APPENDIX E

Draft Preliminary Geotechnical Data

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MEMORANDUM

To: Mr. Steve Mellon, Quincy Engineering, Inc.

From: Martin McIlroy, C.E.G., P.E., Taber Consultants

Date: April 3, 2014

Subject: **Preliminary Geotechnical Data** 2011-0068-4
Rumsey Bridge Project 38122-H2;056N;320W
Yolo County, California

Following is a discussion about preliminary subsurface data for the proposed Rumsey Bridge Project. Also addressed, are preliminary considerations for channel scour, liquefaction potential and bearing capacity for the proposed and existing foundations. Further exploration and testing is planned for the proposed pier locations and potentially at the existing piers to determine existing pile lengths. The discussion and data contained herein is intended for preliminary planning and design only. Future subsurface exploration, laboratory testing and evaluation/analysis is planned to provide geotechnical data and foundation recommendations for final design.

The attached preliminary figures and appendix are meant to supplement the discussion and data presented in this memo. The attached figures are preliminary in nature and have not been subject to our formal QA/QC process.

Exploration and Testing

Three borings were completed between February 27 and March 3, 2014 at the bridge site. Borings were completed at the bridge abutments. Exploration within the channel was not completed during this phase of field studies. We expect to complete channel borings after June 1, 2014, once California Department of Fish and Wildlife permits are acquired.

Boring-1 was completed at the existing Abutment-5 location (east abutment). Boring-2 was advanced at Abutment-1 (west abutment) to approximately 12±ft depth where boulders were encountered. We interpret the boulders as part of the emergency repairs completed at Abutment-1 of the existing bridge after it was washed out in 1995. Because of these boulders, the boring was terminated and relocated as Boring-3 in order to avoid drilling through boulders near the abutment.

Boring elevations were surveyed by Taber personnel using an auto-level. Elevations were referenced to temporary benchmarks and elevations provided by Quincy Engineering:

- CP—Mag Nail “QEI#2” elevation 429.03, and
- CP—Mag Nail “QEI#3” elevation 428.12

Earth Materials

The following descriptions of earth materials are for the abutment areas only. Materials within the channel are expected to be variable in consistency and areal distribution. Therefore, the actual subsurface conditions within the channel could differ significantly from abutment locations.

Generally, alluvial materials were encountered in the borings below embankment fill. Embankment fill was encountered to 8.5 ft (elev. 420±) in Boring-1 and to 12 ft (elev. 409±) and 7-ft (elev. 414±), respectively, in Borings 2 and 3. Fill materials consisted of variably consolidated clayey sand and sandy silty clay. At Abutment-1, boulders were encountered at 12-ft depth in Boring-2 and it is expected that boulders would be present to the depth of the 1995 scour hole (elev. 400±). Boulders may be present to depths on the order of 30-ft (or greater) immediately behind Abutment-1, based on photographs of the 1995 scour hole and assumed repairs.

Alluvial materials consisted of compact to dense clayey sand with gravel and very stiff to very hard sandy gravelly clay. The granular layers were present immediately below the fill embankments and are approximately 15-ft thick. The existing Abutment-1 embankment has a soft clay layer from approximately elev. 420 to elev. 417. Below about elev. 395, alluvial materials are predominately clay with lenses of very dense clayey fine sand to sandy clayey gravel. Granular lenses are 5 to 15-ft thick within hard to very hard clay.

Below elev. 395, Standard Penetration Test interval blow counts (“N”) ranged from 35 to 86 (for the entire “N” interval) except for two stiff clay lenses in each boring with blow counts of 20 and 24. Some of the blow count intervals below elev. 395 were not able to be driven for the full SPT interval due to sampler “refusal.” Unconfined compressive strengths within the hard to very hard clay ranged from 4.4 to 10.5 tons per square foot (tsf) in Boring-1 and from 2.7 to 10 tsf in Boring-3. Moisture content in the clay ranged from 15 to 23 % with unit weights typically ranging from 105 to 123.

Groundwater

Groundwater was measured in Boring-1 and Boring-3 at elev. 409.7 (2-27-2014) and elev. 407.0 (3-3-2014), respectively. Surface water elevation in the channel was measured at elev. 406.0± on March 3, 2014. Groundwater was not measured in Boring-2 as the boring was terminated above groundwater levels at the time of drilling.

Groundwater levels within alluvial materials are expected to closely follow the surface water elevations within Cache Creek. It is expected that alluvial materials below groundwater/surface water elevations will be saturated and contribute seepage to open excavations. Additionally, loose saturated granular materials are expected to be subject to caving.

Liquefaction

Liquefaction potential is expected to be low at the abutment areas considering the cohesive nature of the encountered materials and the consistency of granular soils.

The existing Abutment-1 embankment has a soft clay layer from approximately elev. 420 to elev. 417. This layer could be subject to cyclic softening during a seismic event if it is left in place. This layer should be removed or reprocessed if a retrofit of the existing bridge is considered.

Scour

Materials encountered in the borings are interpreted as recent and older alluvial deposits and are considered susceptible to scour. Lateral migration of the channel is a concern at the abutments and in particular at the south west abutment-1 where the creek washed out the abutment in the previous 1995 storm event.

At the abutment locations, materials below elev. 395 are interpreted as older alluvial deposits. At the abutments, it would appear that this is the lowest historical scour elevation based solely on the consistency and compressive strengths of the encountered soils. Older alluvial deposits are expected to be slightly more resistant to scour compared to recent alluvial deposits above elev. 395 but should not be considered scour resistant.

Scour depths within the main channel are anticipated to be at lower elevations due to anticipated thicker recent alluvial deposits.

Preliminary hydraulics analysis indicates that pier scour is estimated between 23 to 33-ft depending on the angle of creek attack at the main channel pier. From channel elevation records, the channel does not appear to have degraded significantly over time. However, this minimal recorded degradation does not mean that materials in the channel have not been subject to scour. Scour typically removes consolidated materials during flow events and as the creek level lowers, the scour hole is filled in with more recent alluvial deposits.

Corrosivity Testing

Corrosivity testing was completed on bulk and drive samples to determine, pH, resistivity, sulfate and chloride content. The results are presented in the following table.

Table 1: Corrosivity Test Results

Exploration Number	**Sample Number**	**Depth** (ft)	**pH**	**Resistivity** (ohm-cm)	**Sulfate** (ppm)	**Chloride** (ppm)
B-3	Bag D	0 to 5	8.27	2250	30.4	16.5
B-3	8 + 9	40 to 45	7.94	1450	11.0	15.9

According to Caltrans Corrosion Guidelines, November 2012, Version 2.0 the site is considered corrosive if one or more of the following conditions exist for the representative soil and/or water samples taken at the site:

- Chloride concentration is 500 ppm or greater
- Sulfate concentration is 2000 ppm or greater
- pH is 5.5 or less
- In general, the higher the resistivity, the lower the rate for corrosion.

According to the Caltrans Corrosion Guidelines, these soils are not considered corrosive.

