DAILY FIELD LOGS

MWH	Project: NERC JETTY GEOTECH INVESTIGATION	DAILY FIELD ACTIVITY LOG	Date: 8-Nov-2016 Project Number: 1050

Field Representitive: JENNIFER VAN PELT

Note activities, weather conditions, visitors, variances, safety issues, communications, mechanical issues, scheduling issues, etc.

ON SITE:

JEN VAN PELT	(MWH)
STEPHANIE DOWNEY	(MWH)
JANET BROOKS	(EPA)
LANE ANDROSS	(AE)
GREGG SMITH	(NAVARRO)
BINOD CHAUDHURY	(NAVAJO NTN)
MATT CAIN	(NATIONAL)
D. MARTINEZ	(NEWP)
A. CONTEZ	(NEWP

Boring	Description / Work Unit	Quantity
B1	CORE (feet)	32.1
	Core Boxes (ea)	4

07:05 - ON site - drillers not on site - having to pick up new vehicle to replace their truck which blew the turbo.

07:15 Trip down to jetty area to recon boring locations 2 gas lines marked w/ newer plastic/fiberglass markers Conoco Phillips (CP) has maked 2 lines w/ yellow flagging between B2 & B3. There are also 2 lines marked w/ older steel bollards (orange/white?) may be abandoned spoke w/ driller to call CP Rep to be available for drilling. B1 will be accessable and w/in bedrock and we should be able locate to east of gas lines

* Walked upper Jetty area to look at stratigraphy - begun mapping Zone 2 coal seam pinches out - may be coal seam in Zone 1, Zone 3 may or may not be visible along jetty wash out

09:00 at mine office to look at old cores. drillers not on site yet.

09:40 drillers arrive on site, transfer equipment from broken truck begen to setup for drilling.

10:30 site walk to boring locations w/ Rick and drillers confirm locations of boring B1 to B3 are away from gas lines (conoco phillips) Matt (National) called contact at CP to confirm lines sited all borings ≥ 15 feet from gas lines, and Moved B1 to Bedrock outcrop. All borings on other side of Jetty (East) look accessible

11:30 drillers continue setup, will begun at B1 fill water truck & make equip to site

13:30 Begin drilling on B1

16:45 complete drilling on B1 at 32.1 ft bgs.

17: Drillers prep to make to next boring B2

15:30 leave site

Date: 8-Nov-2016

MWH	Project: GE/UNC NECR JETTY INVESTIGATION	DAILY FIELD ACTIVITY LOG	Date: 9-NOV-2016 Project Number:

Field Representitive: Jen VanPelt, S. Downey

Note activities, weather conditions, visitors, variances, safety issues, communications, mechanical issues, scheduling issues, etc.

ON SITE

J. VAN PELT	(MWH)
S. DOWNEY	(MWH)
J. BROOKES	(EPA)
L. ANDROSS	(EA)
M. CAIN	(NEWP)
D. MARTINEZ	(NEWP)
A. CORTEZ	(N.EWP)
R. SPITZ	(AMEC FW)

07:00 ON SITE, brief tailgate
07:15 DRILLER MOBE TO B2, finish logging B1
09:15 Began drilling B2
13:04 Complete drilling B2 at 52.1 feed bgs. Mobe to B3
14:55 Began drilling B3
15:30 at bed rock driller switches to coring
16:30 drillers ready to core - will start tomorrow
17:00 leave site

Boring	Description / Work Unit	Quantity
B2	soil	18.1
	core	34.0
	core boxes	4

Date: _____

MWH	Project: NECR UNR JETTY GEOTECHNICAL	DAILY FIELD ACTIVITY LOG	Date: 10-Nov-2016 Project Number:

Field Representitive: JEN VAN PELT, STEPHANIE DOWNEY

Note activities, weather conditions, visitors, variances, safety issues, communications, mechanical issues, scheduling issues, etc.

BINOD CHAKLADHURY (N. NI. EPA)

ON SITE:

J. VANPELT	(MWH)
S. DOWNEY	(MWH)
J BROOKES	(EPA)
L. ANDROSS	(EA)
M. CAIN	(N.EWP)
DAN Martinez	(NEWP)
ART Cortez	(NEWP)
RICK SPITZ	(AMEC FW)
BINOD CHAUDHURY	(NAVAJO NTN. EPA)

SAMPLES

B4 - 5.5 - 6.0	(SSO)	→ 2" ID
B4 - 16.0 - 16.5	(SSO)	
B4 - 20.5 - 21.0	(SSO)	
B4 - 30.5 - 31.0	(SSO)	
B4 - 40.5 - 41.0	(SSO)	
B4 - 41.0 - 43.6	(GS)	
B4 - 45.0 - 49.0	(GS)	
B4 - 50.5 - 51.0	(SSO)	

Boring	Description / Work Unit	Quantity
B3	Core (ft)	
	Boxes (EA)	4
B4	SPT / Mod Cal Sampling	7
	Retained Mod Cal BRASS.	6
B4	Cont. core CME/ HSA. DRILLING	50.0

07:00 MEET AT office, prep for day,
07:15 Mobe to site, setup for drilling
07:45 SAFETY MTG.
08:00 PREP for DRILLING / CORING B3 at 17.7' bgs
08:15 DRILLING B3 at 15.9' bgs
10:20 coring completed on B3.
" drillers packing up gear to mobe machine and equipment to other side of jetty
Complete logging on B3.
11:50 Pack up gear. photography of core.
13:00, break for lunch
13:15 Degen mobe to B4
14:30 drilling B4
16:30 halt CME drilling for day. drillers winterize rig, continue securing core gear on trailers
17:25 leave site

21.3
(15.9) 5.4' 4.7' Rec.

Date: 10-Nov/2016

MWH	Project: GE/UMC NECR JETTY GEOTECH	DAILY FIELD ACTIVITY LOG	Date: 11-Nov-2016 Project Number:

Field Representitive: JEN VAN PELT / STEPHANIE DOWNEY

505 991-3578

Note activities, weather conditions, visitors, variances, safety issues, communications, mechanical issues, scheduling issues, etc.

ONSITE:

J. VANPELT	(MWH)
S. DOWNEY	(MWH)
L. ANDROSS	(EA)
M. CAIN	(N,EWP)
D. MARTINEZ	(N,EWP)
A. CORTEZ	(N,EWP)
R. SPITZ	(AMER FW)

SAMPLES

B4 - 51.5 - 52.5	(GS)
B4 - 52.5 - 54.0	(GS)
B4 - TW - 55.0 - 57.2	(TW)
B7 - TW - 5.0 - 6.5	(TW)
B7 - 7.0 - 7.5	(SSO)
B7 - 8.0 - 10.0	(GS)
B7 - 10.5 - 11.0	(SSO)
B7 - 14.0 - 15.0	(GS)
B7 - 16.0 - 16.5	(SSO)
B7 - 18.0 - 20.0	(GS)
B7 - 21.0 - 21.5	(SSO)
B7 - 23.2 - 25.0	(GS)
B7 - 27.5 - 29.2	(GS)

Boring	Description / Work Unit	Quantity
B4	CME CONT. CORE HSA	15 ft
B4	MOD/Coal Sampling	1
B4	SHELBY TUBE	1

07:00 onsite.
07:15 move to site prep for continued drilling.
08:00 Tail gate
08:15 Continue drilling B4
09:00 Complete drilling B4 TD = 65.0 ft bgs. ~5' into weathered bedrock.
09:10 Drillers tripping out prep to move to next boring.
09:55 Back filled w/cuttings.
10:05 Move rig to B7 set up.
10:40 Hand auger to ~3'
11:00 Begin drilling B7
15:30 Encounter ground water at ~65' bgs. driller is concerned about requirement for permit. halts drilling to consult with his PM re permitting. If permit required may have to wait until Monday as it is veterans day & weekend.
15:45 contact Jason C. Re issue, plan to Auger/CME core in borings until ground water, then abandon. When permit is granted, will Auger down to last depth and continue w/ CME. Core
16:00 Agree to continue drilling to 125' will revisit additional coring equipment tomorrow. encounter Bedrock ~

Samples cont.

B7 - 30.5 - 31.0	(SSO)
B7 - 32.7 - 35.0	(GS)
B7 - 35.0 - 37.0	(GS)
B7 - 40.5 - 41.0	(SSO)
B7 - TW - 42.5 - 43.5	(TW)
B7 - 50.5 - 51.0	(SSO)
B7 - 51.5 - 55.10	(GS)
B7 - TW - 55.0 - 57.0	(TW)
B7 - 60.5 - 61.0	(SSO)
B7 64.2 - 65.0	(GS)
B7 68.6 - 70	(GS)
B7 - 70.5 - 71.0	(SSO)

Date: 11-Nov-2016

MWH	Project: NECR UNR JETTY GEOTECH INVEST	DAILY FIELD ACTIVITY LOG	Date: 12-Nov-2016 Project Number:

Field Representitive: J. VanDelt / S. Downey

Note activities, weather conditions, visitors, variances, safety issues, communications, mechanical issues, scheduling issues, etc.

ONSITE:

J. VANDELT	(MWH)
S. DOWNEY	(MWH)
L ANDROSS	(AE)
M. CAIN	(N.EWP)
D. MARTINEZ	(N.EWP)
DJ. MARTINEZ	(N.EWP)
R SPITZ	(AMEC FW)

SAMPLES

B7 - 77.2 - 78.4	(GS)
B7 - 78.4 - 80.0	(GS)
B7 - 80.5 - 81.0	(SSO)
B7 - 81.5 - 84.4	(GS)
B7 - 88.4 - 90	(GS)
B7 - 90.5 - 91.0	(SSO)
B7 - 91.5 - 95	(GS)
B7 - 100.5 - 101.0	(SSO)
B7 - 101.5 - 104	(GS)
B7 - 108.9 - 110.0	(GS)

Boring	Description / Work Unit	Quantity
B7	71.5 - 115'	43.5'
B7	BRASS	3

07:00 on site at Admin. Sign in
Drillers prep, head to site
07:30: Retrieve DJ & Return to office for safety induction Re: Radiation
08:05 Tailgate
08:25 Continue drilling, B7 at 71.5'
10:45 At 100' bgs, driller called his PM RE: FOOTAGE over 100
11:45 At 115' bgs, weathered Bedrock.
12:00 Drillers break for lunch.
12:30 Prep for trip out of hole.
12:40 Mixing grout - 24 gal/50lb sack (CETCO) High Solids Bentonite grout
12:50 TREMMIE GROUT,
13:30 Pulled 6 rods/Augers, tremmied again.
178 total gallons of grout - backfill to surface w/cuttings.
14:30 - Mapped Jetty area while drillers continued w/ cleanup & mdpe 178 gal (2.78 gal/ft)
16:30 driller moved to B5 to begen drilling on Sunday Morning =64 feet
17:00 leave site

grout to 51 ft bgs.
Back fill to surface w/cuttings

Date: 12-Nov-2016

MWH	Project: NECR UNC JETTY GEOTECH INVEST.	DAILY FIELD ACTIVITY LOG	Date: 13-Nov-2016 Project Number:

Field Representitive: J. VAN PELT

Note activities, weather conditions, visitors, variances, safety issues, communications, mechanical issues, scheduling issues, etc.

ON SITE:

J. VANPELT	(MWH)
S. DOWNEY	(MWH)
L. ANDROTS	(EA)
M. CAIN	(NEWP)
D. MARTINEZ	(NEWP)
N. MARTINEZ	(NEWP)
R. SPITZ	(AMEC FW)

SAMPLES

BS - 5.5 - 6.0	(SSO)
BS - 9.2 - 10.0	(GS)
BS - 10.5 - 11.0	(SSO)
BS - 13.7 - 15.0	(GS)
BS - 15.5 - 16.0	(SSO)
BS - 18.2 - 20	(GS)
BS - 21.0 - 21.5	(SSO)
BS - 21.5 - 25.0	(GS)
BS - TW - 25.0 - 27.0	(TW)
BS - 27.0 - 30.0	(GS)
BS - 30.5 - 31.0	(SSO)
BS - 31.5 - 35	(GS)
BS - 38.7 - 40.0	(GS)

Boring	Description / Work Unit	Quantity
BS	CME Continuous Core	125'
	2" ID Brass Samp	8 ea
	Shelby 24"	1 ea

07:00 ON site sign in
drillers prep for drilling BS @ 0'
08:10 Tail gate
08:30 Hand auger BS to ~3' bgs
08:45 Drilling BS.
12:30 JVP w/ Rick to dig test pits at UNNAMED ARROYO at NAVAJO Res.
13:15 Continue to MINE SHAFT SITE TO MAP BED ROCK
14:55 Return to BS. at 105' bgs - still no bed rock.
15:15 NEAR MISS - DRILLERS TRIPPING in rod for CME core, ~ 20' of rod being lifted from ground. connector pin came loose as cable neared top dropping 15' of rod at back of rig. close to driller.

16:30 at 125' bgs. No sign of bedrock - contacted Jason Re: terminating boring, desided to move BL6 toward Jetty - in effort to potentially encounter bed rock.
drillers pull CME rod - will grout in morning

SAMPLES CONT

BS - 40.5 - 41.0	(SSO)
BS - 49.0 - 50.0	(GS)
BS 52.6 - 53.9	(GS)
BS - 63.0 - 63.6	(GS)
BS - 68.9 - 69.5	(GS)
BS - 60.5 - 61.0	(SSO)
BS - 75.0 - 77.6	(GS)
BS - 93.1 - 95.0	(GS)
BS - 101.0 - 101.5	(SSO)

Date: 13-Nov-2016

MWH	Project: NECR UMC Jetty Geotech Invest	DAILY FIELD ACTIVITY LOG	Date: 14-Nov-2016 Project Number:

Field Representitive: J. Van Pelt S. Downey

Note activities, weather conditions, visitors, variances, safety issues, communications, mechanical issues, scheduling issues, etc.

