Geotechnical Investigation

Burke Creek Highway 50 Crossing and Realignment Project

Stateline, Douglas County, Nevada

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Project No.: 8484.002

April 22, 2015

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

The project is located about 500 feet north of the intersection of US 50 and Kahle Drive in Stateline, Douglas County, Nevada, and consists of the realignment of Burke Creek. Improvements to be constructed include a new highway waterway crossing, realignment of the creek channel, and installation of stormwater treatment basins.

The soils in the stream realignment zone mainly consist of granular alluvium deposits generally classified as non-plastic, poorly-graded sand to silty sands. Similar subsurface soils were encountered near the proposed highway crossing, although this area appears to have been elevated with an embankment fill and is expected to include utility trenches. An appreciable increase in soil/rock stiffness was encountered at a depth near fifteen feet at each exploration location.

Perched or ponding groundwater was encountered at shallow depths in exploratory borings. It appears that the underlying weathered bedrock zone is acting as a very low permeability layer in localized areas. Wet alluvium was observed above the bedrock, and drive samples from within the weathered bedrock zone presented much lower moisture contents. At the highway crossing location, although encountered at 6+/- feet, groundwater did not daylight nor was observed in the embankment face towards the meadow. This presents the possibility that utility trenches parallel to the highway may be acting as a conduit for groundwater. During our exploration Burke Creek was active, which may have also contributed to our groundwater observations.

The TRPA Code of Ordinances' groundwater interception policies allow for the exception to groundwater interception if drainage structures are necessary to protect the structural integrity of an existing structure, or it is a necessary measure for the protection or improvement of water quality. Care shall be taken during construction to protect the environment against significant adverse effects from grading.

Sloughing soils and the need to dewater should be anticipated for the bulk of the project area. Removal of large root balls and existing vegetation may also present some grading issues. Additional slope stabilization above and beyond OSHA requirements may be warranted due to soil and groundwater conditions; especially since sandy soils have a tendency to slough or cave in the presence of groundwater.

1.0 INTRODUCTION

Presented herein are the results of Wood Rodgers' geotechnical exploration, laboratory testing, and associated geotechnical recommendations for the proposed Burke Creek Restoration and US 50 Crossing Project located in Stateline, Douglas County, Nevada. These recommendations are based on surface and subsurface conditions encountered in our explorations and on details of the proposed project as described in this report. The objectives of this study were to:

1. Determine general groundwater and soil conditions, including estimation of hydraulic conductivity, pertaining to design and construction of the proposed improvements.

2. Provide grading and excavation recommendations associated with channel restoration and culverts as related to these geotechnical conditions.

The area covered by this report is shown on Plate A-1 (Site Plan & Approximate Exploration Locations) in Appendix A. Our study included field exploration, laboratory testing, and engineering analyses to identify the physical and mechanical properties of the earth materials. Results of our field exploration and testing programs are included in this report and form the basis for all conclusions and recommendations.

2.0 PROJECT DESCRIPTION

This project consists of the realignment of Burke Creek stream channel both upstream and downstream of US 50. Phase I will include: culvert replacement across US 50, parking lot abandonment, and stream restoration upstream of the highway. Phase II includes stream channel realignment downstream of US 50 and installation of stormwater treatment basins. The limits of this geotechnical report are specific to the highway crossing and the upstream realignment of the stream channel.

The improvement areas are generally located within NDOT right-of-way, United States Forest Service (USFS) parcels, and Douglas County property. Proposed improvement depths typically extend to eight to ten feet below existing grade; however, deeper facilities, existing or proposed, may exist. All highway improvement construction shall meet the Standard Specifications for Road and Bridge Construction (2014 Silver Book, NDOT).

3.0 SITE CONDITIONS

The site is situated at the base of the northwestern flank of East Peak Mountain within the transition from granitic mountain slopes to depositional lands. Topography in the study corridor varies from moderately steep to slight, ranging from about 2 to 10 percent slopes extending downard toward lake terraces, meadow, and Lake Tahoe. Vegetation is variable within the proposed improvement area and ranges from native grasses, brush; pine and aspen trees surrounding the existing parking lot. Light wood debris and charred bark were encountered beneath the existing parking lot at a depth of four feet.

A significant portion of the stream channel improvements will be situated in the northern half of the existing parking lot. In this area, the pavement is badly deteriorated with many cracks and potholes. The pavement is bound by concrete curbing which is also badly deteriorated, broken, and lifted in areas. Surface drainage is generally directed to the south and east. During our investigation, we encountered a pavement section with an overall thickness of about six inches. From the surface downward, the pavement section is composed of:

- An 1 ½" overlay of asphaltic concrete (AC) with a paving fabric as a stress aborbing membrane interlayer;
- Two to three inches of aggregate base;
- Another 1 ½" layer of AC; directly overlying
- Native alluvium or fill.

The proposed US 50 culvert crossing is positioned directly to the west of the center of the northern portion of the parking lot. At this crossing, US 50 is a five-lane highway presenting an asphaltic concrete pavement surface. The east side of the highway surface is bound by concrete curb and gutter; the west side is confined by a granular shoulder fill and is elevated above the meadow to the west. The elevation difference on the west side of the highway is believed to be attributed to historic grading of the meadow area and limited embankment fills for the highway; based on our observations, the difference between meadow and highway surface is currently on the order of six to ten feet. The highway buffer zone to the parking lot is currently covered by various landscape sections including: landscape rock, concrete sidewalk, a few small trees, and grass; this area also includes the existing concrete pipe culvert which runs parallel to the highway for about 200 feet before the highway culvert is directed to the west.

Underground Service Alert (USA) was notified of our subsurface investigation, and provided locating services of underground utilities in the area. Public underground utiilities that were identified are mainly located parallel to and in the shoulder area on the west side of the highway, and include but are not limited to communications and dry utilities. Private utilities should be expected in the parking lot, and at least include power lines to light poles. No underground utilities were encountered in either of our subsurface explorations.

4.0 FIELD EXPLORATION

The project was explored on March 26, 2015 by advancing two exploratory borings using a CME-75 drill rig. The approximate locations of the test locations are shown on Plate A-1 – Site Plan and Approximate Exploration Locations. To be consistent with the limits of the planned improvement depths, the maximum depth of bore hole advance was 20 feet below the existing ground surface. Soil samples for index testing were collected from the bore holes at specific depths in the soil horizon.

Wood Rodgers' personnel examined and classified all soils in the field in general accordance with ASTM D 2488 (Description and Identification of Soils). During exploration, representative samples were placed in sealed plastic bags and returned to our Reno, Nevada laboratory for testing. Additional soil identification including Munsell soil color, as well as verification of the field classifications, were subsequently performed in accordance with ASTM 2487 (Unified Soil Classification System [USCS]) upon completion of laboratory testing. Descriptive logs of the exploratory borings are presented as Plate A-2a and A-2b in Appendix A. A USCS chart has been included as Plate A-3 - Unified Soil Classification and Key to Soil Descriptions.

