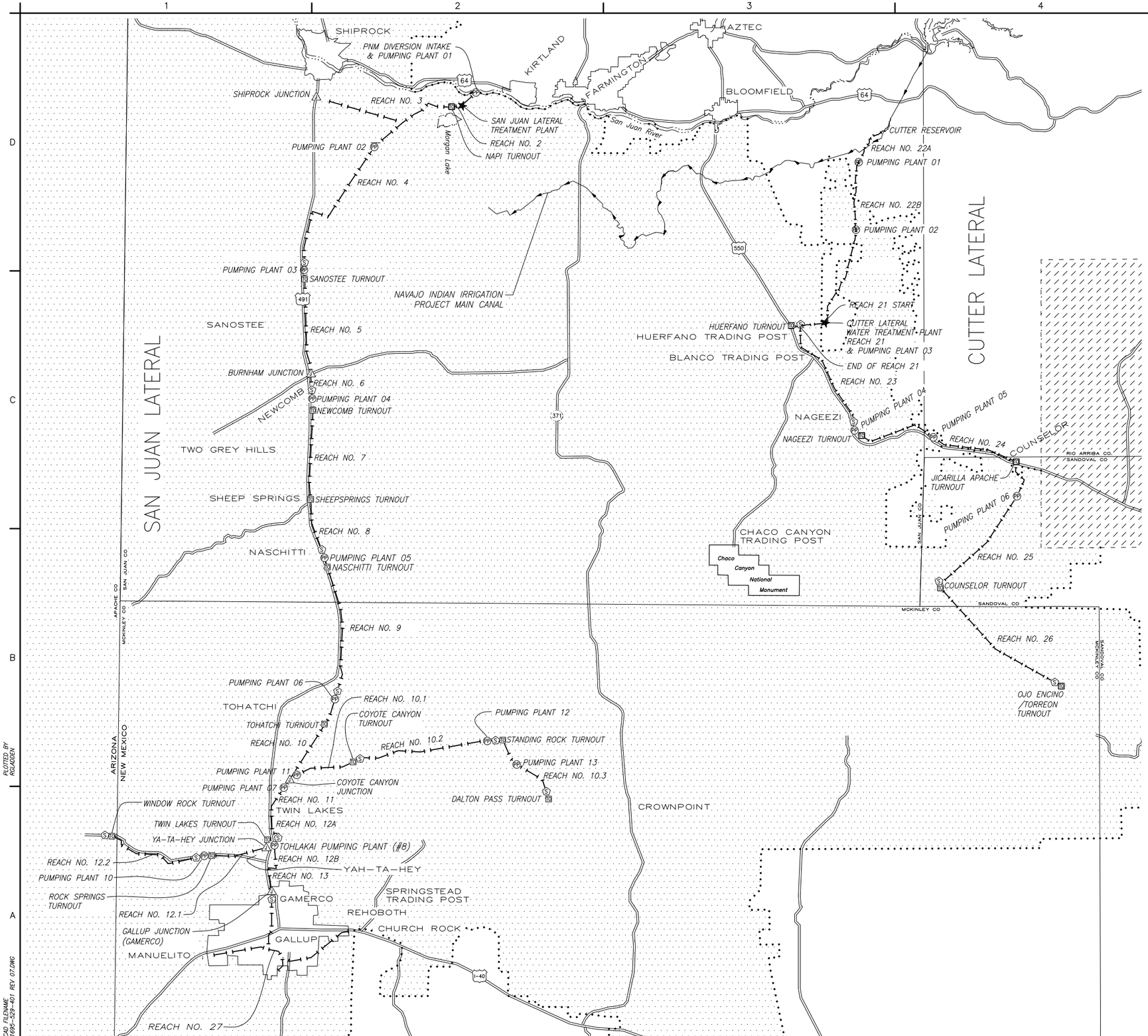

INDEX MAP

EXPLANATION

- PIPELINE
- POWER LINE
- U.S. HIGHWAY
- STATE HIGHWAY
- TURNOUT
- TANK
- PUMPING PLANT (NUMBER SHOWN FROM FEIS)
- JUNCTION
- NAVAJO NATION RESERVATION
- JICARILLA APACHE RESERVATION

N

5 0 5 10 15
SCALE OF MILES

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Managing Water in the West

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NAVAJO GALLUP WATER SUPPLY PROJECT

NEW MEXICO

GENERAL MAP

REV NO		
07	2015-11-04 FCCF-236 RLC	MODIFIED BEGINNING AND ENDING STATIONS FOR REACH 21
06	2014-06-20 FCCF-233 JED	REVISED REACH 22 AND PUMPING PLANT AND TREATMENT PLANT LOCATION
05	2014-04-01 FCCF-233 JED	REVISED REACH 22A ALIGNMENT
04	2013-08-20 FCCF-234 BWD	UPDATED REACHES 3, 4, AND 22 TO CORRESPOND WITH THE LATEST FEASIBILITY ALIGNMENTS
03	2012-07-12 FCCF-234 BWD	UPDATED REACH 22'S PUMPING PLANT LOCATIONS, MYP, AND BROKE INTO REACHES 22A & 22B
02	2010-03-08 FCCF-233 JED	CHANGED "PUMPING PLANT 8" TO "TOHLAKAI PUMPING PLANT (#8)", ADDED NOTE TO "PUMPING PLANT" CALL OUT IN LEGEND

DESIGNED JAYE E. DECKER
DRAWN JAYE E. DECKER
CHECKED s/JAMES W. SANDERS JR.
TECH. APPR. s/DOUG DOCKTER P.E.
APPROVED s/BARRY D. LONGWELL P.E.

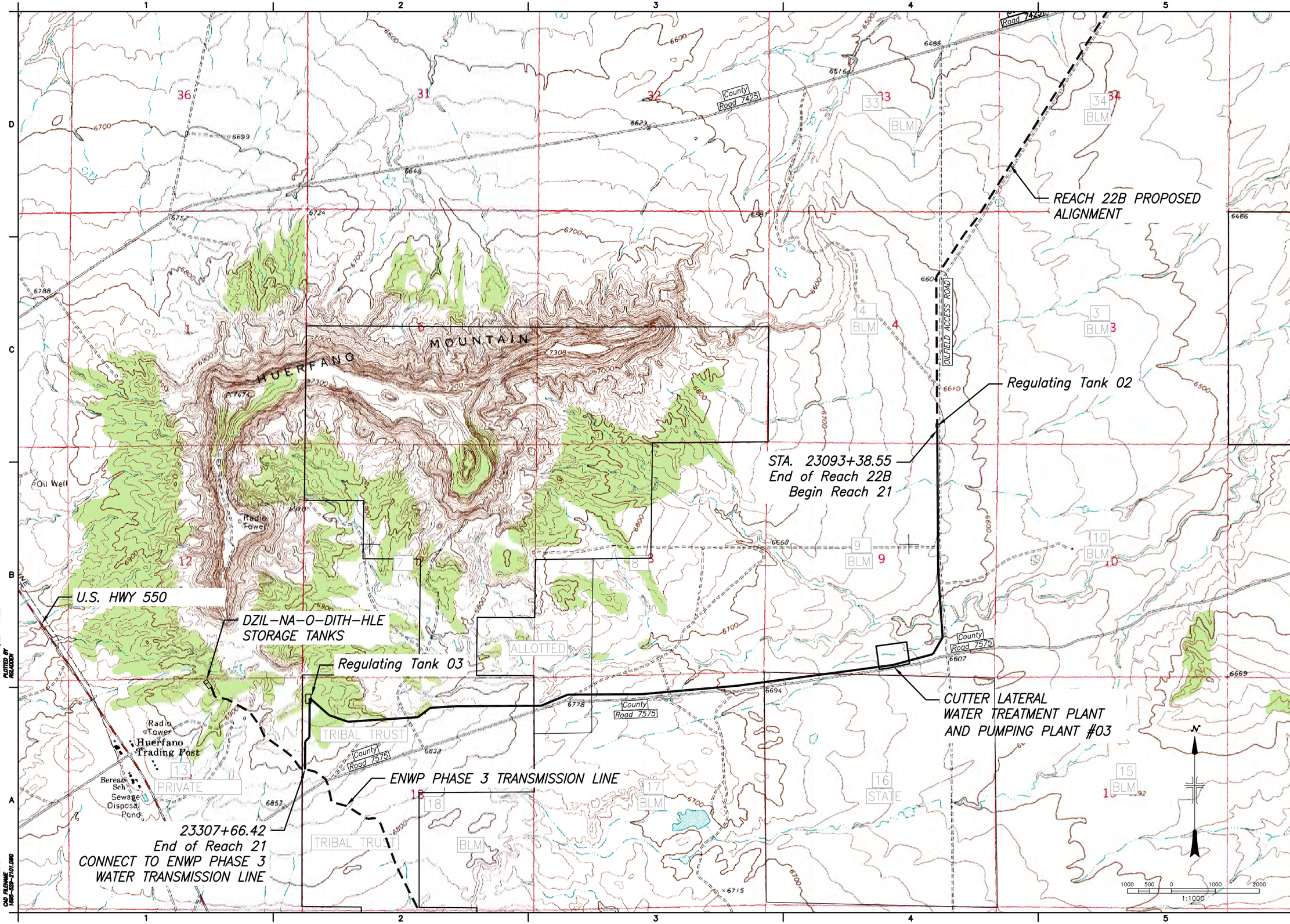
FARMINGTON, NEW MEXICO 2011-03-24

1695-529-401

SHEET 1 OF 1

DATE AND TIME PLOTTED NOVEMBER 5, 2015 11:31
PLOTTED BY RGLADDEN

CAD SYSTEM AutoCAD Rel. 20.0s
CAD FILENAME 1695-529-401 REV 07.DWG



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CUTTER LATERAL – REACH 21

CUTTER WATER TREATMENT PLANT

PROJECT LOCATION MAP

REV NO	REV NO	REV NO	REV NO	REV NO	REV NO

DESIGNED CHICO QUINTANA
DRAWN CHICO QUINTANA
CHECKED RYAN GLADDEN, P.E.
TECH. APPR. Deming, Bart W P.E.
ADMIN APPROVED Longwell, Barry D
ADMIN APPROVAL – Construction Engineer

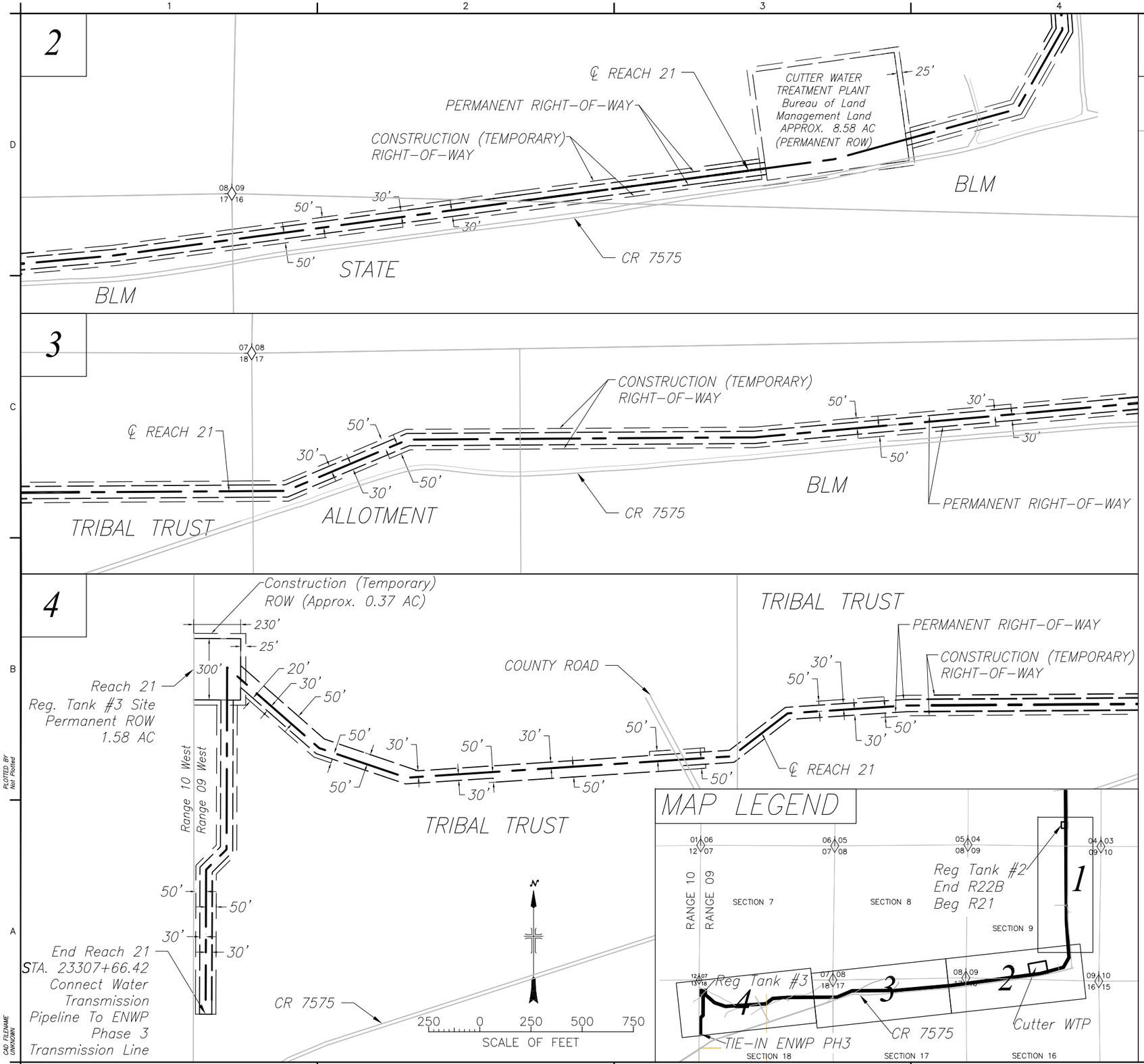
FARMINGTON, NM 2016-02-12

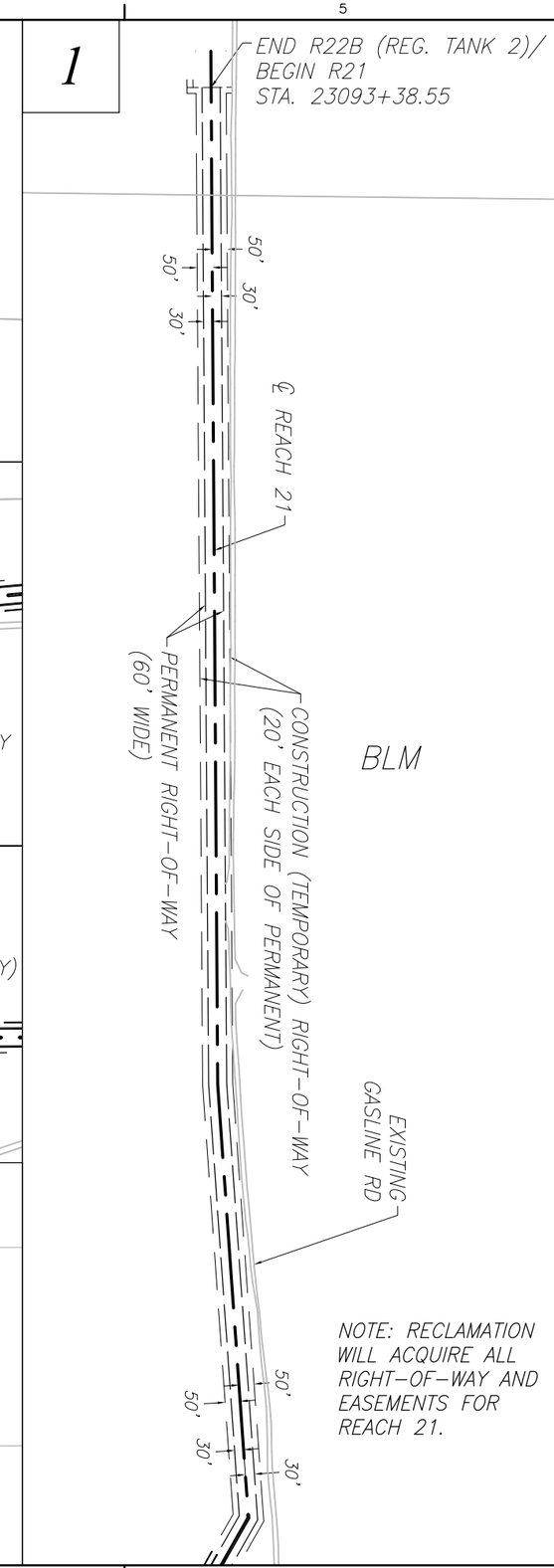
1695-529-2101

SHEET 1 OF 1

DATE AND TIME PLOTTED FEBRUARY 16, 2016 @22
PLOTTED BY RGLADDEN

CAD SYSTEM AutoCAD Rel. 20.0a
CAD FILENAME 1695-529-2101.DWG





NOTE: RECLAMATION WILL ACQUIRE ALL RIGHT-OF-WAY AND EASEMENTS FOR REACH 21.

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NEW MEXICO

CUTTER LATERAL – REACH 21

WATER TREATMENT PLANT

CHICO QUINTANA
DESIGNED
CHICO QUINTANA
DRAWN
RYAN GLADDEN, PE
CHECKED
Deming, Bart W P.E.
TECH. APPR.
Longwell, Barry D
APPROVED
ADMIN APPROVAL – Project Construction Engineer

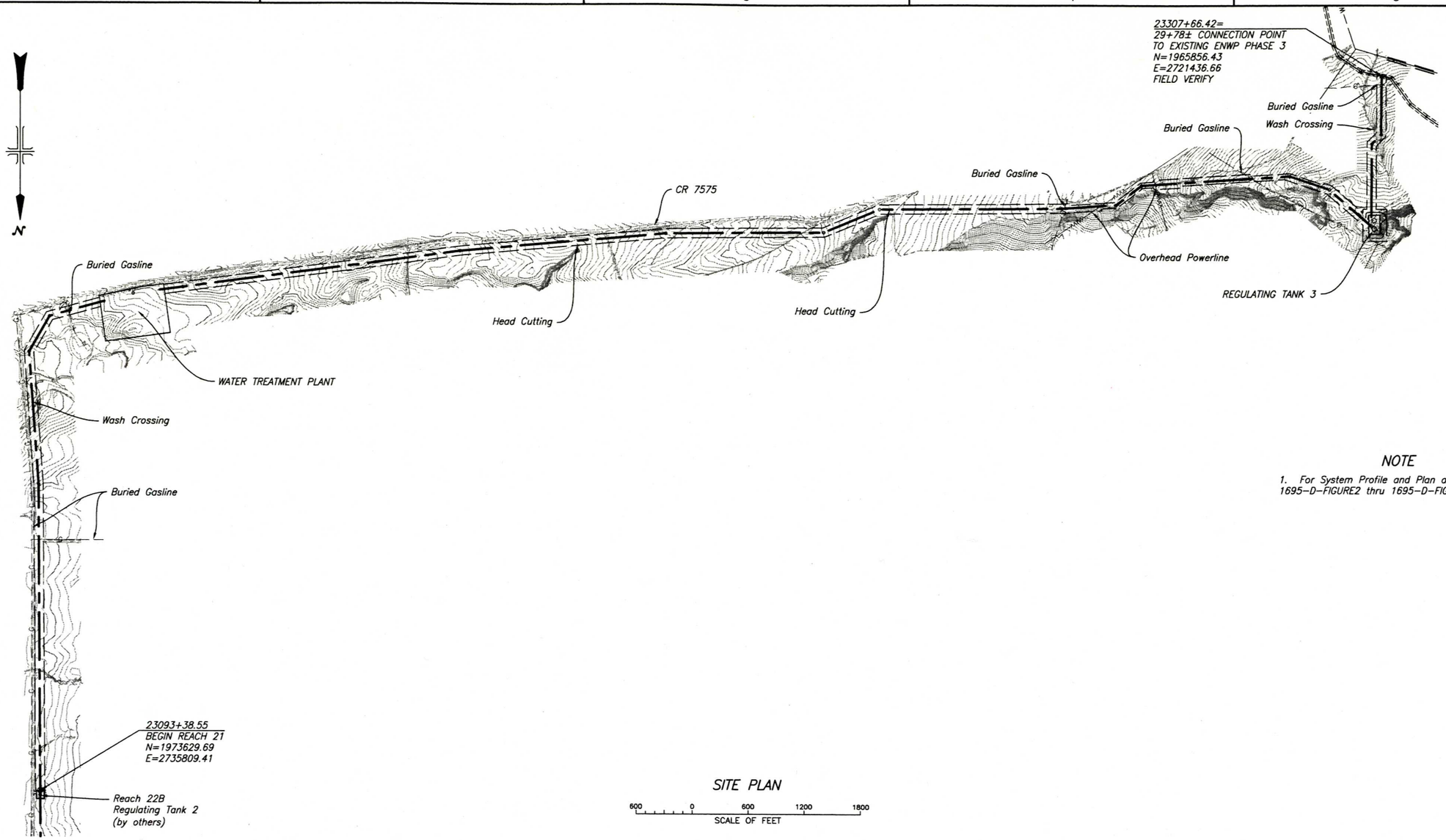
FARMINGTON, NM 2016-02-12

RIGHT-OF-WAY REACH 21 RIGHT-OF-WAY EXHIBIT MAP

1695-529-2103

SHEET 1

DATE AND TIME PLOTTED Not Plotted
PLOTTED BY Not Plotted
CAD SYSTEM AUTOCAD
CAD FILENAME UNKNOWN



SITE PLAN

600 0 600 1200 1800
SCALE OF FEET

NOTE

1. For System Profile and Plan and Profiles see 1695-D-FIGURE2 thru 1695-D-FIGURE6.

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NEW MEXICO

CUTTER LATERAL - REACH 21

REACH 22B TO ENWP PHASE 3

RECLAMATION
Managing Water in the West

DESIGNED

REVIEWED

DENVER, CO 2016-01-01

LINE PIPE

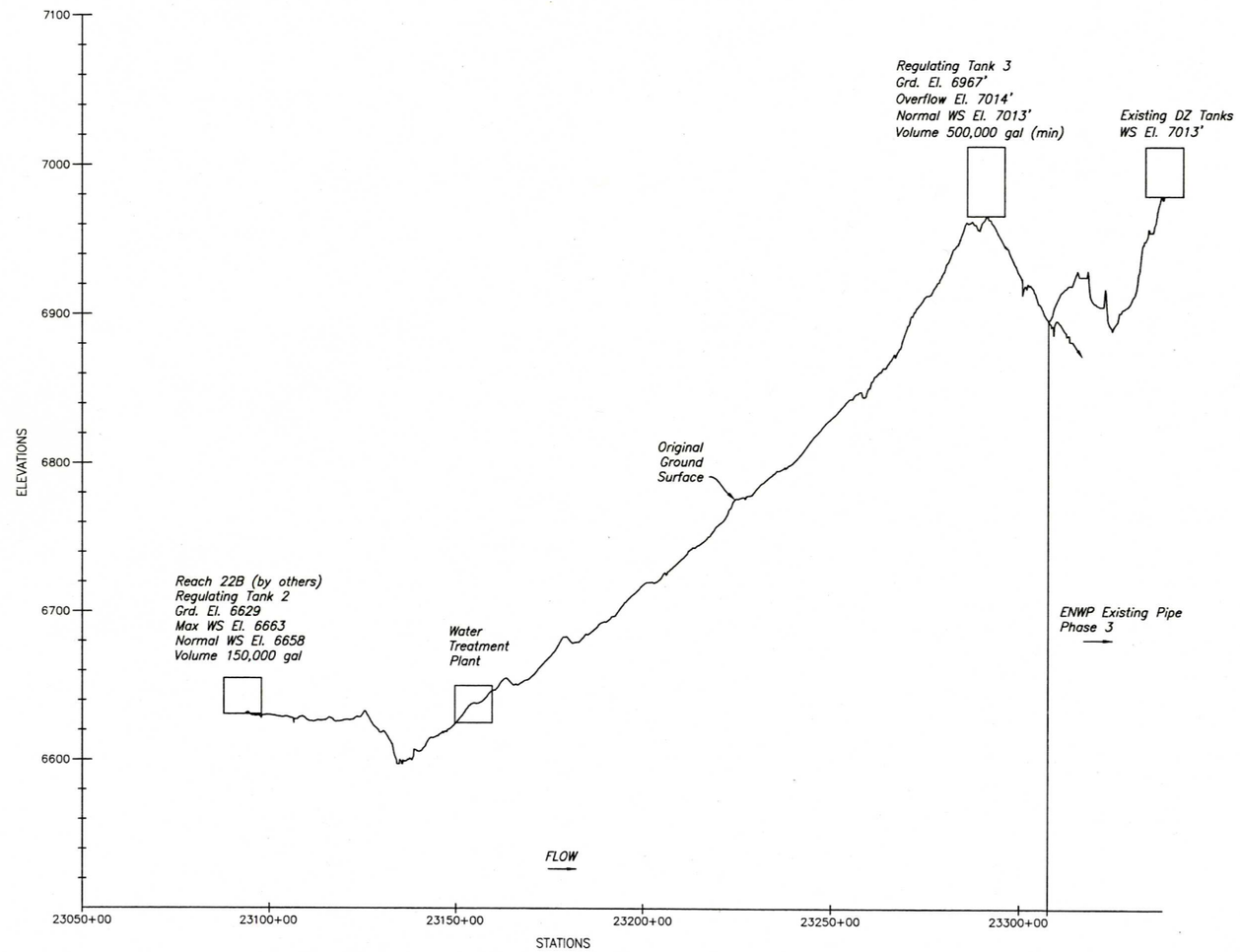
SITE PLAN

1695-D-FIGURE1

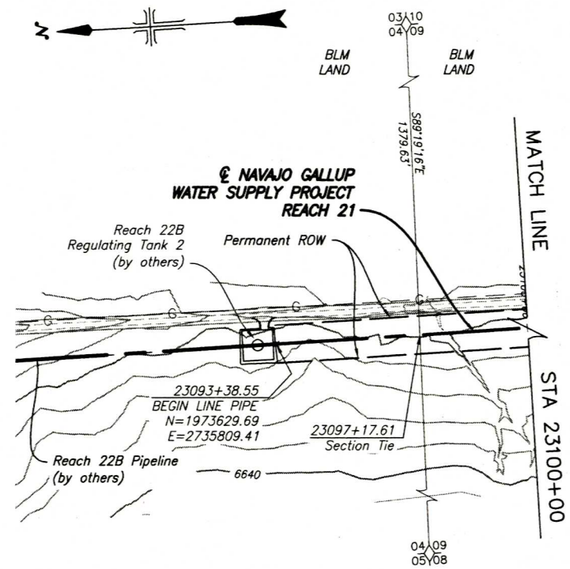
SHEET 1 OF 1

DATE AND TIME PLOTTED
JANUARY 26, 2016 09:33
PLOTTED BY
MLCAHIT

CAD SYSTEM
AutoCAD Rel. 20.0s
CAD FILENAME
1695-D-FIGURE1 - SITE PLAN.DWG

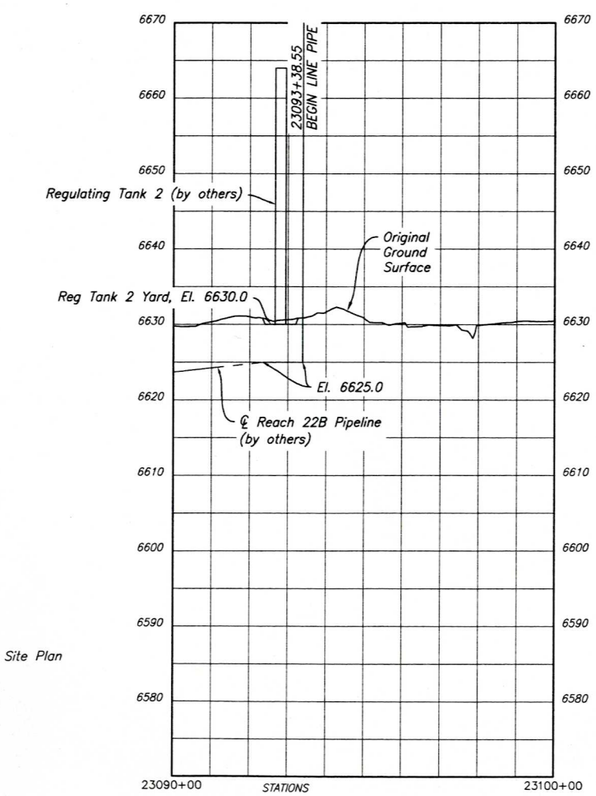


SYSTEM PROFILE



PLAN

200 0 200 400 600
SCALE OF FEET



PROFILE

ABBREVIATIONS

CR – County Road
ENWP – Eastern Navajo Water Pipeline
ROW – Right-of-Way

SYMBOLS

℄ Pipeline
Construction ROW
Dirt Road
Powerline
G Natural Gas pipeline
W Waterline

GENERAL NOTES

1. General Notes, Symbols, and Abbreviations apply to all plan and profile drawings.
2. Grid based on New Mexico State Coordinate West Zone.
3. Ground to grid conversion factor is 0.999620438002.
4. Regulating Tank 3 Normal Water Surface Elevation equals 7013.0 to match the normal water surface of the existing DZ tanks.
5. See ROW drawing 1695-529-2103.

