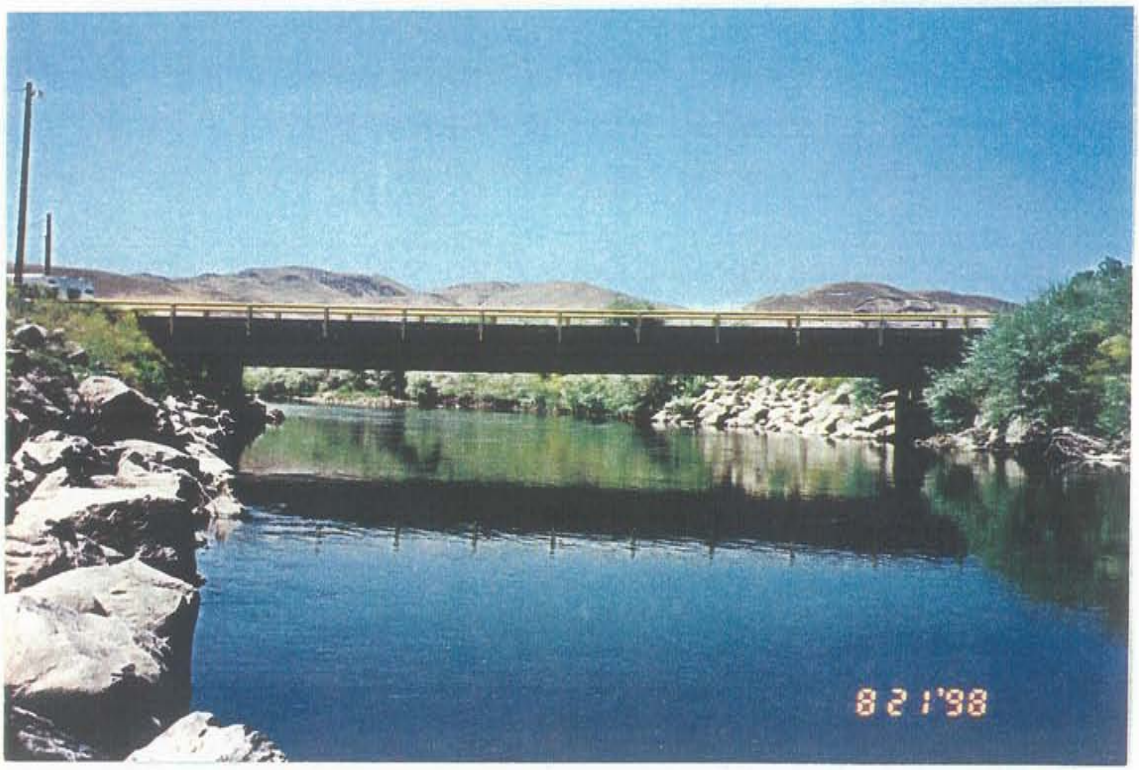
GEOTECHNICAL INVESTIGATION

BRIDGE (B-2352) REPLACEMENT AT HAFED
IN STOREY AND WASHOE COUNTIES

NOVEMBER 2, 2000



NEVADA DOT
GEOTECHNICAL ENGINEERING

MATERIALS DIVISION

STATE OF NEVADA

DEPARTMENT OF TRANSPORTATION

MATERIALS DIVISION

GEOTECHNICAL SECTION

GEOTECHNICAL INVESTIGATION REPORT

BRIDGE (B-2352)
REPLACEMENT AT HAFED
IN STOREY AND WASHOE COUNTIES

Project ID NO. 72423-1

NOVEMBER 2, 2000

Prepared by: _____

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1.0 INTRODUCTION

1.1 General

This report presents the results of our geotechnical investigation for the proposed single span bridge over the Truckee River near Hafed. The proposed bridge will be located south of Interstate 80 at the Mustang Road exit approximately 2 km east of Lockwood in Washoe and Storey Counties. A vicinity map including approximate location of the project is shown on Figure 1.

The exploration was conducted based on the alignment provided to us in the Fall of 1998. The proposed bridge was planned to be constructed approximately 25 meters upstream of the existing structure. However, now a new alignment has been selected and the proposed bridge will located approximately 30 meters downstream of the existing structure. An addendum to this geotechnical report will be issued after an additional exploration is conducted for the new alignment.

The purpose of this investigation was to explore and evaluate subsurface soil conditions and to provide design and construction recommendations for the proposed bridge foundation and roadway.

The scope of this investigation included the following:

- Subsurface exploration
- Laboratory testing
- Analysis of field and laboratory test data
- Site geology review
- Foundation design recommendations
- Construction recommendations

1.2 Project Description

The proposed project consists of construction of approximately 400 meters of two-lane roadway and a single span bridge approximately 48 meters in length over the Truckee river. Grading of existing topography will involve minor cuts north of the Truckee river and fills along the remaining length of the project. The existing bridge consists of a single span bridge approximately 35 meters in length which will be demolished once the new bridge is constructed.

2.0 FIELD EXPLORATION AND LABORATORY TESTING

2.1 Field Exploration

The field exploration was conducted on October 12 through 15, 1998, for the original alignment and consisted of 6 soil borings (MB-1 through MB-6) drilled at the locations shown on the Exploration Plan (see Figure 2). The purpose of the field exploration was to evaluate subsurface conditions and to provide geotechnical recommendations for the bridge foundation. The borings were drilled using a Mobile B-80 truck mounted drill rig equipped with solid auger and rotary wash equipment. Boring MB-2 and MB-3 were drilled using rotary wash. All other borings were drilled using a solid auger. Borings were drilled to depths ranging from 1.5 to 23.8 meters below the existing ground surface. The ground surface elevation at each boring location was determined from topographic maps of the area.

In situ testing and soil sampling were performed using the Standard Penetration Test (SPT). The SPT test is performed using a 35-mm inside diameter, 51-mm outside diameter split-spoon sampler. The sampler was first seated 150 mm and then driven an additional 300 mm with a 620 N (140-pound) hammer, free-falling through a distance of 760 mm (30 inches). The SPT provides a disturbed sample of the soil and an empirical indication (N-value) of the soil density. Representative soil samples were also obtained by bulk method. The soil samples were classified in accordance with the Unified Soil Classification System (ASTM D 2487).

2.2 Laboratory Testing

Representative soil samples from the borings were tested in the laboratory to determine their index properties. Tests performed included moisture content, unit weight, particle size analysis, and Atterberg limits. In addition, selected soil samples were tested for corrosion potential. Tests performed included chlorides, pH, sulfates, and electrical resistivity. Test results are presented in Appendix B.

3.0 SITE CONDITIONS

3.1 Surface

At the time of the exploration the proposed roadway alignment was undeveloped and partially covered with vegetation. The surface soils associated with the proposed roadway alignment consisted of dense sand with gravel and cobbles. The existing river banks at the bridge alignment are approximately 1H:2V (Horizontal:Vertical) with thick vegetation. Utility crossings include a telephone line, gas line and overhead power line along the proposed alignment. One or more power poles may have to be relocated from the area prior to construction of the bridge and roadway.

3.2 Subsurface

The subsurface soils encountered generally consisted of silty sand, and gravelly sand with cobbles and boulders to depths ranging from 5 to 6 meters. Below this layer, soils consisted of silty sand, gravelly sand, and poorly graded gravel with cobbles. Cobbles and boulders were encountered in varying amounts in borings MB-2 and MB-3. The boring logs in Appendix A should be reviewed for a more detailed description of the subsurface conditions encountered at the locations explored.

3.3 Groundwater

Groundwater was encountered in all borings except MB-1. The groundwater elevation varied from 1315.4 to 1317.2 meters. Seasonal fluctuation of the groundwater table should be expected due to variations in precipitation, groundwater withdrawal, and recharge.

4.0 GEOLOGY AND SEISMICITY

4.1 Local Geology

The site is located in an area of flood plain deposits. Based on a geologic map, the project site consists of Quaternary age alluvial-fan deposits of the Truckee River. These deposits consist of silt, sandy silt, silty sand, and gravelly sand with cobbles and boulders. The nearby mountains consist of Tertiary age basalt rock. Bedrock beneath the project is anticipated to be at a depth of more than 24 meters.

4.2 Seismicity

According to geologic maps, multiple fault traces are found in the surrounding area. Historical earthquake records indicate significant acceleration levels can be expected in the area. No faults are mapped to cross through the bridge site. Table 1 shows a list of faults in the area, expected earthquake magnitude, and distance from the proposed bridge.

Table 1. Seismic Sources[1]

Major Quaternary Faults	Earthquake Magnitude	Distance from Site
Eastern Reno Basin Fault Zone (ERBFZ)	6.9	10 km
Northern Virginia Range Fault (NVRF)	6.6	7 km
Olinghouse Fault Zone (OFZ)	7.1	5 km
Spanish Springs Peak Fault Zone (SSPFZ)	6.6	8 km

[1] DePolo M. Craig, Anderson G. John, and Price G. Jonathan (1997).

Based on Division I-A, Seismic Design, of AASHTO Standard Specifications for Highway Bridges, Sixteenth Edition, 1996, the acceleration coefficient in rock at this site is 0.38g, with 10 percent probability of being exceeded in 50 years. Based on subsurface explorations and geologic maps of the area, bedrock was assumed to be more than 24 meters below the ground surface. For seismic design

purposes, a Soil Profile Type II and a Site Coefficient of 1.2 are recommended. Figure 3 shows the seismic response spectra for this site using both the AASHTO and UBC methods. The AASHTO (1996) response spectra is defined in Division I-A, Seismic Design. The UBC method of determining a site response spectra is defined in the Federal Highway Administration (FHWA) Geotechnical Earthquake Engineering Manual, Publication No. FHWA-HI-90-012. Figure 3 also shows the seismic design parameters for both methods.

5.0 ENGINEERING ANALYSIS AND RECOMMENDATIONS

5.1 Drilled Shaft Foundation

Both, shallow and deep foundation systems were considered for support of the bridge. Due to scour potential, drilled shafts are recommended for support of the bridge structure. The drilled shafts will derive their capacities from both skin friction and end bearing.

Figure 4 shows the ultimate downward capacity of a 1.5-m diameter drilled shaft versus the shaft tip elevation. This figure does not take scour into consideration. The downward capacity on Figure 4 needs to be divided by a safety factor to obtain the allowable downward capacity. Since no static load tests are proposed for this project, a safety factor of 2.75 is recommended for the static case with no scour.

Figure 5 shows the ultimate downward capacity of a 1.5-m diameter drilled shaft versus the shaft tip elevation including scour. The ultimate downward capacity on Figure 5 needs to be divided by a safety factor to obtain the allowable downward capacity. A safety factor of 1.1 is recommended for the static case with scour. A value of 6.2 meters below the channel bottom was used as depth of the potential scour in the foundation analysis.

The Ultimate Uplift capacity for a 1.5-m diameter drilled shaft was taken as 70 percent of the side friction capacity plus the weight of the concrete. Figure 6 shows the ultimate uplift capacity vs. shaft tip elevation for a 1.5-m diameter drilled shaft. The ultimate uplift capacity on Figure 6 needs to be divided by a safety factor to obtain the allowable uplift capacity. A safety factor of 1.1 is recommended

for the seismic or cyclic case with no scour.

Drilled shafts should be spaced at least 3 diameters on center. There will be no reduction in the downward capacities of the drilled shafts, due to group action, if the shafts are spaced as recommended.

5.2 Settlement

Settlement analysis for a 1.5-m diameter and 18-m long drilled shaft was conducted. A total settlement of 10 mm is predicted for a design load of 2500 kN. Differential settlement is estimated to be one-half of the total settlement. For a design load less than 2500 kN, the total settlement should be less than 10 mm.

5.3 Liquefaction Evaluation

A simplified liquefaction analysis evaluation was performed in accordance with the *Geotechnical Earthquake Engineering Reference Manual*, December 1998, Publication No. FHWA HI-99-012. The results of the analysis indicated that the factor of safety against initial liquefaction is greater than 1.1. Therefore, no liquefaction mitigation is required.

5.4 Lateral Resistance of Drilled Shafts

In order to evaluate the lateral capacity of a drilled shaft, properties of the subsurface soils are required. The representative subsurface properties presented on Table 2 may be used to analyze the lateral capacity of a drilled shaft.

