STATE OF NEVADA

DEPARTMENT OF TRANSPORTATION

MATERIALS DIVISION

GEOTECHNICAL SECTION

FINAL GEOTECHNICAL REPORT
ROOP STREET ANNEX
NDOT HEADQUARTERS COMPLEX
1253 OREGON STREET, CARSON CITY, NEVADA

JANUARY 3, 2011

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NEVADA DOT GEOTECHNICAL ENGINEERING

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1.0 INTRODUCTION

This report presents the results of our final geotechnical investigation for the proposed Nevada Department of Transportation (NDOT) Roop Street Annex Office Building to be located at 1253 Oregon Street, Carson City, Nevada. Currently, the proposed building will be a single-story structure 270 feet long and 60 feet wide encompassing approximately 16,200 square feet. The structure will be a masonry block building with concrete slab-on-grade flooring and conventional shallow spread foundations. It is our understanding that the current planned finished floor elevation is 4,654.80 feet.

2.0 SCOPE OF WORK

The purpose of this report is to provide final design recommendations for the proposed project. Recommendations are based on our previously prepared Preliminary Geotechnical Report and the results of our recent field exploration and laboratory testing program. The preliminary geotechnical report is included in Appendix E of this report.

Site soils may likely be subject to liquefaction during a seismic event. However, the proposed building will be a one-story structure and does not require a site specific evaluation. A liquefaction analysis was performed as part of this geotechnical investigation to analyze anticipated total and differential settlement of the structure during a seismic event.

3.0 FIELD EXPLORATION

Field exploration consisted of drilling two borings on the site near the northern and southern ends of the proposed structure on December 14th, 15th, 19th and 20th, 2011. Borings RSA-1 and RSA-2 were drilled to depths of 46½ feet and 51½ feet, respectively. Boring locations are presented on the Boring Location Map in Appendix A and were obtained by pacing and measurement from existing structures in the area and should be considered accurate only to the degree implied by the method used.

The borings were drilled using a Diedrich D120 drill rig (Drill Rig Unit #1627) equipped with an automatic hammer utilizing a mud rotary bit with water/bentonite drilling fluid. The borings were backfilled with grout upon completion and the pavement surface was patched with cold mix asphalt.

An NDOT engineer logged the subsurface conditions encountered during the field investigation. Soils were classified according to the Unified Soil Classification System (USCS) as described in American Society of Testing and Materials (ASTM) D 2487. Boring logs and a brief key to the USCS are included in Appendix B.

Soil samples were obtained using a Standard Penetration Sampler driven 18 inches (unless otherwise noted) into the bottom of the boring using a 30-inch drop of a 140-pound hammer (Standard Penetration Test – SPT). The number of blows to drive the sampler the final 12 inches of an 18-inch penetration into undisturbed soil provides an N-value (presented as ‘Blow Count’ on the boring logs). The N-value is an indication of the apparent density/consistency of the *in situ* soils. Blow counts presented on the boring logs have not been corrected for energy, sampler type, rod length, hammer type, etc. It should be noted that the SPT sampler was not lined during sampling. The energy transfer from the automatic hammer into the drill rig string was calibrated at 87.5% for Unit #1627 (SPT Calibration done by Gregg Drilling and Testing, Inc., June 18, 2009).

Soil samples were returned to the NDOT Materials and Testing Laboratory and tested as described under the Laboratory Testing section of this report. The maximum particle size recovered using the SPT sampler is approximately 1⅜ inches. Therefore, the boring logs may not adequately represent the actual quantity or presence of gravels, cobbles or boulders.

4.0 LABORATORY TESTING

Laboratory data is presented in Appendix C of this report and include a summary of test results and graphical reports. A limited Laboratory Testing Program was performed for selected samples consisting of:

- Natural Moisture Contents (Nev. T-104)
- Particle Size Gradations (Nev. T-206)
- Atterberg Limits (Nev. T-210, T-211 and T-212)

5.0 GEOTECHNICAL SUBSURFACE PROFILE

Based on the laboratory and field exploration data, soils were generally granular with a loose to medium dense relative density within the upper ten feet of the soil horizon. A majority of the site soils consisted of silty sand to silty sand with gravel with some clayey sand and poorly graded sand with silt and gravel. A soft sandy silt layer was encountered within both borings at an approximate depth of 2½ feet and varied in thickness from 3 feet within boring RSA-1 to 1½ feet within boring RSA-2. Sandy lean clay was encountered within boring RSA-1 at a depth of 7 feet with an approximate thickness of 3½ feet and within boring RSA-2 at a depth of 14½ feet with a thickness of about 2½ feet.

Groundwater was allowed to stabilize for a minimum of 24 hours and was measured at approximately 7 feet below the ground surface. However, based on previous exploration data and mottling observed in the soils above the current groundwater elevation, groundwater may rise to shallower depths. Fluctuations in soil moisture and/or groundwater conditions as noted in this report may occur due to variations in precipitation and other factors.

6.0 LIQUEFACTION ANALYSIS

The Carson City Development Services Department utilizes the 2006 International Building Code (IBC). It has been determined that lenses of liquefiable soils are present within the subsurface profile; however, the

Standard Penetration Resistance ($\overline{N}$) is between 15 and 50, indicating a Site Class D is applicable for this site. A liquefaction analysis was performed as part of this investigation to determine the maximum anticipated total and differential settlement during a seismic event.

The liquefaction analysis was performed utilizing procedures by Idriss and Boulanger (2008). Based on the data provided in the 2006 IBC, the USGS National Seismic Hazards Maps and the USGS Seismic Hazards Curves, Response Parameters and Design Parameters java software program, a peak ground acceleration of 0.456 was utilized (SDs/2.5). In addition, the earthquake magnitudes (Ms) for the project range from 6.8 to 7.4. The analysis was performed using an anticipated shallow groundwater table depth of 5 feet. The results of the liquefaction analysis are presented in Section 7.3 – Settlement. Refer to Appendix D for liquefaction analysis calculations.

7.0 DISCUSSCION AND RECOMMENDATIONS

The following sections update the recommendations provided in the Preliminary Geotechnical Report. Refer the Preliminary Geotechnical Report presented in Appendix E for additional recommendations and design parameters.

7.1 EARTHWORK

Based on the proposed finished floor elevation of 4,654.80 feet and details provided in the civil plans, footings will be founded at depths of approximately 1.5 feet and 3.5 feet below the existing ground surface at the southern and northern end of the structure, respectively. The boring logs indicate that foundations will either bear directly on or near the soft sandy silt layer encountered within both exploratory borings. It is recommended that the soft silt layer be removed in its entirety and replaced with properly compacted structure fill placed in accordance with the recommendations presented in the Preliminary Geotechnical Report. This soil layer is approximately 1½ to 3 feet thick overlying loose, very moist to wet clayey sand. ***As previously noted in the preliminary report, unstable soil conditions may occur during construction due to the presence of shallow groundwater and fine-grained soils. The contractor should anticipate that pumping and unstable soil conditions will likely be encountered during construction. Refer to Section 7.3 of the Preliminary Geotechnical Report.***

7.2 FOUNDATIONS

Provided that foundation grade soils are properly prepared, the bearing pressures presented in Table 1 in the preliminary report can be utilized for the design of individual column footings and continuous wall footings. Table 1 from the Preliminary Geotechnical Report is presented on the following page.

TABLE 1 – FOUNDATION ALLOWABLE BEARING PRESSURES	
Loading Conditions	**Maximum Net Allowable Bearing Pressures(1)(psf)**
Dead Loads plus full time live loads	1,500
Dead Loads plus live loads, plus transient wind, or seismic loads.	2,000
(1) The net allowable bearing pressure is that pressure at the base of the footing in excess of the adjacent overburden pressure.	

7.3 SETTLEMENT

7.3.1 STATIC LOADING CONDITIONS

Site soils are generally granular and will experience an elastic settlement response under static loading conditions. Therefore, the majority of the settlement will occur rapidly, generally during the construction time frame for the building. Total settlement of an individual foundation will vary depending on the plan dimensions of the foundation and the actual load supported. Based on anticipated foundation dimensions and loads, we estimate that total post-construction settlement of footings designed and constructed in accordance with the preceding recommendations will be less than ½-inch for static loading. In addition, differential settlement between similarly loaded, adjacent footings is expected to be less than ¼-inch.

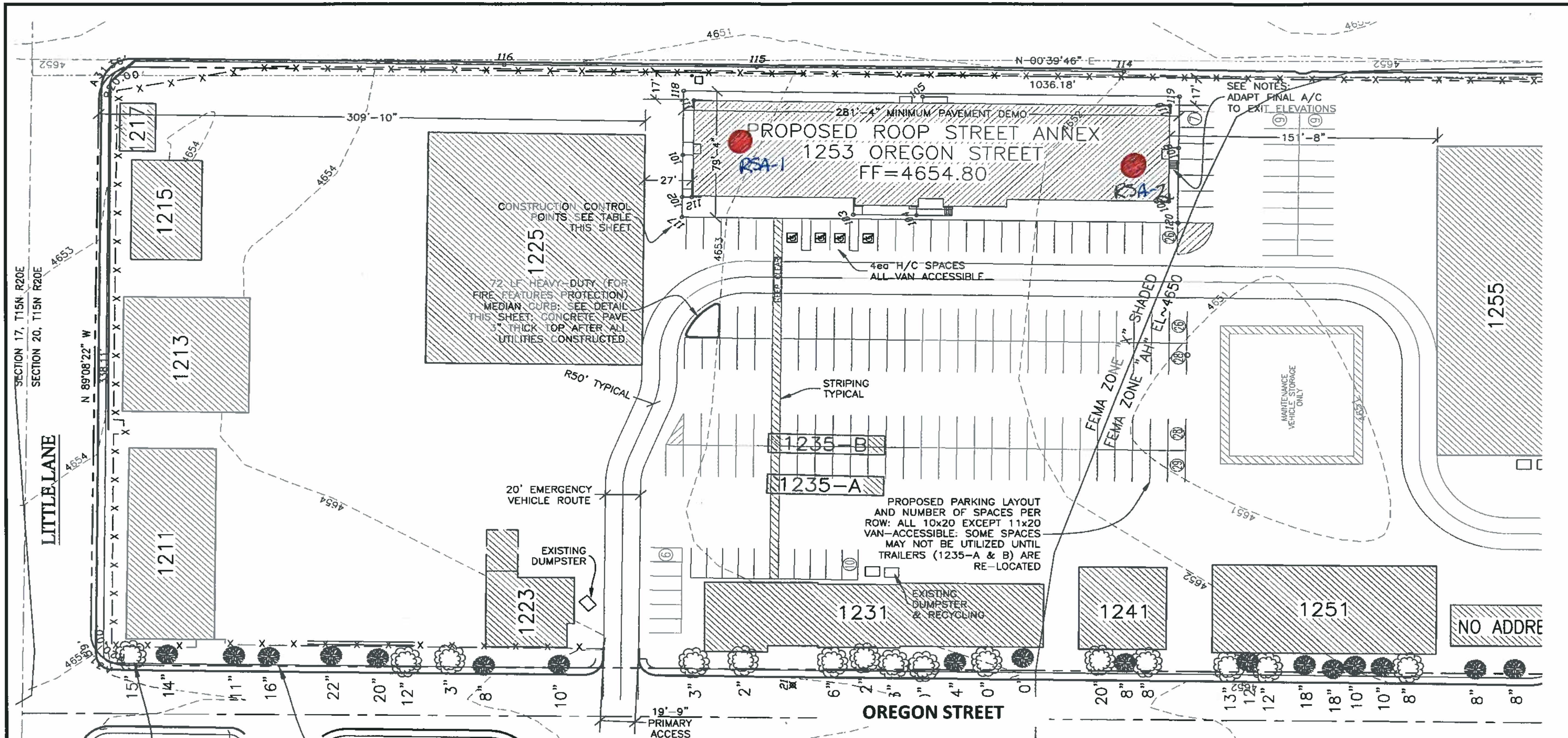
7.3.2 SEISMIC LOADING CONDITIONS

The liquefaction analysis indicates that anticipated total settlement during a seismic event ranges from approximately 2 to 2¾ inches. Differential settlement across the building will be on the order of ¾ of an inch. The upper 10 feet of soils will experience less than ½ an inch of settlement. Over-excavation and/or ground improvement techniques within the upper 10 feet of the soil profile will not substantially reduce liquefaction settlement and are not warranted. However, it is recommended that the structural engineer take steps during design to assist in reducing structural damage during a seismic event due to differential settlement.

8.0 REFERENCES

1) American Society for Testing and Materials (ASTM), *Soil and Rock; Dimension Stone; Geosynthetics,* , 2010, Volume 4.08;
2) Bell, John. W. and Trexler, Dennis T., *New Empire Quadrangle Earthquake Hazards Map*, Nevada Bureau of Mines and Geology, 1979, scale 1:24,000;
3) Bowles, J. E., *Foundation Analysis and Design*, 1996, McGraw Hill;
4) Dames and Moore, *Report of Foundation Investigation, Proposed Office Building, Laboratory and Service Buildings, Carson City, Nevada*, Job No. 4023-002-02, November 5, 1962;
5) dePolo, Craig M., *Quaternary Faults in Nevada*, Nevada Bureau of Mines and Geology, 2008;
6) Idriss, I. M. and Boulanger, R. W., *2008 EERI Monograph, Soil Liquefaction During Earthquakes;*
7) International Code Council, Inc., *International Building Code, 2006*;
8) Nevada State Highway Department, Engineering Geology and Foundation Section, Materials and Testing Division, *Foundation Report, Highway Storage Building, Carson City, Nevada*, Project No. SP-HQ063-CC(2), May 1977;
9) Nevada Department of Transportation, *Memorandum, Foundation Study Report, NDOT Storage Facility, NDOT Maintenance yard, Carson City, Nevada*, January 12, 2004;
10) Nevada Department of Transportation, *Preliminary Geotechnical Report, Roop Street Annex, NDOT Headquarters Complex, Carson City, Nevada,* November 2011.
11) Regional Transportation Commission, *Standard Specifications for Public Works Construction*, 2007 (Washoe County, Sparks-Reno, Carson City, Yerington, Nevada), “Orange Book”;
12) Stantec Consulting, Inc., *Geotechnical Investigation, NDOT Headquarters Complex, Public Service Building, Carson City, Nevada*, January 2007, Project No. 180550884;
13) Trexler, Dennis T., *Carson City Quadrangle Geologic Map*, Map No. 1Ag, , Nevada Bureau of Mines and Geology, 1977, scale 1:24,000;
14) Trexler, Dennis T. and Bell, John W., *Carson City Quadrangle Earthquake Hazards Map,* Map No. 1Ai, prepared by, Nevada Bureau of Mines and Geology, 1979; scale 1:24,000;

APPENDIX A



LEGEND

RSA-2 Boring Location

N
1"=82'

NEVADA DOT GEOTECHNICAL ENGINEERING	*DATE: January 3, 2011*		***BORING LOCATION MAP*** **FINAL GEOTECHNICAL INVESTIGATION** **ROOP STREET ANNEX, NDOT HEADQUARTERS** **1253 OREGON STREET, CARSON CITY, NEVADA**

APPENDIX B

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

EXPLORATION LOG

START DATE	12/14/11	STATION	
END DATE	12/15/11	OFFSET	
JOB DESCRIPTION	ROOP STREET ANNEX	ENGINEER	MLB
LOCATION	NDOT HEADQUARTERS	EQUIPMENT	1627
BORING	RSA-1	OPERATOR	BAKER
E.A. #		DRILLING METHOD	MUD ROTARY
GROUND ELEV.	4653.20 (ft)	BACKFILLED	Yes
HAMMER DROP SYSTEM	AUTOMATIC	DATE	12/15/11

GROUNDWATER LEVEL

DATE	DEPTH ft	ELEV. ft
12/19/11	6.75	4646.5

ELEV. (ft)	DEPTH (ft)	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT 6 inch Increments	BLOW COUNT Last 1 foot	Percent Recov'd	LAB TESTS	USCS Group	MATERIAL DESCRIPTION	REMARKS
	1.00							SM	0.25 **ASPHALT PAVEMENT** **SILTY SAND**, yellow brown, moist, 15% nonplastic fines (decomposed granite)	
	2.50	A	SPT	10 12 12	24	100			2.50	
	4.00	B	SPT	4 3 3	6	33		ML	**SANDY SILT**, black, moist, 50% low plastic fines	
4648.2	5 5.50	C	SPT	1 2 1	3	0			5.50	
	7.00	D	SPT	4 4 4	8	120		SC	**CLAYEY SAND**, very moist, dark brown 7.00	
	8.50	E	SPT	2 3 3	6	44		CL	**SANDY LEAN CLAY**, wet, gray brown, 52% low plastic fines, 47% sand, 1% fine subrounded gravel	
	9.00									
4643.2	10 10.50	F	SPT	2 4 6	10	67			10.50	
	12.00	G	SPT	4 5 6	11	67		SM	**SILTY SAND**, wet, gray brown to brown, 29% to 33% nonplastic fines	
	13.00									
	14.50	H	SPT	5 4 8	12	39				
4638.2	15 15.00								15.00	
	16.50	I	SPT	4 8 12	20	67		SP SM	**POORLY GRADED SAND WITH SILT AND GRAVEL**, wet, gray brown, 12% nonplastic fines, 71% sand, 17% subrounded fine to medium gravel 17.00	
	18.00	J	SPT	4 12 10	22	67		SM	**SILTY SAND WITH GRAVEL**, wet, gray brown with iron staining, 40% low plastic fines, 23% sand, 17% fine subrounded gravel 18.00	
	19.50	K	CMS	12 16 25	41	89		SM SM	**SILTY SAND WITH GRAVEL**, wet, gray brown with iron staining, 25% nonplastic fines, 49% sand, 26% fine to medium subrounded gravel 19.00 **SILTY SAND**, wet, gray brown, 37% low plastic fines, 50% sand, 13 fine gravel 20.00	
4633.2	20 20.00									
	21.50	L	SPT	27 26 15	41	33		SM	**SILTY SAND WITH GRAVEL**, wet, gray brown, 19% nonplastic fines, 54% sand, 27% fine to medium subrounded gravel 22.00	
	22.50								**SILTY SAND**, wet, gray brown to brown, 44% nonplastic fines, 56% sand	
	24.00	M	SPT	4 8 10	18	33		SM		
	25.00								25.00	

EXPLORATION LOG

NEVADA DEPARTMENT OF TRANSPORTATION
GEOTECHNICAL ENGINEERING

START DATE 12/14/11
END DATE 12/15/11
JOB DESCRIPTION ROOP STREET ANNEX
LOCATION NDOT HEADQUARTERS
BORING RSA-1
E.A. #
GROUND ELEV. 4653.20 (ft)
HAMMER DROP SYSTEM AUTOMATIC

GROUNDWATER LEVEL		
DATE	DEPTH ft	ELEV. ft
12/19/11	6.75	4646.5

STATION
OFFSET
ENGINEER MLB
EQUIPMENT 1627
OPERATOR BAKER
DRILLING METHOD MUD ROTARY
BACKFILLED Yes DATE 12/15/11

ELEV. (ft)	DEPTH (ft)	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT 6 inch Increments	BLOW COUNT Last 1 foot	Percent Recov'd	LAB TESTS	USCS Group	MATERIAL DESCRIPTION	REMARKS
	26.50	N	SPT	21 21 9	30	44		SM	**SILTY SAND WITH GRAVEL**, wet, brown, 17% nonplastic fines, 67% sand, 16% fine to medium subrounded gravel	
	27.50								27.00	
	29.00	O	SPT	4 5 7	12	39		ML	**SANDY SILT**, wet, brown, 61% nonplastic fines, 38% low plastic fines, 1% fine gravel	
4623.2	30 / 30.00								30.00	
	31.50	P	SPT	2 5 10	15	33		SM	**SILTY SAND WITH GRAVEL**, wet, gray brown, 35% low plastic fines, 40% sand, 25% fine to medium subrounded gravel	
	32.50								32.00	
	34.00	Q	SPT	7 8 3	11	33		SM	**SILTY SAND**, wet, gravy brown, 26% nonplastic fines, 72% sand, 2% fine subrounded gravel	
	34.50								34.00	
4618.2	35 / 36.00	R	SPT	2 5 5	10	100		SC	**CLAYEY SAND**, wet, gray brown, 49% low plastic fines, 51% sand	
	37.50								37.00	
	39.00	S	SPT	5 7 8	15	44		ML	**SANDY SILT**, wet, gray brown, 50% nonplastic fines, 48% sand, 2% fine subrounded gravel	
4613.2	40 / 40.00								40.00	
	41.50	T	SPT	10 19 26	45	100		SM	**SILTY SAND**, wet, yellow brown, 23 to 27% nonplastic fines, 74% sand, 1% to 3% fine subrounded gravel	
4608.2	45 / 45.00									
	46.50	U	SPT	10 26 18	44	44			46.50	

EXPLORATION LOG

NEVADA DEPARTMENT OF TRANSPORTATION
GEOTECHNICAL ENGINEERING

START DATE	12/19/11	STATION	
END DATE	12/20/11	OFFSET	
JOB DESCRIPTION	ROOP STREET ANNEX	ENGINEER	MLB
LOCATION	NDOT HEADQUARTERS	EQUIPMENT	1627
BORING	RSA-2	OPERATOR	ALTAMIRANO
E.A. #		DRILLING METHOD	MUD ROTARY
GROUND ELEV.	4651.70 (ft)	BACKFILLED	Yes DATE 12/20/11
HAMMER DROP SYSTEM	AUTOMATIC		

GROUNDWATER LEVEL

DATE	DEPTH ft	ELEV. ft
12/21/11	6.00	4645.7

ELEV. (ft)	DEPTH (ft)	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT 6 inch Increments	BLOW COUNT Last 1 foot	Percent Recov'd	LAB TESTS	USCS Group	MATERIAL DESCRIPTION	REMARKS
	1.00								0.25 **ASPHALT**	
	2.50	A	SPT	14 13 12	25	67		SP	**POORLY GRADED SAND**, moist, yellow brown, mostly medium to coarse sand (decomposed granite) 2.50	
	4.00	B	SPT	3 2 2	4	44		ML	**SANDY SILT**, moist, black/dark gray, some fine sand 4.00	
4646.7	5 / 5.50	C	SPT	1 1 1	2	22		SC	**CLAYEY SAND**, moist to very moist, 32% to 48% low plastic fines, 51% to 59% sand, 1% to 9% fine subrounded gravel	
	7.00	D	SPT	2 3 6	9	61		SC	7.00	
	8.50	E	SPT	3 6 7	13	56		SM	**SILTY SAND**, wet, gray brown, 20% low plastic fines, 76% sand, 4% fine subrounded gravel, iron staining observed in soil sample 8.50	
4641.7	10 / 10.00	F	SPT	3 3 3	6	33		SC	**CLAYEY SAND**, wet, gray brown to brown, 41% low plastic fines, 57% sand, 2% fine subrounded gravel 10.00	
	11.50	G	SPT	5 6 8	14	67		SM	**SILTY SAND**, wet, gray brown, 35% low plastic fines, 65% sand 11.50	
	13.00	H	SPT	4 5 8	13	72		SM	**SILTY SAND**, wet gray brown, 38% nonplastic fines, 60% sand, 2% gravel 13.00	
	14.50	I	SPT	7 14 16	30	72		SM	**SILTY SAND**, wet, gray brown, 14% nonplastic fines, 73% sand, 13% gravel 14.50	
4636.7	15 / 16.00	J	SPT	11 5 5	10	56		CL	**SANDY LEAN CLAY**, wet, yellow brown, 62% low plastic fines, 36% sand, 2% gravel	
	17.50								17.00	
	19.00	K	SPT	6 8 4	12	56		SM	**SILTY SAND**, wet, 36% to 50% low plastic fines, 45% to 60% sand, 4% to 5% fine subrounded gravel	
	19.50									
4631.7	20 / 21.00	L	SPT	5 5 9	14	67		SM		
	22.50								22.00	
	24.00	M	SPT	14 21 27	48	56		SM	**SILTY SAND WITH GRAVEL**, wet, yellow brown, 16% fines, 50% sand, 34% fine to medium subrounded gravel	
	24.50									
				15					25.00	

NEVADA DEPARTMENT OF TRANSPORTATION
GEOTECHNICAL ENGINEERING

EXPLORATION LOG

START DATE 12/19/11
END DATE 12/20/11
JOB DESCRIPTION ROOP STREET ANNEX
LOCATION NDOT HEADQUARTERS
BORING RSA-2
E.A. #
GROUND ELEV. 4651.70 (ft)
HAMMER DROP SYSTEM AUTOMATIC

GROUNDWATER LEVEL		
DATE	DEPTH ft	ELEV. ft
12/21/11	6.00	4645.7

STATION
OFFSET
ENGINEER MLB
EQUIPMENT 1627
OPERATOR ALTAMIRANO
DRILLING METHOD MUD ROTARY
BACKFILLED Yes DATE 12/20/11

ELEV. (ft)	DEPTH (ft)	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT 6 inch Increments	BLOW COUNT Last 1 foot	Percent Recov'd	LAB TESTS	USCS Group	MATERIAL DESCRIPTION	REMARKS
	26.00	N	SPT	24 11	35	44		SP SM	**POORLY GRADED SAND WITH GRAVEL**, 9% nonplastic fines, 57% sand, 34% fine to medium subrounded gravel	
	27.50								27.00	
	29.00	O	SPT	2 5 6	11	39		SM	**SILTY SAND**, wet, gray brown, 37% low plastic fines, 59% sand, 4% fine subrounded gravel	
	29.50									
4621.7	30 31.00	P	SPT	3 4 5	9	67		SC	30.00 **CLAYEY SAND**, wet, 46% low plastic fines, 46% sand, 8% fine subrounded gravel	
	32.50								32.00	
	34.00	Q	SPT	6 6 14	20	67		SM	**SILTY SAND**, wet, 32% low plastic fines, 64% sand, 4% fine subrounded gravel	
	34.50									
4616.7	35 36.00	R	SPT	3 7 8	15	50		SM SC	35.00 **SILTY CLAYEY SAND**, wet, gray brown, 45% low plastic fines, 48% sand, 7% fine subrounded gravel	
	39.50									
4611.7	40 41.00	S	SPT	5 13 16	29	56		SM	40.00 **SILTY SAND**, wet, 36% nonplastic fines, 64% sand	
	44.50									
4606.7	45 46.00	T	SPT	3 4 11	15	50		SP SM	45.00 **POORLY GRADED SAND WITH SILT AND GRAVEL**, wet, 6% nonplastic fines, 47% sand, 47% fine to medium subrounded gravel	
	49.50									
				7					50.00	