REFERENCE DRAWINGS

1695-D-60009	Reach 22B Regulating Tank 2 Site Plan
1695-D-60074	Reach 22B Line Pipe Plan
1695-D-60075	Reach 22B Line Pipe Profile

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NAVAJO-GALLUP WATER SUPPLY PROJECT
NEW MEXICO

CUTTER LATERAL – REACH 21

LINE PIPE

DESIGNED

REVIEWED

DENVER, CO 2016-01-07

SYSTEM PROFILE
PLAN AND PROFILE

BEGINNING
TO
STA. 23100+00

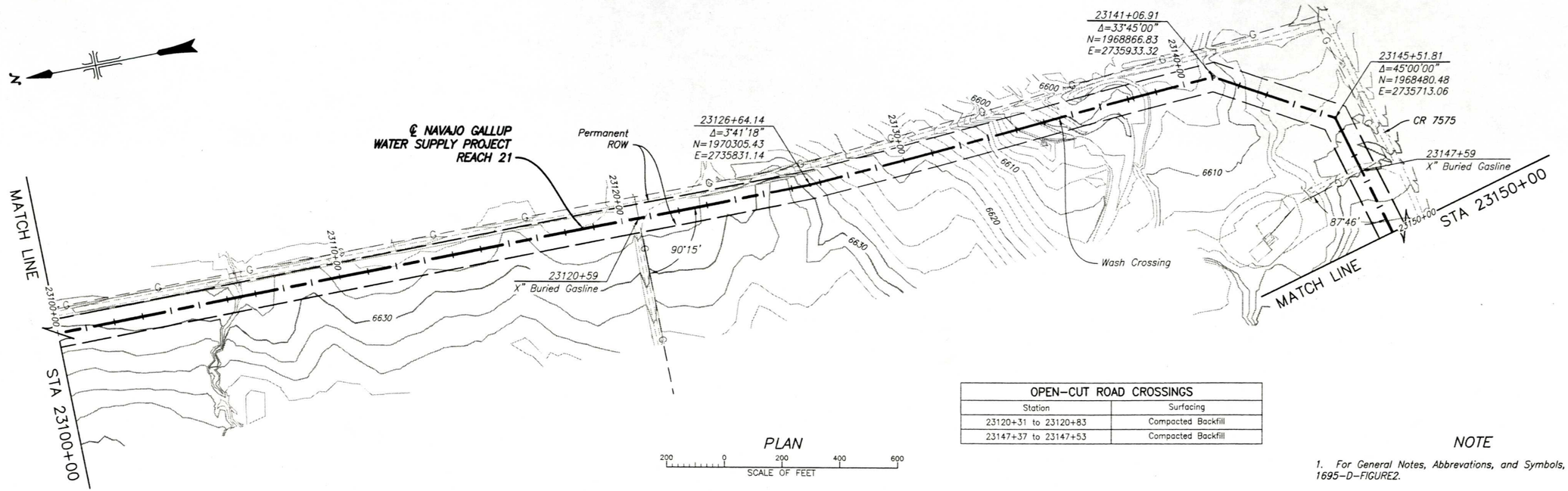
1695-D-FIGURE2

SHEET 1 OF 5

DATE AND TIME PLOTTED JANUARY 26, 2016 10:14
PLOTTED BY MLEWITT

CAD SYSTEM AutoCAD Rel. 20.0s
CAD FILENAME 1695-D-FIGURE2 - 23050+00.00.DWG

RECLAMATION
Managing Water in the West



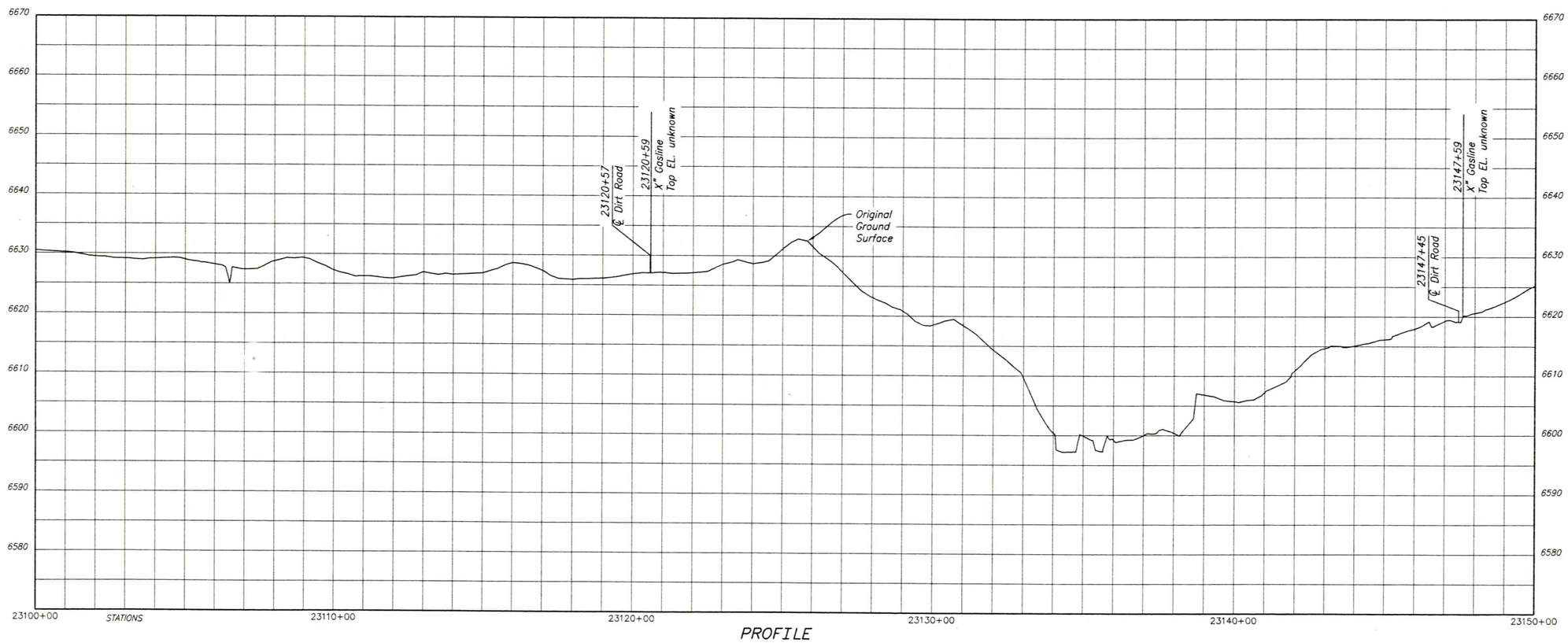
PLAN

200 0 200 400 600
SCALE OF FEET

OPEN-CUT ROAD CROSSINGS	
Station	Surfacing
23120+31 to 23120+83	Compacted Backfill
23147+37 to 23147+53	Compacted Backfill

NOTE

1. For General Notes, Abbrevations, and Symbols, see 1695-D-FIGURE2.



PROFILE

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NAVAJO-GALLUP WATER SUPPLY PROJECT
NEW MEXICO

CUTTER LATERAL – REACH 21

LINE PIPE

DESIGNED

REVIEWED

DENVER, CO 2016-01-01

PLAN AND PROFILE

STA. 23100+00
TO
STA. 23150+00

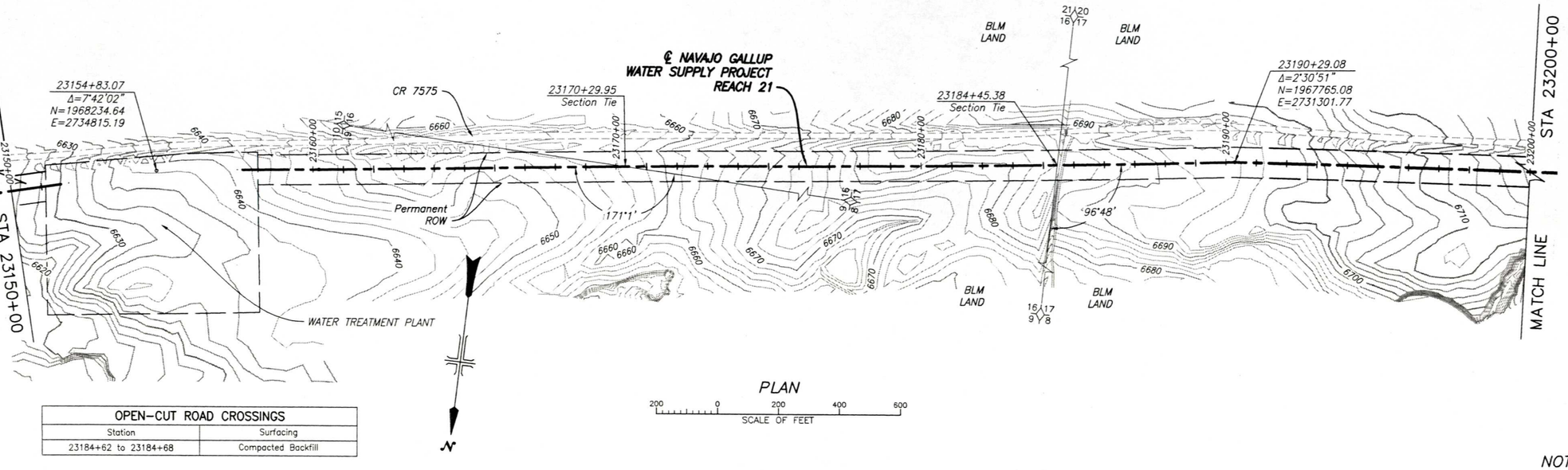
1695-D-FIGURE3

SHEET 2 OF 5

DATE AND TIME PLOTTED
JANUARY 15, 2016 11:22
PLOTTED BY
MCLAMIT

CAD SYSTEM
AutoCAD Rel. 20.0s
CAD FILENAME
REACH 21DB P&P SHEET 2 - 23100+00DBALI.DWG

RECLAMATION
Managing Water in the West



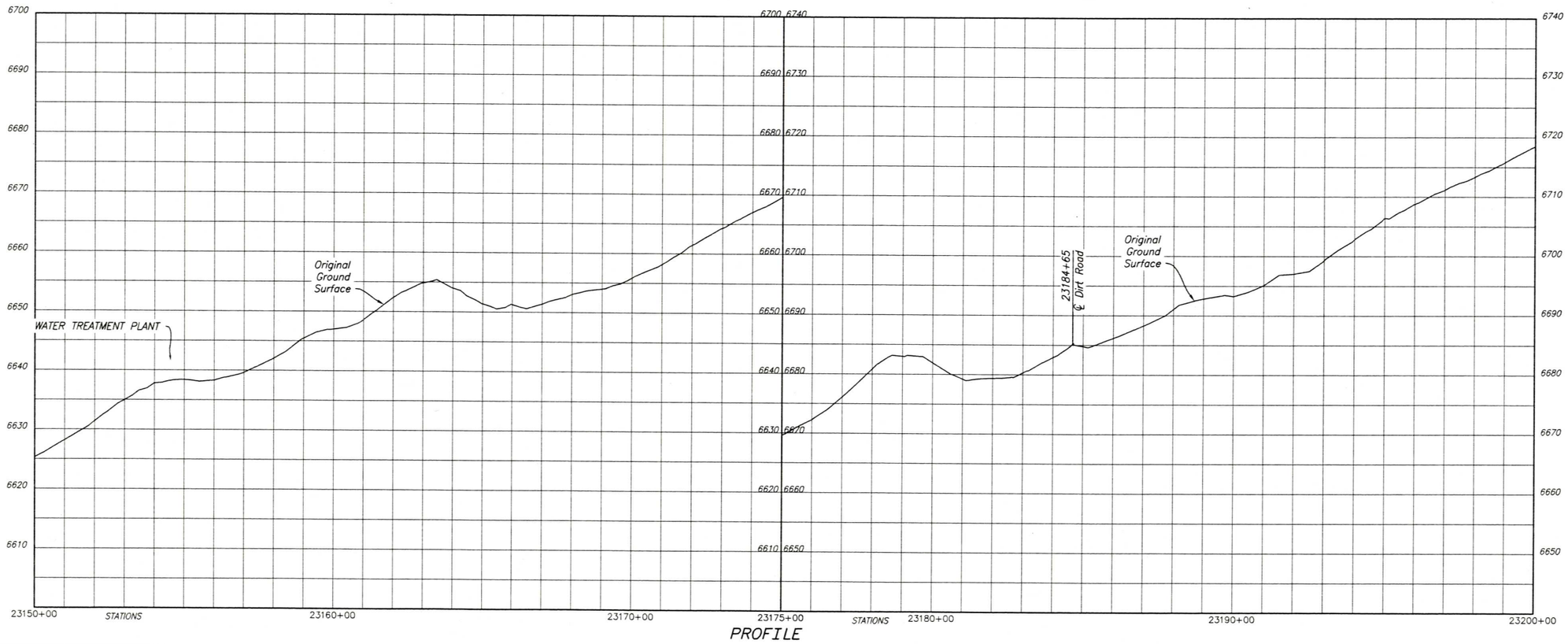
PLAN

200 0 200 400 600
SCALE OF FEET

OPEN-CUT ROAD CROSSINGS	
Station	Surfacing
23184+62 to 23184+68	Compacted Backfill

NOTE

1. For General Notes, Abbrevations, and Symbols, see 1695-D-FIGURE2



PROFILE

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NAVAJO-GALLUP WATER SUPPLY PROJECT
NEW MEXICO

CUTTER LATERAL - REACH 21

LINE PIPE

DESIGNED

REVIEWED

DENVER, CO 2016-01-01

PLAN AND PROFILE

STA. 23150+00
TO
STA. 23200+00

1695-D-FIGURE4

SHEET 3 OF 5

DATE AND TIME PLOTTED
JANUARY 15, 2016 11:23
PLOTTED BY
ALCANTT

CAD SYSTEM
AutoCAD Rel. 20.0s
CAD FILE NAME
REACH 21WP PROF SHEET 3 - 23150+00TO200.DWG

RECLAMATION
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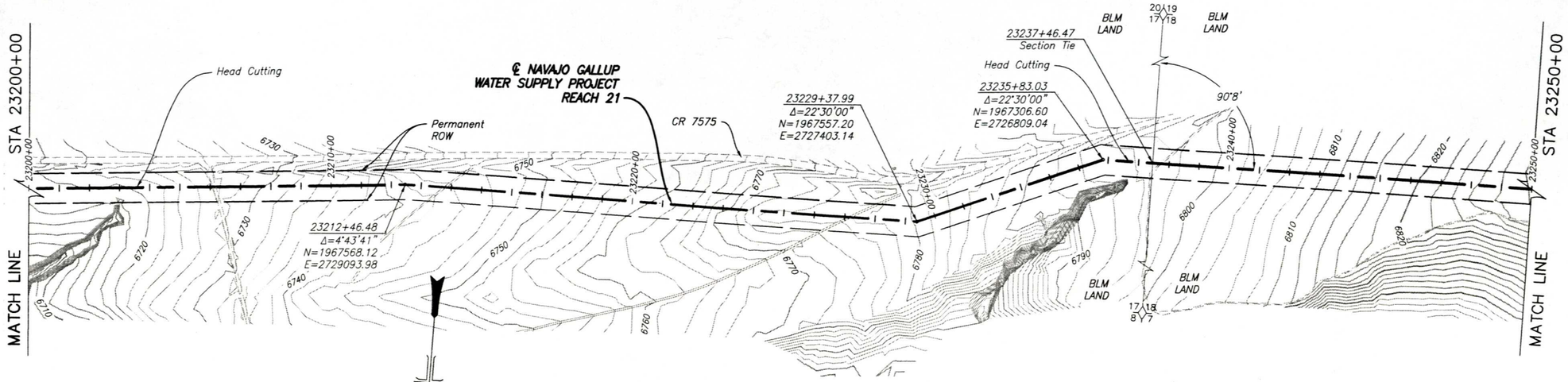


OPEN-CUT ROAD CROSSINGS	
Station	Surfacing
23206+08 to 23206+19	Compacted Backfill
23213+76 to 23213+84	Compacted Backfill
23227+11 to 23227+23	Compacted Backfill
23237+70 to 23237+76	Compacted Backfill

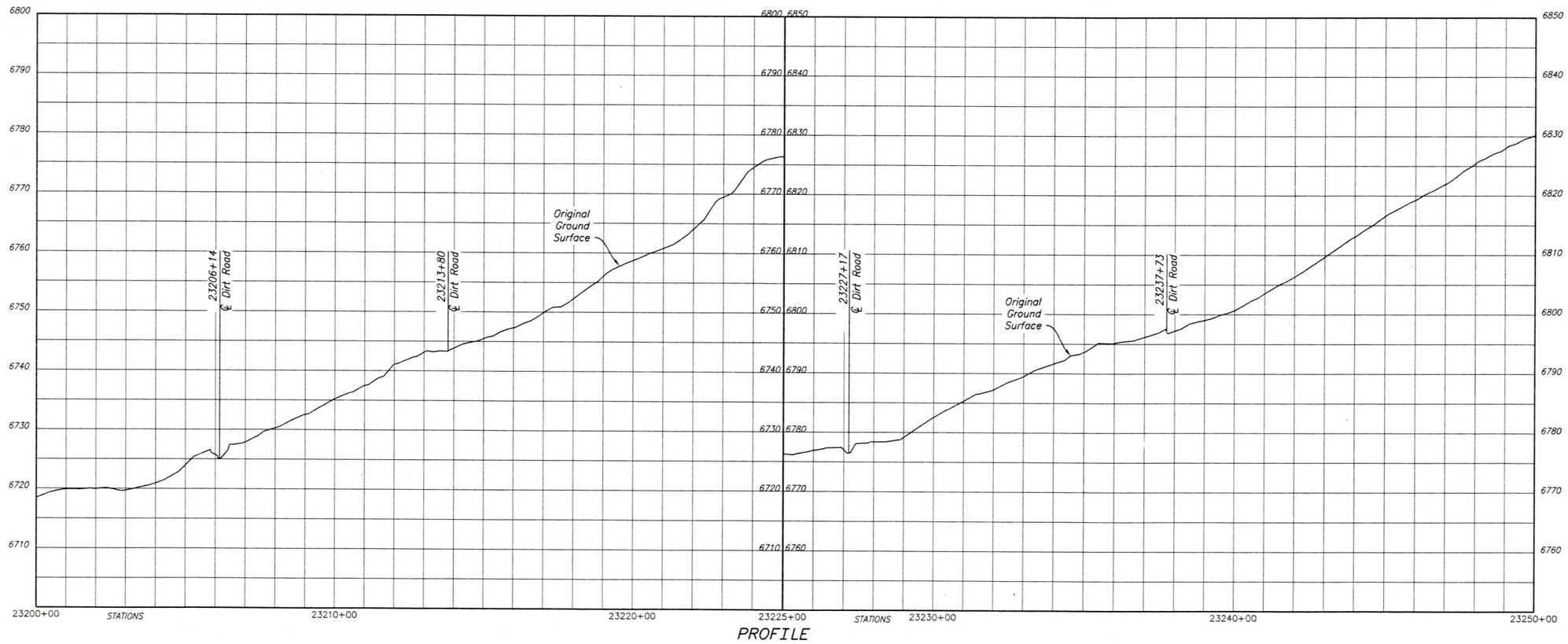
PLAN

SCALE OF FEET

NOTE

1. For General Notes, Abbrevations, and Symbols, see 1695-D-FIGURE2.

FOR INFORMATION ONLY



PROFILE

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NAVAJO-GALLUP WATER SUPPLY PROJECT
NEW MEXICO

CUTTER LATERAL - REACH 21

LINE PIPE

DESIGNED

REVIEWED

DENVER, CO 2016-01-01

PLAN AND PROFILE

STA. 23200+00
TO
STA. 23250+00

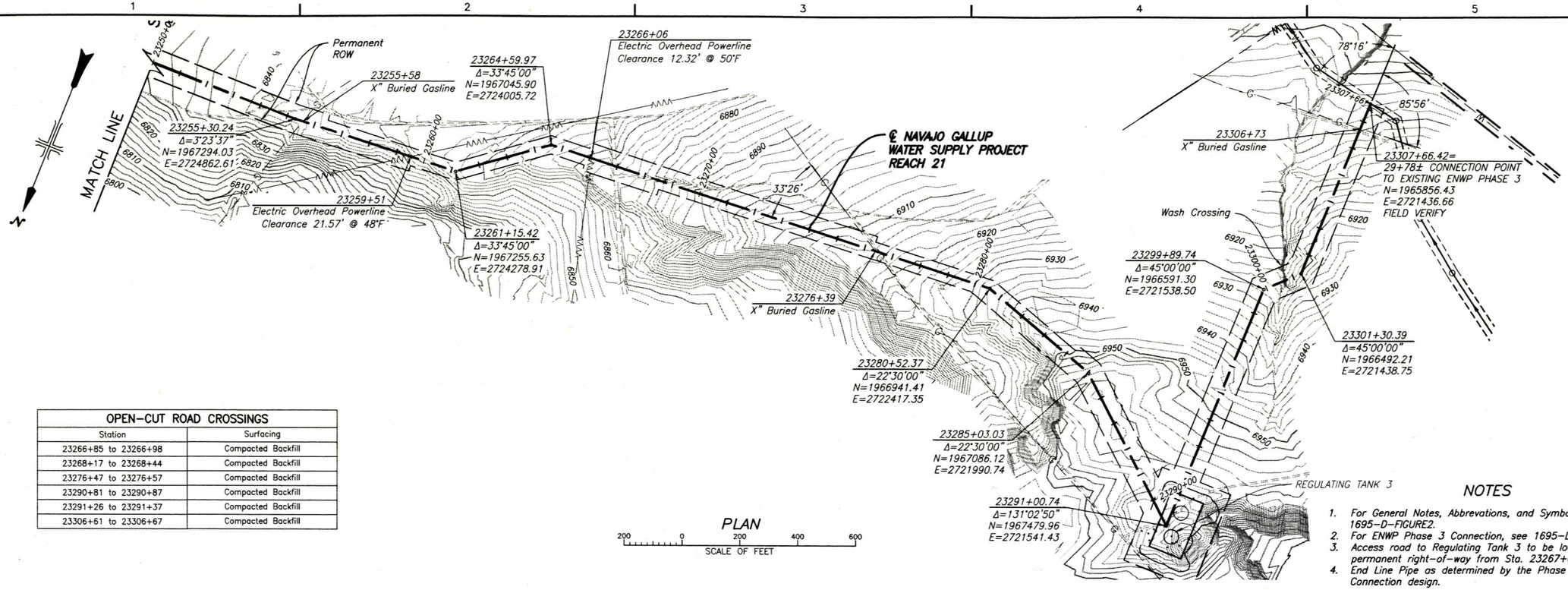
1695-D-FIGURE5

SHEET 4 OF 5

DATE AND TIME PLOTTED
JANUARY 15, 2016 11:23
PLOTTED BY
WLEMUT

CAD SYSTEM
AutoCAD Rel. 20.0s
CAD FILE NAME
REACH 21\NB P&P SHEET 4 - 23200+00\23DL.DWG

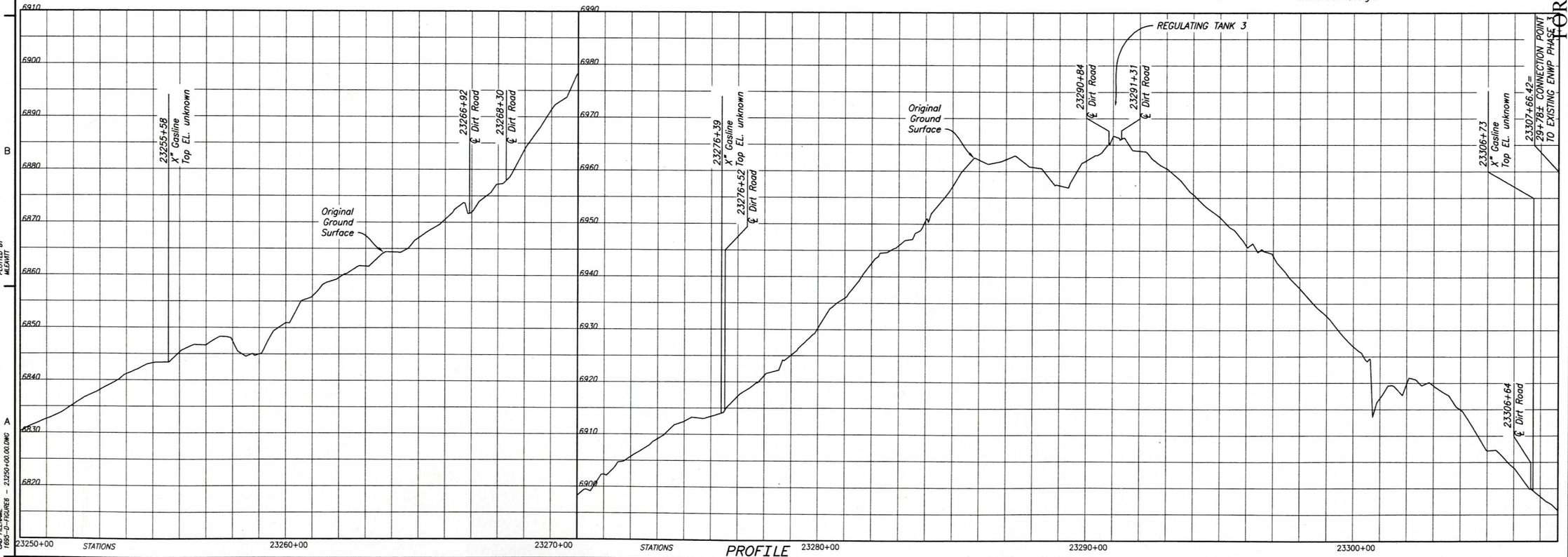
RECLAMATION
Managing Water in the West



OPEN-CUT ROAD CROSSINGS	
Station	Surfacing
23266+85 to 23266+98	Compacted Backfill
23268+17 to 23268+44	Compacted Backfill
23276+47 to 23276+57	Compacted Backfill
23290+81 to 23290+87	Compacted Backfill
23291+26 to 23291+37	Compacted Backfill
23306+61 to 23306+67	Compacted Backfill

NOTES

1. For General Notes, Abbrevations, and Symbols, see 1695-D-FIGURE2.
2. For ENWP Phase 3 Connection, see 1695-D-FIGURE7.
3. Access road to Regulating Tank 3 to be located inside permanent right-of-way from Sta. 23267+00 to tank.
4. End Line Pipe as determined by the Phase 3 Connection design.



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NAVAJO-GALLUP WATER SUPPLY PROJECT
NEW MEXICO

CUTTER LATERAL – REACH 21

LINE PIPE

DESIGNED

REVIEWED

DENVER, CO 2016-01-07

PLAN AND PROFILE

STA. 23250+00
TO
END

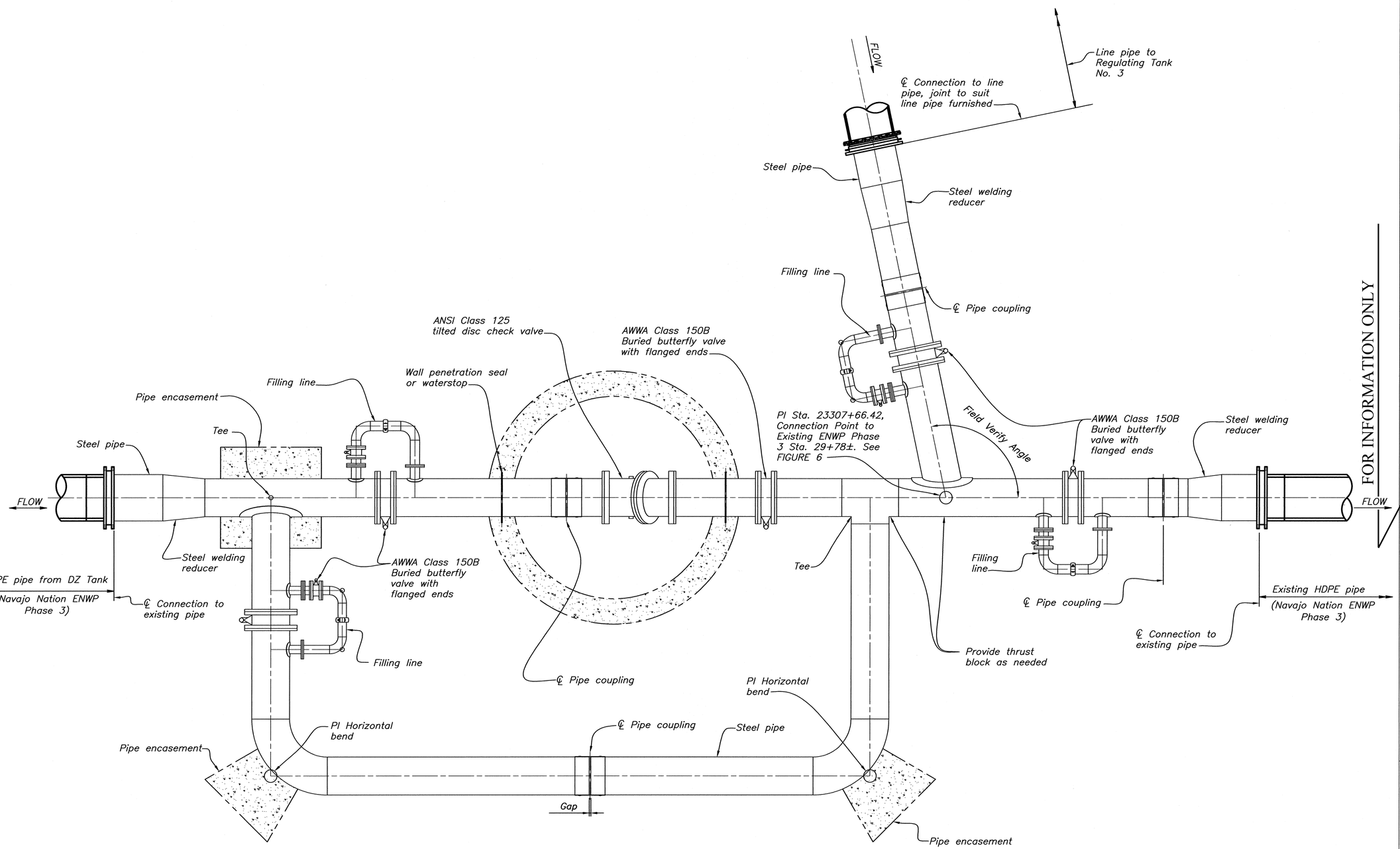
1695-D-FIGURE6

SHEET 5 OF 5

DATE AND TIME PLOTTED JANUARY 26, 2016 09:20
PLOTTED BY MLEANITI

CAD SYSTEM AutoCAD Rel. 20.0a
CAD FILENAME: 1695-D-FIGURE6 – 23250+00.00.DWG

RECLAMATION
Managing Water in the West



PLAN

NOTES

Coordinate ENWP Phase 3 Connection with Navajo Nation.
See as-builts from ENWP Phase 3 for details.
Field verify connections to existing pipe.