The exploration was supplemented with a Refraction Microtremor (ReMi®) geophysical survey in the existing parking lot along the proposed stream realignment. ReMi measured the shear-wave and compression-wave velocities of the subsurface profile to the targeted depth of 35 feet below existing grade. The resulting two-dimensional profiles are presented as Plate A-5, and may be used to identify: depths to more competent units, indications as to excavation characteristics, and development of in-situ soil properties. The compression (P-wave) profile, shown in Figure 1 below, shows the location of boring B-2 relative to the geophysical survey. In general, the profile shows a ten to twenty foot thick layer of saturated soils (4,400 to 5,000 ft/s) overlying a competent zone of weathered rock exhibiting an average subsurface gradient about nine percent downward to the west. A deeper zone of weaker material was detected from about 35 feet to 60 feet along the survey alignment.

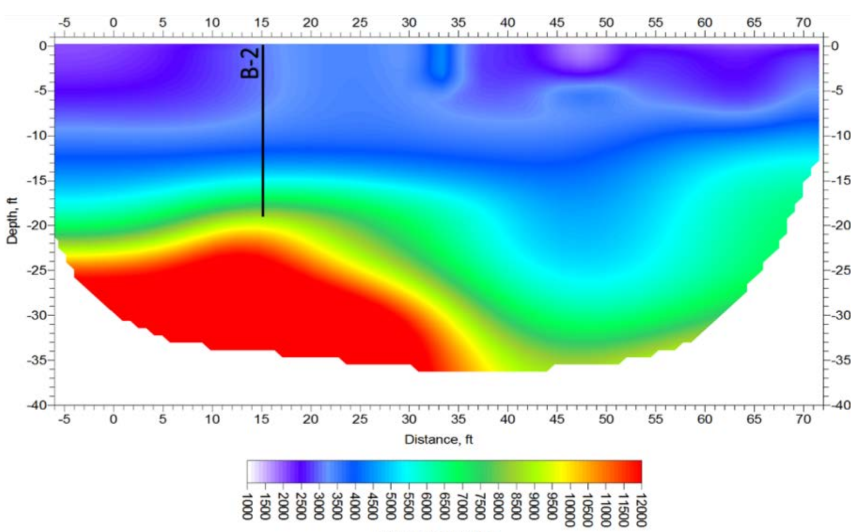

Figure 1 – Two-Dimensional Compression P-wave Profile

5.0 LABORATORY TESTING

All soil testing performed in the Wood Rodgers' laboratory is conducted in accordance with the standards and methods described in Volume 4.08 (Soil and Rock; Dimension Stone; Geosynthetics) of the ASTM Standards. Samples of significant soil types were analyzed to determine their in-situ moisture contents (ASTM D 2216), grain size distributions (ASTM D 6913), and plasticity indices (ASTM D 4318). Results of these tests are shown on Plate A-4a and A-4b – Summaries of Test Data. The test results were used to classify the soils according the USCS (ASTM D 2487) and to verify the field logs, which were then updated.

Table 1: Summary of Laboratory Test Results

	D 2487	D 6913				D 4318		
Sample ID	Soil Type	D_{10} (mm)	D_{60} (mm)	D_{100} (mm)	- #200 (%)	Liquid Limit	Plastic Limit	Plastic Index
B-1 5.0	SM	*0.01	0.29	4.75	28.6	36	31	5
B-1 10.0	SP-SM	0.105	1.65	19	7.1	NP	NP	NP
B-1 15.0	SP-SM	0.119	1.39	9.5	6.0	NP	NP	NP
B-2 2.5	SM	*0.01	0.26	19	30.3	NP	NP	NP
B-2 15.0	SP-SM	0.119	1.39	9.5	6.0	NP	NP	NP

*Extrapolated value developed for K_{sat} correlation.

6.0 GEOLOGIC AND GENERAL SOIL AND GROUNDWATER CONDITIONS

Based on the Geologic Map of the Lake Tahoe Basin published by the California Geological Survey (Figure 2), the site is mapped in area of geologic transition from Granodiorite of East Peak (Keg) to Lacustrine terrace deposits (Qlt) and Alluvium (Q). The soil units encountered in our explorations typically consisted of silty sand with varying amounts of gravel, sand, and silt. Consistent with our borings and geophysical measurements, soil/rock stiffness and competency increases at depths approaching 15 feet.

The bedrock that lies underneath the meadows and forests of Burke Creek is a slightly to moderately weathered granodiorite, which is among the oldest rock in the Tahoe area. The granodiorite formed in a large batholith intrusion during the Cretaceous period; slow even cooling in the batholith allowed medium to coarse grained phaneritic crystals to form. These crystals include (in order of highest to lowest percentage) plagioclase, quartz, microcline, biotite, pyrite, and mafics.

Overlying the bedrock is the Burke Creek fluvial system, occurring as a saturated wet meadow. The wet meadow consists predominantly of granular alluvial deposits which have undergone redoximorphic color reduction. This is likely a result of the creek having a low gradient and the flows mainly transporting fine sands. The shallow gradient of the wet meadow also causes the surrounding area to become saturated which contributes to an anaerobic environment allowing for reduction of the iron in the soil. With the granodiorite being the primary source rock for the soils in the wet meadow, the potential for reduction of the soil is likely enhanced due to the considerable pyrite content. Pyrite is an iron sulfide; when sulfates are released from decomposing pyrite and combined with water, sulfuric acid is formed. This is known as acid rock drainage and may act as a reducing fluid within the wet meadow soils. The potential for this condition is bolstered by a measured pH of 5.0 for soils in the upper four feet of the profile.

