

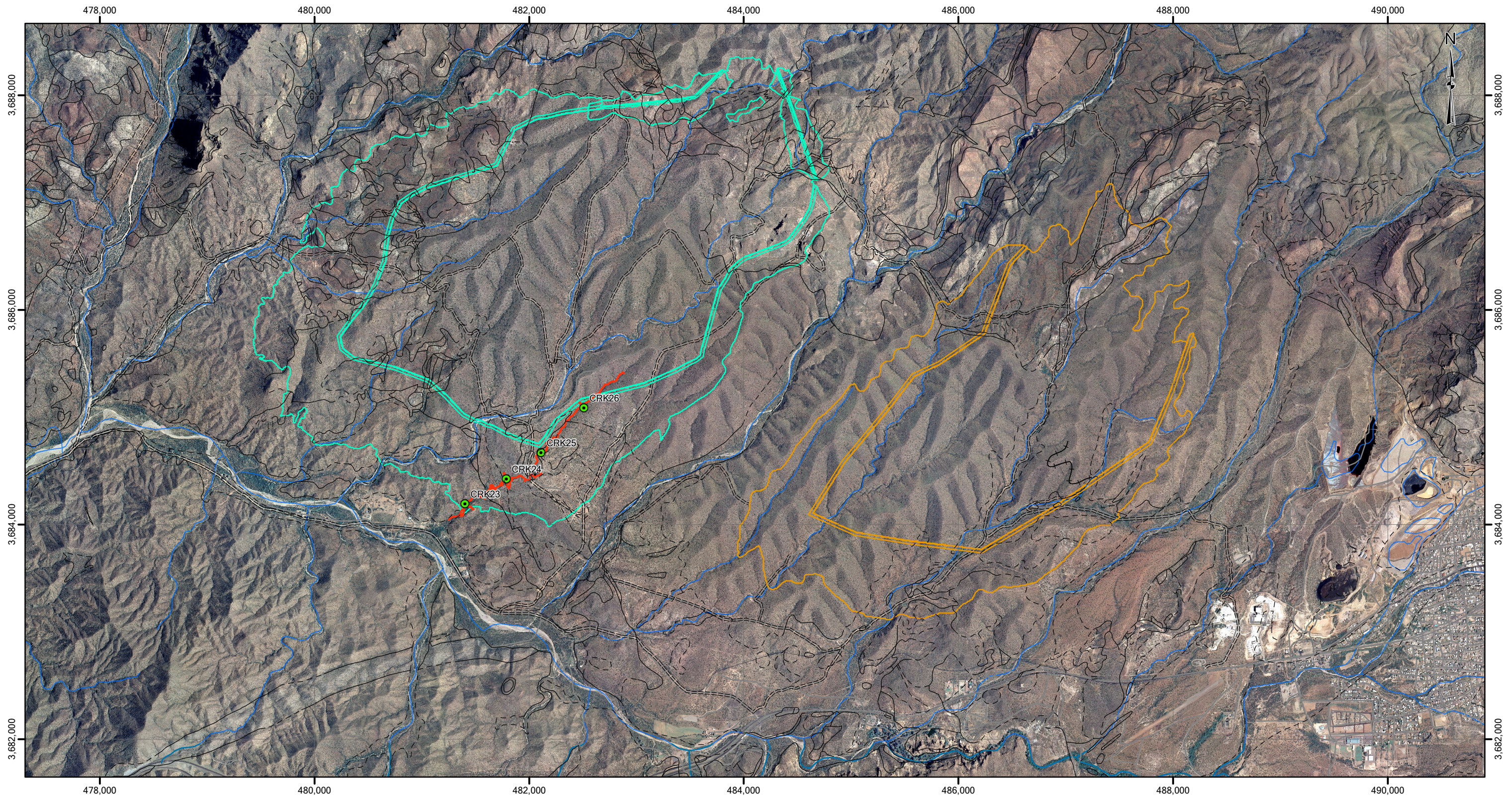
## APPENDIX I-E

### Traverse #5

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LEGEND

- |                                |                        |                                                                                                                                 |
|--------------------------------|------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| CREEK TRAVERSE MAPPING STATION | STREAM                 | CONTACT (BETWEEN GEOLOGIC UNITS)                                                                                                |
| TRAVERSE                       | ROAD (FROM STATE)      | CONTACT - APPROXIMATE                                                                                                           |
| NEAR WEST TAILINGS SITE        | ROAD (FROM RESOLUTION) | CONTACT - INFERRED                                                                                                              |
| HAPPY CAMP OPTION              |                        | CONTACT BETWEEN PINAL SCHIST<br>CLAST-RICH CONGLOMERATE BELOW<br>AND DRIPPING SPRING QUARTZITE<br>CLAST-RICH CONGLOMERATE ABOVE |

Notes:  
1. NAD27 UTM12  
2. Orthophoto from USDA

NOT FOR CONSTRUCTION

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0 1,000 m

PROJECT  
RESOLUTION PROJECT  
2013 NEAR WEST SITE INVESTIGATION

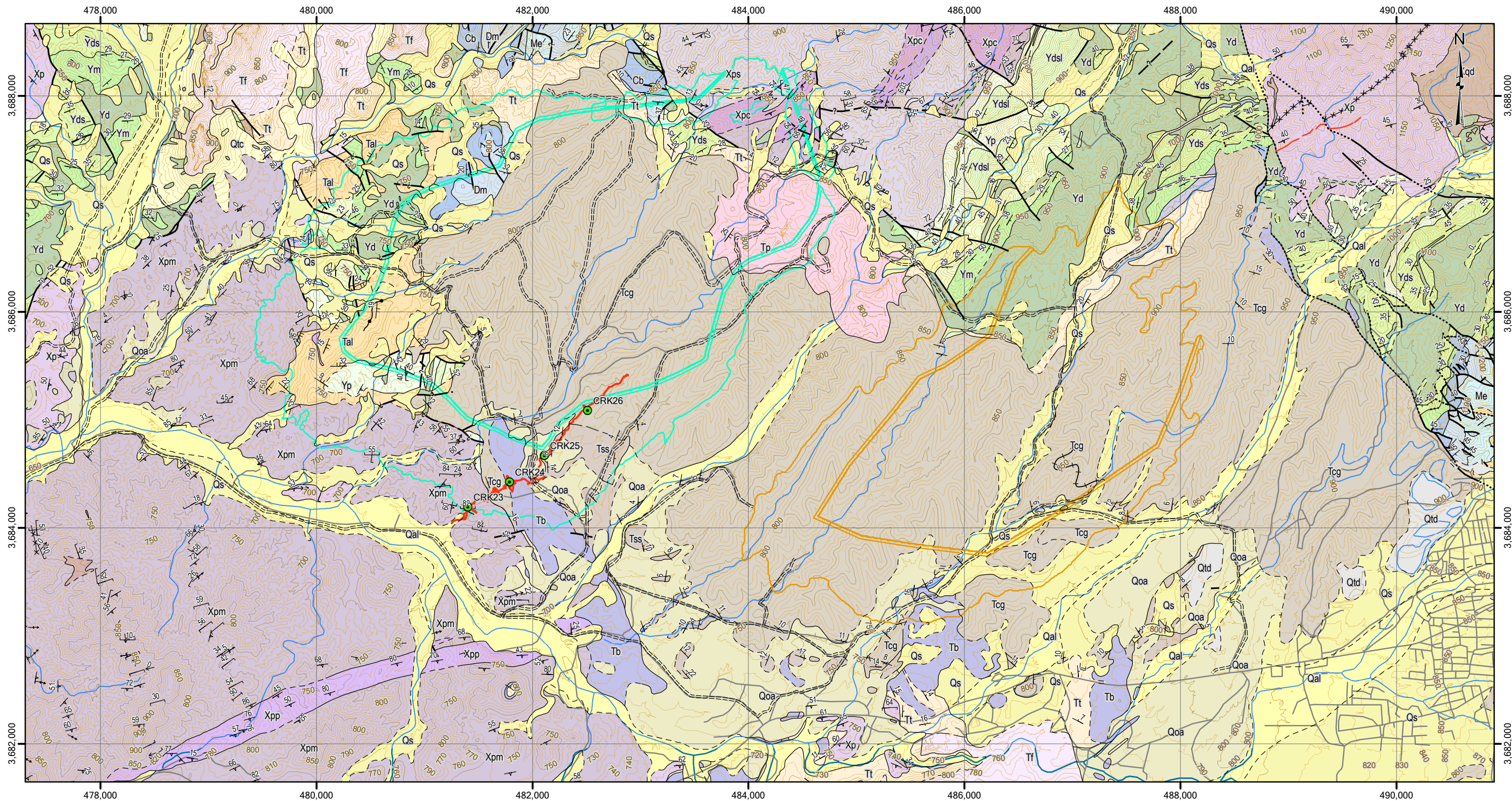
TITLE  
CREEK TRAVERSE #5

PROJECT No.  
M09441A14

FIG No.  
I-E.1



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#### LEGEND

- |                                |                        |                        |                                                                                                                        |
|--------------------------------|------------------------|------------------------|------------------------------------------------------------------------------------------------------------------------|
| CREEK TRAVERSE MAPPING STATION | STREAM                 | FELSIC DYKE            | CONTACT (BETWEEN GEOLOGIC UNITS)                                                                                       |
| TRAVERSE                       | ROAD (FROM STATE)      | FAULT                  | CONTACT - APPROXIMATE                                                                                                  |
| NEAR WEST TAILINGS SITE        | ROAD (FROM RESOLUTION) | FAULT - APPROXIMATE    | CONTACT - INFERRED                                                                                                     |
| HAPPY CAMP OPTION              |                        | FAULT - CONCEALED      | CONTACT BETWEEN PINAL SCHIST CLAST-RICH CONGLOMERATE BELOW AND DRIPPING SPRING QUARTZITE CLAST-RICH CONGLOMERATE ABOVE |
|                                |                        | QUARTZ VEIN            | CONTACT BETWEEN PINAL SCHIST CLAST-RICH CONGLOMERATE BELOW AND DRIPPING SPRING QUARTZITE CLAST-RICH CONGLOMERATE ABOVE |
|                                |                        | MARKER HORIZON (LOCAL) |                                                                                                                        |

Notes:  
1. NAD27 UTM12  
2. Refer to main report for descriptions of geologic units.

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0 1,000 m

PROJECT  
RESOLUTION PROJECT  
2013 NEAR WEST SITE INVESTIGATION

TITLE  
CREEK TRAVERSE #5  
AND GEOLOGY

PROJECT No.  
M09441A14

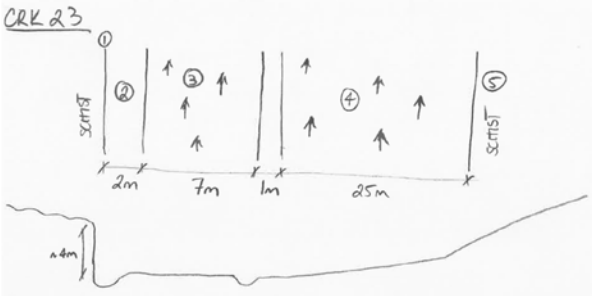





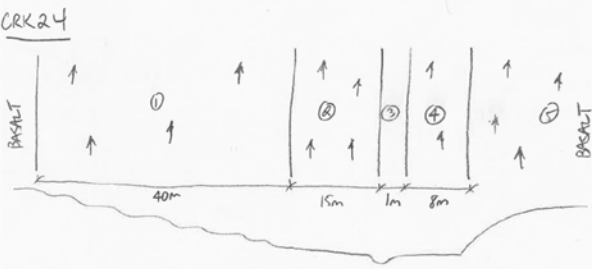





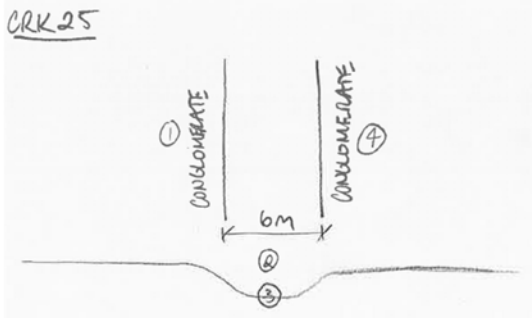


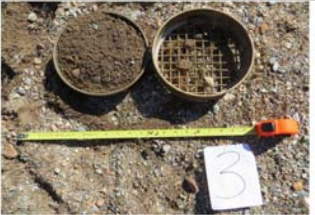

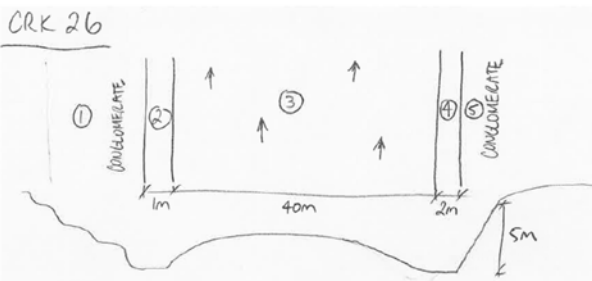





FIG No.  
I-E.2



TRAVERSE 5												
Date Mapped	Traverse Type	Mapping Point	Northing* (m)	Easting* (m)	Total Channel Width** (m) (ft)	Field Sketch	Unit Described	Description (From Left to Right Across Channel Looking Upstream)	Maximum Particle Size in Channel (cm) (inches)	Rock Strength	Geologic Unit	Notes
22-Feb-13	Creek	CRK23	3684188.97	481403.87	8 (26)		1	SCHIST, fresh, R4, steeply dipping foliation cleavage with other randomly oriented fractures cross cutting foliation planes foliation cleavage orientation (046/60)		R4	Xpm	
							2	SAND, GRAVEL and COBBLES (SW-GW), fine to coarse, some boulders in channel but may be talus from slopes, well graded, max. particle size = 8 cm (sample), angular to sub-angular, finer fraction reactive to acid, vegetation in channel, high water mark 15 cm above channel invert			Qs	
							3	SAND, GRAVEL and COBBLES, vegetated channel bar			Qs	
							4	Silty SAND (SM), fine to medium, some gravel, poorly graded, max. particle size = 2 cm, angular to sub-angular, brown, moist, reactive to acid, schist and quartz particles dominate, some organics, hole excavated to 30 cm without refusal			Qoa	
							5	SCHIST, slightly weathered, R4, small outcrops show foliation cleavage dipping back into slope (~30 deg.), very thin spacing between foliation cleavage planes (mm scale)		R4	Xpm	
23-Feb-13	Creek	CRK24	3684421.83	481790.77	9 (30)		1	BASALT, boulders and small outcrops at surface, fresh to slightly weathered, R5/R6		R5/R6	Tb	
							2	Silty SAND (SM), fine to coarse, some gravel, well graded, max. particle size = 5 cm, angular to sub-angular, brown, moist, all particles basalt, hole excavated to 30 cm without refusal and difficult to excavate further - increasing gravel content with depth			Tb	
							3	SAND, GRAVEL and COBBLES (SW-GW), very thin deposit (~5 cm) on top of basalt bedrock, fine to coarse, well graded, max. particle size = 7 cm (sample); >1 m (channel), sub-rounded to angular, moist right below surface, finer fraction reacts to acid, various lithology, high water mark 5 cm above channel invert	>1 m (>393.7)		Qs	
							4	Raised vegetated channel bar with ~30 cm of sand, gravel, cobbles and boulders on top of basalt bedrock, various lithology			Qs	
							5	Silty SAND (SM), fine to coarse, some gravel, some cobbles, well graded, max. particle size = 10 cm, angular to sub-angular, brown, moist, all particles basalt, hole excavated to 40 cm and difficult to excavate further, increasing gravel content with depth			Tb	
23-Feb-13	Creek	CRK25	3684666.46	482111.66	6 (20)		1	Clayey SAND and GRAVEL (SC-GW), fine to coarse, well graded, max. size = 8 cm, sub-rounded to sub-angular, reddish brown, moist, various lithology, refusal reached at 15 cm depth			Tcg	
							2	CONGLOMERATE, R3, range of particle sizes, max. particle = 20 cm, sub-rounded to angular clasts, faint sub-horizontal bedding, forms 1.5m elevation drop in channel invert		R3	Tcg	
							3	SAND (SW), fine to coarse, some gravel, well graded, max. particle size = 3 cm (sample and channel), sub-angular, moist right below surface, trace organics, right above conglomerate "ledge" (see unit 2)	3 (1.2)		Qs	
							4	Clayey SAND and GRAVEL (SC-GW), fine to coarse, well graded, max. particle size = 8 cm, sub-rounded to sub-angular, reddish brown, moist, various lithology, refusal reached at 15 cm depth			Tcg	
23-Feb-13	Creek	CRK26	3685085.14	482511.61	43 (141)		1	Clayey SAND, GRAVEL and COBBLES with various lithology exposed at surface			Tcg	
							2	SAND, GRAVEL and COBBLES (SW-GW), fine to coarse, well graded, max. particle size = 10 cm (sample); 50 cm (channel), angular to sub-angular, moist just below surface, schist, quartz and sandstone particles	50 (19.7)		Qs	
							3	Silty SAND and GRAVEL (SM-GW), fine to coarse, well graded, max. particle size = 8 cm, sub-rounded to angular, brown, moist, strong reaction to acid, various lithology, hole excavated to 20 cm without refusal, soft carbonate layer at 15 cm depth			Tcg	
							4	SAND, GRAVEL and COBBLES (SW-GW), fine to coarse, well graded, max. particle size = 9 cm (sample); 40 cm (channel), moist just below surface, various lithology	40 (15.7)		Qs	
							5	CONGLOMERATE, moist very weak rock or soil above 0.8 m, becomes harder (R3) below, massive, sub-rounded to angular clasts, max. particle size = 30 cm, various clast lithology, acid reaction above and below contact		R0 / R3	Tcg	

\* Coordinates measured with handheld GPS unit. Coordinate System: UTM NAD27 CONUS  
\*\* Total Channel Width includes the width of active channels as well as Old Alluvium deposits



TRAVERSE 5			Traverse Observation Point Photos (See Field Sketch)										
Date Mapped	Traverse Type	Mapping Point	Field Sketch	1		2		3		4		5	
22-Feb-13	Creek	CRK23											
23-Feb-13	Creek	CRK24											
23-Feb-13	Creek	CRK25											
23-Feb-13	Creek	CRK26											

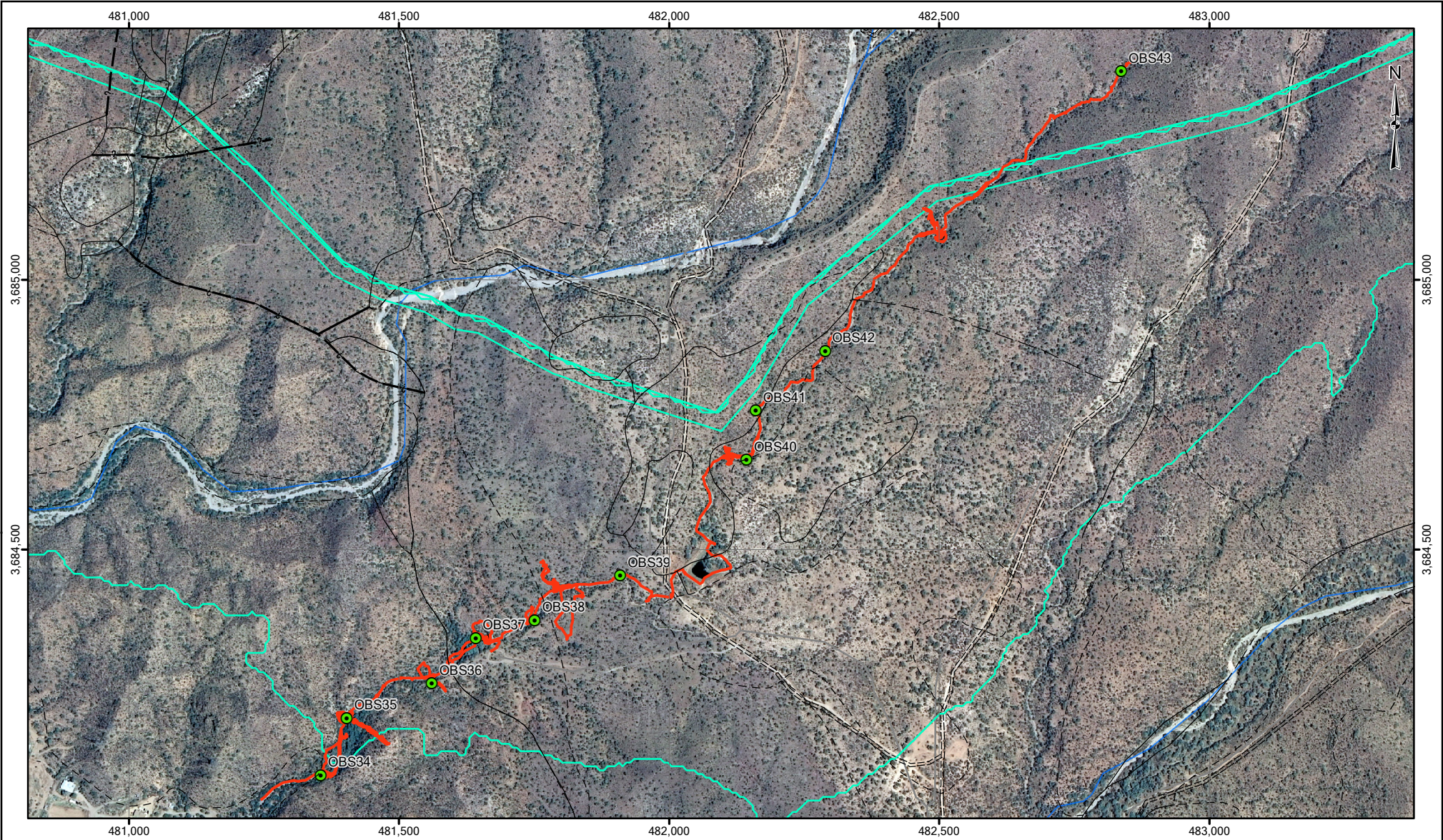


## Creek Traverse #5 Observations

Observation Station	Coordinates <sup>1</sup>	
	Easting (m)	Northing (m)
OBS34	481357	3684079
OBS35	481403	3684188
OBS36	481563	3684249
OBS37	481643	3684333
OBS38	481753	3684365
OBS39	481911	3684448
OBS40	482144	3684663
OBS41	482162	3684755
OBS42	482290	3684864
OBS43	482838	3685383

1 – Coordinates measured with handheld GPS unit. Coordinate system: UTM NAD27 CONUS





LEGEND

- CREEK TRAVERSE  
OBSERVATION POINT

— TRAVERSE

— NEAR WEST TAILINGS SITE

— HAPPY CAMP OPTION
- ==== ROAD (FROM RESOLUTION)

— ROAD (FROM STATE)

— STREAM
- CONTACT (BETWEEN  
GEOLOGIC UNITS)

--- CONTACT - APPROXIMATE

--- CONTACT - INFERRED

+ + CONTACT BETWEEN PINAL SCHIST  
CLAST-RICH CONGLOMERATE BELOW  
AND DRIPPING SPRING QUARTZITE  
CLAST-RICH CONGLOMERATE ABOVE

Notes:  
1. NAD27 UTM12  
2. Orthophoto from USDA

NOT FOR CONSTRUCTION

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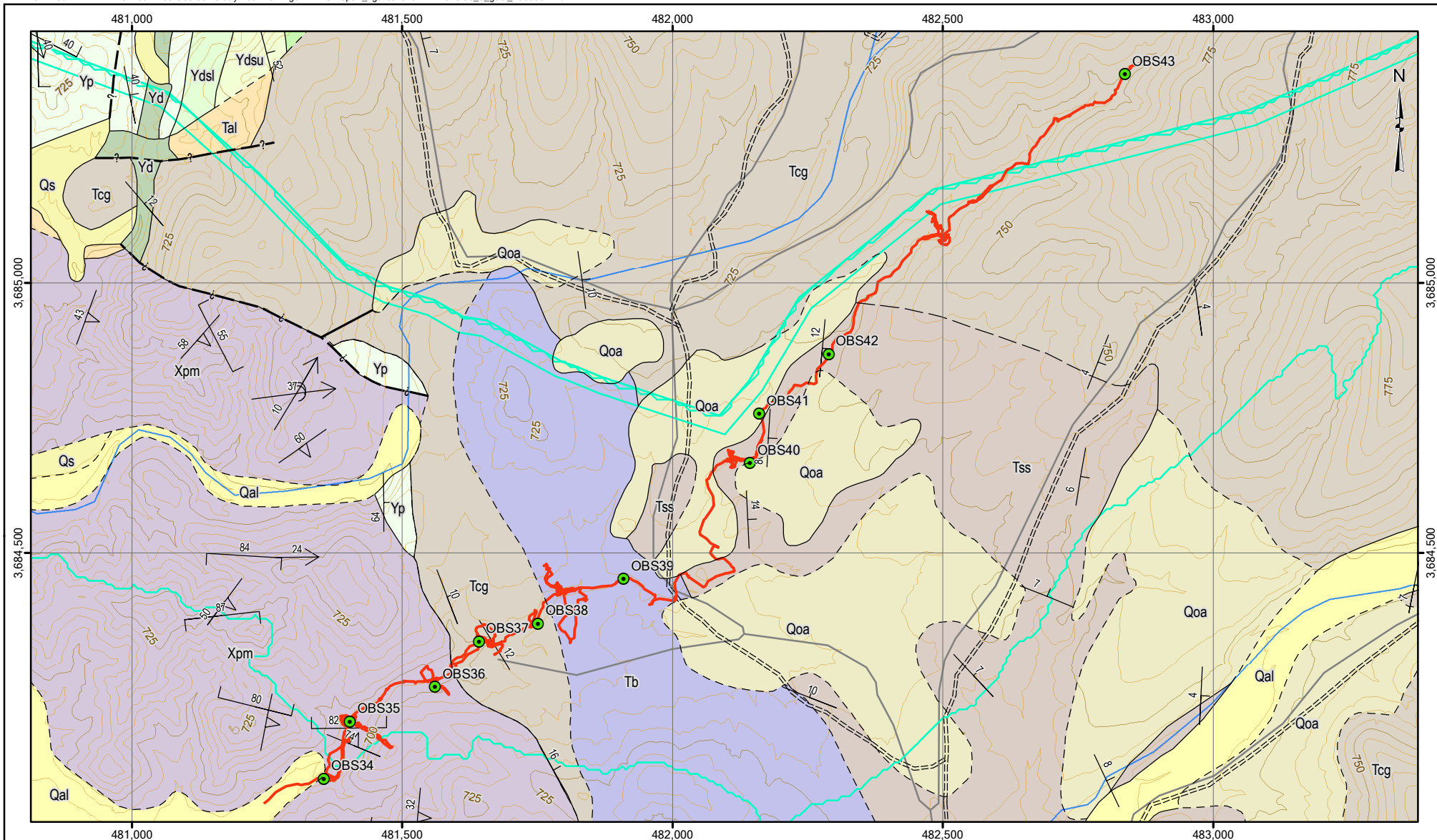
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PROJECT	RESOLUTION PROJECT 2013 NEAR WEST SITE INVESTIGATION	
TITLE	CREEK TRAVERSE #5 OBSERVATIONS	
PROJECT No.	M09441A14	FIG No. I-E.3





## LEGEND

- |                                                                                    |                                     |                                                                                     |                                                                                                                                          |                                                                                     |                        |
|------------------------------------------------------------------------------------|-------------------------------------|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|------------------------|
|  | CREEK TRAVERSE<br>OBSERVATION POINT |  | CONTACT (BETWEEN<br>GEOLOGIC UNITS)                                                                                                      |  | FELSIC DYKE            |
|  | TRAVERSE                            |  | CONTACT - APPROXIMATE                                                                                                                    |  | FAULT                  |
|  | NEAR WEST TAILINGS SITE             |  | CONTACT - INFERRED                                                                                                                       |  | FAULT - APPROXIMATE    |
|  | HAPPY CAMP OPTION                   |  | CONTACT BETWEEN PINAL SCHIST<br><i>CLAST-RICH CONGLOMERATE BELOW<br/>AND DRIPPING SPRING QUARTZITE<br/>CLAST-RICH CONGLOMERATE ABOVE</i> |  | FAULT - CONCEALED      |
|  | ROAD (FROM RESOLUTION)              |                                                                                     |                                                                                                                                          |  | QUARTZ VEIN            |
|  | ROAD (FROM STATE)                   |                                                                                     |                                                                                                                                          |  | MARKER HORIZON (LOCAL) |
|  | STREAM                              |                                                                                     |                                                                                                                                          |                                                                                     |                        |

Notes:  
1. NAD27 UTM12  
2. Refer to main report for descriptions of geologic units.

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PROJECT	RESOLUTION PROJECT 2013 NEAR WEST SITE INVESTIGATION
---------	---------------------------------------------------------

TITLE	CREEK TRAVERSE #5 OBSERVATIONS AND GEOLOGY
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PROJECT No.	M09441A14
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FIG No.	I-E.4
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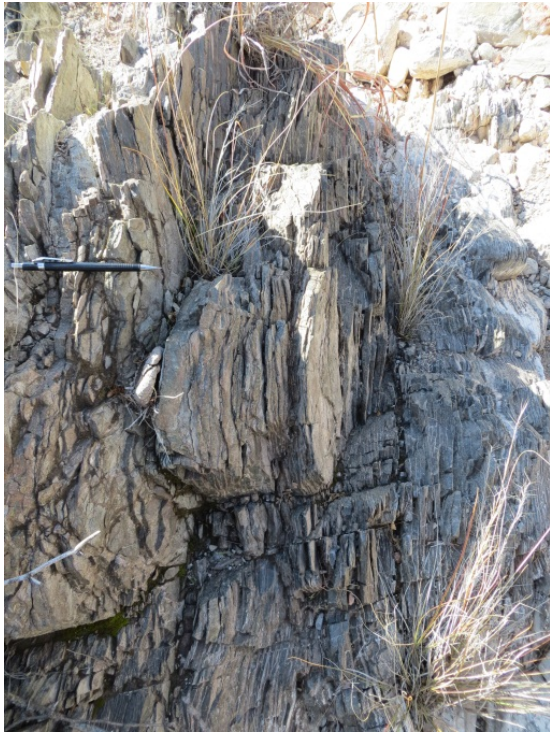




### OBS34

Schist outcrops in channel banks and invert with steeply dipping foliation cleavage. High water mark visible approximately 30 cm (11.8 inches) above invert. Foliation cleavage planes ~ 0.5 cm (0.20 inches) apart and near vertical with evidence of folding.

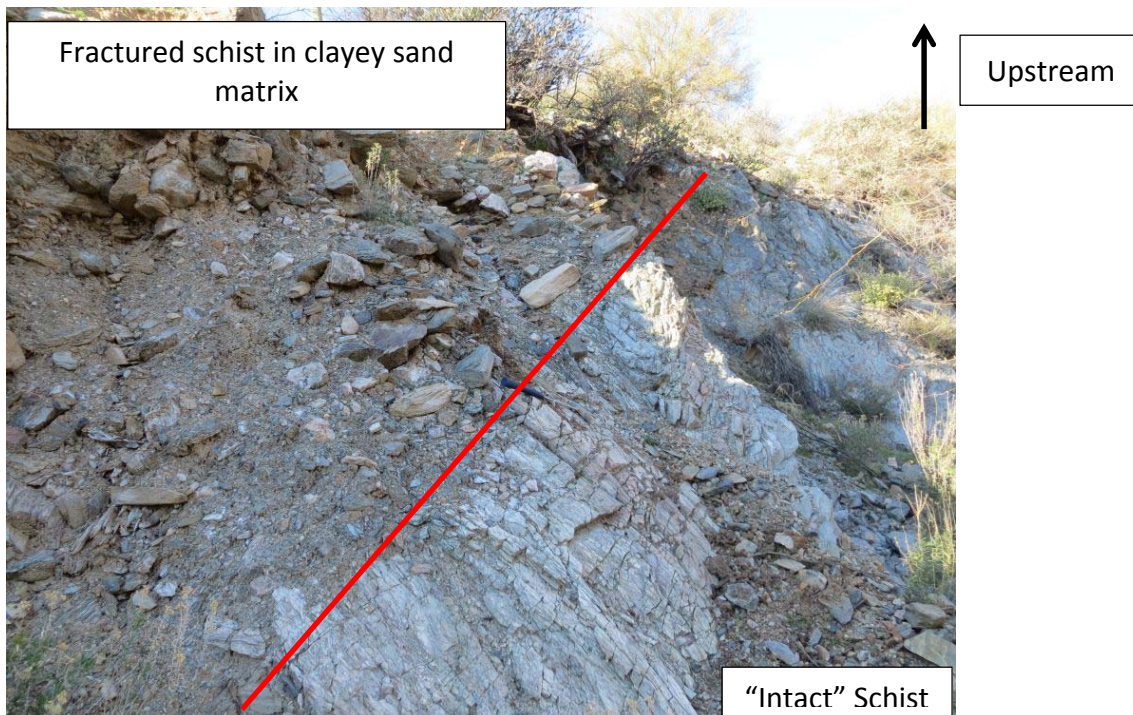
Orientation of dominant foliation cleavage: **285/90**





### OBS35

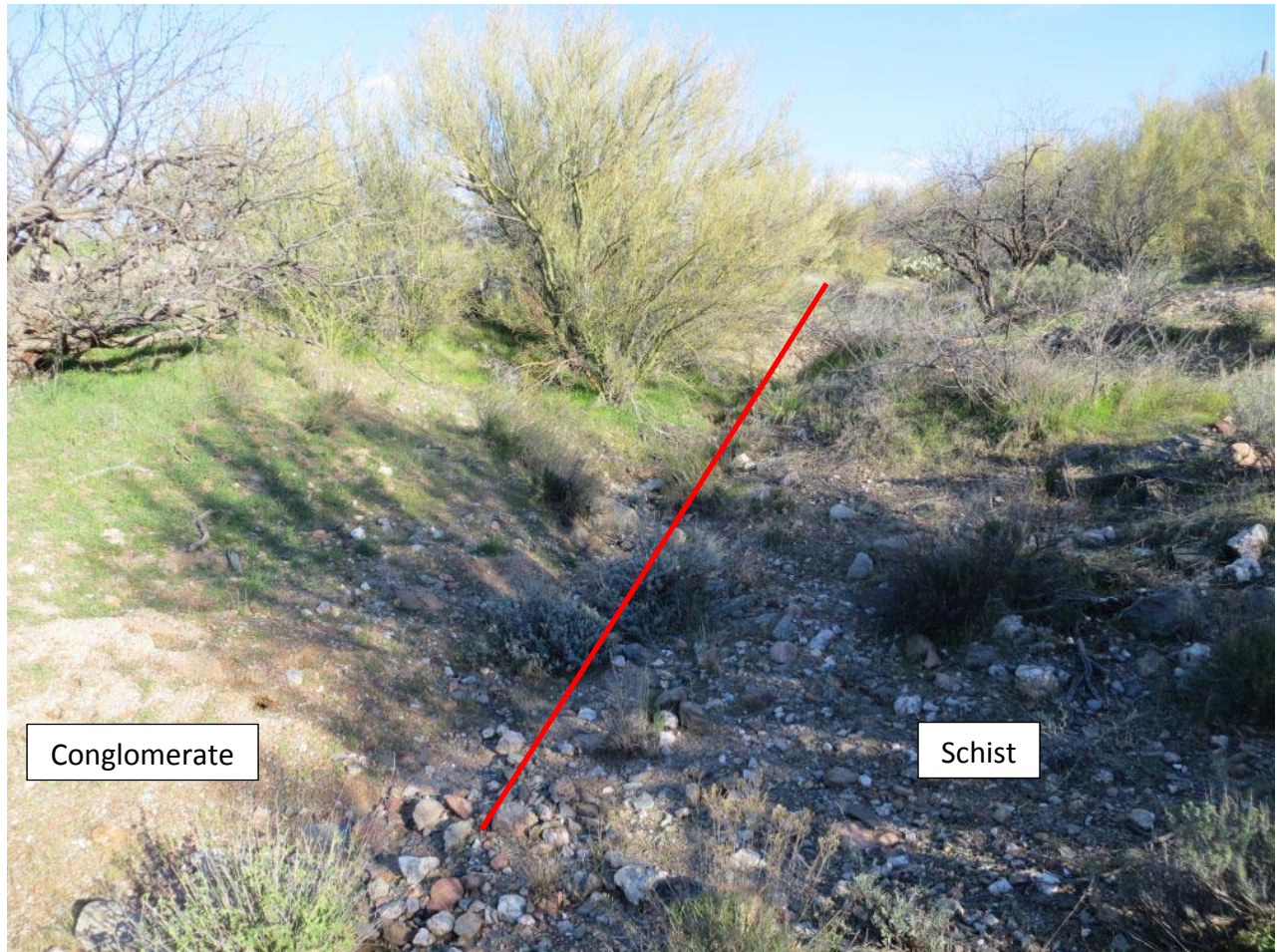
Short erosional gully terminating perpendicular to the main channel. Intact schist exposed on gully sides. Fractured schist particles “floating” in weakly cemented well graded clayey sand exposed in left channel bank near mouth of gully.





**OBS36**

Contact between schist and conglomerate on right channel bank. Small depression along line of contact.





### **OBS37 (BENSON SPRING)**

Sub-horizontal conglomerate beds in creek channel with ponding water. Differential weathering of finer conglomerate beds. Maximum water pond depth  $\approx 0.5$  m (1.64 ft). Beds are sub-horizontal at the center of the channel.

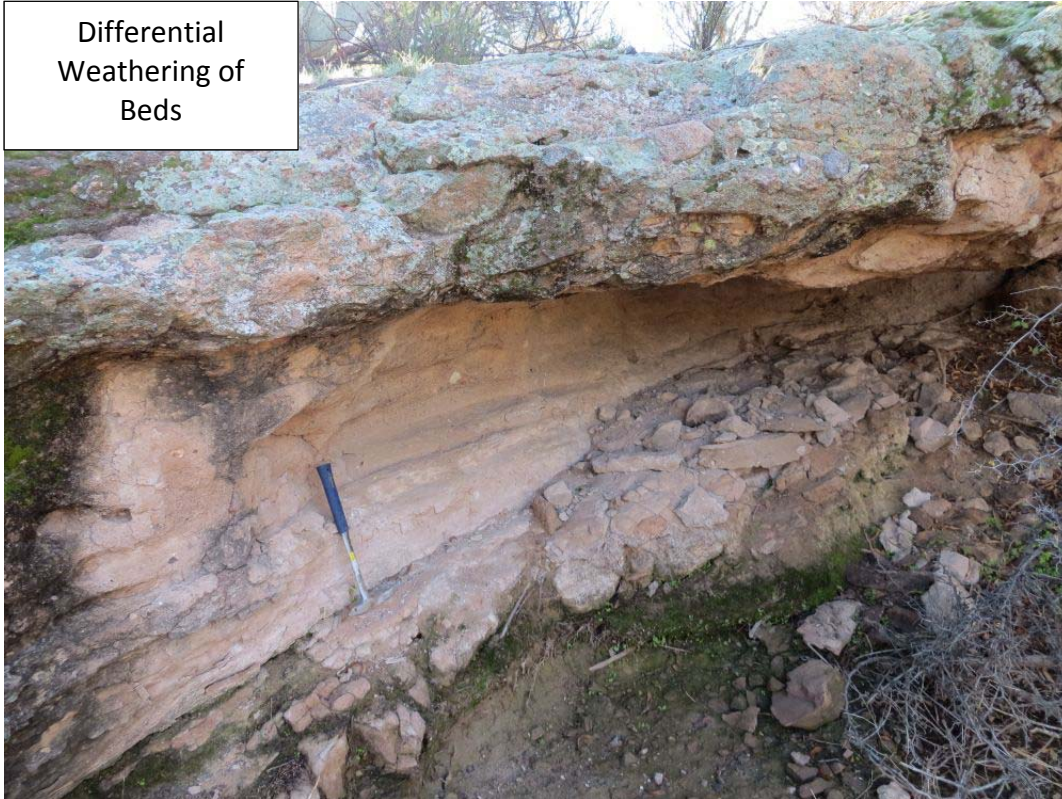
Orientation of beds on left channel bank: **015/11**

Orientation of beds on right channel bank: **320/02**





Differential  
Weathering of  
Beds





**OBS38**

Contact between conglomerate and basalt. Basalt now exposed in both channel banks.





### OBS39

Basalt outcrop in left channel bank, fresh to slightly weathered, R6, flatly dipping (approx. 20 deg.) joints with 5cm – 15 cm (1.97 – 5.91 inches) spacing, closed to open (max. aperture = 1 mm (0.04 inches)), either no infilling or calcite infilling. A fracture zone is exposed next to the basalt outcrop with calcite filled veins and clayey sand infilling in some larger fractures.





**OBS40**

Sub-horizontal conglomerate bed outcropped in right channel bank

Orientation of bed: **355/07**





**OBS41**

Dipping conglomerate bed in left channel bank

Orientation of bed: **000/14**





**OBS42**

Sub-horizontal conglomerate bed outcropped in left channel bank.

Orientation of bed: **000/06**





**OBS43**

Fluvial deposits in the channel invert end and bare conglomerate surface exposed in channel invert.