Conclusions and Discussion

Support for bridge foundations can be generated in older alluvial soils with the use of deep foundations, the use of shallow spread footings is not recommended. Surficial materials are not considered suitable for direct support of bridge foundations but are appropriate for support of embankment and roadway fill loading.

Bridge Foundations

Older alluvial deposits at depth (below elev. 395) are expected to be capable of providing supporting for heavy concentrated foundation loads without distress. It is anticipated that structure support will be achieved in such materials.

Standard Caltrans cast-in-drilled-hole (CIDH) piling is considered technically feasible but shallow groundwater and caving conditions in coarse granular soils within the channel could present difficult installation and construction challenges. Additionally, the use of CIDH piling would require wet specification installation with inspections and minimum 24-inch diameter piles. Similar conditions would affect Cast-in-Steel-Shell (CISS) installations.

Large diameter CIDH/CISS piles are considered technically feasible and, depending on the strategy used for this project, may be required to provide lateral support and bearing capacity. Large diameter piles could be used for either a new bridge structure or for foundation retrofit. Similar requirements for Caltrans Standard CIDH/CISS piles would be required.

Soil conditions are consistent with the use of driven pile foundations penetrating through the recent alluvial materials into the older alluvial materials (competent clay layer below elev. 395).

Displacement piles such as closed end pipe piles and precast concrete piling may be technically feasible; however, extensive pre-drilling through overconsolidated older alluvial materials would be necessary to facilitate driving to required tip elevations. Open ended pipe piles may be used as an alternative to H-piles, however, they may require clean-out (center relief drilling) within the pile to help reach tip elevations.

For planning purposes, anticipated pile loads of 90, 140 and 200 kips are achievable for H-piles at each of the support locations; H-pile lengths are likely to be on the order of 50 ft in length. Pre-drilling for H-pile installation cannot be precluded and the need for pre-drilling may vary depending on installation location and encountered over-consolidated older alluvial materials and presence of groundwater.

Preliminary Bearing Capacity Analysis

Preliminary compressive bearing capacity analysis was performed using subsurface data from the abutment borings. Standard Class 200 Caltrans piles were assumed for proposed foundation support for this analysis. This includes Alternative “W” and “X” pipe piles and HP 14x89 sections. Pile caps at the abutments are assumed to be approximately 10-ft below the existing roadway grade at elevation 419.0. Pile analysis was performed using the FHWA program Driven 1.2. The indicated pile tip elevations within the following tables do not take into consideration scour depths. The pile information below is for planning purposes only and are not recommended pile types or tip elevations. This information is for comparative purposes and is intended to show achievable capacities with the designated pile types for alternative considerations.

Analysis was also performed for large diameter cast-in-drilled-hole (CIDH) and cast-in-steel-shell (CISS) piles using 48-inch and 72-inch piles for comparison. Bearing capacity analysis assumes Working Stress Design. Pile cut off elevations are the same as those used to evaluate the driven piles. Bearing capacities for CIDH and CISS pile capacities are calculated based on the abutment boring (Boring 1 and 3) soil profiles and the assumption that the piles would extend to the total depth of the Borings 1 and 3. End bearing for CIDH and CISS piles is neglected. It is anticipated that lateral demand for these large diameter piles may likely control the tip elevation considering the height of the structure above the channel.

Load and Resistance Factor Design (LRFD) will be used for final design for the selected pile type and required load capacities.

Table 2: Preliminary Bearing Capacities

Location	Pile Type	Assumed Cut-off Elevation (ft)	Nominal Resistance Compression (kips)	Nominal Resistance Tension (kips)	Preliminary Pile Tip Depth/ Elevation (ft)
Abutment-1	HP 14x89	419.0	400	0	50.0/369.0
	PP 14x0.5 Open End	419.0	400	0	51.0/368.0
	Precast Concrete 14-inch	419.0	400	0	40.0/379.0
	CISS 48-inch	419.0	3400	0	105.0/315.0
	CISS 72-inch	419.0	5100	0	105.0/315.0
	CIDH 48-inch	419.0	4500	0	105.0/315.0
	CIDH 72-inch	419.0	6800	0	105.0/315.0
Abutment-5	HP 14x89	419.0	400	0	43.0/376.0
	PP 14x0.5 Open End	419.0	400	0	45.0/374.0
	Precast Concrete 14-inch	419.0	400	0	35.0/384.0
	CISS 48-inch	419.0	3400	0	105.0/315.0
	CISS 72-inch	419.0	5100	0	105.0/315.0
	CIDH 48-inch	419.0	4500	0	105.0/315.0
	CIDH 72-inch	419.0	6800	0	105.0/315.0

Existing Foundations

From As-built plans, it is assumed that piles at the piers are approximately 25 ft long steel H-piles with cut-off at elev. 400. However, plans from the Stevenson Bridge indicate pre-cast concrete piles as foundation support and these plans have a query about whether the same plans were used for the Rumsey Bridge. Based on these discrepancies, the existing bridge foundation type is unclear. Therefore, our analysis of existing pile capacity includes: HP 10x42 steel piles, 12 inch and 14 inch timber piles and 12 inch square precast concrete piles.

Pile capacity estimates assume that the geology across the channel does not vary in elevation and that older alluvial deposits are at a constant elev. 395. These preliminary estimates do not consider corrosion, structural damage, loss of pile section or other deterioration associated with the existing piles. Further, scour is not considered in these calculations. The assumptions and calculations are NOT conservative and present a “best case” for the existing piles. As such, the preliminary capacity estimates are presented with an assumed tip of elev. 375 and a per foot capacity so that discounting capacity is possible. A certain percentage of the pile capacity, say 25%, should be discounted due to potential structural losses and also due to scour. This percentage should be revised once scour calculations are completed.

