GEOTECHNICAL REPORT

REPLACE STRUCTURE B-1615

MINISTER ROAD BRIDGE OVER THE EAST WALKER RIVER

YERINGTON, LYON COUNTY, NEVADA

AUGUST 2019

NEVADA
DOT
GEOTECHNICAL
ENGINEERING

STATE OF NEVADA

DEPARTMENT OF TRANSPORTATION

MATERIALS DIVISION

GEOTECHNICAL SECTION

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EA 74141

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1.0 INTRODUCTION

The Nevada Department of Transportation (NDOT) is proposing to replace bridge structure B-1615, also referred to as Minister Bridge. This is an off-system single span structure owned by the Division of State Lands. It is located on Minister Road, approximately 3.5 miles east of State Route (SR) 208 in Lyon County, just outside of Yerington, Nevada. A Project Location Map is presented as Figure 1 in Appendix A. Minister Bridge is an important access point for the recreational use plans developed by Division of State Lands. The bridge currently permits access from the Walker River State Recreation Area's newly established Visitor Center, east of the East Walker River, to the Parks additional facilities located west of the river. The following report summarizes the results and recommendations from the geotechnical analyses of the proposed replacement of structure B-1615.

2.0 PROJECT DESCRIPTION

Minister bridge is currently accessible by way of East Walker Road, a two-lane unpaved County road that accesses the Parks new Visitor Center. The in-situ structure is simply supported on vertical mass concrete wall type abutments that are founded on shallow spread footings. A water diversion pipe is attached along the north edge of the structure behind the guardrail. Minister Bridge was originally a privately-owned structure intended to provide access to surrounding farms and grazing lands. As a new acquisition by the Division of State Lands, it will now be repurposed to accommodate a variety of park visitors, ranging from large recreational vehicles to bikes and pedestrians.

It is the understanding of the Geotechnical Section that planned construction consists of removing the existing bridge and replacing it with a slightly larger single span structure supported by small diameter drilled shafts. The new bridge will retain the current structures in-situ alignment with widening occurring to the north. The water diversion pipe will be relocated adjacent to the replacement structure supported on the new abutments.

3.0 GEOLOGY AND SEISMICITY

3.1 LOCAL SITE GEOLOGY

Minister Bridge crosses the East Walker River as it flows adjacent to the Pine Grove Hills, a southern extension of the north trending Singatse Range (Moore 1969). The river channel is bounded by Quaternary aged alluvial flood plain deposits composed of moderately to poorly graded sandy gravel, gravelly sand, sand, and sandy silts. The flood plain deposits are derived from the parent Cretaceous granitic rocks of the

Pine Grove Hills. Directly west of the structure are the Quartz Monzonite deposits of the Stronsnider Ranch outcroppings. This unit is classified as a Cretaceous granodiorite (Moore 1969; Web Soil Survey).

The East Walker River originates along the eastern slope of the Sierra Nevada Mountain Range in California. Water flows into the Bridgeport Reservoir, an engineered facility just north of Bridgeport California. The reservoir provides flood control benefits to the communities downstream as well as releasing controlled flows for irrigation needs to Lyon County, Nevada (NDOW.org, 2019). As the river continues north it enters the southernmost portion of the Mason Valley and merges with the West Walker River (Moore 1969; Web Soil Survey).

3.2 SEISMICITY AND FAULTING

Minister Bridge is located within the Great Basin Providence, which covers much of the state of Nevada. The Great Basin Province, also known as the Basin and Range Province, is mainly a function of large normal faulting systems producing alluvial basins bounded by predominantly northern trending mountain ranges.

Inside the Mason and Smith Valleys exist several dominant and subsidiary fault systems. The primary contributing faults to the project location, with respect to seismic hazard, are the Singatse Range fault system and the Smith Valley fault zone. The Singatse fault system (Fault ID 1294) is located within 5 miles of Minister Bridge. This is a north-south trending structure that parallels the Singatse Range. It is Quaternary in age with a slip rate of less than 0.2 mm/yr. Secondary to the Singatse fault is the Smith Valley fault zone (Fault ID 1291). This system is Quaternary in age with a slip rate of 0.2 to 1.0 mm/yr and is located approximately 13 miles from Minister Bridge. Subsidiary fault systems consist of an unnamed fault zone near Pine Grove Flat (Fault ID 1293). These structures are moderately constrained Quaternary faults with slip rates estimated at less than 0.2 mm/yr. While predominantly north-trending, these faults are characterized as typically short with varying strikes (Quaternary Fault and Fold Database, Unified Hazards Tool). A Fault Location Map is presented as Figure 2 in Appendix A.

3.3 SITE CLASS DETERMINATION AND SEISMIC PARAMETERS

Seismic site-specific design parameters and design response spectrum are determined utilizing the LRFD design option within the Design Maps tool, developed by the U.S. Geological Survey, and the minimum standards outlined in the NDOT Structures manual. The site class is determined in accordance with guidelines outlined in Article 3.10.3 of the AAHSTO LRFD using shear wave velocities obtained via the

Refraction MicroTemor (ReMi) geophysical technique. The ReMi investigation and results are detailed below in Section *4.2.1 Geophysical Exploration*. It is determined that site-specific design parameters are controlled by the specification outlined in the NDOT Structures manual and are summarized in Table 1 with the corresponding design response spectrum pictured in Plate 1.

Table 1: Seismic Design Parameters

Design Parameter	Value
Peak ground acceleration coefficient (PGA)	0.40
Short period spectral acceleration coefficient (S_s)	1.00
Spectral acceleration coefficient (S_1)	0.40
Site Class	C

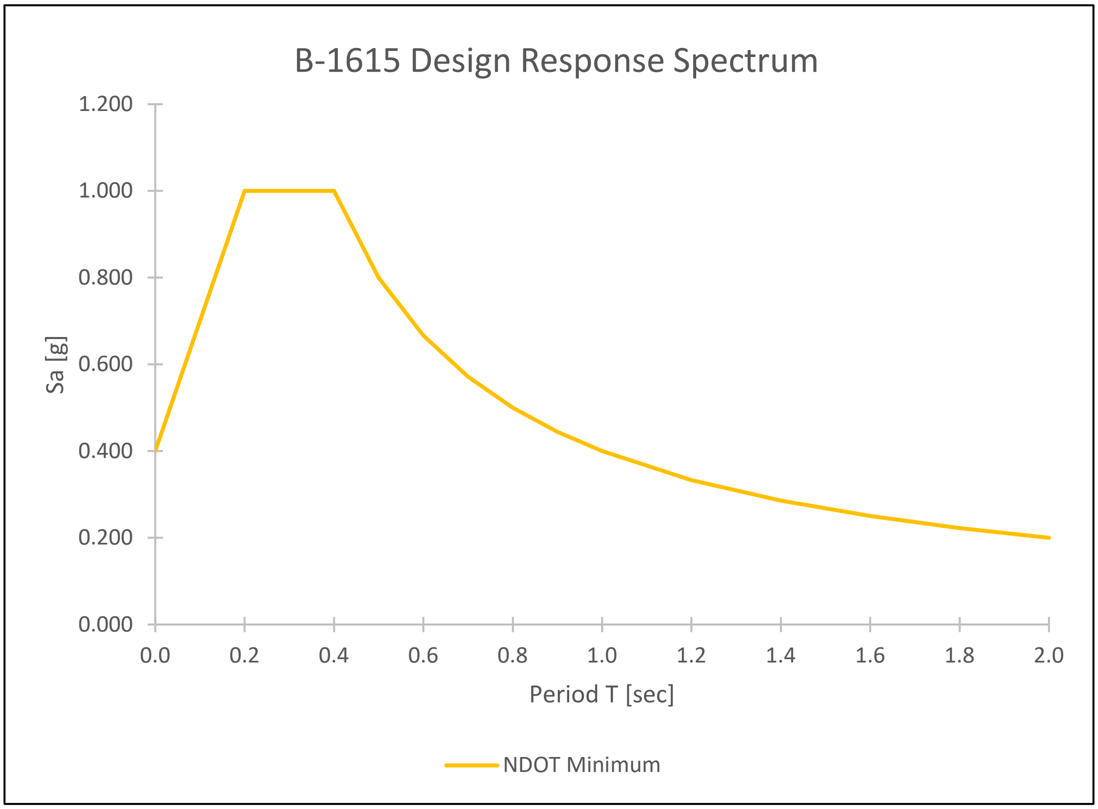

Plate 1: Design Response Spectrum for Structure B-1615 using NDOT minimum standards as outlined in Chapter 12 of the Nevada Department of Transportation's Structures Manual.

4.0 FIELD INVESTIGATION

4.1 SITE DESCRIPTION

The Geotechnical Section conducted a site reconnaissance on May 9, 2018. Thick vegetation cut by unpaved rural roads was observed to surround the East Walker River; where vegetation consisted of mature trees, bushes, and tall grasses. Adjacent to the river, slightly west of the structure, granitic bedrock outcroppings can be observed along a small hill. The outcroppings consist of granitic boulders with sparse vegetation, entailing small bushes and sagebrush. During the reconnaissance visit the river water was clear, water levels were elevated, and the water diversion pipe (attached to the structure) was in service. During subsequent site visits water clarity significantly decreased, water elevations progressively lowered, and the water diversion pipe became inactive. Water levels in the river were measured at approximately 9 ½ -feet below the bridge deck on September 18, 2018.

An aggregates pit, located southwest of the structure, was in service during the field exploration program for substantial construction activities by the Division of State Lands. Minister bridge facilitated access between the aggregates pit and the construction activities near the Park's Visitor Center.

4.2 SUBSURFACE EXPLORATION

Subsurface exploration techniques include geophysical ReMi surveys, mud rotary drilling, and core drilling. These investigations are detailed below.

4.2.1 GEOPHYSICAL EXPLORATION

A ReMi geophysical exploration program was conducted on May 24, 2018. ReMi utilizes surrounding low frequency ambient noise to generate vertical shear wave velocity profiles of the subsurface up to 100 feet Below Ground Surface (bgs) using 240-foot long seismic arrays with 12 – 10 Hz. Two arrays were executed with geophones spaced at 20-feet apart. ReMi array locations are plotted on the Field Investigation Map located in Appendix A, Figure 3. The data was processed by Optim of Reno and results are summarized in Table 2. Detailed shear wave velocity profiles are provided in Appendix D.

Table 2: Geophysical ReMi Results

Seismic Line	Vs_{100} (ft/sec)	Site Class
Seismic Line #1	1270	C
Seismic Line #2	1438	C

4.2.2 EXPLORATORY BOREHOLES

Two subsurface exploration holes were completed on July 16-19, July 24-25, and September 18-19, 2018. The first hole was drilled on the east abutment using mud rotary. A continuation hole was completed 3 feet east utilizing a combination of mud rotary and core drilling techniques. A second hole was drilled on the west abutment, also utilizing a combination of mud rotary and core drilling techniques. Boring locations are plotted on the Field Investigation Map located in Appendix A, Figure 3. Bore hole locations were measured from the centerline of Minister Road and surface elevations were approximated from topographical data compiled by NDOT.

Drilling was conducted using a Diedrich D-120 drill rig equipped with mud rotary and coring capabilities. Representative soil samples were obtained using the Standard Penetration Test (SPT), the California Modified Sampler (CMS), and coring techniques. Mud rotary sampling was conducted on 2½-foot intervals to 20-feet; where, sampling continued on 5-foot intervals thereafter. Core sampling was conducted on a continuous basis. SPT and CMS samplers were driven by a 140-lb automatic hammer, and the energy transfer from the automatic hammer into the drill rig string was calibrated at 87% for drill rig #1087 and 72% for drill rig #1627. A boring log of the subsurface conditions was recorded at the time of drilling and is attached in Appendix B, along with a Boring Log Key and core sample photos. The uncorrected blow counts for both the SPT and CMS methods and core drilling rates are recorded on the boring logs.

4.3 SUBSURFACE PROFILE

The following is a brief summary of the subsurface conditions observed during the field exploration program.

4.3.1 EAST EMBANKMENT

Approximately 4 ½ feet of fill, consisting of silty and clayey sands, was observed directly below the ground surface.

Soils below the fill, to approximately 18 feet bgs, consist of loose to very loose sands. These are poorly graded sands with little fines.

Soils between 18 to 22 feet bgs were observed as dense sands with an increased fines content compared to the layer described above. The stratum becomes very dense at 22 feet bgs and extends to 31 feet bgs.

Extending below the dense sands, from 31 feet to 66 feet bgs, is a slightly to un-weathered granite boulder matrix with a silty sand infilling. Boulder lengths were observed up to 1.4 feet. These are likely deposits from a historic catastrophic glacial lake flood event.

Below the potential flood deposits is an unknown layer likely characterized by fine grained soils. Core drilling returned relatively consistent drilling rates (ranging from 0.42 ft/min to 0.43 ft/min) with zero percent recovery.

4.3.2 WEST EMBANKMENT

Approximately 4 ½ feet of fill consisting of silty and clayey sands was observed directly below the ground surface.

Soils below the fill, to approximately 10 feet bgs, consist of medium dense sands with fines. This layer becomes dense between 10 feet to 17 feet bgs and very dense from 15 feet to 21 feet bgs.

Extending below the dense sands is a slightly to un-weathered granite boulder matrix with a silty sand infilling. Boulder lengths were observed up to 1.3 feet. As mentioned above, these are likely deposits from a historic catastrophic glacial lake flood event.

4.3.3 VERTICAL AND LATERAL VARIABILITY

Areal imagery depicts abandoned river meander formations directly north of Minister bridge and along the East Walker River channel. Areal imagery combined with variability between abutment boring logs indicate the geologic subsurface profile is likely to vary both laterally and horizontally.

4.4 GROUNDWATER

Groundwater, measured post drilling, was recorded at 7.5 feet bgs (elevation 4528.7 feet) in boring EW-1 and 10 feet bgs (elevation 4528 feet) in boring EW-2. These groundwater depths are in agreement with observed water levels in the East Walker River, measured approximately 9.5 feet below the bridge deck (elevation 4526.5 feet) during the September 18th site visit. Groundwater elevations are likely to fluctuate seasonally depending on current and previous groundwater levels, precipitation, evaporation, surface runoff and/or infiltration, and agricultural use.

4.5 LABORATORY ANALYSIS

Soil samples were returned to and tested at the NDOT Materials and Testing Laboratory in Carson City, Nevada. The testing program consists of sieve analyses, Atterberg limits, hydrometer, moisture content, unit weight, direct shear, and chemical tests. Results for each tested sample are attached in Appendix C.

5.0 GEOTECHNICAL ANALYSES AND RECOMMENDATIONS

Drilled shafts are the recommended foundation type and will be the sole focus of this geotechnical investigation. Increased liquefaction potential near the ground surface and elevated scour depths (discussed in detail below) preclude shallow foundation types from being geotechnically viable; therefore, shallow foundations are not recommended for this bridge location. Additionally, very dense soils and boulder deposits at relatively shallow depths prevent pile foundations from being driven to necessary design depths and are therefore also considered an ineffective foundation type. Results from the drilled shaft geotechnical analyses are detailed below.

5.1 MATERIAL PROPERTIES

Design parameters were developed using lab testing data and published correlations found in AASHTO LRFD 2014, FHWA-NHI-01-031, FHWA-NHI-06-089, FHWA-NHI-16-072, NAVFAC 7.2, and Bowles Foundation Analysis and Design 5th edition. Material properties for all layers within the subsurface profile are presented in Table 3.

Table 3: Foundation Soil Material Properties

Material Property	Unit Weight - γ (pcf)	Internal Friction Angle - Φ (º)
Very Loose Sands	105	30
Poorly Sorted Sands	115	34
Medium-Dense Sands	120	35
Dense to Very Dense Sands	130	36
Potential Outwash Deposit	140	38

5.2 SCOUR

The NDOT Hydraulics Section has determined that flooding is a concern within the project limits; therefore, potential scour depths must be included in design analyses. Scour depths communicated to the

Geotechnical Section are determined at the thawlag, reported to be 12-feet 9-inches below the bridge deck (elevation 4523 feet), and are listed in Table 4.

Table 4: Reported Scour Depths

Potential Flood Event	Scour Depth with Revetment (ft)	Scour Depth without Revetment (ft)
Design Level Scour (100 Year Flood Event)	5.5	10
Check Level Scour (500 Year Flood Event)	22	25.25

The design level scour depth is incorporated into the Strength Limit State and Service Limit State designs; where, the check level scour depth is included in the Extreme Limit State design. Soils above these reported depths are neglected in their respective limit state bearing resistance analyses. It is the understanding of the Geotechnical Section that revetment will be applied to both the east and west abutments. Therefore, reported scour depths with revetment are the sole focus of this geotechnical investigation.

5.3 BEARING RESISTANCE DESIGN

Bearing resistances are determined in accordance with Article 10.8 of the LRFD manual. The shaft diameter, design loads, and grouping properties were provided to the Geotechnical Section by the NDOT Structures Section. Subsurface properties are modeled as cohesionless materials with the properties outlined in Table 3 above.

It is the understanding of the Geotechnical Section that the abutments will consist of four 3-foot diameter shafts on an 11-foot spacing. The shaft cap is 3-foot 6-inches thick with a 3-inch shaft embedment into the cap. The superstructure will span the abutment encompassing the southern three shafts and the water diversion pipe will be relocated as a standalone structure supported by the abutment section above the northern most shaft.

Loading conditions reported to the Geotechnical Section and incorporated into design are tabulated in Table 5.

A group resistance factor of 1.0 is applied following Article 10.8.3.6 of the LRFD manual for a single row with shaft spacing of 3D. Group bearing resistances are calculated by summing the resistance of the individual shafts; however, a check for block failure is also performed.

Table 5: Total Shaft Cap Loading Conditions

Limit State	East Abutment	West Abutment
Applied Strength Limit State Loads to Shaft Cap (ksf)	1298	1298
Applied Service Limit State Loads to Shaft Cap (ksf)	988	988
Applied Extreme Limit State Loads to Shaft Cap (ksf)	1298	1298

The AASHTO LRFD guidelines considers the analysis of the following three loading conditions: Strength Limit State, Service Limit State, and Extreme Limit State. The Strength Limit State loading condition calculates the nominal bearing resistance, which defines the bearing strata's ability to support applied loads without producing a shear failure within the soil mass itself. The Service Limit State loading condition calculates the applied bearing pressure to produce a specified amount of total settlement under the structural load. Lastly, the Extreme Limit State loading condition calculates the bearing pressure that can be applied to soils during an extreme event, such as seismic events, scour events, liquefaction, and downdrag.