EXPLORATION LOG

DEPARTMENT OF TRANSPORTATION
GEOTECHNICAL ENGINEERING

START DATE	12/19/11	STATION	
END DATE	12/20/11	OFFSET	
JOB DESCRIPTION	ROOP STREET ANNEX	ENGINEER	MLB
LOCATION	NDOT HEADQUARTERS	EQUIPMENT	1627
BORING	RSA-2	OPERATOR	ALTAMIRANO
E.A. #		DRILLING METHOD	MUD ROTARY
GROUND ELEV.	4651.70 (ft)	BACKFILLED	Yes
HAMMER DROP SYSTEM	AUTOMATIC	DATE	12/20/11

GROUNDWATER LEVEL

DATE	DEPTH ft	ELEV. ft
12/21/11	6.00	4645.7

ELEV. (ft)	DEPTH (ft)	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT 6 inch Increments	BLOW COUNT Last 1 foot	Percent Recov'd	LAB TESTS	USCS Group	MATERIAL DESCRIPTION	REMARKS
		U	SPT	24 28	52	44		SM	**SILTY SAND**, 20% nonplastic fines, 69% sand, 11% fine subrounded gravel	
	51.00								51.50	
4596.7	55									
4591.7	60									
4586.7	65									
4581.7	70									

NV_DOT ROOPSTREET.GPJ NV_DOT.GDT 1/4/12

APPENDIX C

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

EA/Cont # **Job Description** Roop Street Annex

Boring No. RSA - 1 **Elevation (ft)** **Station** **Date** 12/22/2011

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	Peak: Φ deg.	Peak: C psi	Residual: Φ deg.	Residual: C psi	COMMENTS
A	1.0 - 2.5	SPT		SM			15.4	18	NP	NP						
B	2.5 - 4.0	SPT		ML			50.1	34	25	9						
D	5.5 - 7.0	SPT		SC			41.9	30	19	11						
E	7.0 - 8.5	SPT		CL			52.1	33	19	14						
F	9.0 - 10.5	SPT		CL			62.0	30	21	9						
G	10.5 - 12.0	SPT		SM			33.3	23	NP	NP						
H	13.0 - 14.5	SPT		SM			29.0	22	NP	NP						
I	15.0 - 16.5	SPT		SP-SM			11.7	25	NP	NP						
J	16.5 - 18.0	SPT		SM			40.4	25	24	1						
K1	18.0 - 19.0	CMS_{bag}		SM			24.6	23	NP	NP						
K2	19.0 - 19.5	CMS		SM	15.6	118.0	36.6	23	22	1						
L	20.0 - 21.5	SPT		SM			18.4	20	NP	NP						

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 # **Job Description** Roop Street Annex

Boring No. RSA - 1 **Elevation (ft)** **Station** **Date** 12/22/2011

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: TEST TYPE	Peak Φ deg.	Peak C psi	Residual Φ deg.	Residual C psi	COMMENTS
M	22.5 - 24.0	SPT		SM			43.9	23	NP	NP						
N	25.0 - 26.5	SPT		SM			17.1	22	NP	NP						
O	27.5 - 29.0	SPT		ML			61.1	17	NP	NP						
P	30.0 - 31.5	SPT		SM	17.0		34.9	24	23	1						
Q	32.5 - 34.0	SPT		SM	17.1		25.7	26	NP	NP						
R	34.5 - 36.0	SPT		SC	22.3		49.5	29	19	10						
S	37.5 - 39.0	SPT		ML	22.7		50.2	25	NP	NP						
T	40.0 - 41.5	SPT		SM	17.4		22.8	17	NP	NP						
U	45.0 - 46.5	SPT		SM	20.1		26.2	22	NP	NP						

CMS = California Modified Sampler 2.42" ID
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DS = Direct Shear
Φ = Friction
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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
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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 # **Job Description** Roop Street Annex

Boring No. RSA - 2 **Elevation (ft)** **Station** **Date** 12/22/2011

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	Peak Φ deg.	Peak C psi	Residual Φ deg.	Residual C psi	
A	1.0 - 2.5	SPT		SM			19.1	18	NP	NP						
B	2.5 - 4.0	SPT														No Recovery
C	4.0 - 5.5	SPT		SC			32.0	32	20	12						
D	5.5 - 7.0	SPT		SC			47.8	33	19	14						
E	7.0 - 8.5	SPT		SM			19.8	22	21	1						
F	8.5 - 10.0	SPT		SC			40.8	32	19	13						
G	10.0 - 11.5	SPT		SM			34.9	24	21	3						
H	11.5 - 13.0	SPT		SM			37.8	23	NP	NP						
I	13.0 - 14.5	SPT		SM			14.4	21	NP	NP						
J	14.5 - 16.0	SPT		CL			62.1	32	19	13						
K	17.5 - 19.0	SPT		SM			35.5	23	22	1						
L	19.5 - 21.0	SPT		SM			49.9	26	23	3						

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

EA/Cont #

Job Description Roop Street Annex

Boring No. RSA - 2 **Elevation (ft)** **Station** **Date** 12/22/2011

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 TEST TYPE	Φ deg. Peak	C psi Peak	Φ deg. Residual	C psi Residual	COMMENTS
M	22.5 - 24.0	SPT		SM			16.2	21	NP	NP						
N	25.0 - 26.5	SPT		SP-SM			8.7	20	NP	NP						
O	27.5 - 29.0	SPT		SM			36.9	22	20	2						
P	30.0 - 31.5	SPT		SC			46.0	29	20	9						
Q	32.5 - 34.0	SPT		SM			31.9	24	22	2						
R	35.0 - 36.5	SPT		SC-SM			45.2	27	22	5						
S	40.0 - 41.5	SPT		SM			36.0	24	NP	NP						
T	45.0 - 46.5	SPT		SP-SM			6.1	20	NP	NP						
U	50.0 - 51.5	SPT		SM			20.1	21	NP	NP						

CMS = California Modified Sampler 2.42" ID
SPT = Standard Penetration 1.38" ID
CS = Continuous Sample 3.23" ID
RC = Rock Core
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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
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LL = Liquid Limit
PL = Plastic Limit
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O = Organic Content
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RQD = Rock Quality Designation
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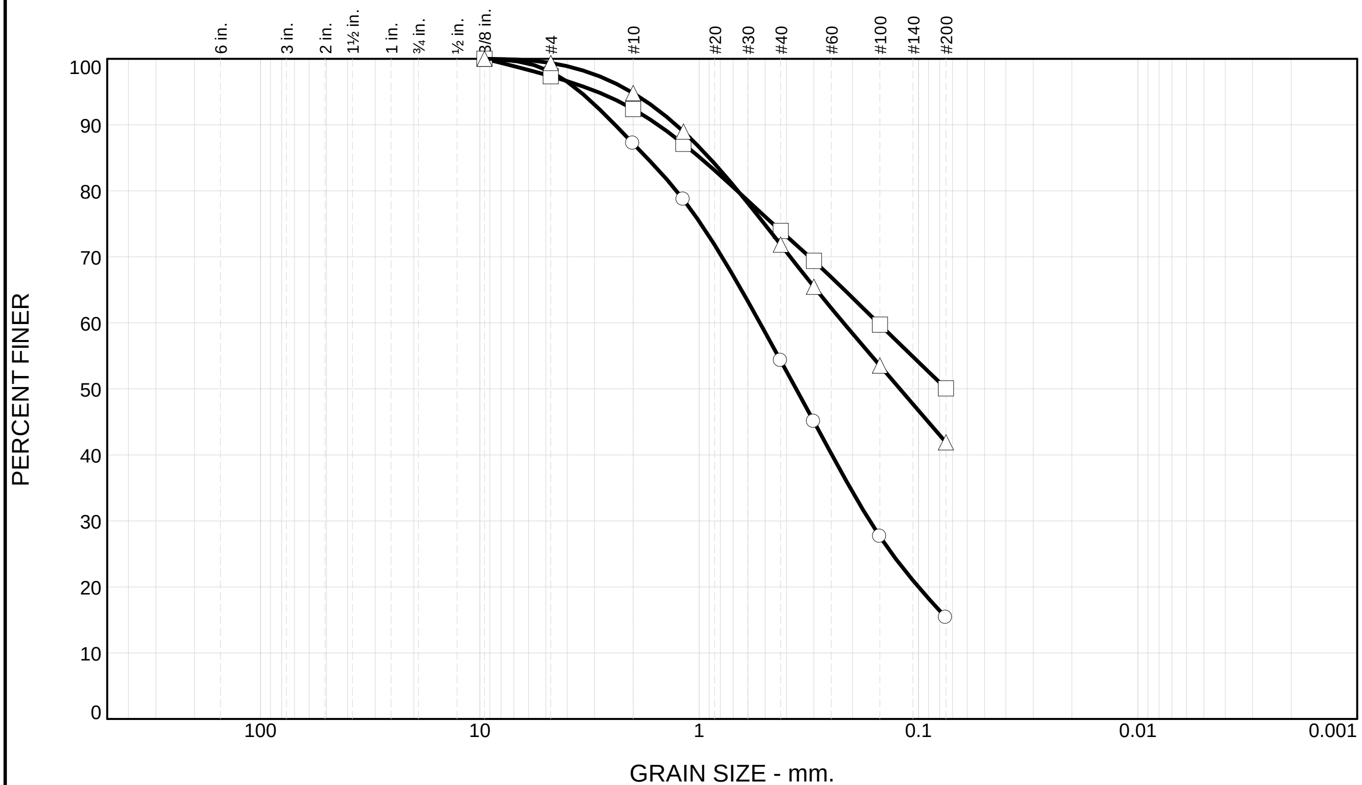
Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT / % CLAY	USCS	AASHTO	PL	LL
○	0.0	2.0	82.6	15.4	SM	A-2-4(0)	NP	18
□	0.0	2.6	47.3	50.1	ML	A-4(2)	26	34
△	0.0	0.6	57.5	41.9	SC	A-6(1)	19	30

SIEVE inches size	PERCENT FINER ○	□	△
3/8"	100.0	100.0	100.0
	GRAIN SIZE		
D_{60}	0.5284	0.1528	0.2196
D_{30}	0.1667		
D_{10}			
	COEFFICIENTS		
C_c			
C_u			

SIEVE number size	PERCENT FINER ○	□	△
#4	98.0	97.4	99.4
#10	87.2	92.4	94.8
#16	78.7	87.1	89.0
#40	54.3	73.9	71.9
#50	45.1	69.4	65.5
#100	27.6	59.7	53.5
#200	15.4	50.1	41.9

Material Description
○ silty sand
□ sandy silt
△ clayey sand

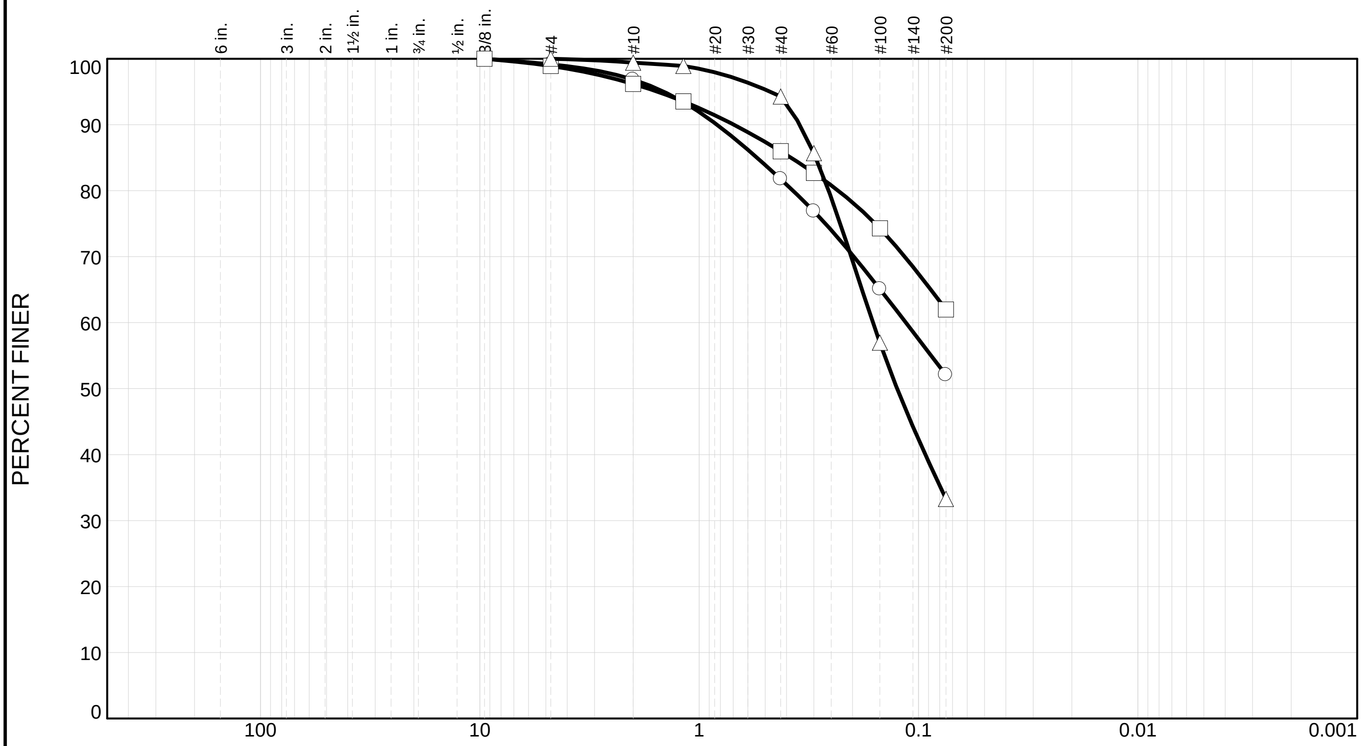
REMARKS:
○
□
△

○ Source of Sample: RSA-1 Depth: 1.0 - 2.5' Sample Number: A
□ Source of Sample: RSA-1 Depth: 2.5 - 4.0' Sample Number: B
△ Source of Sample: RSA-1 Depth: 5.5 - 7.0' Sample Number: D

NEVADA DEPARTMENT OF TRANSPORTATION

Client: M. Boutilier
Project: Roop Street Annex
Project No.: FL-11-11 Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT / % CLAY	USCS	AASHTO	PL	LL
○	0.0	0.9	47.0	52.1	CL	A-6(4)	19	33
□	0.0	1.1	36.9	62.0	CL	A-4(4)	21	30
△	0.0	0.0	66.7	33.3	SM	A-2-4(0)	NP	23

SIEVE inches size	PERCENT FINER ○	□	△
3/8"	100.0	100.0	
GRAIN SIZE			
D_{60}	0.1141		0.1613
D_{30}			
D_{10}			
COEFFICIENTS			
C_c			
C_u			

SIEVE number size	PERCENT FINER ○	□	△
#4	99.1	98.9	100.0
#10	96.8	96.2	99.4
#16	93.4	93.5	98.9
#40	81.8	86.0	94.3
#50	76.9	82.7	85.7
#100	65.1	74.3	57.0
#200	52.1	62.0	33.3

Material Description
○ sandy lean clay
□ sandy lean clay
△ silty sand

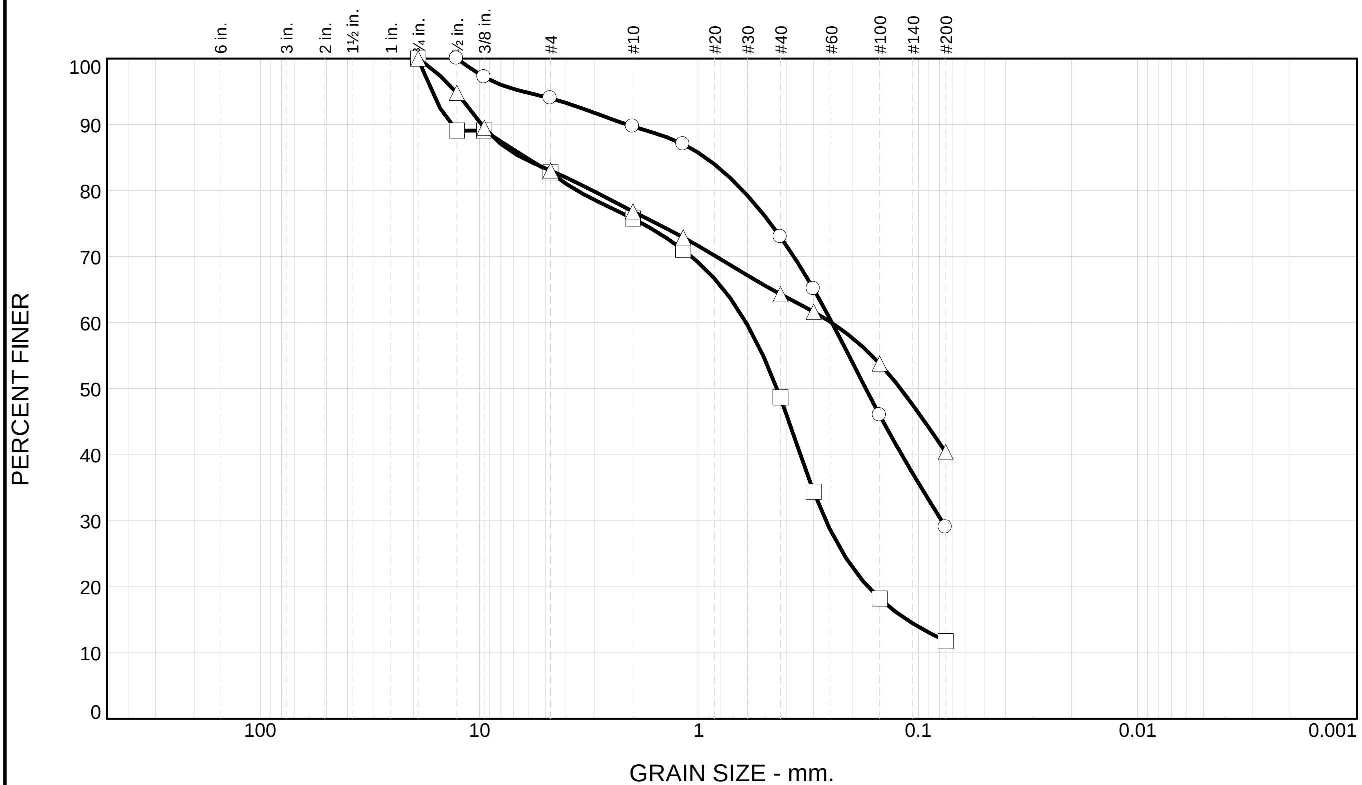
REMARKS:
○
□
△

○ Source of Sample: RSA-1 Depth: 7.0 - 8.5' Sample Number: E
□ Source of Sample: RSA-1 Depth: 9.0 - 10.5' Sample Number: F
△ Source of Sample: RSA-1 Depth: 10.5 - 12.0' Sample Number: G

NEVADA DEPARTMENT OF TRANSPORTATION

Client: M. Boutilier
Project: Roop Street Annex
Project No.: FL-11-11
Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	6.0	65.0	29.0		SM	A-2-4(0)	NP	22
□	0.0	17.2	71.1	11.7		SP-SM	A-1-b	NP	25
△	0.0	17.0	42.6	40.4		SM	A-4(0)	24	25

SIEVE inches size	PERCENT FINER ○	□	△
3/4"		100.0	100.0
1/2"	100.0	89.1	94.8
3/8"	97.2	89.1	89.5
GRAIN SIZE			
D_{60}	0.2474	0.6093	0.2486
D_{30}	0.0783	0.2639	
D_{10}			
COEFFICIENTS			
C_c			
C_u			

SIEVE number size	PERCENT FINER ○	□	△
#4	94.0	82.8	83.0
#10	89.7	75.8	76.8
#16	87.0	71.0	72.9
#40	73.0	48.7	64.3
#50	65.1	34.4	61.6
#100	46.0	18.2	53.8
#200	29.0	11.7	40.4

Material Description
○ silty sand
□ poorly graded sand with silt and gravel
△ silty sand with gravel

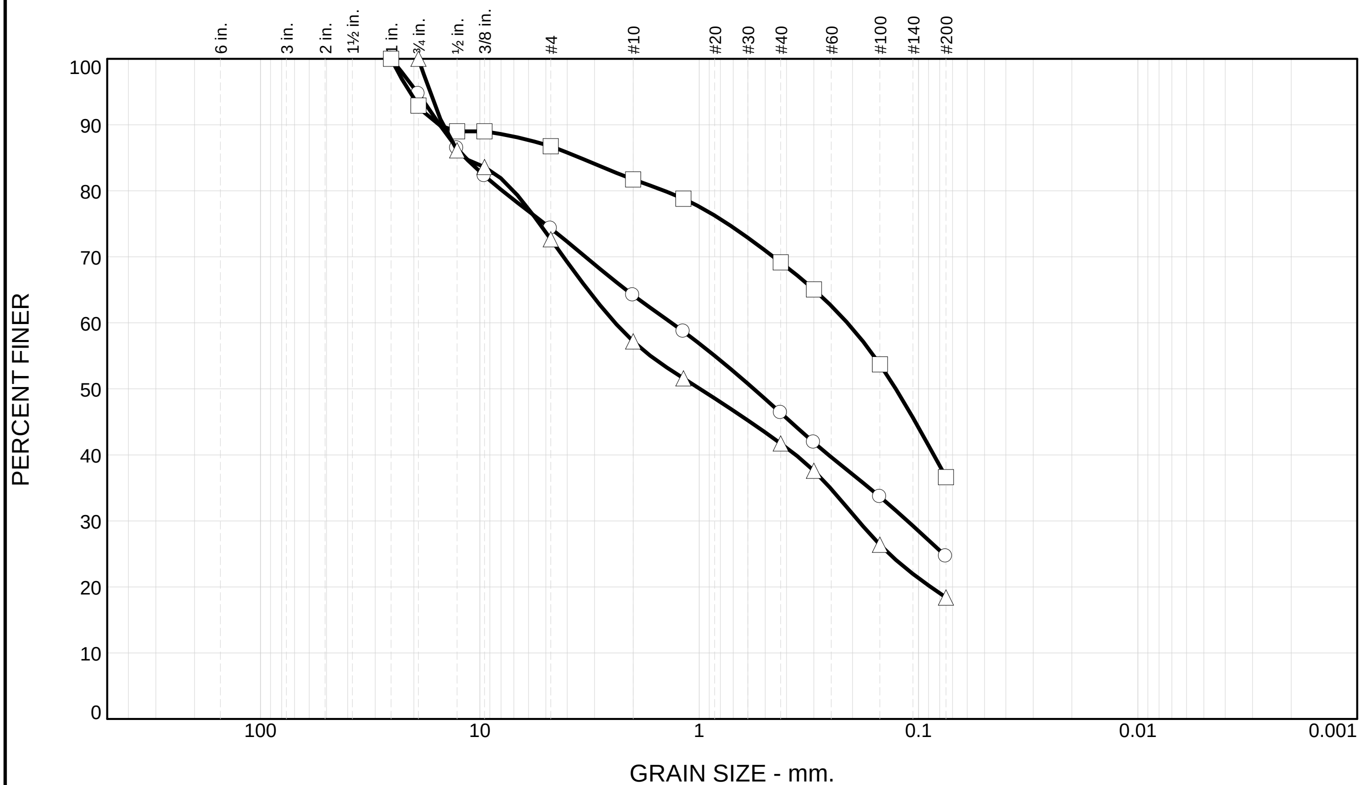
REMARKS:
○
□
△

○ Source of Sample: RSA-1 Depth: 13.0 - 14.5' Sample Number: H
□ Source of Sample: RSA-1 Depth: 15.0 - 16.5' Sample Number: I
△ Source of Sample: RSA-1 Depth: 16.5 - 18.0' Sample Number: J

NEVADA DEPARTMENT OF TRANSPORTATION

Client: M. Boutilier
Project: Roop Street Annex
Project No.: FL-11-11 Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	25.7	49.7	24.6		SM	A-1-b	NP	23
□	0.0	13.2	50.2	36.6		SM	A-4(0)	22	23
△	0.0	27.3	54.3	18.4		SM	A-1-b	NP	20

SIEVE inches size	PERCENT FINER ○	□	△
1"	100.0	100.0	
3/4"	94.7	92.9	100.0
1/2"	86.4	89.0	86.1
3/8"	82.3	89.0	83.6

	GRAIN SIZE ○	□	△
D_{60}	1.3374	0.2108	2.4183
D_{30}	0.1122		0.1878
D_{10}			

	COEFFICIENTS ○	□	△
C_c			
C_u			

SIEVE number size	PERCENT FINER ○	□	△
#4	74.3	86.8	72.7
#10	64.2	81.7	57.2
#16	58.7	78.8	51.6
#40	46.4	69.2	41.7
#50	41.9	65.1	37.6
#100	33.7	53.7	26.4
#200	24.6	36.6	18.4

