LEGEND

B1 BORINGS

FAILURE LIMITS

EXPLORATION DATES:
03/02/2018 & 03/13/2018

A/B
FIG 6/7

0+00

22.52

29.75

30.42

998.75
CP 2

DRIVEWAY

HMA BERM

PRIMROSE DRIVE (CR 604)

+15.8%

+16.2%

+15.7%

+16.0%

2+50

3+00

2+00

B1

B2

B3

0+50

ROAD "SLUMP" AREA

1000.00
CP 1

HMA BERM

HMA BERM

DIFFICULT TO DELINEATE LATERAL MARGINS AND TOE AREA DUE TO MINIMAL SLOPE MOVEMENT

OH

1025 1020 1015 1010 1005 1000 995 990 985 980 975

-1.0:1 -1.1:1 -1.1:1 -1.3:1 -1.5:1 -1.6:1 -1.7:1 -1.2:1

NORTH

Map and Data Source:
Topographic Survey provided by MCDOT via electronic transfer on 10/31/2017. Survey completed by MCDOT.

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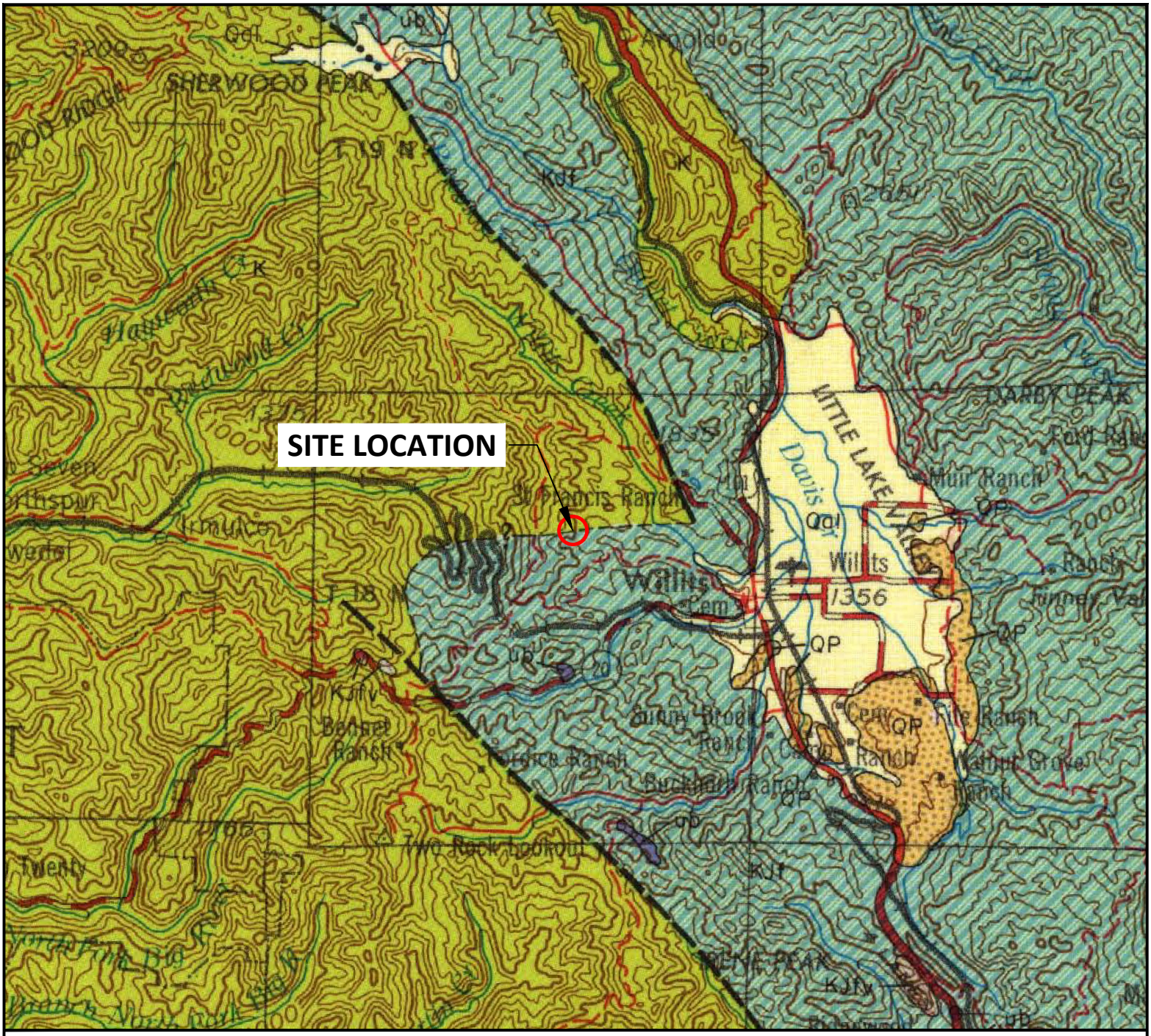
GEOTECHNICAL INVESTIGATION
PRIMROSE DRIVE (CR 604)
FAILURE AT MP 3.80

BROOKTRAILS, MENDOCINO CO., CA

Figure 2
Exploration Location Map

Prj. No: 16-337.15
Scale: 1" = 10'
Date: 09/20/2018

Path: \\Mac\Home\Box\Projects\16-337.X Mendocino 2016 Quadrennial Support Project\16-337.15 Primrose Drive (CR 604) at MP 3.40 and 3.80\CAD\16-337.15-Figures-MP 3.80.dwg Plot Date: Sep 19, 2018 at 8:23pm



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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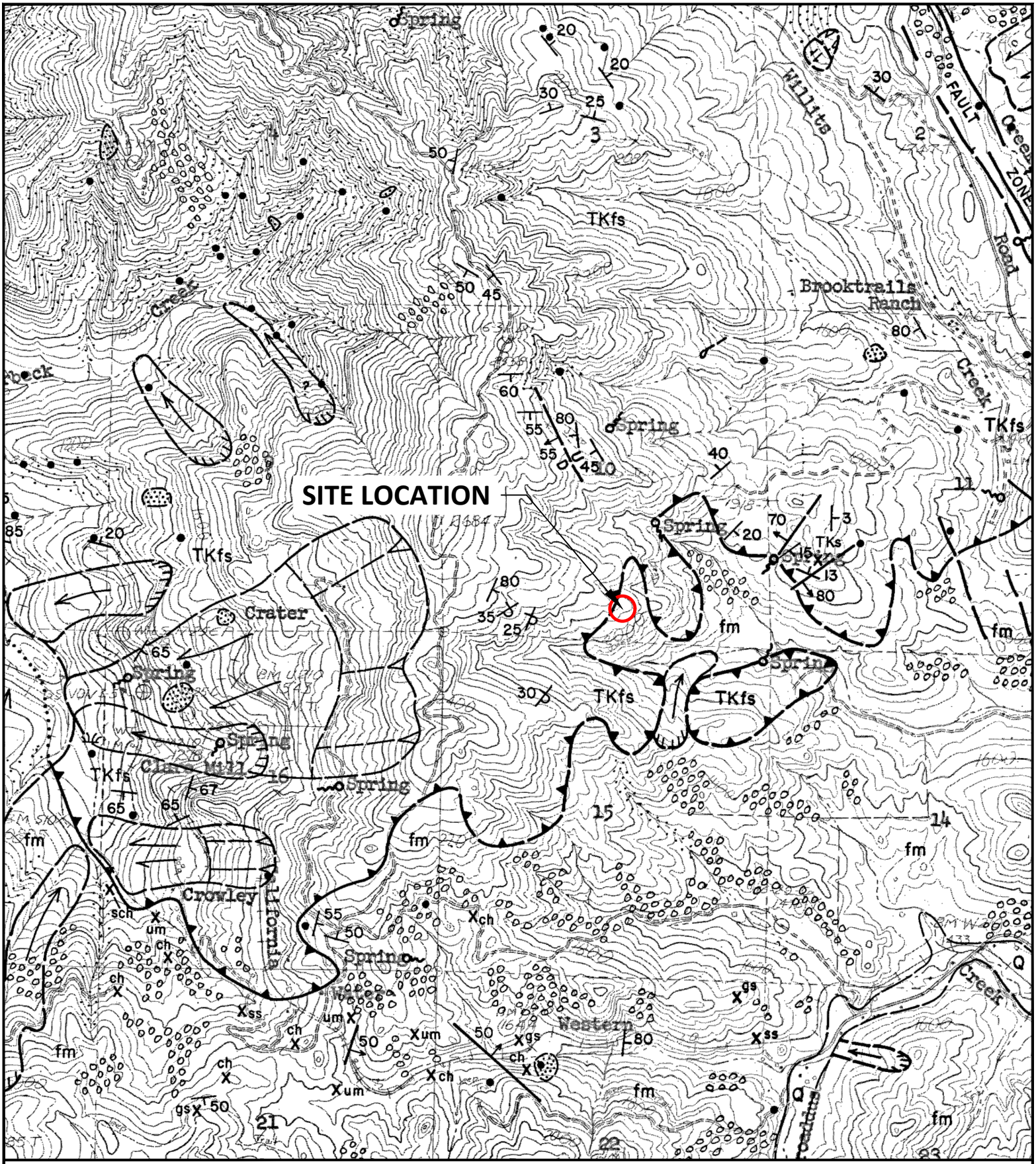
PRIMROSE DRIVE (CR 604)
FAILURE AT MP 3.80