5.3.1 STRENGTH LIMIT STATE

Nominal bearing resistances of the substratum are calculated using the β Method for Cohesionless soils. A resistance factor is applied to the nominal bearing resistance to determine the factored nominal bearing resistance, as outlined in Article 10.8.3.5 of the LRFD. Resistance factors reduce the nominal bearing resistance by a predetermined reduction factor. Applied LRFD Resistance factors are presented in Table 6.

Strength Limit State bearing analysis incorporates the loss of bearing resistance due to scour produced during a design flood event and neglects contributions from tip resistance.

Table 6: Drilled Shaft Nominal Axial Compressive Resistance Factors, $\boldsymbol{\varphi_{stat}}$

Reduction Factor	Value
Nominal Axial Compressive Side Resistance Factor $\boldsymbol{\varphi_{qs}}$ (dim)	0.55
Nominal Axial Compressive Tip Resistance Factor $\boldsymbol{\varphi_{qp}}$ (dim)	0.5

5.3.2 SERVICE LIMIT STATE

Service Limit State design incorporates the loss of bearing resistance due to scour produced during a design flood event and neglects tip resistance. Total shaft settlement is limited to 1-inch with differential settlement limited to ½-inch.

5.3.3 EXTREME LIMIT STATE

Extreme Limit State bearing analysis incorporates the loss of bearing resistance to a depth of one-half the scour produced during a check flood event, neglects tip resistance, and includes additional lateral loading due to seismic conditions.

5.3.3.1 LIQUEFACTION ANALYSIS

Liquefaction is the process in which loose granular materials transform from a solid state to a liquefied state when increased pore-water pressures suddenly develop. The increase in pore-water pressure decreases effective stress and tends to compact loose granular materials when subjected to cyclic shear deformations (Youd and Idriss, 2001).

Liquefaction potential of the subsurface stratum is analyzed under the Extreme Limit State, as recommended in Article 10.5.4.2 of the LRFD manual. Using the Simplified Procedure, outlined by Youd and Idriss, 2001, the likelihood of a liquefaction event is determined by comparing the liquefaction resistance of soils with the seismic demand placed on the soils. These are combined with a magnitude scaling factor in order to quantify a Factor of Safety (FoS) against liquefaction. Corrections for overburden stress and the influence of fines content are also utilized in the analysis. A Factor of Safety against liquefaction ranging between 1.2 to 1.3 is recommended in Article 10.5.4.2 of the LRFD manual in order to assure pore water pressures do not accumulate. Factors of Safety against Liquefaction with depth are presented in Table 7.

Table 7: Factor of Safety (FoS) Against Liquefaction with Depth

Depth (ft)	East Bank FoS	West Bank FoS
2.5	0.91*	0.5*
5	0.57*	0.51*
7.5	0.6*	NL
10	0.77	NL
12.5	0.59	**
15	0.51	NL
17.5	1.65	NL
20	NL	NL
25	NL	NL
30	NL	NL

*An increase in the water table elevation is required for soils to liquefy.

*No sample was recovered at specified depth; therefore, analysis was not conducted.

NL: Non-Liquefiable layers. These layers do not meet the minimum criteria required for a soil layer to liquefy.

Results of the investigation for the east abutment identify Factors of Safety significantly below the minimum 1.2 from 0 to 15 feet bgs. Slight liquefaction potential with a rise in groundwater elevations resulted for the West Abutment from 0 to 5 feet bgs.

Shallow deposits above the water table do not meet the minimum criteria for liquefaction to occur. The liquefaction hazard reported in Table 7 is applicable only to saturated soils; however, liquefaction potential with depth is presented in order to account for the seasonal fluctuation of groundwater elevations.

With the new structure founding on drilled shafts, liquefaction-based settlement is not expected to impact the foundation supports below reported design level scour depths. Since bearing resistance on the East Bank is neglected to approximately 18.5 feet bgs (or 5.5 feet below the thawlag) in the Strength Limit State and 24 feet bgs (or 11 feet below the thawlag) in the Extreme Limit State, liquefaction is not expected to impact bearing resistance design and has therefore been neglected.

5.3.3.2 DOWNDRAG

To a depth of the reported design flood and check flood events the shaft is modeled as a free-standing column. These depths extend below potentially liquefiable materials; therefore, a downdrag component resulting from liquefaction is not included in the Extreme Event Limit State bearing analysis.

5.3.3.3 UPLIFT

Expansive soils were not encountered during the field investigation and are not expected to naturally occur. Hence, an uplift design component is not addressed further.

5.4 RECOMMENDED SHAFT LENGTHS

Factored bearing resistance of the soils were compared against the factored bearing loads applied to the structure to determine minimum shaft lengths. Recommended minimum shaft lengths are as follows:

- 44-feet (tip elevation 4484.5 feet) for the east abutment
- 44-feet (tip elevation 4486.0 feet) for the west abutment.

5.5 SETTLEMENT

Tolerable settlement within the Service Limit State is initially determined using load-settlement curves following FHWA GEC 10 guidelines for a tolerable settlement of ½-inch. Total settlement of the shaft is then calculated using the methods outlined by Hough and Vesic, 1977. Total settlement is estimated to be 0.50 inches and total differential settlement is estimated at 0.25 inches.

5.6 LATERAL EARTH PRESSURE COEFFICIENTS

Recommended lateral earth pressure coefficients and equivalent fluid pressures for the foundation soils are calculated according to the guidelines in Article 3.11.5 of the LRFD and are detailed in Table 8. The values recommended in Table 8 apply to a vertical wall with horizontal backfill conditions. Lateral earth pressures at-rest are calculated using the Rankine method. Active lateral earth pressures are calculated according to the Coulomb method. Passive lateral earth pressures are determined using tables in Article 3.11.5 that follow guidelines originally presented in the NAVFAC DM 7.1 and DM 7.2. Lastly, dynamic active lateral earth pressures are determined using the Mononobe-Okabe method outlined in Article A11.3 of the LRFD.

Table 8: Lateral Earth Pressure Coefficients and Equivalent Fluid Pressures

Pressure Condition	Granular Backfill	Native
Active Lateral Earth Pressure Coefficient (ka)	0.283	0.283
Active Equivalent Fluid Pressure (pcf)	35.34	32.55
At-Rest Lateral Earth Pressure Coefficient (ko)	0.441	0.441
At-Rest Equivalent Fluid Pressure (pcf)	55.10	50.69
Passive Lateral Earth Pressure Coefficient (kp)	8.95	8.95
Passive Equivalent Fluid Pressure (pcf)	1118.75	1029.25
Dynamic Active Lateral Earth Pressure Coefficient (kae)	0.644	0.644
Dynamic Active Equivalent Fluid Pressure (pcf)	80.50	74.06

5.7 LATERAL LOADS

Through collaboration with the NDOT Structures Division, it has been determined that the Structures Division sill complete the seismically induced lateral foundation analysis. Geotechnical input parameters necessary for an L-Pile investigation are reported below. L-Pile is a lateral analysis program by Ensoft Inc. that investigates the lateral forces on pile or shafts. The Reese et al. (1974) p-y model is recommended with material properties outlined in Section 5.1 of this report and Table 9. Program assigned default values are recommended for the Modulus of Subgrade Reaction; which are defined by Equations 1 and 2 below (for soils above and below the water table respectively) (Isenhower et al., 2013).

$$k = 0.4168\varphi^2 - 8.1254\varphi - 83.664 \qquad \text{Eqn. 1}$$

$$k = 0.0166\varphi^3 - 1.5526\varphi^2 + 58.43\varphi - 769.18 \qquad \text{Eqn. 2}$$

Table 9: Material Properties

Depth Below Ground Surface (ft)	Lithologic Layer	Unit Weight - γ (pcf)	Internal Friction Angle - Φ (º)
East: 0-10 West: 0-10	Very Loose Sands	105	30
East: 10-18.5 West: -----	Loose Sands	115	34
East: ------ West: 10-15	Poorly Sorted Sands	120	35
East: 18.5-31 West: 15-21	Medium-Dense Sands	130	36
East: 31-66 West: >21	Dense to Very Dense Sands	140	38

5.8 CORROSION

Chemical lab testing data on soils collected at a depth of 20 feet bgs on the east abutment quantify a low corrosion potential. Testing returned zero chlorides, a pH of 7.1, a Resistivity of 2,835 ohm-cm and a water-soluble sulfate content of 47 ppm. According to ACI 318, tested soils in the project area have a negligible water-soluble sulfate classification indicating a low potential for corrosivity.

5.9 STRUCTURE RECOMMENDATIONS

All construction operations shall conform to the current Nevada Department of Transportation's Standard Specifications for Road and Bridge Construction manual. Hard drilling conditions should be expected. Boulders, observed in excess of 2-feet in diameter, and vertical and lateral subsurface variability are likely to be encountered during drilling. Due to the difficult drilling conditions the use of coring techniques should be expected. Loose, sloughed material, and soft bottoms shall be removed from excavations and drilled holes, and a flat level pad be established prior to concrete placement.

6.0 LIMITATIONS

Recommendations contained in this Geotechnical Report are based on information obtained from the subsurface exploration, laboratory testing of collected samples, bearing resistance analyses, reported scour, liquefaction and downdrag analyses, and observations from our Geotechnical Engineers. The nature and extent of subsurface variations may not be evident until construction takes place; therefore, this report may not fully quantify the natural variation of in-situ soil characteristics. If encountered construction conditions differ from those found in this report, or the scope is altered, the Geotechnical Section must be notified to evaluate in-situ conditions and/or new plan sets and provide additional recommendations, if necessary.

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APPENDIX A

Figures:

Project Location Map
Fault Location Map
Field Investigation Map

Figure 1: Project Location Map

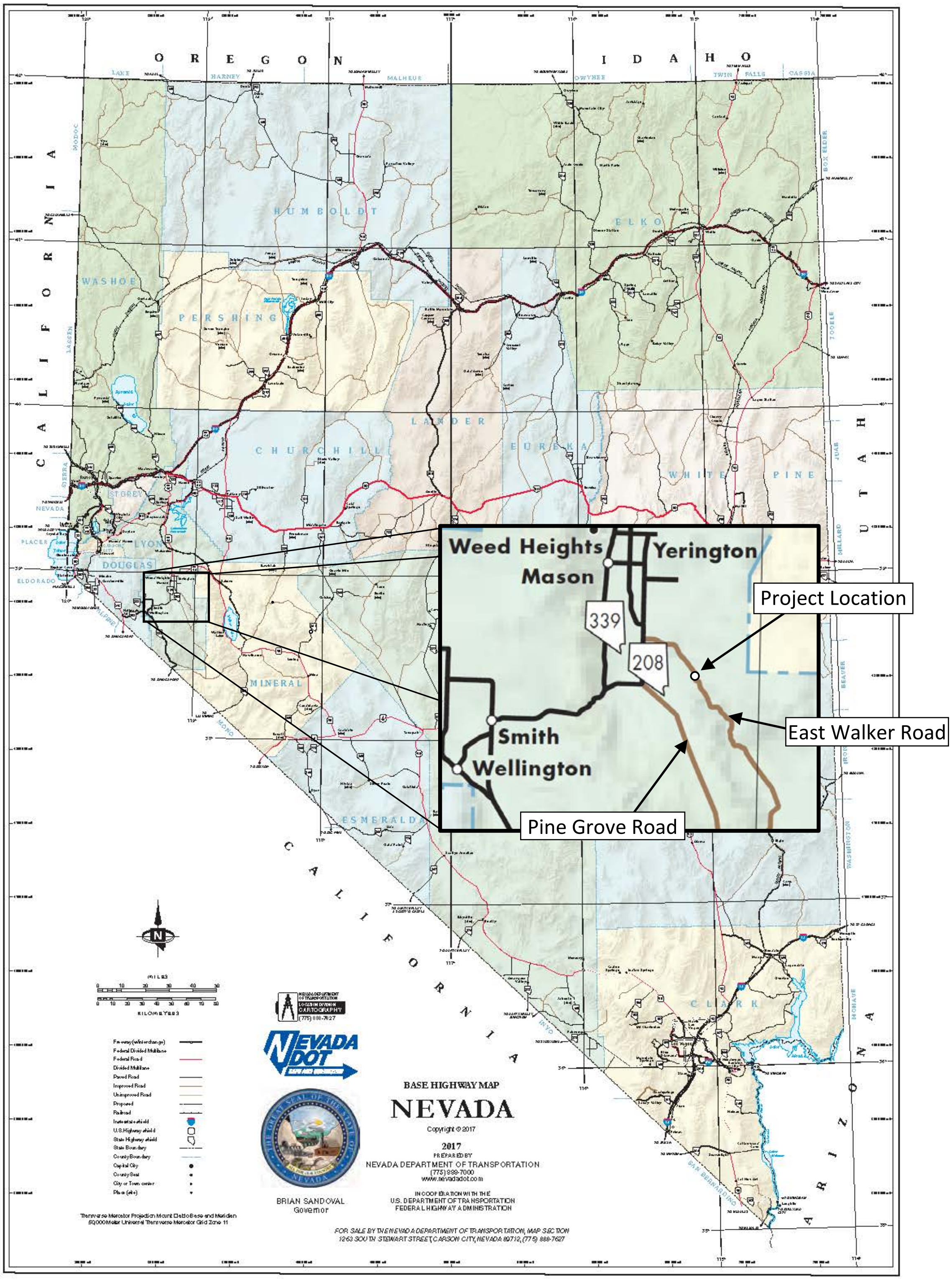
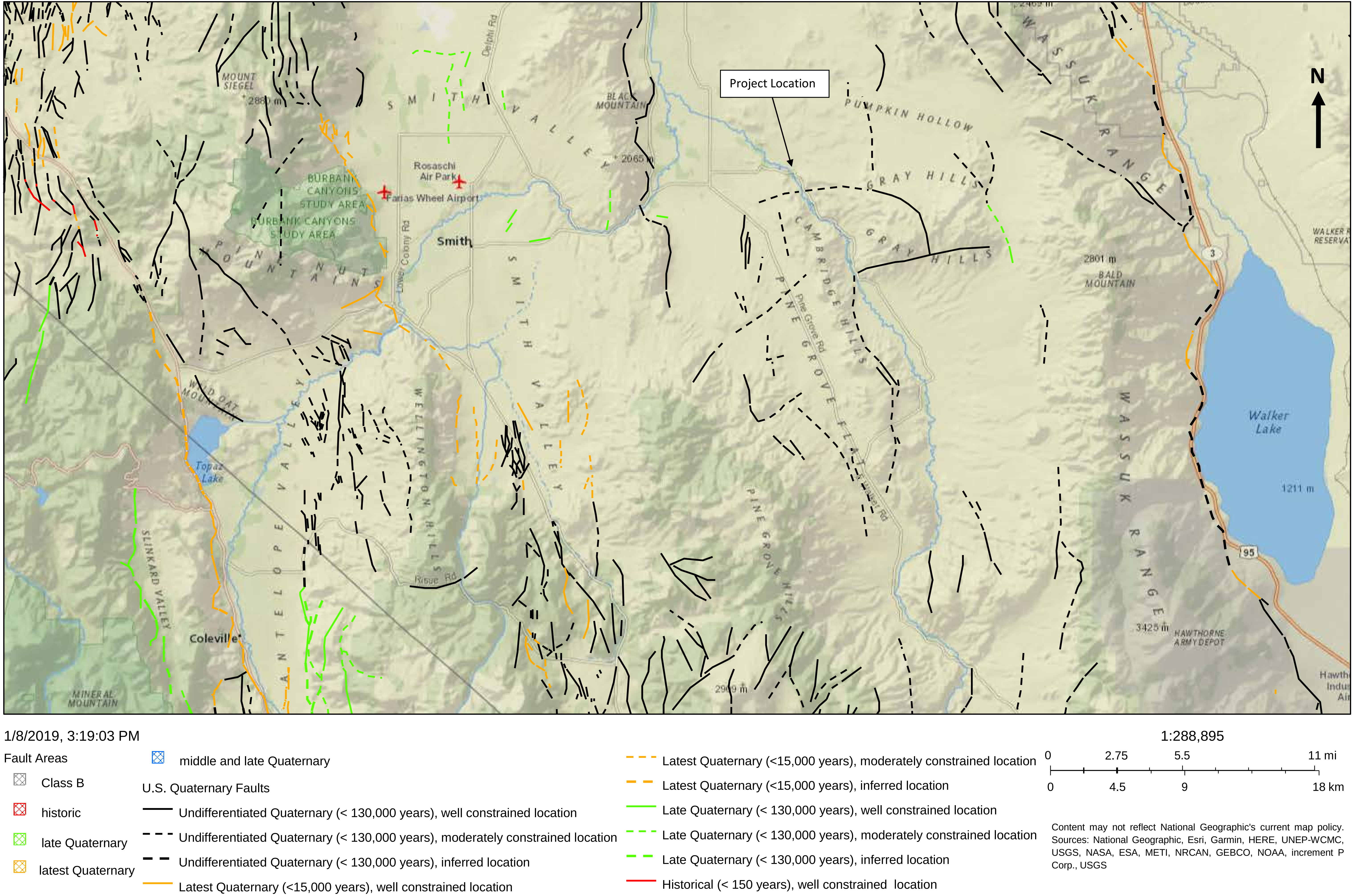