Table 2 - Soil Parameters for Lateral Load Analysis

Elevation (meters)	Soil Description	Buoyant Unit Weight, γ' (kN/m^3)	Friction Angle, ϕ Degrees	Coefficient of Subgrade Reaction, k (Static and Cyclic) (kN/m^3)

1317.4 - 1311.0	Medium Dense Sand w/ Gravel	9.0	34°	16,300
1311.0 -1304.0	Dense Gravelly Sand	9.8	36°	33,900
1304.0 - shaft tip	Dense Sand w/ gravel	9.0	35°	33,900

The loss of lateral capacity due to scour should be considered in the design. The lateral capacity of an individual shaft in a group is a function of its position in the group and the center-to-center shaft spacing. Per AASHTO, use a reduction factor to modify the p-y curve of an individual shaft based upon its position. For in-line (parallel) loading and center-to-center spacing of three diameters, use a reduction factor of 0.25. For normal loading and center-to-center spacing of three diameters, no reduction is necessary. For center-to-center spacing greater than three diameters, refer to Section 4.6.5.6.1.4 of AASHTO Standard Specifications for Highway Bridges, 1996.

5.5 Lateral Earth Pressures

Lateral earth pressures depend on the type of backfill material, in-place density, backfill slope, and wall geometry. The lateral pressure coefficients were computed for NDOT Granular Backfill using Coulomb equation (per AASHTO Standard Specifications for Highway Bridges, 1996). The lateral seismic active pressure coefficient (K_{AE}) and passive pressure coefficient (K_{PE}) were calculated using the Mononobe-Okabe equation.

In the absence of specific data for Granular Backfill, the lateral pressure coefficients were determined using an internal friction angle of 32 degrees, moist unit weight of 18.8 kN/m^3, and level backfill.

A static active earth pressure coefficient (K_A) of 0.3 and a static passive pressure coefficient (K_P) of 3.0 may be used. For seismic design, an active earth pressure coefficient of 0.45 and a seismic passive earth pressure coefficient of 5.0 may be used. A coefficient of friction against sliding of 0.35 may be used. Any surcharge from adjacent loadings should be added to the above pressures using a factor of 0.3 for active conditions.

5.6 Drilled Shaft Construction Recommendations

Based on the subsurface exploration, cobbles and boulders are expected within the soil matrix in the top 5 to 6 meters overlying dense to very dense gravelly sand with cobbles. Although the boring logs do not show any boulders beyond 6 meters, large boulders may be present. Near the surface, 1.0 to 1.5 meter diameter boulders may be encountered. Therefore, hard drilling is expected and may require rock coring along with other heavy construction equipment.

Due to high ground water and cohesionless soils encountered, full depth temporary casing will be required to prevent sloughing and caving during drilling. In addition, use of drilling slurry may be needed. It is recommended that the contractor visit the site and review the boring logs in Appendix A.

5.7 Site Grading

Within construction limits, clearing and grubbing of existing vegetation and surface debris should be conducted according to Section 201 of NDOT Standard Specifications for Road and Bridge Construction (SSRBC), 1996 Edition. On average, removal of 150 mm of the top soil is recommended. Based on the subsurface exploration and laboratory test results, any soils that need to be excavated north of the river are suitable for use as Borrow.

5.8 Drainage System

A drainage system should be provided to prevent hydrostatic pressures that might develop by water trapped behind the abutment retaining walls. Drainage can be accomplished by providing weepholes along the face of the abutment walls.

Weepholes should be at least 102 mm in diameter and be placed at a maximum horizontal spacing of 4.5 meters approximately 75 mm ± above the finished grade. The backside of the weepholes should be covered with a 150 mm-square aluminum or galvanized steel wire mesh hardware cloth with a minimum wire diameter of 0.75 mm. A minimum of 0.06 m^3 of NDOT Type 2 Drain Backfill encapsulated in a

high strength filter fabric should be placed at each weephole. The filter fabric should meet or exceed the specifications shown on Figure 7.

5.9 Permanent Slopes and Temporary Excavations

In areas of fill, permanent slopes no steeper than 1.0V:2.0H (vertical:horizontal) are recommended. Temporary unsurcharged excavations on the existing fill should be no steeper than 1.5H:1V. Due to the granular nature of the soils, some sloughing of temporary slopes should be anticipated. However, it is the contractor's responsibility to determine the stable slope during construction in accordance with OSHA requirements. It is anticipated that excavations steeper than 1.0V:1.5H will require shoring. The contractor must meet all OSHA requirements for temporary excavation slopes and excavation shorings (Federal Register 29 Code of Federal Regulation, Part 1926) and Section 206 of NDOT Standard Specifications for Road and Highway Bridges.

REFERENCES

1. AASHTO, Standard Specifications for Highway Bridges, American Association of State Highway and Transportation Officials, Washington, D.C., Sixteenth Edition, 1996.

2. Bell John W., Bonham Harold F. Jr., Nevada Bureau of Mines and Geology, Vista Quadrangle Geologic Map, 1987.

3. Bonham Harold F., Geologic Map of Washoe and Storey Counties, Nevada Bureau of Mines, 1969.

4. Bowles, Joseph E. Bowles, Foundation Analysis and Design, fourth edition, 1988.

5. Das Braja M., Principles of Foundation Engineering, second edition, 1990.

6. DePolo, Craig M.; Anderson John G.; and Price Jonathan G., Seismological Research Letters, Volume 68, May/June, 1997.

7. FHWA, Geotechnical Earthquake Engineering Reference Manual, December 1998, Publication No. FHWA HI-99-012

8. NAVFAC, Design Manual 7.2, Foundations and Earth Structures. Naval Facilities Engineering Command, May 1982.

9. Siddharthan Raj; Bell John W.; Anderson John G.; and DePolo, Craig M., Peak Bedrock Acceleration for Reno-Carson City Region. University of Nevada, Reno, Report No. 91-01, January 1991.

10. Transportation Research Board, Manual for the Design of Bridge Foundations. National Cooperative Highway Research Program Report No. 343, December 1991.

FIGURES

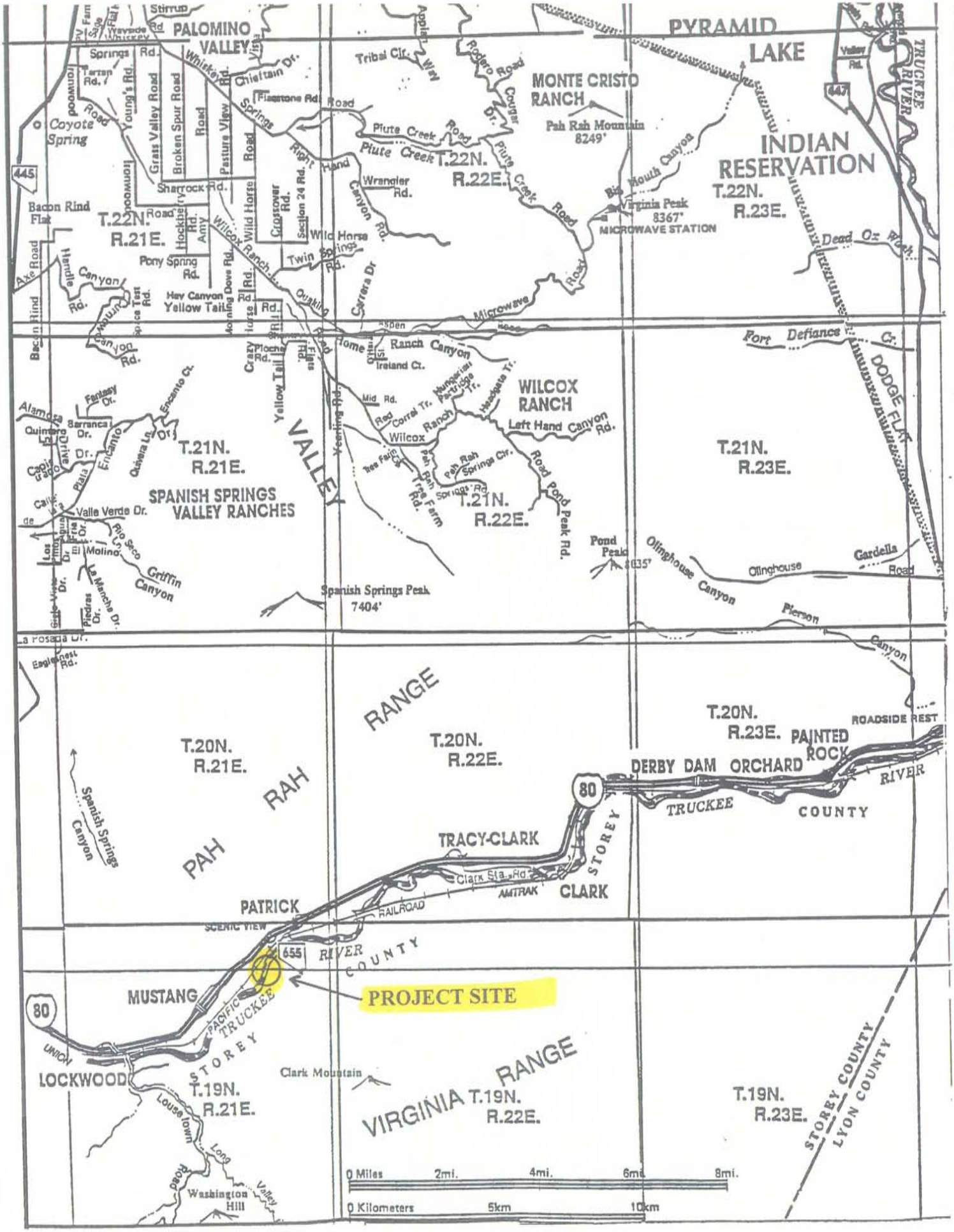


FIGURE 1 - VICINITY MAP

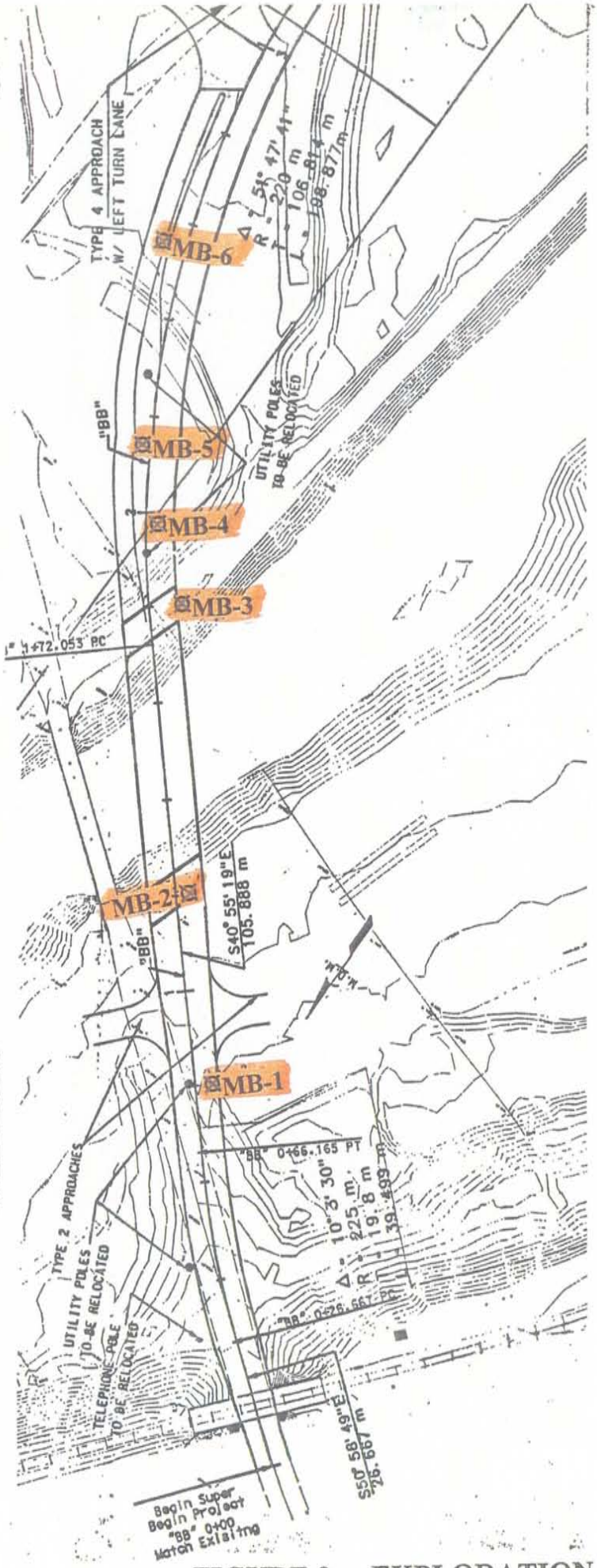


FIGURE 2 - EXPLORATION PLAN

FIGURE 3
Site Seismic Response Spectra
B-2352 Bridge Replacement

UBC Method
Soil Profile = Sc/Sd
Ca = 0.353
Cv = 0.505
PGA = 0.31g (10% in 50 yrs.)
from USGS Map

AASHTO Method
Soil Profile Type = II
Acceleration Coefficient = 0.38g
(10% in 50 yrs.)