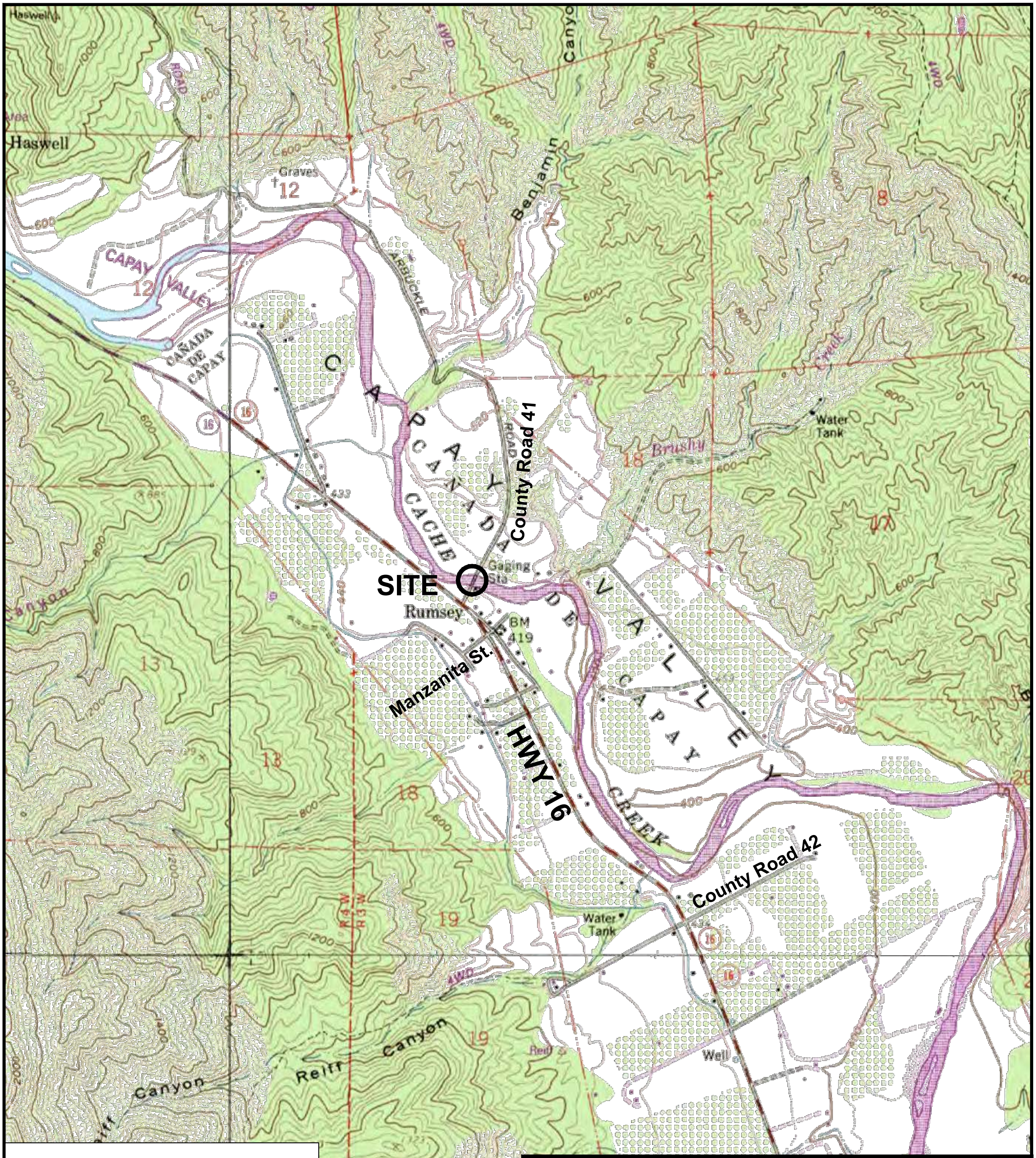
Based on our bearing capacity analysis at the abutments and the unconservative assumption that bearing materials are at similar levels, existing H-pile sections at the pier locations would be assigned a best assumptive value of 90 kips per pile in compressive capacity only. Lateral capacity analysis of the piles was not completed. It is assumed that current prescribed lateral capacity values from the Caltrans Bridge Design Manual should be used for preliminary analysis. The condition, length and size of the existing piles is unknown.

Table 3: Estimated Existing Pile Bearing Capacities

Location	Pile Type	Assumed Cut-off Elevation (ft)	Estimated Ultimate Resistance Compression (kips)	Nominal Resistance Compression (kips)	Capacity per foot of pile (kips)	Assumed Tip Elevation (ft)
Pier-2	HP10x42	400	184	--	7	375
	12-inch Timber	400	233	--	9	375
	14-inch Timber	400	307	--	12	375
	Precast Concrete 12-inch	400	335	--	13	375
Pier-4	HP10x42	400	281	--	11	375
	12-inch Timber	400	338	--	13	375
	14-inch Timber	400	436	--	17	375
	Precast Concrete 12-inch	400	458	--	18	375

Please call if you have questions regarding site conditions or if you wish to discuss further.

Attachments:	Figure 1	Vicinity Map
	Figure 2	ARS Curve
		Log of Test Borings Sheet
		Boring Log
		Boring Legend
	Appendix A	Laboratory Test Results



0 2,000FT 4,000FT

SCALE

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N

Scale: 1:24,000

USGS "Rumsey", "Glascock Mountain", "Guinda", "Knoxville", CA QUADRANGLE 7.5 MINUTE SERIES (TOPOGRAPHIC), DATE 1993

Quincy Engineering, Inc.

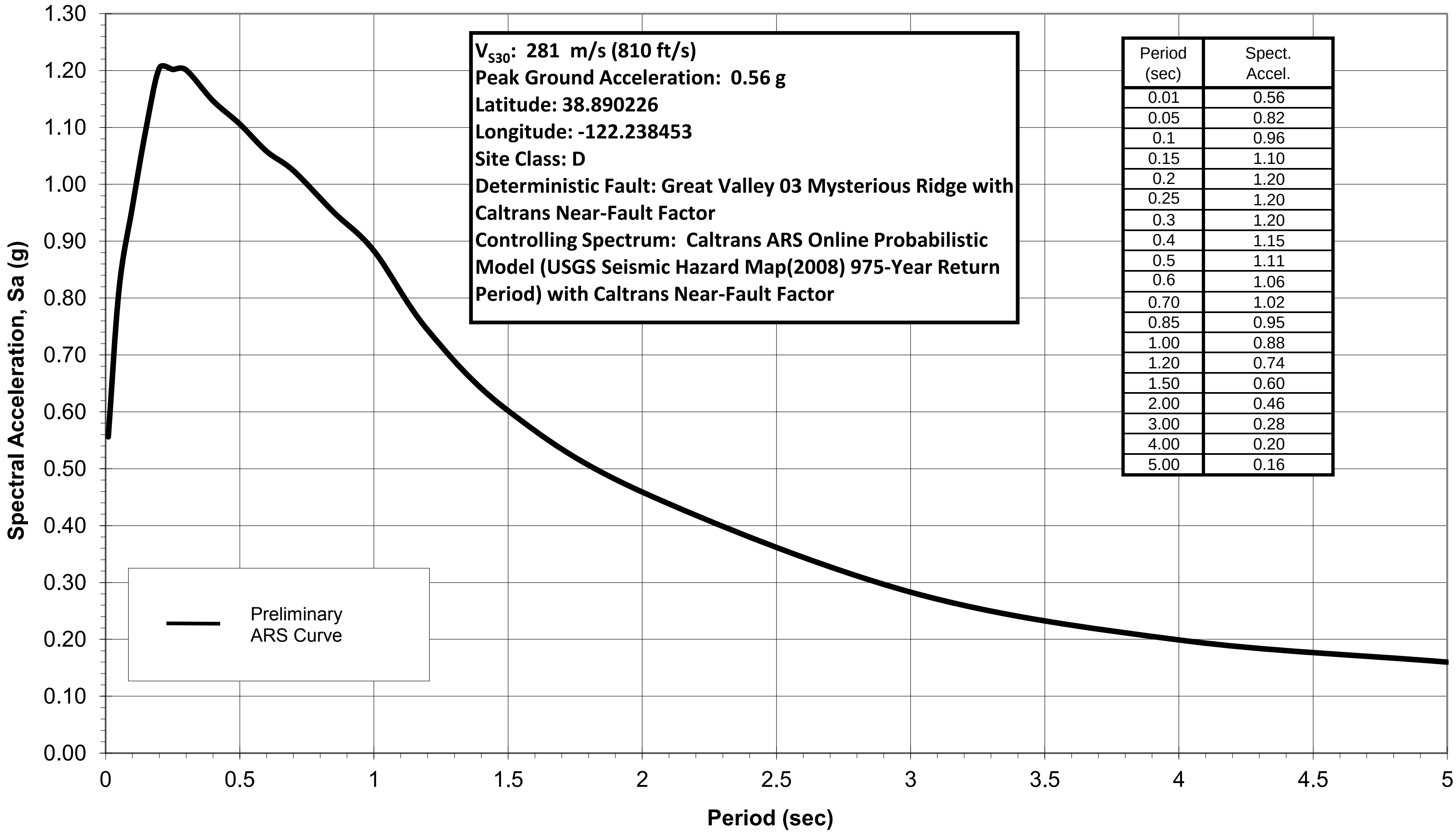
Rumsey Bridge Project
Rumsey, California