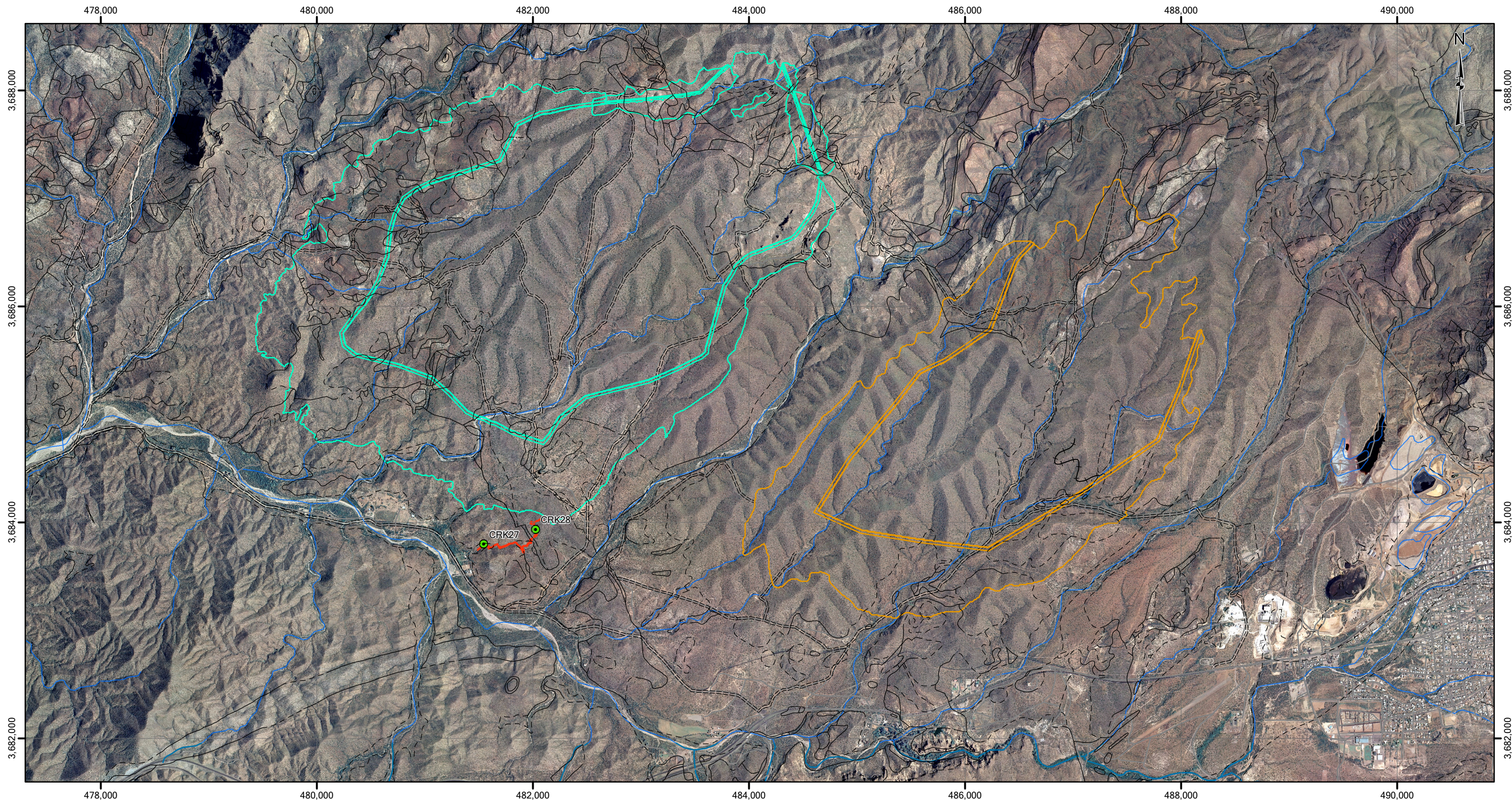
## APPENDIX I-F

### Traverse #6

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LEGEND

- |                                |                        |                                                                                                                                |
|--------------------------------|------------------------|--------------------------------------------------------------------------------------------------------------------------------|
| CREEK TRAVERSE MAPPING STATION | STREAM                 | CONTACT (BETWEEN GEOLOGIC UNITS)                                                                                               |
| TRAVERSE                       | ROAD (FROM STATE)      | CONTACT - APPROXIMATE                                                                                                          |
| NEAR WEST TAILINGS SITE        | ROAD (FROM RESOLUTION) | CONTACT - INFERRED                                                                                                             |
| HAPPY CAMP OPTION              |                        | CONTACT BETWEEN PINAL SCHIST<br>CLAST-RICH CONGOMERATE BELOW<br>AND DRIPPING SPRING QUARTZITE<br>CLAST-RICH CONGLOMERATE ABOVE |

Notes:  
1. NAD27 UTM12  
2. Orthophoto from USDA

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PROJECT  
RESOLUTION PROJECT  
2013 NEAR WEST SITE INVESTIGATION

TITLE  
CREEK TRAVERSE #6

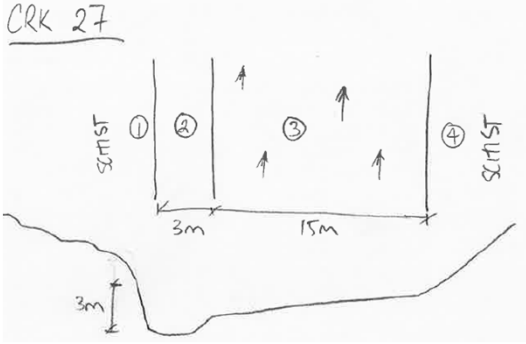
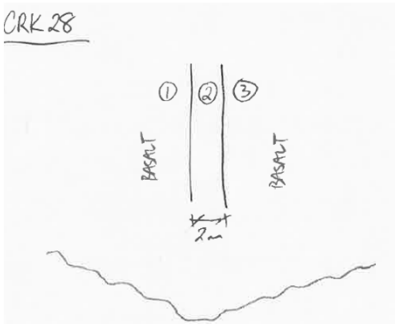
PROJECT No.  
M09441A14

FIG No.  
I-F.1



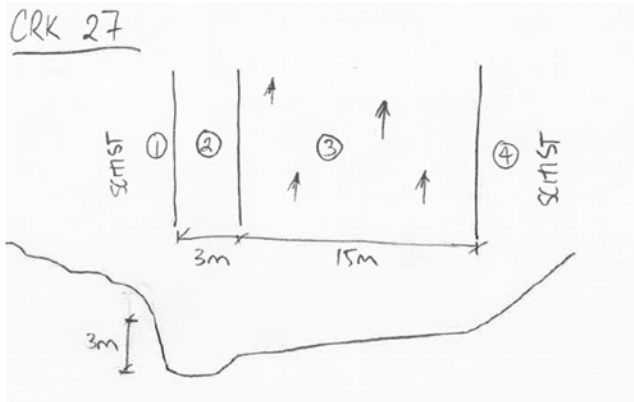






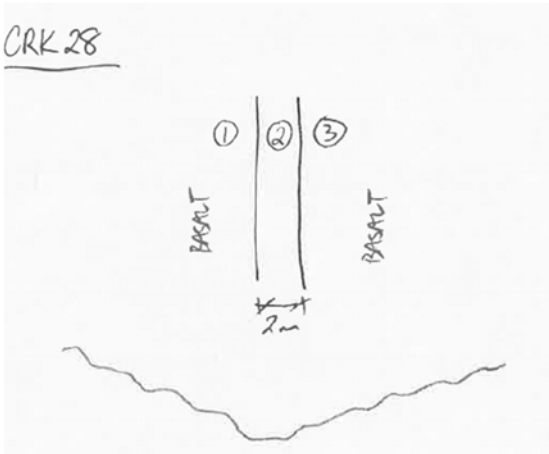


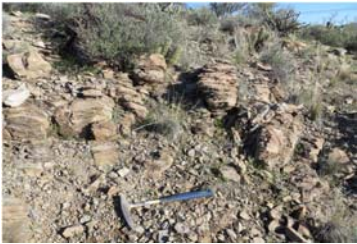
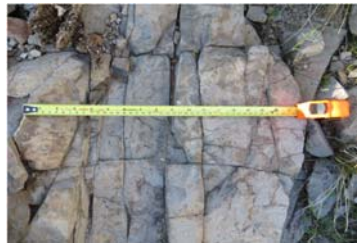






TRAVERSE 6												
Date Mapped	Traverse Type	Mapping Point	Northing* (m)	Easting* (m)	Total Channel Width (m)** (ft)	Field Sketch	Unit Described	Description (From Left to Right Across Channel Looking Upstream)	Maximum Particle Size in Channel (cm) (inches)	Rock Strength	Geologic Unit	Notes
23-Feb-13	Creek	CRK27	3683794.9	481545.01	18 (59)		1	SCHIST, fresh, R3, fractured with steeply dipping foliation cleavage, mm spacing up to 3 cm, closed, signs of folding along foliation cleavage, quartz infilling along some foliations		R3	Xpm	
							2	Gravelly SAND (SW), fine to coarse, trace cobbles (in sampling area), well graded, max. particle size = 4 cm (sample); 30 cm (channel), angular to sub-angular, moist just below surface,, minor vegetation (grass) in channel	30 (11.8)		Qs	
							3	Silty SAND (SM), fine to coarse, some gravel to gravelly, well graded, max. particle size = 5 cm, sub-angular to angular, some organics, hole excavated to 30 cm without refusal			Qoa	
							4	SCHIST, small outcrops and gravel/boulders/cobbles at surface			Xpm	
23-Feb-13	Creek	CRK28	3683930.48	482023.63	2 (7)		1	BASALT, fresh, R5, one set of vertical joints, 2 cm to 15 cm spacing closed to partly open, silty infilling, other randomly oriented fractures cross cutting joints joint orientation (340/90)		R5	Tb	
							2	SAND, GRAVEL and COBBLES (SW-GW), fine to coarse, trace silt, well graded, max. particle size = 5 cm (sample); 40 cm (channel; likely talus), angular to sub-angular, moist just below surface, all particles basalt	40 (15.8)		Qs	
							3	BASALT, fresh to slightly weathered, R5, joint set dipping into channel bank, 1 cm spacing, joints closed where they daylight from slope; variable aperture in outcrops, undulating joint orientation (037/20) (questionable; difficult to find representative surface)		R5	Tb	

\* Coordinates measured with handheld GPS unit. Coordinate System: UTM NAD27 CONUS  
\*\* Total Channel Width includes the width of active channels as well as Old Alluvium deposits



TRAVERSE 6							
Date Mapped	Traverse Type	Mapping Point	Field Sketch	Traverse Observation Point Photos (See Field Sketch)			
				1	2	3	4
23-Feb-13	Creek	CRK27					
							
23-Feb-13	Creek	CRK28					
							

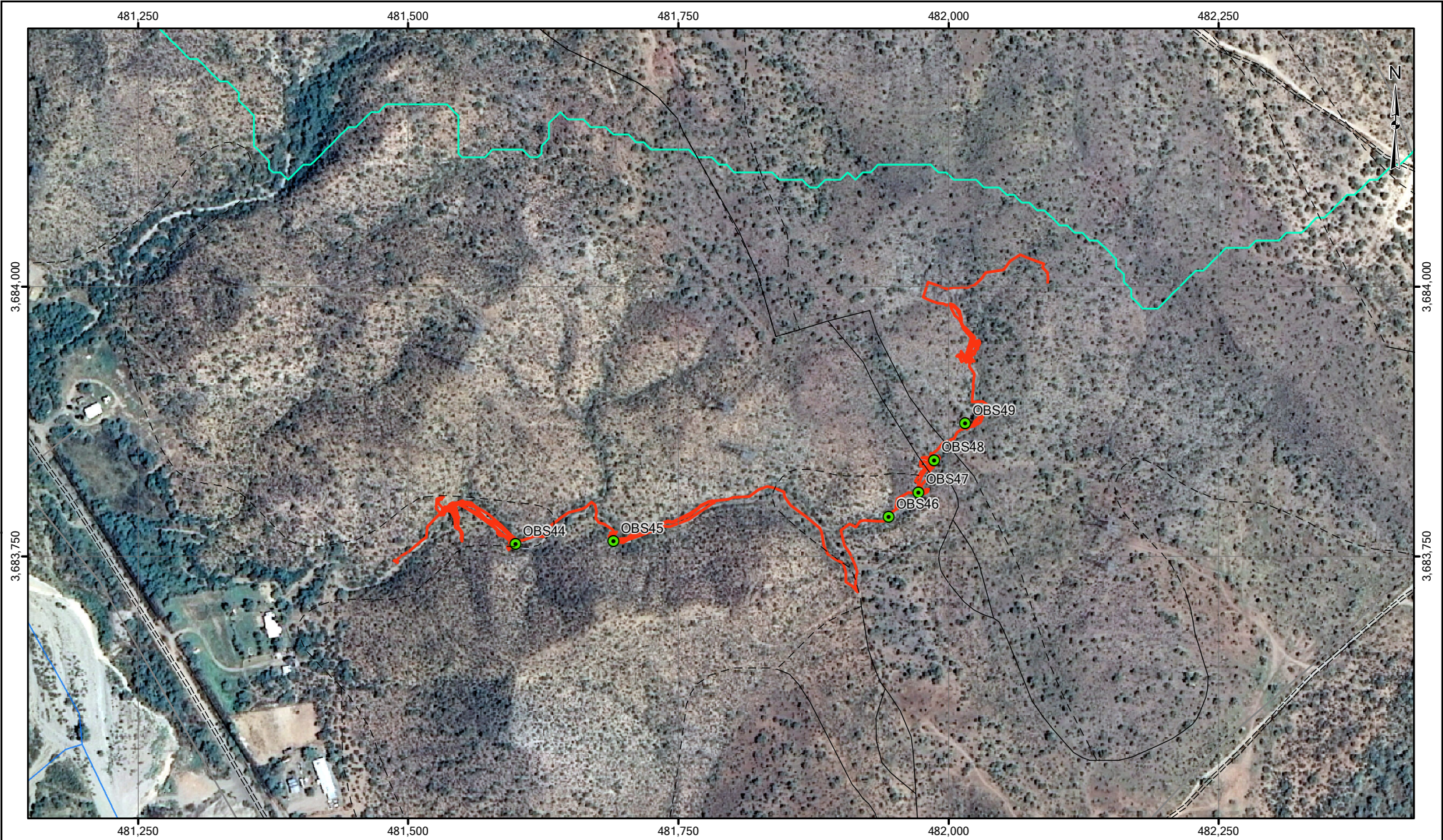


## Creek Traverse #6 Observations

Observation Station	Coordinates <sup>1</sup>	
	Easting (m)	Northing (m)
OBS44	481601	3683758
OBS45	481692	3683761
OBS46	481946	3683783
OBS47	481974	3683806
OBS48	481988	3683836
OBS49	482017	3683870

1 – Coordinates measured with handheld GPS unit. Coordinate system: UTM NAD27 CONUS





LEGEND

- CREEK TRAVERSE OBSERVATION POINT

— TRAVERSE

— NEAR WEST TAILINGS SITE

— HAPPY CAMP OPTION
- ==== ROAD (FROM RESOLUTION)

— ROAD (FROM STATE)

— STREAM
- CONTACT (BETWEEN GEOLOGIC UNITS)

--- CONTACT - APPROXIMATE

--- CONTACT - INFERRED

+--- CONTACT BETWEEN PINAL SCHIST CLAST-RICH CONGLOMERATE BELOW AND DRIPPING SPRING QUARTZITE CLAST-RICH CONGLOMERATE ABOVE

Notes:  
1. NAD27 UTM12  
2. Orthophoto from USDA

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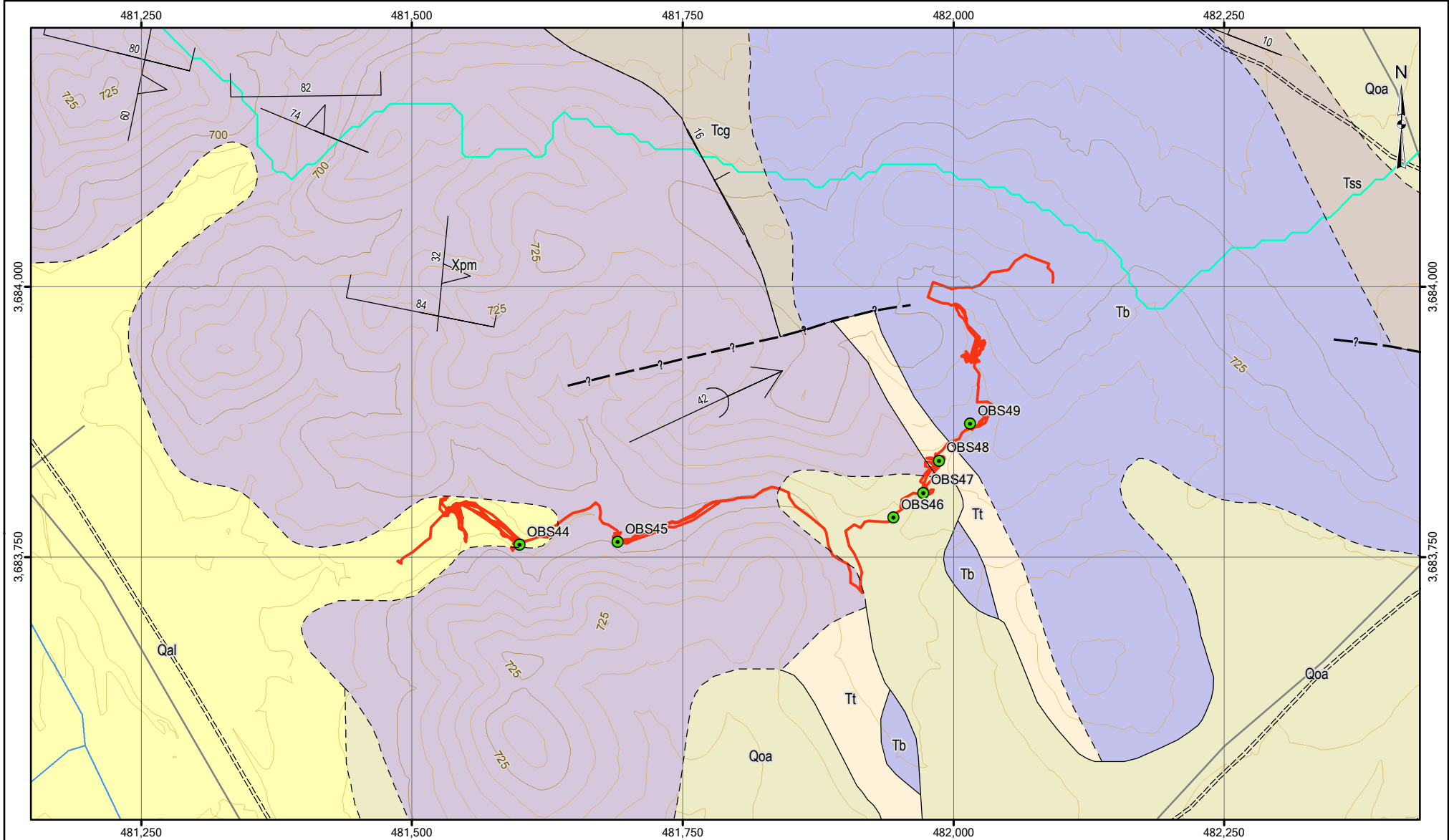
Resolution Copper Mining

Klohn Crippen Berger

PROJECT	RESOLUTION PROJECT 2013 NEAR WEST SITE INVESTIGATION	
TITLE	CREEK TRAVERSE #6 OBSERVATIONS	
PROJECT No.	M09441A14	FIG No. I-F.3







# LEGEND

- |                                    |                                                                                                                              |                           |
|------------------------------------|------------------------------------------------------------------------------------------------------------------------------|---------------------------|
| ● CREEK TRAVERSE OBSERVATION POINT | — CONTACT (BETWEEN GEOLOGIC UNITS)                                                                                           | ××× FELSIC DYKE           |
| — TRAVERSE                         | - - - CONTACT - APPROXIMATE                                                                                                  | — FAULT                   |
| — NEAR WEST TAILINGS SITE          | - - - CONTACT - INFERRED                                                                                                     | — FAULT - APPROXIMATE     |
| — HAPPY CAMP OPTION                | + + + CONTACT BETWEEN PINAL SCHIST CLAST-RICH CONGLOMERATE BELOW AND DRIPPING SPRING QUARTZITE CLAST-RICH CONGLOMERATE ABOVE | ..... FAULT - CONCEALED   |
| ==== ROAD (FROM RESOLUTION)        |                                                                                                                              | — QUARTZ VEIN             |
| — ROAD (FROM STATE)                |                                                                                                                              | ● MARKER HORIZON (LOCAL)  |
| — STREAM                           |                                                                                                                              | — NEAR WEST TAILINGS SITE |
|                                    |                                                                                                                              | — HAPPY CAMP OPTION       |

Notes:  
1. NAD27 UTM12  
2. Refer to main report for descriptions of geologic units.

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### CLIENT



0 125 m

PROJECT	RESOLUTION PROJECT 2013 NEAR WEST SITE INVESTIGATION	
TITLE	CREEK TRAVERSE #6 OBSERVATIONS AND GEOLOGY	
PROJECT No.	M09441A14	FIG No. I-F.4



**OBS44**

Joint set visible in schist outcrop. R4 rock, 10 cm to 20 cm (*3.94 inches to 7.87 inches*) joint spacing, closed aperture.

Orientation of joint set: 194/38





**OBS45**

Gently folded, near vertical foliation cleavage in schist outcrop. Millimeter scale spacing between foliation planes.





**OBS46**

Outcrop of very foliated schist with parallel foliation cleavage planes.

Orientation of foliation cleavage: **255/40**





**OBS47**

Poorly welded tuff (Tt) outcrops in channel banks. Contact between schist and tuff. Tuff is massive, R2, some low angle "bedding" observed.

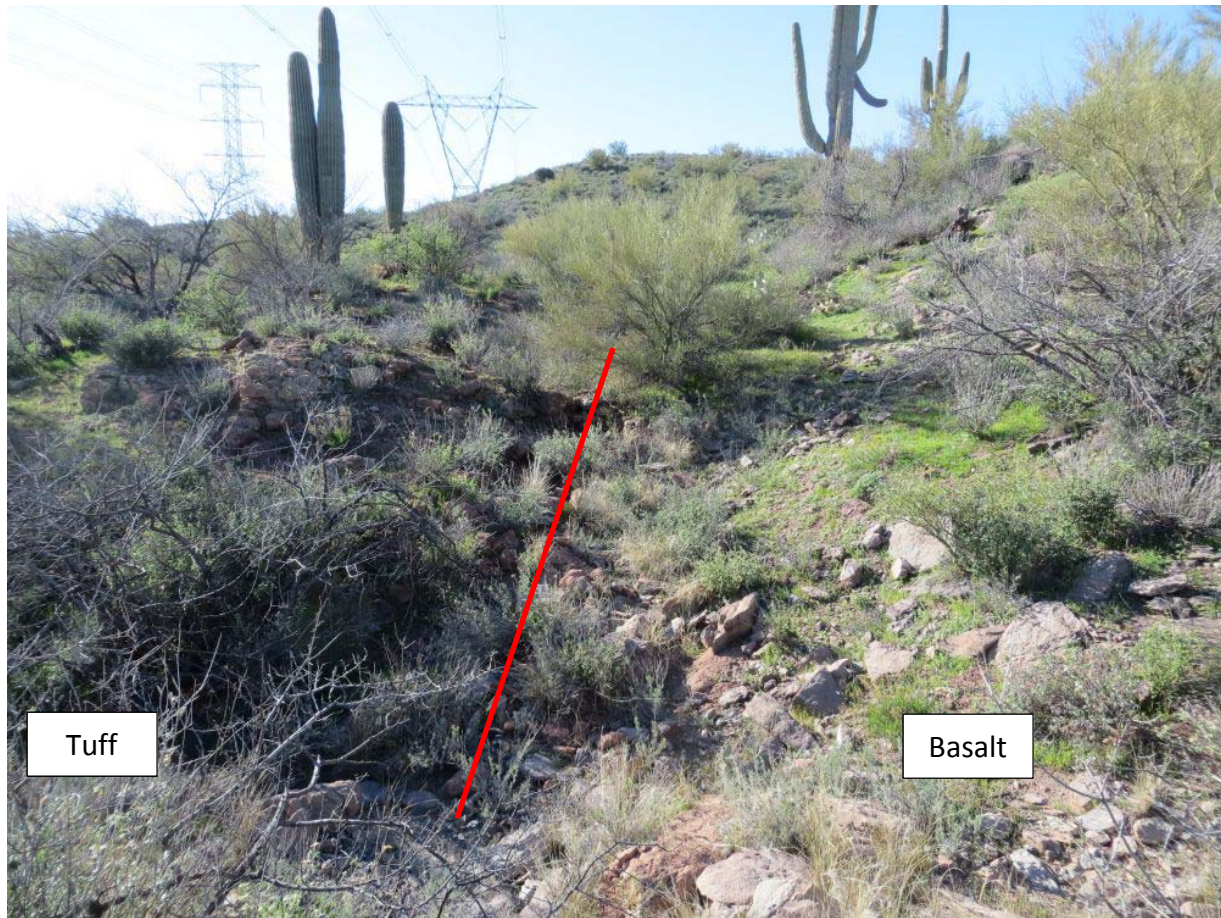
Orientation of bedding structure: **353/07**





**OBS48**

Contact between tuff (Tt) and basalt (Tb). Small depression along contact line.



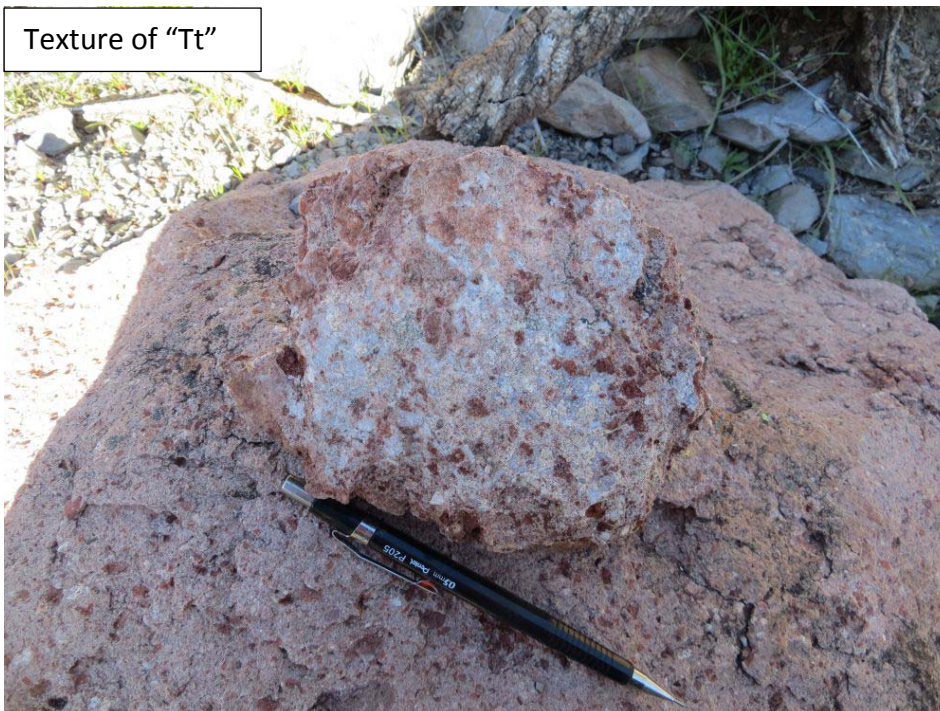


#### OBS49

Elevation drop of approximately 2 m (6.56 ft) in channel invert over tuff outcrop. Tuff is fresh, R2, massive with some randomly oriented closed to tight fractures. Reactive to acid on some but not all fresh surfaces.



Texture of "Tt"





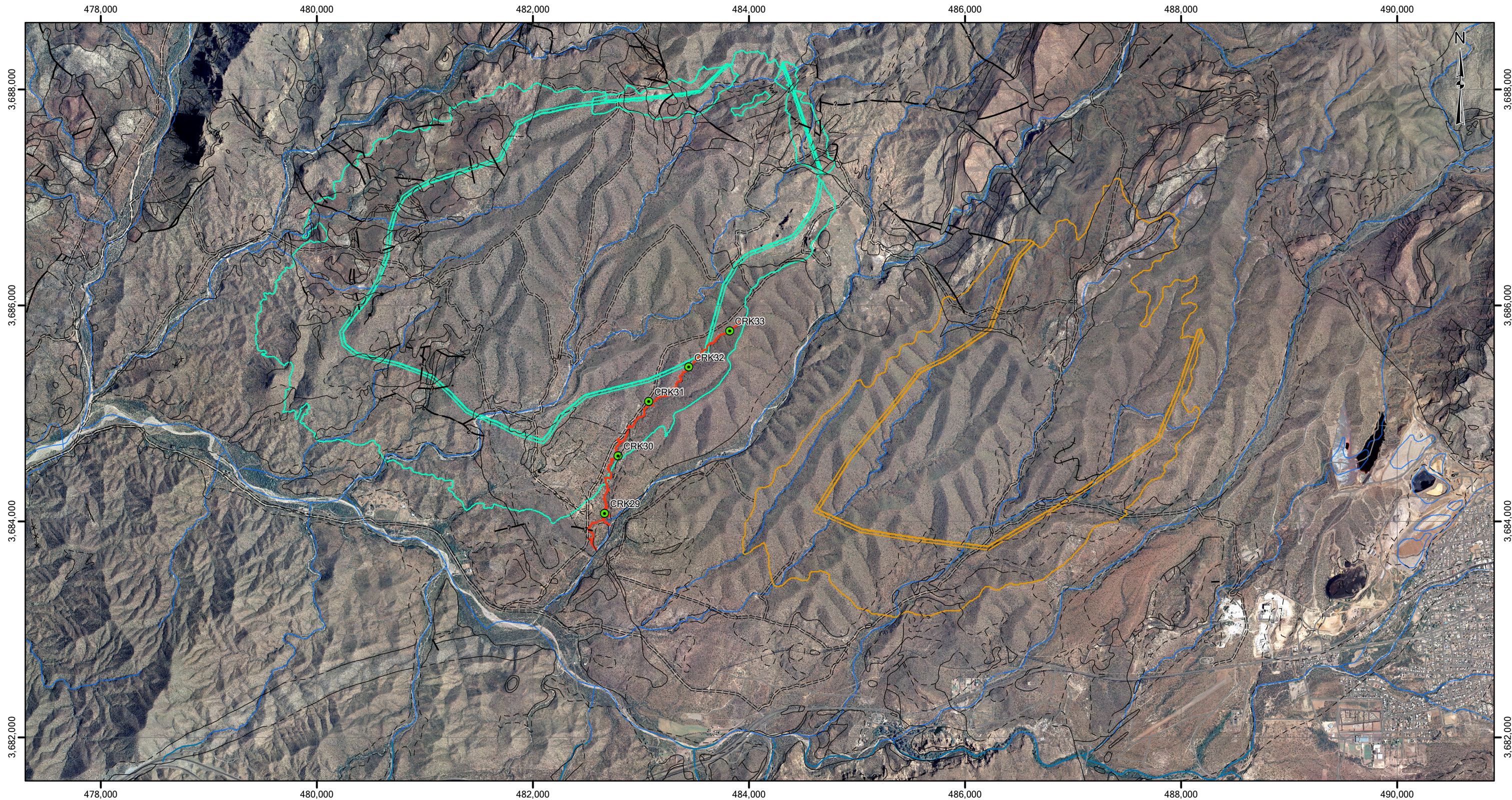
## APPENDIX I-G

### Traverse #7

---



CB Z:\MVC\RM09441A14 - RES-Near West\Geotech Study\400 Drawings\MXD\SI\report\_figures\tabled\FMTraverse\_7\_orho\_130605.mxd 7/23/2013 12:05:39 PM



LEGEND

- |  |                                |  |                        |  |                                                                                                                                 |
|--|--------------------------------|--|------------------------|--|---------------------------------------------------------------------------------------------------------------------------------|
|  | CREEK TRAVERSE MAPPING STATION |  | STREAM                 |  | CONTACT (BETWEEN GEOLOGIC UNITS)                                                                                                |
|  | TRAVERSE                       |  | ROAD (FROM STATE)      |  | CONTACT - APPROXIMATE                                                                                                           |
|  | NEAR WEST TAILINGS SITE        |  | ROAD (FROM RESOLUTION) |  | CONTACT - INFERRED                                                                                                              |
|  | HAPPY CAMP OPTION              |  |                        |  | CONTACT BETWEEN PINAL SCHIST<br>CLAST-RICH CONGLOMERATE BELOW<br>AND DRIPPING SPRING QUARTZITE<br>CLAST-RICH CONGLOMERATE ABOVE |

Notes:  
1. NAD27 UTM12  
2. Orthophoto from USDA

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0 1,000 m

PROJECT  
RESOLUTION PROJECT  
2013 NEAR WEST SITE INVESTIGATION

TITLE  
CREEK TRAVERSE #7

PROJECT No.  
M09441A14

FIG No.  
I-G.1

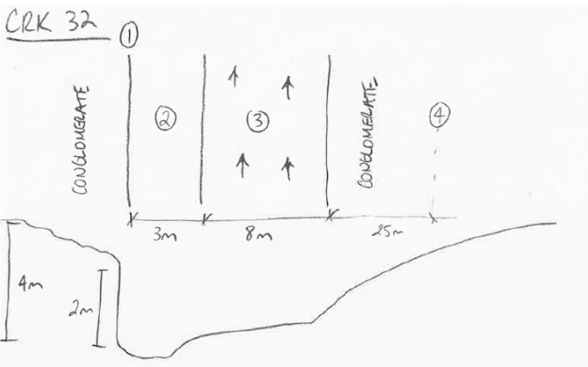
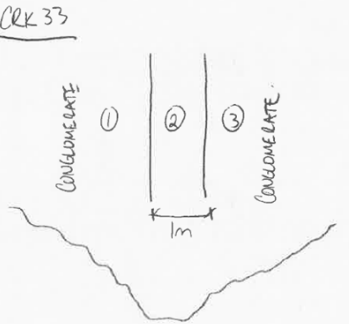






TRAVERSE 7													
Date Mapped	Traverse Type	Mapping Point	Northing* (m)	Easting* (m)	Total Channel Width (m)** (ft)	Field Sketch	Unit Described	Description (From Left to Right Across Channel Looking Upstream)	Maximum Particle Size in Channel (cm) (inches)	Rock Strength	Geologic Unit	Notes	
25-Feb-13	Creek	CRK29	3684069	482665.07	45 (148)		1	Clayey SAND, GRAVEL and COBBLES (SC-GW), fine to coarse, well graded, max. particle size = 9 cm, reddish brown, moist, various lithology, refusal reached at 10 cm - very hard digging through cobbles			Tss	Weathered surface of Tertiary sandstone	
							2	SAND, GRAVEL and COBBLES (SW-GW), fine to coarse, well graded, max. particle size = 13 cm (sample); 30 cm (channel), sub-rounded to angular, moist just below surface, very weak acid reaction around some grains, various lithology, grasses in channel	30 (11.8)		Qs		
							3	Silty SAND (SM), fine to coarse, some gravel to gravelly, well graded, max. particle size = 9 cm, sub-angular to sub-rounded, brown, moist, various lithology, hole excavated to 30 cm without refusal			Qoa		
							4	Silty SAND (SM), fine to medium, some gravel, poorly graded, max. particle size = 3 cm, sub-angular to sub-rounded, brown, moist, variable lithology, hole excavated to 30 cm without refusal			Qoa		
							5	Clayey SAND, GRAVEL and COBBLES (SC-GW), fine to coarse, well graded, max. particle size = 9 cm, reddish brown, moist, various lithology, refusal reached at 10 cm - very hard digging through cobbles			Tss	Weathered surface of Tertiary sandstone	
25-Feb-13	Creek	CRK30	3684603.82	482788.73	4 (13)		1	Clayey Gravelly SAND (SC), fine to coarse, trace cobbles, well graded, max. particle size = 15 cm, sub-angular, brown, moist, some organics, variable lithology, hole excavated to 30 cm without refusal			Tcg	Weathered surface of conglomerate	
							2	Silty Gravelly SAND (SM), fine to coarse, some cobbles, well graded, max. particle size = 11 cm, angular to sub-rounded, brown, moist, variable lithology including some conglomerate particles, strong acid reaction, some organics, hole excavated to 30 cm without refusal			Tcg	Weathered surface of conglomerate	
							3	SAND, GRAVEL and COBBLES (SW-GW), fine to coarse, well graded, max. particle size = 10 cm (sample); 40 cm (channel), rounded to angular, moist just below surface, various lithology, very slight acid reaction around some grains	40 (15.8)		Qs		
							4	CONGLOMERATE, fresh, R2, bedded with thin laminations (mm scale) up to beds 40 cm thick, range of particle sizes (max. 20 cm), rounded to angular clasts, reactive to acid, various lithology, some vertical fractures up to 10 cm aperture, fractures appear to be caused by root penetration		R2	Tcg		
25-Feb-13	Creek	CRK31	3685103.32	483073.92	8 (26)		1	CONGLOMERATE, fresh, R2/R3, massive with some faint undulating beds (visible by thin, continuous sub-horizontal discontinuities), range of particle sizes (max. = 40 cm), rounded to angular clasts, reactive to acid, various lithology, some openings parallel to the exposure face (max. aperture = 10 cm) with very stepped and rough surfaces likely caused by root penetration		R2 to R3	Tcg		
							2	SAND, GRAVEL and COBBLES (SW-GW), fine to coarse, trace to some silt, well graded, max. particle size = 10 cm (sample); 30 cm (surrounding area), sub-angular to angular, moist just below surface, various lithology, grass and small bushes on channel bar	30 (11.8)		Qs		
							3	SAND, GRAVEL and COBBLES (SW-GW), fine to coarse, trace to some silt, well graded, max. particle size = 8 cm (sample); 50 cm (channel), sub-angular to angular, moist just below surface or at surface, slight acid reaction around some grains, various lithology, 10 cm thick deposit on top of conglomerate surface	50 (19.7)		Qs		
							4	Clayey SAND, GRAVEL and COBBLES (SC-GW), fine to coarse, well graded, max. particle size = 30 cm, reddish brown, moist, various lithology, refusal reached at 5 cm - very hard digging through cobbles			Tcg	Weathered surface of conglomerate	



TRAVERSE 7													
Date Mapped	Traverse Type	Mapping Point	Northing* (m)	Easting* (m)	Total Channel Width (m)** (ft)	Field Sketch	Unit Described	Description (From Left to Right Across Channel Looking Upstream)	Maximum Particle Size in Channel (cm) (inches)	Rock Strength	Geologic Unit	Notes	
25-Feb-13	Creek	CRK32	3685425.52	483443.86	3 (10)		1	CONGLOMERATE, fresh, R2 to R3, massive, range of particle sizes (max. = 30 cm), sub-rounded to angular clasts, reactive to acid, various lithology, some horizontal discontinuities in top 50 cm of exposure, some roots penetrating down through unit		R2 to R3	Tcg		
							2	SAND and GRAVEL (SW-GW), fine to coarse, some cobbles, well graded, max. particle size = 7 cm (sample); 35 cm (channel), sub-angular to angular, moist just below surface, mild acid reaction around some grains, various lithology, grass in channel	35 (13.8)		Qs		
							3	Clayey/Gravelly SAND (SC), fine to coarse, trace cobbles, well graded, max. particle size = 10 cm, angular to sub-angular, brown, moist, some organics, hole excavated to 30 cm without refusal			Tcg	Weathered surface of conglomerate	
							4	Clayey SAND (SC), fine to medium, some gravel, poorly graded, max. particle size = 4 cm, sub-angular to angular, brown, moist ("sticky"), trace organics, hole excavated to 30 cm without refusal			Tcg	Weathered surface of conglomerate	
25-Feb-13	Creek	CRK33	3685950	483751	1 (3)		1	CONGLOMERATE, gravel and cobbles at surface with some small outcrops, outcrops R2 and reactive to acid, range of clast sizes at surface (max. particle size = 40 cm), sub-rounded to sub-angular, various lithology			Tcg	Weathered surface of conglomerate	
							2	SAND, GRAVEL and COBBLES (SW-GW), fine to coarse, trace silt, well graded, max. particle size = 20 cm (sample); 60 cm (channel) (likely colluvium), sub-angular to angular, moist just below surface, minor acid reaction around some grains, bushes/grass and cacti in channel	60 (23.6)		Qs		
							3	Loose boulders and cobbles at surface with no outcrops visible, variable lithology			Tcg	Weathered surface of conglomerate	

\* Coordinates measured with handheld GPS unit. Coordinate System: UTM NAD27 CONUS  
\*\* Total Channel Width includes the width of active channels and Old Alluvium deposits



TRAVERSE 7			Field Sketch	Traverse Observation Point Photos (See Field Sketch)				
Date Mapped	Traverse Type	Mapping Point		1	2	3	4	5
25-Feb-13	Creek	CRK29		 	 	 	 	
25-Feb-13	Creek	CRK30		 	 	 		
25-Feb-13	Creek	CRK31		 	 	 	 	
25-Feb-13	Creek	CRK32		 	 	 	 	
25-Feb-13	Creek	CRK33		 	 			

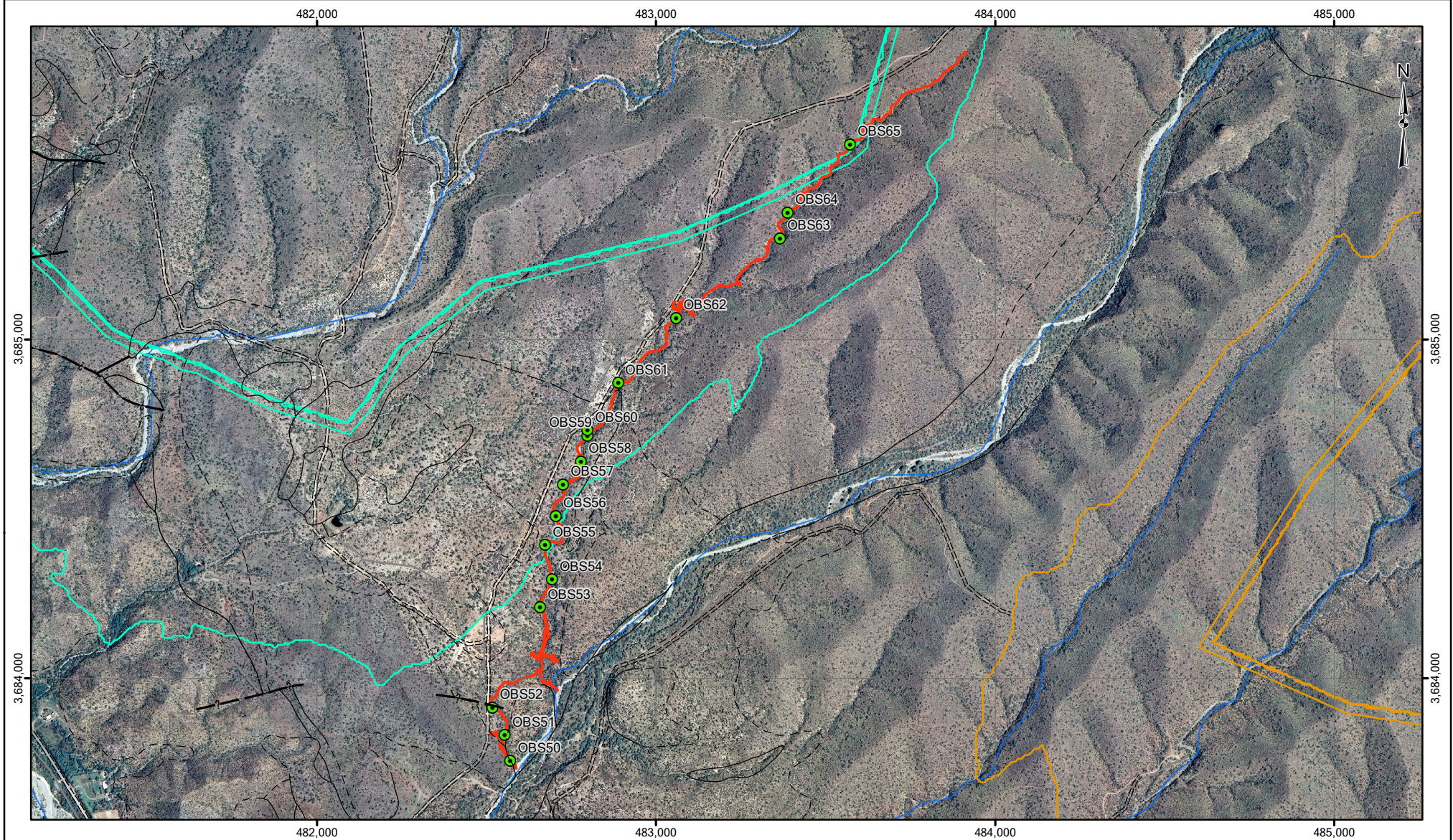


## Creek Traverse #7 Observations

Observation Station	Coordinates <sup>1</sup>	
	Easting (m)	Northing (m)
OBS50	482572	3683753
OBS51	482555	3683829
OBS52	482519	3683911
OBS53	482659	3684206
OBS54	482695	3684288
OBS55	482675	3684390
OBS56	482706	3684475
OBS57	482727	3684569
OBS58	482781	3684637
OBS59	482799	3684713
OBS60	482799	3684729
OBS61	482889	3684868
OBS62	483061	3685061
OBS63	483367	3685295
OBS64	483390	3685370
OBS65	483574	3685573

1 – Coordinates measured with handheld GPS unit





#### LEGEND

- |                                  |                        |                                                                                                                        |
|----------------------------------|------------------------|------------------------------------------------------------------------------------------------------------------------|
| CREEK TRAVERSE OBSERVATION POINT | ROAD (FROM RESOLUTION) | CONTACT (BETWEEN GEOLOGIC UNITS)                                                                                       |
| TRAVERSE                         | ROAD (FROM STATE)      | CONTACT - APPROXIMATE                                                                                                  |
| NEAR WEST TAILINGS SITE          | STREAM                 | CONTACT - INFERRED                                                                                                     |
| HAPPY CAMP OPTION                |                        | CONTACT BETWEEN PINAL SCHIST CLAST-RICH CONGLOMERATE BELOW AND DRIPPING SPRING QUARTZITE CLAST-RICH CONGLOMERATE ABOVE |

Notes:  
1. NAD27 UTM12  
2. Orthophoto from USDA

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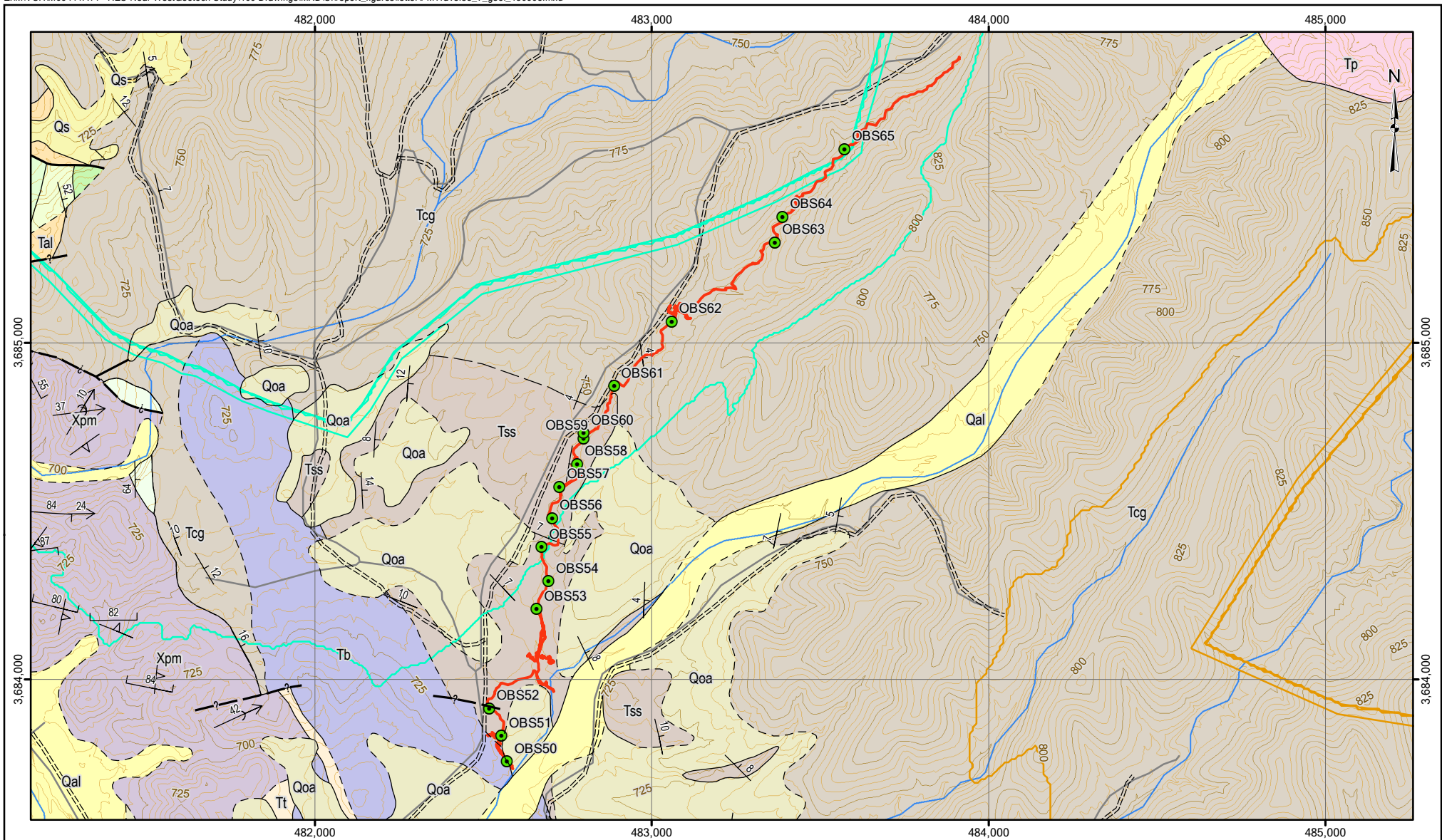
CLIENT



0 500 m

PROJECT	RESOLUTION PROJECT 2013 NEAR WEST SITE INVESTIGATION	
TITLE	CREEK TRAVERSE #7 OBSERVATIONS	
PROJECT No.	M09441A14	FIG No. I-G.3





# LEGEND

- |                                       |                                                                                                                                   |                           |
|---------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|---------------------------|
| ● CREEK TRAVERSE<br>OBSERVATION POINT | — CONTACT (BETWEEN<br>GEOLOGIC UNITS)                                                                                             | *** FELSIC DYKE           |
| — TRAVERSE                            | - - - CONTACT - APPROXIMATE                                                                                                       | — FAULT                   |
| — NEAR WEST TAILINGS SITE             | - - - CONTACT - INFERRED                                                                                                          | - ? - FAULT - APPROXIMATE |
| — HAPPY CAMP OPTION                   | — CONTACT BETWEEN PINAL SCHIST<br>CLAST-RICH CONGLOMERATE BELOW<br>AND DRIPPING SPRING QUARTZITE<br>CLAST-RICH CONGLOMERATE ABOVE | ..... FAULT - CONCEALED   |
| ==== ROAD (FROM RESOLUTION)           |                                                                                                                                   | — QUARTZ VEIN             |
| — ROAD (FROM STATE)                   |                                                                                                                                   | — MARKER HORIZON (LOCAL)  |
| — STREAM                              |                                                                                                                                   | — NEAR WEST TAILINGS SITE |
|                                       |                                                                                                                                   | — HAPPY CAMP OPTION       |

Notes:  
1. NAD27 UTM12  
2. Refer to main report for descriptions of geologic units.