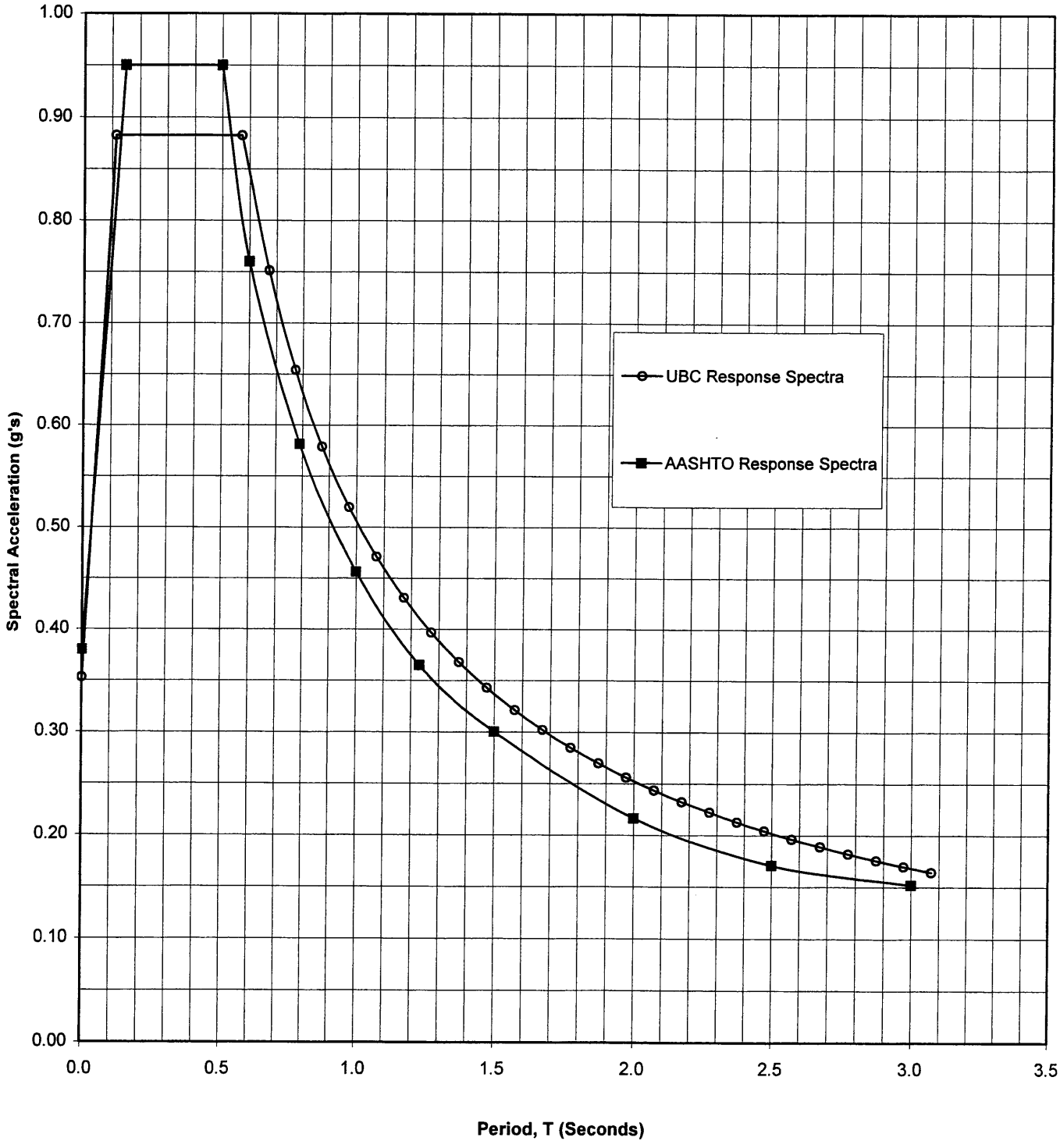


Figure 4
Shaft Tip Elevation vs. Ultimate Capacity
Without Scour
B-2352 Bridge Replacement

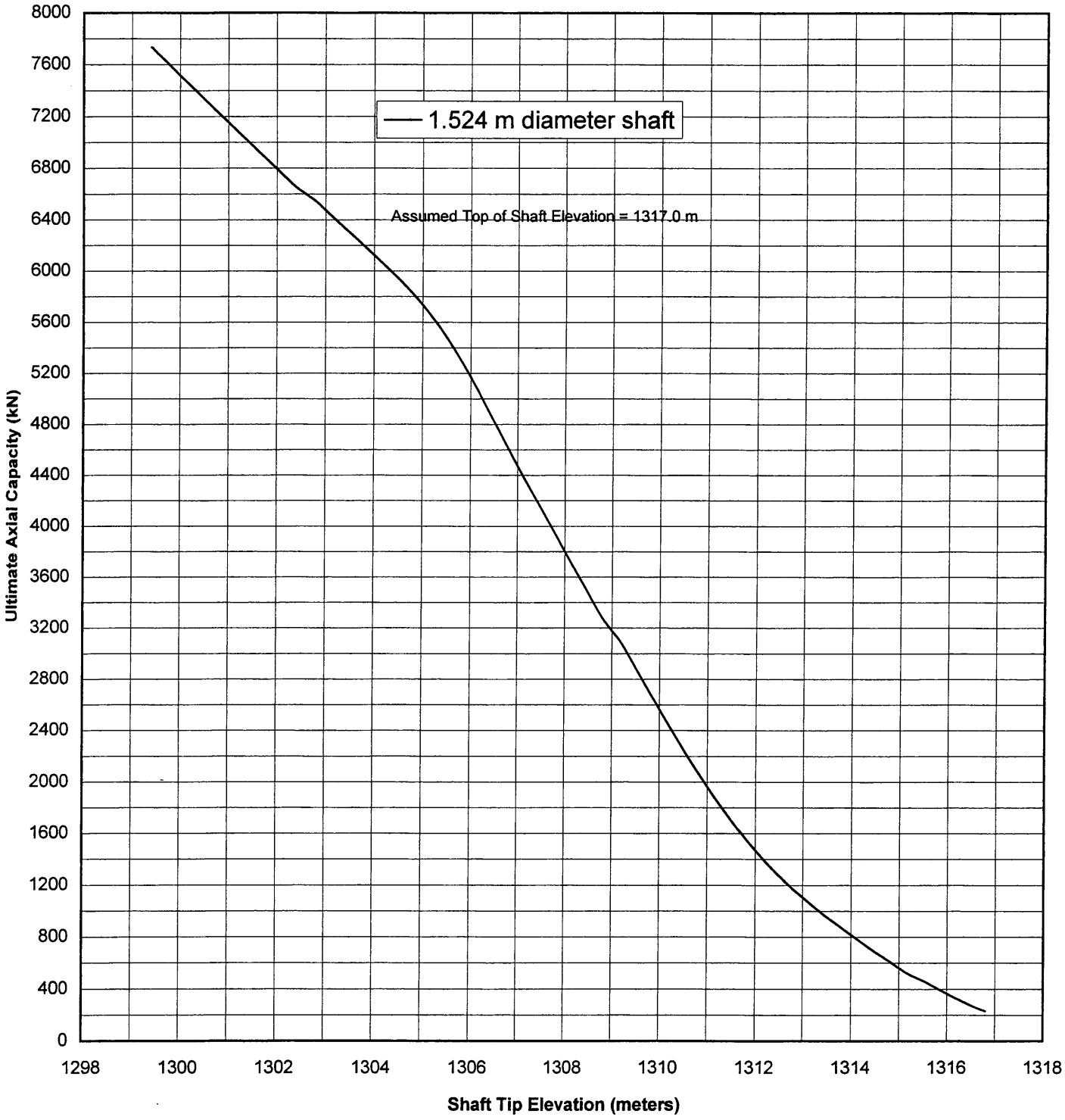


FIGURE 5
Shaft Tip Elevation vs. Ultimate Axial Capacity
With Scour
B-2352 Bridge Replacement