On Site:

J. Van Pelt	(MWH)
S. Downey	(MWH)
L. Andross	(EA)
M. Cann	(NEWP)
D. Martinez	(NEWP)
DJ. Martinez	(NEWP)

To Do: B6 to bedrock?

- TP-3 ✓
- TP-4 ✓
- Core Prep ✓
- GPS Borings & Test Pits ✓

GPS - All Locations.

	UTM NAD 83		
B1	12 S	0725716	3947688
B2	12 S	0725632	3947645
B3	12 S	0725606	3947618
B4	12S	0725763	3947644
B5	12 S	0725797	3947622
B6	12S	0725729	3947569
B7	12 S	0725645	3947534
TP1	12S	0725759	3949521
TP2	12S	0725748	3949499
TP3	12 S	0726668	3947995
TP4	12S	0726672	3947958

07:00 on site, meet w/ Rick. Borrow Post hole digger for Test pits.

Drillers prepping for day - getting water. will grout B5 to ~60' bgs, & backfill w/ cuttings.

08:10 Tail gate - Stretching discuss near miss from Sunday

08:30 - Begin by pulling 2 augers (10') to blow slough out of bottom of Augers.

09:48 drillers have added ~196 gallons at 2.74 gal/ft grouts hole to ~54' bgs, water table estimated to be at ~7' bgs.

10:00 Dilco Hill - take samples (5 gal) for TP3 & 4

11:15 Return to B5 - drillers continue to decon augers getting ready for make to B6

12:00 Select Core for lab work, pack up to box for transport.

13:00 Begen drilling B6

16:30 halt drilling for day driller winterize equip for overnight

17:00 leave site.

Boring	Description / Work Unit	Quantity
B6	CME cont. core	80'
B6	Mod Cal 2" ID	6
B6	Thin Wall Shelby	1
B6	Grab Samples	10

Core Samples

B3 - 24.2 - 24.9	(core)	SS
B3 - 24.9 - 25.6	(core)	SS
B3 28.8 29.5	(core)	SS
B3 - 49.9 - 50.6	(core)	SS/SH
B2 26.45 - 27.25	(core)	SS
B2 42.0 - 42.5	(core)	SH
B2 30.25 - 31.1	(core)	SS
B1 17.3 - 18.1	(core)	SS
B1 5.3 - 5.95	(core)	SS
B1 29.45 - 30.15	(core)	SS/SH
B6 - 57.2 - 59.4	(GS)	
B6 - 60.5 - 61.0	(SSO)	
B6 - 72 - 73.6	(GS)	
B6 - 80.5 - 81.0	(SSO)	

Samples

B6 - 7.0 - 9.3	(GS)
B6 10.5 - 11.0	(SSO)
B6 12.8 - 13.5	(GS)
B6 13.5 - 15	(GS)
B6 15.5 - 16.0	(SSO)
B6 - 16.5 - 20.0	(GS)
B6 - 20.5 - 21.0	(SSO)
B6 - 26.6 - 30	(GS)
B6 - TW - 30.0 - 32.0	(TW)
B6 - 37.5 - 38.4	(GS)
B6 - 40.5 - 41.0	(SSO)
B6 - 42.3 - 43.8	(GS)
B6 - 47.0 - 48.9	(GS)
B6 52.2 - 53.6	(GS)

Date: 14-Nov-2016

MWH	Project: GE/UMC JETTY GEOTECH INVEST	DAILY FIELD ACTIVITY LOG	Date: 15-Nov-2016 Project Number:

Field Representitive: JEN VANPELT, STEPHANIE DOWNEY

Note activities, weather conditions, visitors, variances, safety issues, communications, mechanical issues, scheduling issues, etc.

ON SITE:

J. VanPelt	(MWH)
S. Downey	(MWH)
L. Andross	(EA)
M. CAIN	(N. EWP)
D. Martinez	(N. EWP)
BJ. Martinez	(N. EWP)
R. SPITZ	(AMEC FW)

SAMPLES

B6 - 100.5 - 101.0	(SSO)
B6 - 101.5 - 105	(GS)

Boring	Description / Work Unit	Quantity
B6	CME (80-125?)	45'?

07:00 on site - sign in, drillers prep for site discuss storage of core w/ Rick. - who will pick up and store.
08:10 Tail gate, last day of drilling. anticipated schedule - drillers may have to wait 24hrs before driving rig back to yard. Stretching
08:30 drilling at 80-feet onward, B6.
09:30 Rick picked up core for storage.
10:40 Max of AMEC scans vehicle and samples.
11:00 leave site

Date: 15-Nov-2016

MWH	Project: NECR Jetty Geotech Investigation	DAILY FIELD ACTIVITY LOG	Date: 15-Nov-2016 Project Number:

Field Representitive: S. Downey

Note activities, weather conditions, visitors, variances, safety issues, communications, mechanical issues, scheduling issues, etc.

On site:

S. Downey	(MWH)
L. Andress	(EA)
M. Cain	(NEWP)
D. Martinez	(NEWP)
DJ Martinez	(NEWP)

1100 - Jennifer Van Pelt left site
1130 - Finish drilling BUC 126.5 ft bgs
1200 to 1230 - drillers take lunch
1230 - begin grouting and pulling auger
1400 - drillers added ~192 gallons of grout total. At 2.75 gal/ft, hole grouted to 526.7 ft bgs, water table estimated at 65 ft bgs
- Continue to pull and decon auger, L. Andress leaves site
1530 - auger pulled and deconned, drillers continue to decon other equipment, drill rig, and clean up site/prep for demobilization
1600 - RSO (Max), AMEC, scanned car, tables, chairs, boots, other equipment
1700 - leave site

Boring	Description / Work Unit	Quantity

Date: 15-Nov-2016

MWH	Project: NECR Jetty Geotech Investigation	DAILY FIELD ACTIVITY LOG	Date: 16-Nov-2016 Project Number:

Field Representitive: S. Downey

Note activities, weather conditions, visitors, variances, safety issues, communications, mechanical issues, scheduling issues, etc.

On site:

S. Downey	(MWH)
M. Cain	(NEWP)
D. Martinez	(NEWP)
DJ. Martinez	(NEWP)

0700- Arrive on site, drillers had their own tailgate safety meeting
- continue demob and decon
- I worked in UNC office

0830- Drillers demob from site and have all equip. at UNC office lot, including porta potty

0900- leave site
- Drillers loaded equip. onto trailers and finish decon., get scanned by RSO

* Drillers dailies note they finished @ 1100
* Drillers required to take 24 hour layover before driving equipment back to yard in Peralta, NM
Left UNC site on 17-Nov-2016

Boring	Description / Work Unit	Quantity

Date: 16-Nov-2016

APPENDIX B FIELD PHOTOS

1. PIPELINE ARROYO, LOOKING DOWNSTREAM

2. PIPELINE ARROYO, LOOKING UPSTREAM

3. SIDEWALL OF ARROYO, LOOKING WEST-SOUTHWEST

4. EXPOSED COAL LAYER BELOW BORING B1 LOCATION

5. EXISTING JETTY EXPOSED IN THE EROSIONAL FLOW PATHWAY, PARALLEL TO JETTY

6. DRILLING OPERATIONS

7. DRILLING OPERATIONS, GROUTING BOREHOLE B6

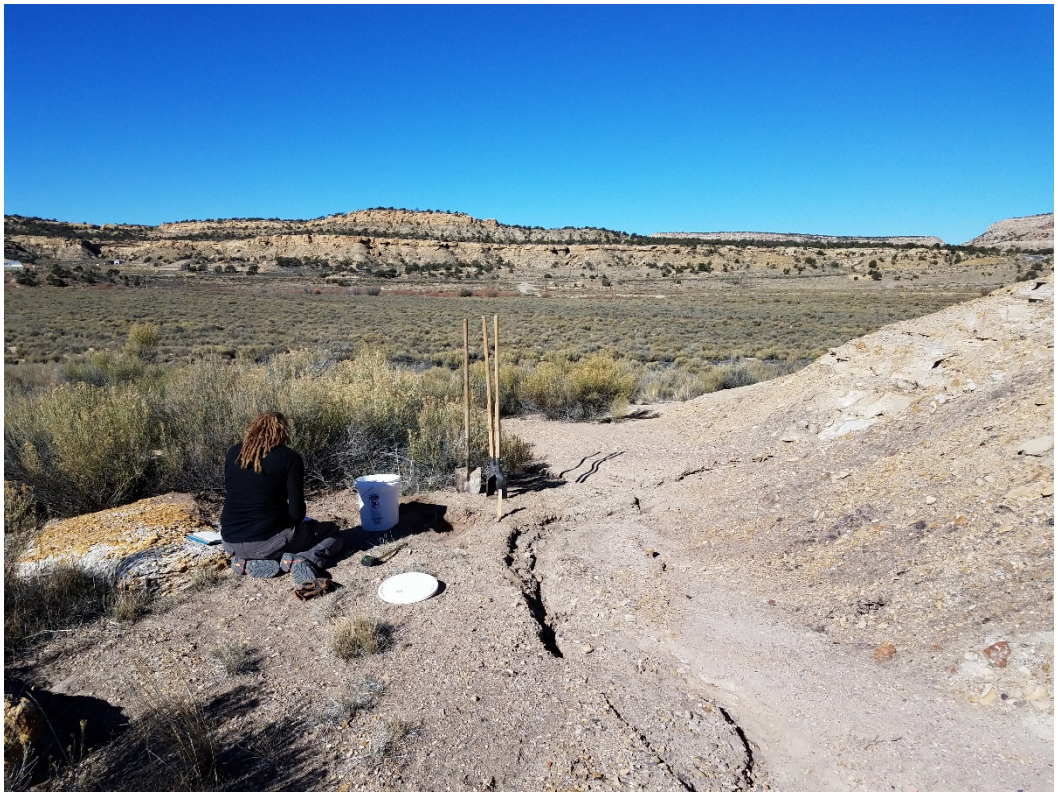
8. GENERAL AREA OF DRILL SITE, LOCATION B6

9. TEST PIT 1

10. TEST PIT 2

11. TEST PIT 3

12. GENERAL LOCATION OF TEST PIT 3, LOOKING SOUTHEAST



13. GENERAL AREA OF TEST PIT 3 NEAR DILCO HILL, LOOKING NORTHWEST

14. TEST PIT 4 NEAR DILCO HILL

APPENDIX C LABORATORY DATA

SAMPLE LOCATION	SAMPLE DEPTH (FT)	FIELD CLASS	MOISTURE (%)	DRY DENSITY (pcf)
B-4	16.0-16.5	--	10.4	77.6
B-5	10.5-11.0	--	5.2	82.9
B-5 (TRIAXIAL)	TW 25.0-27.5	--	21.2	98.8
B-5	40.5-41.0	--	22.7	99.6
B-6	15.5-16.5	--	10.7	93.0
B-6	40.5-41.0	--	17.9	97.0
B-7	TW 5.0-6.5	--	6.9	94.3
B-7	10.5-11.0	--	7.0	99.7
B-7	30.5-31.0	--	16.7	102.5

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2937 & ASTM D 2216

Ninyo & Moore		MOISTURE - DENSITY TEST DATA	FIGURE
PROJECT NO.	DATE	STANTEC/MWH/LAB TESTING PHOENIX, ARIZONA	
604667003	3/17		

WEIGHT OF SAMPLE DISPERSED: 51.2
PERCENT PASSING #10 SIEVE: 100.0

SPECIFIC GRAVITY OF SOLIDS: 2.650 Assumed

HYDROMETER RESULTS (% PASSING)

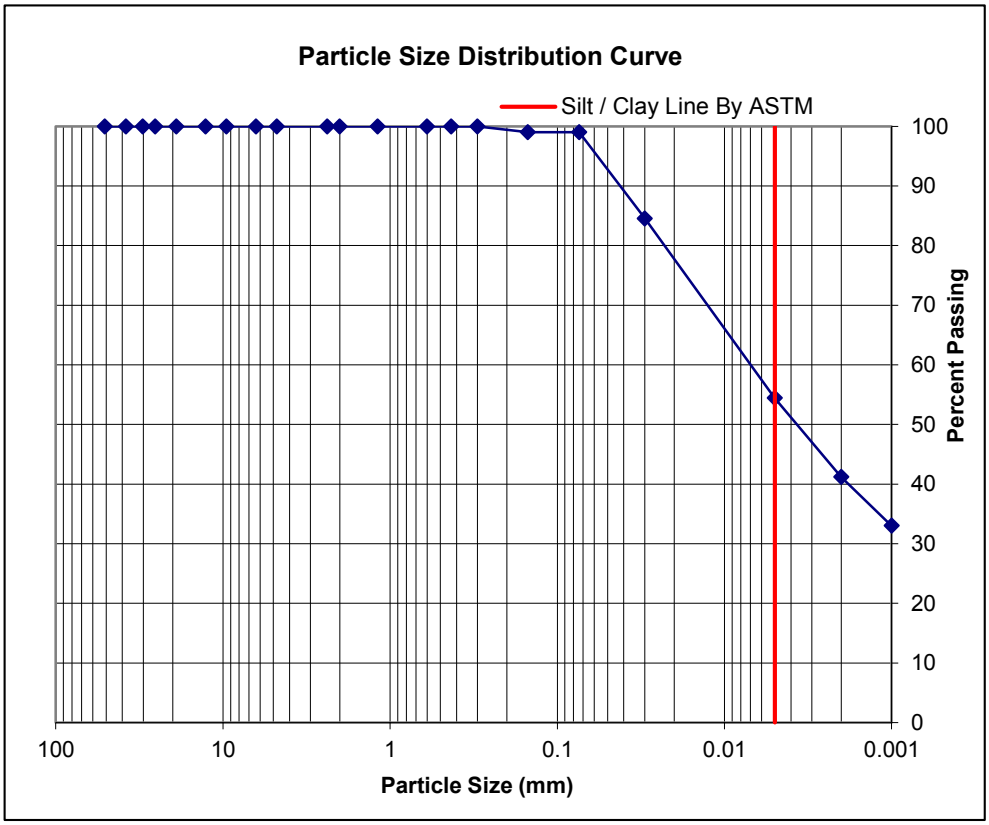
PARTICLE SIZE (DIA. mm)	0.0438	0.0283	0.0168	0.0123	0.0089	0.0046	0.0020	0.0014
PERCENT SAMPLE TESTED	87.9	84.0	78.2	70.3	65.5	52.8	41.0	37.1
PERCENT TOTAL SAMPLE	87.9	84.0	78.2	70.3	65.5	52.8	41.0	37.1