Vicinity Map

2011-0068-4	Figure - 1

Caltrans ARS Curve
Rumsey Bridge Project
Yolo County, California

2011-0068-4
March 2014



Period (sec)	Spect. Accel.
0.01	0.56
0.05	0.82
0.1	0.96
0.15	1.10
0.2	1.20
0.25	1.20
0.3	1.20
0.4	1.15
0.5	1.11
0.6	1.06
0.70	1.02
0.85	0.95
1.00	0.88
1.20	0.74
1.50	0.60
2.00	0.46
3.00	0.28
4.00	0.20
5.00	0.16

Figure-2

DIST.	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
03	YOL	C.R.			

CERTIFIED ENGINEERING GEOLOGIST

PLANS APPROVAL DATE

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(196) 371-1690
JOB No. 2011-0068-4 LOCATION: 38122-H2: 056N; 320W

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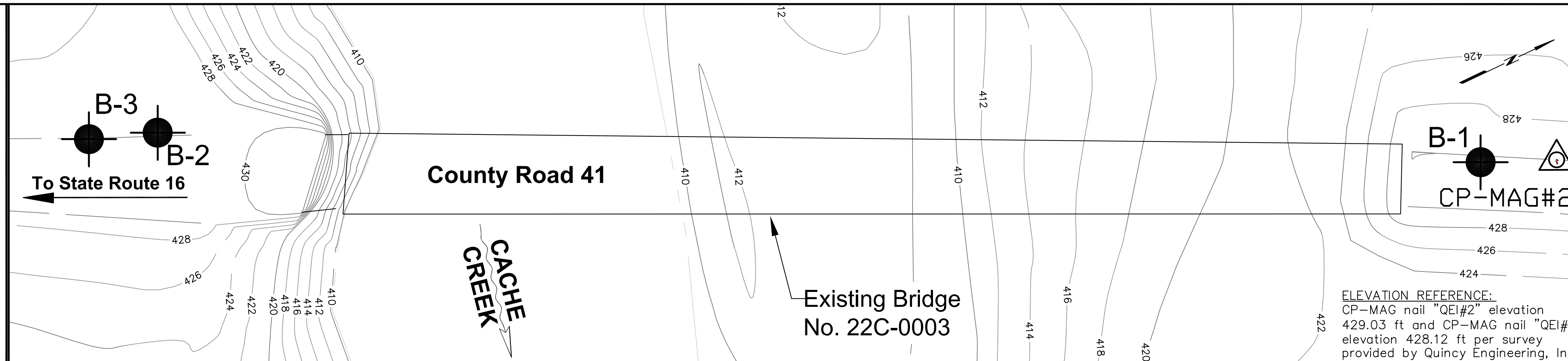
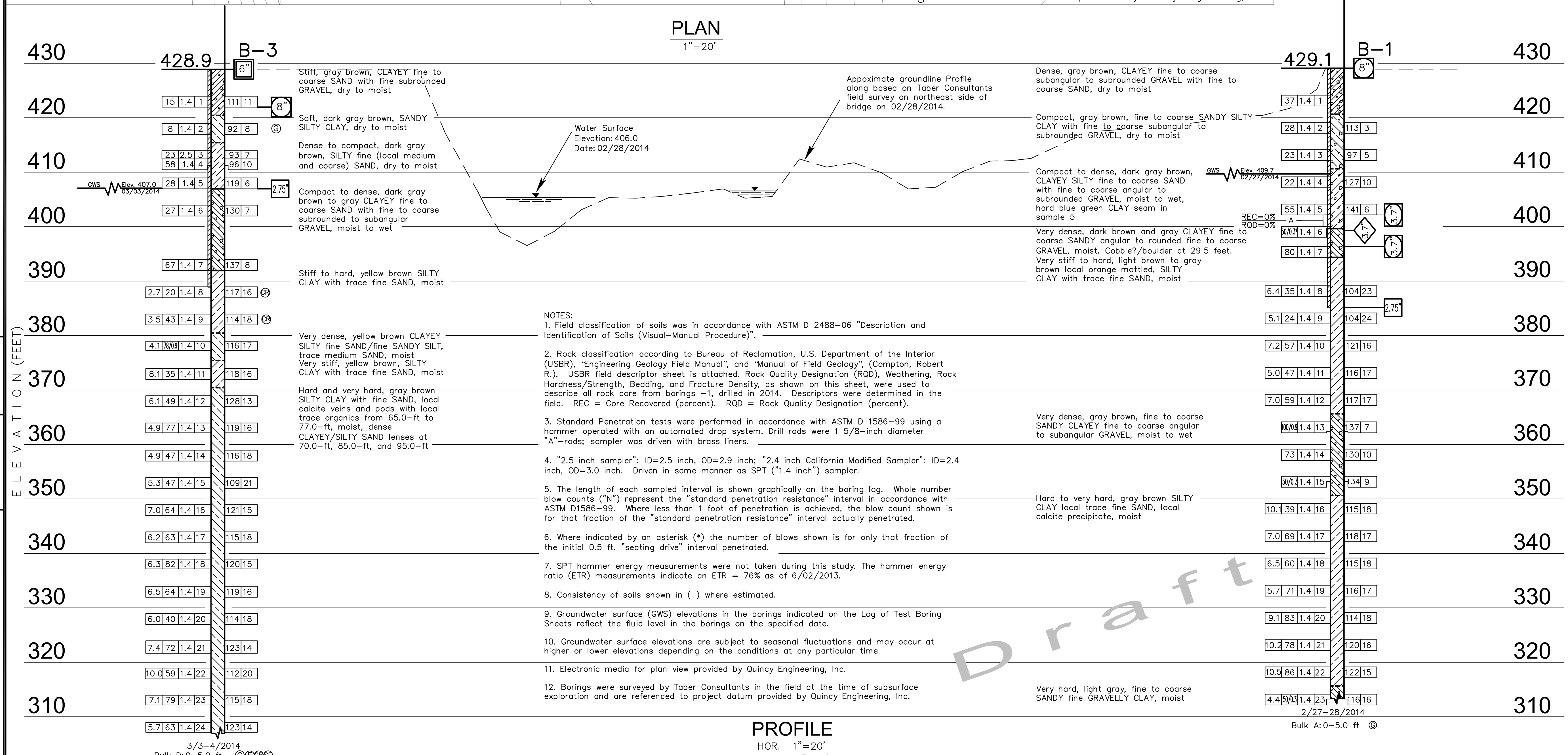
PROFESSIONAL GEOLOGIST MARTIN W. McILROY No. 2322 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA



PLAN
1"=20'



NOTES:

1. Field classification of soils was in accordance with ASTM D 2488-06 "Description and Identification of Soils (Visual-Manual Procedure)".

2. Rock classification according to Bureau of Reclamation, U.S. Department of the Interior (USBR), "Engineering Geology Field Manual", and "Manual of Field Geology", (Compton, Robert R.). USBR field descriptor sheet is attached. Rock Quality Designation (RQD), Weathering, Rock Hardness/Strength, Bedding, and Fracture Density, as shown on this sheet, were used to describe all rock core from borings -1, drilled in 2014. Descriptors were determined in the field. REC = Core Recovered (percent). RQD = Rock Quality Designation (percent).

3. Standard Penetration tests were performed in accordance with ASTM D 1586-99 using a hammer operated with an automated drop system. Drill rods were 1 5/8-inch diameter "A"-rods; sampler was driven with brass liners.

4. "2.5 inch sampler": ID=2.5 inch, OD=2.9 inch; "2.4 inch California Modified Sampler": ID=2.4 inch, OD=3.0 inch. Driven in same manner as SPT ("1.4 inch") sampler.

5. The length of each sampled interval is shown graphically on the boring log. Whole number blow counts ("N") represent the "standard penetration resistance" interval in accordance with ASTM D1586-99. Where less than 1 foot of penetration is achieved, the blow count shown is for that fraction of the "standard penetration resistance" interval actually penetrated.

6. Where indicated by an asterisk (*) the number of blows shown is for only that fraction of the initial 0.5 ft. "seating drive" interval penetrated.

7. SPT hammer energy measurements were not taken during this study. The hammer energy ratio (ETR) measurements indicate an ETR = 76% as of 6/02/2013.

8. Consistency of soils shown in ( ) where estimated.

9. Groundwater surface (GWS) elevations in the borings indicated on the Log of Test Boring Sheets reflect the fluid level in the borings on the specified date.

10. Groundwater surface elevations are subject to seasonal fluctuations and may occur at higher or lower elevations depending on the conditions at any particular time.

11. Electronic media for plan view provided by Quincy Engineering, Inc.

12. Borings were surveyed by Taber Consultants in the field at the time of subsurface exploration and are referenced to project datum provided by Quincy Engineering, Inc.

PROFILE
HOR. 1"=20'
VERT. 1"=10'

Draft

LEGEND OF BORING OPERATIONS

LEGEND OF EARTH MATERIALS

CONSISTENCY CLASSIFICATION FOR SOILS
According to the Standard Penetration Test

Standard Penetration "N"-Value	Granular	Cohesive
0-5	Very loose	Very soft
6-10	Loose	Soft
11-20	Semicompact	Stiff
21-35	Compact	Very stiff
36-70	Dense	Hard
>70	Very dense	Very hard

NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

DESIGN OVERSIGHT	DRAWN BY	M.W. McILROY/ X. Vang	Amanda B. Kahn FIELD INVESTIGATOR
SIGN OFF DATE	CHECKED BY	Amanda B. Kahn	DATE February/March 2014

PREPARED FOR YOLO COUNTY DEPARTMENT OF PLANNING AND PUBLIC WORKS

PROJECT ENGINEER

BRIDGE NO.

POST MILE

RUMSEY BRIDGE PROJECT

LOG OF TEST BORINGS

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU EA

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY) SHEET OF

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TEST BORING LOG

Job No. 2011-0068-4

STATION:
SURFACE ELEVATION: 429.23

TYPE: 6-INCH SFA, 8-INCH HSA

BORING NO. B-2

UNCONFINED COMPRESSIVE STRENGTH or POCKET PENETROMETER (tsf)	OTHER TESTS	DRY DENSITY (lbs/cu. ft.)	Moisture (%)	BLOWS PER FOOT 350 ft-lb DROP HAMMER	SAMPLE SIZE (inches)	SAMPLE No.	DEPTH (ft)	DESCRIPTION
							0–12.0	Very dense to dense, brown to gray brown, CLAYEY fine to coarse SAND with angular fine to coarse GRAVEL, dry to moist (fill material - boulders)
					Bulk	C	5	
3.3		103	10	50/0.5*	1.4	1		
							10	
4.5		111	8	40	1.4	2	12.0	
								Bottom of hole at 12.0 feet.
								Backfilled with soil cuttings on 3/3/2014.
							15	
							20	

MATERIAL SYMBOL | UNIFIED SOIL CLASSIFICATION

LOG OF BORING (SOILS ONLY QU) 2011-0068-4.GPJ CURRENT-LIBRARY.GLB CURRENT-TEMPLATE.GDT 3/26/14

THE BORING LOGS SHOW SUBSURFACE CONDITIONS AT THE DATES AND LOCATIONS INDICATED AND IT IS NOT WARRANTED THAT THEY ARE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

LOGGED BY: ABK

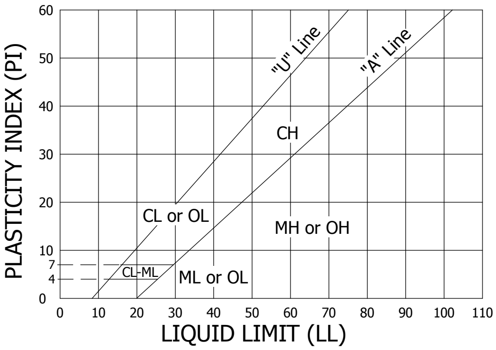
DATE: 03-03-2014

FIGURE 3

UNIFIED SOIL CLASSIFICATION SUMMARY

(ASTM D 2489)

Pt	OH	CH	MH	OL	CL	ML	SC	SM	SP	SW	GC	GM	GP	GW
Highly organic soils	Silts and clays Liquid limit 50 or more			Silts and clays Liquid limit less than 50			Sands with fines >12% fines		Clean sands < 5% fines		Gravels with fines > 12% fines		Clean gravels < 5% fines	
							Sands-50% or more of coarse fraction is smaller than No 4 Sieve				Gravels-more than 50% of coarse fraction is larger than No 4 sieve			
Fine grained soils (50% or more is smaller than No 200 sieve)							Coarse grained soils (More than 50% is larger than No 200 sieve)							



LABORATORY CLASSIFICATION CRITERIA

GW and SW - Cu > 4 for GW and 6 FOR SW; 1 < Cc < 3

GP and SP-Clean gravel or sand not meeting requirements for GW and SW.

