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August 7, 2009

Mr. Garrett McLaughlin, PE
Quincy Engineering, Inc.
3247 Ramos Circle
Sacramento, CA 95827

1P2/399/296-4
38120-F7:346,239W

Subject: Subsurface Investigation Report
US 50 / Missouri Flat Road Interchange Bike Path
El Dorado County, California

Dear Mr. McLaughlin:

The following summarizes our limited investigation of subsurface materials and conditions performed for the subject project in accordance with the agreement between Quincy Engineering and Taber Consultants. The purpose of this study is to determine the suitability of constructing a cutslope for construction of the proposed bike path, to provide retaining wall recommendations if required, and to provide soils criteria expected to be encountered during construction. Pavement recommendations or earthwork recommendations beyond those for construction of the proposed cut slope and/or retaining wall were not part of the scope of services and have not been addressed in this report. Other limitations of this work are discussed in the attached "General Conditions."

Site and Project Description

The project is located in El Dorado County, along West Forni Road (Figure 1). The subject slope is an approximately ±2H:1V slope overall, with significant variation (from approximately .5H:1V to approximately 3H:1V.) The slope is predominately covered with grass with scattered scrub and trees. The proposed project is shown on preliminary plan drawings (not dated) received electronically from Quincy Engineering.

The lower portion of the slope appears to have been cut during the construction of the existing US 50 roadway, as evidenced by an approximately 6±ft high area at the base of slope that is steeper then the slopes above. This steepened portion of the slope has occasional rock outcroppings which are lacking further up the slope. An unlined earthen ditch runs along the base of slope and parallels US 50 in the area of the proposed cut; bedrock exists along the base of the ditch.

A new bike path is planned as part of the US Highway 50 / Missouri Flat Road Interchange project. This bike path is shown on provided site plans to parallel the south side of US 50 to the west of the Placerville Drive overcrossing before turning south to end at Forni Road. The proposed alignment would necessitate either cutting

the existing slope between US 50 and Forni Road or constructing a retaining wall at the toe of slope.

Exploration and Testing

Information on the nature and distribution of subsurface materials and conditions was obtained during this study by means of two (2) logged and sampled auger/rotary boring penetrating to a maximum depth 45±ft (elev. 1680.5±) using a CME-55 drill rig. Where competent rock was encountered the borings were advanced using diamond coring equipment.

Drive samples were recovered from the borings by means of a 2.0 inch O.D. "standard penetration" sampler advanced with standard 350 ft-lb striking force (ASTM D1586) to provide a field estimate of soils consistency. Sampler penetration resistance was recoded and can be correlated to strength and bearing characteristics of the foundation materials. Selected portions of recovered drive samples were retained in moisture-proof containers for laboratory testing and reference.

Moisture content-dry density and compressive strength tests were unable to be performed on collected samples due to the rocky nature of the samples collected.

The borings were logged and earth materials field-classified by a geologist as to consistency, color, gradation and texture on the bases of sampler penetration resistance, and examination and inspection of samples and drill cuttings. Where diamond coring was used to advance the boring, the recovered cores were logged as to percent recovery and Rock Quality Designation (RQD). Cores were photographed and stored in core boxes for reference. Groundwater observations were made in the borings during drilling operations. Each boring was backfilled with cement grout and topped with a cold A/C patch upon completion of drilling operations.

The boring locations and elevations were referenced to the County's project survey datum and were marked in the field. Locations, elevations, details of borings and results of tests are shown on the attached "Log of Test Borings" drawing. Tracy Compton was the field geologist for this study. David A. Kitzmann, C.E.G. and Marty A. Wills were the representatives from our office performing the refraction seismic profiles for this study.

Seismic Refraction Profiling

Two double-ended seismic refraction profiles were completed during our study. Both seismic refraction profiles were located along the approximate ±2H:1V slope below West Forni Road.

Refraction seismic profiling indicates primary wave (compression wave) velocities ranging from 900 fps to as much as 8800 fps. Seismic lines were approximately 60-70±feet in length and would represent materials to depths of 30-50±feet.

Interpreted results/details of the seismic refraction profiles are summarized in the following table:

Refraction Seismic Profiles			
Seismic Line	**Estimated Depth to Bottom of Layer (ft)**	**Layer Velocity (fps)**	**Materials Description***
S1-S2	7-11	1000-1300	Native Soil / collovial deposits
	25	2000-4000	Decomposed / intensely weatherd rock
		7300-8800	Weathered rock
S3-S4	2-5	900-1000	Native soil / collovial deposits
	20	1400-2800	Decomposed / intensely weatherd rock
		4800-7700	Weathered rock

* Materials description is interpreted, based on site observations and layer velocities.

Locations of seismic profiles are shown in Figure-2. Time-distance graphs for refraction seismic profiles are shown on Figure-5.

Geologic Conditions

The site is shown on published geologic mapping ("Geologic Map of California, Sacramento Sheet" 1:250,000, 1981) as underlain by Mesozoic granitic rocks. Mapped adjacent to the site is metavolcanic rock of the Logtown Ridge Formation.

No faults are indicated to pass through the project site on published mapping. The nearest mapped fault to the site is Melones fault zone located approximately 3.1 miles to the east of the site. This fault is considered inactive during the Holocene by the California Geological Survey and is not included in the faults shown on the Caltrans "Seismic Hazard Map." The project site is not located within an Alquist Priolo "Earthquake Fault Zone."

Site geologic reconnaissance (July 22, 2009) of the area indicates metamorphic rock rather than the igneous rock is exposed along the cut slope that was created during the US-50 construction (below Forni Road). The exposed metamorphic rock in the cut slope is field-described similarly to the rock encountered at both borings completed for this project (discussed below) and is observed as predominately moderately to intensely weathered with local areas of very intensely weathered metamorphic rock. The rock is characterized as moderately soft and intensely fractured/jointed in accordance with descriptors shown on the attached "Engineering Geology Field Descriptors" sheet (Figure-4). More prominent fractures/joints observed within the metamorphic rock were measured as follows:

Strike	Dip
Northwesterly	49°-72° southwest
Northeasterly	73° southeast

Earth Materials and Conditions

Earth materials encountered in the borings are consistent with the metavolcanic unit described in published mapping. Encountered materials can be divided into two units considered significant to the proposed project: roadway fill/native soils and rock.