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NEW MEXICO

CUTTER LATERAL – REACH 21

PHASE 3 CONNECTION

DESIGNED R.V. Fring

REVIEWED K.R. Smith

DENVER, CO

STEEL PIPE

PLAN

1695-D-FIGURE7

SHEET 1

DATE AND TIME PLOTTED JANUARY 15, 2015 12:00
PLOTTED BY LADANG

CAD SYSTEM AutoCAD Rel. 20.0s
CAD FILENAME 1695-D-60805-RD-1.DWG

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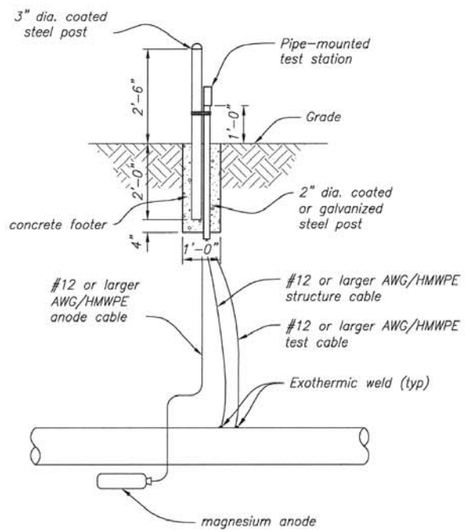
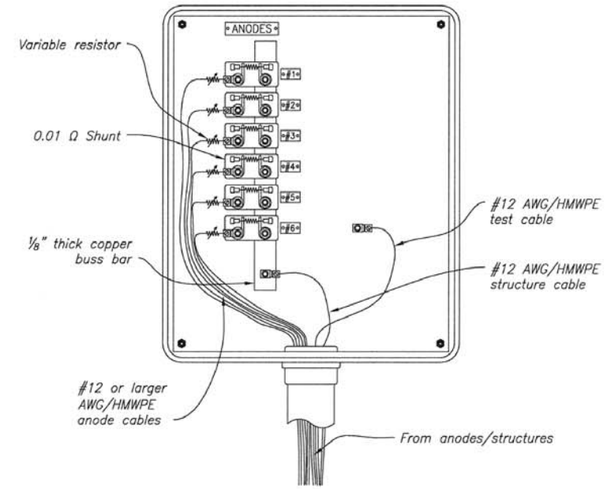


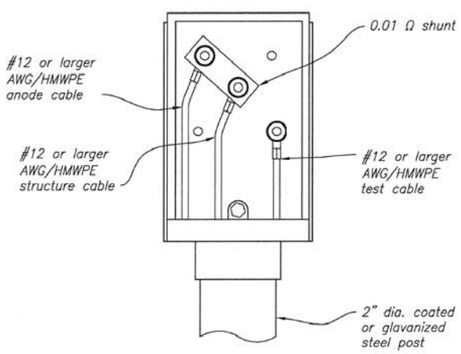
ANODE TEST STATION (ATS) – SINGLE ANODE

(NOT-TO-SCALE)



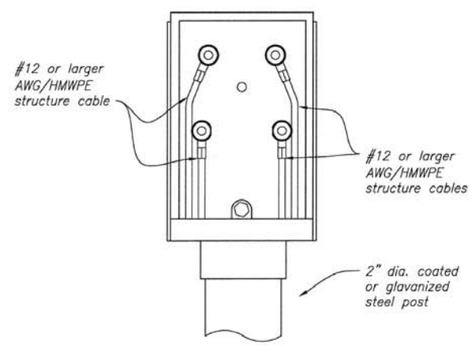
GALVANIC ANODE JUNCTION BOX

(NOT-TO-SCALE)



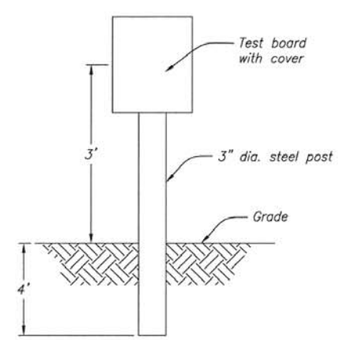
TEST BOARD – ATS – SINGLE ANODE

(NOT-TO-SCALE)



TEST BOARD – IJTS

(NOT-TO-SCALE)



JUNCTION BOX

(NOT-TO-SCALE)

NOTES

1. Place anode at the same depth as the bottom of the structure.
2. Anodes are to be installed a minimum distance of 30 feet from the structure.
3. Minimum of one anode length from non-metallic pipe.
4. One shunt for each anode installed at location.
5. Number of anodes at each structure in accordance with Specification Section 26 42 10.

REFERENCE DRAWINGS

WELDING AND CABLE I.D. DETAILS _____ 1695-D-356

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CUTTER LATERAL – REACH 22A

CUTTER DAM TO NAVAJO ALLOTTED LANDS
CATHODIC PROTECTION
TEST STATION AND JUNCTION BOX

DESIGNED
DRAWN
CHECKED
TECH. APPR. JESSICA BOSTT – PHD.
PEER REVIEW ROGER VURCOTTE, P.E. CP SPECIALIST

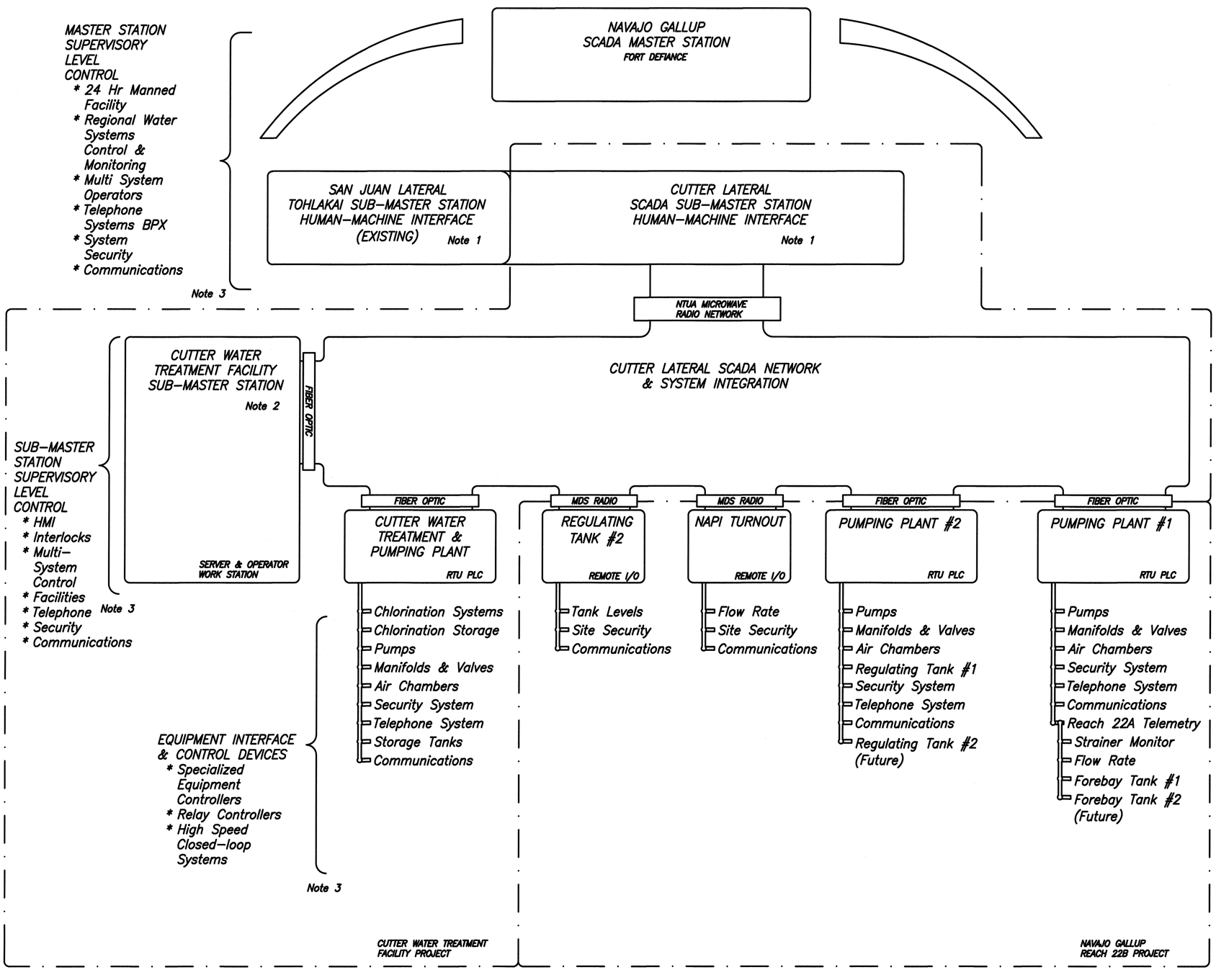
DENVER, COLORADO 2014-07-21

1695-D-355

SHEET 1 OF 1

DATE AND TIME PLOTTED July 21, 2014 03:44
PLOTTED BY JTORREY

CADD SYSTEM AutoCAD Rel. 19.0s (LMS Tech)
CADD FILENAME NG Reach 22A 2014-07-17.dwg



EXPLANATION

PLC	Programmable Logic Controller
RTU	Remote Terminal Unit
HMI	Human-Machine Interface

REFERENCE DRAWINGS

SCADA, NETWORK, SECURITY, AND TELEPHONE SYSTEMS OVERVIEW_____1695-D-60096

SCADA AND SECURITY EQUIPMENT CABINETS LAYOUTS_____1695-D-60097

NOTES

1. Sub-Master Station Human Machine Interface Terminal screens ported to Fort Defiance Master Station for remote monitoring.
2. Cutter Lateral Sub-Master Station:
   - 2.1. System Monitoring & Control
   - 2.2. Historian – Trending
   - 2.3. Human-Machine Interface
   - 2.4. Operator Intervention
   - 2.5. Environmental Controls
3. Levels of Control reach across page with the listed characteristics.

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NAVAJO-GALLUP WATER SUPPLY PROJECT
NEW MEXICO

CUTTER LATERAL – REACH 22B

SCADA SYSTEM

STEVEN GOBERDHAN, PE
DESIGNED
STEPHEN MCHARGUE
DRAWN
VINCE HOANG
CHECKED
STEVEN GOBERDHAN, PE
TECH. APPR.

APPROVED
ADMIN APPROVAL – NATHAN MYERS

DENVER, CO

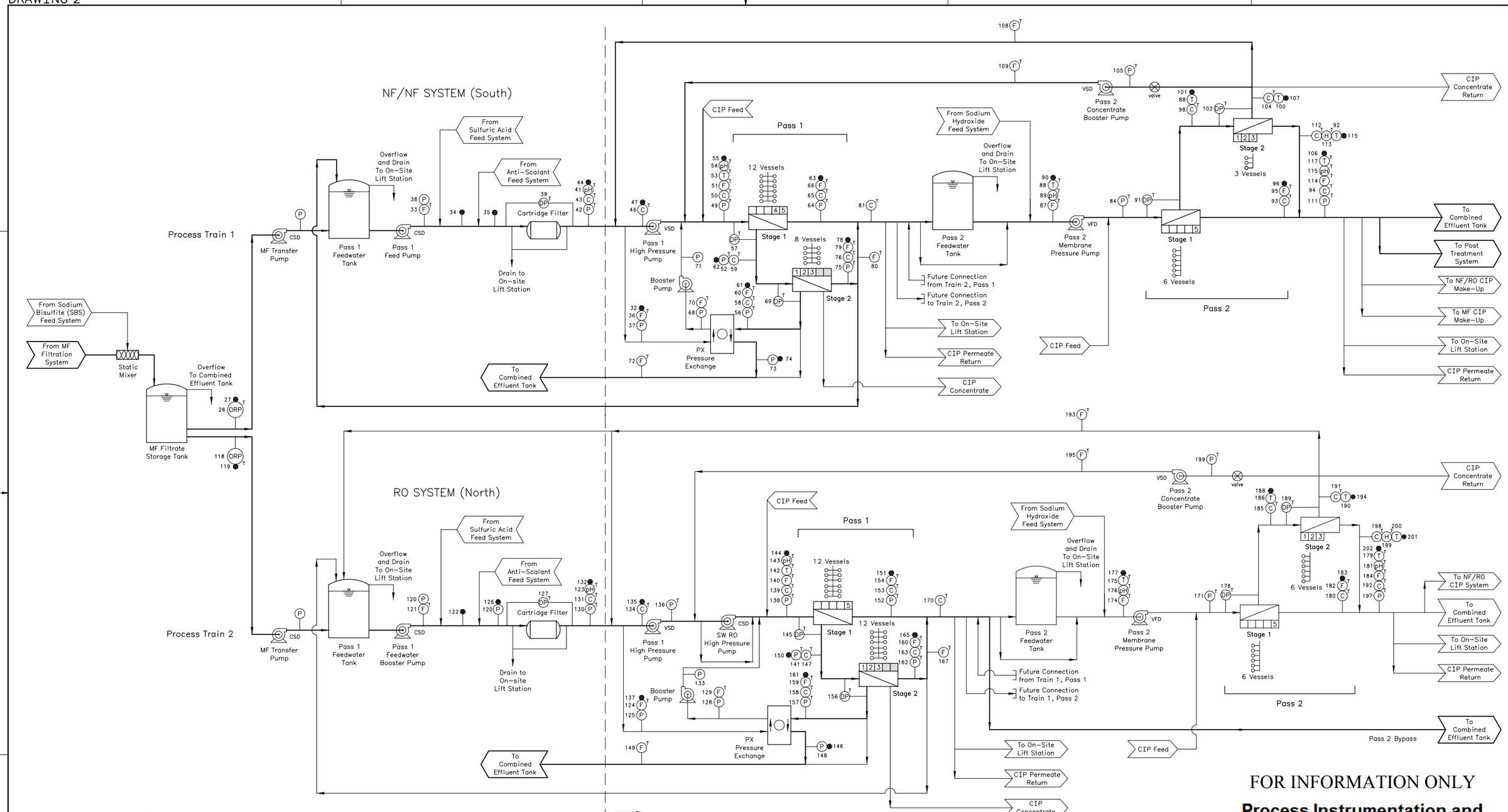
CUTTER LATERAL SCADA SYSTEMS INTEGRATION OVERVIEW

1695-D-60095

SHEET 1

DATE AND TIME PLOTTED Not Plotted
PLOTTED BY Not Plotted

CAD SYSTEM AUTOCAD
CAD FILENAME UNKNOWN



NOTES

1. *This drawing was developed from the Montgomery Watson Harza August 2003 final submittal drawings.*
2. *Some process lines, valves, etc are not shown for clarity.*
3. *Potable water hardness and alkalinity must meet Pall's requirements to prevent $CaCO_3$/MgOH scaling during high pH cleaning.*
4. *High pressure and/or low flow sensors for pump overload protection are not shown, but are to be included.*
5. *Level sensors with transmitters for all tanks are not shown, but are to be included.*
6. *Hardness meters are not furnished by owner within furnished by owner box.*

FOR INFORMATION ONLY

Process Instrumentation and Sampling Plan Schematic Example

RRODRIGU
FILE PATH: H:\EnvRes Share\DB2.3\DFN\DRAWINGS\LONG BEACH\

Cutter Reservoir
Water Quality Data
Designe Kennedy, 10/21/15
Checke Tiffenbach, 10/23/15

Removed from stat calcs because statistical outliers
Known Reporting Limit

FOR INFORMATION ONLY

Water Quality Data

WQ Type	Parameter	Units	7/6/2011	9/27/2011	7/12/2012	8/7/2012	11/28/2012	12/5/2012	2/7/2013	3/6/2013	4/11/2013	5/2/2013	6/6/2013	7/9/2013
USEPA Unregulated or Secondary Regulated Constituents – General	pH	-	8.00		7.99	8.14	8.10	8.11	8.39	8.30	8.17	8.3	8.21	7.93
	Conductivity	µS/cm	246		225	218	483	244	264	303	274	254	260	247
	Total Organic Carbon (TOC)	mg/L	2.31	2.95	2.79	2.92	1.31	0.83	3.07	2.85	2.64	2.83	2.94	3.02
	Dissolved Organic Carbon (DOC)	mg/L	2.36											
	Ultraviolet Absorbance at 254 nm (UV_{254})	1/cm	0.074											
	Color (total)	color units	10											
	Alkalinity (total)	mg/L as $CaCO_3$	79	81	40	82	134	85	80	87	85	87	80	78
	Carbonate (CO_3^{2-})	mg/L	12	10	10	10	10	10	10	10	10	10	10	10
	Bicarbonate (HCO_3^-)	mg/L	67	81	40	82	134	85	78	87	85	85	80	78
	Hardness (total)	mg/L as $CaCO_3$												
	Hardness (dissolved)	mg/L as $CaCO_3$	101											
	Odor	TON	1.0											
	Total Dissolved Solids (TDS)	mg/L	145		90	145	225	200	130	65.0	55	155	140	135
	Total Suspended Solids (TSS)	mg/L	2.0							4.57	5.00	15.7		3.53
	Total Nitrogen	mg/L	0.52											
	Total Kjeldahl Nitrogen (TKN, organic N + NH_3/NH_4^+)	mg/L	0.500		0.500	0.500	1.00	1.0	0.500	0.627	0.500	0.500	0.500	0.500
	Silica (SiO_2) (total)	mg/L												
	Silica (SiO_2) (dissolved)	mg/L	13											
D i	Ammonia (NH_3)	mg/L	0.050											
Metals/Cations – total	Aluminum (Al)	mg/L		0.196	0.050	0.058	0.050	0.050	0.050	0.150	0.380	0.205	0.152	0.249
	Calcium (Ca)	mg/L		28.2	27.2	29.2	68.3	26.0	30.9	31.2	29.4	30.4	31.4	27.9
	Iron (Fe)	mg/L	0.050	0.157	0.051	0.054	0.103	0.070	0.055	0.144	0.307	0.209	0.153	0.300
	Magnesium (Mg)	mg/L		5.36	5.14	5.66	10.2	4.89	5.56	5.66	5.71	5.79	5.94	5.16
	Manganese (Mn)	mg/L	0.0023	0.0118	0.0025	0.0008	0.156	0.0087	0.0047	0.012	0.0123	0.0074	0.0036	0.0041
	Nickel (Ni)	mg/L		0.0015	0.0013	0.0016	0.0031	0.0019	0.0016	0.0017	0.0017	0.002	0.0016	0.0009
	Potassium (K)	mg/L		2.59	4.01	1.85	2.12	2.04	1.46	1.58	2.19	1.84	2.01	1.50
	Silicon (Si)	mg/L		4.96	5.3	5.99	6.79	3.96	3.85	4.45	4.79	4.98	5.14	5.76
	Silver (Ag)	mg/L		0.0001	0.0007	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.001	0.0001	0.0001
	Sodium (Na)	mg/L		12.3	10.8	12.1	17.8	11.3	12.7	13.4	13.6	14.3	15.1	13.3
	Zinc (Zn)	mg/L		0.0020	0.0050	0.0040	0.0150	0.0150	0.0015	0.0100	0.0010	0.0100	0.0021	0.0404
Metals/Cations – dissolved	Aluminum (Al^{3+})	mg/L	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
	Boron (B^{3+})	mg/L	0.300											
	Calcium (Ca^{2+})	mg/L	30.6											
	Iron (Fe^{2+})	mg/L	0.050		0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
	Magnesium (Mg^{2+})	mg/L	5.94											
	Manganese (Mn^{2+})	mg/L	0.0023	0.0038	0.0022	0.0017	0.172	0.0040	0.0015	0.0016	0.0015	0.0011	0.0015	0.0028
	Nickel (Ni)	mg/L	0.0009	0.0009	0.0011	0.0013	0.0020	0.0013	0.0012	0.0014	0.0012	0.0012	0.0015	0.0013
	Potassium (K^+)	mg/L	1.88											
	Silicon (Si^{4+})	mg/L	6.07											
	Silver (Ag^-)	mg/L	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
	Sodium (Na^+)	mg/L	13.7											
	Strontium (Sr^{2+})	mg/L	0.296											
	Zinc (Zn^{2+})	mg/L	0.0056	0.0013	0.0024	0.0051	0.0106	0.0073	0.0013	0.0025	0.0010	0.0023	0.0034	0.038
Anions – total	Orthophosphate	mg/L as P	0.050	0.025	0.120	0.127	0.104	0.094	0.050	0.027	0.019	0.048	0.0132	0.083
	Phosphate	mg/L as P	0.050	0.096	0.102	0.222	0.087	0.086	0.084	0.092	0.109	0.030		0.054
Anions – dissolved	Bromide (Br^-)	mg/L	0.188	1.00										
	Chloride (Cl^-)	mg/L	10		10	10	10	10	10	10	10	10	10	10
	Phosphate	mg/L as P	0.050	0.092	0.098	0.187	0.188	0.245	0.138	0.088	0.086	0.129		0.0249
	Sulfate (SO_4^{2-})	mg/L	40	41	40	41	140	43	48	54	48	50	46	48
USEPA Regulated Primary Contaminants – Inorganic (total)	Antimony (Sb)	mg/L	0.0005											
	Arsenic (As)	mg/L	0.0006	0.0008	0.0007	0.0007	0.0005	0.0009	0.0006	0.0007	0.0009	0.0007	0.0008	0.0008
	Asbestos	MFL	0.19											
	Barium (Ba)	mg/L	0.0627											
	Beryllium (Be)	mg/L	0.0005											
	Cadmium (Cd)	mg/L	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
	Chromium (Cr)	mg/L	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010
	Copper (Cu)	mg/L	0.0010	0.0001	0.0017	0.0001	0.0007	0.0012	0.0022	0.0013	0.0057	0.0018	0.0016	0.0047
	Cyanide (CN^-)	mg/L	0.0050											
	Fluoride (F^-)	mg/L	0.200		0.200	0.200	0.749	0.220	0.311	0.312	0.241	0.200	0.200	0.200
	Lead (Pb)	mg/L	0.0005	0.0005	0.0005	0.0005	0.0007	0.0005	0.0005	0.0005	0.0006	0.0005	0.0005	0.0005
	Mercury (Hg)	mg/L	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
	Nitrate (NO_3^-) / Nitrite (NO_2^-)	mg/L as N / mg/L as N	0.060		0.060	0.039	0.078	0.029	0.100	0.103	0.088	0.056	0.097	1.65
	Selenium (Se)	mg/L	0.0021	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010
	Thallium (Tl)	mg/L	0.0001											
Inorganic (dissolved)	Arsenic (As)	mg/L		0.0006	0.0007	0.0008	0.0005	0.0010	0.0007	0.0008	0.0008	0.0008	0.0007	0.0008
	Cadmium (Cd)	mg/L		0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
	Chromium (total) (Cr)	mg/L		0.0010	0.0024	0.0027	0.0010	0.0010	0.0010	0.0010	0.0021	0.001	0.001	0.0032
	Copper (Cu^{2+})	mg/L		0.0013	0.0011	0.0001	0.0006	0.0012	0.0016	0.0025	0.0015	0.0021	0.002	0.0020
	Lead (Pb)	mg/L		0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
	Mercury (Hg)	mg/L		0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
	Selenium (Se)	mg/L		0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010
Radionuclides	Combined Radium (Ra-226 & Ra-228)	pCi/L	1.00											
	Gross Alpha (excluding Ra & U)	pCi/L	3.0					1.4		3.2	1.2	1.6		1.5
	Gross Beta	pCi/L	5.2					2.6		2.4	3.9	2.6		2.5
	Uranium	mg/L	0.0010											
Biological	Turbidity	NTU	1.06								6.10	6.10		4.7
	Cryptosporidium	oocysts/L	0.093											
	Giardia	cysts/L	0.093											
	Heterotrophic Plate Count	MPN/mL	100											

Parameter	8/8/2013	9/17/2013	10/18/2013	11/7/2013	12/9/2013	6/2/2014	7/7/2014	8/4/2014	9/10/2014	10/6/2014	11/3/2014	12/8/2014
pH	8.07	8.33	8.08	8.03	7.97	8.20	8.20	8.28	8.00	8.04	8.32	8.40
Conductivity	266	239	278	277	299	252	233	242	222	236	231	448
Total Organic Carbon (TOC)	3.06	3.29	2.85	3.05	2.96	2.67		2.61	3.16	3.22	3.01	2.69
Dissolved Organic Carbon (DOC)		3.29	3.37	3.19	3.04	2.60		2.63	2.96	3.12	2.84	2.75
Ultraviolet Absorbance at 254 nm (UV_{254})						0.069		0.086	0.081	0.084	0.082	0.078
Color (total)						8	7	13	13	15	13	12
Alkalinity (total)	90	90	80	89	86	88	82	77	62	78	77	80
Carbonate (CO_3^{2-})	10	10	10	10	10	10	10	10	10	10	10	10
Bicarbonate (HCO_3^-)	90	90	80	89	86	88	80	77	62	78	77	80
Hardness (total)						104	97.3	96.2	89.7	91.9	96.3	99.5
Hardness (dissolved)						101	97.3	103	85.0	96.3	89.7	96.6
Odor												
Total Dissolved Solids (TDS)	195	110	145	140	100	40	135	155	95	130	95	150
Total Suspended Solids (TSS)						2.0	2.0	8.0	2.4	17.6	21.4	5.6
Total Nitrogen												
Total Kjeldahl Nitrogen (TKN, organic N + NH_3/NH_4^+)	0.500	0.500	0.500	0.502	0.583							
Silica (SiO_2) (total)						12.6	12.1	12.7	11.8	11.6	13.9	13.2
Silica (SiO_2) (dissolved)						12.6	12.6	13.8	11.6	12.7	12.5	12.1
Ammonia (NH_3)												
Aluminum (Al)	0.148	0.153	0.705	0.520	0.157	0.169	0.059	0.080	0.053	0.092	0.282	0.278
Calcium (Ca)	29.7	29.2	28.4	32.0	32.8	32.1	30.0	29.7	27.7	28.6	30.0	31.2
Iron (Fe)	0.154	0.150	0.531	0.377	0.169	0.081	0.071	0.107	0.050	0.208	0.386	0.319
Magnesium (Mg)	5.49	5.38	5.14	5.66	5.55	5.73	5.43	5.32	4.97	5.00	5.19	5.21
Manganese (Mn)	0.0039	0.0040	0.0241	0.0254	0.0336	0.0024	0.0030	0.0034	0.0040	0.0083	0.0233	0.0115
Nickel (Ni)	0.0016	0.0016	0.0018	0.002	0.0015	0.0015	0.0017	0.0037	0.0017	0.0025	0.0011	0.0013
Potassium (K)	2.06	2.45	2.20	2.89	2.07	1.66	1.85	1.57	2.38	2.46	2.12	2.69
Silicon (Si)	3.72	3.75	5.19	5.6	4.43	5.90	5.65	5.94	5.52	5.44	6.51	6.16
Silver (Ag)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Sodium (Na)	13.7	13.2	12.7	14.0	13.3	15.0	13.8	14.3	12.8	12.8	12.8	12.8
Zinc (Zn)	0.02	0.0089	0.0015	0.001	0.0070	0.0032	0.0152	0.0083	0.0050	0.0150	0.0036	0.0021
Aluminum (Al^{3+})	0.050	0.050	0.056	0.050	0.063	0.050	0.050	0.050	0.050	0.050	0.050	0.050
Boron (B^{3+})												
Calcium (Ca^{2+})						31.4	29.9	31.9	26.2	30.0	27.8	30.3
Iron (Fe^{2+})	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
Magnesium (Mg^{2+})						5.59	5.48	5.59	4.74	5.22	4.91	5.08
Manganese (Mn^{2+})	0.0016	0.0014	0.0145	0.0067	0.0311	0.0009	0.0018	0.0014	0.0022	0.0018	0.0022	0.0019
Nickel (Ni)	0.001	0.0012	0.0015	0.0016	0.0015	0.0012	0.0015	0.0012	0.0009	0.0012	0.0014	0.0012
Potassium (K^+)												
Silicon (Si^{4+})						5.88	5.90	6.43	5.42	5.95	5.86	5.68
Silver (Ag^-)	0.0001	0.0001	0.0001	0.0001	0.0001							
Sodium (Na^+)						14.5	13.3	17.9	12.3	13.7	12.1	12.8
Strontium (Sr^{2+})												
Zinc (Zn^{2+})	0.0069	0.0017	0.0019	0.0035	0.0020	0.0019	0.0112	<0.003	0.0013	0.0026	0.0024	0.0022
Orthophosphate	0.104	0.093	0.141	0.12	0.054	0.050	0.057	0.050	0.104	0.062	0.050	0.050
Phosphate	0.035	0.055	0.025	0.023	0.040	0.098	0.050	0.086	0.050	0.092	0.148	0.050
Bromide (Br^-)						0.100	0.100	0.100	0.200	0.100	0.500	0.500
Chloride (Cl^-)	10	10	10	10	10	10	10	10	10	10	10	10
Phosphate	0.0249	0.059	0.0249	0.0249	0.035							
Sulfate (SO_4^{2-})	44	40	43	39	50	43	44	43	45	45	41	45
Antimony (Sb)						0.0005	0.0005	0.0008	0.0005	0.0005	0.0005	0.0005
Arsenic (As)	0.0009	0.0008	0.001	0.0014	0.0024	0.0008	0.0009	0.0008	0.0008	0.0009	0.0012	0.0011
Asbestos												
Barium (Ba)						0.0790	0.0734	0.0705	0.0656	0.0764	0.0902	0.0951
Beryllium (Be)						0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
Cadmium (Cd)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Chromium (Cr)	0.0020	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010
Copper (Cu)	0.0018	0.0019	0.0013	0.001	0.0050	0.0016	0.0024	0.0019	0.0016	0.0014	0.0015	0.0014
Cyanide (CN^-)												
Fluoride (F^-)	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.250	0.250	0.250	0.250
Lead (Pb)	0.0015	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
Mercury (Hg)	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
Nitrate (NO_3^-) / Nitrite (NO_2^-)	0.084	2.62	0.144	0.170	0.164	0.317	0.143	0.152	0.352	0.283	0.210	0.177
Selenium (Se)	0.0010	0.0010	0.0010	0.0010	0.0188	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Thallium (Tl)						0.0002	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Arsenic (As) (dissolved)	0.0009	0.0009	0.0011	0.0011	0.0012	0.0008	0.0009	0.0006	0.0008	0.0008	0.0011	0.0011
Cadmium (Cd) (dissolved)	0.0001	0.0001	0.0001	0.0001	0.0001							
Chromium (total) (Cr) (dissolved)	0.0026	0.0023	0.005	0.0029	0.0031							
Copper (Cu^{2+}) (dissolved)	0.0015	0.0013	0.0013	0.0009	0.0010							
Lead (Pb) (dissolved)	0.0005	0.0005	0.0005	0.0005	0.0005							
Mercury (Hg) (dissolved)	0.0002	0.0002	0.0002	0.0002	0.0002							
Selenium (Se) (dissolved)	0.0010	0.0010	0.0010	0.0010	0.0010							
Combined Radium (Ra-226 & Ra-228)						1.0	0.9	1.2	1.1	1.2	1.1	1.2
Gross Alpha (excluding Ra & U)						3.0	0.9	0.8	0.9	1.0	1.1	0.7
Gross Beta						4.0	2.3	4.0	8.0	3.7	5.7	6.4
Uranium						0.0005	0.0005	0.0006	0.0005	0.0005	0.0005	0.0005
Turbidity						2.10	1.14	1.55	1.56	0.75	3.50	1.45
Cryptosporidium						0.089		0.091	0.2	0.087	0.089	0.089
Giardia						0.089		0.091	0.2	0.087	0.089	0.089
Heterotrophic Plate Count						146		623	414	738	257	195