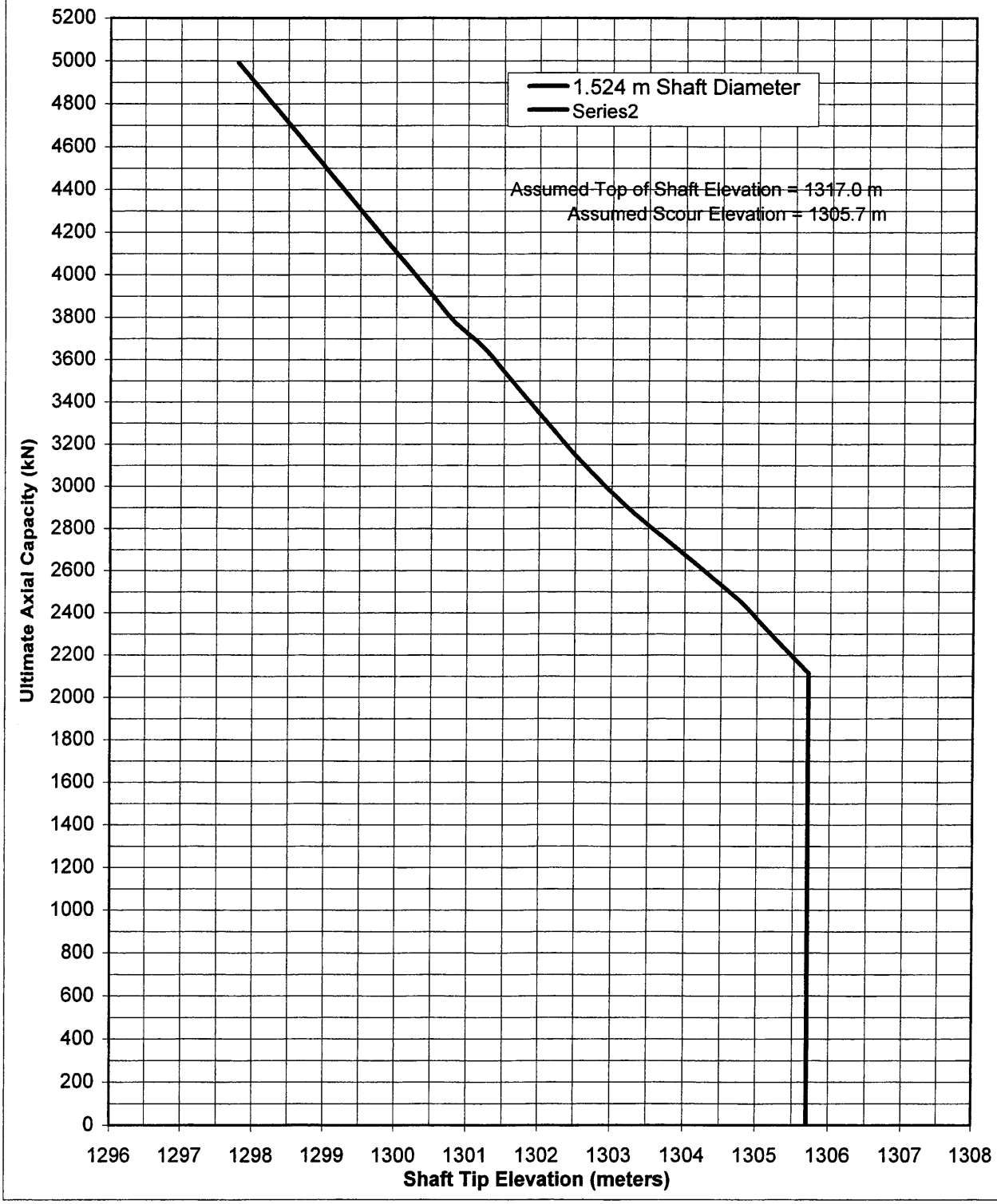
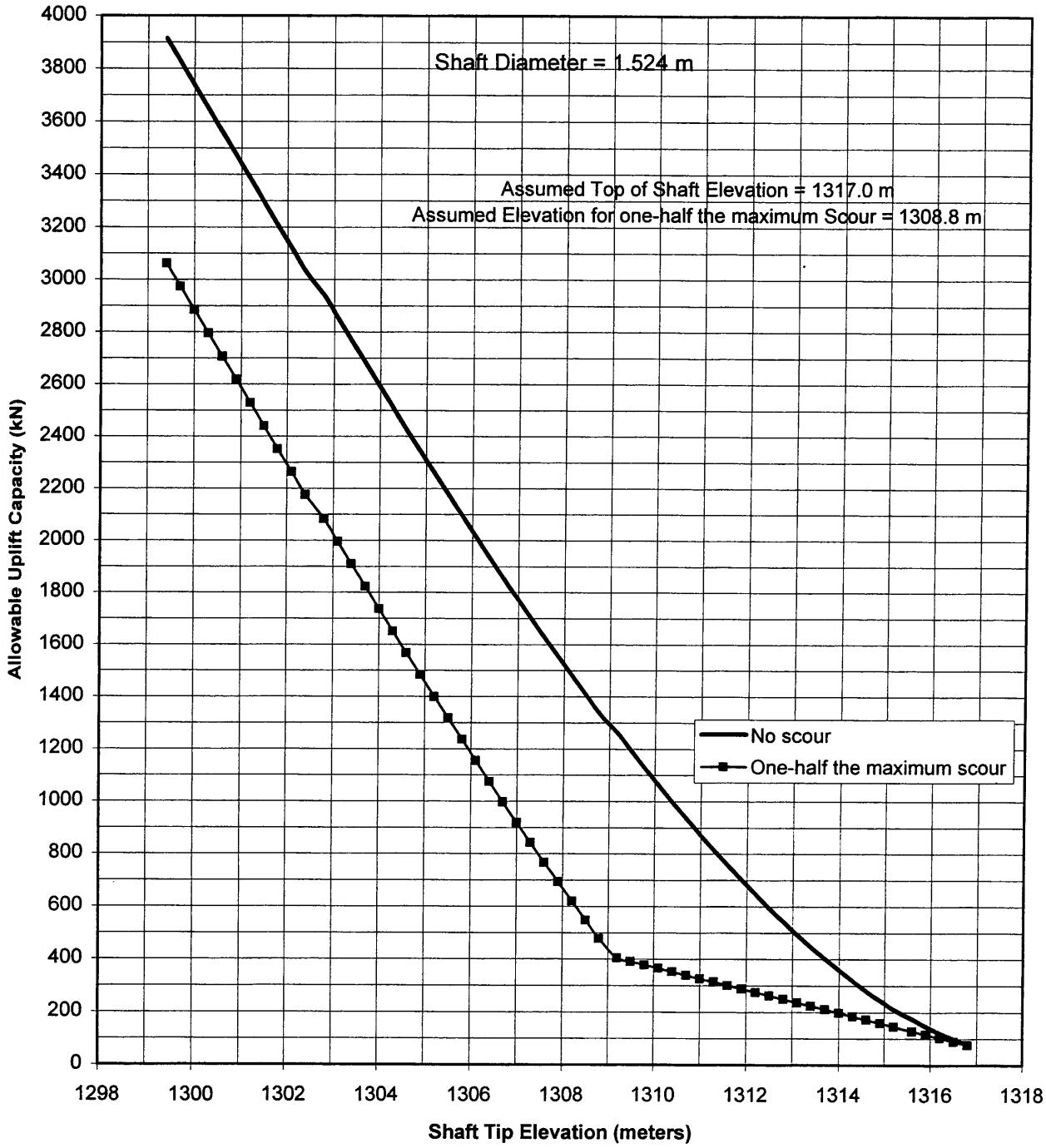
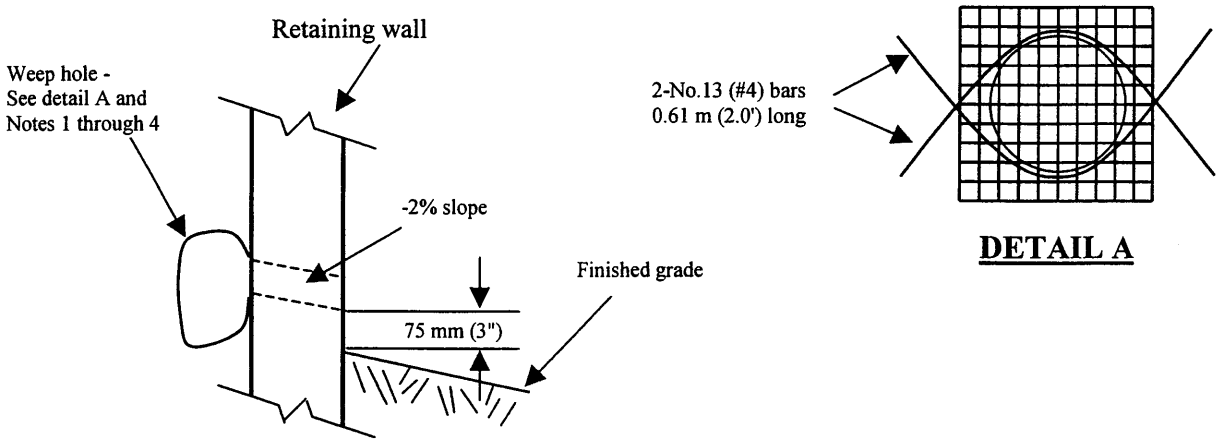


FIGURE 6
Shaft Tip Elevation vs. Allowable Uplift Capacity
B-2352 Bridge Replacement



WEEP HOLE DETAIL



NOTES:

1. 50 mm (2") diameter drains with horizontal and vertical spacing of 4.5 m (15') ± center to center. The bottom row must be located 75 mm (3") above finished grade.

2. 150 mm (6") square aluminum or galvanized steel wire mesh hardware cloth with a minimum wire diameter of 0.75 mm (0.03").

3. 0.06m^3 (2 ft^3) of NDOT Type 1 or 2 Drain Backfill, encapsulated in a geotextile fabric, securely tied. The geotextile fabric must:
   a) meet or exceed AASHTO Test Method M288 Class 2 strength requirements.
   b) have an AOS no greater than U.S. Sieve No. 40.
   c) have a permittivity of at least 0.5 sec^{-1}.

4. No direct payment will be made for the construction of weep holes.

FIGURE 7

APPENDIX A

BORING LOGS

NEVADA DEPARTMENT OF TRANSPORTATION
GEOTECHNICAL ENGINEERING

EXPLORATION LOG

SHEET 1 OF 1

START DATE 10/15/99
END DATE 10/15/98
JOB DESCRIPTION Truckee River Bridge Replacement (B-2352)
LOCATION Truckee River Near Hafed
BORING MB-1
E.A. # 72423-1
GROUND ELEV. 1319.78 (m)
HAMMER DROP SYSTEM Safety

GROUNDWATER LEVEL		
DATE	DEPTH m	ELEV. m

STATION BB 0+80
OFFSET 3 m Right
ENGINEER H. Perez
EQUIPMENT MOBILE B-80
OPERATOR Pat Argall
DRILLING METHOD 150 mm Solid Auger
BACKFILLED Yes DATE 10/15/98

ELEV. (m)	DEPTH (m)	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT 150 mm Increments	BLOW COUNT Last 300 mm	Percent Recov'd	LAB TESTS	USCS Group	MATERIAL DESCRIPTION	REMARKS
	0.00									
		A	BULK			100	S	SM	**SM** - Silty sand with gravel.	
	0.30									
									0.61	
1318.8	1							GM	**GM** - Silty gravel with sand and cobbles.	Auger refusal.
									1.52	
1317.8	2									
1316.8	3									
1315.8	4									
1314.8	5									
1313.8	6									
1312.8	7									
1311.8	8									
1310.8	9									

NV_DOT HAFED.GPJ NV_DOT.GDT 11/02/00

NEVADA DEPARTMENT OF TRANSPORTATION
GEOTECHNICAL ENGINEERING

EXPLORATION LOG

START DATE 10/12/98
END DATE 10/13/98
JOB DESCRIPTION Truckee River Bridge Replacement (B-2352)
LOCATION Truckee River Near Hafed
BORING MB-2
E.A. # 72423-1
GROUND ELEV. 1318.87 (m)
HAMMER DROP SYSTEM Safety

GROUNDWATER LEVEL		
DATE	DEPTH m	ELEV. m
10/15/98	3.70	1315.2

STATION BB 1+20
OFFSET 5 m Right
ENGINEER H. Perez
EQUIPMENT MOBILE B-80
OPERATOR Pat Argall
DRILLING METHOD Rotary Wash
BACKFILLED Yes DATE 10/15/98

ELEV. (m)	DEPTH (m)	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT 150 mm Increments	BLOW COUNT Last 300 mm	Percent Recov'd	LAB TESTS	USCS Group	MATERIAL DESCRIPTION	REMARKS
									SP-SM - poorly sand with silt and gravel. Cobbles and boulders within the soil matrix.	
1317.9	1							SP SM		
1316.9	2									
	2.44								2.40	
	2.90	A	SPT	7 8 10	18	90	W, G, S, Ch	GM	**GM** - silty gravel with sand.	
									2.90	
1315.9	3								**SM** - silty sand with gravel. Cobbles and boulders within the soil matrix.	
	3.96									
1314.9	4	B	CSS	21 15/50mm	15/50mm	45	W, UW, G, S Ch	SM		Sample refusal
	4.16									
1313.9	5									Very hard drilling
	5.49									
									5.50	
	5.94	C	CSS	22 29 34	63	90	W, UW, G, S, Ch	GM	**GM** - silty gravel with sand.	
1312.9	6								5.90	
	6.40	D	SPT	14 32 38	70	90	W, G, S	SM	**SM** - Silty sand with gravel.	
									6.40	
									GP - poorly graded sand with gravel. Cobbles within the soil matrix.	
1311.9	7									
1310.9	8									
	8.53 8.98	E	SPT	10/25mm	10/25mm	0				Sample refusal
1309.9	9							GP		

NV_DOT HAFED.GPJ NV_DOT.GDT 11/02/00

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OPERATOR Pat Argall
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BACKFILLED Yes DATE 10/15/98

ELEV. (m)	DEPTH (m)	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT 150 mm Increments	BLOW COUNT Last 300 mm	Percent Recov'd	LAB TESTS	USCS Group	MATERIAL DESCRIPTION	REMARKS
1307.9	11									
	11.58							GW	11.60	
		F	SPT	24 8/0mm	8/0mm	30	W, S	GM	11.70 GW-GM - well-graded gravel with silt and sand.	Sample resufal
1306.9	12 12.04							GP	GP - poorly graded gravel. Cobbles within the soil matrix.	Very hard drilling
1305.9	13 13.11								13.11	
	13.31	G	SPT	26 30/50mm 30/50mm	30/50mm	40	S	GP	GP - poorly graded gravel. Cobbles within the soil matrix.	Sample refusal
1304.9	14									
									14.63	
1303.9	15							GP	GP - poorly graded gravel. Cobbles within the soil matrix.	
1302.9	16									
									16.15	
1301.9	17							GP	GP - poorly graded gravel. Cobbles within the soil matrix.	
	17.22									
	17.45	H	SPT	12 25/50mm 25/50mm	25/50mm	30	S			
									17.68	
1300.9	18							GP	GP - poorly graded gravel. Cobbles within the soil matrix.	
1299.9	19									
									19.20	
									GP - poorly graded gravel. Cobbles within the soil matrix.	