Figure 2: Fault Location Map



USGS

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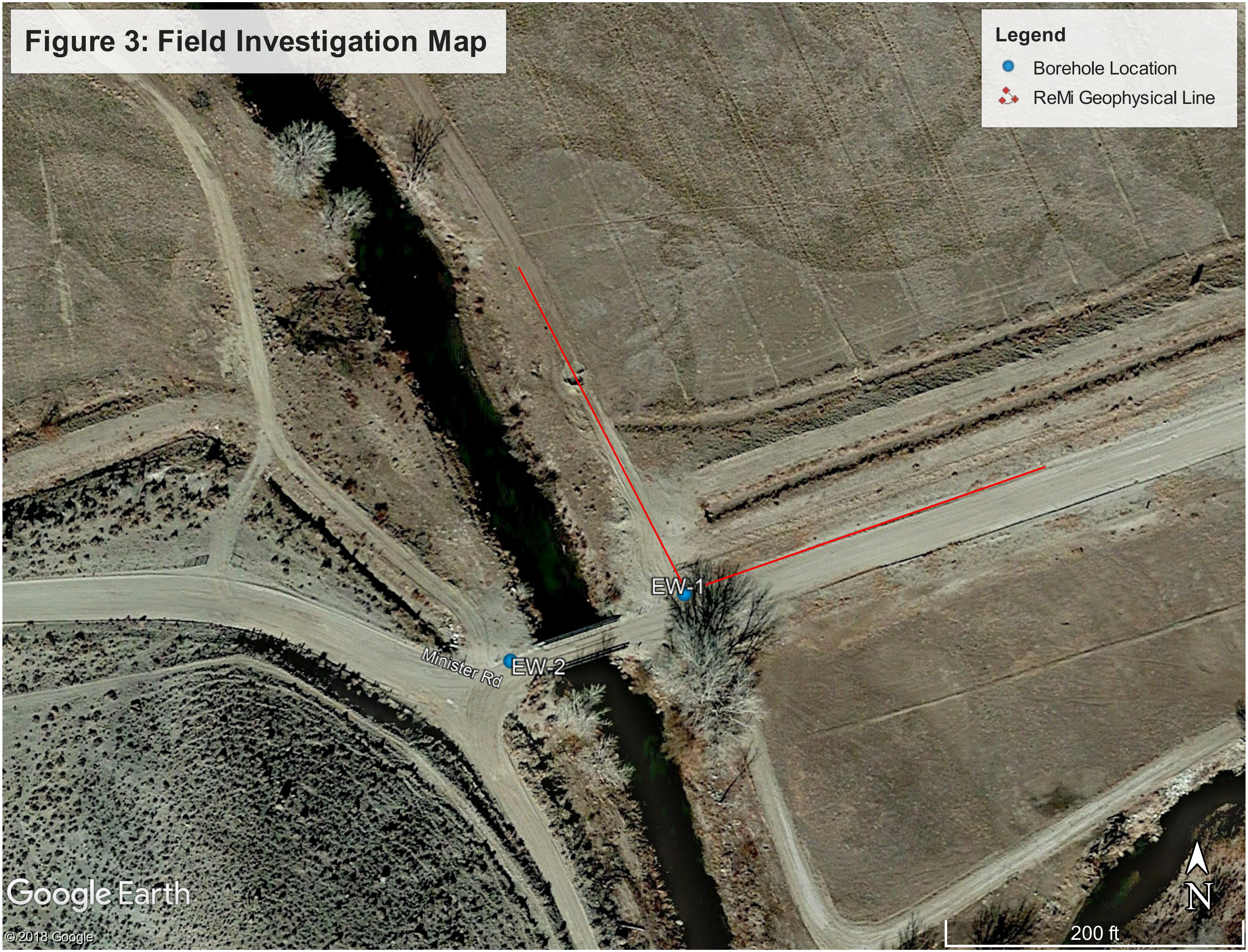
Figure 3: Field Investigation Map



APPENDIX B

Boring Log Key
Boring Log
Core Sample Photos

KEY TO EXPLORATION LOGS

PARTICLE SIZE LIMITS

CLAY	SILT	SAND			GRAVEL		COBBLES	BOULDERS
		FINE	MEDIUM	COARSE	FINE	COARSE		

.002 mm #200 #40 #10 #4 ¾ inch 3 inch 12 inch

USCS GROUP	TYPICAL SOIL DESCRIPTION
GW	Well graded gravels, gravel-sand mixtures, little or no fines
GP	Poorly graded gravels, gravel-sand mixtures, little or no fines
GC	Clayey gravels, poorly graded gravel-sand-clay mixtures
SW	Well graded sands, gravelly sands, little or no fines
SP	Poorly graded sands, gravelly sands, little or no fines
SM	Silty sands, poorly graded sand-silt mixtures
SC	Clayey sands, poorly graded sand-clay mixtures
ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity
CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
OL	Organic silts and organic silt-clays of low plasticity
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
PT	Peat and other highly organic soils

MOISTURE CONDITION CRITERIA

Description	Criteria
Dry	Absence of moisture, dusty, dry to touch.
Moist	Damp, no visible free water.
Wet	Visible free water, usually below groundwater table.

∇ ▼ Groundwater Elevation Symbols

SOIL CEMENTATION CRITERIA

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Won't break or crumble w/finger pressure

STANDARD PENETRATION CLASSIFICATION*

GRANULAR SOIL		CLAYEY SOIL	
BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY
0 - 4	VERY LOOSE	0 - 1	VERY SOFT
5 – 10	LOOSE	2 - 4	SOFT
11 - 30	MEDIUM DENSE	5 - 8	MEDIUM STIFF
31 - 50	DENSE	9 - 15	STIFF
OVER 50	VERY DENSE	16 - 30	VERY STIFF
		31 - 60	HARD
		OVER 60	VERY HARD

*Standard Penetration Test (N) 140 lb hammer 30 inch free fall on 2 inch O.D. x 1.4 inch I.D. sampler.

Field Blow counts on California Modified Sampler (N_{CMS}) can be converted to $N_{SPT\ field}$ by:

$(N_{CMS\ field})(0.62) = N_{SPT\ field}$

Blow counts from Automatic Hammer can be converted to Standard SPT N_{60} by:

Rig #1627: $(N_{SPT\ field})(1.2) = N_{60}$

Rig #1082: $(N_{SPT\ field})(1.45) = N_{60}$

TEST ABBREVIATIONS

CD	CONSOLIDATED DRAINED
CH	CHEMICAL (CORROSIVENESS)
CM	COMPACTION
CU	CONSOLIDATED UNDRAINED
D	DISPERSIVE SOILS
DS	DIRECT SHEAR
E	EXPANSIVE SOIL
G	SPECIFIC GRAVITY
H	HYDROMETER
HC	HYDRO-COLLAPSE
K	PERMEABILITY
OC	ORGANIC CONTENT
C	CONSOLIDATION
PI	PLASTICITY INDEX
RQD	ROCK QUALITY DESIGNATION
RV	R-VALUE
S	SIEVE ANALYSIS
SL	SHRINKAGE LIMIT
U	UNCONFINED COMPRESSION
UU	UNCONSOLIDATED UNDRAINED
UW	UNIT WEIGHT
W	MOISTURE CONTENT

SOIL COLOR DESIGNATIONS ARE FROM THE MUNSELL SOIL/ROCK COLOR CHARTS.

EXAMPLE: (7.5 YR 5/3) BROWN

SAMPLER NOTATION

CMS	CALIF. MODIFIED SAMPLER[1]
CPT	CONE PENETRATION TEST
CS	CONTINUOUS SAMPLER[2]
PB	PITCHER BARREL
RC	ROCK CORE[3]
SH	SHELBY TUBE[4]
SPT	STANDARD PENETRATION TEST
TP	TEST PIT

1- I.D.= 2.421 inch

2- I.D.=3.228 inch with tube; 3.50 inch w/o tube

3- NXB I.D.= 1.875 inch

4- I.D.= 2.875 inch

Revised August 2010

NEVADA DOT
SAFE AND CONNECTED

Materials Division
Geotechnical Section
1263 S. Stewart St
Carson City, NV 89712

BORING LOG

SHEET 1 OF 6

START DATE 7/16/18
END DATE 9/19/18
PROJECT Replace Structure B-1615
LOCATION Minister Road, South of Yerington, Lyon County, NV
E.A. # 74141
BORING EW-1
GROUND ELEV. ft 4536.0
TOTAL DEPTH ft 80

GROUNDWATER LEVEL			
DATE	TIME	DEPTH ft	ELEV. ft
7/19/18	AD	7.4	4529

STATION "E" 6+28.53
OFFSET 17.0 ft.
ENGINEER Jensen
OPERATOR Altamirano/Neusel
DRILL RIG Diedrich D-120 (#1627)/(#108
METHOD Mud Rotary and Core
HAMMER Auto. (ETR 72%/87%)
BACKFILLED Yes DATE

ELEV. (ft)	DEPTH (ft)	SAMPLE NO.	TYPE	BLOWS / 6"	Uncorrected N Value	Recovery (%)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	% PASSING NO.4	% PASSING NO.200	LIQUID LIMIT	PLASTICITY INDEX	OTHER TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION	REMARKS
4535.0	1															Advance boring from 0-38 ft using mud rotary drilling 7/16/2018 - 7/17/2018
4534.0	2													SM		
4533.0	3	A	◣	2 2 3	5				93	33	22	3			**FILL: SILTY SAND** Loose, fine grained, moist, dark brown	
4532.0	4															
4531.0	5														**SANDY SILT** Loose, fine grained, subangular, moist, dark brown	
4530.0	6	B	◣	2 3 4	7	80			100	63	26	2		ML		
4529.0	7															
	▼															
4528.0	8	C1 C2	⧗	6 6 6	12		 13	 112	70 75	4 4	19	NP	 UW, DS		**POORLY GRADED SAND WITH GRAVEL** Loose, coarse grained, subrounded, moist, brown, phi=37 degrees, c=9.1 psi	
4527.0	9													SP		
4526.0	10														**POORLY GRADED SAND WITH FINES** Medium dense, medium grained, angular to subrounded, moist, dark brown	
4525.0	11	D	◣	8 6 6	12	33	19		85	6						
4524.0	12														**SILTY SAND WITH GRAVEL** Loose, medium to coarse grained, angular to subrounded, moist, dark brown	
4523.0	13	E	◣	4 5 5	10	27	20		83	7				SC-SM		
4522.0	14															
														SP		

◣	Standard Penetration Test	⧗	Modified California Sampler	▯	Rock Core	▨	USCS Silty Sand	▥	USCS Silt	▨	USCS Poorly-graded Sand	▨	USCS Silty Clayey Sand
▨	USCS Clayey Sand	▨	Boulders and cobbles	▨	Soil Matrix								

NEVADA DOT
SAFE AND CONNECTED

Materials Division
Geotechnical Section
1263 S. Stewart St
Carson City, NV 89712

BORING LOG

SHEET 2 OF 6

START DATE 7/16/18
END DATE 9/19/18
PROJECT Replace Structure B-1615
LOCATION Minister Road, South of Yerington, Lyon County, NV
E.A. # 74141
BORING EW-1
GROUND ELEV. ft 4536.0
TOTAL DEPTH ft 80

GROUNDWATER LEVEL			
DATE	TIME	DEPTH ft	ELEV. ft
7/19/18	AD	7.4	4529

STATION "E" 6+28.53
OFFSET 17.0 ft.
ENGINEER Jensen
OPERATOR Altamirano/Neusel
DRILL RIG Diedrich D-120 (#1627)/(#108
METHOD Mud Rotary and Core
HAMMER Auto. (ETR 72%/87%)
BACKFILLED Yes DATE

ELEV. (ft)	DEPTH (ft)	SAMPLE NO.	TYPE	BLOWS / 6"	Uncorrected N Value	Recovery (%)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	% PASSING NO.4	% PASSING NO.200	LIQUID LIMIT	PLASTICITY INDEX	OTHER TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION	REMARKS
4520.0	16	F	◣	8 6 5	11	37	11		62	5				SP	**POORLY GRADED SAND WITH GRAVEL** Medium dense, subangular to subrounded, moist, light brown	
4519.0	17															
4518.0	18	G	◣	6 10 13	23		14		69	3					**POORLY GRADED SAND WITH GRAVEL** Medium dense, subangular to subrounded, moist, light brown to brown	
		H					20		98	29	36	19			**CLAYEY SAND** Medium dense, subangular to subrounded, moist, light brown to brown	
4517.0	19															
4516.0	20	I1	⧗				13		81	23	32	15			**CLAYEY SAND WITH GRAVEL** Dense, fine grained, moist, dark brown	Additional sample "1a" recovered with a four ring CMS sampler on 9/18/2018, Blow count: 18,29,29, CH testing
4515.0	21	I2		13 22 34	56	100	19	104	100	27	30	12	UW, DS	SC	**CLAYEY SAND** Dense, fine grained, moist, dark brown, phi=37 degrees, c=5.2 psi	
		I3					17	107	99	28	31	14			Sample I3: phi=36 degrees, c=8.1 psi	
4514.0	22															
4513.0	23															
4512.0	24															Slight rig chatter
4511.0	25															
4510.0	26	J	◣	16 28 44	72		14		99	25	24	7		SC-SM	**SILTY, CLAYEY SAND** Very dense, fine grained, subangular, moist, dark brown	
4509.0	27															
4508.0	28															
4507.0	29													SC		

◣ Standard Penetration Test
⧗ Modified California Sampler
Rock Core
USCS Silty Sand
USCS Silt
USCS Poorly-graded Sand
USCS Silty Clayey Sand
USCS Clayey Sand
Boulders and cobbles
Soil Matrix

NEVADA DOT SAFE AND CONNECTED

Materials Division
Geotechnical Section
1263 S. Stewart St
Carson City, NV 89712

BORING LOG

SHEET 3 OF 6

START DATE 7/16/18
END DATE 9/19/18
PROJECT Replace Structure B-1615
LOCATION Minister Road, South of Yerington, Lyon County, NV
E.A. # 74141
BORING EW-1
GROUND ELEV. ft 4536.0
TOTAL DEPTH ft 80

GROUNDWATER LEVEL			
DATE	TIME	DEPTH ft	ELEV. ft
7/19/18	AD	7.4	4529

STATION "E" 6+28.53
OFFSET 17.0 ft.
ENGINEER Jensen
OPERATOR Altamirano/Neusel
DRILL RIG Diedrich D-120 (#1627)/(#108
METHOD Mud Rotary and Core
HAMMER Auto. (ETR 72%/87%)
BACKFILLED Yes DATE

ELEV. (ft)	DEPTH (ft)
4505.0	31
4504.0	32
4503.0	33
4502.0	34
4501.0	35
4500.0	36
4499.0	37
4498.0	38
4497.0	39
4496.0	40
4495.0	41
4494.0	42
4493.0	43
4492.0	44

SAMPLE NO.	TYPE	BLOWS / 6"	Uncorrected N Value	Recovery (%)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	% PASSING NO.4	% PASSING NO.200	LIQUID LIMIT	PLASTICITY INDEX	OTHER TESTS	GRAPHIC LOG
K	◣	26 37 50/3"		120	19		100	26	27	8	H	SC
												BLDR CBBL
	▮			50								
	▮			77								
	▮			43								
	▮			233								
	▮			40								
	▮			5								

MATERIAL DESCRIPTION

CLAYEY SAND Very dense, fine grained, subangular, moist, light brown

COBBLE AND BOULDER MATRIX; SAND WITH FINES INFILLING Recovered cobbles/boulders range from 0.1 to 3 ft in length

SAND WITH SILT Rate: 0.24 ft/min; Recovery: 0.7 ft; Recovered granitic cobble/boulder size is 0.5 ft in length; medium to coarse grained, brown

GRANITIC COBBLES/BOULDERS Rate: 0.14 ft/min; Recovery: 1.2 ft; Recovered granitic cobble/boulder size ranges from 0.5 to 0.7 ft in length; light gray, visible unopened fractures

SANDY CLAY WITH GRAVEL Rate: 0.18 ft/min; Recovery: 0.7 ft; Recovered granitic cobble/boulder size ranges from 0.1 to 0.2 ft in length; rounded, moist, brown

CLAYEY SAND WITH SILT Rate: 0.13 ft/min; Recovery: 0.8 ft; fine grained, moist, brown

-Becomes **FAT CLAY WITH SAND** Fine grained, dry to moist, brown

GRANITIC COBBLES/BOULDERS Rate: 0.21 ft/min; Recovery: 1.6 ft; Recovered granitic cobble/boulder size ranges from 0.4 to 1.3 ft in length; highly weathered, weathering decreases with depth, gray, thin coarse sand with fines infilling in fractures, rounded

GRANITIC COBBLES/BOULDERS Rate: 0.42 ft/min; Recovery: 0.4 ft; Recovered granitic cobble/boulder size is 0.4 ft in length; gray, thin coarse sand with fines infilling in fractures, rounded to subrounded, approximate 45 degree intersecting fracture planes

REMARKS

31 ft. Audible drill bit bouncing on rock, 31-36 ft: 300 psi down pressure, slight rig chatter, 32 ft: Thin soft lens 35 ft: SPT sampler driven 13/0.5", No recovery, 36-37 ft: 0 down pressure, 37-38 ft: 500 psi down pressure, slight rig chatter, slow drilling

Extend boring by moving ~3 ft East of EW1. Advanced boring from 0-33 ft using mud rotary and from 33-80 ft using core drilling 9/18/2008 - 9/19/2008,

33-34.5 ft: 150 psi down pressure

34.5-36.5 ft: 200 psi down pressure

36.5-40.5 ft: 350 psi down pressure

40.5 ft: 0 psi down pressure, Sample removed from shoe

◣ Standard Penetration Test
⧗ Modified California Sampler
▮ Rock Core
▨ USCS Silty Sand
▨ Soil Matrix
▥ USCS Silt
▨ USCS Poorly-graded Sand
▨ USCS Silty Clayey Sand
▨ USCS Clayey Sand
▨ Boulders and cobbles

BORING LOG

NEVADA DOT SAFE AND CONNECTED

Materials Division
Geotechnical Section
1263 S. Stewart St
Carson City, NV 89712

START DATE 7/16/18
END DATE 9/19/18
PROJECT Replace Structure B-1615
LOCATION Minister Road, South of Yerington, Lyon County, NV
E.A. # 74141
BORING EW-1
GROUND ELEV. ft 4536.0
TOTAL DEPTH ft 80

GROUNDWATER LEVEL

DATE	TIME	DEPTH ft	ELEV. ft
7/19/18	AD	7.4	4529

STATION "E" 6+28.53
OFFSET 17.0 ft.
ENGINEER Jensen
OPERATOR Altamirano/Neusel
DRILL RIG Diedrich D-120 (#1627)/(#108
METHOD Mud Rotary and Core
HAMMER Auto. (ETR 72%/87%)
BACKFILLED Yes DATE