BROOKTRAILS, MENDOCINO CO., CA

Figure 3
Regional Geologic Map

Prj. No: 16-337.15
Scale: 1" = 10,000'
Date: 06/20/2018



SEE FIGURE 4B FOR LEGEND

NORTH

Map Source:
Kilbourne, R.T., 1984, Geology and Geomorphic Features Related to Landsliding, Willits NW (Burbeck) 7.5' Quadrangle, OFR 84-19, California Division of Mines and Geology, Scale 1:24,000

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GEOTECHNICAL INVESTIGATION
PRIMROSE DRIVE (CR 604)
FAILURE AT MP 3.80

BROOKTRAILS, MENDOCINO CO., CA

Figure 4A
Landslide and Geologic Map

Prj. No: 16-337.15
Scale: 1" = 2,000'
Date: 06/20/2018

Path: \\psf\Home\Box\Projects\16-337.X Mendocino 2016 Quadrennial Support Project\16-337.15 Primrose Drive (CR 604) at MP 3.40 and 3.80\CAD\16-337.15-Figures-MP 3.80.dwg Plot Date: Jun 23, 2018 at 6:43pm

EXPLANATION

TRANSLATIONAL/ROTATIONAL SLIDE: relatively cohesive slide mass with a failure plane that is deep-seated in comparison to that of a debris slide of similar areal extent; sense of motion along slide plane is linear in a translational slide and arcuate or "rotational" in a rotational slide; complex versions with rotational heads and translational movement or earthflows downslope are common; translational movement along a planar joint or bedding discontinuity may be referred to as a block glide; ⩕ indicates scarp, ⟸ indicates direction of movement; solid where active, dashed where dormant, queried where uncertain.

EARTHFLOW: mass movement resulting from slow to rapid flowage of saturated soil and debris in a semiviscous, highly plastic state; after initial failure, the flow may move, or creep, seasonally in response to destabilizing forces; ⩕ indicates scarp, ⟵ indicates direction of movement; solid where active, dashed where dormant, queried where uncertain.

DEBRIS SLIDE: unconsolidated rock, colluvium, and soil that has moved slowly to rapidly downslope along a relatively steep (generally greater than 65 percent), shallow translational failure plane; forms steep, unvegetated scars in the head region and irregular hummocky deposits (when present) in the toe region; scars likely to ravel and remain unvegetated for many years; revegetated scars recognized by steep, even-faceted slope and light-bulb shape; includes scarp and slide deposits; solid where active, dashed where dormant.

DEBRIS FLOW/TORRENT TRACK: long stretches of bare, generally unstable stream channel banks scoured and eroded by the extremely rapid movement of water-laden debris; commonly triggered by debris sliding in the upper part of the drainage during high intensity storms; scoured debris may be deposited downslope as a tangled mass of organic material in a matrix of rock and soil; debris may be reactivated or washed away during subsequent events; solid where active, dashed where dormant.

DEBRIS SLIDE SLOPE: geomorphic feature characterized by steep (generally greater than 65 percent), slopes that have been sculpted by numerous debris slide events; vegetated soils and colluvium above shallow soil/bedrock interface may be disrupted by active debris slides or bedrock exposed by former debris sliding; slopes near angle of repose may be relatively stable except where weak bedding planes and extensive bedrock joints and fractures parallel slope.

ACTIVE SLIDE: too small to delineate at this scale.

DISRUPTED GROUND: irregular ground surface caused by complex landsliding processes resulting in features that are indistinguishable or too small to delineate individually at this scale; also may include areas affected by downslope creep, expansive soils, and/or gully erosion; boundaries usually are indistinct.

Ql LACUSTRINE DEPOSITS (Holocene): flat-lying, uncemented alluvial deposits of fine sand and silt containing significant amounts of organic matter.

Qf ALLUVIAL FAN DEPOSITS (Holocene): fan-shaped deposits of unconsolidated, poorly sorted sand and gravel; found in lowlands at the mouth of steep drainage canyons; deposits may represent material transported by debris torrents.

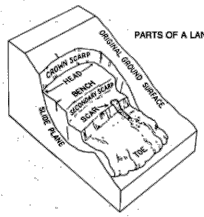
Q ALLUVIUM (Holocene): unconsolidated, fine-grained sand and silt along modern river flood plains; minor amounts of gravel in channel areas.

TKs SANDSTONE (Tertiary-Cretaceous): deeply weathered, gently folded, massive sandstone with small amounts of mudstone; overlying, in fault contact, or possibly within TKfs unit.

TKfs COASTAL BELT FRANCISCAN (Tertiary-Cretaceous): well consolidated, clastic sedimentary rocks; includes arkosic sandstone, pebble conglomerate, and shale, with small amounts of limestone; sandstone and conglomerate units predominant on ridgetops; streams tend to lie in less competent, sheared shale; on the Willits NW quadrangle, TKfs beds are generally homoclinally folded to strike NW and dip moderately to the NE except where they are disrupted near fault contacts.

fm FRANCISCAN MELANGE (Tertiary-Cretaceous): pervasively sheared argillaceous matrix surrounding pebble-sized to individually mappable blocks of graywacke, sandstone, greenstone, chert, schist, serpentine, and serpentinized ultramafic rocks; the highly erodible, sheared shale matrix generally is unstable and prone to landsliding, even on gentle slopes; locally the melange is indistinguishable from fault gouge of the Maacama fault zone.

- ss graywacke, sandstone
- gs greenstone and metamorphosed volcanic rock
- ch chert
- um serpentine and serpentinized ultramafic rocks
- sch greenschist
- ls limestone



PARTS OF A LANDSLIDE

LITHOLOGIC CONTACT: solid where well located, dashed where approximately located; faults and lineaments are sometimes used to depict contacts when such features coincide.

x ROCK OUTCROP: too small to delineate at this scale.

FAULT: solid where well located, dashed where approximately located, dotted where concealed or inferred, queried where uncertain; usually associated with highly sheared, landslide-prone fault gouge; arrows (⟸⟹) and letters (D=Down U=Up) indicate sense of movement.

THRUST FAULT: solid where well located, dashed where approximately located; barbs on upper plate.

LINEAMENT: linear feature of unknown origin observed on aerial photographs; usually associated with more erodible portions of rock units such as fault gouge.

45 STRIKE AND DIP OF BEDDING: does not apply to Quaternary units; when appearing in these units the symbol represents underlying bedrock exposed in small outcrops along stream channel banks.

30 STRIKE AND DIP OF OVERTURNED BEDDING

HORIZONTAL BEDDING

STRIKE OF VERTICAL BEDDING

70 STRIKE AND DIP OF FAULT

SPRING

MARSH

QUARRY OR BORROW PIT

REFERENCES

California Department of Forestry, 1981 Cal Aero Photos: Photos CDF-ALL-UK; Flight 7/9/81; Frames 21-21 to 21-28, 23-21 to 23-28, and 25-20 to 25-28; black and white, scale 1:24,000.

California Division of Mines and Geology, 1984, Alquist-Priolo Special Studies Zone Map of the Willits NW 7.5-minute quadrangle, scale 1:24,000.

California Division of Mines and Geology, 1976-1983, Geologic review of Timber Harvesting Plans: Unpublished field studies conducted for the California Department of Forestry.

Durham, J., 1979, Geologic map, Willits 15-minute quadrangle: California Department of Forestry, Title II Geologic Data Compilation Project, unpublished, scale 1:62,500.

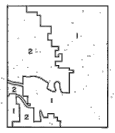
Kramer, J.C., 1976, Geology and tectonic implications of the Coastal Belt Franciscan, Fort Bragg-Willits area, northern Coast Ranges, California: Unpublished Ph.D. Thesis, University of California, Davis, 128 pages.

