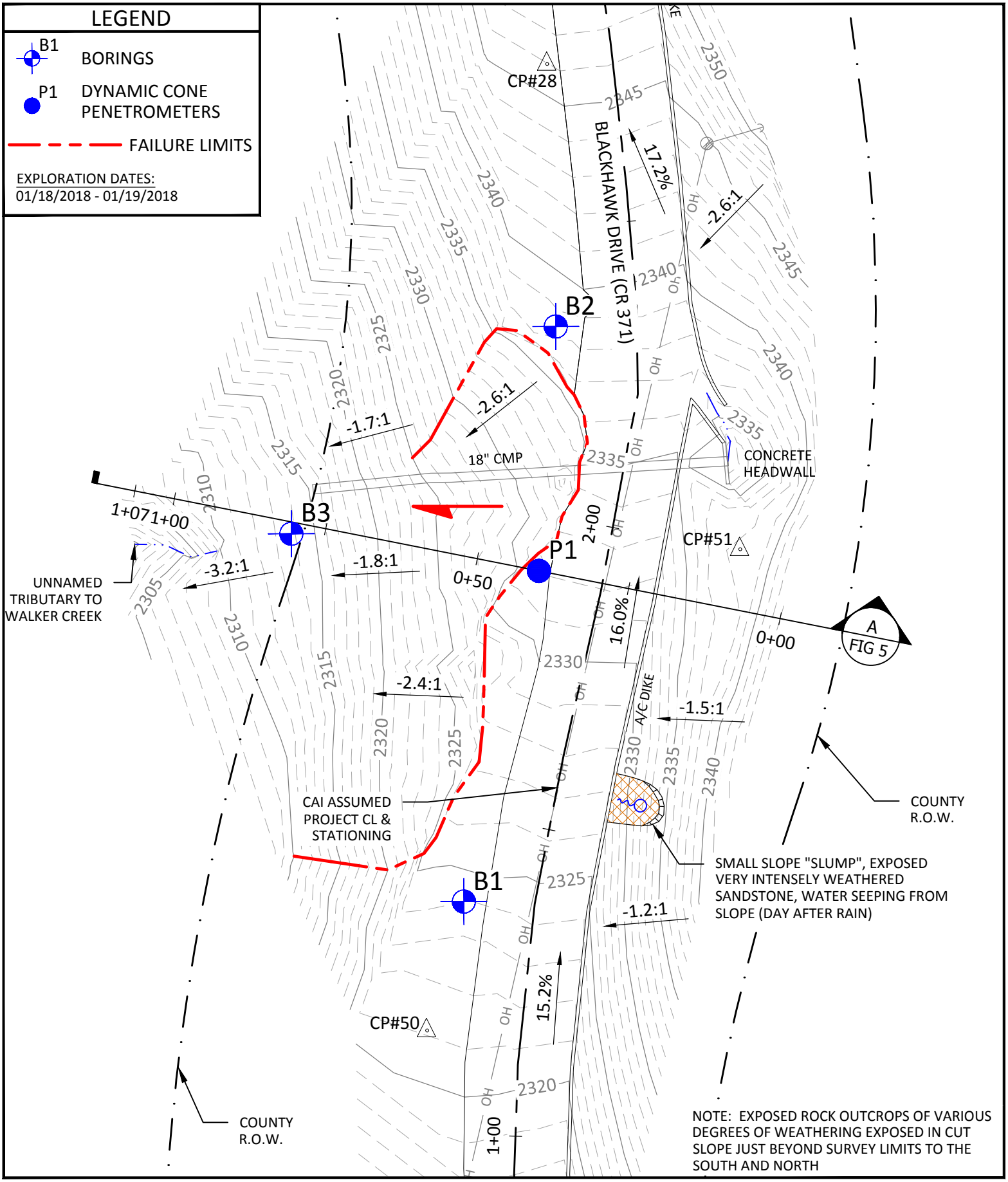

NORTH

Map and Data Source:
Basemap provided by MCDOT via electronic transfer on 10/31/2017. Survey completed by SHN Engineers & Geologist, Inc. in July, 2017.

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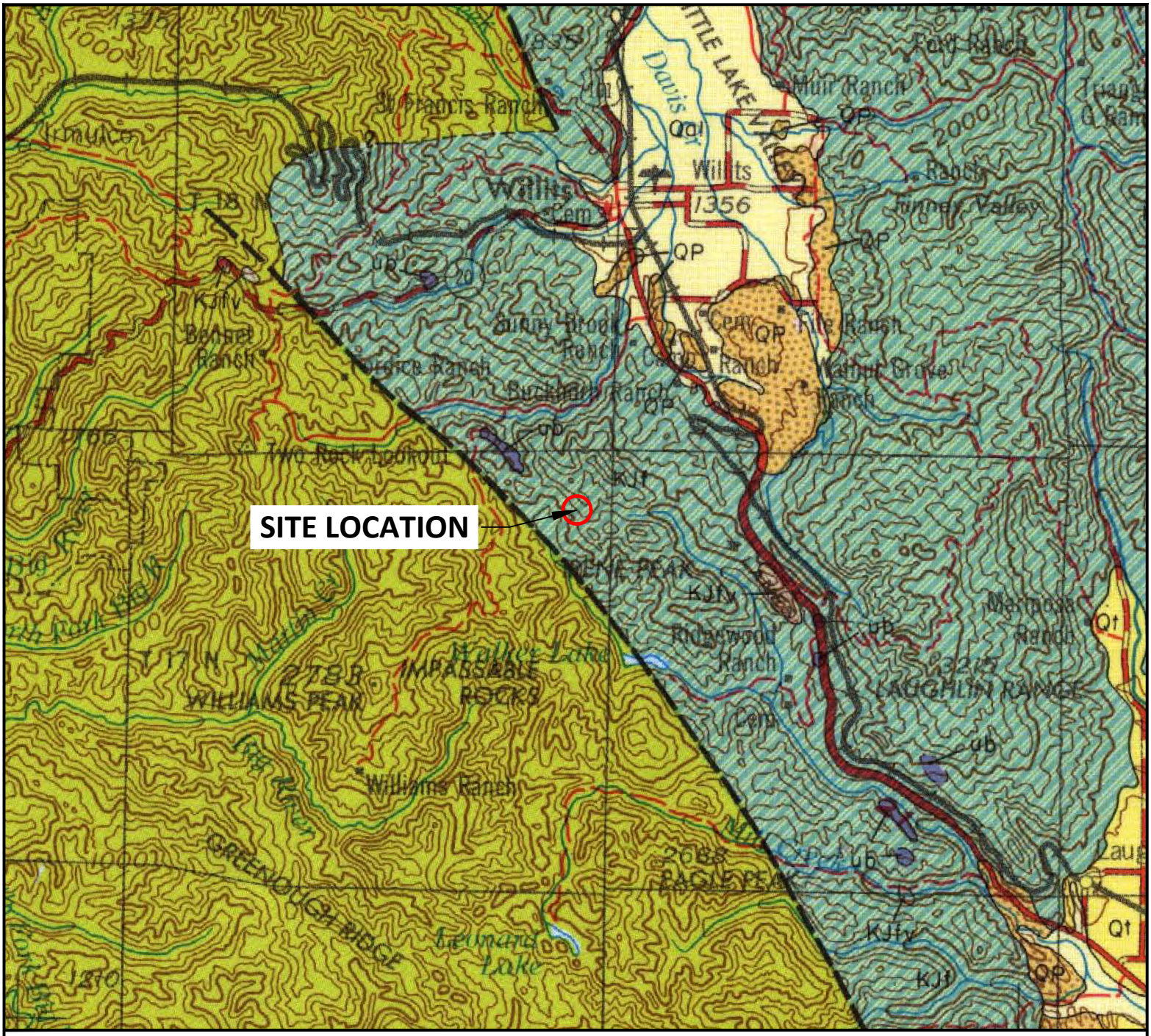
GEOTECHNICAL INVESTIGATION
BLACKHAWK DRIVE (CR 371)
FAILURE AT MP 2.00

WILLITS, MENDOCINO COUNTY, CA

Figure 2
Exploration Location Map

Proj. No:	16-337.8
Scale:	1" = 20'
Date:	12/15/2017

Path: \\psf\Home\Box\Projects\16-337.X Mendocino 2016 Quadrennial Support Project\16-337.8 Blackhawk Drive (CR 371) at MP 2.00\CAD\16-337.8-Figures.dwg Plot Date: Mar 07, 2018 at 10:58am



LEGEND

Geologic Formations

Qal — **Alluvium (Recent) -** *alluvial materials (sand, silt, clay); valley fill.*

K — **Undivided Marine Sedimentary Rocks (Cretaceous) -** *sandstone, shale, and conglomerate.*

KJf — **Franciscan Formation (Jurassic-Cretaceous) -** *sandstone, shale, chert, and conglomerate, with locally small areas of greenstone, limestone, basalt, schist, and related metamorphic rocks.*

CONTACT
(Dashed where approximately located, gradational or inferred)

FAULT
(Dashed where approximately located)

NORTH

Map Source:
Jennings, C.W. and Strand, R.G., 1960, Geologic Map of California, Ukiah Sheet, California Division of Mines and Geology, Scale 1:250,000