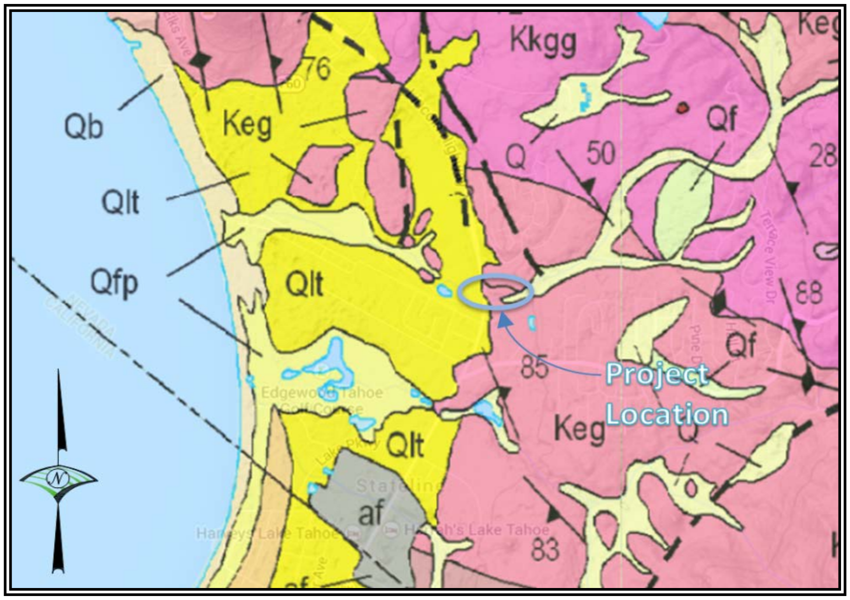

Figure 2 – Geologic Map of Burke Creek Area

Perched or ponding groundwater was encountered at depths of six and three feet below ground surface in exploratory borings B-1 and B-2, respectively. It appears that the underlying weathered bedrock zone is acting as a practically impervious layer in localized areas, as wet alluvium was observed above the bedrock, and drive samples from within the weathered bedrock zone presented much lower moisture contents. At the highway crossing location, no daylight of groundwater was observed towards the embankment and meadow. This indicates the possibility that utility trenches parallel to the highway may be acting as a conduit for groundwater. During our exploration Burke Creek was active, which may have also contributed to our groundwater observations.

7.0 DISCUSSION AND RECOMMENDATIONS

The recommendations provided herein along with proper design and construction of the planned improvements, work together as a system to improve overall performance. If any aspect of this system is ignored or poorly implemented, the performance of the project will suffer. Any evaluation of the site for the presence of surface or subsurface hazardous substances is beyond the scope of this study. When suspected hazardous substances are encountered during routine geotechnical investigations, they are noted in the exploration logs and reported to the client. No such substances were identified during our exploration.

7.1 Excavations and Trenching

Based on the results of our exploration, it is our opinion that the site soils appear to be predominantly OSHA Soil Type C, although variations exist. Areas with very loose, poorly-graded, wet sand and silty sand were encountered, and due to their cohesionless and saturated condition, are expected to possess a low unconfined compressive strength. Therefore, additional slope stabilization above and beyond OSHA requirements may be warranted. Bank stability is the responsibility of the contractor, who is present at the site, able to observe changes in ground conditions and has control over personnel and equipment.

7.2 Highway Creek Crossing

The waterway opening for the highway creek crossing is currently in the preliminary design phase with two options being discussed; an open-bottom archway or a pipe culvert. With either option, invert elevations are expected to be on the order of eight to ten feet below the roadway surface. Based on the subsurface soil profile encountered in exploratory boring B-1, the foundation materials at this elevation excavated as dense sandy soils which should allow for the use of shallow foundations or trenching, as needed.

7.2.1 Foundations

An allowable bearing capacity of the foundation soils at a depth of ten feet may be estimated at 4,000 pounds per square foot, provided NDOT Silver Book Structure Excavation and Backfill specifications are adhered to. This preliminary estimate is based on a continuous footing, a minimum of two feet wide, bearing on cohesionless soils. Hydraulic design considerations, including scour potential, should account for the protection of foundation elements by means of erosion protection, flow control, and regular maintenance of the channel and culvert inlet.

7.2.2 Lateral Earth Pressure

Lateral loads, such as wind or seismic, may be resisted by passive soil pressure and friction on the bottom of the footing. The recommended coefficient of base friction is 0.4 and has been reduced by a factor of 1.5 on the ultimate soil strength. Lateral earth pressures imposed on retaining walls are dependent on the relative rigidity and movement of the structure, soil type, and moisture conditions behind the wall. Recommended lateral earth pressures are presented in Table 1 – Lateral Earth Pressures.

Table 2 – Lateral Earth Pressures

Wall Type	Lateral Earth Pressure (psf/f)
Restrained Wall resisting At-Rest Pressure	55
Rotation of wall face to allow full development of Static Active Pressure	38
Static Passive Pressure	375
Combined Static & Dynamic – Driving Wedge	90
Combined Static & Dynamic – Resisting Wedge	250

Wall backfill shall be granular material meeting the specification of NDOT Silver Book (704.03.11). Excessive pressures can be developed due to heavy compaction equipment during backfill placement. Therefore, all backfill behind any retaining structures should be screened to 3" minus and shall be compacted to not less than 90 percent relative compaction. Due care must be exercised during compaction to avoid build-up of excessive pressures. The values presented in Table 2 do not take into account hydrostatic pressures. French drains, a drainage backfill geotextile such as Mirafi 140 N, or a pre-manufactured drain system such as Tensor® DC1200 may be used if hydrostatic pressure buildup is possible.

7.2.3 Soil Corrosivity

Chemical soil screening was performed on a composite soil sample obtained from exploratory boring B-1. The results are presented on Plate A-6. Based on American Concrete Institute exposure categories, the sulfate exposure may be considered negligible; however, the pH value indicates an acidity level near the NDOT specification for concrete culverts and below the specification range for steel culverts. This may require an import backfill be used in the zone surrounding the proposed culvert. The NDOT Specification for granular backfill is presented in Table 3:

Table 3 – NDOT Specification 704.03.11 for Granular Backfill			
Sieve Size	**Percent Passing by Mass**		
75 mm (3 in.)	100		
4.75 mm (No. 4)	35 - 100		
600 µm (No. 30)	20 - 100		
75 µm (No. 200)	0 - 12		
Project Control Tests	**Test Method**	**Requirements**	
Sieve Analysis	Nev. T206	Above	
Sampling Aggregate	Nev. T200	-	
Liquid Limit	Nev. T210	35 Max.	
Plasticity Index	Nev. T212	10 Max	
Source Requirement Tests	**Test Method**	**Culverts and Structures (Concrete) Culverts (Aluminum & Plastic) Requirements**	**Culverts (Steel) Requirements**
pH Value	AASHTO T289	5.0 to 9.5	6.0 to 9.0
Resistivity	AASHTO T288	1000 ohm*cm Min.	2000 ohm*cm Min.