Material Description
○ silty sand with gravel
□ silty sand
△ silty sand with gravel

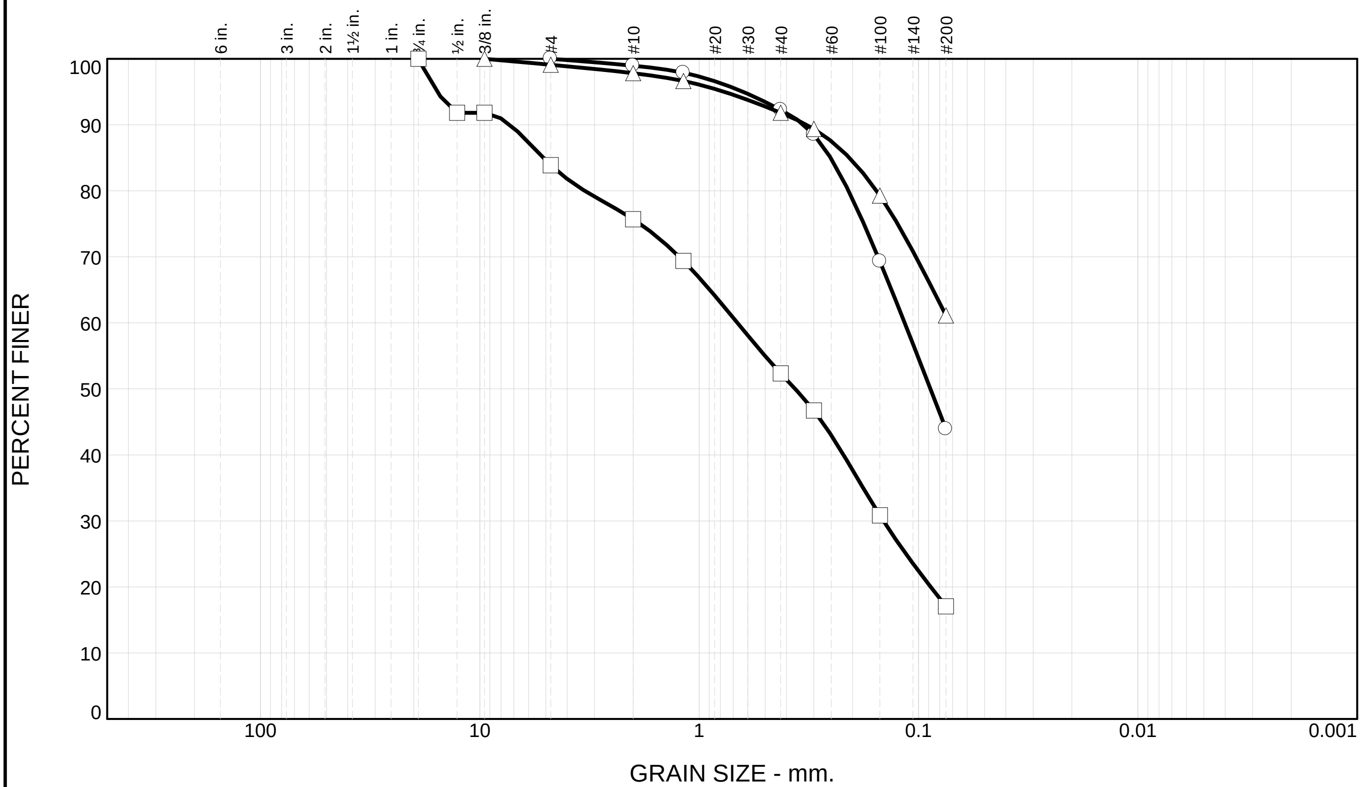
REMARKS:
○
□
△

○ Source of Sample: RSA-1 Depth: 18.0 - 19.0' Sample Number: K1
□ Source of Sample: RSA-1 Depth: 19.0 - 19.5' Sample Number: K2
△ Source of Sample: RSA-1 Depth: 20.0 - 21.5' Sample Number: L

NEVADA DEPARTMENT OF TRANSPORTATION

Client: M. Boutilier
Project: Roop Street Annex
Project No.: FL-11-11 Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	0.0	56.1	43.9		SM	A-4(0)	NP	23
□	0.0	16.1	66.8	17.1		SM	A-2-4(0)	NP	22
△	0.0	0.9	38.0	61.1		ML	A-4(0)	NP	17

SIEVE inches size	PERCENT FINER ○	□	△
3/4"		100.0	
1/2"		91.8	
3/8"		91.8	100.0
GRAIN SIZE			
D_{60}	0.1156	0.6691	
D_{30}		0.1445	
D_{10}			
COEFFICIENTS			
C_c			
C_u			

SIEVE number size	PERCENT FINER ○	□	△
#4	100.0	83.9	99.1
#10	98.9	75.7	97.8
#16	97.9	69.4	96.6
#40	92.3	52.3	91.8
#50	88.5	46.7	89.4
#100	69.3	30.8	79.3
#200	43.9	17.1	61.1

Material Description
○ silty sand
□ silty sand with gravel
△ sandy silt

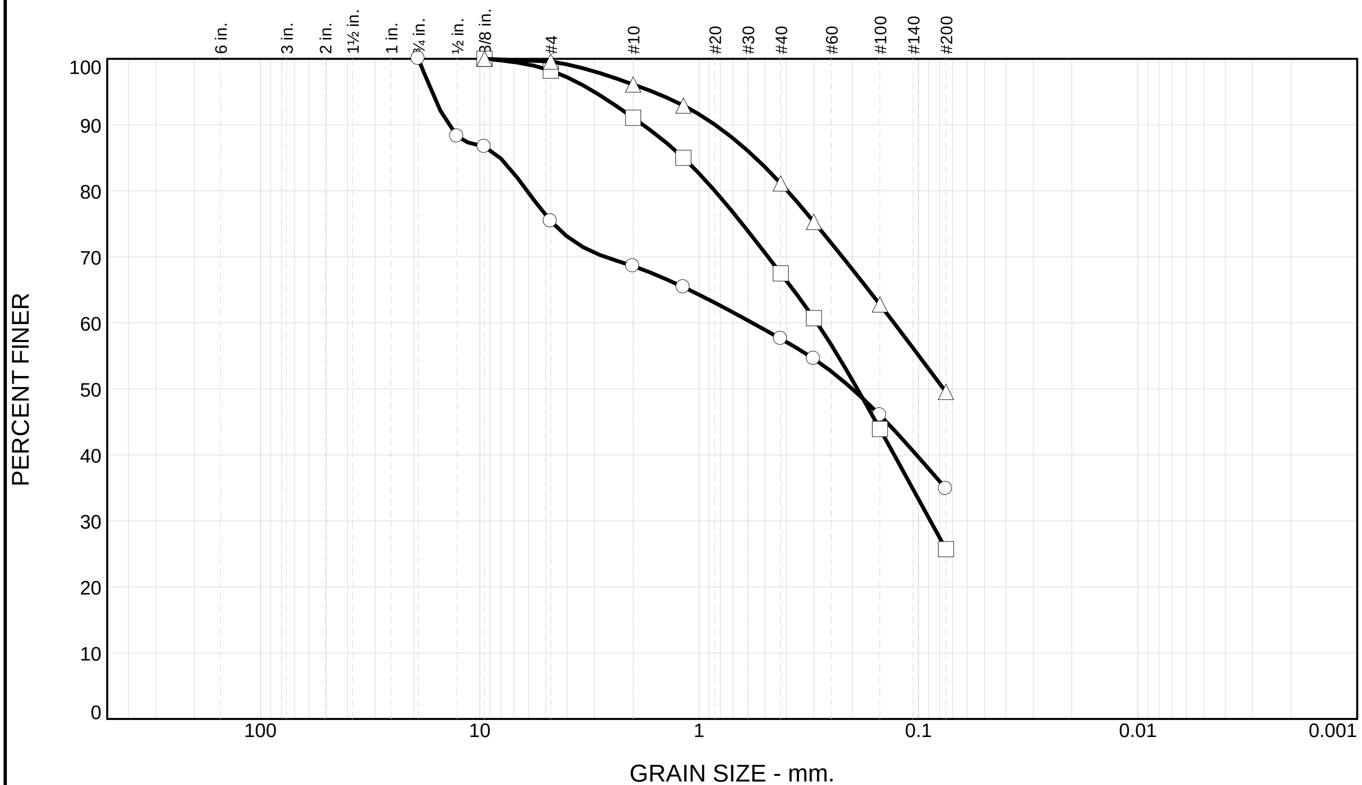
REMARKS:
○
□
△

○ Source of Sample: RSA-1 Depth: 22.5 - 24.0' Sample Number: M
□ Source of Sample: RSA-1 Depth: 25.0 - 26.5' Sample Number: N
△ Source of Sample: RSA-1 Depth: 27.5 - 29.0' Sample Number: O

NEVADA DEPARTMENT OF TRANSPORTATION

Client: M. Boutilier
Project: Roop Street Annex
Project No.: FL-11-11 Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	24.6	40.5	34.9		SM	A-2-4(0)	23	24
□	0.0	1.8	72.5	25.7		SM	A-2-4(0)	NP	26
△	0.0	0.4	50.1	49.5		SC	A-4(2)	19	29

SIEVE inches size	PERCENT FINER ○	□	△
3/4"	100.0		
1/2"	88.3		
3/8"	86.7	100.0	100.0
	GRAIN SIZE		
D_{60}	0.5721	0.2901	0.1293
D_{30}		0.0882	
D_{10}			
	COEFFICIENTS		
C_c			
C_u			

SIEVE number size	PERCENT FINER ○	□	△
#4	75.4	98.2	99.6
#10	68.6	91.1	96.1
#16	65.4	85.0	92.9
#40	57.6	67.5	81.1
#50	54.6	60.7	75.3
#100	46.0	43.9	62.8
#200	34.9	25.7	49.5

Material Description

○ silty sand with gravel

□ silty sand

△ clayey sand

REMARKS:

○

□

△

○ Source of Sample: RSA-1 Depth: 30.0 - 31.5' Sample Number: P

□ Source of Sample: RSA-1 Depth: 32.5 - 34.0' Sample Number: Q

△ Source of Sample: RSA-1 Depth: 34.5 - 36.0' Sample Number: R

NEVADA DEPARTMENT OF TRANSPORTATION

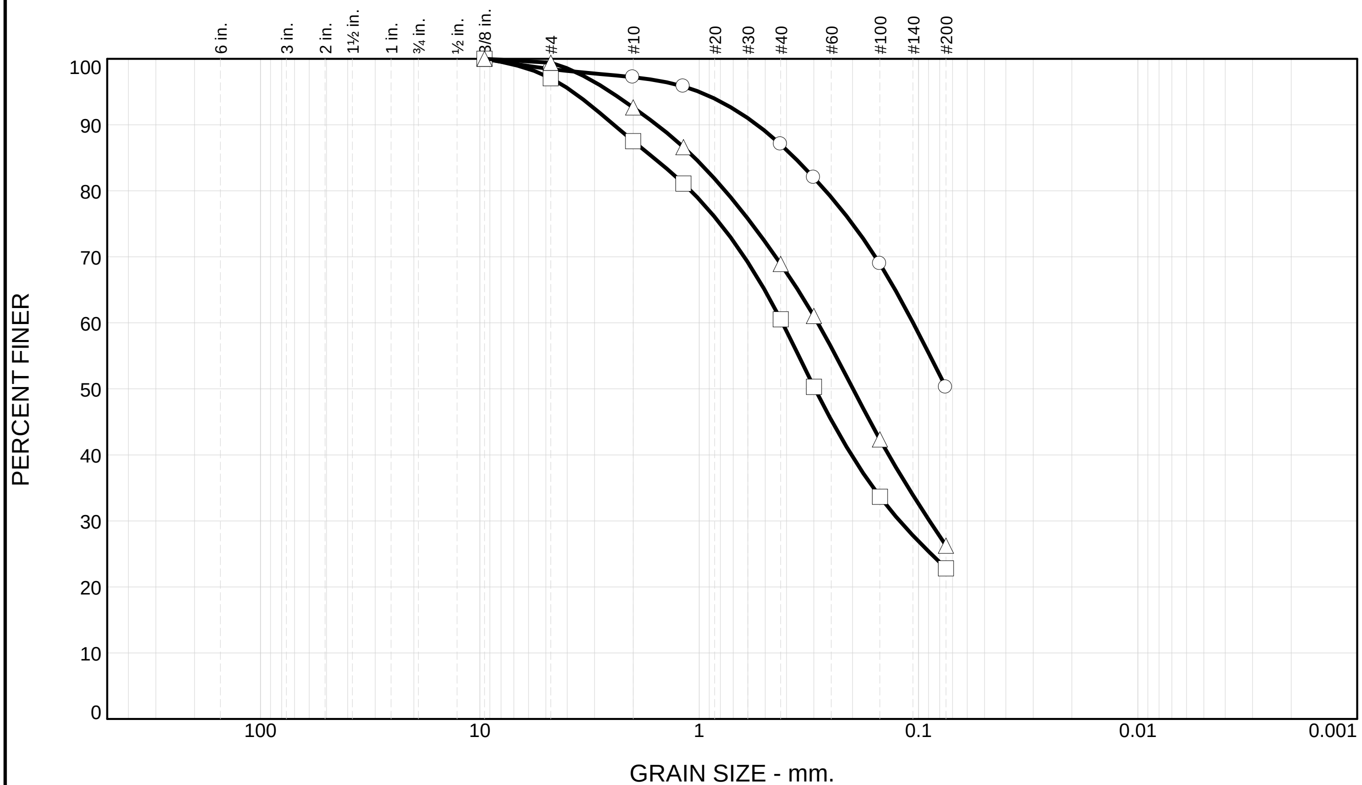
Client: M. Boutilier

Project: Roop Street Annex

Project No.: FL-11-11

Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	1.6	48.2	50.2		ML	A-4(0)	NP	25
□	0.0	2.9	74.3	22.8		SM	A-2-4(0)	NP	17
△	0.0	0.6	73.2	26.2		SM	A-2-4(0)	NP	22

SIEVE inches size	PERCENT FINER ○	□	△
3/8"	100.0	100.0	100.0
GRAIN SIZE			
D_{60}	0.1058	0.4170	0.2877
D_{30}		0.1219	0.0890
D_{10}			
COEFFICIENTS			
C_c			
C_u			

SIEVE number size	PERCENT FINER ○	□	△
#4	98.4	97.1	99.4
#10	97.2	87.5	92.6
#16	95.8	81.1	86.6
#40	87.0	60.5	68.9
#50	82.0	50.3	61.0
#100	68.9	33.7	42.3
#200	50.2	22.8	26.2

Material Description
○ sandy silt
□ silty sand
△ silty sand

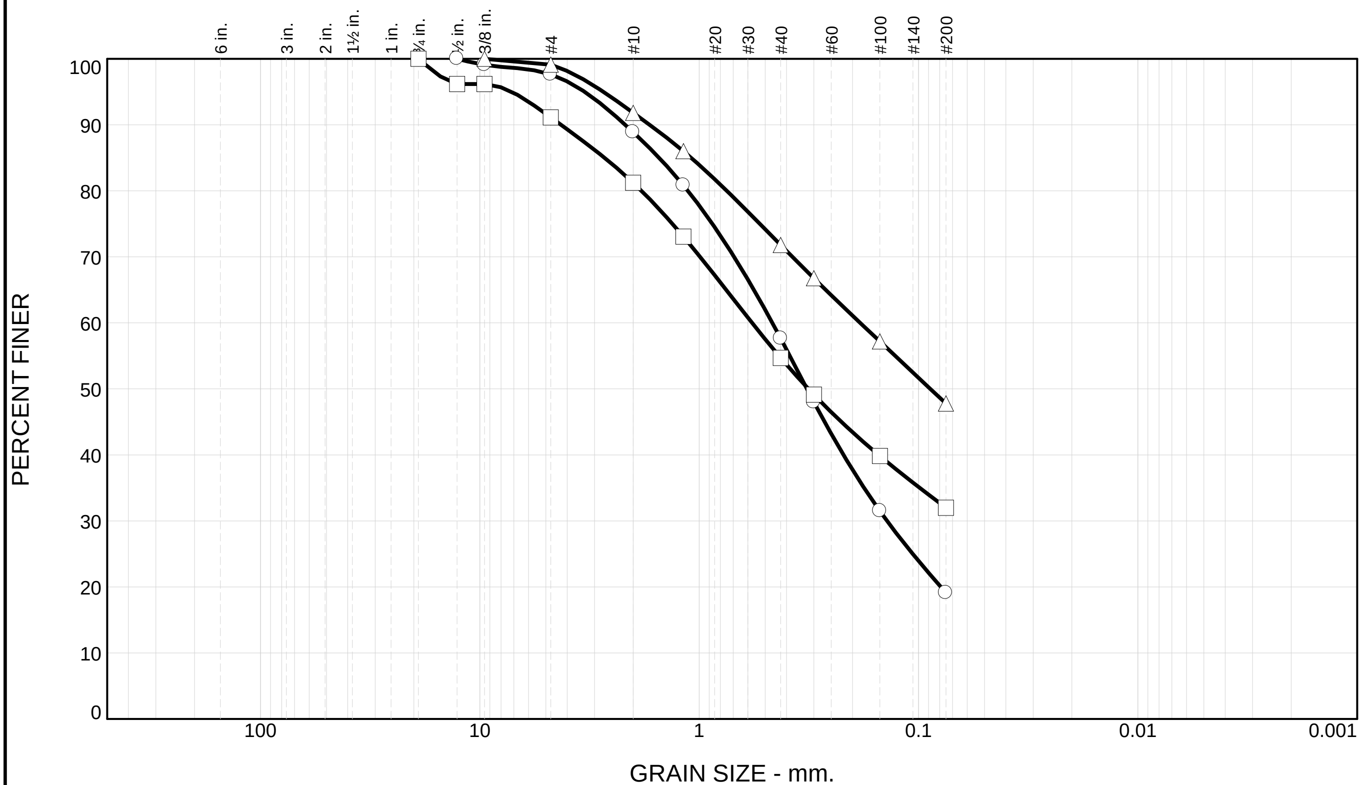
REMARKS:
○
□
△

○ Source of Sample: RSA-1 Depth: 37.5 - 39.0' Sample Number: S
□ Source of Sample: RSA-1 Depth: 40.0 - 41.5' Sample Number: T
△ Source of Sample: RSA-1 Depth: 45.0 - 46.5' Sample Number: U

NEVADA DEPARTMENT OF TRANSPORTATION

Client: M. Boutilier
Project: Roop Street Annex
Project No.: FL-11-11 Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT / % CLAY	USCS	AASHTO	PL	LL
○	0.0	2.4	78.5	19.1	SM	A-2-4(0)	NP	18
□	0.0	8.9	59.1	32.0	SC	A-2-6(0)	20	32
△	0.0	0.9	51.3	47.8	SC	A-6(3)	19	33

SIEVE inches size	PERCENT FINER ○	□	△
3/4"		100.0	
1/2"	100.0	96.2	
3/8"	99.1	96.2	100.0

	GRAIN SIZE ○	□	△
D_{60}	0.4636	0.5738	0.1844
D_{30}	0.1391		
D_{10}			

	COEFFICIENTS ○	□	△
C_c			
C_u			

SIEVE number size	PERCENT FINER ○	□	△
#4	97.6	91.1	99.1
#10	88.9	81.2	91.8
#16	80.8	73.1	86.0
#40	57.7	54.7	71.8
#50	48.0	49.1	66.8
#100	31.5	39.8	57.2
#200	19.1	32.0	47.8

Material Description
○ silty sand
□ clayey sand
△ clayey sand

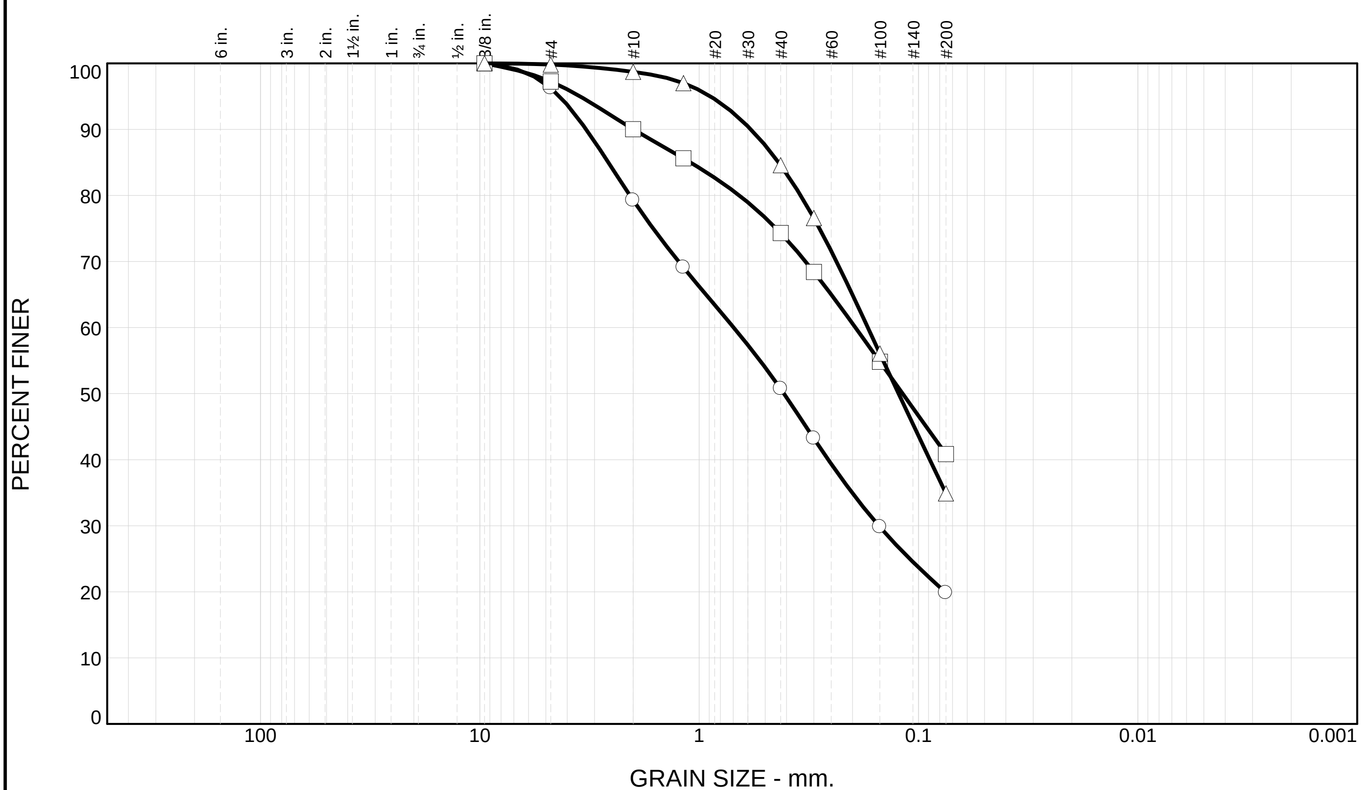
REMARKS:
○
□
△

○ Source of Sample: RSA-2 Depth: 1.0 - 2.5' Sample Number: A
□ Source of Sample: RSA-2 Depth: 4.0 - 5.5' Sample Number: C
△ Source of Sample: RSA-2 Depth: 5.5 - 7.0' Sample Number: D

NEVADA DEPARTMENT OF TRANSPORTATION

Client: M. Boutilier
Project: Roop Street Annex
Project No.: FL-11-11 Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	3.7	76.5	19.8		SM	A-2-4(0)	21	22
□	0.0	2.7	56.5	40.8		SC	A-6(2)	19	32
△	0.0	0.2	64.9	34.9		SM	A-2-4(0)	21	24

SIEVE inches size	PERCENT FINER ○	□	△
3/8"	100.0	100.0	100.0
	GRAIN SIZE		
D_{60}	0.6961	0.1938	0.1702
D_{30}	0.1517		
D_{10}			
	COEFFICIENTS		
C_c			
C_u			

SIEVE number size	PERCENT FINER ○	□	△
#4	96.3	97.3	99.8
#10	79.3	90.0	98.7
#16	69.1	85.6	97.0
#40	50.7	74.3	84.6
#50	43.2	68.4	76.6
#100	29.8	54.8	56.1
#200	19.8	40.8	34.9

Material Description

○ silty sand

□ clayey sand

△ silty sand

REMARKS:

○

□

△

○ Source of Sample: RSA-2 Depth: 7.0 - 8.5' Sample Number: E

□ Source of Sample: RSA-2 Depth: 8.5 - 10.0' Sample Number: F

△ Source of Sample: RSA-2 Depth: 10.0 - 11.5' Sample Number: G

NEVADA DEPARTMENT OF TRANSPORTATION

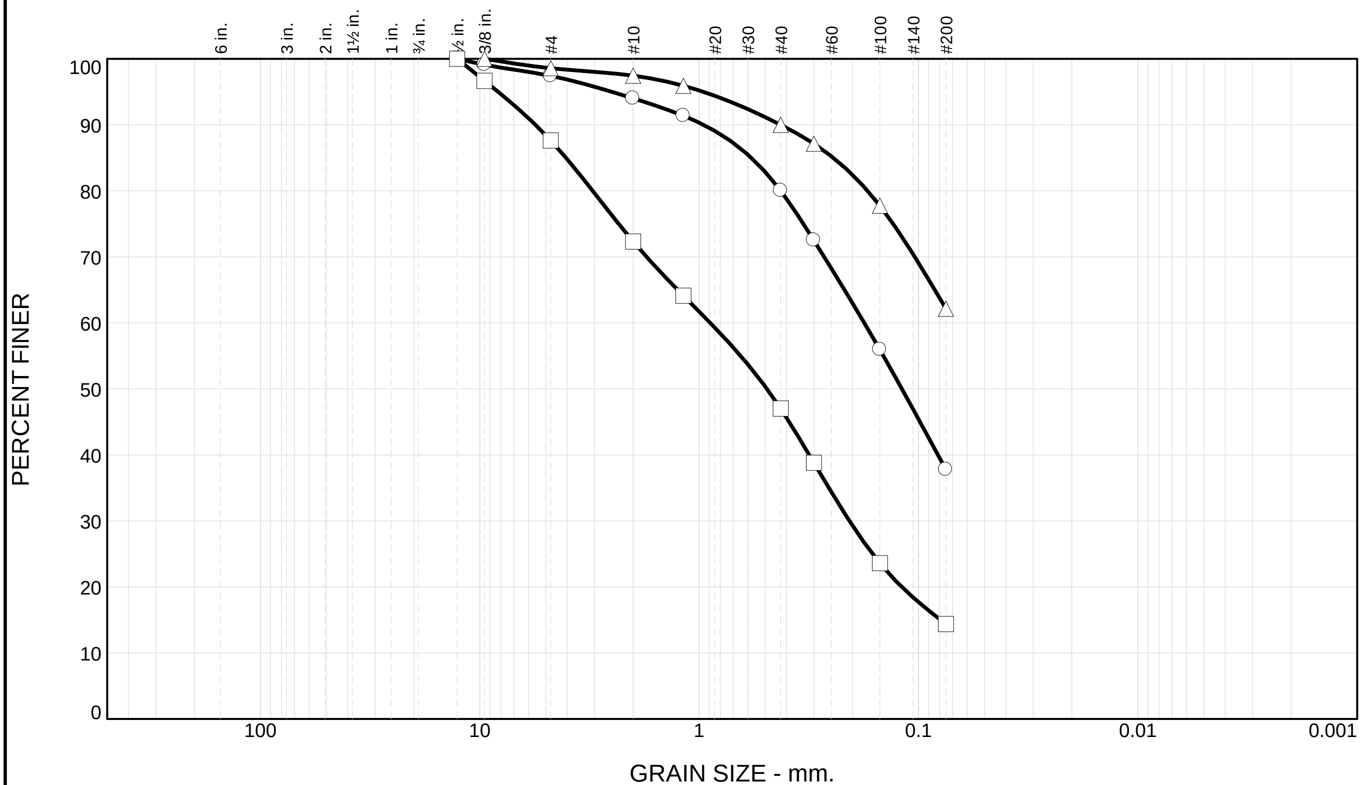
Client: M. Boutilier

Project: Roop Street Annex

Project No.: FL-11-11

Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT / % CLAY	USCS	AASHTO	PL	LL
○	0.0	2.6	59.6	37.8	SM	A-4(0)	NP	23
□	0.0	12.4	73.2	14.4	SM	A-1-b	NP	21
△	0.0	1.4	36.5	62.1	CL	A-6(6)	19	32

SIEVE inches size	PERCENT FINER ○	□	△
1/2"	100.0	100.0	
3/8"	99.1	96.7	100.0

GRAIN SIZE	○	□	△
D_{60}	0.1767	0.8905	
D_{30}		0.2064	
D_{10}			

COEFFICIENTS	○	□	△
C_c			
C_u			

SIEVE number size	PERCENT FINER ○	□	△
#4	97.4	87.6	98.6
#10	94.0	72.3	97.4
#16	91.4	64.1	95.9
#40	80.0	47.0	90.0
#50	72.5	38.8	87.1
#100	55.9	23.6	77.8
#200	37.8	14.4	62.1

Material Description
○ silty sand
□ silty sand
△ sandy lean clay

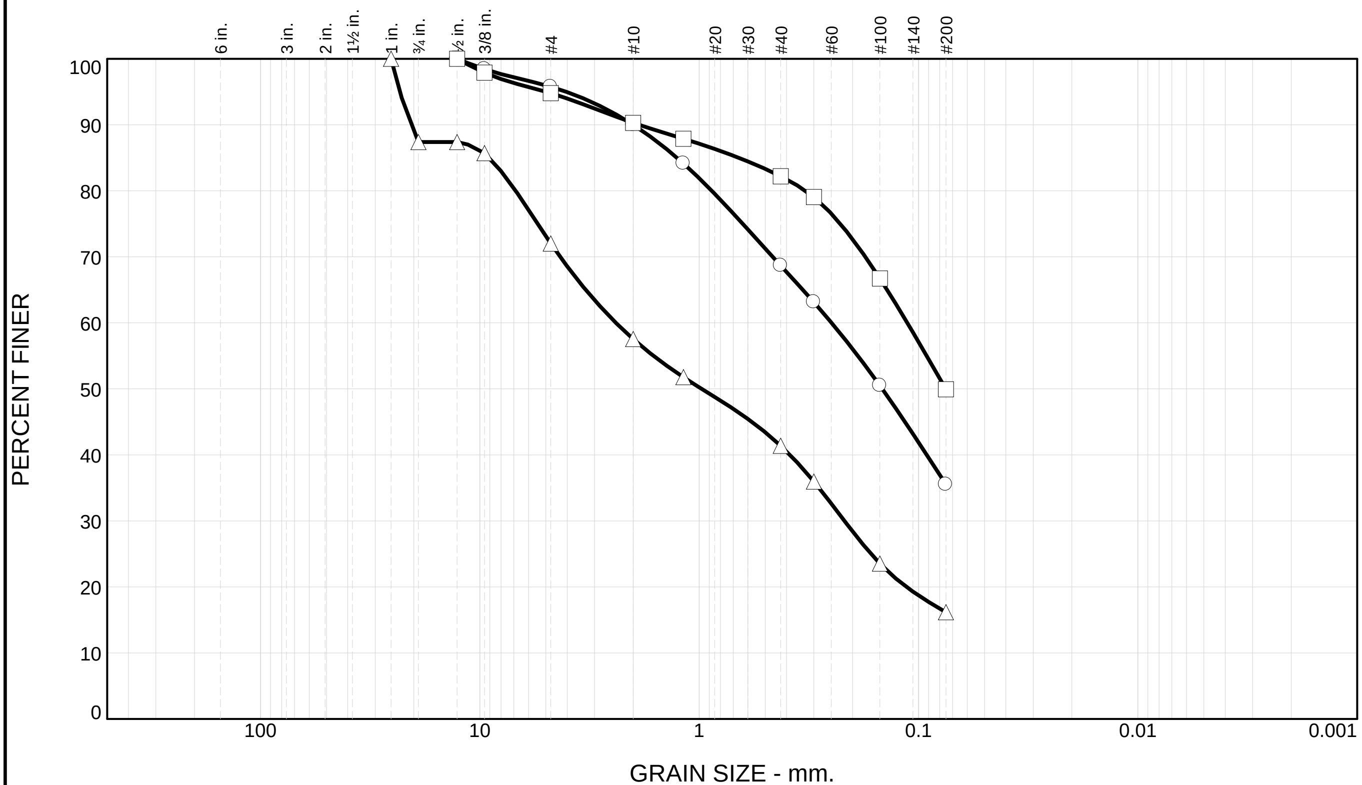
REMARKS:
○
□
△

○ Source of Sample: RSA-2 Depth: 11.5 - 13.0' Sample Number: H
□ Source of Sample: RSA-2 Depth: 13.0 - 14.5' Sample Number: I
△ Source of Sample: RSA-2 Depth: 14.5 - 16.0' Sample Number: J

NEVADA DEPARTMENT OF TRANSPORTATION

Client: M. Boutilier
Project: Roop Street Annex
Project No.: FL-11-11 Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	4.2	60.3	35.5		SM	A-4(0)	22	23
□	0.0	5.2	44.9	49.9		SM	A-4(0)	23	26
△	0.0	28.0	55.8	16.2		SM	A-1-b	NP	21

SIEVE inches size	PERCENT FINER ○	□	△
1"			100.0
3/4"			87.4
1/2"	100.0	100.0	87.4
3/8"	98.4	97.9	85.7
	GRAIN SIZE		
D_{60}	0.2490	0.1124	2.3973
D_{30}			0.2175
D_{10}			
	COEFFICIENTS		
C_c			
C_u			

SIEVE number size	PERCENT FINER ○	□	△
#4	95.8	94.8	72.0
#10	90.0	90.3	57.5
#16	84.1	87.9	51.8
#40	68.7	82.2	41.4
#50	63.1	79.1	36.0
#100	50.5	66.7	23.5
#200	35.5	49.9	16.2

Material Description
○ silty sand
□ silty sand
△ silty sand with gravel

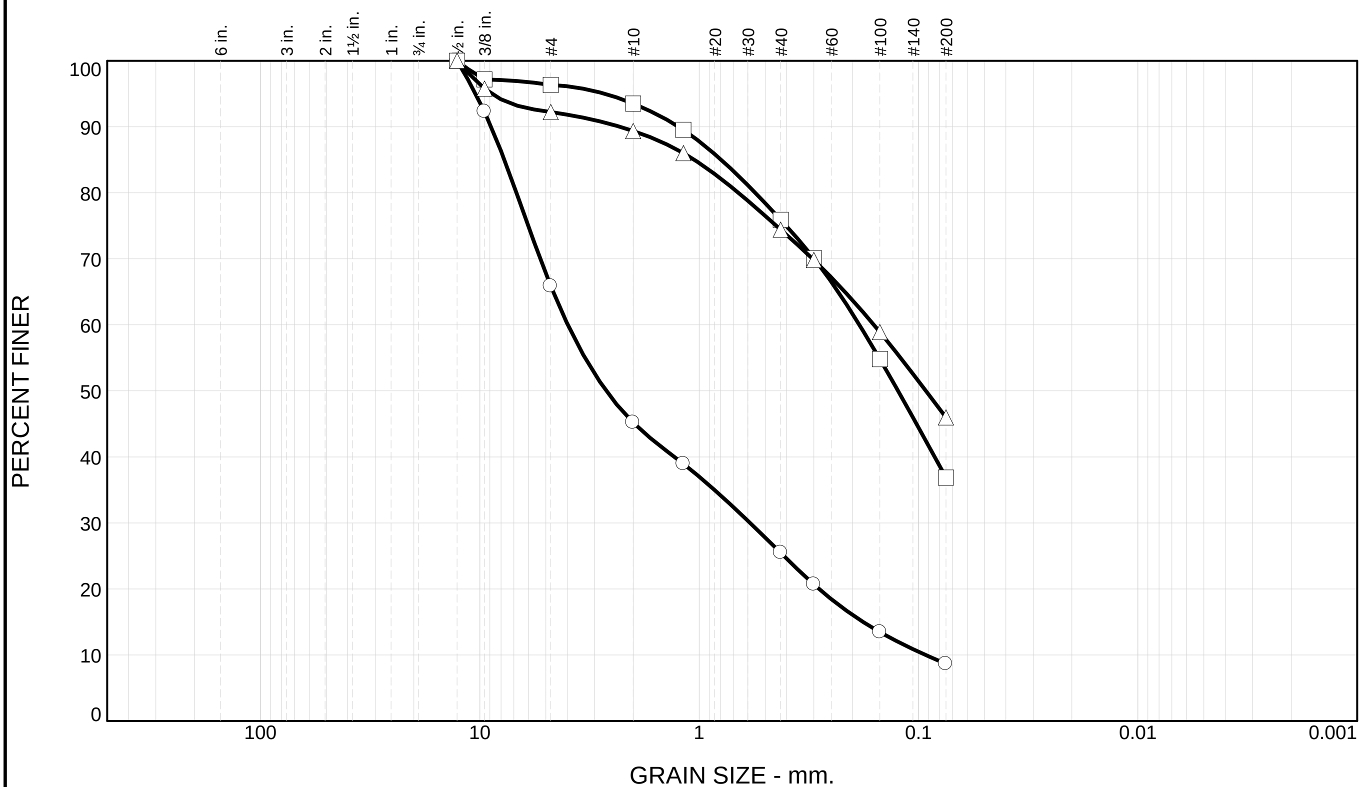
REMARKS:
○
□
△

○ Source of Sample: RSA-2 Depth: 17.5 - 19.0' Sample Number: K
□ Source of Sample: RSA-2 Depth: 19.5 - 21.0' Sample Number: L
△ Source of Sample: RSA-2 Depth: 22.5 - 24.0' Sample Number: M

NEVADA DEPARTMENT OF TRANSPORTATION

Client: M. Boutilier
Project: Roop Street Annex
Project No.: FL-11-11 Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	34.1	57.2	8.7		SP-SM	A-1-a	NP	20
□	0.0	3.7	59.4	36.9		SM	A-4(0)	20	22
△	0.0	7.8	46.2	46.0		SC	A-4(1)	20	29

SIEVE inches size	PERCENT FINER ○	PERCENT FINER □	PERCENT FINER △
1/2"	100.0	100.0	100.0
3/8"	92.3	97.2	95.8
GRAIN SIZE			
D_{60}	3.9751	0.1860	0.1597
D_{30}	0.5859		
D_{10}	0.0927		
COEFFICIENTS			
C_c	0.93		
C_u	42.89		

SIEVE number size	PERCENT FINER ○	PERCENT FINER □	PERCENT FINER △
#4	65.9	96.3	92.2
#10	45.2	93.5	89.4
#16	38.9	89.5	86.0
#40	25.5	75.9	74.4
#50	20.7	70.1	69.8
#100	13.5	54.8	58.9
#200	8.7	36.9	46.0

Material Description

○ poorly graded sand with silt and gravel

□ silty sand

△ clayey sand

REMARKS:

○

□

△

○ Source of Sample: RSA-2 Depth: 25.0 - 26.5' Sample Number: N

□ Source of Sample: RSA-2 Depth: 27.5 - 29.0' Sample Number: O

△ Source of Sample: RSA-2 Depth: 30.0 - 31.5' Sample Number: P

NEVADA DEPARTMENT OF TRANSPORTATION

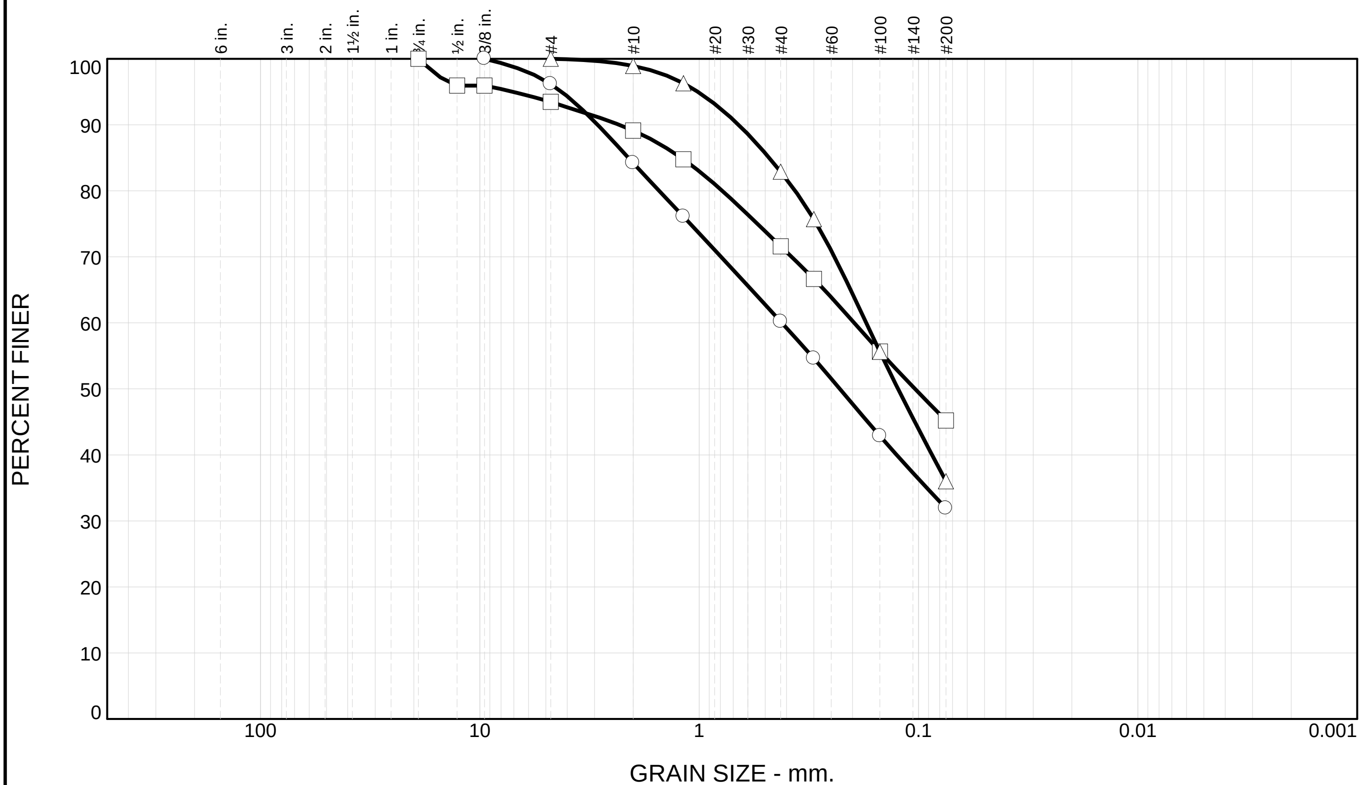
Client: M. Boutilier

Project: Roop Street Annex

Project No.: FL-11-11

Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT / % CLAY	USCS	AASHTO	PL	LL
○	0.0	3.8	64.3	31.9	SM	A-2-4(0)	22	24
□	0.0	6.5	48.3	45.2	SC-SM	A-4(0)	22	27
△	0.0	0.0	64.0	36.0	SM	A-4(0)	NP	24

SIEVE inches size	PERCENT FINER ○	□	△
3/4"		100.0	
1/2"		95.9	
3/8"	100.0	95.9	
GRAIN SIZE			
D_{60}	0.4197	0.1964	0.1731
D_{30}			
D_{10}			
COEFFICIENTS			
C_c			
C_u			

SIEVE number size	PERCENT FINER ○	□	△
#4	96.2	93.5	100.0
#10	84.2	89.1	98.9
#16	76.1	84.8	96.3
#40	60.2	71.6	82.9
#50	54.6	66.7	75.7
#100	42.9	55.7	55.6
#200	31.9	45.2	36.0

Material Description
○ silty sand
□ silty, clayey sand
△ silty sand

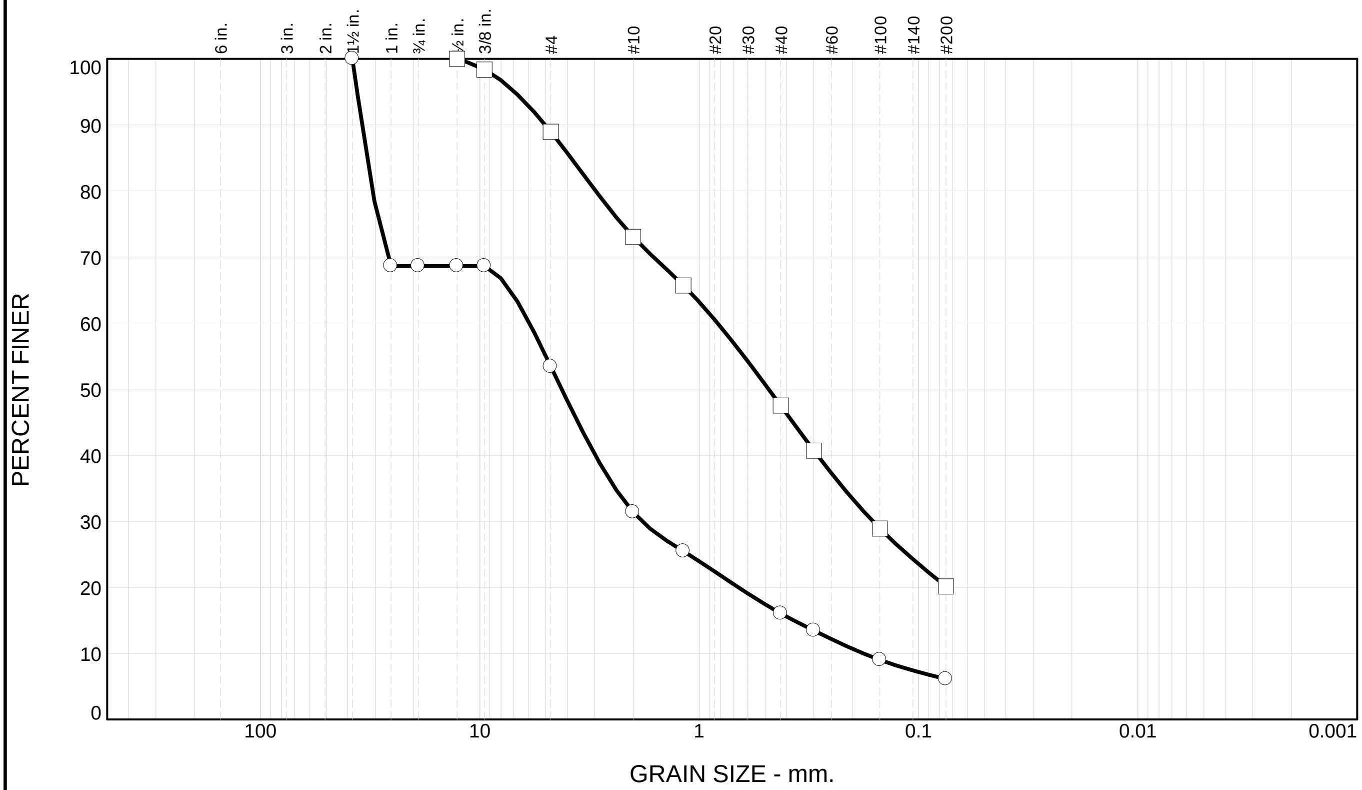
REMARKS:
○
□
△

○ Source of Sample: RSA-2 Depth: 32.5 - 34.0' Sample Number: Q
□ Source of Sample: RSA-2 Depth: 35.0 - 36.5' Sample Number: R
△ Source of Sample: RSA-2 Depth: 40.0 - 41.5' Sample Number: S

NEVADA DEPARTMENT OF TRANSPORTATION

Client: M. Boutilier
Project: Roop Street Annex
Project No.: FL-11-11 Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	46.6	47.3	6.1		SP-SM	A-1-a	NP	20
□	0.0	11.0	68.9	20.1		SM	A-1-b	NP	21

SIEVE inches size	PERCENT FINER ○	PERCENT FINER □	
1.5"	100.0		
1"	68.6		
3/4"	68.6		
1/2"	68.6	100.0	
3/8"	68.6	98.4	
	GRAIN SIZE		
D_{60}	5.9444	0.8253	
D_{30}	1.8266	0.1616	
D_{10}	0.1788		
	COEFFICIENTS		
C_c	3.14		
C_u	33.25		

SIEVE number size	PERCENT FINER ○	PERCENT FINER □	
#4	53.4	89.0	
#10	31.4	73.1	
#16	25.5	65.7	
#40	16.0	47.5	
#50	13.5	40.7	
#100	9.0	28.9	
#200	6.1	20.1	

Material Description

○ poorly graded sand with silt and gravel

□ silty sand

REMARKS:

○

□

○ Source of Sample: RSA-2 Depth: 45.0 - 46.5' Sample Number: T

□ Source of Sample: RSA-2 Depth: 50.0 - 51.5' Sample Number: U

NEVADA DEPARTMENT OF TRANSPORTATION

Client: M. Boutilier

Project: Roop Street Annex

Project No.: FL-11-11 Figure

APPENDIX D

LIQUEFACTION POTENTIAL EVALUATION BASED ON THE PROCEDURES BY IDRISS AND BOULANGER (EERI,2008)

PROJECT: ROOP STREET ANNEX

Soil Unit Weight (pcf)	=	110
Energy Ratio (%)	=	87.5
Design Groundwater Depth (feet)	=	5
Peak Ground Acceleration (g)	=	0.456
Earthquake Magnitude	=	7.4