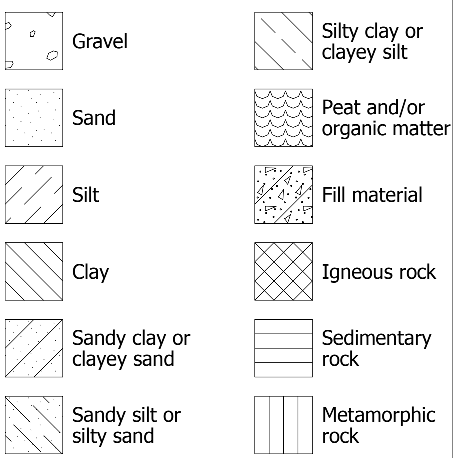
GM and SM-Atterberg limits of fines below "A" line or P.I. less than 4.

GC and SC-Atterberg limits of fines above "A" line with P.I. greater than 7.

Fines (silt or clay)	Sand			Gravel		Cobbles	Boulders
	Fine	Medium	Coarse	Fine	Coarse		
Sieve sizes	200	40	10	4	3/4"	3"	10"

Classification of earth materials shown on the test boring logs is based on field observation and should not be construed to imply laboratory analysis unless so stated.

MATERIAL SYMBOLS



CONSISTENCY CLASSIFICATION FOR SOILS

Standard Penetration "N"-Value*	Granular	Cohesive
0-5	Very loose	Very soft
6-10	Loose	Soft
11-20	Semicompact	Stiff
21-35	Compact	Very stiff
36-70	Dense	Hard
> 70	Very dense	Very hard

* According to the Standard Penetration Test (ASTM D 1586)

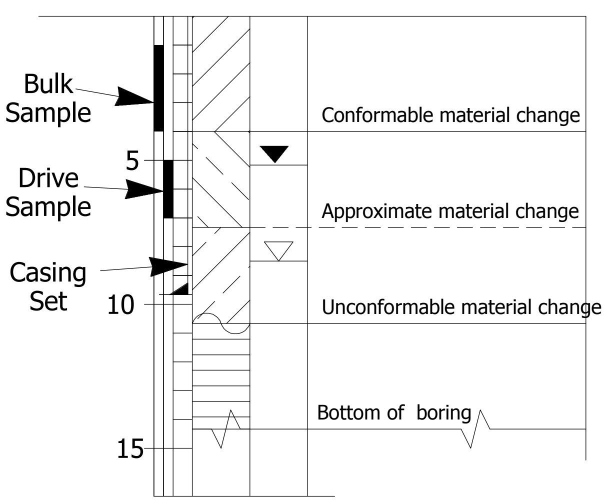
Blow count of 50/0.5 indicates 50 blows for 1/2 foot.

Where standard penetration test has not been performed, consistencies shown (in parenthesis) on logs are estimated.

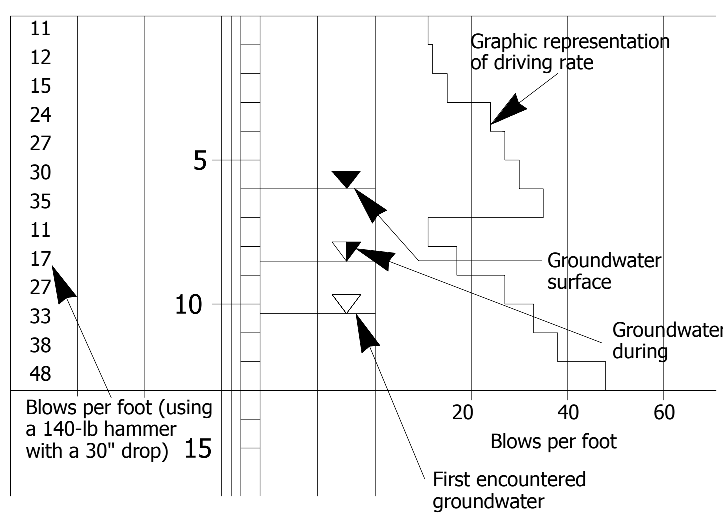
KEY TO "OTHER TESTS" LABORATORY

A - Atterberg Limits
C - Consolidation
CR - Corrosivity
E - Expansion Index
G - Gradation
H - Hydrometer
M - Maximum Dry Density
O - Organic Content
P - Permeability
PL - Point Load
R - Resistance Value
S - Direct Shear
SE - Sand Equivalent
SG - Specific Gravity
T - Triaxial Shear

LEGEND OF BORING



LEGEND OF PENETRATION TEST



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BORING LEGEND

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SUMMARY OF LABORATORY RESULTS

CLIENT Quincy Engineering, Inc.
PROJECT NAME Rumsey Bridge Project
PROJECT NUMBER 2011-0068-4
PROJECT LOCATION Rumsey, California

Borehole/ Sample	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<3" Sieve	%<#4 Sieve	%<#200 Sieve	Class-ification	Direct Shear phi	Direct Shear c	Water Content (%)	Dry Density (pcf)	Wet Density (pcf)	QU (TSF)	QU Strain at Failure (%)
B-1/A	0.0	28	16	12	63	100	45	16	GC							
B-1/1	5.0											4.9				
B-1/2	10.0											3.1	112.6	116.1		
B-1/3	15.0											4.5	97.0	101.4		
B-1/4	20.0											10.0	127.3	140.0		
B-1/5	25.0											6.1	141.1	149.7		
B-1/6	29.5											8.2				
B-1/7	32.8											16.8				
B-1/8	40.0											23.2	104.3	128.6	6.4	10.7
B-1/9	45.0											23.8	104.3	129.2	5.1	14.8
B-1/10	50.0											15.9	121.2	140.5	7.2	14.0
B-1/11	55.0											16.6	116.2	135.5	5.0	12.1
B-1/12	60.0											17.2	116.6	136.6	7.0	18.6
B-1/13	65.0											7.5	137.2	147.5		
B-1/14	70.0											10.3	130.3	143.8		
B-1/15	75.0											9.1	134.0	146.1		
B-1/16	80.0											17.8	114.8	135.2	10.1	11.4
B-1/17	85.0											16.7	117.7	137.4	7.0	16.1
B-1/18	90.0											18.3	114.8	135.8	6.5	14.0
B-1/19	95.0											17.4	116.3	136.5	5.7	14.9
B-1/20	100.0											18.3	113.9	134.7	9.1	18.3
B-1/21	105.0											15.9	119.7	138.7	10.2	14.7
B-1/22	110.0											14.7	121.5	139.5	10.5	10.1
B-1/23	115.0											16.5	116.1	135.2	4.4	8.0
B-2/C	0.0															
B-2/1	5.0											10.3	102.9	113.5		
B-2/2	10.0											7.6	110.7	119.1		
B-3/D	0.0	24	15	9	37.5	100	80	31	SC							
B-3/1	5.0											10.8	111.3	123.3		
B-3/2	10.0	27	21	6	9.5	100	100	59	CL-ML			8.0	92.2	99.6		
B-3/3	15.0											6.8	93.0	99.3		
B-3/4	16.5											10.0	96.2	105.8		
B-3/5	20.0											5.9	118.7	125.7		
B-3/6	25.0											7.0	129.7	138.8		
B-3/7	35.0											7.8	137.5	148.2		
B-3/8	40.0											16.3	117.2	136.3	2.7	10.8
B-3/9	45.0											17.7	114.4	134.7	3.5	10.1
B-3/10	50.0											16.7	116.1	135.4	4.1	8.8
B-3/11	55.0											16.5	117.8	137.2	8.1	18.5
B-3/12	60.0											12.6	127.8	143.9	6.1	8.1
B-3/13	65.0	25	19	6								15.5	118.8	137.2	4.9	8.0
B-3/14	70.0											17.6	115.6	135.9	4.9	15.9
B-3/15	75.0											21.1	108.7	131.6	5.3	18.3