7.3 Hydraulic Conductivity Predictions

A variety of empirical methods have been developed to predict saturated hydraulic conductivity of soils based on grain-size analysis, laboratory tests, and field tests. One of the most simple and commonly used approaches is the Hazen equation which utilizes the results from grain-size analysis to estimate saturated hydraulic conductivity[1]. The grain-size method will give an order-of-magnitude estimate for soils that are relatively coarse-grained, i.e. sands and some silty sands; however, judgement must be used to account for in-situ conditions such as: soil texture, soil consistency, depth to groundwater and/or bedrock, or other geologic conditions. The non-plastic silty sands beneath the parking lot are very loose to loose; therefore, the soil matrix presents good drainage conditions. Using the Hazen equation, the coefficient of permeability for these sands may be estimated to be on the order of 10^{-2} centimeters per second (cm/s). Based on NRCS Web Soil Survey research, the minor site soils and individual layers may present saturated hydraulic conductivity values as quick as 10^{-1} cm/s; however overall, the soils in the upper five feet are expected to present a rating of 10^{-2} to 10^{-3} cm/s.

The bedrock underlying the site appears to present a low permeability below the extent of weathering. Although the bedrock may prove to be excavatable, the in-situ coefficient of permeability[2] may be estimated to be on the order of 10^{-6} to 10^{-7} cm/s. These values are intended to provide a general k_{sat} estimate based on the conditions observed; subsurface variations and percolation losses caused by sediment deposition over time will influence these values. If a more refined approach is necessary for hydraulic modelling, field data should be collected for representative in-situ percolation or steady-state infiltration rates per the applicable

[1] Hazen Equation: k_{sat} (cm/s) = $(D_{10})^2$; where D_{10} is in mm.
[2] Bureau of Reclamation, Earth Manual.

standard test methods. The Guelph permeameter is an instrument typically used to measure in-situ hydraulic conductivity and is supported by the standard ASTM D5126.

8.0 STANDARD LIMITATION CLAUSE

This report has been prepared in accordance with generally accepted local geotechnical practices. Test results, analyses, and recommendations submitted are based upon field exploration performed and the conditions encountered as discussed in our report. This report does not reflect soil variations that may become evident during the construction period, at which time re-evaluation of the recommendations or additional testing may be necessary. We recommend our firm be retained to perform construction observation in all phases of the project related to geotechnical factors to document compliance with construction standards and our recommendations.

This report was prepared by Wood Rodgers, Inc. for the benefit of Nevada Tahoe Conservation District. The material in it reflects Wood Rodgers' best judgment in light of the information available to it at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Wood Rodgers' accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

9.0 REFERENCES

American Society for Testing and Materials (ASTM), 1993, *Soil and Rock; Dimension Stone; Geosynthetics,* Volume 4.08.

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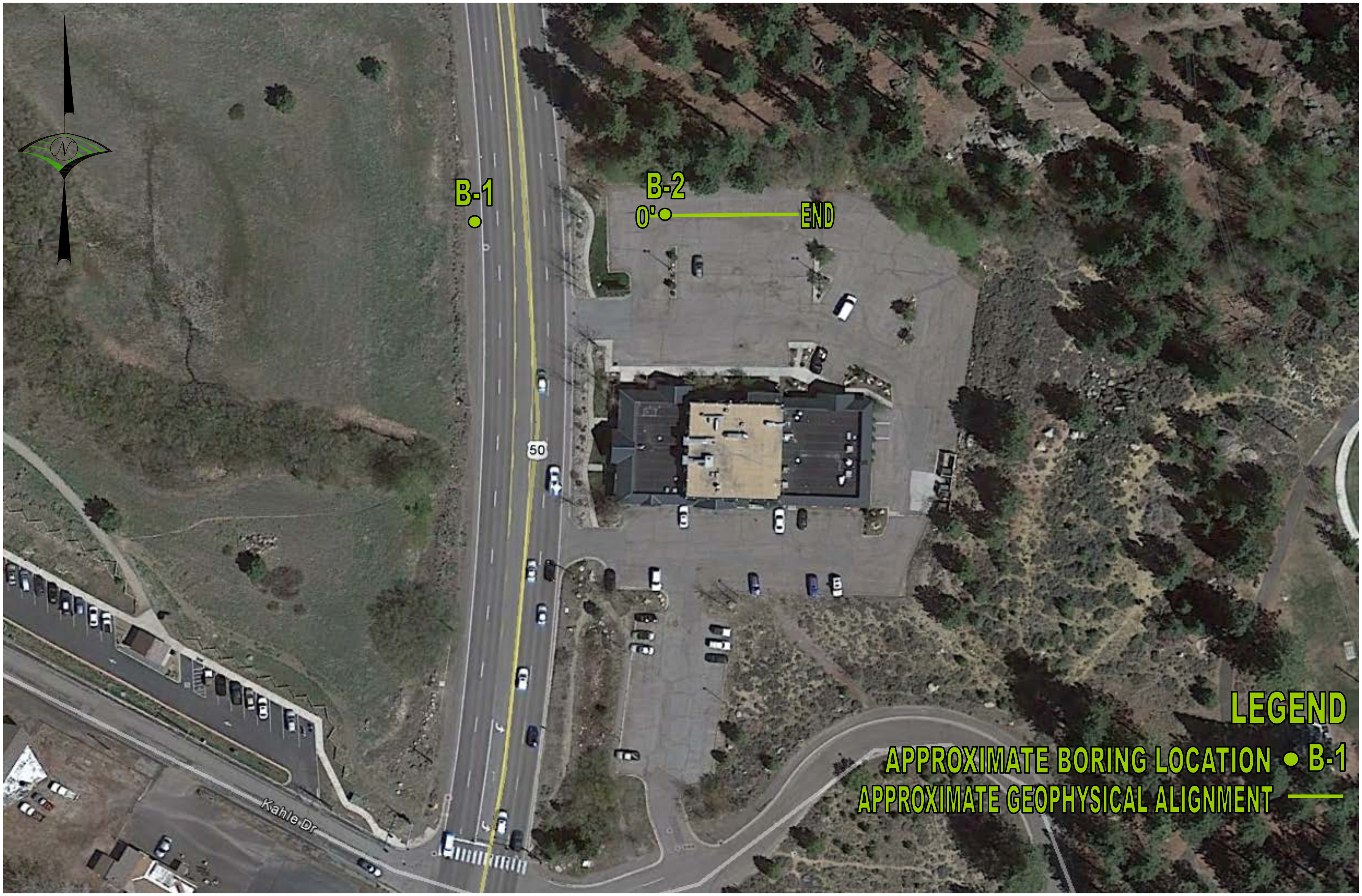

Reference: Google Earth Imagery, date 4/2014.