Roadway fill and native soils / colluvium

Surface soils include roadway fill and native soils / colluvium. The unit consists of silty clay with sand to sandy clay with gravel and silt and generally has a stiff to very stiff consistency (per Standard Penetration blow counts). Roadway fill materials were typically encountered in both borings to 1± foot below ground surface. This fill/native soil layer extends to approximately 4-ft and 7-ft below ground surface in borings B-1 and B-2, respectively (elev. 521± and 526±, respectively).

Rock

Metamorphic rock was encountered in both borings completed for this study. The use of solid flight augers as means to penetrate the decomposed rock was sufficient, however as the rock became harder with depth, the SPT sampler was eventually unable to penetrate the weathered rock for sampling and diamond coring equipment was used to obtain samples.

The transition from decomposed rock to more competent rock in Borings B-1 and B-2 is at 34.5 and 9.5-ft depth, respectively (elev. 492± and 523±, respectively).

Encountered weathered rock was field-described as blue-gray to brown and slightly to intensely weathered. The encountered rock is moderately hard to hard, moderately to intensely fractured (locally very intensely fractured) with iron oxide stains along the fracture surfaces. From recovered cores there does not appear to be any visible bedding and the rock mass appears to be massive. Between both borings, core recovery ranged from 25-107% with an average recovery of 82%. Rock Quality Designation was low and ranged from 0 to 25% for all diamond core runs in both borings, indicating numerous fractures within the rock mass.

Similar rock was observed in the outcrops along the lower portion of the slope below Forni Road. It is likely that the elevation of the soil:rock contact may vary (possibly significantly) within the project site.

Conclusions and Discussion

The materials found underlying the slope below Forni Road are considered capable of supporting the proposed steepened slope. Unfavorable jointing was not observed in the rock outcroppings and the existing cutslope has apparently performed well with little evidence of erosion or instability. A laid back slope no steeper then 1H:1V is considered acceptable if provisions are made to allow for minimization of erosion and prevention of loose material falling into the bike path. The upper limit of the cutslope should be made to avoid areas with known roadway fill (Figure-2 and -6)

Rippability

The material encountered during this investigation within the vertical limits of the proposed cutslope is considered generally rippable by conventional heavy-duty excavation equipment. Rippability can be expected to decrease with depth from existing surface elevations with deeper portions of the proposed cut possibly being marginally rippable at least in part.

Erosion Control

While the existing cutslope appears to have performed well it is recommended to protect the cutslope from stormwater flows to minimize erosion of the slope face. Surface water along Forni Road should be directed away from the slope face and relieved to an area outside of the limits of the proposed cutslope in a way that will minimize erosion of the slope. It is recommended that any drainage improvements also limit infiltration along Forni Road in the area of the cutslope. This can be accomplished using concrete lined V-ditches or a trench drain installed along the inboard roadway edge and a raised asphalt concrete berm along the outboard roadway edge.

The existing toe of slope area has been incised, likely by storm water runoff. It is recommended to protect the new toe of slope from similar erosion by placement of a concrete lined V-ditch along the base of slope.

It is recommended to provide provisions for limiting the possibility of debris falling onto the proposed bike path. At a minimum a "runout" area between the base of the proposed cutslope and the bike path is recommended. This runout area is recommended to be a minimum of 5-ft wide. The recommended V-ditch at the toe of slope can be collocated in this runout area. It is likely that rock netting or a debris fence will be required to reduce the probability of falling debris to an acceptable level. The completed cut slope should be reviewed by an engineering geologist to determine if rock netting or other measures are required.

It is recommended that the upper portions of the cutslope that consists of softer/looser native soil/colluvium be protected from erosion. Straw waddles staked across slope immediately after construction to lessen runoff velocity is recommended. Long term protection can take the form of planting / seeding with native deep rooted draught resistant plants and placement of erosion control mats across the exposed soil/colluvium to retain soil until plants are established. Consultation with an erosion control specialist is recommended to further define erosion control measures for this proposed project and to determine if other portions of the cutslope will require erosion protection.

* * * * *

Please call if you have any questions regarding the foregoing or earth materials and foundation conditions at the site. We appreciate this opportunity to be of service.

Very truly yours,

TABER CONSULTANTS

Reviewed by: Ronald E. Loutzenhiser
R.C.E. 64089

David Kitzmann
C.E.G. 2412

Attachments:

"Selected References"
"General Conditions"

Figure-1	"Vicinity Map"
Figure-2	"Site Plan"
Figure-3	"Test Boring Logs"
Figure-4	"Engineering Geology Field Descriptors"
Figure-5	"Seismic Refraction Logs"
Figure-6	"Cutslope Cross-Section"

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SELECTED REFERENCES

1. California Department of Transportation, "Caltrans Seismic Design Criteria (Ver. 1.4)", 1996.

2. DMG Staff, 2000, Digital images of Official Maps of Alquist-Priolo Earthquake Fault Zones of California, northern and eastern region: California Division of Mines and Geology, CD 2000-005, scale 1:24000.

3. DMG Staff, 1987, Geologic Map of the Sacramento Quadrangle: California Geological Survey (California Division of Mines and Geology), Map scale 1:250000, 1987.

4. Mualchin, Lalliana, "California Seismic Hazard Map – Detail 2", California Department of Transportation, 1996, approximate scale 4"=15'.

1P2/399/296-4

GENERAL CONDITIONS

The conclusions and recommendations of this study are professional opinion based upon the indicated project criteria and the limited data described herein. It is recognized there is potential for sufficient variation in subsurface conditions that modification of conclusions and recommendations might emerge from further, more detailed study.

This report is intended only for the purpose, site location and project description indicated and assumes design and construction in accordance with Caltrans practice.

As changes in appropriate standards, site conditions and technical knowledge cannot be adequately predicted, review of recommendations by this office for use after a period of two years is a condition of this report.