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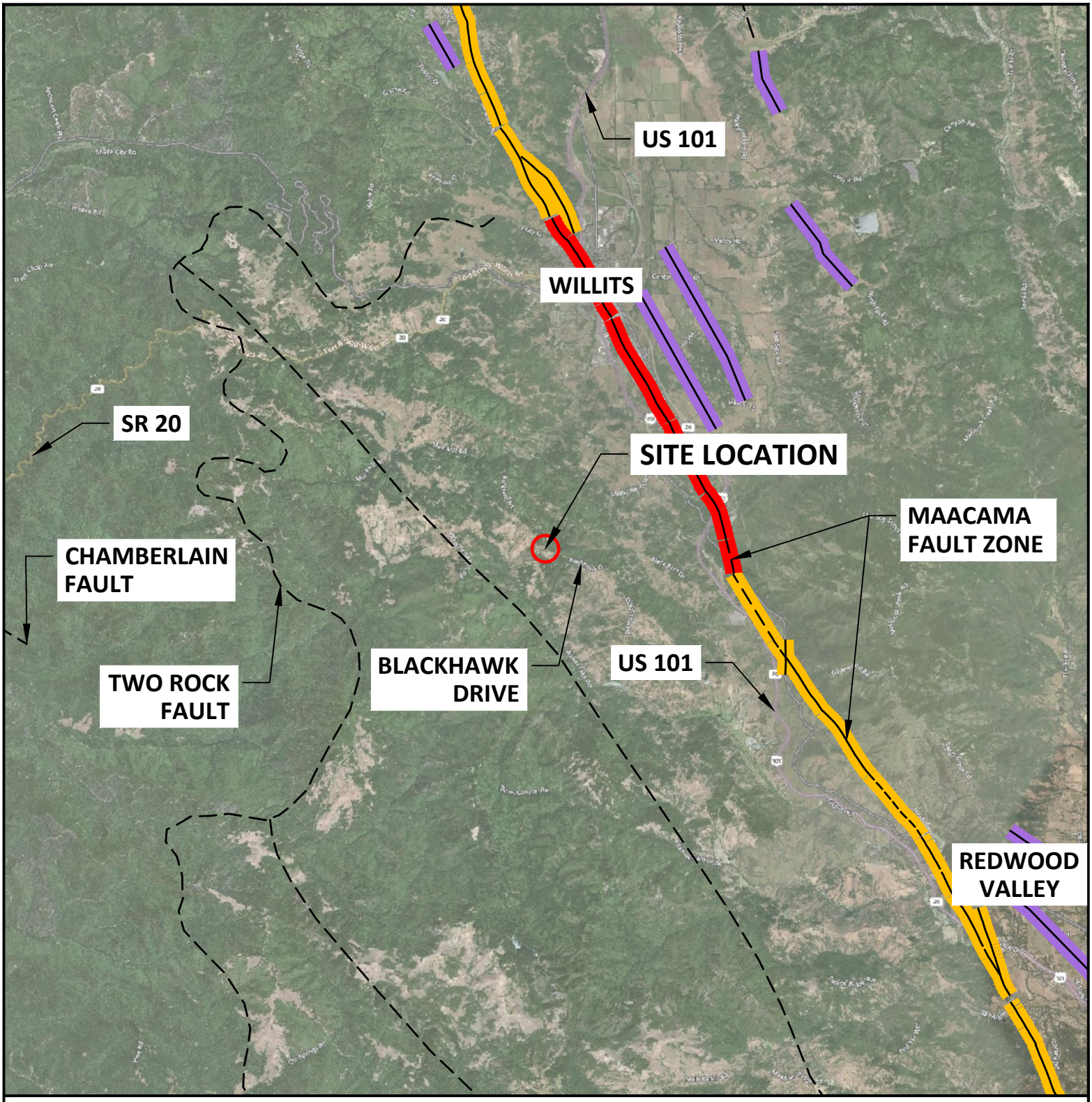
BLACKHAWK DRIVE (CR 371)
FAILURE AT MP 2.00

WILLITS, MENDOCINO COUNTY, CA

Figure 3
Regional Geologic Map

Proj. No: 16-337.8
Scale: 1" = 10,000'
Date: 12/15/2017

Path: \\psf\Home\Box\Projects\16-337.X Mendocino 2016 Quadrennial Support Project\16-337.8 Blackhawk Drive (CR 371) at MP 2.00\CAD\16-337.8-Figures.dwg Plot Date: Mar 07, 2018 at 1:34pm



LEGEND

CGS Faults (Last Activity Age)	CGS Faults (Last Activity Age)	Fault Location
<200 years (Historic)	<1.6 million years (Quaternary)	Certain
<11,700 years (Holocene)	>1.6 million years (Pre-Quaternary)	Approx. or Inferred
<700,000 years (Late Quaternary)		Concealed

NORTH

Map and Data Sources:

1. Basemap via AutoCAD Civil 3D geolocation tool

2. Fault data via CGS Fault Activity Map of California 2010 GIS data

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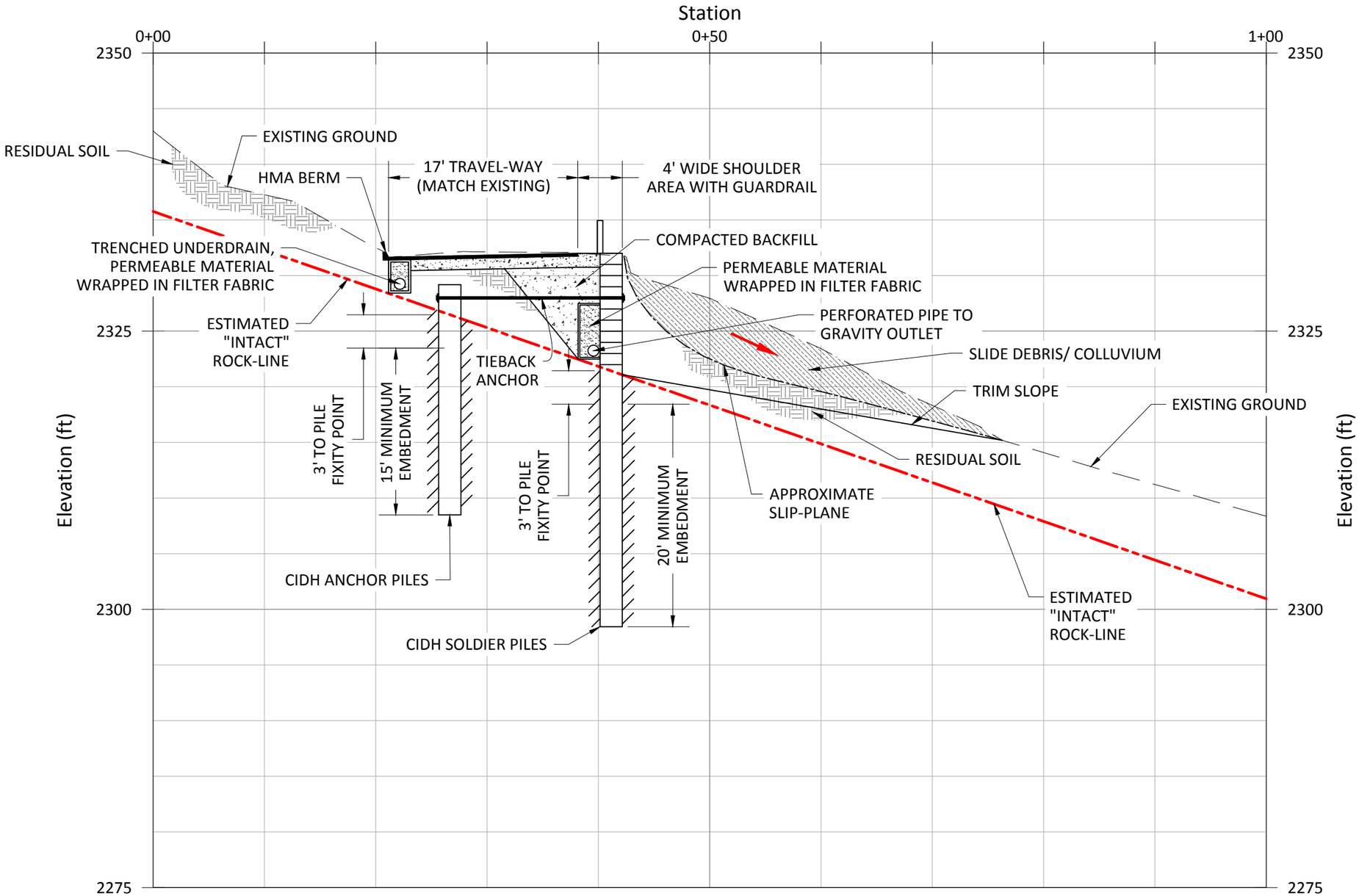
BLACKHAWK DRIVE (CR 371)
FAILURE AT MP 2.00

WILLITS, MENDOCINO COUNTY, CA

Figure 4
Fault Activity Map

Proj. No: 16-337.8
Scale: 1" = 10,000'
Date: 12/15/2017

Path: \\psf\Home\Box\Projects\16-337.X Mendocino 2016 Quadrennial Support Project\16-337.8 Blackhawk Drive (CR 371) at MP 2.00\CAD\16-337.8-Figures.dwg Plot Date: Mar 07, 2018 at 2:26pm



Profile of Section A

NORTH

Data Source:
Existing Topography provided by MCDOT via electronic transfer on 10/31/2017. Survey completed by SHN Engineers & Geologist, Inc. in July, 2017.

