3/8"	73			
#4	56			
#8	46			
#16	40			
#30	35			
#50	31			
#100	28			
#200	23			

Comments: R-Value graph on page 2.

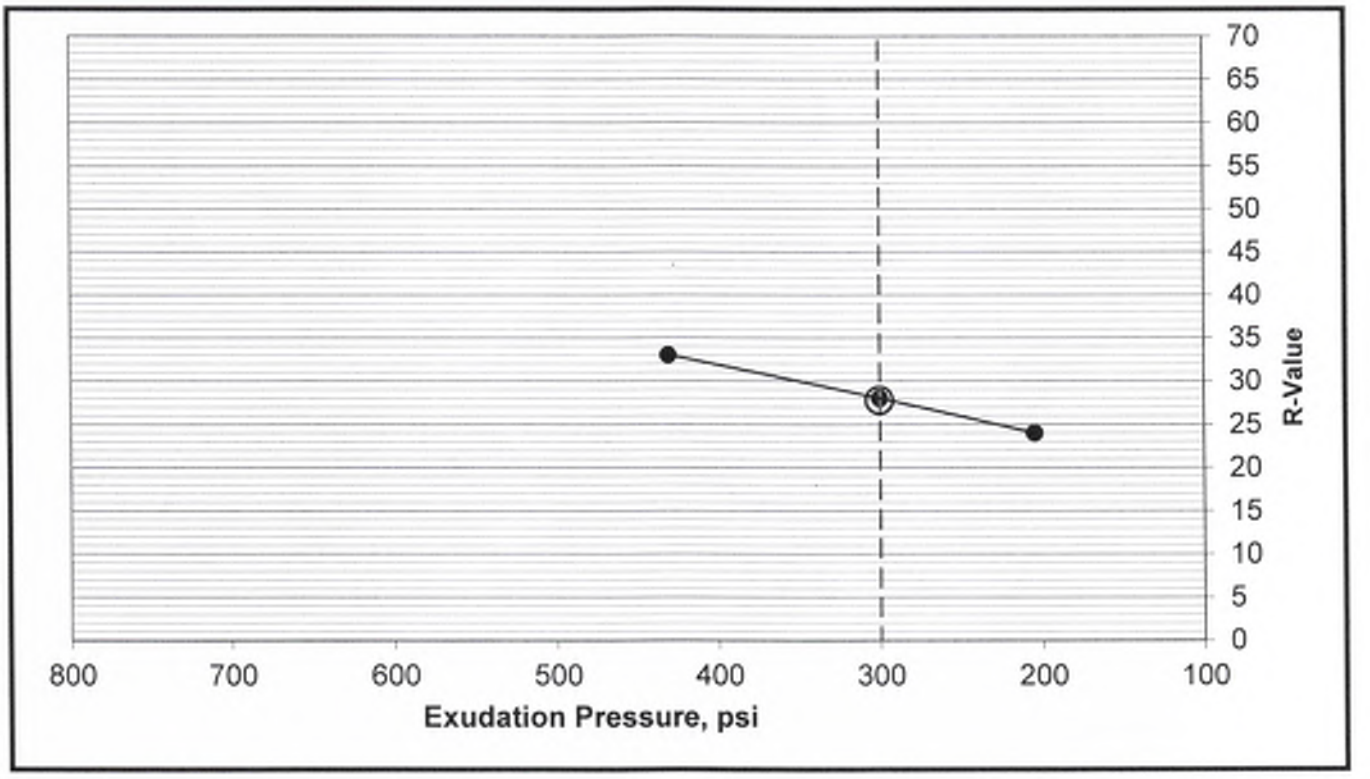
Reviewed By: Jesse Ruzicka

Date: 3-25-2022

AZTECH
INSPECTIONS & TESTING

RESISTANCE R-VALUE
NDOT T115

Client:	NewFields 1301 N. McCarran Blvd Ste. 101 Sparks, NV 89431 Mr. Jesse Ruzicka	Date of Report: Project Number: Sample Number: Page	3/24/22 NEFX-003 79740 2 of 2
Project: Sample Location: Material Use:	I-15 TCL 70.7 to 71.9 21-BH-31, Sample Depth *0.0'-5.0'* Bulk	Date Sampled: Date Received: Sampled By:	- 3/14/22 Client



Comments: _____

Reviewed By: Leo Rios

Date: 3-25-2022

AZTECH
INSPECTIONS & TESTING

SUMMARY REPORT OF SOIL AND AGGREGATE TESTS

		Revised On:	***3/25/22***
Client:	NewFields	Date of Report:	3/24/22
	1301 N. McCarran Blvd Ste. 101	Aztech Project No.:	NEFX-003
	Sparks, NV 89431	Laboratory No.:	79741
Attention:	Mr. Jesse Ruzicka	Sample No.:	24
		Client Project No.:	475.0464.002
		Page:	1 of 2

Project Name:	I-15 TCL 70.7 to 71.9	Soil Symbol:	SC
Sample Location:	21-BH-32, Sample Depth *0.0'-5.0'*	Date Sampled:	-
Material Type:	Bulk	Date Received:	3/14/22
Soil Classification:	Clayey Sand with Gravel	Sampled By:	Client

SOIL AND AGGREGATE PROPERTIES

	Test Method	Results	Specifications	Pass or Fail
Liquid Limit, LL	NDOT T210	28		
Plastic Limit, PL	NDOT T211	17		
Plasticity Index, PI	NDOT T212	11		
R-Value	NDOT T115	20		

SIEVE ANALYSIS - AASHTO T27, T11

Sieve Size	Percent Passing	Specification Limits Min.	Specification Limits Max.	Pass or Fail
3"				
2"				
1 1/2"	100			
1"	99			
3/4"	98			
1/2"	93			
3/8"	89			
#4	77			
#8	66			
#16	57			
#30	50			
#50	45			
#100	40			
#200	33			

Comments: R-Value graph on page 2.

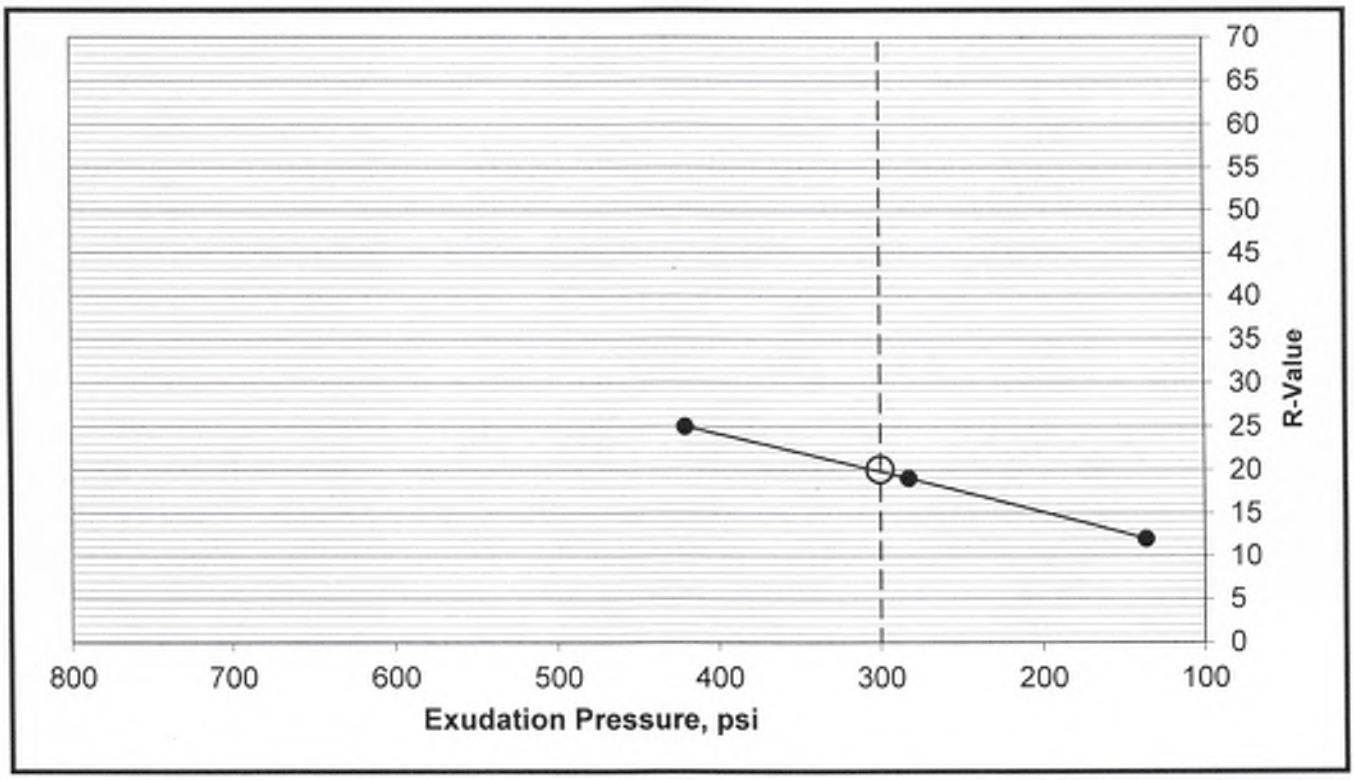
Reviewed By: Jesse Ruzicka

Date: 3-25-2022

AZTECH
INSPECTIONS & TESTING

RESISTANCE R-VALUE
NDOT T115

Client:	NewFields 1301 N. McCarran Blvd Ste. 101 Sparks, NV 89431 Mr. Jesse Ruzicka	Date of Report: Project Number: Sample Number: Page	3/24/22 NEFX-003 79741 2 of 2
Project: Sample Location: Material Use:	I-15 TCL 70.7 to 71.9 21-BH-32, Sample Depth *0.0'-5.0'* Bulk	Date Sampled: Date Received: Sampled By:	- 3/14/22 Client



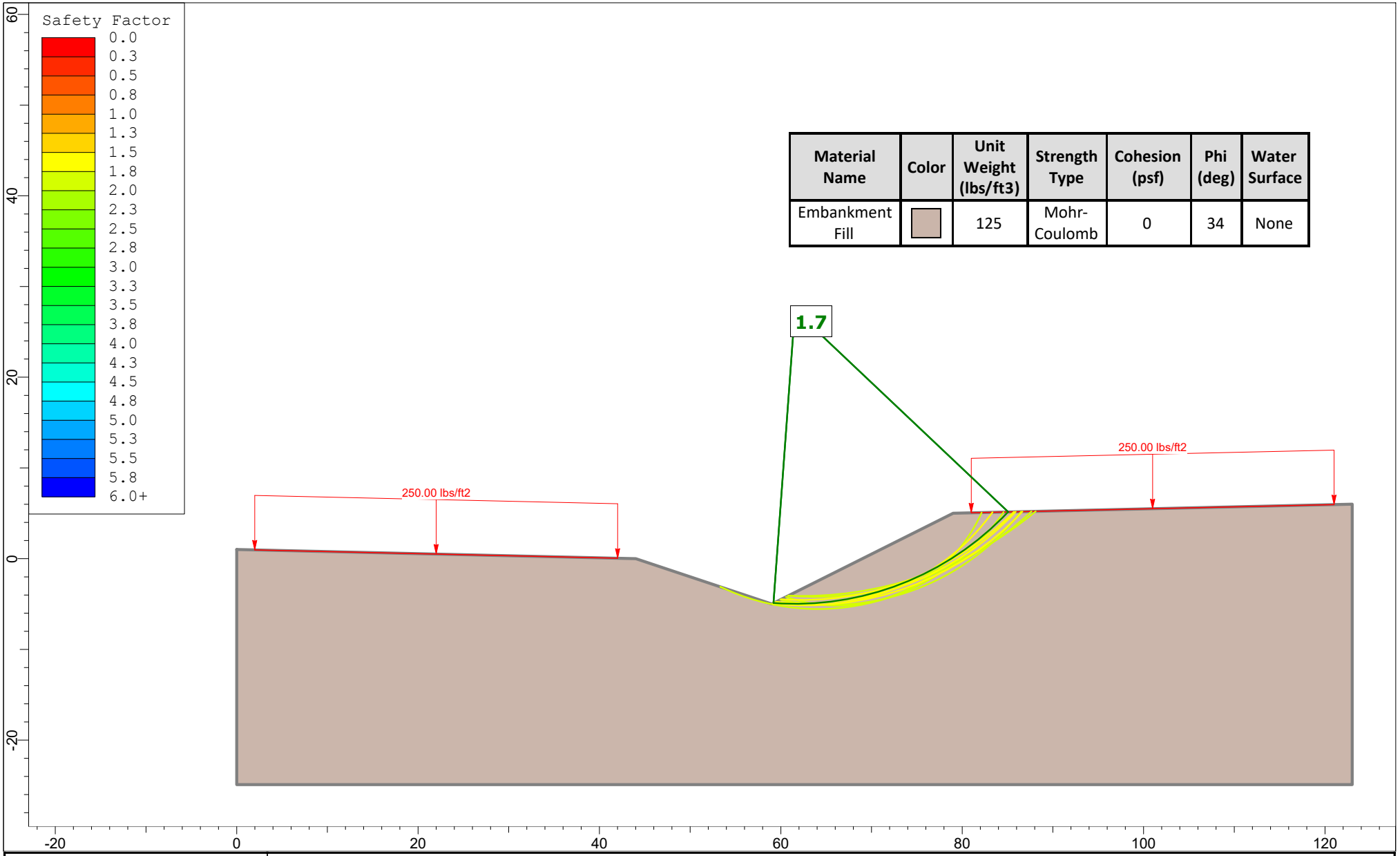
Comments: _____

Reviewed By: Jesse Ruiz

Date: 3-25-2022

APPENDIX D

Slope Stability Outputs



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Embankment Fill		125	Mohr-Coulomb	0	34	None

NewFields

SLIDEINTERPRET 9.015

I-15 TCL MP CL 70.7 to 71.9

Analysis Description	Embankment (Static, Circular)				
Drawn By	JR	*Scale*	1:175	*Company*	NewFields
Date Printed	4/18/2022			*File Name*	Static_Circular.slim