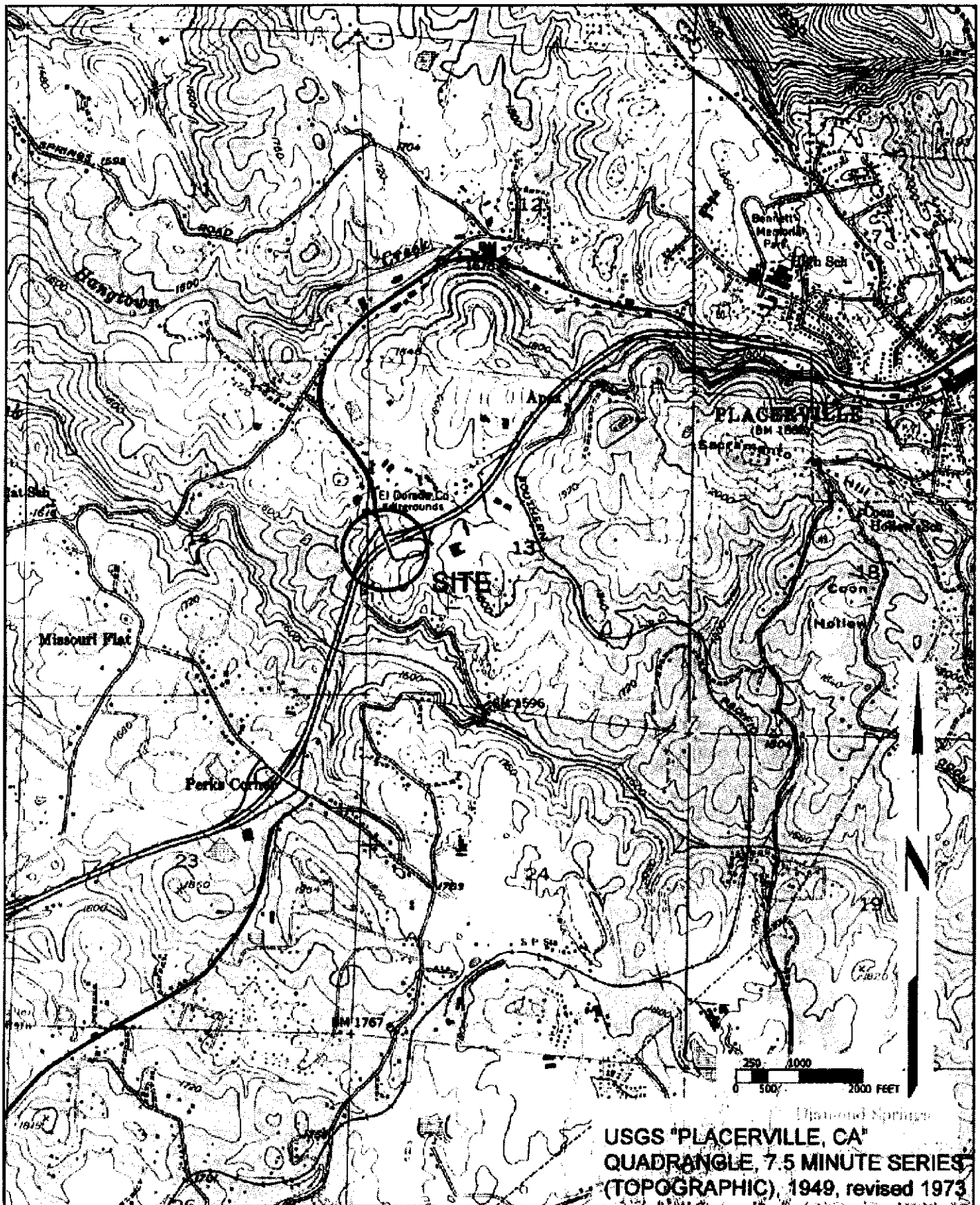
A review by this office of any foundation and/or grading plans and specifications or other work product insofar as they rely upon or implement the content of this report, together with the opportunity to make supplemental recommendations as indicated therefrom is considered an integral part of this study and a condition of recommendations.

Subsequently defined construction observation procedures and/or agencies are an element of work that may affect supplementary recommendations.

Should there be significant change in the project, or should earth materials or conditions different from those described in this report be encountered during construction, this office should be notified for evaluation and supplemental recommendations as necessary or appropriate.

Opinions and recommendations apply to current site conditions and those reasonably foreseeable for the described development – which includes appropriate operation and maintenance thereof. They cannot apply to site changes occurring, made, or induced, of which this office is not aware and has not had opportunity to evaluate.

The scope of this study specifically excluded sampling and/or testing for, or evaluation of the occurrence and distribution of, hazardous substances. No opinion is intended regarding the presence or distribution of any hazardous substances at this or nearby sites.