Parameter	1/5/2015	2/10/2015	3/9/2015	4/6/2015	5/4/2015	6/1/2015	7/6/2015	8/3/2015	9/2/2015	10/6/2015	10/27/2015	12/2/2015	Average	Standard Deviation	Minimum	Maximum	Count
pH	8.26	8.26	7.89	8.15	8.19	8.35	8.21	8.10	7.99	8.07	8.02	8.15	8.1	0.1	7.9	8.4	35
Conductivity	316	287	292	256	218	246	251	289	220	219	223	778	266	57	218	483	34
Total Organic Carbon (TOC)	2.86	2.82	2.56	2.59	2.91	2.58	2.37	2.50	2.70	2.82	2.78	1.68	2.7	0.5	0.8	3.5	35
Dissolved Organic Carbon (DOC)	2.90	2.91	2.55	2.46	3.26	3.45	2.29	2.82	2.99	2.74	2.97	1.60	2.8	0.4	1.6	3.5	23
Ultraviolet Absorbance at 254 nm (UV_{254})	0.080	0.070	0.069	0.079	0.070	0.064	0.064	0.069	0.068	0.074	0.076	0.028	0.072	0.012	0.028	0.086	19
Color (total)	10	10	13	10	10	12		5	10	12	15	10	11	3	5	15	19
Alkalinity (total)	85	86	82	81	83	81	82	71	83	87	77	79	82	13	40	134	36
Carbonate (CO_3^{2-})	10	10	10	10	10	10	10	10	10	10	10	10	10	37	10	134	36
Bicarbonate (HCO_3^-)	85	86	82	81	83	81	82	71	83	87	77	77	82	14	40	134	36
Hardness (total)	108	115	113	101	89.2	91.9	96.2	90.5	87.8	89.6	89.6	412	97	8	85	116	18
Hardness (dissolved)	106	116	112	97.0	98.0	90.6	90.2	94.4	84.6	92.4	89	376	97	8	85	116	19
Odor													1.0	--	1.0	1.0	1
Total Dissolved Solids (TDS)	190	165	60	160	165	200	185	115	135	145	125	655	136	44	40	225	34
Total Suspended Solids (TSS)	2.6	6.0	7.8	4.5	4.9	2.2	22.0	2.0	2.0	2.0		4.7	6.5	6.3	2.0	22	23
Total Nitrogen													0.5	0.2	0.5	1.0	1
Total Kjeldahl Nitrogen (TKN, organic N + NH_3/NH_4^+)													0.6	6.2	0.5	15	16
Silica (SiO_2) (total)	12.8	12.0	14.5	14.0	12.3	11.3	13.2	12.2	12.2	13.6	12.8	12.5	13	0.9	11	15	19
Silica (SiO_2) (dissolved)	12.1	11.7	12.6	12.8	13.7	12.1	12.9	13.6	12.1	13.7	12.7	10.9	13	0.8	11	14	20
Ammonia (NH_3)													0.05	--	0.05	0.05	1
Aluminum (Al)	0.098	0.050	0.349	0.209	0.111	0.063	0.306	0.050	0.050	0.181	0.055	0.219	0.146	0.097	0.050	0.380	33
Calcium (Ca)	34.0	36.6	35.8	31.5	27.6	28.4	29.6	27.9	27.2	27.7	27.9	145	34	20	26	145	35
Iron (Fe)	0.120	0.110	0.255	0.140	0.449	0.069	0.444	0.150	0.050	0.191	0.076	0.309	0.184	0.131	0.050	0.531	36
Magnesium (Mg)	5.63	5.81	5.81	5.51	4.95	5.11	5.45	5.03	4.82	4.96	4.86	12.4	5.7	1.5	4.8	12.4	35
Manganese (Mn)	0.0134	0.0141	0.0187	0.0091	0.0041	0.0028	0.0110	0.0030	0.0075	0.0073	0.0141	0.0826	0.0087	0.0067	0.0008	0.0254	33
Nickel (Ni)	0.0018	0.0016	0.0013	0.0013	0.0013	0.0012	0.0018	0.0014	0.0025	0.0012	0.0011	0.0054	0.0018	0.0008	0.0009	0.0054	35
Potassium (K)	2.53	2.94	3.25	3.21	1.67	2.22	2.39	1.86	1.83	1.97	1.89	2.40	2.2	0.6	1.5	4.0	35
Silicon (Si)	5.97	5.61	6.80	6.56	5.77	5.29	6.15	5.72	5.7	6.34	5.96	5.84	5.5	0.8	3.7	6.8	35
Silver (Ag)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.005	0.0001	0.0001	0.0001	0.0003	0.0008	0.0001	0.0050	35
Sodium (Na)	13.2	13.3	14.2	15.3	12.7	13.1	13.6	12.4	12	12	11.8	21.8	14	1.9	11	22	35
Zinc (Zn)	0.0057	0.0010	0.0030	0.0028	0.0010	0.0031	0.0100	0.0010	0.0050	0.0100	0.0100	0.0100	0.0074	0.0077	0.0010	0.0404	35
Aluminum (Al^{3+})	0.050	0.050	0.050	0.050	0.069	0.050	0.050	0.050	0.050	0.050	0.050	0.100	0.052	0.009	0.050	0.100	36
Boron (B^{3+})													0.300	--	0.300	0.300	1
Calcium (Ca^{2+})	33.3	36.8	35.4	30.2	30.5	28.0	27.8	29.2	26.2	28.7	27.6	132.0	35	23	26	132	20
Iron (Fe^{2+})	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.000	0.050	0.050	35
Magnesium (Mg^{2+})	5.44	5.77	5.64	5.23	5.32	5.02	5.06	5.21	4.66	5.05	4.89	11.3	5.6	1.4	4.7	11.3	20
Manganese (Mn^{2+})	0.0045	0.0007	0.0105	0.0024	0.0012	0.0013	0.0056	0.0022	0.0023	0.0046	0.0063	0.0778	0.0060	0.0137	0.0007	0.0778	35
Nickel (Ni)	0.0017	0.0015	0.0013	0.0014	0.0019	0.0013	0.0013	0.0015	0.0013	0.0010	0.0013	0.0048	0.0014	0.0006	0.0009	0.0048	36
Potassium (K^+)													1.9	--	1.9	1.9	1
Silicon (Si^{4+})	5.68	5.46	5.89	5.96	6.42	5.63	6.04	6.34	5.64	6.4	5.94	5.08	5.9	0.4	5.1	6.4	20
Silver (Ag^-)													0.0001	0.0000	0.0001	0.0001	17
Sodium (Na^+)	12.9	13.3	13.9	13.2	13.8	12.8	12.8	13.4	11.9	11.7	12.2	19.3	14	1.9	12	19	20
Strontium (Sr^{2+})													0.296	--	0.296	0.296	1
Zinc (Zn^{2+})	0.0024	0.0038	0.0044	0.0016	<0.001	0.0019	0.0011	0.0131	0.0036	0.0049	0.0032	0.0027	0.0047	0.0066	0.0010	0.0380	34
Orthophosphate	0.050	0.050	0.054	0.050	0.050	0.050	0.050	0.062	0.050	0.050	0.109	0.050	0.066	0.032	0.013	0.141	36
Phosphate	0.119	0.050	0.050	0.061	0.067	0.058	0.059	0.071	0.050	0.050	0.050	0.050	0.071	0.038	0.023	0.222	35
Bromide (Br^-)	0.100	0.200	0.100	0.200	0.100	0.100	0.100	0.500	0.100	0.100	0.100	0.100	0.218	0.227	0.100	1.0	21
Chloride (Cl^-)	10	10	10	10	10	10	10	10	15	10	2.33	2.71	9.7	2.0	2.3	15	35
Phosphate													0.093	0.068	0.025	0.245	16
Sulfate (SO_4^{2-})	48	55	54	45	37	39.3	37.4	33	34.8	36	31.2	382	55	59	31	382	36
Antimony (Sb)	0.0010	0.0006	0.0005	0.0005	0.0005	0.0010	0.0015	0.0015	0.0025	0.0005	0.0005	0.0005	0.0008	0.0005	0.0005	0.0025	20
Arsenic (As)	0.0017	0.0011	0.0016	0.0010	0.0012	0.0008	0.0010	0.0010	0.0025	0.0005	0.0005	0.0005	0.0010	0.0005	0.0005	0.0025	36
Asbestos													0.19	--	0.19	0.19	1
Barium (Ba)	0.115	0.093	0.0858	0.0776	0.0864	0.0685	0.0793	0.0703	0.0732	0.066	0.0639	0.0818	0.0787	0.0129	0.0627	0.1150	20
Beryllium (Be)	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0025	0.0005	0.0005	0.0005	0.0006	0.0004	0.0005	0.0025	20
Cadmium (Cd)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0005	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0005	36
Chromium (Cr)	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0150	0.0050	0.0050	0.0050	0.0018	0.0025	0.0010	0.0150	36
Copper (Cu)	0.0012	0.0010	0.0014	0.0017	0.0014	0.0010	0.0017	0.0018	0.0050	0.0016	0.0012	0.0010	0.0018	0.0013	0.0001	0.0057	36
Cyanide (CN^-)													0.0050	--	0.0050	0.0050	1
Fluoride (F^-)	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.327	0.220	0.248	0.094	0.200	0.749	35
Lead (Pb)	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0025	0.0005	0.0005	0.0005	0.0006	0.0004	0.0005	0.0025	36
Mercury (Hg)	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0000	0.0002	0.0002	36
Nitrate (NO_3^-) / Nitrite (NO_2^-)	0.414	0.135	0.193	0.177	0.127	0.099	0.168	0.174	0.170	0.209	0.168	0.050	0.161	0.089	0.029	0.414	33
Selenium (Se)	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.005	0.001	0.001	0.001	0.002	0.003	0.001	0.019	36
Thallium (Tl)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002	0.0001	0.0005	0.0001	0.0003	0.0001	0.0001	0.0001	0.0001	0.0005	20
Arsenic (As) (dissolved)	0.0012	0.0010	0.0005	0.0010	0.0010	0.0008	0.0009	0.0009	0.0008	0.0009	0.0010	0.0006	0.0009	0.0002	0.0005	0.0012	35
Cadmium (Cd) (dissolved)													0.0001	0.0000	0.0001	0.0001	16
Chromium (total) (Cr) (dissolved)													0.0021	0.0012	0.0010	0.0050	16
Copper (Cu^{2+}) (dissolved)													0.0014	0.0006	0.0001	0.0025	16
Lead (Pb) (dissolved)													0.0005	0.0000	0.0005	0.0005	16
Mercury (Hg) (dissolved)													0.0002	0.0000	0.0002	0.0002	16
Selenium (Se) (dissolved)													0.0010	0.0000	0.0010	0.0010	16
Combined Radium (Ra-226 & Ra-228)	1.6	1.1	1.2	1.2	1.2	1.2	1.2	1.2	0.9	0.7	0.7	1.0	1.1	0.2	0.7	1.6	20
Gross Alpha (excluding Ra & U)	1.1	1.0	1.0	0.7	0.4	0.5	1.1	0.3	0.4	0.8	0.4	0.5	1.1	0.8	0.3	3.2	25
Gross Beta	2.2	7.6	2.2	2.2	2.2	2.2	1.2	2.7	3.0	2.8	2	2.7	3.5	1.8	1.2	8.0	25
Uranium	0.0006	0.0005	0.0005	0.0005	0.0006	0.0005	0.0005	0.0005	0.0005	0.0005	0.0004	0.0007	0.0005	0.0001	0.0004	0.0010	20
Turbidity	2.30	2.30	6.40	4.50	2.20	1.30	11.0	1.02		2.5	1.77	1.40	3.0	2.5	0.1	11	22
Cryptosporidium		0.093	0.093	0.087	0.091	0.095	0.087	0.095	0.089	0.091	0.091	0.091	0.097	0.026	0.087	0.200	18
Giardia		0.093	0.093	0.087	0.091	0.095	0.087	0.095	0.089	0.091	0.091	0.091	0.097	0.026	0.087	0.200	18
Heterotrophic Plate Count	189	19	83	53	108	372	372	738	223	738	90	738	326	263	1	738	19

Acceptable Materials Pipe Schedule. (For Pipe/Tube Standards.) For related Standards (i.e. fittings, gaskets, installation, etc.), see Pipe Tabs.

FOR INFORMATION ONLY

Pipe Category	Pipe Type	Installation	Pipe Size	Cast Iron	Concrete	Copper	Chlorinated PolyvVinyl Chloride (CPVC)	Ductile Iron	Fiber Reinforced Plastic (FRP)	Fiber Reinforced Plastic (FRP)	High Density Polyethylene	High Density Polyethylene (HDPE)	Polyethylene (PE) Tube	Polypropylene (PP)	Polytetrafluoroethylene (PTFE) / PFA solid or lined	Polyvinyl Chloride (PVC)	Polyvinyl Chloride (PVC)	Polyvinyl Chloride (PVC)	Polyvinyl Chloride (PVC)	Polyvinyl Chloride (PVC)	Polyvinyl Chloride (PVC)	Polyvinyl Chloride (PVC)	Polyvinylidene fluoride Kynar (PVDF) Solid or lined	Stainless Steel	Stainless Steel	Steel	Steel	Steel - Galvanized	Steel - Corrugated
				AWWA C101 or C106	ASTM C76 or ASTM C361	ASTM B88	ASTM F2618 Sch 80; ASTMD2846	AWWA C150, C151	ASTM D2996, D2997, D3262, and D3754.	C950	AASHTO 30, M252, &M294; ; ASTM D2104, D2683, D3350, F667, F810, F2306, F2788	C906	ASTM D2683, 2737; F876, F2623, or 2769	Schedule 80	ASTM D4894,	ASTM 1784, 1785; Sch 80	ASTMD3034 SDR35; ASTMD2241; ASTMD2729;	C900	C905	DWV	ASTM F512 (Electrical Conduit)	Schedule 80	304L / 316L	ASTM A312	ASTM A53			
Building Systems Pipe (See Section 01 86 16)	Air	Exposed	≤ 1/2"			x																		x			x	
			> 1/2"			x		x																x			x	
		Buried	≤ 1/2"			x																		x			x	
			> 1/2"			x		x																x			x	
	Drainage	Exposed		x			x		x		x									x								
		Buried		x			x		x		x									x								
	Fire Supression (See Section 01 86 13 for Materials)	Exposed				x																		x		x		
		Buried				x																		x		x		
	Fuel Gas	Exposed									x													x	x			
		Buried									x													x	x			
	Potable Water & Non-Potable Water	Exposed				x		x								x								x				
		Buried				x		x								x								x				
	Sanitary Sewer	Exposed		x			x		x											x								
		Buried		x			x		x											x								
	Waste Vent	Exposed		x			x		x											x								
		Buried		x			x		x											x								
Chemical Pipe (See Section 01 89 19)	Chemical - Alum (48%)	Exposed					x		x		x		x			x												
		Buried					x		x		x		x			x												
	Chemical - Alum (10%)	Exposed					x							x		x							316			x		
		Buried					x							x		x							316			x		
	Chemical - Citric acid	Exposed					x				x		x	x	x	x						x	x					
		Buried					x				x		x	x	x	x						x	x					
	Chemical - Chlorine (gas) - dry	Exposed				x									x							x				carbon		
		Buried													x							x				carbon		
	Chemical - Chlorine (gas) - Pressure	Exposed																										
		Buried																										
	Chemical - Chlorine (liquid) (up to 15%)	Exposed					x		x							x										carbon		
		Buried					x		x							x										carbon		
	Chemical - Iron based (40%)	Exposed					x		x						x	x						x				carbon		
		Buried					x		x						x	x						x				carbon		
	Chemical - Ozone	Exposed					x									x							316					
		Buried					x									x							316					
	Chemical - Soda Ash	Exposed					x				x			x	x	x						x						
		Buried					x				x			x	x	x						x						
	Chemical - Lime CaO	Exposed					x				x			x								x						
		Buried					x				x			x								x						
	Chemical - Sulfuric acid (93%)	Exposed													x							x	316					
		Buried													x							x	316					
	Chemical - Sulfuric acid (30%)	Exposed					x				x			x	x	x												
		Buried					x				x			x	x	x												
	Chemical - Hydrochloric acid (20%)	Exposed					x							x	x	x												
		Buried					x							x	x	x												
	Chemical - Hydrochloric acid (37%)	Exposed					x							x	x	x												
		Buried					x							x	x	x												
	Chemical - Sodium Hydroxide (25% to 50%)	Exposed							x					x	x	x						x	x					
		Buried							x					x	x	x						x	x					
	Chemical - Sodium Hydroxide (15%)	Exposed												x		x							x					
		Buried												x		x							x					
	Chemical - Sodium Bisulfite (38%)	Exposed					x		x					x	x	x						x	316			carbon		
		Buried					x		x					x	x	x						x	316			carbon		
	Chemical - Chlorine Dioxide	Exposed													x											carbon		
		Buried													x											carbon		
	Secondary containment	Exposed														x					x							
		Buried									x					x					x							
Line Pipe (See Section 01 89 33)	Line	Buried	≥ 20"							x		x							x									
Process Pipe (See Section 01 89 19)	Process Sample	Exposed							x							x							x		x			
		Buried							x		x		x			x							x		x			
	Clearwell Pumps Discharge Pipe	Exposed																							x			
		Buried																							x			
	Process	Exposed	≤ 3"						x							x							x		x			
			> 3"					x	x							x							x		x			
		Buried	≤ 3"						x		x					x							x		x			
			> 3"					x	x		x					x		x					x		x			
Utility Pipe (See Section 01 89 19)	Fire Service	Buried	≤ 3"			x	x		x		x					x									x		x	
			> 3"				x	x	x		x					x		x							x			
	Fuel Gas	Exposed		x																					x		x	
		Buried		x																					x		x	
	Potable Water & Non-Potable Water (outside of buildings)	Exposed	≤ 3"																								x	
			> 3"					x																				
		Buried	≤ 3"			x			x		x					x									x		x	
			> 3"				x	x	x		x					x		x							x			
	On-Site Sewage	Exposed									x					x	3034											
		Buried									x					x	3034											
	Septic disposal field	Buried									x						2241											
	Storm Sewer	Exposed			x						x																	x
		Buried			x						x																	x
	Sub-surface drainage	Buried									x		x				2729											

LINE	Identification of motor (Unit No., Item No., etc as applicable) (Note 2)						
1	Manufacturer (Nameplate)						
2	Horsepower rating (Nameplate)						
3	Time rating (Nameplate)						
4	Temperature rise of windings by resistance (Not ambient temperature)						
5	Calculated starting time of the pumping unit under specified conditions, seconds (Note 1)						
6	Rated load speed. R.P.M. (Nameplate)						
7	Number of phases (Nameplate)						
8	Armature connected (delta or wye)						
9	Voltage (Nameplate)						
10	Rated load amperes (Nameplate)						
11	Code letter for locked–rotor Kva/hp. (Nameplate)						
12	Design letter						
13	Power factor at nameplate rated load						
	Power factor at 3/4 load (Note 4)						
	Power factor at 1/2 load (Note 4)						
14	Capacitor KVAR rating to correct power factor over range of pump (Notes 3 and 4)						
15	Corrected power factor (minimum) (Note 4)						
16	Efficiency at nameplate rated load						
	Efficiency at 3/4 load (Note 4)						
	Efficiency at 1/2 load (Note 4)						
17	Type of enclosure (open, drip–proof, TEFC)						
18	Stator insulation, class						
19	Type of stator windings (form wound or random wound)						
20	Type of bearings (ball, roller, sleeve)						
21	Net weight each motor, lbs.						
22	Motor WR^2 – ($lb–ft^2$)						

NOTES

1. Applicable only to pumping units with motors above 20 hp.
2. Provide column for each different size motor at each plant or structure. All reference to nameplates means the date shall be as it appears on the nameplate furnished.
3. Capacitor KVAR rating should be at capacitor rated voltage but capacitor must be sized for operation at motor rated voltage.
4. Applicable only to units where power factor correction is specified.

Specifications or Solication No. _____
Project _____
Name of structure _____

2 – 19 – 99 D – L.J.R.	REVISED AND REDRAWN INTO AUTOCAD FORMAT.
8 – 1 – 73 D – P.L.A.	GENERAL REVISIONS, RETRACED

ALWAYS THINK **SAFETY**

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

STANDARD DESIGNS

INDUCTION MOTORS

DESIGN AND NAMEPLATE DATA TO BE FURNISHED BY THE CONTACTOR

DESIGNED R.S.N. SUBMITTED J.V BAPTIST
TRACED L. Mc Farlane RECOMMENDED H.G. ARTHUR
CHECKED E.M.J. – P.L.A. APPROVED B.P. BELLPORT
CHIEF ENGINEER

CADD SYSTEM	CADD FILENAME	DATE AND TIME PLOTTED
AutoCAD Rel. 19.1s	40–D–6032–RD–1.DWG	JANUARY 29, 2016 12:42

DENVER, COLORADO MARCH 18, 1965 **40–D–6032**

LGAMUCIE

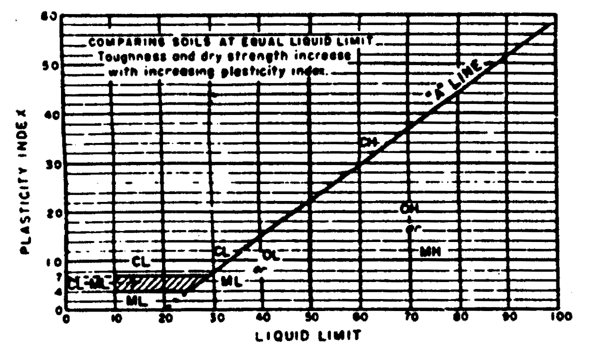
UNIFIED SOIL CLASSIFICATION
INCLUDING IDENTIFICATION AND DESCRIPTION

FIELD IDENTIFICATION PROCEDURES (Excluding particles larger than 3 inches and basing fractions on estimated weights)				GROUP SYMBOLS ‡	TYPICAL NAMES	INFORMATION REQUIRED FOR DESCRIBING SOILS	LABORATORY CLASSIFICATION CRITERIA	
COARSE GRAINED SOILS — More than half of material is <u>larger</u> than No. 200 sieve size ‡ (The No. 200 sieve size is about the smallest particle visible to the naked eye)	GRAVELS — More than half of coarse fraction is larger than No. 4 sieve size. (For visual classifications, the ¼" size may be used as equivalent to the No. 4 sieve size.)	CLEAN GRAVELS (Little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes.	GW	Well graded gravels, gravel-sand mixtures, little or no fines.	Give typical name; indicate approximate percentages of sand and gravel, max. size; angularity, surface condition, and hardness of the coarse grains; local or geologic name and other pertinent descriptive information, and symbol in parentheses.	$C_u = \frac{D_{60}}{D_{10}}$ Greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between one and 3	
			Predominantly one size or a range of sizes with some intermediate sizes missing.	GP	Poorly graded gravels, gravel-sand mixtures, little or no fines.		Not meeting all gradation requirements for GW	
		GRAVELS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below).	GM	Silty gravels, poorly graded gravel-sand-silt mixtures.	For undisturbed soils add information on stratification, degree of compactness, cementation, moisture conditions and drainage characteristics.	Atterberg limits below "A" line, or PI less than 4	Above "A" line with PI between 4 and 7 are <u>borderline</u> cases requiring use of dual symbols.
			Plastic fines (for identification procedures see CL below).	GC	Clayey gravels, poorly graded gravel-sand-clay mixtures.		Atterberg limits above "A" line with PI greater than 7	
	SANDS — More than half of coarse fraction is smaller than No. 4 sieve size.	CLEAN SANDS (Little or no fines)	Wide range in grain sizes and substantial amounts of all intermediate particle sizes.	SW	Well graded sands, gravelly sands; little or no fines.	EXAMPLE:- <u>Silty sand</u>, gravelly; about 20% hard, angular gravel particles ½-in maximum size; rounded and subangular sand grains coarse to fine; about 15% non-plastic fines with low dry strength; well compacted and moist in place; alluvial sand; (SM)	$C_u = \frac{D_{60}}{D_{10}}$ Greater than 6; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between one and 3	
			Predominantly one size or a range of sizes with some intermediate sizes missing	SP	Poorly graded sands, gravelly sands; little or no fines.		Not meeting all gradation requirements for SW	
		SANDS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below)	SM	Silty sands, poorly graded sand-silt mixtures.		Atterberg limits below "A" line or PI less than 4	Above "A" line with PI between 4 and 7 are <u>borderline</u> cases requiring use of dual symbols.
			Plastic fines (for identification procedures see CL below).	SC	Clayey sands, poorly graded sand-clay mixtures		Atterberg limits above "A" line with PI greater than 7	

Laboratory classification criteria (coarse grained soils): Use grain size curve in identifying the fractions as given under field identification. Determine percentages of gravel and sand from grain size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size) coarse grained soils are classified as follows:-
Less than 5% — GW, GP, SW, SP.
More than 12% — GM, GC, SM, SC.
5% to 12% — <u>Borderline</u> cases requiring use of dual symbols.

IDENTIFICATION PROCEDURES ON FRACTION SMALLER THAN No. 40 SIEVE SIZE

FINE GRAINED SOILS — More than half of material is <u>smaller</u> than No 200 sieve size. (The No. 200 sieve size is about the smallest particle visible to the naked eye)		DRY STRENGTH (CRUSHING CHARACTERISTICS)	DILATANCY (REACTION TO SHAKING)	TOUGHNESS (CONSISTENCY NEAR PLASTIC LIMIT)	GROUP SYMBOLS ‡	TYPICAL NAMES	INFORMATION REQUIRED FOR DESCRIBING SOILS
	SILTS AND CLAYS — Liquid limit less than 50	None to slight	Quick to slow	None	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity.	Give typical name; indicate degree and character of plasticity, amount and maximum size of coarse grains; color in wet condition, odor if any, local or geologic name, and other pertinent descriptive information; and symbol in parentheses.
		Medium to high	None to very slow	Medium	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	
		Slight to medium	Slow	Slight	OL	Organic silts and organic silt-clays of low plasticity	For undisturbed soils add information on structure, stratification, consistency in undisturbed and remolded states, moisture and drainage conditions
	SILTS AND CLAYS — Liquid limit greater than 50	Slight to medium	Slow to none	Slight to medium	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	EXAMPLE:- <u>Clayey silt</u>, brown; slightly plastic, small percentage of fine sand, numerous vertical root holes, firm and dry in place, loess, (ML)
		High to very high	None	High	CH	Inorganic clays of high plasticity, fat clays	
		Medium to high	None to very slow	Slight to medium	OH	Organic clays of medium to high plasticity	
HIGHLY ORGANIC SOILS		Readily identified by color, odor, spongy feel and frequently by fibrous texture.			Pt	Peat and other highly organic soils	



PLASTICITY CHART
FOR LABORATORY CLASSIFICATION OF FINE GRAINED SOILS

‡ <u>Boundary classifications</u> - Soils possessing characteristics of two groups are designated by combinations of group symbols. For example GW-GC, well graded gravel-sand mixture with clay binder.
‡ All sieve sizes on this chart are U.S. standard.

FIELD IDENTIFICATION PROCEDURES FOR FINE GRAINED SOILS OR FRACTIONS

These procedures are to be performed on the minus No 40 sieve size particles, approximately $\frac{1}{64}$ in. For field classification purposes, screening is not intended, simply remove by hand the coarse particles that interfere with the tests.

DILATANCY (Reaction to shaking)

After removing particles larger than No 40 sieve size, prepare a pat of moist soil with a volume of about one-half cubic inch. Add enough water if necessary to make the soil soft but not sticky.

Place the pat in the open palm of one hand and shake horizontally, striking vigorously against the other hand several times. A positive reaction consists of the appearance of water on the surface of the pat which changes to a livery consistency and becomes glossy. When the sample is squeezed between the fingers, the water and gloss disappear from the surface, the pat stiffens, and finally it cracks or crumbles. The rapidity of appearance of water during shaking and of its disappearance during squeezing assist in identifying the character of the fines in a soil.

Very fine clean sands give the quickest and most distinct reaction whereas a plastic clay has no reaction. Inorganic silts, such as a typical rock flour, show a moderately quick reaction.

DRY STRENGTH (Crushing characteristics)

After removing particles larger than No 40 sieve size, mold a pat of soil to the consistency of putty, adding water if necessary. Allow the pat to dry completely by oven, sun, or air drying, and then test its strength by breaking and crumbling between the fingers. This strength is a measure of the character and quantity of the colloidal fraction contained in the soil. The dry strength increases with increasing plasticity.

High dry strength is characteristic for clays of the CH group. A typical inorganic silt possesses only very slight dry strength. Silty fine sands and silts have about the same slight dry strength, but can be distinguished by the feel when powdering the dried specimen. Fine sand feels gritty whereas a typical silt has the smooth feel of flour.

TOUGHNESS (Consistency near plastic limit)

After removing particles larger than the No 40 sieve size, a specimen of soil about one-half inch cube in size is molded to the consistency of putty. If too dry, water must be added and if sticky, the specimen should be spread out in a thin layer and allowed to lose some moisture by evaporation. Then the specimen is rolled out by hand on a smooth surface or between the palms into a thread about one-eighth inch in diameter. The thread is then folded and rerolled repeatedly. During this manipulation the moisture content is gradually reduced and the specimen stiffens, finally loses its plasticity, and crumbles when the plastic limit is reached.

After the thread crumbles, the pieces should be lumped together and a slight kneading action continued until the lump crumbles.

The tougher the thread near the plastic limit and the stiffer the lump when it finally crumbles, the more potent is the colloidal clay fraction in the soil. Weakness of the thread at the plastic limit and quick loss of coherence of the lump below the plastic limit indicate either inorganic clay of low plasticity, or materials such as kaolin-type clays and organic clays which occur below the A-line.