Pampeyan, E.H., Harsh, P.W., and Coakley, J.M., 1981, Preliminary map showing recently active breaks along the Maacama fault zone between Laytonville and Hopland, Mendocino County, California: United States Geological Survey, Miscellaneous Field Studies Map, MF 1217, scale 1:24,000.

SOURCES OF GEOLOGIC DATA

Geologic data were compiled from aerial photo interpretation, field reconnaissance, and the modification of published and unpublished geologic maps listed in references above. The author was assisted in field and office studies by Charles Smith and Jerald Rich.

1. Mapping from aerial photo interpretation, previously existing geologic data, and reconnaissance level field work.
2. Mapping from aerial photo interpretation and previously existing geologic data; field access not available.



ACTIVITY OF LANDSLIDES

Active or probably active - presently moving or recently moved. Distinct topographic slide features present, i.e., sharp barren scarps, cracks, jackstrawed trees. Major revegetation has not occurred.

Dormant - little evidence of recent movement. Slide features modified by weathering and erosion. Vegetation generally well established. Some mass movements may have developed under climatic conditions different from today. Causes of failure may remain and movement could be renewed.

RATES OF LANDSLIDE MOVEMENT*

10 ft/sec or more	= extremely rapid
1 ft/min-10 ft/sec	= very rapid
5 ft/day-1 ft/min	= rapid
5 ft/mo-5 ft/day	= moderate
5 ft/yr-5 ft/mo	= slow
1 ft/5yr-5 ft/yr	= very slow
1 ft/5yr or less	= extremely slow

*Modified from: Varnes, D.J., 1978, Slope movement types and processes. *in* Landslides: Analysis and Control, Transportation Research Board, National Academy of Sciences, Washington, D.C., Special Report 176, Figure 2.1.

SEE FIGURE 4A FOR MAP

NORTH

Map Source:
Kilbourne, R.T., 1984, Geology and Geomorphic Features Related to Landsliding, Willits NW (Burbeck) 7.5' Quadrangle, OFR 84-19, California Division of Mines and Geology, Scale 1:24,000

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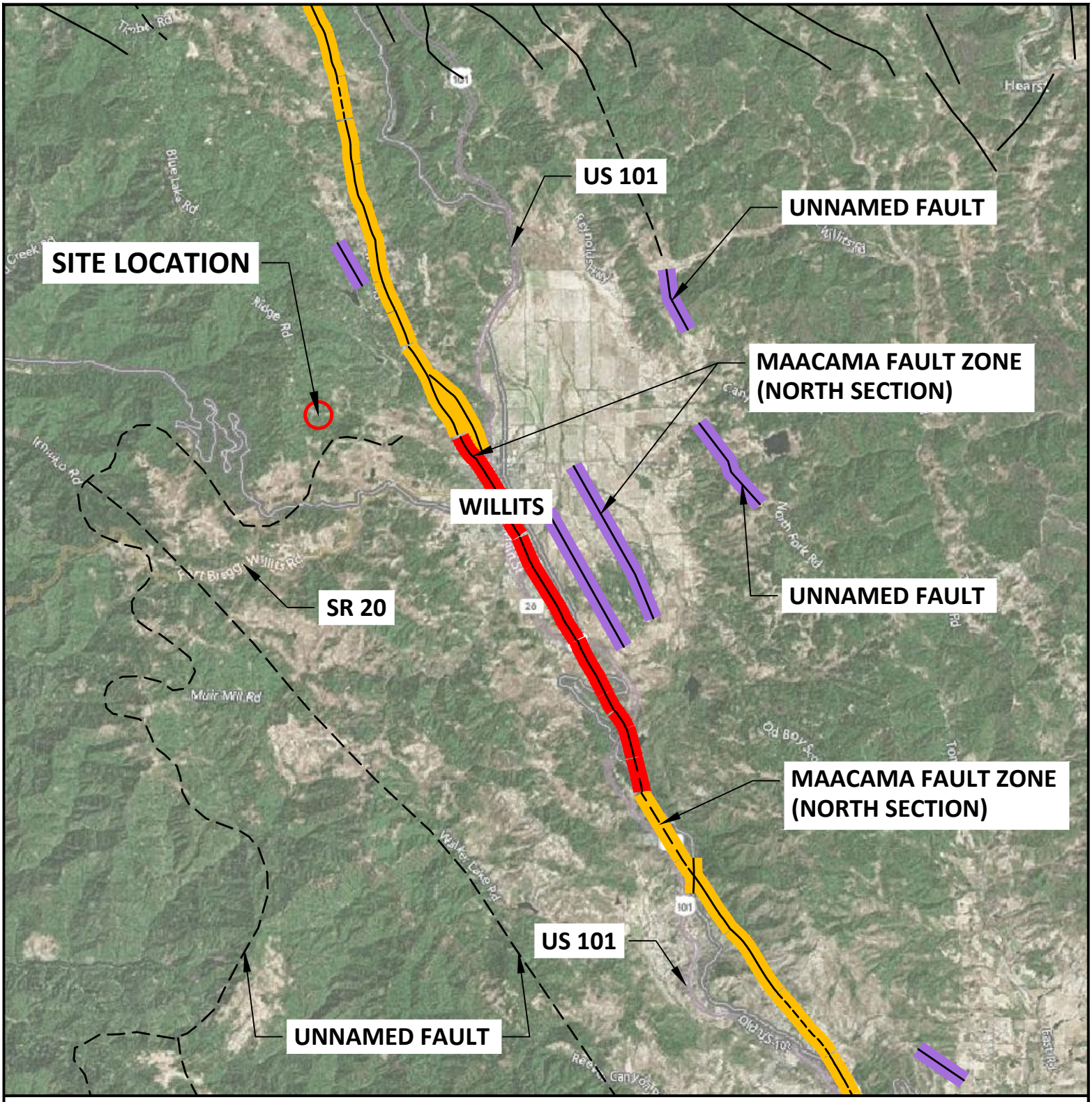
GEOTECHNICAL INVESTIGATION
PRIMROSE DRIVE (CR 604)
FAILURE AT MP 3.80

BROOKTRAILS, MENDOCINO CO., CA

Figure 4B
Landslide and Geologic Map Legend

Prj. No: 16-337.15
Scale: N/A
Date: 06/20/2018

Path: \\psf\Home\Box\Projects\16-337.X Mendocino 2016 Quadrennial Support Project\16-337.15 Primrose Drive (CR 604) at MP 3.40 and 3.80\CAD\16-337.15-Figures-MP 3.80.dwg Plot Date: Jun 23, 2018 at 6:43pm