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Slide Analysis Information

I-15 TCL MP CL 70.7 to 71.9

Project Summary

Slide Modeler Version:	9.015
Compute Time:	00h:00m:01.98s
Author:	JR
Company:	NewFields
Date Created:	04/18/2022

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
	Spencer
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Slope Search
Number of Surfaces:	5000
Upper Angle [deg]:	Not Defined
Lower Angle [deg]:	Not Defined
Composite Surfaces:	Disabled
Reverse Curvature:	Invalid Surfaces
Minimum Elevation:	Not Defined
Minimum Depth [ft]:	5
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Loading

2 Distributed Loads present

Distributed Load 1	
Distribution:	Constant
Magnitude [psf]:	250
Orientation:	Vertical
Distributed Load 2	
Distribution:	Constant
Magnitude [psf]:	250
Orientation:	Vertical

Materials

Embankment Fill	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	125
Cohesion [psf]	0
Friction Angle [deg]	34
Water Surface	None
Ru Value	0

Global Minimums

Method: bishop simplified

FS	1.659090
Center:	61.555, 27.389
Radius:	32.378
Left Slip Surface Endpoint:	59.194, -4.903
Right Slip Surface Endpoint:	85.076, 5.138
Resisting Moment:	246640 lb-ft
Driving Moment:	148659 lb-ft
Total Slice Area:	87.139 ft2
Surface Horizontal Width:	25.8823 ft
Surface Average Height:	3.36674 ft

Method: spencer

FS	1.659000
Center:	61.555, 27.389
Radius:	32.378
Left Slip Surface Endpoint:	59.194, -4.903
Right Slip Surface Endpoint:	85.076, 5.138
Resisting Moment:	246626 lb-ft
Driving Moment:	148659 lb-ft
Resisting Horizontal Force:	6895.03 lb
Driving Horizontal Force:	4156.14 lb
Total Slice Area:	87.139 ft2
Surface Horizontal Width:	25.8823 ft
Surface Average Height:	3.36674 ft

Global Minimum Support Data

No Supports Present

Valid and Invalid Surfaces

Method: bishop simplified

Number of Valid Surfaces:	2698
Number of Invalid Surfaces:	2302

Error Codes

Error Code -105 reported for 1 surface
Error Code -106 reported for 39 surfaces
Error Code -107 reported for 348 surfaces
Error Code -108 reported for 3 surfaces
Error Code -114 reported for 122 surfaces
Error Code -115 reported for 1789 surfaces

Method: spencer

Number of Valid Surfaces:	2632
Number of Invalid Surfaces:	2368

Error Codes

Error Code -105 reported for 1 surface
Error Code -106 reported for 39 surfaces
Error Code -107 reported for 348 surfaces
Error Code -108 reported for 10 surfaces
Error Code -111 reported for 59 surfaces
Error Code -114 reported for 122 surfaces
Error Code -115 reported for 1789 surfaces

Error Code Descriptions

The following errors were encountered during the computation:
-105 = More than two surface / slope intersections with no valid slip surface.
-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.
-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-111 = Safety factor equation did not converge
-114 = Surface with Reverse Curvature.
-115 = Surface too shallow, below the minimum depth.

Slice Data

Global Minimum Query (bishop simplified) - Safety Factor: 1.65909

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	0.517645	9.46333	-3.72278	Embankment Fill	0	34	7.63412	12.6657	18.7777	0	18.7777	18.2809	18.2809
2	0.517645	28.1209	-2.80524	Embankment Fill	0	34	22.5343	37.3864	55.4277	0	55.4277	54.3235	54.3235
3	0.517645	46.241	-1.88842	Embankment Fill	0	34	36.8101	61.0713	90.5418	0	90.5418	89.3281	89.3281
4	0.517645	63.8247	-0.972089	Embankment Fill	0	34	50.475	83.7426	124.154	0	124.154	123.297	123.297
5	0.517645	80.8725	-0.0560029	Embankment Fill	0	34	63.5415	105.421	156.293	0	156.293	156.231	156.231
6	0.517645	97.3847	0.860069	Embankment Fill	0	34	76.0218	126.127	186.99	0	186.99	188.131	188.131
7	0.517645	113.361	1.77636	Embankment Fill	0	34	87.9253	145.876	216.27	0	216.27	218.997	218.997
8	0.517645	128.801	2.69311	Embankment Fill	0	34	99.2628	164.686	244.158	0	244.158	248.827	248.827
9	0.517645	143.704	3.61055	Embankment Fill	0	34	110.044	182.573	270.674	0	270.674	277.618	277.618
10	0.517645	158.068	4.52891	Embankment Fill	0	34	120.276	199.549	295.844	0	295.844	305.371	305.371
11	0.517645	171.892	5.44845	Embankment Fill	0	34	129.968	215.628	319.682	0	319.682	332.079	332.079
12	0.517645	185.172	6.36939	Embankment Fill	0	34	139.125	230.821	342.207	0	342.207	357.737	357.737
13	0.517645	197.907	7.29199	Embankment Fill	0	34	147.756	245.14	363.436	0	363.436	382.343	382.343
14	0.517645	210.093	8.21649	Embankment Fill	0	34	155.865	258.594	383.382	0	383.382	405.888	405.888
15	0.517645	221.727	9.14316	Embankment Fill	0	34	163.458	271.191	402.058	0	402.058	428.366	428.366
16	0.517645	232.804	10.0722	Embankment Fill	0	34	170.54	282.941	419.476	0	419.476	449.769	449.769
17	0.517645	243.32	11.004	Embankment Fill	0	34	177.115	293.849	435.648	0	435.648	470.088	470.088
18	0.517645	253.269	11.9387	Embankment Fill	0	34	183.185	303.921	450.581	0	450.581	489.314	489.314
19	0.517645	262.647	12.8767	Embankment Fill	0	34	188.756	313.164	464.285	0	464.285	507.435	507.435
20	0.517645	271.447	13.8182	Embankment Fill	0	34	193.83	321.582	476.766	0	476.766	524.44	524.44
21	0.517645	279.661	14.7635	Embankment Fill	0	34	198.409	329.179	488.027	0	488.027	540.314	540.314
22	0.517645	287.284	15.7129	Embankment Fill	0	34	202.495	335.957	498.077	0	498.077	555.045	555.045
23	0.517645	294.306	16.6668	Embankment Fill	0	34	206.088	341.919	506.916	0	506.916	568.615	568.615
24	0.517645	300.718	17.6255	Embankment Fill	0	34	209.191	347.066	514.546	0	514.546	581.008	581.008
25	0.517645	306.512	18.5893	Embankment Fill	0	34	211.803	351.4	520.97	0	520.97	592.206	592.206
26	0.517645	311.677	19.5586	Embankment Fill	0	34	213.924	354.919	526.189	0	526.189	602.19	602.19
27	0.517645	316.202	20.5337	Embankment Fill	0	34	215.554	357.624	530.198	0	530.198	610.935	610.935
28	0.517645	320.074	21.5151	Embankment Fill	0	34	216.692	359.512	532.999	0	532.999	618.422	618.422
29	0.517645	323.282	22.5032	Embankment Fill	0	34	217.337	360.582	534.584	0	534.584	624.623	624.623
30	0.517645	325.81	23.4984	Embankment Fill	0	34	217.487	360.83	534.953	0	534.953	629.512	629.512

31	0.517645	327.643	24.5011	Embankment Fill	0	34	217.139	360.253	534.097	0	534.097	633.058	633.058
32	0.517645	328.765	25.5119	Embankment Fill	0	34	216.29	358.845	532.011	0	532.011	635.231	635.231
33	0.517645	329.159	26.5314	Embankment Fill	0	34	214.938	356.602	528.685	0	528.685	635.996	635.996
34	0.517645	328.804	27.5599	Embankment Fill	0	34	213.079	353.517	524.11	0	524.11	635.315	635.315
35	0.517645	327.681	28.5982	Embankment Fill	0	34	210.707	349.582	518.277	0	518.277	633.15	633.15
36	0.517645	325.766	29.6469	Embankment Fill	0	34	207.819	344.79	511.172	0	511.172	629.455	629.455
37	0.517645	323.035	30.7066	Embankment Fill	0	34	204.407	339.13	502.781	0	502.781	624.181	624.181
38	0.517645	319.461	31.778	Embankment Fill	0	34	200.468	332.594	493.09	0	493.09	617.279	617.279
39	0.517645	310.658	32.8621	Embankment Fill	0	34	193.282	320.673	475.416	0	475.416	600.275	600.275
40	0.517645	289.869	33.9596	Embankment Fill	0	34	178.767	296.59	439.713	0	439.713	560.109	560.109
41	0.517645	267.594	35.0714	Embankment Fill	0	34	163.538	271.325	402.256	0	402.256	517.071	517.071
42	0.517645	244.341	36.1986	Embankment Fill	0	34	147.935	245.438	363.877	0	363.877	472.144	472.144
43	0.517645	220.068	37.3422	Embankment Fill	0	34	199.63	331.204	491.029	0	491.029	643.339	643.339
44	0.517645	194.729	38.5036	Embankment Fill	0	34	192.433	319.263	473.328	0	473.328	626.416	626.416
45	0.517645	168.271	39.684	Embankment Fill	0	34	174.891	290.16	430.179	0	430.179	575.294	575.294
46	0.517645	140.637	40.885	Embankment Fill	0	34	156.94	260.378	386.027	0	386.027	521.901	521.901
47	0.517645	111.762	42.1082	Embankment Fill	0	34	138.577	229.912	340.858	0	340.858	466.108	466.108
48	0.517645	81.5741	43.3554	Embankment Fill	0	34	119.798	198.755	294.665	0	294.665	407.776	407.776
49	0.517645	49.9911	44.6289	Embankment Fill	0	34	100.599	166.903	247.444	0	247.444	346.748	346.748
50	0.517645	16.92	45.931	Embankment Fill	0	34	80.9805	134.354	199.188	0	199.188	282.844	282.844

Global Minimum Query (spencer) - Safety Factor: 1.659

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	0.517645	9.46333	-3.72278	Embankment Fill	0	34	9.50814	15.774	23.3859	0	23.3859	22.7672	22.7672
2	0.517645	28.1209	-2.80524	Embankment Fill	0	34	27.8048	46.1282	68.388	0	68.388	67.0256	67.0256
3	0.517645	46.241	-1.88842	Embankment Fill	0	34	45.0046	74.6627	110.692	0	110.692	109.208	109.208
4	0.517645	63.8247	-0.972089	Embankment Fill	0	34	61.1573	101.46	150.421	0	150.421	149.384	149.384
5	0.517645	80.8725	-0.0560029	Embankment Fill	0	34	76.3098	126.598	187.689	0	187.689	187.615	187.615
6	0.517645	97.3847	0.860069	Embankment Fill	0	34	90.5039	150.146	222.602	0	222.602	223.961	223.961
7	0.517645	113.361	1.77636	Embankment Fill	0	34	103.78	172.171	255.255	0	255.255	258.473	258.473
8	0.517645	128.801	2.69311	Embankment Fill	0	34	116.174	192.733	285.739	0	285.739	291.204	291.204
9	0.517645	143.704	3.61055	Embankment Fill	0	34	127.72	211.888	314.137	0	314.137	322.196	322.196
10	0.517645	158.068	4.52891	Embankment Fill	0	34	138.45	229.688	340.526	0	340.526	351.493	351.493
11	0.517645	171.892	5.44845	Embankment Fill	0	34	148.392	246.183	364.983	0	364.983	379.136	379.136
12	0.517645	185.172	6.36939	Embankment Fill	0	34	157.576	261.418	387.568	0	387.568	405.158	405.158
13	0.517645	197.907	7.29199	Embankment Fill	0	34	166.024	275.434	408.348	0	408.348	429.593	429.593
14	0.517645	210.093	8.21649	Embankment Fill	0	34	173.763	288.272	427.38	0	427.38	452.471	452.471
15	0.517645	221.727	9.14316	Embankment Fill	0	34	180.812	299.967	444.718	0	444.718	473.82	473.82
16	0.517645	232.804	10.0722	Embankment Fill	0	34	187.193	310.554	460.414	0	460.414	493.665	493.665
17	0.517645	243.32	11.004	Embankment Fill	0	34	192.926	320.064	474.514	0	474.514	512.029	512.029
18	0.517645	253.269	11.9387	Embankment Fill	0	34	198.028	328.529	487.063	0	487.063	528.934	528.934
19	0.517645	262.647	12.8767	Embankment Fill	0	34	202.516	335.974	498.103	0	498.103	544.398	544.398
20	0.517645	271.447	13.8182	Embankment Fill	0	34	206.406	342.428	507.669	0	507.669	558.437	558.437
21	0.517645	279.661	14.7635	Embankment Fill	0	34	209.712	347.913	515.801	0	515.801	571.067	571.067
22	0.517645	287.284	15.7129	Embankment Fill	0	34	212.448	352.452	522.533	0	522.533	582.301	582.301
23	0.517645	294.306	16.6668	Embankment Fill	0	34	214.628	356.068	527.891	0	527.891	592.147	592.147
24	0.517645	300.718	17.6255	Embankment Fill	0	34	216.262	358.779	531.912	0	531.912	600.62	600.62
25	0.517645	306.512	18.5893	Embankment Fill	0	34	217.362	360.604	534.617	0	534.617	607.722	607.722
26	0.517645	311.677	19.5586	Embankment Fill	0	34	217.94	361.562	536.037	0	536.037	613.464	613.464
27	0.517645	316.202	20.5337	Embankment Fill	0	34	218.002	361.666	536.192	0	536.192	617.846	617.846
28	0.517645	320.074	21.5151	Embankment Fill	0	34	217.561	360.934	535.107	0	535.107	620.873	620.873
29	0.517645	323.282	22.5032	Embankment Fill	0	34	216.624	359.379	532.801	0	532.801	622.544	622.544
30	0.517645	325.81	23.4984	Embankment Fill	0	34	215.198	357.013	529.293	0	529.293	622.856	622.856
31	0.517645	327.643	24.5011	Embankment Fill	0	34	213.291	353.85	524.605	0	524.605	621.812	621.812
32	0.517645	328.765	25.5119	Embankment Fill	0	34	210.91	349.9	518.748	0	518.748	619.401	619.401
33	0.517645	329.159	26.5314	Embankment Fill	0	34	208.061	345.173	511.74	0	511.74	615.618	615.618