MECHANICAL SIEVE ANALYSIS AFTER HYDROMETER (% PASSING)

SCREEN SIZE	#200	#100	#50	#40	#30	#16	#10
PERCENT TOTAL SAMPLE	99.0	99.4	99.6	99.6	99.8	100.0	100.0

FULL SIEVE ANALYSIS MECHANICAL SIEVE & HYDROMETER

	% Pass	Spec
2 IN	100	
1 1/2 IN	100	
1 1/4 IN	100	
1 IN	100	
3/4 IN	100	
1/2 IN	100	
3/8 IN	100	
1/4 IN	100	
# 4	100	
# 8	100	
# 10	100	
# 16	100	
# 30	100	
# 40	100	
# 50	100	
# 100	99	
# 200	99	
0.03 mm	84.6	
0.005 mm	54.4	
0.002 mm	41.2	
0.001 mm	33.0	



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	USCS
	B-5	40.5-41.0	49	20	29	--	--	0.007	--	--	99.0	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

Ninyo & Moore	PARTICLE-SIZE ANALYSIS OF SOILS (ASTM D422)	FIGURE
PROJECT NO. 604667003 / DATE 3/17	STANTEC/MWH/LAB TESTING PHOENIX, ARIZONA	

WEIGHT OF SAMPLE DISPERSED: 50.0
PERCENT PASSING #10 SIEVE: 100.0

SPECIFIC GRAVITY OF SOLIDS: 2.650 Assumed

HYDROMETER RESULTS (% PASSING)

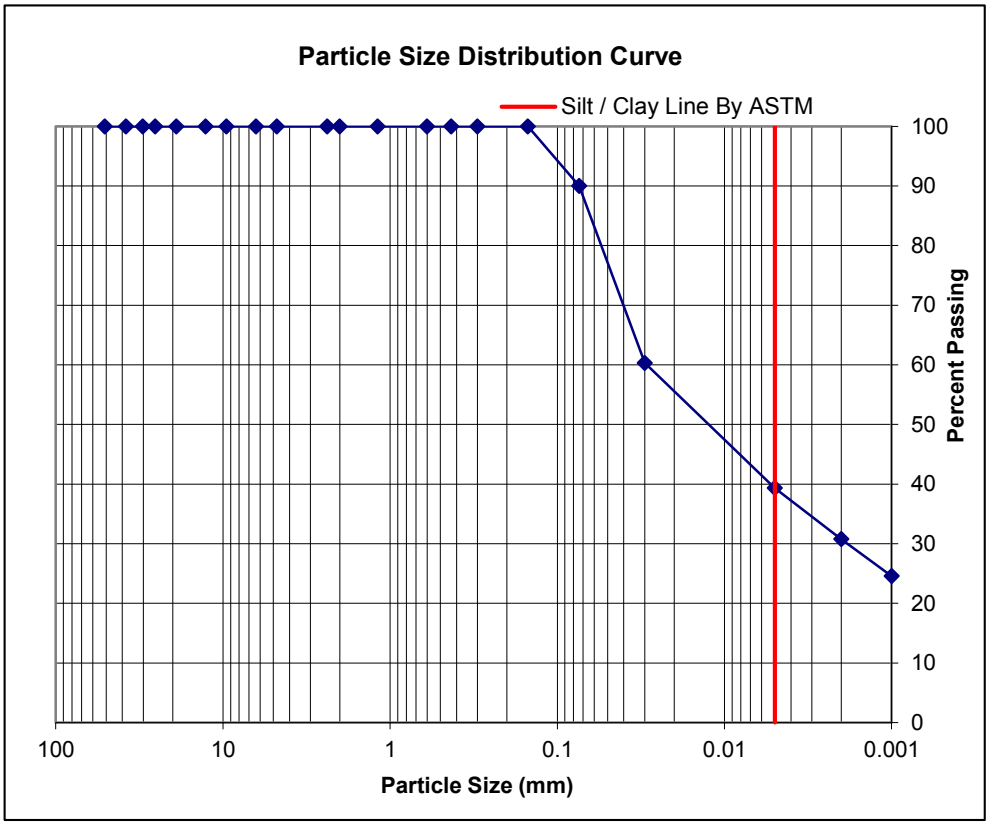
PARTICLE SIZE (DIA. mm)	0.0485	0.0315	0.0187	0.0134	0.0096	0.0048	0.0021	0.0015
PERCENT SAMPLE TESTED	68.0	61.0	54.0	50.0	46.0	39.0	31.0	28.0
PERCENT TOTAL SAMPLE	68.0	61.0	54.0	50.0	46.0	39.0	31.0	28.0

MECHANICAL SIEVE ANALYSIS AFTER HYDROMETER (% PASSING)

SCREEN SIZE	#200	#100	#50	#40	#30	#16	#10
PERCENT TOTAL SAMPLE	89.8	99.6	99.8	100.0	100.0	100.0	100.0

FULL SIEVE ANALYSIS MECHANICAL SIEVE & HYDROMETER

	% Pass	Spec
2 IN	100	
1 1/2 IN	100	
1 1/4 IN	100	
1 IN	100	
3/4 IN	100	
1/2 IN	100	
3/8 IN	100	
1/4 IN	100	
# 4	100	
# 8	100	
# 10	100	
# 16	100	
# 30	100	
# 40	100	
# 50	100	
# 100	100	
# 200	90	
0.03 mm	60.3	
0.005 mm	39.3	
0.002 mm	30.8	
0.001 mm	24.6	



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	USCS
	B-6	15.0-16.0	42	17	25	--	0.002	0.029	--	--	90.0	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

Ninyo & Moore	PARTICLE-SIZE ANALYSIS OF SOILS (ASTM D422)	FIGURE
PROJECT NO. 604667003 / DATE 3/17	STANTEC/MWH/LAB TESTING PHOENIX, ARIZONA	

WEIGHT OF SAMPLE DISPERSED: 50.0
PERCENT PASSING #10 SIEVE: 100.0

SPECIFIC GRAVITY OF SOLIDS: 2.650 Assumed

HYDROMETER RESULTS (% PASSING)

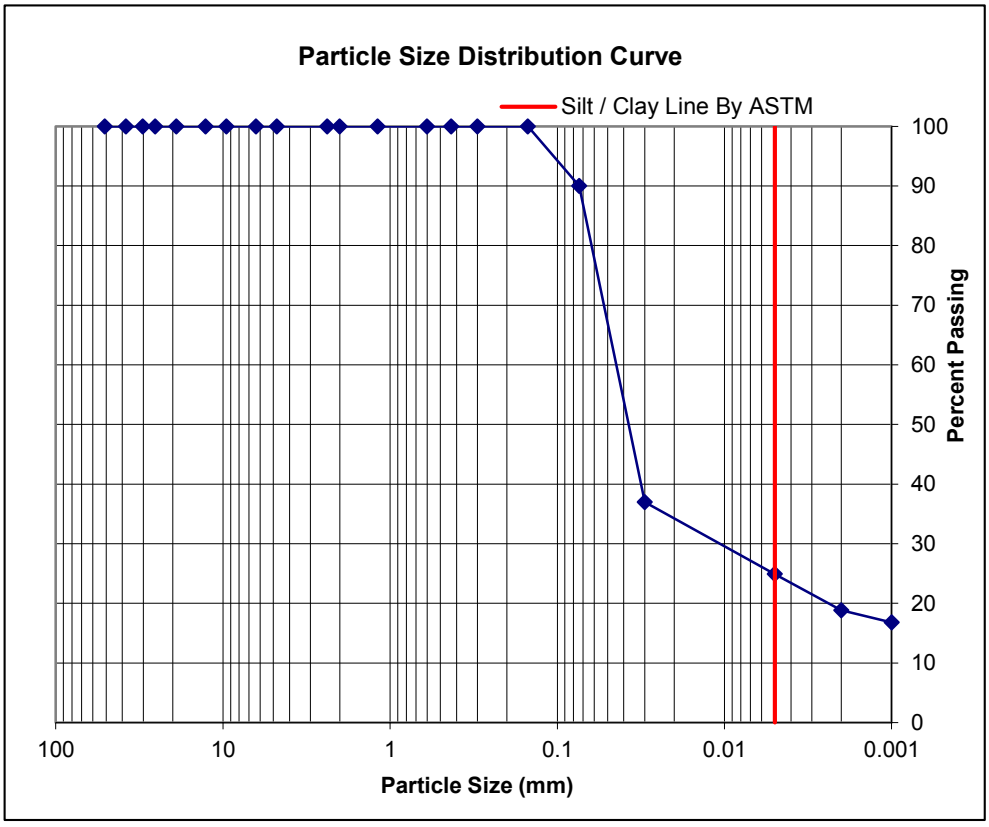
PARTICLE SIZE (DIA. mm)	0.0535	0.0343	0.0201	0.0143	0.0102	0.0051	0.0021	0.0015
PERCENT SAMPLE TESTED	42.0	38.0	34.0	32.0	29.0	25.0	19.0	18.0
PERCENT TOTAL SAMPLE	42.0	38.0	34.0	32.0	29.0	25.0	19.0	18.0

MECHANICAL SIEVE ANALYSIS AFTER HYDROMETER (% PASSING)

SCREEN SIZE	#200	#100	#50	#40	#30	#16	#10
PERCENT TOTAL SAMPLE	89.8	99.6	99.8	100.0	100.0	100.0	100.0

FULL SIEVE ANALYSIS MECHANICAL SIEVE & HYDROMETER

	% Pass	Spec
2 IN	100	
1 1/2 IN	100	
1 1/4 IN	100	
1 IN	100	
3/4 IN	100	
1/2 IN	100	
3/8 IN	100	
1/4 IN	100	
# 4	100	
# 8	100	
# 10	100	
# 16	100	
# 30	100	
# 40	100	
# 50	100	
# 100	100	
# 200	90	
0.03 mm	37.0	
0.005 mm	24.9	
0.002 mm	18.8	
0.001 mm	16.8	



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	USCS
	B-7	10.5-11.0	--	--	N Test	--	0.011	0.044	--	--	90.0	

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

Ninyo & Moore	PARTICLE-SIZE ANALYSIS OF SOILS (ASTM D422)	FIGURE
PROJECT NO. 604667003 / DATE 3/17	STANTEC/MWH/LAB TESTING PHOENIX, ARIZONA	

WEIGHT OF SAMPLE DISPERSED: 49.8
PERCENT PASSING #10 SIEVE: 100.0

SPECIFIC GRAVITY OF SOLIDS: 2.650 Assumed

HYDROMETER RESULTS (% PASSING)

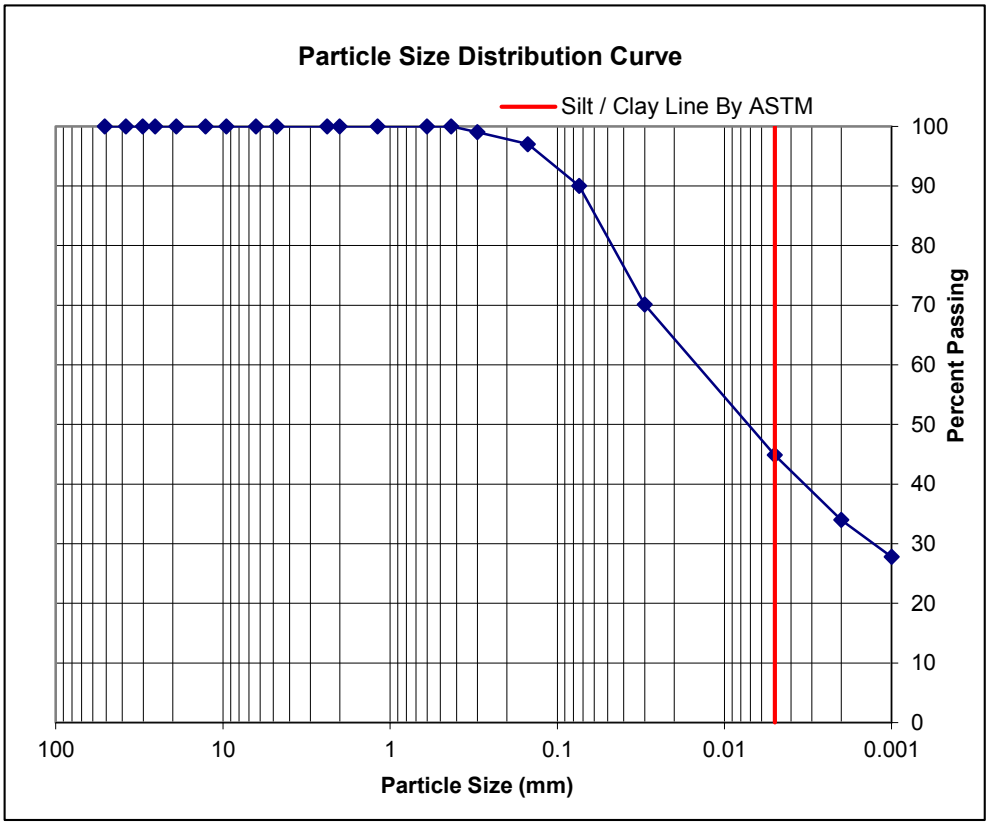
PARTICLE SIZE (DIA. mm)	0.0470	0.0304	0.0181	0.0131	0.0094	0.0048	0.0020	0.0015
PERCENT SAMPLE TESTED	75.3	70.3	63.2	57.2	53.2	44.2	34.1	31.1
PERCENT TOTAL SAMPLE	75.3	70.3	63.2	57.2	53.2	44.2	34.1	31.1