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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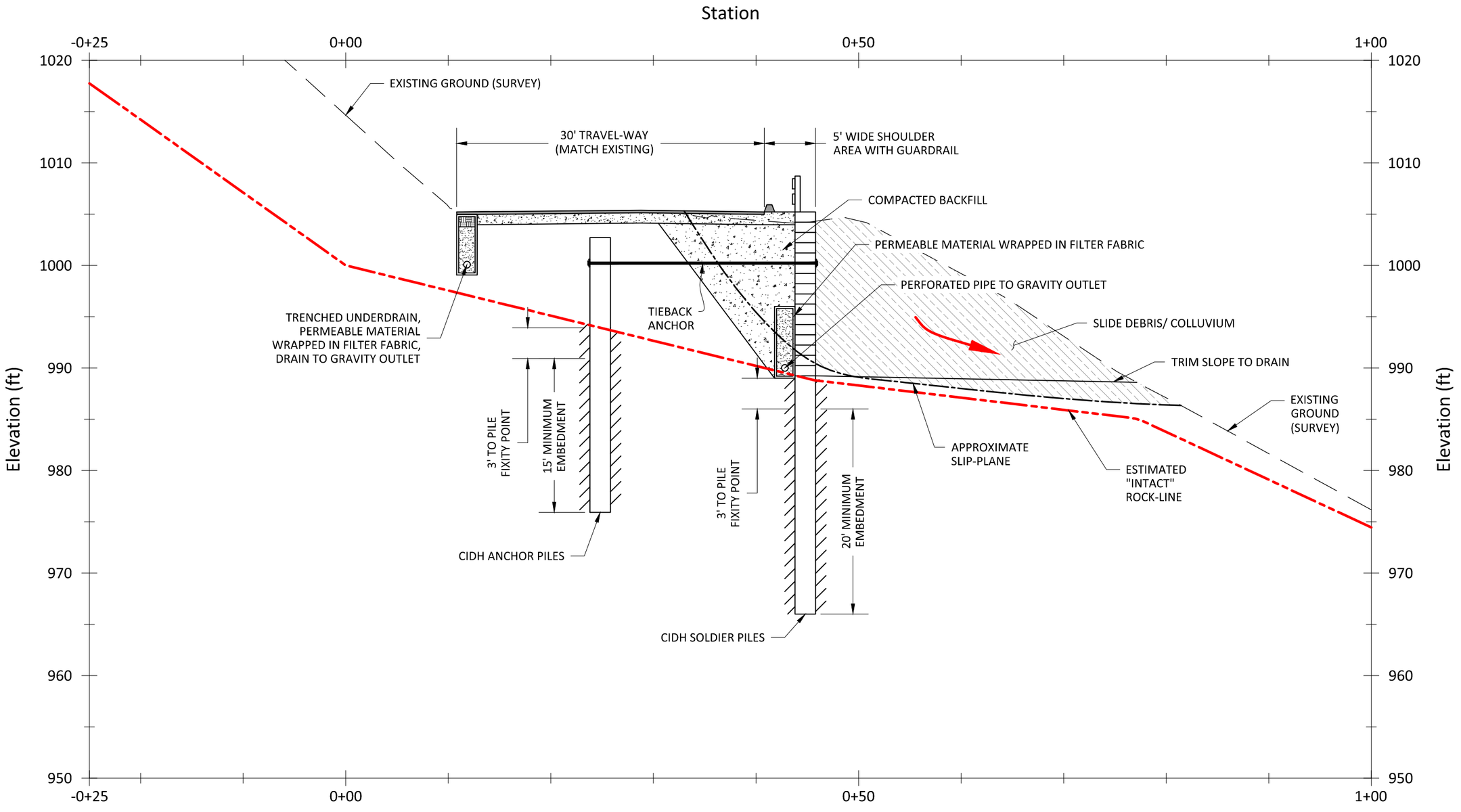
BROOKTRAILS, MENDOCINO CO., CA

Figure 5
Fault Activity Map

Prj. No: 16-337.15
Scale: 1" = 10,000'
Date: 06/20/2018

Path: \\psf\Home\Box\Projects\16-337.X Mendocino 2016 Quadrennial Support Project\16-337.15 Primrose Drive (CR 604) at MP 3.40 and 3.80\CAD\16-337.15-Figures-MP 3.80.dwg Plot Date: Jun 23, 2018 at 6:44pm



Section A

NORTH

Data Source:
Topographic Survey provided by MCDOT via electronic transfer on 10/31/2017. Survey completed by MCDOT.

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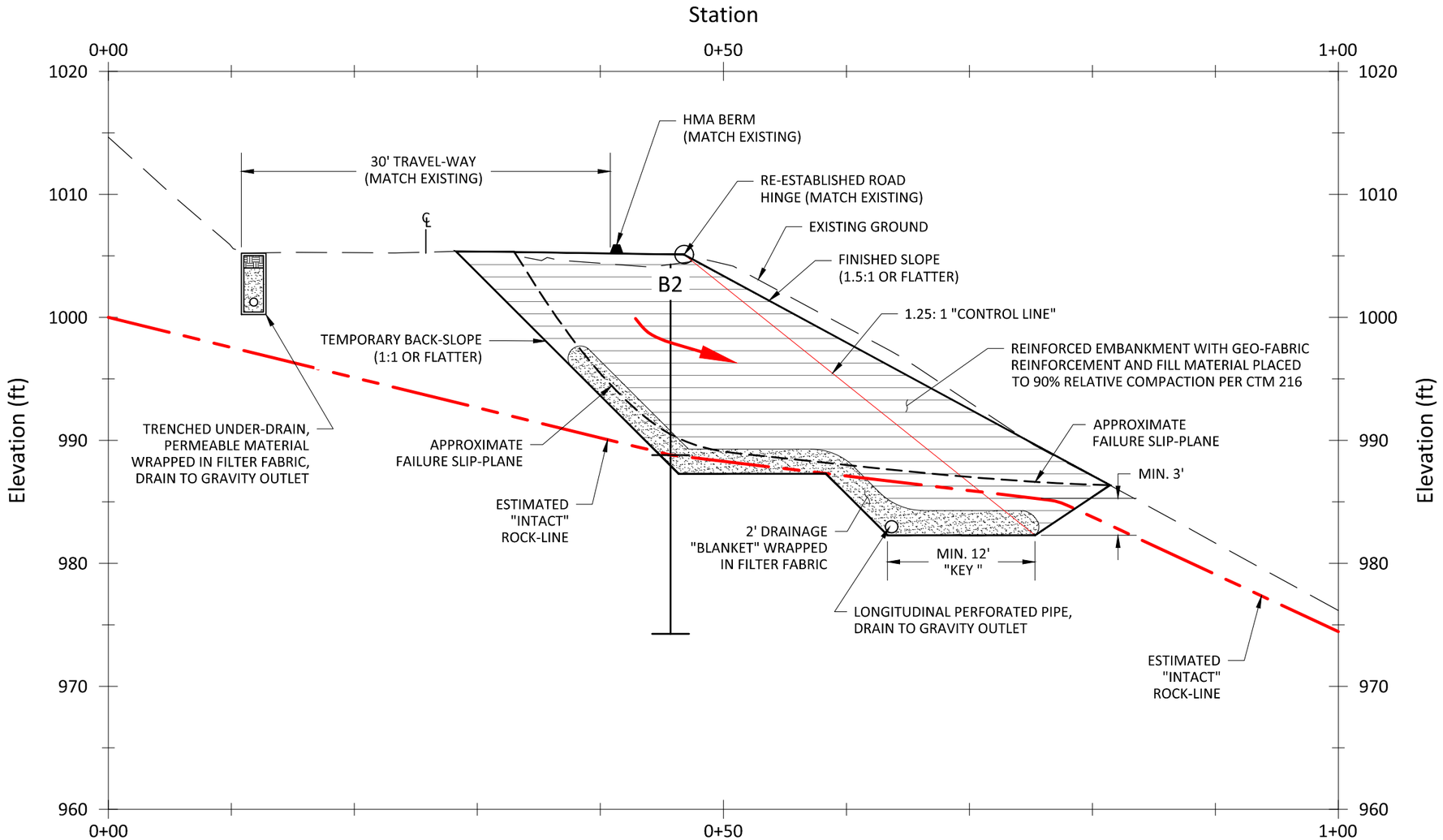
PRIMROSE DRIVE (CR 604)
FAILURE AT MP 3.80

BROOKTRAILS, MENDOCINO CO., CA

Figure 6
Typical Section
Soldier Pile
Tieback Wall

Prj. No: 16-337.15
Scale: 1" = 10'
Date: 09/20/2018

Path: \\Mac\Home\Box\Projects\16-337.X Mendocino 2016 Quadrennial Support Project\16-337.15 Primrose Drive (CR 604) at MP 3.40 and 3.80\CAD\16-337.15-Figures-MP 3.80.dwg Plot Date: Sep 20, 2018 at 4:13pm



Section B

NORTH

Data Source:
Topographic Survey provided by MCDOT via electronic transfer on 10/31/2017. Survey completed by MCDOT.