34	0.517645	328.804	27.5599	Embankment Fill	0	34	204.75	339.68	503.596	0	503.596	610.455	610.455
35	0.517645	327.681	28.5982	Embankment Fill	0	34	200.982	333.429	494.329	0	494.329	603.9	603.9
36	0.517645	325.766	29.6469	Embankment Fill	0	34	196.763	326.429	483.95	0	483.95	595.94	595.94
37	0.517645	323.035	30.7066	Embankment Fill	0	34	192.095	318.686	472.471	0	472.471	586.559	586.559
38	0.517645	319.461	31.778	Embankment Fill	0	34	186.985	310.208	459.901	0	459.901	575.737	575.737
39	0.517645	310.658	32.8621	Embankment Fill	0	34	178.925	296.837	440.079	0	440.079	555.663	555.663
40	0.517645	289.869	33.9596	Embankment Fill	0	34	164.233	272.462	403.941	0	403.941	514.549	514.549
41	0.517645	267.594	35.0714	Embankment Fill	0	34	149.092	247.344	366.704	0	366.704	471.376	471.376
42	0.517645	244.341	36.1986	Embankment Fill	0	34	133.825	222.016	329.152	0	329.152	427.092	427.092
43	0.517645	220.068	37.3422	Embankment Fill	0	34	179.179	297.258	440.703	0	440.703	577.41	577.41
44	0.517645	194.729	38.5036	Embankment Fill	0	34	171.356	284.279	421.46	0	421.46	557.78	557.78
45	0.517645	168.271	39.684	Embankment Fill	0	34	154.489	256.298	379.978	0	379.978	508.165	508.165
46	0.517645	140.637	40.885	Embankment Fill	0	34	137.51	228.129	338.214	0	338.214	457.266	457.266
47	0.517645	111.762	42.1082	Embankment Fill	0	34	120.423	199.781	296.187	0	296.187	405.029	405.029
48	0.517645	81.5741	43.3554	Embankment Fill	0	34	103.234	171.266	253.912	0	253.912	351.384	351.384
49	0.517645	49.9911	44.6289	Embankment Fill	0	34	85.956	142.601	211.414	0	211.414	296.263	296.263
50	0.517645	16.92	45.931	Embankment Fill	0	34	71.0747	117.913	174.813	0	174.813	248.236	248.236

Interslice Data

Global Minimum Query (bishop simplified) - Safety Factor: 1.65909

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	59.194	-4.903	0	0	0
2	59.7116	-4.93668	4.57986	0	0
3	60.2293	-4.96204	17.6377	0	0
4	60.7469	-4.97911	38.2165	0	0
5	61.2646	-4.98789	65.4063	0	0
6	61.7822	-4.9884	98.3411	0	0
7	62.2999	-4.98063	136.197	0	0
8	62.8175	-4.96458	178.189	0	0
9	63.3352	-4.94023	223.57	0	0
10	63.8528	-4.90756	271.63	0	0
11	64.3705	-4.86656	321.691	0	0
12	64.8881	-4.81719	373.11	0	0
13	65.4057	-4.7594	425.274	0	0
14	65.9234	-4.69317	477.602	0	0
15	66.441	-4.61842	529.539	0	0
16	66.9587	-4.53511	580.562	0	0
17	67.4763	-4.44316	630.174	0	0
18	67.994	-4.3425	677.903	0	0
19	68.5116	-4.23305	723.307	0	0
20	69.0293	-4.11472	765.967	0	0
21	69.5469	-3.9874	805.49	0	0
22	70.0646	-3.85098	841.508	0	0
23	70.5822	-3.70535	873.678	0	0
24	71.0998	-3.55038	901.682	0	0
25	71.6175	-3.38592	925.226	0	0
26	72.1351	-3.21182	944.043	0	0
27	72.6528	-3.02791	957.89	0	0
28	73.1704	-2.83403	966.549	0	0
29	73.6881	-2.62996	969.829	0	0
30	74.2057	-2.41551	967.567	0	0
31	74.7234	-2.19045	959.627	0	0
32	75.241	-1.95454	945.901	0	0
33	75.7587	-1.7075	926.313	0	0
34	76.2763	-1.44906	900.818	0	0
35	76.7939	-1.1789	869.403	0	0
36	77.3116	-0.896691	832.092	0	0
37	77.8292	-0.602067	788.946	0	0
38	78.3469	-0.294631	740.067	0	0
39	78.8645	0.0260481	685.6	0	0
40	79.3822	0.360442	626.564	0	0
41	79.8998	0.709067	565.705	0	0
42	80.4175	1.07249	504.078	0	0
43	80.9351	1.45133	442.721	0	0
44	81.4528	1.84627	352.015	0	0
45	81.9704	2.25808	256.598	0	0
46	82.488	2.68759	162.261	0	0
47	83.0057	3.13575	70.4089	0	0
48	83.5233	3.60361	-17.4112	0	0
49	84.041	4.09237	-99.4854	0	0
50	84.5586	4.60335	-173.908	0	0
51	85.0763	5.1381	0	0	0

Global Minimum Query (spencer) - Safety Factor: 1.659

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	59.194	-4.903	0	0	0
2	59.7116	-4.93668	5.7074	2.39067	22.7274
3	60.2293	-4.96204	21.8289	9.14351	22.7274
4	60.7469	-4.97911	47.0046	19.6889	22.7274
5	61.2646	-4.98789	79.9701	33.4972	22.7274
6	61.7822	-4.9884	119.55	50.076	22.7274
7	62.2999	-4.98063	164.649	68.9667	22.7274
8	62.8175	-4.96458	214.249	89.7429	22.7274
9	63.3352	-4.94023	267.403	112.007	22.7273
10	63.8528	-4.90756	323.228	135.391	22.7274
11	64.3705	-4.86656	380.902	159.549	22.7274
12	64.8881	-4.81719	439.664	184.163	22.7275
13	65.4057	-4.7594	498.802	208.934	22.7274
14	65.9234	-4.69317	557.659	233.587	22.7274
15	66.441	-4.61842	615.622	257.867	22.7275
16	66.9587	-4.53511	672.127	281.535	22.7274
17	67.4763	-4.44316	726.651	304.374	22.7275
18	67.994	-4.3425	778.712	326.181	22.7275
19	68.5116	-4.23305	827.867	346.77	22.7274
20	69.0293	-4.11472	873.711	365.973	22.7274
21	69.5469	-3.9874	915.873	383.633	22.7274
22	70.0646	-3.85098	954.02	399.612	22.7274
23	70.5822	-3.70535	987.85	413.782	22.7274
24	71.0998	-3.55038	1017.09	426.032	22.7275
25	71.6175	-3.38592	1041.51	436.261	22.7275
26	72.1351	-3.21182	1060.91	444.384	22.7274
27	72.6528	-3.02791	1075.09	450.327	22.7275
28	73.1704	-2.83403	1083.93	454.029	22.7275
29	73.6881	-2.62996	1087.31	455.443	22.7274
30	74.2057	-2.41551	1085.14	454.533	22.7274
31	74.7234	-2.19045	1077.36	451.276	22.7274
32	75.241	-1.95454	1063.96	445.663	22.7274
33	75.7587	-1.7075	1044.94	437.696	22.7274
34	76.2763	-1.44906	1020.34	427.392	22.7275
35	76.7939	-1.1789	990.232	414.78	22.7274
36	77.3116	-0.896691	954.721	399.906	22.7275
37	77.8292	-0.602067	913.947	382.826	22.7274
38	78.3469	-0.294631	868.087	363.617	22.7274
39	78.8645	0.0260481	817.356	342.367	22.7274
40	79.3822	0.360442	762.776	319.505	22.7274
41	79.8998	0.709067	706.93	296.113	22.7274
42	80.4175	1.07249	650.806	272.604	22.7274
43	80.9351	1.45133	595.355	249.377	22.7274
44	81.4528	1.84627	514.013	215.306	22.7275
45	81.9704	2.25808	429.116	179.745	22.7275
46	82.488	2.68759	345.847	144.866	22.7275
47	83.0057	3.13575	265.423	111.178	22.7274
48	83.5233	3.60361	189.158	79.2329	22.7274
49	84.041	4.09237	118.474	49.6253	22.7274
50	84.5586	4.60335	54.9202	23.0045	22.7274
51	85.0763	5.1381	0	0	0

Discharge Sections

Entity Information

Distributed Load

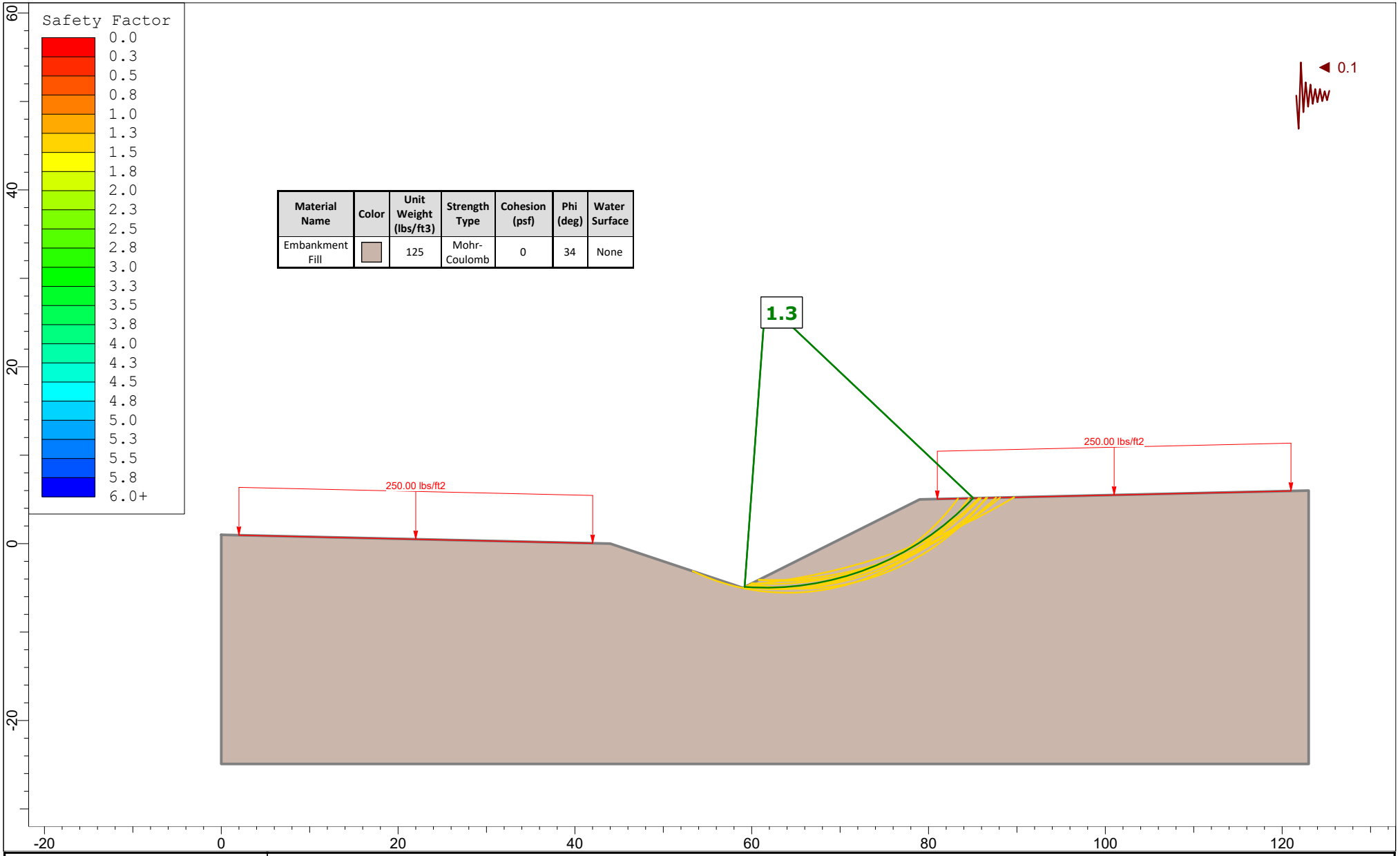
X	Y
1.99441	0.954673
42.0063	0.0453111

Distributed Load

X	Y
81.0014	5.04549
121.001	5.95458

External Boundary

X	Y
0	1
0	-24.912
123	-24.912
123	6
79	5
59	-5
44	0



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Embankment Fill		125	Mohr-Coulomb	0	34	None

NewFields

SLIDEINTERPRET 9.015

I-15 TCL MP CL 70.7 to 71.9

Analysis Description	Embankment (Seismic, Circular)				
Drawn By	JR	*Scale*	1:180	*Company*	NewFields
Date Printed	4/18/2022			*File Name*	Seismic_Circular.slim

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Slide Analysis Information

I-15 TCL MP CL 70.7 to 71.9

Project Summary

Slide Modeler Version:	9.015
Compute Time:	00h:00m:01.69s
Author:	JR
Company:	NewFields
Date Created:	04/18/2022

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
	Spencer
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Slope Search
Number of Surfaces:	5000
Upper Angle [deg]:	Not Defined
Lower Angle [deg]:	Not Defined
Composite Surfaces:	Disabled
Reverse Curvature:	Invalid Surfaces
Minimum Elevation:	Not Defined
Minimum Depth [ft]:	5
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No
Seismic Load Coefficient (Horizontal):	0.1

Loading

2 Distributed Loads present

Distributed Load 1	
Distribution:	Constant
Magnitude [psf]:	250
Orientation:	Vertical
Distributed Load 2	
Distribution:	Constant
Magnitude [psf]:	250
Orientation:	Vertical

Materials

Embankment Fill	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	125
Cohesion [psf]	0
Friction Angle [deg]	34
Water Surface	None
Ru Value	0

Global Minimums

Method: bishop simplified

FS	1.332980
Center:	61.555, 27.389
Radius:	32.378
Left Slip Surface Endpoint:	59.194, -4.903
Right Slip Surface Endpoint:	85.076, 5.138
Resisting Moment:	238117 lb-ft
Driving Moment:	178635 lb-ft
Total Slice Area:	87.139 ft2
Surface Horizontal Width:	25.8823 ft
Surface Average Height:	3.36674 ft

Method: spencer

FS	1.337100
Center:	61.555, 27.389
Radius:	32.378
Left Slip Surface Endpoint:	59.194, -4.903
Right Slip Surface Endpoint:	85.076, 5.138
Resisting Moment:	238853 lb-ft
Driving Moment:	178635 lb-ft
Resisting Horizontal Force:	6696.3 lb
Driving Horizontal Force:	5008.08 lb
Total Slice Area:	87.139 ft2
Surface Horizontal Width:	25.8823 ft
Surface Average Height:	3.36674 ft

Global Minimum Support Data

No Supports Present

Valid and Invalid Surfaces

Method: bishop simplified

Number of Valid Surfaces:	2873
Number of Invalid Surfaces:	2127

Error Codes

Error Code -105 reported for 1 surface
Error Code -106 reported for 39 surfaces
Error Code -107 reported for 175 surfaces
Error Code -108 reported for 1 surface
Error Code -114 reported for 122 surfaces
Error Code -115 reported for 1789 surfaces

Method: spencer

Number of Valid Surfaces:	2804
Number of Invalid Surfaces:	2196

Error Codes

Error Code -105 reported for 1 surface
Error Code -106 reported for 39 surfaces
Error Code -107 reported for 175 surfaces
Error Code -108 reported for 6 surfaces
Error Code -111 reported for 64 surfaces
Error Code -114 reported for 122 surfaces
Error Code -115 reported for 1789 surfaces

Error Code Descriptions

The following errors were encountered during the computation:
-105 = More than two surface / slope intersections with no valid slip surface.
-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.
-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-111 = Safety factor equation did not converge
-114 = Surface with Reverse Curvature.
-115 = Surface too shallow, below the minimum depth.