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0 500 m

PROJECT	RESOLUTION PROJECT 2013 NEAR WEST SITE INVESTIGATION	
TITLE	CREEK TRAVERSE #7 OBSERVATIONS AND GEOLOGY	
PROJECT No.	M09441A14	FIG No. I-G.4



### OBS50

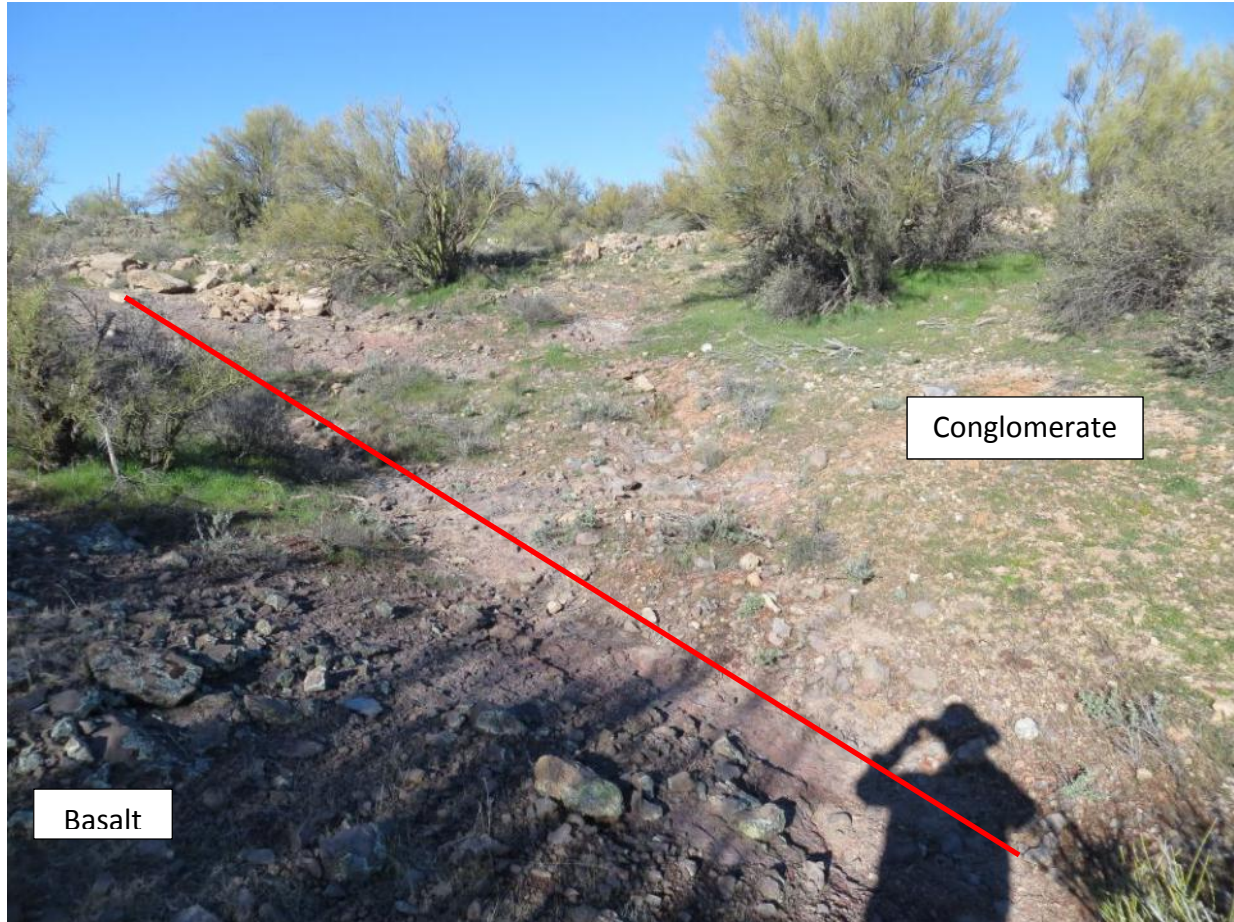
Elevation drop in channel invert of 2.5 m (8.20 ft) over basalt outcrop where small drainage terminates at Potts Canyon. Basalt is fresh, R5/R6, very blocky with a number of joint sets, max. joint aperture = 2 cm (0.79 inches) but closed at 30 cm (11.8 inches) depth, no infilling, smooth and planar joint surfaces. High water mark 15 cm (5.91 inches) above channel invert.





**OBS51**

Contact between basalt (Tb) and Gila conglomerate (Tcg). Small depression along line of contact filled with well graded clayey sand.





### OBS52

Fluvial deposits in channel: SAND (SW), fine to coarse, some gravel, some silt, well graded, max. particle size = 0.5 cm (*0.20 inches*), sub-rounded to sub-angular, brown, moist just below surface, strong reaction to acid, 20 cm (*7.87 inches*) thick with conglomerate surface below.





**OBS53**

Sub-horizontal sandstone bed outcropping in left channel bank.

Orientation of bed: **298/05**





#### OBS54

3 m to 4 m (9.84 to 13.1 ft) high Tss (Tertiary Sandstone) outcrop on right channel bank. Fresh, R2, sub-horizontal beds, bed thickness ranges from thin laminations (mm scale) to massive beds up to 20 cm (7.87 inches) thick, range of particle sizes (max. = 15 cm (5.91 inches)), various clast lithology, reactive to acid, differential weathering of finer beds.









**OBS55**

40 cm (*15.75 inches*) elevation drop in channel invert over sandstone “ledge”. Moist sand at bottom of drop.

Orientation of beds: **327/04**







**OBS56**

Sub-horizontal Tss bedding exposed in channel invert. **Not photographed.**

Orientation of beds: **338/03**

**OBS57**

Sub-horizontal Tss beds exposed in left channel bank.

Orientation of beds: **033/11**







**OBS58**

Large sub-horizontal surface of conglomerate spanning channel invert (~10 m (32.8 ft) across) with thin fluvial soil cover in some areas.





**OBS59**

Localized wetting of thin (~15 cm (5.91 inches) thick) fluvial sediments deposited on top of sub-horizontal conglomerate surface. Wet spots concentrated along channel edges.



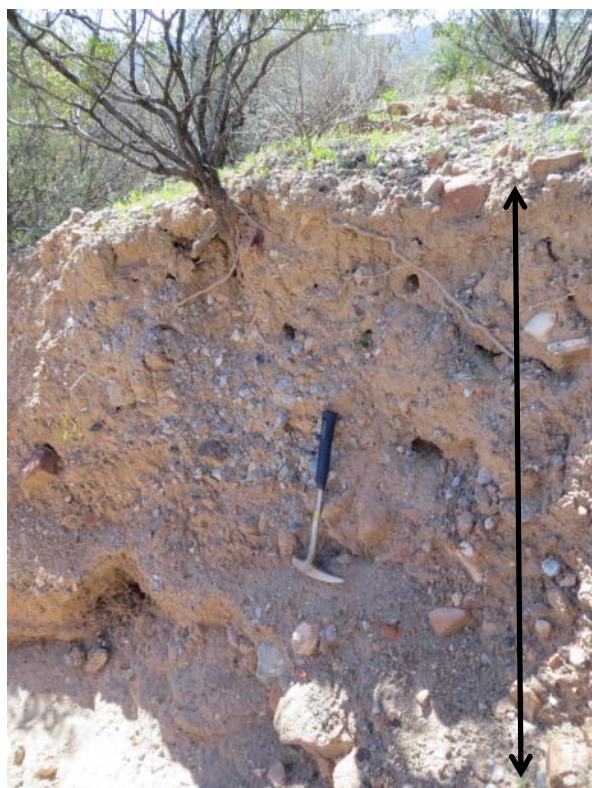


### OBS60

Erosional gully (~1.5 m (4.9 ft) wide) perpendicular to right channel bank. Soil-like exposure ~ 1.3 m (4.3 ft) thick and reactive to acid. Could be weathered conglomerate or reworked material from road construction (berm). Gully looks to have been formed by runoff collected in a low spot on the road.







1.3 m



1.3 m



### OBS61

2.8 m (9.2 ft) elevation drop in channel invert large conglomerate exposure. CONGLOMERATE, fresh, R2/R3, sub-horizontal bedding ranging from 2 cm to 60 cm (0.79 to 23.6 inches) thick, max. particle size = 30 cm (11.8 inches), range of particle shapes (rounded to angular) and lithology, reactive to acid, differential erosion of finer beds, topmost bed is hardest, coarsest and most erosion resistant, some vertical cracks that terminate at lift interfaces.







Elevation  
Drop in  
Channel





**OBS62**

1.2 m (3.9 ft) elevation drop in channel invert over conglomerate exposure. Outcrop strength = R3





**OBS63**

Conglomerate exposure. Moist at surface. Well graded sand with gravel and cobble clasts. Very weak and “soil-like” rock with strength R0 to R1.





**OBS64**

2.5 m (8.2 ft) high conglomerate exposure. Massive with no apparent bedding, R1, max. clast size of 15 cm (5.91 inches).





**OBS65**

“Cave” hollowed out into base of conglomerate exposure. Cave penetrates at least 2.2 m (7.2 ft) deep into exposure. Strength of conglomerate = R2.



View into  
Cave





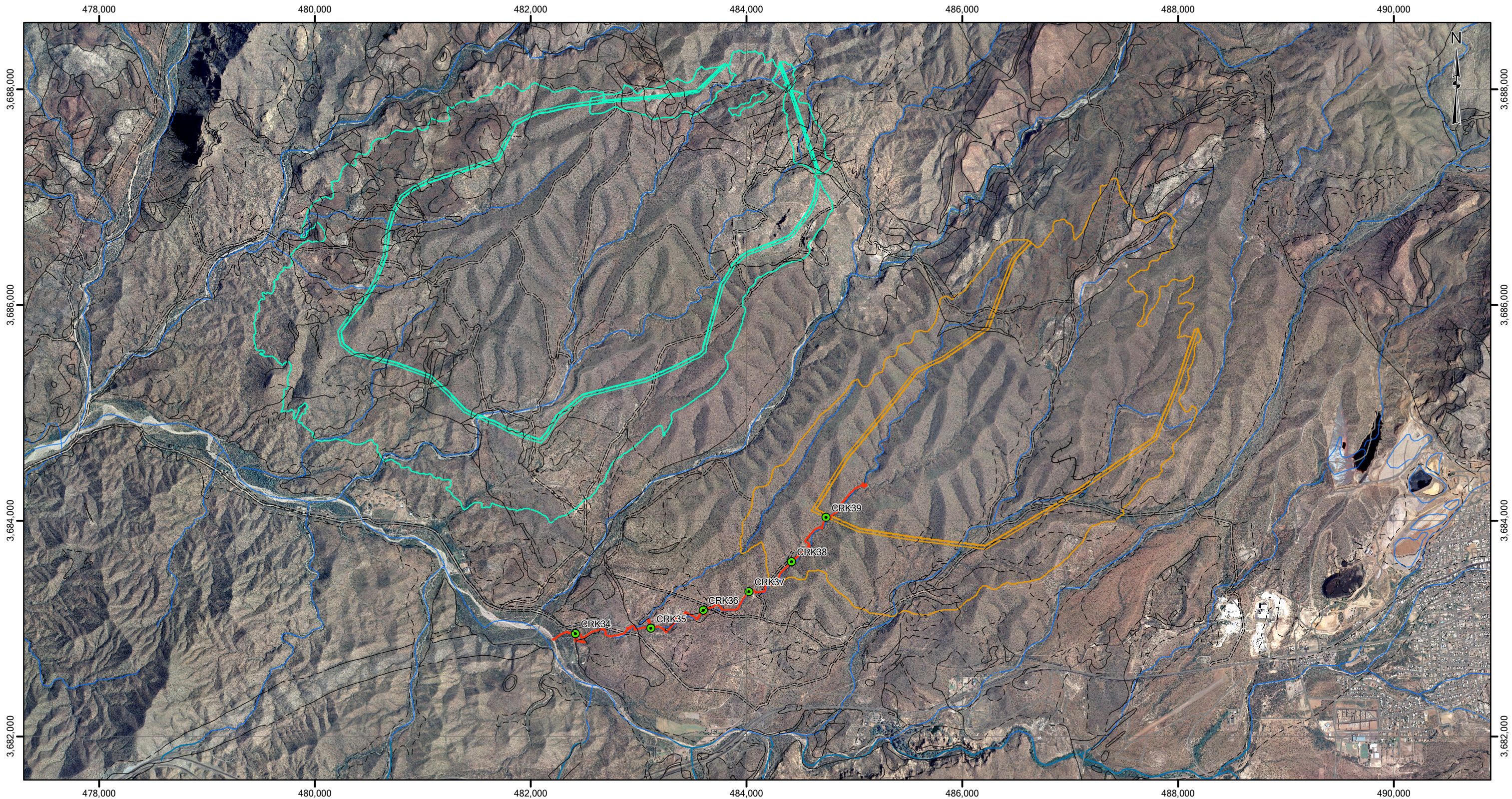
## APPENDIX I-H

### Traverse #8

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LEGEND

- |                                |                        |                                                                                                                                |
|--------------------------------|------------------------|--------------------------------------------------------------------------------------------------------------------------------|
| CREEK TRAVERSE MAPPING STATION | STREAM                 | CONTACT (BETWEEN GEOLOGIC UNITS)                                                                                               |
| TRAVERSE                       | ROAD (FROM STATE)      | CONTACT - APPROXIMATE                                                                                                          |
| NEAR WEST TAILINGS SITE        | ROAD (FROM RESOLUTION) | CONTACT - INFERRED                                                                                                             |
| HAPPY CAMP OPTION              |                        | CONTACT BETWEEN PINAL SCHIST<br>CLAST-RICH CONGOMERATE BELOW<br>AND DRIPPING SPRING QUARTZITE<br>CLAST-RICH CONGLOMERATE ABOVE |

Notes:  
1. NAD27 UTM12  
2. Orthophoto from USDA

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0 1,000 m

PROJECT  
RESOLUTION PROJECT  
2013 NEAR WEST SITE INVESTIGATION

TITLE  
CREEK TRAVERSE #8

PROJECT No.  
M09441A14

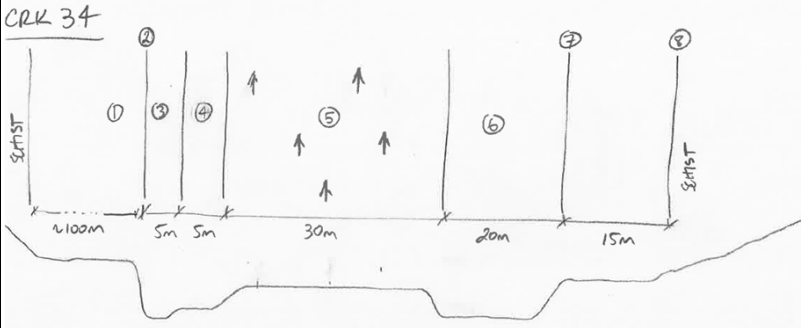
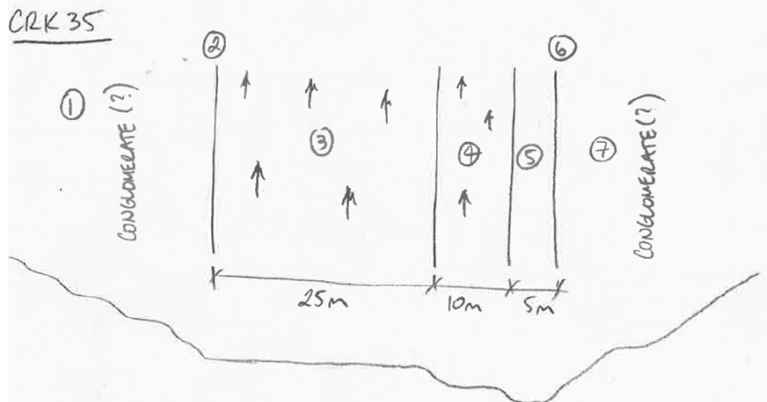
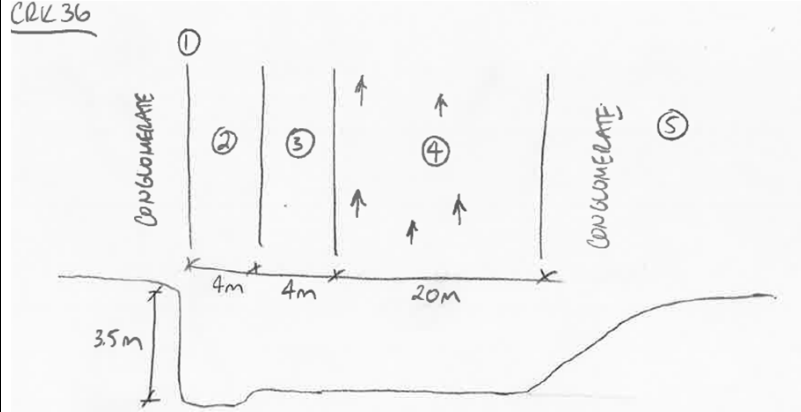
FIG No.  
I-H.1







TRAVERSE 8

Date Mapped	Traverse Type	Mapping Point	Northing* (m)	Easting* (m)	Total Channel Width (m)** (ft)	Field Sketch	Unit Described	Description (From Left to Right Across Channel Looking Upstream)	Maximum Particle Size in Channel (cm) (inches)	Rock Strength	Geologic Unit	Notes
26-Feb-13	Creek	CRK34	3682950.93	482415.21	60 (197)		1	Clayey SAND and GRAVEL (SC-GW), fine to coarse, some cobbles, well graded, max. particle size = 8 cm, sub-rounded to sub-angular, brown, moist, some organics, various lithology, hole excavated to 20 cm - difficult digging thorough gravelly/cobbly soil			Qoa	
							2	TUFF, fresh, R3, joints spacing 10 cm with some randomly oriented fractures, joint aperture at surface closed to partly open (max. aperture = 0.5 cm), silty sand infilling, undulating joint surfaces, overlain by old alluvium		R3	Tt	
							3	SAND, GRAVEL and COBBLES (SW-GW), fine to coarse, well graded, max. particle size = 12 cm (sample); 25 cm (channel), rounded to angular, moist just below surface, mild acid reaction, various lithology, minor grass growth in channel	25 (10)		Qs	
							4	SAND, GRAVEL and COBBLES (SW-GW), fine to coarse, trace silt, well graded, max. particle size = 7 cm (sample); 25 cm (channel), rounded to angular, moist just below surface, mild acid reaction, various lithology, grass growth	25 (10)		Qs	
							5	SAND (SP), fine to medium, some silt, some gravel, trace cobbles, poorly graded, max. particle size = 8 cm, sub-rounded to sub-angular, brown, moist, strong reaction to acid, trace organics, hole excavated to 40 cm without refusal			Qoa	
							6	SAND, GRAVEL and COBBLES (SW-GW), fine to coarse, well graded, max. particle size = 10 cm (sample); 60 cm (channel), rounded to angular, moist just below surface, mild acid reaction, various lithology, grass and small bush growth in channel	60 (24)		Qs	
							7	TUFF, fresh, R5, massive boulders exposed		R5	Tt	
							8	SCHIST, fresh, R2, extremely foliated with vertical foliation cleavage surfaces spaced <1 mm apart, smooth and planar along cleavage planes		R2	Xpm	
26-Feb-13	Creek	CRK35	3682996.25	483115.21	40 (131)		1	CLAY, SAND, GRAVEL and COBBLES, fine to coarse, well graded, max. particle size = 13 cm, angular to sub-rounded, reddish brown, moist (clay above PL), various lithology, some organics, hole excavated to 20 cm - difficult digging through gravelly/cobbly soil			Tcg?	
							2	Exposure of fine grained (silt and fine sand) cemented sedimentary rock, R2, sub-horizontal bed		R2	Tss	
							3	Silty SAND (SM), fine, trace gravel, poorly graded, max. particle size = 0.5 cm, angular to sub-angular, brown, moist, strong reaction to acid, some organics and roots, hole excavated to 30 cm without refusal			Qoa	
							4	SAND, GRAVEL and COBBLES (SW-GW), fine to coarse, some cobbles, well graded, max. particle size = 10 cm (sample); >1 m (channel), rounded to angular, moist just below surface, very mild reaction to acid, various lithology, bushes and grass growing. Elevated fluvial deposits on inside of channel meander.	>1 m (39)		Qs	
							5	SAND and GRAVEL (SW-GW), fine to coarse, some cobbles, well graded, max. particle size = 8 cm (sample); 25 cm (channel), rounded to angular, moist just below surface, very mild acid reaction around some grains, various lithology	25 (10)		Qs	
							6	Exposure of bedded and cemented silt and fine grained sand, 1 m high, R2, sub-horizontal beds		R2	Tss	
							7	CLAY, SAND, GRAVEL and COBBLES exposed near surface of slope			Tcg?	
26-Feb-13	Creek	CRK36	3683166.03	483600.42	28 (92)		1	CONGLOMERATE, fresh, R2 to R3 (depends on bed), bedded with thickness ranging from 0.5 cm to 30 cm, sub-horizontal discontinuities along bedding interfaces with variable opening width, range of clast sizes (max. = 20 cm), angular to sub-rounded clasts, various lithology, differential weathering of finer, siltier beds, some holes and "burrows" along some bedding planes penetrate 1 m into unit bedding orientation (325/10)		R2 to R3	Tcg	
							2	SAND and GRAVEL (SW-GW), fine to coarse, some cobbles, well graded, max. particle size = 12 cm (sample); 35 cm (channel), sub-rounded to angular, moist just below surface, very mild acid reaction around some grains, various lithology	35 (14)		Qs	
							3	Silty SAND, GRAVEL and COBBLES (SM-GW), fine to coarse, well graded, max. particle size = 10 cm (sample); 40 cm (along elevated area), rounded to angular, dry, various lithology, mild acid reaction around some grains, bushes and grass growing. Elevated fluvial deposits along inside of channel meander.	40 (16)		Qs	
							4	Silty SAND (SM), fine to medium, some gravel, trace cobbles, poorly graded, max. particle size = 11 cm, angular to sub-angular, brown, moist, variable lithology, hole excavated to 30 cm depth without refusal			Qoa	
							5	Silty/Gravelly SAND (SM), fine to medium, some gravel, some cobbles, poorly graded, max. particle size = 10 cm, angular to sub-angular, brown, moist, reactive to acid, various lithology, hole excavated to 15 cm depth with refusal reached in cobbly ground			Tcg	Weathered conglomerate surface



TRAVERSE 8

Date Mapped	Traverse Type	Mapping Point	Northing* (m)	Easting* (m)	Total Channel Width (m)** (ft)	Field Sketch	Unit Described	Description (From Left to Right Across Channel Looking Upstream)	Maximum Particle Size in Channel (cm) (inches)	Rock Strength	Geologic Unit	Notes
trav83	Creek	CRK37	3683338.5	484025.01	5 (16)		1	CONGLOMERATE, fresh, R3, massive with one continuous undulating sub-horizontal discontinuity (bedding interface?) with max. aperture of 10 cm, range of clast sizes (max. = 60 cm), rounded to angular clasts, various lithology, overhanging portion of outcrop approximately 2 m above the channel invert		R3	Tcg	
							2	SAND, GRAVEL and COBBLES (SW-GW), fine to coarse, well graded, max. particle size = 15 cm (sample); 70 cm (channel), sub-rounded to angular, moist just below surface, slight acid reaction, various lithology, vegetation on elevated channel bars but not on low-lying channel areas	70 (28)		Qs	
							3	CONGLOMERATE, fresh, R2/R3, massive with some open fissures parallel to exposure face likely caused by root penetration, fissure openings <5 cm wide and penetrate up to 50 cm into outcrop, range of clast sizes (max. = 30 cm), rounded to angular, various lithology, roots penetrating unit		R2 to R3	Tcg	
26-Feb-13	Creek	CRK38	3683616.35	484420.05	6 (20)		1	CONGLOMERATE, fresh, R3, bedding indicated by sub-horizontal parallel discontinuities, range of clast sizes (max. = 30 cm), rounded to angular clasts, various lithology, some root penetration and "burrows" in the exposure face		R3	Tcg	
							2	SAND (SW), fine to coarse, trace gravel, well graded, max. particle size = 3.5 cm, sub-angular to sub-rounded, moist just below surface, approximately 20 cm thick layer of fluvial sediments overtop of sub-horizontal conglomerate surface			Qs	
							3	SAND and GRAVEL (SW-GW), fine to coarse, trace cobbles, well graded, max. particle size = 7 cm (sample); 20 cm (channel), rounded to angular, moist just below surface, mild acid reaction around some grains, various lithology	20 (8)		Qs	
							4	CONGLOMERATE, fresh, R3, massive, range of clast sizes (max. = 40 cm), rounded to angular clasts, low (1.5 m high) exposure at edge of channel invert		R3	Tcg	
							5	Silty/Gravelly SAND (SM), fine to coarse, some cobbles, well graded, max. particle size = 9 cm, angular to sub-angular, brown, moist, various lithology, some organics/roots, hole excavated to 20 cm with refusal on hard cobbly surface			Tcg	Weathered conglomerate surface
27-Feb-13	Creek	CRK39	3684026.81	484741.16	8 (26)		1	CONGLOMERATE, fresh, R3, massive with no continuous bedding interfaces, range of clast sizes (max. = 80 cm), sub-rounded to angular clasts, various lithology, some bushes and plants growing on exposure face		R3	Tcg	
							2	SAND, GRAVEL and COBBLES (SW-GW), fine to coarse, well graded, max. particle size = 30 cm (sample); 1.6 m (channel; tuff boulder), sub-rounded to angular, moist just below surface, various lithology, no vegetation except on one small elevated channel bar (bushes and grass)	160 (63)		Qs	
							3	CONGLOMERATE, fresh, R3, massive with no discontinuities except for one small sub-horizontal bed at the top of the exposure (<10 cm thick), range of clast sizes (max. = 60 cm), sub-rounded to sub-angular clasts, various lithology, plants growing on exposed surface		R3	Tcg	
							4	Gravelly SAND (SW), fine to coarse, some silt to silty, well graded, max. particle size = 7 cm, angular to sub-angular, brown, moist, trace organics			Tcg	Weathered conglomerate surface

\* Coordinates measured with handheld GPS unit. Coordinate System: UTM NAD27 CONUS  
\*\*Total Channel Width includes the width of active channels and Old Alluvium deposits



TRAVERSE 8						Traverse Observation Point Photos (See Field Sketch)																
Date Mapped	Traverse Type	Mapping Point	Northing	Easting	Total Channel Width (m)	Field Sketch	1		2		3		4		5		6		7		8	
26-Feb-13	Creek	CRK34	3682950.93	482415.21	60																	
26-Feb-13	Creek	CRK35	3682996.25	483115.21	40																	
26-Feb-13	Creek	CRK36	3683166.03	483600.42	28																	
26-Feb-13	Creek	CRK37	3683338.5	484025.01	5																	



TRAVERSE 8														
Date Mapped	Traverse Type	Mapping Point	Northing	Easting	Total Channel Width (m)	Field Sketch	Traverse Observation Point Photos (See Field Sketch)							
							1	2	3	4	5	6	7	8
26-Feb-13	Creek	CRK38	3683616.35	484420.05	6									
27-Feb-13	Creek	CRK39	3684026.81	484741.16	8									

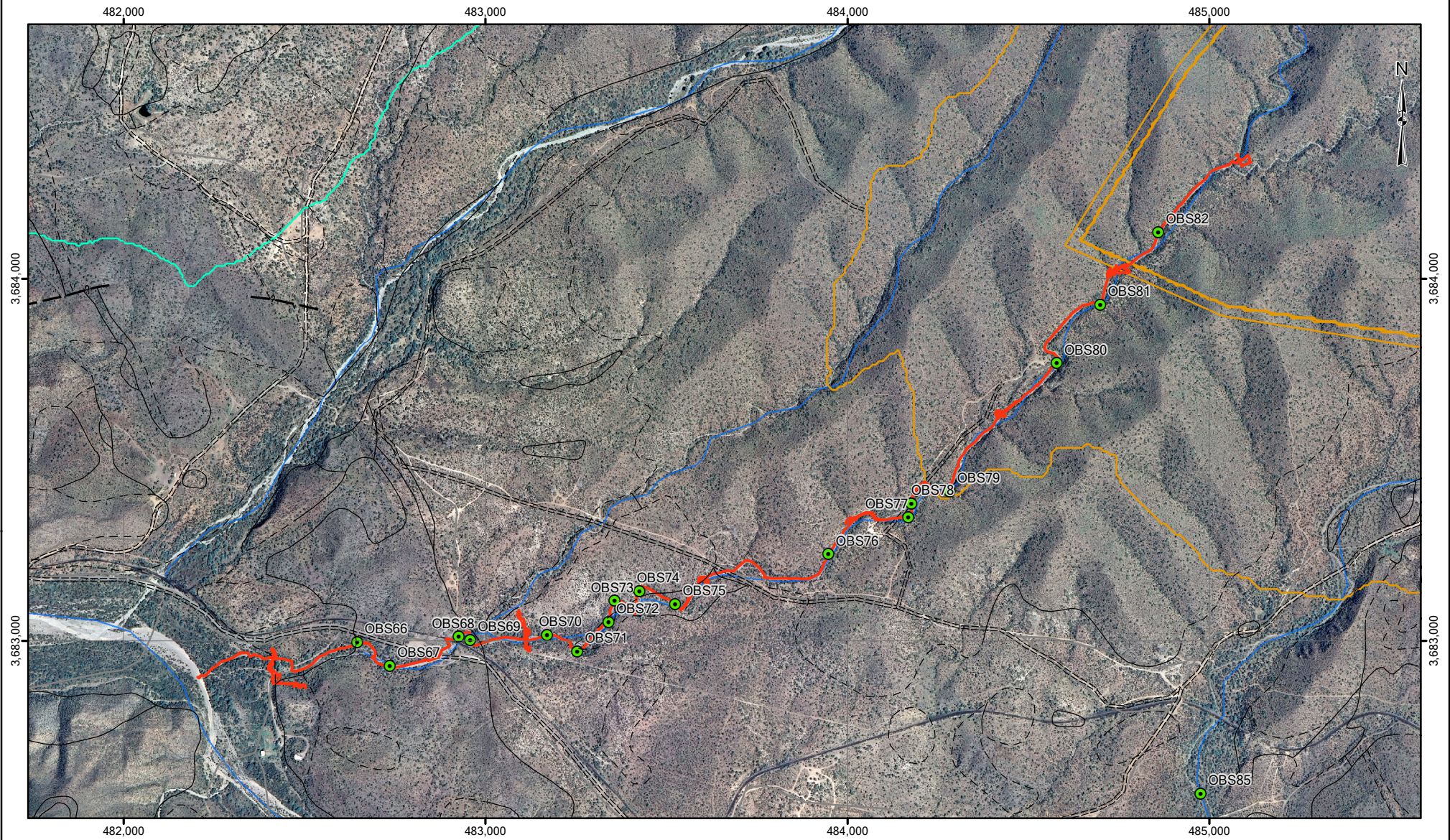


## Creek Traverse #8 Observations

Observation Station	Coordinates <sup>1</sup>	
	Easting (m)	Northing (m)
OBS66	482647	3682992
OBS67	482636	3683142
OBS68	482928	3683008
OBS69	482960	3682999
OBS70	483171	3683013
OBS71	483255	3682967
OBS72	483342	3683048
OBS73	483358	3683107
OBS74	483426	3683134
OBS75	483525	3683099
OBS76	483949	3683236
OBS77	484169	3683338
OBS78	484178	3683376
OBS79	484180	3683605
OBS80	484580	3683764
OBS81	484700	3683926
OBS82	484861	3684125

1 – Coordinates measured with handheld GPS unit. Coordinate system: UTM NAD27 CONUS





LEGEND

- CREEK TRAVERSE OBSERVATION POINT
- ==== ROAD (FROM RESOLUTION)
- ROAD (FROM STATE)
- STREAM
- CONTACT (BETWEEN GEOLOGIC UNITS)
- - - CONTACT - APPROXIMATE
- - - CONTACT - INFERRED
- + + + CONTACT BETWEEN PINAL SCHIST CLAST-RICH CONGLOMERATE BELOW AND DRIPPING SPRING QUARTZITE CLAST-RICH CONGLOMERATE ABOVE
- NEAR WEST TAILINGS SITE
- HAPPY CAMP OPTION

Notes:  
1. NAD27 UTM12  
2. Orthophoto from USDA

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CLIENT



0 500 m

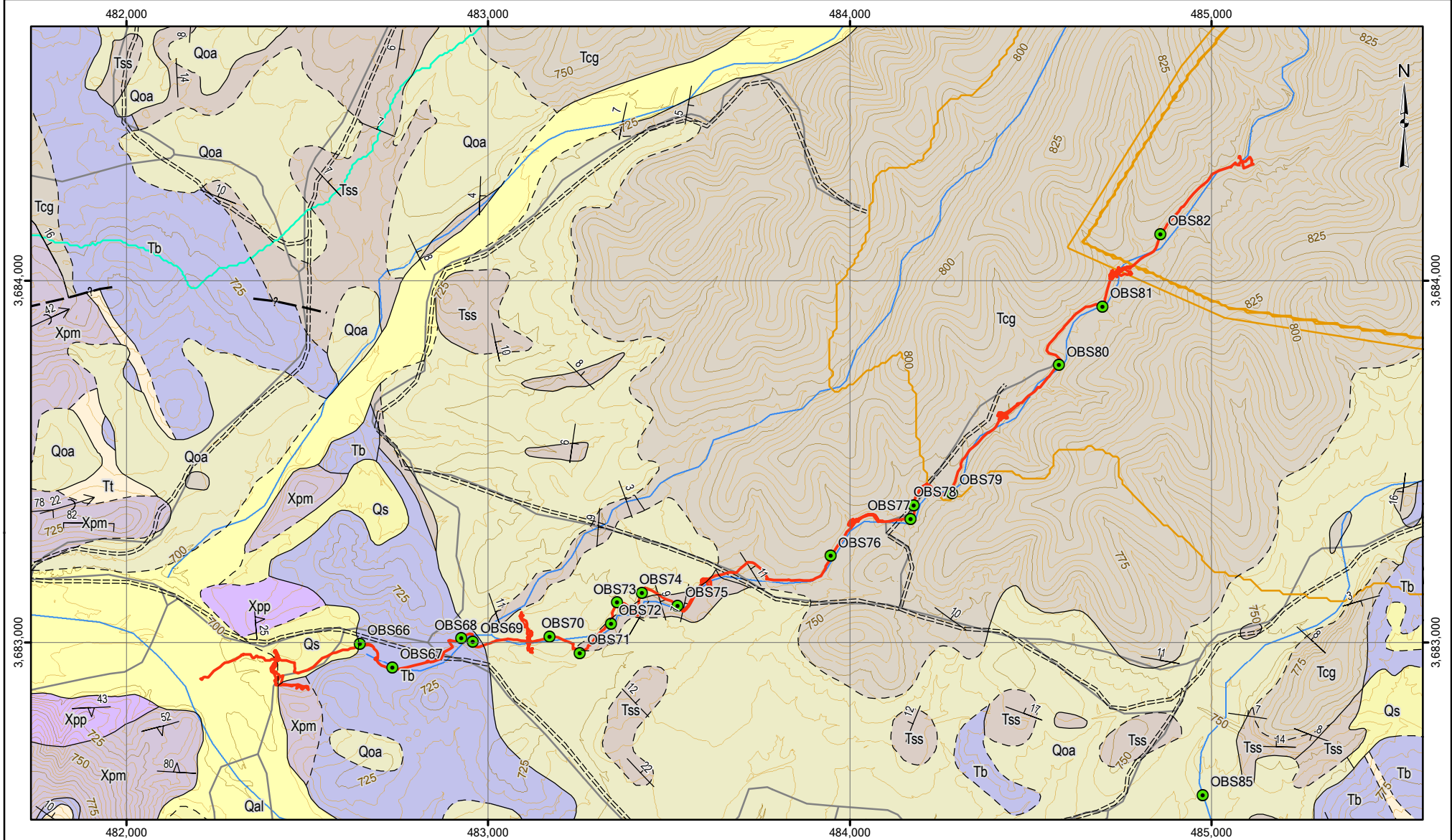
PROJECT RESOLUTION PROJECT  
2013 NEAR WEST SITE INVESTIGATION

TITLE  
CREEK TRAVERSE #8  
OBSERVATIONS

PROJECT No. M09441A14

FIG No. I-H.3





# LEGEND

- |                                                                       |                                                                                                                              |                                                |
|-----------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|
| <span style="color: green;">●</span> CREEK TRAVERSE OBSERVATION POINT | — CONTACT (BETWEEN GEOLOGIC UNITS)                                                                                           | *** FELSIC DYKE                                |
| <span style="color: red;">—</span> TRAVERSE                           | - - - CONTACT - APPROXIMATE                                                                                                  | — FAULT                                        |
| <span style="color: cyan;">—</span> NEAR WEST TAILINGS SITE           | - - - CONTACT - INFERRED                                                                                                     | - ? - FAULT - APPROXIMATE                      |
| <span style="color: orange;">—</span> HAPPY CAMP OPTION               | + + + CONTACT BETWEEN PINAL SCHIST CLAST-RICH CONGLOMERATE BELOW AND DRIPPING SPRING QUARTZITE CLAST-RICH CONGLOMERATE ABOVE | ..... FAULT - CONCEALED                        |
| ==== ROAD (FROM RESOLUTION)                                           |                                                                                                                              | <span style="color: red;">—</span> QUARTZ VEIN |
| — ROAD (FROM STATE)                                                   |                                                                                                                              | — MARKER HORIZON (LOCAL)                       |
| <span style="color: blue;">—</span> STREAM                            |                                                                                                                              |                                                |

Notes:  
1. NAD27 UTM12  
2. Refer to main report for descriptions of geologic units.

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### CLIENT



0 500 m

PROJECT	RESOLUTION PROJECT 2013 NEAR WEST SITE INVESTIGATION	
TITLE	CREEK TRAVERSE #8 OBSERVATIONS AND GEOLOGY	
PROJECT No.	M09441A14	FIG No. I-H.4



**OBS66**

Basalt outcrop in channel. Fresh, R5 to R6, some vertical parallel joints with average spacing of 10 cm (3.94 inches), closed to open (max. aperture = 1 cm (0.39 inches)), planar surfaces.

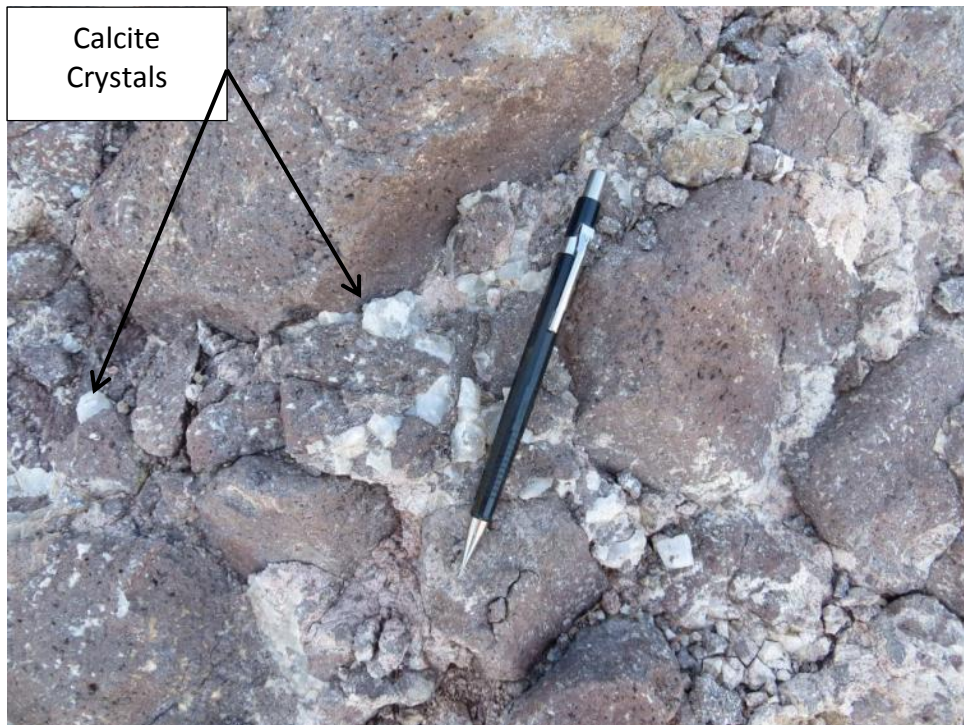
Orientation of joint set: **133/90**





### OBS67

Basalt outcrop in channel. Disturbed rock mass. Half of the exposure weathering to a different colour however both sides appear to be the same rock type. Abundance of calcite (some large crystals) on basalt surface and infilling voids.