ELEV. (ft)	DEPTH (ft)	SAMPLE NO.	TYPE	BLOWS / 6"	Uncorrected N Value	Recovery (%)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	% PASSING NO.4	% PASSING NO.200	LIQUID LIMIT	PLASTICITY INDEX	OTHER TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION	REMARKS
4490.0	46														**GRANITIC COBBLES/BOULDERS** Rate: 0.39 ft/min, Recovery: 0.9 ft; Recovered granitic cobble/boulder size ranges from 0.2 to 0.5 ft in length; slight weathering, gray, thin fine grained dark gray infilling in fractures, surface staining weathering	
4489.0	47					32										
4488.0	48										Soil Matrix					
4487.0	49														**GRANITIC COBBLES/BOULDERS MATRIX; SAND WITH FINES INFILLING** Rate: 0.33 ft/min, Recovery: 2.3 ft; Recovered granitic cobble/boulder size ranges from 0.5 to 1.4 ft in length; gray to dark gray, coarse infilling, rounded, brown	
4486.0	50															
4485.0	51					46										
4484.0	52															
4483.0	53													BLDR CBBL		
4482.0	54														**COBBLE MATRIX; SAND WITH FINES INFILLING** Rate: 0.30 ft/min, Recovery: 2.5 ft; Recovered granitic cobble/boulder size is 0.7 ft in length; dark gray	
4481.0	55					74										
4480.0	56															
4479.0	57														**GRANITIC COBBLES/BOULDERS** Rate: 0.36 ft/min, Recovery: 0.8 ft; Recovered granitic cobble/boulder size ranges from 0.2 to 0.6 ft in length; slightly weathered, weathering increases with depth, gray, thin sand with fines infilling in fractures, coarse, brown	Disturbance to sample during extraction
4478.0	58															
4477.0	59					16										

Standard Penetration Test
Modified California Sampler
Rock Core
USCS Silty Sand
Soil Matrix
USCS Silt
USCS Poorly-graded Sand
USCS Silty Clayey Sand
USCS Clayey Sand
Boulders and cobbles

BORING LOG

Materials Division
Geotechnical Section
1263 S. Stewart St
Carson City, NV 89712

START DATE 7/16/18
END DATE 9/19/18
PROJECT Replace Structure B-1615
LOCATION Minister Road, South of Yerington, Lyon County, NV
E.A. # 74141
BORING EW-1
GROUND ELEV. ft 4536.0
TOTAL DEPTH ft 80

GROUNDWATER LEVEL			
DATE	TIME	DEPTH ft	ELEV. ft
7/19/18	AD	7.4	4529

STATION "E" 6+28.53
OFFSET 17.0 ft.
ENGINEER Jensen
OPERATOR Altamirano/Neusel
DRILL RIG Diedrich D-120 (#1627)/(#108
METHOD Mud Rotary and Core
HAMMER Auto. (ETR 72%/87%)
BACKFILLED Yes DATE

ELEV. (ft)	DEPTH (ft)	SAMPLE NO.	TYPE	BLOWS / 6"	Uncorrected N Value	Recovery (%)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	% PASSING NO.4	% PASSING NO.200	LIQUID LIMIT	PLASTICITY INDEX	OTHER TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION	REMARKS
4475.0	61													BLDR CBBL		
4474.0	62														**GRANITIC COBBLES/BOULDERS** Rate: 0.29 ft/min, Recovery: 0.3 ft; Recovered granitic cobble/boulder size is 0.3 ft in length; slight surface staining weathering, thin fines infilling in fractures	
4473.0	63														**LITHOLOGY CHANGE TO SOIL MATRIX** Lithology of soils could not be confirmed with recovered samples. Soil matrix estimated by drilling rates and lack of sample recovery through stratum	
4472.0	64					5										
4471.0	65															
4470.0	66															
4469.0	67														**Rate:** 0.45 ft/min	No Recovery
4468.0	68													Soil Matrix		
4467.0	69					0										
4466.0	70															
4465.0	71															
4464.0	72														**Rate:** 0.45 ft/min	No Recovery
4463.0	73															
4462.0	74					0										

◩	Standard Penetration Test
⧗	Modified California Sampler
▯	Rock Core
░	USCS Silty Sand
▥	USCS Silt
░	USCS Poorly-graded Sand
▨	USCS Silty Clayey Sand
▨	USCS Clayey Sand
○	Boulders and cobbles
▨	Soil Matrix

SHEET 6 OF 6

BORING LOG

NEVADA DOT SAFE AND CONNECTED

Materials Division
Geotechnical Section
1263 S. Stewart St
Carson City, NV 89712

START DATE 7/16/18
END DATE 9/19/18
PROJECT Replace Structure B-1615
LOCATION Minister Road, South of Yerington, Lyon County, NV
E.A. # 74141
BORING EW-1
GROUND ELEV. ft 4536.0
TOTAL DEPTH ft 80

GROUNDWATER LEVEL			
DATE	TIME	DEPTH ft	ELEV. ft
7/19/18	AD	7.4	4529

STATION "E" 6+28.53
OFFSET 17.0 ft.
ENGINEER Jensen
OPERATOR Altamirano/Neusel
DRILL RIG Diedrich D-120 (#1627)/(#108
METHOD Mud Rotary and Core
HAMMER Auto. (ETR 72%/87%)
BACKFILLED Yes DATE

ELEV. (ft)	DEPTH (ft)	SAMPLE NO.	TYPE	BLOWS / 6"	Uncorrected N Value	Recovery (%)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	% PASSING NO.4	% PASSING NO.200	LIQUID LIMIT	PLASTICITY INDEX	OTHER TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION	REMARKS
4460.0	76		▯											▨	**SOIL MATRIX** Lithology of soils could not be confirmed from recovered samples. Soil matrix estimated by drilling rates and lack of sample recovery through stratum	
4459.0	77		▯											▨	**Rate:** 0.42 ft/min	No Recovery
4458.0	78					0								Soil Matrix		
4457.0	79													▨		
4456.0	80														**B.O.H.**	
4455.0	81															
4454.0	82															
4453.0	83															
4452.0	84															
4451.0	85															
4450.0	86															
4449.0	87															
4448.0	88															
4447.0	89															

◩ Standard Penetration Test
⧗ Modified California Sampler
▯ Rock Core
░ USCS Silty Sand
▥ USCS Silt
░ USCS Poorly-graded Sand
▨ USCS Silty Clayey Sand
▨ USCS Clayey Sand
○ Boulders and cobbles
▨ Soil Matrix

BORING LOG

SHEET 1 OF 4

Materials Division
Geotechnical Section
1263 S. Stewart St
Carson City, NV 89712

START DATE 7/18/18
END DATE 7/24/18
PROJECT Replace Structure B-1615
LOCATION Minister Road, South of Yerington, Lyon County, NV
E.A. # 74141
BORING EW-2
GROUND ELEV. ft 4538.0
TOTAL DEPTH ft 50.7

STATION "E" 4+77.03
OFFSET 1.7 ft.
ENGINEER Jensen
OPERATOR Altamirano
DRILL RIG Diedrich D-120 (#1627)
METHOD Mud Rotary and Core
HAMMER Auto. (ETR 72%)
BACKFILLED Yes DATE

GROUNDWATER LEVEL			
DATE	TIME	DEPTH ft	ELEV. ft
7/25/18	AD	9.6	4528

ELEV. (ft)	DEPTH (ft)	SAMPLE NO.	TYPE	BLOWS / 6"	Uncorrected N Value	Recovery (%)	MOISTURE CONTENT (%)	% PASSING NO.4	% PASSING NO.200	LIQUID LIMIT	PLASTICITY INDEX	OTHER TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION	REMARKS
4537.0	1														Advance boring from 0-24 ft using mud rotary drilling
4536.0	2												SC		
4535.0	3	AA	◣	4 4 5	9	67		90	32	16	22			**FILL: CLAYEY SAND** Loose, subangular, dry to moist, dark brown	
4534.0	4														
4533.0	5														
4532.0	6	BB	◣	2 1 1	2	33		92	32				SM	**SILTY SAND** Very loose, subrounded, moist, dark brown	
4531.0	7														
4530.0	8	CC	◣	0 0 2	2	73	39	100	53	27	3	H	ML	**SANDY SILT** Very loose, subrounded, moist to wet, light brown, orange veining	
4529.0	9 ▼														
4528.0	10												SM/ML	**SILTY SAND** Dense, moist, dark brown, orange veining	
4527.0	11	DD-1 DD-2	◣	9 15 16	31	43	32 9	100 53	49 11				GM/SM	**WELL GRADED SAND WITH SILT AND GRAVEL** Dense, subangular to angular, moist to wet, brown	
4526.0	12														Slight rig chatter
4525.0	13		◣	10 18 31	49	0									No Recovery
4524.0	14												SC		

◣ Standard Penetration Test	▯ Rock Core	▨ USCS Clayey Sand	⁘ USCS Silty Sand	▥ USCS Silt	▥ USCS Borderline SM/ML	● USCS Borderline GM/SM	○ Boulders and cobbles

NEVADA DOT SAFE AND CONNECTED

Materials Division
Geotechnical Section
1263 S. Stewart St
Carson City, NV 89712

BORING LOG

START DATE 7/18/18
END DATE 7/24/18
PROJECT Replace Structure B-1615
LOCATION Minister Road, South of Yerington, Lyon County, NV
E.A. # 74141
BORING EW-2
GROUND ELEV. ft 4538.0
TOTAL DEPTH ft 50.7

GROUNDWATER LEVEL			
DATE	TIME	DEPTH ft	ELEV. ft
7/25/18	AD	9.6	4528

STATION "E" 4+77.03
OFFSET 1.7 ft.
ENGINEER Jensen
OPERATOR Altamirano
DRILL RIG Diedrich D-120 (#1627)
METHOD Mud Rotary and Core
HAMMER Auto. (ETR 72%)
BACKFILLED Yes DATE

ELEV. (ft)	DEPTH (ft)	SAMPLE NO.	TYPE	BLOWS / 6"	Uncorrected N Value	Recovery (%)	MOISTURE CONTENT (%)	% PASSING NO.4	% PASSING NO.200	LIQUID LIMIT	PLASTICITY INDEX	OTHER TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION	REMARKS
4522.0	16	EE	◣	15 11 50/4"		109	27	94	34	31	16	H		**CLAYEY SAND** Very dense, fine grained, moist, light brown	
4521.0	17														Slight rig chatter
4520.0	18	FF-1 FF-2	◣	50 50/2"			30 16	97 81	31 21	37 29	13 8		SC	**CLAYEY SAND WITH GRAVEL** Very dense, fine grained, moist, dark brown, white inclusions, transitions into very weathered granite, coarse grained, subrounded, moist, black and white	
4519.0	19														
4518.0	20	GG	◣	15 50/5"		125	25	91	38	35	17	H		**CLAYEY SAND** Very dense, fine grained, subrounded, moist, brown, black and white inclusions, granitic rock in shoe, coarse grained, surface staining weathering	Rock in shoe (Granite)
4517.0	21													**COBBLE AND BOULDER MATRIX; SAND WITH FINES INFILLING** Recovered cobbles/boulders range from 0.1 to 3 ft in length	Audible grinding
4516.0	22														
4515.0	23														
4514.0	24		‖												Advance boring from 24-50.7 ft using core drilling
4513.0	25		‖			36							BLDR CBBL	**COBBLE AND BOULDER MATRIX; SAND WITH FINES INFILLING** Recovery: 2.25 ft.; Recovered granitic cobble/boulder size ranges from 0.2 to 0.8 ft in length; light gray, slight surface staining weathering, coarse grained infilling, brown	
4512.0	26		‖												
4511.0	27		‖											**COBBLE AND BOULDER MATRIX; CLAYEY SANDY GRAVEL INFILLING** Recovery: 2.2 ft; Recovered granitic cobble/boulder size ranges from 0.1 to 0.75 ft in length; coarse grained infilling, brown	
4510.0	28		‖			68									
4509.0	29		‖												

◣	Standard Penetration Test
‖	Rock Core
▨	USCS Clayey Sand
⁝	USCS Silty Sand
‖	USCS Silt
⁝	USCS Borderline SM/ML
●	USCS Borderline GM/SM
○	Boulders and cobbles

BORING LOG

SHEET 3 OF 4

Materials Division
Geotechnical Section
1263 S. Stewart St
Carson City, NV 89712

START DATE 7/18/18
END DATE 7/24/18
PROJECT Replace Structure B-1615
LOCATION Minister Road, South of Yerington, Lyon County, NV
E.A. # 74141
BORING EW-2
GROUND ELEV. ft 4538.0
TOTAL DEPTH ft 50.7

GROUNDWATER LEVEL			
DATE	TIME	DEPTH ft	ELEV. ft
7/25/18	AD	9.6	4528

STATION "E" 4+77.03
OFFSET 1.7 ft.
ENGINEER Jensen
OPERATOR Altamirano
DRILL RIG Diedrich D-120 (#1627)
METHOD Mud Rotary and Core
HAMMER Auto. (ETR 72%)
BACKFILLED Yes DATE

ELEV. (ft)	DEPTH (ft)	SAMPLE NO.	TYPE	BLOWS / 6"	Uncorrected N Value	Recovery (%)	MOISTURE CONTENT (%)	% PASSING NO.4	% PASSING NO.200	LIQUID LIMIT	PLASTICITY INDEX	OTHER TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION	REMARKS
						49								**<u>COBBLE AND BOULDER MATRIX; CLAYEY SANDY GRAVEL INFILLING</u>** Recovery: 1.15 ft; Recovered granitic cobble/boulder size ranges from 0.1 to 1.7 ft in length; coarse grained infilling, brown	
4507.0	31														
4506.0	32													**<u>COBBLE AND BOULDER MATRIX; CLAYEY SANDY GRAVEL INFILLING</u>** Rate: 0.23 ft/min, Recovery: 1.1 ft; Recovered granitic cobble/boulder size ranges from 0.1 to 0.6 ft in length; coarse grained matrix	
4505.0	33														
						31									
4504.0	34														
4503.0	35														
														<u>CLAYEY SAND MATRIX; GRAVEL INFILLING</u> Rate: 0.28 ft/min, Recovery: 1.3 ft; subangular to subrounded, dark brown	
4502.0	36														
4501.0	37														
						26							BLDR CBBL		
4500.0	38														
4499.0	39														
4498.0	40														
														<u>CLAYEY SAND WITH GRAVEL</u> Rate: 0.26 ft/min, Recovery: 2.3 ft; Recovered granitic cobble/boulder size is 0.5 ft in length; angular, gravel is highly weathered, dark brown	
4497.0	41														
4496.0	42														
						46									
4495.0	43														
4494.0	44														

- Standard Penetration Test
- Rock Core
- USCS Clayey Sand
- USCS Silty Sand
- USCS Silt
- USCS Borderline SM/ML
- USCS Borderline GM/SM
- Boulders and cobbles

BORING LOG

SHEET 4 OF 4

Materials Division
Geotechnical Section
1263 S. Stewart St
Carson City, NV 89712

START DATE 7/18/18
END DATE 7/24/18
PROJECT Replace Structure B-1615
LOCATION Minister Road, South of Yerington, Lyon County, NV
E.A. # 74141
BORING EW-2
GROUND ELEV. ft 4538.0
TOTAL DEPTH ft 50.7

GROUNDWATER LEVEL			
DATE	TIME	DEPTH ft	ELEV. ft
7/25/18	AD	9.6	4528

STATION "E" 4+77.03
OFFSET 1.7 ft.
ENGINEER Jensen
OPERATOR Altamirano
DRILL RIG Diedrich D-120 (#1627)
METHOD Mud Rotary and Core
HAMMER Auto. (ETR 72%)
BACKFILLED Yes DATE

ELEV. (ft)	DEPTH (ft)	SAMPLE NO.	TYPE	BLOWS / 6"	Uncorrected N Value	Recovery (%)	MOISTURE CONTENT (%)	% PASSING NO.4	% PASSING NO.200	LIQUID LIMIT	PLASTICITY INDEX	OTHER TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION	REMARKS
4492.0	46		▮			108								**COBBLE AND BOULDER MATRIX; CLAYEY SANDY GRAVEL INFILLING** Rate: 0.09 ft/min, Recovery: 1.7 ft; Recovered cobble/boulder size ranges from 0.1 to 0.7 ft in length, subangular to subrounded, slightly weathered	
4491.0	47		▮											**COBBLE AND BOULDER MATRIX; CLAYEY SAND WITH GRAVEL INFILLING** Rate: 0.31 ft/min, Recovery: 2.83 ft; Recovered cobble/boulder size is 1.2 ft in length; dark brown	
4490.0	48		▮			92							BLDR CBBL		
4489.0	49		▮												
4488.0	50		▮			51								**GRAVELLY SAND WITH FINES** Rate: 0.04 ft/min, Recovery: 0.67 ft; slight cementation, dark brown	
4487.0	51													**B.O.H.**	
4486.0	52														
4485.0	53														
4484.0	54														
4483.0	55														
4482.0	56														
4481.0	57														
4480.0	58														
4479.0	59														

- ◣ Standard Penetration Test
- ▮ Rock Core
- ▨ USCS Clayey Sand
- ⁘ USCS Silty Sand
- ▥ USCS Silt
- ▥ USCS Borderline SM/ML
- ● USCS Borderline GM/SM
- ° Boulders and cobbles

Figure B-1: Boring EW-1; Box 1

Figure B-2: Boring EW-1; Box 2

Figure B-3: Boring EW-2; Box 1

Figure B-4: Boring EW-2; Box 2

APPENDIX C

Lab Results:

Lab Summary Sheets
Particle Size Distribution Reports
Direct Shear Test Reports
Chemical Analysis Sheet

SUMMARY OF RESULTS
N.D.O.T. GEOTECHNICAL SECTION

EA/Cont # 74141 **Job Description** Minister Bridge (B-1615) Replacement

Boring No. EW-1 **Elevation (ft)** **Station** **Date** 7/26/2018

SAMPLE NO.	SAMPLE DEPTH (ft)	SAMPLER TYPE	N BLOWS per ft.	SOIL GROUP	W%	DRY UW pcf	% PASS #200	LL %	PL %	PI %	STRENGTH TEST					COMMENTS
											TEST TYPE	Φ deg.	C psi	Φ deg.	C psi	
												Peak		Residual		
A	2.5 - 4.0	SPT	5	SM			32.7	22	19	3						
B	5.0 - 6.5	SPT	7	ML			62.8	26	24	2						
C1	7.5 - 8.0	CMS	12	SP			3.8	19	NP	NP						
C2	8.0 - 8.5	CMS		SP	12.8	111.8	3.7				DS	37	9.1	38	6.9	
D	10.0 - 11.5	SPT	12		19.4		5.5									
E	12.5 - 14.0	SPT	10		20.3		7.2									
F	15.0 - 16.5	SPT	11	SW	10.5		4.6									
G	17.5 - 17.9	SPT	23	SP	13.7		3.2									
H	17.9 - 18.6	SPT	23	SC	20.2		29.1	36	17	19						
I1	20.0 - 20.5	CMS	46	SC	12.8		23.1	32	17	15						
I2	20.5 - 21.0	CMS		SC	18.9	104.0	26.7	30	18	12	DS	37	5.2	36	3.7	
I3	21.0 - 21.5	CMS		SC	16.5	106.5	28.0	31	17	14	DS	36	8.1	37	3.8	