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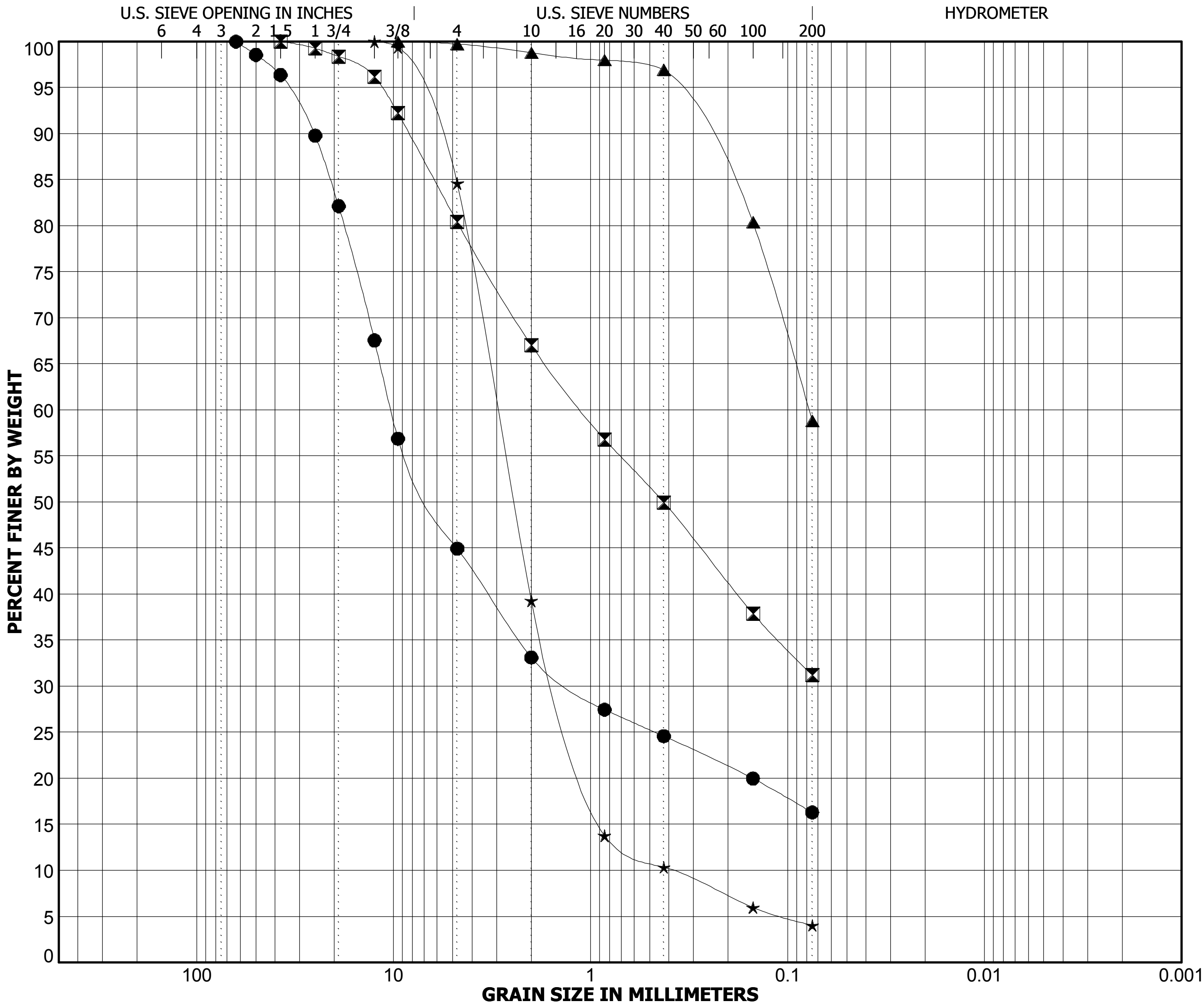
SUMMARY OF LABORATORY RESULTS

CLIENT Quincy Engineering, Inc. **PROJECT NAME** Rumsey Bridge Project

PROJECT NUMBER 2011-0068-4 **PROJECT LOCATION** Rumsey, California

Borehole/ Sample	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<3" Sieve	%<#4 Sieve	%<#200 Sieve	Class-ification	Direct Shear phi	Direct Shear c	Water Content (%)	Dry Density (pcf)	Wet Density (pcf)	QU (TSF)	QU Strain at Failure (%)
B-3/16	80.0											14.9	121.0	139.1	7.0	15.6
B-3/17	85.0											17.6	114.9	135.1	6.2	15.4
B-3/18	90.0											15.1	120.5	138.7	6.3	13.5
B-3/19	95.0											16.3	118.9	138.3	6.5	10.0
B-3/20	100.0											18.0	114.5	135.1	6.0	14.0
B-3/21	105.0											14.2	122.6	139.9	7.4	10.1
B-3/22	110.0											19.5	112.1	133.9	10.0	9.7
B-3/23	115.0											18.1	114.9	135.6	7.1	12.1
B-3/24	120.0											14.3	123.0	140.5	5.7	6.6
Bulk B/B	0.0				12.5	100	85	4	SW							



Boring/ Sample	% COBBLES	% GRAVEL		% SAND			% FINES	
		coarse	fine	coarse	medium	fine	% Silt	% Clay
● B-1/A	0.0	17.9	37.2	11.8	8.6	8.2	16.3	
⧗ B-3/D	0.0	1.6	18.0	13.4	17.2	18.6	31.2	
▲ B-3/2	0.0	0.0	0.3	1.0	2.0	37.9	58.8	
★ Bulk B	0.0	0.0	15.4	45.3	29.0	6.3	4.0	