USGS "PLACERVILLE, CA" QUADRANGLE, 7.5 MINUTE SERIES (TOPOGRAPHIC), 1949, revised 1973

Taber Since 1954	**VICINITY MAP**	Project No. 1P2/399/296-4
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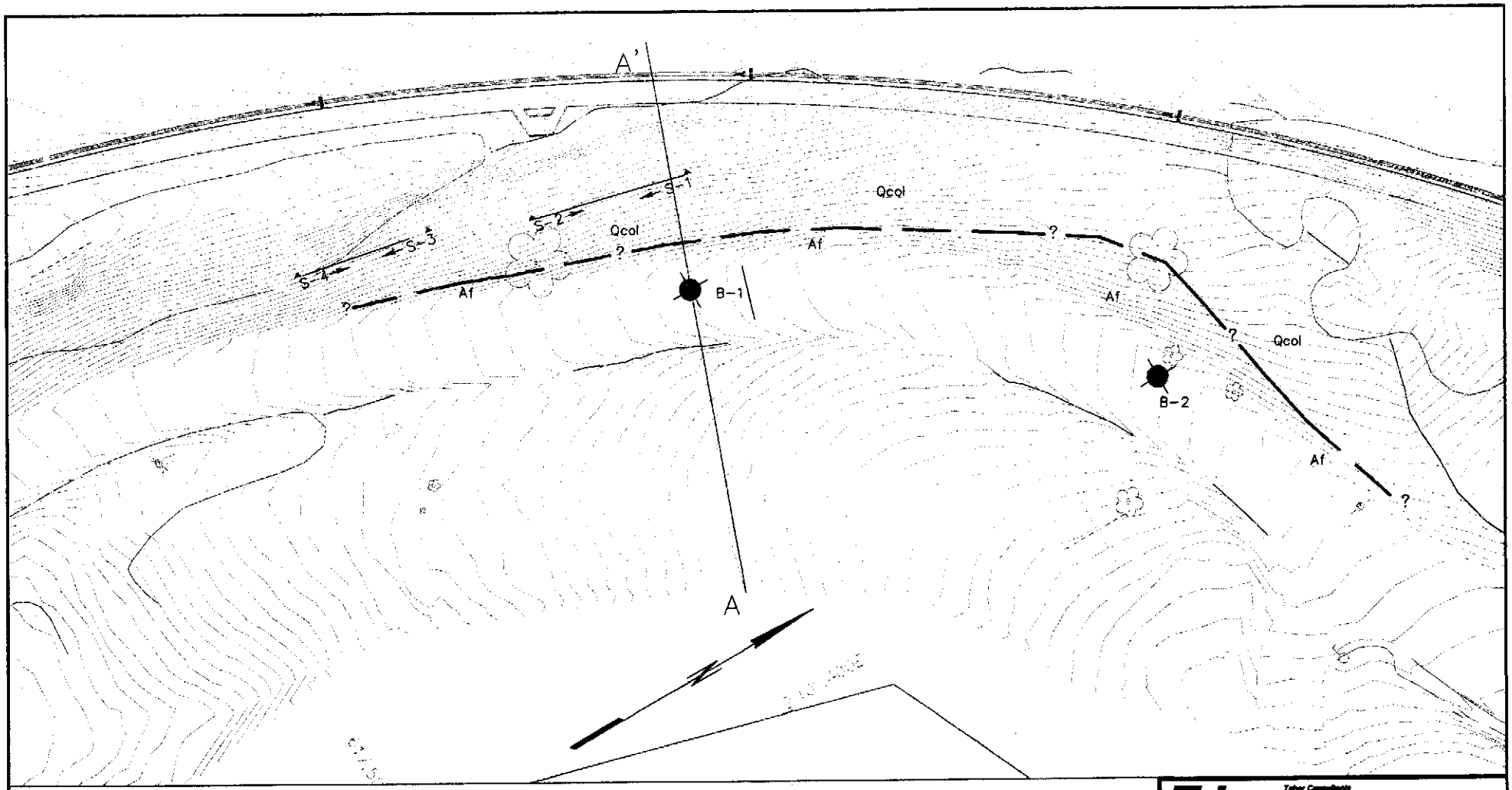
	Missouri Flat Road Bike Path Placerville, California	August 2009
		FIGURE-1



LEGEND

S-1 ← → S-2 Seismic Refraction Profile

— — — ? Approximate Location of Geologic Contact – queried where inferred.

Qcol Quaternary Colluvium

Af Artificial Fill

Boring Locations

A' A Cross Section Line

PLAN
1"=40'

NOTE: SEISMIC SURVEY COMPLETED ON 07/22/2009 BY DAK and MAW.
BORINGS DRILLED ON 07/22/2009-07/23/2009 BY TJC.
PLAN VIEW PROVIDED BY Quincy Engineering.

ORIGINAL SCALE IN INCHES 0 0.5 1.0

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Missouri Flat Road Bike Path
Placerville, California

SITE PLAN

1P2/399/296-4 | Figure - 2

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TEST BORING LOG

Job No. 1P2 399 296-4

TYPE: 4-INCH AUGER/HQ CORE

SURFACE ELEVATION:

BORING NO 1

UNCONFINED COMPRESSIVE STRENGTH (tsf)	OTHER TESTS	DRY DENSITY (lbs/cu. ft.)	Moisture (%)	BLOWS/FOOT 350 ft-lb / RECV. / RQD%	SAMPLE SIZE (inches)	SAMPLE No.	DEPTH IN FEET	MATERIAL SYMBOL	UNIFIED SOIL CLASS	
				82	1.4	1	0		CL	2" asphalt concrete over (Stiff), brown to orange-brown, SILTY CLAY with fine to coarse SAND, dry (fill)
							5		SW	Very dense, brown GRAVELLY fine to coarse SAND with CLAY, dry (decomposed meta-igneous rock)
				19	1.4	2				Very hard (locally semicompact to 12-ft depth), brown to light brown SILTY CLAY with SAND to SANDY CLAY with SILT, dry (decomposed meta-igneous rock)
				91	1.4	3	10			
				50/0.5"	1.4	4	15			
				50/0.5	1.4	5	20			
				50/0.3"	1.4	6	25			
				50/0.1"	1.4	7	30			
				25% / 20%	HQ		35			META-IGNEOUS ROCK, medium-grained, blue-green-gray, moderately weathered (locally intensely weathered), hard (locally moderately soft), intensely to very intensely fractured, iron oxidized stains on fracture surfaces
							40			--CONTINUED--

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: TJC | DATE: 07-22-2009

LOG OF BORING (WITH REC/RQD) 1P2 399 296-4.GPJ LIBRARY.GLB TEMPLATE.GDT 8/3/09

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TEST BORING LOG

Job No. 1P2 399 296-4

TYPE: 4-INCH AUGER/HQ CORE

SURFACE ELEVATION:

BORING NO 1

DEPTH IN FEET	SAMPLE No.	SAMPLE SIZE (inches)	BLOWS/FOOT 350 ft-lb / REC% / RQD%	MATERIAL SYMBOL	UNIFIED SOIL CLASS	UNCONFINED COMPRESSIVE STRENGTH (tsf)	OTHER TESTS	DRY DENSITY (lbs/cu. ft.)	Moisture (%)
45		HQ	78% / 0%						
		HQ	96% / 19%						

META-IGNEOUS ROCK, medium-grained, blue-green-gray, moderately weathered (locally intensely weathered), hard (locally moderately soft), intensely to very intensely fractured, iron oxidized stains on fracture surfaces

Bottom of hole at 45.0 feet.

Borehole backfilled with cement grout upon completion.
No groundwater encountered while augering.

50
55
60
65
70
75
80

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.

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TEST BORING LOG

Job No. 1P2 399 296-4

TYPE: 4-INCH AUGER/HQ CORE

SURFACE ELEVATION:

BORING NO 2

UNCONFINED COMPRESSIVE STRENGTH (tsf)	OTHER TESTS	DRY DENSITY (lbs/cu. ft.)	Moisture (%)	BLOWS/FOOT 300 lb-lb / REC% / RQD%	SAMPLE SIZE (inches)	SAMPLE No.	DEPTH IN FEET	MATERIAL SYMBOL	UNIFIED SOIL CLASS	
					1.4	1	5		CL	2" asphalt concrete over (Stiff), brown fine to coarse SANDY CLAY with GRAVEL, dry (fill)
				21	1.4	2			CL	Very stiff, orange brown to light brown fine SANDY CLAY with SILT, dry
				50/0.1"	1.4	3			CL	Very hard, light brown CLAY with SILT and fine SAND, dry (decomposed meta-igneous rock)
				92% / 20%			10			META-IGNEOUS ROCK, medium-grained, blue-green, hard to very hard (locally soft), moderately to intensely weathered (locally very intensely weathered), intensely to very intensely fractured, iron oxidized stains on fracture surfaces
				80% / 22%			15			
				40% / 0%			20			
				84% / 0%						
				95% / 0%			25			
				92% / 0%			30			
				83% / 0%						
				90% / 0%			35			
				90% / 50%						
				107% / 0%			40			

--CONTINUED--

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.