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GEOTECHNICAL INVESTIGATION
BLACKHAWK DRIVE (CR 371)
FAILURE AT MP 2.00

WILLITS, MENDOCINO COUNTY, CA

Figure 5
Typical Section of Tieback Wall

Prj. No:	16-337.8
Scale:	1" = 10'
Date:	03/08/2018

APPENDIX A

BORING LOG LEGEND
BORING LOGS

GROUP SYMBOLS AND NAMES

Graphic / Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GM	SILTY GRAVEL SILTY GRAVEL with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL
SP	Poorly graded SAND Poorly graded SAND with GRAVEL
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SM	SILTY SAND SILTY SAND with GRAVEL
SC	CLAYEY SAND CLAYEY SAND with GRAVEL
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL
PT	PEAT
	COBBLES COBBLES and BOULDERS BOULDERS

Graphic / Symbol	Group Names
CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY elastic ELASTIC SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND

FIELD AND LABORATORY TESTS

C	Consolidation (ASTM D 2435)
CL	Collapse Potential (ASTM D 4546)
CP	Compaction Curve (CTM 216)
CR	Corrosion, Sulfates, Chlorides (CTM 643, CTM 417, CTM 422)
CU	Consolidated Undrained Triaxial (ASTM D 4767)
DR	Drained Residual Shear Strength (ASTM D 6467)
DS	Direct Shear (ASTM D 3080)
EI	Expansion Index (ASTM D 4829)
M	Moisture Content (ASTM D 2216)
OC	Organic Content (ASTM D 2974)
P	Permeability (CTM 220)
PA	Particle Size Analysis (ASTM D 422)
PI	Liquid Limit, Plastic Limit, Plasticity Index (AASHTO T 89, AASHTO T 90)
PL	Point Load Index (ASTM D 5731)
PM	Pressure Meter
R	R-Value (CTM 301)
SE	Sand Equivalent (CTM 217)
SG	Specific Gravity (AASHTO T 100)
SW	Swell Potential (ASTM D 4546)
UC	Unconfined Compression - Soil (ASTM D 2166) Unconfined Compression - Rock (ASTM D 7012-C)
UU	Unconsolidated Undrained Triaxial (ASTM D 2850)
UW	Unit Weight (ASTM D 7263)

SAMPLER GRAPHIC SYMBOLS

- Standard Penetration Test (SPT)
- Standard California Sampler (ID 2.5 in.)
- Modified California Sampler (ID 2.0 in.)
- Shelby Tube
- Piston Sampler
- NX Rock Core
- HQ Rock Core
- Bulk Sample
- Other (see remarks)

DRILLING METHOD SYMBOLS

- Auger Drilling
- Rotary Drilling
- Dynamic Cone or Hand Driven
- Diamond Core

WATER LEVEL SYMBOLS

- First Water Level Reading (during drilling)
- Static Water Level Reading (short-term)
- Static Water Level Reading (long-term)

REFERENCE: Caltrans Soil and Rock Logging, Classification, and Presentation Manual (2010) with Errata Sheet (2015).

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Boring Record Legend

Soil Legend

CONSISTENCY OF COHESIVE SOILS				
Descriptor	**Unconfined Compressive Strength (tsf)**	**Pocket Penetrometer (tsf)**	**Torvane (tsf)**	**Field Approximation**
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 - 0.50	0.25 - 0.50	0.12 - 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 - 1.0	0.50 - 1.0	0.25 - 0.50	Can be penetrated several inches by thumb with moderate effort
Stiff	1.0 - 2.0	1.0 - 2.0	0.50 - 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2.0 - 4.0	2.0 - 4.0	1.0 - 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

APPARENT DENSITY OF COHESIONLESS SOILS	
Descriptor	**SPT N_{60} (blows / 12 inches)**
Very Loose	0 - 5
Loose	5 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	> 50

MOISTURE	
Descriptor	**Criteria**
Dry	No discernable moisture
Moist	Moisture present, but no free water
Wet	Visible free water

PERCENT OR PROPORTION OF SOILS	
Descriptor	**Criteria**
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

SOIL PARTICLE SIZE		
Descriptor		**Size**
Boulder		> 12 inches
Cobble		3 to 12 inches
Gravel	Coarse	3/4 inch to 3 inches
	Fine	No. 4 Sieve to 3/4 inch
Sand	Coarse	No. 10 Sieve to No. 4 Sieve
	Medium	No. 40 Sieve to No. 10 Sieve
	Fine	No. 200 Sieve to No. 40 Sieve
Silt and Clay		Passing No. 200 Sieve

PLASTICITY OF FINE-GRAINED SOILS	
Descriptor	**Criteria**
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled, and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll, and not much time is required to reach the plastic limit; it cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

CEMENTATION	
Descriptor	**Criteria**
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

REFERENCE: Caltrans Soil and Rock Logging, Classification, and Presentation Manual (2010).

ROCK GRAPHIC SYMBOLS


IGNEOUS ROCK


SEDIMENTARY ROCK


METAMORPHIC ROCK

BEDDING SPACING

Descriptor	Thickness or Spacing
Massive	> 10 ft
Very thickly bedded	3 ft - 10 ft
Thickly bedded	1 ft - 3 ft
Moderately bedded	4 in - 1 ft
Thinly bedded	1 in - 4 in
Very thinly bedded	1/4 in - 1 in
Laminated	< 1/4 in

WEATHERING DESCRIPTORS FOR INTACT ROCK

	Diagnostic Features					
	Chemical Weathering-Discoloration-Oxidation		Mechanical Weathering and Grain Boundary Conditions	Texture and Solutioning		
Descriptor	Body of Rock	Fracture Surfaces		Texture	Solutioning	General Characteristics
Fresh	No discoloration, not oxidized	No discoloration or oxidation	No separation, intact (tight)	No change	No solutioning	Hammer rings when crystalline rocks are struck.
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.
Moderately Weathered	Discoloration or oxidation extends from fractures usually throughout; Fe-Mg minerals are "rusty"; feldspar crystals are "cloudy"	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.
Intensely Weathered	Discoloration or oxidation throughout; all feldspars and Fe-Mg minerals are altered to clay to some extent; or chemical alteration produces in situ disaggregation (refer to grain boundary conditions)	All fracture surfaces are discolored or oxidized; surfaces are friable	Partial separation, rock is friable; in semi-arid conditions, granitics are disaggregated	Altered by chemical disintegration such as via hydration or argillation	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 hairline fractures or veinlets. Rock is significantly weakened.
Decomposed	Discolored of 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. Resistant minerals such as quartz may be present as "stringers" or "dikes".

Note: Combination descriptors (such as "slightly weathered to fresh") are used where equal distribution of both weathering characteristics is present over significant intervals or where characteristics present are "in between" the diagnostic feature. However, combination descriptors should not be used where significant identifiable zones can be delineated. Only two adjacent descriptors shall be combined. "Very intensely weathered" is the combination descriptor for "decomposed to intensely weathered".

PERCENT CORE RECOVERY (REC)

$$\frac{\Sigma \text{ Length of the recovered core pieces (in.)}}{\text{Total length of core run (in.)}} \times 100$$

ROCK QUALITY DESIGNATION (RQD)

$$\frac{\Sigma \text{ Length of intact core pieces} > 4 \text{ in.}}{\text{Total length of core run (in.)}} \times 100$$

Note: RQD* indicates soundness criteria not met

ROCK HARDNESS

Descriptor	Criteria
Extremely Hard	Specimen cannot be scratched with pocket knife or sharp pick; can only be chipped with repeated heavy hammer blows
Very hard	Specimen cannot be scratched with pocket knife or sharp pick; breaks with repeated heavy hammer blows
Hard	Specimen can be scratched with pocket knife or sharp pick with heavy pressure; heavy hammer blows required to break specimen
Moderately Hard	Specimen can be scratched with pocket knife or sharp pick with light or moderate pressure; breaks with moderate hammer blows
Moderately Soft	Specimen can be grooved 1/16 in. with pocket knife or sharp pick with moderate or heavy pressure; breaks with light hammer blow or heavy hand pressure
Soft	Specimen can be grooved or gouged with pocket knife or sharp pick with light pressure, breaks with light to moderate hand pressure
Very Soft	Specimen can be readily indented, grooved, or gouged with fingernail, or carved with pocket knife; breaks with light manual pressure.

FRACTURE DENSITY

Descriptor	Criteria
Unfractured	No fractures
Very Slightly Fractured	Core lengths greater than 3 ft.
Slightly Fractured	Core lengths mostly from 1 ft. to 3 ft.
Moderately Fractured	Core lengths mostly from 4 in. to 1 ft.
Intensely Fractured	Core lengths mostly from 1 in. to 4 in.
Very Intensely Fractured	Mostly chips and fragments.

REFERENCE: Caltrans Soil and Rock Logging, Classification, and Presentation Manual (2010).