MECHANICAL SIEVE ANALYSIS AFTER HYDROMETER (% PASSING)

SCREEN SIZE	#200	#100	#50	#40	#30	#16	#10
PERCENT TOTAL SAMPLE	90.0	97.0	99.4	99.6	99.6	99.8	100.0

FULL SIEVE ANALYSIS MECHANICAL SIEVE & HYDROMETER

	% Pass	Spec
2 IN	100	
1 1/2 IN	100	
1 1/4 IN	100	
1 IN	100	
3/4 IN	100	
1/2 IN	100	
3/8 IN	100	
1/4 IN	100	
# 4	100	
# 8	100	
# 10	100	
# 16	100	
# 30	100	
# 40	100	
# 50	99	
# 100	97	
# 200	90	
0.03 mm	70.1	
0.005 mm	44.9	
0.002 mm	34.0	
0.001 mm	27.8	



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	USCS
	TP-1	BUCKET	--	--	N Tested	--	0.001	0.015	--	--	90.0	

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

Ninyo & Moore	PARTICLE-SIZE ANALYSIS OF SOILS (ASTM D422)	FIGURE
PROJECT NO. 604667003 / DATE 3/17	STANTEC/MWH/LAB TESTING PHOENIX, ARIZONA	

WEIGHT OF SAMPLE DISPERSED: 54.5
PERCENT PASSING #10 SIEVE: 99.8

SPECIFIC GRAVITY OF SOLIDS: 2.650 Assumed

HYDROMETER RESULTS (% PASSING)

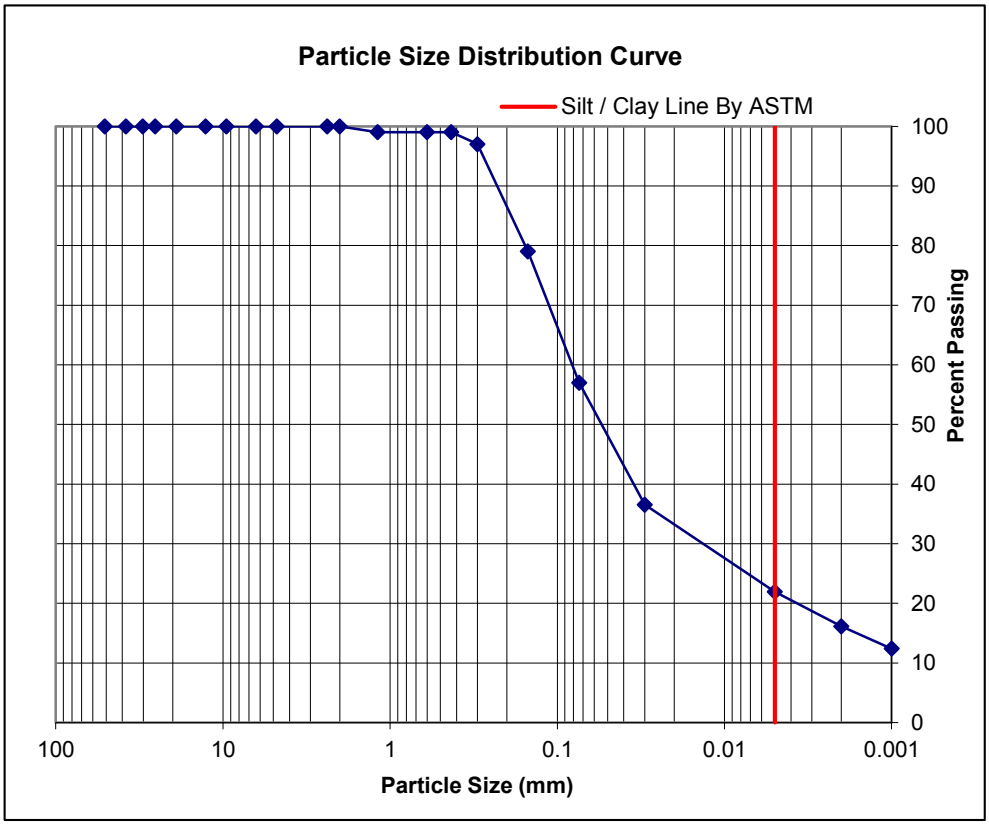
PARTICLE SIZE (DIA. mm)	0.0531	0.0339	0.0199	0.0142	0.0102	0.0051	0.0021	0.0015
PERCENT SAMPLE TESTED	40.4	37.6	33.0	31.2	27.5	22.0	16.5	14.7
PERCENT TOTAL SAMPLE	40.3	37.5	33.0	31.1	27.5	22.0	16.5	14.6

MECHANICAL SIEVE ANALYSIS AFTER HYDROMETER (% PASSING)

SCREEN SIZE	#200	#100	#50	#40	#30	#16	#10
PERCENT TOTAL SAMPLE	56.8	79.3	96.5	98.5	99.1	99.4	99.8

FULL SIEVE ANALYSIS MECHANICAL SIEVE & HYDROMETER

	% Pass	Spec
2 IN	100	
1 1/2 IN	100	
1 1/4 IN	100	
1 IN	100	
3/4 IN	100	
1/2 IN	100	
3/8 IN	100	
1/4 IN	100	
# 4	100	
# 8	100	
# 10	100	
# 16	99	
# 30	99	
# 40	99	
# 50	97	
# 100	79	
# 200	57	
0.03 mm	36.5	
0.005 mm	21.9	
0.002 mm	16.1	
0.001 mm	12.4	

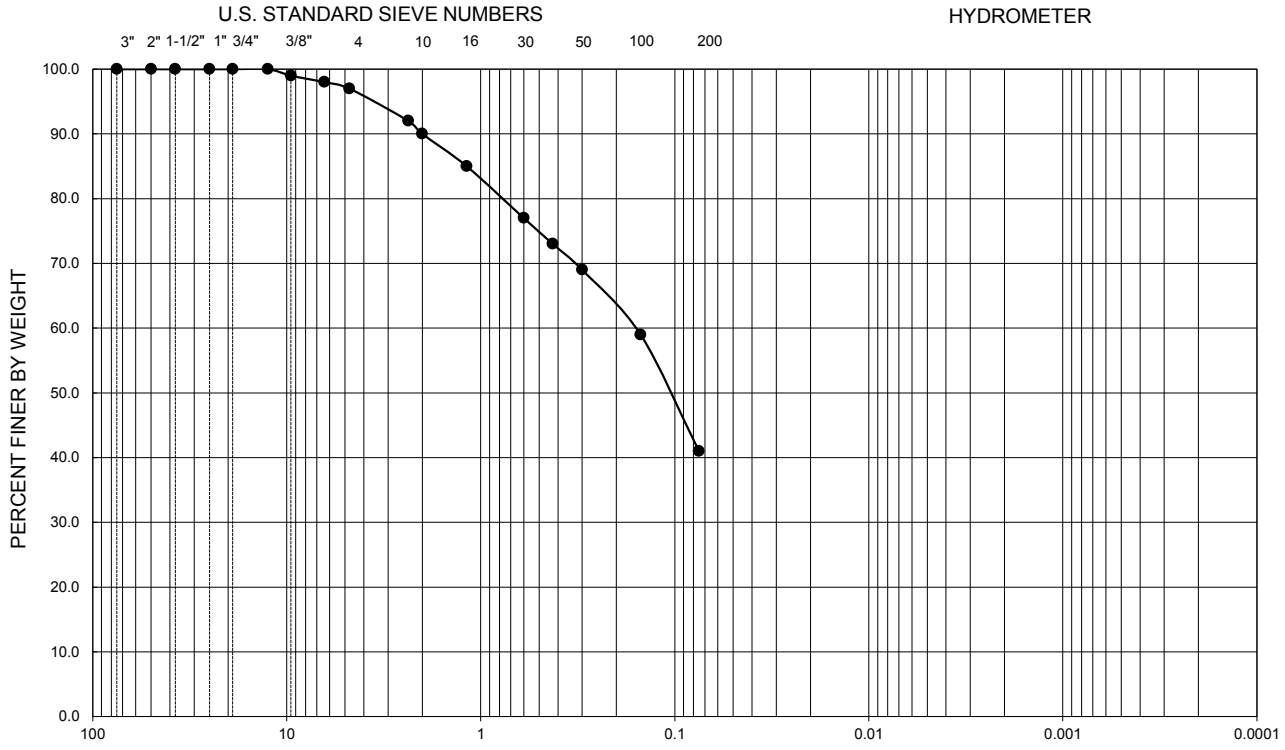


Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	USCS
	TP-2	BUCKET	--	--	N Tested	--	0.013	0.081	--	--	57.0	

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

Ninyo & Moore	PARTICLE-SIZE ANALYSIS OF SOILS (ASTM D422)	FIGURE
PROJECT NO. 604667003 / DATE 3/17	STANTEC/MWH/LAB TESTING PHOENIX, ARIZONA	

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	USCS
●	TP-3	BUCKET	--	--	NT	--	--	0.16	--	--	41.0	

PERFORMED IN GENERAL ACCORDANCE WITH ASTM C136 AND C117

Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO.	DATE	STANTEC/MWH/LAB TESTING
604667003	3/17	PHOENIX, ARIZONA

WEIGHT OF SAMPLE DISPERSED: 51.8
PERCENT PASSING #10 SIEVE: 94.9

SPECIFIC GRAVITY OF SOLIDS: 2.650 Assumed

HYDROMETER RESULTS (% PASSING)

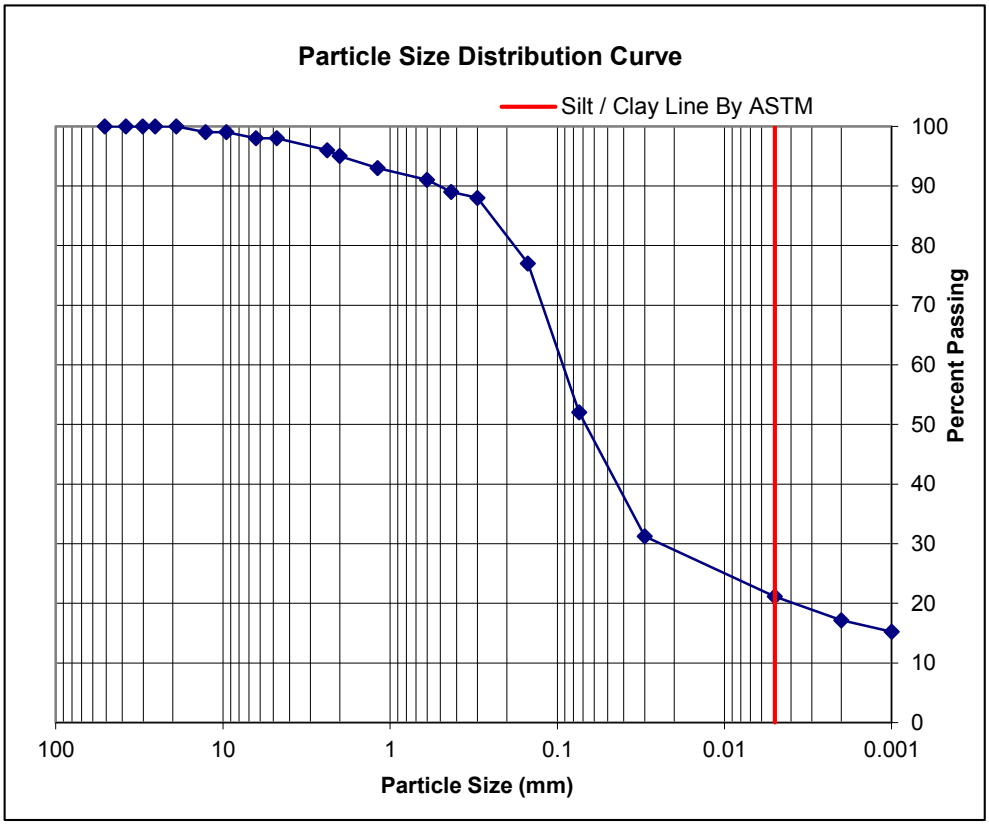
PARTICLE SIZE (DIA. mm)	0.0544	0.0347	0.0204	0.0145	0.0103	0.0051	0.0022	0.0015
PERCENT SAMPLE TESTED	35.7	32.8	27.0	27.0	24.1	21.2	17.4	16.4
PERCENT TOTAL SAMPLE	33.9	31.1	25.6	25.6	22.9	20.1	16.5	15.6

MECHANICAL SIEVE ANALYSIS AFTER HYDROMETER (% PASSING)