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DATE: 07-23-2009

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TEST BORING LOG

Job No. 1P2 399 296-4

TYPE: 4-INCH AUGER/HQ CORE

SURFACE ELEVATION:

BORING NO 2

UNCONFINED COMPRESSIVE STRENGTH (tsf)	OTHER TESTS	DRY DENSITY (lbs/cu. ft.)	Moisture (%)	BLOWS/FOOT 350 ft-lb / REC% / RQD%	SAMPLE SIZE (inches)	SAMPLE No.	DEPTH IN FEET	MATERIAL SYMBOL	UNIFIED SOIL CLASS	
				87% / 13%			45			META-IGNEOUS ROCK, medium-grained, blue-green, hard to very hard (locally soft), moderately to intensely weathered (locally very intensely weathered), intensely to very intensely fractured, iron oxidized stains on fracture surfaces
							50			Bottom of hole at 43.8 feet. Borehole backfilled with cement grout upon completion. No groundwater encountered while augering.
							55			
							60			
							65			
							70			
							75			
							80			

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: TJC

DATE: 07-23-2009

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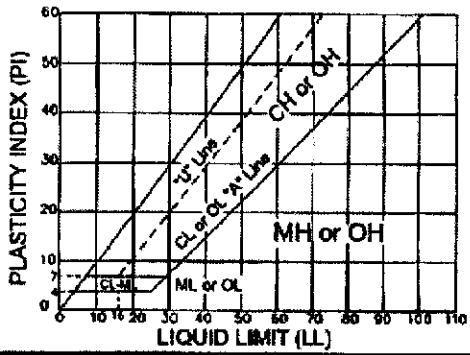
UNIFIED SOIL CLASSIFICATION SUMMARY

(ASTM D 2487-00)

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 >15% fines		Clean sands ≤ 5% fines		Gravels with fines > 15% 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 inspection and should not be construed to imply laboratory analysis unless so stated.

MATERIAL SYMBOLS

- Gravel
- Sand
- Silt
- Clay
- Sandy clay or clayey sand
- Sandy silt or silty sand
- Silty clay or clayey silt
- Peat and/or organic matter
- Fill material
- Igneous rock
- Sedimentary rock
- Metamorphic rock

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)

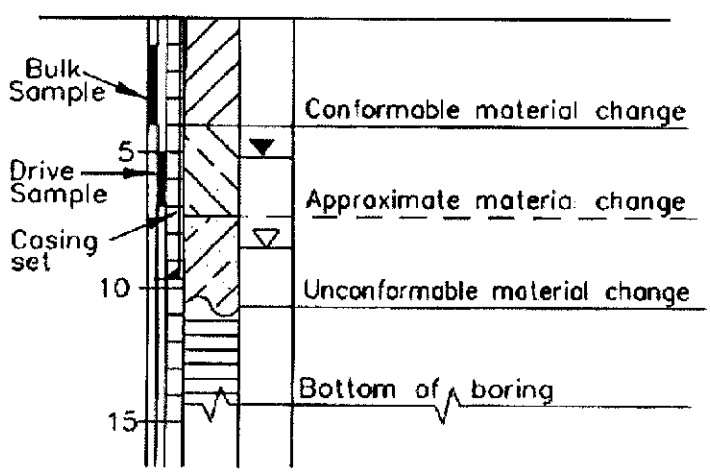
Blow count of 50/0.5 indicates 50 blows for 0.5 feet.