### OBS68

Exposure of phyllitic facies schist (Xpp). Fresh to slightly weathered, R5, very strong parallel foliation cleavage surfaces avg. 1 cm (*0.39 inches*) apart, closed, some other randomly oriented fractures cross cutting foliation planes, one large open vertical joint penetrating 60 cm (*23.6 inches*) into outcrop, foliation cleavage surfaces planar to undulating with “grainy” surface texture

Orientation of foliation cleavage: **355/15**

Orientation of large vertical joint: **350/90**









**OBS69**

Basalt exposure on right channel bank.





**OBS70**

Dipping cemented silty sand bed in left bank (Tss).

Orientation of bed: **346/17**





**OBS71**

2.5 m (8.2 ft) high exposure of parallel bedded silt and sand (Tss). Bed thickness ranges from scale of millimeters up to 20 cm (7.87 inches) thick. Cemented.

Orientation of bedding: **350/10**









**OBS72**

Bedded Tss. Cemented silt to well graded sand, gravel and cobbles. Beds range from >1 mm to 20 cm (>0.04 to 7.87 inches) thick. Differential weathering of finer beds. Fine, silty beds = R0 (soil) and coarser beds = R2/R3.









**OBS73**

Potential contact between sandstone (Tss) and conglomerate (Tcg). Outcrops become coarser and more massive (bedding less apparent).

Orientation of bedding: **348/07**





**OBS74**

Two 1 m (3.3 ft) elevation drops in channel over conglomerate outcrops spanning the channel invert. Water ponding at the base of the first (upstream) ledge.

Orientation of bedding: **331/08**





### OBS75

Two 1 m (3.3 ft) elevation drops in channel over conglomerate outcrops spanning the channel invert. Water ponding at foot of ledges. Stream makes a 90 degree bend at this location. Steep conglomerate exposure on the outside of bend is coarse and massive (R4).

Orientation of bedding: **306/08**





**OBS76**

Channel width = 6 m (19.7 ft).





**OBS77**

Alternating coarse and fine beds in Gila conglomerate.

Orientation of bedding: **299/07**





**OBS78**

1 m (3.3 ft) elevation drop in channel over sub-horizontal conglomerate ledge spanning channel invert. Moist sand at base of drop.





**OBS79**

Conglomerate exposure on outside of channel bend. Massive with some large clasts (>1 m (>3.3 ft)), cemented, rock strength controlled by strength of large clasts.









**OBS80**

8 m (26.2 ft) high conglomerate exposure with large scale massive beds, range of clast sizes up to 60 cm (23.6 inches), R3.





**OBS81**

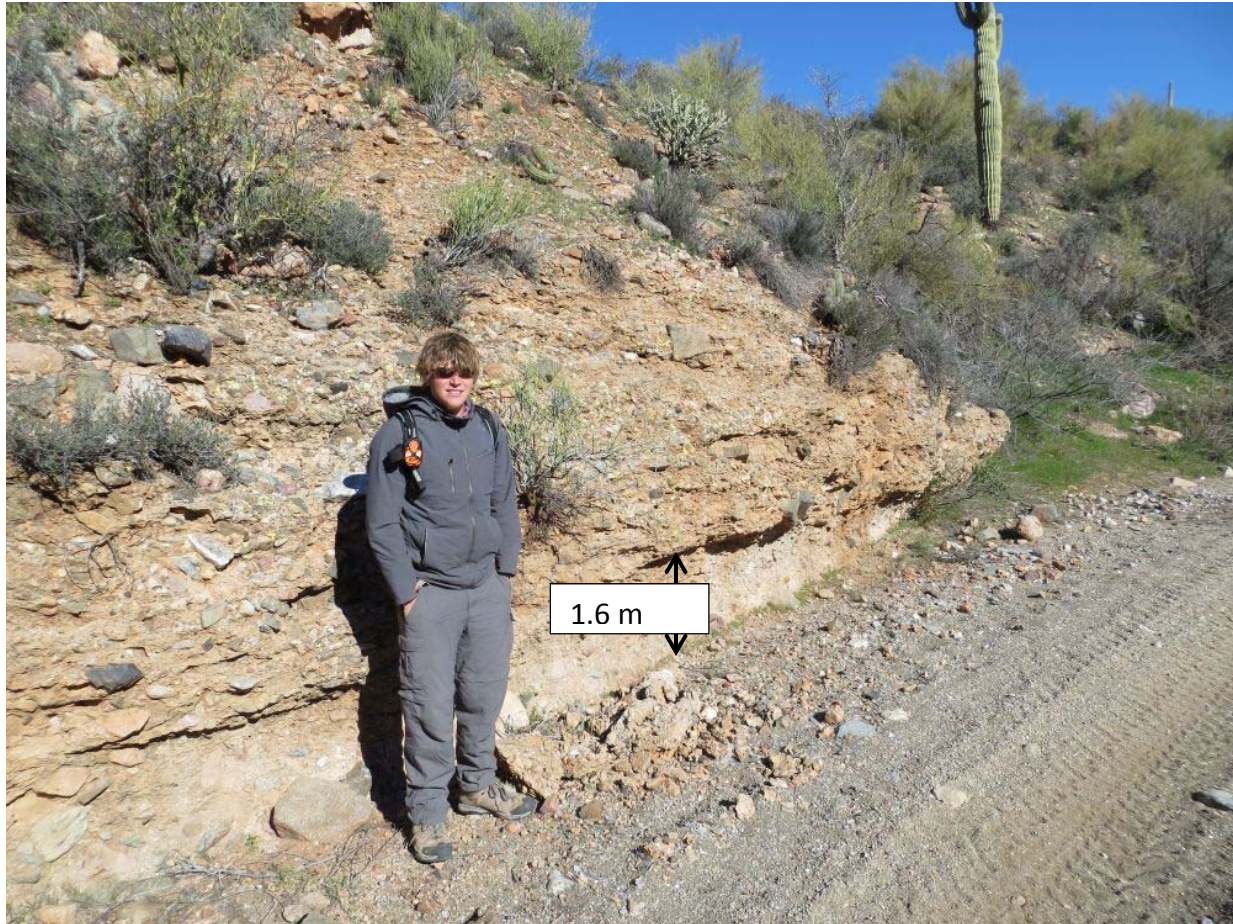
Conglomerate (~ 1.5 m (~4.9 ft) thick, R3) overlain by either weathered and weakened conglomerate or old alluvium (R1 to R0). Softer material is moist at surface, reactive to acid and has the same clast lithology and size as the more cemented unit below.





**OBS82**

0.6 m (1.97 ft) high overhang carved out of base of conglomerate exposure on outside of gradual channel bend. Rock strength = R3.





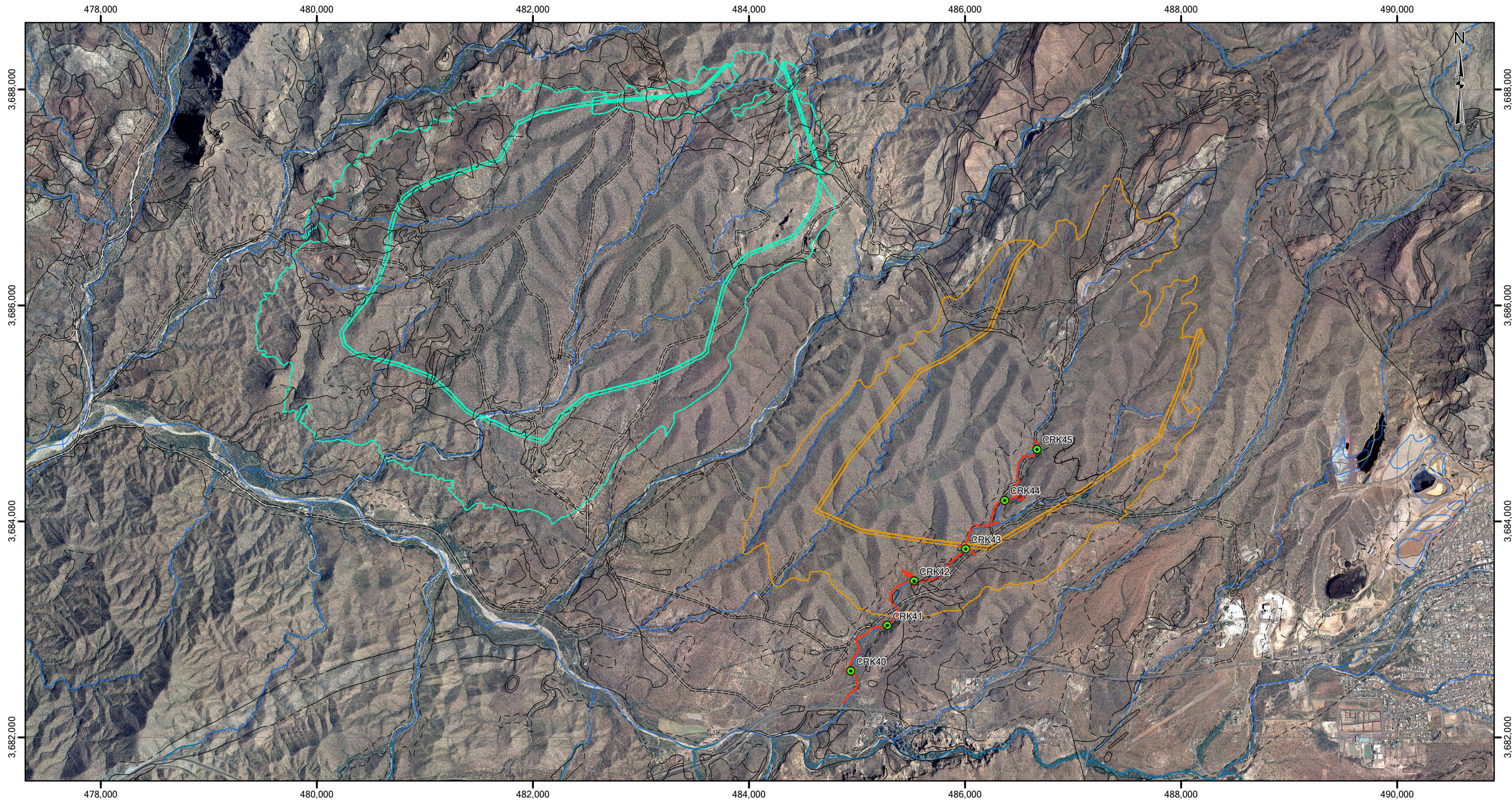
## APPENDIX I-I

### Traverse #9

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CB Z:\MVC\RM09441A14 - RES-Near West\Geotech Study\400 Drawings\MXD\Si\report\_figures\blodf\MTTraverse\_9\_ortho\_130605.mxd 7/23/2013 12:11:32 PM



LEGEND

- |                                |                        |                                                                                                                                |
|--------------------------------|------------------------|--------------------------------------------------------------------------------------------------------------------------------|
| CREEK TRAVERSE MAPPING STATION | STREAM                 | CONTACT (BETWEEN GEOLOGIC UNITS)                                                                                               |
| TRAVERSE                       | ROAD (FROM STATE)      | CONTACT - APPROXIMATE                                                                                                          |
| NEAR WEST TAILINGS SITE        | ROAD (FROM RESOLUTION) | CONTACT - INFERRED                                                                                                             |
| HAPPY CAMP OPTION              |                        | CONTACT BETWEEN PINAL SCHIST<br>CLAST-RICH CONGOMERATE BELOW<br>AND DRIPPING SPRING QUARTZITE<br>CLAST-RICH CONGLOMERATE ABOVE |

Notes:  
1. NAD27 UTM12  
2. Orthophoto from USDA

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CLIENT



0 1,000 m

PROJECT  
RESOLUTION PROJECT  
2013 NEAR WEST SITE INVESTIGATION

TITLE  
CREEK TRAVERSE #9

PROJECT No.  
M09441A14

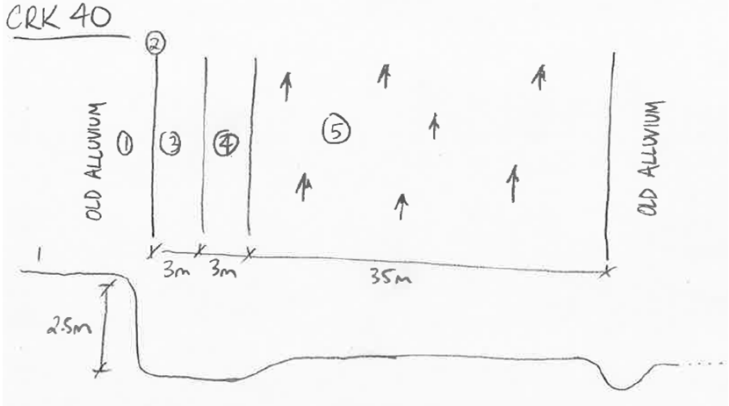
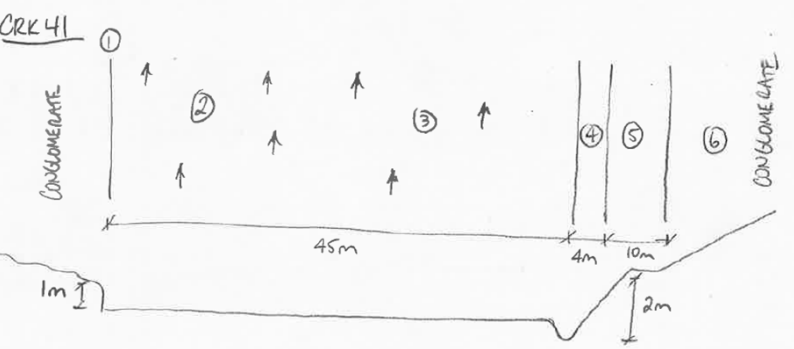
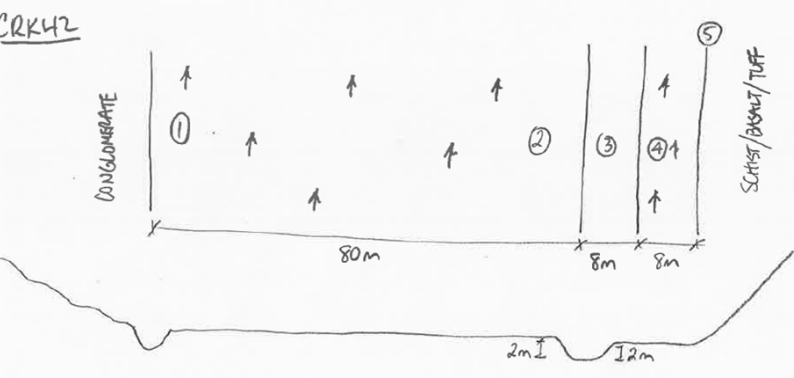
FIG No.  
I-I.1







TRAVERSE 9

Date Mapped	Traverse Type	Mapping Point	Northing* (m)	Easting* (m)	Total Channel Width (m)** (ft)	Field Sketch	Unit Described	Description (From Left to Right Across Channel Looking Upstream)	Maximum Particle Size in Channel (cm) (inches)	Rock Strength	Geologic Unit	Notes
27-Feb-13	Creek	CRK40	3682609.19	484944.53	>35 (115)		1	Silty SAND (SM), fine to medium, some gravel, poorly graded, max. particle size = 7 cm, sub-angular to angular, brown, moist, strong acid reaction, various lithology, trace organics, hole excavated to 40 cm without refusal			Qoa	
							2	Silty SAND , GRAVEL and COBBLES (SM-GW) exposed in vertical cut, fine to coarse, some boulders in exposure, well graded, max. particle size = 35 cm, sub-rounded to angular, brown, moist, reactive to acid, various lithology			Qoa	
							3	SAND and GRAVEL (SW-GW), fine to coarse, well graded, max. particle size = 7 cm, sub-angular to sub-rounded, moist just below surface, mild acid reaction around some grains, various lithology			Qs	
							4	SAND and GRAVEL (SW-GW), fine to coarse, some cobbles, well graded, max. particle size = 10 cm (sample); 20 cm (channel), sub-angular to sub-rounded, moist just below surface, mild acid reaction around some grains, various lithology	20 (8)		Qs	
							5	SAND, GRAVEL and COBBLES (SW-GW), fine to coarse, well graded, max. particle size = 12 cm, sub-angular to sub-rounded, moist to dry, various lithology			Qoa	
27-Feb-13	Creek	CRK41	3683028.41	485283.26	49 (161)		1	CONGLOMERATE, fresh, R3, massive, range of clast sizes (max. = 30 cm), sub-rounded to angular clasts, various lithology, plants growing on exposure face		R3	Tcg	
							2	Silty SAND (SM), fine, poorly graded, brown, moist, reactive to acid, trace organics, hole excavated to 35 cm without refusal			Qoa	
							3	Silty SAND (SM), fine, poorly graded, brown, moist, reactive to acid, trace organics, hole excavated to 35 cm without refusal			Qoa	
							4	SAND, GRAVEL and COBBLES (SW-GW), fine to coarse, well graded, max. particle size = 10 cm (sample); 60 cm (channel), angular to sub-rounded, moist just below surface, slight acid reaction around grains, various lithology, small vegetation on elevated areas of channel	60 (24)		Qs	
							5	Silty/Gravelly SAND (SM), fine to coarse, well graded, max. particle size = 6 cm, sub-angular to angular, brown, moist, reactive to acid, trace organics. Exposed in vertical exposure.			Qoa	
							6	CONGLOMERATE, fresh, strength controlled by clast strength, massive with some faint, closed horizontal bedding interfaces , range of clast sizes (max. = 80 cm), sub-rounded to angular clasts, various lithology		Variable	Tcg	
27-Feb-13	Creek	CRK42	3683441.89	485530.91	88 (289)		1	Gravelly/Silty SAND (SM), fine to medium, poorly graded, max. particle size= 3 cm, angular to sub-angular, brown, moist, various lithology, trace organics, hole excavated to 30 cm without refusal			Qoa	
							2	Gravelly/Silty SAND (SM), fine to medium, poorly graded, max. particle size= 3 cm, angular to sub-angular, brown, moist, various lithology, trace organics, exposed in eroded gully wall			Qoa	
							3	SAND, GRAVEL and COBBLES (SW-GW), fine to coarse, some boulders in channel, well graded, max. particle size = 10 cm (sample); 1 00 cm (channel), sub-rounded to angular, moist just below surface, acid reaction around grains, various lithology, small bushes growing on elevated bars	100 (39)		Qs	
							4	Gravelly/Silty SAND (SM), fine to medium, trace cobbles, poorly graded, max. particle size= 8 cm, angular to sub-angular, brown, moist, various lithology, trace organics, hole excavated to 30 cm without refusal			Qoa	
							5	Contact between SCHIST and BASALT w/ TUFF. Vertical line of contact forming shallow depression filled with sand and cobbles  SCHIST, fresh, R4, strong parallel foliation cleavage spaced 2 - 3 cm apart, closed, planar to undulating cleavage surfaces with rough "grainy" surface texture, some additional closed and widely spaced fractures perpendicular to cleavage orientation, one 10 cm welded tuff filled joint perpendicular to cleavage orientation orientation of cleavage (175/44) orientation of tuff filled joint (047/47)  BASALT/TUFF fresh welded ash flow tuff with angular sand and gravel particles, R3, randomly oriented fractures typically opened ~ 1mm, calcite on some surfaces, calcite rich basalt inclusions at the bottom of exposure (basalt R4), large calcite crystals formed within pores in the basalt		R4 (Schist) R3 (Tuff) R5 (Basalt)	Xpp/Tt/Tb	



TRAVERSE 9												
Date Mapped	Traverse Type	Mapping Point	Northing* (m)	Easting* (m)	Total Channel Width (m)** (ft)	Field Sketch	Unit Described	Description (From Left to Right Across Channel Looking Upstream)	Maximum Particle Size in Channel (cm) (inches)	Rock Strength	Geologic Unit	Notes
28-Feb-13	Creek	CRK43	3683738.97	486008.7	97 (318)		1	Silty/Gravelly SAND (SM), fine to coarse, well graded, max. particle size = 6 cm, sub-angular to angular, reddish brown, moist, various lithology, trace organics, hole excavated to 20 cm without refusal			Tcg	
							2	Silty SAND (SP), fine to medium, some gravel to gravelly, poorly graded, max. particle size = 4 cm, sub-angular to angular, brown, moist, various lithology, some organics and roots, hole excavated to 30 cm without refusal			Qoa	
							3	SAND, GRAVEL and COBBLES (SW-GW), fine to coarse, well graded, max. particle size = 8 cm (sample); 40 cm (channel), sub-rounded to angular, moist just below surface, reactive to acid, various lithology	40 (16)		Qs	
							4	SAND and GRAVEL (SW-GW), fine to coarse, some cobbles, well graded, max. particle size = 6 cm (sample); 40 cm (channel), sub-rounded to angular, moist just below surface, reactive to acid, various lithology	40 (16)		Qs	
							5	Silty SAND (SP), fine to medium, some gravel to gravelly, some cobbles, poorly graded, max. particle size = 9 cm, sub-angular to angular, brown, moist, reactive to acid, various lithology, some organics and roots, hole excavated to 30 cm with refusal in cobbly ground			Qoa	
							6	SAND, CLAY, GRAVEL and COBBLES, fine to coarse well graded, max. particle size = 15 cm, sub-angular to angular, reddish brown, moist, various lithology, hole excavated to 20 cm with refusal in cobbly ground			Tcg	
28-Feb-13	Creek	CRK44	3684188.02	486369.73	5 (16)		1	Clayey/Gravelly SAND (SC), fine to medium, poorly graded, max. particle size = 6 cm, sub-angular to angular, brown, moist, strong reaction to acid, various lithology, trace organics, hole excavated to 30 cm without refusal			Tcg	Weathered conglomerate surface
							2	Gravelly SAND (SW), fine to coarse, trace cobbles, well graded, max. particle size = 12 cm (sample); 20 cm (channel) (some very large boulders in channel but appear to be clasts from underlying conglomerate), moist just below surface, mild acid reaction around grains, various lithology	20 (8)		Qs	
							3	CONGLOMERATE, fresh, strength controlled by clast strength, massive, range of clast sizes (max. = 80 cm), rounded to angular clasts, various lithology, bushes and grass growing on face of outcrop		Variable	Tcg	
28-Feb-13	Creek	CRK45	3684662.21	486668.77	12 (39)		1	Clayey/Gravelly SAND (SC), fine with trace coarse and medium grains, poorly graded, max. particle size = 7 cm, sub-angular to angular, reddish brown, moist, various lithology, trace organics, hole excavated to 30 cm without refusal			Tcg	Weathered conglomerate surface
							2	Silty/Gravelly SAND (SM), fine to medium, some cobbles, poorly graded, max. particle size = 12 cm, sub-rounded to angular, brown, moist, mild reaction to acid, various lithology, trace organics, hole excavated to 30 cm without refusal			Qoa	
							3	SAND (SW), fine to coarse, trace gravel, trace cobbles, well graded, max. particle size = 4 cm (sample); 22 cm (channel), moist just below surface, mild reaction to acid around grains, various lithology, deposit appears to be ~ 30 cm thick - very hard layer reached at that depth	22 (9)		Qs	
							4	CONGLOMERATE, strength controlled by clast strength, massive, range of clast sizes (max. = 110 cm), rounded to angular clasts, various lithology, bushes and grass growing on face of exposure		Variable	Tcg	

\* Coordinates measured with handheld GPS unit. Coordinate System: UTM NAD27 CONUS  
\*\* Total Channel Width includes the width of active channels and Old Alluvium deposits



TRAVERSE 9									
Date Mapped	Traverse Type	Mapping Point	Field Sketch	Traverse Observation Point Photos (See Field Sketch)					
				1	2	3	4	5	6
27-Feb-13	Creek	CRK40							
									
27-Feb-13	Creek	CRK41							
									
27-Feb-13	Creek	CRK42							
									
28-Feb-13	Creek	CRK43							
									



TRAVERSE 9									
Date Mapped	Traverse Type	Mapping Point	Field Sketch	Traverse Observation Point Photos (See Field Sketch)					
				1	2	3	4	5	6
28-Feb-13	Creek	CRK44							
28-Feb-13	Creek	CRK45							

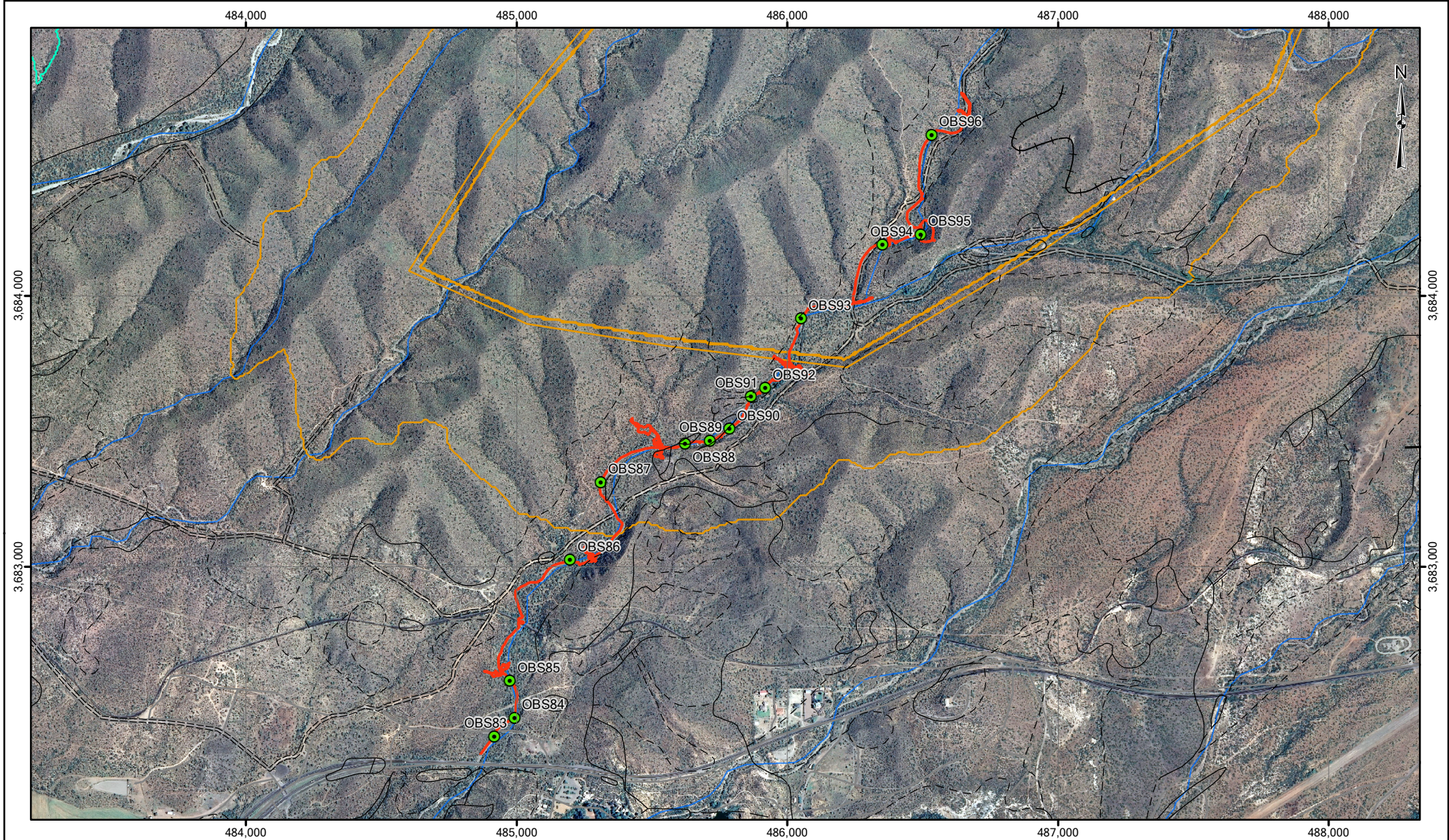


## Creek Traverse #9 Observations

Observation Station	Coordinates <sup>1</sup>	
	Easting (m)	Northing (m)
OBS83	484855	3682576
OBS84	484993	3682438
OBS85	484977	3682575
OBS86	485198	3683021
OBS87	485312	3683307
OBS88	485623	3683451
OBS89	485715	3683462
OBS90	485787	3683505
OBS91	485868	3683625
OBS92	485920	3683657
OBS93	486052	3683912
OBS94	486354	3684185
OBS95	486493	3684224
OBS96	486534	3684591

1 – Coordinates measured with handheld GPS unit. Coordinate system: UTM NAD27 CONUS





#### LEGEND

- |                                       |                             |                                                                                                                                     |
|---------------------------------------|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| ● CREEK TRAVERSE<br>OBSERVATION POINT | ==== ROAD (FROM RESOLUTION) | — CONTACT (BETWEEN<br>GEOLOGIC UNITS)                                                                                               |
| — TRAVERSE                            | — ROAD (FROM STATE)         | --- CONTACT - APPROXIMATE                                                                                                           |
| — NEAR WEST TAILINGS SITE             | — STREAM                    | - - - CONTACT - INFERRED                                                                                                            |
| — HAPPY CAMP OPTION                   |                             | + + CONTACT BETWEEN PINAL SCHIST<br>CLAST-RICH CONGLOMERATE BELOW<br>AND DRIPPING SPRING QUARTZITE<br>CLAST-RICH CONGLOMERATE ABOVE |

Notes:  
1. NAD27 UTM12  
2. Orthophoto from USDA

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0 500 m

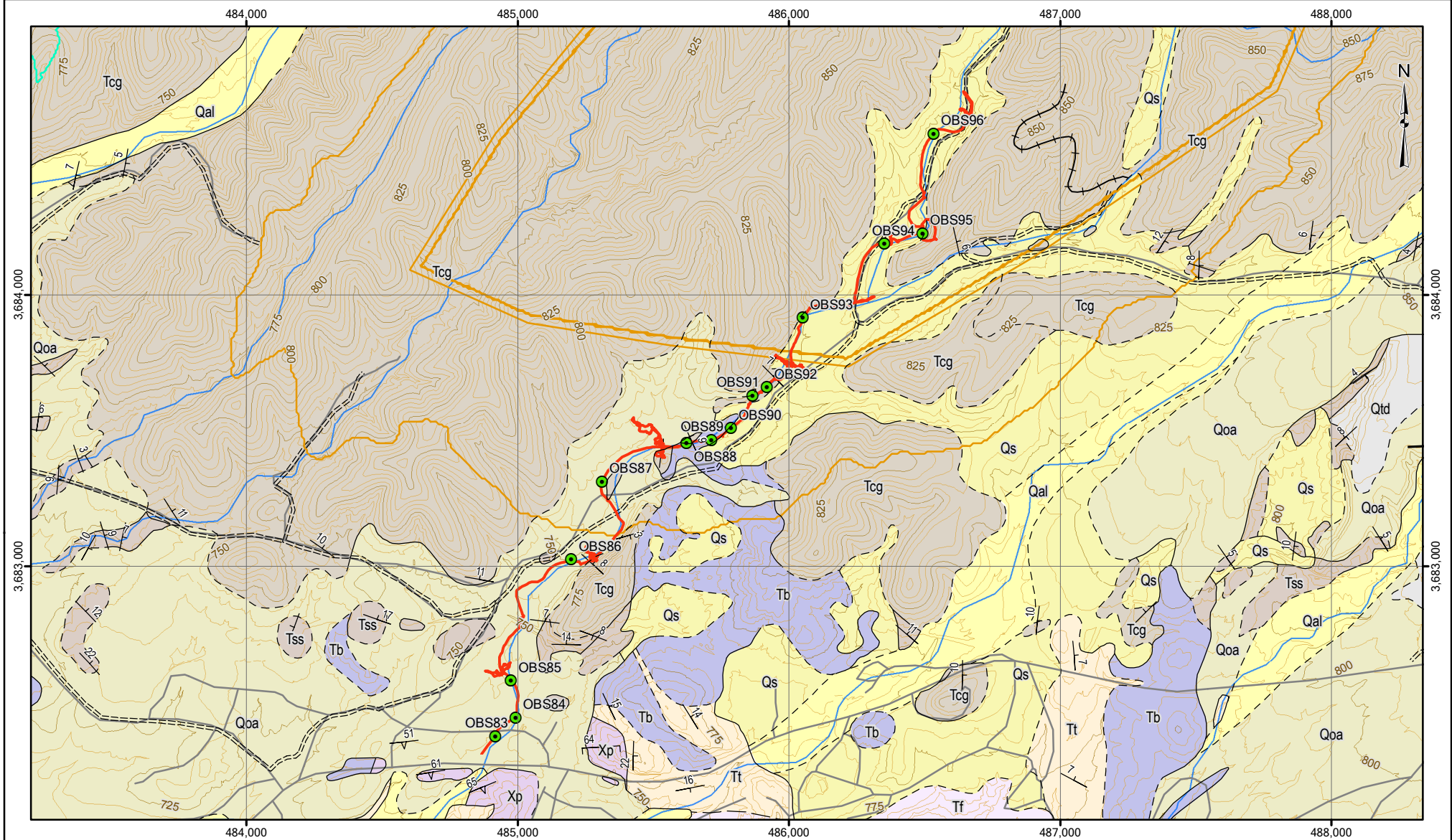
PROJECT RESOLUTION PROJECT  
2013 NEAR WEST SITE INVESTIGATION

TITLE  
CREEK TRAVERSE #9  
OBSERVATIONS

PROJECT No. M09441A14

FIG No. I-1.3





# LEGEND

- |                                                                       |                                                                                                                              |                                                             |
|-----------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|
| <span style="color: green;">●</span> CREEK TRAVERSE OBSERVATION POINT | — CONTACT (BETWEEN GEOLOGIC UNITS)                                                                                           | ××× FELSIC DYKE                                             |
| <span style="color: red;">—</span> TRAVERSE                           | - - - CONTACT - APPROXIMATE                                                                                                  | — FAULT                                                     |
| <span style="color: cyan;">—</span> NEAR WEST TAILINGS SITE           | - - - CONTACT - INFERRED                                                                                                     | — ? FAULT - APPROXIMATE                                     |
| <span style="color: orange;">—</span> HAPPY CAMP OPTION               | — + — CONTACT BETWEEN PINAL SCHIST CLAST-RICH CONGLOMERATE BELOW AND DRIPPING SPRING QUARTZITE CLAST-RICH CONGLOMERATE ABOVE | ..... FAULT - CONCEALED                                     |
| ==== ROAD (FROM RESOLUTION)                                           |                                                                                                                              | <span style="color: red;">—</span> QUARTZ VEIN              |
| — ROAD (FROM STATE)                                                   |                                                                                                                              | — MARKER HORIZON (LOCAL)                                    |
| <span style="color: blue;">—</span> STREAM                            |                                                                                                                              | <span style="color: cyan;">—</span> NEAR WEST TAILINGS SITE |
|                                                                       |                                                                                                                              | <span style="color: orange;">—</span> HAPPY CAMP OPTION     |

Notes:  
1. NAD27 UTM12  
2. Refer to main report for descriptions of geologic units.

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### CLIENT



0 500 m

PROJECT	RESOLUTION PROJECT 2013 NEAR WEST SITE INVESTIGATION	
TITLE	CREEK TRAVERSE #9 OBSERVATIONS AND GEOLOGY	
PROJECT No.	M09441A14	FIG No. I-1.4



**OBS83**

Basalt exposure on left channel bank. Fresh, R4, disturbed rock mass with randomly oriented fractures. One joint set observed with spacing ranging from 10 cm to 0.5 cm (*3.94 inches to 0.20 inches*), closed with smooth/planar surfaces.





#### OBS84

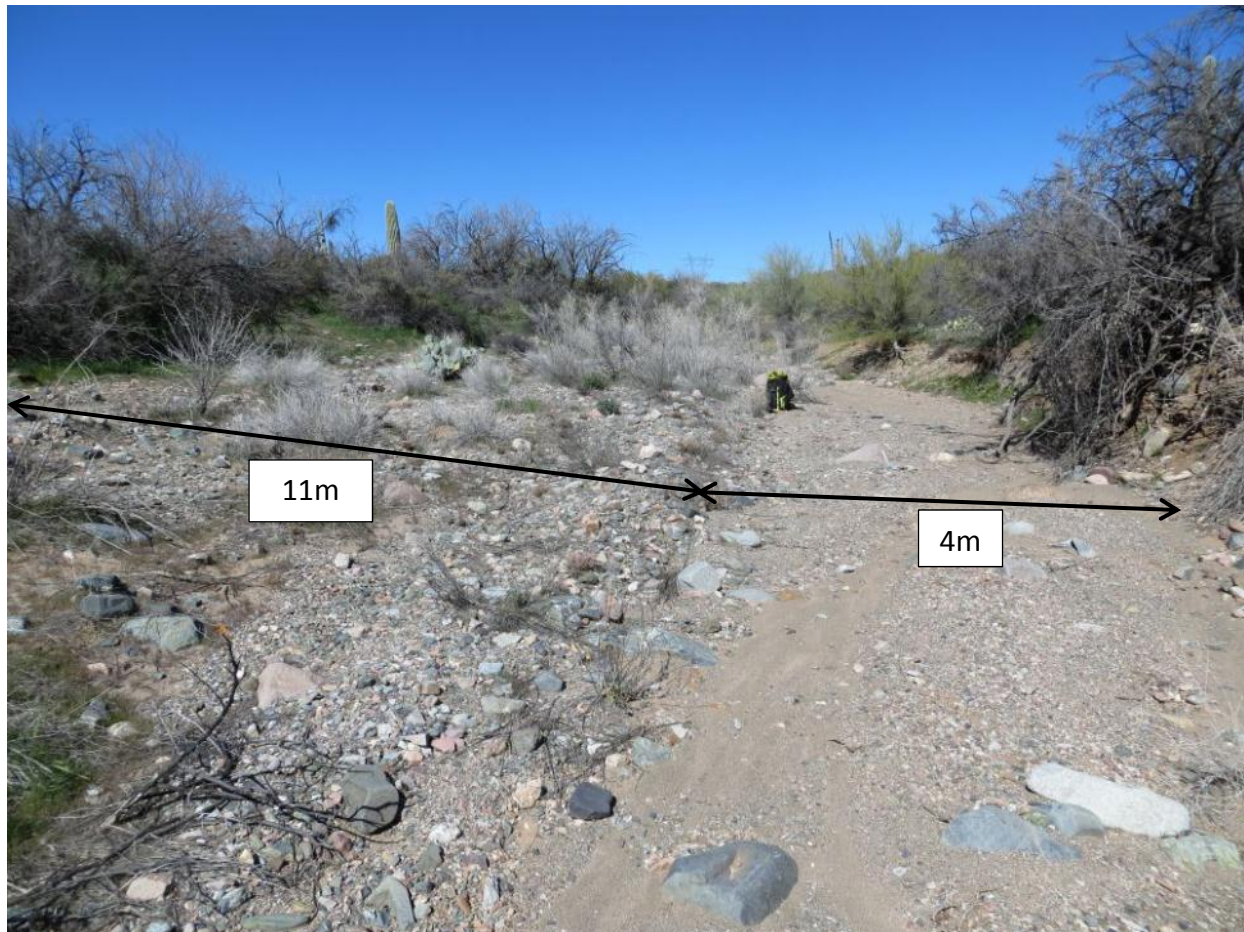
Exposure of Tertiary Sandstone (Tss). Cemented well graded gravelly sand, R4, max. particle size = 5 cm (1.97 inches), sub-angular to angular grains, bed thickness ranges from 70 cm (27.6 inches) to mm scale, differential weathering of finer, siltier beds.





**OBS85**

Channel 15 m wide (49.2 ft). 4 m (13.1 ft) wide sandy section and 11 m (36.1 ft) wide slightly elevated and vegetated section with coarser sediments. Elevated portion is on the inside of the channel bend.





**OBS86**

1.5 m (4.9 ft) high massive conglomerate outcrop in left channel bank, R3.





**OBS87**

Horizontal conglomerate beds spanning the channel invert.





**OBS88**

Differential weathering of disturbed basalt surface on left channel bank. Basalt along strike of vertical joints less weathered than surrounding rock.

Orientation of two joint sets: **310/90 and 225/90**



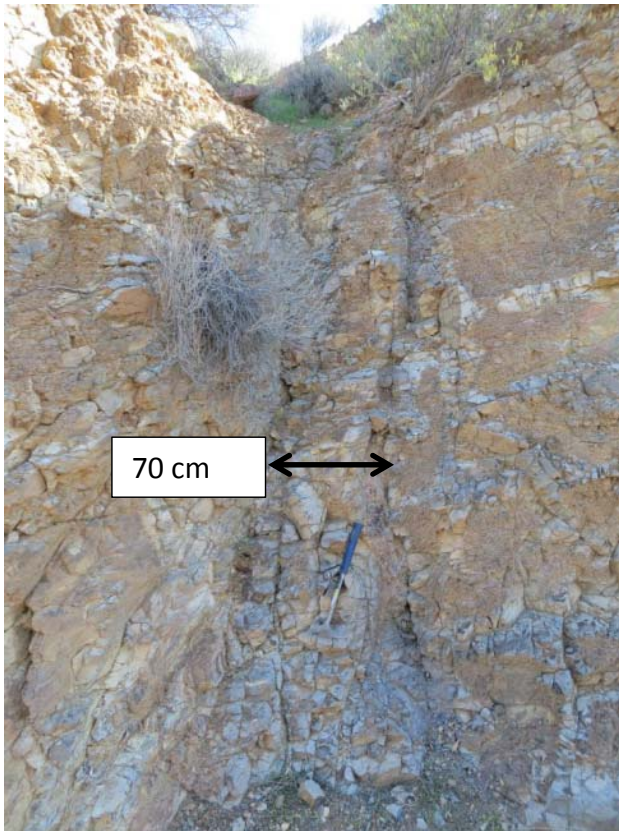


### OBS89

Fractured/disturbed basalt. Two continuous vertical fractures observed running the length of the outcrop. One wide (70 cm (27.6 inches)), vertical, heavily fractured zone that forms a depression in the outcrop face and along the ridge above the outcrop. Fractured zone infilled with well graded sand and fractured basalt. Rock mass strength R3 to R4.









**OBS90**

High water marks caused by calcite staining on the surface of cobbles in the river channel. Calcite staining extends 8 cm (3.15 inches) above channel invert.





**OBS91**

Welded tuff with basalt inclusions outcropped on left channel bank. Large calcite crystals formed in voids within the basalt.





**OBS92**

Water ponding in channel invert where flatly dipping beds of conglomerate span channel invert. Large trees growing in channel centre.





**OBS93**

Conglomerate exposure on left channel bank with large scale, massive beds.

Orientation of bedding: **023/10**





**OBS94**

30 cm (11.8 inches) elevation drop in channel over sub-horizontal conglomerate bed spanning the channel invert. Sand at foot of drop moist just below surface.