SCREEN SIZE	#200	#100	#50	#40	#30	#16	#10
PERCENT TOTAL SAMPLE	51.7	76.8	87.7	89.4	91.0	92.9	94.9

FULL SIEVE ANALYSIS MECHANICAL SIEVE & HYDROMETER

	% Pass	Spec
2 IN	100	
1 1/2 IN	100	
1 1/4 IN	100	
1 IN	100	
3/4 IN	100	
1/2 IN	99	
3/8 IN	99	
1/4 IN	98	
# 4	98	
# 8	96	
# 10	95	
# 16	93	
# 30	91	
# 40	89	
# 50	88	
# 100	77	
# 200	52	
0.03 mm	31.2	
0.005 mm	21.1	
0.002 mm	17.2	
0.001 mm	15.2	



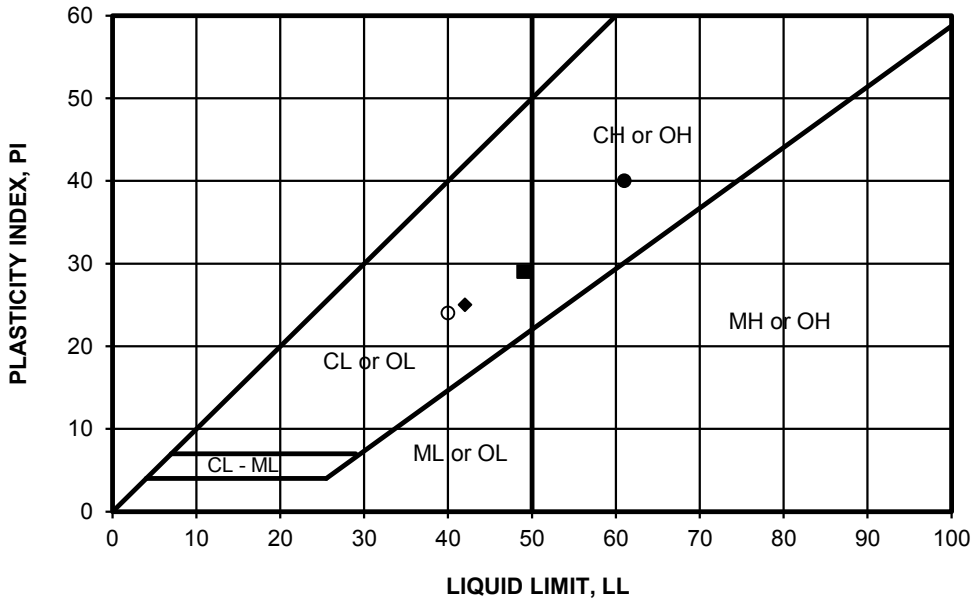
Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	USCS
	TP-4	BUCKET	--	--	N Tested	--	0.024	0.093	--	--	52.0	

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

Ninyo & Moore	PARTICLE-SIZE ANALYSIS OF SOILS (ASTM D422)	FIGURE
PROJECT NO. 604667003 / DATE 3/17	STANTEC/MWH/LAB TESTING PHOENIX, ARIZONA	

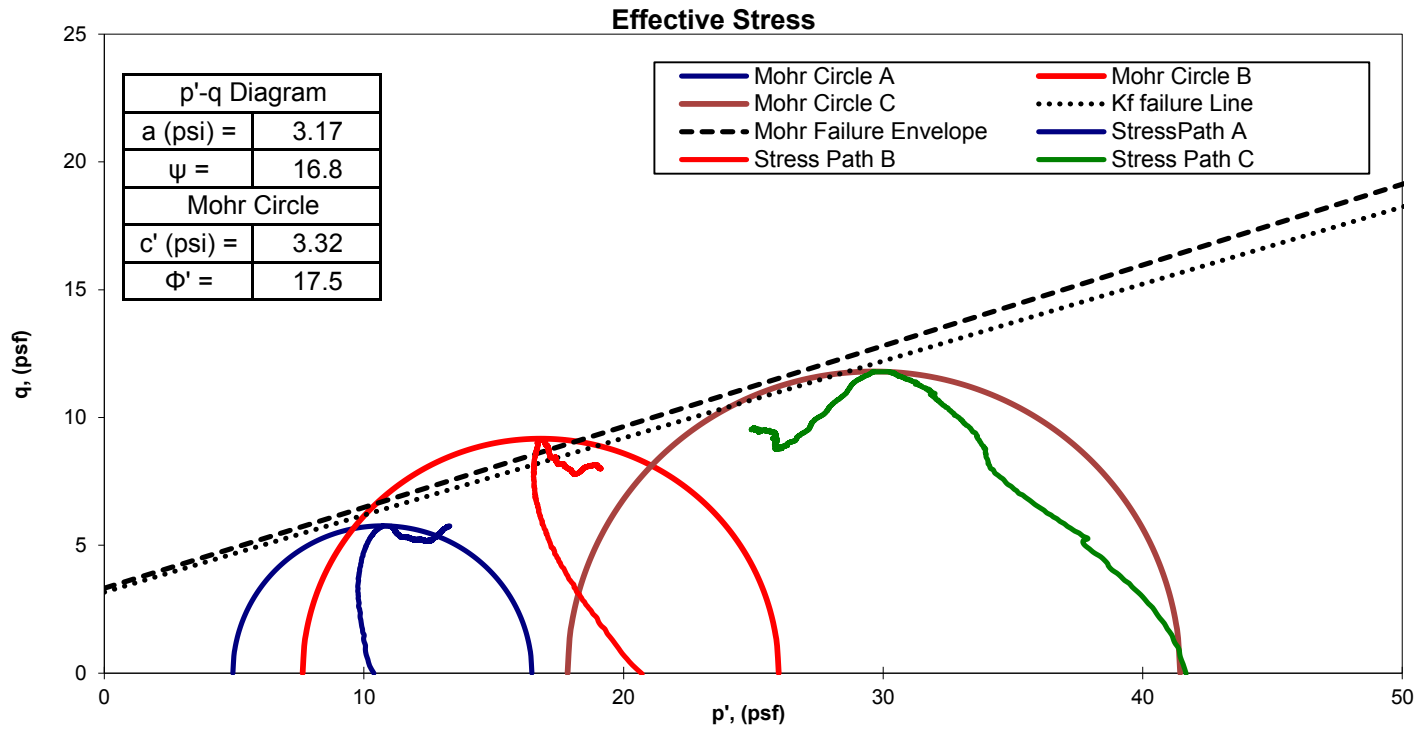
SYMBOL	LOCATION	DEPTH (FT)	LIQUID LIMIT, LL	PLASTIC LIMIT, PL	PLASTICITY INDEX, PI	USCS CLASSIFICATION (Fraction Finer Than No. 40 Sieve)	USCS (Entire Sample)
●	B-5	TW 25-27	61	21	40	CH	CH
■	B-5	40.5-41.0	49	20	29	CL	CL
◆	B-6	15.0-16.0	42	17	25	CL	CL
○	B7	30.5-31.0	40	16	24	CL	CL

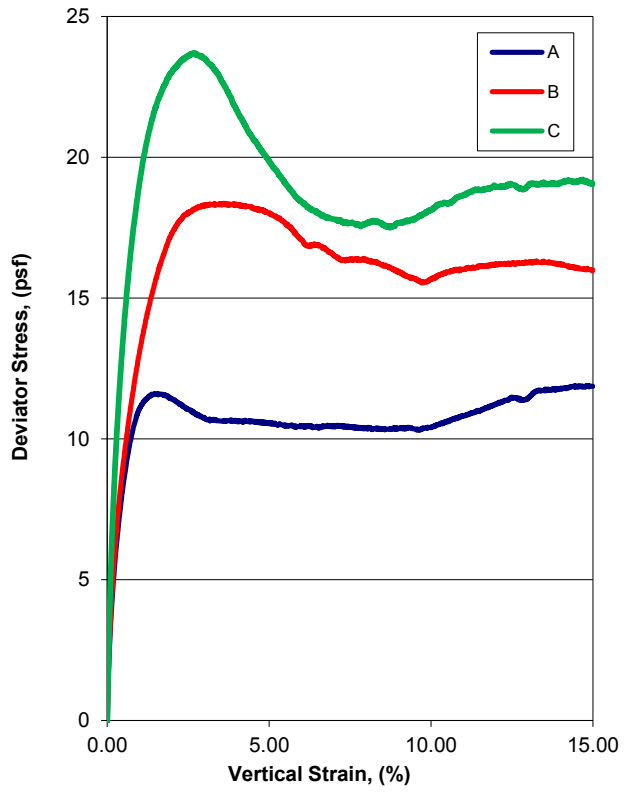
NP - INDICATES NON-PLASTIC



PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 4318

Ninyo & Moore		ATTERBERG LIMITS TEST RESULTS	FIGURE
PROJECT NO.	DATE	STANTEC/MWH/LAB TESTING PHOENIX, ARIZONA	
604667003	3/17		