Slice Data

Global Minimum Query (bishop simplified) - Safety Factor: 1.33298

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	0.517645	9.46333	-3.72278	Embankment Fill	0	34	9.56481	12.7497	18.9022	0	18.9022	18.2799	18.2799
2	0.517645	28.1209	-2.80524	Embankment Fill	0	34	28.1862	37.5717	55.7022	0	55.7022	54.3211	54.3211
3	0.517645	46.241	-1.88842	Embankment Fill	0	34	45.9671	61.2732	90.8412	0	90.8412	89.3257	89.3257
4	0.517645	63.8247	-0.972089	Embankment Fill	0	34	62.9297	83.884	124.363	0	124.363	123.295	123.295
5	0.517645	80.8725	-0.0560029	Embankment Fill	0	34	79.0942	105.431	156.308	0	156.308	156.231	156.231
6	0.517645	97.3847	0.860069	Embankment Fill	0	34	94.4808	125.941	186.715	0	186.715	188.134	188.134
7	0.517645	113.361	1.77636	Embankment Fill	0	34	109.107	145.437	215.619	0	215.619	219.003	219.003
8	0.517645	128.801	2.69311	Embankment Fill	0	34	122.988	163.94	243.052	0	243.052	248.837	248.837
9	0.517645	143.704	3.61055	Embankment Fill	0	34	136.14	181.472	269.043	0	269.043	277.634	277.634
10	0.517645	158.068	4.52891	Embankment Fill	0	34	148.577	198.05	293.622	0	293.622	305.39	305.39
11	0.517645	171.892	5.44845	Embankment Fill	0	34	160.312	213.693	316.813	0	316.813	332.104	332.104
12	0.517645	185.172	6.36939	Embankment Fill	0	34	171.357	228.416	338.642	0	338.642	357.77	357.77
13	0.517645	197.907	7.29199	Embankment Fill	0	34	181.724	242.235	359.127	0	359.127	382.38	382.38
14	0.517645	210.093	8.21649	Embankment Fill	0	34	191.422	255.162	378.294	0	378.294	405.934	405.934
15	0.517645	221.727	9.14316	Embankment Fill	0	34	200.461	267.211	396.155	0	396.155	428.419	428.419
16	0.517645	232.804	10.0722	Embankment Fill	0	34	208.849	278.392	412.734	0	412.734	449.831	449.831
17	0.517645	243.32	11.004	Embankment Fill	0	34	216.595	288.717	428.042	0	428.042	470.159	470.159
18	0.517645	253.269	11.9387	Embankment Fill	0	34	223.706	298.196	442.093	0	442.093	489.393	489.393
19	0.517645	262.647	12.8767	Embankment Fill	0	34	230.187	306.835	454.901	0	454.901	507.522	507.522
20	0.517645	271.447	13.8182	Embankment Fill	0	34	236.046	314.644	466.478	0	466.478	524.536	524.536
21	0.517645	279.661	14.7635	Embankment Fill	0	34	241.286	321.629	476.834	0	476.834	540.42	540.42
22	0.517645	287.284	15.7129	Embankment Fill	0	34	245.912	327.796	485.976	0	485.976	555.159	555.159
23	0.517645	294.306	16.6668	Embankment Fill	0	34	249.929	333.15	493.915	0	493.915	568.74	568.74
24	0.517645	300.718	17.6255	Embankment Fill	0	34	253.338	337.695	500.655	0	500.655	581.143	581.143
25	0.517645	306.512	18.5893	Embankment Fill	0	34	256.145	341.436	506.199	0	506.199	592.348	592.348
26	0.517645	311.677	19.5586	Embankment Fill	0	34	258.35	344.375	510.558	0	510.558	602.341	602.341
27	0.517645	316.202	20.5337	Embankment Fill	0	34	259.955	346.515	513.729	0	513.729	611.096	611.096
28	0.517645	320.074	21.5151	Embankment Fill	0	34	260.961	347.856	515.717	0	515.717	618.592	618.592
29	0.517645	323.282	22.5032	Embankment Fill	0	34	261.369	348.399	516.523	0	516.523	624.802	624.802
30	0.517645	325.81	23.4984	Embankment Fill	0	34	261.177	348.144	516.144	0	516.144	629.698	629.698

31	0.517645	327.643	24.5011	Embankment Fill	0	34	260.387	347.09	514.583	0	514.583	633.254	633.254
32	0.517645	328.765	25.5119	Embankment Fill	0	34	258.996	345.236	511.834	0	511.834	635.435	635.435
33	0.517645	329.159	26.5314	Embankment Fill	0	34	257.002	342.579	507.894	0	507.894	636.207	636.207
34	0.517645	328.804	27.5599	Embankment Fill	0	34	254.404	339.116	502.761	0	502.761	635.533	635.533
35	0.517645	327.681	28.5982	Embankment Fill	0	34	251.2	334.844	496.426	0	496.426	633.374	633.374
36	0.517645	325.766	29.6469	Embankment Fill	0	34	247.383	329.756	488.884	0	488.884	629.685	629.685
37	0.517645	323.035	30.7066	Embankment Fill	0	34	242.951	323.849	480.127	0	480.127	624.418	624.418
38	0.517645	319.461	31.778	Embankment Fill	0	34	237.9	317.116	470.144	0	470.144	617.522	617.522
39	0.517645	310.658	32.8621	Embankment Fill	0	34	229.012	305.268	452.579	0	452.579	600.518	600.518
40	0.517645	289.869	33.9596	Embankment Fill	0	34	211.474	281.89	417.92	0	417.92	560.343	560.343
41	0.517645	267.594	35.0714	Embankment Fill	0	34	193.143	257.456	381.694	0	381.694	517.293	517.293
42	0.517645	244.341	36.1986	Embankment Fill	0	34	174.423	232.503	344.699	0	344.699	472.351	472.351
43	0.517645	220.068	37.3422	Embankment Fill	0	34	234.972	313.213	464.357	0	464.357	643.632	643.632
44	0.517645	194.729	38.5036	Embankment Fill	0	34	226.105	301.393	446.833	0	446.833	626.708	626.708
45	0.517645	168.271	39.684	Embankment Fill	0	34	205.124	273.426	405.371	0	405.371	575.572	575.572
46	0.517645	140.637	40.885	Embankment Fill	0	34	183.73	244.908	363.091	0	363.091	522.158	522.158
47	0.517645	111.762	42.1082	Embankment Fill	0	34	161.922	215.839	319.995	0	319.995	466.345	466.345
48	0.517645	81.5741	43.3554	Embankment Fill	0	34	139.704	186.222	276.085	0	276.085	407.99	407.99
49	0.517645	49.9911	44.6289	Embankment Fill	0	34	117.075	156.059	231.366	0	231.366	346.935	346.935
50	0.517645	16.92	45.931	Embankment Fill	0	34	94.0434	125.358	185.851	0	185.851	283.001	283.001

Global Minimum Query (spencer) - Safety Factor: 1.3371

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	0.517645	9.46333	-3.72278	Embankment Fill	0	34	12.9749	17.3488	25.7208	0	25.7208	24.8766	24.8766
2	0.517645	28.1209	-2.80524	Embankment Fill	0	34	37.7062	50.417	74.7463	0	74.7463	72.8987	72.8987
3	0.517645	46.241	-1.88842	Embankment Fill	0	34	60.6587	81.1068	120.246	0	120.246	118.246	118.246
4	0.517645	63.8247	-0.972089	Embankment Fill	0	34	81.9385	109.56	162.429	0	162.429	161.038	161.038
5	0.517645	80.8725	-0.0560029	Embankment Fill	0	34	101.642	135.905	201.487	0	201.487	201.388	201.388
6	0.517645	97.3847	0.860069	Embankment Fill	0	34	119.858	160.262	237.597	0	237.597	239.397	239.397
7	0.517645	113.361	1.77636	Embankment Fill	0	34	136.668	182.739	270.922	0	270.922	275.161	275.161
8	0.517645	128.801	2.69311	Embankment Fill	0	34	152.147	203.436	301.607	0	301.607	308.764	308.764
9	0.517645	143.704	3.61055	Embankment Fill	0	34	166.365	222.446	329.788	0	329.788	340.286	340.286
10	0.517645	158.068	4.52891	Embankment Fill	0	34	179.383	239.853	355.596	0	355.596	369.805	369.805
11	0.517645	171.892	5.44845	Embankment Fill	0	34	191.262	255.736	379.144	0	379.144	397.387	397.387
12	0.517645	185.172	6.36939	Embankment Fill	0	34	202.054	270.167	400.539	0	400.539	423.094	423.094
13	0.517645	197.907	7.29199	Embankment Fill	0	34	211.813	283.215	419.884	0	419.884	446.987	446.987
14	0.517645	210.093	8.21649	Embankment Fill	0	34	220.582	294.94	437.267	0	437.267	469.119	469.119
15	0.517645	221.727	9.14316	Embankment Fill	0	34	228.406	305.402	452.777	0	452.777	489.538	489.538
16	0.517645	232.804	10.0722	Embankment Fill	0	34	235.325	314.653	466.491	0	466.491	508.292	508.292
17	0.517645	243.32	11.004	Embankment Fill	0	34	241.376	322.744	478.487	0	478.487	525.424	525.424
18	0.517645	253.269	11.9387	Embankment Fill	0	34	246.594	329.721	488.832	0	488.832	540.972	540.972
19	0.517645	262.647	12.8767	Embankment Fill	0	34	251.012	335.628	497.589	0	497.589	554.97	554.97
20	0.517645	271.447	13.8182	Embankment Fill	0	34	254.659	340.505	504.82	0	504.82	567.456	567.456
21	0.517645	279.661	14.7635	Embankment Fill	0	34	257.566	344.391	510.58	0	510.58	578.456	578.456
22	0.517645	287.284	15.7129	Embankment Fill	0	34	259.757	347.321	514.925	0	514.925	588.003	588.003
23	0.517645	294.306	16.6668	Embankment Fill	0	34	261.257	349.327	517.9	0	517.9	596.116	596.116
24	0.517645	300.718	17.6255	Embankment Fill	0	34	262.091	350.442	519.552	0	519.552	602.821	602.821
25	0.517645	306.512	18.5893	Embankment Fill	0	34	262.279	350.693	519.925	0	519.925	608.137	608.137
26	0.517645	311.677	19.5586	Embankment Fill	0	34	261.843	350.11	519.059	0	519.059	612.083	612.083
27	0.517645	316.202	20.5337	Embankment Fill	0	34	260.8	348.716	516.992	0	516.992	614.676	614.676
28	0.517645	320.074	21.5151	Embankment Fill	0	34	259.17	346.536	513.761	0	513.761	615.93	615.93
29	0.517645	323.282	22.5032	Embankment Fill	0	34	256.969	343.593	509.398	0	509.398	615.855	615.855
30	0.517645	325.81	23.4984	Embankment Fill	0	34	254.213	339.908	503.934	0	503.934	614.46	614.46
31	0.517645	327.643	24.5011	Embankment Fill	0	34	250.917	335.501	497.402	0	497.402	611.757	611.757
32	0.517645	328.765	25.5119	Embankment Fill	0	34	247.096	330.392	489.826	0	489.826	607.748	607.748
33	0.517645	329.159	26.5314	Embankment Fill	0	34	242.762	324.597	481.234	0	481.234	602.437	602.437