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GEOTECHNICAL INVESTIGATION
PRIMROSE DRIVE (CR 604)
FAILURE AT MP 3.80

BROOKTRAILS, MENDOCINO CO., CA

Figure 7
Typical Section
Reinforced
Embankment

Prj. No:	16-337.15
Scale:	1" = 10'
Date:	09/20/2018

Path: \\Mac\Home\Box\Projects\16-337.X Mendocino 2016 Quadrennial Support Project\16-337.15 Primrose Drive (CR 604) at MP 3.40 and 3.80\CAD\16-337.15-Figures-MP 3.80.dwg Plot Date: Sep 19, 2018 at 8:40pm

APPENDIX A

BORING LOGS 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: 16-337.15
PROJECT: Primrose Drive MP 3.80
LOCATION: Primrose Dr. (CR 604), Willits
CITY/COUNTY: Mendocino
CLIENT: MCDOT
LOGGED BY: MVG
DEPTH OF BORING: 51.17 (ft)

BEGIN DATE: 3/13/18
COMPLETION DATE: 3/13/18
SURFACE ELEVATION: 1000.4 (ft)*
SURFACE CONDITION: HMA
WATER DEPTH: 30 (ft)
READING TAKEN: 3/13/18
HAMMER EFFICIENCY: 80 (%)

DRILLING CONTRACTOR: Clear Heart Drilling, Inc.
DRILLING METHOD: Hollow-Stem Auger (6" OD, 2.25" ID)
DRILL RIG: Deeprock - DR5K (Truck)
HAMMER TYPE: Automatic, 140 lbs, 30" drop
SAMPLER TYPE & SIZE: SPT (ID 1.4")
BOREHOLE DIAMETER: 6"
BACKFILL METHOD: Cement, Quick Grout

FIELD									LABORATORY							
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
1000	0							SANDY lean CLAY with GRAVEL (CL); yellowish brown; moist; about 15% fine, subangular to subrounded GRAVEL, max. 3/4 in. dia.; about 25% coarse to fine SAND; medium plasticity, medium toughness fines [FILL].									
998	2																
996	4																
	5		1	28 34 31	65	>4.50		CLAYEY SAND (SC); very dense; yellowish brown variegated reddish yellow; moist; about 58% medium to fine SAND; medium plasticity, medium toughness fines; poorly to moderately indurated [RESIDUAL SOIL].	83		41	22			42		
994	6																
992	8																
990	10		2	34 21 17	38	>4.50			83				14	103.6			
988	12																
986	14							SANDY lean CLAY (CL); hard; tan variegated with yellowish brown and yellowish red; moist; about 36% medium to fine SAND; medium plasticity, medium toughness fines; moderately indurated.									
984	16		3	12 17 12	29	>4.50			61						64		Chemical Analysis pH = 5.31 Min. Res. = 3220 ohm-cm Chloride = 1.8 ppm Sulfate = 1.7 ppm
982	18																
980	20		4	14 2 1	3	3.50		Very stiff; poorly to moderately indurated.	44				19.7	100.5			
978	22																
976	24																
	25		5	19 14 12	26	>4.50		Hard; moderately indurated.	83								
974	26					3.00		SEDIMENTARY ROCK (SHALE), clay, dark gray variegated with yellowish red, decomposed, (Lean CLAY with SAND (CL), very stiff, moist, poorly indurated) [FRANCISCAN MELANGE].									
972	28																
970	30 ▼		6	36 32 37	69	>4.50		Thickly bedded, dark gray, intensely to moderately weathered, soft to moderately soft, moderately indurated.	67				8	125			
968	32																
	33																

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PROJECT NUMBER: 16-337.15
PROJECT: Primrose Drive MP 3.80
BORING: B1
ENTRY BY: MVG
CHECKED BY: RRH

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
	33							SEDIMENTARY ROCK (Shale) *(continued)*.									
966	34																
	35		7	26 48 30	78			Very intensely weathered.	44								
964	36					>4.50											
	37																
962	38																
	39																
960	40		8	18 21 42	63			Intensely weathered, moderately soft to moderately hard.	83				9.1	132.2			
	41					>4.50											
958	42																
	43																
956	44																
	45		9	13 15 11	26				39								
954	46					>4.50											
	47																
952	48																
	49																
950	50		10	30 40 50/2"	90/8			Moderately weathered, moderately hard.	21								
	51					>4.50											
								Bottom of borehole at 51.2 ft bgs Backfilled with 6, 94lbs bags of portland cement grout; 1 bag of quick grout; and 60 gal water *Elevation Reference: CP 1, Elev. 1000.00 feet per MCDOT topographic survey									
948	52																
	53																
946	54																
	55																
944	56																
	57																
942	58																
	59																
940	60																
	61																
938	62																
	63																
936	64																
	65																
934	66																
	67																
932	68																
	69																
930	70																
	71																
928	72																

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PROJECT NUMBER: 16-337.15
PROJECT: Primrose Drive MP 3.80
BORING: B1
ENTRY BY: MVG
CHECKED BY: RRH

LOG OF BORING B2

PROJECT NO: 16-337.15
PROJECT: Primrose Drive MP 3.80
LOCATION: Primrose Dr. (CR 604), Willits
CITY/COUNTY: Mendocino
CLIENT: MCDOT
LOGGED BY: MVG
DEPTH OF BORING: 30.04 (ft)

BEGIN DATE: 3/2/18
COMPLETION DATE: 3/2/18
SURFACE ELEVATION: 1004.3 (ft)*
SURFACE CONDITION: Dirt/Grass
WATER DEPTH: Not Encountered (ft)
READING TAKEN: 3/2/18
HAMMER EFFICIENCY: 81.5 (%)

DRILLING CONTRACTOR: Clear Heart Drilling, Inc.
DRILLING METHOD: Hollow-Stem Auger (7" OD, 3.25" ID)
DRILL RIG: Deeprock - DR8K (Track)
HAMMER TYPE: Automatic, 140 lbs, 30" drop
SAMPLER TYPE & SIZE: SPT (ID 1.4"), BULK
BOREHOLE DIAMETER: 7"
BACKFILL METHOD: Cement Grout

FIELD									LABORATORY							
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
1004	0		0					SANDY lean CLAY (CL); reddish yellow; moist; about 38% medium to fine SAND; medium plasticity, medium toughness fines [COLLUVIUM].	100						62		Direct Shear phi = 28.0 deg c = 185 psf
	1																
1002	2																
	3																
1000	4																
	5		1	1 1 1	2	0.50		Medium stiff; trace coarse SAND.	61				23.3	87.2			
998	6																
	7																
996	8							CLAYEY SAND (SC); very loose; light yellowish brown; moist; trace subangular GRAVEL, max. 1 in. dia.; about 63% medium to fine SAND; medium plasticity fines.									
	9																
994	10		2	2 1 2	3	0.25			83						37		
	11																
992	12																
	13																
990	14																
	15		3	10 19 27	46	4.50		SEDIMENTARY ROCK (SHALE), clay, gray, intensely to moderately weathered, soft to moderately soft [FRANCISCAN MELANGE].	83				12.6	115.6			
988	16																
	17																
986	18																
	19																
984	20		4	32 50/6"	50/6	4.50		Moderately weathered, moderately soft to moderately hard.	100								
	21																
982	22																
	23																
980	24																
	25																Driller reports hard drilling at 25'
978	26																
	27																
976	28																
	29																

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PROJECT NUMBER: 16-337.15
PROJECT: Primrose Drive MP 3.80
BORING: B2
ENTRY BY: MVG
CHECKED BY: RRH

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
	29							SEDIMENTARY ROCK (Shale) *(continued)*.										
974	30		5	50/0.5"	REF			SEDIMENTARY ROCK (GRAYWACKE), medium sand to fine sand, gray, fresh, hard, (classified from rock fragment in sampler).	0									Auger refusal at 30'
	31							Bottom of borehole at 30.0 ft bgs										
972	32							Backfilled with 4, 94lbs bags of portland cement grout and 40 gal water										
	33																	
970	34							*Elevation Reference: CP 1, Elev. 1000.00 feet per MCDOT topographic survey										
	35																	
968	36																	
	37																	
966	38																	
	39																	
964	40																	
	41																	
962	42																	
	43																	
960	44																	
	45																	
958	46																	
	47																	
956	48																	
	49																	
954	50																	
	51																	
952	52																	
	53																	
950	54																	
	55																	
948	56																	
	57																	
946	58																	
	59																	
944	60																	
	61																	
942	62																	
	63																	

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PROJECT NUMBER: 16-337.15
PROJECT: Primrose Drive MP 3.80
BORING: B2
ENTRY BY: MVG
CHECKED BY: RRH

LOG OF BORING B3

PROJECT NO: 16-337.15
PROJECT: Primrose Drive MP 3.80
LOCATION: Primrose Dr. (CR 604), Willits
CITY/COUNTY: Mendocino
CLIENT: MCDOT
LOGGED BY: MVG
DEPTH OF BORING: 45.08 (ft)

BEGIN DATE: 3/13/18
COMPLETION DATE: 3/13/18
SURFACE ELEVATION: 1014.4 (ft)*
SURFACE CONDITION: HMA
WATER DEPTH: 35 (ft)
READING TAKEN: 3/13/18
HAMMER EFFICIENCY: 80 (%)

DRILLING CONTRACTOR: Clear Heart Drilling, Inc.
DRILLING METHOD: Hollow-Stem Auger (6" OD, 2.25" ID)
DRILL RIG: Deeprock - DR5K (Truck)
HAMMER TYPE: Automatic, 140 lbs, 30" drop
SAMPLER TYPE & SIZE: SPT (ID 1.4"), BULK
BOREHOLE DIAMETER: 6"
BACKFILL METHOD: Cement, Quick Grout