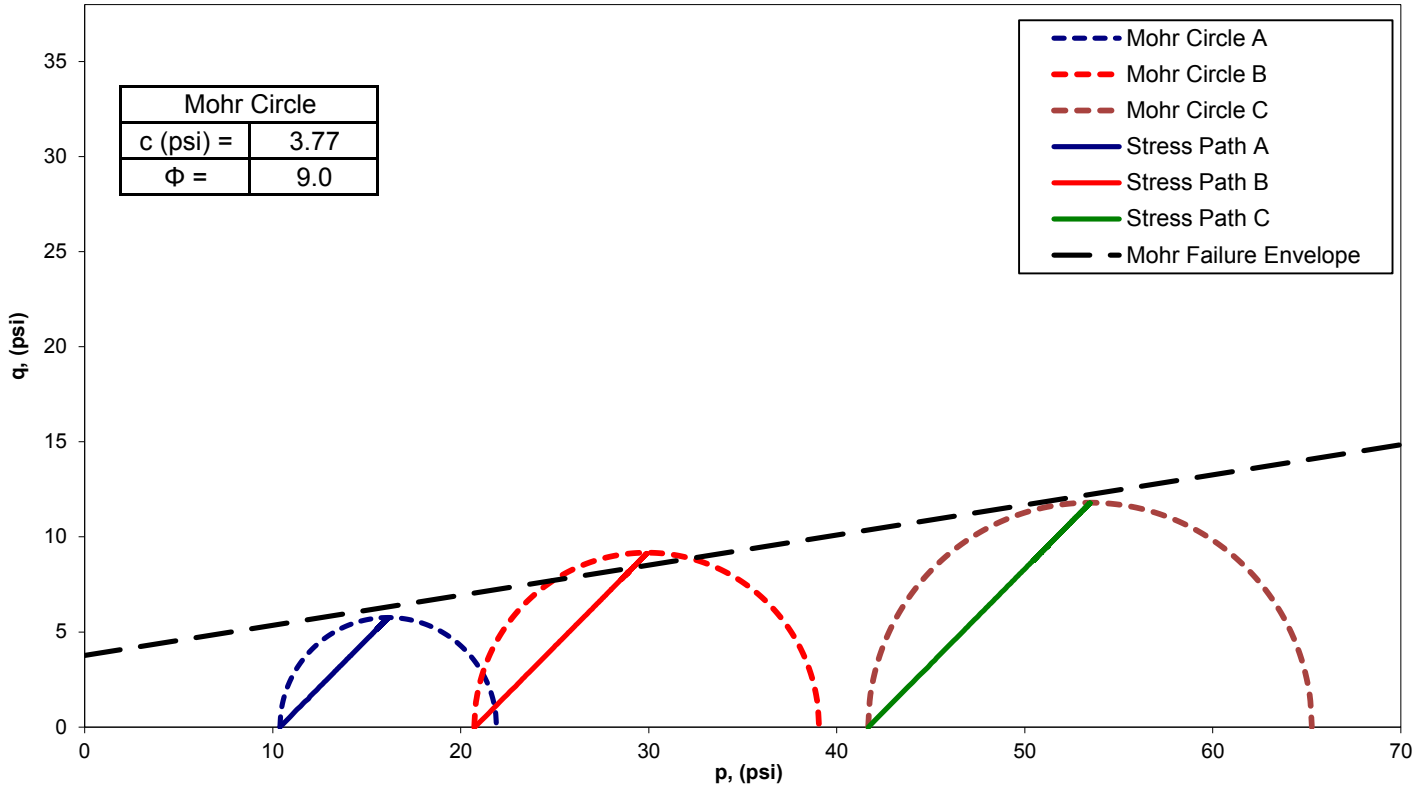


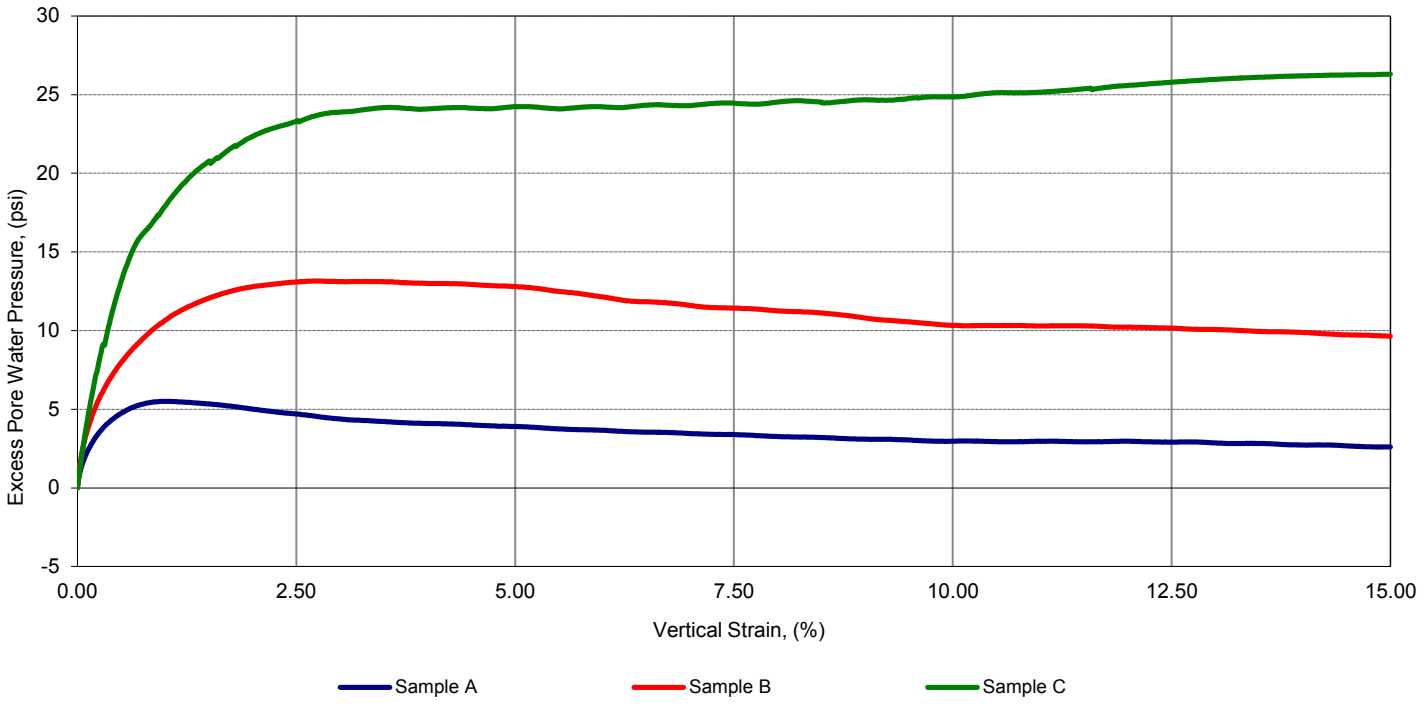


Location:		B-5		
Sample Depth:		TW 25.0-27.0		
Lab Technican:		JCE		
Checked By:		HJG		
Sample ID		A	B	C
Date Tested		2/25/2017	2/25/2017	2/25/2017
Initial	Diameter, in	2.88	2.88	2.87
	Height, in	5.68	5.71	5.68
	Water Content %	21.3%	21.5%	20.8%
	Dry Density, pcf	99.1	98.3	99.0
	Saturation, %	82.3%	81.2%	80.0%
	Void Ratio	0.700	0.714	0.701
Before Shear	Water Content %	26.1%	25.9%	25.0%
	Dry Density, pcf	96.8	98.5	98.4
	Saturation, %	100.0%	100.0%	100.0%
	Void Ratio	0.741	0.710	0.712
	Back pressure, psf	50	50	50
Obliquity Effective Failture %		1.28	3.32	2.89
Obliquity Total Failture %		1.28	3.32	2.89
Effective Confinement, psi		10.4	20.7	41.7
B- Value		0.95	0.95	0.95
Strain Rate, %/min		0.05	0.05	0.05

Ninyo & Moore		**Consolidated Undrained Triaxial Test Data Sheet**	**Figure**
Project Number	**Date**	STANTEC/MWH/LAB TESTING PHOENIX, ARIZONA	
604667003	**3/17**		

Total Stress

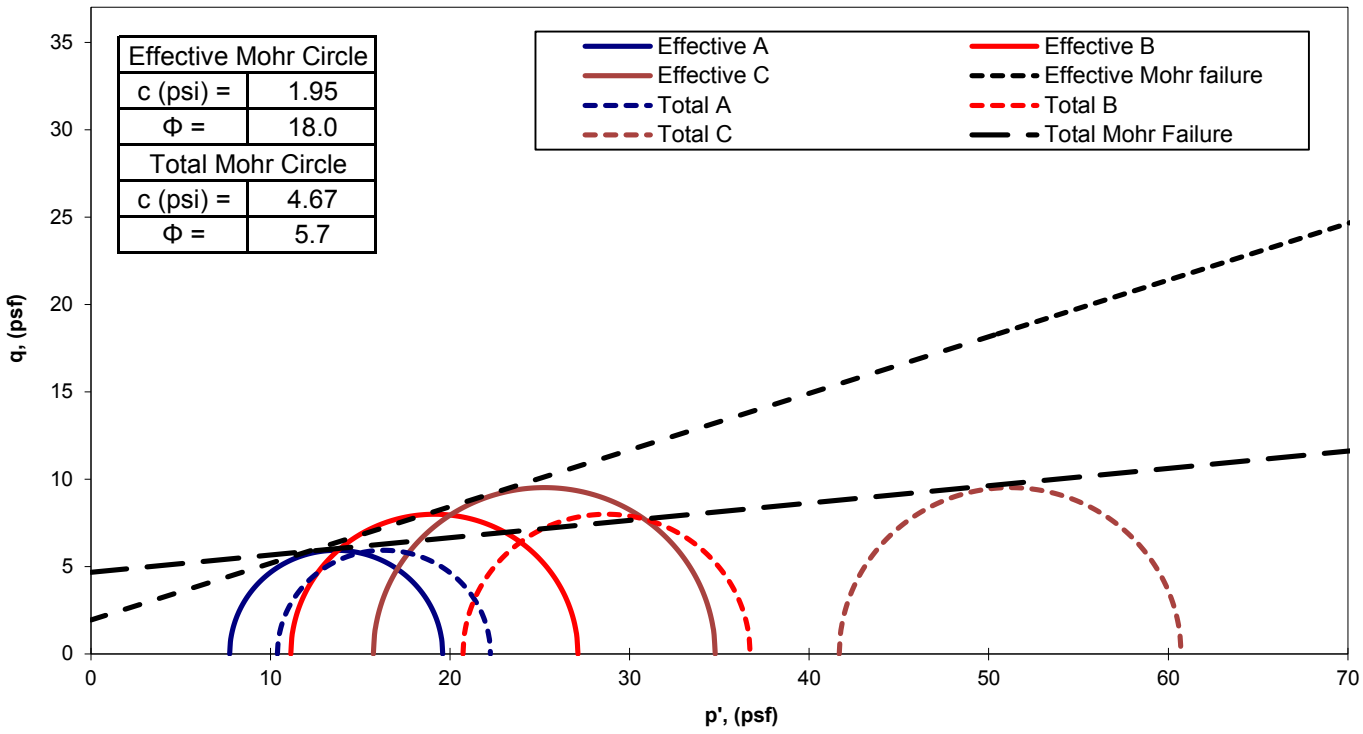


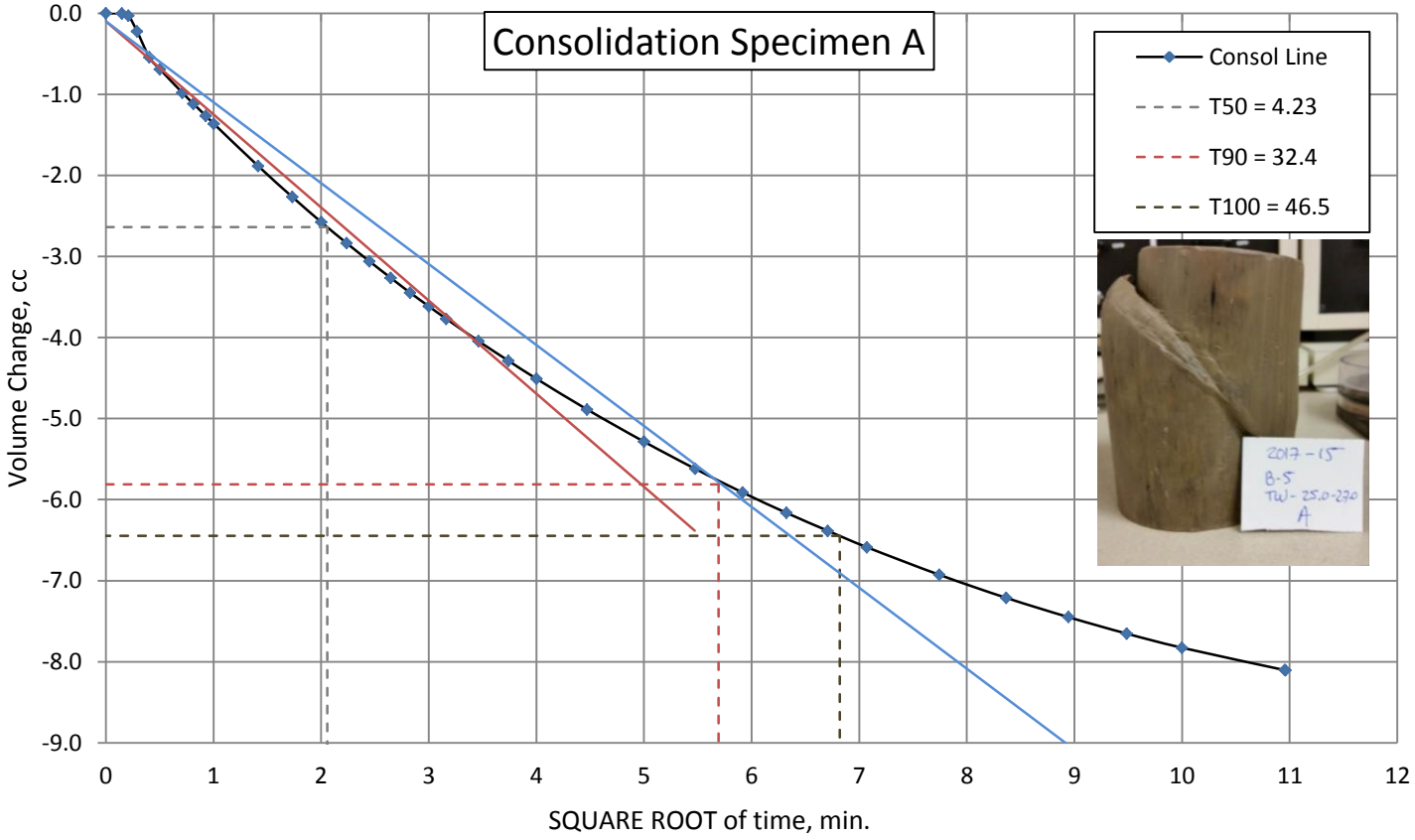


Ninyo & Moore		Consolidated Undrained Triaxial Test Data Sheet	Figure
Location:	B-5	STANTEC/MWH/LAB TESTING PHOENIX, ARIZONA	
Sample Depth (ft):	TW 25.0-27.0		
Project Number:	604667003		
Date:	3/17		