34	0.517645	328.804	27.5599	Embankment Fill	0	34	237.928	318.134	471.653	0	471.653	595.827	595.827
35	0.517645	327.681	28.5982	Embankment Fill	0	34	232.606	311.018	461.102	0	461.102	587.914	587.914
36	0.517645	325.766	29.6469	Embankment Fill	0	34	226.807	303.264	449.608	0	449.608	578.697	578.697
37	0.517645	323.035	30.7066	Embankment Fill	0	34	220.542	294.887	437.187	0	437.187	568.17	568.17
38	0.517645	319.461	31.778	Embankment Fill	0	34	213.82	285.899	423.862	0	423.862	556.323	556.323
39	0.517645	310.658	32.8621	Embankment Fill	0	34	203.793	272.492	403.985	0	403.985	535.634	535.634
40	0.517645	289.869	33.9596	Embankment Fill	0	34	186.32	249.129	369.349	0	369.349	494.832	494.832
41	0.517645	267.594	35.0714	Embankment Fill	0	34	168.48	225.274	333.982	0	333.982	452.266	452.266
42	0.517645	244.341	36.1986	Embankment Fill	0	34	150.635	201.414	298.609	0	298.609	408.852	408.852
43	0.517645	220.068	37.3422	Embankment Fill	0	34	204.801	273.839	405.982	0	405.982	562.237	562.237
44	0.517645	194.729	38.5036	Embankment Fill	0	34	195.747	261.733	388.035	0	388.035	543.759	543.759
45	0.517645	168.271	39.684	Embankment Fill	0	34	176.132	235.506	349.152	0	349.152	495.296	495.296
46	0.517645	140.637	40.885	Embankment Fill	0	34	156.54	209.31	310.314	0	310.314	445.842	445.842
47	0.517645	111.762	42.1082	Embankment Fill	0	34	136.978	183.153	271.535	0	271.535	395.339	395.339
48	0.517645	81.5741	43.3554	Embankment Fill	0	34	117.452	157.045	232.829	0	232.829	343.724	343.724
49	0.517645	49.9911	44.6289	Embankment Fill	0	34	97.9732	131	194.215	0	194.215	290.927	290.927
50	0.517645	16.92	45.931	Embankment Fill	0	34	79.0277	105.668	156.659	0	156.659	238.298	238.298

Interslice Data

Global Minimum Query (bishop simplified) - Safety Factor: 1.33298

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	59.194	-4.903	0	0	0
2	59.7116	-4.93668	4.62879	0	0
3	60.2293	-4.96204	17.7826	0	0
4	60.7469	-4.97911	38.4424	0	0
5	61.2646	-4.98789	65.6438	0	0
6	61.7822	-4.9884	98.4734	0	0
7	62.2999	-4.98063	136.066	0	0
8	62.8175	-4.96458	177.602	0	0
9	63.3352	-4.94023	222.304	0	0
10	63.8528	-4.90756	269.437	0	0
11	64.3705	-4.86656	318.304	0	0
12	64.8881	-4.81719	368.244	0	0
13	65.4057	-4.7594	418.634	0	0
14	65.9234	-4.69317	468.882	0	0
15	66.441	-4.61842	518.431	0	0
16	66.9587	-4.53511	566.755	0	0
17	67.4763	-4.44316	613.357	0	0
18	67.994	-4.3425	657.771	0	0
19	68.5116	-4.23305	699.559	0	0
20	69.0293	-4.11472	738.313	0	0
21	69.5469	-3.9874	773.65	0	0
22	70.0646	-3.85098	805.216	0	0
23	70.5822	-3.70535	832.684	0	0
24	71.0998	-3.55038	855.751	0	0
25	71.6175	-3.38592	874.144	0	0
26	72.1351	-3.21182	887.616	0	0
27	72.6528	-3.02791	895.945	0	0
28	73.1704	-2.83403	898.938	0	0
29	73.6881	-2.62996	896.43	0	0
30	74.2057	-2.41551	888.283	0	0
31	74.7234	-2.19045	874.388	0	0
32	75.241	-1.95454	854.666	0	0
33	75.7587	-1.7075	829.072	0	0
34	76.2763	-1.44906	797.589	0	0
35	76.7939	-1.1789	760.237	0	0
36	77.3116	-0.896691	717.071	0	0
37	77.8292	-0.602067	668.185	0	0
38	78.3469	-0.294631	613.714	0	0
39	78.8645	0.0260481	553.834	0	0
40	79.3822	0.360442	489.671	0	0
41	79.8998	0.709067	424.174	0	0
42	80.4175	1.07249	358.422	0	0
43	80.9351	1.45133	293.459	0	0
44	81.4528	1.84627	209.378	0	0
45	81.9704	2.25808	122.637	0	0
46	82.488	2.68759	37.6065	0	0
47	83.0057	3.13575	-44.3179	0	0
48	83.5233	3.60361	-121.605	0	0
49	84.041	4.09237	-192.568	0	0
50	84.5586	4.60335	-255.344	0	0
51	85.0763	5.1381	0	0	0

Global Minimum Query (spencer) - Safety Factor: 1.3371

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	59.194	-4.903	0	0	0
2	59.7116	-4.93668	6.65951	3.64405	28.6873
3	60.2293	-4.96204	25.3289	13.8598	28.6872
4	60.7469	-4.97911	54.2648	29.6934	28.6872
5	61.2646	-4.98789	91.8698	50.2706	28.6872
6	61.7822	-4.9884	136.68	74.7904	28.6872
7	62.2999	-4.98063	187.352	102.518	28.6872
8	62.8175	-4.96458	242.656	132.78	28.6872
9	63.3352	-4.94023	301.461	164.958	28.6873
10	63.8528	-4.90756	362.732	198.485	28.6872
11	64.3705	-4.86656	425.521	232.843	28.6873
12	64.8881	-4.81719	488.958	267.555	28.6872
13	65.4057	-4.7594	552.249	302.187	28.6872
14	65.9234	-4.69317	614.667	336.342	28.6872
15	66.441	-4.61842	675.55	369.657	28.6872
16	66.9587	-4.53511	734.295	401.802	28.6872
17	67.4763	-4.44316	790.355	432.478	28.6872
18	67.994	-4.3425	843.236	461.414	28.6872
19	68.5116	-4.23305	892.494	488.367	28.6872
20	69.0293	-4.11472	937.729	513.12	28.6872
21	69.5469	-3.9874	978.587	535.477	28.6872
22	70.0646	-3.85098	1014.76	555.269	28.6871
23	70.5822	-3.70535	1045.96	572.346	28.6873
24	71.0998	-3.55038	1071.98	586.579	28.6871
25	71.6175	-3.38592	1092.6	597.862	28.6871
26	72.1351	-3.21182	1107.66	606.106	28.6873
27	72.6528	-3.02791	1117.04	611.24	28.6873
28	73.1704	-2.83403	1120.65	613.214	28.6873
29	73.6881	-2.62996	1118.42	611.995	28.6873
30	74.2057	-2.41551	1110.33	607.568	28.6873
31	74.7234	-2.19045	1096.38	599.933	28.6872
32	75.241	-1.95454	1076.6	589.111	28.6873
33	75.7587	-1.7075	1051.07	575.139	28.6872
34	76.2763	-1.44906	1019.88	558.072	28.6872
35	76.7939	-1.1789	983.164	537.982	28.6872
36	77.3116	-0.896691	941.091	514.959	28.6872
37	77.8292	-0.602067	893.859	489.114	28.6872
38	78.3469	-0.294631	841.703	460.575	28.6872
39	78.8645	0.0260481	784.897	429.491	28.6872
40	79.3822	0.360442	724.596	396.495	28.6872
41	79.8998	0.709067	663.625	363.132	28.6872
42	80.4175	1.07249	603.002	329.959	28.6872
43	80.9351	1.45133	543.687	297.502	28.6872
44	81.4528	1.84627	467.718	255.933	28.6873
45	81.9704	2.25808	390.126	213.475	28.6873
46	82.488	2.68759	314.821	172.268	28.6872
47	83.0057	3.13575	242.997	132.967	28.6873
48	83.5233	3.60361	175.929	96.2676	28.6873
49	84.041	4.09237	114.984	62.9187	28.6873
50	84.5586	4.60335	61.6341	33.7258	28.6872
51	85.0763	5.1381	0	0	0

Discharge Sections

Entity Information

Distributed Load

X	Y
1.99441	0.954673
42.0063	0.0453111

Distributed Load

X	Y
81.0014	5.04549
121.001	5.95458

External Boundary

X	Y
0	1
0	-24.912
123	-24.912
123	6
79	5
59	-5
44	0

APPENDIX D

Bearing Resistance Calculations

Project:	I-15 TCL MP 70.7 to 71.9	Project No:	475.0464.002
Structure:	B-690S Wingwall		
Stationing:	"XW" 290+00		
Borings	21-BH-30		

Ground surface elevation (ft)	2083.63
Footing elevation (ft)	2082.63
Boring elevation (ft)	2088
Depth to groundwater (ft)	200

Groundwater elevation (ft) 1888
Depth of groundwater below footing (ft) 194.63

Bearing Pressure Calculations (AASHTO LRFDBDS, 2020)

Load Case	Calculated Values		
Strength I	q_n 5.70	q_R	2.57
qr is less than the gross bearing demand.			

10.6.3.1.1-1	$q_R = \emptyset_R q_n$		
10.6.3.1.2a-1	$q_n = cN_{cm} + \gamma D_f N_{qm} C_{wq} + 0.5\gamma B N_{ym} C_{w\gamma}$		
10.6.3.1.2a-2	$N_{cm} = N_c s_c i_c$	N_{cm}	52.18
10.6.3.1.2a-3	$N_{qm} = N_q s_q d_q i_q$	N_{qm}	43.36
10.6.3.1.2a-4	$N_{ym} = N_\gamma s_\gamma i_\gamma$	N_{ym}	50.52
10.6.3.1.2a-6	$i_c = i_q - [(1-i_q)/(N_q - 1)]$	i_c	1
10.6.3.1.2a-7	$i_q = [1-H/(V+cBL\cot\emptyset_f)]^{(n)}$	i_q	1
10.6.3.1.2a-8	$i_\gamma = [1-H/(V+cBL\cot\emptyset_f)]^{(n+1)}$	i_γ	1
10.6.3.1.2a-9	$n = [(2+L/B)/(1+L/B)]\cos^2\theta + [2+B/L)/(1+B/L)]\sin^2\theta$	n	1.65
Table 10.6.3.1.2a-3	$s_c = 1 + (B/L)(N_q/N_c)$	s_c	1.24
	$s_\gamma = 1-0.4(B/L)$	s_γ	0.86
	$s_q = 1+((B/L)\tan\emptyset_f))$	s_q	1.23

Bearing resistance (q_R) (ksf)			
Resistance factor ($\emptyset_r$)	Section 10 5.5.3		0.45
Nominal bearing resistanc (q_n) (ksf)			
Cohesion (c) (ksf)			0
Cohesion term (N_c)			42.2
Surcharge/embedment term (N_q)	Table 10.6.3.1.2a-1		29.4
Unit weight term (N_γ)	Table 10.6.3.1.2a-1		41.1
Total (moist) unit wt (γ) (kcf)	Table 10.6.3.1.2a-1		0.125
Footing embedment depth (D_f) (ft)			1
Effective Footing width (B') (ft)			4.5
Footing length (L) (ft)(based on stationing)			13.25
Correction factors for location of groundwater		(C_{wq})	1
	Table 10.6.3.1.2a-2	($C_{w\gamma}$)	1
Shearing correction factor (d_q)	Table 10.6.3.1.2a-4		1.2
Load inclination factors		(i_c)	1
		(iq)	1
		(i_γ)	1
Angle of internal friction ($\emptyset_f$) (degrees)			34
Radians			0.59

Table 10.5.5.2.2-1—Resistance Factors for Geotechnical Resistance of Shallow Foundations at the Strength Limit State

Method/Soil/Condition			Resistance Factor
Bearing Resistance	ϕ_b	Theoretical method (Munfakh et al., 2001), in clay	0.50
		Theoretical method (Munfakh et al., 2001), in sand, using *CPT*	0.50
		Theoretical method (Munfakh et al., 2001), in sand, using *SPT*	0.45
		Semi-empirical methods (Meyerhof, 1957), all soils	0.45
		Footings on rock	0.45
		Plate Load Test	0.55
Sliding	ϕ_τ	Precast concrete placed on sand	0.90
		Cast-in-Place Concrete on sand	0.80
		Cast-in-Place or precast Concrete on Clay	0.85
		Soil on soil	0.90
	ϕ_{ep}	Passive earth pressure component of sliding resistance	0.50

Table 10.6.3.1.2a-2—Coefficients C_{wq} and $C_{w\gamma}$ for Various Groundwater Depths

D_w	C_{wq}	$C_{w\gamma}$
0.0	0.5	0.5
D_f	1.0	0.5
$\geq 1.5B + D_f$	1.0	1.0

Table 10.6.3.1.2a-1—Bearing Capacity Factors N_c (Prandtl, 1921), N_q (Reissner, 1924), and N_γ (Vesic, 1975)

ϕ_f	N_c	N_q	N_γ	ϕ_f	N_c	N_q	N_γ
0	5.14	1.0	0.0	23	18.1	8.7	8.2
1	5.4	1.1	0.1	24	19.3	9.6	9.4
2	5.6	1.2	0.2	25	20.7	10.7	10.9
3	5.9	1.3	0.2	26	22.3	11.9	12.5
4	6.2	1.4	0.3	27	23.9	13.2	14.5
5	6.5	1.6	0.5	28	25.8	14.7	16.7
6	6.8	1.7	0.6	29	27.9	16.4	19.3
7	7.2	1.9	0.7	30	30.1	18.4	22.4
8	7.5	2.1	0.9	31	32.7	20.6	26.0
9	7.9	2.3	1.0	32	35.5	23.2	30.2
10	8.4	2.5	1.2	33	38.6	26.1	35.2
11	8.8	2.7	1.4	34	42.2	29.4	41.1
12	9.3	3.0	1.7	35	46.1	33.3	48.0
13	9.8	3.3	2.0	36	50.6	37.8	56.3
14	10.4	3.6	2.3	37	55.6	42.9	66.2
15	11.0	3.9	2.7	38	61.4	48.9	78.0
16	11.6	4.3	3.1	39	67.9	56.0	92.3
17	12.3	4.8	3.5	40	75.3	64.2	109.4
18	13.1	5.3	4.1	41	83.9	73.9	130.2
19	13.9	5.8	4.7	42	93.7	85.4	155.6
20	14.8	6.4	5.4	43	105.1	99.0	186.5
21	15.8	7.1	6.2	44	118.4	115.3	224.6
22	16.9	7.8	7.1	45	133.9	134.9	271.8

Table 10.6.3.1.2a-4—Depth Correction Factor d_q

Friction Angle, ϕ_f (degrees)	D_f/B	d_q
32	1	1.20
	2	1.30
	4	1.35
	8	1.40
37	1	1.20
	2	1.25
	4	1.30
	8	1.35
42	1	1.15
	2	1.20
	4	1.25
	8	1.30

Project:	I-15 TCL MP 70.7 to 71.9	Project No:	475.0464.002
Structure:	B-690S Wingwall		
Stationing:	"XW" 290+00		
Borings	21-BH-30		

Ground surface elevation (ft)	2083.63
Footing elevation (ft)	2082.63
Boring elevation (ft)	2088
Depth to groundwater (ft)	200

Groundwater elevation (ft) 1888
Depth of groundwater below footing (ft) 194.63

Bearing Pressure Calculations (AASHTO LRFDBDS, 2020)

Load Case	Calculated Values		
Extreme	q_n	5.70	q_R 5.70
qr is greater than the gross bearing demand.			