### OBS95

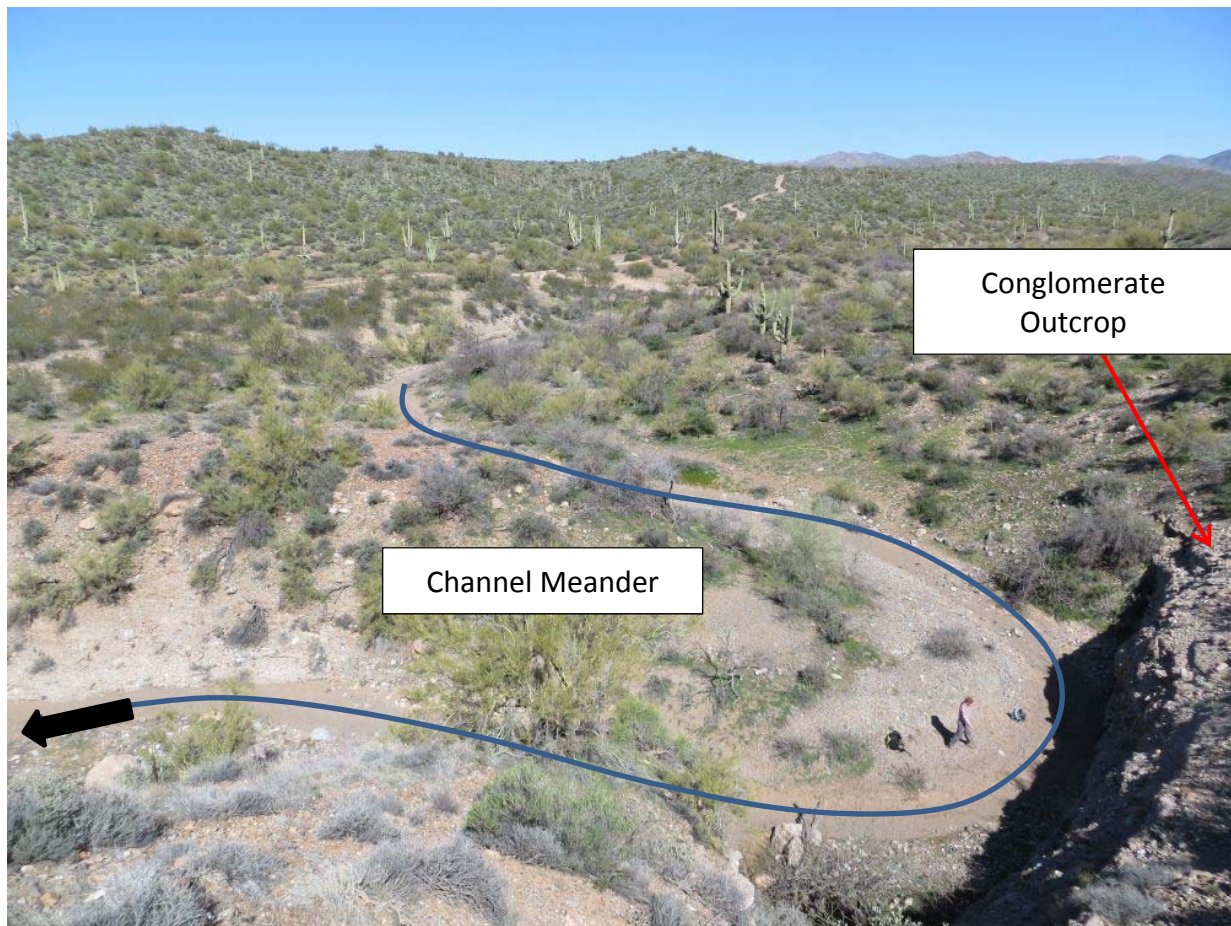
Large well cemented conglomerate exposure on outside of sharp channel bend. Range of clast sizes up to 70 cm (27.6 inches), range of clast lithology and shape. Overhang running along the base of the exposure cut approximately 1 m (3.3 ft) above the channel invert. Moist sand with grass below the overhang. Differential weathering of a finer bed at the base of the exposure may be due to fluvial erosion. Moderate acid reaction on the conglomerate surface consistent across exposure.



Overhang

Finest Bed







**OBS96**

Extremely hard (R6) calcite stained rock exposed in channel invert (chert?). Strong acid reaction on surface. Likely an exposed clast from conglomerate underlying the channel invert.





## **APPENDIX II**

### **Detailed Gila Mapping**

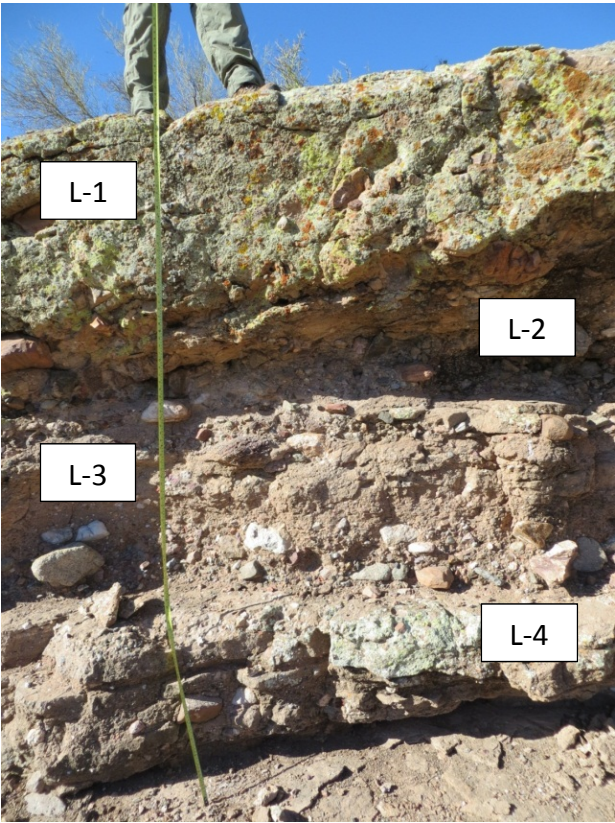
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CRK20

Date Mapped	Mapping Point	Northing* (m)	Easting* (m)	Layer Described	From (m) (ft)	To (m) (ft)	Description (Top to Bottom)	Acid Reaction**	Rock Strength	Relative Weathering	Soak Test	Laboratory Testing			Outcrop Notes
												Moisture Content (%)	Soluble Salts (ppm)	Soluble Salts (%)	
7-Mar-13	CRK20	3684886	481469	L-1	0 (0)	0.5 (1.6)	Gravelly SAND (SW), some silt, trace cobbles, well graded, max. particle size = 20 cm, angular to sub-angular clasts, pink, various lithology (quartzite, tuff, schist, quartz), clast supported (sand), massive	matrix - none to moderate	R5-R6 (exposure face) R3 (chunk of material)	Strong, forms overhang	No slaking - moderate strength loss	2.4	430	0.043	No dominant structure noted in rock mass. Massive with small discontinuous fractures in all layers.
				L-2	0.5 (1.6)	0.9 (3.0)	SAND, GRAVEL and COBBLES, well graded, max. particle size = 30 cm, angular to sub-angular clasts, pink, various lithology (quartzite, tuff, granodiorite, schist, quartz, quartz arenite, limestone), matric supported in some areas and clast supported in others, massive	matrix and limestone clasts - moderate to strong	R3	Weakest, cut back below overhang	Some slaking - moderate strength loss	5.2	150	0.015	
				L-3	0.9 (3.0)	1.5 (4.9)	Gravelly SAND (SW), some cobbles, trace silt, well graded, max. particle size = 20 cm, angular to sub-rounded clasts, pinkish brown, various lithology (quartzite, tuff, granodiorite, schist, quartz, quartz arenite, limestone), clast supported (sand), massive	matrix and limestone clasts - weak to strong	R3	Average	No slaking - moderate strength loss	1.9	130	0.013	
				L-4	1.5 (4.9)	2.1 (6.9)	SAND and GRAVEL (SW-GW), some cobbles, trace silt, well graded, max. particle size = 15 cm, sub-angular to angular, brown, various lithology (quartzite, tuff, granodiorite, schist, quartz, quartz arenite, limestone), clast supported (sand), massive	matrix and limestone clasts - moderate to strong	R3	Strong, forms ledge	Some slaking - moderate strength loss	3.2	580	0.058	

\* Coordinates measured with handheld GPS unit. Coordinate System: UTM NAD27 CONUS  
\*\* ACID REACTION RATING SYSTEM  
\*\*\* Samples taken for calcite content are representative of the matrix of the material and have not been adjusted for the coarse fraction  
    **none** no bubbling or audible effervescence  
    **weak** small bubbles forming around grains/clasts (must look closely to see), barely audible effervescence  
    **moderate** bubbles clearly seen around grains or on surface of exposure, audible effervescence  
    **strong** bubbles protrude/foam from surface, loud effervescence, visible vapors coming from contact area

















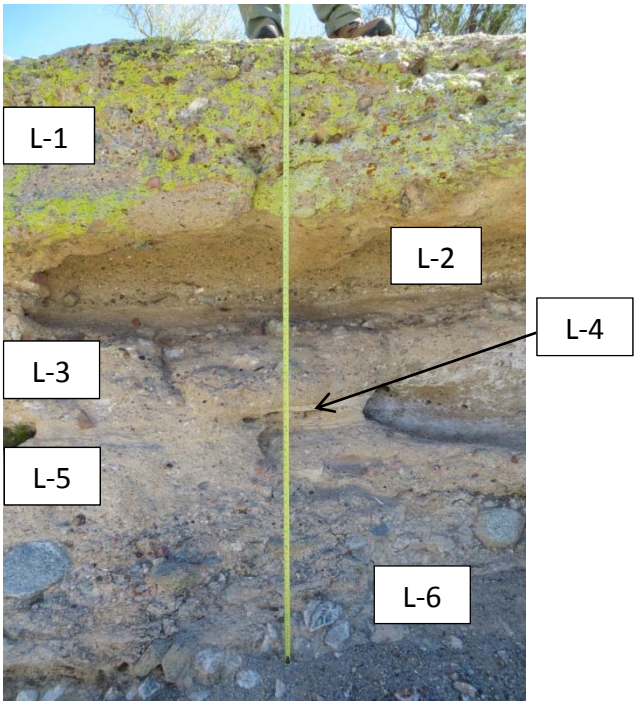




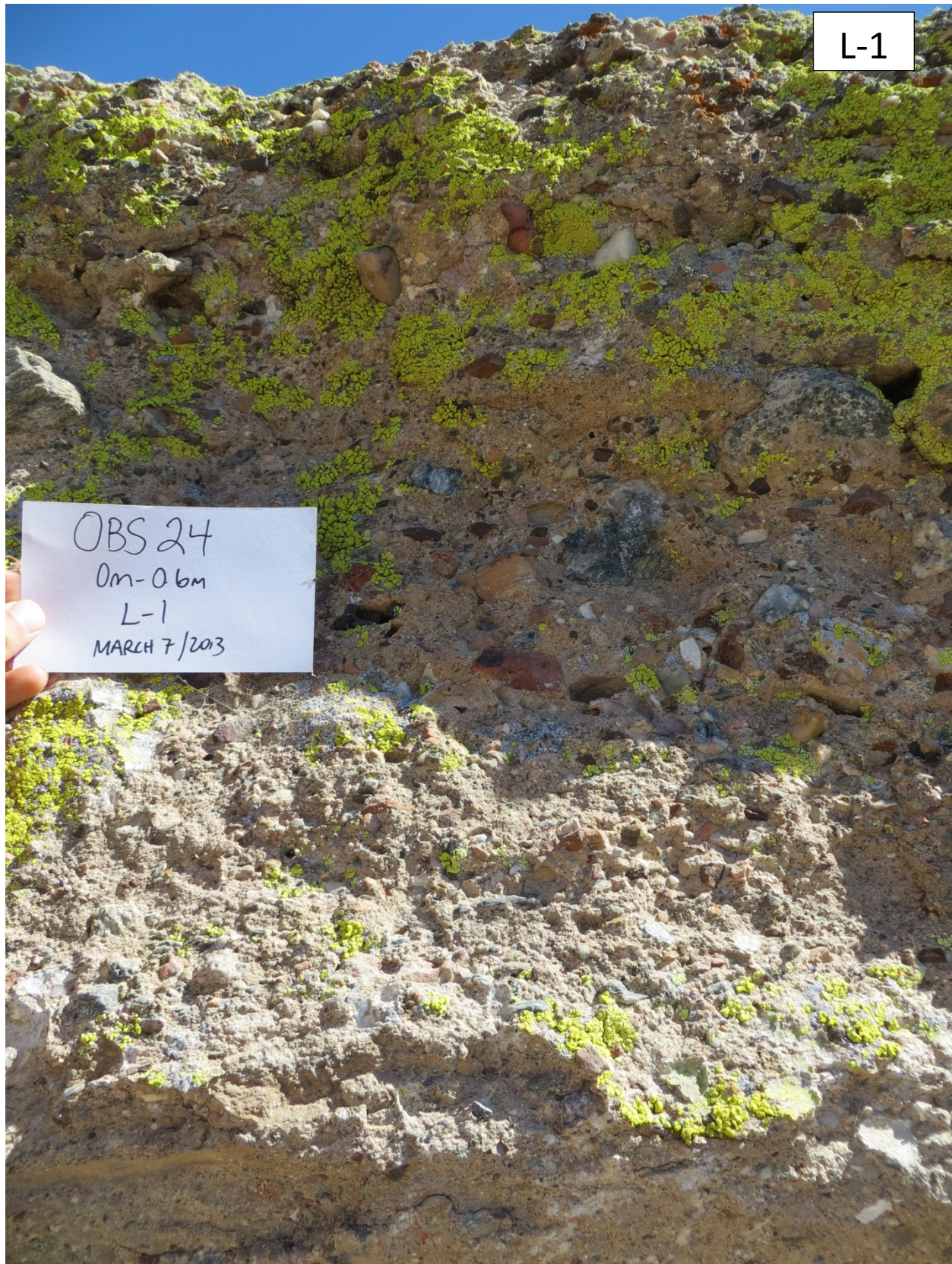
OBS24

Mapping Point	Northing* (m)	Easting* (m)	Layer Described	From (m) (ft)	To (m) (ft)	Description (Top to Bottom)	Acid Reaction**	Rock Strength	Relative Weathering	Soak Test	Laboratory Testing			Outcrop Notes
											Moisture Content (%)	Soluble Salts (ppm)	Soluble Salts (%)	
OBS24	3685063	482067	L-1	0 (0)	0.6 (2.0)	SAND and GRAVEL (SW-GW), trace fines, well graded, max. particle size = 5 cm, angular to sub-rounded clasts, pink, various lithology (tuff, schist, quartz, sandstone, granodiorite, quartzite), clast supported (sand), massive	matrix - none to moderate	R5-R6 (exposure face) R3 (chunk of material)	Strong, forms overhang	No slaking - No strength loss with wetting	1.5	420	0.042	No joints or fractures in outcrop. Sub-horizontal beds as described
			L-2	0.6 (2.0)	0.85 (2.3)	SAND and GRAVEL (SW-GW), trace cobbles, trace fines, well graded, max. particle size = 10 cm, angular to sub-rounded clasts, pink, various lithology (tuff, schist, quartz, sandstone, granodiorite, quartzite), clast supported (sand), massive	matrix - moderate to strong	R3	Weakest, undercut below overhang	No slaking - No strength loss with wetting	2.3	170	0.017	
				0.85 (2.8)	0.9 (3.0)	SILT, some fine grained sand, white, sub-horizontal laminations	strong	R0			Not Tested			
				0.95 (3.0)	1 (3.3)	As 0.6m - 0.85m					Not Tested			
			L-3	1 (3.3)	1.3 (4.3)	Gravelly SAND (SW), fine to coarse, some fines, well graded, max. particle size = 12 cm, angular to sub-angular clasts, pinkish brown, various lithology, matrix supported, massive	moderate to strong	R2 to R3	Average	No slaking - moderate strength loss	3.7	17730	1.8	
			L-4	1.3 (4.3)	1.4 (4.6)	SILT, some fine grained sand, whitish grey, dry, finely laminated	strong	R0	Weak, eroded away in some areas	N/A	5.6	740	0.074	
			L-5	1.4 (4.6)	2.2 (7.2)	SAND and GRAVEL, some cobbles, some fines, well graded, max. particle size = 30 cm, sub-rounded to sub-angular clasts, pinkish brown, various lithology, matrix to clast supported (some clasts touching). "soil like", massive	strong	R1	Average	N/A	Not Tested			
			L-6	2.2 (7.2)	2.8 (9.2)	SAND and GRAVEL, some fines, well graded, max. particle size = 12 cm, sub-rounded to angular, grey, various lithology, clast (sand) supported, massive	strong	R5 (exposure face) R3 (chunk of material)	Strong, forms ledge and extends out beyond foot of outcrop	No slaking - No strength loss	3.0	790	0.079	

Measured with handheld GPS unit. Coordinate System: UTM NAD27 CONUS  
DN RATING SYSTEM  
:en for calcite content are representative of the matrix of the material and have not been adjusted for the coarse fraction  
no bubbling or audible effervescence  
small bubbles forming around grains/clasts (must look closely to see), barely audible effervescence  
bubbles clearly seen around grains or on surface of exposure, audible effervescence  
bubbles protrude/foam from surface, loud effervescence, visible vapors coming from contact area



























L-6



GILA1

Date Mapped	Mapping Point	Northing* (m)	Easting* (m)	Layer Described	From (m) (ft)	To (m) (ft)	Description (Top to Bottom)	Acid Reaction**	Rock Strength	Relative Weathering	Soak Test	Laboratory Testing			Outcrop Notes
												Moisture Content (%)	Soluble Salts (ppm)	Soluble Salts (%)	
7-Mar-13	CRK20	3684886	481469	L-1	0 (0)	0.5 (1.6)	Gravelly SAND (SW), some silt, trace cobbles, well graded, max. particle size = 20 cm, angular to sub-angular clasts, pink, various lithology (quartzite, tuff, schist, quartz), clast supported (sand), massive	matrix - none to moderate	R5-R6 (exposure face) R3 (chunk of material)	Strong, forms overhang	No slaking - moderate strength loss	2.4	430	0.043	No dominant structure noted in rock mass. Massive with small discontinuous fractures in all layers.
				L-2	0.5 (1.6)	0.9 (3.0)	SAND, GRAVEL and COBBLES, well graded, max. particle size = 30 cm, angular to sub-angular clasts, pink, various lithology (quartzite, tuff, granodiorite, schist, quartz, quartz arenite, limestone), matrix supported in some areas and clast supported in others, massive	matrix and limestone clasts - moderate to strong	R3	Weakest, cut back below overhang	Some slaking - moderate strength loss	5.2	150	0.015	
				L-3	0.9 (3.0)	1.5 (4.9)	Gravelly SAND (SW), some cobbles, trace silt, well graded, max. particle size = 20 cm, angular to sub-rounded clasts, pinkish brown, various lithology (quartzite, tuff, granodiorite, schist, quartz, quartz arenite, limestone), clast supported (sand), massive	matrix and limestone clasts - weak to strong	R3	Average	No slaking - moderate strength loss	1.9	130	0.013	
				L-4	1.5 (4.9)	2.1 (6.9)	SAND and GRAVEL (SW-GW), some cobbles, trace silt, well graded, max. particle size = 15 cm, sub-angular to angular, brown, various lithology (quartzite, tuff, granodiorite, schist, quartz, quartz arenite, limestone), clast supported (sand), massive	matrix and limestone clasts - moderate to strong	R3	Strong, forms ledge	Some slaking - moderate strength loss	3.2	580	0.058	

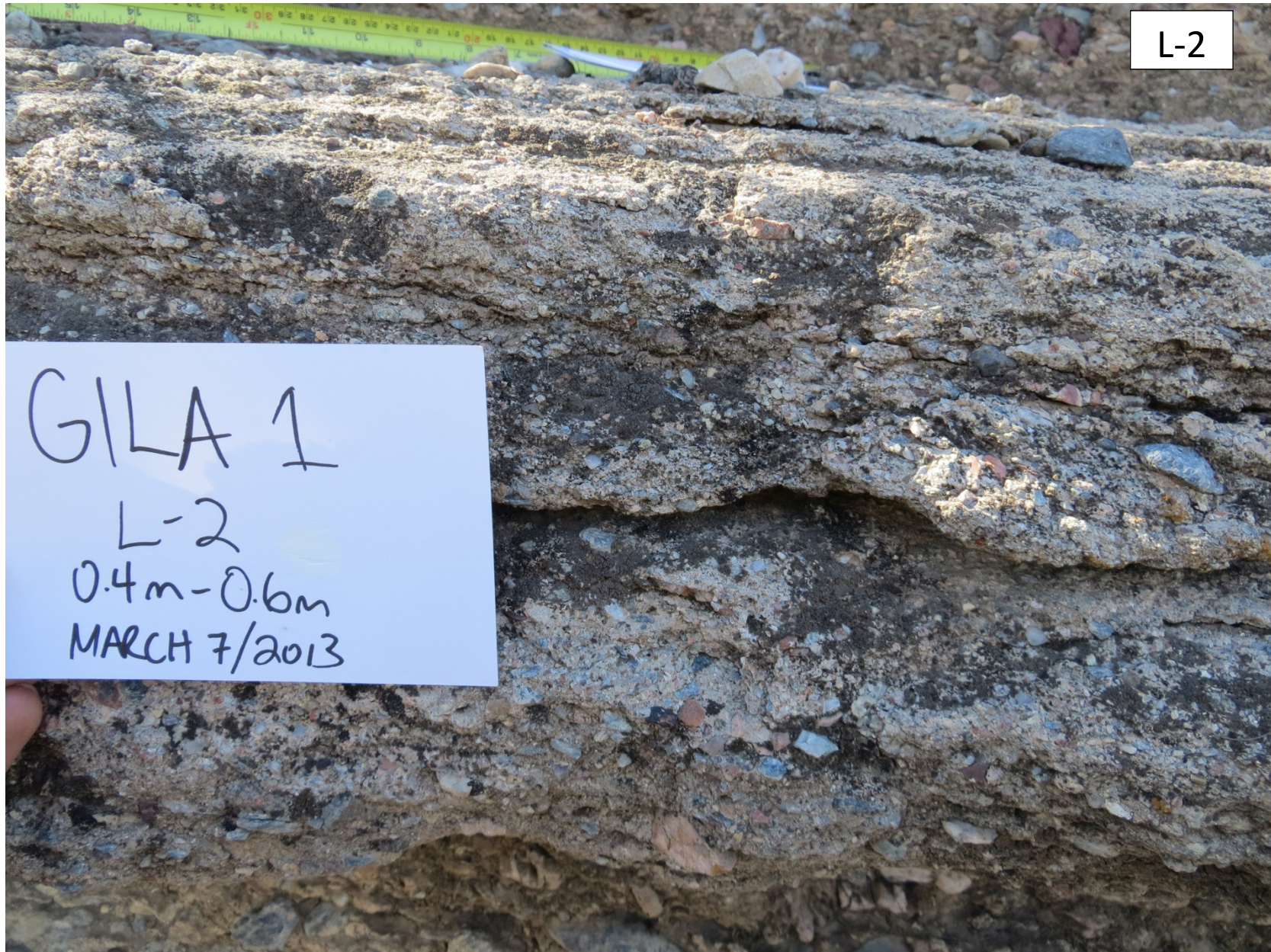
\* Coordinates measured with handheld GPS unit. Coordinate System: UTM NAD27 CONUS  
\*\* ACID REACTION RATING SYSTEM  
\*\*\* Samples taken for calcite content are representative of the matrix of the material and have not been adjusted for the coarse fraction  
    **none** no bubbling or audible effervescence  
    **weak** small bubbles forming around grains/clasts (must look closely to see), barely audible effervescence  
    **moderate** bubbles clearly seen around grains or on surface of exposure, audible effervescence  
    **strong** bubbles protrude/foam from surface, loud effervescence, visible vapors coming from contact area



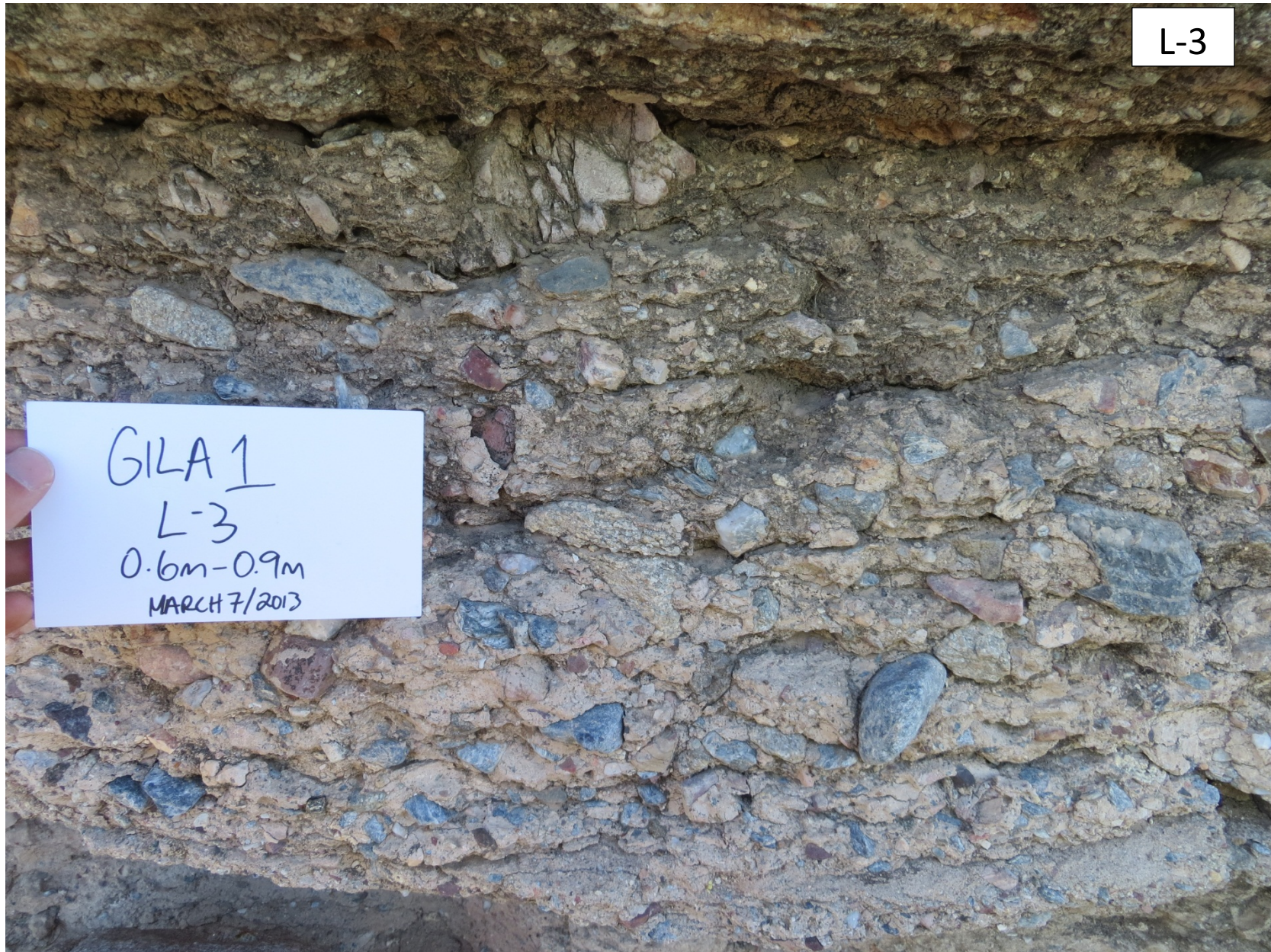














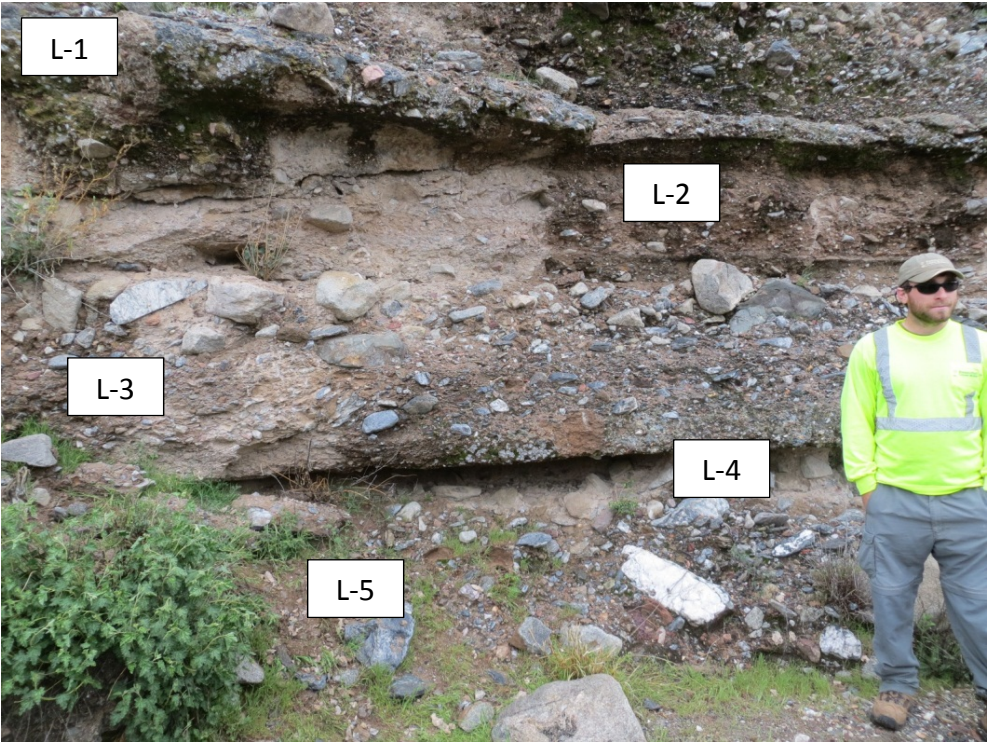




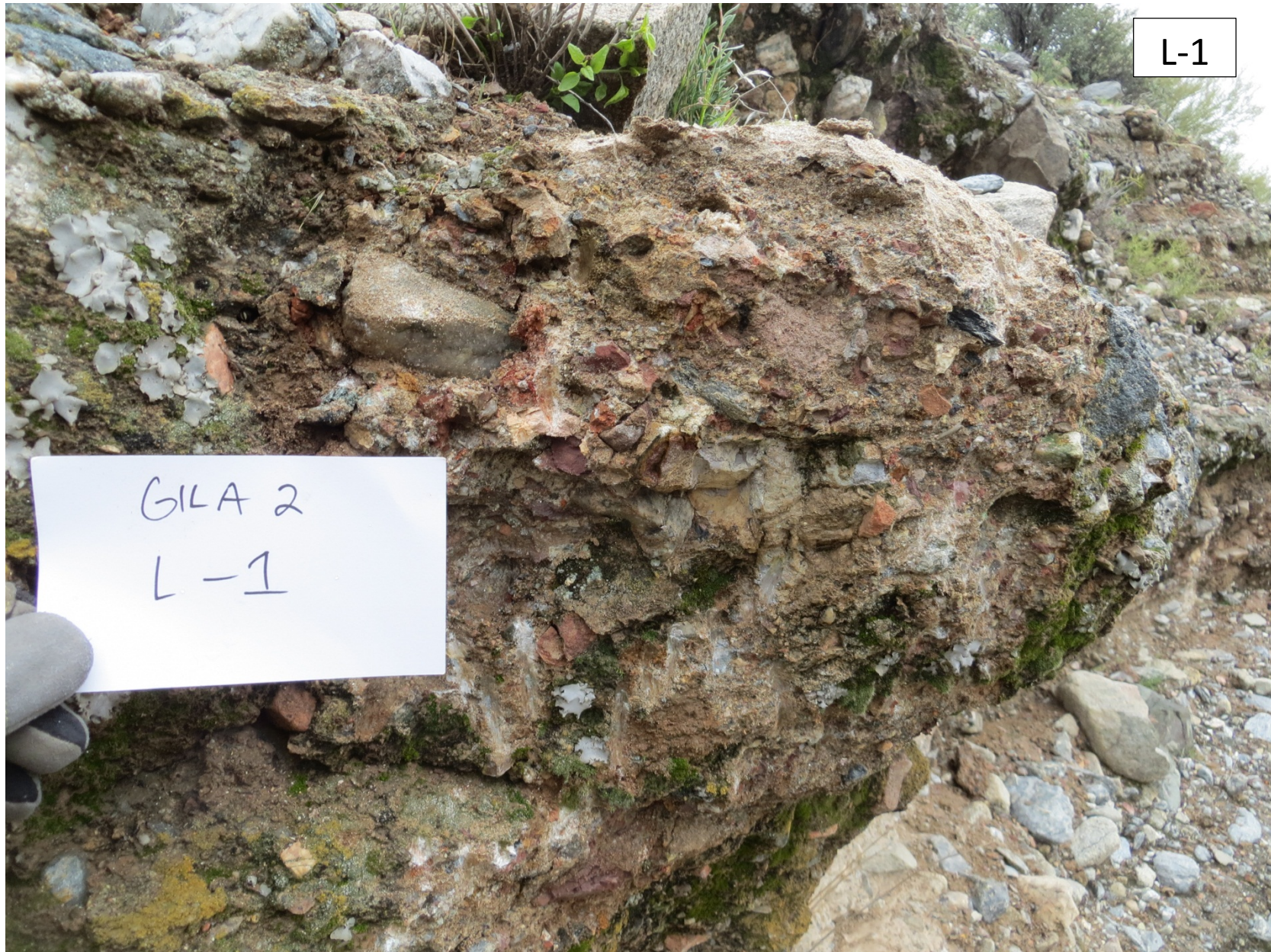
GILA2

Date Mapped	Mapping Point	Northing* (m)	Easting* (m)	Layer Described	From (m) (ft)	To (m) (ft)	Description (Top to Bottom)	Acid Reaction**	Rock Strength	Relative Weathering	Soak Test	Laboratory Testing			Outcrop Notes
												Moisture Content (%)	Soluble Salts (ppm)	Soluble Salts (%)	
9-Mar-13	GILA2	3685785	482410	L-1	0 (0)	0.3 (1.0)	SAND and GRAVEL, fine to coarse, some cobbles, some clay, well graded, max. particle size = 12 cm, angular to sub-angular clasts, reddish brown to yellow, variable lithology (quartz, quartz sandstone, schist, granodiorite, siltstone), clast supported, massive	moderate	R2	Strong, forms ledge	No slaking - moderate strength loss	3.7	260	0.026	Moist at time of sampling
				L-2	0.3 (1.0)	0.9 (3.0)	Silty SAND and GRAVEL, fine to coarse, some cobbles, well graded, max. particle size = 20 cm, sub-angular to angular, light brown/grey, various lithology (as L-1), clast (sand) supported, massive	none to weak	R1	Weak, cut back	No slaking - no strength loss	2.2	1860	0.19	
				L-3	0.9 (3.0)	1.9 (6.2)	Silty SAND and GRAVEL, fine to coarse, some cobbles, trace boulders, well graded, max. particle size = 40 cm, sub-angular to angular, light brown/grey, various lithology (as L-1), clast (sand) supported, massive	weak	R1	Stronger, forms sloping ledge	No slaking - moderate strength loss	3.8	170	0.017	Moist at time of sampling
				L-4	1.9 (6.2)	2.2 (7.2)	SILT, SAND and GRAVEL, fine to coarse, to gravelly, some cobbles, well graded, max. particle size = 30 cm, sub-angular to angular, light brown/grey, various lithology (as L-1), matrix supported in more eroded areas, clast supported in more resistant areas, massive	weak to moderate	R1	Weak, cut back	No slaking - moderate strength loss	1.1	380	0.038	
				L-5	2.2 (7.2)	2.8 (9.2)	Clayey SAND, GRAVEL and COBBLES, fine to coarse, some boulders, well graded, max. particle size = 60 cm, angular to sub-rounded, brown, various lithology (as L-1) clast supported, massive	moderate	R1	Stronger, forms sloping ledge	No slaking - moderate strength loss	2.3	560	0.056	Moist at time of sampling

\* Coordinates measured with handheld GPS unit. Coordinate System: UTM NAD27 CONUS  
\*\* ACID REACTION RATING SYSTEM  
\*\*\* Samples taken for calcite content are representative of the matrix of the material and have not been adjusted for the coarse fraction  
    **none** no bubbling or audible effervescence  
    **weak** small bubbles forming around grains/clasts (must look closely to see), barely audible effervescence  
    **moderate** bubbles clearly seen around grains or on surface of exposure, audible effervescence  
    **strong** bubbles protrude/foam from surface, loud effervescence, visible vapors coming from contact area





















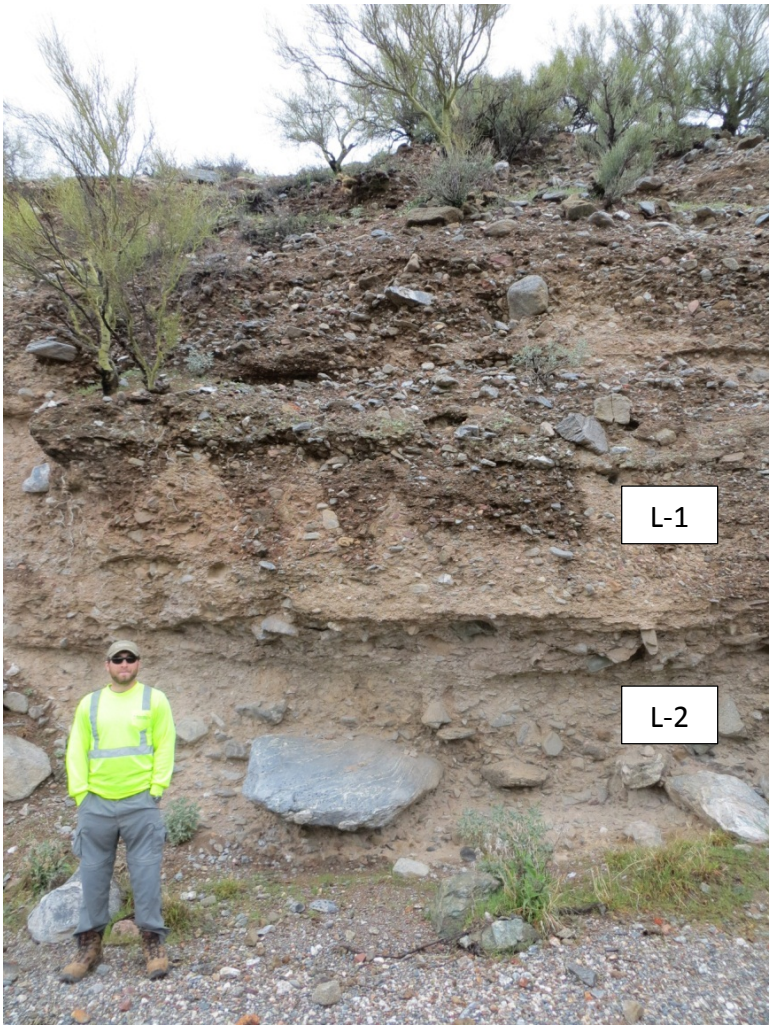




GILA3

Date Mapped	Mapping Point	Northing* (m)	Easting* (m)	Layer Described	From (m) (ft)	To (m) (ft)	Description (Top to Bottom)	Acid Reaction**	Rock Strength	Relative Weathering	Soak Test	Laboratory Testing			Outcrop Notes
												Moisture Content (%)	Soluble Salts (ppm)	Soluble Salts (%)	
9-Mar-13	GILA3	3686534	482631	L-1	0 (0)	1.6 (5.3)	SAND, GRAVEL and COBBLES, fine to coarse, trace boulders, some to trace clay, well graded, max. particle size = 30 cm, sub-rounded to angular, light brown, various lithology (schist, quartz, granodiorite, quartz sandstone, siltstone, quartzite), matrix supported, massive	weak to moderate	R3 (exposure face) R1 (hand sample)	Stronger, forms overhang	No slaking - moderate strength loss	2.4 1.8	140 170	.014 .017	Moist at time of sampling 2 samples taken
				L-2	1.6 (5.3)	3.1 (10.2)	Silty SAND, GRAVEL and COBBLES, fine to coarse, some boulders, well graded, max. particle size = 1.6 m (schist boulder), angular to sub-angular, light brown, various lithology (as L-1), clast supported, massive	weak to moderate	R1	Weaker, forms undercut	Significant slaking - total strength loss	0.7	1750	0.18	Two samples taken

\* Coordinates measured with handheld GPS unit. Coordinate System: UTM NAD27 CONUS  
\*\* ACID REACTION RATING SYSTEM  
\*\*\* Samples taken for calcite content are representative of the matrix of the material and have not been adjusted for the coarse fraction  
**none** no bubbling or audible effervescence  
**weak** small bubbles forming around grains/clasts (must look closely to see), barely audible effervescence  
**moderate** bubbles clearly seen around grains or on surface of exposure, audible effervescence  
**strong** bubbles protrude/foam from surface, loud effervescence, visible vapors coming from contact area













GILA4

Date Mapped	Mapping Point	Northing* (m)	Easting* (m)	Layer Described	From (m) (ft)	To (m) (ft)	Description (Top to Bottom)	Acid Reaction**	Rock Strength	Relative Weathering	Soak Test	Laboratory Testing			Outcrop Notes
												Moisture Content (%)	Soluble Salts (ppm)	Soluble Salts (%)	
9-Mar-13	GILA4	3687033	483112	L-1	0 (0)	0.8 (2.6)	SAND and GRAVEL, fine to coarse, some cobbles to cobbly, some clay, well graded, max. particle size = 10 cm, angular to sub-angular, reddish brown, various lithology (schist, quartzite, tuff, quartz), clast supported, massive	none to moderate	R1	Both layers the same	No slaking - moderate strength loss	11.6	180	0.018	Moist at time of sampling, very similar to L-1 in GILA3
				L-2	0.8 (2.6)	1.6 (5.3)	SAND, GRAVEL and COBBLES, some clay, well graded, max. particle size = 35 cm, sub-angular to angular, brown, various lithology (as L-1), clast supported, massive	weak to moderate	R1	Both layers the same	No slaking - moderate strength loss	5.4	1370	0.137	Very similar to L-1 in GILA3

\* Coordinates measured with handheld GPS unit. Coordinate System: UTM NAD27 CONUS  
\*\* ACID REACTION RATING SYSTEM  
\*\*\* Samples taken for calcite content are representative of the matrix of the material and have not been adjusted for the coarse fraction  
    **none** no bubbling or audible effervescence  
    **weak** small bubbles forming around grains/clasts (must look closely to see), barely audible effervescence  
    **moderate** bubbles clearly seen around grains or on surface of exposure, audible effervescence  
    **strong** bubbles protrude/foam from surface, loud effervescence, visible vapors coming from contact area













## **APPENDIX III**

### **Bedrock Geology Mapping**

---



## **APPENDIX III-A**

### **North Mixed Geology Area**

---



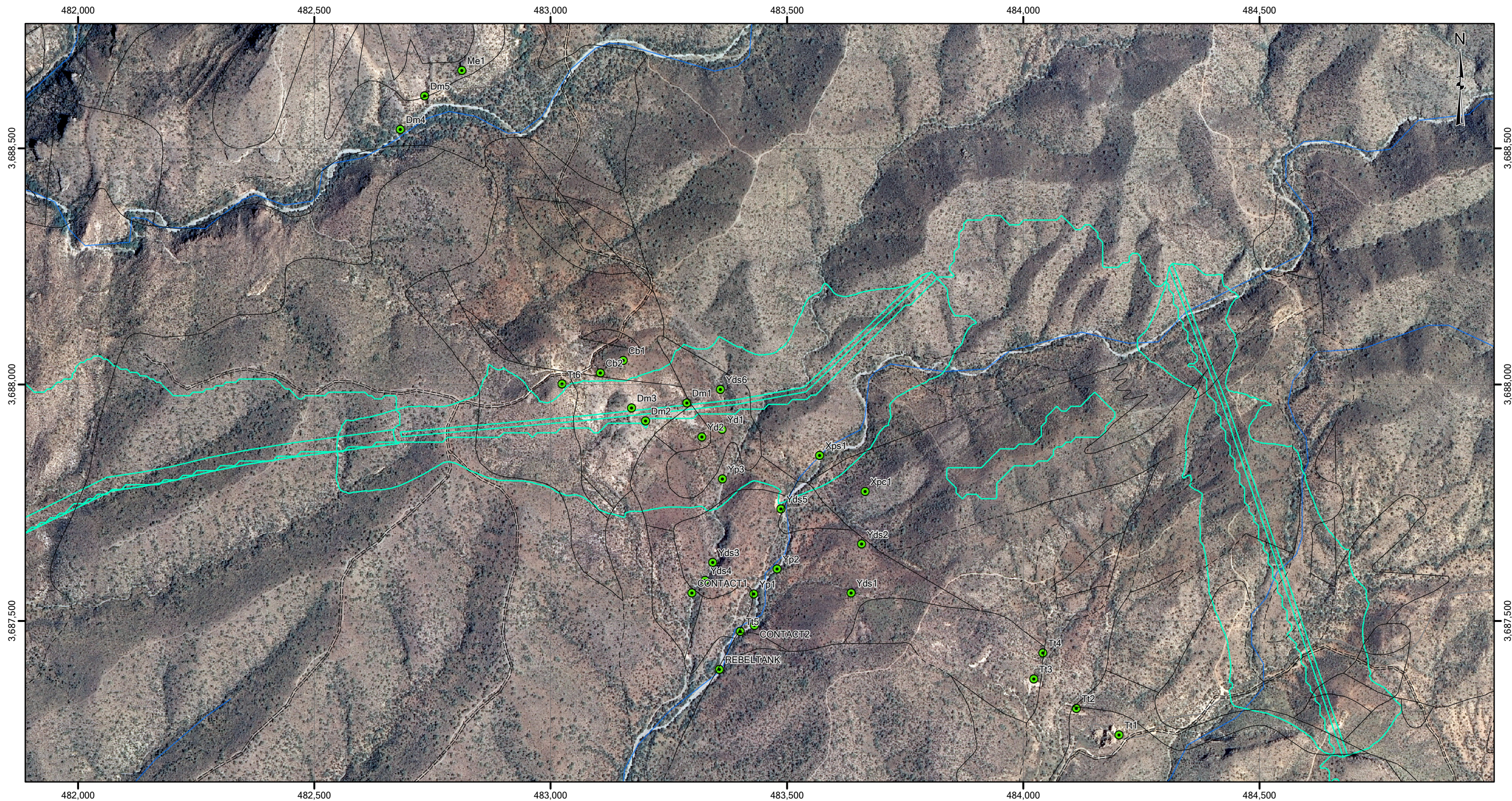
## Bedrock Geology Observations – North Mixed Geology Area