WOOD RODGERS 5440 Reno Corporate Drive, Reno, NV 89511 Phone 775.823.4068 Fax 775.823.4066	**SITE PLAN AND APPROXIMATE EXPLORATION LOCATIONS**	***Geotechnical Investigation*** ***BURKE CREEK HIGHWAY 50 CROSSING and REALIGNMENT*** ***STATELINE, NEVADA*** Project No.: 8484.001 Date: 04/09/15 **PLATE A-1**

Wood Rodgers, Inc.
5440 Reno Corporate Drive
Reno, NV 89511
Telephone: 775-823-4068
Fax: 775-823-4066

BORING NUMBER B-1

CLIENT Nevada Tahoe Conservation District
PROJECT NAME Burke Creek Highway 50 Crossing and Realignment Project
PROJECT NUMBER 8484.002
PROJECT LOCATION Stateline, Nevada
DATE STARTED 3/26/15 **COMPLETED** 3/26/15
GROUND ELEVATION Shoulder **HOLE SIZE** 4 inches
DRILLING CONTRACTOR PC Exploration
GROUND WATER LEVELS:
DRILLING METHOD CME 75
▽ **AT TIME OF DRILLING** 6.0 ft
LOGGED BY Blake Carter **CHECKED BY** Blake Carter
▼ **AT END OF DRILLING** 6.0 ft
NOTES: Backfilled with cuttings
▼ **AFTER DRILLING** 6.0 ft

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	R-VALUE	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		FILL - GRAVEL SHOULDER - POORLY GRADED SAND WITH GRAVEL, (SP) medium dense to dense, dry, grayish brown										
		SILTY SAND, (SM) very loose to loose, moist to wet, grayish black, (Gley 1 / 2.5 / N)	SPT 1A		7-4-4 (8)							
5		▼ Reddish gray (2.5Y 5/1)	SPT 1B		3-3-3 (6)		105	30.6	36	31	5	28.6
			SPT 1C		2-2-2 (4)							
10		POORLY GRADED SAND WITH SILT, (SP-SM) dense, wet to moist, light brown (7.5YR 5/6)	SPT 1D		21-15-21 (36)		105	12.0	NP	NP	NP	7.1
15		BEDROCK, GRANODIORITE, slightly to moderately weathered, weak to moderately strong increasing with depth, intensely fractured; excavates as a Poorly Graded Sand with Silt (SP-SM), very dense, moist, gray (Gley / 6 / N)	SPT 1E		13-25-50 (75)		130	12.0	NP	NP	NP	6.0
20												

Bottom of Borehole at 20.0 Feet.

Wood Rodgers, Inc.
5440 Reno Corporate Drive
Reno, NV 89511
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Fax: 775-823-4066

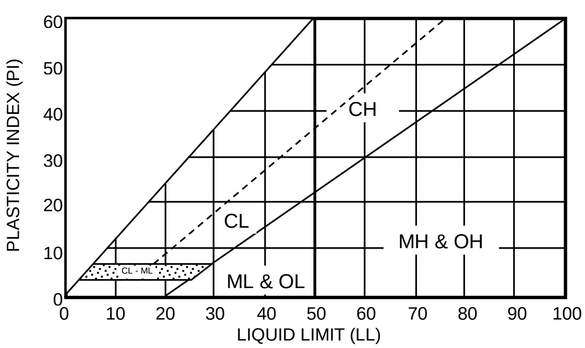
BORING NUMBER B-2

CLIENT Nevada Tahoe Conservation District
PROJECT NAME Burke Creek Highway 50 Crossing and Realignment Project
PROJECT NUMBER 8484.002
PROJECT LOCATION Stateline, Nevada
DATE STARTED 3/26/15 **COMPLETED** 3/26/15
GROUND ELEVATION Lot **HOLE SIZE** 4 inches
DRILLING CONTRACTOR PC Exploration
GROUND WATER LEVELS:
DRILLING METHOD CME 75
▽ **AT TIME OF DRILLING** 3.0 ft
LOGGED BY Blake Carter **CHECKED BY** Blake Carter
▼ **AT END OF DRILLING** 3.0 ft
NOTES: Backfilled with cuttings, sealed w/grout
▼ **AFTER DRILLING** 3.0 ft

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	R-VALUE	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	FINES CONTENT (%)
0		ASPHALT CONCRETE										
		SILTY SAND WITH GRAVEL, (SM) medium dense, wet, dark gray, (Gley 1 / 4 / 1)										
		▼	SPT 2A		7-11-18 (29)		105	16.6	NP	NP	NP	30.3
		SILTY SAND, (SM) very loose to loose, moist to wet, very dark gray, (Gley 1 / 3/ N)										
5			SPT 2B		6-8-12 (20)							
			SPT 2C		2-2-2 (4)							
10			SPT 2D		3-10-19 (29)							
			SPT 2E		17-20-24 (44)		105		NP	NP	NP	
15		BEDROCK, GRANODIORITE, slightly to moderately weathered, weak to moderately strong increasing with depth, intensely fractured; excavates as a Poorly Graded Sand with Silt (SP-SM), very dense, moist, gray (Gley / 6 / N)	SPT 2F		21-30-50 (80)		130	12.0	NP	NP	NP	6.0
20												

Bottom of Borehole at 20.0 Feet.

MAJOR DIVISION				TYPICAL NAMES
COARSED-GRAINED SOILS MORE THAN HALF IS COARSER THAN NO. 200 SIEVE	**GRAVEL** MORE THAN HALF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE	CLEAN SANDS WITH LITTLE OR NO FINES	GW	WELL GRADED GRAVELS WITH OR WITHOUT SAND, LITTLE OR NO FINES
			GP	POORLY GRADED GRAVELS WITH OR WITHOUT SAND, LITTLE OR NO FINES
		GRAVELS WITH OVER 12% FINES	GM	SILTY GRAVELS, SILTY GRAVELS WITH SAND
			GC	CLAYEY GRAVELS, CLAYEY GRAVELS WITH SAND
	SAND MORE THAN HALF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE	CLEAN SANDS WITH LITTLE OR NO FINES	SW	WELL GRADED SANDS WITH OR WITHOUT GRAVEL, LITTLE OR NO FINES
			SP	POORLY GRADED SAND WITH OR WITHOUT GRAVEL, LITTLE OR NO FINES
		SANDS WITH OVER 12% FINES	SM	SILTY SANDS WITH OR WITHOUT GRAVEL
			SC	CLAYEY SANDS WITH OR WITHOUT GRAVEL
FINE-GRAINED SOILS MORE THAN HALF IS FINER THAN NO. 200 SIEVE	**SILT AND CLAY** LIQUID LIMIT 50% OR LESS		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTS WITH SANDS AND GRAVELS
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY CLAYS WITH SANDS AND GRAVELS, LEAN CLAYS
			OL	ORGANIC SILTS OR CLAYS OF LOW PLASTICITY
	SILT AND CLAY LIQUID LIMIT GREATER THAN 50%		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOLID, ELASTIC SILTS
			CH	INORGANIC CLAYS OR HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC SILTS OR CLAYS MEDIUM TO HIGH PLASTICITY
HIGHLY ORGANIC SOILS			Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS



CONSISTENCY		RELATIVE DENSITY	
SILTS & CLAYS	SPT BLOW* COUNTS (N)	SANDS & GRAVELS	SPT BLOW* COUNTS (N)
VERY SOFT	0 - 2	VERY LOOSE	0 - 4
SOFT	3 - 4	LOOSE	5 - 10
MEDIUM STIFF	5 - 8	MEDIUM DENSE	11 - 30
STIFF	9 - 15	DENSE	31 - 50
VERY STIFF	16 - 30	VERY DENSE	50 +
HARD	30 +		

* The Standard Penetration Resistance (N) In blows per foot is obtained by the ASTM D1585 procedure using 2" O.D., 1 3/8" I.D. samplers.