BORING (No.)	DEPTH (feet)	LAYER THICKNESS (feet)	SPT-N (bl/ft)	SOIL CLASSIF.	PERCENT FINES P200	DEPTH TO WATER (feet)	BORING DIA. (inch)	TOTAL PRESSURE (ksf)	EFFECT. PRESS. (ksf)	DEPTH FACTOR Cn	ENERGY FACTOR Ce	BORING DIAMETER FACTOR, Cb	ROD FACTOR Cr	SAMPLER FACTOR Cs	MODIFIED PENETR. (N1)60	PENETR. RESIST. (N1)60*
RSA-1	1	1.5	24	SM	15.4	4	8	0.11	0.11	1.70	1.46	1.15	0.75	1.24	63.6	67.0
RSA-1	2.5	3	4	ML	50.1	2.5	8	0.28	0.28	1.70	1.46	1.15	0.75	1.10	9.4	15.0
RSA-1	5.5	1.5	8	SC	41.9	-0.5	8	0.61	0.23	1.70	1.46	1.15	0.75	1.10	18.8	24.4
RSA-1	7	2	6	CL	52.1	-2	8	0.77	0.21	1.69	1.46	1.15	0.75	1.10	14.1	19.7
RSA-1	9	1.5	10	CL	62.0	-4	8	0.99	0.18	1.51	1.46	1.15	0.75	1.10	20.8	26.4
RSA-1	10.5	2.5	11	SM	33.3	-5.5	8	1.16	0.16	1.44	1.46	1.15	0.75	1.11	22.1	27.6
RSA-1	13	2	12	SM	29.0	-8	8	1.43	0.12	1.36	1.46	1.15	0.75	1.12	23.0	28.3
RSA-1	15	1.5	20	SP-SM	11.7	-10	8	1.65	0.09	1.22	1.46	1.15	0.85	1.20	41.8	43.7
RSA-1	16.5	1.5	22	SM	40.4	-11.5	8	1.82	0.07	1.19	1.46	1.15	0.85	1.22	45.5	51.1
RSA-1	18	2	41	SM	24.6	-13	8	1.98	0.05	1.17	1.46	1.15	0.85	1.30	88.9	93.9
RSA-1	20	2.5	41	SM	18.4	-15	8	2.20	0.02	1.15	1.46	1.15	0.95	1.30	97.3	101.5
RSA-1	22.5	2.5	18	SM	43.9	-17.5	8	2.48	-0.02	1.13	1.46	1.15	0.95	1.18	38.1	43.7
RSA-1	25	2.5	30	SM	17.1	-20	8	2.75	-0.06	1.09	1.46	1.15	0.95	1.30	68.0	71.9
RSA-1	27.5	2.5	12	ML	61.1	-22.5	8	3.03	-0.10	1.10	1.46	1.15	0.95	1.12	23.6	29.2
RSA-1	30	2.5	15	SM	25.7	-25	8	3.30	-0.13	1.07	1.46	1.15	0.95	1.15	29.4	34.5
RSA-1	32.5	2	11	SM	34.9	-27.5	8	3.58	-0.17	1.05	1.46	1.15	0.95	1.11	20.5	26.0
RSA-1	34.5	3	10	SC	49.5	-29.5	8	3.80	-0.20	1.03	1.46	1.15	1.00	1.10	19.1	24.7
RSA-1	37.5	2.5	15	ML	50.2	-32.5	8	4.13	-0.24	1.00	1.46	1.15	1.00	1.15	29.0	34.6
RSA-1	40	5	45	SM	17.4	-35	8	4.40	-0.28	0.99	1.46	1.15	1.00	1.30	97.0	100.9
RSA-1	45	1.5	44	20.1	50.0	-40	8	4.95	-0.35	0.96	1.46	1.15	1.00	1.30	92.3	97.9

BORING (No.)	DEPTH (feet)	REDUCTION FACTOR Rd	EFFECT. PRESS. DURING LIQ. (ksf)	INDUCED STRESS RATIO	DEV. STRESS RATIO M=7.5	CORRECTED RESISTANCE STRESS RATIO	K_σ	FACTOR OF SAFETY	LIMITED SHEAR STRAIN, γ_{lim}	PARA. $F\alpha$	MAXIMUM SHEAR STRAIN, γ_{MAX}	ΔLDI_{li} (ft)	LATERAL DISP. INDEX (LDI, ft)	VOLUM. STRAIN	SETTLE LAYER (in)	SETTLE TOTAL (in)
RSA-1	1	1.00	0.11	0.298	0.290	2.000	1.1	Above GT	0.00	-3.03	0.00	0.00	0.80	0.00	0.00	2.1
RSA-1	2.5	1.00	0.28	0.297	0.289	0.172	1.1	Above GT	0.27	0.75	0.00	0.00	0.80	0.00	0.00	2.1
RSA-1	5.5	0.99	0.57	0.310	0.302	0.304	1.1	0.93	0.10	0.27	0.04	0.06	0.80	0.01	0.18	2.1
RSA-1	7	0.99	0.65	0.350	0.341	Non-liquefiable	1.1	Non-liquefiable	0.16	0.53	0.00	0.00	0.74	0.00	0.00	1.9
RSA-1	9	0.98	0.74	0.390	0.379	Non-liquefiable	1.1	Non-liquefiable	0.07	0.14	0.00	0.00	0.74	0.00	0.00	1.9
RSA-1	10.5	0.98	0.81	0.413	0.402	0.405	1.1	0.93	0.06	0.07	0.04	0.10	0.74	0.01	0.26	1.9
RSA-1	13	0.97	0.93	0.442	0.430	0.438	1.1	0.93	0.06	0.02	0.04	0.08	0.64	0.01	0.20	1.6
RSA-1	15	0.96	1.03	0.459	0.447	2.000	1.1	2.00	0.00	-1.09	0.00	0.00	0.56	0.00	0.00	1.4
RSA-1	16.5	0.96	1.10	0.469	0.457	2.000	1.1	2.00	0.00	-1.68	0.00	0.00	0.56	0.00	0.00	1.4
RSA-1	18	0.95	1.17	0.478	0.465	2.000	1.1	2.00	0.00	-5.49	0.00	0.00	0.56	0.00	0.00	1.4
RSA-1	20	0.94	1.26	0.487	0.474	2.000	1.1	2.00	0.00	-6.21	0.00	0.00	0.56	0.00	0.00	1.4
RSA-1	22.5	0.93	1.38	0.496	0.483	2.000	1.1	2.00	0.00	-1.09	0.00	0.00	0.56	0.00	0.00	1.4
RSA-1	25	0.92	1.50	0.501	0.488	2.000	1.1	2.00	0.00	-3.47	0.00	0.00	0.56	0.00	0.00	1.4
RSA-1	27.5	0.91	1.62	0.505	0.492	0.464	1.1	0.86	0.05	-0.04	0.05	0.12	0.56	0.01	0.28	1.4
RSA-1	30	0.90	1.74	0.507	0.494	1.047	1.1	1.92	0.02	-0.40	0.00	0.00	0.44	0.00	0.01	1.1
RSA-1	32.5	0.89	1.86	0.508	0.494	0.322	1.0	0.59	0.08	0.17	0.08	0.16	0.44	0.02	0.43	1.1
RSA-1	34.5	0.88	1.95	0.507	0.494	0.286	1.0	0.52	0.09	0.25	0.09	0.28	0.28	0.02	0.69	0.7
RSA-1	37.5	0.87	2.10	0.506	0.493	1.035	1.0	1.89	0.02	-0.41	0.00	0.01	0.01	0.00	0.01	0.0
RSA-1	40	0.86	2.22	0.504	0.490	2.000	1.0	2.00	0.00	-6.16	0.00	0.00	0.00	0.00	0.00	0.0
RSA-1	45	0.83	2.45	0.497	0.484	2.000	1.0	2.00	0.00	-5.87	0.00	0.00	0.00	0.00	0.00	0.0

LIQUEFACTION POTENTIAL EVALUATION BASED ON THE PROCEDURES BY IDRISS AND BOULANGER (EERI,2008)

PROJECT: ROOP STREET ANNEX

Soil Unit Weight (pcf)	=	110
Energy Ratio (%)	=	87.5
Design Groundwater Depth (feet)	=	5
Peak Ground Acceleration (g)	=	0.456
Earthquake Magnitude	=	7.4

BORING (No.)	DEPTH (feet)	LAYER THICKNESS (feet)	SPT-N (bl/ft)	SOIL CLASSIF.	PERCENT FINES P200	DEPTH TO WATER (feet)	BORING DIA. (inch)	TOTAL PRESSURE (ksf)	EFFECT. PRESS. (ksf)	DEPTH FACTOR Cn	ENERGY FACTOR Ce	BORING DIAMETER FACTOR, Cb	ROD FACTOR Cr	SAMPLER FACTOR Cs	MODIFIED PENETR. (N1)60	PENETR. RESIST. (N1)60*	REDUCTION FACTOR Rd	EFFECT. PRESS. DURING LIQ. (ksf)	INDUCED STRESS RATIO	DEV. STRESS RATIO M=7.5	CORRECTED RESISTANCE STRESS RATIO	K_σ	FACTOR OF SAFETY	LIMITED SHEAR STRAIN, γ_{lim}	PARA. $F\alpha$	MAXIMUM SHEAR STRAIN, γ_{MAX}	ΔLDI_i (ft)	LATERAL DISP. INDEX (LDI, ft)	VOLUM. STRAIN	SETTLE LAYER (in)	SETTLE TOTAL (in)
RSA-2	1	1.5	25	SM	19.1	4	8	0.11	0.11	1.70	1.46	1.15	0.75	1.25	66.8	71.1	1.00	0.11	0.298	0.290	2.000	1.1	Above GT	0.00	-3.40	0.00	0.00	1.17	0.00	0.00	2.6
RSA-2	2.5	1.5	4	ML	51.0	2.5	8	0.28	0.28	1.70	1.46	1.15	0.75	1.10	9.4	15.0	1.00	0.28	0.297	0.289	0.172	1.1	Above GT	0.27	0.75	0.00	0.00	1.17	0.00	0.00	2.6
RSA-2	4	1.5	2	SC	32.0	1	8	0.44	0.25	1.70	1.46	1.15	0.75	1.10	4.7	10.1	1.00	0.44	0.296	0.288	0.131	1.1	Above GT	0.47	0.91	0.00	0.00	1.17	0.00	0.00	2.6
RSA-2	5.5	1.5	9	SC	47.8	-0.5	8	0.61	0.23	1.66	1.46	1.15	0.75	1.10	20.7	26.3	0.99	0.57	0.310	0.302	0.358	1.1	1.19	0.08	0.15	0.02	0.04	1.17	0.01	0.10	2.6
RSA-2	7	1.5	13	SM	19.8	-2	8	0.77	0.21	1.51	1.46	1.15	0.75	1.13	27.9	32.4	0.99	0.65	0.350	0.341	0.751	1.1	2.00	0.03	-0.25	0.00	0.00	1.14	0.00	0.00	2.5
RSA-2	8.5	1.5	6	SC	40.8	-3.5	8	0.94	0.19	1.63	1.46	1.15	0.75	1.10	13.5	19.1	0.98	0.72	0.381	0.371	0.215	1.1	0.58	0.18	0.57	0.18	0.26	1.14	0.02	0.43	2.5
RSA-2	10	1.5	14	SM	34.9	-5	8	1.10	0.16	1.40	1.46	1.15	0.75	1.14	28.1	33.6	0.98	0.79	0.405	0.395	0.925	1.1	2.00	0.03	-0.34	0.00	0.00	0.87	0.00	0.00	2.1
RSA-2	11.5	1.5	13	SM	37.8	-6.5	8	1.27	0.14	1.38	1.46	1.15	0.75	1.13	25.5	31.0	0.98	0.86	0.425	0.414	0.614	1.1	1.48	0.04	-0.16	0.01	0.02	0.87	0.00	0.04	2.1
RSA-2	13	1.5	30	SM	14.4	-8	8	1.43	0.12	1.24	1.46	1.15	0.75	1.30	60.9	64.0	0.97	0.93	0.442	0.430	2.000	1.1	2.00	0.00	-2.77	0.00	0.00	0.86	0.00	0.00	2.1
RSA-2	14.5	3	10	CL	62.1	-9.5	8	1.60	0.10	1.34	1.46	1.15	0.85	1.10	21.0	26.6	0.96	1.00	0.455	0.443	Non-liquefiable	1.1	Non-liquefiable	0.07	0.13	0.00	0.00	0.86	0.00	0.00	2.1
RSA-2	17.5	2	12	SM	35.5	-12.5	8	1.93	0.05	1.25	1.46	1.15	0.85	1.12	24.0	29.5	0.95	1.15	0.475	0.463	0.503	1.1	1.09	0.05	-0.06	0.03	0.06	0.86	0.01	0.14	2.1
RSA-2	19.5	3	14	SM	49.9	-14.5	8	2.15	0.02	1.20	1.46	1.15	0.85	1.14	27.3	33.0	0.95	1.24	0.485	0.472	0.829	1.1	1.76	0.03	-0.29	0.01	0.02	0.80	0.00	0.04	1.9
RSA-2	22.5	2	48	SM	16.2	-17.5	8	2.48	-0.02	1.12	1.46	1.15	0.95	1.30	111.2	114.9	0.93	1.38	0.496	0.483	2.000	1.1	2.00	0.00	-7.51	0.00	0.00	0.78	0.00	0.00	1.9
RSA-2	24.5	3	35	SP-SM	8.7	-19.5	8	2.70	-0.05	1.10	1.46	1.15	0.95	1.30	79.7	80.3	0.93	1.48	0.500	0.487	2.000	1.1	2.00	0.00	-4.22	0.00	0.00	0.78	0.00	0.00	1.9
RSA-2	27.5	2	11	SM	36.9	-22.5	8	3.03	-0.10	1.11	1.46	1.15	0.95	1.11	21.6	27.1	0.91	1.62	0.505	0.492	0.367	1.0	0.75	0.07	0.10	0.06	0.12	0.78	0.01	0.32	1.9
RSA-2	29.5	3	9	SC	46.0	-24.5	8	3.25	-0.12	1.09	1.46	1.15	0.95	1.10	17.2	22.8	0.90	1.72	0.507	0.493	0.254	1.0	0.52	0.11	0.36	0.11	0.34	0.66	0.02	0.74	1.6
RSA-2	32.5	2	20	SM	31.9	-27.5	8	3.58	-0.17	1.04	1.46	1.15	0.95	1.20	39.6	45.0	0.89	1.86	0.508	0.494	2.000	1.0	2.00	0.00	-1.19	0.00	0.00	0.31	0.00	0.00	0.8
RSA-2	34.5	5	15	SC-SM	45.2	-29.5	8	3.80	-0.20	1.03	1.46	1.15	1.00	1.15	29.7	35.3	0.88	1.95	0.507	0.494	1.211	1.0	2.00	0.02	-0.46	0.00	0.00	0.31	0.00	0.00	0.8
RSA-2	39.5	5	29	SM	36.0	-34.5	8	4.35	-0.27	0.99	1.46	1.15	1.00	1.29	62.2	67.7	0.86	2.19	0.504	0.491	2.000	1.0	2.00	0.00	-3.09	0.00	0.00	0.31	0.00	0.00	0.8
RSA-2	44.5	5	15	SP-SM	6.1	-39.5	8	4.90	-0.35	0.95	1.46	1.15	1.00	1.15	27.5	27.5	0.83	2.43	0.498	0.485	0.355	1.0	0.73	0.06	0.08	0.06	0.31	0.31	0.01	0.81	0.8
RSA-2	49.5	1.5	52	SM	20.1	-42.1	8	5.45	-0.27	0.94	1.46	1.15	1.00	1.30	106.7	111.2	0.81	2.67	0.490	0.477	2.000	0.9	2.00	0.00	-7.15	0.00	0.00	0.31	0.00	0.00	0.8

APPENDIX E

STATE OF NEVADA

DEPARTMENT OF TRANSPORTATION

MATERIALS DIVISION

GEOTECHNICAL SECTION

PRELIMINARY GEOTECHNICAL REPORT
ROOP STREET ANNEX
NDOT HEADQUARTERS COMPLEX

CARSON CITY, NEVADA

NOVEMBER 2011

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NEVADA DOT GEOTECHNICAL ENGINEERING

TABLE OF CONTENTS

1.0 INTRODUCTION

This report presents the results of our preliminary geotechnical investigation for the proposed Nevada Department of Transportation (NDOT) Roop Street Annex Office Building. Final design plans are not available at this time. Currently, the proposed building will be a single-story structure encompassing approximately 16,200 square feet. It is assumed the structure will be either a wood-framed or masonry block building with concrete slab-on-grade flooring and conventional shallow spread foundations. Appurtenant construction will include asphalt concrete pavements, sidewalks, curbs and gutters, and underground utilities.

2.0 SCOPE OF WORK

The purpose of this report is to provide preliminary recommendations for planning and design of the project. Recommendations are based on a review of published maps and references, unpublished foundation reports and preliminary project data. We request that the Geotechnical Section review final design plans to verify the validity of these recommendations. Following this review, field exploration may be required prior to submitting a final geotechnical report.

3.0 PROJECT SITE

The project is located in Section 20, Township 15 North, Range 20 East, MDM in Carson City, Nevada. The proposed building is to be constructed in the northeast portion of the NDOT Headquarters Campus in an asphalt-paved parking lot. The site is bordered by Roop Street to the east, the NDOT car barn to the north, a sand storage facility to the south and an asphalt parking area to the east. The site is devoid of vegetation. Site access is obtained by two entrances on Oregon Street. The project site is shown in Figure 1.

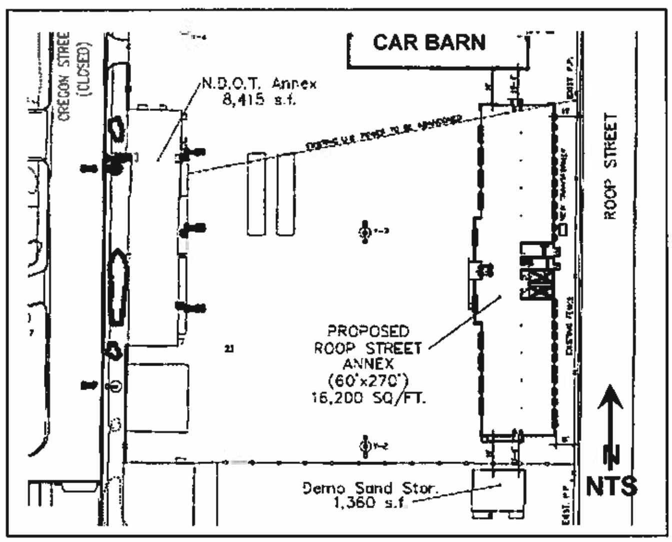


FIGURE 1 – PROJECT SITE

4.0 GENERAL SITE GEOLOGY AND SUBSURFACE SOIL CONDITONS

4.1 Geology

Based on a review of the referenced geologic map, the site overlies alluvial plain deposits of Eagle Valley. This deposit is described as *unbedded to poorly bedded, poorly to moderately sorted, fine silty sand, sandy silt, granular muddy coarse sand, and minor sand, gravel.*

4.2 *Subsurface Soils and Ground Water Conditions*

Previous geotechnical investigations indicate the soil profile in the project vicinity generally consists of loose sand interbedded with medium stiff to stiff silt or clay within the upper ten feet overlying medium dense to dense silty sand, sand and gravel. Soils are generally moist to wet. Ground water was encountered at depths ranging from 4½ feet to 7 feet below the ground surface.

5.0 SEISMIC HAZARDS

5.1 *Faulting*

Carson City is located in Eagle Valley, a faulted basin bounded by the Carson Range to the west, the Virginia Range to the north and the Pine Nut Mountains to the east. The region is an extremely active tectonic area as evidenced by a series of Holocene Active Faults located at the base of the Carson and Virginia Ranges. These faults generally consist of a parallel series (en echelon) of normal faults that drop down toward the valley and are typical of "mountain building" tectonics in the northern Nevada area.

The referenced maps and documents indicate that no mapped faults trend through the site. An unnamed Holocene-aged fault trace is mapped about 3,000 feet west of the site. Several faults are located within a five-mile radius of the site and include the Carson City Fault Zone, Eastern Prison Hill Fault Zone, Kings Canyon Fault Zone, and Genoa Fault Zone. Eastern Prison Hill is the closest fault zone located about 1½ miles east of the site. The Genoa Fault Zone has the highest potential earthquake magnitude and is situated about five miles southwest of the site.

Faults in the project area are capable of generating earthquake magnitudes (Ms) of 6.8 to 7.4 and are considered either Late Quaternary Active or Holocene Active according to criteria set forth by the State of Nevada Seismic Safety Council. The site is mapped by the United States Geological Society, National Earthquake Hazards Reduction Program (NEHRP) as having a horizontal acceleration (expressed as percent gravity) in rock with 10% probability of exceedance in 50 years of 0.4g.

5.2 *Liquefaction*

Based on a review of available data, **soils from 3 feet to 10 feet below the ground surface are subject to liquefaction when saturated** during a seismic event with a moderate to high magnitude ($M \geq 6.0$). However, the liquefaction potential within soils below this depth is negligible. In Nevada, no specific policy requires structures to be designed for liquefaction mitigation. Based on current design plans for the single-story structure, it may not be economical to mitigate for liquefaction. If mitigation measures are planned, additional field exploration will be required.

6.0 SEISMIC DESIGN PARAMETERS

The Carson City Development Services Department utilizes the 2006 International Building Code (IBC). Seismic design parameters are based on site-specific estimates of spectral response ground acceleration as designated in the 2006 IBC. Without additional exploration, a Site Class D is applicable for this site. The site coefficients, Fa and Fv, as a function of Site Class B are 1.0 and 1.5, respectively. Although the upper soil layers may be subject to liquefaction indicating a Site Class F, the proposed structure period does not warrant a site specific evaluation.

7.0 DISCUSSCION AND RECOMMENDATIONS

7.1 GENERAL INFORMATION

The following recommendations are ***preliminary only*** and are based on a review of the referenced data. Available boring logs and boring location maps from previous geotechnical reports are included in the appendix of this report. As previously stated, we request that the Geotechnical Section review the final plans prior to finalizing the geotechnical report to verify that recommendations presented in this report are sufficient.

Structural areas referred to in this report include all areas of buildings, concrete slabs, pavements, and pads for any minor structures. All compaction requirements in this report are relative to ASTM D 1557. Unless stated in this report, all related construction should be in accordance with the Standard Specifications for Public Works Construction (Orange Book, 2007).

7.2 EARTHWORK & SITE PREPARATION

It should be noted that shallow ground water may be encountered. The contractor should be aware that excessive compactive efforts on wet, fine-grained soils can cause instability in otherwise stable subgrade soils. It is the responsibility of the contractor to not disturb otherwise firm site soils.

The existing pavement below the proposed building footprint is to be removed in its entirety and may be pulverized and re-used as structural fill. Existing utilities located below the proposed building footprint should be relocated and the resulting excavations backfilled with properly placed structural fill.

Very loose to loose soils are likely present within the upper ten feet of the soil profile. Foundations should not bear directly on these soils. To improve support of shallow spread footings and concrete slabs-on-grade, the upper *in situ* soils should be over-excavated a depth of four feet below footings and one foot below concrete slabs-on-grade. The resulting excavations should be backfilled with properly placed structural fill. If NDOT determines that mitigation for liquefaction is necessary, the entire building footprint should be over-excavated to a depth of ten feet below the existing ground surface and backfilled with properly placed structural fill. In lieu of over-excavation, geopiers or soil grouting can be utilized.

Over-excavations should extend laterally from the edge of the foundations or slabs a minimum distance equal to the depth of over-excavation. Prior to the placement of structural fill or structural loading, soils should be properly prepared in accordance with the recommendations of this report.

All areas to receive structural fill or structural loading should be densified to a minimum depth of 8 inches to at least 90 percent relative compaction in accordance with ASTM D 1557. Soils should have moisture contents of plus or minus 2 percent of optimum moisture (ASTM D1557) prior to densification and may require scarification and moisture conditioning. It is recommended that the moisture content of native soils and imported fill be determined prior to densification to evaluate the need for moisture conditioning.

After the densification process, a firm stable surface should be produced. If foundation grade soils are allowed to be exposed to inclement or freezing weather conditions, they may be scarified and recompacted or removed to expose suitable foundation soils and replaced with structural fill. The base of all excavations for foundations and concrete slabs-on-grade should be dry and free of loose materials at the time of concrete placement. Unstable soils due to excessive moisture content may be encountered and should be scarified and allowed to dry or over-excavated and replaced with structural fill. If these stabilization methods are not appropriate due to either time constraints or depth of unstable material, the unstable soil areas could be bridged using methods discussed in the Section 7.3 of this report.

Structural fill is defined as supporting soils placed below structural elements such as foundations, concrete slabs-on-grade, pavements, or any structure that derives support from the underlying subsoils. Structural fill should meet the requirements presented below in Table 1.

TABLE 1 - GUIDELINE SPECIFICATION FOR IMPORTED STRUCTURAL FILL

Sieve Size	**Percent by Weight Passing**	
6 Inch	100	
¾ Inch	70 – 100	
No. 40	15 – 70	
No. 200	5 – 35	
Percent Passing No. 200 Sieve	**Maximum Liquid Limit**	**Maximum Plastic Index**
5 – 20	40	15
21 – 35	35	10

Structural fill should be placed in maximum 12-inch thick (loose) level lifts or layers and densified to at least 90 percent relative compaction. Fills exceeding 5 feet in depth should be densified to at least 95 percent relative compaction. Soils should have moisture contents of plus or minus 2 percent of optimum moisture (ASTM D1557). Higher moisture contents are acceptable if the soil lift is stable and required relative compaction can be attained in the soil lift and succeeding soil lifts. Grading should not be performed with frozen soils or on frozen soils.

7.3 Stabilization Methods

If stabilization is required, there should be sufficient depth between the over-excavated surface and the structural element to allow the placement of stabilization material. The appropriate construction method to treat unstable soil areas will be determined during construction.

7.3.1 Rock Fill

Stabilization can be achieved by utilizing rock fill. Rock fill should be angular, well-graded and consist of hard, durable particles without organics, clay lumps, or other unstable substances. A general particle sizing for rock fill is presented below in the Table 2. Other material types may be considered and should be approved by the engineer prior to placement. Rock fill is to be placed in an 18-inch lift and initially seated by pushing the rock fill into the underlying substrate with the trackhoe bucket and densified by at least 5 complete passes with a minimum 10-ton roller. An additional 18-inch layer of rock fill may be required if instability is still severe.

Table 2 - Guideline Specification for Rock Fill

Sieve Size	Percent by Weight Passing
12-Inch	100
6-Inch	40 – 70
No. 4	5 – 25
No. 200	0 – 5

A nonwoven geotextile meeting the specifications given in Table 3 should then be placed over the rock. If the rock fill surface is coarse and angular, a minimum 2-inch drain rock layer should be placed over the rock fill prior to installation of the geotextile.