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

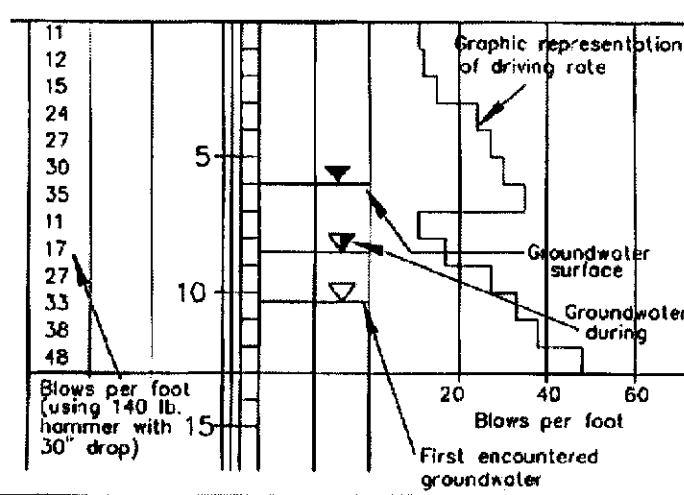
KEY TO "OTHER TESTS" LABORATORY

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

LEGEND OF BORING



LEGEND OF PENETRATION TEST



WEATHERING DESCRIPTORS

Descriptors	Diagnostic features: Chemical weathering–Discoloration and/or oxidation: Body of rock	Chemical weathering–Discoloration and/or oxidation: Fracture surfaces †	Mechanical weathering–Grain boundary conditions (disaggregation) primarily for granitics and some coarse–grained sediments	Texture and solutioning: Texture	Texture and solutioning: Solutioning	General characteristic (strength, excavation, etc.)‡
Fresh	No discoloration, not oxidized	No discoloration or oxidation	No separation, intact (tight)	No change	No solutioning	Hammer rings when crystalline rocks are struck. Almost always rock excavation except for naturally weak or weakly cemented rocks such as siltstones or shales.
Slightly weathered to fresh*						
Slightly weathered	Discoloration or oxidation is limited to surface of, or short distance from, fractures; some feldspar crystals are dull	Minor to complete discoloration or oxidation of most surfaces	No visible separation, intact (tight)	Preserved	Minor leaching of some soluble minerals may be noted	Hammer rings when crystalline rocks are struck. Body of rock not weakened. With few exceptions, such as siltstones or shales, classified as rock excavation.
Moderately to slightly weathered*						
Moderately weathered	Discoloration or oxidation extends from fractures usually throughout; Fe–Mg minerals are "rusty", feldspar crystals are "dusty".	All fracture surfaces are discolored or oxidized	Partial separation of boundaries visible	Generally preserved	Soluble minerals may be mostly leached	Hammer does not ring when rock is struck. Body of rock is slightly weakened. Depending on fracturing, usually is rock excavation except in naturally weak rocks such as siltstones or shales.
Intensely to moderately weathered*						
Intensely weathered	Discoloration or oxidation throughout; all feldspars and Fe–Mg minerals are altered to clay to some extent; or entire chemical alteration produces in situ disaggregation, see grain boundary conditions.	All fracture surfaces are discolored or oxidized, surfaces friable	Partial separation, rock is friable in hands; in sandy conditions granitics are disaggregated	Texture altered by chemical disintegration (hydration, oxidation)	Leaching of soluble minerals may be complete	Dull sound when struck with hammer, usually can be broken with moderate to heavy manual pressure or by light hammer blow without reference to planes of weakness such as incipient or healed fractures, or veinlets. Rock is significantly weakened. Usually conveyor excavation.
Very intensely weathered*						
Decomposed	Discolored or oxidized throughout, but resistant minerals such as quartz may be unaltered; all feldspars and Fe–Mg minerals are completely altered to clay.		Complete separation of grain boundaries (disaggregated)	Resembles a soil, partial or complete remnant rock structure may be preserved, leaching of soluble minerals usually complete		Can be granulated by hand. Always conveyor excavation. Resistant minerals such as quartz may be present as "stringers" or "dikes".

NOTE: This chart and its horizontal categories are more readily applied to rocks with feldspars and mafic minerals. Weathering in various sedimentary rocks, particularly limestones and poorly indurated sediments, will not always fit the categories established. This chart and weathering categories may have to be modified for particular site conditions or alterations such as hydrothermal effects; however, the basic framework and similar descriptors are to be used.

* Combination descriptors are permissible where equal distribution of both weathering characteristics are present over significant intervals or where characteristics present are "in between" the diagnostic features. However, dual descriptors should not be used where significant, identifiable zones can be delineated. When given as a range, only two adjacent terms may be combined (i.e., decomposed to slightly weathered or moderately weathered to fresh) are not acceptable.

† Does not include discontinuous weathering along shears or faults and their associated features. For example, a shear zone that carried weathering to great depths into a fresh rock mass would not require the rock mass to be classified as weathered.

‡ These are generalizations and should not be used as diagnostic features for weathering or cementation classification. These characteristics vary to a large extent based on naturally weak materials or cementation and type of excavation.

ROCK HARDNESS/STRENGTH DESCRIPTORS

Descriptor	Criteria
Extremely hard	Core, fragment, or exposure cannot be scratched with knife or sharp pick; can only be chipped with repeated heavy hammer blows.
Very hard	Can be scratched with knife or sharp pick. Core or fragment breaks with repeated heavy hammer blows.
Hard	Can be scratched with knife or sharp pick with difficulty (heavy pressure). Heavy hammer blow required to break specimen.
Moderately hard	Can be scratched with knife or sharp pick with light or moderate pressure. Core or fragment breaks with moderate hammer blow.
Moderately soft	Can be grooved 1/16 inch (2 mm) deep by knife or sharp pick with moderate or heavy pressure. Core or fragment breaks with light hammer blow or heavy manual pressure.
Soft	Can be grooved or gouged easily by knife or sharp pick with light pressure, can be scratched with fingernail. Breaks with light to moderate manual pressure.
Very soft	Can be readily indented, grooved or gouged with fingernail, or carved with a knife. Breaks with light manual pressure.

Any bedrock unit softer than very soft, is to be described using USBR 5000 consistency descriptors.

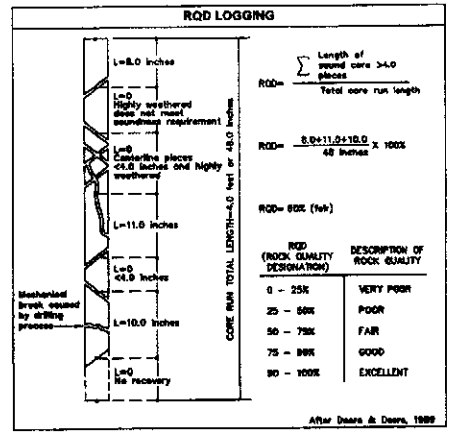
NOTE: Although "sharp pick" is included in these definitions, descriptions of ability to be scratched, grooved or gouged by a knife is the preferred criteria.

BEDDING, FOLIATION, OR FLOW TEXTURE DESCRIPTORS

Descriptor	Thickness/spacing
Massive	Greater than 10 ft (3 m)
Very thickly (bedded, foliated, or banded)	3 to 10 ft (1 to 3 m)
Thickly	1 to 3 ft (300 mm to 1 m)
Moderately	0.3 to 1 ft (100 to 300 mm)
Thinly	0.1 to 0.3 ft (30 to 100 mm)
Very thinly	0.03 [3/8 in] to 0.1 ft (10 to 30 mm)
Laminated (intensely foliated or banded)	Less than 0.03 ft [3/8 in] (<10 mm)

Source: U.S. Department of Interior, Bureau of Reclamation "Engineering Geology Field Manual".

RQD LOGGING



$$RQD = \frac{\sum \text{Length of sound core } >4.0 \text{ pieces}}{\text{Total core run length}}$$

$$RQD = \frac{8.0+11.0+10.0}{60 \text{ inches}} \times 100\%$$

RQD= 60% (fair)

RQD (ROCK QUALITY DESIGNATION)	DESCRIPTION OF ROCK QUALITY
0 – 25%	VERY POOR
25 – 50%	POOR
50 – 75%	FAIR
75 – 90%	GOOD
90 – 100%	EXCELLENT

After Deere & Deere, 1989

IGNEOUS AND METAMORPHIC ROCK GRAIN SIZE DESCRIPTORS

Descriptor	Average crystal diameter
Very coarse–grained or pegmatitic	> 3/8 inch
Coarse–grained	3/16–3/8 inch
Medium–grained	1/32–3/16 inch
Fine–grained	0.04–1/32 inch
Aphanitic (cannot be seen with the unaided eye)	<0.04 inch

FRACTURE DENSITY

FRACTURE DENSITY – Based on the spacing of all natural fractures in an exposure or core recovery lengths in drill holes; excludes mechanical breaks, slickrock and shear zones; however, shear–distributed zones (fracturing outside the shear) are included. Descriptors for fracture density apply to all rock exposures such as tunnel walls, shear trenches, outcrops, or foundation cut slopes and bowls, as well as boreholes. Descriptive criteria presented below are based on drill hole cores where lengths are measured along the core axis, for other exposures the criteria is distance measured between fractures (dips of blocks).