DESCRIPTION OF ESTIMATED PERCENTAGES OF GRAVEL, SAND, AND FINES	
TRACE	Particles are present but est. < 5%
FEW	5% - 10%
LITTLE	15% - 20%
SOME	30% - 45%
MOSTLY	50% - 100%

NOTE: Percentages are presented within soil description for soil horizon with laboratory tested soil samples.

DEFINITIONS OF SOIL FRACTIONS	
SOIL COMPONENT	PARTICLE SIZE RANGE
COBBLES	ABOVE 3 INCHES
GRAVEL	3 IN. TO NO. 4 SIEVE
COARSE GRAVEL	3 IN. TO 3/4 IN.
FINE GRAVEL	3/4 IN. TO NO. 4 SIEVE
SAND	NO. 4 TO NO. 200
COARSE SAND	NO. 4 TO NO. 10
MEDIUM SAND	NO. 10 TO NO. 40
FINE SAND	NO. 40 TO NO. 200
FINES (SILT OR CLAY)	MINUS NO. 200 SIEVE

WOOD RODGERS
5440 Reno Corporate Drive, Reno, NV 89511
Phone 775.823.4068 Fax 775.823.4066

UNIFIED SOIL CLASSIFICATION AND KEY TO SOIL DESCRIPTIONS

Geotechnical Investigation

BURKE CREEK HIGHWAY 50 CROSSING and REALIGNMENT STATELINE, NEVADA

Project No.: 8484.001
Date: 04/09/15

PLATE A-3

Wood Rodgers, Inc.
5440 Reno Corporate Drive
Reno, NV 89511
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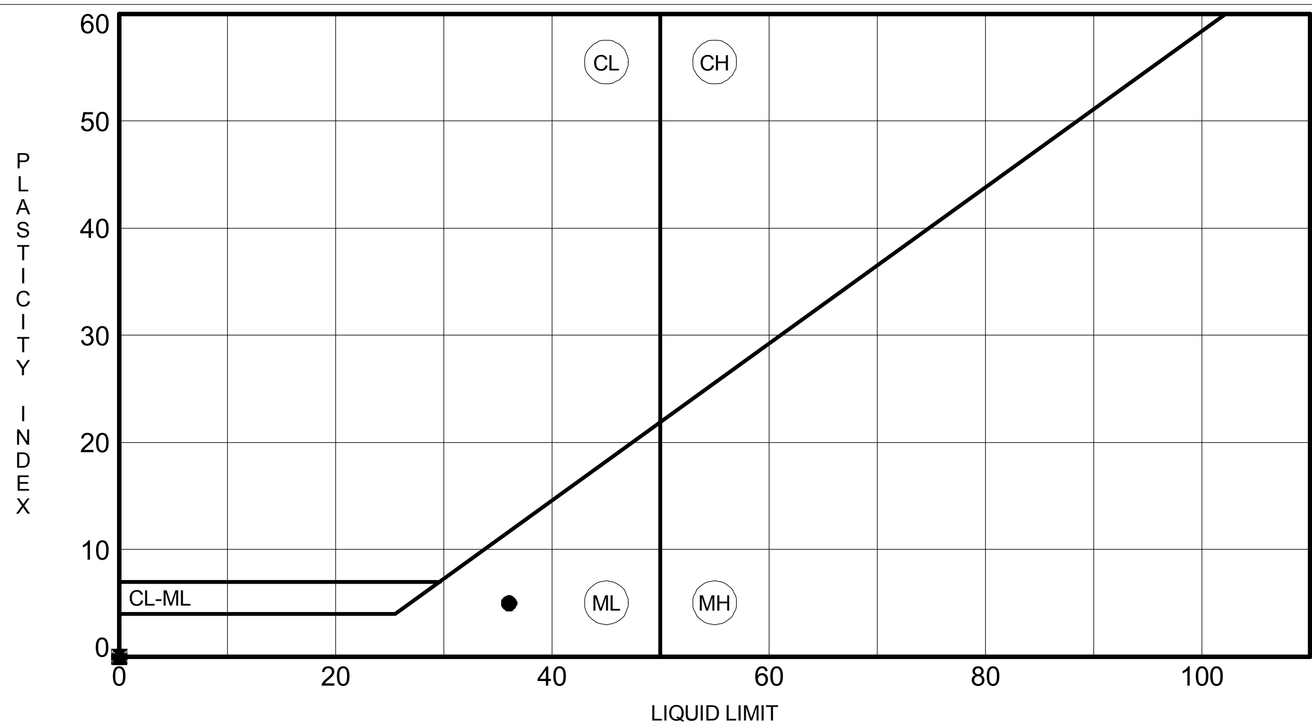
Fax: 775-823-4066

ATTERBERG LIMITS' RESULTS

CLIENT Nevada Tahoe Conservation District
PROJECT NAME Burke Creek Highway 50 Crossing and Realignment Project
PROJECT NUMBER 8484.002
PROJECT LOCATION Stateline, Nevada