NV_DOT HAFED.GPJ NV_DOT.GDT 11/02/00

NEVADA DEPARTMENT OF TRANSPORTATION
GEOTECHNICAL ENGINEERING

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EQUIPMENT MOBILE B-80
OPERATOR Pat Argall
DRILLING METHOD Rotary Wash
BACKFILLED Yes DATE 10/15/98

ELEV. (m)	DEPTH (m)	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT 150 mm Increments	BLOW COUNT Last 300 mm	Percent Recov'd	LAB TESTS	USCS Group	MATERIAL DESCRIPTION	REMARKS
								GP		
	20.78	1	SPT	10/25mm	10/25mm	0				Sample refusal
									20.90	
1297.9	21									Very hard drilling Lost slurry circulation
1296.9	22									
1295.9	23									
1294.9	24									
1293.9	25									
1292.9	26									
1291.9	27									
1290.9	28									
1289.9	29									

NV_DOT HAFED.GPJ NV_DOT.GDT 11/02/00

NEVADA DEPARTMENT OF TRANSPORTATION
GEOTECHNICAL ENGINEERING

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ENGINEER H. Perez
EQUIPMENT MOBILE B-80
OPERATOR Pat Argall
DRILLING METHOD Rotary Wash
BACKFILLED Yes DATE 10/15/98

ELEV. (m)	DEPTH (m)	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT 150 mm Increments	BLOW COUNT Last 300 mm	Percent Recov'd	LAB TESTS	USCS Group	MATERIAL DESCRIPTION	REMARKS
								SW	**SW** - Well-graded sand with gravel.	
	0.30								0.30	
								SW	**SW** - Well-graded sand with cobbles.	
	0.91								0.91	
1317.8	1							SW	**SW** - Well-graded sand with cobbles and boulders.	
	1.52								1.52	
								GW	**GW** - well-graded gravel with sand, cobbles and boulders.	
1316.8	2									
	2.44								2.44	
	2.90	A	SPT	4 4 5	9	100	S, W, PI, LL, PL	CL	**CL** - Sandy lean clay. 2.90	
1315.8	3									
								GP	**GP** - poorly graded gravel with sand, cobbles and boulders.	
1314.8	4									
1313.8	5									Very hard drilling. Drilling rate: 75 mm/min @ 300 psi downward pressure.
	5.49								5.49	
	5.94	B	SPT	21 16 19	35	90	S, W	GW GM	**GW-GM** - Well graded gravel with silt and sand. 5.94	
1312.8	6									
								SM	**SM** - silty sand with gravel, cobbles and boulders.	
1311.8	7									
1310.8	8									Very hard drilling. Drilling rate: 50 mm/ min @ 300 psi downward pressure.
	8.53								8.53	
	8.99	C	SPT	25 23 18	41	90	S, W	GP GM	**GP-GM** - Poorly graded gravel with silt and sand. 8.99	
1309.8	9									
								GP	**GP** - poorly graded gravel with sand and cobbles.	

NV_DOT HAFED.GPJ NV_DOT.GDT 11/02/00

NEVADA DEPARTMENT OF TRANSPORTATION
GEOTECHNICAL ENGINEERING

EXPLORATION LOG

START DATE 10/14/98
END DATE 10/15/98
JOB DESCRIPTION Truckee River Bridge Replacement (B-2352)
LOCATION Truckee River Near Hafed
BORING MB-3
E.A. # 72423-1
GROUND ELEV. 1318.81 (m)
HAMMER DROP SYSTEM Safety

GROUNDWATER LEVEL		
DATE	DEPTH m	ELEV. m
10/15/98	3.66	1315.2

STATION BB 1+75
OFFSET 7 m Right
ENGINEER H. Perez
EQUIPMENT MOBILE B-80
OPERATOR Pat Argall
DRILLING METHOD Rotary Wash
BACKFILLED Yes DATE 10/15/98

ELEV. (m)	DEPTH (m)	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT 150 mm Increments	BLOW COUNT Last 300 mm	Percent Recov'd	LAB TESTS	USCS Group	MATERIAL DESCRIPTION	REMARKS
	10.06	D	SPT	18 19 20	39	90	S, W	GP GM	10.06 **GP-GM** - Poorly graded gravel with silt and sand.	
	10.52								10.52 **GP** - poorly graded gravel with sand.	
1307.8	11							GP		
	11.58								11.58	
	12.04	E	CSS	48 28 27	55	100	S, UW, W, G, Ch	GP GM	**GP-GM** - Poorly graded gravel with silt and sand.	
1306.8	12								12.04 **GP** - poorly graded gravel with sand.	
	13.11							GP		
1305.8	13								13.11	
	13.56	F	SPT	22 22 37	59	92	S, W	SM	**SM** - silty sand with gravel.	
									13.56	
1304.8	14								**GP** - poorly graded gravel with sand and cobbles.	
1303.8	15									
1302.8	16									
								GP		
1301.8	17									
1300.8	18									
1299.8	19									
	19.20								19.20	
	19.35	G	SPT	40	40	0			**GP** - poorly graded gravel with sand and cobbles.	
								GP	19.66 **GP** - poorly graded gravel with sand and	No recovery.

NEVADA DEPARTMENT OF TRANSPORTATION
GEOTECHNICAL ENGINEERING

EXPLORATION LOG

START DATE 10/14/98
END DATE 10/15/98
JOB DESCRIPTION Truckee River Bridge Replacement (B-2352)
LOCATION Truckee River Near Hafed
BORING MB-3
E.A. # 72423-1
GROUND ELEV. 1318.81 (m)
HAMMER DROP SYSTEM Safety

GROUNDWATER LEVEL		
DATE	DEPTH m	ELEV. m
10/15/98	3.66	1315.2

STATION BB 1+75
OFFSET 7 m Right
ENGINEER H. Perez
EQUIPMENT MOBILE B-80
OPERATOR Pat Argall
DRILLING METHOD Rotary Wash
BACKFILLED Yes DATE 10/15/98

ELEV. (m)	DEPTH (m)	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT 150 mm Increments	BLOW COUNT Last 300 mm	Percent Recov'd	LAB TESTS	USCS Group	MATERIAL DESCRIPTION	REMARKS
									cobbles.	
								GP		
1297.8	21									
	21.64								21.64	
									GP - poorly graded gravel with sand and cobbles.	Coring was stopped due to equipment difficulties.
1296.8	22	H	CORE			15		GP		
	22.25								22.25	
									GP - poorly graded gravel with sand and cobbles.	
1295.8	23							GP		
									23.77	Very hard drilling.
1294.8	24									Drilling rate: 75 mm/min @ 300 psi downward pressure.
1293.8	25									
1292.8	26									
1291.8	27									
1290.8	28									
1289.8	29									

NV_DOT HAFED.GPJ NV_DOT.GDT 11/02/00

NEVADA DEPARTMENT OF TRANSPORTATION
GEOTECHNICAL ENGINEERING

EXPLORATION LOG

START DATE 10/15/99
END DATE 10/15/98
JOB DESCRIPTION Truckee River Bridge Replacement (B-2352)
LOCATION Truckee River Near Hafed
BORING MB-4
E.A. # 72423-1
GROUND ELEV. 1316.98 (m)
HAMMER DROP SYSTEM Safety

GROUNDWATER LEVEL		
DATE	DEPTH m	ELEV. m
10/15/98	1.52	1315.5

STATION BB 1+98
OFFSET 2 m Right
ENGINEER H. Perez
EQUIPMENT MOBILE B-80
OPERATOR Pat Argall
DRILLING METHOD 150 mm Solid Auger
BACKFILLED Yes DATE 10/15/98

ELEV. (m)	DEPTH (m)	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT 150 mm Increments	BLOW COUNT Last 300 mm	Percent Recov'd	LAB TESTS	USCS Group	MATERIAL DESCRIPTION	REMARKS
	0.00	A	BULK			100	S, RV	SM	**SM** - Silty sand, light brown, moist.	
	0.91								0.91	
1316.0	1	B	BULK			100	S, RV	SP SM	**SP-SM** - Poorly graded sand with silt and gravel, light brown, wet.	
	1.83								1.83	
1315.0	2	C	BULK			100	S, RV	GP GM	**GP-GM** - Poorly graded gravel with silt and sand, light brown, wet.	
	2.74								2.74	
1314.0	3									
1313.0	4									
1312.0	5									
1311.0	6									
1310.0	7									
1309.0	8									
1308.0	9									

NV_DOT_HAFED.GPJ NV_DOT.GDT 10/26/00

NEVADA DEPARTMENT OF TRANSPORTATION
GEOTECHNICAL ENGINEERING

EXPLORATION LOG

START DATE 10/15/99
END DATE 10/15/98
JOB DESCRIPTION Truckee River Bridge Replacement (B-2352)
LOCATION Truckee River Near Hafed
BORING MB-5
E.A. # 72423-1
GROUND ELEV. 1316.74 (m)
HAMMER DROP SYSTEM Safety

GROUNDWATER LEVEL		
DATE	DEPTH m	ELEV. m
10/15/98	2.13	1314.6

STATION BB 2+10
OFFSET 1 m Left
ENGINEER H. Perez
EQUIPMENT MOBILE B-80
OPERATOR Pat Argall
DRILLING METHOD 150 mm Solid Auger
BACKFILLED Yes DATE 10/15/98

ELEV. (m)	DEPTH (m)	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT 150 mm Increments	BLOW COUNT Last 300 mm	Percent Recov'd	LAB TESTS	USCS Group	MATERIAL DESCRIPTION	REMARKS
	0.00								**SM** - Silty sand, light brown, moist.	
		A	BULK			100	S, RV	SM		
	0.91								0.91	
1315.7	1								**SM** - Silty sand with gravel, light brown, wet.	
		B	BULK			100	S, RV	SM		
	1.83								1.83	
1314.7	2									
		C	BULK			100	S, RV			
	2.74								2.74	
1313.7	3									
1312.7	4									
1311.7	5									
1310.7	6									
1309.7	7									
1308.7	8									
1307.7	9									

NV_DOT HAFED.GPJ NV_DOT.GDT 10/26/00

NEVADA DEPARTMENT OF TRANSPORTATION
GEOTECHNICAL ENGINEERING

EXPLORATION LOG

SHEET 1 OF 1

START DATE 10/15/98
END DATE 10/15/98
JOB DESCRIPTION Truckee River Bridge Replacement (B-2352)
LOCATION Truckee River Near Hafed
BORING MB-6
E.A. # 72423-1
GROUND ELEV. 1316.89 (m)
HAMMER DROP SYSTEM Safety

GROUNDWATER LEVEL		
DATE	DEPTH m	ELEV. m
10/15/98	1.83	1315.1

STATION BB 2+56
OFFSET 5 m Left
ENGINEER H. Perez
EQUIPMENT MOBILE B-80
OPERATOR Pat Argall
DRILLING METHOD 150 mm Solid Auger
BACKFILLED Yes DATE 10/15/1998

ELEV. (m)	DEPTH (m)	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT 150 mm Increments	BLOW COUNT Last 300 mm	Percent Recov'd	LAB TESTS	USCS Group	MATERIAL DESCRIPTION	REMARKS
	0.00	A	BULK			100	S, RV	SM	**SM** - Silty sand, light brown, moist.	
	0.91								0.91	
1315.9	1	B	BULK			100	S, RV	SM	**SM** - Silty sand with some gravel, light brown, wet.	
	1.83								1.83	
1314.9	2	C	BULK			100	S, RV	GP GM	**GP-GM** - Poorly graded gravel with silt and sand, light brown, wet.	
	2.74								2.74	
1313.9	3									
1312.9	4									
1311.9	5									
1310.9	6									
1309.9	7									
1308.9	8									
1307.9	9									

NV_DOT_HAFED.GPJ NV_DOT.GDT 10/26/00

KEY TO BORING LOGS

PARTICLE SIZE LIMITS								
CLAY	SILT	SAND			GRAVEL		COBBLES	BOULDERS
		FINE	MEDIUM	COARSE	FINE	COARSE		
.002 mm		#200	#40	#10	#4	19 mm	75 mm	300 mm

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
GM	Silty gravels, poorly graded gravel-sand-silt mixtures
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
CS	Claystone/Siltstone
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/0.3m	DENSITY	BLOWS/0.3m	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) 63.5 Kg hammer 760mm free fall on 50.8mm O.D. x 35mm I.D. sampler.