Table 3 – Minimum Average Roll Strength Properties for Geotextile

Trapezoid Tear Strength (ASTM D 4533)	80 lbs.
Puncture Strength (ASTM D 4833)	100 lbs.
Grab Strength (ASTM D 4632)	210 lbs.
Burst Strength (ASTM D 3786)	450 psi.
Permittivity(ASTM D 4491)	0.02 sec^{-1}
Apparent Opening Size (ASTM D 4751)	0.60 mm (max)

7.3.2 *Stabilizing Fill*

Within areas of low to moderate instability as determined during construction, unstable soils can be replaced with stabilizing fill meeting the requirements presented below in Table 4. Prior to placement of stabilizing fill, a geotextile should be placed at the bottom of the excavation. Once the over-excavation depth is determined in the field, the exposed subgrade surface should be smooth without sharp particles or abrupt edges. The geotextile should be placed in accordance with the manufacturer's recommendations and a minimum joint overlap of 18 inches. The geotextile should be non-woven and meet the specifications given in Table 3.

It is recommended that the initial lift of stabilizing fill have a minimum loose lift thickness of 15 inches. Construction equipment is prohibited from traveling over the geotextile surface. It is recommended that track construction equipment (Caterpillar D-6 or similar) be utilized to place the initial lift of stabilizing fill over the geotextile. The stabilizing fill should be pushed ahead of the construction equipment during placement over the geotextile. Additional layers may be required for stabilization and should be determined with a test section.

Table 4 – Stabilizing Fill Gradation Specifications

Sieve Size	Percent by Dry Weight Passing
4 Inch	100
¾ Inch	70 – 100
No. 4	20 – 70
No. 200	0 – 8
Maximum Liquid Limit	**Maximum Plastic Index**
40	5
R-Value: Minimum 70	

7.3.3 *Test Section*

Regardless of the stabilization method, a test section should be used to determine the required thickness of stabilizing rock or stabilizing fill. Stabilization is always a trial and error procedure with requirements and effectiveness varying within the same project. Other stabilization methods may include the use of cement, or scarification and drying. A mix design will be required for the cement alternative.

7.4 Trenching and Excavation

All trenching and excavation should be performed and stabilized in accordance with local, state and OSHA standards. In any case, bank stability will remain the responsibility of the contractor. It is our opinion that the bulk of the site soils appear to be predominately Type C, although variations may exist. Any area in question should be specifically examined by qualified personnel.

Trench backfill should conform to the Orange Book, including the latest revisions and addendums. Bedding and initial backfill should conform to the requirements of the utility having jurisdiction. Excavations below the ground water table may require dewatering. If ground water is encountered, bedding and backfill should consist of densified Class C backfill in accordance with Section 200.03.04 of the Orange Book placed to the estimated high groundwater level. Class C backfill should be separated from the native backfill soils with a non-woven geotextile meeting the minimum properties presented in Table 5.

TABLE 5 – MINIMUM AVERAGE ROLL STRENGTH PROPERTIES FOR GEOTEXTILE	
Grab Tensile (ASTM D 4632)	160 lbs.
Puncture Strength (ASTM D 4833)	90 lbs.
Burst Strength (ASTM D 3786)	200 psi.
Minimum permittivity (ASTM D 4491)	0.2 sec^{-1}
Maximum AOS (ASTM D4751)	0.25 mm

7.5 FOUNDATION DESIGN

It is recommended that shallow spread foundations be utilized at the project site. Provided that foundation grade soils are prepared in accordance with the recommendations of this report, the bearing pressures presented in Table 6 can be utilized for the design of individual column footings and continuous wall footings.

TABLE 6 – FOUNDATION ALLOWABLE BEARING PRESSURES

Loading Conditions	Maximum Net Allowable Bearing Pressures(1)(psf)
Dead Loads plus full time live loads	1,500
Dead Loads plus live loads, plus transient wind, or seismic loads.	2,000

(1) The net allowable bearing pressure is that pressure at the base of the footing in excess of the adjacent overburden pressure.

For frost protection, footings should all be set at least two feet below adjacent outside or unheated interior finish grades. Footings not located within frost prone areas should be placed at least 12 inches below surrounding ground or slab level for confinement. Regardless of loading, individual column foundations and continuous spread foundations should be at least 18 and 12 inches wide, respectively, or as required by code.

Lateral loads, such as wind or seismic, may be resisted by passive soil pressure and friction on the bottom of the footing. A friction factor of 0.40 may be utilized for sliding resistance at the base of the spread footing. This value has been reduced by 1/3 from its ultimate strength. Passive pressure available in engineered fill or undisturbed native soil may be calculated using an equivalent fluid unit weight of 300 pounds per cubic foot. Both passive and frictional resistances may be assumed to act concurrently. In designing for passive pressure, the upper one-foot of the soil profile should not be included unless confined by a concrete slab or pavement. Design values are for spread footings bearing on either native granular soils or structural fill and backfilled with structural fill.

7.6 SETTLEMENTS

Total settlement of individual foundations will vary depending on foundation plan dimensions and actual loads. Based on anticipated dimensions and loads, total post-construction settlement of footings designed and constructed in accordance with the preceding recommendations will be on the order of ¾-inch. Differential settlement between similarly loaded, adjacent footings is expected to be less than ¼-inch. Settlement of all foundations is expected to occur rapidly and should essentially be complete shortly after initial load application. ***Please note that these values do not include settlement due to liquefaction.***

Estimated settlements are based on structural fills placed in accordance with the recommendations of this report. Moisture contents are critical. Failure to adequately moisture condition fills during placement will delay consolidation and may result in greater settlement being experienced by the structures and improvements. The estimated settlements do not account for settlement during a seismic event.

7.7 CONCRETE SLABS

All concrete slabs should be directly underlain by Type 2, Class B aggregate base. The thickness of base material should be six inches beneath curbs and gutters, four inches beneath sidewalks and six inches beneath the building slab. Aggregate base courses should be densified to at least 95 percent relative compaction.

In situ and imported fill materials should be tested to evaluate the corrosion potential to concrete and the cement type utilized should be determined based on these results. Refer to Section 7.8 for laboratory testing recommendations.

Western Nevada is a region with exceptionally low relative humidity. As a consequence, concrete flatwork is prone to excessive shrinking and curing. Concrete mix proportions and construction techniques can adversely affect the finished quality of the concrete and result in cracking, curling and spalling of slabs. We recommend that all placement and curing be performed in accordance with procedures outlined by the American Concrete Institute. Special considerations should be given to concrete placed and cured during hot or cold weather conditions. Proper control joints and reinforcing should be provided to minimize any damage resulting from shrinkage.

7.8 CORROSION

Due to insufficient data, it is recommended that native soils and imported fill material be tested prior to placement of concrete and underground metallic pipes or structures. Laboratory testing should consist of analysis for soluble sulfates, resistivity, pH, and chlorides. The results should be evaluated by qualified personnel to determine if protective measures are required.

7.9 SITE DRAINAGE

Adequate surface drainage should be constructed and maintained away from the structure. The permanent finished slope should grade away from the structure to drain water away quickly from the building area to prevent any ponding adjacent to the structure.

For concrete slab-on-grade flooring, a perforated pipe foundation drainage system should be constructed. The drain line should be set at or below footing level within a sand-free, pea gravel filled trench. The drainage course should be carried upward to within one foot of finish grade and wrapped in an engineering fabric in order to reduce infiltration of fine material. The drain line should discharge by gravity or into a pumped sump. To avoid compromising footing integrity, a plane subtended at an inclination of 1H:1V from the base of the footing should not intersect the drainage materials.

7.10 MOISTURE VAPOR BARRIER

A moisture vapor barrier is recommended below any concrete slab-on-grade supporting floor coverings. Moisture vapor migrating through the slab can cause the debonding and discoloration of tile, linoleum, or other products placed directly on the concrete slab. The recommended method to reduce moisture migration is to place a moisture barrier directly below the base course that meets or exceeds specifications presented in ASTM E-1745 for a Class B water vapor retarder. The moisture vapor barrier should be placed in accordance with the manufacturer's recommendations and the manufacturer should approve the use of the moisture barrier directly below the base course layer. A summary of construction recommendations for moisture barriers are as follows:

- The moisture vapor retarder membrane can be placed directly on densified subgrade; however, all sharp or angular rocks should be removed from the ground surface. The ground surface should be densified with a steel drum roller to provide a smooth surface.

- The membrane should be tensioned by hand until taut, free of wrinkles and lying flat. All seams, punctures, and penetrations must be sealed with a minimum 10-mil polyethylene tape. The membrane should overlap at least 12-inches at the seams.

- Vehicle traffic should not be allowed on the membrane. Care should be taken in the placement of fill material over the membrane. Fill materials should be placed, spread and compacted in such a manner that minimizes the development of wrinkles in and/or movement of the membrane. It will be essential for the contractor and his crews to work with care so that the membrane is not punctured or damaged during installation.

- Water based floor adhesives are extremely sensitive to slab moisture. Under some conditions, the small amount of moisture vapor which bypasses the vapor membrane, or excess water remaining in the slab from the original concrete placement, can be sufficient to cause debonding and discoloration. Therefore, it is essential for the contractor should work with care to ensure seams and penetrations are sealed and the moisture vapor retarder is not punctured or damaged during installation.

7.11 ASPHALT CONCRETE PAVEMENT

Parking areas restricted to automobile traffic and occasional heavy truck traffic (one to two trips per week) can consist of 3 inches of asphalt underlain by 6-inches of aggregate base. Pavement areas with heavy truck traffic should consist of 4 inches of asphalt underlain by 6-inches of aggregate base.

Subgrade soil should be prepared in accordance with the recommendations of this report. Base material should be densified to at least 95 percent relative compaction. A Type 2 Plantmix aggregate in accordance with Section 200.02 of the "Orange Book" should be utilized for the pavement. The contractor should submit a pavement mix design to the owner at least five working days prior to construction for approval. For pavements constructed adjacent to concrete flatwork, the finished grade of the pavement should be at least ¼ to ½ of an inch higher than the edge of the adjacent concrete surface to allow for adequate compaction of the pavement without damaging the concrete.

7.12 EROSION CONTROL

Temporary erosion control will be required during construction. The contractor shall prevent dust from being generated during construction in compliance with all applicable city, county, state, and federal regulations and shall submit an acceptable dust control plan to appropriate agencies prior to starting site preparation or earthwork activities.

7.13 ANTICIPATED CONSTRUCTION PROBLEMS

Shallow ground water will likely be encountered and may cause difficulty during trenching and subgrade soil preparation.

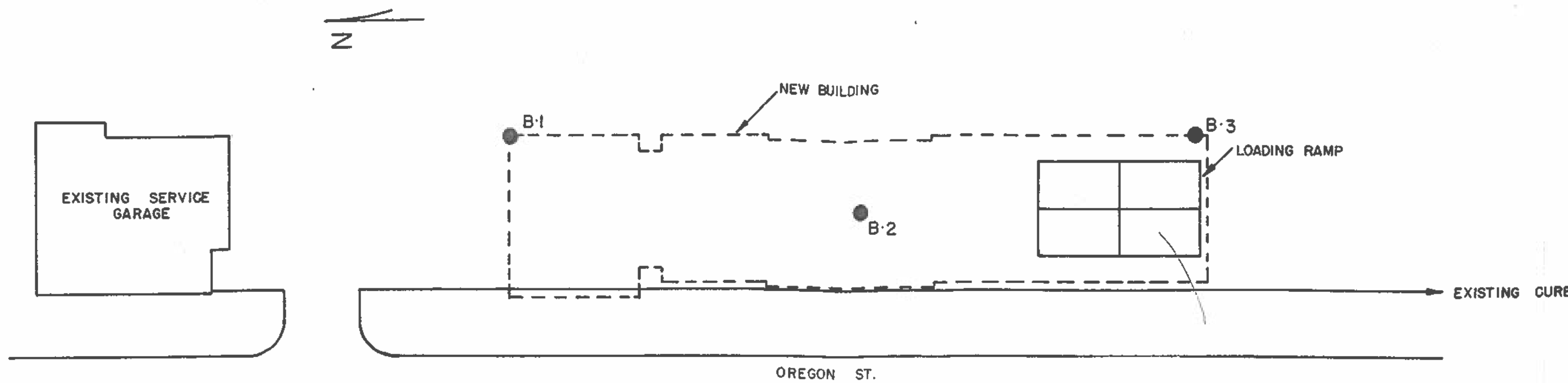
8.0 REFERENCES

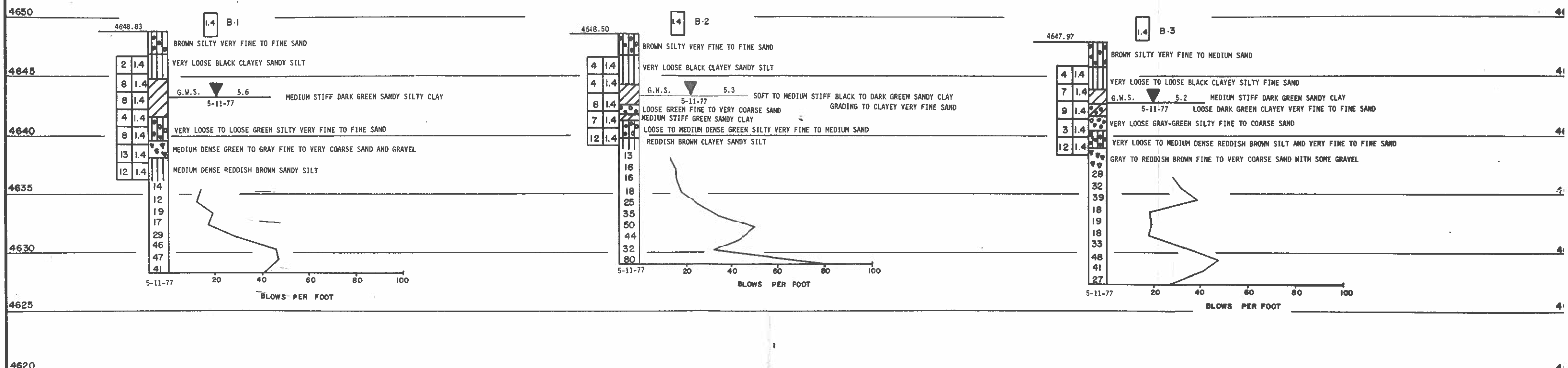
1) American Society for Testing and Materials (ASTM), *Soil and Rock; Dimension Stone; Geosynthetics*, , 2010, Volume 4.08;
2) Bell, John. W. and Trexler, Dennis T., *New Empire Quadrangle Earthquake Hazards Map*, Nevada Bureau of Mines and Geology, 1979, scale 1:24,000;
3) Bowles, J. E., *Foundation Analysis and Design*, 1996, McGraw Hill;
4) Dames and Moore, *Report of Foundation Investigation, Proposed Office Building, Laboratory and Service Buildings, Carson City, Nevada*, Job No. 4023-002-02, November 5, 1962;
5) dePolo, Craig M., *Quaternary Faults in Nevada*, Nevada Bureau of Mines and Geology, 2008;
6) International Code Council, Inc., *International Building Code, 2006*;
7) Nevada State Highway Department, Engineering Geology and Foundation Section, Materials and Testing Division, *Foundation Report, Highway Storage Building, Carson City, Nevada*, Project No. SP-HQ063-CC(2), May 1977;
8) Nevada Department of Transportation, *Memorandum, Foundation Study Report, NDOT Storage Facility, NDOT Maintenance yard, Carson City, Nevada*, January 12, 2004.
9) Regional Transportation Commission, *Standard Specifications for Public Works Construction*, 2007 (Washoe County, Sparks-Reno, Carson City, Yerington, Nevada), "Orange Book";
10) Stantec Consulting, Inc., *Geotechnical Investigation, NDOT Headquarters Complex, Public Service Building, Carson City, Nevada*, January 2007, Project No. 180550884;
11) Trexler, Dennis T., *Carson City Quadrangle Geologic Map*, Map No. 1Ag, , Nevada Bureau of Mines and Geology, 1977, scale 1:24,000;
12) Trexler, Dennis T. and Bell, John W., *Carson City Quadrangle Earthquake Hazards Map*, Map No. 1Ai, prepared by, Nevada Bureau of Mines and Geology, 1979; scale 1:24,000.

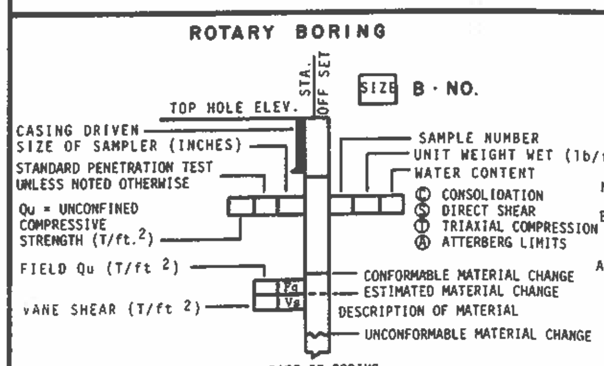
APPENDIX

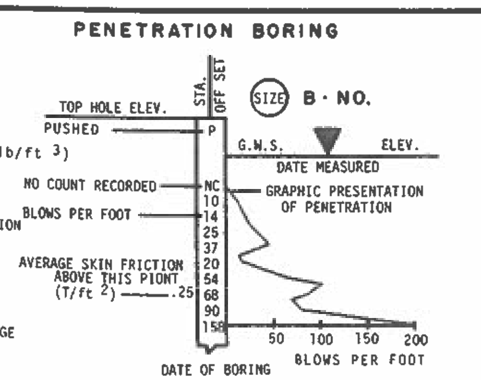
FED. RD. REG. NO.	STATE	PROJECT NO.	COUNTY
9	NEVADA		CARSON CITY

NOTE: FOUNDATION REPORT AVAILABLE FOR CONTRACTORS STUDY IN DISTRICT OFFICE AND MATERIALS & TESTING DIVISION ...









- PLAN OF ANY BORING
- PENETROMETER (FLUSH-COUPLED)
- 2" CONE PENETROMETER
- SAMPLE BORING (DRY)
- ROTARY BORING (WET)
- AUGER BORING (DRY)
- JET BORING
- DIAMOND CORE BORING
- TEST PIT

BIT SIZE: (O.D.) : "AX"=1-13/16","BX"=2-9/32", "NX"=2-29/32".
CASING SIZES: (O.D.) : "BX"=2-7/8", "NX"=3-1/2"

THE UNIFIED SOIL CLASSIFICATION SYSTEM

MAJ. DIV.		LETTER	DESCRIPTION
COARSE GRAINED MATERIAL	GRAVEL AND GRAVELLY SOIL	GW	WELL-GRADED GRAVEL OR GRAVEL-SAND MIXTURES. LITTLE OR NO FINES.
		GP	POORLY-GRADED GRAVEL OR GRAVEL-SAND MIXTURES. LITTLE OR NO FINES.
		GM	SILTY GRAVEL, GRAVEL-SAND-SILT MIXTURES.
		GC	CLAYEY GRAVEL, GRAVEL-SAND-CLAY MIXTURES.
	SAND AND SANDY SOIL	SW	WELL-GRADED SAND OR GRAVELLY SAND, LITTLE OR NO FINES.
		SP	POORLY-GRADED SAND OR GRAVELLY SAND, LITTLE OR NO FINES.
		SM	SILTY SAND, SAND-SILT MIXTURES.
		SC	CLAYEY SAND, SAND-CLAY MIXTURES.
FINE GRAINED MATERIAL	SILTS AND CLAYS LL.<50	ML	INORGANIC SILT AND VERY FINE SAND, ROCK FLOUR, SILTY OR CLAYEY FINE SAND OR CLAYEY SILT WITH SLIGHT PLASTICITY.
		CL	INORGANIC CLAY OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAY. SANDY CLAY SILTY CLAY, LEAN CLAY
		OL	ORGANIC SILT AND ORGANIC SILTY-CLAY OF LOW PLASTICITY
	SILTS AND CLAYS LL.>50	MH	INORGANIC SILT, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILT.
		CH	INORGANIC CLAY OF HIGH PLASTICITY, FAT CLAY.
		OH	ORGANIC CLAY OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILT.
		PT	PEAT AND OTHER HIGHLY ORGANIC SOILS.

STANDARD PENETRATION CLASSIFICATIO

GRANULAR SOIL		CLAYEY SOIL	
BLOWS/ FT. *	DENSITY	BLOWS /FT. *	CONSISTEN
0 - 4	VERY LOOSE	0 - 1	VERY SOF
5 - 10	LOOSE	2 - 4	SOFT
11 - 24	MEDIUM DENSE	5 - 8	MEDIUM ST
25 - 50	DENSE	9 - 15	STIFF
OVER 50	VERY DENSE	16 - 30	VERY STI
* STANDARD PENETRATION TEST(N) 140 lb. HAMMER, 30" FREE FALL ON 2" O.D. X 1 3/8" I.D. SAMPLER		31 - 60	HARD
		OVER 60	VERY HAR

DWN. Q.Q.Q.
CHK. 5-20-77
DATE

NEVADA HIGHWAY DEPARTMENT — MATERIALS AND TESTING DIVISION

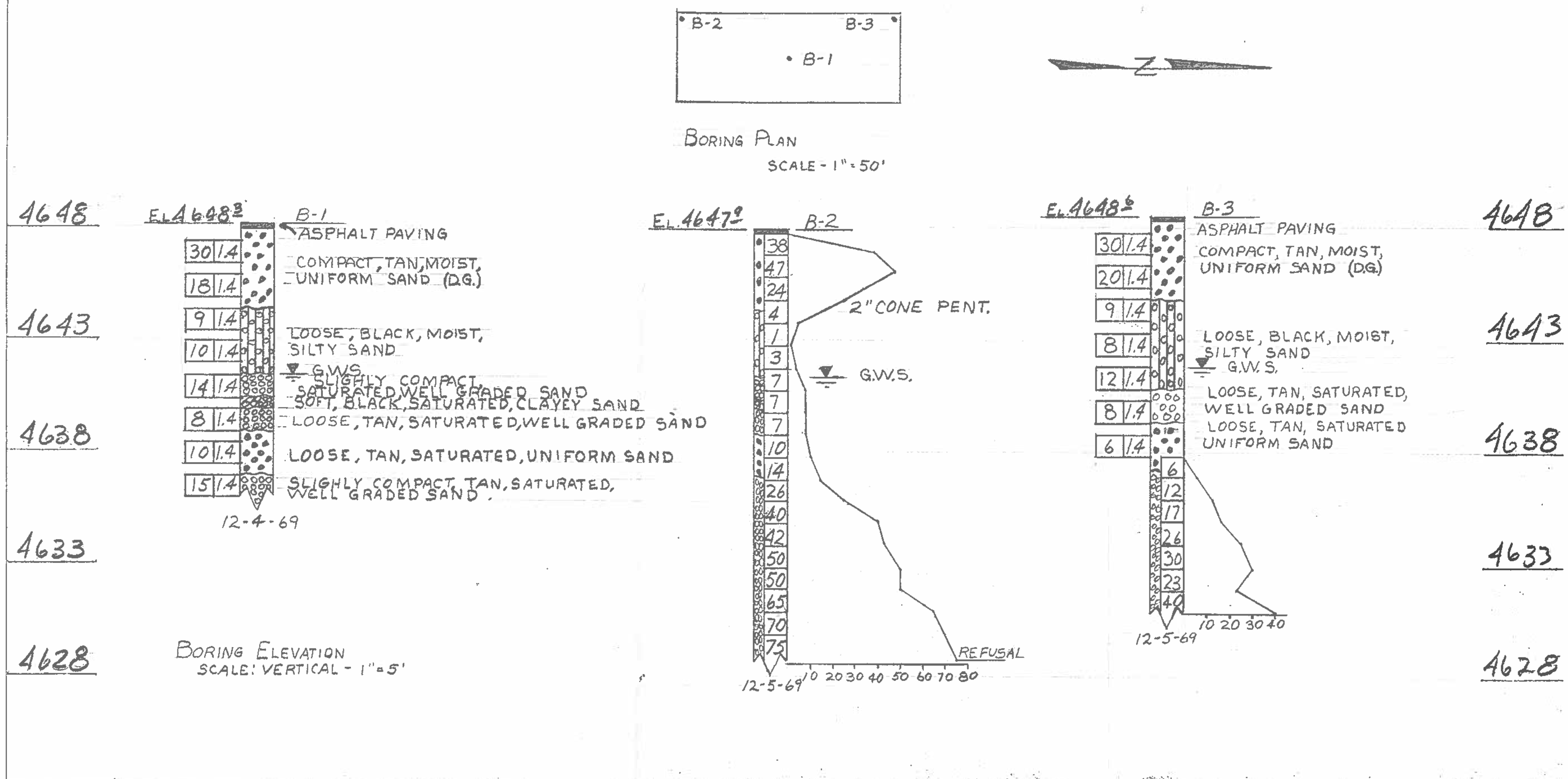
FOUNDATIONS AND ENGINEERING GEOLOGY SECTION

HIGHWAY STORAGE BUILDING

DWG. 1

E.A.70

CARSON CITY MAINTENANCE SAND STORAGE BUILDING



LOG OF TEST BORING NO. B1

PROJECT: PUBLIC SERVICE BUILDING, NEVADA DEPARTMENT OF TRANSPORTATION
RIG & BORING TYPE: CME 75, HSA/MUD ROTARY
LOCATION: NORTH END OF PARKING LOT
PROJECT NO. 180550884 DATE 11-04-06 LOGGED BY: MLM SURFACE ELEVATION

Depth in Feet	Unified Soil Classification	Graphical Log	Sample	Sample Type	Sample No.	Blow Counts (SPTs)	Consistency/ Density	Moisture	Visual Description	Dry Density (lbs. per cubic foot)	Moisture Content Percent of Dry Weight	Laboratory Tests
0	FILL						Loose	Moist	0-3": ASPHALTIC CONCRETE 3"-1 1/2': POORLY GRADED SAND WITH SILT (FILL), mostly fine to coarse sand, few nonplastic fines, orange-brown.			
	SM-SC			S	1A	5	Very Loose to Loose	Moist	1 1/2'-7': SILTY CLAYEY SAND with approximately 57% fine to coarse sand, 33% low plastic fines, 10% fine to coarse gravel, dark brown to brown.			
5				S	1B	10						
	ML			S	1C	11	Loose to Med. Dense	Moist to Wet	7'-10 1/2': SANDY SILT with approximately 52% low plastic fines, 48% fine to coarse sand, mottled orange brown/gray/dark brown.			
▽ 10	SM			S	1D	21	Med. Dense to Dense	Wet	10 1/2'-14': SILTY SAND WITH GRAVEL with approximately 50% fine to coarse sand, 23% nonplastic fines, 27% fine to medium gravel, orange brown mottled green-gray and dark orange brown.			
				S	1E	34						
	SM						Very Dense to Dense	Wet	14'-24': SILTY SAND with approximately 58% fine to coarse sand, 24% nonplastic fines, 18% fine to medium gravel, gray brown to brown.			
15				S	1F	53						
				S	1G	42						
20				S	1H	40						
	SM						Dense to Med. Dense	Wet	24'-36': SILTY SAND with approximately 49% fine to coarse sand, 43% nonplastic fines, 8% fine gravel,			
25				S	1I	40						
30				S	1J	22						
35				S	1K	25			NOTE: Color change to dark orange brown at 36 feet.			