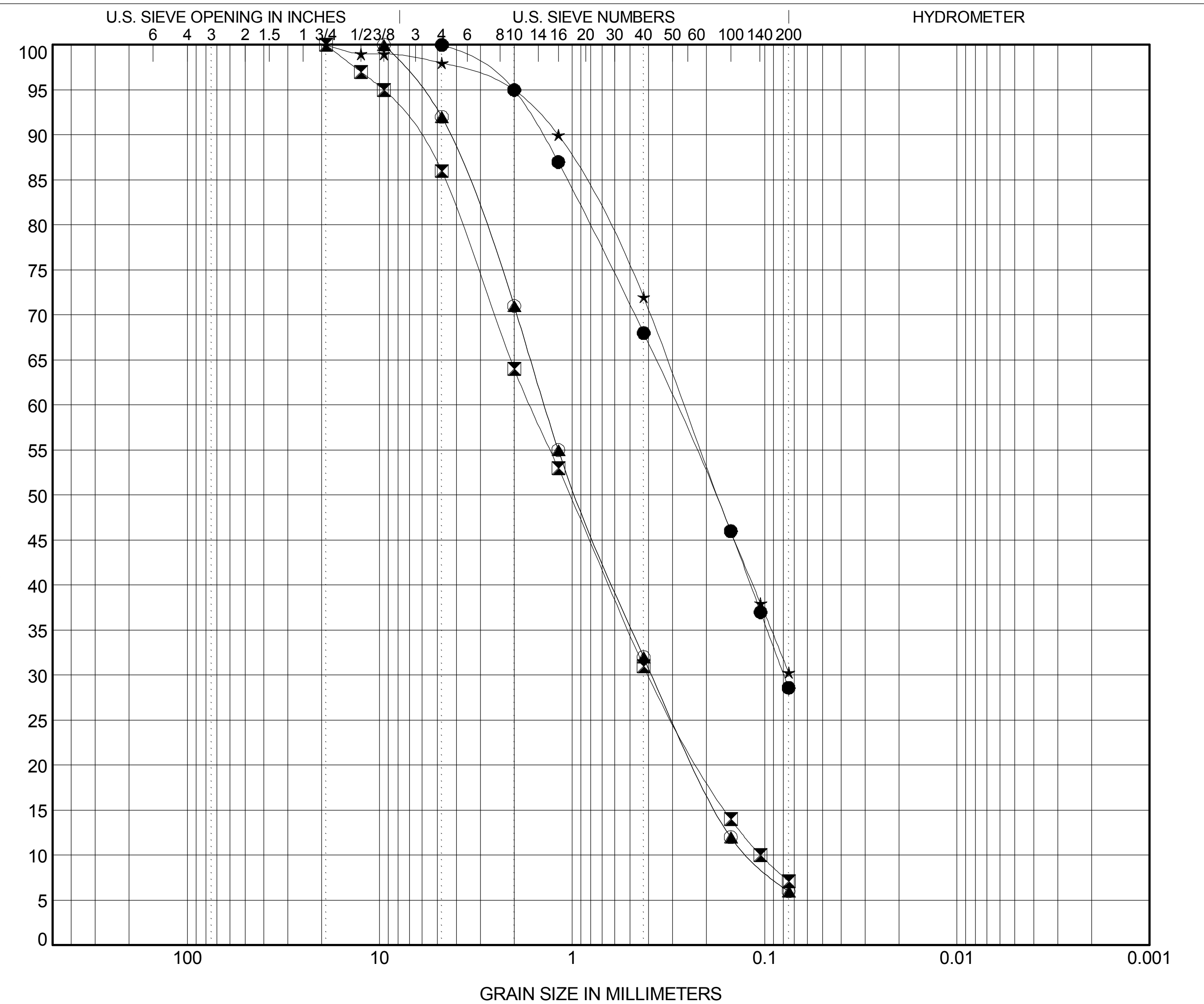
	TEST PIT	DEPTH	LL	PL	PI	Fines	Classification
●	**B-1**	**5.0**	**36**	**31**	**5**	**29**	**SILTY SAND(SM)**
⧗	**B-1**	**10.0**	**NP**	**NP**	**NP**	**7**	**POORLY GRADED SAND with SILT(SP-SM)**
▲	**B-1**	**15.0**	**NP**	**NP**	**NP**	**6**	**POORLY GRADED SAND with SILT(SP-SM)**
★	**B-2**	**2.5**	**NP**	**NP**	**NP**	**30**	**SILTY SAND(SM)**
⊙	**B-2**	**12.5**	**NP**	**NP**	**NP**		**SILTY SAND(SM)**
✿	**B-2**	**15.0**	**NP**	**NP**	**NP**	**6**	**POORLY GRADED SAND with SILT(SP-SM)**

ATTERBERG LIMITS - GINT STD US LAB.GDT - 4/14/15 12:48 - C:\USERS\PUBLIC\DOCUMENTS\BENTLEY\GINT\PROJECTS\NEVADA TAHOE CONSERVATION DISTRICT.GPJ

Wood Rodgers, Inc.
5440 Reno Corporate Drive
Reno, NV 89511
Telephone: 775-823-4068
Fax: 775-823-4066

GRAIN SIZE DISTRIBUTION

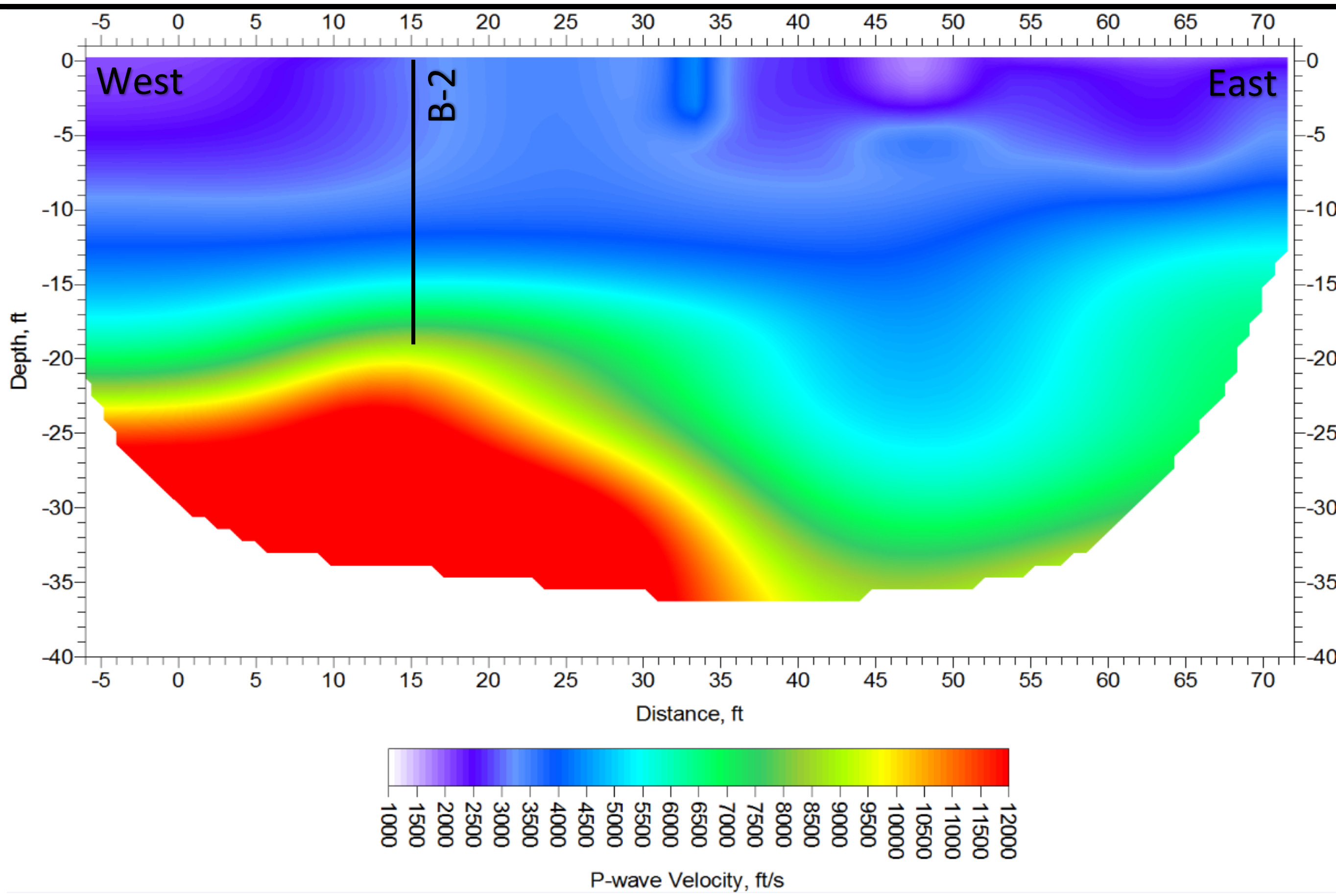
CLIENT Nevada Tahoe Conservation District
PROJECT NAME Burke Creek Highway 50 Crossing and Realignment Project
PROJECT NUMBER 8484.002
PROJECT LOCATION Stateline, Nevada