FIELD									LABORATORY							
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
1014	0		0					CLAYEY SAND with GRAVEL (SC); yellowish brown; moist; about 15% fine, subangular to subrounded GRAVEL, max. 3/4 in. dia.; about 53% coarse to fine SAND; medium plasticity, medium toughness fines [FILL].	100		26	17			32		Chemical Analysis pH = 5.60 Min. Res. = 3750 ohm-cm Chloride = 2.8 ppm Sulfate = 66.3 ppm
1012	5		1	30 18 20	38	2.25		CLAYEY SAND (SC); very dense; yellowish brown; moist; trace coarse to fine, subangular to subrounded GRAVEL; about 60% medium to fine SAND; medium plasticity, medium toughness fines.	28								
1008	10		2	50/1"	REF	3.00		SEDIMENTARY ROCK (SANDSTONE), medium sand to fine sand, yellowish brown, intensely weathered, moderately soft to moderately hard, moderately lithified [FRANCISCAN MELANGE].	100								
1004	15		3	10 11 17	28	>4.50		SEDIMENTARY ROCK (GRAYWACKE), medium sand to very fine sand, light gray, slightly weathered, hard.	17								
1000	20		4	10 30 30	60	>4.50		SEDIMENTARY ROCK (SHALE), clay, dark gray, decomposed, (Lean to Fat CLAY with SAND (CL/CH), hard, moist). Slightly oxidized.	61				9.7	127.9			UC = 8251 psf
996	25		5	42 50/5"	50/5	>4.50		Fracture faces of Shale fragments are oxidized brown.	100				9.6	118.2			
992	30		6	24 18 35	53				11								Sampler blocked with coarse Sandstone fragments at 30'
988	35																
984	40																
982	45																

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PROJECT NUMBER: 16-337.15
PROJECT: Primrose Drive MP 3.80
BORING: B3
ENTRY BY: MVG
CHECKED BY: RRH

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
980	33							SEDIMENTARY ROCK (Shale) *(continued)*.									
	34																
	35		7	38 50/3"	50/3	>4.50		Very intensely weathered, very soft to soft, moderately indurated.	67								
978	36																
	37																
	38																
976	39																
	40		8	50/5"	REF	>4.50		Moderately weathered, moderately soft to moderately hard, moderately to well indurated.	100								
974	41																
	42																
972	43																
	44																
970	45		9	50/1"	REF			Bottom of borehole at 45.1 ft bgs	100								Auger refusal at 45'
	46							Backfilled with 6, 94lbs bags of portland cement grout; 2 bags of quick grout; and 60 gal water									
968	47																
	48							*Elevation Reference: CP 1, Elev. 1000.00 feet per MCDOT topographic survey									
966	49																
	50																
964	51																
	52																
962	53																
	54																
960	55																
	56																
958	57																
	58																
956	59																
	60																
954	61																
	62																
952	63																
	64																
950	65																
	66																
948	67																
	68																
946	69																
	70																
944	71																
	72																
942																	

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PROJECT NUMBER: 16-337.15
PROJECT: Primrose Drive MP 3.80
BORING: B3
ENTRY BY: MVG
CHECKED BY: RRH

APPENDIX B

LABORATORY AND FIELD TEST SUMMARY

Job: **Primrose Drive MP 3.80**
Job No: **16-337.15**
Date: **9/14/18**

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Laboratory and Field Test Summary

	Boring I.D.	Top of Sampling Depth (ft)	Sample I.D.	Retained Sample Depths (ft)	USCS Class.	Field Blows N (bpf)	SPT Blows N_{60} (bpf)	Moisture/Density			Classification				Strength				Chemical Analysis			
								Dry Density (pcf)	Moist. Content (%)	In-Situ Density (pcf)	Atterberg Limits			Fines (%)	Pocket Pent. (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 Borings	B1	5.0	1	5.5-6.5	SC	65	87				41	22	19	42	+4.50							
	B1	10.0	2	10.5-11.5	SC	38	51	103.6	14.0	118.1					+4.50							
	B1	15.0	3	15.5-16.5	CL	29	39							64	+4.50				5.31	3,220	1.8	1.7
	B1	20.0	4	21.0-21.5	CL	3	4	100.5	19.7	120.3					3.50							
	B1	25.0	5B	25.5-26.0	CL	26	35								+4.50							
			5A	26.0-26.5	W. ROCK										3.00							
	B1	30.0	6	30.5-31.5	W. ROCK	69	92	125.0	8.0	135.0					+4.50							
	B1	35.0	7	36.0-36.5	W. ROCK	78	104								+4.50							
	B1	40.0	8	40.5-41.5	W. ROCK	63	84	132.2	9.1	144.2					+4.50							
	B1	45.0	9	46.0-46.5	W. ROCK	26	35								+4.50							
	B1	50.0	10	None	W. ROCK	90/8"	-								+4.50							
	B2	0.0	0	0.0-5.0	CL	N/A	-							62	-		28.0	185				
	B2	5.0	1	5.5-6.5	CL	2	3	87.2	23.3	107.5					0.50							
	B2	10.0	2	10.5-11.5	SC	3	4							37	0.25							
	B2	15.0	3	15.5-16.5	W. ROCK	46	62	115.6	12.6	130.2					4.50							
	B2	20.0	4	20.0-21.0	W. ROCK	50/6"	-								4.50							
	B2	30.0	5	None	W. ROCK	REF	-								-							
	B3	0.0	0	0.0-5.0	SC	N/A	-				26	17	9	32	-				5.60	3,750	2.8	66.3
	B3	5.0	1	6.0-6.5	SC	38	51								2.25							
	B3	10.0	2	None	W. ROCK	REF	-								3.00							
	B3	15.0	3	16.0-16.5	W. ROCK	28	37								+4.50							
	B3	20.0	4	20.5-21.5	W. ROCK	60	80	127.9	9.7	140.3					+4.50	8,251						
	B3	25.0	5	25.0-25.9	W. ROCK	50/5"	-	118.2	9.6	129.5					+4.50							
	B3	30.0	6	None	W. ROCK	53	71								-							
	B3	35.0	7	35.3-35.8	W. ROCK	50/3"	-								+4.50							
	B3	40.0	8	40.0-40.4	W. ROCK	REF	-								+4.50							
	B3	45.0	9	None	W. ROCK	REF	-								-							

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Project Name: Primrose Drive MP 3.80
CAInc File No: 16-3377.15
Date: 7/24/18
Technician: CAP

MOISTURE-DENSITY TESTS - D2216

	1	2	3	4	5
Sample No.	B1-2	B1-4	B1-6	B1-8	B2-1
USCS Symbol	SC	SC	GC	W.Rock	CL
Depth (ft.)	11	21	31	41	6
Sample Length (in.)	4.213	4.414	5.748	5.543	5.976
Diameter (in.)	1.429	1.438	1.438	1.430	1.435
Sample Volume (ft^3)	0.00391	0.00415	0.00540	0.00515	0.00559
Total Mass Soil+Tube (g)	343.8	357.0	460.9	457.6	403.8
Mass of Tube (g)	134.3	130.7	130.5	120.8	131.2
Tare No.	A20	H23	D8	B16	C18
Tare (g)	13.7	13.5	13.7	21.0	13.6
Wet Soil + Tare (g)	65.4	59.9	76.6	86.1	52.8
Dry Soil + Tare (g)	59.0	52.3	72.0	80.7	45.4
Dry Soil (g)	45.4	38.8	58.3	59.7	31.8
Water (g)	6.3	7.6	4.6	5.4	7.4
Moisture (%)	**14.0**	**19.7**	**8.0**	**9.1**	**23.3**
Dry Density (pcf)	**103.6**	**100.5**	**125.0**	**132.2**	**87.2**

Notes:

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

Project Name: Primrose Drive MP 3.80
CAInc File No: 16-3377.15
Date: 7/24/18
Technician: KE

MOISTURE-DENSITY TESTS - D2216

	1	2	3	4	5
Sample No.	B2-3A	B3-4A	B3-5A		
USCS Symbol	SC	W.Rock	W. Rock		
Depth (ft.)	16	21	25.5		
Sample Length (in.)	5.368	3.357	5.714		
Diameter (in.)	1.413	1.413	1.402		
Sample Volume (ft^3)	0.00487	0.00304	0.00510		
Total Mass Soil+Tube (g)	417.6	193.8	431.7		
Mass of Tube (g)	130.4	0.0	131.7		
Tare No.	G19	H20	F9		
Tare (g)	13.7	13.4	13.7		
Wet Soil + Tare (g)	68.3	87.9	67.4		
Dry Soil + Tare (g)	62.2	81.3	62.7		
Dry Soil (g)	48.5	68.0	48.9		
Water (g)	6.1	6.6	4.7		
Moisture (%)	**12.6**	**9.7**	**9.6**		
Dry Density (pcf)	**115.6**	**127.9**	**118.2**		