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Boring Record Legend

Rock Legend

LOG OF BORING B1

PROJECT NO: 16-337.8
PROJECT: Blackhawk Drive at MP 2.00
LOCATION: Blackhawk Drive, Willits
CITY/COUNTY: Mendocino
CLIENT: MCDOT
LOGGED BY: RRH
DEPTH OF BORING: 40.25 (ft)

BEGIN DATE: 1/19/18
COMPLETION DATE: 1/19/18
SURFACE ELEVATION: 2324.0 (ft)*
SURFACE CONDITION: Grass/Dirt
WATER DEPTH: Not Encountered (ft)
READING TAKEN: 1/19/18
HAMMER EFFICIENCY: 81.5 (%)

DRILLING CONTRACTOR: Clear Heart Drilling, Inc.
DRILLING METHOD: Hollow-Stem Auger (7.5" OD, 3.25" ID)
DRILL RIG: Deeprock - DR8K (Track)
HAMMER TYPE: Automatic, 140 lbs, 30" drop
SAMPLER TYPE & SIZE: SPT (ID 1.4") and CAL (ID 2.4")
BOREHOLE DIAMETER: 7.5"
BACKFILL METHOD: Type II-V Portland Cement

ELEV (ft)	DEPTH (ft)	SAMPLE	SAMPLE NO	BLOWS PER 6 INCH	BLOWS PER FOOT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	RECOVERY(%)	RQD (%)	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE (%)	D. DENSITY (PCF)	% PASSING 200 SIEVE	DRILL METHOD	CASING DEPTH	REMARKS
	0							SANDY lean CLAY with GRAVEL (CL); brown; dry [FILL].										
2322	2		0						100		43	21			54			Chemical Analysis pH = 6.32 Min. Res. = 2680 ohm-cm Chloride = 3.9 ppm Sulfate = 38.5 ppm
2320	4																	
	5		1	13 17 17	34	4.00 >4.50 >4.50		SEDIMENTARY ROCK (SANDSTONE), brown, decomposed, moist, with scattered intact rock fragments, break downs to silty sand (SM) [DECOMPOSED BEDROCK].	67				18.8	106				
2318	6																	
2316	8																	
	9							SEDIMENTARY ROCK (SANDSTONE), grayish brown with mottling, very intensely weathered, moist, intensely weathered rock in sampler tip [FRANCISCAN FORMATION].										Increased drilling effort at 9'
2314	10		2	27 50/5"	50/5	>4.50 >4.50			82				9.2	112				
2312	12																	
2310	14																	
	15		3	25 50/2"	50/2	4.50 >4.50		Grayish brown, intensely weathered, very soft to soft, very intensely fractured, moist, with piece of intact rock.	88				4.3	104.1				
2308	16																	
2306	18							SEDIMENTARY ROCK (GRAYWACKE), brownish gray with mottling, intensely weathered, moist.										Further increase in drilling effort at 18'
	20		4	21 50/4"	50/4	>4.50 >4.50			100				7.5	103.8				
2304	21																	
2302	22																	
	23																	

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ELEV (ft)	DEPTH (ft)	SAMPLE	SAMPLE NO	BLOWS PER 6 INCH	BLOWS PER FOOT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	RECOVERY(%)	RQD (%)	LABORATORY: LIQUID LIMIT	LABORATORY: PLASTIC LIMIT	LABORATORY: MOISTURE (%)	LABORATORY: D. DENSITY (PCF)	LABORATORY: % PASSING 200 SIEVE	DRILL METHOD / CASING DEPTH	REMARKS
								SEDIMENTARY ROCK (Graywacke) *(continued)*.									
2298	25 26		5	28 37 50/5"	87/11	>4.50 >4.50		Medium gray, moderately weathered, moderately hard, dry, interbeds of very intensely weathered brown sandstone, with fresh to slightly weathered rock pieces in sampler tip.	88				8.9	113.5			
2296	27 28 29																
2294	30		6	17 28 27	55	>4.50 >4.50 >4.50		Brownish gray, very intensely weathered, moist, with moderately weathered rock fragments.	94				7.5	110.4			
2292	31 32 33																Drill chatter, very hard drilling, slow auger progression at 33'
2290	34 35		7	50/6"	REF			Medium gray, slightly weathered to fresh, moderately hard, dry.	67								
2288	36 37																Very slow auger progression at 36'
2286	38 39																Heavy drill chatter at 39'
2284	40		8	50/3"	REF			Moderately weathered, dry.	100								Essential auger refusal at 40'
								Bottom of borehole at 40.3 ft bgs Backfilled with 94lbs bags of portland cement grout (mix 5 bags/50 gal. water) *Elevation Reference: CP#50, Elev. 2321.37 feet per SHN topographic survey								
2282	41 42 43																
2280	44 45																
2278	46 47																
2276	48 49																
2274	50 51																
2272	52 53																

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PROJECT NUMBER: 16-337.8
PROJECT: Blackhawk Drive at MP 2.00
BORING: B1
ENTRY BY: RRH
CHECKED BY: RDS

LOG OF BORING B2

PROJECT NO: 16-337.8
PROJECT: Blackhawk Drive at MP 2.00
LOCATION: Blackhawk Drive, Willits
CITY/COUNTY: Mendocino
CLIENT: MCDOT
LOGGED BY: RRH
DEPTH OF BORING: 43.92 (ft)

BEGIN DATE: 1/18/18
COMPLETION DATE: 1/18/18
SURFACE ELEVATION: 2338.4 (ft)*
SURFACE CONDITION: Baserock
WATER DEPTH: Not Encountered (ft)
READING TAKEN: 1/18/18
HAMMER EFFICIENCY: 81.5 (%)

DRILLING CONTRACTOR: Clear Heart Drilling, Inc.
DRILLING METHOD: Hollow-Stem Auger (7.5" OD, 3.25" ID)
DRILL RIG: Deeprock - DR8K (Track)
HAMMER TYPE: Automatic, 140 lbs, 30" drop
SAMPLER TYPE & SIZE: SPT (ID 1.4") and CAL (ID 2.4")
BOREHOLE DIAMETER: 7.5"
BACKFILL METHOD: Type II-V Portland Cement

ELEV (ft)	DEPTH (ft)	SAMPLE	SAMPLE NO	BLOWS PER 6 INCH	BLOWS PER FOOT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	RECOVERY(%)	RQD (%)	LABORATORY: LIQUID LIMIT	PLASTIC LIMIT	MOISTURE (%)	D. DENSITY (PCF)	% PASSING 200 SIEVE	DRILL METHOD	CASING DEPTH	REMARKS
2338	0							Well-graded GRAVEL with SILT and SAND (GW-GM); dark reddish brown; wet [BASEROCK, FILL].										
2336	2																	
2334	4							Lean CLAY with SAND (CL); medium stiff; reddish brown; moist [RESIDUAL SOIL].										
	5		1	2 4 6	10	0.75 1.50 3.25			100				26.3	98.9				Unconfined Comp. Test UC = 749 psf
2332	6							SEDIMENTARY ROCK (SANDSTONE), olive, decomposed, moist, with some calcite veins [DECOMPOSED BEDROCK].										
2330	8							SEDIMENTARY ROCK (SANDSTONE), moderate reddish brown, very intensely weathered, moist, breaks down to silty sand (SM) [FRANCISCAN FORMATION].										
2328	10		2	12 24 22	46	>4.50 >4.50			83				11.7	120.5				
2326	12																	
2324	14																	
	15		3	17 21 27	48	>4.50 >4.50		Dark brown.	100				15.9	117.6				
2322	16																	
2320	18							SEDIMENTARY ROCK (GRAYWACKE), dark gray, decomposed, moist, with few intact rock fragments, breaks down to silty, clayey sand (SC-SM).										Increased drilling effort at 18'
	20		4	10 13 17	30	4.25 >4.50			67				7.9	130.8				Unconfined Comp. Test UC = 3110 psf
2318	21																	
2316	22																	
	23																	

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Sacramento, CA 95831
(916) 455-4225

PROJECT NUMBER: 16-337.8
PROJECT: Blackhawk Drive at MP 2.00
BORING: B2
ENTRY BY: RRH
CHECKED BY: RDS

ELEV (ft)	DEPTH (ft)	SAMPLE	SAMPLE NO	BLOWS PER 6 INCH	BLOWS PER FOOT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	RECOVERY(%)	RQD (%)	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE (%)	D. DENSITY (PCF)	% PASSING 200 SIEVE	DRILL METHOD	CASING DEPTH	REMARKS
2314								SEDIMENTARY ROCK (Graywacke) *(continued)*.										
	25		5	3 5 3	8	3.50 2.50		Moist, breaks down to silty clay with sand (CL-ML).	67				14.3	119				Unconfined Comp. Test UC = 8698 psf
2312	26																	
	27																	
2310	28																	Hard drilling at 28.5'; cuttings are dry, gray coarse sand-sized particles
	29																	
2308	30		6	25 33 36	69	>4.50 >4.50		Very intensely weathered.	100				4.9	125				
	31																	
2306	32																	Very hard drilling, slow auger progression
	33																	
2304	34																	
	35		7	50/3"	REF			Moderately weathered.	33									
2302	36																	
	37																	Drill chatter/screeching at 37', add water to help bind cuttings
2300	38																	
	39																	
2298	40		8	10 27 33	60	>4.50 >4.50		Very intensely weathered, moist, with shale interbeds and moderately weathered rock fragments.	94				4.6	129.5				
	41																	
2296	42																	
	43		9	33 50/5"	50/5			Intensely to moderately weathered, dry.	64									Essential auger refusal at 43' (bit teeth worn down)
2294	44							Bottom of borehole at 43.9 ft bgs Backfilled with 94lbs bags of portland cement grout (mix 7 bags/70 gal. water) *Elevation Reference: CP#50, Elev. 2321.37 feet per SHN topographic survey										
	45																	
2292	46																	
	47																	
2290	48																	
	49																	
2288	50																	
	51																	
2286	52																	
	53																	