Highly organic clays have a very weak and spongy feel at the plastic limit.

Letter symbols in the logs, are group symbols of the Unified Soil Classification System based on field identification. Copies of Drawing No. 103-D-347, Unified Soil Classification, may be obtained on request to office of Director of Design and Construction, Bureau of Reclamation, Denver, Colorado 80225.

ADOPTED BY - CORPS OF ENGINEERS AND BUREAU OF RECLAMATION JANUARY 1952

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103-D-347

11-7-84

AS BUILT

WEATHERING

FRESH (W1): Body of rock is not oxidized or discolored; fracture surfaces are not oxidized or discolored*; no separation of grain boundaries; no change of texture and no solutioning. Hammer rings when crystalline rocks are struck.

SLIGHTLY WEATHERED TO FRESH (W2):**

SLIGHTLY WEATHERED (W3): Discoloration or oxidation is limited to surface of, or short distance from fractures; some feldspar crystals are dull; fracture surfaces have minor to complete discoloration or oxidation; no visible separation of grain boundaries; texture preserved and minor leaching of soluble minerals may be present. Hammer rings when crystalline rocks are struck, body of rock is not weakened by weathering.

MODERATELY TO SLIGHTLY WEATHERED (W4):**

MODERATELY WEATHERED (W5): Discoloration or oxidation extends from fractures, usually throughout body of rock; ferromagnesian minerals are "rusty," feldspar crystals are "cloudy;" all fracture surfaces are discolored or oxidized; partial opening of grain boundaries visible; texture generally preserved but soluble minerals may be mostly leached. Hammer does not ring when rock is struck, body of rock is slightly weakened.

INTENSLEY TO MODERATELY WEATHERED (W6):**

INTENSELY WEATHERED (W7): Body of rock is discolored or oxidized throughout; all feldspars and ferromagnesian minerals are altered to clay to some extent. All fracture surfaces are discolored or oxidized, surfaces friable; partial separation of grain boundaries, rock is friable; in situ disaggregation of granitics common in semi-arid regions; texture altered and leaching of soluble minerals may be complete. Rock has dull sound when struck with hammer; rock is weakened, usually can be broken with moderate to heavy manual pressure or by light hammer blow without reference to planes of weakness.

VERY INTENSELY WEATHERED (W8):**

DECOMPOSED (W9): Body of rock is discolored or oxidized throughout, but resistant minerals such as quartz may be unaltered; all feldspars and ferromagnesian minerals are completely altered to clay; complete separation of grain boundaries (disaggregated), partial or complete remnant rock structure may be preserved, but resembles a soil.

NOTE: Weathering categories are established primarily for crystalline rocks and those with ferromagnesian minerals, weathering in various sedimentary rocks will not always fit the categories established - weathering categories may be modified for particular site conditions or alteration such as hydrothermal alteration. Where modified criteria are established, they are identified and described.

* Characteristics of fracture surfaces do not include directional weathering along shears or faults and their associated fracture zones; for example a shear that carries weathering to great depths in a fresh rock mass would not require the whole rock mass to be classified as weathered.

** Combination descriptors are used where equal distribution of both weathering characteristics are present over significant intervals or where characteristics noted are "in between" the diagnostic characteristics.

DURABILITY INDEX

DURABILITY DESCRIPTOR	DESCRIPTIVE CRITERIA
DI0	Rock specimen or exposure remains intact with no deleterious cracking after exposure longer than 1 year.
DI1	Rock specimen or exposure develops hairline cracking on surfaces within 1 month, but no disaggregation within 1 year of exposure.
DI2	Rock specimen or exposure develops hairline cracking on surfaces within 1 week, and/or disaggregation within 1 month of exposure.
DI3	Specimen or exposure may develop hairline cracks in 1 day and displays pronounced separation of bedding and/or disaggregation within 1 week of exposure.
DI4	Specimen or exposure displays pronounced cracking and disaggregation within 1 day (24 hours) of exposure. Generally ravels and degrades to small fragments.

COLOR

The Munsell color system (Geologic Society of America Rock Color Chart) was used. This system defines wet color by its hue, value, and chroma. Color symbols (i.e., 5 YR 5/6 may be included).

SEDIMENTARY AND PYROCLASTIC ROCK PARTICLE SIZES

Size in mm	Sedimentary: Rounded, subrounded, subangular — Particle or fragment	Sedimentary: Rounded, subrounded, subangular — Lithified product	Pyroclastic — Fragment	Pyroclastic — Lithified product
256	Boulder	Boulder conglomerate	Block* or Bomb**	Volcanic breccia* or Volcanic agglomerate**
64	Cobble	Cobble conglomerate		
4	Pebble	Pebble conglomerate	Lapilli	Lapillistone and Lapilli tuff
2	Granule	Granule conglomerate		
1	Very coarse sand	Sandstone (Very coarse, coarse, medium, fine, or very fine)	Coarse ash	Coarse tuff
0.5	Coarse sand			
0.25	Medium sand			
0.125	Fine sand			
0.0625	Very fine sand			
0.00391	Silt	Siltstone/ Shale	Fine ash	Fine tuff
	Clay	Claystone/ Shale		

* Broken from previous igneous rock, block shaped (angular to subangular).
** Solidified from plastic material while in flight, rounded clasts.

IGNEOUS AND METAMORPHIC ROCK TEXTURE

TEXTURE DESCRIPTOR	AVERAGE GRAIN DIAMETER
VERY COARSE GRAINED OR PEGMATITIC	>10 mm [>3/8 in]
COARSE GRAINED	5-10 mm [3/16 - 3/8 in]
MEDIUM GRAINED	1-5 mm [1/32 - 3/16 in]
FINE GRAINED	0.1-1 mm [0.004 - 1/32 in]
APHANITIC (Cannot be seen with the unaided eye)	<0.1 mm [<0.004 in]

ADDITIONAL TEXTURAL ADJECTIVES

PIT (pitted) - Pinhole to 0.03 ft [3/8 in] (<1 to 10 mm) openings.

VUG (vuggy) - Small openings (usually lined with crystals) ranging in diameter from 0.03 ft [3/8 in] to 0.33 ft [4 in] (10 to 100 mm).

CAVITY - An opening larger than 0.33 ft [4 in] (100 mm), size descriptions are required, and adjectives such as small, large, etc., may be used.

HONEYCOMBED - If numerous enough that only thin walls separate individual pits or vugs, this term further describes the preceding nomenclature to indicate cell-like form.

VESICLE (vesicular) - Small openings in volcanic rocks of variable shape and size formed by entrapped gas bubbles during solidification.

BEDDING FOLIATION OR FLOW TEXTURE

DESCRIPTORS	THICKNESS/SPACING
MASSIVE	Greater than 10 ft (>3 m)
VERY THICKLY (bedded, foliated, or banded)	3 to 10 ft (1 to 3 m)
THICKLY	1 to 3 ft (300 mm to 1 m)
MODERATELY	0.3 to 1 ft (100 to 300 mm)
THINLY	0.1 to 0.3 ft (30 to 100 mm)
VERY THINLY	0.03 [3/8 in] to 0.1 ft (10 to 30 mm)
LAMINATED (Intensely foliated or banded)	Less than 0.03 ft [3/8 in] (<10 mm)

BEDROCK HARDNESS / STRENGTH

EXTREMELY HARD (H1): Core, fragment or exposure cannot be scratched with knife or sharp pick; can only be chipped with repeated heavy hammer blows.

VERY HARD (H2): Cannot be scratched with knife or sharp pick. Core or fragment breaks with repeated heavy hammer blows.

HARD (H3): Can be scratched with knife or sharp pick with difficulty (heavy pressure). Heavy hammer blow required to break specimen.

MODERATELY HARD (H4): Can be scratched with knife or sharp pick with light or moderate pressure. Core or fragment breaks with moderate hammer blow.

MODERATELY SOFT (H5): Can be grooved 1/16 inch (2 mm) deep by knife or sharp pick with (moderate or heavy) pressure. Core or fragment breaks with light hammer blow or heavy manual pressure.

SOFT (H6): Can be grooved or gouged easily by knife or sharp pick with light pressure, can be scratched with fingernail. Breaks with light to moderate manual pressure.

VERY SOFT (H7): Can be readily indented, groved or gouged with fingernail, or carved with a knife. Breaks with light manual pressure.

Note: Bedrock units softer than H7, Very Soft, are described using USCS (soils) consistency descriptors.

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GEOLOGY FOR DESIGNS & SPECIFICATIONS
STANDARD DESCRIPTORS AND DESCRIPTIVE CRITERIA FOR ROCK

GEOLOGY NOMENCLATURE COMM. TECHNICAL APPROVAL Richard Thorne
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DENVER, COLORADO OCTOBER 1, 1984 40-D-6493

DISCONTINUITY TERMINOLOGY

DISCONTINUITY - A collective term used for all structural breaks in geologic materials which usually have zero or low tensile strength. Discontinuities also may be healed. Discontinuities comprise fractures (including joints), planes of weakness, shears/faults, and shear/fault zones. Contacts between various units also may be considered discontinuties.

FRACTURE - A term used to describe any natural break in geologic material excluding shears and shear zones. Additional fracture terminology is provided below.

SHEAR - A structural break where differential movement has taken place along a surface or zone of failure by shear; characterized by striations, slickensides, gouge, breccia, mylonite, or any combination of these. Often direction, amount of displacement, and continuity may not be known because of limited exposures or observations.

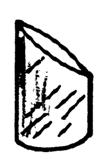
FAULT - A shear with significant continuity which can be correlated between observations; occurs over a significant portion of a given site, foundation area, or region; or is a segment of a fault or fault zone defined in the literature. The designation of a shear as a fault or fault zone is a site-specific determination.

SHEAR/FAULT ZONE - A shear that is expressed in relative terms of width. The zone may consist of gouge, breccia, or many related faults or shears together with fractured and crushed rock between the shears or faults, or any combination of these. In the literature, many fault zones simply are referred to as faults.

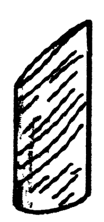
SHEAR/FAULT-DISTURBED ZONE - An associated zone of fractures and/or folds adjacent to a shear or shear zone where the country rock has been subjected to only minor cataclastic action and may be mineralized. If adjacent to a fault or fault zone, the term is fault-disturbed zone. Occurrence, orientation, and areal extent of these phenomena depend upon depth of burial (pressure and temperature) during shearing, brittleness of materials, and the stress envelope.

FRACTURE TERMINOLOGY

EXAMPLES SHOWN FOR CORE, BUT APPLICABLE TO ANY OBSERVATION



JOINT (JT) - A relatively planar fracture along which there has been little or no shearing displacement.

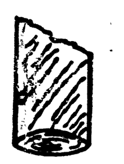


FOLIATION JOINT (FJ) OR BEDDING JOINT (BJ) - A relatively planar fracture which is parallel to foliation or bedding along which there has been little or no shearing displacement.

BEDDING PLANE SEPARATION - A separation along bedding after extraction or exposure due to stress relief or slaking.

INCIPIENT JOINT (IJ) OR INCIPIENT FRACTURE (IF) - A joint or fracture which does not continue through the specimen or at least not seen with the naked eye. However, when the specimen is wetted and then allowed to dry, the joint or fracture trace is evident. When core is broken, it breaks along an existing plane.

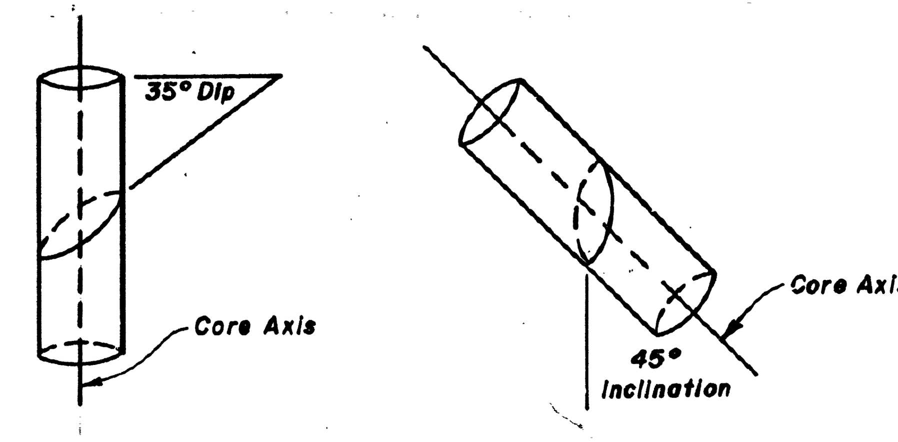
RANDOM FRACTURE (RF) - A natural break (fracture) with a generally rough, very irregular, nonplanar surface which does not belong to a joint set.



MECHANICAL BREAK (MB) - A break due to drilling, blasting, or handling. Mechanical breaks parallel to bedding or foliation are called Bedding Breaks (BB) or Foliation Breaks (FB), respectively. Recognizing mechanical breaks may be difficult. The absence of oxidation, staining, or mineral fillings, and often a hackly or irregular surface are clues for recognition.

FRACTURE ZONE (FZ) - Numerous very closely spaced intersecting fractures. Often fragmented core cannot be fitted together.

METHOD OF MEASURING DIP OF PLANAR DISCONTINUITIES, FOLIATION, AND BEDDING IN CORE

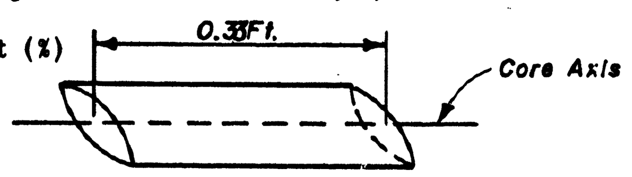


1. Vertical hole – true dip is measured and reported.
2. Angle hole – true dip usually not known; angle is measured from core axis and is called inclination.

ROCK QUALITY DESIGNATION (RQD)

$$RQD = \frac{\text{Sum of length of solid core pieces} \geq 0.33 \text{ ft [4 in] (100 mm) long}}{\text{Length of the run in feet (mm)}} \times 100$$

Expressed as percent (%)



FRACTURE FREQUENCY

FRACTURE FREQUENCY - The number of natural fractures occurring within a base length or core run. The number of fractures is divided by the length and is reported as fractures per foot or fractures per meter. Expressed as 3/m or 6/ft.

FRACTURE DENSITY

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

UNFRACTURED (FDØ): No fractures.

VERY SLIGHTLY FRACTURED (FD1): Core recovered mostly in lengths greater than 3 feet (1 m).

SLIGHTLY TO VERY SLIGHTLY FRACTURED (FD2)*

SLIGHTLY FRACTURED (FD3): Core recovered mostly in lengths from 1 to 3 feet (300 to 1000 mm) with few scattered lengths less than 1 foot (300 mm) or greater than 3 feet (1000 mm).

MODERATELY TO SLIGHTLY FRACTURED (FD4)*

MODERATELY FRACTURED (FD5): Core recovered mostly in 0.3- to 1.0-foot (100- to 300-mm) lengths with most lengths about 0.6 foot (200 mm).

INTENSELY TO MODERATELY FRACTURED (FD6)*

INTENSELY FRACTURED (FD7): Lengths average from 0.1 to 0.3 foot (30 to 100 mm) with scattered fragmented intervals. Core recovered mostly in lengths less than 0.3 foot (100 mm).

VERY INTENSELY TO INTENSELY FRACTURED (FD8)*

VERY INTENSELY FRACTURED (FD9): Core recovered mostly as chips and fragments with a few scattered short core lengths.

---

* Combinations of fracture densities (e.g., Very Intensely to Intensely Fractured or Moderately to Slightly Fractured) are used where equal distribution of both fracture density characteristics are present over a significant interval or exposure, or where characteristics are "in between" the descriptor definitions.

FRACTURE SPACING

JOINT SET, OR FRACTURE SPACING DESCRIPTOR	TRUE SPACING
EXTREMELY WIDELY SPACED (SP1)	Greater than 10 ft (>3 m)
VERY WIDELY SPACED (SP2)	3 to 10 ft (1 to 3 m)
WIDELY SPACED (SP3)	1 to 3 ft (300 mm to 1 m)
MODERATELY SPACED (SP4)	0.3 to 1 ft (100 to 300 mm)
CLOSELY SPACED (SP5)	0.1 to 0.3 ft (30 to 100 mm)
VERY CLOSELY SPACED (SP6)	Less than 0.1 ft (<30 mm)

FRACTURE CONTINUITY

CONTINUITY DESCRIPTOR	DISCONTINUITY LENGTH
DISCONTINUOUS (C1)	Less than 3 ft (<1 m)
SLIGHTLY CONTINUOUS (C2)	3 to 10 ft (1 to 3 m)
MODERATELY CONTINUOUS (C3)	10 to 30 ft (3 to 10 m)
HIGHLY CONTINUOUS (C4)	30 to 100 ft (10 to 30 m)
VERY CONTINUOUS (C5)	Greater than 100 ft (>30 m)

FRACTURE ENDS (JOINT SURVEYS)

FRACTURE ENDS DESCRIPTOR	DESCRIPTIVE CRITERIA
EØ	Zero ends leave the exposure (both ends can be seen).
E1	One end of the fracture terminates in the exposure (one end can be seen).
E2	Two fracture ends do not terminate in the exposure (both ends cannot be seen).

FRACTURE OPENNESS OR FILLING THICKNESS

FILLING THICKNESS DESCRIPTOR	THICKNESS/OPENNESS	OPENNESS DESCRIPTOR
CLEAN (TØ)	No film or coating	
	No visible separation	TIGHT (OØ)
VERY THIN (T1)	Less than 0.003 ft [1/32 in] (<1 mm)	SLIGHTLY OPEN (O1)
MODERATELY THIN (T2)	0.003 to 0.01 ft [1/32 to 1/8 in] (1 to 3 mm)	MODERATELY OPEN (O2)
THIN (T3)	0.01 to 0.03 ft [1/8 to 3/8 in] (3 to 10 mm)	OPEN (O3)
MODERATELY THICK (T4)	0.03 ft [3/8 in] to 0.1 ft (10 to 30 mm)	MODERATELY WIDE (O4)
THICK (T5)	Greater than 0.1 ft (>30 mm) Actual thickness or openings recorded	WIDE (O5)

FRACTURE MOISTURE CONDITIONS

MOISTURE DESCRIPTOR	DESCRIPTIVE CRITERIA
M1	The fracture is dry. It is tight or filling (where present) is of sufficient density or composition to impede waterflow. Waterflow along the fracture does not appear possible.
M2	The fracture is dry with no evidence of previous waterflow. Waterflow appears possible.
M3	The fracture is dry but shows evidence of waterflow such as staining, leaching, and/or vegetation.
M4	The fracture or filling (where present) is damp, but no free water is present.
M5	The fracture shows seepage. It is wet with occasional drops of water.
M6	The fracture emits a continuous flow (estimate flow rate) under low pressure. Filling materials (where present) may show signs of leaching or piping.
M7	The fracture emits a continuous flow (estimate flow rate) under moderate to high pressure. Water is squirting and/or filling material (where present) may be substantially washed out.

FRACTURE ROUGHNESS

Refers to small scale asperities of surfaces, not large scale undulations or waviness

STEPPED (R1): Near-normal steps and ridges occur on the fracture surface.
ROUGH (R2): Large, angular asperities can be seen.
MODERATELY ROUGH (R3): Asperities are clearly visible and fracture surface feels abrasive.
SLIGHTLY ROUGH (R4): Small asperities on the fracture surface are visible and can be felt.
SMOOTH (R5): No asperities, smooth to the touch.
POLISHED (R6): Extremely smooth and shiny.

FRACTURE SURFACE AND / OR FILLING ALTERATION AND HARDNESS

Descriptors for weathering or alteration of fracture surfaces and fracture fillings (excluding soil materials) are the same as those used for weathering and alteration of rock.

Descriptors for hardness/strength of fillings and/or fracture surfaces are the same as those presented for hardness of rock or consistency of soils.

DISCONTINUITY HEALING

TOTALLY HEALED (HL1) - All fragments bonded, discontinuity is completely healed or recemented to a degree at least as hard as surrounding rock.

MODERATELY HEALED (HL3) - Greater than 50 percent of fractured or sheared material, discontinuity surface or filling is healed or recemented; and/or strength of healing agent is less hard than surrounding rock.

PARTLY HEALED (HL5) - Less than 50 percent of fractured or sheared material, discontinuity surface or filling is healed or recemented.

NOT HEALED (HL6) - Discontinuity surface, fracture zone, sheared material or filling is not healed or recemented, rock fragments or filling (if present) held in place by their own angularity and/or cohesiveness.

SHEAR / FAULT DESCRIPTORS

SHEAR / FAULT GOUGE CONSISTENCY

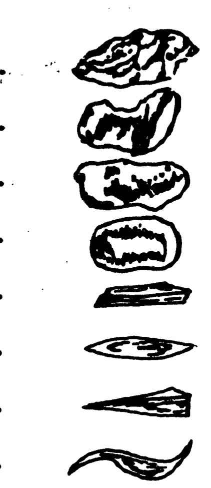
DESCRIPTOR	DESCRIPTIVE CRITERIA (Similar to consistency of soils)
VERY HARD	Gouge cannot be broken with finger pressure; cannot be indented with fingernail.
HARD	Gouge can be broken with firm finger pressure; can be indented with fingernail; cannot be indented with thumb.
FIRM	Gouge can be easily crumbled; can be indented with thumb 1 to 5 mm.
SOFT	Gouge can be easily molded; can be penetrated with thumb 5 to 25 mm.
VERY SOFT	Gouge can be penetrated with thumb more than 25 mm.

SHEAR / FAULT MOISTURE CONDITIONS

The apparent moisture content of gouge is described as **WET** (visible free water); **MOIST** (damp but no visible water); and **DRY** (absence of moisture, dusty, dry to the touch). Moisture descriptors M1 through M7 may be used to describe the shear or shear zone.

BRECCIA SHAPES

Angular . . . .
Subangular. . . . .
Subrounded. . . . .
Rounded . . . .
Platy . . . .
Lens-shaped . . . .
Wedge-shaped. . . . .
Contorted . . . .



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GEOLOGY FOR DESIGNS & SPECIFICATIONS

STANDARD DESCRIPTORS AND DESCRIPTIVE CRITERIA FOR DISCONTINUITIES

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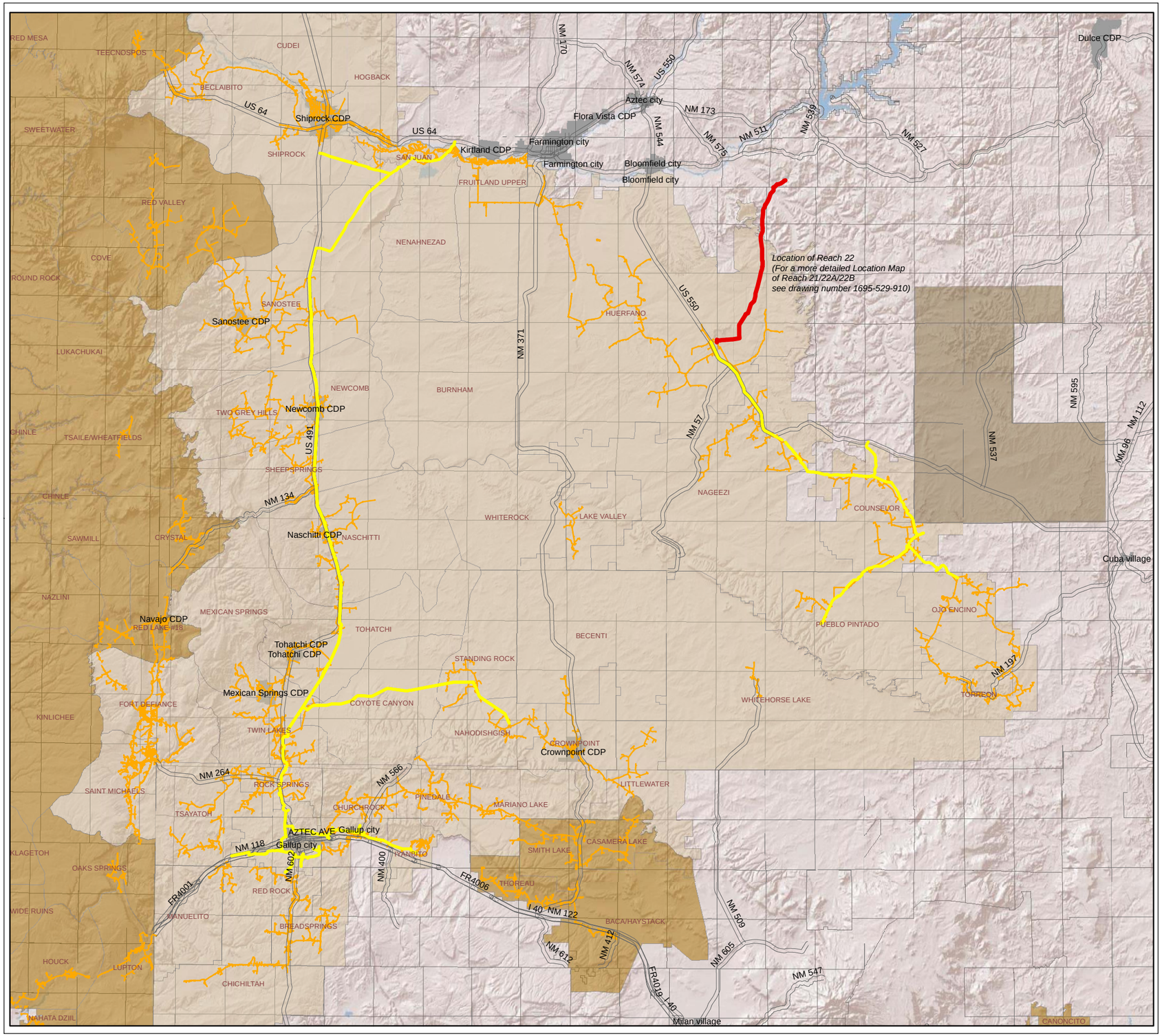
DENVER, COLORADO OCTOBER 1, 1984	40-D-6499



N

0 5 10 20 30

Miles

LEGEND

- SAN JUAN AND CUTTER LATERALS
- Reach 22
- Highway
- NTUA Line
- Navajo Nation Serviced Chapters
- Navajo Nation Non-Serviced Chapters
- Jicarilla Apache Reservation

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

NAVAJO GALLUP WATER SUPPLY PROJECT
NEW MEXICO

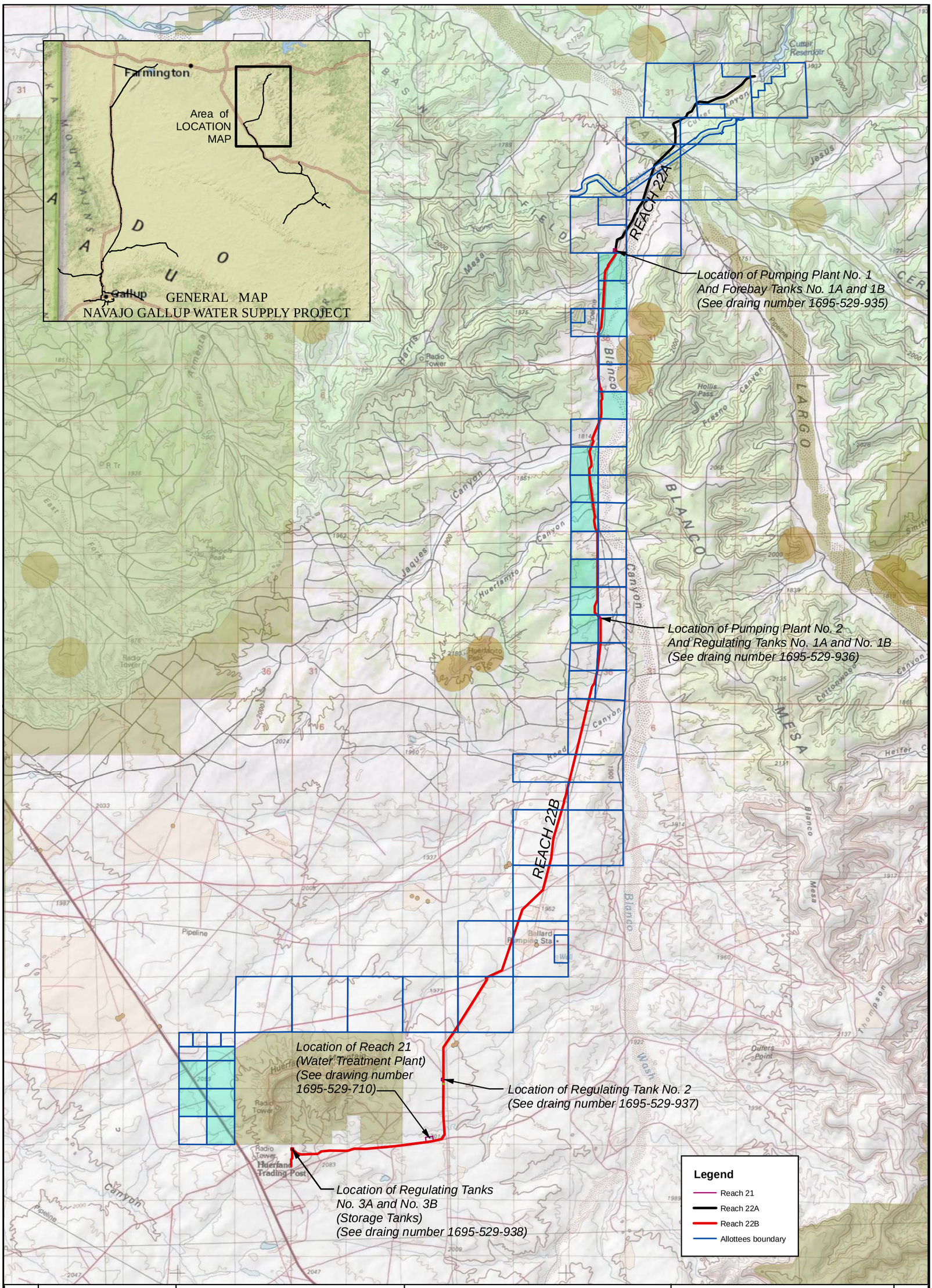
CUTTER LATERAL

REACH 22

GENERAL LOCATION MAP

1695-529-618

Date: 11/12/2014



1695-529-90

Date: 5/5/2015

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U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