UNFRACTURED: No observed fractures.

VERY SLIGHTLY FRACTURED: Core recovered mostly in lengths greater than 3 feet (1 m).

SLIGHTLY TO VERY SLIGHTLY FRACTURED

SLIGHTLY FRACTURED: Core recovered mostly in lengths from 1 to 3 feet (300 to 1000 mm) with few scattered lengths less than 1 foot (300 mm) or greater than 3 feet (1000 mm).

MODERATELY TO SLIGHTLY FRACTURED

MODERATELY FRACTURED: Core recovered mostly in 0.33 to 1.0 foot (100 to 300 mm) lengths with most lengths about 0.67 feet (200 mm).

INTENSELY TO MODERATELY FRACTURED

INTENSELY FRACTURED: Lengths average from 0.1 to 0.33 feet (30 to 100 mm) with scattered fragmented intervals. Core recovered mostly in lengths less than 0.33 feet (100 mm).

VERY INTENSELY TO INTENSELY FRACTURED

VERY INTENSELY FRACTURED: Core recovered mostly as chips and fragments with a few scattered short core lengths.

* Combinations of fracture densities (e.g. very intensely to intensely fractured or moderately to slightly fractured) are used where equal distributions of both fracture density characteristics are present over a significant interval or exposure, or where characteristics are "in between" the descriptor definitions.

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ENGINEERING GEOLOGY FIELD DESCRIPTORS

1P2/399/296-4 | Figure - 4

ORIGINAL SCALE IN INCHES 0 1 2 3

08/05/09 Field Descriptor_SHEET.dwg

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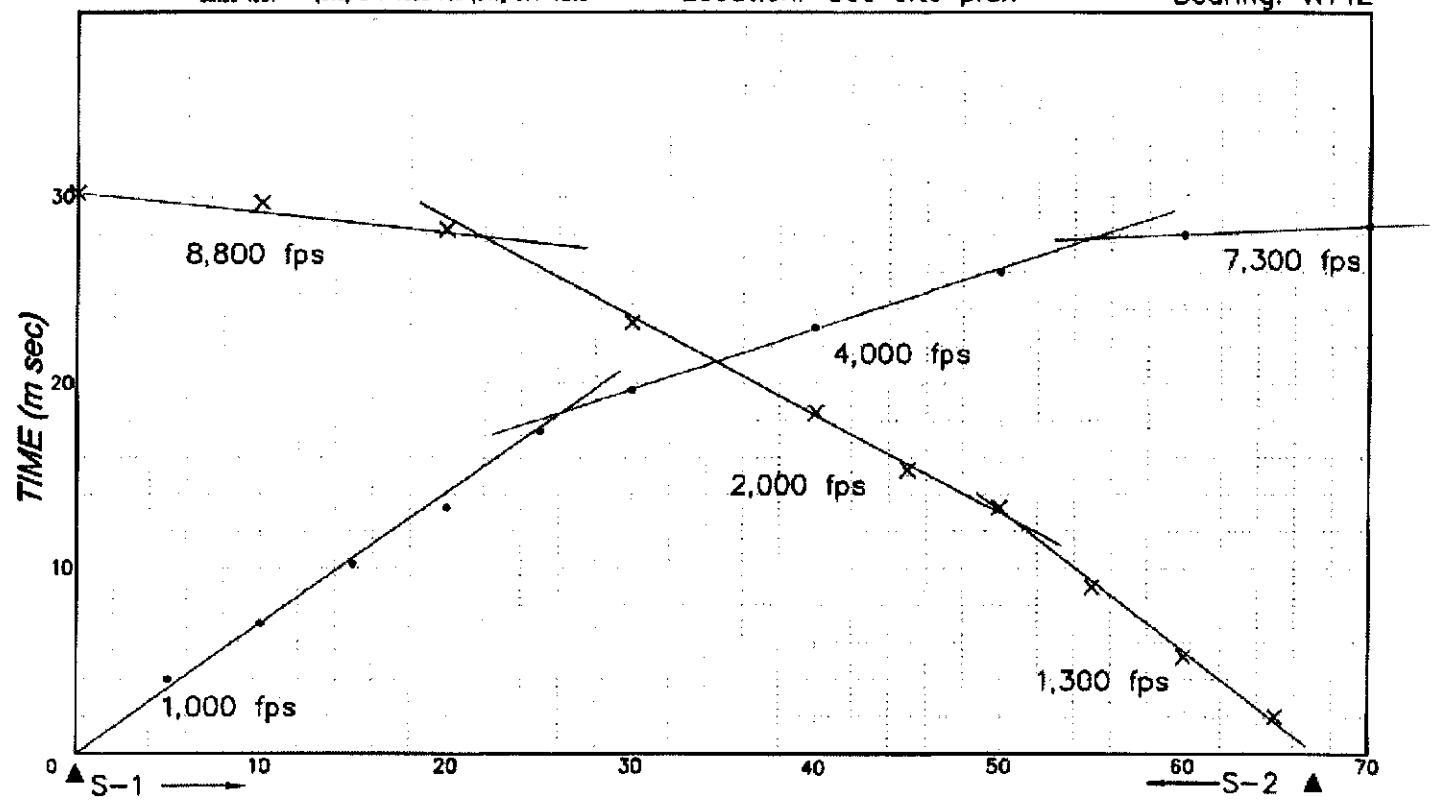
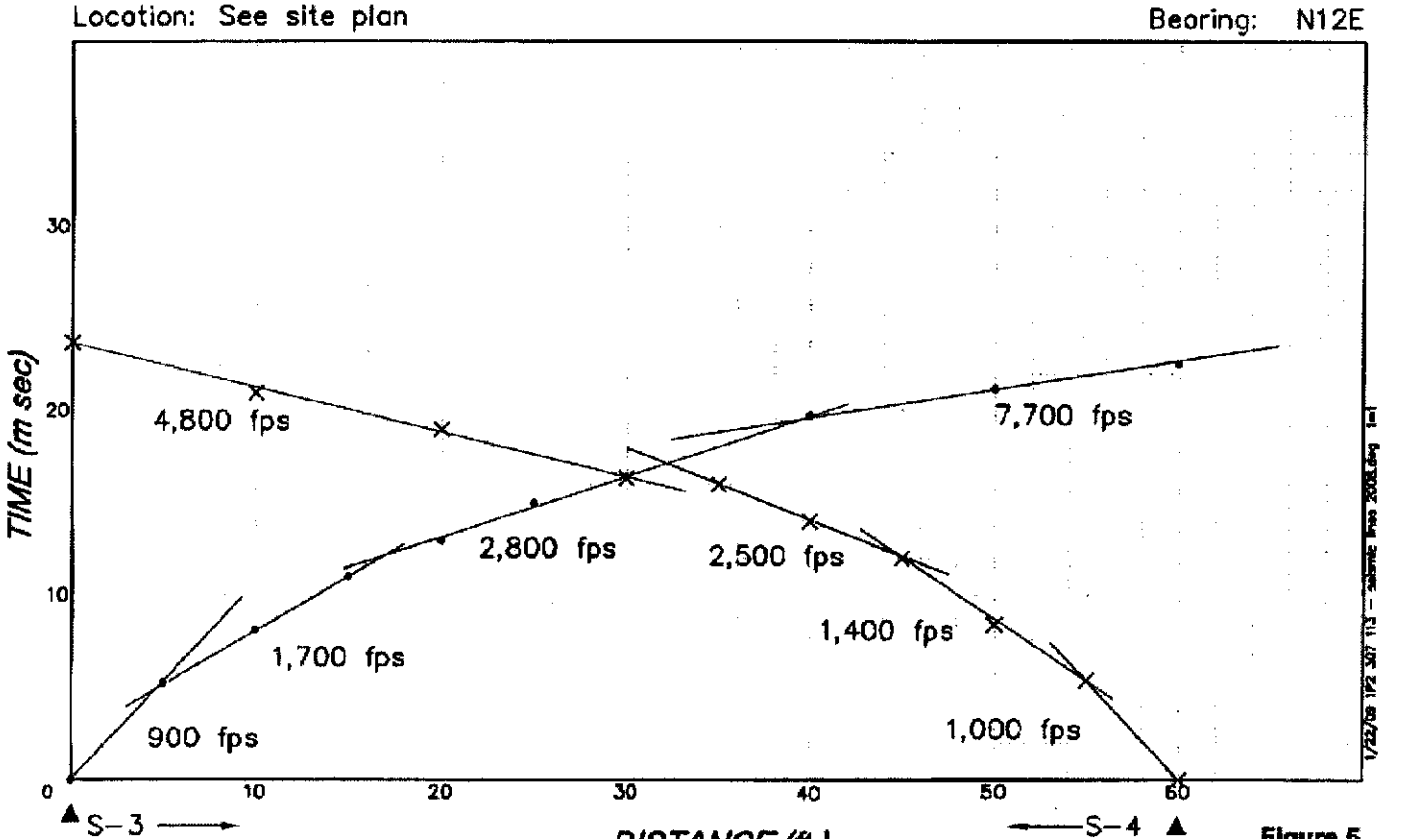
Location: See site plan Bearing: N14E