Notes:

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

Project Name: Primrose Drive MP 3.80
CAInc File No: 16-337.15
Date: 7/1/18
Technician: AC

200 Wash - ASTM D1140
Method A

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.	B1-1A	B1-3B	B2 Bulk	B2-2A	B3 Bulk
USCS Symbol	SC	CL	CL	SC	SC
Depth (ft.)	6	15.5	0-5	11	0-5
Tare No.	1015	1019	1005	1014	1009
Tare (g)	127.1	126.7	126	125.7	122.2
Dry Soil + Tare (g)	303.1	302.1	331.2	319.2	319.5
Dry Mass before (g)	176.0	175.4	205.2	193.5	197.3
Dry Mass after (g)	102.4	64.0	78.6	121.5	134.2
Percent Fines (%)	42	64	62	37	32

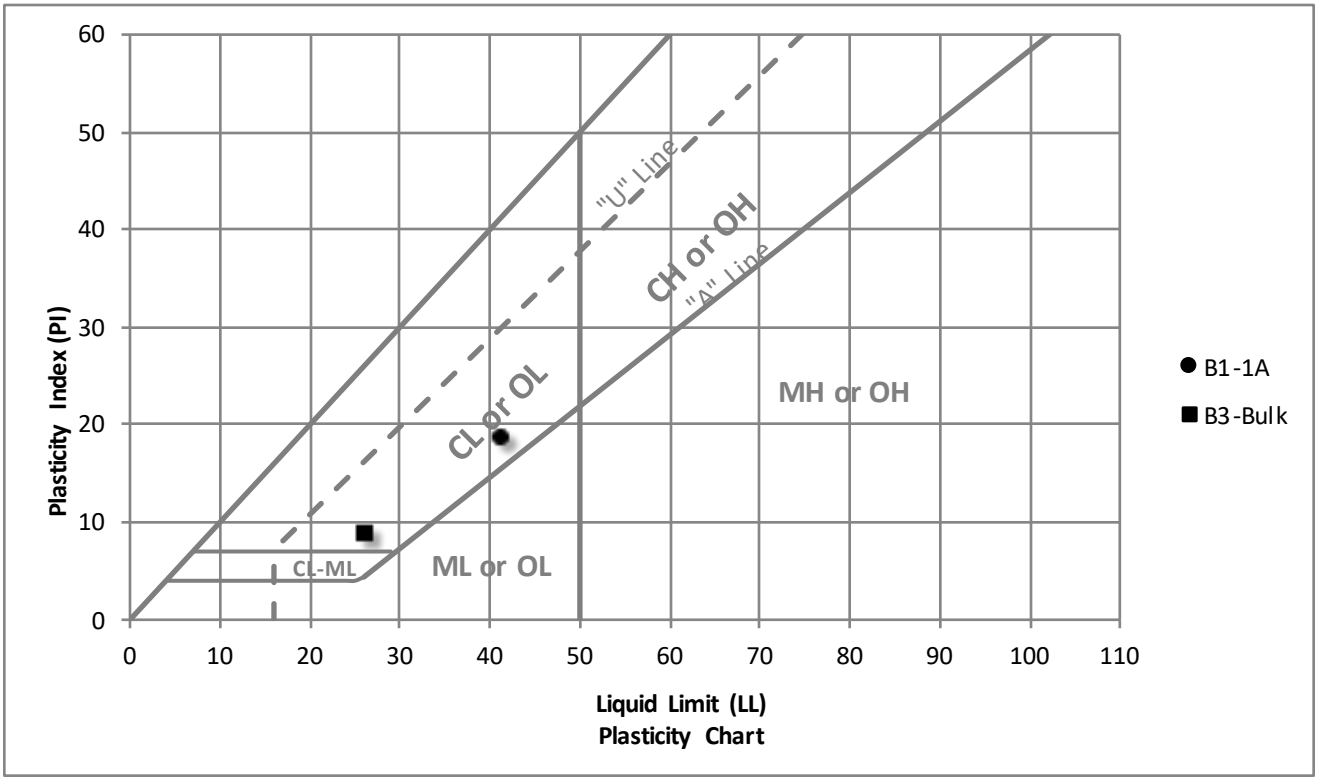
Notes:

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

Project Name: Primrose Drive MP 3.80
CAInc File No: 16-337.15
Date: 7/24/18
Technician: AC

Plastic Index - ASTM D4318

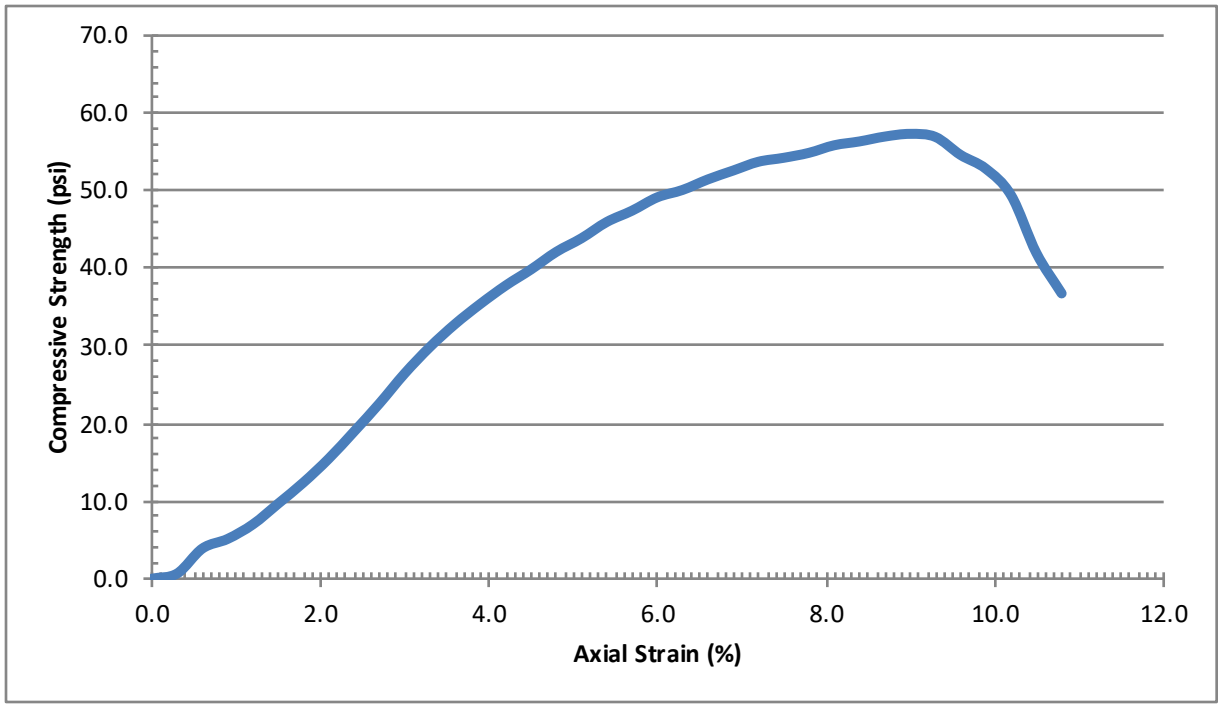
Sample ID	Depth (ft)	Liquid Limit	Plastic Limit	PI
B1-1A	6	41	22	19
B3-Bulk	0-5	26	17	9



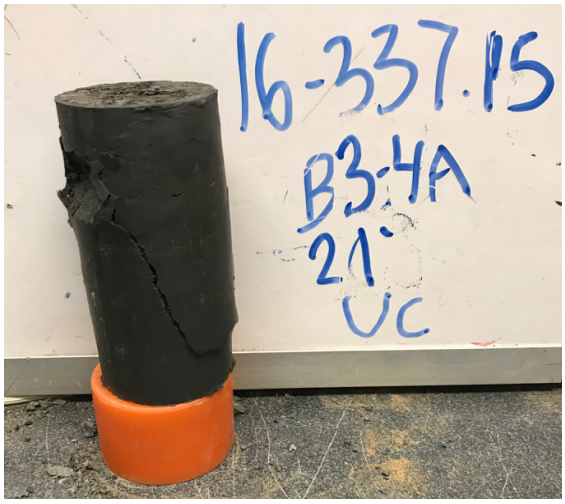
Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Primrose Drive MP 3.80
CAInc File No: 16-337.15
Date: 7/5/18
Technician: HFW
Sample ID: B3-4A Depth (ft): 21.0
USCS Classification: W.Rock