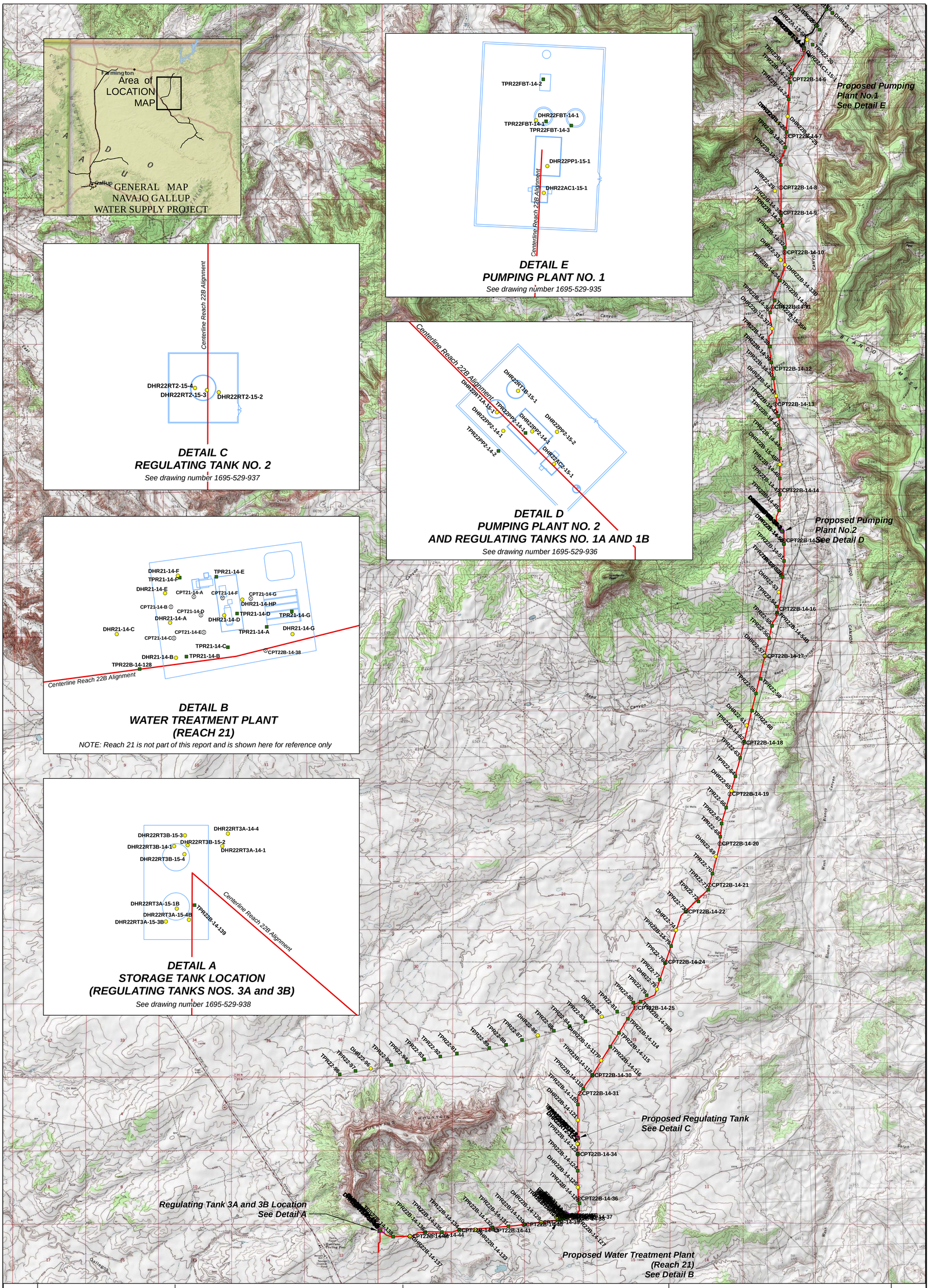
NAVAJO WATER SUPPLY PROJECT
NEW MEXICO

CUTTER LATERAL
REACH 22A, 22B AND 21
LOCATION MAP

N
S
0 0.5 1 2
Miles

RECLAMATION
Managing Water for the West

G5



1695-529-853

Date: 5/5/2015

N
S
0 0.5 1 2
Miles

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U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

NAVAJO WATER SUPPLY PROJECT
NEW MEXICO

CUTTER LATERAL
REACH 22B
LOCATION OF EXPLORATION

Legend

- OBSERVATION WELLS
- CONE PENETROMETER TEST
- TEST PITS
- DRILL HOLES
- FACILITY LOCATIONS
- Preliminary Alignment 22B

RECLAMATION
Managing Water for the West

G6

GENERAL GEOLOGIC LEGEND

STRATIGRAPHY

Quaternary Alluvium (Qal)

Consists of a variety of materials from clayey sand (SC), silty sand (SM), poorly graded sand with silt (SP–SM), to poorly graded sand (SP).

Tertiary Nacimiento Formation (Tn)

Bedrock is often covered by a thin layer of Qal/Qsw.

Sandstone (SS), is fine to medium to fine to coarse, color transitions between brown, orange, grey, and yellow, soft (H6) to moderately hard (H4), Intensely weathered (W7), to slightly weathered (W3), thinly to moderately bedded, sporadic zones containing carbon inclusions and iron/manganese oxide staining, occasional conglomeratic zones with subrounded to subangular fine gravel and mud ripup clasts.

Siltstone (SLTSN), is grey to brown in color, very soft (H7) to moderately hard (H4), slightly weathered (W3) to intensely to moderately weathered (W7–W9), thinly to moderately bedded, occasional gypsum veins.

Claystone (CLSTN), is dark grey, to brown in color, very soft (H7) to soft (H6), decomposed (W9) to intensely weathered (W7), moderately to thinly bedded, occasional carbon inclusions, gypsum and calcite veins, iron/manganese oxide staining.

GEOLOGIC EXPLANATION

DHR21–14–A — *Drill hole location with year and identification number*

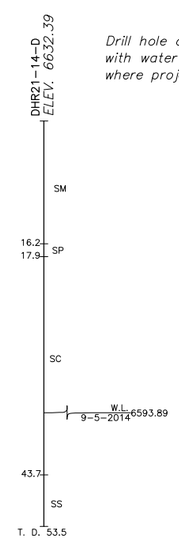
TPR21–14–A — *Test Pit location with year and Identification number*

CPTR21–14–A — *Cone Penetrometer Test location with year and Identification number*

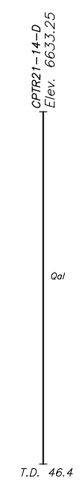
Qal / Tn — *Geologic Unit Contact*

Qal / Tn — *Dashed where approximate*

? Qal / Tn ? — *Queried where inferred*



Drill hole or Test Pit on profile with water level shown (dashed where projected over 20 feet)



Cone Penetration Test (CPT) hole on profile (dashed where projected over 20 feet)

GENERAL GEOLOGIC NOTES

Geologic standards and definitions used for rock quality and rock discontinuities are based on Bureau of Reclamation Engineering Geology Field Manual and drawing numbers 40–D–6493 and 40–D–6499.

The Unified Soil Classification System and descriptions are based on the USCS (Unified Soil Classification System) and Bureau of Reclamation procedures and guidelines as described in Geotechnical Branch Training Manuals Nos. 4, 5, 6, and Designations 5000 (laboratory classification) and USBR 5005 (visual classification). These procedures are similar to ASTM D2485–87 and D2487–88 respectively.

Interpretations shown on geologic profiles are based on Test Pit, Drill hole, CPT Holes, outcrop, and field mapping data. Interpretations suggest general trends between data points and do not depict localized irregularities.

For the entire description of material, drilling or excavation method and conditions, exact locations of the hole, etc., see complete log.

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BUREAU OF RECLAMATION
NAVAJO GALLUP WATER SUPPLY PROJECT
NEW MEXICO

CUTTER LATERAL
REACH 21

GENERAL GEOLOGIC LEGEND
EXPLANATION AND NOTES

GEOLOGY
DRAWN
CHECKED
TECH. APPR.
APPROVED
ADMINISTRATIVE APPROVAL – NAME – TITLE

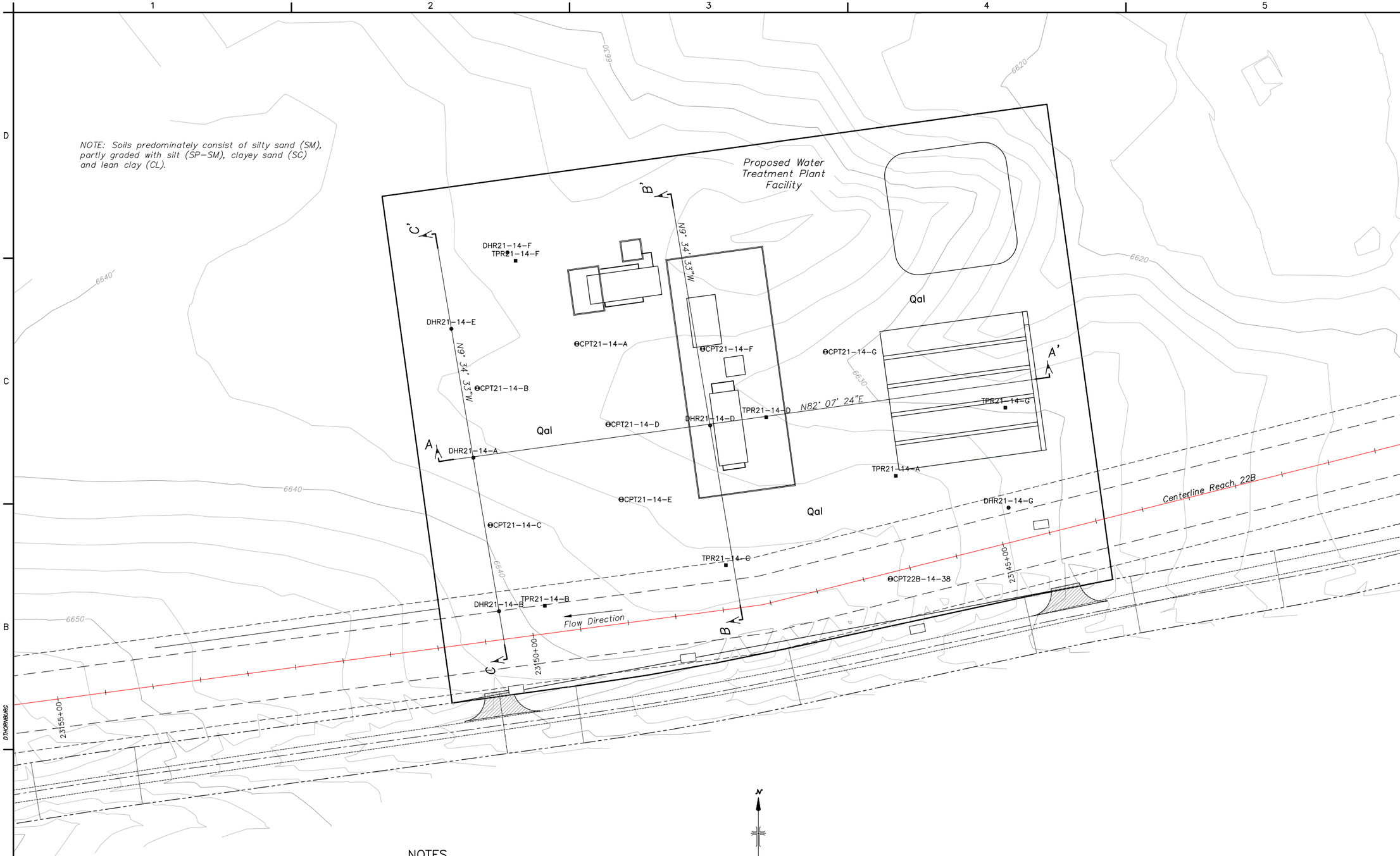
FARMINGTON, NEW MEXICO October 31, 2014

1695–529–941

SHEET 1 OF 1

APRIL 7, 2015 12:04 DTHORNBURG
AutoCAD Rel. 19.1s
1695–529–941.DWG

NOTE: Soils predominately consist of silty sand (SM), partly graded with silt (SP–SM), clayey sand (SC) and lean clay (CL).



NOTES

Contour interval is 2 feet.

Coordinates are in NAD83 state plane, New Mexico West Zone

For Geologic Section A–A' see drawing number 1695–529–932.
For Geologic Section B–B' and C–C' see drawing number 1695–529–933.
For General Geologic Legend Explanation and Notes Drawing see 1695–529–941.

N

50 0 50 100 150
SCALE OF FEET

RECLAMATION
Managing Water in the West

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BUREAU OF RECLAMATION
NAVAJO GALLUP WATER SUPPLY PROJECT
NEW MEXICO

CUTTER LATERAL
REACH 21
WATER TREATMENT PLANT

SURFACE GEOLOGY AND LOCATION OF EXPLORATION

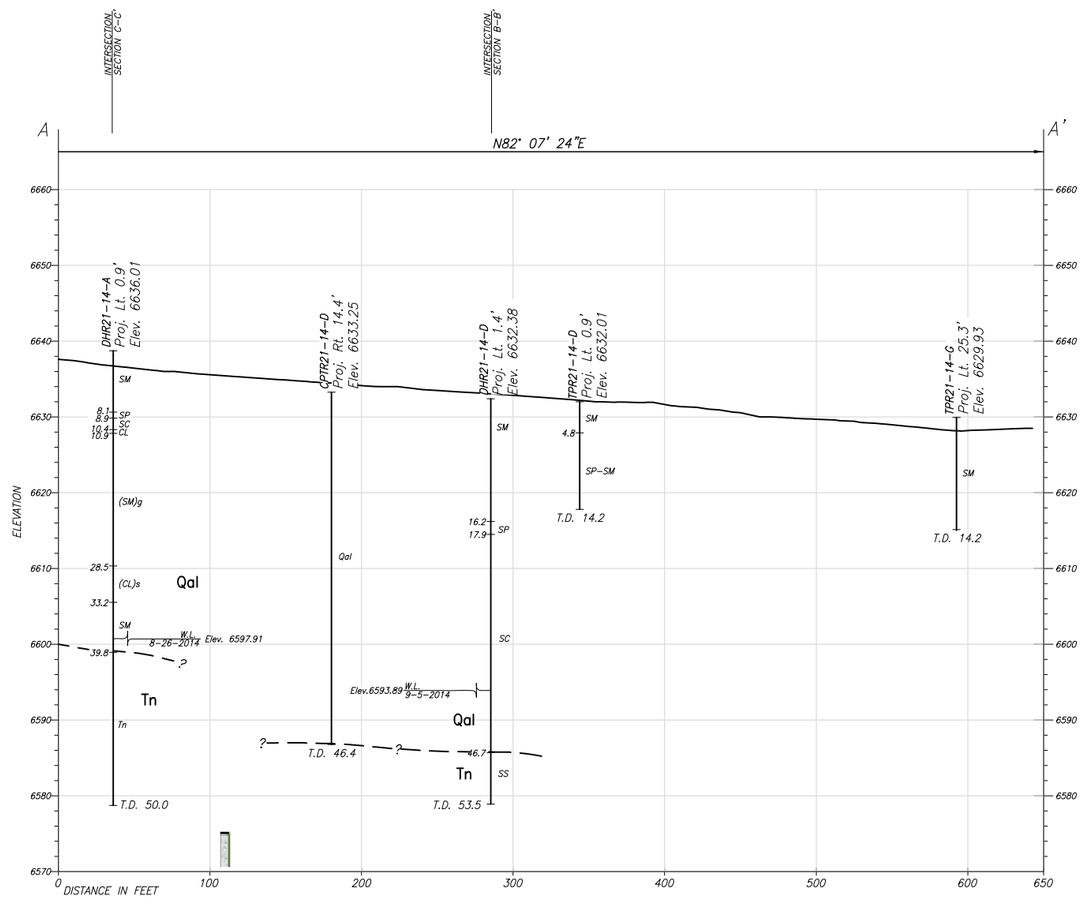
GEOLOGY
DRAWN
CHECKED
TECH. APPR.
APPROVED

FARMINGTON, NM 2013–02–14

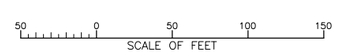
1695–529–710

SHEET 1 OF 1

APRIL 6, 2015 20:05
D.THORNBURG
AutoCAD Rel. 19.1s
1695–529–710.DWG



GEOLOGIC SECTION A–A'



NOTES

Coordinates are in NAD83 state plane, New Mexico West Zone

For General Geologic Legend Explanation and Notes Drawing see 1695-529-941.

RECLAMATION
Managing Water in the West

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U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
NAVAJO GALLUP WATER SUPPLY PROJECT
NEW MEXICO

CUTTER LATERAL

REACH 21

X GEOLOGY
X DRAWN
X CHECKED
X TECH. APPR.
X APPROVED
ADMIN APPROVAL – TITLE

FARMINGTON, NEW MEXICO 2015-03-30

WATER TREATMENT PLANT

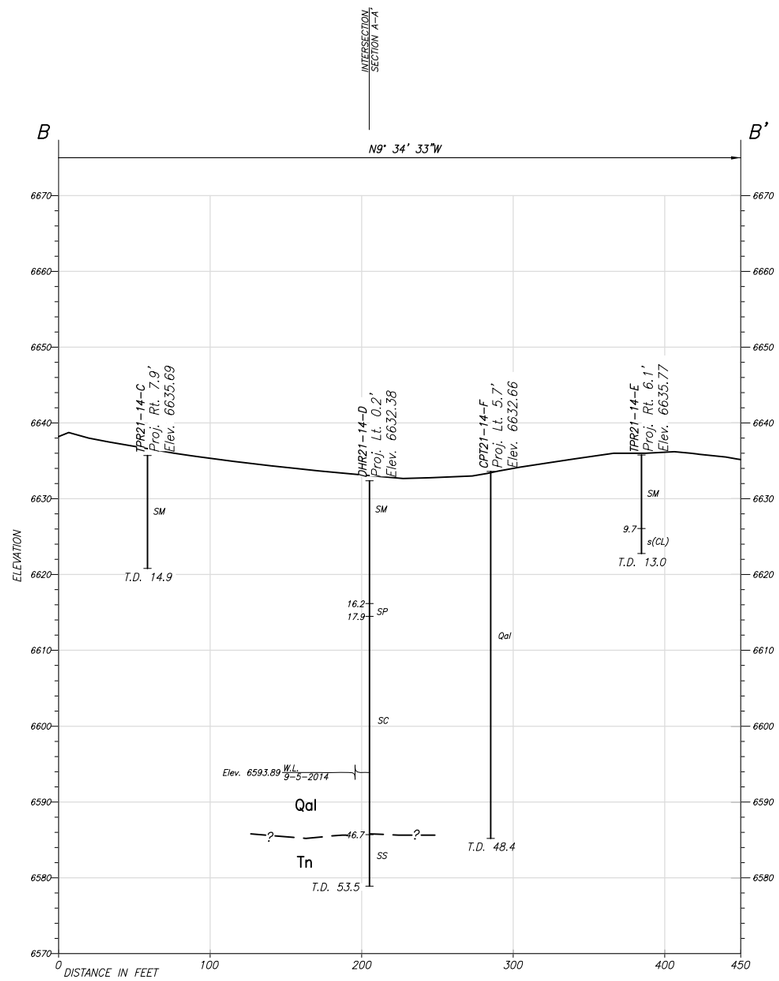
GEOLOGIC SECTION A–A'

1695-529-932

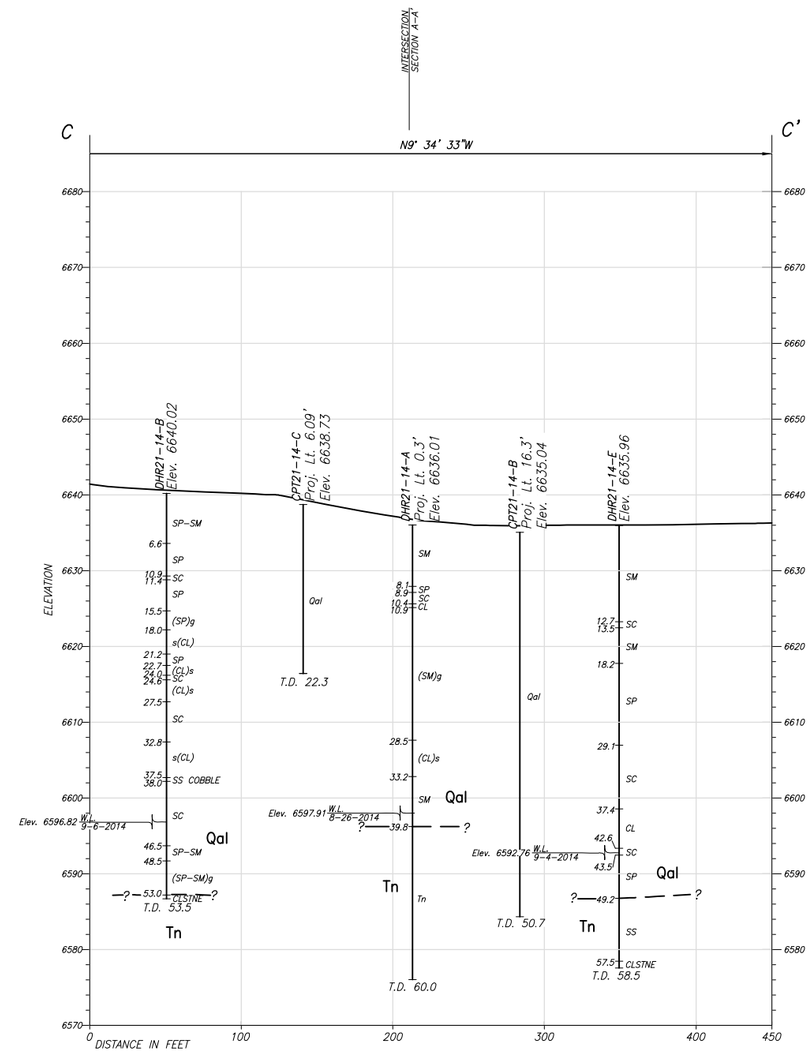
SHEET 1

DATE AND TIME PLOTTED Not Plotted
PLOTTED BY Not Plotted

CAD SYSTEM AUTOCAD
CAD FILENAME UNKNOWN



GEOLOGIC SECTION B–B'



GEOLOGIC SECTION C–C'

NOTES

Coordinates are in NAD83 state plane, New Mexico West Zone

For General Geologic Legend Explanation and Notes Drawing see 1695-529-941.

RECLAMATION
Managing Water in the West

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U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
NAVAJO GALLUP WATER SUPPLY PROJECT
NEW MEXICO

CUTTER LATERAL

REACH 21

GEOLOGY
DRAWN
CHECKED
TECH. APPR.
X
APPROVED
ADMIN APPROVAL – TITLE

FARMINGTON, NEW MEXICO 2015-03-30

WATER TREATMENT PLANT

GEOLOGIC SECTIONS B–B' AND C–C'

1695-529-933

SHEET 1

DATE AND TIME PLOTTED Not Plotted
PLOTTED BY Not Plotted
CAD SYSTEM AUTOCAD
CAD FILENAME UNKNOWN

20 0 20 40 60
SCALE OF FEET

NOTES

Coordinates are in NAD83 state plane, New Mexico West Zone

For General Geologic Legend Explanation and Notes Drawing see 1695-529-942.

For Section A-A' see drawing number 1695-529-946.

For Sections B-B' and C-C' see drawing number 1695-529-948.

RECLAMATION
Managing Water in the West

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BUREAU OF RECLAMATION
NAVAJO-GALLUP WATER SUPPLY PROJECT
NEW MEXICO

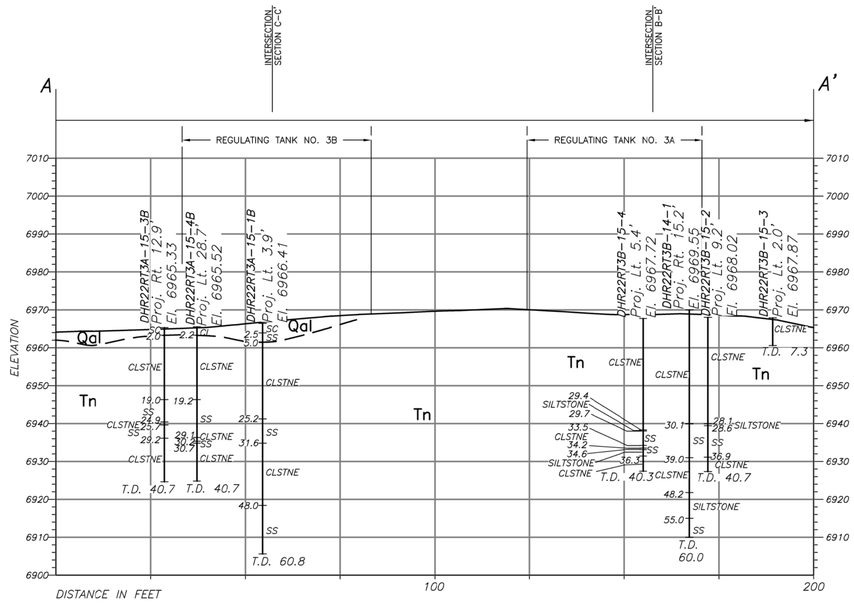
CUTTER LATERAL
REACH 22B
REGULATING TANKS 3A AND 3B
SURFACE GEOLOGY AND LOCATION OF EXPLORATION

GEOLOGY
DRAWN
CHECKED
TECH. APPR.
APPROVED
ADMINISTRATIVE APPROVAL
FARMINGTON, NEW MEXICO 2014-10-13

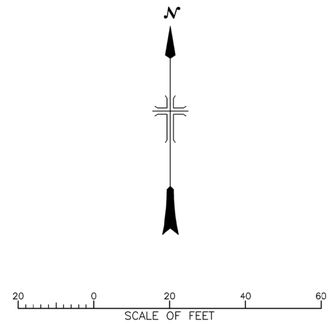
1695-529-938
SHEET 1 OF 1

DATE AND TIME PLOTTED
May 21, 2015 10:43
PLOTTED BY
DTHORNBURG

CADD SYSTEM
AutoCAD Rel. 19.1s (LMS Tech)
CADD FILENAME
1695-529-938.dwg



GEOLOGIC SECTION A–A'

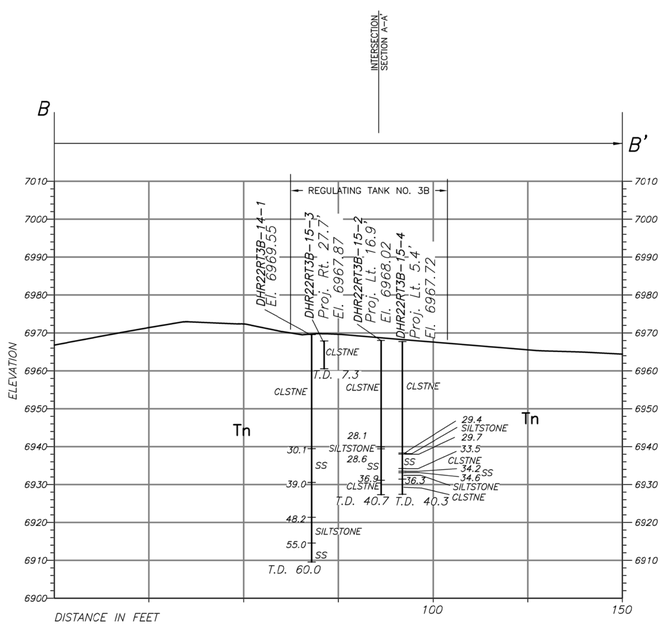


NOTES

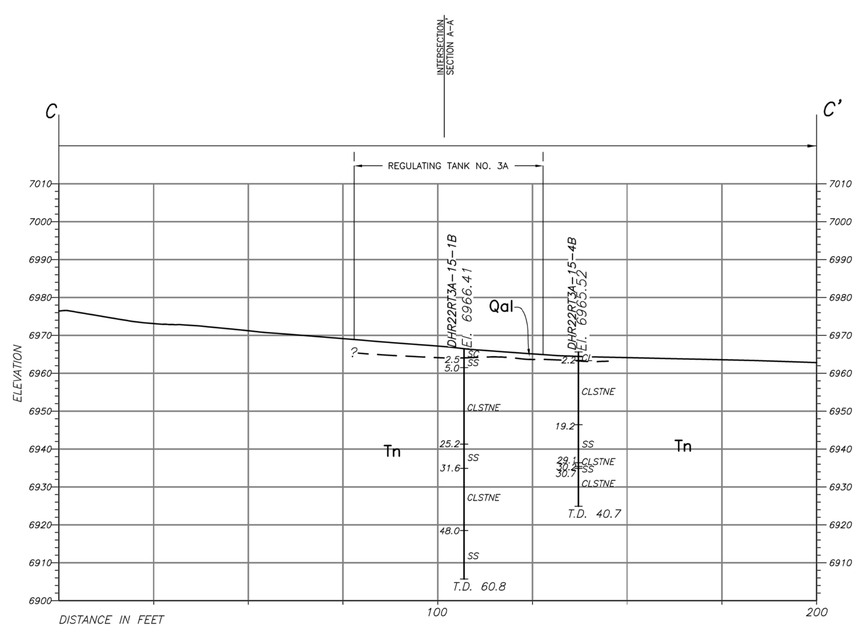
Coordinates are in NAD83 state plane, New Mexico West Zone

For General Geologic Legend Explanation and Notes Drawing see 1695–529–942.

For location of Section A–A', B–B' AND C–C' see drawing number 1695–529–938.