DISTANCE (ft.)

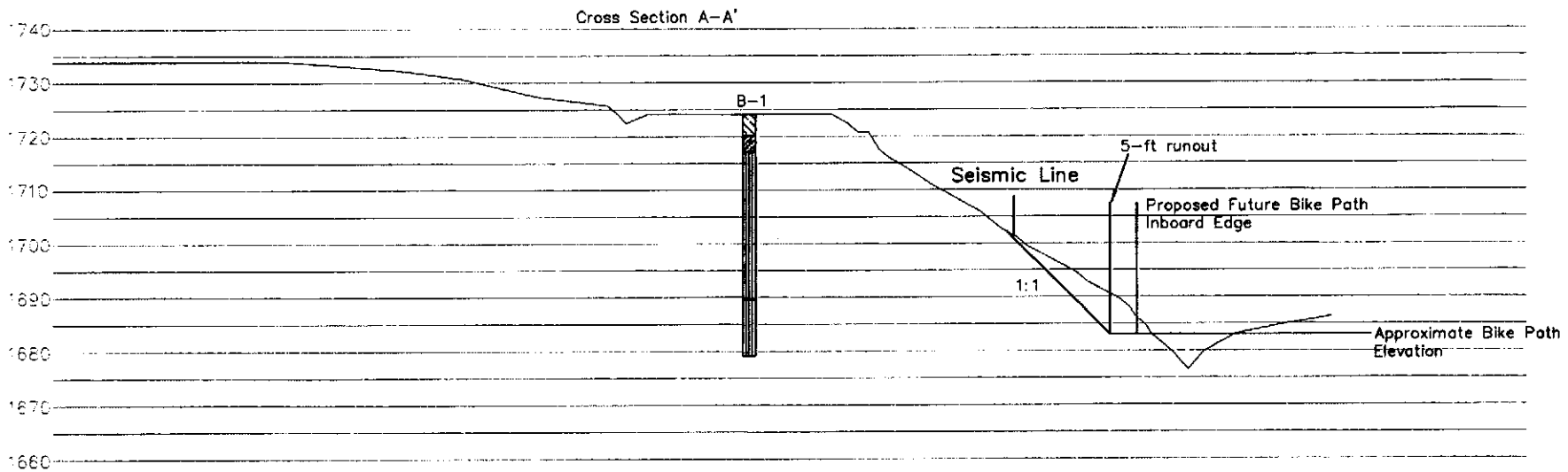
Location: See site plan Bearing: N12E



DISTANCE (ft.)

Figure 5
Page 1 of 1

REFRACTION SEISMIC RECORD



PLAN
1"=20'

NOTE: BORINGS DRILLED ON 07/22/2009-07/23/2009 BY TJC.
PLAN VIEW PROVIDED BY Quincy Engineering.

ORIGINAL SCALE IN INCHES 0 0.5 1 1.5

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Cross Section A-A'

1P2/399/296-4

Figure - 6