Blow counts on Calif. Modified Sampler (N_{CMS}) can be converted to N_{SPT} by:
$(N_{CMS})(0.62) = N_{SPT}$

Blow counts from Automatic or Safety Hammer can be converted to Standard SPT N_{60} by:
$(N_{AUTOMATIC})(1.25) = N_{60}$
$(N_{SAFETY})(1.17) = N_{60}$

TEST ABBREVIATIONS

CD	CONSOLIDATED DRAINED	O	ORGANIC CONTENT
CH	CHEMICAL (CORROSIVENESS)	OC	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 COLOR CHART.
EXAMPLE: (7.5 YR 5/3) BROWN

SAMPLER NOTATION

CMS	CALIF. MODIFIED SAMPLER①
CPT	CONE PENETRATION
CS	CONTINUOUS SAMPLER②
CSS	CALIFORNIA SPLIT SPOON①
P	PUSHED (NOT DRIVEN)
PB	PITCHER BARREL
RC	ROCK CORE③
SH	SHELBY TUBE④
SPT	STANDARD PENETRATION TEST
TP	TEST PIT

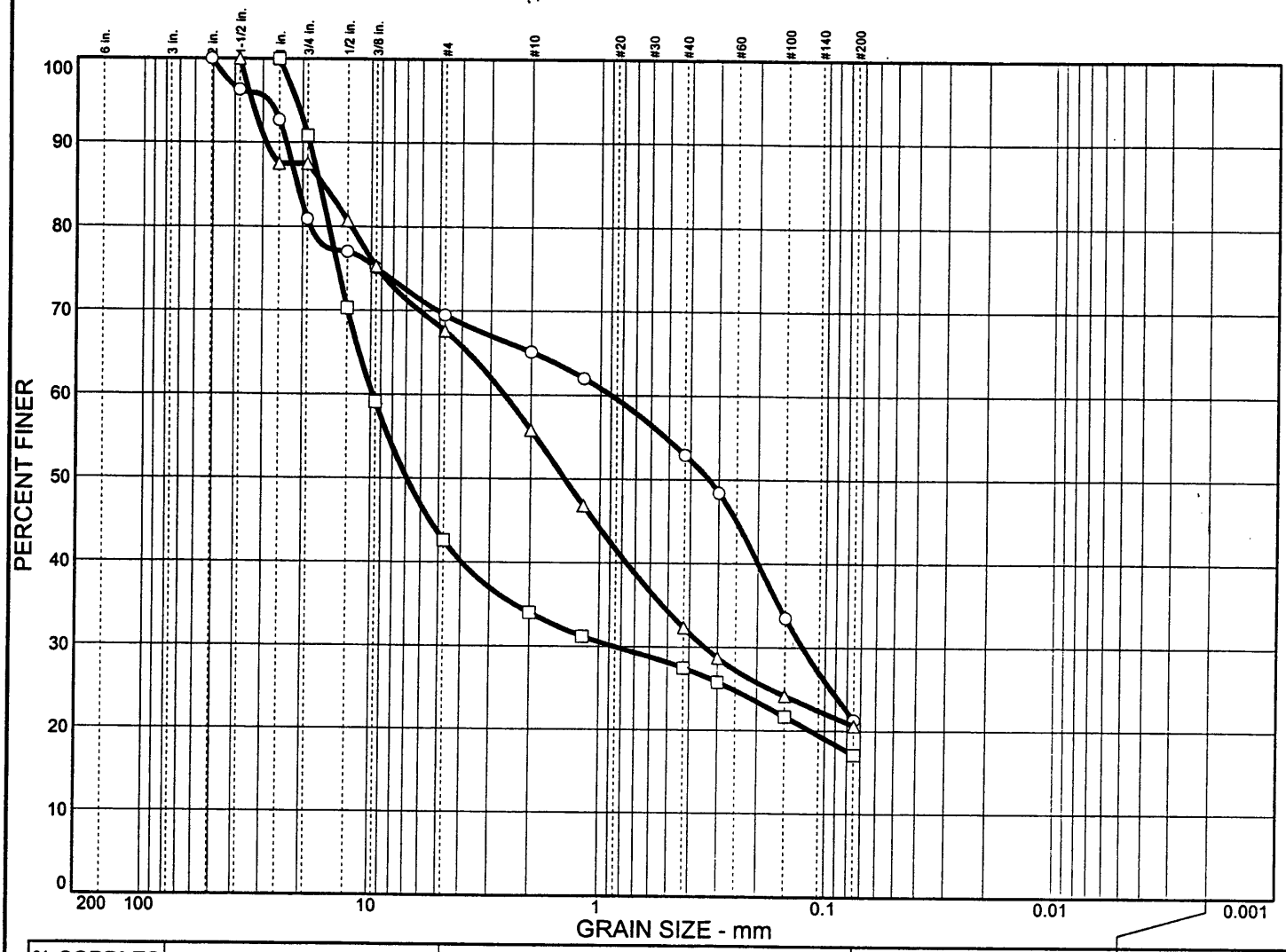
①- I.D.= 61.5 mm
②- I.D.=82 mm with tube; 88.9mm w/o tube
③- NXB I.D.= 47.625mm
④- I.D.= 73mm

LAST MODIFIED: March 1, 2000

APPENDIX B

LABORATORY TEST RESULTS

PARTICLE SIZE DISTRIBUTION TEST REPORT



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	30.5	48.2	21.3	
□	0.0	57.4	25.5	17.1	
△	0.0	32.4	47.0	20.6	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			21.1	0.902	0.333	0.126				
□			16.8	9.79	6.90	0.861				
△			16.3	2.61	1.42	0.344				

MATERIAL DESCRIPTION	USCS	AASHTO
○ Silty sand with gravel	SM	
□ Silty gravel with sand	GM	
△ Silty sand with gravel	SM	

Project No. 72423 **Client:**

Project: Mustang bridge replacement

○ **Location:** Boring MB1, sample: A

□ **Location:** Boring MB2, sample: A

△ **Location:** Boring MB2, sample: B

Remarks:

○

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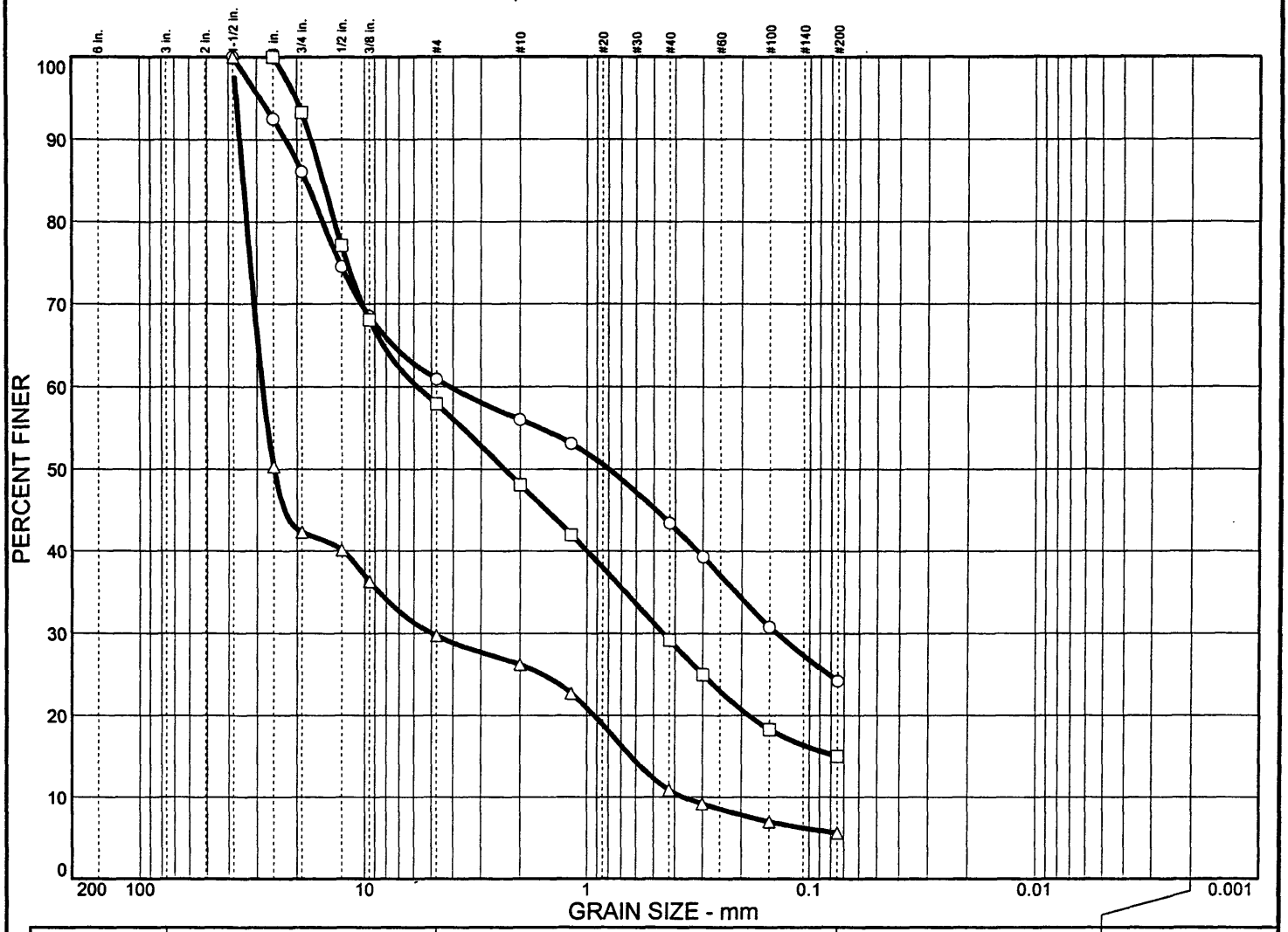
PARTICLE SIZE DISTRIBUTION TEST REPORT

NEVADA DEPARTMENT OF TRANSPORTATION

PARTICLE SIZE DISTRIBUTION TEST REPORT



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	39.1	36.7	24.2	
□	0.0	42.1	42.9	15.0	
△	0.0	70.3	24.1	5.6	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			18.3	4.16	0.801	0.139				
□			15.4	5.80	2.36	0.453	0.0750			
△			34.4	28.4	25.3	4.99	0.631	0.365	2.41	77.60

MATERIAL DESCRIPTION	USCS	AASHTO
○ Silty gravel with sand	GM	
□ Silty sand with gravel	SM	
△ Well-graded gravel with silt and sand	GW-GM	

Project No. 72423 **Client:**

Project: Mustang bridge replacement

○ **Location:** Boring MB2, sample: C

□ **Location:** Boring MB2, sample: D

△ **Location:** Boring MB2, sample: F

Remarks:

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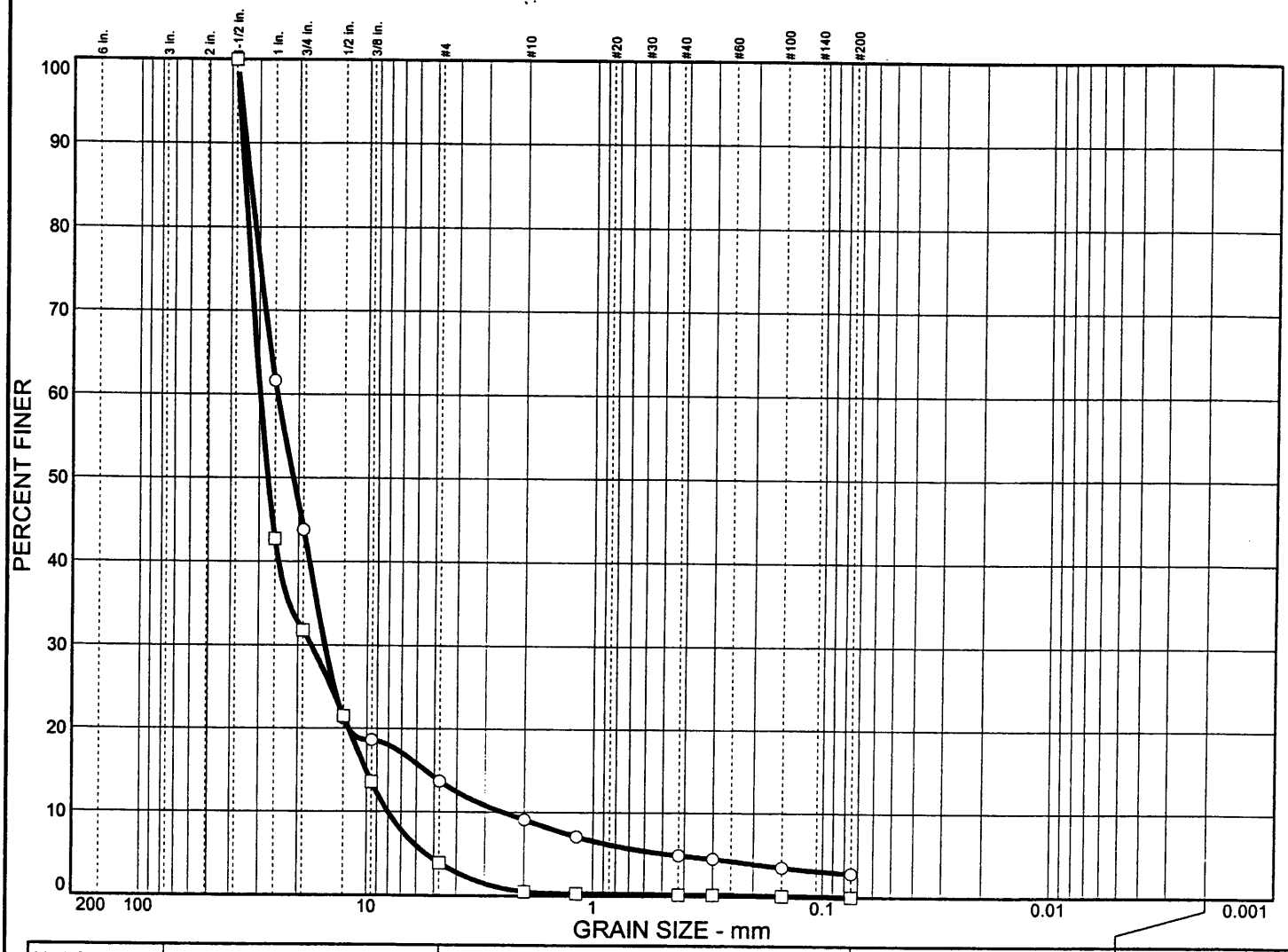
PARTICLE SIZE DISTRIBUTION TEST REPORT