Coefficients

Boring/ Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Sand	Cc	Cu	Sieve Size Percent Finer										
● B-1/A	0.0	63	10.294	6.372	1.248		55.1	28.7			1.5" 96.4	1" 89.8	3/4" 82.1	1/2" 67.6	3/8" 56.9	#4 44.9	#10 33.1	#20 27.5	#40 24.6	#100 20.0	#200 16.3
⧗ B-3/D	0.0	37.5	1.111	0.427			19.6	49.2			1.5" 100.0	1" 99.3	3/4" 98.4	1/2" 96.2	3/8" 92.2	#4 80.4	#10 67.0	#20 56.8	#40 50.0	#100 37.9	#200 31.2
▲ B-3/2	10.0	9.5	0.078				0.3	40.9							3/8" 100.0	#4 99.7	#10 98.8	#20 98.0	#40 96.9	#100 80.4	#200 58.8
★ Bulk B	0.0	12.5	2.97	2.454	1.465	0.392	15.4	80.6	1.84	7.58				1/2" 100.0	3/8" 99.4	#4 84.6	#10 39.3	#20 13.8	#40 10.3	#100 6.0	#200 4.0

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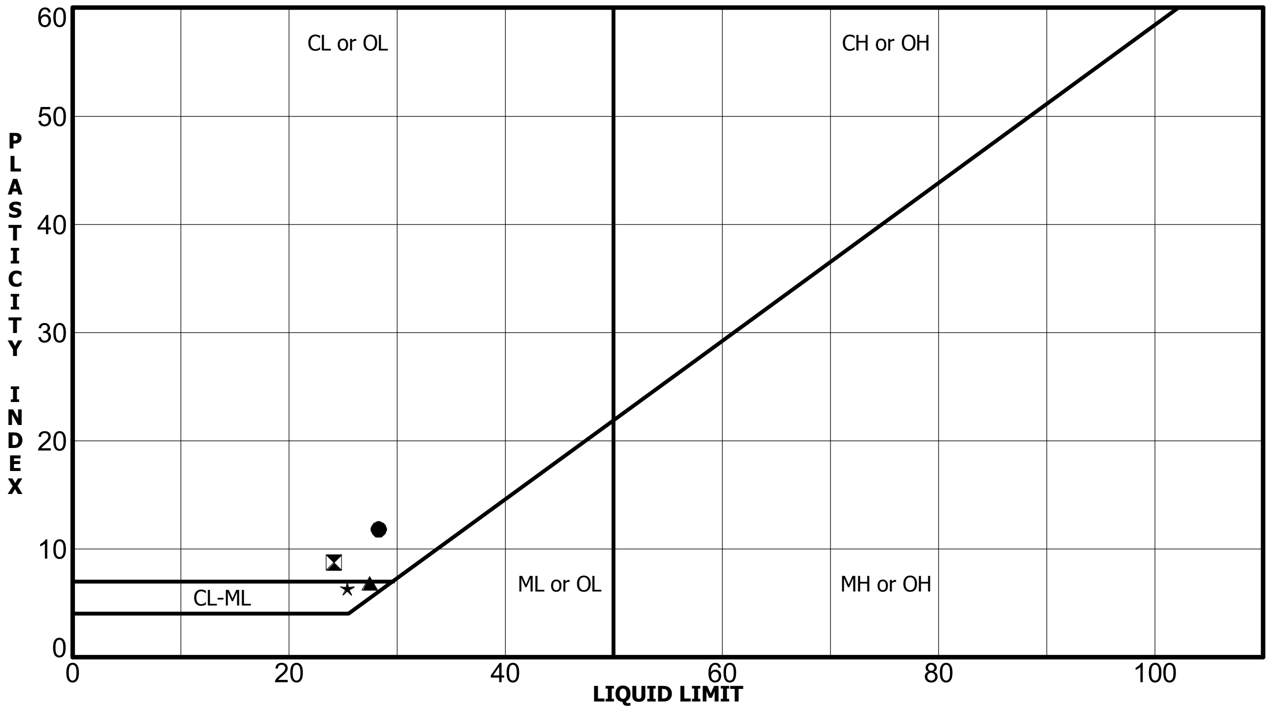
GRAIN SIZE DISTRIBUTION

Quincy Engineering, Inc.
Rumsey Bridge Project
Rumsey, California

Project No.
2011-0068-4

Appendix A



	Boring/Sample	Depth	Description	LL	PL	PI	Fines
●	B-1 / A	0.0	CLAYEY GRAVEL with SAND(GC)	28	16	12	16
⧗	B-3 / D	0.0	CLAYEY SAND with GRAVEL(SC)	24	15	9	31
▲	B-3 / 2	10.0	SANDY SILTY CLAY(CL-ML)	27	21	6	59
★	B-3 / 13	65.0		25	19	6	

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ATTERBERG LIMITS RESULTS

Quincy Engineering, Inc.
Rumsey Bridge Project
Rumsey, California

Project No.
2011-0068-4

Appendix A

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2011-0068-4
CR41 at Cache Creek

LABORATORY TEST RESULTS

EXPANSION INDEX TEST - ASTM D4829

4" dia x 1" thick remolded specimen, 144 psf surcharge, 24 hr. saturation

Boring/ Sample #	Dry Density (pcf)	Initial Moisture Content (%)	Final Moisture Content (%)	Expansion Index
B3/D	120.1	8.3	14.0	**26**

SAND EQUIVALENT TEST - ASTM D2419

Boring/ Sample #	Sand Equivalent
B3/D	**13**

Sunland Analytical
11353 Pyrites Way
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 03/12/14
Date Submitted 03/07/14

To: Ray Downes
Taber Consultants
3911 West Capital Avenue
W. Sacramento, CA, 95691-2116

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following:
Location : 2011-0068-4 Site ID: B3-D
Thank you for your business.

* For future reference to this analysis please use SUN # 66486 - 137597

EVALUATION FOR SOIL CORROSION

Soil pH	8.27			
Minimum Resistivity	2.25		ohm-cm (x1000)	
Chloride	16.5	ppm	0.0017	%
Sulfate-S	30.4	ppm	0.003	%

METHODS:
pH and Min.Resistivity CA DOT Test #643 Mod.(Sm.Cell)
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

Sunland Analytical

11353 Pyrites Way
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 03/12/14
Date Submitted 03/07/14

To: Ray Downes
Taber Consultants
3911 West Capital Avenue
W. Sacramento, CA, 95691-2116

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following:
Location : 2011-0068-4 Site ID: B3-8&9
Thank you for your business.

* For future reference to this analysis please use SUN # 66486 - 137598

EVALUATION FOR SOIL CORROSION

Soil pH	7.94			
Minimum Resistivity	1.45		ohm-cm (x1000)	
Chloride	15.9	ppm	0.0016	%
Sulfate-S	11.0	ppm	0.0011	%

METHODS:
pH and Min.Resistivity CA DOT Test #643 Mod.(Sm.Cell)
Sulfate CA DOT Test #417, Chloride CA DOT Test #422