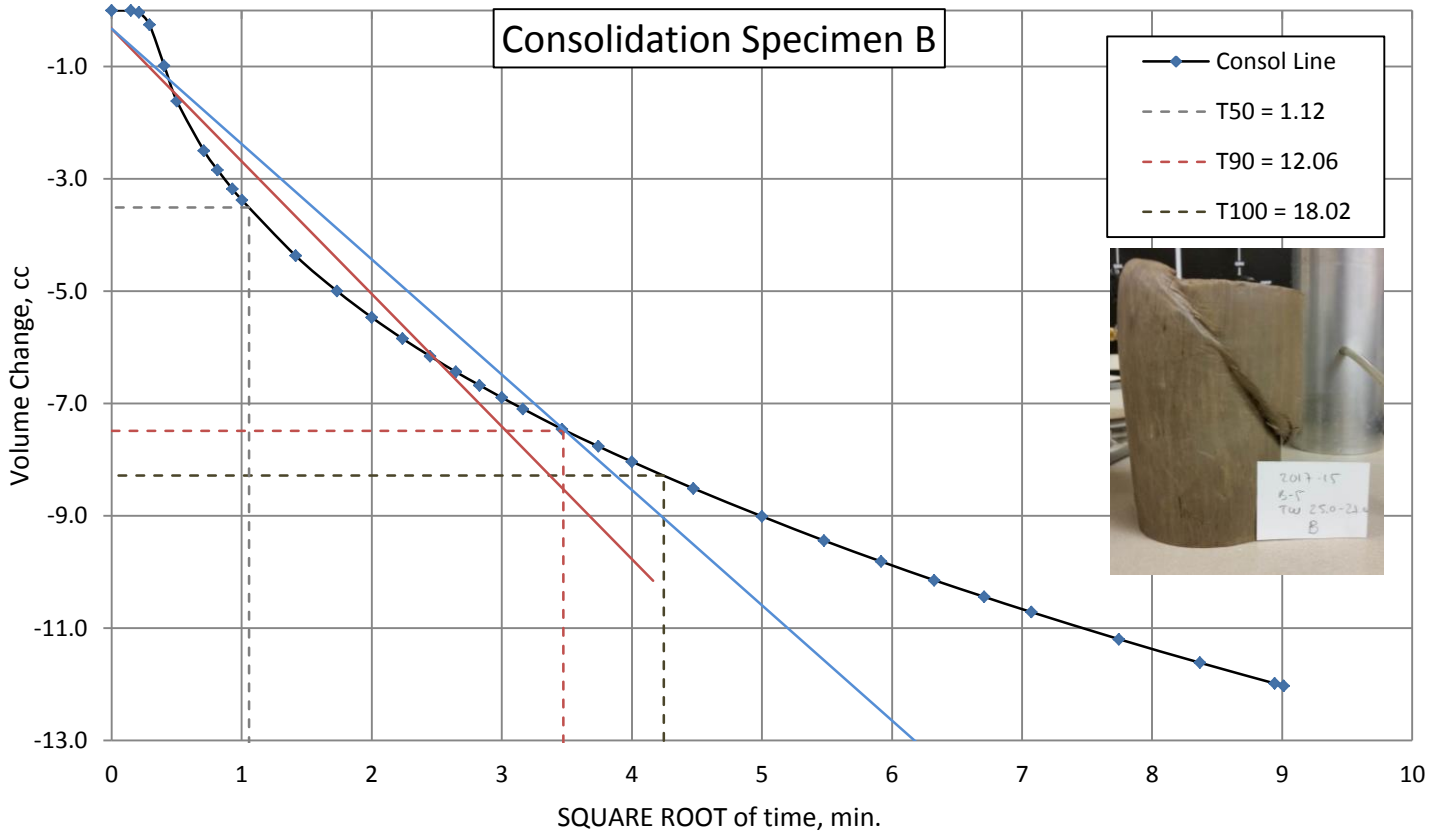
Effective & Total Stress at 15% Shear

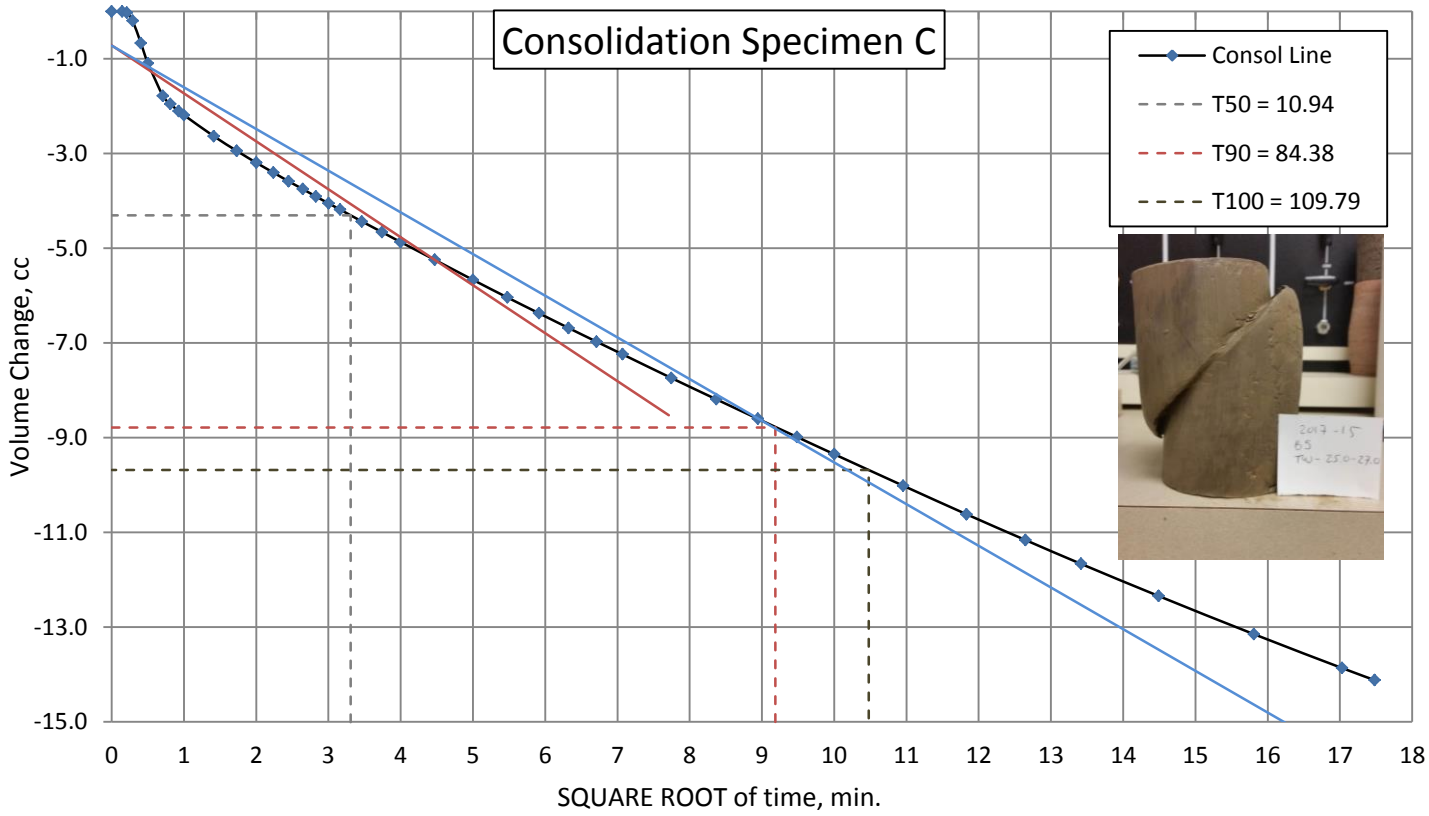
Effective Mohr Circle	
c (psi) =	1.95
Φ =	18.0
Total Mohr Circle	
c (psi) =	4.67
Φ =	5.7





Ninyo & Moore		Consolidated Undrained Triaxial Test Data Sheet	Figure
Location:	B-5		
Sample Depth (ft):	TW 25.0-27.0	STANTEC/MWH/LAB TESTING	
Project Number:	604667003	PHOENIX, ARIZONA	
Date:	3/17		





Ninyo & Moore		Consolidated Undrained Triaxial Test Data Sheet	Figure
Location:	B-5		
Sample Depth (ft):	TW 25.0-27.0	STANTEC/MWH/LAB TESTING	
Project Number:	604667003	PHOENIX, ARIZONA	
Date:	3/17		

SAMPLE LOCATION	COMPRESSION STRENGTH Lb/ft2	VOLUMETRIC DENSITY pcf	SPECIFIC GRAVITY	ABSORTION %	INITIAL MOISTURE %	SULFATE SOUNDNESS % LOSS
B-1 5.3-9.5	1210	117.4	1.871	10.8	5.6	100.0
B-1 17.3-18.0	2560	135.3	2.096	7.4	2.8	81.8
B-2 26.45-27.25	2490	129.1	2.006	8.1	10.3	88.6
B-3 24.2-24.9	1390	115.6	1.937	9.3	3.9	87.7
B-3 24.9-25.6	1230	117.1	1.920	9.7	3.2	100.0

Ninyo & Moore		COMPRESSIVE STRENGTH OF SOIL SPECIMENS	FIGURE
PROJECT NO.	DATE	STANTEC/MWH/LAB TESTING PHOENIX, ARIZONA	
604667003	3/17		

APPENDIX D PETROGRAPHIC ANALYSIS FOR RIRPAP SOURCES

MWH now part of Stantec

Memo

To:	UNC/GE	From:	Stantec Consulting Services Inc.
File:	NECR Removal Action 60% Design Petrographic Analysis	Date:	April 24, 2017

Introduction

This memorandum has been prepared to assess the suitability of three rock samples for durability and long-term weathering for the project. The three samples analyzed were an igneous rock, a carbonate, and a sandstone. The igneous rock and the carbonate are from offsite quarries. The sandstone is from a rock core sample collected near the buried rock jetty area. The conclusions presented in this document are the results of hand sample and microscopic examination of thin sections analyses of the three samples. Two pieces of the each rock were chosen for thin sections (2 cm x 4 cm) and studied under the petrographic microscope.

Summary

Sandstone – Sampled from the UNC Mill Site

Modal analyses showed that the sandstone is a quartz arenite according to the classification of Folk (1974). The original sample was collected from 2-inch diameter core. The sandstone is fine (0.1mm) to medium (0.25 mm) grained, moderately well sorted, and loosely packed. The sandstone has a weak structure due to the fact that most quartz grains have poorly developed secondary quartz overgrowths, with additional weak cementation resulting from iron oxide and clay formation in the pore spaces.

The bulk of the sandstone is primarily composed of quartz. Subordinate constituents are iron oxides, clays, and rare calcite minerals. Abundant porosity results from the point-to-point grain contacts throughout the sample. These pores appear to be well connected in the two dimensional framework of the thin section, and are probably commonly interconnected in three dimensions. Unlike typical quarts arenites, secondary quartz overgrowths are rare, resulting in a highly friable rock with little competency.

Carbonate (Tampico Limestone)

The limestone sample contains predominately calcite with notable amounts of dolomite. The original rock fragment was approximately 20 cm in diameter and had a pink to rose color. The sample composed of interlocking very fine (0.05 mm) to medium (0.25 mm) grained carbonate crystals, numerous fractures and vugs are filled with large grained recrystallized calcite. The pink coloration is a result of trace amount of iron oxide within the limestone.

With the exception of trace amounts of iron oxide the sample contained only massively interlocking carbonate (calcite and dolomite) grains. The natural filled fractures do not provide

structural weakness or a natural flowpath. Rare, isolated, small (0.1mm) pore spaces were observed; however no pore spaces were noted to be connecting, suggesting that the rock has very low effective porosity.

Igneous Rock (Page Granite)

Modal mineral analysis of the igneous sample showed that it is a granite. The original rock fragment was approximately 20 cm in diameter and had a dark pink to red color. The sample composed of fine (0.1 mm) to medium (0.25 mm) grained interlocking crystals. In decreasing abundance the granite contained quartz, orthoclase, plagioclase, hornblende, mica, and hematite. The red coloration results from the abundance of orthoclase (which is pink) and trace amount of iron oxide observed staining some of the grain boundaries. Rare, isolated, small (0.1mm) pore spaces were observed; however, no pore spaces were noted to be connecting, suggesting that the rock has very low effective porosity.

Conclusions

Sandstone

The sandstone is friable and not structurally competent from a mineralogical perspective. The sandstone is judged to be poor material for riprap, equal to a clay cemented sandstone. Figure 1 presents a subjective assessment of the suitability of the sandstone for riprap material. This sandstone is considered to be approximately 3 in terms of its suitability for riprap material.

Limestone

With the exception of the potential for the limestone to react (and dissolve) under acidic conditions, the limestone sample would make good rip-rap material, slightly less competent than a quartzite. The absence of fractures or effective porosity suggests that freeze/thaw will not cause fracturing of the rock. Because of its potential reactivity, this limestone is subjectively judged to be approximately 7 in terms of its suitability for riprap material (Figure 1).

Granite

The granite is very competent and is judged to be excellent material for riprap. This granite is considered to be 10 in terms of its suitability for riprap material. It is considered to be a "10" because of the low porosity (both primary and secondary), the interlocking nature of the grains, lack of sulfide minerals (Figure 1).

Methods

The samples to be examined were chosen by the petrographer and then cut with a diamond saw to expose fresh, flat surfaces. A rectangular billet was cut out of each of the samples with a diamond saw and mounted on a glass slide. The mounted rocks were then ground to about 30 microns on a lapidary wheel; final polishing was completed with a fine lapidary lap by an automatic procedure and then by hand. The thin sections were impregnated with blue-epoxy

in a heated laboratory vacuum oven. Following evacuation, atmospheric pressure was used to force the blue epoxy into the pores of the samples.

Thin sections were examined using a Leica Ortholux II petrographic microscope. Color photomicrography was done using a Leica EC3 automatic digital camera mounted on top of the petrographic microscope. Photomicrographs were calibrated by use of an E. Leitz Wetzlar stage micrometer with a 0.01 mm graduated scale. Point counts of the two stained thin sections were made by inserting the thin section into a thin section holder, which was attached to the microscope stage. The holder was adjusted so that the slide would move in increments adjusted to the grain size (approximately one increment per grain) of the samples so that the modal analyses would be representative of the samples. Minerals at the points were recorded on a Lab-Count Denominator.

Point counts consisted of 300 points per thin section. Folk (1974) recommended for purposes of statistical accuracy that at least 300 points are necessary to reflect the mineralogy of a sample in a modal analysis.

Holes in sandstone are called "pores". The pores in these are primary pores created by packing of the grains (in the case of the sandstone) or isolated 'vugs' in the granite or limestone sample. These pores are generally no larger than the size of the original feldspar grain or rock fragment (approximately 0.10 to 0.20 mm). Although Folk (1974) recommends that up to 1,000 points in pores be counted per thin section to most accurately assess the amount of porosity, this amount of point-counting is cost prohibitive. Furthermore, when porosity consists of very small moldic pores formed by grain dissolution as in this study, the percentage of porosity acquired from 300 grain pore counts is close enough to the true porosity to be statistically meaningful.

Figure 1. Subjective Estimate of Riprap Suitability

Petrography of the samples

Sample 1. Quartz arenite

Description of sandstone in thin section: Moderately well sorted; poorly-cemented sandstone with predominately 'point-to-point' contacts with cementation dominated by clays and some carbonates. The sample is comprised of mainly quartz with very little altered rock fragments or feldspar; well-developed porosity.

Framework Minerals

Quartz – Fine to medium grained; no quartz overgrowths, long edge to edge contacts rare.

K-feldspar – Angular; very fine grained; one.

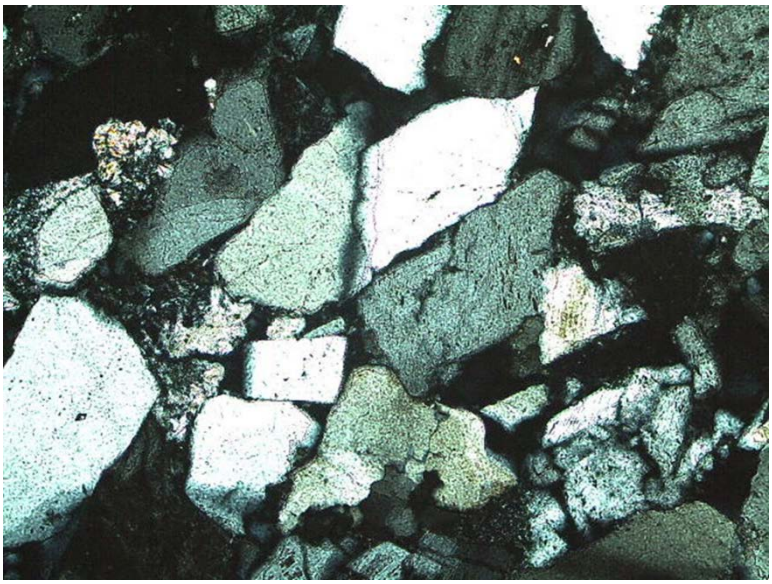
Siltstone rock fragment – Fine grained; subrounded; trace.