CMS = California Modified Sampler 2.42" ID
SPT = Standard Penetration 1.38" ID
CS = Continuous Sample 3.23" ID
RC = Rock Core
PB = Pitcher Barrel
CSS = Calif. Split Spoon 2.42" ID
CPT = Cone Penetration Test
TP = Test Pit
P = Pushed, not driven
R = Refusal
Sh = Shelby Tube 2.87" ID

U = Unconfined Compressive
UU = Unconsolidated Undrained
CD = Consolidated Drained
CU = Consolidated Undrained
DS = Direct Shear
Φ = Friction
C = Cohesion
N = No. of blows per ft., sampler

N = Field SPT $N = (N_{cms})(0.62)$

H = Hydrometer
S = Sieve
G = Specific Gravity
PI = Plasticity Index
LL = Liquid Limit
PL = Plastic Limit
NP = Non-Plastic
OC = Consolidation
Ch = Chemical
RV = R - Value
MD = Moisture Density

CM = Compaction
E = Swell/Pressure on Expansive Soils
SL = Shrinkage Limit
UW= Unit Weight
W = Moisture Content
K = Permeability
O = Organic Content
D = Dispersive
RQD = Rock Quality Designation
X = X-Ray Defraction
HCpot = Hydro-Collapse Potential

*** = Average of subsamples**

SUMMARY OF RESULTS
N.D.O.T. GEOTECHNICAL SECTION

EA/Cont # 74141 **Job Description** Minister Bridge (B-1615) Replacement

Boring No. EW-1 **Elevation (ft)** **Station** **Date** 7/26/2018

SAMPLE NO.	SAMPLE DEPTH (ft)	SAMP-LER TYPE	N BLOWS per ft.	SOIL GROUP	W%	DRY UW pcf	% PASS #200	LL %	PL %	PI %	STRENGTH TEST					COMMENTS
											TEST TYPE	Φ deg.	C psi	Φ deg.	C psi	
												Peak		Residual		
J	25.0 - 26.5	SPT	72	SC-SM	14.0		25.4	24	17	7						
K	30.0 - 31.4	SPT	R	SC	18.6		26.2	27	19	8						H, G = 2.699

CMS = California Modified Sampler 2.42" ID
SPT = Standard Penetration 1.38" ID
CS = Continuous Sample 3.23" ID
RC = Rock Core
PB = Pitcher Barrel
CSS = Calif. Split Spoon 2.42" ID
CPT = Cone Penetration Test
TP = Test Pit
P = Pushed, not driven
R = Refusal
Sh = Shelby Tube 2.87" ID

U = Unconfined Compressive
UU = Unconsolidated Undrained
CD = Consolidated Drained
CU = Consolidated Undrained
DS = Direct Shear
Φ = Friction
C = Cohesion
N = No. of blows per ft., sampler

N = Field SPT $N = (N_{css})(0.62)$

H = Hydrometer
S = Sieve
G = Specific Gravity
PI = Plasticity Index
LL = Liquid Limit
PL = Plastic Limit
NP = Non-Plastic
OC = Consolidation
Ch = Chemical
RV = R - Value
MD = Moisture Density

CM = Compaction
E = Swell/Pressure on Expansive Soils
SL = Shrinkage Limit
UW= Unit Weight
W = Moisture Content
K = Permeability
O = Organic Content
D = Dispersive
RQD = Rock Quality Designation
X = X-Ray Defraction
HCpot = Hydro-Collapse Potential

*** = Average of subsamples**

SUMMARY OF RESULTS
N.D.O.T. GEOTECHNICAL SECTION

EA/Cont # 74141 **Job Description** Minister Bridge (B-1615) Replacement

Boring No. EW-1a **Elevation (ft)** **Station** **Date** 9/20/2018

SAMPLE NO.	SAMPLE DEPTH (ft)	SAMP-LER TYPE	N BLOWS per ft.	SOIL GROUP	W%	DRY UW pcf	% PASS #200	LL %	PL %	PI %	STRENGTH TEST					COMMENTS
											TEST TYPE	Φ deg.	C psi	Φ deg.	C psi	
												Peak		Residual		
1	20.0 - 22.0	CMS														Ch

CMS = California Modified Sampler 2.42" ID
SPT = Standard Penetration 1.38" ID
CS = Continuous Sample 3.23" ID
RC = Rock Core
PB = Pitcher Barrel
CSS = Calif. Split Spoon 2.42" ID
CPT = Cone Penetration Test
TP = Test Pit
P = Pushed, not driven
R = Refusal
Sh = Shelby Tube 2.87" ID

U = Unconfined Compressive
UU = Unconsolidated Undrained
CD = Consolidated Drained
CU = Consolidated Undrained
DS = Direct Shear
Φ = Friction
C = Cohesion
N = No. of blows per ft., sampler

N = Field SPT $N = (N_{css})(0.62)$

H = Hydrometer
S = Sieve
G = Specific Gravity
PI = Plasticity Index
LL = Liquid Limit
PL = Plastic Limit
NP = Non-Plastic
OC = Consolidation
Ch = Chemical
RV = R - Value
MD = Moisture Density

CM = Compaction
E = Swell/Pressure on Expansive Soils
SL = Shrinkage Limit
UW= Unit Weight
W = Moisture Content
K = Permeability
O = Organic Content
D = Dispersive
RQD = Rock Quality Designation
X = X-Ray Defraction
HCpot = Hydro-Collapse Potential

*** = Average of subsamples**

SUMMARY OF RESULTS
N.D.O.T. GEOTECHNICAL SECTION

EA/Cont # 74141 **Job Description** Minister Bridge (B-1615) Replacement

Boring No. EW-2 **Elevation (ft)** **Station** **Date** 7/26/2018

SAMPLE NO.	SAMPLE DEPTH (ft)	SAMPLER TYPE	N BLOWS per ft.	SOIL GROUP	W%	DRY UW pcf	% PASS #200	LL %	PL %	PI %	STRENGTH TEST TEST TYPE	Φ deg.	C psi	Φ deg.	C psi	COMMENTS
												Peak		Residual		
AA	2.5 - 4.0	SPT	9	SC			31.9	38	16	22						
BB	5.0 - 6.5	SPT	2				32.1									
CC	7.5 - 9.0	SPT		ML	38.8		53.0	27	24	3						H, G = 2.628
DD1	10.0 - 10.4	SPT	31		32.3		49.0									
DD2	10.4 - 10.7	SPT			9.4		11.4									
EE	15.0 - 16.5	SPT	R	SC	27.3		34.0	31	15	16						H, G = 2.780
FF1	17.5 - 17.9	SPT	R	SC	30.2		30.7	37	24	13						
FF2	17.9 - 18.1	SPT		SC	15.7		20.6	29	21	8						
GG	20.0 - 21.5	SPT	R	SC	25.4		37.5	35	18	17						H, G = 2.740

CMS = California Modified Sampler 2.42" ID
SPT = Standard Penetration 1.38" ID
CS = Continuous Sample 3.23" ID
RC = Rock Core
PB = Pitcher Barrel
CSS = Calif. Split Spoon 2.42" ID
CPT = Cone Penetration Test
TP = Test Pit
P = Pushed, not driven
R = Refusal
Sh = Shelby Tube 2.87" ID

U = Unconfined Compressive
UU = Unconsolidated Undrained
CD = Consolidated Drained
CU = Consolidated Undrained
DS = Direct Shear
Φ = Friction
C = Cohesion
N = No. of blows per ft., sampler

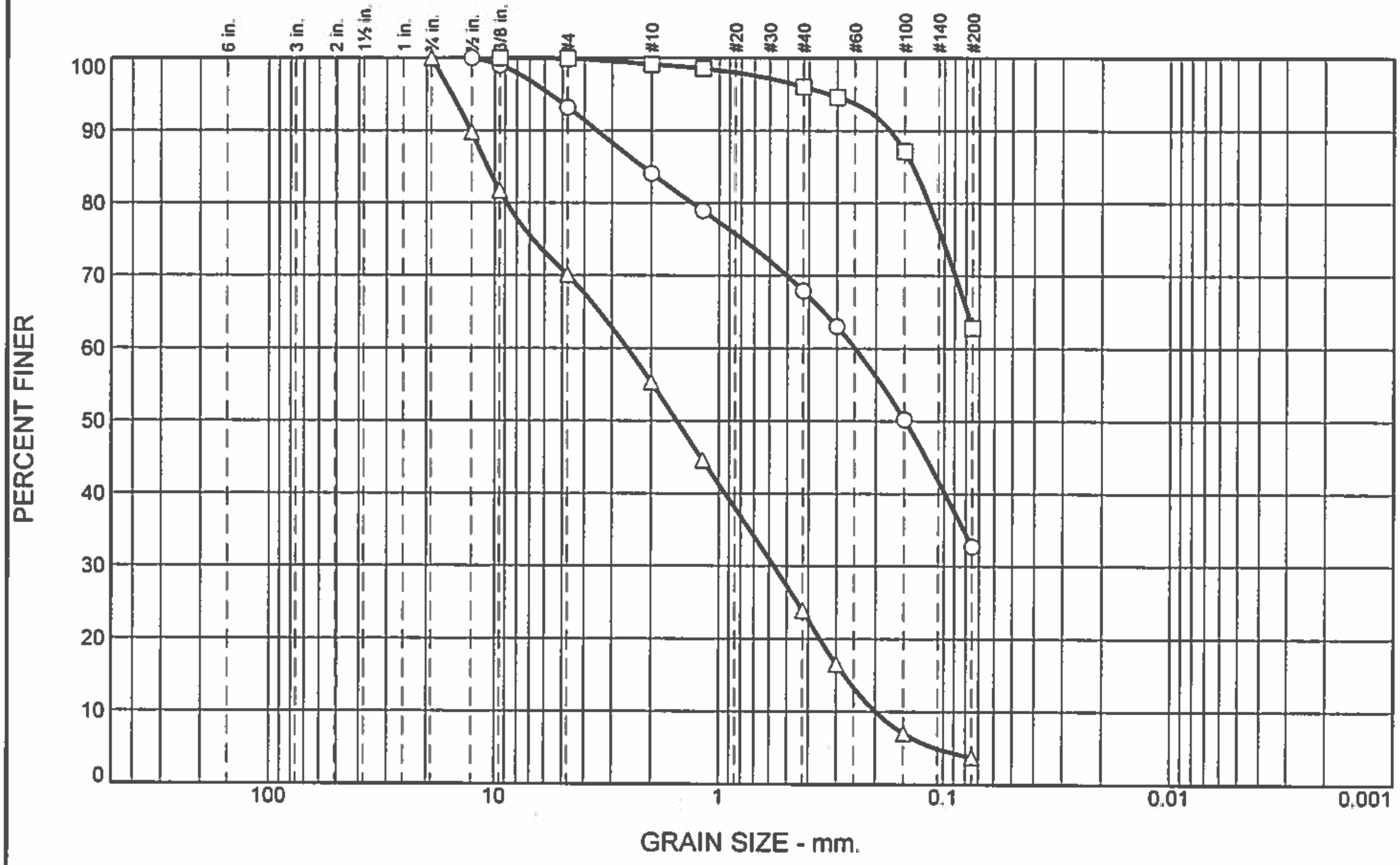
N = Field SPT $N = (N_{cms})(0.62)$

H = Hydrometer
S = Sieve
G = Specific Gravity
PI = Plasticity Index
LL = Liquid Limit
PL = Plastic Limit
NP = Non-Plastic
OC = Consolidation
Ch = Chemical
RV = R - Value
MD = Moisture Density

CM = Compaction
E = Swell/Pressure on Expansive Soils
SL = Shrinkage Limit
UW= Unit Weight
W = Moisture Content
K = Permeability
O = Organic Content
D = Dispersive
RQD = Rock Quality Designation
X = X-Ray Defraction
HCpot = Hydro-Collapse Potential

*** = Average of subsamples**

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	6.8	60.5	32.7		SM	A-2-4(0)	19	22
□	0.0	0.1	37.1	62.8		ML	A-4(0)	24	26
△	0.0	29.9	66.3	3.8		SP	A-1-b	NP	19

SIEVE inches size	PERCENT FINER ○	□	△
3/4"			100.0
1/2"	100.0		89.8
3/8"	99.0	100.0	81.7
	GRAIN SIZE		
D_{60}	0.2484		2.5552
D_{30}			0.5696
D_{10}			0.1995
	COEFFICIENTS		
C_c			0.64
C_u			12.81

SIEVE number size	PERCENT FINER ○	□	△
#4	93.2	99.9	70.1
#10	84.1	99.1	55.3
#16	78.9	98.5	44.6
#40	67.9	96.0	23.9
#50	63.0	94.6	16.5
#100	50.2	87.1	7.0
#200	32.7	62.8	3.8

Material Description

○ silty sand

□ sandy silt

△ poorly graded sand with gravel

REMARKS:

○

□

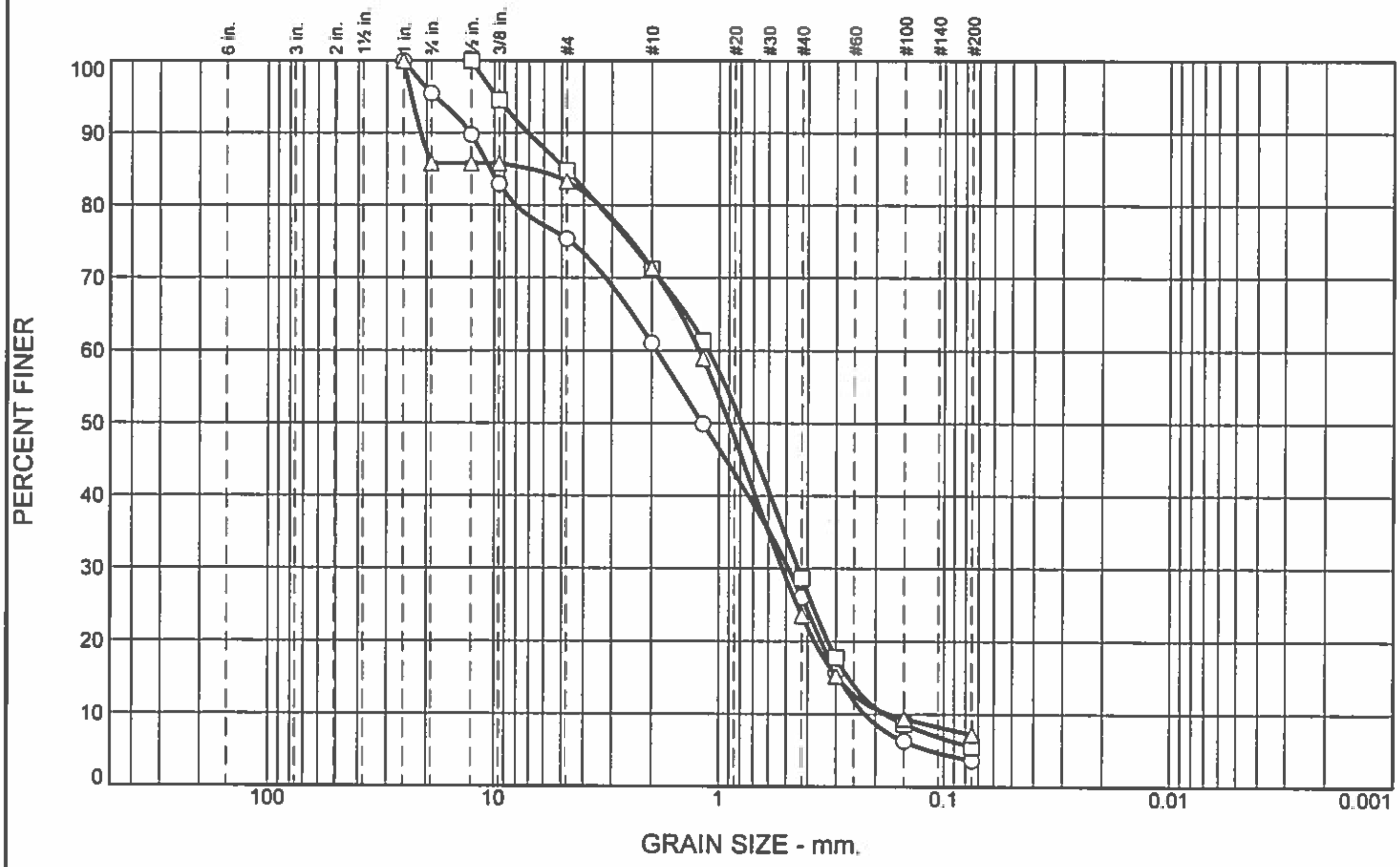
△

○ Source of Sample: EW-1 Depth: 2.5' - 4.0' Sample Number: A
□ Source of Sample: EW-1 Depth: 5.0' - 6.5' Sample Number: B
△ Source of Sample: EW-1 Depth: 7.5' - 8.0' Sample Number: C1

NEVADA DEPARTMENT OF TRANSPORTATION

Client: S. Jensen
Project: Minister Bridge (B-1615) Replacement
Project No.: EA 74141
Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	24.7	71.6	3.7		SP			
□	0.0	15.2	79.3	5.5					
△	0.0	16.7	76.1	7.2					

SIEVE inches size	PERCENT FINER ○	□	△
1"	100.0		100.0
3/4"	95.5		85.8
1/2"	89.7	100.0	85.8
3/8"	82.9	94.5	85.8
	GRAIN SIZE		
D_{60}	1.9042	1.1189	1.2246
D_{30}	0.4874	0.4416	0.5198
D_{10}	0.2233	0.1820	0.1746
	COEFFICIENTS		
C_c	0.56	0.96	1.26
C_u	8.53	6.15	7.01

SIEVE number size	PERCENT FINER ○	□	△
#4	75.3	84.8	83.3
#10	61.0	71.2	71.3
#16	49.9	61.3	58.9
#40	26.1	28.7	23.5
#50	15.7	17.8	15.3
#100	6.3	8.7	9.4
#200	3.7	5.5	7.2

Material Description

○

□

△

REMARKS:

○

□

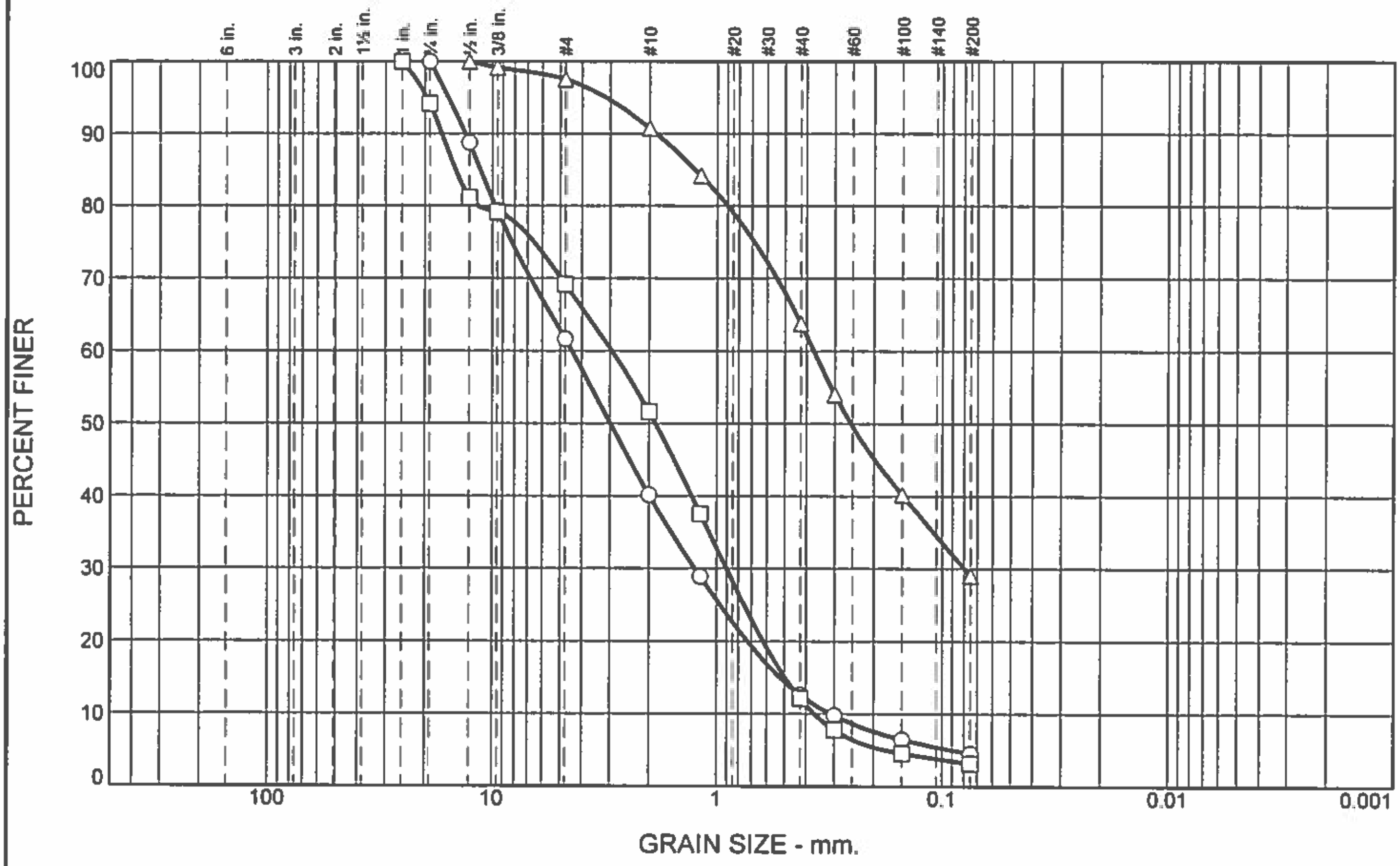
△

○ Source of Sample: EW-1 Depth: 8.0' - 8.5' Sample Number: C2
□ Source of Sample: EW-1 Depth: 10.0' - 11.5' Sample Number: D
△ Source of Sample: EW-1 Depth: 12.5' - 14.0' Sample Number: E

**NEVADA
DEPARTMENT OF
TRANSPORTATION**

Client: S. Jensen
Project: Minister Bridge (B-1615) Replacement
Project No.: EA 74141
Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	38.4	57.0	4.6		SW			
□	0.0	30.8	66.0	3.2		SP			
△	0.0	2.5	68.4	29.1		SC	A-2-6(1)	17	36

SIEVE inches size	PERCENT FINER ○	□	△
1"		100.0	
3/4"	100.0	94.1	
1/2"	88.7	81.1	100.0
3/8"	79.3	79.2	99.2
	GRAIN SIZE		
D_{60}	4.4369	2.9428	0.3716
D_{30}	1.2462	0.9041	0.0796
D_{10}	0.3104	0.3676	
	COEFFICIENTS		
C_c	1.13	0.76	
C_u	14.29	8.01	

SIEVE number size	PERCENT FINER ○	□	△
#4	61.6	69.2	97.5
#10	40.2	51.6	90.7
#16	28.9	37.6	84.2
#40	12.6	12.1	63.8
#50	9.8	7.8	54.0
#100	6.5	4.6	40.2
#200	4.6	3.2	29.1

Material Description

○

□

△ clayey sand

REMARKS:

○

□

△

○ Source of Sample: EW-1 Depth: 15.0' - 16.5' Sample Number: F

□ Source of Sample: EW-1 Depth: 17.5' - 17.9' Sample Number: G

△ Source of Sample: EW-1 Depth: 17.9' - 18.6' Sample Number: H

**NEVADA
DEPARTMENT OF
TRANSPORTATION**

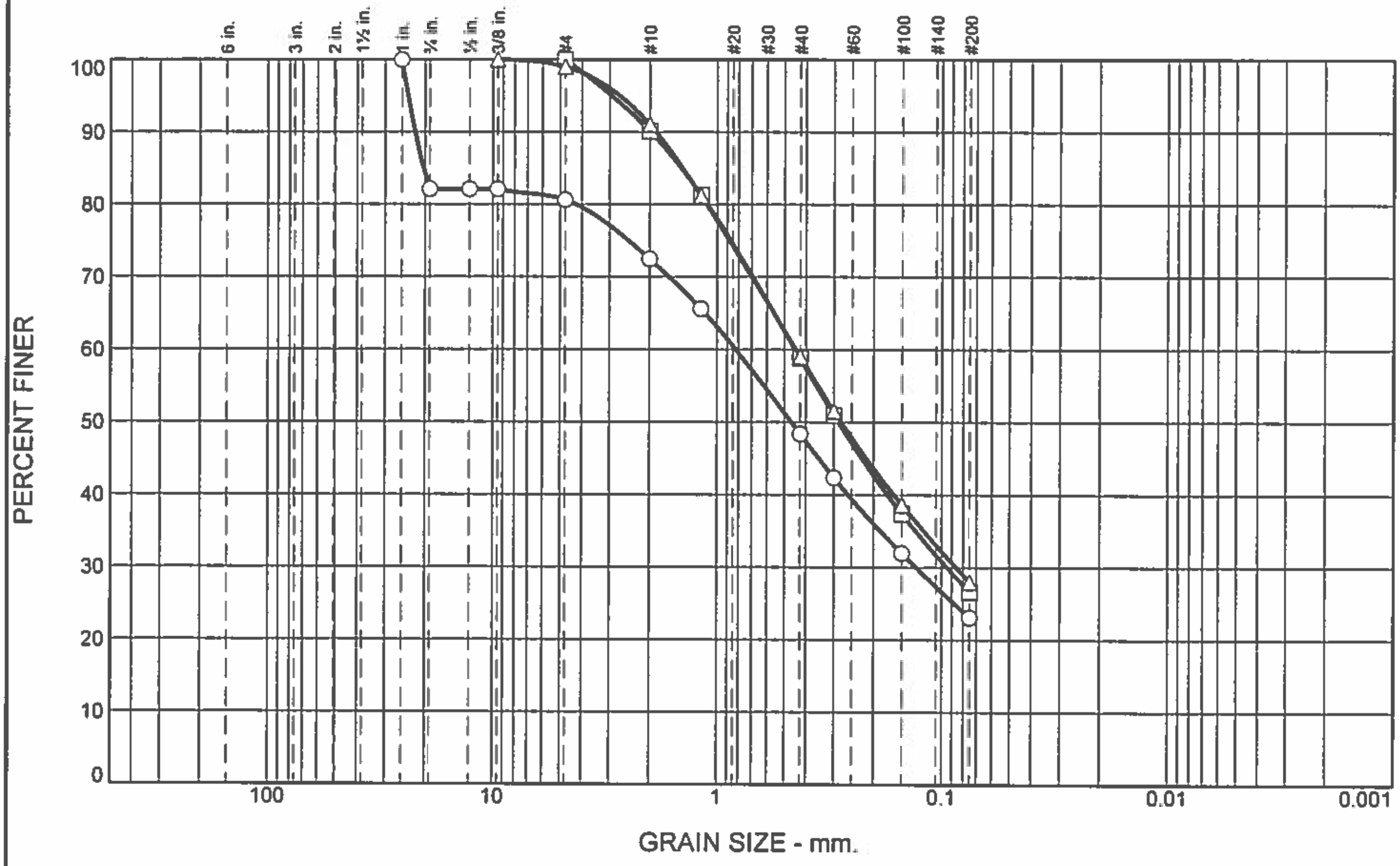
Client: S. Jensen

Project: Minister Bridge (B-1615) Replacement

Project No.: EA 74141

Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	19.4	57.5	23.1		SC	A-2-6(0)	17	32
☐	0.0	0.0	73.3	26.7		SC	A-2-6(0)	18	30
△	0.0	1.0	71.0	28.0		SC	A-2-6(1)	17	31

SIEVE inches size	PERCENT FINER ○	☐	△
1"	100.0		
3/4"	82.1		
1/2"	82.1		
3/8"	82.1		100.0
	GRAIN SIZE		
D_{60}	0.8251	0.4485	0.4446
D_{30}	0.1292	0.0941	0.0857
D_{10}			
	COEFFICIENTS		
C_c			
C_u			

SIEVE number size	PERCENT FINER ○	☐	△
#4	80.6	100.0	99.0
#10	72.5	90.1	91.0
#16	65.6	81.3	81.2
#40	48.4	58.8	59.0
#50	42.4	51.0	51.5
#100	32.0	37.4	38.7
#200	23.1	26.7	28.0

Material Description

○ clayey sand with gravel

☐ clayey sand

△ clayey sand

REMARKS:

○

☐

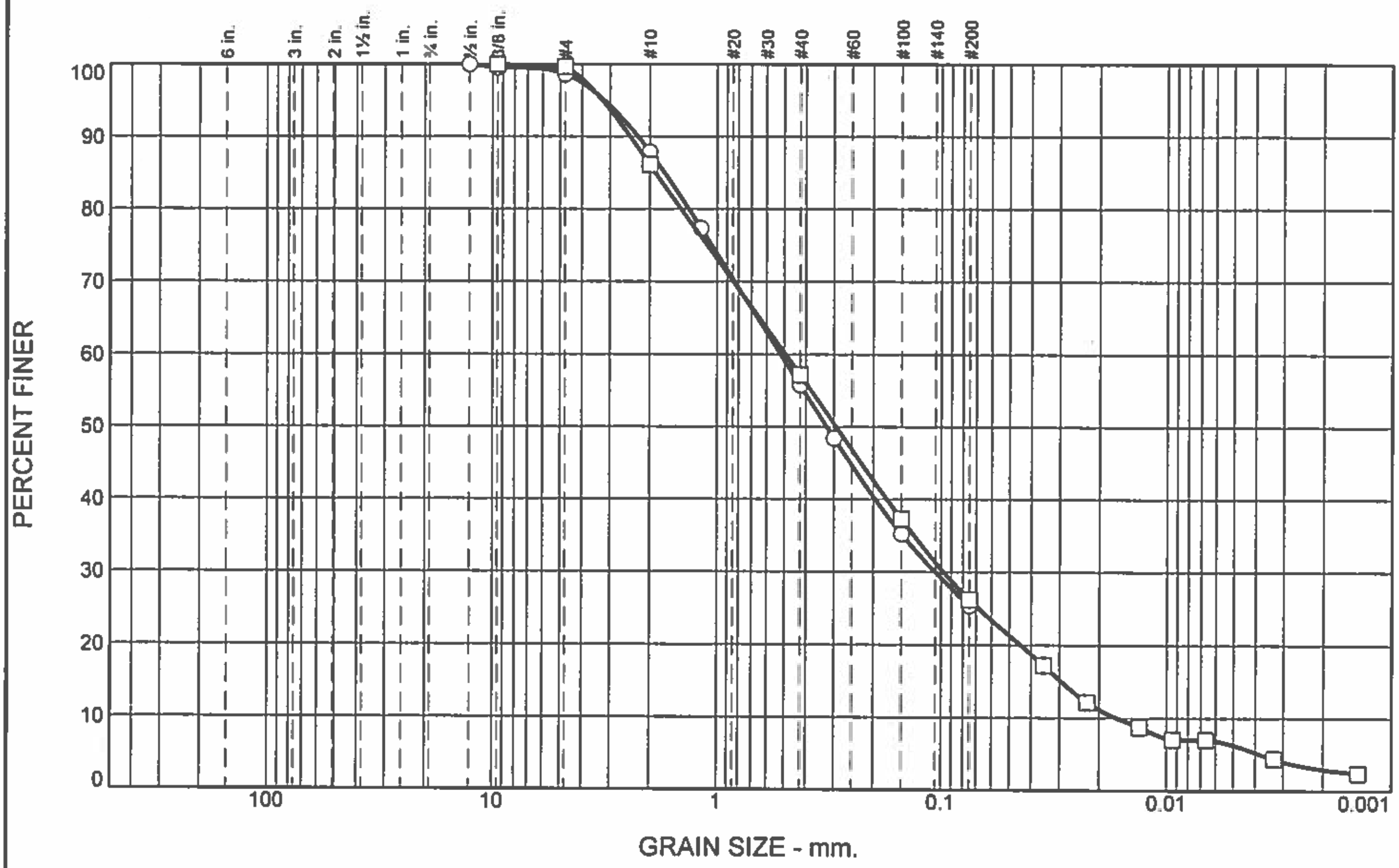
△

○ Source of Sample: EW-1 Depth: 20.0' - 20.5' Sample Number: I1
☐ Source of Sample: EW-1 Depth: 20.5' - 21.0' Sample Number: I2
△ Source of Sample: EW-1 Depth: 21.0' - 21.5' Sample Number: I3

NEVADA DEPARTMENT OF TRANSPORTATION

Client: S. Jensen
Project: Minister Bridge (B-1615) Replacement
Project No.: EA 74141 Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	1.4	73.2	25.4		SC-SM	A-2-4(0)	17	24
☐	0.0	0.4	73.4	23.2	3.0	SC	A-2-4(0)	19	27

SIEVE inches size	PERCENT FINER ○	☐	
1/2"	100.0		
3/8"	99.6	100.0	
	GRAIN SIZE		
D_{60}	0.5188	0.4932	
D_{30}	0.1060	0.0973	
D_{10}		0.0167	
	COEFFICIENTS		
C_c		1.15	
C_u		29.59	

SIEVE number size	PERCENT FINER ○	☐	
#4	98.6	99.6	
#10	87.9	86.1	
#16	77.3		
#40	55.8	57.2	
#50	48.4		
#100	35.2	37.3	
#200	25.4	26.2	

Material Description

○ silty, clayey sand

☐ clayey sand

REMARKS:

○

☐

○ Source of Sample: EW-1 Depth: 25.0' - 26.5' Sample Number: J

☐ Source of Sample: EW-1 Depth: 30.0' - 31.42 Sample Number: K

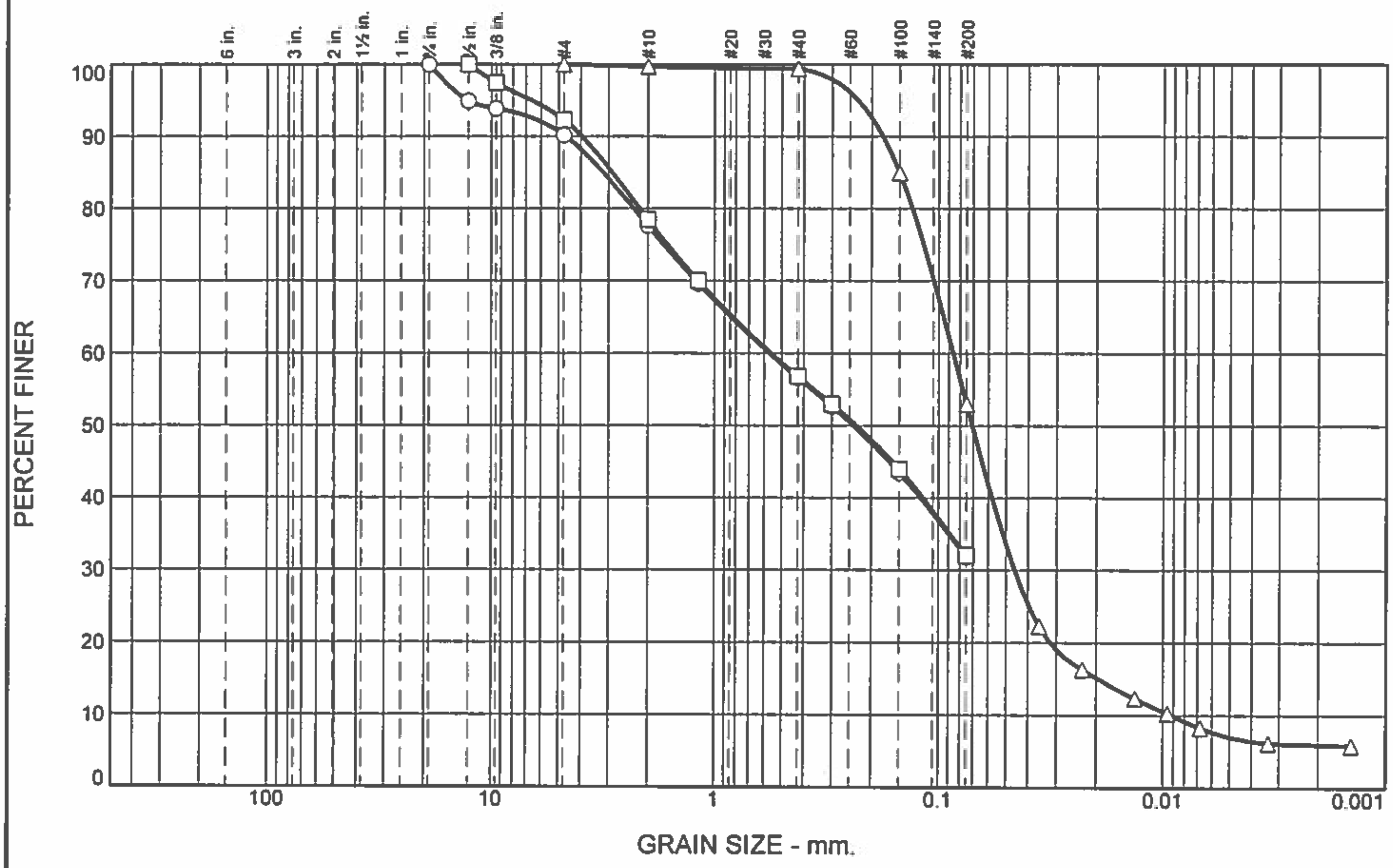
NEVADA DEPARTMENT OF TRANSPORTATION

Client: S. Jensen

Project: Minister Bridge (B-1615) Replacement

Project No.: EA 74141 Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	9.8	58.3	31.9		SC	A-2-6(2)	16	38
□	0.0	7.7	60.2	32.1					
△	0.0	0.0	47.0	47.0	6.0	ML	A-4(0)	24	27