Observation Station	Coordinates <sup>1</sup>	
	Easting (m)	Northing (m)
Tt1	484204	3687255
Tt2	484114	3687311
Tt3	484024	3687374
Tt4	484043	3687428
Yds1	483637	3687555
Yds2	483660	3687659
Yds3	483344	3687620
Yds4	483328	3687582
CONTACT1	483300	3687555
REBELTANK	483359	3687394
Tt5	483403	3687474
CONTACT2	483433	3687487
Yp1	483432	3687553
Yp2	483481	3687606
Yds5	483489	3687733
Xps1	483571	3687846
Xpc1	483667	3687770
Yds6	483361	3687986
Yp3	483365	3687797
Yd1	483364	3687901
Yd2	483321	3687886
Dm1	483290	3687958
Dm2	483203	3687920
Dm3	483172	3687948
Cb1	483155	3688048
Cb2	483107	3688021
Tt6	483026	3687998
Dm4	482683	3688536
Me1	482813	3688661
Dm5	482735	3688608

1 – Coordinates measured with handheld GPS unit. Coordinate system: UTM NAD27 CONUS



CB Z:\MVC\RM\09441A14 - RES-Near West\Geotech Study\400 Drawings\MXD\SI\report\_1\figures\tabled\FM\Traverse\_NorthMixedGeoArea\_ortho\_1\_30603.mxd 7/23/2013 12:14:19 PM



LEGEND

- |                         |                        |                                                                                                                                 |
|-------------------------|------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| OBSERVATION POINT       | ROAD (FROM RESOLUTION) | CONTACT (BETWEEN GEOLOGIC UNITS)                                                                                                |
| NEAR WEST TAILINGS SITE | ROAD (FROM STATE)      | CONTACT - APPROXIMATE                                                                                                           |
| HAPPY CAMP OPTION       | STREAM                 | CONTACT - INFERRED                                                                                                              |
|                         |                        | CONTACT BETWEEN PINAL SCHIST<br>CLAST-RICH CONGLOMERATE BELOW<br>AND DRIPPING SPRING QUARTZITE<br>CLAST-RICH CONGLOMERATE ABOVE |

Notes:  
1. NAD27 UTM12  
2. Orthophoto from USDA

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CLIENT



0 250 m

PROJECT  
RESOLUTION PROJECT  
2013 NEAR WEST SITE INVESTIGATION

TITLE  
BEDROCK GEOLOGY OBSERVATIONS  
NORTH MIXED GEOLOGY AREA

PROJECT No.  
M09441A14

FIG No.  
III-A. 1







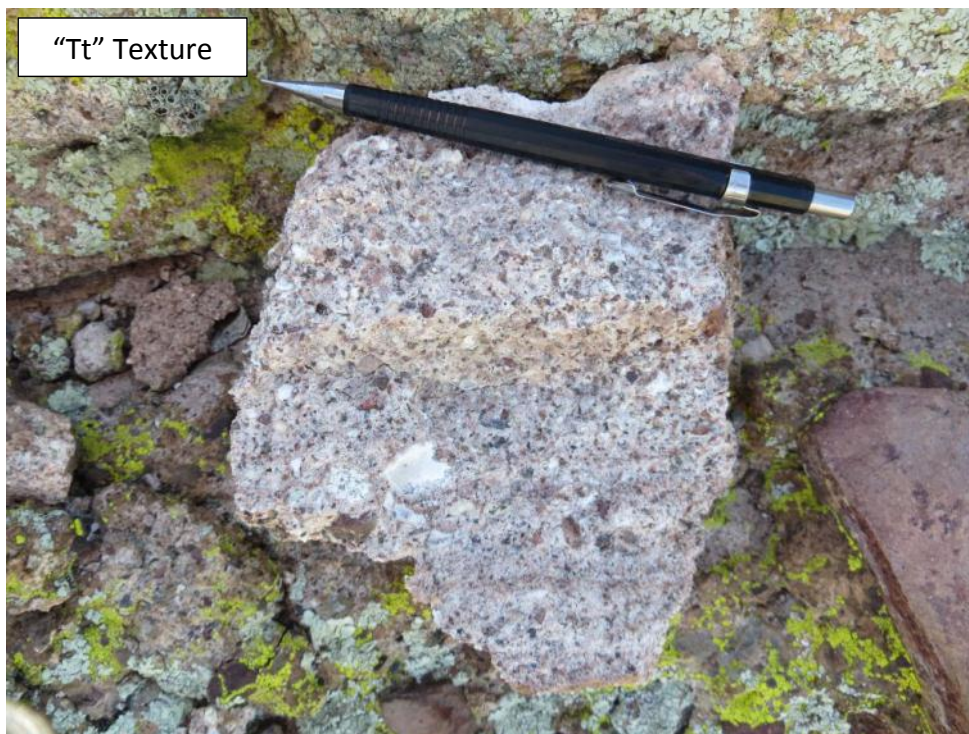
### Tt1

Contact area between perlite/rhyolite and poorly welded tuff (Tt). Rhyolite forms steep bluffs; R2 to R3, white powdery texture with perlite inclusions, surface of exposure is covered with thin, discolored hardened “crust”.

Directly behind rhyolite bluffs is gently dipping layers of tuff. R4, angular to sub-angular coarse particles in very fine grained felsic matrix, sub-horizontal layers with thickness ranging from 100 cm to 5 cm (*39.37 inches to 1.97 inches*), discontinuities along layer interfaces generally closed down section in the outcrop but open up near the ground surface.









**Tt2**

Flatly dipping tuff layers exposed in small wash. Large, massive layers exposed on the channel banks.

Orientation of tuff layers: **115/11**





### Tt3

Open area with flatly dipping tuff exposed at the intersection of two washes. Layered tuff exposed in the bank showing differential weathering.

More eroded layer. Tuff (Tt), R2, angular to sub-rounded gravel clasts in white powdery matrix, no jointing or fracturing (massive).

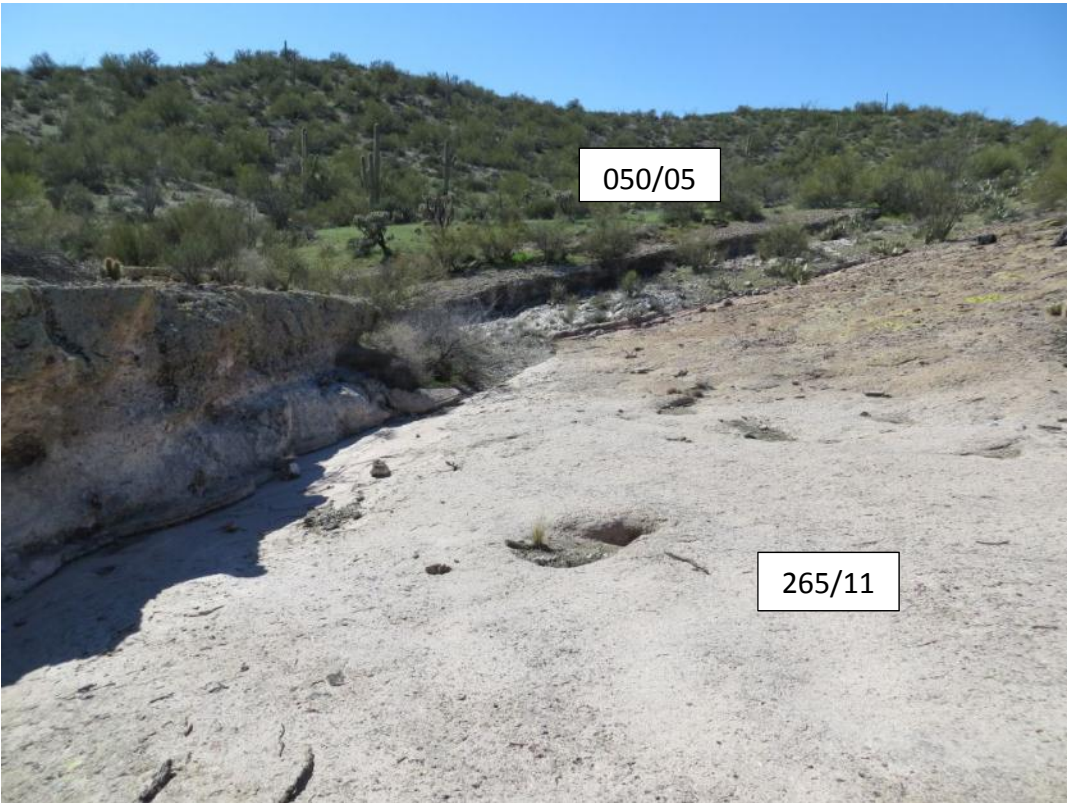
More competent layer exposed at base of outcrop and in the channel invert. Tuff (Tt), R3 to R4, dominantly well graded sand clasts in pink felsic matrix, massive.

Orientation of dipping tuff in invert (see photo below): **265/11**

Orientation of dipping tuff on opposite bank (see photo below): **050/05**









Tt4

Contact between poorly welded tuff (Tt) and Pinal schist (Xpm).





### Yds1

Disturbed outcrop of dripping springs quartzite (Yds) in narrow wash invert. Tuff outcrops are visible just upstream/uphill of the quartzite.

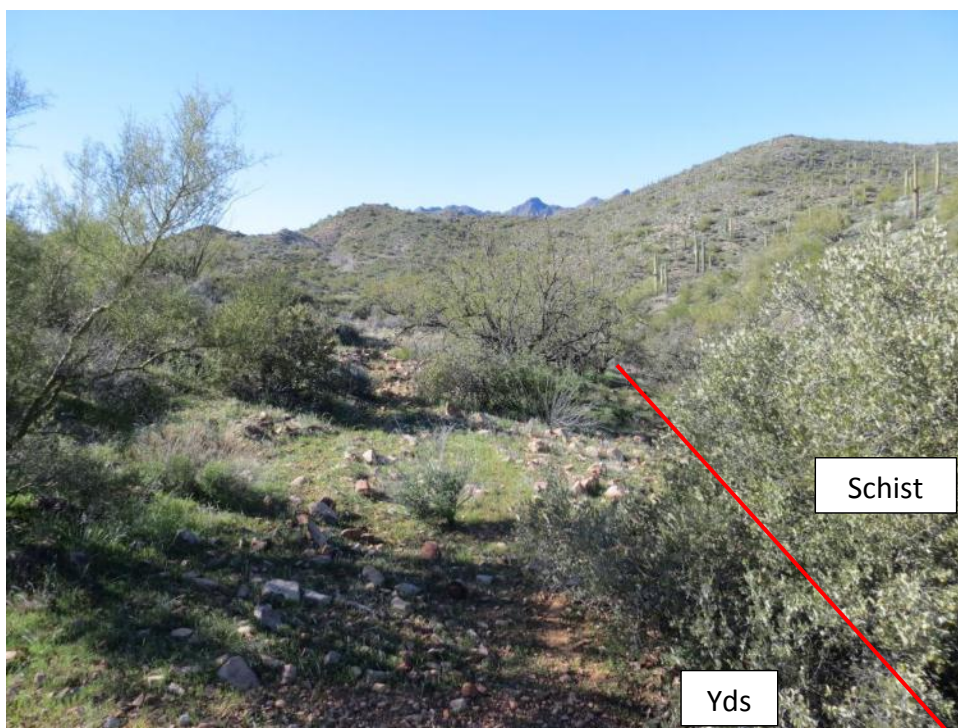
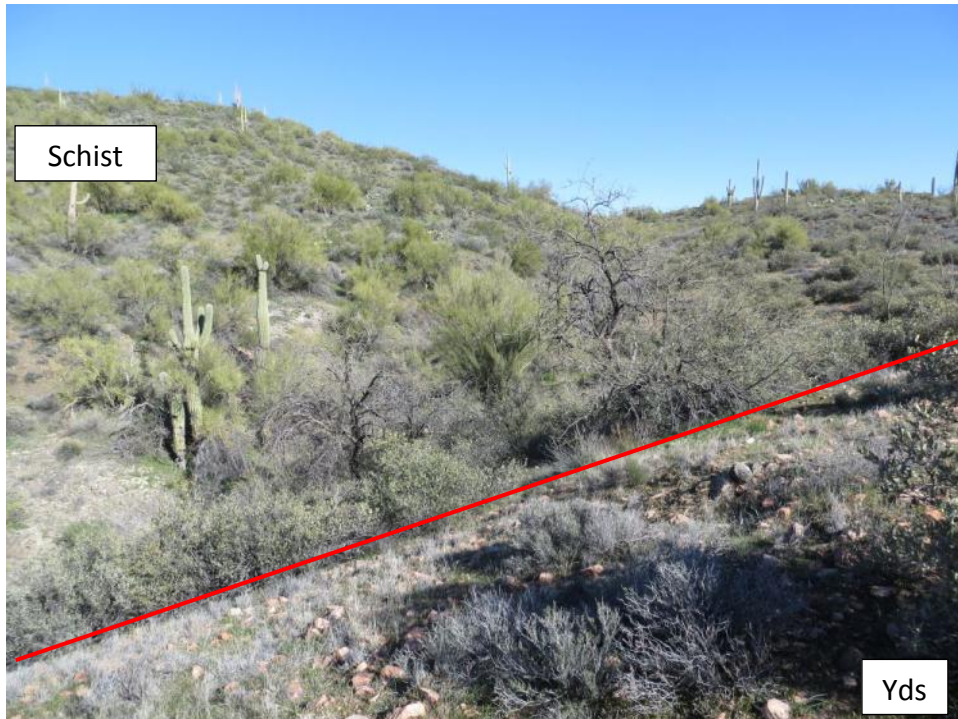
Yds fresh, R4 (breaks preferentially along bedding planes), red, white and grey fine grained quartz beds (rock is quartz arenite, not quartzite), bedding at mm scale.





## Yds2

Contact between dripping springs quartzite and schist. Two units separated by gully depression filled with cobbles and boulders.





### Yds3

Bedded quartz arenite, fresh, R5, fractures along bedding planes with other fractures cross cutting bedding planes, one joint set running parallel with the face of the outcrop, joints spaced 2 cm to 30 cm (*0.79 inches to 11.81 inches*) apart, 0.5 cm (*0.20 inches*) (max.) joint aperture to closed, planar joint surfaces with rough “grainy” surface texture.

Orientation of joint set: **155/54**









#### Yds4

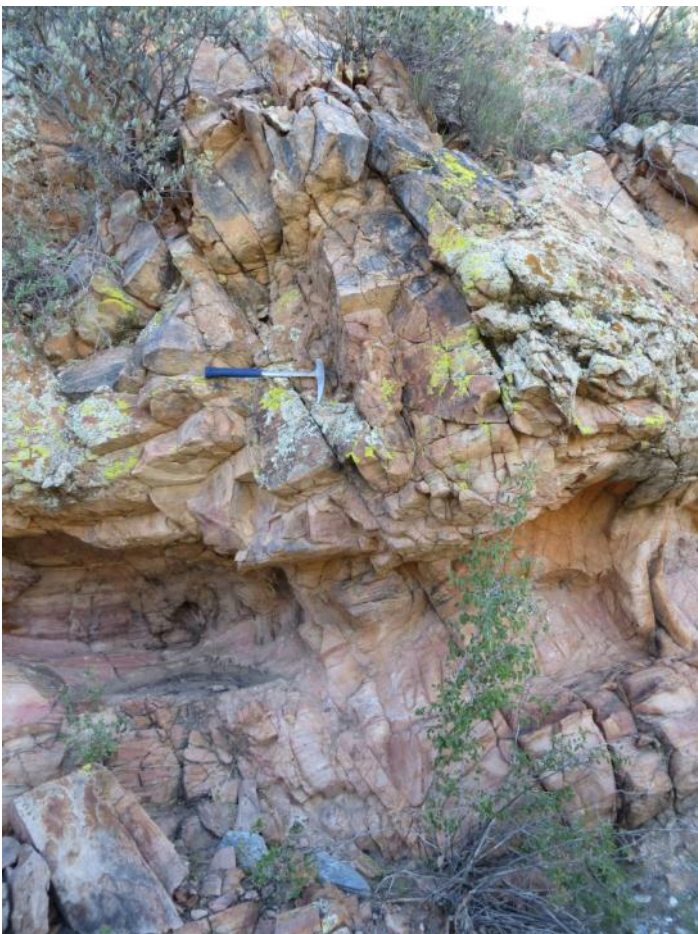
Heavily jointed/blocky quartz arenite. Eroded overhang 1.5 m (4.9 ft) above channel invert. Two dominant joint sets:

Orientation of Joint Set #1: **048/39**

Orientation of Joint Set #2: **160/50**









### CONTACT1

Point of contact between dripping springs quartzite and poorly welded tuff (Tt). Layered tuff outcrop just downstream of observation point





### REBELTANK

Well installation location in elevated bar of undivided surficial sediments (Qs). Gila conglomerate outcrops on channel banks directly adjacent to the windmill. Tuff exposed just upstream of the Gila.





**Tt5**

Dipping tuff layer exposed in creek invert just upstream of REBELTANK.

Orientation of dipping tuff layer: **126/20**





## CONTACT2

Line of contact between poorly welded tuff (Tt) and dripping springs quartzite (Yds). Quartzite appears to be “diving below” the tuff. Layer of brecciated tuff with Yds clasts at the bottom of the tuff exposure.









### Yp1

Outcrop of Pioneer shale with strong parallel fracturing parallel to bedding planes, fractures <1 mm to 20 cm (<0.04 inches to 7.9 inches) apart, smooth planar surfaces, darker coloured beds are weaker and very fine grained (shale), lighter coloured beds are fine grained quartz arenite.

Orientation of bedding: **049/44**





Yp2

As Yp1. Orientation of bedding/fracturing: **047/36**



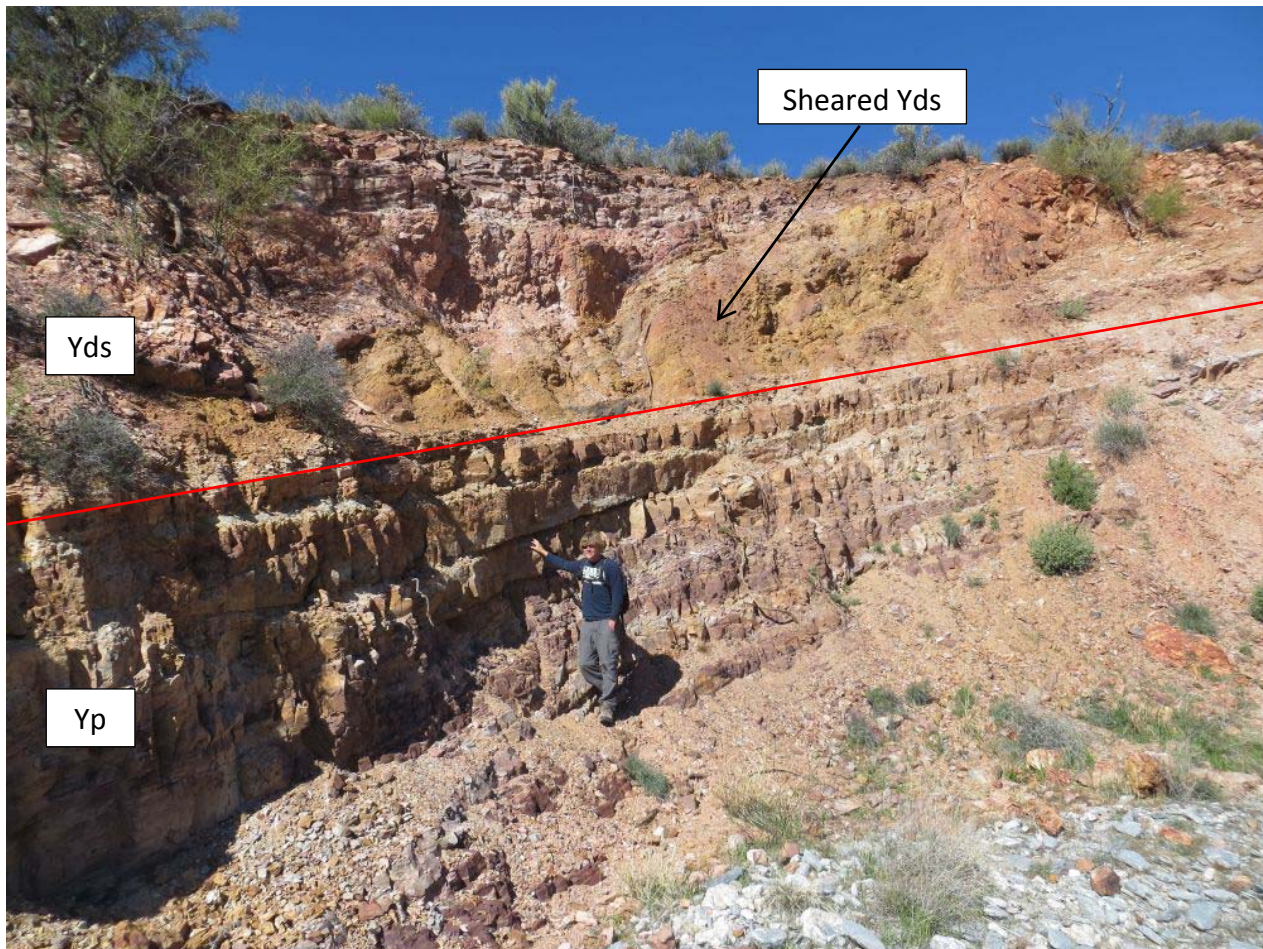


### Yds5

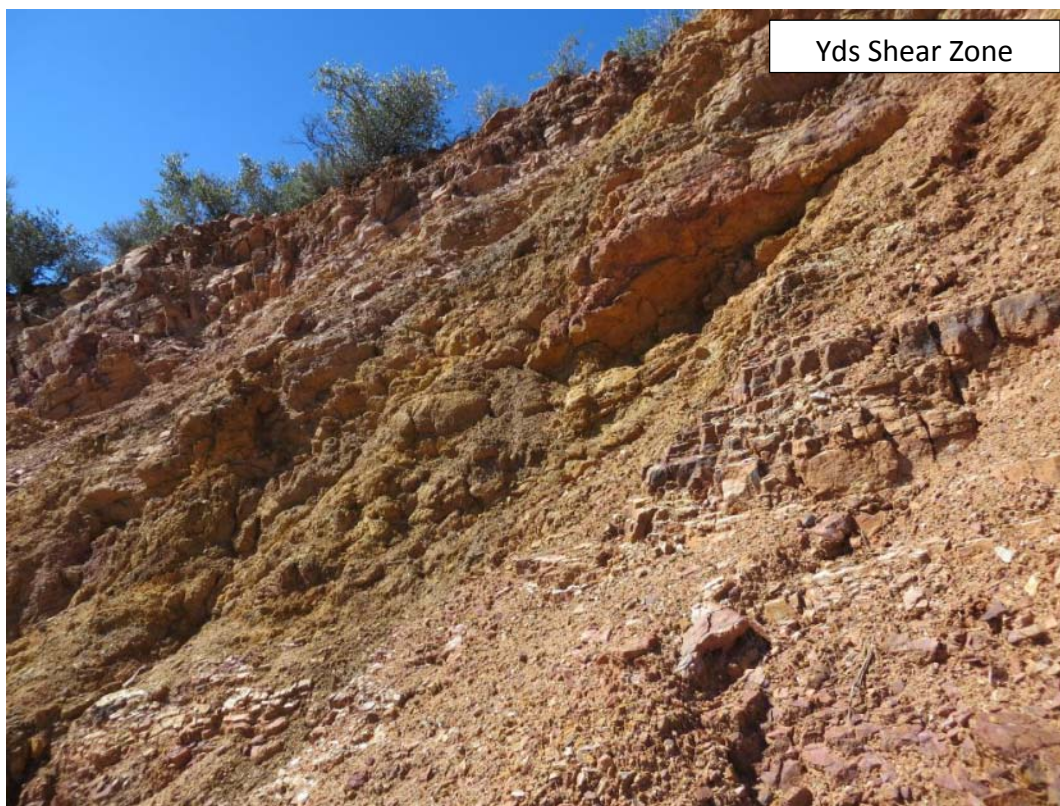
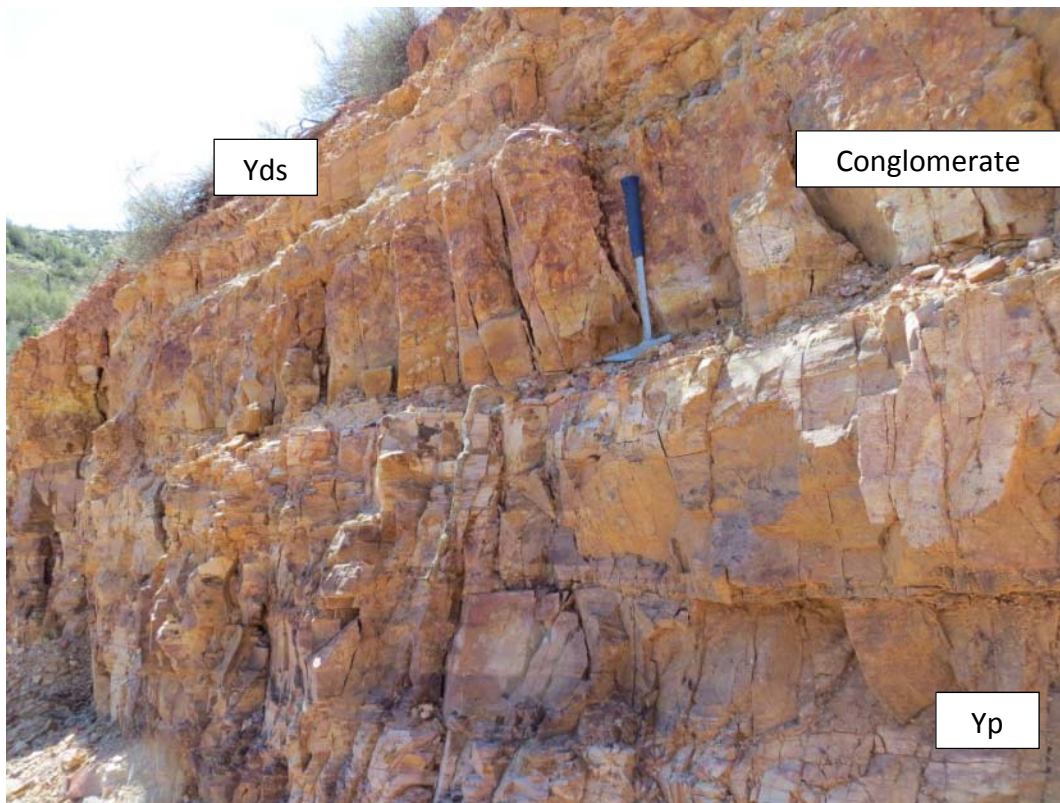
Vertical contact between Pioneer Shale (Yp) and Dripping Springs Quartzite (Yds) shown in large exposure. Two units separated by ~ 70 cm (27.6 inches) of Barne's Conglomerate (marker unit, rounded gravel sized quartzite clasts in fine grained quartz sand matrix).

Fracture zone cutting through the Yds unit. Yp below the conglomerate appears undisturbed. Fractured material contains clay.

Orientation of Yp beds: **035/13**









Xps1

Schist, fresh, R4, two dominant joint sets/foliation cleavage orientations, variable spacing (30 cm (11.8 inches) to mm scale), max. 10 mm (0.4 inches) aperture to closed, silt or calcite (reactive) infilling, smooth planar surfaces

Orientation of Joint Set #1: **(022/65)**

Orientation of Joint Set #2: **(090/57)**

Shear zone cutting vertically up through exposure filled with fractured schist. Rock exposed on either side of shear zone is fresh. Strong parallel cleavage foliation with < 1 mm (0.04 inches) spacing observed in rock on right side of shear zone.

Orientation of foliation cleavage in rock on right side of shear zone: **065/63**

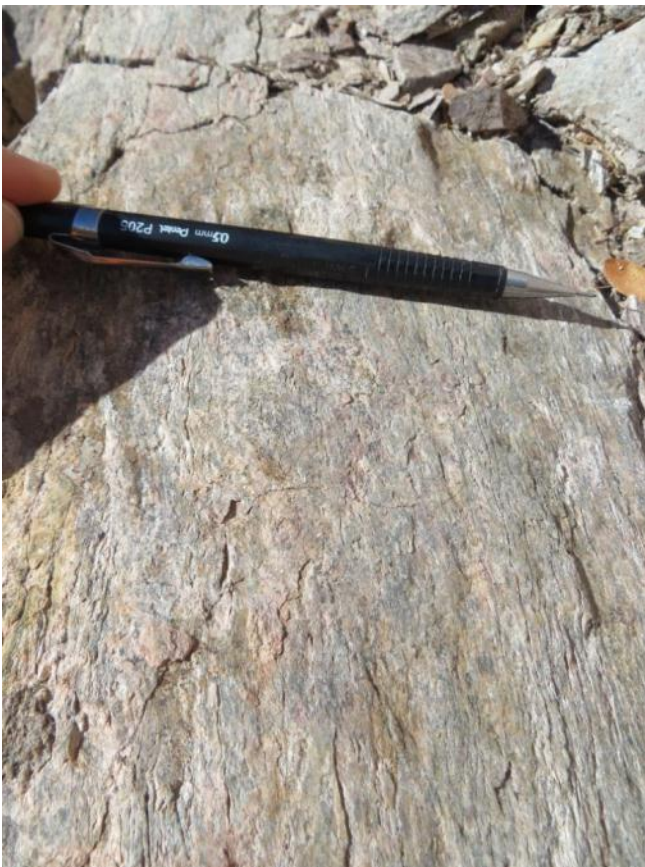
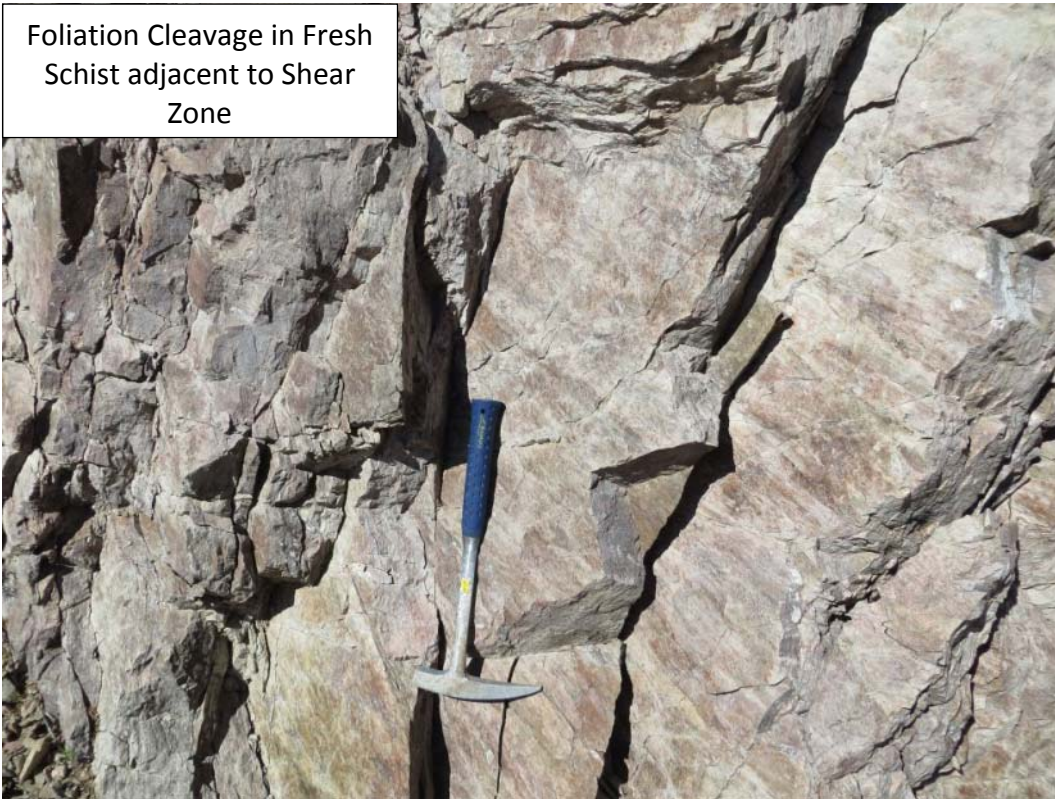








Foliation Cleavage in Fresh  
Schist adjacent to Shear  
Zone





### Xpc1

Small outcrop of Xpc facies schist. Very similar in structure to typical Xpm shale. Fresh, R4, strong foliation cleavage spaced in mm scale with some evidence of folding, some quartz veining and infilling, cleavage planes are undulating with smooth, shiny surfaces.

Foliation cleavage orientation      **077/61**





Yds6

(stated as Yds8 in the panorama video)

Boulders of Yds quartz arenite at surface. R5 to R6. See panorama photos and video.





### Yp3

Exposure of Pioneer Shale in channel invert below the Yds unit. Fresh, R4 to R5, bedded, some parallel fractures perpendicular to bedding orientation, average fracture spacing 5 cm to 10 cm (*1.97 inches to 3.94 inches*), closed to max. aperture of 1 mm (*0.04 inches*), no infilling or silty sand infilling with some grass growth, smooth planar surfaces.





Yd1

Typical surface exposure of diabase. Flat lying area without outcrops visible, only oxidized (rust coloured) gravel sized particles of diabase at surface.





## Yd2

Disintegrated (extremely fractured) diabase exposed along small wash with limestone above. Rock strength R3 (breaks along fractures), one exposure in wash showing two sets of tightly spaced (~ 3 cm (*1.18 inches*)) perpendicular fractures, closed with some fractures calcite infilled, calcite crystals on the exposed diabase surface.



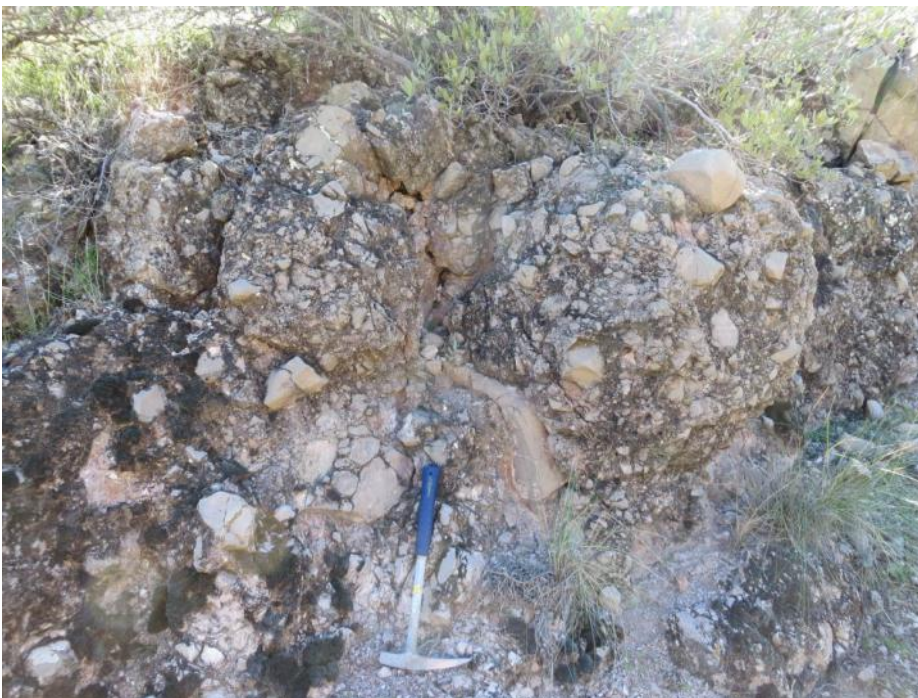






### Dm1

Limestone conglomerate exposure on left side of steep ravine. Fresh, R4 (strength of massive, fine grained intact blocks) to R3 (strength of conglomerate), gravel to cobble fine grained fossiliferous limestone clasts in fine grained calcareous matrix, massive with randomly oriented joints (largest aperture = 3 cm (1.18 inches)) and void space, calcite crystals forming along some areas of the outcrop in void space





Dm2

Fresh, R4, light grey very fine limestone (calcareous siltstone?), massive with randomly oriented fractures, pitting on surface





### Dm3

Fresh, R3, fine to medium grained fossiliferous calcareous sandstone, bedded, some joints spaced 2 cm to 10 cm (*0.79 inches to 3.94 inches*) apart, closed near the ground surface but open up at the surface of the outcrop, rough planar surfaces.

Orientation of beds: **103/32**





**Cb1**

Bolsa quartzite cobbles and boulders at surface. Slightly weathered (rusty oxidized surfaces), R5, bedded well graded quartz arenite, preferentially breaks along bedding planes.





## Cb2

Weathered (jagged and massive) exposure of Bolsa quartzite. R5, quartzite, some areas of exposure appear to be brecciated with angular pieces of quartzite in siliceous fine grained matrix.





### Tt6

Tuff, 1.2 m (3.9 ft) of harder pink tuff (R3) underlying ~0.6 m (~2.0 ft) of white, weaker (R2) and lower density tuff, random fracture orientation, fractures closed just below surface of outcrop, rough, planar fracture surfaces.





#### Dm4

Fresh limestone, R5 (coarse sandy beds) to R3 (finer siltstone beds), interbedded calcareous sandstone and siltstone, bed thickness ranges from cm scale to metres thick, wide openings between interbedded units appear to be caused by differential erosion of the finer beds.

Orientation of dominant bedding planes in the outcrop: **055/20**

Orientation of dominant bedding planes in channel invert: **065/12**





### Me1

Fresh limestone, R5, massive, light grey fine grained calcareous siltstone(?), many discontinuous and randomly oriented fractures, pitted surface, calcite infilling in the wider fractures.





### Dm5

Exposure of limestone in small wash invert. R4 to R5, randomly oriented fractures all filled with calcite, fracture aperture ranging from closed to ~ 2 cm (0.79 inches) but all well healed with calcite.

Orientation of limestone beds in channel bank:

061/21





## **APPENDIX III-B**

### **West Mixed Geology Area**

---



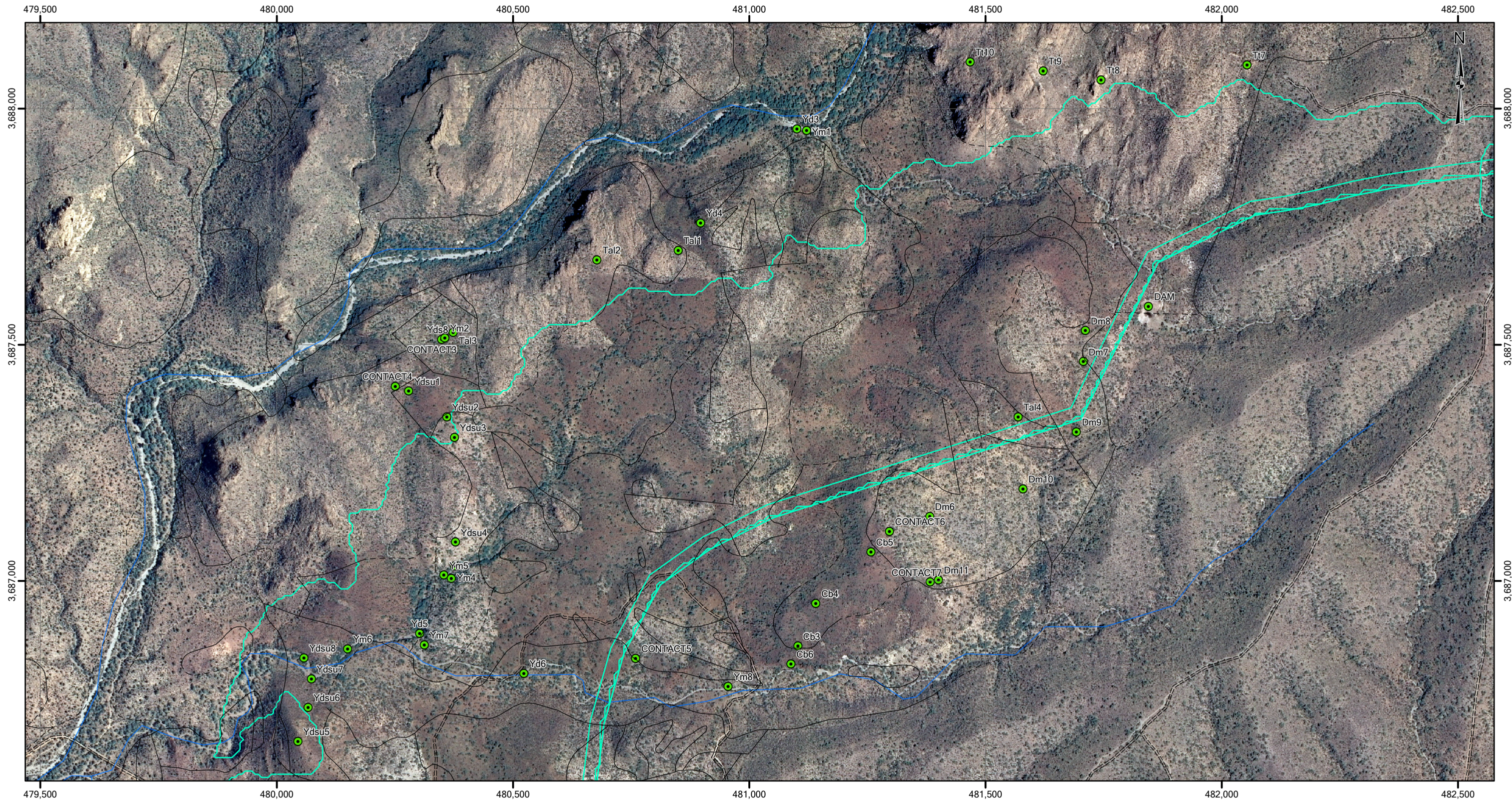
## BEDROCK GEOLOGY OBSERVATIONS – WEST MIXED GEOLOGY AREA

Observation Station	Coordinates <sup>1</sup>	
	Easting (m)	Northing (m)
Tt7	482055	3688089
Tt8	481746	3688057
Tt9	481623	3688076
Tt10	481469	3688095
Ym1	481123	3687950
Yd3	481103	3687954
Yd4	480899	3687755
Tal1	480851	3687697
Tal2	480679	3687676
Tal3	480375	3687522
Ym2	480357	3687511
CONTACT3	480357	3687511
Yds8	480351	3687508
Ydsu1	480281	3687398
CONTACT4	480252	3687409
Ydsu2	480361	3687343
Ydsu3	480377	3687300
Ydsu4	480380	3687079
Ym3	480378	3687028
Ym4	480371	3687002
Ym5	480355	3687009
Ydsu5	480046	3686657
Ydsu6	480068	3686729
Ydsu7	480075	3686789
Ydsu8	480059	3686834
Ym6	480151	3686853
Yd5	480303	3686886
Ym7	480314	3686861
Yd6	480525	3686801
CONTACT5	480761	3686833
Cb3	481104	3686858
Cb4	481142	3686948
Cb5	481259	3687058
CONTACT6	481299	3687102
Dm6	481384	3687134
Tal4	481571	3687343
Dm7	481709	3687461
Dm8	481713	3687526
DAM	481847	3687578
Dm9	481694	3687312
Dm10	481581	3687191
Dm11	481402	3686999
CONTACT7	481384	3686994
Cb6	481090	3686820
Ym8	480957	3686773

1 – Coordinates measured with handheld GPS unit. Coordinate system: UTM NAD27 CONUS



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LEGEND

- |                         |                        |                                                                                                                                 |
|-------------------------|------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| OBSERVATION POINT       | ROAD (FROM RESOLUTION) | CONTACT (BETWEEN GEOLOGIC UNITS)                                                                                                |
| NEAR WEST TAILINGS SITE | ROAD (FROM STATE)      | CONTACT - APPROXIMATE                                                                                                           |
| HAPPY CAMP OPTION       | STREAM                 | CONTACT - INFERRED                                                                                                              |
|                         |                        | CONTACT BETWEEN PINAL SCHIST<br>CLAST-RICH CONGLOMERATE BELOW<br>AND DRIPPING SPRING QUARTZITE<br>CLAST-RICH CONGLOMERATE ABOVE |

Notes:  
1. NAD27 UTM12  
2. Orthophoto from USDA

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PROJECT RESOLUTION PROJECT 2013 NEAR WEST SITE INVESTIGATION	
TITLE BEDROCK GEOLOGY OBSERVATIONS WEST MIXED GEOLOGY AREA	
PROJECT No. M09441A14	FIG No. III-B.1







### Tt7

Large tuff exposure near Tt and Tcg (Gila conglomerate) contact. Massive with no joints visible, fresh, R3, white very fine felsic matrix with biotite grains visible.