UNCONFINED COMPRESSION TEST - D2166

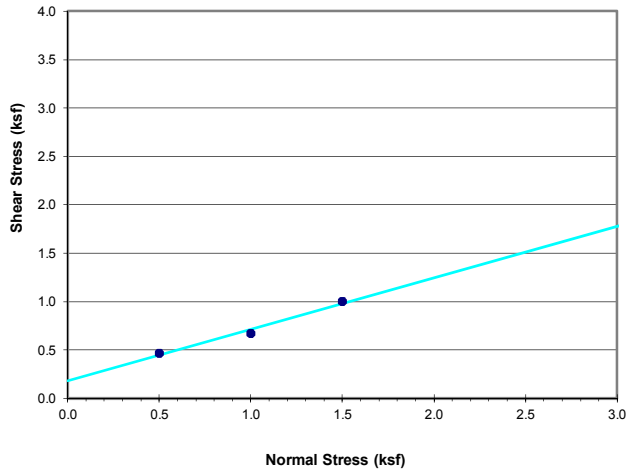


Dry Density (pcf)	**127.9**
Water Content (%)	**9.7**
Unconfined Compressive Strength (psi)	**57.3**
Unconfined Compressive Strength (psf)	**8251**
Shear Strength (psf)	**4125.6**
Average Height (in)	3.357
Average Diameter (in)	1.413
Rate of strain (%)	1.0
Strain at Failure (%)	9.0

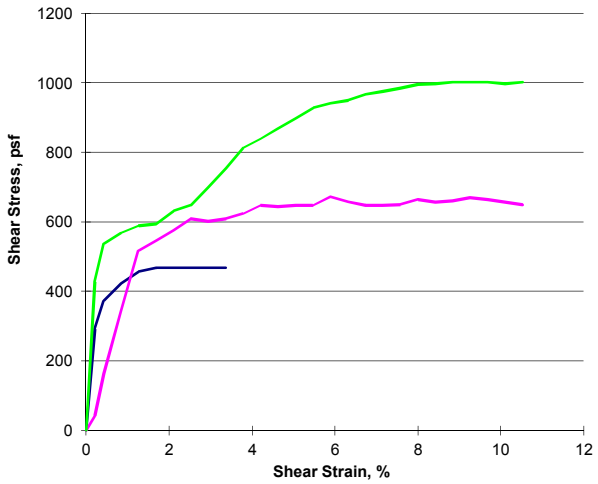


Notes:

SHEAR STRENGTH



STRESS-STRAIN



Sample Description Remolded to Approximately 90% of Wet Density of CTM 216			
Boring Number	B2-Bulk		
Sample Depth (feet)			
Material Description	yellowish brown CLAY		
Initial Conditions at Start of Test			
Sample ID (psf)	**500**	**1000**	**1500**
Height (inch)	1.00	1.00	1.00
Diameter (inch)	2.375	2.375	2.375
Moisture Content (%)	15.6	14.5	14.5
Wet Denisty (g/cm^3)	1.70	1.73	1.72
Dry Density (pcf)	91.9	94.2	94.0
Estimated Specific Gravity	2.73	2.90	2.80
Saturation (%)	49.9	45.5	47.1
Shear Test Conditions			
Strain Rate (%/min)	0.143	0.135	0.143
Major Principle Stress at Failure (psf)	468	673	1001
Strain at Failure (%)	3.37	5.89	8.84
Test Results			
ϕ, degrees **28.0**			
c, psf **185**			

GEOCON CONSULTANTS, INC.
Geocon Consultants, Inc.
3160 Gold Valley Drive, Suite 800
Rancho Cordova, California 95742
Telephone: (916) 852-9118
Fax: (916) 852-9132

Direct Shear Strength Test (ASTM D3080)

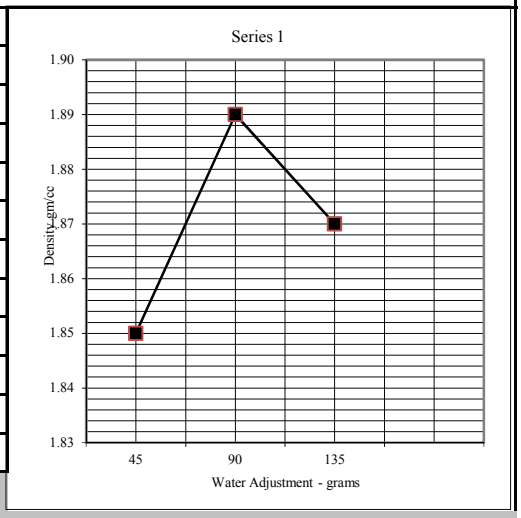
Project: Crawford 16.337.15
Location:
Number: S9763-05-131
Figure:

GEOCON
CONSULTANTS, INC.
3160 GOLD VALLEY DR – SUITE 800 – RANCHO CORDOVA, CA 95742
PHONE 916.852.9118 – FAX 916.852.9132

Project Number	**S9763-05-131**	**SAMPLE I.D.**	**Bulk-2**
Project Name	**Crawford 16.337.15 Primrose Drive MP 3.80**		
Client Name	**Crawford and Associates**		
Date	**Wednesday, July 18, 2018**		

	IMPACT TEST DATA				
I	Initial Wet Weight of Test Specimen (g)	2250			
	Increment	**1**	**2**	**3**	**4**
	Water Adjustment (g0	45	90	135	
J	Tamper Reading	11.5	11.3	11.4	
K	Adjusted Wet Density (g/cc)	1.85	1.89	1.87	

	ROCK CORRECTION	
L	Total Sample Weight	
	< 3/4-inch (g)	
M	+ 3/4 - inch Weight in Air (g)	
N	+ 3/4 - inch Weight in Water (g)	
O	+ 3/4 - Inch Volume (M-N)	
P	% + 3/4 inch 100(M/L)	
Q	% - 3/4 inch 100-P	
R	Density of + 3/4 inch (M/O)	
S	(% + 3/4 - inch)/Density of + 3/4 - inch (P/RY)	
T	(% - 3/4 - inch)/Density of - 3/4 - inch (Q/K)	
U	Sum of S and T (S + T)	
V	Average Adjusted Wet Density (100/U)	



+ 3/4 - inch Aggregate Adjustment (Y)	
% + 3/4 - inch (P)	Adjustment
20 or Less	1.00
21 - 25	0.99
26 - 30	0.98
31 - 35	0.97
36 - 40	0.96
41 - 45	0.95
46 - 50	0.94

% Moisture by CTM 226				
Increment	**1**	**2**	**3**	**4**
Pan I.D.		**T-6**		
Tare (g)		**523.8**		
Wet Wt (g)		**2850.2**		
Dry Wt (g)		**2510.7**		
Water Wt (g)		**339.5**		
% Water		17.1%		

Sunland Analytical

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

Date Reported 07/11/2018
Date Submitted 07/05/2018

To: Hailey Wagenman
Crawford & Associates, Inc.
1100 Corporate Way STE. 230
Sacramento, CA 95831-6120

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

The reported analysis was requested for the following location:
Location : 16-337.15 MP 3.80 Site ID : B1-3A@15.5FT.
Thank you for your business.

* For future reference to this analysis please use SUN # 77468-161813.

EVALUATION FOR SOIL CORROSION

Soil pH	5.31		
Minimum Resistivity	3.22 ohm-cm (x1000)		
Chloride	1.8 ppm	00.00018	%
Sulfate	1.7 ppm	00.00017	%

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
(916) 852-8557

Date Reported 07/11/2018
Date Submitted 07/05/2018

To: Hailey Wagenman
Crawford & Associates, Inc.
1100 Corporate Way STE. 230
Sacramento, CA 95831-6120

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

The reported analysis was requested for the following location:
Location : 16-337.15 MP 3.80 Site ID : B3-BULK 0-5FT.
Thank you for your business.

* For future reference to this analysis please use SUN # 77468-161812.

EVALUATION FOR SOIL CORROSION

Soil pH	5.60	
Minimum Resistivity	3.75 ohm-cm (x1000)	
Chloride	2.8 ppm	00.00028 %
Sulfate	66.3 ppm	00.00663 %

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