Metamorphic rock fragment – Fine grained; mica and quartz; subrounded; trace. Muscovite –0.1 to 0.5 mm long; rare.

Cement

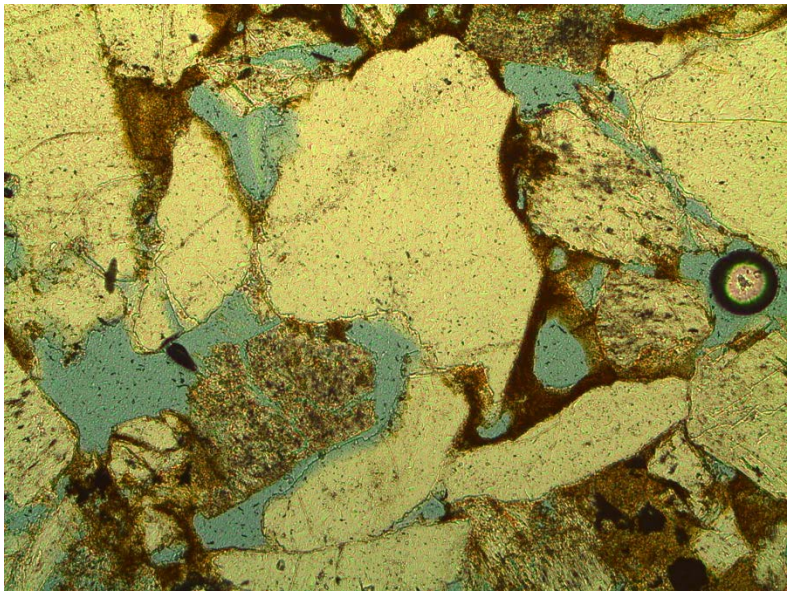
Clay – Clay minerals unidentifiable in thin-section; iron oxide stained; on edges of vugs and in grains.

Iron oxides – Orange-red; pore filling; common.



Photograph 1. Grain-supported quartz matrix, feldspar grain and calcite grains. XP, 100x, FL 1.0 mm.

Photograph 2. Grain-supported quartz matrix (same field of view as Figure 1); feldspar grain and calcite grains identified all other grains are quartz. Blue is epoxy showing pore spaces. LP, 100x, FL 1.0 mm.



Photograph 3. Quartz showing abundant porosity and cementation by iron oxides and clays. PL, 100x, FL 1.0 mm.

XP = Crossed polarizers
PL = Polarized light

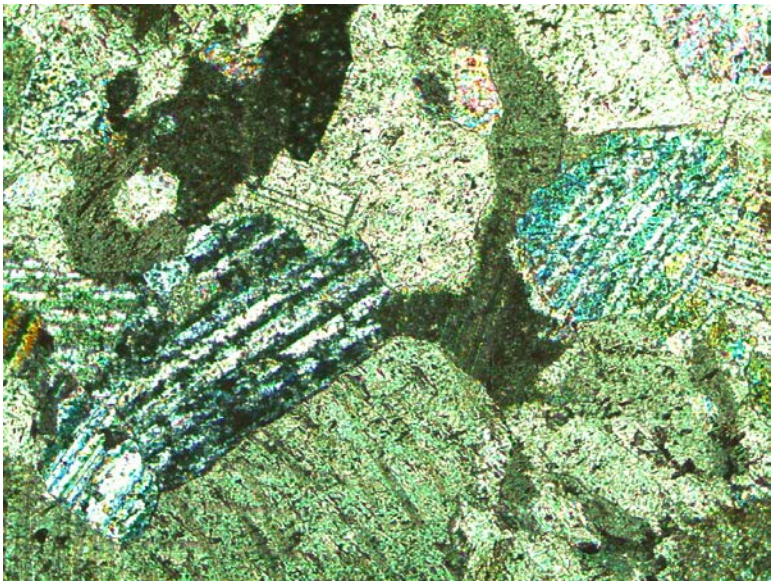
100x = Magnification
FL = Long dimension of image

Sample 2. Limestone
Description of sandstone in thin section: Very fine to medium grained; angular to subangular; close packed (long highly sutured contacts); carbonate grains are intergrown and locally recrystallized; Rare porosity (<1%).

Framework Minerals
Calcite – Occurs in the original rock matrix intergrown with dolomite and recrystallized as fine grained fracture filling.

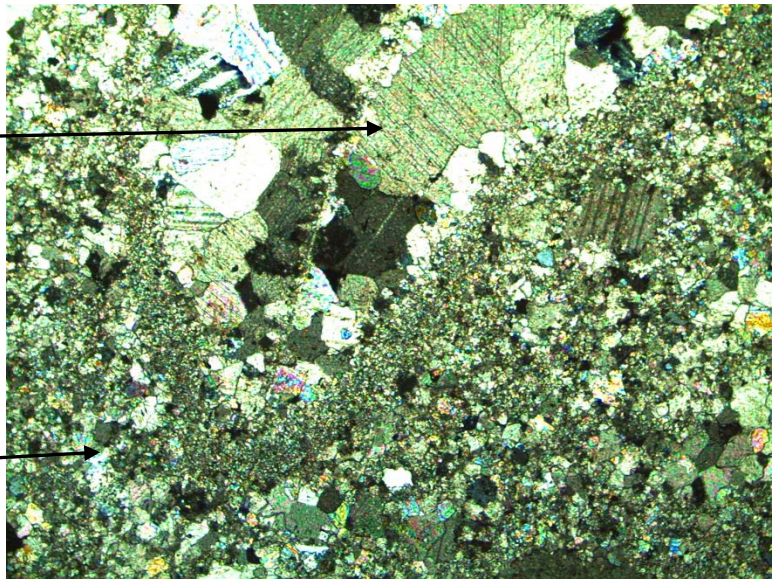
Dolomite - Occurs in the original rock matrix intergrown with calcite.

Accessory Minerals
None noted.



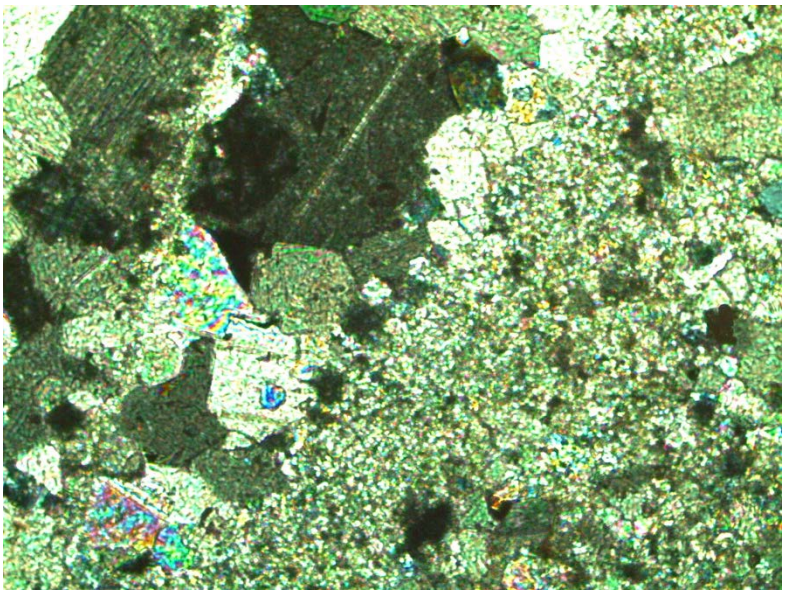
Photograph 4. Interlocking and intergrown carbonate minerals.

XP, 100x, FL 1.0 mm.



Photograph 5. Very fine grained calcite fracture filling.

XP, 40x, FL 2.5 mm.



Photograph 6. Close-up of Figure 5. Note intergrown crystals.

XP, 100x, FL 1.0 mm.

XP = Crossed polarizers
PL = Polarized light
100x = Magnification

FL = Long dimension of image

Sample 3. Granite

Description of sample in thin section: The sample composed of fine (0.1 mm) to medium (0.25 mm) grained interlocking crystals. In decreasing abundance the granite contained quartz, orthoclase, plagioclase, hornblende, mica, and hematite. The red coloration results from the abundance of orthoclase (which is pink) and trace amount of iron oxide observed staining some of the grain boundaries.

Framework Minerals

Quartz – Angular; interlocking with surrounding grains (approximately60%).

K-feldspar – Untwinned and twinned; angular; fine grained; fresh (approximately 20%).

Plagioclase – Twinned; angular; fine grained; fresh (approximately 15%).

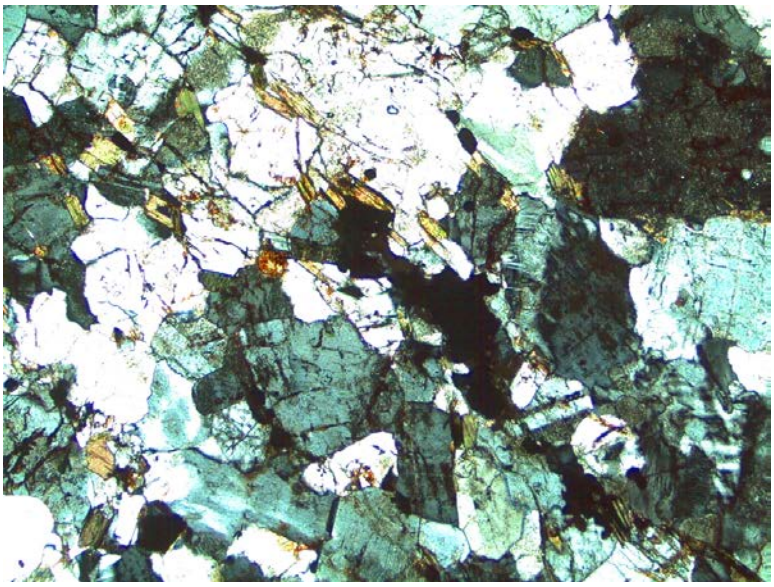
Hornblende – Very fine grained (approximately 3%).

Biotite– some individual grains (approximately1%).

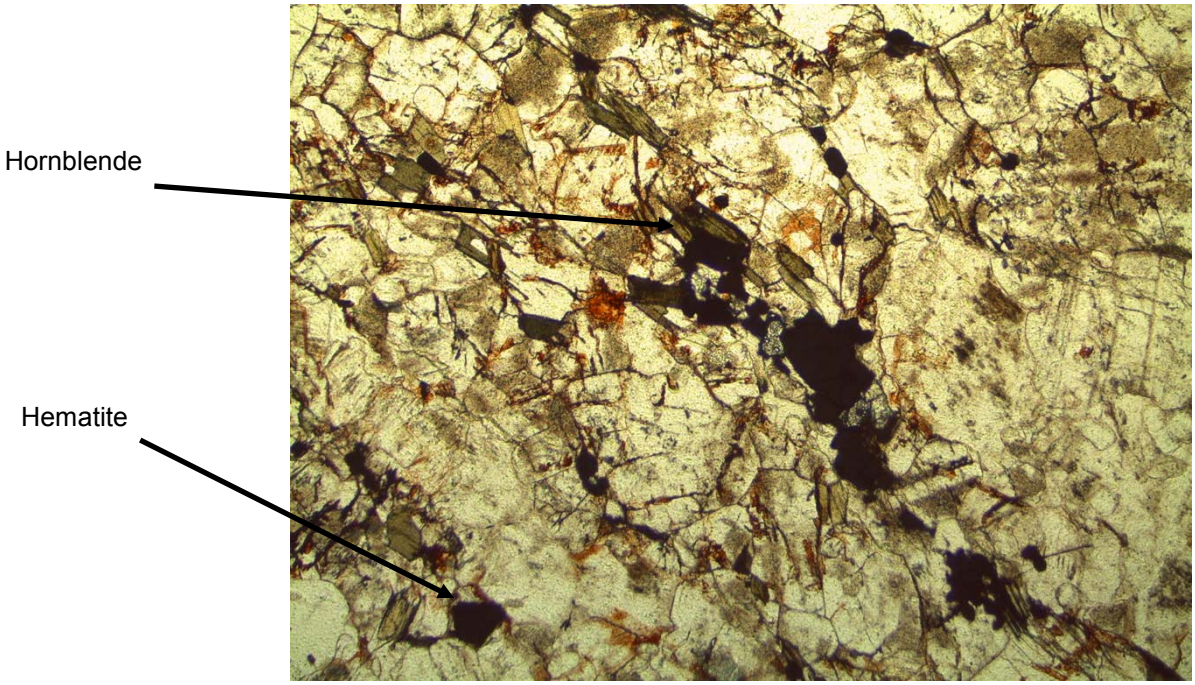
Accessory Minerals

Hematite – Fine-grained (<0.1mm) opaque angular grains; trace

Iron oxides – Orange-brown; clay size; common.



Photograph 7. Granite, showing interlocking euhedral grains. XP, 100x, FL 1mm.



Photograph 8. Granite, showing interlocking euhedral grains. Note: Opaque hematite and associated hornblende, PL, 100x, FL 1mm.

XP = Crossed polarizers
PL = Polarized light
100x = Magnification
FL = Long dimension of image

References

Folk, R., L., 1974, Petrology of Sedimentary Rocks. Austin, Texas: Hemphill's Book Store, 182 pp.