NEVADA DEPARTMENT OF TRANSPORTATION

PARTICLE SIZE DISTRIBUTION TEST REPORT



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	86.3	10.9	2.8	
□	0.0	96.1	3.9	0.0	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			33.0	24.8	21.2	15.3	5.51	2.50	3.78	9.92
□			34.9	29.7	27.4	17.5	10.1	8.02	1.29	3.70

	MATERIAL DESCRIPTION	USCS	AASHTO
○	Poorly graded gravel	GP	
□	Poorly graded gravel	GP	

Project No. 72423 **Client:**

Project: Mustang bridge replacement

○ **Location:** Boring MB2, sample: G

□ **Location:** Boring MB2, sample: H

Remarks:

○

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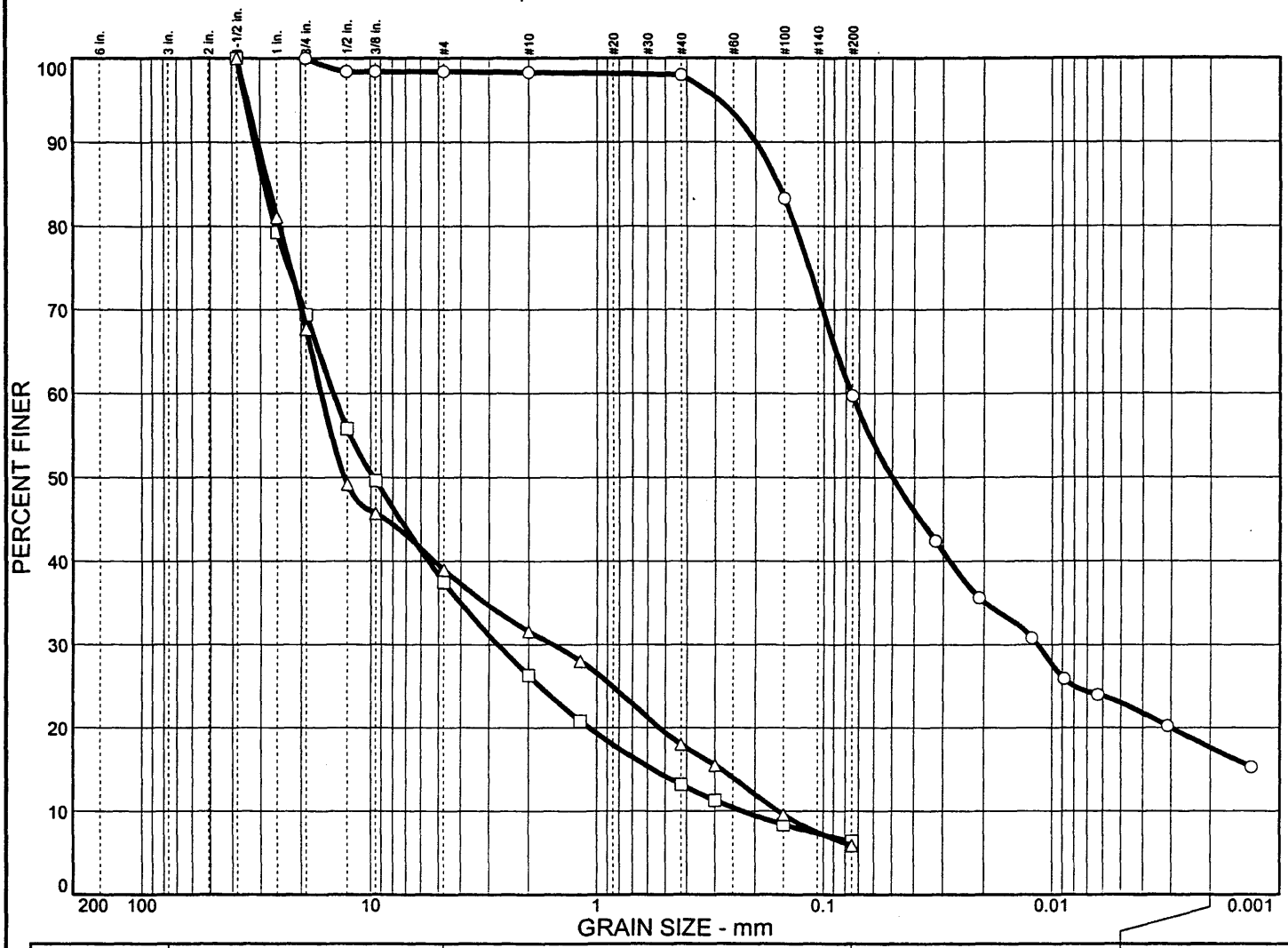
PARTICLE SIZE DISTRIBUTION TEST REPORT

NEVADA DEPARTMENT OF TRANSPORTATION

PARTICLE SIZE DISTRIBUTION TEST REPORT



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	1.6	38.7	42.1	17.6
□	0.0	62.5	31.1	6.4	
△	0.0	61.0	33.1	5.9	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	41	22	0.160	0.0757	0.0501	0.0116				
□			28.8	14.6	9.73	2.75	0.567	0.227	2.28	64.06
△			27.7	16.4	13.1	1.56	0.281	0.158	0.94	103.92

MATERIAL DESCRIPTION	USCS	AASHTO
○ Sandy lean clay	CL	
□ Well-graded gravel with silt and sand	GW-GM	
△ Poorly graded gravel with silt and sand	GP-GM	

Project No. 72423 **Client:**

Project: Mustang bridge replacement

○ **Location:** Boring MB3, sample: A

□ **Location:** Boring MB3, sample: B

△ **Location:** Boring MB3, sample: C

Remarks:

○

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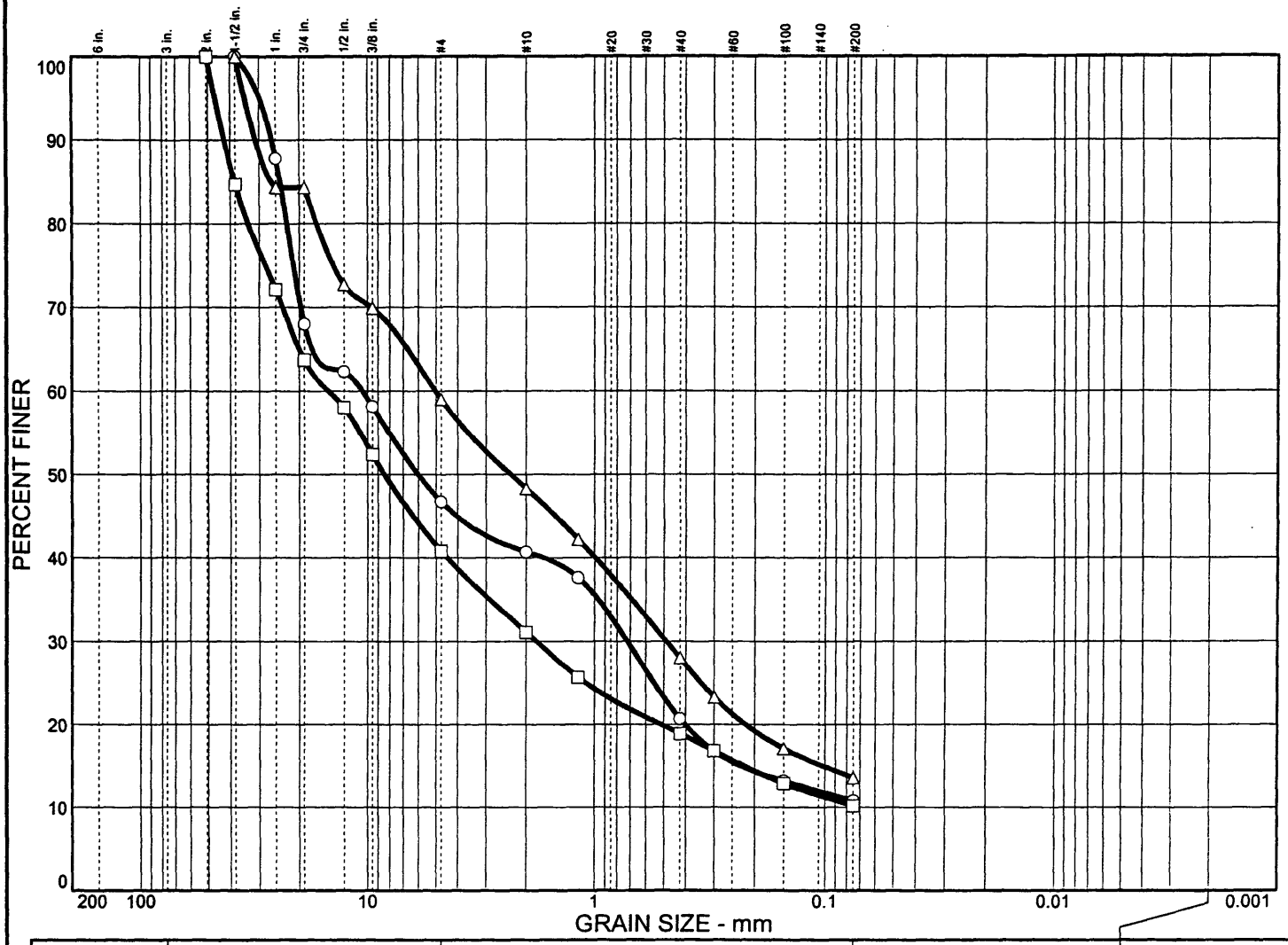
PARTICLE SIZE DISTRIBUTION TEST REPORT

NEVADA DEPARTMENT OF TRANSPORTATION

PARTICLE SIZE DISTRIBUTION TEST REPORT



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	53.3	35.9	10.8	
□	0.0	59.2	30.6	10.2	
△	0.0	41.0	45.4	13.6	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			24.3	10.6	6.01	0.722	0.230			
□			38.4	14.9	8.44	1.80	0.222			
△			26.6	5.04	2.34	0.489	0.102			

MATERIAL DESCRIPTION	USCS	AASHTO
○ Poorly graded gravel with silt and sand	GP-GM	
□ Poorly graded gravel with silt and sand	GP-GM	
△ Silty sand with gravel	SM	

Project No. 72423 **Client:**

Project: Mustang bridge replacement

○ **Location:** Boring MB3, sample: D

□ **Location:** Boring MB3, sample: E

△ **Location:** Boring MB3, sample: F

Remarks:

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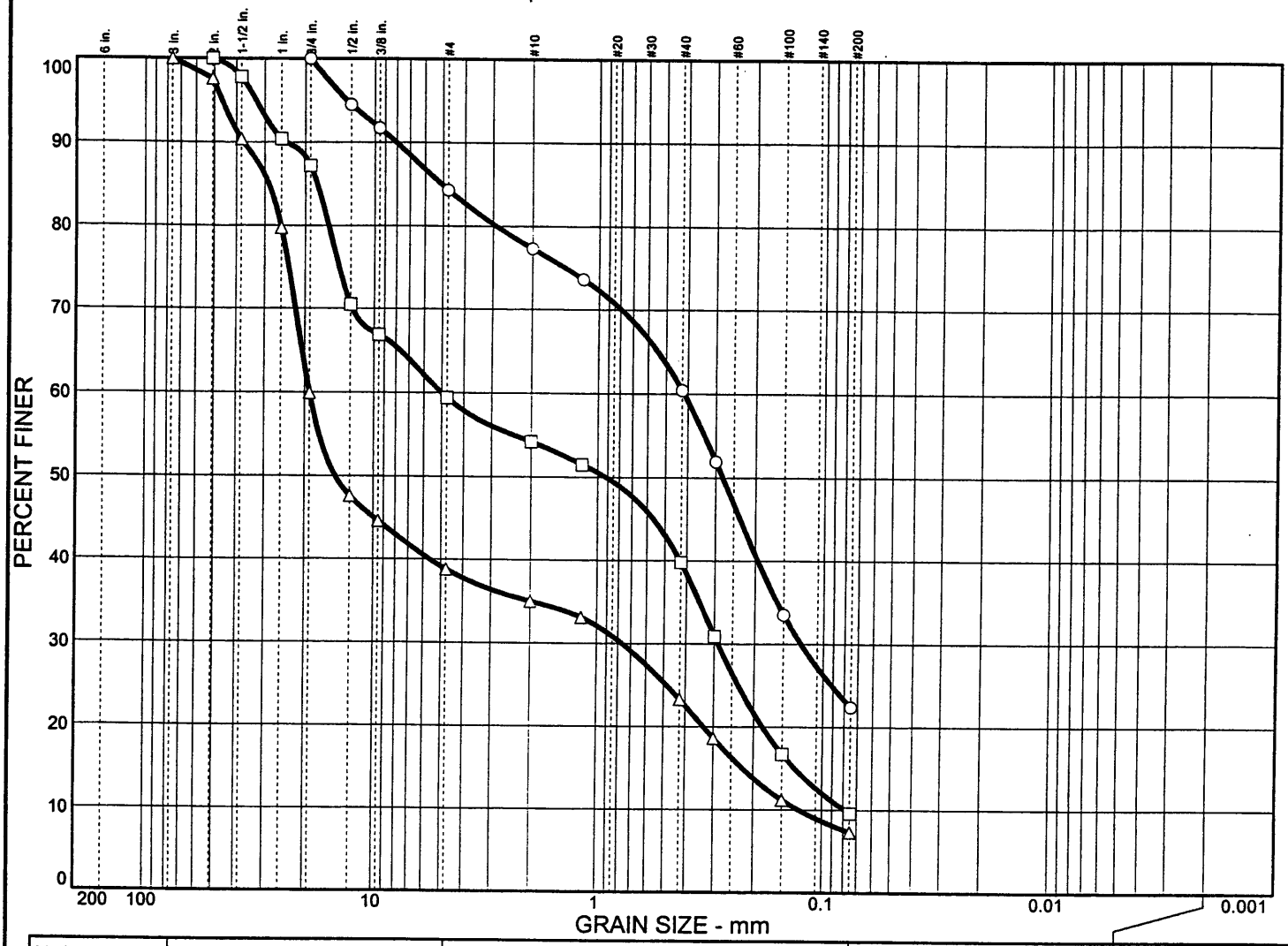
PARTICLE SIZE DISTRIBUTION TEST REPORT

NEVADA DEPARTMENT OF TRANSPORTATION

PARTICLE SIZE DISTRIBUTION TEST REPORT



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	15.7	61.9	22.4	
□	0.0	40.6	49.8	9.6	
△	0.0	61.2	31.5	7.3	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			5.09	0.417	0.280	0.126				
□			17.8	5.02	0.920	0.290	0.132	0.0788	0.21	63.75
△			28.8	19.1	14.7	0.769	0.223	0.127	0.25	150.73

MATERIAL DESCRIPTION	USCS	AASHTO
○ Silty sand with gravel	SM	
□ Poorly graded sand with silt and gravel	SP-SM	
△ Poorly graded gravel with silt and sand	GP-GM	

Project No. 72423 **Client:**

Project: Mustang bridge replacement

○ **Location:** Boring MB4, sample: A

□ **Location:** Boring MB4, sample: B

△ **Location:** Boring MB4, sample: C

Remarks:

○

□

△

PARTICLE SIZE DISTRIBUTION TEST REPORT

NEVADA DEPARTMENT OF TRANSPORTATION

PARTICLE SIZE DISTRIBUTION TEST REPORT

	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	13.0	53.3	33.7	
□	0.0	23.7	50.2	26.1	
△	0.0	23.5	52.6	23.9	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			3.07	0.214	0.145					
□			13.5	0.502	0.259	0.0946				
△			18.4	0.335	0.223	0.107				

MATERIAL DESCRIPTION	USCS	AASHTO
○ Silty sand	SM	
□ Silty sand with gravel	SM	
△ Silty sand with gravel	SM	

Project No. 72423 **Client:**

Project: Mustang bridge replacement

○ **Location:** Boring MB5, sample: A

□ **Location:** Boring MB5, sample: B

△ **Location:** Boring MB5, sample: C

Remarks:

○

□

△

PARTICLE SIZE DISTRIBUTION TEST REPORT

NEVADA DEPARTMENT OF TRANSPORTATION

PARTICLE SIZE DISTRIBUTION TEST REPORT

	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	5.5	65.1	29.4	
□	0.0	16.9	65.9	17.2	
△	0.0	64.9	25.3	9.8	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.713	0.196	0.143	0.0764				
□			7.14	0.849	0.452	0.192				
△			20.6	13.1	10.7	2.31	0.171	0.0776	5.23	169.41

MATERIAL DESCRIPTION	USCS	AASHTO
○ Silty sand	SM	
□ Silty sand with gravel	SM	
△ Poorly graded gravel with silt and sand	GP-GM	

Project No. 72423 **Client:**

Project: Mustang bridge replacement

○ **Location:** Boring MB6, sample:A

□ **Location:** Boring MB6, sample: B

△ **Location:** Boring MB6, sample: C

Remarks:

○

□

△

PARTICLE SIZE DISTRIBUTION TEST REPORT

NEVADA DEPARTMENT OF TRANSPORTATION

Summary Table

Project Description: Truckee River Bridge Replacement at Hafed
E.A. No.: 72423-1

Table 1. R-Value and Electrochemical Test Results

[1]Boring No.	Sample I.D.	[2]Depth (meters)	R-Value	Chlorides (PPM)	Sulfates (PPM)	pH	Resistivity (Ohm-cm)
MB-4	A	0 - 0.9	72	70	0	8.1	3937
	B	0.9 - 1.8	76	60	0	8.0	4926
	C	1.8 - 2.7	78	60	0	8.1	5051
MB-5	A	0 - 0.91	44	140	0	8.0	1425
	B	0.9 - 1.8	51	110	0	8.1	2353
	C	1.8 - 2.7	32	60	0	7.8	4032
MB-6	A	0 - 0.9	70	70	0	8.0	3236
	B	0.9 - 1.8	68	60	0	7.8	6410

[1] See attached map for boring location.

[2] Measured from the ground surface.

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

E.A. No. 72423 Job Description Mustang bridge replacement

Boring No. MB1 & MB2 Elevation (m) See boring logs Station See boring logs

SAMPLE NO.	SAMPLE DEPTH (m)	SAMP-LER TYPE	N BLOWS per .3m	SOIL GROUP	W%	WET UW KN/m³	% PASS #200	LL %	PL %	PI %	STRENGTH TEST TEST TYPE	φ deg.	C KN/m²	OTHERS
MB1-A	0 - .30	bulk		SM			21.3							
MB2-A	2.43 - 2.90	SPT	18	GM	17.2		17.1							Chem
MB2-B	3.96 - 4.15	CSS	15\2"	SM	15.0	21.41	20.6							Chem
MB2-C	5.49 - 5.64	CSS	63	GM	19.5	21.96	24.2							
MB2-D	5.94 - 6.40	SPT	70	SM	13.6		15.0							
MB2-F	11.58 - 11.73	SPT	8\0"	GW-GM	8.0		5.6							
MB2-G	13.10 - 13.29	SPT	30\2"	GP	4.2		2.8							
MB2-H	17.22 - 17.47	SPT	25\3"	GP	3.0		0.0							

SPT - Standard Penetration 35mm ID
CS - Continuous Sample 82mm ID
RC - Rock Core
PB - Pitcher Barrel
CSS - Calif. Split Spoon 61.5mm ID
CPT - Cone Penetration Test
TP - Test Pit
P - Pushed, not driven
R - Refusal

U - Unconfined Compressive
UU - Unconsolidated Undrained
CD - Consolidated Drained
CU - Consolidated Undrained
DS - Direct Shear
φ - Friction
C - Cohesion
N - No. of blows per 0.3m, sampler driven under 64kg mass dropped 760mm.
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

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

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

E.A. No. 72423 Job Description Mustang bridge replacement

Boring No. MB3 Elevation (m) See boring logs Station See boring logs

SAMPLE NO.	SAMPLE DEPTH (m)	SAMP-LER TYPE	N BLOWS per .3m	SOIL GROUP	W%	WET UW KN/m³	% PASS #200	LL %	PL %	PI %	STRENGTH TEST TEST TYPE	STRENGTH TEST φ deg.	STRENGTH TEST C KN/m²	OTHERS
MB3-A	2.43 - 2.90	SPT	9	ML	30.2		51.1	41	22	19				
MB3-B	5.49 - 5.94	SPT	35	GW-GM	12.4		6.4							
MB3-C	8.53 - 8.99	SPT	41	GP-GM	9.6		5.9							
MB3-D	10.06 - 10.52	SPT	39	GP-GM	15.6		10.8							
MB3-E	11.58 - 12.04	CSS	55	GP-GM	13.7	20.44	10.2							G, Chem
MB3-F	13.11 - 13.56	SPT	59	SM	15.2		13.6							
MB3-G	19.0 - 19.34	SPT	40\5"											No recovery
MB3-H	21.64 - 22.25	RC												3.5" recovery

SH - Shelby Tube 73mm ID
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C - Cohesion
N - No. of blows per 0.3m, sampler driven under 64kg mass dropped 760mm.
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
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CM - Compaction
E - Swell/Pressure on Expansive Soils
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UW - Unit Weight
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K - Permeability
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RQD - Rock Quality Designation

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

E.A. No. 72423 Job Description Mustang bridge replacement

Boring No. MB4, MB5, & MB6 Elevation (m) See boring logs Station See boring logs

SAMPLE NO.	SAMPLE DEPTH (m)	SAMP-LER TYPE	N BLOWS per .3m	SOIL GROUP	W%	WET UW KN/m³	% PASS #200	LL %	PL %	PI %	STRENGTH TEST TEST TYPE	STRENGTH TEST φ deg.	STRENGTH TEST C KN/m²	OTHERS
MB4-A	0 - .91	bulk		SM			22.4							RV= 72
MB4-B	.91 - 1.83	bulk		SP-SM			9.6							RV= 76
MB4-C	1.83 - 2.74	bulk		GP-GM			7.3							RV= 78
MB5-A	0 - .91	bulk		SM			33.7							RV= 44
MB5-B	.91 - 1.83	bulk		SM			26.1							RV= 51
MB5-C	1.83 - 2.74	bulk		SM			23.9							RV= 32
MB6-A	0 - .91	bulk		SM			29.4							
MB6-B	.91 - 1.83	bulk		SM			17.2							RV= 70
MB6-C	1.83 - 2.74	bulk		GP-GM			9.8							RV= 60

SH - Shelby Tube 73mm ID
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N - No. of blows per 0.3m, sampler driven under 64kg mass dropped 760mm.
N - Field SPT N = $(N_{CSS})(0.62)$

H - Hydrometer
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G - Specific Gravity
PI - Plasticity Index
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