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PROJECT NUMBER: 16-337.8
PROJECT: Blackhawk Drive at MP 2.00
BORING: B2
ENTRY BY: RRH
CHECKED BY: RDS

LOG OF BORING B3

PROJECT NO: 16-337.8
PROJECT: Blackhawk Drive at MP 2.00
LOCATION: Blackhawk Drive, Willits
CITY/COUNTY: Mendocino
CLIENT: MCDOT
LOGGED BY: RRH
DEPTH OF BORING: 17.25 (ft)

BEGIN DATE: 1/19/18
COMPLETION DATE: 1/19/18
SURFACE ELEVATION: 2313.8 (ft)*
SURFACE CONDITION: Grass
WATER DEPTH: Not Encountered (ft)
READING TAKEN: 1/19/18
HAMMER EFFICIENCY: 60 (%)

DRILLING CONTRACTOR: Clear Heart Drilling, Inc.
DRILLING METHOD: Solid-Stem Auger (4" OD)
DRILL RIG: Portable Drill
HAMMER TYPE: Cathead, 140 lbs, 30" drop
SAMPLER TYPE & SIZE: SPT (ID 1.4") and CAL (ID 2.4")
BOREHOLE DIAMETER: 4"
BACKFILL METHOD: Type II-V Portland Cement

ELEV (ft)	DEPTH (ft)	SAMPLE	SAMPLE NO	BLOWS PER 6 INCH	BLOWS PER FOOT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	RECOVERY(%)	RQD (%)	LABORATORY: LIQUID LIMIT	LABORATORY: PLASTIC LIMIT	LABORATORY: MOISTURE (%)	LABORATORY: D. DENSITY (PCF)	LABORATORY: % PASSING 200 SIEVE	DRILL METHOD	CASING DEPTH	REMARKS
2312	1							CLAYEY SAND (SC); brown; moist [RESIDUAL SOIL].										
	2																	
	3							SANDY lean CLAY (CL); very stiff; brown; moist.										
2310	4																	
	5		1	7	18				67									
2308	6			9		>4.50					42	22	15.6	117.5				Chemical Analysis pH = 5.12 Min. Res. = 3480 ohm-cm Chloride = 2.9 ppm Sulfate = 17.2 ppm
				9		2.5		SEDIMENTARY ROCK (SANDSTONE), brown with mottling, decomposed, moist, with intensely weathered rock fragments in tip [DECOMPOSED BEDROCK].										
	7																	
2306	8							SEDIMENTARY ROCK (SANDSTONE), grayish brown with mottling, very intensely weathered, moist, scattered moderately weathered rock fragments, breaks down to silty sand [FRANCISCAN FORMATION].										
	9																	
2304	10		2	21	78/11				76				15.6	115.7				Direct Shear Test Phi = 30.6 deg. C = 750 psf
	11			28		>4.50												
				50/5"		>4.50												
2302	12							SEDIMENTARY ROCK (GRAYWACKE), medium gray, intensely weathered, soft to moderately soft, dry.										Hard drilling at 12'
	13																	
2300	14																	
	15		3	40	50/5	>4.50			91									Drill chatter at 14.5'
2298	16			50/5"		>4.50							7.2	133.9				
	17		4	50/3"	REF			Moderately to slightly weathered, moderately hard, with pieces of intact rock.	33									Heavy chatter/screeching, drill being lifted off ground, no auger progression, essential auger refusal at 17'
2296	18							Bottom of borehole at 17.3 ft bgs										
	19							Backfilled with 94lbs bags of portland cement grout (mix 2 bags/20 gal. water)										
2294	20							*Elevation Reference: CP#50, Elev. 2321.37 feet per SHN topographic survey										
	21																	
2292	22																	
	23																	
2290	24																	

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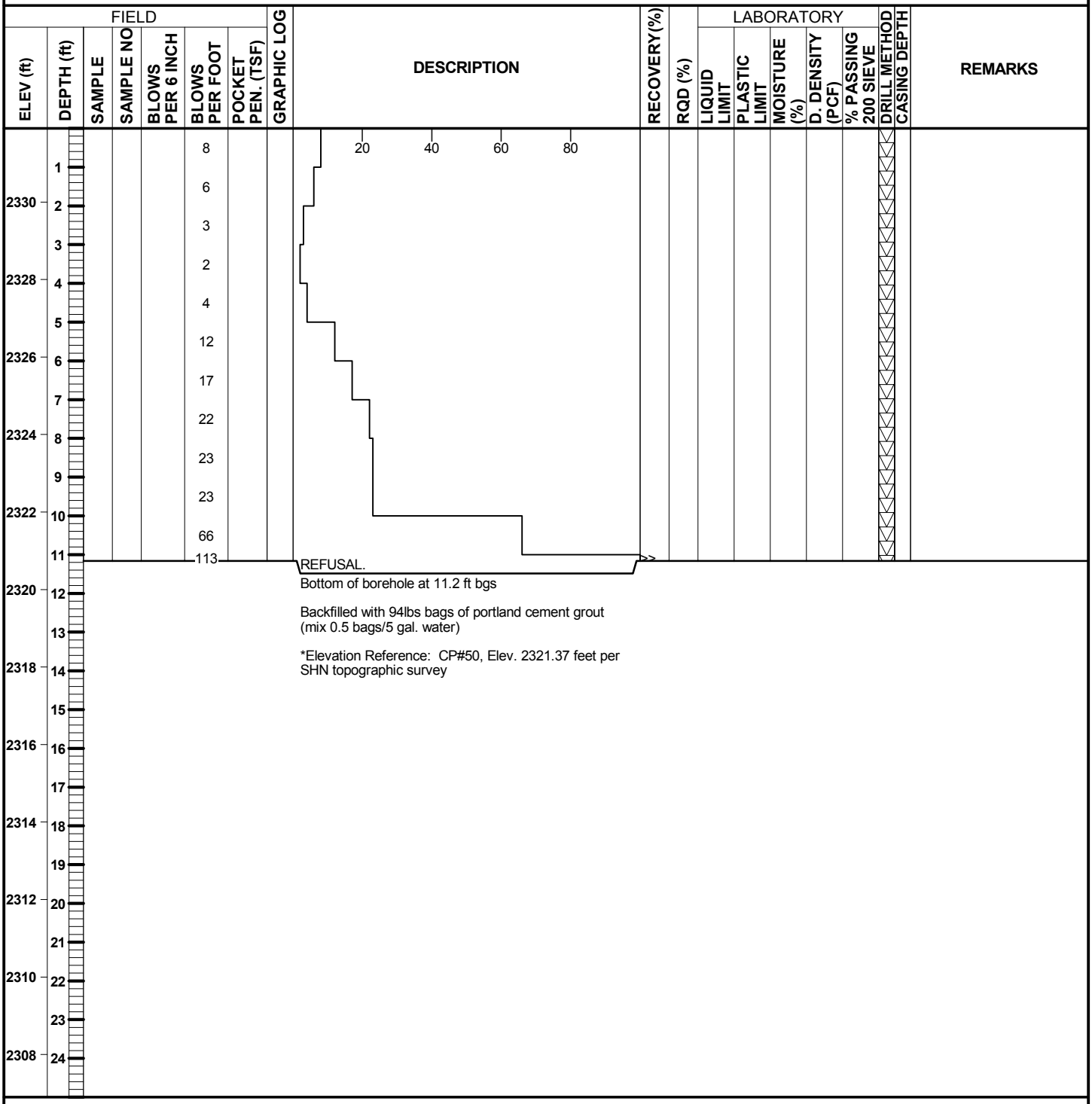
PROJECT NUMBER: 16-337.8
PROJECT: Blackhawk Drive at MP 2.00
BORING: B3
ENTRY BY: RRH
CHECKED BY: RDS

LOG OF BORING P1

PROJECT NO: 16-337.8
PROJECT: Blackhawk Drive at MP 2.00
LOCATION: Blackhawk Drive, Willits
CITY/COUNTY: Mendocino
CLIENT: MCDOT
LOGGED BY: RRH
DEPTH OF BORING: 11.16 (ft)

BEGIN DATE: 1/19/18
COMPLETION DATE: 1/19/18
SURFACE ELEVATION: 2331.9 (ft)*
SURFACE CONDITION: Baserock
WATER DEPTH: Not Encountered (ft)
READING TAKEN: 1/19/18
HAMMER EFFICIENCY: 81.5 (%)

DRILLING CONTRACTOR: Clear Heart Drilling, Inc.
DRILLING METHOD: Dynamic Cone Penetrometer (2" OD)
DRILL RIG: Deeprock - DR8K (Track)
HAMMER TYPE: Automatic, 140 lbs, 30" drop
SAMPLER TYPE & SIZE: None
BOREHOLE DIAMETER: 2"
BACKFILL METHOD: Type II-V Portland Cement