"Tt"  
Texture





### Tt8

Large tuff exposure, fresh, R4, massive with some randomly oriented fractures, calcite infilling of some thin (<1 mm (*0.04 inches*) aperture) fractures, white very fine felsic matrix with biotite grains visible.





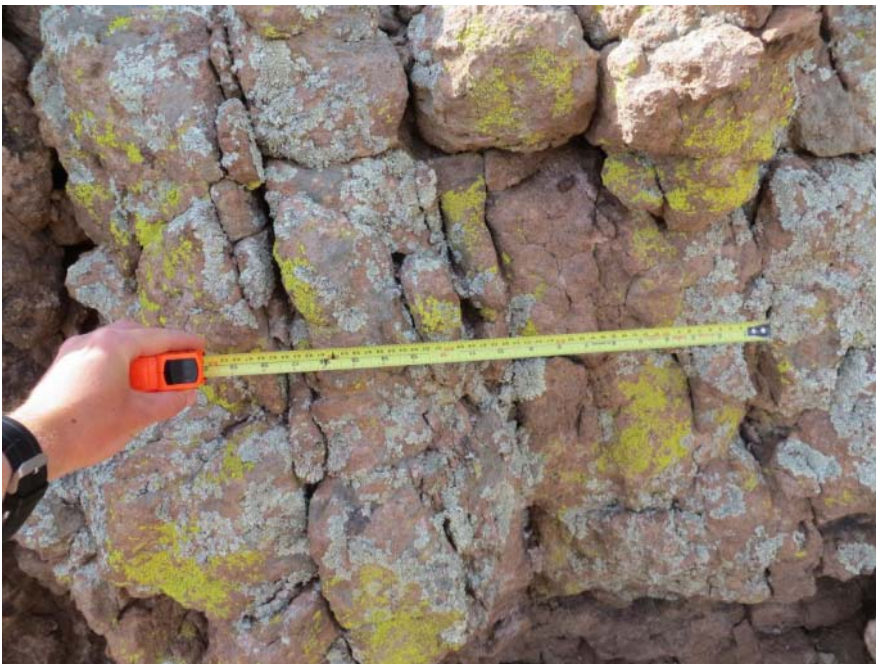




**Tt9**

2 m (6.6 ft) high exposure of tuff, R4, parallel vertical joints spaced ~ 40 cm (15.7 inches) apart. Some more tightly spaced joints on sub-horizontal tuff exposure below, spaced 5 cm (2.0 inches) below. Joints can be wide open on the exposure surface but close off quickly, rough and stepped joint surfaces.

Orientation of joint set: **040/90**





### Tt10

Tuff, fresh, R4, parallel vertical joints with avg. spacing of ~30 cm (*11.8 inches*), closed to moderately wide aperture (max. 5 mm (*0.2 inches*)) but appear to close off below the outcrop surface, rough and stepped joint surfaces. Second set of flatly dipping joints with 40 cm (*15.7 inches*) spacing and closed just below surface.

Orientation of joint set: **031/90**





### Ym1

Mescal Limestone overtop of Dripping Springs Quartzite (Yds) in channel bank.

Ym – Calcareous shale, laminated, R1 (powdery, laminations can be pulled apart and crushed by hand), weakest along bedding laminations, numerous other tightly spaced fractures cross cutting laminations.

Yds – Conglomerate with rounded quartzite particles in fine grained siliceous matrix, R5, numerous randomly oriented fractures with aperture up to 2 cm (*0.79 inches*), all fractures infilled and well healed with calcite.

Orientation of Ym laminations: **309/16**

Orientation of Yds bed in channel invert: **279/23**





Laminated Calcareous Silt



Quartzite Conglomerate

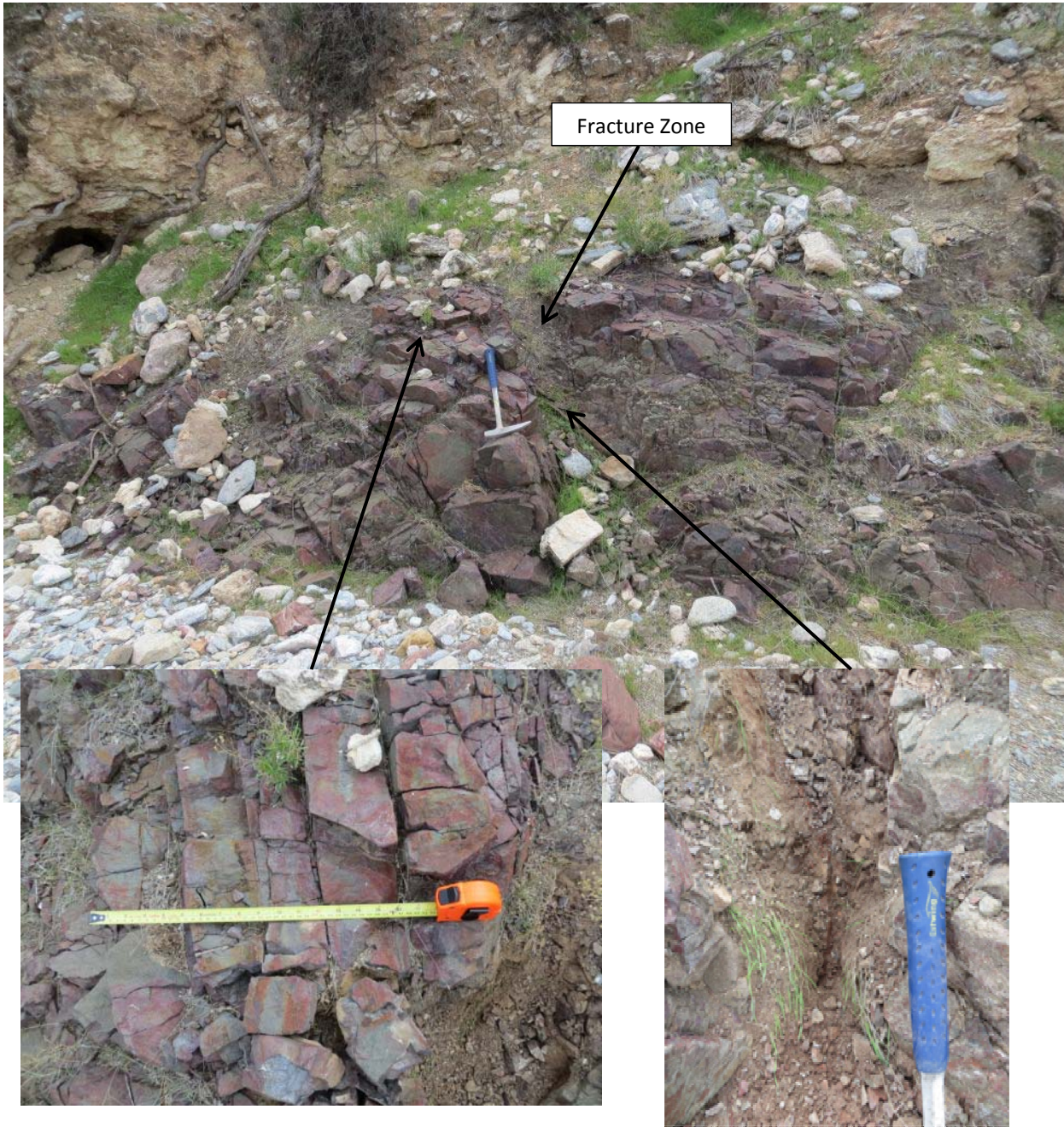




### Yd3

Small exposure of diabase adjacent to Ym in channel bank. Fresh, R5, blocky with numerous joints, joints spaced 1 - 10 cm (*0.04 to 3.94 inches*) apart in more intact areas of the outcrop, joints appear to be closed (when the loose blocks at surface are removed), smooth planar joint surfaces.

40 cm (*15.75 inches*) wide fracture/shear zone cutting vertically through outcrop, highly fractured diabase and clayey sand in fracture zone.





Yd4

Diabase and Mescal Limestone cobbles exposed at surface. Some very small diabase outcrops at surface.





### Tal1

Exposure of Apache Leap Tuff near the contact with Yd. Fresh, R4, very fine grained felsic rock, some steeply dipping parallel joints with spacing ranging from 5 to 25 cm (*1.97 to 9.74 inches*), aperture closed to very wide (max. 5cm (*1.97 inches*)), quartz infilling of larger joints, stepped and rough joint surfaces





## Tal2

Fresh, R5, fine grained felsic matrix with some visible quartz/biotite/feldspar crystals, parallel joints with range of spacing from 0.5 cm (*0.20 inches*) up to 30 cm (*11.81 inches*), joint aperture closed to moderately wide (max. 5 mm (*0.20 inches*)), joint faces undulating to stepped and rough.

Orientation of joint set: **190/81**



"Tal" Texture





### Tal3

Tuff with open voids in surface outcropped near bottom of gully just uphill of the diabase and Mescal Limestone. Voids in surface are elliptical and can be as wide as 10 cm (*3.94 inches*), voids penetrate <5 cm (*1.97 inches*) into unit. Rock strength and behavior same as other Tal (R5) with no visible joint sets.





Ym2

Outcrops of Mescal Limestone exposed directly below diabase and Apache Leap Tuff (see Tal3).

Orientation of bedding: **202/26**





### CONTACT3

Point of contact in gully between Apache Leap Tuff (Tal), diabase (Yd) and Mescal Limestone (Ym).





### Yds8

Outcrop of hard (R5) very fine grained quartz arenite, joint structures not visible in small outcrop, randomly oriented fractures fill with calcite, reactive to acid. May be coarse component of the Mescal Limestone, not dripping springs quartzite.





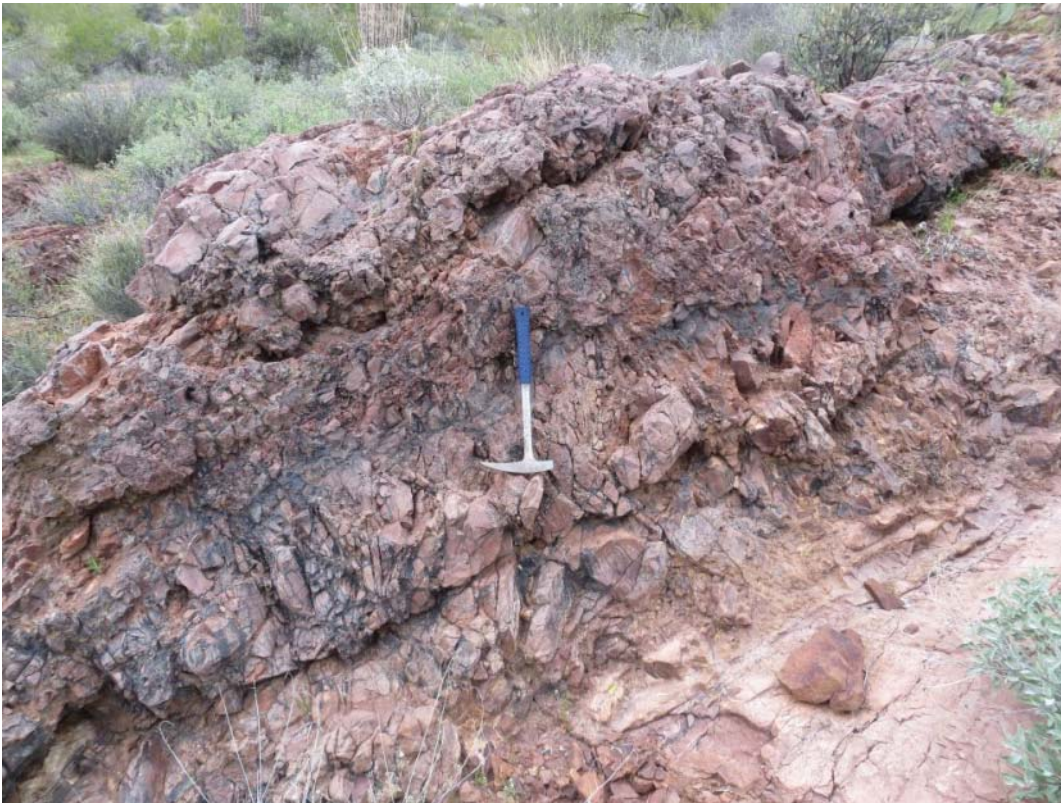
**Ydsu1**

Slightly weathered (oxidized/rust colored surfaces), R5, fine grained quartz arenite or quartzite, very blocky/heavily fractured rock mass, rock breaks along oxidized pre-existing fracture planes, some “clasts” of finely bedded quartz arenite cobbles. Fault Breccia(?)

Orientation of dipping layer: **181/24**









#### CONTACT 4

Contact between Apache Leap Tuff (Tal) and Dripping Springs Quartzite (Upper) (Ydsu). Dark red breccia(?) (similar to rock observed at **Ydsu1**) outcrops along line of contact.

#### Ydsu2

Transition from red, oxidized brecciated Ydsu into white Ydsu.



### Ydsu3

Cobbles of Dripping Springs Quartzite (Upper) on top of hill. Cobbles slightly weathered, R4, laminated (5 mm (0.20 inches)) siltstone/sandy siltstone with some hard siliceous beds, breaks preferentially along laminations.





#### Ydsu4

Ydsu outcrop below tuff (Tal) bluff, R4 to R5, very thin laminations visible (mm scale), fine grained quartz rich siltstone or quartzite laminations, fractures preferentially along bedding laminations, exposed laminations planar and smooth, some open joints but no joint sets identified.

Orientation of laminations: **000/21**





### Ym3

Small outcrop of calcareous siltstone in bank of small wash at foot of Ydsu hill, R3, preferentially fractures along very thin (<0.5 mm (*0.02 inches*)) planar laminations, strong reaction to acid.

Orientation of laminations: **336/22**





Ym4

Fresh, fine grained light grey beds of calcareous siltstone interbedded with calcareous shale (?), siltstone beds are dark grey, R3 to R4. Shale beds are laminated, white, powdery and very weak (breaks apart in hands). Differential weathering of shaley beds between the more competent dark grey siltstone resulting in large “blocks” in outcrop.

Orientation of bedding: **028/24**









### Ym5

Very weak, white, powdery laminated material interbedded with harder (R3 to R4) dark grey calcareous siltstone, some vertical joints perpendicular to bedding planes, closed to moderately wide aperture (max. 5 mm (0.20 inches)), silty sand infilling, smooth and planar joint surfaces, differential weathering of white powdery beds.

Orientation of bedding: **001/36**





Ydsu5

Cobbles of Ydsu exposed on top of hill. Laminated (mm scale) fine grained quartz arenite, oxidized surfaces, R5.





Ydsu6

Brecciated dripping springs quartzite. Oxidized (rusty colored), R5, clasts of laminated quartz arenite in fine siliceous matrix, rock fractures preferentially around arenite clasts.





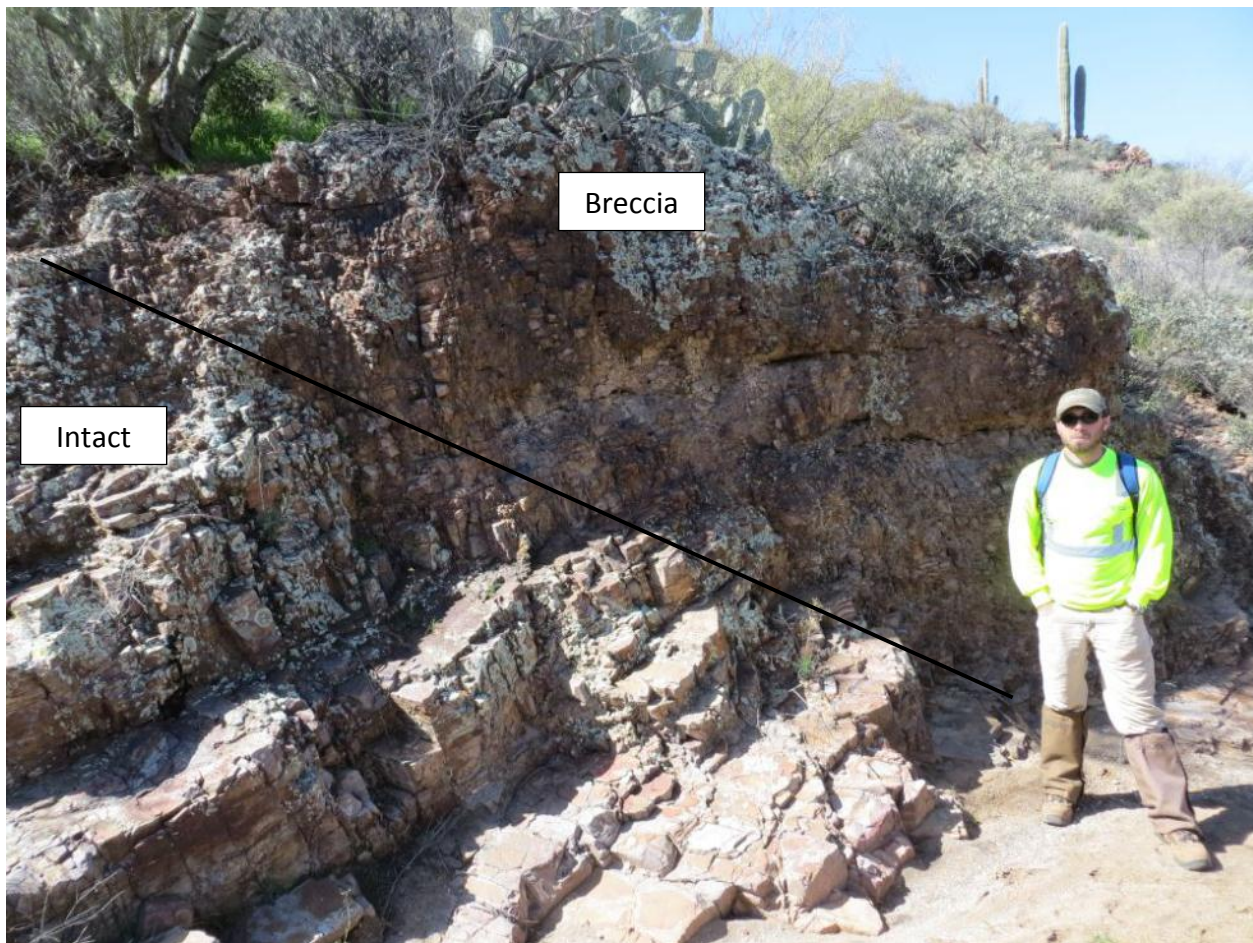
### Ydsu7

Intact and brecciated Ydsu exposed in channel bank.

Intact Portion: Fresh to slightly weathered (oxidized), R5, fine grained laminated quartz arenite or quartzite, preferentially fractures along bedding planes with other fractures cutting perpendicular and obliquely to bedding planes, fractures closed to open with open fractures being well healed with calcite.

Orientation of bedding: **003/26**

Brecciated Portion: R5, breaks around clasts, angular clasts of laminated quartz arenite in siliceous matrix, carbonate cement present on some exposed surfaces and around some clasts, one open discontinuous sub-horizontal void in the exposure face.









**Ydsu8**

Exposure of intact Ydsu with overlaid by breccia. Similar to Ydsu7 but on the opposite bank of the creek.

Orientation of bedding: **013/22**





### Ym6

Exposure of limestone in channel banks and invert. Fresh, R5, light grey to pink finely laminated calcareous siltstone, “whispy” laminations < 1mm (*0.04 inches*) thick, large separated blocks in outcrop, two orthogonal joint sets with joints typically spaced 10 – 30 cm (*3.94 – 11.81 inches*) apart, closed to moderately wide aperture (max. 5 mm (*0.20 inches*)), calcite or silty sand infilling.

Orientation of bedding laminations: **001/20**

Orientation of Joint Set #1: **269/90**

Orientation of Joint Set #2: **015/90**









### Yd5

Diabase outcrop in channel bank and invert. Oxidized surfaces, R5 to R6, blocky with numerous tightly spaced (2 – 3 cm (*0.79 – 1.18 inches*) avg.) parallel joints (Set #1), closed. Another flatly dipping joint set (Set #2) identified with wider spacing (10 – 15 cm (*3.94 – 5.91 inches*), closed, only visible in two locations.

Orientation of Joint Set #1: **200/71**

Orientation of Joint Set #2: **052/26**





Ym7

Folded sub-vertical limestone beds near diabase exposure.





Yd6

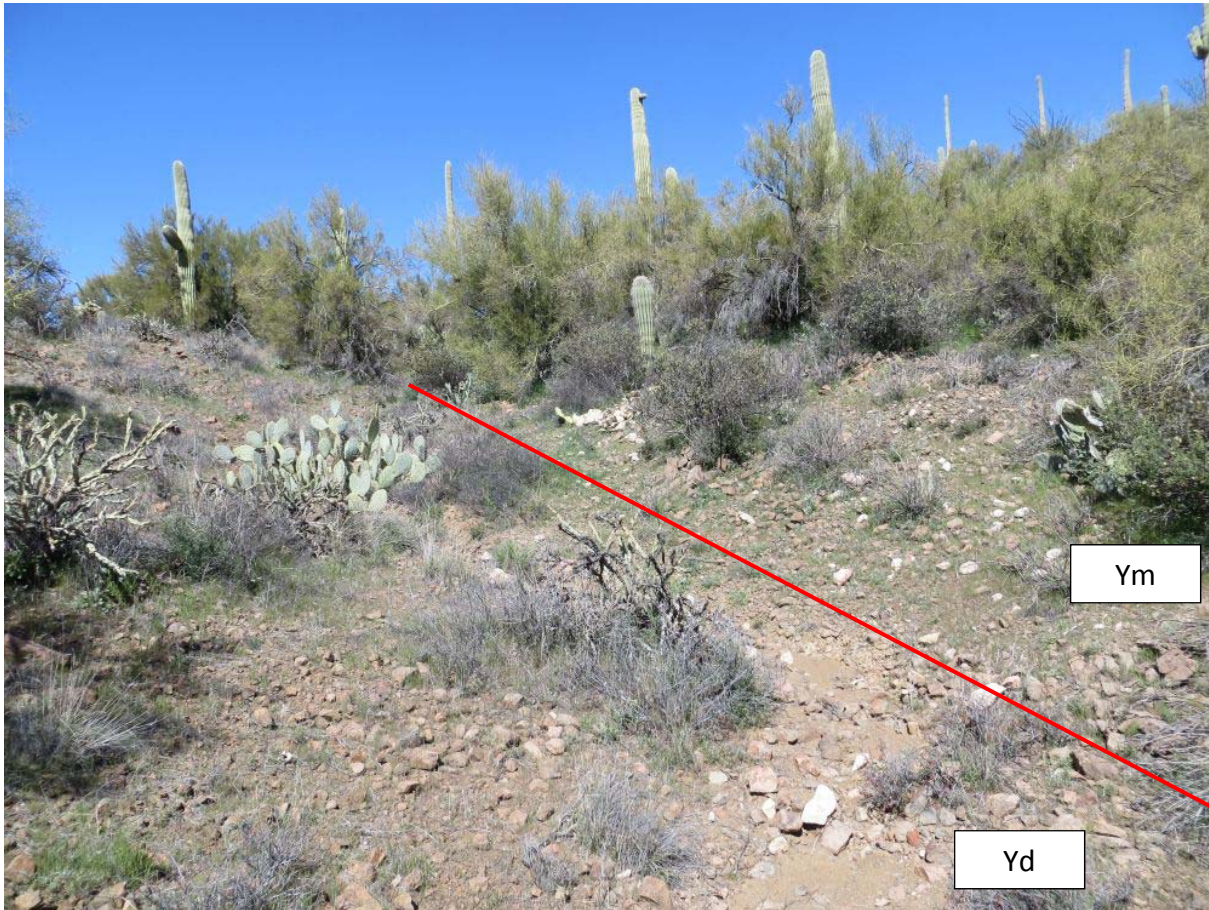
Heavily fractured diabase exposed in channel invert. Calcite infilling of some fractures.





## CONTACTS

Contact between diorite (Yd) and Mescal Limestone (Ym) in small depression.





### Cb3

Bolsa Quartzite boulders and cobbles exposed on hill slope surface. Fresh, reddish purple, R6, well graded quartz sandstone (arenite) with cross bedding and parallel bedding.





**Cb4**

Massive outcrop of Bolsa Quartzite on top of hill. Fresh, R6, separated blocks of well graded bedded quartz arenite.





Cb5

Quartz grains in Cb cobbles and boulders exposed at surface getting finer moving uphill. Parallel laminations of fine grained quartz sand instead of well graded sand with cross bedding. R6.





### CONTACT6

Contact near top of hill between Martin Limestone (Dm) and Bolsa Quartzite (Cb). No gullies or topographic depressions noted along line of contact.





### Dm6

Small outcrop of Martin limestone on top of hill. Fresh, R4 to R5, massive grey calcareous siltstone with randomly oriented fractures well healed with calcite.

Outcrop of limestone conglomerate as well with blocks of grey calcareous siltstone in fine carbonate matrix. Both rock types display “pitted” surface texture.





#### Tal4

Massive tuff outcrop exposed in small gully between Cb and Dm. Fresh, R5, massive, fine grained white felsic matric with quartz/feldspar/biotite grains.





**Dm7**

Fresh, R5, light grey calcareous siltstone, dipping beds with pitted surface texture, some circular “growths” of calcite crystals.

Orientation of bedding: **076/33**





**Dm8**

Sub-horizontal exposure of greyish white calcareous siltstone in small wash near the Cb contact. Fresh, R3 to R4, numerous fractures on surface but are closed or well healed with calcite, one fracture tightly filled with brecciated limestone.

Orientation of bedding (flat surface exposed in channel bank)

**302/04**





### DAM

Embankment made of carbonate rich sand blocking the end of a small drainage. No standing water in impounded area.





### Dm9

Outcrop of very weak (R1) very fine grained white silty/powdery limestone but more likely cemented overbank deposits since material directly below contains sub-rounded clasts of Cb and is likely old alluvium.





**Dm10**

Brecciated limestone outcrop. Fresh, R5, clast size ranges from large (1m) intact massive boulders of calcareous siltstone to sand size, carbonate cement, many voids in exposure face.





**Dm11**

Small bedded limestone exposure on hill slope amongst limestone cobbles and boulders.

Orientation of bedding: **095/17**





### CONTACT7

Contact between Dm and Cb along small depression. Brecciated limestone (R5) on one side of contact line and brecciated quartzite (Cb) (R5 to R6) on the other. Cobbles and gravel of both units in depression invert.

Strike of line of contact: **009**



Brecciated Limestone



Brecciated Quartzite



### Cb6

Oxidized, R3 to R4 (fractures along pre-existing (?) oxidized planes), interbedded fine to coarse grained quartz arenite, bed thickness ranges from mm scale laminations up to ~ 8 cm (*3.15 inches*) beds, fractures cutting perpendicular to bedding planes, fracture aperture not measurable in blocky exposure.

Orientation of bedding: **184/26**







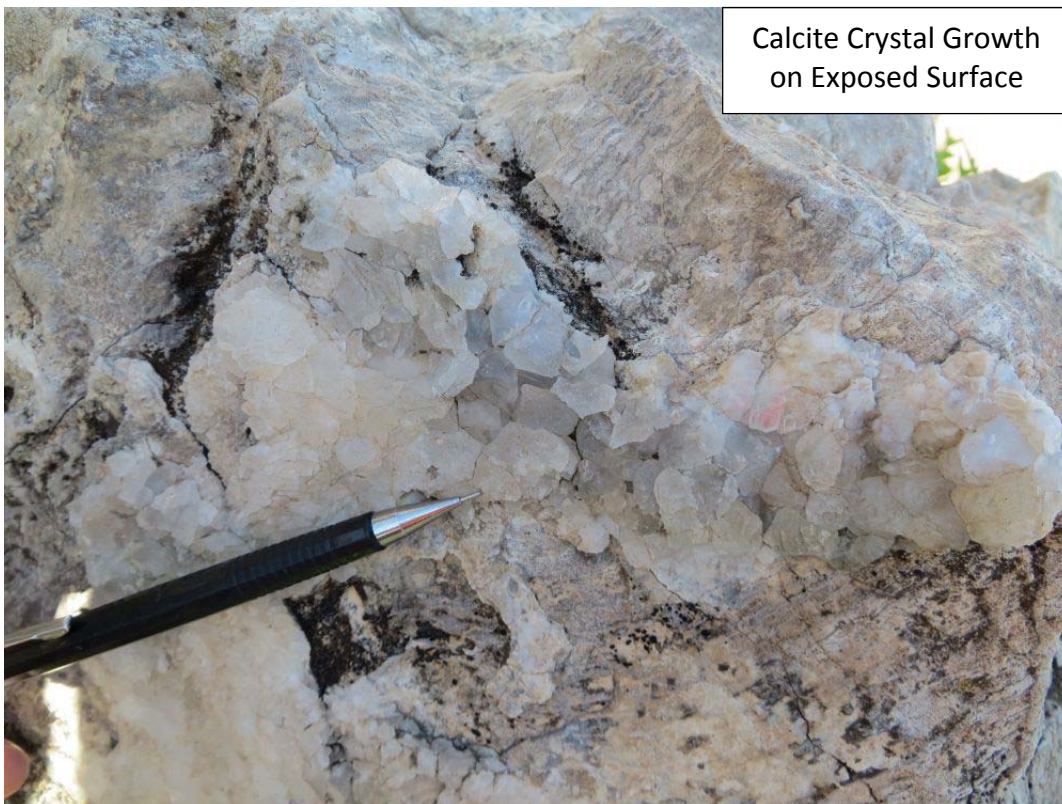


### Ym8

2 m (6.6 ft) high exposure of jointed limestone. Fresh, R5, very fine grained calcareous siltstone, sub-vertical jointing, blocks out turned and not possible to estimate joint spacing or aperture, smooth and planar joint surfaces on overturned blocks, large calcite crystals forming on exposed block faces.







Calcite Crystal Growth  
on Exposed Surface



## APPENDIX III-C

### Perlite Area

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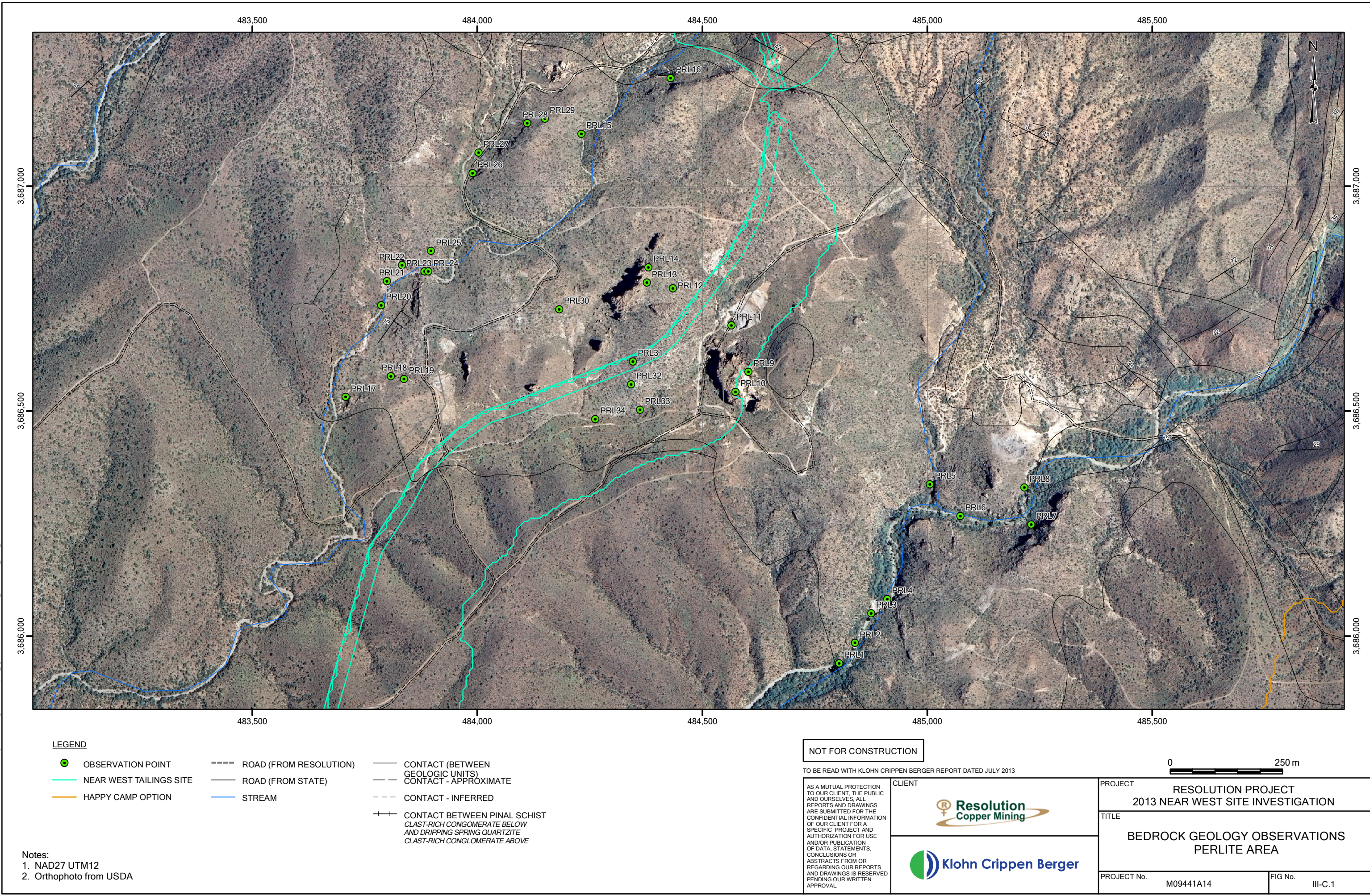
## BEDROCK GEOLOGY OBSERVATIONS – PERLITE AREA

Observation Station	Coordinates <sup>1</sup>	
	Easting (m)	Northing (m)
PRL1	484806	3685936
PRL2	484841	3685981
PRL3	484877	3686047
PRL4	484913	3686079
PRL5	485008	3686334
PRL6	485075	3686263
PRL7	485233	3686245
PRL8	485217	3686326
PRL9	484604	3686584
PRL10	484575	3686539
PRL11	484567	3686687
PRL12	484436	3686770
PRL13	484378	3686782
PRL14	484382	3686816
PRL15	484233	3687113
PRL16	484432	3687237
PRL17	483709	3686528
PRL18	483810	3686574
PRL19	483838	3686568
PRL20	483788	3686732
PRL21	483801	3686786
PRL22	483834	3686820
PRL23	483885	3686806
PRL24	483893	3686807
PRL25	483899	3686852
PRL26	483991	3687025
PRL27	484004	3687071
PRL28	484112	3687136
PRL29	484152	3687147
PRL30	484183	3686723
PRL31	484347	3686607
PRL32	484344	3686556
PRL33	484363	3686499
PRL34	484264	3686479

1 – Coordinates measured with handheld GPS unit. Coordinate system: UTM NAD27 CONUS



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LEGEND

- |                         |                        |                                                                                                                                 |
|-------------------------|------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| OBSERVATION POINT       | ROAD (FROM RESOLUTION) | CONTACT (BETWEEN GEOLOGIC UNITS)                                                                                                |
| NEAR WEST TAILINGS SITE | ROAD (FROM STATE)      | CONTACT - APPROXIMATE                                                                                                           |
| HAPPY CAMP OPTION       | STREAM                 | CONTACT - INFERRED                                                                                                              |
|                         |                        | CONTACT BETWEEN PINAL SCHIST<br>CLAST-RICH CONGLOMERATE BELOW<br>AND DRIPPING SPRING QUARTZITE<br>CLAST-RICH CONGLOMERATE ABOVE |

Notes:  
1. NAD27 UTM12  
2. Orthophoto from USDA

NOT FOR CONSTRUCTION

TO BE READ WITH KLOHN CRIPPEN BERGER REPORT DATED JULY 2013

AS A MUTUAL PROTECTION TO OUR CLIENT, THE PUBLIC AND OURSELVES, ALL REPORTS AND DRAWINGS ARE SUBMITTED FOR THE CONFIDENTIAL INFORMATION OF OUR CLIENT FOR A SPECIFIC PROJECT AND AUTHORIZATION FOR USE AND/OR PUBLICATION OF DATA, STATEMENTS, CONCLUSIONS OR ABSTRACTS FROM OR REGARDING OUR REPORTS AND DRAWINGS IS RESERVED PENDING OUR WRITTEN APPROVAL.

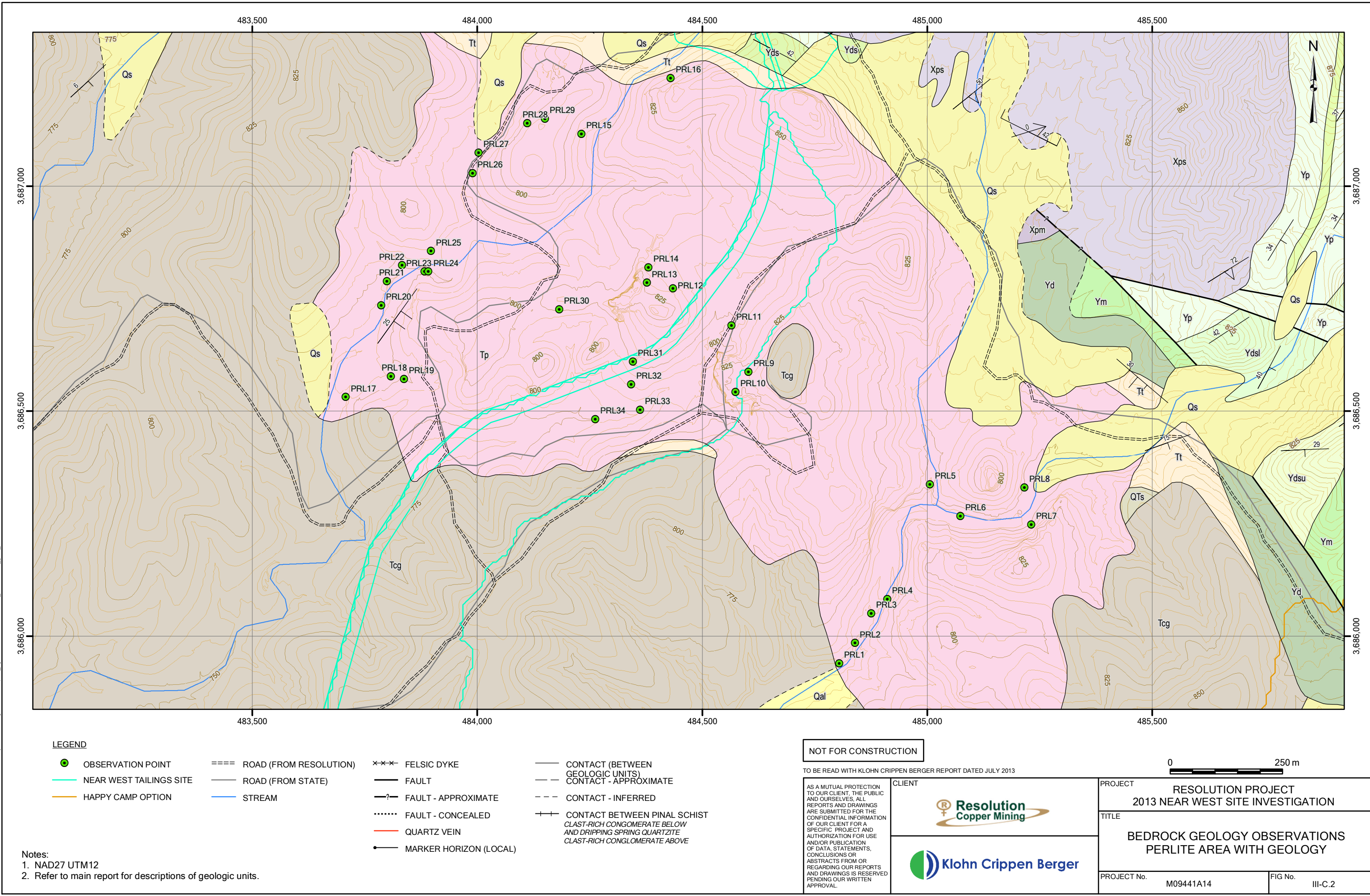
CLIENT



PROJECT RESOLUTION PROJECT 2013 NEAR WEST SITE INVESTIGATION	
TITLE BEDROCK GEOLOGY OBSERVATIONS PERLITE AREA	
PROJECT No. M09441A14	FIG No. III-C.1



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**PRL1**

Contact between conglomerate and rhyolite in Pott's Canyon.





## PRL2

Rhyolite exposure on left channel bank. Millimeter scale folded bands of chalcedony. Very hard and fissile; rock fractures along bands. R5.





### PRL3

Exposure of massive rhyolite. Generally randomly oriented closed fractures with some closed parallel fractures exposed on one outcrop with 30 cm to 50 cm (11.81 inch to 19.69 inch) spacing. Composed of mostly microcrystalline quartz (chalcedony) (very hard, R5 to R6) with shiny lustrous surfaces. Some pink and grey banding.