SIEVE inches size	PERCENT FINER ○	□	△
3/4"	100.0		
1/2"	94.9	100.0	
3/8"	93.9	97.4	
	GRAIN SIZE		
D_{60}	0.5672	0.5588	0.0859
D_{30}			0.0457
D_{10}			0.0091
	COEFFICIENTS		
C_c			2.66
C_u			9.41

SIEVE number size	PERCENT FINER ○	□	△
#4	90.2	92.3	100.0
#10	77.6	78.5	99.7
#16	69.6	70.0	
#40	56.6	56.8	99.4
#50	52.7	53.0	
#100	43.5	44.0	84.9
#200	31.9	32.1	53.0

Material Description

○ clayey sand

□

△ sandy silt

REMARKS:

○

□

△

○ Source of Sample: EW-2	Depth: 2.5' - 4.0'	Sample Number: AA
□ Source of Sample: EW-2	Depth: 5.0' - 6.5'	Sample Number: BB
△ Source of Sample: EW-2	Depth: 7.5' - 9.0'	Sample Number: CC

NEVADA DEPARTMENT OF TRANSPORTATION

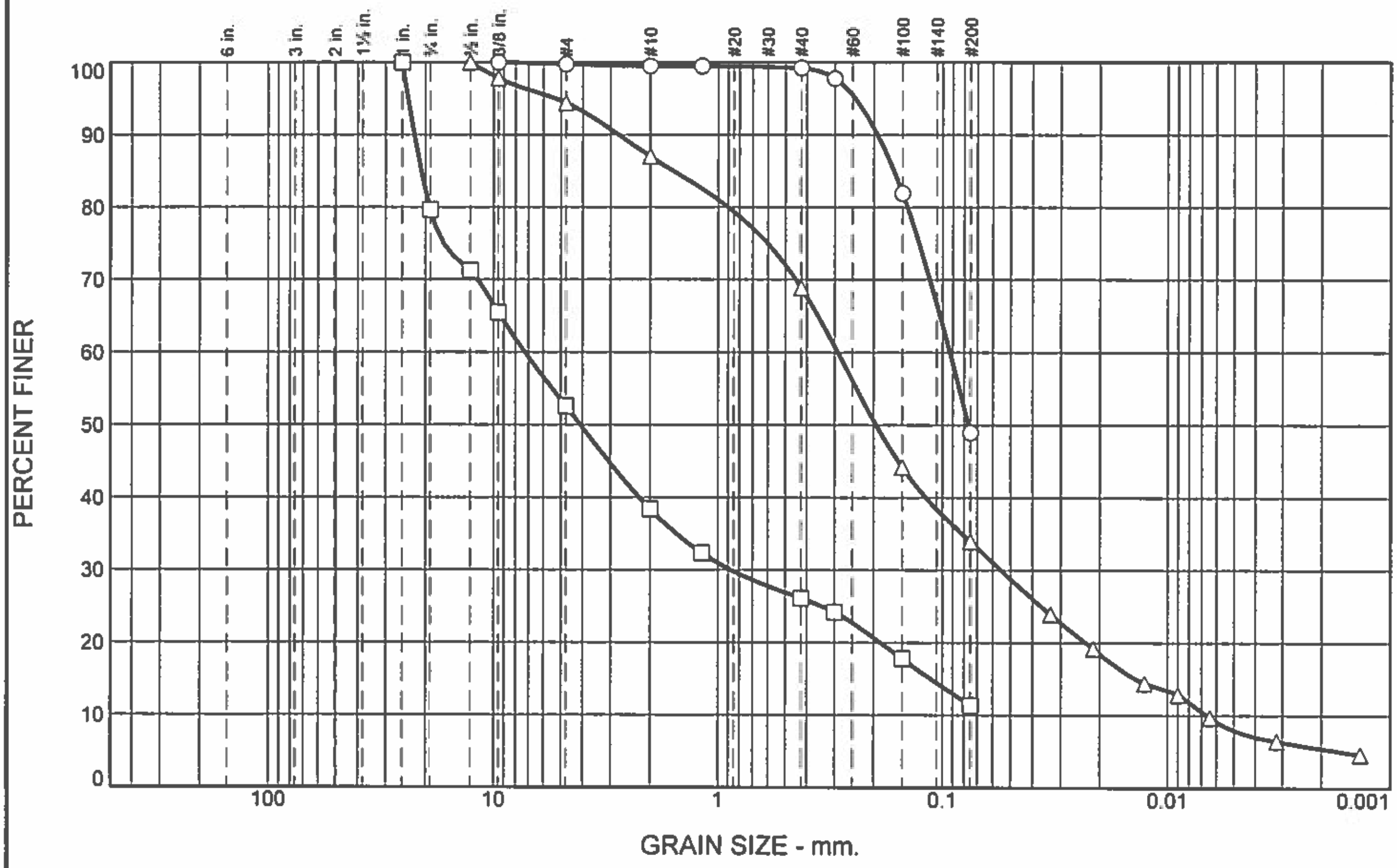
Client: S. Jensen

Project: Minister Bridge (B-1615) Replacement

Project No.: EA 74141

Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	0.3	50.7	49.0					
□	0.0	47.4	41.2	11.4					
△	0.0	5.6	60.4	28.6	5.4	SC	A-2-6(1)	15	31

SIEVE inches size	PERCENT FINER ○	□	△
1"		100.0	
3/4"		79.7	
1/2"		71.3	100.0
3/8"	100.0	65.5	97.8
	GRAIN SIZE		
D60	0.0927	7.2514	0.2907
D30		0.8739	0.0549
D10			0.0066
	COEFFICIENTS		
Cc			1.56
Cu			43.81

SIEVE number size	PERCENT FINER ○	□	△
#4	99.7	52.6	94.4
#10	99.5	38.4	87.0
#16	99.5	32.4	
#40	99.2	26.1	68.9
#50	97.8	24.2	
#100	81.9	17.8	44.2
#200	49.0	11.4	34.0

Material Description

○

□

△ clayey sand

REMARKS:

○

□

△

○ Source of Sample: EW-2 Depth: 10.0' - 10.35' Sample Number: DD1

□ Source of Sample: EW-2 Depth: 10.35' - 10.65' Sample Number: DD2

△ Source of Sample: EW-2 Depth: 15.0' - 16.5' Sample Number: EE

NEVADA DEPARTMENT OF TRANSPORTATION

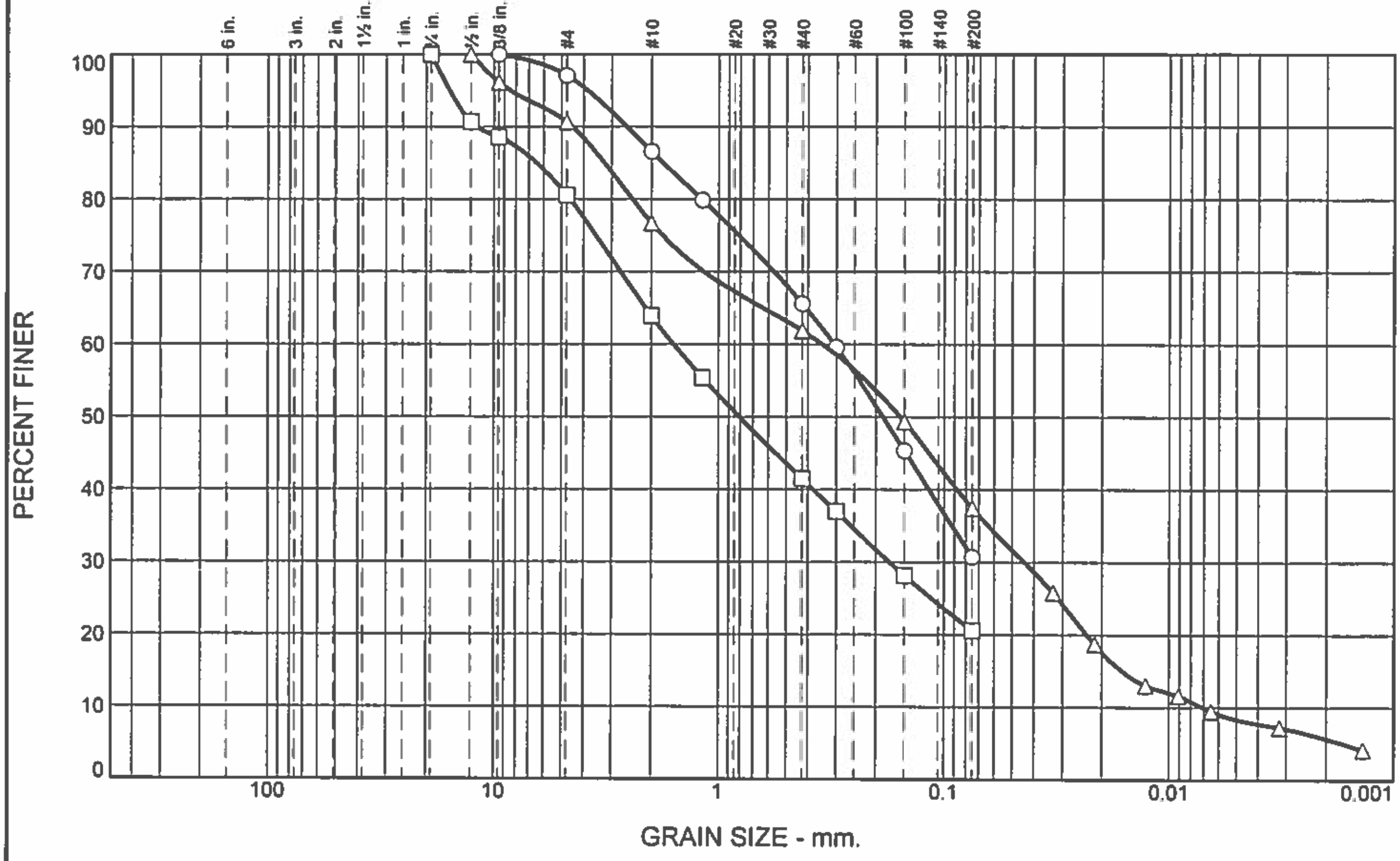
Client: S. Jensen

Project: Minister Bridge (B-1615) Replacement

Project No.: EA 74141

Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	2.9	66.4	30.7		SC	A-2-6(0)	24	37
□	0.0	19.4	60.0	20.6		SC	A-2-4(0)	21	29
△	0.0	9.4	53.1	31.8	5.7	SC	A-6(2)	18	35

SIEVE inches size	PERCENT FINER		
	○	□	△
3/4"		100.0	
1/2"		90.7	100.0
3/8"	100.0	88.6	96.1
	GRAIN SIZE		
D60	0.3066	1.5917	0.3462
D30		0.1742	0.0439
D10			0.0070
	COEFFICIENTS		
Cc			0.79
Cu			49.12

SIEVE number size	PERCENT FINER		
	○	□	△
#4	97.1	80.6	90.6
#10	86.6	63.9	76.7
#16	79.9	55.4	
#40	65.6	41.5	61.9
#50	59.6	37.0	
#100	45.3	28.2	49.3
#200	30.7	20.6	37.5

Material Description

○ clayey sand

□ clayey sand with gravel

△ clayey sand

REMARKS:

○

□

△

○ Source of Sample: EW-2 Depth: 17.5' - 17.9' Sample Number: FF1
□ Source of Sample: EW-2 Depth: 17.9' - 18.14' Sample Number: FF2
△ Source of Sample: EW-2 Depth: 20.0' - 21.5' Sample Number: GG

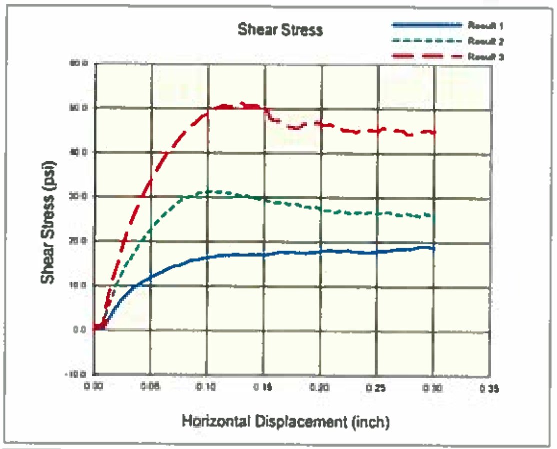
**NEVADA
DEPARTMENT OF
TRANSPORTATION**

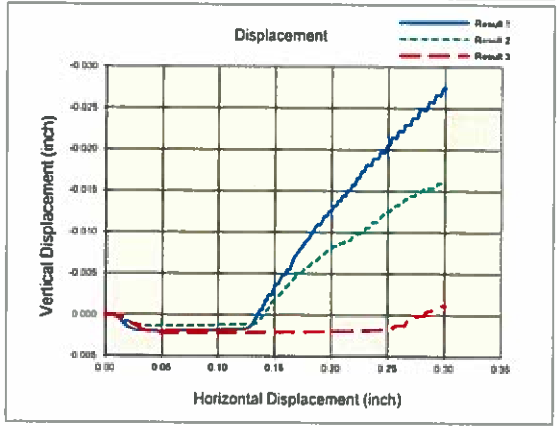
Client: S. Jensen
Project: Minister Bridge (B-1615) Replacement

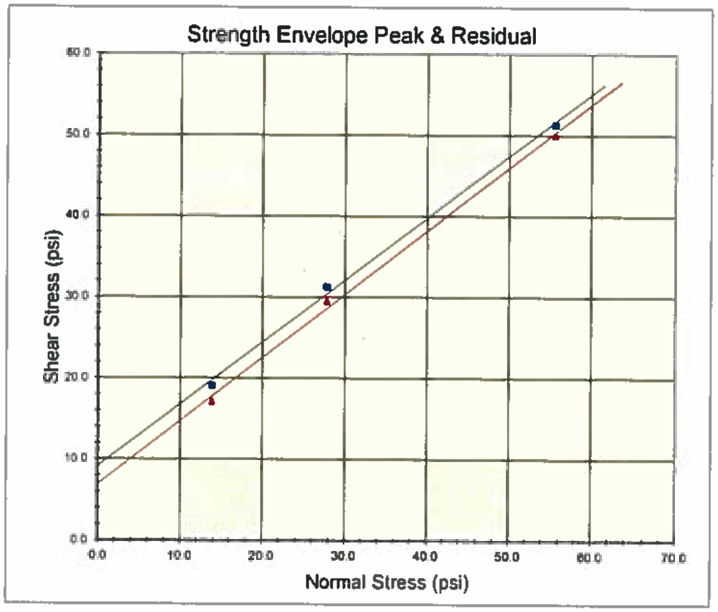
Project No.: EA 74141

Figure

DIRECT SHEAR TEST REPORT







Strength Parameters

	Peak		Residual
Friction Angle =	37	degrees	38
Cohesion =	9.14	psi	6.91

Project: FL-5-18 Boring: EW-1 Sample: C2

	Result 1	Result 2	Result 3
Specimen:	a	b	c
Date Tested	8/29/2018	8/27/2018	8/28/2018
Diameter (inch):	2.42	2.42	2.42
Height (inch):	1.00	1.00	1.00
Depth (ft):	8.00	8.00	8.00
Moisture (%)	14.2	13.8	13.5
Dry Unit Wt (pcf)	109.0	108.7	106.8
SHEAR			
Displacement Rate($^{in}/_{min}$)	0.0056	0.0055	0.0055
Normal Stress (psi)	13.88	27.74	55.54
Peak Shear Stress(psi)	19.11	31.31	51.30
Residual Shear Stress(psi)	17.1	29.5	50.0
Residual Point Picked @(in)	0.151	0.151	0.150
Time @ Peak Failure (min)	53.4	18.7	23.5

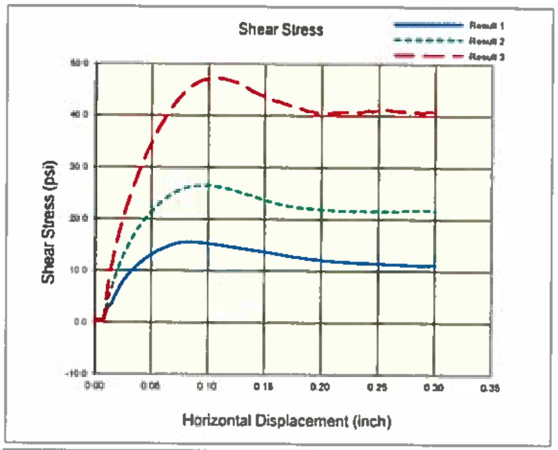
Specimen Comments

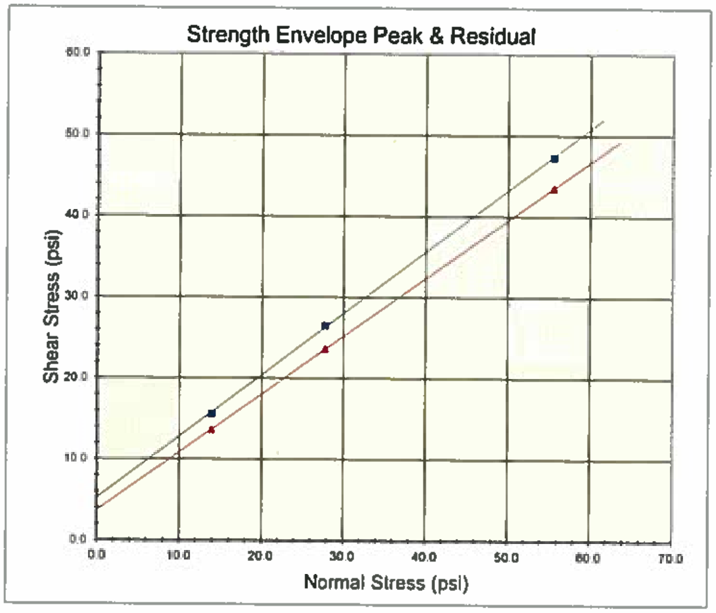
a Sheared @ 2,000 psf
b Sheared @ 4,000 psf
c Sheared @ 8,000 psf