GROUNDWATER

	DEPTH	HOUR	DATE
▽	10'		11-04-06
▼			

SAMPLE TYPE

A - Drill Cuttings. B. Bag sample.
S - 2" O.D. 1.38" I.D. tube sample.
U - 3" O.D. 2.42" I.D. tube sample.
T - 3" O.D. thin-walled Shelby tube.
C - CME sample. R - Rotary Cuttings.

LABORATORY TESTS

A - Atterberg Limits
G - Grain Size
C - Consolidation
MD - Moisture/Density

Stantec

PLATE NO.: A-2a

STANTEC CONSULTING
6980 Sierra Center Pkwy
Reno, Nevada 89511
Tel: 775.850.0777
Fax: 775.850.0787

LOG OF TEST BORING NO. B1

PROJECT PUBLIC SERVICE BUILDING
NEVADA DEPARTMENT OF TRANSPORTATION
RIG & BORING TYPE CME 75, HSA/MUD ROTARY
LOCATION NORTH END OF PARKING LOT
PROJECT NO. 180550884 **DATE** 11-04-06 **LOGGED BY:** MLM **SURFACE ELEVATION**

Depth in Feet	Unified Soil Classification	Graphical Log	Sample	Sample Type	Sample No.	Blow Counts (SPTs)	Consistency/ Density	Moisture	Visual Description	Dry Density (lbs. per cubic foot)	Moisture Content Percent of Dry Weight	Laboratory Tests
40	SP-SM			S	1L	60	Very Dense	Wet	40'-41 1/2': POORLY GRADED SAND WITH SILT with approximately 87% fine to coarse sand, 8% fine gravel, and 5% nonplastic fines, brown to gray brown.			
									Bottom of boring at 40 feet, end of sample at 41 1/2 feet.			
45												
50												
55												
60												
65												
70												

GROUNDWATER

	DEPTH	HOUR	DATE
▽	10'		11-04-06
▼			

SAMPLE TYPE

A - Drill Cuttings. B. Bag sample.
S - 2" O.D. 1.38" I.D. tube sample.
U - 3" O.D. 2.42" I.D. tube sample.
T - 3" O.D. thin-walled Shelby tube.
C - CME sample. R - Rotary Cuttings.

LABORATORY TESTS

A - Atterberg Limits
G - Grain Size
C - Consolidation
MD - Moisture/Density

PLATE NO.: A-2a

Stantec
STANTEC CONSULTING
6980 Sierra Center Pkwy
Reno, Nevada 89511
Tel: 775.850.0777
Fax: 775.850.0787

LOG OF TEST BORING NO. B2

PROJECT PUBLIC SERVICE BUILDING NEVADA DEPARTMENT OF TRANSPORTATION **RIG & BORING TYPE** CME-75, HSA/MUD ROTARY

LOCATION SOUTH END OF PROPOSED BUILDING SITE

PROJECT NO. 180550884 **DATE** 11-04-06 **LOGGED BY:** MLM **SURFACE ELEVATION**

Depth in Feet	Unified Soil Classification	Graphical Log	Sample	Sample Type	Sample No.	Blow Counts (SPTs)	Consistency/ Density	Moisture	Visual Description	Dry Density (lbs. per cubic foot)	Moisture Content Percent of Dry Weight	Laboratory Tests
0	FILL						Loose	Moist	0-3": ASPHALTIC CONCRETE 3"-2': POORLY GRADED SAND WITH SILT (FILL), mostly fine to coarse sand, low plastic fines, orange brown.			
	CL						Med. Stiff	Moist	2'-7': SANDY LEAN CLAY with approximately 58% low plastic fines and 42% fine to coarse sand, dark gray brown.			
				S	2A	5						
5				S	2B	6						
	SM						Med. Dense	Moist to Very Moist	7'-10': SILTY SAND with approximately 52% fine to coarse sand and 48% nonplastic fines, gray brown mottled orange and dark gray.			
				S	2C	11						
10	SP-SM						Med. Dense to Very Dense	Wet	10'-20': SILTY SAND with approximately 53% fine to coarse sand, 28% nonplastic fines, 19% fine gravel, gray brown.			
				S	2D	24						
				S	2E	41						
15				S	2F	50						
20	SM			S	2G	18	Med. Dense	Wet	20'-25': SILTY SAND with approximately 55% fine to coarse sand, 41% low plastic fines, 4% fine gravel, brown to gray brown. NOTE: Thin interbeds of POORLY GRADED SAND WITH SILT observed within soil horizon.			
25	SM-SC			S	2H	18	Med. Dense	Wet	25'-30': SILTY CLAYEY SAND with approximately 55% fine to coarse sand and 45% low plastic fines.			
30	SM			S	2I	20	Med. Dense to Very Dense	Wet	30'-41 1/2': SILTY SAND with approximately 70% fine to coarse sand, 27% nonplastic fines, and 3% fine gravel, gray brown.			
35				S	2J	45						

GROUNDWATER

DEPTH	HOUR	DATE
10'		11-04-06

SAMPLE TYPE

A - Drill Cuttings. B. Bag sample.
S - 2" O.D. 1.38" I.D. tube sample.
U - 3" O.D. 2.42" I.D. tube sample.
T - 3" O.D. thin-walled Shelby tube.
C - CME sample. R - Rotary Cuttings.

LABORATORY TESTS

A - Atterberg Limits
G - Grain Size
C - Consolidation
MD - Moisture/Density

PLATE NO.: A-2b

Stantec

STANTEC CONSULTING
6980 Sierra Center Pkwy
Reno, Nevada 89511
Tel: 775.850.0777
Fax: 775.850.0787

LOG OF TEST BORING NO. B2

PROJECT: PUBLIC SERVICE BUILDING, NEVADA DEPARTMENT OF TRANSPORTATION
RIG & BORING TYPE: CME 75, HSA/MUD ROTARY
LOCATION: SOUTH END OF PROPOSED BUILDING SITE
PROJECT NO.: 180550884 DATE: 11-04-06 LOGGED BY: MLM SURFACE ELEVATION:

Depth in Feet	Unified Soil Classification	Graphical Log	Sample	Sample Type	Sample No.	Blow Counts (SPTs)	Consistency/ Density	Moisture	Visual Description	Dry Density (lbs. per cubic foot)	Moisture Content Percent of Dry Weight	Laboratory Tests
40				S	2K	70						
									Bottom of boring at 40 feet, end of sample at 41 1/2 feet.			
45												
50												
55												
60												
65												
70												

GROUNDWATER

	DEPTH	HOUR	DATE
∇	10'		11-04-06
▼			

SAMPLE TYPE

A - Drill Cuttings. B. Bag sample.
S - 2" O.D. 1.38" I.D. tube sample.
U - 3" O.D. 2.42" I.D. tube sample.
T - 3" O.D. thin-walled Shelby tube.
C - CME sample. R - Rotary Cuttings.

LABORATORY TESTS

A - Atterberg Limits
G - Grain Size
C - Consolidation
MD - Moisture/Density

Stantec

PLATE NO.: A-2b

STANTEC CONSULTING
6980 Sierra Center Pkwy
Reno, Nevada 89511
Tel: 775.850.0777
Fax: 775.850.0787

EXPLORATION LOG

NEVADA DEPARTMENT OF TRANSPORTATION
GEOTECHNICAL ENGINEERING

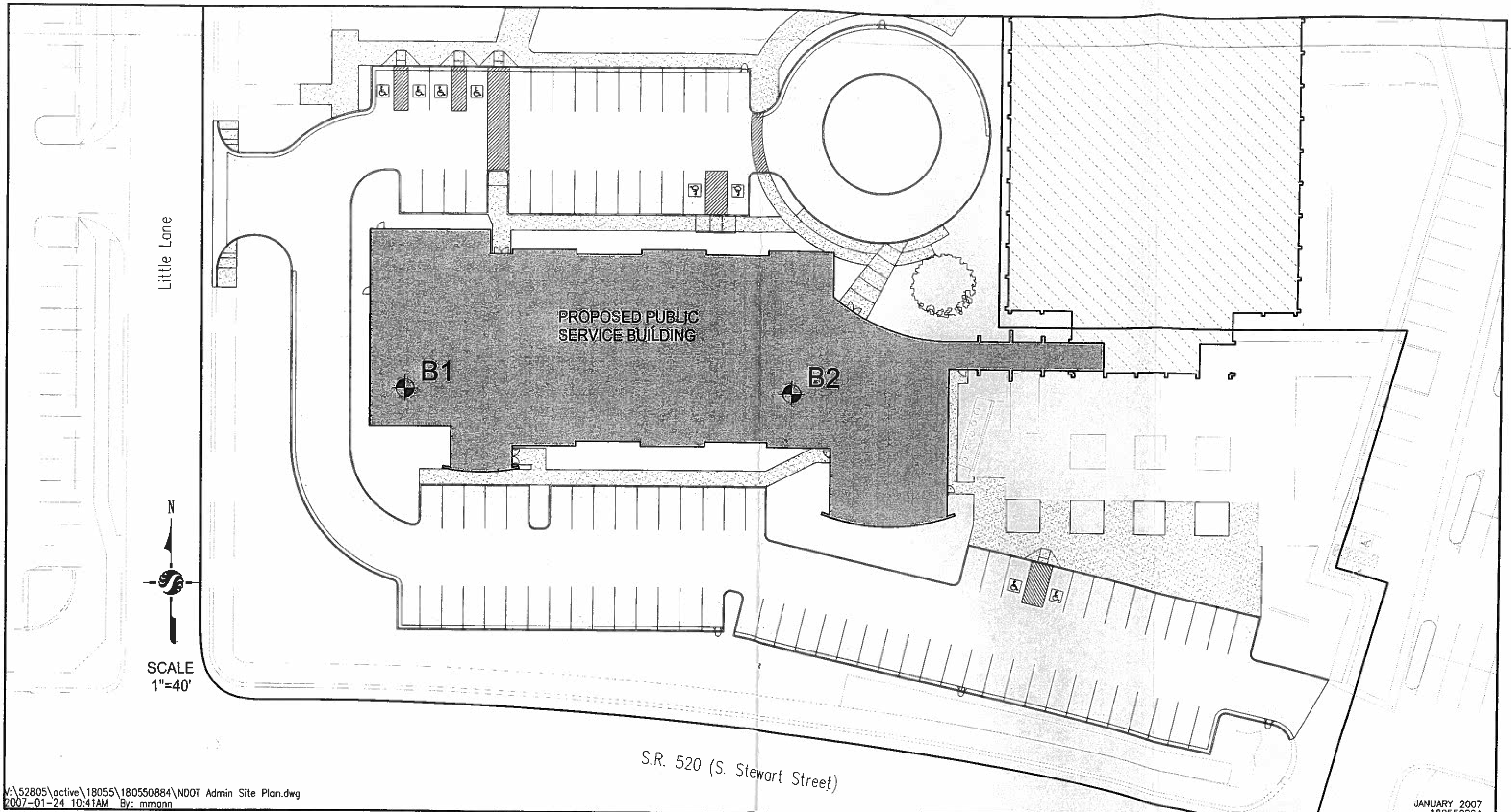
START DATE	9/4/02	STATION	NW CORNER
END DATE	9/5/02	OFFSET	12' W., 14' N. FENCE
JOB DESCRIPTION	NDOT STORAGE BUILDING	ENGINEER	ABBAS Bafghi
LOCATION	CARSON CITY MAINTENANCE YARD	EQUIPMENT	MOBILE B-80, UNIT 2041
BORING	DOT2	OPERATOR	GILLESPIE
E.A. #		DRILLING METHOD	3.5" bit & bentonite mud
GROUND ELEV.	(ft)	BACKFILLED	Yes DATE 09/5/2002
HAMMER DROP SYSTEM	SAFETY		

GROUNDWATER LEVEL

DATE	DEPTH ft	ELEV. ft
9/5/02	4.00	

ELEV. (ft)	DEPTH (ft)	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT 6 inch Increments	BLOW COUNT Last 1 foot	Percent Recov'd	LAB TESTS
	2.00						
	3.50	A	SPT	3, 4, 2	6	100	S,PI,W,Ch
	5.00	B	SPT	1, 3, 2	5	100	S,CH,W,Ch
	7.00	C	SH			79	H,PI,W,DS,OC,S
	8.50	D	SPT	2, 4, 4	8	100	S,W,PI
	10.00	E	SPT	3, 7, 10	17	100	S,W,PI
	12.00	F	SH			100	S,PI,W,OC,DS
	13.50	G1 G2	MC	4, 13, 15	28	100	W, UW,OC
	15.00	H1 H2	SPT	5, 11, 16	27	67	S,W,PI
	16.50	I	SPT	11, 17, 12	29	70	S,W
	17.00						
	18.50	J1 J2	MC	11, 26, 15	41	100	S,W,UW
	20.00	K	SPT	3, 3, 4	7	80	S,W,PI
	21.50	L1 L2	MC	4, 7, 15	22	100	S,PI,W,UW
	23.00	M	SPT	5, 8, 8	16	80	S,W
	25.00						
	26.50	N1 N2	MC	5, 8, 10	18	100	S,W,UW

Depth to (ft)	USCS Group	MATERIAL DESCRIPTION	REMARKS
0.30	AC	3.5 INCHES OF ASPHALTIC CONCRETE	
2.00	SM	TAN SILTY SAND loose< moist (fill)	
8.50	CL	SANDY LEAN CLAY soft to medium stiff, trace of organics, trace of oxidation color changes to greenish-grey at 5. feet.	2.5 feet of stroke, weather:sunny
14.25	ML	GREENISH GREY SANDY SILT medium dense, wet, occassional moderate cementation associated with oxidation, trace of organics (well-preserved vegetation)	drilling down-pressure:300 to 400 psi
18.50	SM	GREYISH SILTY SAND WITH FINE GRAVEL dense, wet, high groundwater seepage into the borehole within this zone	
28.00	SM	YELLOWISH BROWN SILTY SAND medium dense, wet, non-plastic, trace of mica	



ORIGINAL SHEET - ANSI B

Stantec

Stantec Consulting Inc.
Suite 100, 6980 Sierra Center Parkway
Reno NV U.S.A.
89511
Tel. 775.850.0777
Fax. 775.850.0787
www.stantec.com

Legend

⊕ B2 APPROXIMIATE EXPLORATION LOCATIONS

Notes

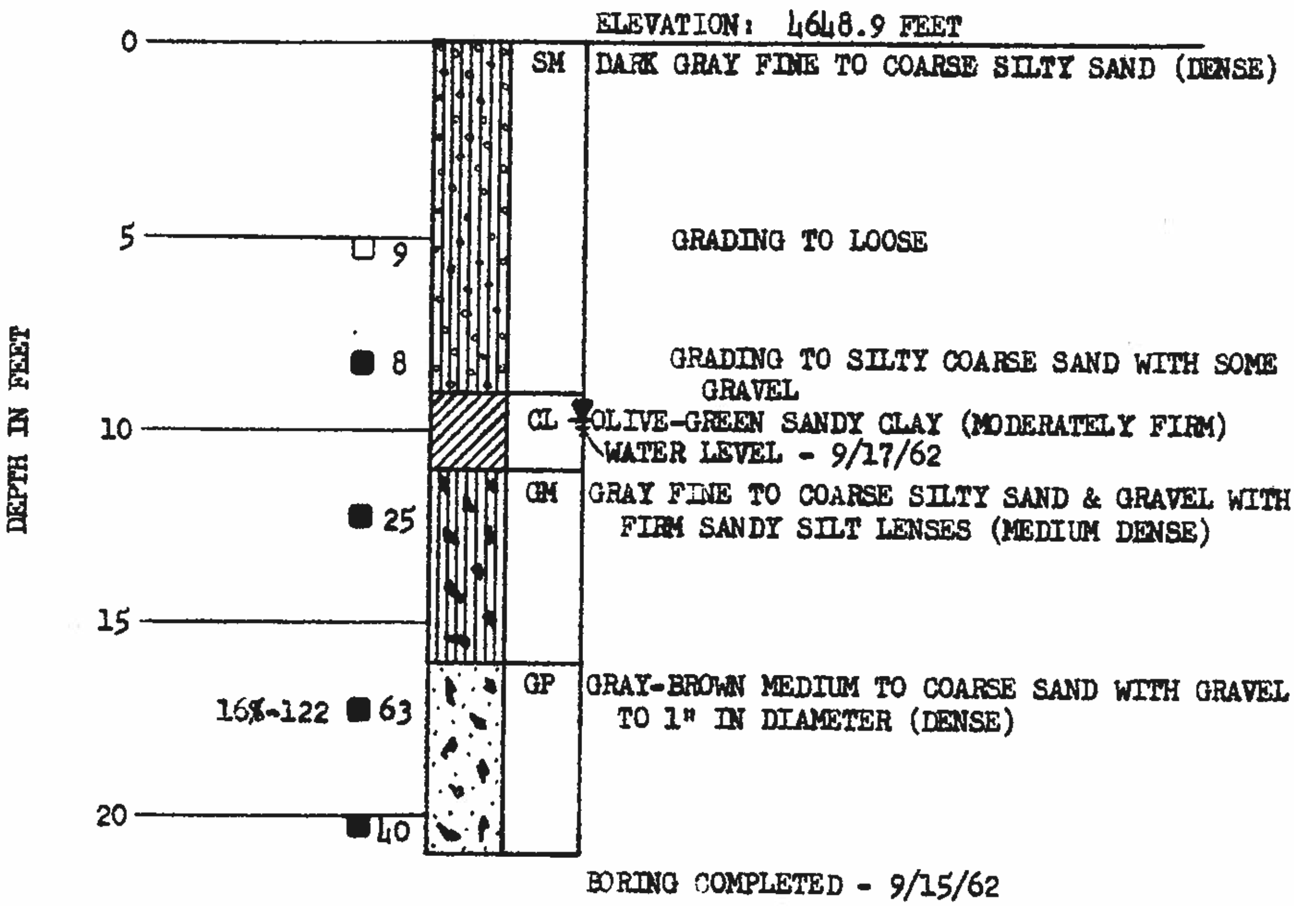
BASE MAP PROVIDED BY
HERSHENOW & KLIPPENSTEIN ARCHITECTS

Client/Project
NDOT
GEOTECHNICAL INVESTIGATION
PUBLIC SERVICE BUILDING

Figure No.
PLATE A-1

Title
SITE MAP &
EXPLORATION LOCATIONS

BORING 1



L O G   O F   B O R I N G

KEY:

A - B ■ C

A FIELD MOISTURE EXPRESSED AS A PERCENTAGE OF THE DRY WEIGHT OF SOIL

B DRY DENSITY EXPRESSED IN LBS./CU. FT.

C BLOWS PER FOOT OF PENETRATION USING A 200 LB. HAMMER DROPPING 30"

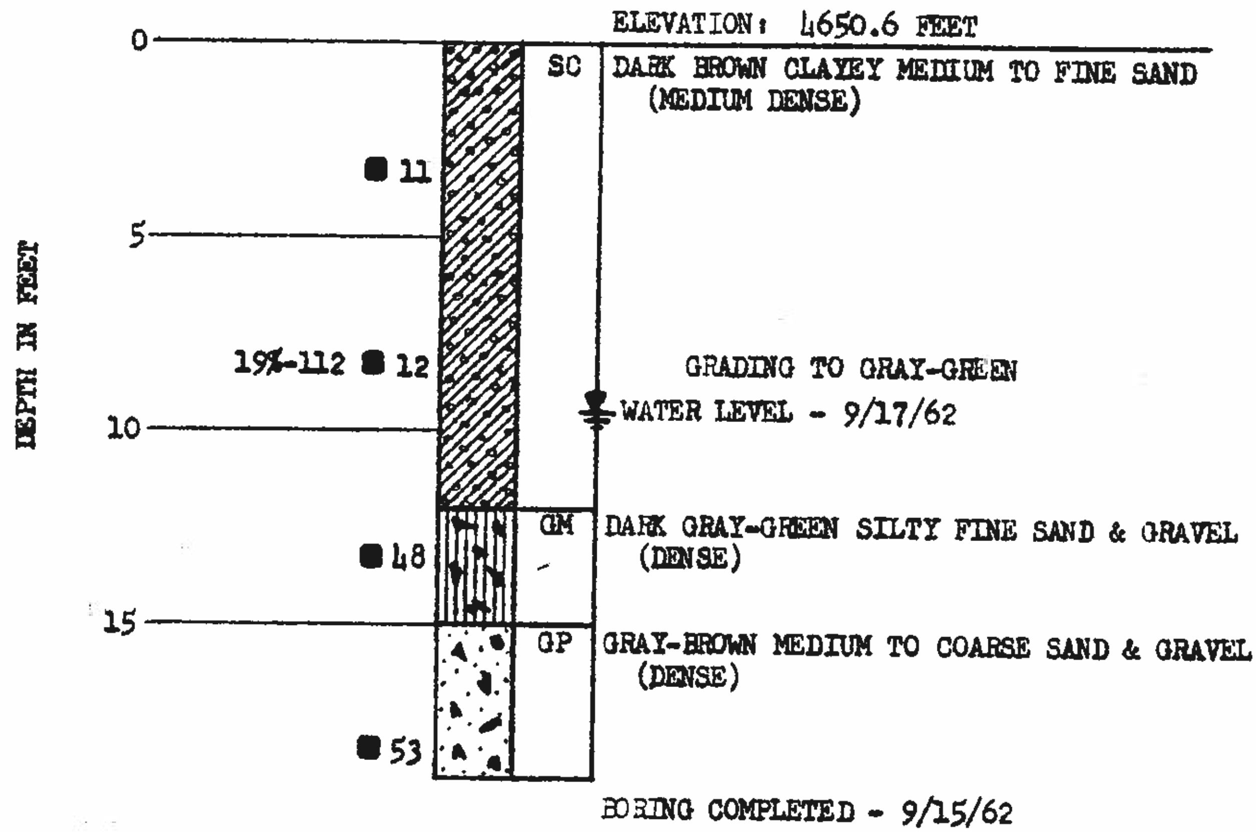
■ DEPTH OF UNDISTURBED SAMPLE

□ DEPTH OF SAMPLING ATTEMPT WITH NO RECOVERY

ELEVATIONS REFER TO M.S.L. = 0.0'