10.6.3.1.1-1	$q_R = \emptyset_R q_n$		
10.6.3.1.2a-1	$q_n = cN_{cm} + \gamma D_f N_{qm} C_{wq} + 0.5\gamma B N_{ym} C_{w\gamma}$		
10.6.3.1.2a-2	$N_{cm} = N_c s_c i_c$	N_{cm}	52.18
10.6.3.1.2a-3	$N_{qm} = N_q s_q d_q i_q$	N_{qm}	43.36
10.6.3.1.2a-4	$N_{ym} = N_\gamma s_\gamma i_\gamma$	N_{ym}	50.52
10.6.3.1.2a-6	$i_c = i_q - [(1-i_q)/(N_q - 1)]$	i_c	1
10.6.3.1.2a-7	$i_q = [1-H/(V+cBL\cot\emptyset_f)]^{(n)}$	i_q	1
10.6.3.1.2a-8	$i_\gamma = [1-H/(V+cBL\cot\emptyset_f)]^{(n+1)}$	i_γ	1
10.6.3.1.2a-9	$n = [(2+L/B)/(1+L/B)]\cos^2\theta + [2+B/L)/(1+B/L)]\sin^2\theta$	n	1.65
Table 10.6.3.1.2a-3	$s_c = 1 + (B/L)(N_q/N_c)$	s_c	1.24
	$s_\gamma = 1-0.4(B/L)$	s_γ	0.86
	$s_q = 1+((B/L)\tan\emptyset_f))$	s_q	1.23

Bearing resistance (q_R) (ksf)			
Resistance factor ($\emptyset_r$)	Section 10 5.5.3		1
Nominal bearing resistanc (q_n) (ksf)			
Cohesion (c) (ksf)			0
Cohesion term (N_c)			42.2
Surcharge/embedment term (N_q)	Table 10.6.3.1.2a-1		29.4
Unit weight term (N_γ)	Table 10.6.3.1.2a-1		41.1
Total (moist) unit wt (γ) (kcf)	Table 10.6.3.1.2a-1		0.125
Footing embedment depth (D_f) (ft)			1
Effective Footing width (B') (ft)			4.5
Footing length (L) (ft)(based on stationing)			13.25
Correction factors for location of groundwater		(C_{wq})	1
	Table 10.6.3.1.2a-2	($C_{w\gamma}$)	1
Shearing correction factor (d_q)	Table 10.6.3.1.2a-4		1.2
Load inclination factors		(i_c)	1
		(iq)	1
		(i_γ)	1
Angle of internal friction ($\emptyset_f$) (degrees)			34
Radians			0.59

Table 10.5.5.2.2-1—Resistance Factors for Geotechnical Resistance of Shallow Foundations at the Strength Limit State

Method/Soil/Condition			Resistance Factor
Bearing Resistance	φ_b	Theoretical method (Munfakh et al., 2001), in clay	0.50
		Theoretical method (Munfakh et al., 2001), in sand, using *CPT*	0.50
		Theoretical method (Munfakh et al., 2001), in sand, using *SPT*	0.45
		Semi-empirical methods (Meyerhof, 1957), all soils	0.45
		Footings on rock	0.45
		Plate Load Test	0.55
Sliding	φ_τ	Precast concrete placed on sand	0.90
		Cast-in-Place Concrete on sand	0.80
		Cast-in-Place or precast Concrete on Clay	0.85
		Soil on soil	0.90
	φ_{ep}	Passive earth pressure component of sliding resistance	0.50

Table 10.6.3.1.2a-2—Coefficients C_{wq} and $C_{w\gamma}$ for Various Groundwater Depths

D_w	C_{wq}	$C_{w\gamma}$
0.0	0.5	0.5
D_f	1.0	0.5
$\geq 1.5B + D_f$	1.0	1.0

Table 10.6.3.1.2a-1—Bearing Capacity Factors N_c (Prandtl, 1921), N_q (Reissner, 1924), and N_γ (Vesic, 1975)

ϕ_f	N_c	N_q	N_γ	ϕ_f	N_c	N_q	N_γ
0	5.14	1.0	0.0	23	18.1	8.7	8.2
1	5.4	1.1	0.1	24	19.3	9.6	9.4
2	5.6	1.2	0.2	25	20.7	10.7	10.9
3	5.9	1.3	0.2	26	22.3	11.9	12.5
4	6.2	1.4	0.3	27	23.9	13.2	14.5
5	6.5	1.6	0.5	28	25.8	14.7	16.7
6	6.8	1.7	0.6	29	27.9	16.4	19.3
7	7.2	1.9	0.7	30	30.1	18.4	22.4
8	7.5	2.1	0.9	31	32.7	20.6	26.0
9	7.9	2.3	1.0	32	35.5	23.2	30.2
10	8.4	2.5	1.2	33	38.6	26.1	35.2
11	8.8	2.7	1.4	34	42.2	29.4	41.1
12	9.3	3.0	1.7	35	46.1	33.3	48.0
13	9.8	3.3	2.0	36	50.6	37.8	56.3
14	10.4	3.6	2.3	37	55.6	42.9	66.2
15	11.0	3.9	2.7	38	61.4	48.9	78.0
16	11.6	4.3	3.1	39	67.9	56.0	92.3
17	12.3	4.8	3.5	40	75.3	64.2	109.4
18	13.1	5.3	4.1	41	83.9	73.9	130.2
19	13.9	5.8	4.7	42	93.7	85.4	155.6
20	14.8	6.4	5.4	43	105.1	99.0	186.5
21	15.8	7.1	6.2	44	118.4	115.3	224.6
22	16.9	7.8	7.1	45	133.9	134.9	271.8

Table 10.6.3.1.2a-4—Depth Correction Factor d_q

Friction Angle, ϕ_f (degrees)	D_f/B	d_q
32	1	1.20
	2	1.30
	4	1.35
	8	1.40
37	1	1.20
	2	1.25
	4	1.30
	8	1.35
42	1	1.15
	2	1.20
	4	1.25
	8	1.30

Project:	I-15 TCL MP 70.7 to 71.9	Project No:	475.0464.002
Structure:	B-690S Extension		
Stationing:	"XW" 290+00		
Borings	21-BH-30		

Ground surface elevation (ft)	2083.63
Footing elevation (ft)	2082.63
Boring elevation (ft)	2088
Depth to groundwater (ft)	200

Groundwater elevation (ft) 1888
Depth of groundwater below footing (ft) 194.63

Bearing Pressure Calculations (AASHTO LRFDBDS, 2020)

Load Case	Calculated Values		
Strength I	q_n 9.34	q_R	4.20
qr is less than the gross bearing demand.			

10.6.3.1.1-1	$q_R = \emptyset_R q_n$		
10.6.3.1.2a-1	$q_n = cN_{cm} + \gamma D_f N_{qm} C_{wq} + 0.5\gamma B N_{ym} C_{w\gamma}$		
10.6.3.1.2a-2	$N_{cm} = N_c s_c i_c$	N_{cm}	63.76
10.6.3.1.2a-3	$N_{qm} = N_q s_q d_q i_q$	N_{qm}	52.73
10.6.3.1.2a-4	$N_{ym} = N_\gamma s_\gamma i_\gamma$	N_{ym}	61.43
10.6.3.1.2a-6	$i_c = i_q - [(1-i_q)/(N_q - 1)]$	i_c	1
10.6.3.1.2a-7	$i_q = [1-H/(V+cBL\cot\emptyset_f)]^{(n)}$	i_q	1
10.6.3.1.2a-8	$i_\gamma = [1-H/(V+cBL\cot\emptyset_f)]^{(n+1)}$	i_γ	1
10.6.3.1.2a-9	$n = [(2+L/B)/(1+L/B)]\cos^2\theta + [2+B/L)/(1+B/L)]\sin^2\theta$	n	1.55
Table 10.6.3.1.2a-3	$s_c = 1 + (B/L)(N_q/N_c)$	s_c	1.51
	$s_\gamma = 1-0.4(B/L)$	s_γ	0.71
	$s_q = 1+((B/L)\tan\emptyset_f))$	s_q	1.49

Bearing resistance (q_R) (ksf)			
Resistance factor ($\emptyset_r$)	Section 10 5.5.3		0.45
Nominal bearing resistanc (q_n) (ksf)			
Cohesion (c) (ksf)			0
Cohesion term (N_c)			42.2
Surcharge/embedment term (N_q)	Table 10.6.3.1.2a-1		29.4
Unit weight term (N_γ)	Table 10.6.3.1.2a-1		41.1
Total (moist) unit wt (γ) (kcf)	Table 10.6.3.1.2a-1		0.125
Footing embedment depth (D_f) (ft)			1
Effective Footing width (B') (ft)			44
Footing length (L) (ft)(based on stationing)			60
Correction factors for location of groundwater		(C_{wq})	1
	Table 10.6.3.1.2a-2	($C_{w\gamma}$)	1
Shearing correction factor (d_q)	Table 10.6.3.1.2a-4		1.2
Load inclination factors		(i_c)	1
		(iq)	1
		(i_γ)	1
Angle of internal friction ($\emptyset_f$) (degrees)			34
Radians			0.59

Table 10.5.5.2.2-1—Resistance Factors for Geotechnical Resistance of Shallow Foundations at the Strength Limit State

Method/Soil/Condition			Resistance Factor
Bearing Resistance	φ_b	Theoretical method (Munfakh et al., 2001), in clay	0.50
		Theoretical method (Munfakh et al., 2001), in sand, using *CPT*	0.50
		Theoretical method (Munfakh et al., 2001), in sand, using *SPT*	0.45
		Semi-empirical methods (Meyerhof, 1957), all soils	0.45
		Footings on rock	0.45
		Plate Load Test	0.55
Sliding	φ_τ	Precast concrete placed on sand	0.90
		Cast-in-Place Concrete on sand	0.80
		Cast-in-Place or precast Concrete on Clay	0.85
		Soil on soil	0.90
	φ_{ep}	Passive earth pressure component of sliding resistance	0.50

Table 10.6.3.1.2a-2—Coefficients C_{wq} and $C_{w\gamma}$ for Various Groundwater Depths

D_w	C_{wq}	$C_{w\gamma}$
0.0	0.5	0.5
D_f	1.0	0.5
$\geq 1.5B + D_f$	1.0	1.0

Table 10.6.3.1.2a-1—Bearing Capacity Factors N_c (Prandtl, 1921), N_q (Reissner, 1924), and N_γ (Vesic, 1975)

ϕ_f	N_c	N_q	N_γ	ϕ_f	N_c	N_q	N_γ
0	5.14	1.0	0.0	23	18.1	8.7	8.2
1	5.4	1.1	0.1	24	19.3	9.6	9.4
2	5.6	1.2	0.2	25	20.7	10.7	10.9
3	5.9	1.3	0.2	26	22.3	11.9	12.5
4	6.2	1.4	0.3	27	23.9	13.2	14.5
5	6.5	1.6	0.5	28	25.8	14.7	16.7
6	6.8	1.7	0.6	29	27.9	16.4	19.3
7	7.2	1.9	0.7	30	30.1	18.4	22.4
8	7.5	2.1	0.9	31	32.7	20.6	26.0
9	7.9	2.3	1.0	32	35.5	23.2	30.2
10	8.4	2.5	1.2	33	38.6	26.1	35.2
11	8.8	2.7	1.4	34	42.2	29.4	41.1
12	9.3	3.0	1.7	35	46.1	33.3	48.0
13	9.8	3.3	2.0	36	50.6	37.8	56.3
14	10.4	3.6	2.3	37	55.6	42.9	66.2
15	11.0	3.9	2.7	38	61.4	48.9	78.0
16	11.6	4.3	3.1	39	67.9	56.0	92.3
17	12.3	4.8	3.5	40	75.3	64.2	109.4
18	13.1	5.3	4.1	41	83.9	73.9	130.2
19	13.9	5.8	4.7	42	93.7	85.4	155.6
20	14.8	6.4	5.4	43	105.1	99.0	186.5
21	15.8	7.1	6.2	44	118.4	115.3	224.6
22	16.9	7.8	7.1	45	133.9	134.9	271.8

Table 10.6.3.1.2a-4—Depth Correction Factor d_q

Friction Angle, ϕ_f (degrees)	D_f/B	d_q
32	1	1.20
	2	1.30
	4	1.35
	8	1.40
37	1	1.20
	2	1.25
	4	1.30
	8	1.35
42	1	1.15
	2	1.20
	4	1.25
	8	1.30

Project:	I-15 TCL MP 70.7 to 71.9	Project No:	475.0464.002
Structure:	B-690S Extension		
Stationing:	"XW" 290+00		
Borings	21-BH-30		

Ground surface elevation (ft)	2083.63
Footing elevation (ft)	2082.63
Boring elevation (ft)	2088
Depth to groundwater (ft)	200

Groundwater elevation (ft) 1888
Depth of groundwater below footing (ft) 194.63

Bearing Pressure Calculations (AASHTO LRFDBDS, 2020)

Load Case	Calculated Values		
Extreme	q_n	9.34	q_R 9.34
qr is greater than the gross bearing demand.			