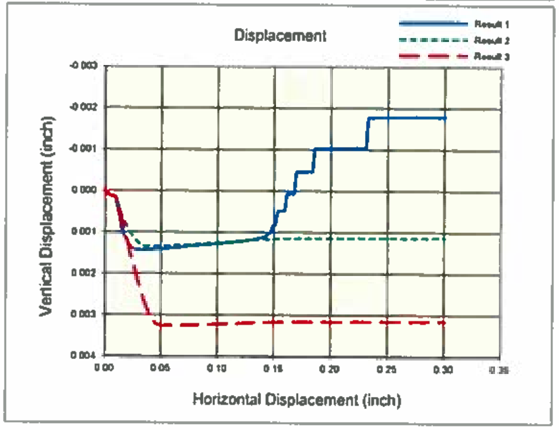
Geotechnical Section

NEVADA DOT

DIRECT SHEAR TEST REPORT







Strength Parameters

	Peak		Residual
Friction Angle =	37	degrees	36
Cohesion =	5.20	psi	3.70

Project: FL-5-18 Boring: EW-1 Sample: I2

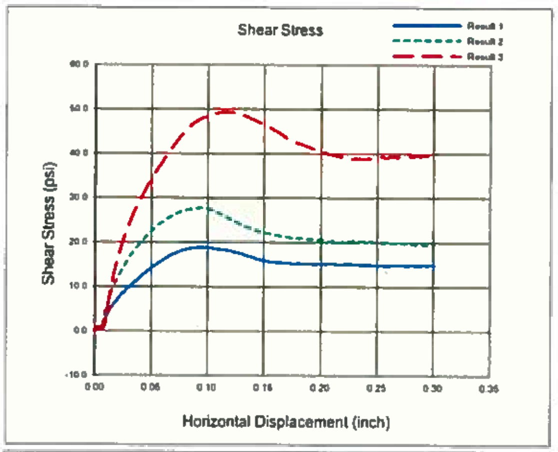
	Result 1	Result 2	Result 3
Specimen:	a	b	c
Date Tested	8/30/2018	8/31/2018	9/4/2018
Diameter (inch):	2.42	2.42	2.42
Height (inch):	1.00	1.00	1.00
Depth (ft):	20.50	20.50	20.50
Moisture (%)	19.5	18.9	19.2
Dry Unit Wt (pcf)	109.1	109.9	109.0
SHEAR			
Displacement Rate($^{in}/_{min}$)	0.0056	0.0054	0.0055
Normal Stress (psi)	13.88	27.75	55.55
Peak Shear Stress(psi)	15.57	26.54	47.31
Residual Shear Stress(psi)	13.7	23.6	43.5
Residual Point Picked @(in)	0.151	0.151	0.151
Time @ Peak Failure (min)	15.2	17.5	19.3

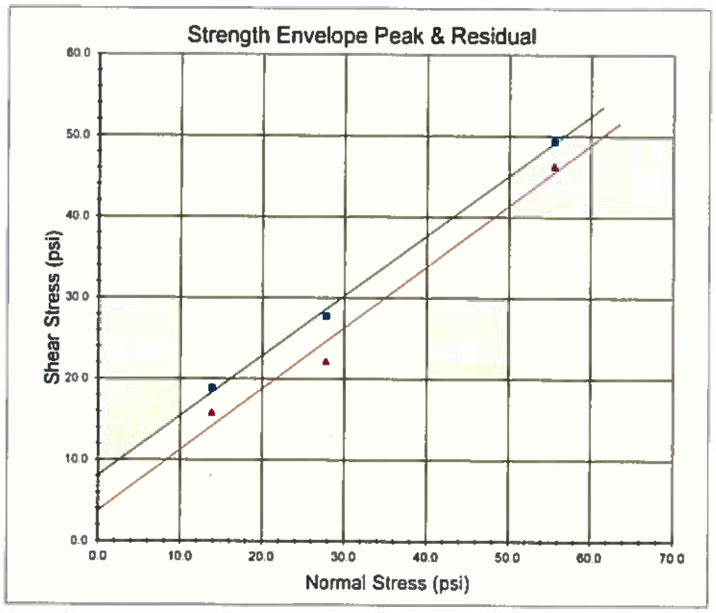
Specimen Comments

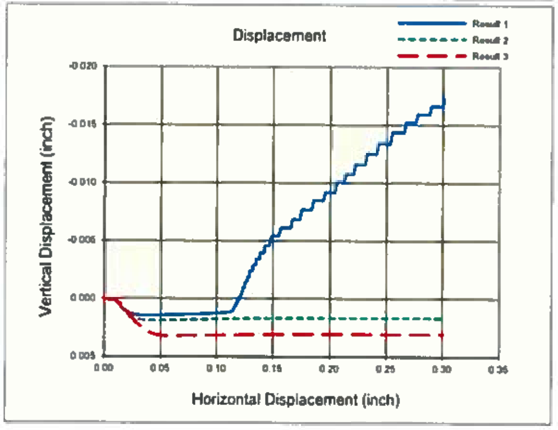
a	Sheared @ 2,000 psf
b	Sheared @ 4,000 psf
c	Sheared @ 8,000 psf

Geotechnical Section

DIRECT SHEAR TEST REPORT







Strength Parameters

	Peak		Residual
Friction Angle =	36	degrees	37
Cohesion =	8.09	psi	3.75

Project: FL-5-18 Boring: EW-1 Sample: I3

	Result 1	Result 2	Result 3
Specimen:	a	b	c
Date Tested	9/11/2018	9/12/2018	9/13/2018
Diameter (inch):	2.42	2.42	2.42
Height (inch):	1.00	1.00	1.00
Depth (ft):	21.00	21.00	21.00
Moisture (%)	16.4	17.9	17.3
Dry Unit Wt (pcf)	111.8	109.2	110.4
SHEAR			
Displacement Rate($^{in}/_{min}$)	0.0055	0.0055	0.0056
Normal Stress (psi)	13.85	27.74	55.55
Peak Shear Stress(psi)	18.86	27.76	49.39
Residual Shear Stress(psi)	15.8	22.2	46.4
Residual Point Picked @(in)	0.151	0.150	0.151
Time @ Peak Failure (min)	18.1	17.2	20.9

Specimen Comments

- a sheared @ 2,000 psf
- b Sheared @ 4,000 psf
- c Sheared @ 8,000 psf

Geotechnical Section
NEVADA DOT

NEVADA DEPARTMENT OF TRANSPORTATION
GEOTECHNICAL SECTION

CHEMICAL ANALYSIS

Contract No.: 74141

Project: Minister Bridge (B-1615) Replacement

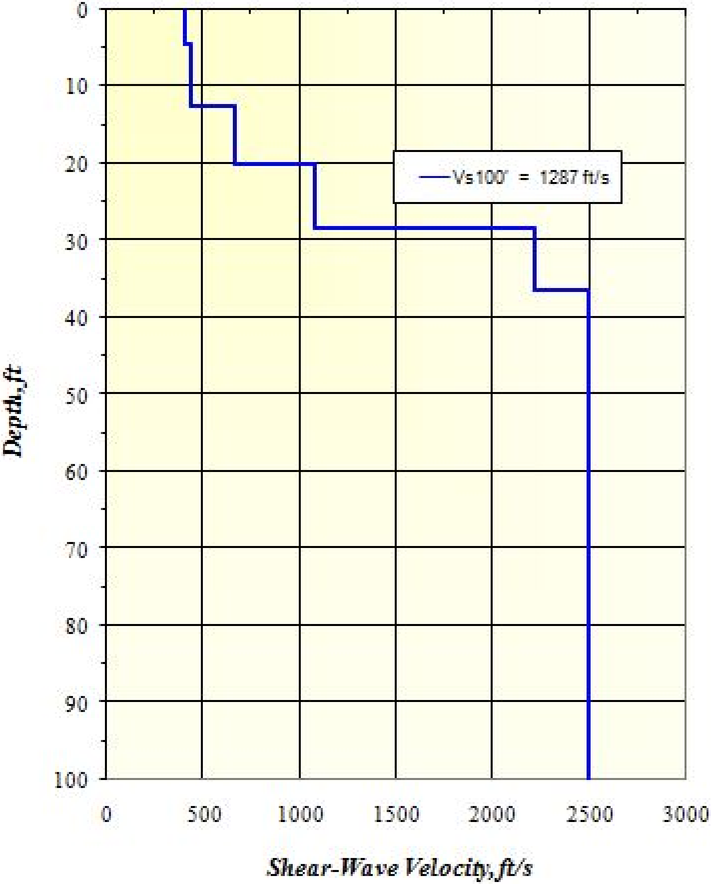
Sample ID	Date Tested	Chlorides ppm AASHTO T 291 A	Sulfates ppm AASHTO T 290 B	pH AASHTO T 289	Resistivity ohm - cm AASHTO T 288
EW-1a - 1	9/25/18	0	47	7.1	2,835

APPENDIX D

ReMi Geophysical Data

Shear Wave Velocity Profile

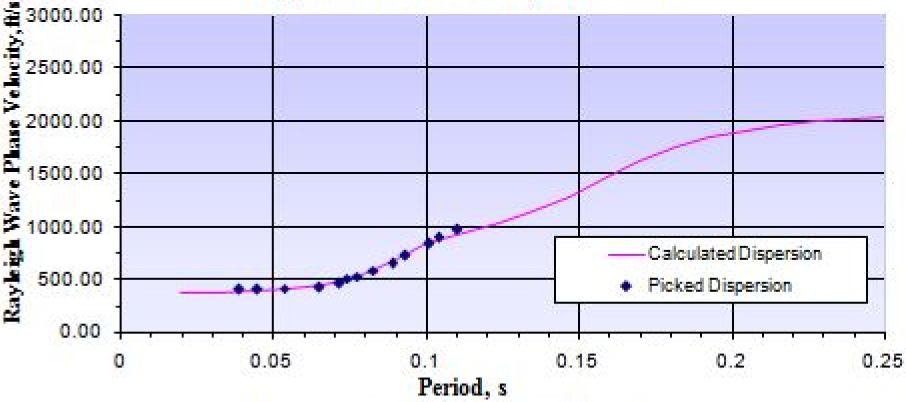
Minister Bridge Line-01



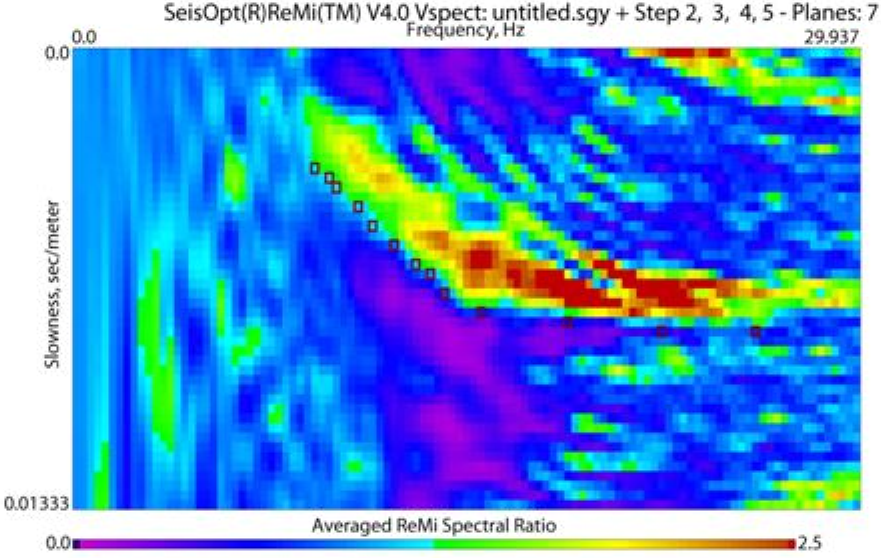
Dispersion Curve and Slowness Spectrum

Minister Bridge Line-01

Dispersion Curve Showing Picks and Fit

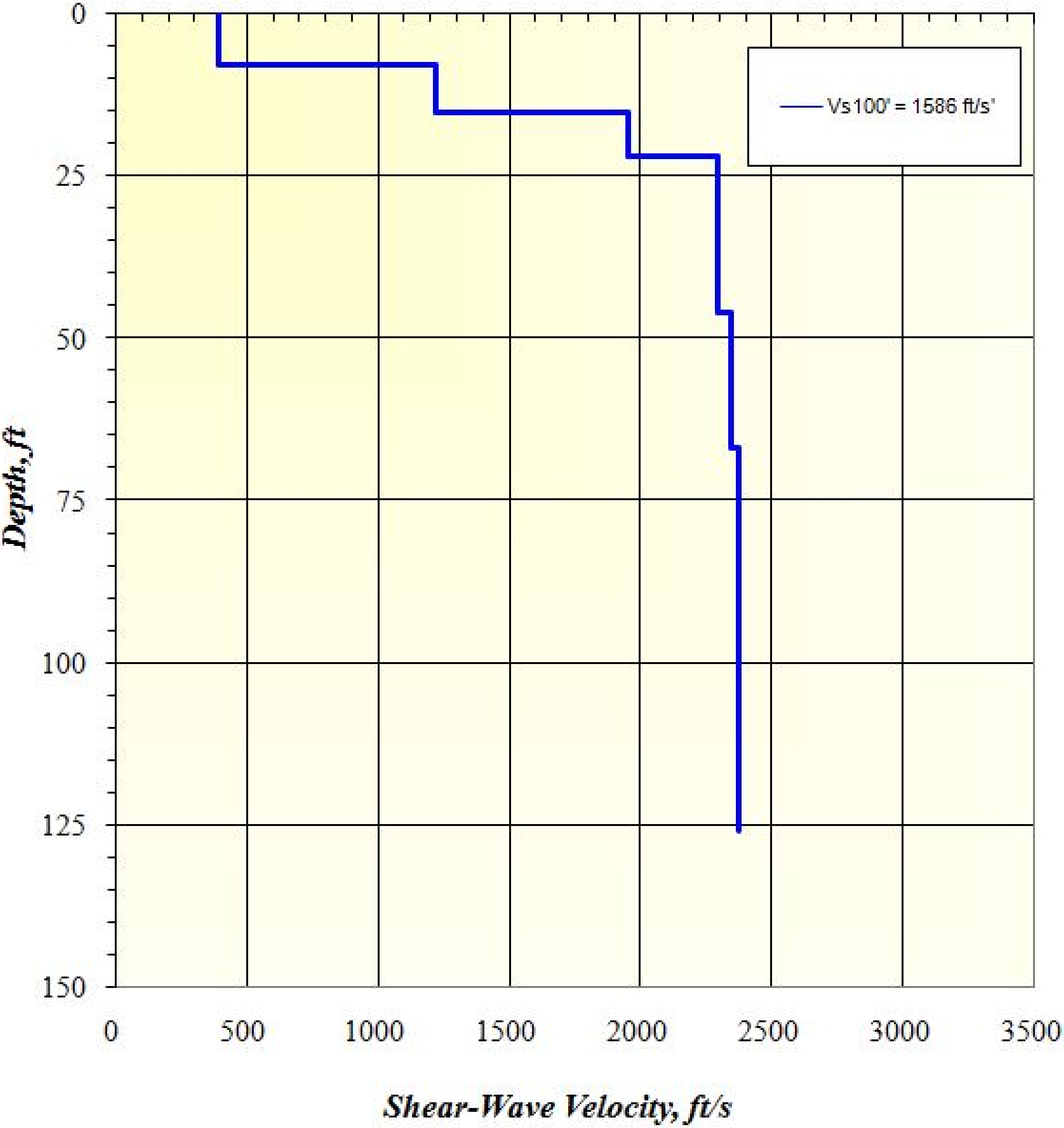


p-f Image with Dispersion Modeling Picks



Vs Model

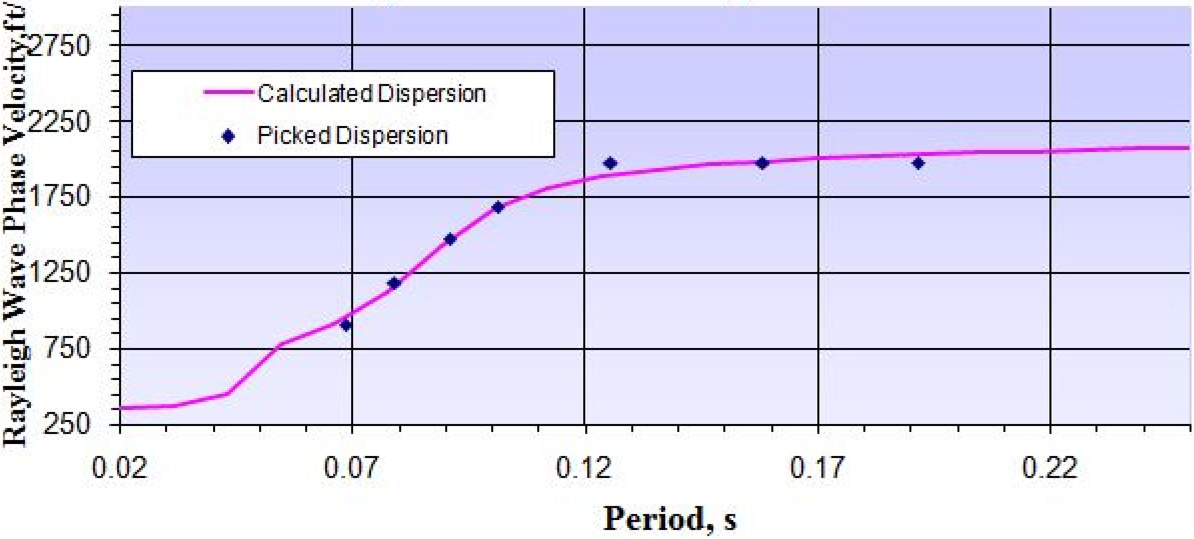
Minister Bridge Line-02



Dispersion Curve and Slowness Spectrum

Minister Bridge Line-02

Dispersion Curve Showing Picks and Fit



p-f Image with Dispersion Modeling Picks