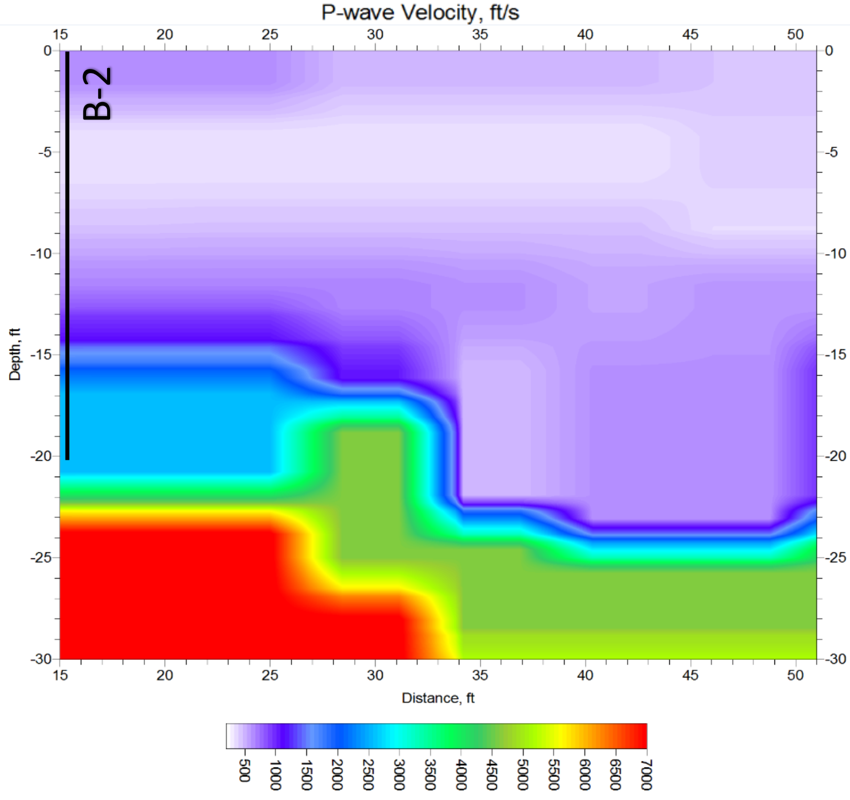


	BORING	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	B-1	5.0	SILTY SAND(SM)	36	31	5		
⧗	B-1	10.0	POORLY GRADED SAND with SILT(SP-SM)	NP	NP	NP	0.92	15.72
▲	B-1	15.0	POORLY GRADED SAND with SILT(SP-SM)	NP	NP	NP	0.89	11.69
★	B-2	2.5	SILTY SAND(SM)	NP	NP	NP		
⊙	B-2	15.0	POORLY GRADED SAND with SILT(SP-SM)	NP	NP	NP	0.89	11.69

	BORING	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-1	5.0	4.75	0.291	0.079		0.0	71.4	28.6	
⧗	B-1	10.0	19	1.651	0.4	0.105	14.0	78.9	7.1	
▲	B-1	15.0	9.5	1.392	0.383	0.119	8.0	86.0	6.0	
★	B-2	2.5	19	0.263			2.0	67.7	30.3	
⊙	B-2	15.0	9.5	1.392	0.383	0.119	8.0	86.0	6.0	

GRAIN SIZE - BORING - GINT STD US LAB.GDT - 4/14/15 12:49 - C:\USERS\PUBLIC\DOCUMENTS\BENTLEY\GINT\PROJECTS\NEVADA TAHOE CONSERVATION DISTRICT.GPJ





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2-D GEOPHYSICAL PROFILES

Geotechnical Investigation
BURKE CREEK HIGHWAY 50 CROSSING and REALIGNMENT
STATELINE, NEVADA

Project No.: 8484.001
Date: 04/09/15

PLATE A-5

SilverState
Analytical Laboratories

LABORATORY REPORT

DATE: April 07, 2015

LABORATORY NO: R15-0151

CLIENT: Wood Rodgers
5440 Reno Corporate Drive
Reno, NV 89511

PAGE: 1 of 1

CLIENT PROJECT: Burke Creek

CLIENT PO #: 8484.001

Sampled By: B. Carter
Date Sampled: ---
Time Sampled: ---

Submitted by: ---
Date Received: 04/03/15
Time Received: 1240

Report Attention: B. Carter

Sample ID	Parameter	Result	Unit	MRL	Method	Date Analyzed	Analyst
B-1 3'-4'	Sodium	0.01	%	0.01	ASTM D2791A	04/06/15	LB
	Sulfate	<0.01	%	0.01	SM4500E	04/06/15	LB
	Sodium Sulfate	<0.01	%	0.01	Calculation	04/06/15	LB
	pH	4.99	S.U.	---	EPA9045D	04/06/15	LB
	Chloride	88.02	mg/kg	10	SM4500ClD	04/06/15	LB

ND: Non Detect
MRL: Method Reporting Limit
EPA Flags: None

Note: The results for each constituent denote the percentage (%) for that particular element which is soluble in a 1:5 (soil to water) extraction ratio and corrected for dilution

REVIEWED BY: [signature] signing for
John Sloan
Laboratory Director
EPA: NV00931 (SSAL-Reno)
EPA: NV00930 (SSAL-LV)

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