10.6.3.1.1-1	$q_R = \emptyset_R q_n$		
10.6.3.1.2a-1	$q_n = cN_{cm} + \gamma D_f N_{qm} C_{wq} + 0.5\gamma B N_{ym} C_{w\gamma}$		
10.6.3.1.2a-2	$N_{cm} = N_c s_c i_c$	N_{cm}	63.76
10.6.3.1.2a-3	$N_{qm} = N_q s_q d_q i_q$	N_{qm}	52.73
10.6.3.1.2a-4	$N_{ym} = N_\gamma s_\gamma i_\gamma$	N_{ym}	61.43
10.6.3.1.2a-6	$i_c = i_q - [(1-i_q)/(N_q - 1)]$	i_c	1
10.6.3.1.2a-7	$i_q = [1-H/(V+cBL\cot\emptyset_f)]^{(n)}$	i_q	1
10.6.3.1.2a-8	$i_\gamma = [1-H/(V+cBL\cot\emptyset_f)]^{(n+1)}$	i_γ	1
10.6.3.1.2a-9	$n = [(2+L/B)/(1+L/B)]\cos^2\theta + [2+B/L)/(1+B/L)]\sin^2\theta$	n	1.55
Table 10.6.3.1.2a-3	$s_c = 1 + (B/L)(N_q/N_c)$	s_c	1.51
	$s_\gamma = 1-0.4(B/L)$	s_γ	0.71
	$s_q = 1+((B/L)\tan\emptyset_f))$	s_q	1.49

Bearing resistance (q_R) (ksf)			
Resistance factor ($\emptyset_r$)	Section 10 5.5.3		1
Nominal bearing resistanc (q_n) (ksf)			
Cohesion (c) (ksf)			0
Cohesion term (N_c)			42.2
Surcharge/embedment term (N_q)	Table 10.6.3.1.2a-1		29.4
Unit weight term (N_γ)	Table 10.6.3.1.2a-1		41.1
Total (moist) unit wt (γ) (kcf)	Table 10.6.3.1.2a-1		0.125
Footing embedment depth (D_f) (ft)			1
Effective Footing width (B') (ft)			44
Footing length (L) (ft)(based on stationing)			60
Correction factors for location of groundwater		(C_{wq})	1
	Table 10.6.3.1.2a-2	($C_{w\gamma}$)	1
Shearing correction factor (d_q)	Table 10.6.3.1.2a-4		1.2
Load inclination factors		(i_c)	1
		(iq)	1
		(i_γ)	1
Angle of internal friction ($\emptyset_f$) (degrees)			34
Radians			0.59

Table 10.5.5.2.2-1—Resistance Factors for Geotechnical Resistance of Shallow Foundations at the Strength Limit State

Method/Soil/Condition			Resistance Factor
Bearing Resistance	φ_b	Theoretical method (Munfakh et al., 2001), in clay	0.50
		Theoretical method (Munfakh et al., 2001), in sand, using *CPT*	0.50
		Theoretical method (Munfakh et al., 2001), in sand, using *SPT*	0.45
		Semi-empirical methods (Meyerhof, 1957), all soils	0.45
		Footings on rock	0.45
		Plate Load Test	0.55
Sliding	φ_τ	Precast concrete placed on sand	0.90
		Cast-in-Place Concrete on sand	0.80
		Cast-in-Place or precast Concrete on Clay	0.85
		Soil on soil	0.90
	φ_{ep}	Passive earth pressure component of sliding resistance	0.50

Table 10.6.3.1.2a-2—Coefficients C_{wq} and $C_{w\gamma}$ for Various Groundwater Depths

D_w	C_{wq}	$C_{w\gamma}$
0.0	0.5	0.5
D_f	1.0	0.5
$\geq 1.5B + D_f$	1.0	1.0

Table 10.6.3.1.2a-1—Bearing Capacity Factors N_c (Prandtl, 1921), N_q (Reissner, 1924), and N_γ (Vesic, 1975)

ϕ_f	N_c	N_q	N_γ	ϕ_f	N_c	N_q	N_γ
0	5.14	1.0	0.0	23	18.1	8.7	8.2
1	5.4	1.1	0.1	24	19.3	9.6	9.4
2	5.6	1.2	0.2	25	20.7	10.7	10.9
3	5.9	1.3	0.2	26	22.3	11.9	12.5
4	6.2	1.4	0.3	27	23.9	13.2	14.5
5	6.5	1.6	0.5	28	25.8	14.7	16.7
6	6.8	1.7	0.6	29	27.9	16.4	19.3
7	7.2	1.9	0.7	30	30.1	18.4	22.4
8	7.5	2.1	0.9	31	32.7	20.6	26.0
9	7.9	2.3	1.0	32	35.5	23.2	30.2
10	8.4	2.5	1.2	33	38.6	26.1	35.2
11	8.8	2.7	1.4	34	42.2	29.4	41.1
12	9.3	3.0	1.7	35	46.1	33.3	48.0
13	9.8	3.3	2.0	36	50.6	37.8	56.3
14	10.4	3.6	2.3	37	55.6	42.9	66.2
15	11.0	3.9	2.7	38	61.4	48.9	78.0
16	11.6	4.3	3.1	39	67.9	56.0	92.3
17	12.3	4.8	3.5	40	75.3	64.2	109.4
18	13.1	5.3	4.1	41	83.9	73.9	130.2
19	13.9	5.8	4.7	42	93.7	85.4	155.6
20	14.8	6.4	5.4	43	105.1	99.0	186.5
21	15.8	7.1	6.2	44	118.4	115.3	224.6
22	16.9	7.8	7.1	45	133.9	134.9	271.8

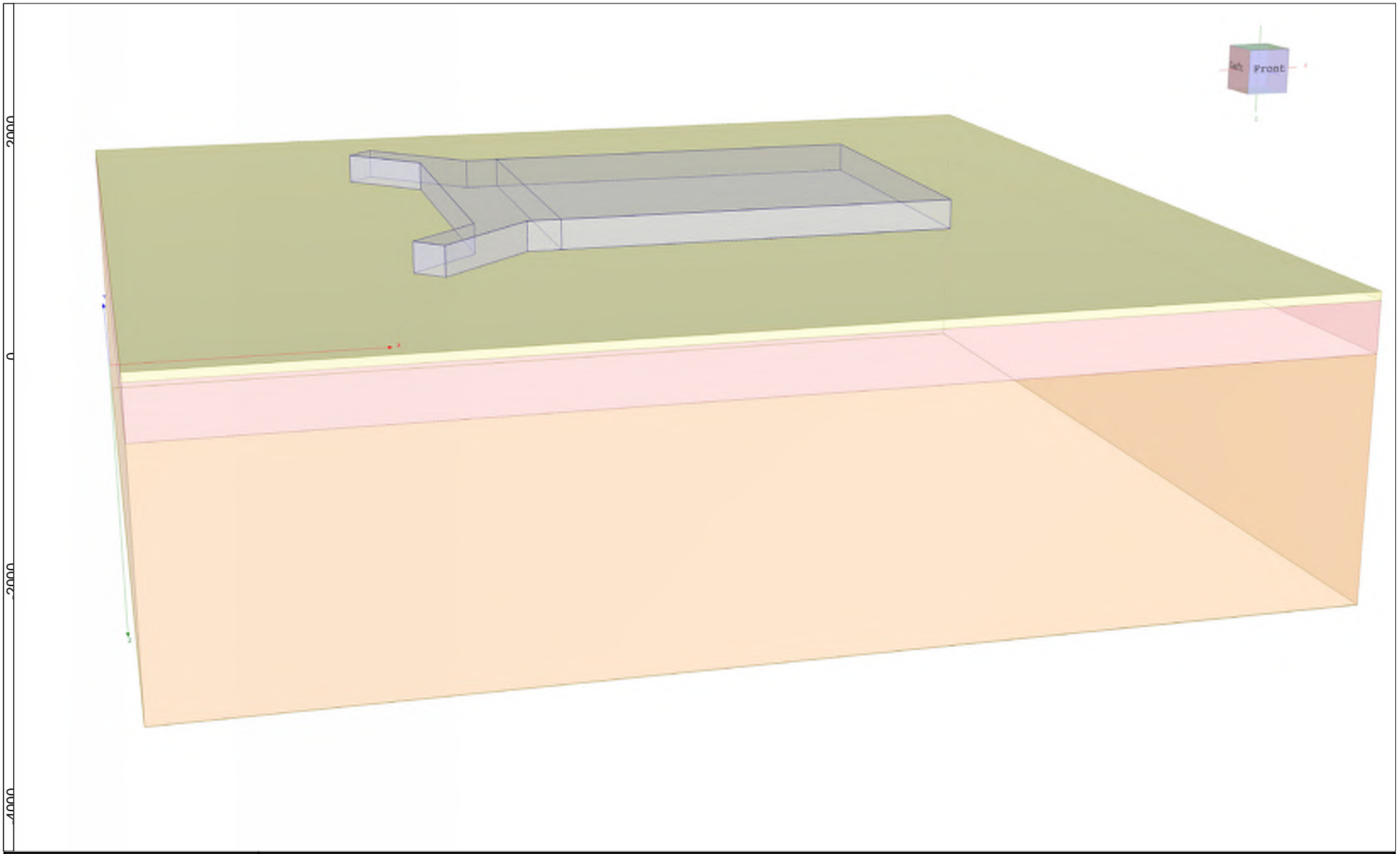
Table 10.6.3.1.2a-4—Depth Correction Factor d_q

Friction Angle, ϕ_f (degrees)	D_f/B	d_q
32	1	1.20
	2	1.30
	4	1.35
	8	1.40
37	1	1.20
	2	1.25
	4	1.30
	8	1.35
42	1	1.15
	2	1.20
	4	1.25
	8	1.30