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PROJECT NUMBER: 16-337.8
PROJECT: Blackhawk Drive at MP 2.00
BORING: P1
ENTRY BY: RRH
CHECKED BY: RDS SHEET 1 of 1

APPENDIX B

LABORATORY AND FIELD TEST RESULTS SUMMARY

Job: **Blackhawk Drive (CR 371) MP 2.00**
Job No: **16-337.8**
Date: **02/22/18**

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Laboratory and Field Test Summary

	Boring I.D.	Sample I.D.	Sample Depth (ft)	USCS Class.	Field Blows N (bpf)	Corr. SPT Blows N_{60}	Moisture/Density			Classification						Strength				Chemical Analysis			
							Dry Density (pcf)	Moist. Content (%)	In-Situ Density (pcf)	Atterberg Limits			Gravel (%)	Sand (%)	Fines (%)	Pocket Pentr. (tsf)	Uncon. Comp. (psf)	Direct Shear		pH	Minimum Resistivity (ohm-cm)	Chloride Content (ppm)	Sulfate Content (ppm)
										Liquid Limit	Plastic Limit	Plasticity Index						Phi (deg)	Cohesion (psf)				
Road-Level	B1	0	2.0	CL	N/A	N/A				43	21	22			54					6.32	2,680	3.9	38.5
	B1	1	5.5	ROCK	34	30	106.0	18.8	125.9							+4.50							
	B1	2	10.5	ROCK	50/5"	50/5"	112.0	9.2	122.3							+4.50							
	B1	3	15.0	ROCK	50/2"	50/2"	104.1	4.3	108.6							+4.50							
	B1	4	20.5	ROCK	50/4"	50/4"	103.8	7.5	111.6							+4.50							
	B1	5	26.0	ROCK	87/11"	87/11"	113.5	8.9	123.6							+4.50							
	B1	6	31.0	ROCK	55	75	110.4	7.5	118.7							+4.50							
	B1	7	35.0	ROCK	REF	REF																	
	B1	8	40.0	ROCK	REF	REF																	
	B2	1	5.5	ROCK	10	9	98.9	26.3	124.9							1.50 - 3.25	749						
	B2	2	11.0	ROCK	46	41	120.5	11.7	134.6							+4.50							
	B2	3	15.5	ROCK	48	42	117.6	15.9	136.3							+4.50							
	B2	4	20.5	ROCK	30	27	130.8	7.9	141.1							+4.50	3,110						
	B2	5	25.5	ROCK	8	11	119.0	14.3	136.0							2.50 - 3.50	8,698						
	B2	6	31.0	ROCK	69	94	125.0	4.9	131.1							+4.50							
	B2	7	35.0	ROCK	REF	REF																	
	B2	8	41.0	ROCK	60	82	129.5	4.6	135.5							+4.50							
	B2	9	43.0	ROCK	50/5"	50/5"																	
Slope	B3	1	5.5	CL	18	12	117.5	15.6	135.8	42	22	20				2.50 - 4.50				**5.12**	3,480	2.9	17.2
	B3	2	10.0	ROCK	78/11"	78/11"	115.7	15.6	133.8							+4.50		30.6	750				
	B3	3	15.5	ROCK	50/5"	50/5"	133.9	7.2	143.5							+4.50							
	B3	4	17.0	ROCK	REF	REF																	

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Project Name: Blackhawk Drive at MP 2.0
CAInc File No: 16-337.8
Date: 2/14/18
Technician: HFW/CAP/KE

MOISTURE-DENSITY TESTS - D2216

	1	2	3	4	5
Sample No.	B1-1	B1-2	B1-3	B1-4	B1-5
USCS Symbol	Rock	Rock	Rock	Rock	Rock
Depth (ft.)	5.5	10.5	15	20.5	26
Sample Length (in.)	5.552	4.572	6.002	6.002	6.000
Diameter (in.)	2.387	2.377	1.418	1.415	1.415
Sample Volume (ft^3)	0.01438	0.01174	0.00549	0.00546	0.00546
Total Mass Soil+Tube (g)	821.5	928.4	395.8	397.8	431.8
Mass of Tube (g)	0.0	277.0	125.8	121.3	125.7
Tare No.	D14	F4	D20	H14	D5
Tare (g)	20.9	20.7	13.9	13.4	13.9
Wet Soil + Tare (g)	73.3	90.3	76.9	72.3	75.3
Dry Soil + Tare (g)	65.0	84.4	74.3	68.2	70.3
Dry Soil (g)	44.2	63.6	60.4	54.7	56.5
Water (g)	8.3	5.9	2.6	4.1	5.0
Moisture (%)	**18.8**	**9.2**	**4.3**	**7.5**	**8.9**
Dry Density (pcf)	**106.0**	**112.0**	**104.1**	**103.8**	**113.5**

Notes:

Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Blackhawk Drive at MP 2.0
CAInc File No: 16-337.8
Date: 2/14/18
Technician: HFW/CAP/KE

MOISTURE-DENSITY TESTS - D2216

	1	2	3	4	5
Sample No.	B1-6	B2-1	B2-2	B2-3	B2-4
USCS Symbol	Rock	D. Rock	Rock	Rock	Rock
Depth (ft.)	31	5.5	11	15.5	20.5
Sample Length (in.)	5.993	4.959	5.718	5.603	5.949
Diameter (in.)	1.418	2.381	2.404	2.382	2.375
Sample Volume (ft^3)	0.00548	0.01278	0.01502	0.01445	0.01525
Total Mass Soil+Tube (g)	420.2	723.8	1175.2	1170.5	976.7
Mass of Tube (g)	125.5	0.0	258.5	276.9	0.0
Tare No.	A1	F1	C20	G19	D6
Tare (g)	13.7	13.7	20.7	20.9	13.7
Wet Soil + Tare (g)	77.4	62.5	82.4	78.9	54.0
Dry Soil + Tare (g)	73.0	52.3	76.0	71.0	51.0
Dry Soil (g)	59.2	38.6	55.3	50.0	37.3
Water (g)	4.4	10.2	6.5	8.0	3.0
Moisture (%)	**7.5**	**26.3**	**11.7**	**15.9**	**7.9**
Dry Density (pcf)	**110.4**	**98.9**	**120.5**	**117.6**	**130.8**

Notes:

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Geotechnical Engineering, Design and Construction Services

Project Name: Blackhawk Drive at MP 2.0
CAInc File No: 16-337.8
Date: 2/14/18
Technician: HFW/CAP/KE

MOISTURE-DENSITY TESTS - D2216

	1	2	3	4	5
Sample No.	B2-5	B2-6	B2-8	B3-1	B3-3
USCS Symbol	Rock	Rock	Rock	CL	Rock
Depth (ft.)	25.5	31	41	5.5	15.5
Sample Length (in.)	3.235	5.998	5.635	5.639	5.708
Diameter (in.)	1.369	1.423	1.418	2.382	1.420
Sample Volume (ft^3)	0.00276	0.00552	0.00515	0.01454	0.00523
Total Mass Soil+Tube (g)	169.9	458.6	438.9	1123.4	463.9
Mass of Tube (g)	0.0	130.2	122.6	227.4	123.4
Tare No.	E4	A16	G7	A8	C8
Tare (g)	20.8	13.7	20.5	13.7	13.6
Wet Soil + Tare (g)	72.2	80.5	79.6	61.4	74.2
Dry Soil + Tare (g)	65.8	77.4	77.0	54.9	70.2
Dry Soil (g)	44.9	63.6	56.5	41.3	56.5
Water (g)	6.4	3.1	2.6	6.4	4.1
Moisture (%)	**14.3**	**4.9**	**4.6**	**15.6**	**7.2**
Dry Density (pcf)	**119.0**	**125.0**	**129.5**	**117.5**	**133.9**

Notes:

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Project Name: Blackhawk Drive at MP 2.00
CAInc File No: 16-337.8
Date: 2/14/18
Technician: ETT

200 Wash - ASTM D1140

Max Particle Size (100% Passing)	Standard Sieve Size	Recommended Min Mass of Test Specimens
2 mm or less	No. 10	20 g
4.75 mm	No. 4	100 g
9.5 mm	3/8 "	500 g
19.0 mm	3/4 "	2.5 kg
37.5 mm	1 1/2 "	10 kg
75.0 mm	3 "	50 kg

Table from 6.2 of ASTM D1140

Sample No.	B1-0				
USCS Symbol	CL				
Depth (ft.)	2				
Tare No.	R16				
Tare (g)	128.9				
Dry Soil + Tare (g)	313.5				
Dry Mass before (g)	184.6				
Dry Mass after (g)	84.3				
Percent Fines (%)	54				