GEOLOGIC SECTION B–B'



GEOLOGIC SECTION C–C'

RECLAMATION
Managing Water in the West

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BUREAU OF RECLAMATION
NAVAJO GALLUP WATER SUPPLY PROJECT
NEW MEXICO

CUTTER LATERAL

REACH 22B

DESIGNED
DRAWN
CHECKED
X
TECH. APPR.
APPROVED
ADMIN APPROVAL – TITLE

FARMINGTON, NEW MEXICO 2015–04–09

REGULATING TANKS NO 3A AND 3B

GEOLOGIC SECTIONS A–A', B–B' AND C–C'

1695–529–946

SHEET 1

DATE AND TIME PLOTTED MAY 21, 2015 11:02
PLOTTED BY DTHORNBURG

CAD SYSTEM AutoCAD Rel. 19.1s
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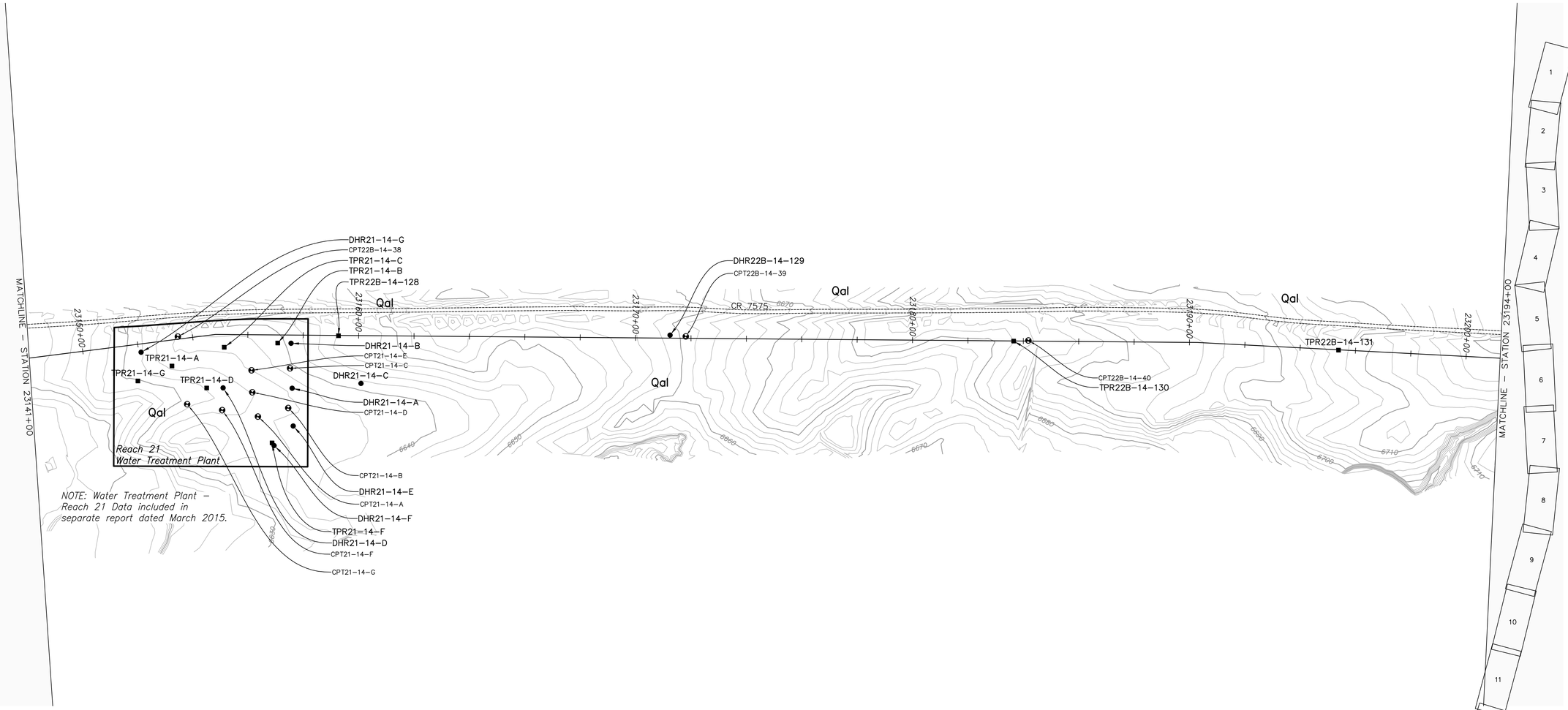

NOTE: Water Treatment Plant – Reach 21 Data included in separate report dated March 2015.

SHEET INDEX

NOTES

For General geologic Legend Explanation and Notes see drawing number 1695–520–560.

For Location of Exploration see drawing number 1695–529–853.

Arial photography was flown in April 6, 2010, by Woolpert Inc. from approximately 3,600 feet. using NAD–83 datum. Additional topography was collected by Four Corners Construction Office survey crew between stations 22980+00 to the end of Reach 22B, where aerial photography was not available.

N

PLAN

200 0 200 400 600
SCALE OF FEET

RECLAMATION
Managing Water in the West

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BUREAU OF RECLAMATION
NAVAJO – GALLUP WATER SUPPLY PROJECT
NEW MEXICO

CUTTER LATERAL
REACH 22B
STATION 23141+00 TO STATION 23194+00
SURFACE GEOLOGY

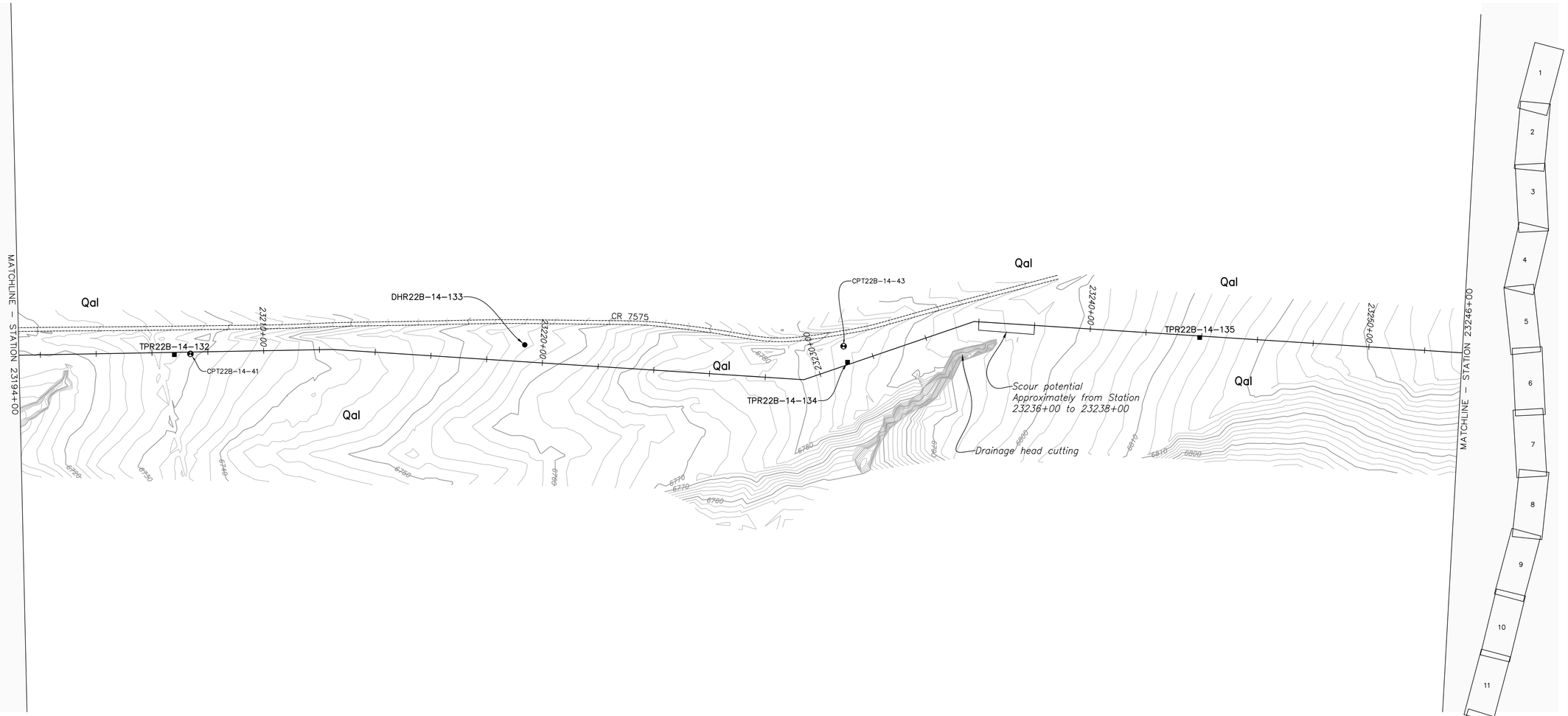
GEOLOGY
DRAWN
CHECKED
TECH. APPR.
APPROVED

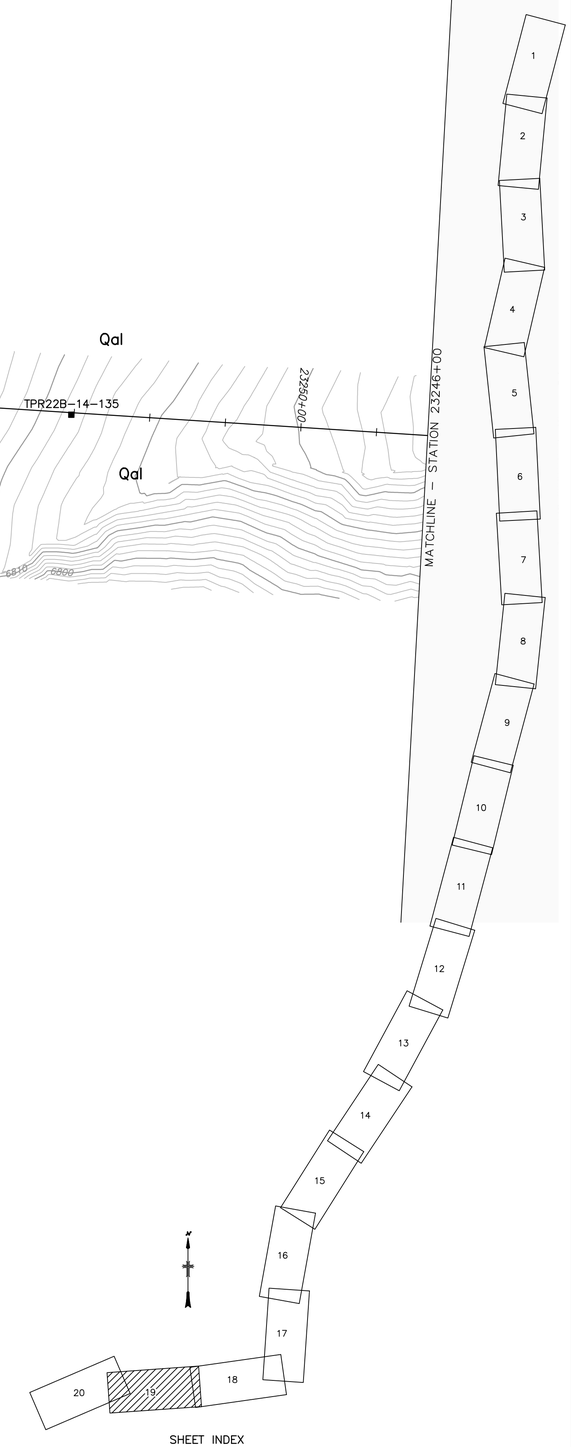
FARMINGTON, NEW MEXICO October 30, 2013

1695–529–770

SHEET 18 OF 20

AutoCAD Rel. 19.1s
ARBIL-X:\2010\53 TM\B5772.DWG





NOTES

For General geologic Legend Explanation and Notes see drawing number 1695–520–560.

For Location of Exploration see drawing number 1695–529–853.

Arial photography was flown in April 6, 2010, by Woolpert Inc. from approximately 3,600 feet. using NAD–83 datum. Additional topography was collected by Four Corners Construction Office survey crew between stations 22980+00 to the end of Reach 22B, where aerial photography was not available.

PLAN

200 0 200 400 600
SCALE OF FEET

RECLAMATION
Managing Water in the West

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U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
NAVAJO – GALLUP WATER SUPPLY PROJECT
NEW MEXICO

CUTTER LATERAL
REACH 22B
STATION 23194+00 TO STATION 23246+00
SURFACE GEOLOGY

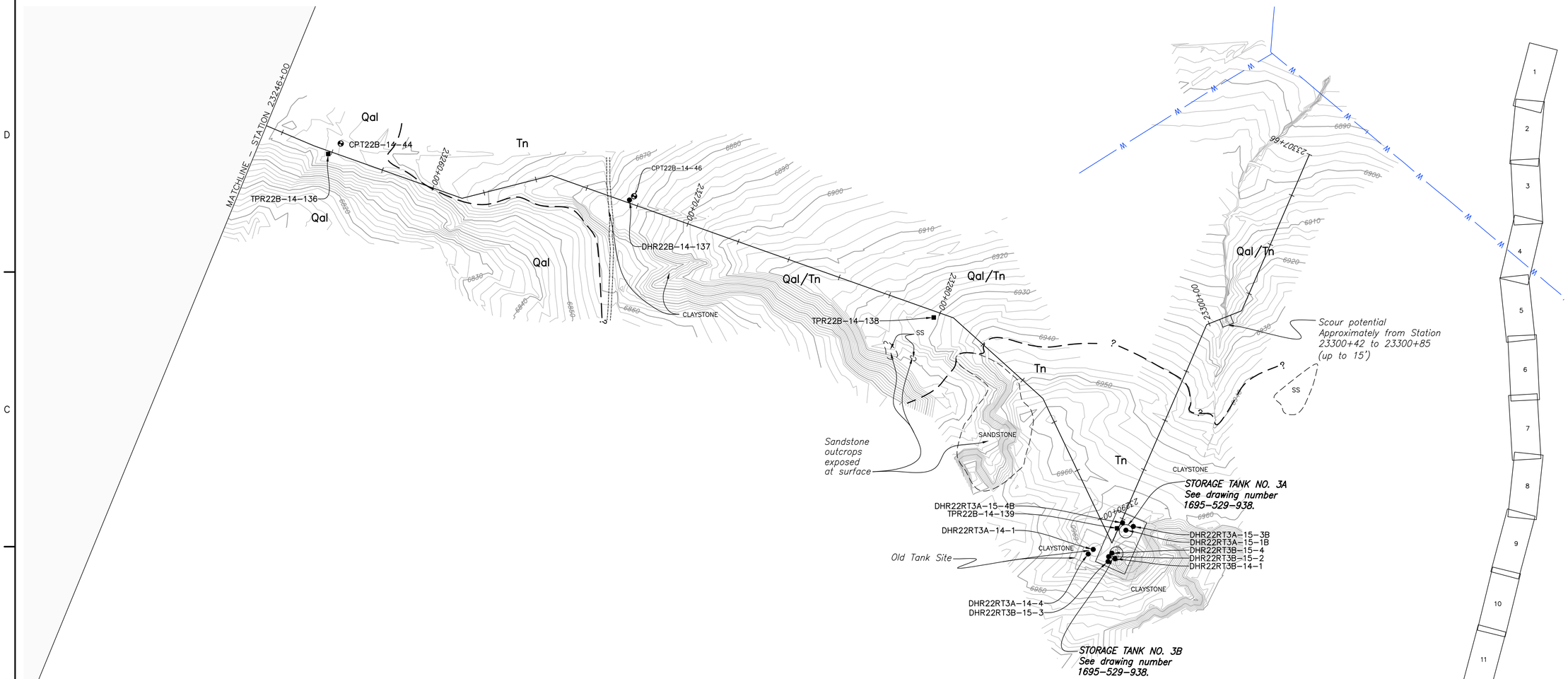
GEOLOGY
DRAWN
CHECKED
TECH. APPR.
APPROVED

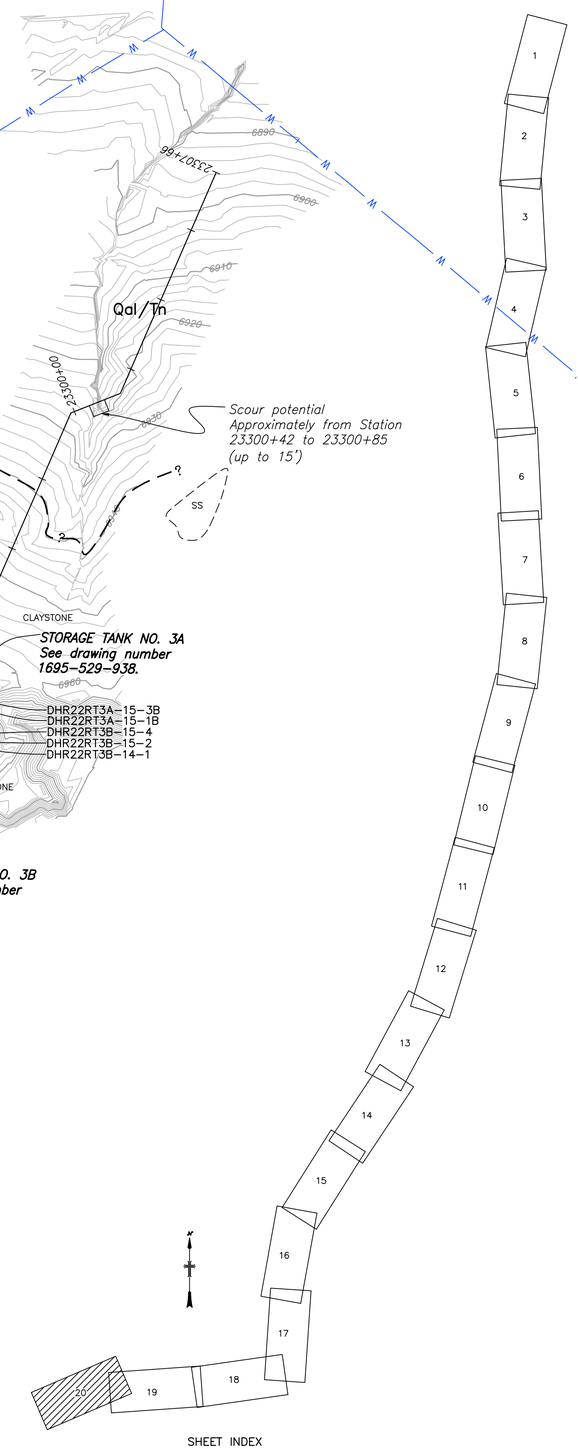
FARMINGTON, NEW MEXICO October 30, 2013

1695–529–771

SHEET 19 OF 20

AutoCAD Rel. 19.1s
ARBIL-2/20/13 THIS 772.DWG





PLAN

200 0 200 400 600
SCALE OF FEET

NOTES

For General geologic Legend Explanation and Notes see drawing number 1695–520–560.

For Location of Exploration see drawing number 1695–529–853.

Arial photography was flown in April 6, 2010, by Woolpert Inc. from approximately 3,600 feet. using NAD–83 datum. Additional topography was collected by Four Corners Construction Office survey crew between stations 22980+00 to the end of Reach 22B, where aerial photography was not available.

RECLAMATION
Managing Water in the West

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BUREAU OF RECLAMATION

NAVAJO – GALLUP WATER SUPPLY PROJECT
NEW MEXICO

CUTTER LATERAL
REACH 22B
STATION 23253+50 TO END
SURFACE GEOLOGY

GEOLOGY
DRAWN
CHECKED
TECH. APPR.
APPROVED

FARMINGTON, NEW MEXICO October 30, 2013

1695–529–772

SHEET 20 OF 20

AutoCAD Rel. 19.1s
AE695-529D753 TM695772.DWG

GEOLOGIC LOG OF DRILL HOLE NO. DHR21-14-A

FEATURE: REACH 22 PIPELINE
LOCATION: WATER TREATMENT PLANT
BEGUN: 8/25/14 FINISHED: 8/26/14
DEPTH AND ELEVATION OF WATER LEVEL: WLNE
AND DATE MEASURED: 38.1 (6597.9) 8/26/2014

PROJECT: NAVAJO GALLUP WATER SUPPLY PROJECT
COORDINATES: N 1,968,388.4 E 2,734,514.0
TOTAL DEPTH: 60.0
DEPTH TO BEDROCK: 39.8

STATE: NEW MEXICO
GROUND ELEVATION: 6636.0
ANGLE FROM HORIZONTAL: 90
HOLE LOGGED BY: J. GILBERT
REVIEWED BY:

NOTES

ALL MEASUREMENTS ARE FROM GROUND SURFACE AND ARE THE SAME AS THOSE USED BY THE DRILLER.

ALL MEASUREMENTS ARE REPORTED IN FEET EXCEPT WHERE NOTED.

DRILLED BY: U.C. REGION DRILL CREW; DRILLER; JEFF VAN AUSDALE, HELPERS; RON TODDHUNTER; GREG LOTT.

PURPOSE:
PRECONSTRUCTION SOIL AND BEDROCK FOUNDATION INVESTIGATIONS.

DRILL EQUIPMENT:
CME 85.

DRILL METHOD:
0- 60.0 FT 4 1/4" HSA AND DRY CORE SYSTEM WITH SPTs.
CASING RECORD:
NONE USED.

DRILLING MEDIUM:
NONE USED.

HOLE COMPLETION: HOLE BACKFILLED WITH CUTTINGS.

DEPTH	% CORE RECOVERY	% FINES	% SAND	% GRAVEL	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT	LABORATORY CLASSIFICATION	BLOWS / 0.5 FT	GEOLOGIC UNIT SYMBOL	VISUAL CLASSIFICATION / ELEVATION
5	76	17.1	17.1	82.9	0	NA	NP	2.5	SM	4/10/11	Qal: SM
	92	20.5	20.5	79.5	0	21.3	7.1	3.4	SC	8/15/14	
10	80	50.1	50.1	48.4	1.5	25.4	11.7	6.7	s(CL)	10/17/22	SP 6627.1; SC 6625.6; CL 6625.1
	60	19.5	19.5	80.5	0	NA	NP	2.8	SM	9/7/8	Qal: (SM)g
15	92	17.2	17.2	82.8	0	NA	NP	2.7	SM	6/6/8	
	60	12.3	12.3	70.4	17.3	NA	NP	2.2	(SM)g	7/17/23	
20	94	36	36.2	63.8	0	NA	NP	5.7	SM	6/12/15	
25	94	22	22.3	61.3	16.4	21.3	5.5	5.2	(SC-SM)g	10/16/10	
30	100	73	73.4	26.6	0	35.9	21.7	17.1	(CL)s	3/5/11	Qal: (CL)s 6602.8
35	80	33	33.5	66.5	0	NA	NP	12.7	SM	5/7/8	Qal: SM 6596.2
40	58	23	23.4	69.9	6.7	24.5	9.6	16	SC	5/8/20	
45	90	12	12.3	51.9	35.8	22.7	8.0	18.7	(SC)g	6/10/15	Tn: SS 6586.7
50	100										Tn: CLSTNE 6584.3
55	100										Tn: SS 6580.6; CLSTNE 6576.0
60	60										

BOTTOM OF HOLE

CLASSIFICATION AND PHYSICAL CONDITION

0.0 - 39.8 FT QUATERNARY ALLUVIUM (Qal)

0.0 - 8.1 FT: SILTY SAND (SM): ABOUT 80% FINE SAND, MAXIMUM SIZE, FINE SAND; ABOUT 20% FINES WITH NO PLASTICITY, RAPID DILATANCY, LOW DRY STRENGTH; DRY, TAN IN COLOR; STRONG REACTION WITH HCl.

8.1 - 8.9 FT POORLY GRADED SAND (SP): ABOUT 95% FINE SAND; AB0UT 5% NONPLASTIC FINES WITH RAPID DILATANCY AND NO DRY STRENGTH; TRACE COARSE GRAVEL, MAXIMUM SIZE, 40MM; DRY, NO REACTION WITH HCl.

8.9 TO 10.4 FT CLAYEY SAND (SC): ABOUT 80% FINE SAND; ABOUT 20% FINES WITH LOW PLASTICITY, LOW TO MEDIUM DRY STENGTH, LOW TOUGHNESS AND SLOW DILATANCY; GREY TO ORANGE IN COLOR, DRY, NO REACTION WITH HCl.

10.4 - 10.9 FT LEAN CLAY (CL): ABOUT 90% FINES WITH MEDUIM PLASTICITY, MEDIUM DRY STRENGTH, MEDIUM TOUGHNESS; ABOUT 10% FINE TO MEDIUM SAND; MAXIMUM SIZE, MEDIUM SAND; NO REACTION WITH HCl.

10.9 - 28.5 FT SILTY SAND WITH GRAVEL (SM)g: ABOUT 80% PREDOMINATELY FINE SAND; ABOUT 15% FINE TO COARSE GRAVEL; ABOUT 5% NONPLASTIC FINES WITH RAPID DILATANCY AND NO DRY STRENGTH; MAXIMUM SIZE, 50MM; GREY IN COLOR; NO REACTION WITH HCl.

28.5 - 33.2 FT LEAN CLAY WITH SAND (CL)s: ABOUT 70% FINES WITH MEDIUM TO HIGH PLASTICITY, MEDIUM TO HIGH DRY STRENGTH, NO DILATANCY AND MEDIUM TO HIGH TOUGHNESS; ABOUT 30% FINE SAND; MAXIUMUM SIZE, FINE SAND; DRY, GREY IN COLOR, NO REACTION WITH HCl.

33.2 - 39.8 FT: SILTY SAND (SM): ABOUT 80% FINE SAND, MAXIMUM SIZE, FINE SAND; ABOUT 20% FINES WITH NO PLASTICITY, RAPID DILATANCY, LOW DRY STRENGTH, DRY, TAN IN COLOR; STRONG REACTION WITH HCl.

39.8 - 60.0 FT TERTIARY NACIMIENTO FORMATION (TN)

39.8 - 49.3 FT SANDSTONE: FINE TO MEDIUM GRAINED, TAN IN COLOR, MODERATELY TO INTENSELY WEATHERED (W5-W7), MODERATELY HARD (H4), THINLY BEDDED TO LAMINATED; TRACE OF SUBANGULAR TO SUBROUNDED GRAVEL, MAX SIZE 40 mm; NO REACTION WITH HCl.
DISCONTINUED SPT's AT 45.0 FEET AND CONTINUED TO AUGER

49.3 - 51.7 FT CLAYSTONE: GREY TO DARK GREY IN COLOR, VERY INTENESLEY WEATHERED TO DECOMPOSED (W8-W9) ,SOFT TO VERY SOFT (H6-H7); WEAK REACTION WITH HCl.

51.7 - 55.4 FT SANDSTONE: FINE TO MEDIUM GRAINED, TAN IN COLOR, MODERATELY TO INTENSELY WEATHERED (W5-W7) MODERATELY SOFT (H5), THINLY BEDDED TO LAMINATED; NO REACTION WITH HCl.

COMMENTS:

ALL ANGLES MEASURED FROM CORE AXIS AT ZERO DEGREES, UNLESS OTHERWISE NOTED.
THE DATA FOR THE CENTER COLUMN AND"CLASSIFICATION AND PHYSICAL CONDITIONS" COLUMN ARE BASED ON BUREAU OF RECLAMATION GEOLOGY FIELD MANUAL AND DRAWINGS TITLED FOR DESIGNS AND SPECIFICATIONS AS FOLLOWS- DRAWING NO. 40-D-6493. STANDARD DESCRIPTIONS AND DESCRIPTIVE CRITERIA FOR ROCK. DRAWING NO. 40-D-6499. STANDARD DESCRIPTORS AND DESCRIPTIVE CRITERIA FOR DISCONTINUITIES.

GEOLOGIC LOG OF DRILL HOLE NO. DHR21-14-A

FEATURE: REACH 22 PIPELINE
LOCATION: WATER TREATMENT PLANT
BEGUN: 8/25/14 FINISHED: 8/26/14
DEPTH AND ELEVATION OF WATER LEVEL: WLNE
AND DATE MEASURED: 38.1 (6597.9) 8/26/2014

PROJECT: NAVAJO GALLUP WATER SUPPLY PROJECT
COORDINATES: N 1,968,388.4 E 2,734,514.0
TOTAL DEPTH: 60.0
DEPTH TO BEDROCK: 39.8

STATE: NEW MEXICO
GROUND ELEVATION: 6636.0
ANGLE FROM HORIZONTAL: 90
HOLE LOGGED BY: J. GILBERT
REVIEWED BY:

NOTES	DEPTH	% CORE RECOVERY	LABORATORY DATA						LABORATORY CLASSIFICATION	BLOWS / 0.5 FT	GEOLOGIC UNIT SYMBOL	VISUAL CLASSIFICATION / ELEVATION	CLASSIFICATION AND PHYSICAL CONDITION
			% FINES	% SAND	% GRAVEL	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT					

55.4 - 60.0 FT CLAYSTONE: GREY TO DARK GREY IN COLOR, VERY INTENSLEY WEATHERED TO DECOMPOSED (W8-W9) , VERY SOFT TO SOFT (H6-H7); WEAK REACTION WITH HCl.

ROCK APPEARS TO BE BROKEN DURING DRILLING AND IS RECOVERED MOSTLY AS ANGULAR FRAGMENTS FROM 1/2-INCH TO APPROXIMATELY 7- INCHES IN SIZE. MOST SURFACES ON THE FRAGMENTS APPEAR FRESHLY BROKEN. OCCASIONAL PLANAR SURFACES ARE STAINED WITH IRON OXIDE INDICATING SOME JOINTS AND FRACTURES EXISTING IN THE ROCK. ORIENTATION AND DENSITY OF THE JOINTS AND FRACTURES COULD NOT BE DETERMINED.

STRATIGRAPHY:
0.0 - 39.8 FT: QUATERNARY ALLUVIUM (Qal)
39.8 - 60.0 FT: TERTIARY NACIMIENTO FORMATION (Tn)
ABBREVIATIONS:
WLNE = WATER LEVEL NOT ENCOUNTERED
I.D. = INSIDE DIAMETER
BNE = BEDROCK NOT ENCOUNTERED
NE=NOT ENCOUNTERED
FT=FEET
HSA=HOLLOW STEM AUGER
CME=CENTRAL MINING EQUIPMENT
SPT=STANDARD PENETRATION TEST.

GEOLOGIC LOG OF DRILL HOLE NO. DHR21-14-B

FEATURE: REACH 22 PIPELINE
LOCATION: WATER TREATMENT PLANT
BEGUN: 9/6/14 FINISHED: 9/6/14
DEPTH AND ELEVATION OF WATER LEVEL: WLNE
AND DATE MEASURED: 43.2 (6596.8) 9/6/2014

PROJECT: NAVAJO GALLUP WATER SUPPLY PROJECT
COORDINATES: N 1,968,228.0 E 2,734,540.8
TOTAL DEPTH: 53.5
DEPTH TO BEDROCK: 53.0

STATE: NEW MEXICO
GROUND ELEVATION: 6640.0
ANGLE FROM HORIZONTAL: 90
HOLE LOGGED BY: C. BEYER
REVIEWED BY:

NOTES

ALL MEASUREMENTS ARE FROM GROUND SURFACE AND ARE THE SAME AS THOSE USED BY THE DRILLER.

ALL MEASUREMENTS ARE REPORTED IN FEET EXCEPT WHERE NOTED.