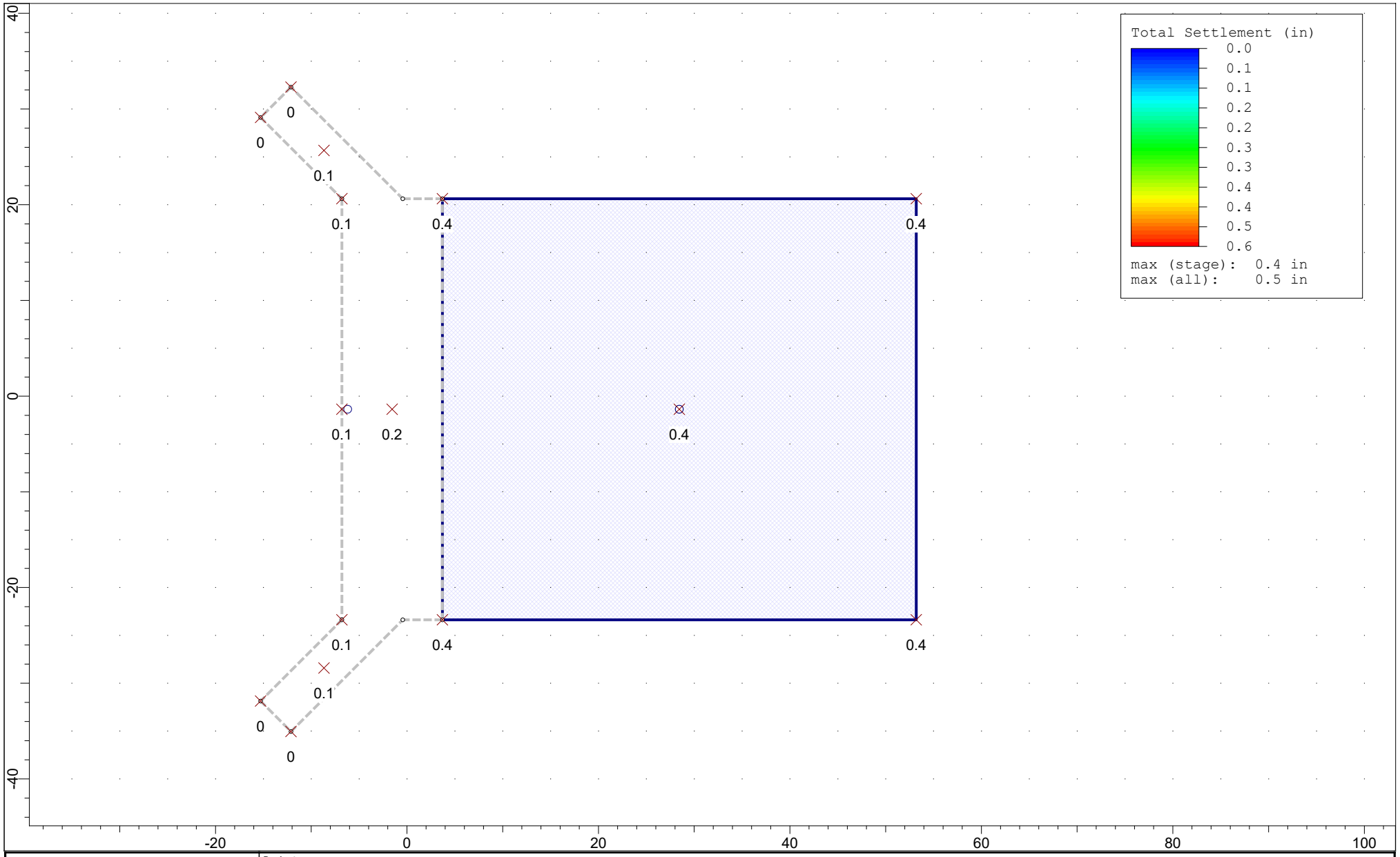
NewFields

APPENDIX F

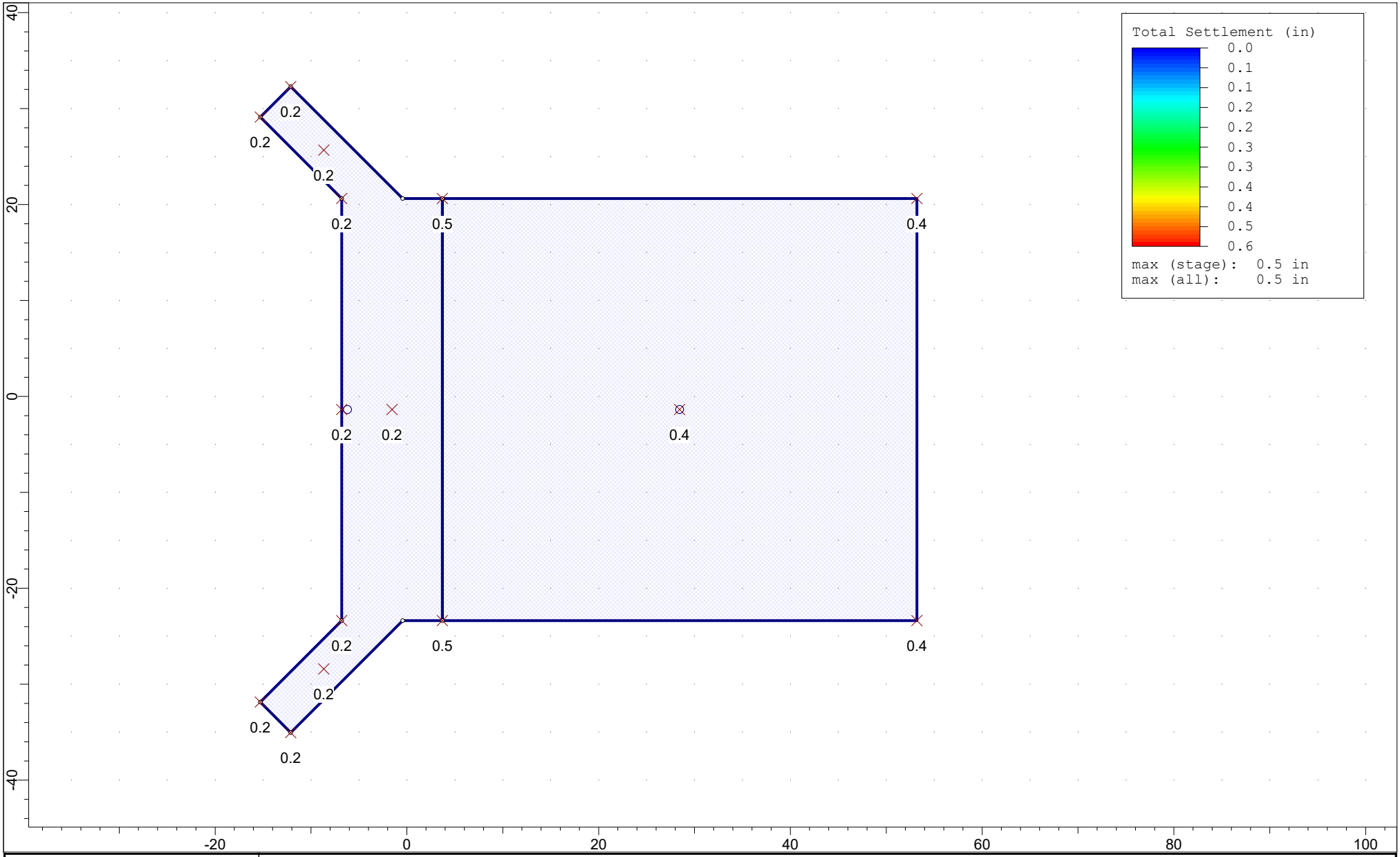
SETTLE3 Results



NewFields	Project	I-15 TCL MP CL 70.7 To Cl 71.9		
	Analysis Description	RCB B-690S Extension		
	Drawn By	J. Ruzicka	Scale $ModelScale	Company NewFields
SETTLE3 5.008	Date	4/18/2022		File Name RCB_Staged_Settlement_Rev0.s3z



NewFields	Project	I-15 TCL MP CL 70.7 To Cl 71.9		
	Analysis Description	RCB B-690S Extension		
	Drawn By	J. Ruzicka	Scale $ModelScale	Company NewFields
SETTLE3 5.008	Date	4/18/2022	File Name	RCB_Staged_Settlement_Rev0.s3z



NewFields	Project	I-15 TCL MP CL 70.7 To Cl 71.9		
	Analysis Description	RCB B-690S Extension		
	Drawn By	J. Ruzicka	Scale $ModelScale	Company NewFields
SETTLE3 5.008	Date	4/18/2022	File Name	RCB_Staged_Settlement_Rev0.s3z

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Settle3 Analysis Information

I-15 TCL MP CL 70.7 To Cl 71.9

Project Settings

Document Name	RCB_Staged_Settlement_Rev0.s3z
Project Title	I-15 TCL MP CL 70.7 To Cl 71.9
Analysis	RCB B-690S Extension
Author	J. Ruzicka
Company	NewFields
Date Created	4/18/2022
Stress Computation Method	Boussinesq
Minimum settlement ratio for subgrade modulus	0.9
Use average properties to calculate layered stresses	
Improve consolidation accuracy	
Ignore negative effective stresses in settlement calculations	

Stage Settings

Stage #	Name
1	Stage 1
2	Stage 2

Results

Time taken to compute: 4.28433 seconds

Stage: Stage 1

Data Type	Minimum	Maximum
Total Settlement [in]	0	0.43271
Total Consolidation Settlement [in]	0	0
Virgin Consolidation Settlement [in]	0	0
Recompression Consolidation Settlement [in]	0	0
Immediate Settlement [in]	0	0.43271
Loading Stress ZZ [ksf]	3.3633e-09	2.99062
Loading Stress XX [ksf]	-10.51	7.35856
Loading Stress YY [ksf]	-10.3243	7.31071
Total Stress ZZ [ksf]	3.3633e-09	5.37138
Total Stress XX [ksf]	-8.82355	7.63884
Total Stress YY [ksf]	-8.73159	7.59099
Modulus of Subgrade Reaction (Total) [ksf/ft]	0	109.923
Modulus of Subgrade Reaction (Immediate) [ksf/ft]	0	109.923
Modulus of Subgrade Reaction (Consolidation) [ksf/ft]	0	0
Total Strain	0	0.00155712
Degree of Consolidation [%]	0	0
Pre-consolidation Stress [ksf]	0.0065	5.37002
Over-consolidation Ratio	1	1
Void Ratio	0	0
Hydroconsolidation Settlement [in]	0	0
Undrained Shear Strength	0	0.0475579

Stage: Stage 2

Data Type	Minimum	Maximum
Total Settlement [in]	0	0.549066
Total Consolidation Settlement [in]	0	0
Virgin Consolidation Settlement [in]	0	0
Recompression Consolidation Settlement [in]	0	0
Immediate Settlement [in]	0	0.549066
Loading Stress ZZ [ksf]	0.324629	4.93498
Loading Stress XX [ksf]	-9.02475	10.8651
Loading Stress YY [ksf]	-10.2469	10.6468
Total Stress ZZ [ksf]	1.30472	5.47426
Total Stress XX [ksf]	-7.27412	11.3375
Total Stress YY [ksf]	-8.59591	11.1192
Modulus of Subgrade Reaction (Total) [ksf/ft]	0	125.175
Modulus of Subgrade Reaction (Immediate) [ksf/ft]	0	125.175
Modulus of Subgrade Reaction (Consolidation) [ksf/ft]	0	0
Total Strain	0.000308673	0.00235279
Degree of Consolidation [%]	0	0
Pre-consolidation Stress [ksf]	1.31122	5.47289
Over-consolidation Ratio	1	1
Void Ratio	0	0
Hydroconsolidation Settlement [in]	0	0
Undrained Shear Strength	0	0.0499552

Loads

1. Rectangular Load: "B690S Existing Culvert"

Length	49.5 ft
Width	44 ft
Rotation angle	0 degrees
Load Type	Rigid
Area of Load	2178 ft2
Load	2.4 ksf
Depth	0 ft
Installation Stage	Stage 1

Coordinates

X [ft]	Y [ft]
3.698	-23.379
53.198	-23.379
53.198	20.621
3.698	20.621

2. Polygonal Load: "Extension B690S"

Label	Extension B690S
Load Type	Rigid
Area of Load	590.218 ft2
Load	2.4 ksf
Depth	0 ft
Installation Stage	Stage 2

Coordinates

X [ft]	Y [ft]
-0.442	20.621
-12.112	32.291
-15.292	29.111
-6.802	20.621
-6.802	-23.379
-15.292	-31.869
-12.112	-35.049
-0.442	-23.379
3.698	-23.379
3.698	20.621

Soil Layers

Layer #	Type	Thickness [ft]	Depth [ft]
1	Fill GM	1	0
2	GC	6	1
3	CL-CH	29	7
4	Fill GM	0	36

Soil Properties

Property	Fill GM	GC	CL-CH
Color			
Unit Weight [kips/ft3]	0.13	0.13	0.12
K0	0.44	0.44	0.5
Immediate Settlement	Enabled	Enabled	Enabled
Es [ksf]	2120	2000	1000
Esur [ksf]	2120	2000	1000
Undrained Su A [kips/ft2]	0	0	0
Undrained Su S	0.2	0.2	0.2
Undrained Su m	0.8	0.8	0.8

Query Points

Point #	Query Point Name	(X,Y) Location	Number of Divisions
1	Query Point 1	-6.802, 20.621	Auto: 47
2	Query Point 2	-6.802, -23.379	Auto: 47
3	Query Point 3	-6.802, -1.37677	Auto: 47
4	Query Point 4	-1.552, -1.379	Auto: 47
5	Query Point 5	3.698, -23.379	Auto: 47
6	Query Point 6	3.698, 20.621	Auto: 47
7	Query Point 7	28.448, -1.379	Auto: 47
8	Query Point 8	53.198, 20.621	Auto: 47
9	Query Point 9	53.198, -23.379	Auto: 47
10	Query Point 10	-15.292, 29.111	Auto: 47
11	Query Point 11	-12.112, 32.291	Auto: 47
12	Query Point 12	-15.292, -31.869	Auto: 47
13	Query Point 13	-12.112, -35.049	Auto: 47
14	Query Point 14	-8.662, -28.419	Auto: 47
15	Query Point 15	-8.662, 25.661	Auto: 47

APPENDIX G

Lateral Earth Pressure Calculations

NewFields
Perspective. Vision. Solutions.

PROJECT I-15 TCL MP CL 70.7 to CL 71.9 PROJECT NO. 475.0464.002
SUBJECT RCB Extension Lateral Earth Pressure SHEET NO. 1 of 2
DESIGNED R. Berg DATE 3/29/22 CHECKED [illegible] DATE

At rest Lateral Earth pressure Coefficient = K_o

$K_o = 1 - \sin \phi'_f$ (AASHTO LRDF 2020 (3.11.5.2-1))

$\phi_f = 34°$ based on Spt blow count corrections for 21-BH-30

$K_o = 1 - \sin 34 = \boxed{0.44 = K_o}$

Active Lateral Earth Pressure Coefficient = K_a

$$K_a = \frac{\sin^2(\theta + \phi'_f)}{\tau \left[\sin^2\theta \sin(\theta - \delta)\right]}$$ (AASHTO LRDF 2020 (3.11.5.3-1))

$$\tau = \left[1 + \sqrt{\frac{\sin(\phi'_f + \delta)\sin(\phi'_f - \beta)}{\sin(\theta - \delta)\sin(\theta + \beta)}}\right]^2$$ (AASHTO LRDF 2020 (3.11.5.3-2))

β = angle of fill from horizontal = 0° (Backslope)
θ = Wall inclination = 90°
δ = Fiction angle between fill & wall (Interface) = $2/3\,\phi'_f = (2/3) \cdot 34° = 23°$

$$\therefore K_a = \frac{\sin^2(90-34)}{\left(\left(1 + \left(\sqrt{\frac{\sin(34+23)\sin(34-0)}{\sin(90-23)\sin(90+0)}}\right)\right)^2\right)\sin^2(90)\sin(90-23)} = \frac{0.69}{\left(1 + \sqrt{\frac{0.47}{0.91}}\right)^2 \cdot (0.91)} = \frac{0.69}{2.95 \cdot 0.91} = \frac{0.69}{2.68} = \boxed{0.26 = K_a}$$

Passive Earth Pressure coefficient = K_p

$\phi'_f = 34°$
$\beta = 0°$
$\delta = 23°$
$\delta/\phi'_f = 0.7$
$\beta/\phi'_f = 0$

Using Table in Figure (3.11.5.4.2 (AASHTO LRDF 2020)), a reduction factor (R) of 0.84 was used

Using Figure 3.11.5.4.2 $K_p \approx 9$

$\therefore$ K_p for Design = $K_p \cdot R = 9 \cdot 0.84 = 7.56 \approx \boxed{7.5 = K_p}$

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PROJECT T-15 TCL MP CL 70.7 to CL 71.9 PROJECT NO. 475.0464.002
SUBJECT RCB Extension Lateral Earth Pressures SHEET NO. 2 OF 2
DESIGNED R. Berg DATE 3/29/22 CHECKED [illegible] DATE

Seismic Active Earth Pressure = K_{AE}

$\phi_f = 34$ $\delta = 23°$ $\beta = 0°$ $i = 0°$

$A_S = 0.15$ (Page 12-21 NDOT Structures manual PGA clark County)

$K_V = 0$

$K_h = 0.5 \cdot A_S = 0.5 \cdot 0.15 = 0.075$ (Page 11-26 AASHTO LRDF 2020)

$\theta_{mo} = \arctan\left(\frac{K_h}{1 - K_V}\right) \approx \arctan\left(\frac{0.075}{1 - 0}\right) \approx 4.3°$ (AASHTO LRDF 2020 (A11.3.1-1))

$$K_{AE} = \frac{\cos(\phi_f - \theta_{mo} - \beta)^2}{\cos(\theta_{mo})\cos(\beta)^2\cos(\delta + \beta + \theta_{mo})} \cdot \left(1 + \sqrt{\frac{\sin(\phi_f + \delta)\cdot\sin(\phi_f - \theta_{mo} - i)}{\cos(\delta + \beta + \theta_{mo})\cdot\cos(i - \beta)}}\right)^{-2}$$

$$K_{AE} = \frac{\cos(36 - 4.3 - 0)^2}{\cos(4.3)\cos(0)^2\cos(23 + 0 + 4.3)} + \left(1 + \sqrt{\frac{\sin(34 + 23)\cdot\sin(34 - 4.3 - 0)}{\cos(23 + 0 + 4.3)\cdot\cos(0 - 0)}}\right)^{-2}$$

$K_{AE} = \boxed{0.37}$