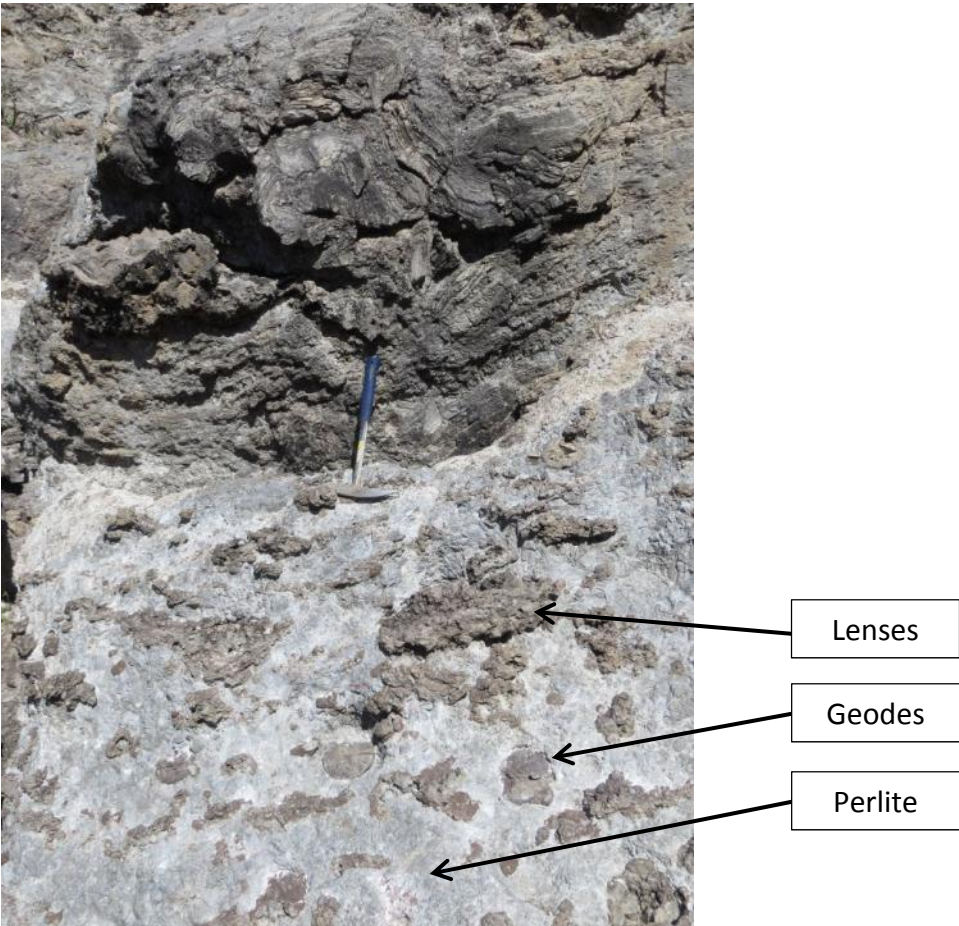


#### PRL4

5 m (16.4 ft) thick layer of perlite between two layers of microcrystalline siliceous rock. Perlite is heavily fractured with geodes (“thunder eggs”) and lenses of microcrystalline silica (chalcedony) floating in the unit. Rhyolite beds are very hard (R5 to R6) with numerous air voids.









### PRL5

Steep sided gully with ponding water in invert. Brecciated rhyolite forms gully walls (angular clasts of banded rhyolite in very hard (R6) rhyolitic groundmass. One 10 cm (3.94 inches) wide vertical fault cutting across gully filled with very hard, non-acid reactive brecciated gouge.

Orientation of fault/joint: **335/90**











Fault/joint with  
brecciated gouge



**PRL6**

Water ponding and moist sand at surface on rhyolite surface in channel invert. Trees growing in channel. Calcite staining on exposed rock surfaces.





### PRL7

Vertical exposure of perlite. Heavily fractured/disturbed. Some sub-mm scale horizontal banding spaced 15 cm to 30 cm (*5.91 inches to 11.81 inches*) apart. Two vertical shear or fracture zones. Presence of a hardened and discoloured “crust” on the perlite surface. Fresh perlite is easily fractured with one light blow with hammer pick.







Concentric Fracturing  
Common in Glassy Perlite



### PRL8

Exposure of brecciated rhyolite on left channel bank. R5, angular rhyolite clasts in rhyolitic groundmass with some perlite inclusions. Parallel vertical joints running ~parallel to exposure face, 20 cm to 60 cm (7.87 inches to 23.62 inch) spacing between joints, closed to very wide aperture (max. 10 cm (3.94 inches)) with silty sand and gravel infilling in widest joints.

Orientation of joints: **335/90**





### PRL9

Perlite exposure near the top of a conglomerate (Tcg) capped hill. Harder than perlite observed at previous observation points (R4). “Glassy” texture is less developed and rock does not display the same degree of concentric fracturing. Some low angle closed parallel fractures.





### PRL10

“Jagged” outcrops of perlite with parallel layers spaced <1 cm to 20 cm (*<0.39 inches to 7.87 inches*) apart. Typically closed. Layers interfaces are planar to stepped with a rough surface texture. R3 to R4 rock strength.

Orientation of layers: **256/63**









### PRL11

“Glassy” perlite exposed in quarry area. R3 strength with blunt end of hammer but noticeably weaker when struck with the point of pick. Strong parallel layering with closed interfaces between layers. Some exposed layer interfaces are smooth, glossy and planar. Average layer spacing = 5 cm (1.97 inches). Some other randomly orientated fracturing perpendicular to layer interfaces.

Orientation of parallel layers: **007/24**









### PRL12

Vertical exposure of perlite. Disturbed rock mass with numerous randomly oriented fractures. Some vertical widely spaced (minimum 0.6 m (2.0 ft) spacing) joints extending through the full height of the exposure. R3 to R4 rock strength but weaker when struck with pick. Glassy cleavage surfaces – preferentially breaks along concentric planes. One large vertical fracture with discoloration; closed.









**PRL13**

Outcrop of perlite with parallel “layers”. Similar properties to the material seen at PRL9. R3 to R4 strength with relatively small glass “grains”.

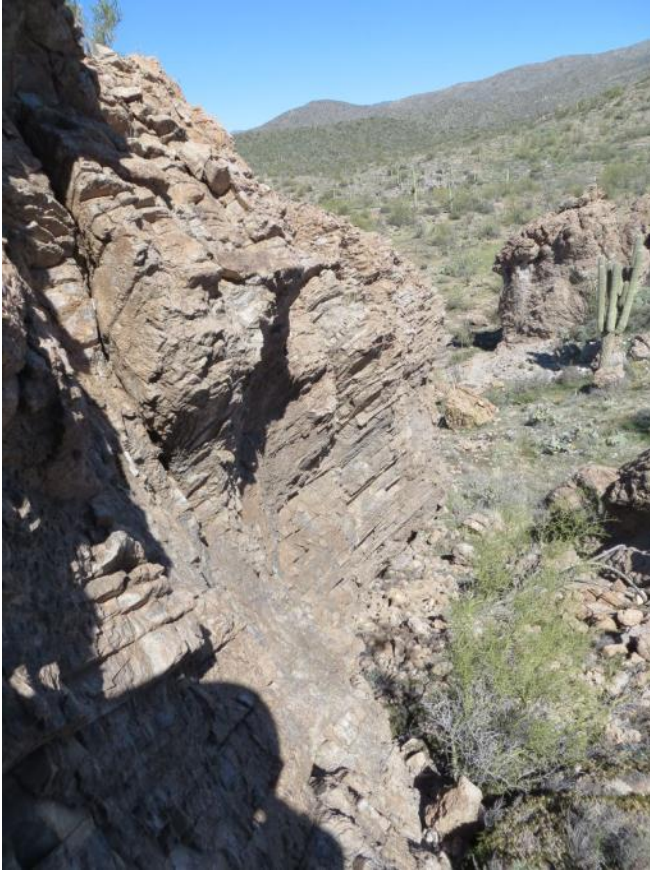
Orientation of “layers”: **188/37**





**PRL14**

Parallel jointing in perlite outcrop. Joint spacing 0.5 cm up to 10 cm (*0.20 inches to 3.94 inches*), planar exposed joint surfaces, closed. Rock strength R3 to R4.



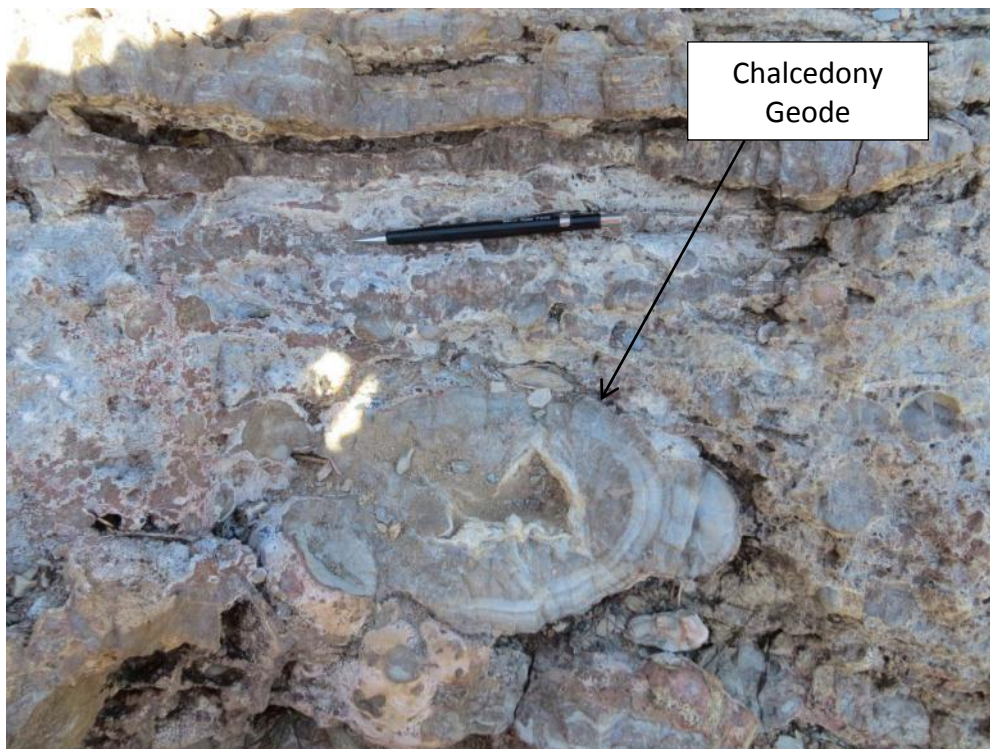


### PRL15

Outcrop of rhyolite in left bank of creek channel. Fresh R5 to R6, parallel gently folded “banding” with irregularly shaped voids between bands. Mean spacing between bands is 1 cm to 2 cm (*0.39 inches to 0.79 inches*), void space between bands is variable but can be as wide as 2 cm (*0.79 inches*), penetration of voids into the rock mass appears to be shallow (voids close off at depth). Spherical chalcedony geodes common throughout. Trace “inclusions” of glassy perlite. Based on subsequent observations (**see PRL26**) void space between rhyolite bands is likely caused by differential erosion of previously existing perlite bands.



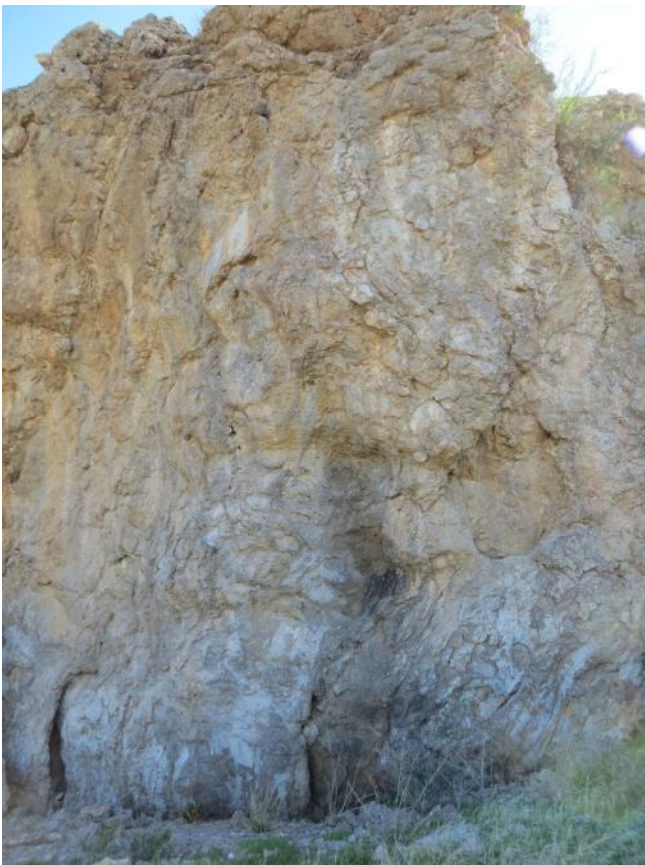






**PRL16**

Massive rhyolite exposure, R5 to R6, widely spaced randomly oriented fractures.





### PRL17

Perlite with areas of brecciation. Perlite, R3 to R4, “banded” with light grey and dark grey laminations, differential weathering of some bands, massive, some areas of the exposure have a brecciated appearance with clasts of banded perlite in massive perlite matrix.



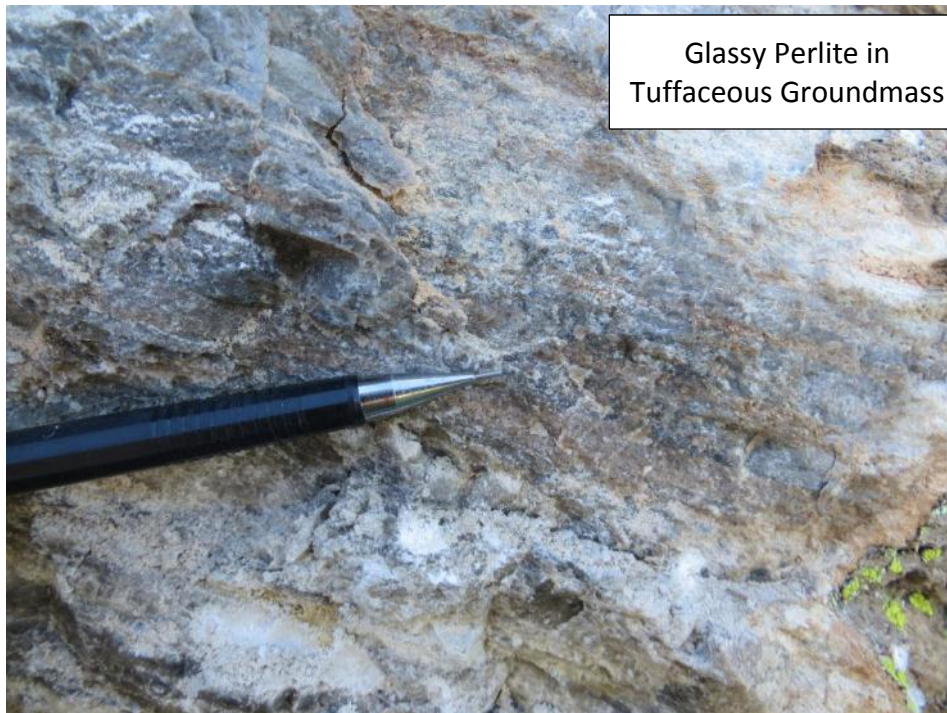


**PRL18**

Jagged surface outcrops of perlite tuff. Fresh, R3 to R4 (with intact “crust”), gravel sized clasts of grey perlite in fine grained porous pink felsic matrix, massive.









**PRL19**

Tilted “blocks” of perlite showing strong parallel layering. Fresh, R3, layer spacing from mm scale to 1 cm (*0.40 inches*), spacing between parallel color banding seen on fresh perlite surfaces is < 1 mm (*0.04 inches*), some closed fractures perpendicular to layers.

Orientation of perlite layers:               **070/28** (on side of hill)  
                                                         **033/31**(in channel invert)









**PRL20**

Exposure of perlite “tuff” in channel invert and banks. Gravel to cobble sized angular perlite clasts floating in fine grained pink felsic matrix, R3 to R4, massive.





### PRL21

Rock exposures become perlite with well developed “glassy” texture moving upstream out of tuff. Fresh, R3 (weaker when struck with pick of hammer), fractures along irregular glassy surfaces, massive with no joints visible, cross cut by some pink felsic “bands”.





### PRL22

Outcrop of sub-horizontally banded perlite. Perlite and pink microcrystalline bands of silica, differential weathering of glassy perlite bands, three vertical cracks in the exposure close off right below surface, massive.







Shallowly Penetrating  
Vertical Joint



### PRL23

Perlite and rhyolite exposure. Fresh, R4 to R5, pink silica with perlite, “glassy” texture in perlite not well developed, joint spacing = 30 cm (*11.81 inches*), sub-vertical, wide range of joint aperture at surface from closed to ~ 20 cm (*7.87 inches*), maximum depth of measured joint penetration into outcrop = 100 cm (*39.37 inches*), stepped and rough joint surfaces, silty sand or no infill.

Orientation of joint set: 187/90





**PRL24**

Deep pond formed at the bottom of a 2 m (6.6 ft) channel elevation drop over perlite outcrop.





**PRL25**

Jagged outcrops of perlite. Fresh, R3, strong sub-horizontal parallel layering (banding) with evidence of folding, banding spaced at mm scale, differential weathering between bands, some hard grey siliceous bands, few vertical closed fractures.





### PRL26

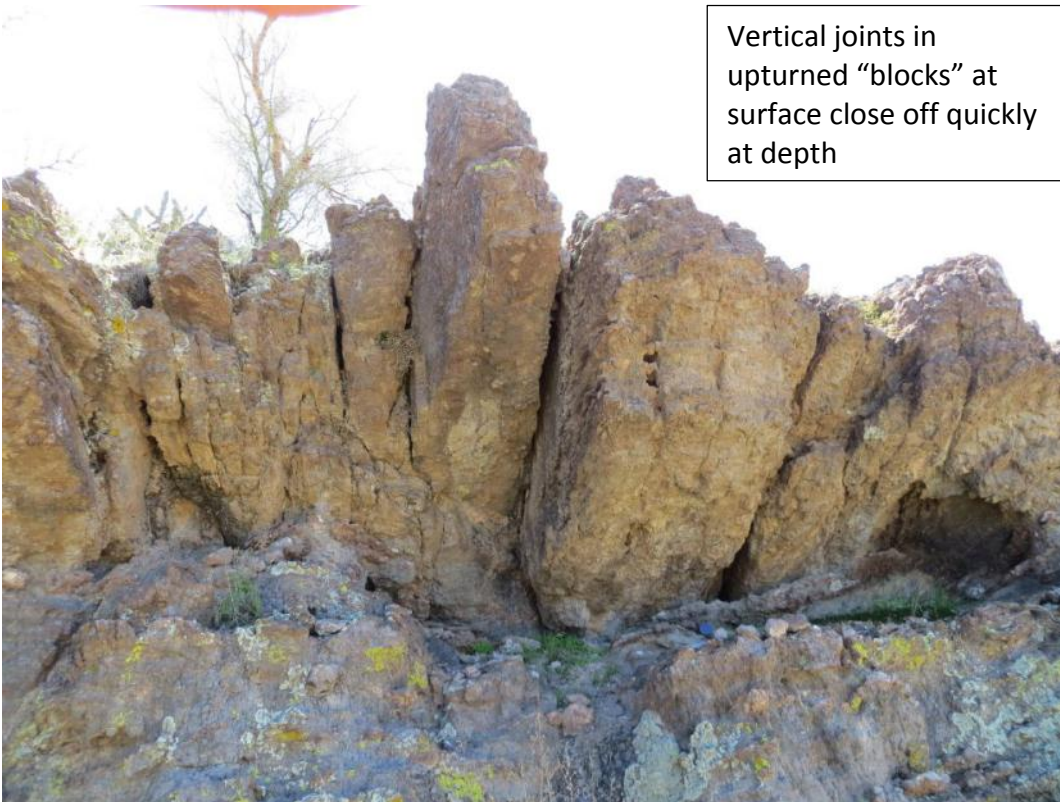
Banded perlite and pinkish grey silica with silica geodes (thunder eggs), silica bands much more weathering resistant. Fresh, R3 to R4, poorly developed “glassy” texture in perlite, some closed vertical cracks cutting across height of the outcrop, rock near the top of the outcrop displays vertical jointing but they close off at depth.











Vertical joints in  
upturned “blocks” at  
surface close off quickly  
at depth



**PRL27**

Outcrop of perlite with well developed “glassy” texture. No microcrystalline silica banding.





**PRL28**

Outcrop of white fine grained siliceous rock. Fresh, R4 to R5, tight spaced sub-vertical joints with spacing of 1 cm to 6 cm (*0.40 inches to 2.36 inches*), joints closed to moderately wide (max. 3 mm (*0.12 inches*)), stepped and rough surfaces, no infill, brecciated texture exposed on some joint faces.

Orientation of joint set: 350/83





**PRL29**

White jointed siliceous rock forms a 2 m (6.6 ft) thick “cap” over banded silica/perlite (as PRL26) below.





### PRL30

Outcrop of perlite at the top of a hill. Fresh, R3, well developed “glassy” texture, strong sub-vertical gently folded parallel layers, parallel laminations seen in fresh perlite, average spacing between layers = 3 cm (*1.18 inches*), layer interfaces open at surface but fresh exposures are closed, stepped and rough planes, other randomly oriented fractures and joints cutting across layers.

Orientation of layers: **078/73**





**PRL31**

Exposure of white to grey siliceous rock, similar to PRL29. Massive with no joint sets/discontinuities.





**PRL32**

Perlite with well developed “glassy” texture exposed in road surface right below PRL31.





**PRL33**

Banded perlite (glassy perlite with hard purplish grey microcrystalline silica) exposed in channel invert. Fresh, R4, bands on mm to cm scale (up to 30 cm (*11.81 inches*)), evidence of folding, some randomly oriented closed fractures perpendicular to bands, water ponding on surface.









#### PRL34

Perlite exposure in channel invert and banks with well developed “glassy” texture. Fresh, R2 to R3 (weaker when chipped with pick), strong layering spaced 3 mm to 15 cm (*0.12 inches to 5.91 inches*) apart, sub-horizontal, smooth, planar layer interfaces, numerous fractures perpendicular to layering, concentric fracturing in intact perlite along smooth glassy planes. Water ponding in channel invert of exposed perlite.





Concentric Fracturing of  
Intact Perlite





## **APPENDIX IV**

### **Laboratory Testing of Alluvium**

---



### Alluvium Sampling

Alluvium samples were collected at select creek traverse mapping stations along Traverse #1 (Roblas Canyon), Traverse #4 (Bear Tank Canyon) and Traverse #9 (Happy Camp Canyon). At each sampling location one sample of active channel sediments and at least one sample of overbank material (older alluvium) were collected. Samples were also taken from the south end of Pott's Canyon where there are significant Old Alluvium deposits.

Samples were sent to ATL Inc. Laboratory based in Phoenix, AZ for geotechnical and geochemical testing. Samples were collected at approximately 1ft depth, screened across a 5/8" sieve, described, tested for acid reaction, photographed and double-bagged in resealable plastic bags. The percentage of the total sample volume retained on the 5/8" sieve was estimated visually and only the portion passing 5/8" was collected to reduce sample weight. The tests performed included: water content, gradation, hydrometers, Atterberg limits, water soluble salts and specific gravity.

A summary of the samples with field descriptions and tests requested is presented in Table 1. Test results are presented in Table 1 and Figure 1 through Figure 4.



Table 1      Summary of Samples and Testing Performed

Sample Details				Field Description of Sample			Testing Performed					
Mapping Area	Mapping Station	Sample Number	Sample Area	Material Type	Acid Reaction*	% Retained on 5/8" Sieve†	Moisture Content	Particle Size Analysis	Hydrometer	Atterberg Limits	Specific Gravity	Total and Water Soluble Salts
Traverse #1 Roblas Canyon	CRK1	S1	Channel	SW-GW, some cobbles	none	20	X	X				X
	CRK1	S2	Overbank	SM	moderate	10	X	X				X
	CRK2	S1	Channel	SW-GW	weak	30	X	X				X
	CRK2	S2	Overbank	SM-GW	none	20	X	X				X
	CRK3	S1	Channel	SW-GW, some cobbles	weak	30	X	X				X
	CRK3	S2	Overbank	SM, some gravel, some cobbles	none	5	X	X	X	X	X	X
	CRK4	S1	Channel	SW-GW, and cobbles	weak	35	X	X				X
	CRK4	S2	Overbank	Gravelly SM, trace cobbles	strong	10	X	X	X	X		X
	CRK4	S3	Overbank	Gravelly SM, trace cobbles	none	15	X	X	X	X		X
	CRK5	S1	Channel	SW-GW, trace cobbles	weak	15	X	X			X	X
	CRK5	S2	Overbank	Gravelly SM	none	5	X	X				X
	CRK6	S1	Channel	SW-GW and cobbles	weak	50						
	CRK6	S2	Overbank	SM, trace to some gravel	moderate	< 5						
Traverse #4 Bear Tank Canyon	CRK22	S1	Channel	SW-GW, trace cobbles	weak	15	X	X				X
	CRK22	S2	Overbank	SM, some to trace gravel	weak	< 5	X	X	X	X		X
	CRK21	S1	Channel	SW-GW, some cobbles	weak	30	X	X				X
	CRK21	S2	Overbank	SW-GW, silty, trace cobbles	none	15	X	X	X	X	X	X
	CRK20	S1	Channel	SW-GW and cobbles	weak	45	X	X				X
	CRK20	S2	Overbank	SP, some gravel	none	15	X	X				X
	CRK19	S1	Channel	SW-GW and cobbles	weak	50	X	X				X
Traverse #9 Happy Camp Canyon	CRK40	S1	Channel	Gravelly SW, trace cobbles	weak	20	X	X				X
	CRK40	S2	Overbank	SM, some gravel	none	15	X	X				X
	CRK40	S3	Overbank	SC	none	0	X	X	X	X		X
	CRK41	S1	Channel	SW-GW, cobbly, trace silt	moderate	40	X	X				X
	CRK41	S2	Overbank	SC, trace gravel	moderate	< 5	X	X	X	X		X
	CRK42	S1	Channel	SW-GW and cobbles, trace silt	moderate	50	X	X			X	X
	CRK42	S2	Overbank	SW, trace gravel, some silt	none	5	X	X				X
	CRK42	S3	Overbank	Gravelly SM, some cobbles	none	30	X	X				X
	CRK43	S1	Channel	SW-GW, some cobbles, trace silt	none	30	X	X				X
	CRK43	S2	Overbank	Gravelly SM, trace cobbles	strong	10	X	X	X	X	X	X
Potts Canyon		POTTS1	Old Alluvium	SC, gravelly	none	10	X	X				X
		POTTS2	Old Alluvium	SC, some gravel, trace cobbles	none	5	X	X	X	X		X
		POTTS3	Old Alluvium	SC, trace gravel	none	< 5	X	X				X
		POTTS4	Old Alluvium	SC, trace cobbles, trace gravel	strong	10	X	X	X	X	X	X
		POTTS5	Old Alluvium	SC, trace gravel	none	< 5	X	X				X
		POTTS6	Old Alluvium	SM, trace to some gravel	none	10	X	X	X	X		X
		POTTS7	Old Alluvium	Sandy CH, trace gravel	moderate	5	X	X				X
		POTTS8	Old Alluvium	SM, some gravel, trace cobbles	none	20	X	X	X	X	X	X
		POTTS9	Old Alluvium	Gravelly SC, some cobbles	none	30	X	X				X
		POTTS10	Old Alluvium	SC, some gravel, some cobbles	strong	20	X	X				X
		POTTS11	Old Alluvium	CH, trace to some sand, trace gravel and cobbles	none	5	X	X	X	X		X
		POTTS12	Old Alluvium	CH, some sand, trace gravel and cobbles	none	5	X	X				X
		POTTS13	Old Alluvium	CH, some sand to sandy, trace gravel and cobbles	weak	< 5	X	X	X	X	X	X
		POTTS14	Old Alluvium	Sandy CH, some gravel and cobbles	weak	20	X	X				X

† - Portion retained estimated visually as percentage of total volume.



\*Acid Reaction Rating System

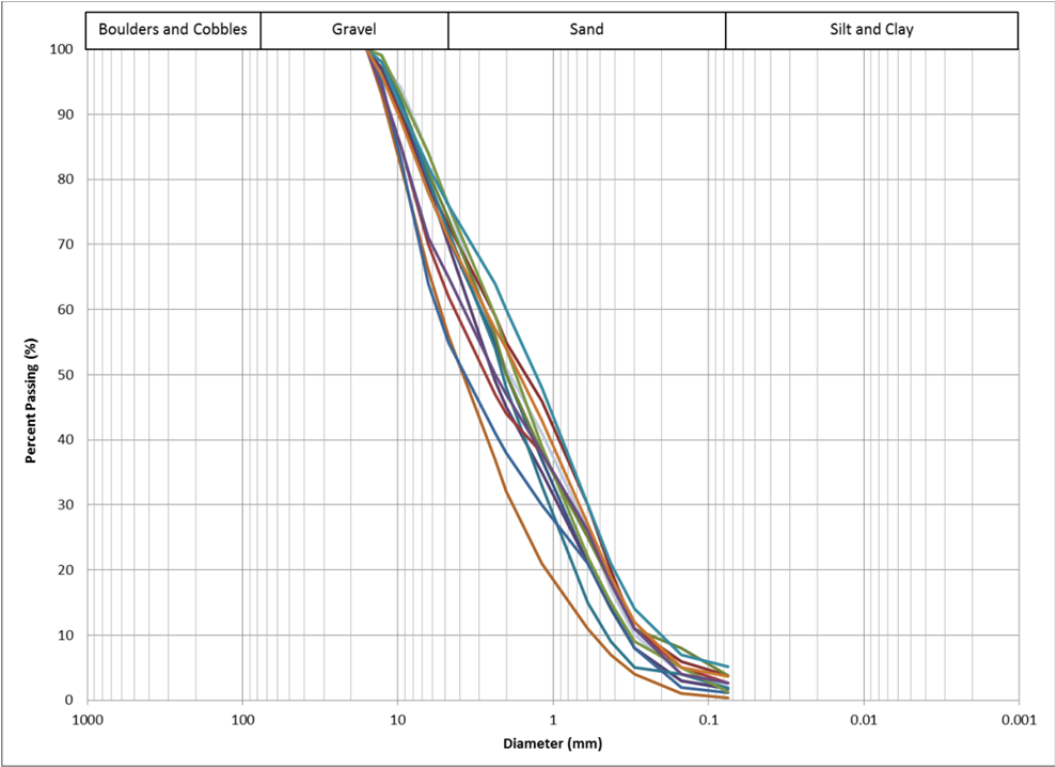
Reaction	Description
None	No bubbling or audible effervescence
Weak	Small bubbles forming around grain/clasts (must look closely to see); barely audible effervescence
Moderate	Bubbles clearly seen around grains or on surface of exposure; audible effervescence
Strong	Bubbles protrude from surface; loud effervescence; visible vapours coming from contact area



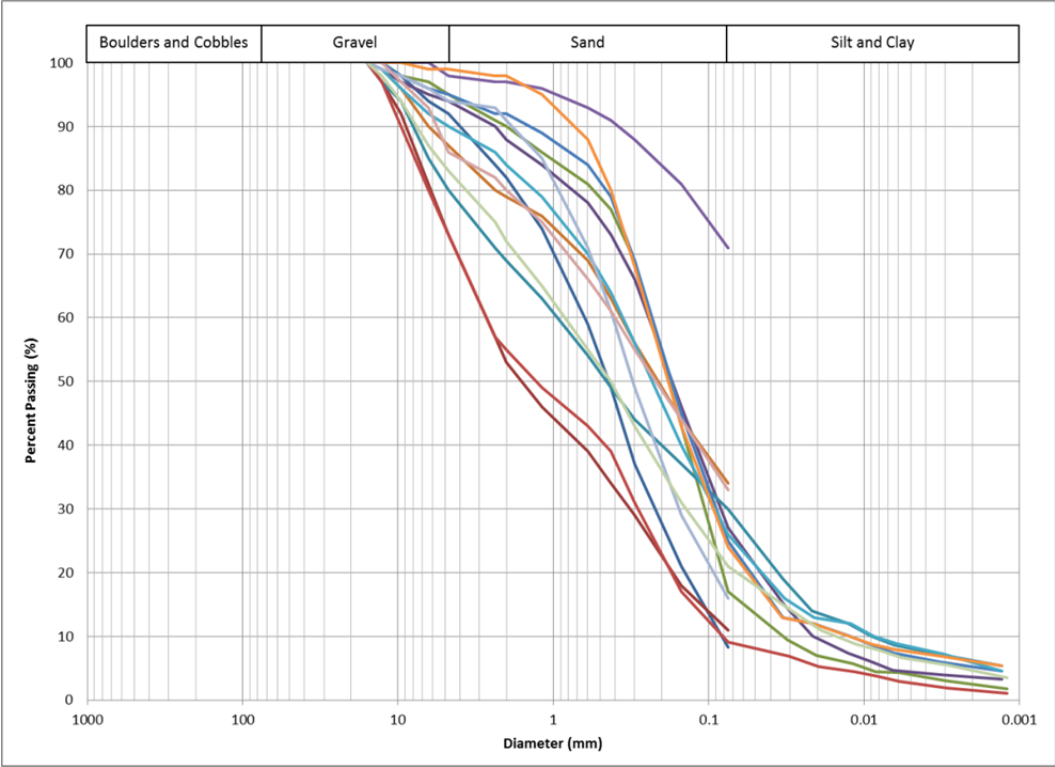
Sample Details				Atterberg Limits*				Soluble Salts		Specific Gravity	Particle Size Distribution (% Passing)†												
Mapping Area	Mapping Station	Sample Name	Sample Area	Water Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index	Soluble Salts (ppm)	Soluble Salts (%)		15.875 mm (0.625 inches)	12.700 mm (0.5 inches)	9.525 mm (0.375 inches)	6.350 mm (0.25 inches)	4.750 mm (0.187 inches)	2.360 mm (0.093 inches)	2.000 mm (0.079 inches)	1.180 mm (0.046 inches)	0.600 mm (0.024 inches)	0.425 mm (0.017 inches)	0.300 mm (0.012 inches)	0.150 mm (0.006 inches)	0.075 mm (0.003 inches)
Traverse #1 Roblas Canyon	CRK1	S1	Channel	2.2				120	0.012		100	98	94	84	76	55	51	41	26	17	10	4	2
	CRK1	S2	Overbank	3.7				190	0.019		100	100	98	94	92	84	82	74	59	49	37	21	8
	CRK2	S1	Channel	2.2				120	0.012		100	97	90	78	71	55	50	37	21	14	8	3	2
	CRK2	S2	Overbank	2.3				220	0.022		100	97	92	81	73	57	53	46	39	34	29	18	11
	CRK3	S1	Channel	2.8				120	0.012	2.870	100	97	90	79	73	59	55	46	30	20	11	6	4
	CRK3	S2	Overbank	6.3	NV	NP	NP	140	0.014		100	100	98	97	95	91	90	86	81	77	69	43	17
	CRK4	S1	Channel	2.3				120	0.012		100	97	92	81	74	56	50	38	25	18	11	8	4
	CRK4	S2	Overbank	8.5				170	0.017		100	99	97	95	94	90	88	84	78	73	66	46	27
	CRK4	S3	Overbank	4.3	NV	NP	NP	550	0.055		100	97	94	85	80	71	69	63	54	49	44	37	30
	CRK5	S1	Channel	1.5				120	0.012	2.860	100	97	91	79	70	49	45	35	21	15	8	3	2
CRK5	S2	Overbank	7.8				170	0.017		100	99	96	90	87	80	79	76	69	63	56	44	34	
Traverse #4 Bear Tank Canyon	CRK22	S1	Channel	2.3				120	0.012		100	99	92	80	72	54	48	33	15	9	5	4	2
	CRK22	S2	Overbank	7.8	NV	NP	NP	190	0.019		100	100	98	96	95	92	92	89	84	79	69	45	25
	CRK21	S1	Channel	1.6				120	0.012		100	93	82	66	56	37	32	21	11	7	4	1	0
	CRK21	S2	Overbank	5.1	NV	NP	NP	190	0.019	2.922	100	97	90	80	73	57	55	49	43	39	31	17	9
	CRK20	S1	Channel	2				120	0.012		100	95	83	64	55	41	38	30	21	15	8	2	1
	CRK20	S2	Overbank	8.8				150	0.015		100	99	97	91	86	79	76	70	61	57	51	39	28
	CRK19	S1	Channel	4.4				170	0.017		100	94	85	70	62	47	44	38	26	18	11	5	3
Traverse #9 Happy Camp Canyon	CRK40	S1	Channel	4.3				130	0.013		100	99	93	84	76	59	54	39	22	15	9	5	1
	CRK40	S2	Overbank	12.7				130	0.013		100	100	100	100	98	97	97	96	93	91	88	81	71
	CRK40	S3	Overbank	6.3	NV	NP	NP	190	0.019		100	99	96	92	90	86	84	79	70	64	56	40	26
	CRK41	S1	Channel	2.6				120	0.012		100	94	85	71	65	50	47	38	26	18	11	4	3
	CRK41	S2	Overbank	7.2	NV	NP	NP	270	0.027		100	100	100	99	99	98	98	95	88	80	68	43	24
	CRK42	S1	Channel	2.1				150	0.015	2.929	100	98	91	82	76	64	60	48	30	21	14	7	5
	CRK42	S2	Overbank	5.5				180	0.018		100	99	98	96	94	93	91	85	71	61	49	29	16
	CRK42	S3	Overbank	8.7				120	0.012		100	100	97	93	86	82	80	75	66	61	55	44	33
	CRK43	S1	Channel	2.9				150	0.015		100	96	89	78	71	57	54	43	27	19	12	5	4
	CRK43	S2	Overbank	7.8	NV	NP	NP	240	0.024	2.895	100	98	94	87	83	75	72	65	55	50	43	31	21
Potts Canyon		POTTS1	Old Alluvium	8.8				120	0.012		100	97	93	88	86	78	75	71	67	64	61	54	46
		POTTS2	Old Alluvium	11.4	44	18	26	150	0.015		100	96	91	89	86	81	80	78	74	71	68	61	52
		POTTS3	Old Alluvium	8.3				130	0.013		100	100	100	100	97	88	86	82	78	76	73	68	61
		POTTS4	Old Alluvium	10.5	40	19	21	190	0.019	2.690	100	100	97	93	90	84	81	77	70	67	63	59	46
		POTTS5	Old Alluvium	11.9				150	0.015		100	100	100	92	82	73	71	67	64	62	61	58	54
		POTTS6	Old Alluvium	9.5	41	23	18	130	0.013		100	100	98	95	87	75	72	66	56	52	50	48	44
		POTTS7	Old Alluvium	12.4				240	0.024		100	100	100	100	90	88	88	86	85	84	83	79	73
		POTTS8	Old Alluvium	6.4	24	18	6	180	0.018	2.835	100	100	100	96	92	86	84	79	72	68	64	57	49
		POTTS9	Old Alluvium	12.1				140	0.014		100	100	82	67	57	49	47	44	42	41	40	37	34
		POTTS10	Old Alluvium	17.7				180	0.018		100	100	100	96	86	77	76	73	70	69	68	64	59
		POTTS11	Old Alluvium	26	55	21	34	140	0.014		100	100	100	100	83	80	79	77	73	72	69	68	59
		POTTS12	Old Alluvium	21.1				120	0.012		100	100	100	100	96	90	87	84	79	76	73	66	60
		POTTS13	Old Alluvium	18.3	55	20	35	170	0.017	2.654	100	100	100	97	92	88	87	84	81	78	76	69	63
		POTTS14	Old Alluvium	18.9				120	0.012		100	100	100	100	64	58	56	52	49	48	47	45	41

\* - NP = non-plastic; NV = non-viscous  
† - The portion of the material larger than 15.875 mm (5/8”) was removed before testing





**Figure 1      Active Channel Sediments Gradations**



**Figure 2      Overbank Sediments Gradations**



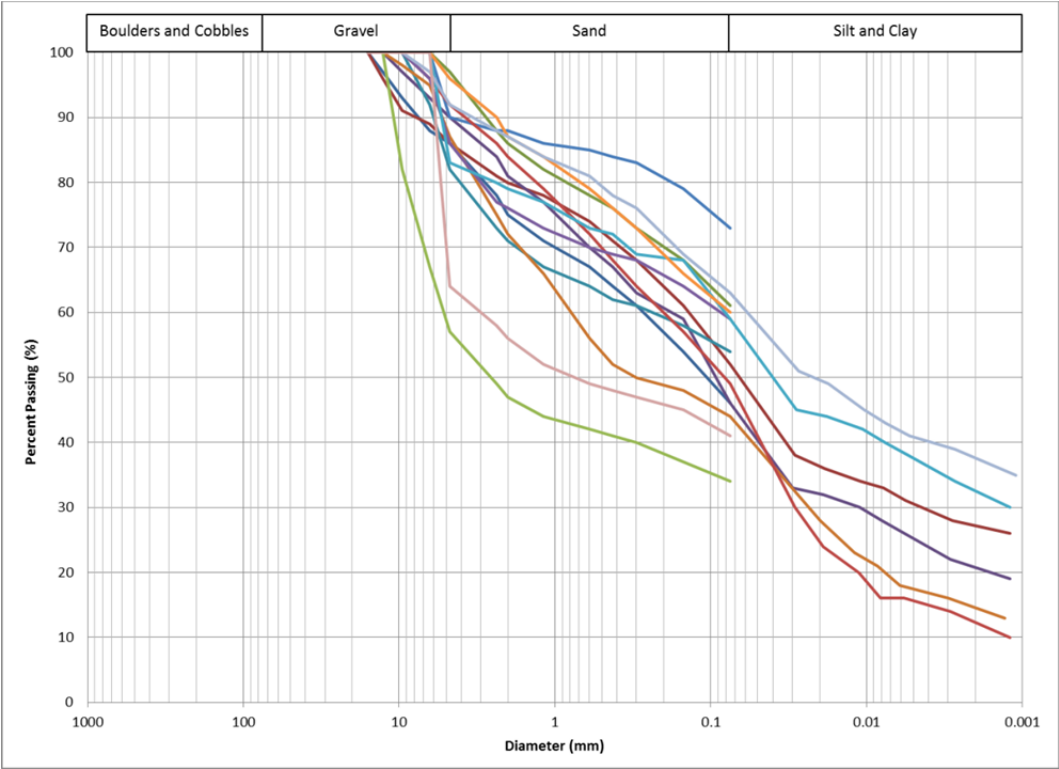


Figure 3 Old Alluvium Gradations

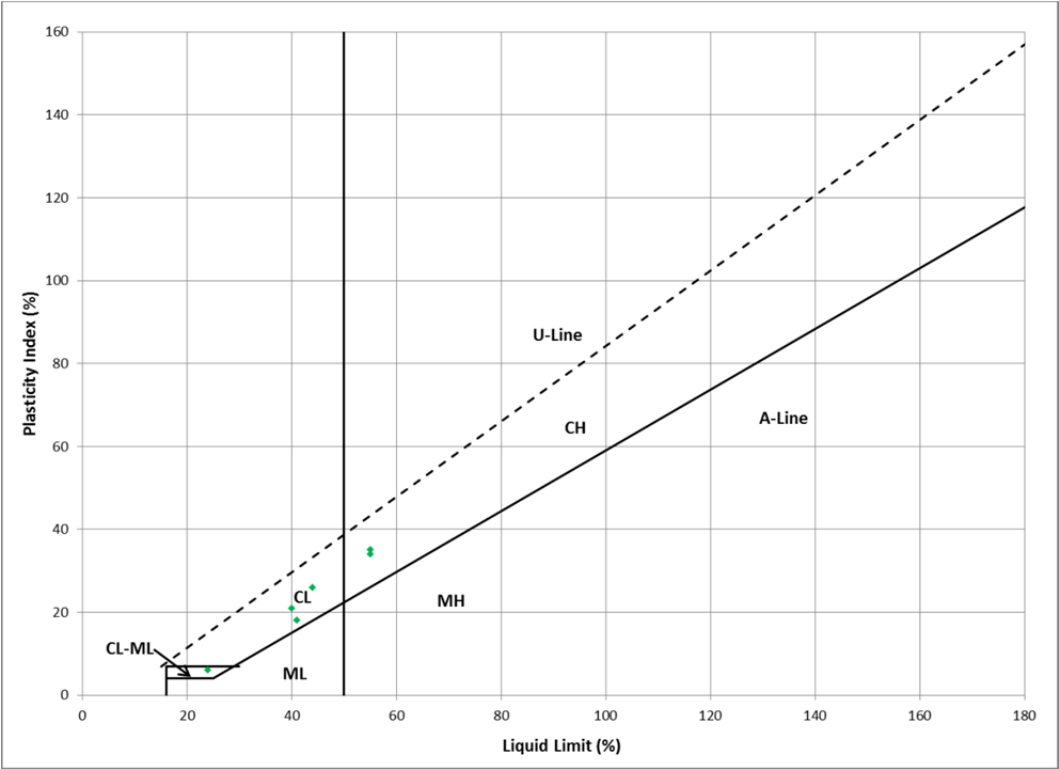


Figure 4 Old Alluvium Atterberg Limits