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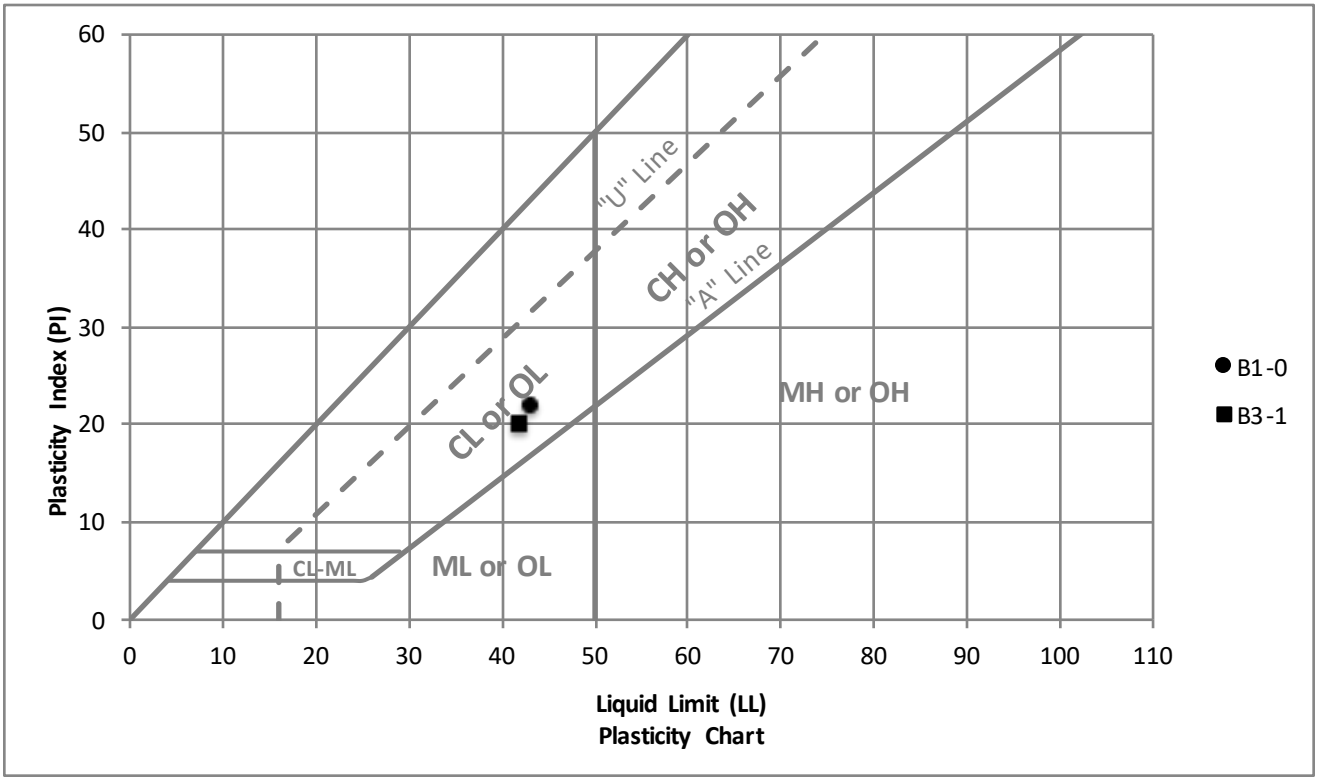
Project Name: Blackhawk Drive at MP 2.00
CAInc File No: 16-337.8
Date: 2/12/18
Technician: ETT/MEA

Plastic Index - ASTM D4318

Sample ID	Depth (ft)	Liquid Limit	Plastic Limit	PI
B1-0	2	43	21	22
B3-1	5.5	42	22	20



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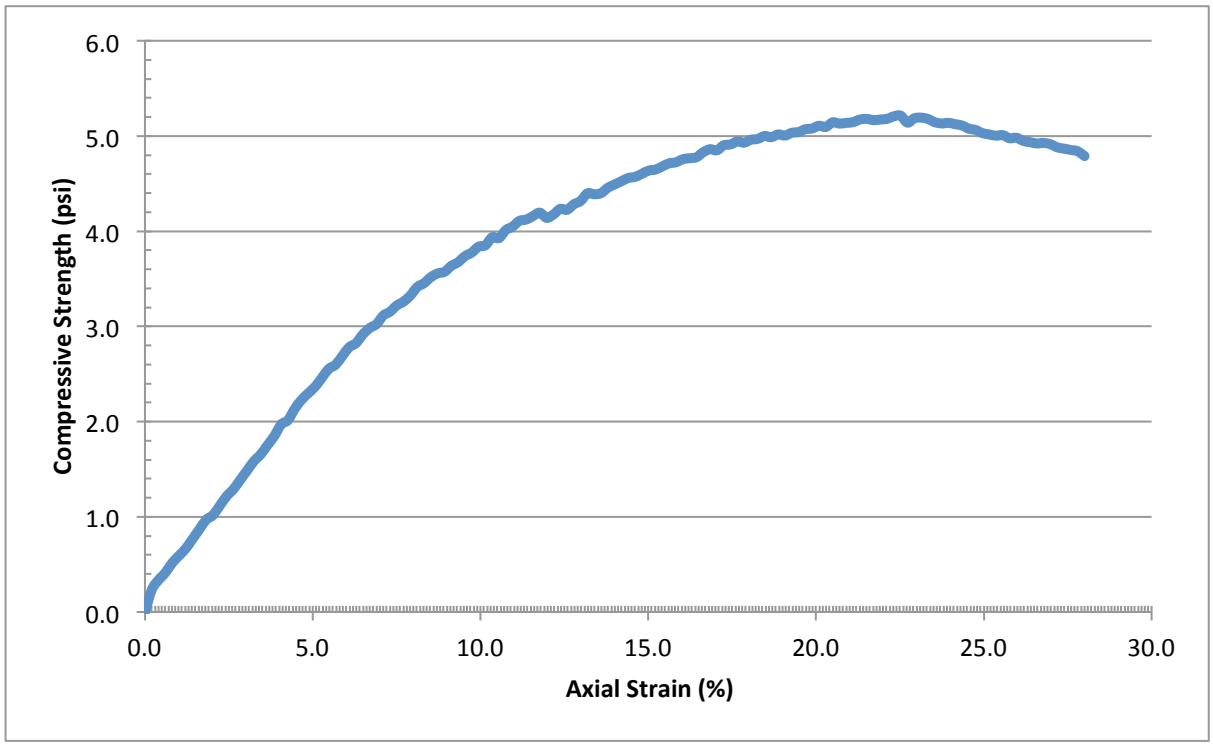
Project Name: Blackhawk Road MP 2.00
CAInc File No: 16-337.8
Date: 2/12/17
Technician: HFW
Sample ID: B2-1 Depth (ft): 5.5
USCS Classification: D.Rock

UNCONFINED COMPRESSION TEST - D2166



Dry Density (pcf)	**98.8**
Water Content (%)	**26.3**
Unconfined Compressive Strength (psi)	**5.2**
Unconfined Compressive Strength (psf)	**749**
Shear Strength (psf)	**374.4**
Average Height (in)	4.959
Average Diameter (in)	2.381
Rate of strain (%)	1.0
Strain at Failure (%)	22.5

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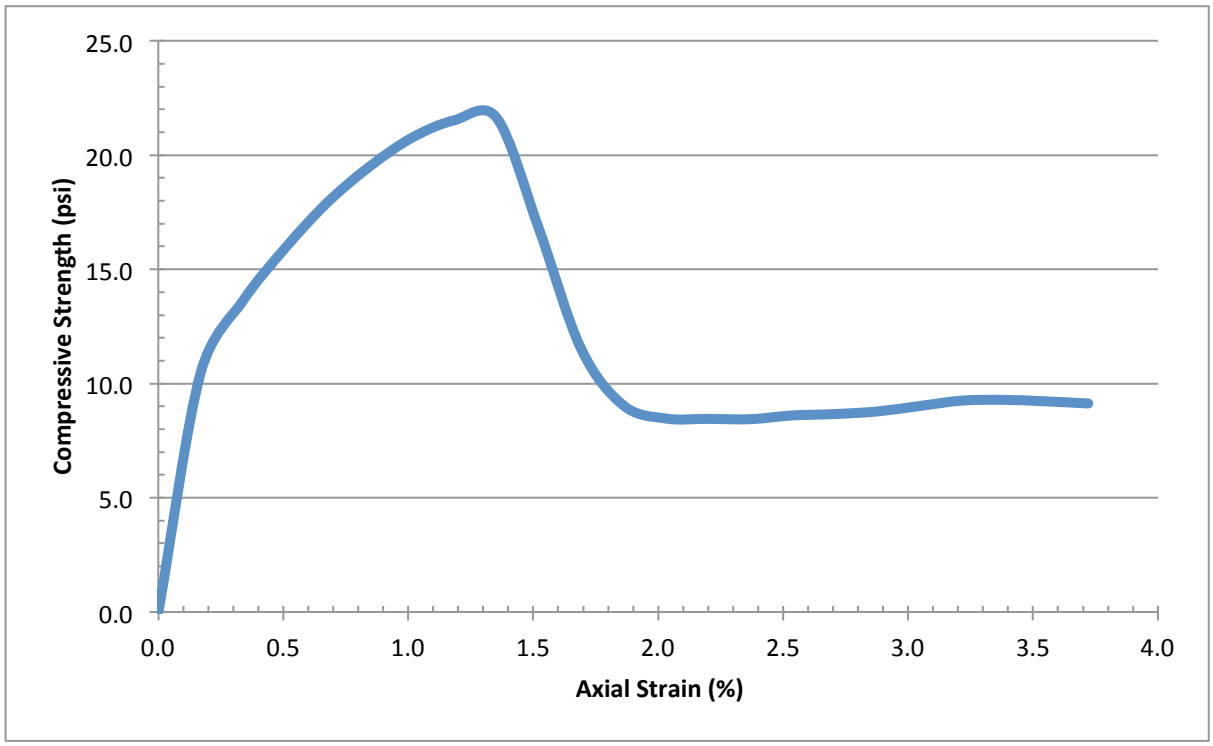
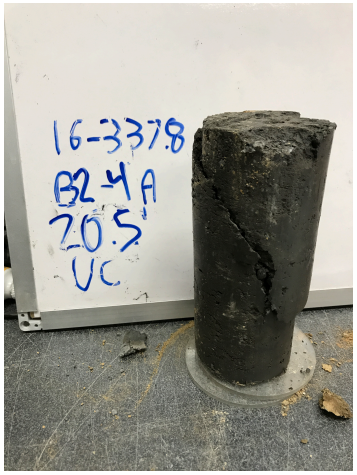
Project Name: Blackhawk Road MP 2.00
CAInc File No: 16-337.8
Date: 2/12/17
Technician: HFW
Sample ID: B2-4 Depth (ft): 20.5
USCS Classification: D.Rock