DAMES & MOORE
APPLIED EARTH SCIENCES

BORING 2

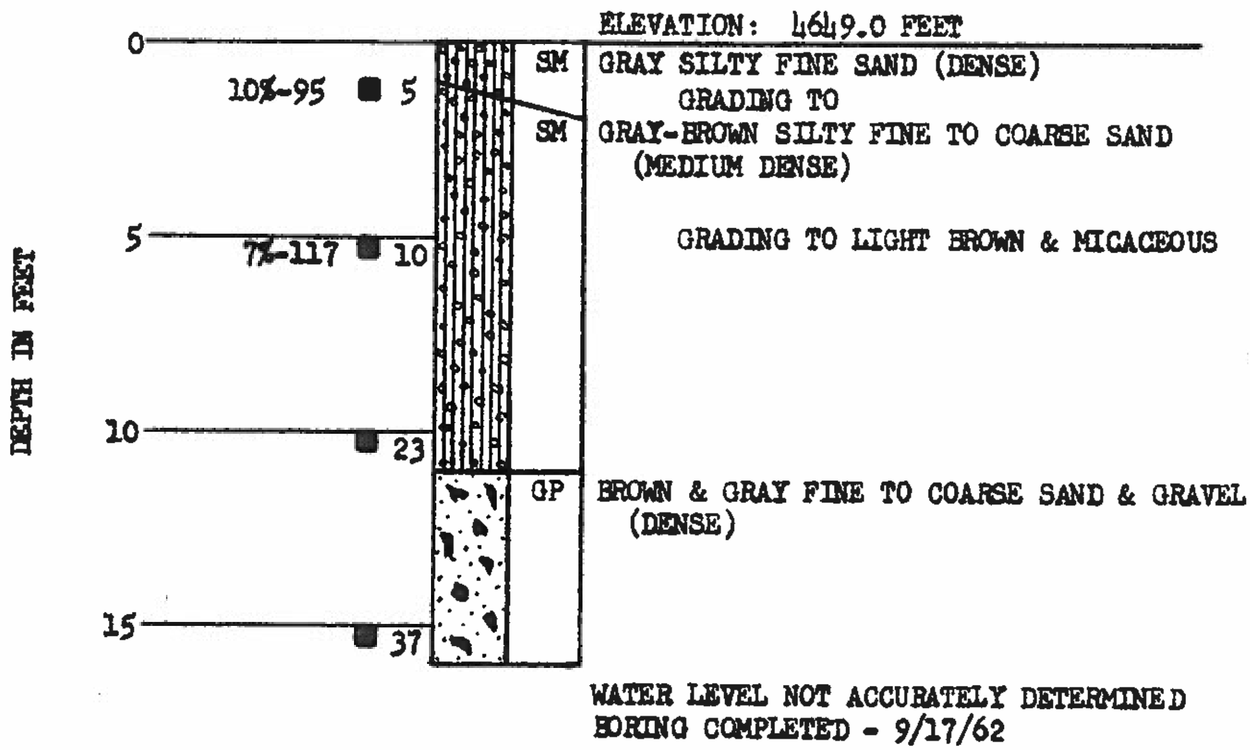


LOG OF BORING

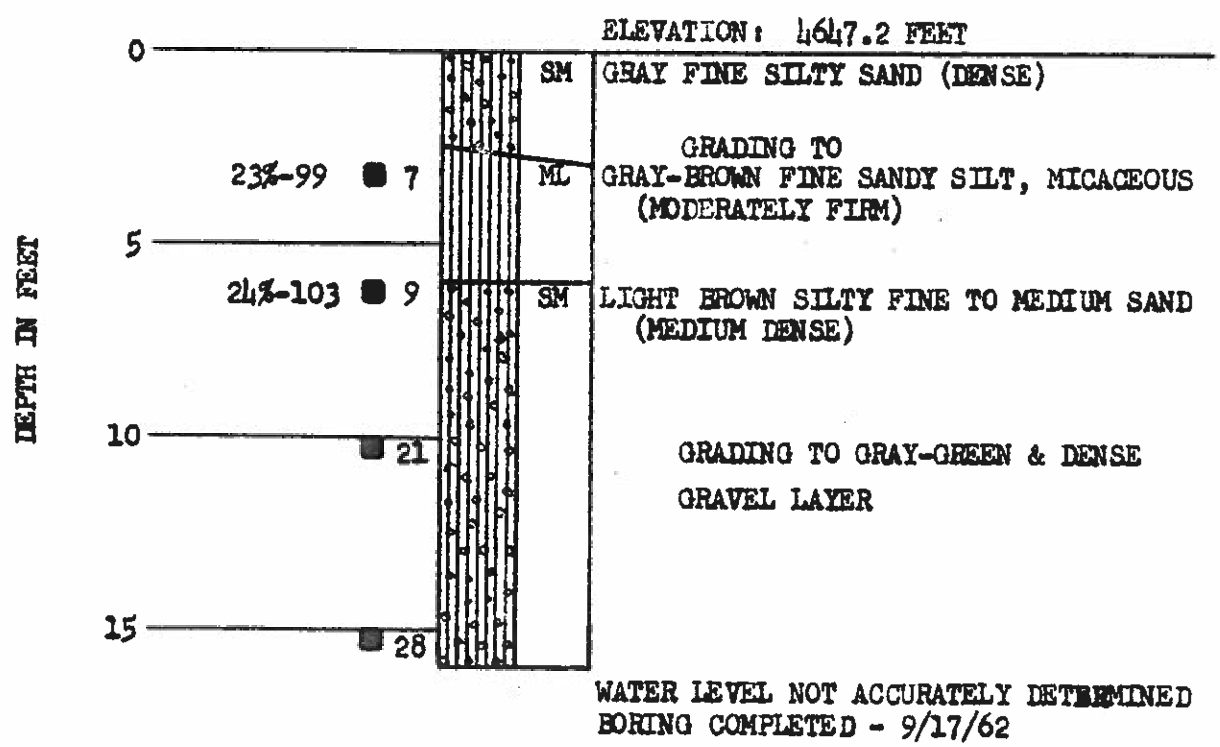
DAMES & MOORE
APPLIED EARTH SCIENCES

PLATE A-1B

BORING 3



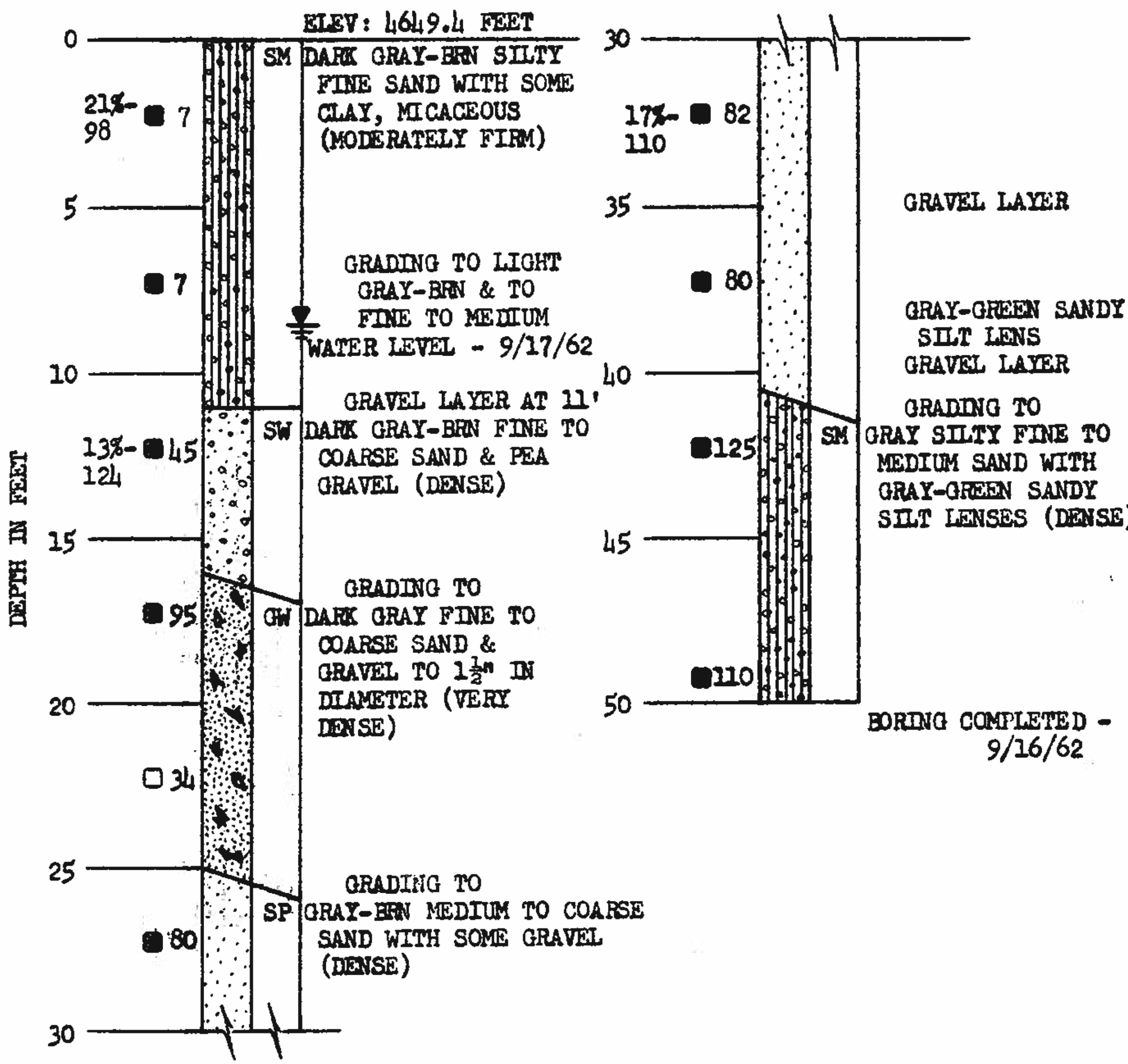
BORING 4



LOG OF BORINGS

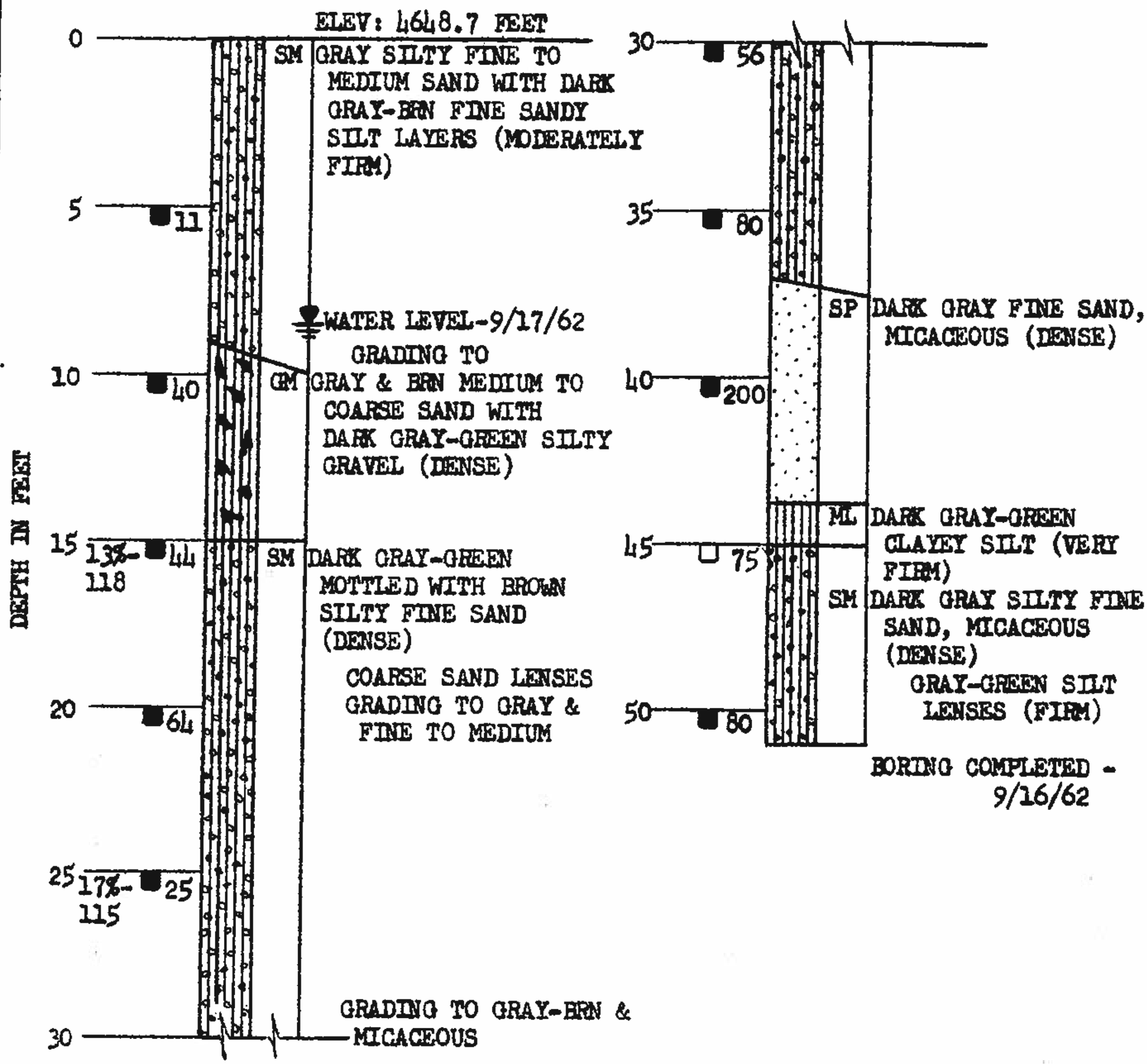
DAMES & MOORE
APPLIED EARTH SCIENCES

BORING 5



LOG OF BORING

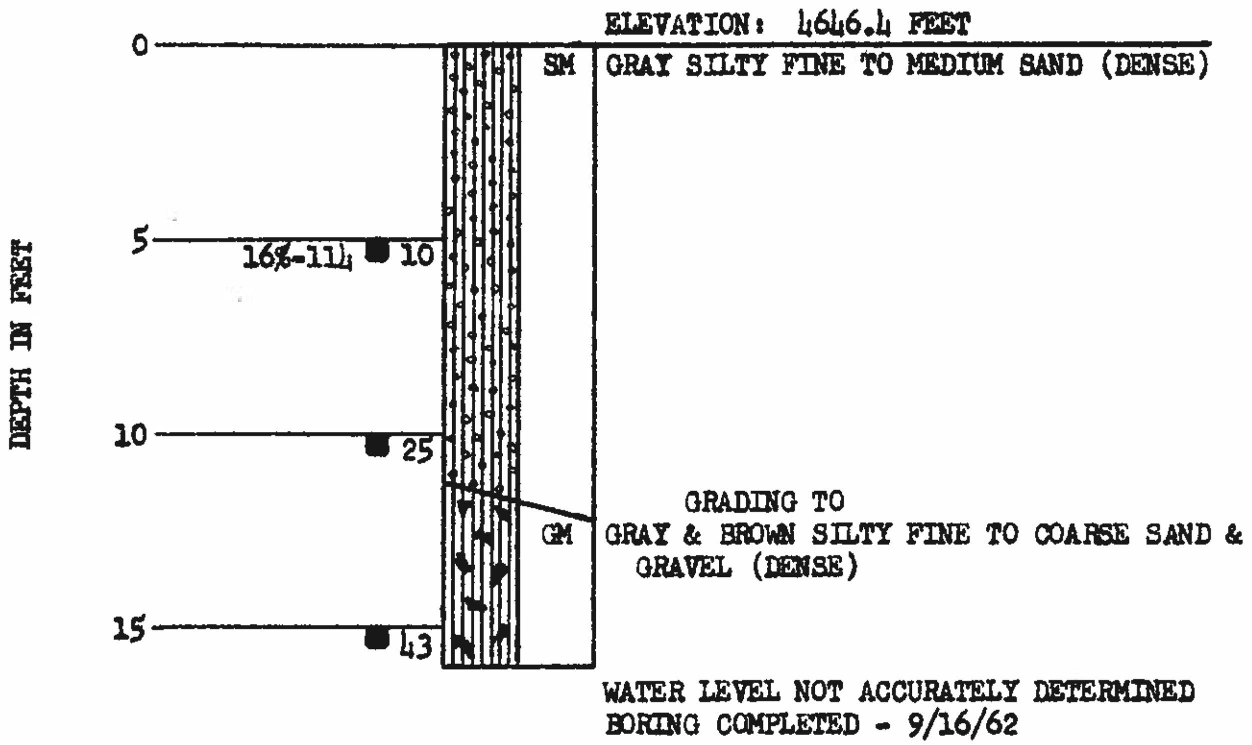
BORING 6



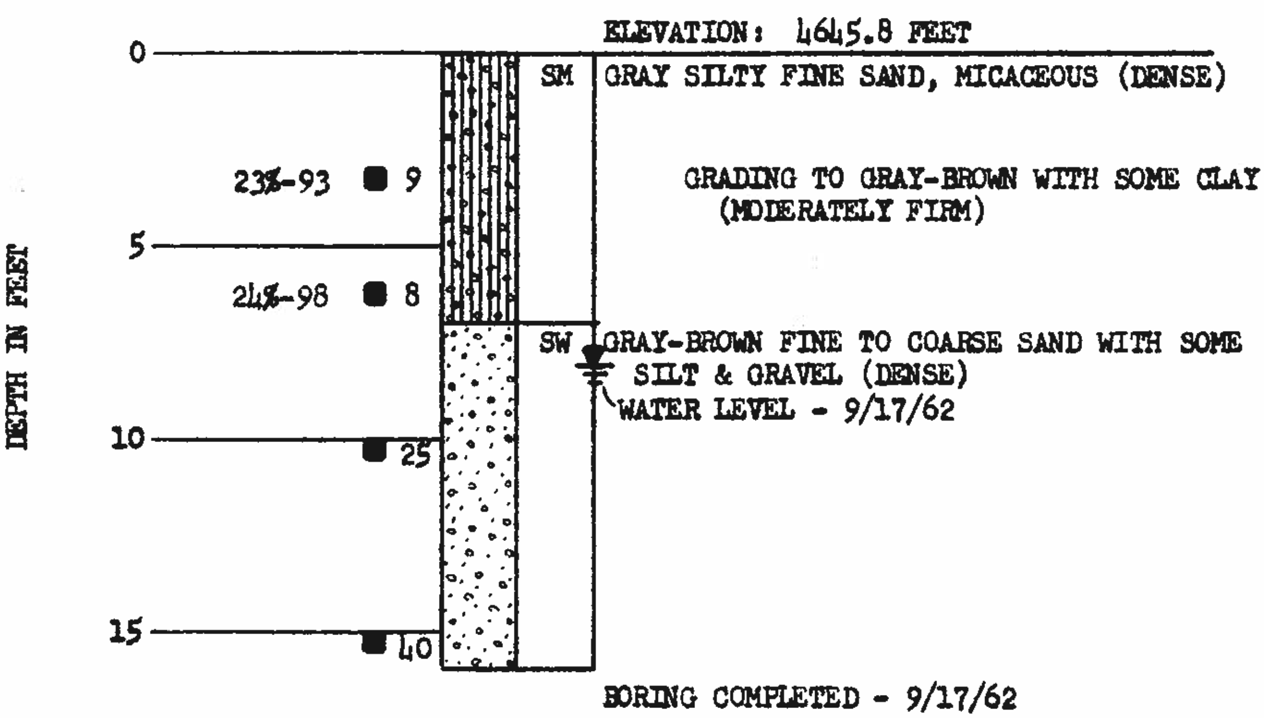
LOG OF BORING

DAMES & MOORE
APPLIED EARTH SCIENCES

BORING 7



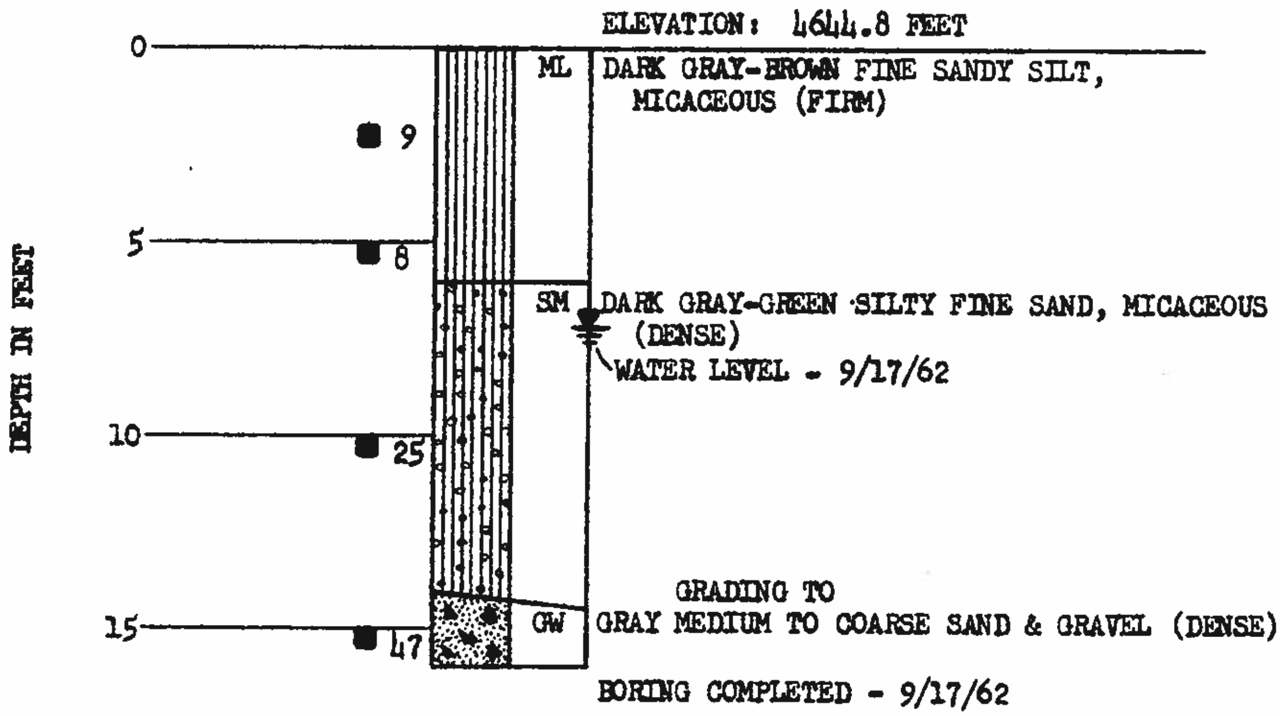
BORING 8



LOG OF BORINGS

DAMES & MOORE
APPLIED EARTH SCIENCES

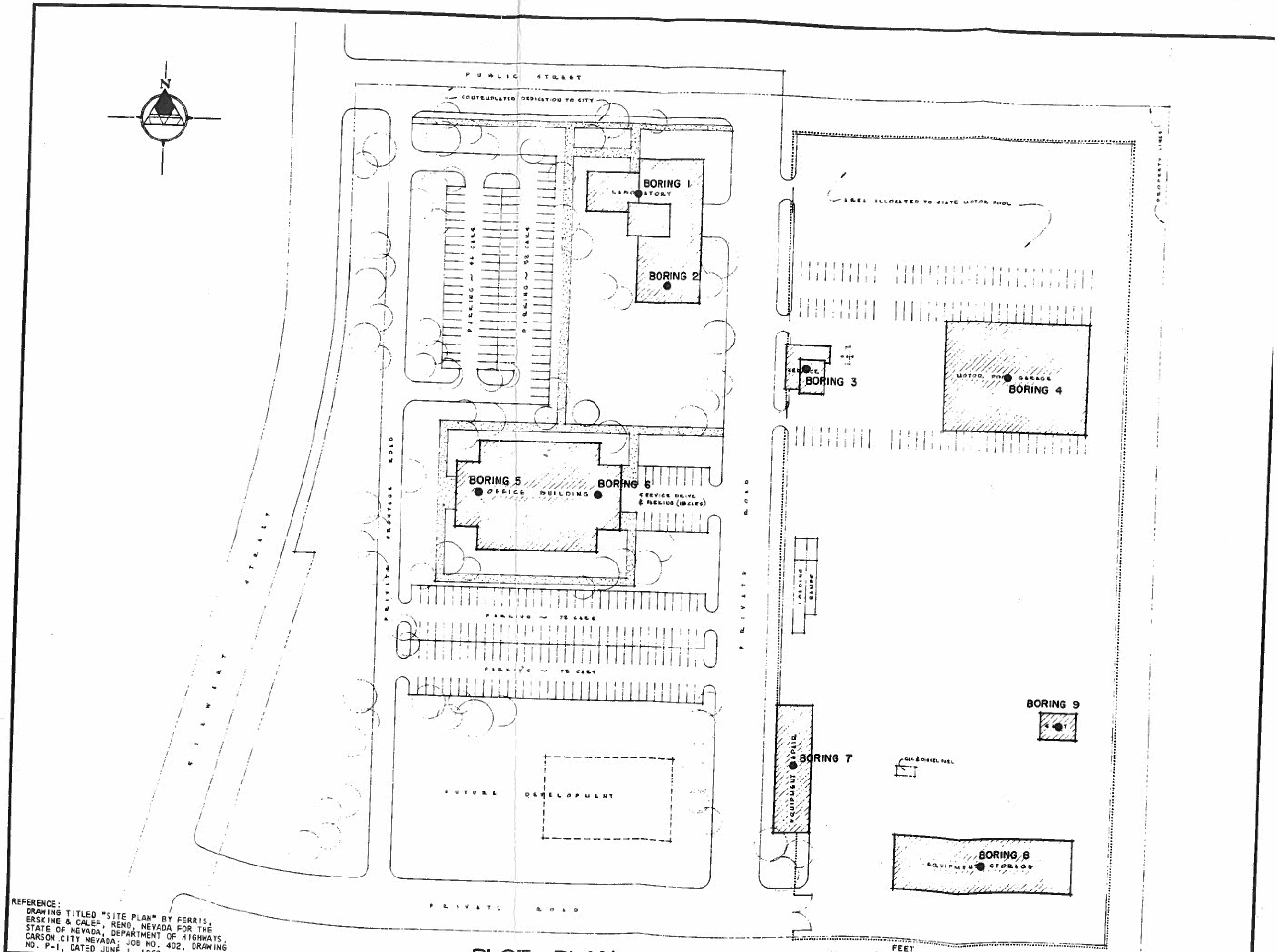
BORING 9



LOG OF BORING

CHECKED BY

DAMES & MOORE
APPLIED EARTH SCIENCES


N
PUBLIC STREET
CONTEMPLATED DEDICATION TO CITY
BORING 1
LABORATORY
BORING 2
BORING 3
BORING 4
MOTOR POOL GARAGE
BORING 5
BORING 6
OFFICE BUILDING
SERVICE DRIVE & PARKING
PARKING ~ 72 CARS
PARKING ~ 72 CARS
FUTURE DEVELOPMENT
PRIVATE ROAD
BORING 7
BORING 8
EQUIPMENT STORAGE
BORING 9
STEWART STREET
REFERENCE:
DRAWING TITLED "SITE PLAN" BY FERRIS, ERSKINE & CALEF, RENO, NEVADA FOR THE STATE OF NEVADA, DEPARTMENT OF HIGHWAYS, CARSON CITY NEVADA, JOB NO. 402, DRAWING NO. P-1, DATED JUNE 1, 1962.
FEET
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PLOT PLAN