UNCONFINED COMPRESSION TEST - D2166



Dry Density (pcf)	**130.8**
Water Content (%)	**7.9**
Unconfined Compressive Strength (psi)	**21.6**
Unconfined Compressive Strength (psf)	**3110**
Shear Strength (psf)	**1555.2**
Average Height (in)	5.948
Average Diameter (in)	2.375
Rate of strain (%)	1.0
Strain at Failure (%)	1.4



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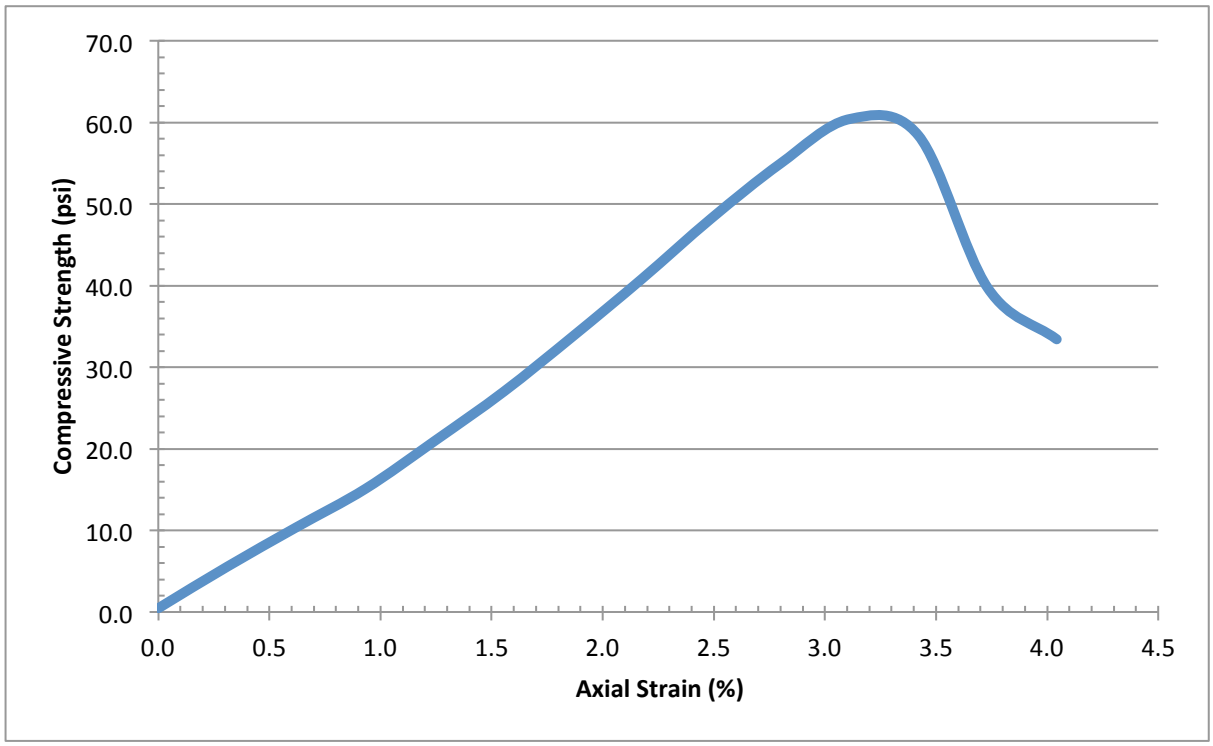
Project Name: Blackhawk Road MP 2.00
CAInc File No: 16-337.8
Date: 2/12/17
Technician: HFW
Sample ID: B2-5 Depth (ft): 25.5
USCS Classification: D.Rock

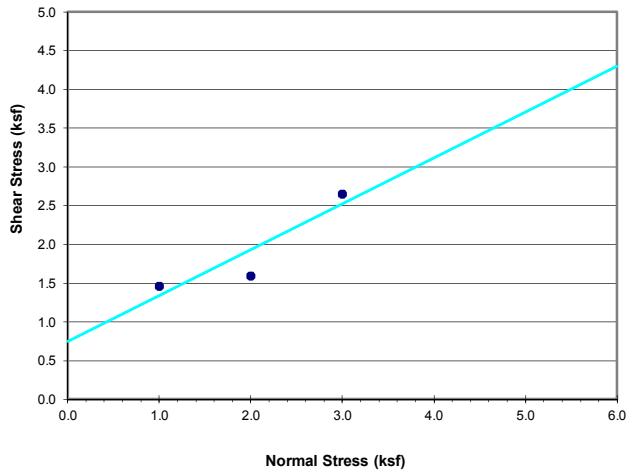
UNCONFINED COMPRESSION TEST - D2166



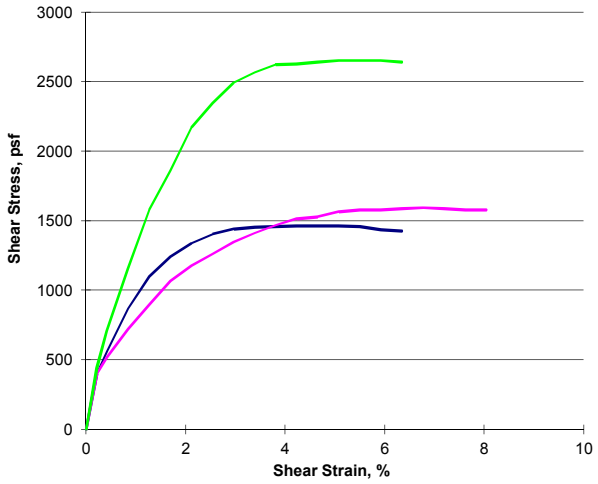
Dry Density (pcf)	**118.9**
Water Content (%)	**14.3**
Unconfined Compressive Strength (psi)	**60.4**
Unconfined Compressive Strength (psf)	**8698**
Shear Strength (psf)	**4348.8**
Average Height (in)	3.235
Average Diameter (in)	1.369
Rate of strain (%)	1.0
Strain at Failure (%)	3.1

Notes:

SHEAR STRENGTH



STRESS-STRAIN



Sample Description			
Boring Number	B3-2		
Sample Depth (feet)			
Material Description	Olive gray lean CLAY with gravel		
Initial Conditions at Start of Test			
Sample ID (psf)	**1000**	**2000**	**3000**
Height (inch)	1.00	1.00	1.00
Diameter (inch)	2.363	2.363	2.363
Moisture Content (%)	13.3	17.1	16.5
Dry Density (pcf)	121.0	111.1	115.0
Estimated Specific Gravity	2.80	2.80	2.80
Saturation (%)	83.8	83.5	89.3
Shear Test Conditions			
Strain Rate (%/min)	0.719	0.679	0.614
Major Principle Stress at Failure (psf)	1462	1592	2652
Strain at Failure (%)	4.23	6.77	5.08
Test Results			
ϕ, degrees	**30.6**		
c, psf	**750**		

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Telephone: (916) 852-9118
Fax: (916) 852-9132

Direct Shear Strength Test (ASTM D3080)

Project: Crawford Lab 16-337.8
Location:
Number: S9763-05-111
Figure:

Sunland Analytical

11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 02/16/2018
Date Submitted 02/12/2018

To: Ellen Tiedemann
Crawford & Associates, Inc.
1100 Corporate Way Suite 230
Sacramento, CA 95831

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

The reported analysis was requested for the following location:
Location : 16-337.8 Site ID : B1-0.
Thank you for your business.

* For future reference to this analysis please use SUN # 76176-158867.

EVALUATION FOR SOIL CORROSION

Soil pH	6.32	
Minimum Resistivity	2.68 ohm-cm (x1000)	
Chloride	3.9 ppm	00.00039 %
Sulfate	38.5 ppm	00.00385 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
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1100 Corporate Way Suite 230
Sacramento, CA 95831

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

The reported analysis was requested for the following location:
Location : 16-337.8 Site ID : B3-1.
Thank you for your business.

* For future reference to this analysis please use SUN # 76176-158868.

EVALUATION FOR SOIL CORROSION

Soil pH	5.12	
Minimum Resistivity	3.48 ohm-cm (x1000)	
Chloride	2.9 ppm	00.00029 %
Sulfate	17.2 ppm	00.00172 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422