DRILLED BY: U.C. REGION DRILL CREW; DRILLER; JEFF VAN AUSDALE, HELPERS; KYLE KILEBREW; DAVE NIELSON.

PURPOSE:
PRECONSTRUCTION SOIL AND BEDROCK FOUNDATION INVESTIGATIONS.

DRILL EQUIPMENT:
CME 85.

DRILL METHOD:
0- 53.5 FT 4 1/4" HSA AND DRY CORE SYSTEM WITH SPTs.
CASING RECORD:
NONE USED.

DRILLING MEDIUM:
NONE USED.

HOLE COMPLETION: HOLE BACKFILLED WITH CUTTINGS.

DEPTH	% CORE RECOVERY	% FINES	% SAND	% GRAVEL	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT	LABORATORY CLASSIFICATION	BLOWS / 0.5 FT	GEOLOGIC UNIT SYMBOL	VISUAL CLASSIFICATION / ELEVATION
	8	21.2	21.2	78.8	0	NA	NP	2.8%	SM	9/9/11	Qal
5	60	10.2	10.2	89.8	0	NA	NP	1.6%	SP-SM	4/8/10	
	80	11.3	11.3	88.7	0	NA	NP	1.7%	SP-SM	4/13/23	
10	80	21.6	21.6	78.4	0	NA	NP	2.7%	SM	15/19/19	
	80	12.9	12.9	87.1	0	NA	NP	1.3%	SM	5/14/17	
15	64	17.1	17.1	78.0	4.9	NA	NP	2.1%	SM	11/14/13	
	78	82.5	82.5	17.5	0	36.6%	22.1%	10.5%	(CL)s	13/19/20	
20	96	61.9	61.9	38.1	0	20.7%	5.3%	10.4%	s(CL-ML)	7/12/12	
25	64	18.8	18.8	68.8	12.4	21.0%	6.8%	4.9%	SC-SM	12/16/23	
30	100	52.5	52.5	47.5	0	27.6%	14.8%	14.7%	s(CL)	7/11/15	

VISUAL CLASSIFICATION / ELEVATION:
SP-SM; 6633.4; SP; 6629.1; SC; 6628.6; SP; 6624.5; (SP)g; 6622.0; s(CL); 6618.8; SP; 6617.3; (CL)s; 6616.0; SC; 6615.4; (CL)s; 6612.5; SC; 6607.2; s(CL)

CLASSIFICATION AND PHYSICAL CONDITION

0.0 - 49.2 FT QUATERNARY ALLUVIUM (Qal)

0.0 TO 6.6 FT POORLY GRADED SAND WITH SILT (SP-SM): ABOUT 90% FINE SAND; ABOUT 10% FINES WITH NO PLASTICITY, NO DRY STRENGTH, AND RAPID DILATANCY; DRY, LIGHT BROWN IN COLOR, ROOTS IN TOP 2.0 FT; NO REACTION WITH HCl.

6.6 TO 10.9 FT POORLY GRADED SAND (SP): ABOUT 95% FINE SAND; AB0UT 5% NONPLASTIC FINES WITH RAPID DILATANCY AND NO DRY STRENGTH; TRACE COARSE GRAVEL, MAXIMUM SIZE, 40MM; DRY; NO REACTION WITH HCl.

10.9 TO 11.4 FT CLAYEY SAND (SC): ABOUT 80% FINE SAND; ABOUT 20% FINES WITH LOW PLASTICITY, LOW TO MEDIUM DRY STENGTH, LOW TOUGHNESS AND SLOW DILATANCY; GREY TO ORANGE IN COLOR, DRY; NO REACTION WITH HCl.

11.4 TO 15.5 FT POORLY GRADED SAND (SP): ABOUT 95% FINE SAND, TRACE COARSE SAND; AB0UT 5% NONPLASTIC FINES WITH RAPID DILATANCY, AND NO DRY STRENGTH; MAXIMUM SIZE, COARSE SAND, DRY; NO REACTION WITH HCl.

15.5 TO 18.0 FT POORLY GRADED SAND WITH GRAVEL (SP)g ABOUT 80% PREDOMINATELY FINE SAND; ABOUT 15% FINE TO COARSE GRAVEL; ABOUT 5% NONPLASTIC FINES WITH RAPID DILATANCY AND NO DRY STRENGTH; MAXIMUM SIZE, 50MM; GREY IN COLOR; NO REACTION WITH HCl.

18.0 TO 21.2 FT SANDY LEAN CLAY s(CL): ABOUT 70% FINES WITH MEDIUM TO HIGH PLASTICITY, MEDIUM TO HIGH DRY STRENGTH, NO DILATANCY AND MEDIUM TO HIGH TOUGHNESS; ABOUT 30% FINE SAND; MAXIUMUM SIZE, FINE SAND; DRY, GREY IN COLOR; NO REACTION WITH HCl.

21.2 TO 22.7 FT POORLY GRADED SAND (SP): ABOUT 95% PREDOMINATELY FINE SAND; ABOUT 5% NONPLASTIC FINES WITH RAPID DILATANCY, AND NO DRY STRENGTH; TRACE GRAVEL, MAXIMUM SIZE, 25MM; NO REACTION WITH HCl.

22.7 TO 24.0 FT LEAN CLAY WITH SAND (CL)s: ABOUT 85% FINES WITH MEDIUM TO HIGH PLASTICITY, MEDIUM TO HIGH DRY STRENGTH, NO DILATANCY AND MEDIUM TO HIGH TOUGHNESS; ABOUT 15% FINE SAND; MAXIUMUM SIZE, FINE SAND; DRY, GREY; NO REACTION WITH HCl.

24.0 TO 24.6 FT CLAYEY SAND (SC): ABOUT 80% FINE SAND; ABOUT 20% FINES WITH LOW PLASTICITY, LOW TO MEDIUM DRY STENGTH, LOW TOUGHNESS AND SLOW DILATANCY; GREY TO ORANGE IN COLOR, DRY; NO REACTION WITH HCl.

24.6 TO 27.5 FT LEAN CLAY WITH SAND (CL)s: ABOUT 85% FINES WITH MEDIUM TO HIGH PLASTICITY, MEDIUM TO HIGH DRY STRENGTH, NO DILATANCY AND MEDIUM TO HIGH TOUGHNESS; ABOUT 15% FINE SAND; MAXIUMUM SIZE, FINE SAND; DRY, GREY; NO REACTION WITH HCl.

27.5 TO 32.8 FT CLAYEY SAND (SC): ABOUT 80% FINE SAND; ABOUT 20% FINES WITH LOW

COMMENTS:

ALL ANGLES MEASURED FROM CORE AXIS AT ZERO DEGREES, UNLESS OTHERWISE NOTED.
THE DATA FOR THE CENTER COLUMN AND"CLASSIFICATION AND PHYSICAL CONDITIONS" COLUMN ARE BASED ON BUREAU OF RECLAMATION GEOLOGY FIELD MANUAL AND DRAWINGS TITLED FOR DESIGNS AND SPECIFICATIONS AS FOLLOWS- DRAWING NO. 40-D-6493. STANDARD DESCRIPTIONS AND DESCRIPTIVE CRITERIA FOR ROCK. DRAWING NO. 40-D-6499. STANDARD DESCRIPTORS AND DESCRIPTIVE CRITERIA FOR DISCONTINUITIES.

GEOLOGIC LOG OF DRILL HOLE NO. DHR21-14-B

FEATURE: REACH 22 PIPELINE
LOCATION: WATER TREATMENT PLANT
BEGUN: 9/6/14 FINISHED: 9/6/14
DEPTH AND ELEVATION OF WATER LEVEL: WLNE
AND DATE MEASURED: 43.2 (6596.8) 9/6/2014

PROJECT: NAVAJO GALLUP WATER SUPPLY PROJECT
COORDINATES: N 1,968,228.0 E 2,734,540.8
TOTAL DEPTH: 53.5
DEPTH TO BEDROCK: 53.0

STATE: NEW MEXICO
GROUND ELEVATION: 6640.0
ANGLE FROM HORIZONTAL: 90
HOLE LOGGED BY: C. BEYER
REVIEWED BY:

NOTES	DEPTH	% CORE RECOVERY	LABORATORY DATA: % FINES	% SAND	% GRAVEL	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT	LABORATORY CLASSIFICATION	BLOWS / 0.5 FT	GEOLOGIC UNIT SYMBOL	VISUAL CLASSIFICATION / ELEVATION
		100									Qal	s(CL) 6602.5
												(SC)g 6601.6
	40	76	31.9	31.9	57.0	11.1	25.4%	13.8%	11.8%	SC	8/11/9	SC
	45	75	23.5	23.5	76.5	0	NA	NP	16.3%	SM	5/7/8	6593.5 (SP-SM) 6591.5
	50	20	5.0	5.0	44.8	43.7	19.3%	4.0%	14.5%	(SP-SC)g		(SP-SM)g 6587.0
											Tn	CLSTNE 6586.5

BOTTOM OF HOLE

CLASSIFICATION AND PHYSICAL CONDITION

PLASTICITY, LOW TO MEDIUM DRY STENGTH, LOW TOUGHNESS AND SLOW DILATANCY; TRACE FINE TO COARSE GRAVEL; MAXUMUM SIZE, 50MM, DARK BROWN IN COLOR, MOIST; NO REACTION WITH HCl.

32.8 TO 37.5 FT SANDY LEAN CLAY s(CL): ABOUT 70% FINES WITH MEDIUM TO HIGH PLASTICITY, MEDIUM TO HIGH DRY STRENGTH, NO DILATANCY AND MEDIUM TO HIGH TOUGHNESS; ABOUT 30% FINE SAND; MAXIMUM SIZE, FINE SAND; MOIST, GREY; NO REACTION WITH HCL.

37.5 TO 38.0 FT SANDSTONE COBBLE: FINE GRAINED, GREY, MODERATELY HARD (H4), SLIGHTLY WEATHERED (W3).

38.0 TO 43.6 FT CLAYEY SAND (SC) : ABOUT 80% PREDOMINATELY FINE SAND; ABOUT 20% FINES WITH LOW PLASTICITY, LOW DRY STENGTH, LOW TOUGHNESS AND SLOW DILATANCY; TRACE FINE TO COARSE GRAVEL; MAXUMUM SIZE, 50MM, DARK BROWN IN COLOR, MOIST, BECOMES WET BELOW 43.2 FT; NO REACTION WITH HCl.

43.6 TO 46.5 FT CLAYEY SAND (SC): ABOUT 80% FINE SAND; ABOUT 20% FINES WITH LOW PLASTICITY, LOW DRY STENGTH, LOW TOUGHNESS AND SLOW DILATANCY; MAXUMUM SIZE, FINE SAND; DARK BROWN IN COLOR, WET; NO REACTION WITH HCl. FINAL SPT CONDUCTED AT 43.5 FT DUE TO FLOWING SANDS WHITHIN PERCHED WATER TABLE, ABOVE NACIMIENTO FORMATION CLAYSTONE.

46.5 TO 48.5 FT POORLY GRADED SAND WITH SILT (SP-SM): ABOUT 90% PREDOMINATELY FINE SAND; ABOUT 10% FINES WITH NO PLASTICITY, NO DRY STRENGTH, AND RAPID DILATANCY; TRACE FINE GRAVEL, MAXIMUM SIZE, 15MM; WET, LIGHT BROWN IN COLOR; NO REACTION WITH HCl.

48.5 TO 53.0 FT POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM)g: ABOUT 70% PREDOMINATELY FINE SAND; ABOUT 20% FINE TO COARSE SUBROUNDED GRAVEL; ABOUT 10% NONPLASTIC FINES WITH RAPID DILATANCY, AND NO DRY STRENGTH; MAXIMUM SIZE, 60MM; BROWN IN COLOR; NO REACTION WITH HCl.

53.0 - 53.5 FT TERTIARY NACIMIENTO FORMATION (TN)

53.0 TO 53.5 FT CLAYSTONE: GREY TO GREEN IN COLOR, VERY INTENSLEY WEATHERED (W8), VERY SOFT (H7), SANDY; WEAK REACTION WITH HCl.

ROCK APPEARS TO BE BROKEN DURING DRILLING AND IS RECOVERED MOSTLY AS FRAGMENTS. MOST SURFACES ON THE FRAGMENTS APPEAR FRESHLY BROKEN. OCCASIONAL PLANAR SURFACES ARE STAINED WITH IRON OXIDE INDICATING SOME JOINTS AND FRACTURES EXISTING IN THE ROCK. ORIENTATION AND DENSITY OF THE JOINTS AND FRACTURES COULD NOT BE DETERMINED.

DISCONTINUED HOLE AT 53.5 FT AFTER CONFIRMATION OF BEDROCK TO AVOID PROBLEMS ENCOUNTERED IN A NEIGHBORING DRILL HOLE. AUGERS WERE ALMOST LOST IN PREVOUS DRILL HOLE AFTER BECOMING STUCK IN CLAYSTONE BELOW FLOWING SANDS.

STRATIGRAPHY:
0.0 - 53.0 FT: QUATERNARY ALLUVIUM (Qal)
53.0 - 53.5 FT: TERTIARY NACIMIENTO FORMATION (Tn)

GEOLOGIC LOG OF DRILL HOLE NO. DHR21-14-B

FEATURE: REACH 22 PIPELINE
LOCATION: WATER TREATMENT PLANT
BEGUN: 9/6/14 FINISHED: 9/6/14
DEPTH AND ELEVATION OF WATER LEVEL: WLNE
AND DATE MEASURED: 43.2 (6596.8) 9/6/2014

PROJECT: NAVAJO GALLUP WATER SUPPLY PROJECT
COORDINATES: N 1,968,228.0 E 2,734,540.8
TOTAL DEPTH: 53.5
DEPTH TO BEDROCK: 53.0

STATE: NEW MEXICO
GROUND ELEVATION: 6640.0
ANGLE FROM HORIZONTAL: 90
HOLE LOGGED BY: C. BEYER
REVIEWED BY:

NOTES	DEPTH	% CORE RECOVERY	LABORATORY DATA						LABORATORY CLASSIFICATION	BLOWS / 0.5 FT	GEOLOGIC UNIT SYMBOL	VISUAL CLASSIFICATION / ELEVATION	CLASSIFICATION AND PHYSICAL CONDITION
			% FINES	% SAND	% GRAVEL	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT					

ABBREVIATIONS:
WLNE = WATER LEVEL NOT ENCOUNTERED
I.D. = INSIDE DIAMETER
BNE = BEDROCK NOT ENCOUNTERED
NE=NOT ENCOUNTERED
FT=FEET
HSA=HOLLOW STEM AUGER
CME=CENTRAL MINING EQUIPMENT
SPT=STANDARD PENETRATION TEST.

GEOLOGIC LOG OF DRILL HOLE NO. DHR21-14-C

FEATURE: REACH 22 PIPELINE
LOCATION: WATER TREATMENT PLANT
BEGUN: 9/3/14 FINISHED: 9/3/14
DEPTH AND ELEVATION OF WATER LEVEL: WLNE
AND DATE MEASURED: 43.5 (6597.4) 9/3/2014

PROJECT: NAVAJO GALLUP WATER SUPPLY PROJECT
COORDINATES: N 1,968,335.9 E 2,734,270.8
TOTAL DEPTH: 58.5
DEPTH TO BEDROCK: 49.3

STATE: NEW MEXICO
GROUND ELEVATION: 6640.9
ANGLE FROM HORIZONTAL: 90
HOLE LOGGED BY: J. GILBERT
REVIEWED BY:

NOTES

ALL MEASUREMENTS ARE FROM GROUND SURFACE AND ARE THE SAME AS THOSE USED BY THE DRILLER.

ALL MEASUREMENTS ARE REPORTED IN FEET EXCEPT WHERE NOTED.

DRILLED BY: U.C. REGION DRILL CREW; DRILLER; JEFF VAN AUSDALE, HELPERS; KYLE KILEBREW; DAVE NIELSON.

PURPOSE:
PRECONSTRUCTION SOIL AND BEDROCK FOUNDATION INVESTIGATIONS.

DRILL EQUIPMENT:
CME 85.

DRILL METHOD:
0- 58.5 FT 4 1/4" HSA AND DRY CORE SYSTEM WITH SPTs.
CASING RECORD:
NONE USED.

DRILLING MEDIUM:
NONE USED.

HOLE COMPLETION: HOLE BACKFILLED WITH CUTTINGS.

DEPTH	% CORE RECOVERY	% FINES	% SAND	% GRAVEL	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT	LABORATORY CLASSIFICATION	BLOWS / 0.5 FT	GEOLOGIC UNIT SYMBOL	VISUAL CLASSIFICATION / ELEVATION
5	96	11.7	11.7	88.3	0	NA	NP	1.4%	SP-SM	4/7/8	Qal: SM
	92	10.9	10.9	88.1	1.0	NA	NP	1.6%	SP-SM	5/12/20	SM 6633.6
10	100	73.5	73.5	26.5	0	29.8	12.7	7.5%	(CL)s	8/13/14	SC
	100	49.7	49.7	50.3	0	25.5	9.5	5.3%	SC	13/18/26	
15	100	76.9	76.9	23.1	0	29.2	12.3	7.2%	(CL)s	8/13/25	SC 6626.7
											SM 6624.9
	100	61.5	61.5	38.5	0	34.8	19.7	8.5%	s(CL)	11/17/26	(CL)s 6623.7
20	64	14.8	14.8	84.6	0.6	NA	NP	2.4%	SM	8/12/12	SP
25	84	19.7	19.7	78.6	1.7	NA	NP	4.4%	SM	8/11/13	SP 6615.9
30	100	30.3	30.3	69.7	0	22.8	6.6	7.1%	SC-SM	6/10/12	SC
35	0										SC
40	82	56.2	56.2	43.8	0	28.8	14.1	18.9%	s(CL)		SC
45	100	13.3	13.3	67.6	19.1	NA	NP	15.5%	(SM)g		SC 6591.6
50	100										Tn: SS
55	0										SS 6582.4

BOTTOM OF HOLE

CLASSIFICATION AND PHYSICAL CONDITION

0.0 - 49.3 FT QUATERNARY ALLUVIUM (Qal)

0.0 - 7.3 FT: SILTY SAND (SM): ABOUT 80% FINE SAND, MAXIMUM SIZE, FINE SAND; ABOUT 20% FINES WITH NO PLASTICITY, RAPID DILATANCY, LOW DRY STRENGTH, DRY, TAN IN COLOR; STRONG REACTION WITH HCL.

7.3 TO 14.2 FT CLAYEY SAND (SC): ABOUT 60% FINE SAND; ABOUT 40% FINES WITH LOW PLASTICITY, LOW TO MEDIUM DRY STENGTH, LOW TOUGHNESS AND SLOW DILATANCY; GREY TO ORANGE IN COLOR, DRY; NO REACTION WITH HCl.

14.2 - 16.0 FT SILTY SAND (SM): ABOUT 80% FINE SAND, MAXIMUM SIZE, FINE SAND; ABOUT 20% FINES WITH NO PLASTICITY, RAPID DILATANCY, LOW DRY STRENGTH, DRY, TAN IN COLOR; STRONG REACTION WITH HCl.

16.0- 17.2 FT LEAN CLAY WITH SAND (CL)s: ABOUT 60% FINES WITH MEDIUM TO HIGH PLASTICITY, MEDIUM TO HIGH DRY STRENGTH, MEDIUM TO HIGH TOUGHNESS, NO DILATANCY; ABOUT 40% FINE SAND; MAXIUMUM SIZE, FINE SAND; DRY, GREY IN COLOR, NO REACTION WITH HCl.

17.2 - 25.0 FT POORLY GRADED SAND (SP): ABOUT 95% FINE SAND; AB0UT 5% NONPLASTIC FINES WITH RAPID DILATANCY AND NO DRY STRENGTH; TRACE COARSE GRAVEL, MAXIMUM SIZE, 40MM; DRY, NO REACTION WITH HCl.

25.0 - 49.3 FT CLAYEY SAND (SC): ABOUT 60% PREDOMINATELY FINE SAND; ABOUT 40% FINES WITH LOW PLASTICITY, LOW DRY STENGTH, LOW TOUGHNESS AND SLOW DILATANCY; TRACE FINE TO COARSE GRAVEL; MAXUMUM SIZE, 50MM; DARK BROWN IN COLOR, MOIST, BECOMES WET BELOW 43.5 FT, NO REACTION WITH HCl.

49.3- 58.5 FT TERTIARY NACIMIENTO FORMATION (TN)

49.3 - 58.5 FT CONGLOMERATIC SANDSTONE: FINE TO MEDIUM GRAINED, TAN IN COLOR, MODERATELY TO INTENSELY WEATHERED (W5-W7), MODERATLEYSOFT TO SOFT (H5-H6), SUBANGULAR TO SUBROUNDED GRAVEL, MAX SIZE 70 mm; NO REACTION WITH HCl.

ROCK APPEARS TO BE BROKEN DURING DRILLING AND IS RECOVERED MOSTLY AS ANGULAR FRAGMENTS FROM 1/2-INCH TO APPROXIMATELY 3- INCHES IN SIZE. MOST SURFACES ON THE FRAGMENTS APPEAR FRESHLY BROKEN. OCCASIONAL PLANAR SURFACES ARE STAINED WITH IRON OXIDE INDICATING SOME JOINTS AND FRACTURES EXISTING IN THE ROCK. ORIENTATION AND DENSITY OF THE JOINTS AND FRACTURES COULD NOT BE DETERMINED.

BAG SAMPLE TAKEN AT 50.0 FT: Lab Classification (SP-SM)g: 54.3% sand, 9.4% fines, 36.3% gravel

STRATIGRAPHY:
0.0 - 49.3 FT: QUATERNARY ALLUVIUM (Qal)
49.3 - 58.5 FT: TERTIARY NACIMIENTO

COMMENTS:

ALL ANGLES MEASURED FROM CORE AXIS AT ZERO DEGREES, UNLESS OTHERWISE NOTED.
THE DATA FOR THE CENTER COLUMN AND"CLASSIFICATION AND PHYSICAL CONDITIONS" COLUMN ARE BASED ON BUREAU OF RECLAMATION GEOLOGY FIELD MANUAL AND DRAWINGS TITLED FOR DESIGNS AND SPECIFICATIONS AS FOLLOWS- DRAWING NO. 40-D-6493. STANDARD DESCRIPTIONS AND DESCRIPTIVE CRITERIA FOR ROCK. DRAWING NO. 40-D-6499. STANDARD DESCRIPTORS AND DESCRIPTIVE CRITERIA FOR DISCONTINUITIES.

GEOLOGIC LOG OF DRILL HOLE NO. DHR21-14-C

FEATURE: REACH 22 PIPELINE
LOCATION: WATER TREATMENT PLANT
BEGUN: 9/3/14 FINISHED: 9/3/14
DEPTH AND ELEVATION OF WATER LEVEL: WLNE
AND DATE MEASURED: 43.5 (6597.4) 9/3/2014

PROJECT: NAVAJO GALLUP WATER SUPPLY PROJECT
COORDINATES: N 1,968,335.9 E 2,734,270.8
TOTAL DEPTH: 58.5
DEPTH TO BEDROCK: 49.3

STATE: NEW MEXICO
GROUND ELEVATION: 6640.9
ANGLE FROM HORIZONTAL: 90
HOLE LOGGED BY: J. GILBERT
REVIEWED BY:

NOTES	DEPTH	% CORE RECOVERY	LABORATORY DATA						LABORATORY CLASSIFICATION	BLOWS / 0.5 FT	GEOLOGIC UNIT SYMBOL	VISUAL CLASSIFICATION / ELEVATION	CLASSIFICATION AND PHYSICAL CONDITION
			% FINES	% SAND	% GRAVEL	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT					

FORMATION (Tn)
ABBREVIATIONS:
WLNE = WATER LEVEL NOT ENCOUNTERED
I.D. = INSIDE DIAMETER
BNE = BEDROCK NOT ENCOUNTERED
NE=NOT ENCOUNTERED
FT=FEET
HSA=HOLLOW STEM AUGER
CME=CENTRAL MINING EQUIPMENT
SPT=STANDARD PENETRATION TEST.

GEOLOGIC LOG OF DRILL HOLE NO. DHR21-14-D

FEATURE: REACH 22 PIPELINE
LOCATION: WATER TREATMENT PLANT
BEGUN: 9/5/14 FINISHED: 9/5/14
DEPTH AND ELEVATION OF WATER LEVEL: WLNE
AND DATE MEASURED: 38.5 (6593.8) 9/5/2014

PROJECT: NAVAJO GALLUP WATER SUPPLY PROJECT
COORDINATES: N 1,968,421.7 E 2,734,760.9
TOTAL DEPTH: 53.5
DEPTH TO BEDROCK: 46.7

STATE: NEW MEXICO
GROUND ELEVATION: 6632.3
ANGLE FROM HORIZONTAL: 90
HOLE LOGGED BY: J. GILBERT
REVIEWED BY:

NOTES

ALL MEASUREMENTS ARE FROM GROUND SURFACE AND ARE THE SAME AS THOSE USED BY THE DRILLER.

ALL MEASUREMENTS ARE REPORTED IN FEET EXCEPT WHERE NOTED.

DRILLED BY: U.C. REGION DRILL CREW; DRILLER; JEFF VAN AUSDALE, HELPERS; KYLE KILEBREW; DAVE NIELSON.

PURPOSE:
PRECONSTRUCTION SOIL AND BEDROCK FOUNDATION INVESTIGATIONS.

DRILL EQUIPMENT:
CME 85.

DRILL METHOD:
0- 53.5 FT 4 1/4" HSA AND DRY CORE SYSTEM WITH SPTs.
CASING RECORD:
NONE USED.

DRILLING MEDIUM:
NONE USED.

HOLE COMPLETION: HOLE BACKFILLED WITH CUTTINGS.

DEPTH	% CORE RECOVERY	LABORATORY DATA: % FINES	% SAND	% GRAVEL	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT	LABORATORY CLASSIFICATION	BLOWS / 0.5 FT	GEOLOGIC UNIT SYMBOL	VISUAL CLASSIFICATION / ELEVATION
5	19.0	19.0	81.0	0	NA	NP	2.7%	SM	8/8/5	Qal	SM
	8.6	8.6	91.4	0	NA	NP	1.6%	SP-SM	6/10/17		
10	11.7	11.7	88.3	0	NA	NP	2.0%	SP-SM	7/11/14		
	21.6	21.6	78.1	0	NA	NP	3.3%	SM	6/12/15		
15	21.6	21.6	79.4	0	NA	NP	2.7%	SM	5/7/8		
	13.4	13.4	84.7	1.9	NA	NP	1.9%	SM	6/10/9		6616.1
											SP 6614.4
20	53.2	53.2	46.8	0	26.3%	13.7%	8.8%	s(CL)	9/16/17		
25	21.5	21.5	75.1	3.4	20.0%	6.4%	5.3%	SC-SM	9/16/39		
30	67.1	67.1	32.9	0	28.3%	13.9%	14.1%	s(CL)	4/8/10		SC
35	17.9	17.9	70.0	2.1	21.4%	8.3%	10.0%	SC	6/8/10		
40	19.3	19.3	78.7	2.0	NA	NP	16.5%	SM	8/11/15		
45											6585.6
50										Tn	SS
											6578.8

BOTTOM OF HOLE

CLASSIFICATION AND PHYSICAL CONDITION

0.0 - 46.7 FT QUATERNARY ALLUVIUM (Qal)

0.0 - 16.2 FT SILTY SAND (SM): ABOUT 80% FINE SAND, MAXIMUM SIZE, FINE SAND; ABOUT 20% FINES WITH NO PLASTICITY, RAPID DILATANCY, LOW DRY STRENGTH; DRY, TAN IN COLOR; STRONG REACTION WITH HCl.

16.2 TO 17.9 FT POORLY GRADED SAND (SP): ABOUT 95% FINE SAND; ABOUT 5% NONPLASTIC FINES WITH RAPID DILATANCY AND NO DRY STRENGTH; TRACE COARSE GRAVEL, MAXIMUM SIZE, 40MM; DRY, NO REACTION WITH HCl.

17.9 - 46.7 FT CLAYEY SAND (SC): ABOUT 60% PREDOMINATELY FINE SAND; ABOUT 40% FINES WITH LOW PLASTICITY, LOW DRY STENGTH, LOW TOUGHNESS AND SLOW DILATANCY; TRACE FINE TO COARSE GRAVEL; MAXIMUM SIZE, 50MM; DARK BROWN IN COLOR, MOIST; NO REACTION WITH HCl.

46.7- 53.5 FT TERTIARY NACIMIENTO FORMATION (TN)

46.7- 53.5 FT SANDSTONE: FINE TO MEDIUM GRAINED, GREY IN COLOR, MODERATELY TO INTENSELY WEATHERED (W5-W7) SOFT TO MODERATLEY SOFT (H5-H6) CONTAINS CALICHE LAYER FROM 46.8 TO 47.0 FT; NO REACTION WITH HCl.

ROCK APPEARS TO BE BROKEN DURING DRILLING AND IS RECOVERED MOSTLY AS FRAGMENTS FROM 1/2-INCH TO APPROXIMATELY 8- INCHES IN SIZE. MOST SURFACES ON THE FRAGMENTS APPEAR FRESHLY BROKEN. OCCASIONAL PLANAR SURFACES ARE STAINED WITH IRON OXIDE INDICATING SOME JOINTS AND FRACTURES EXISTING IN THE ROCK. ORIENTATION AND DENSITY OF THE JOINTS AND FRACTURES COULD NOT BE DETERMINED.

STRATIGRAPHY:
0.0 - 46.7 FT: QUATERNARY ALLUVIUM (Qal)
46.7 - 53.5 FT: TERTIARY NACIMIENTO FORMATION (Tn)
ABBREVIATIONS:
WLNE = WATER LEVEL NOT ENCOUNTERED
I.D. = INSIDE DIAMETER
BNE = BEDROCK NOT ENCOUNTERED
NE=NOT ENCOUNTERED
FT=FEET
HSA=HOLLOW STEM AUGER
CME=CENTRAL MINING EQUIPMENT
SPT=STANDARD PENETRATION TEST.

COMMENTS:

ALL ANGLES MEASURED FROM CORE AXIS AT ZERO DEGREES, UNLESS OTHERWISE NOTED.
THE DATA FOR THE CENTER COLUMN AND"CLASSIFICATION AND PHYSICAL CONDITIONS" COLUMN ARE BASED ON BUREAU OF RECLAMATION GEOLOGY FIELD MANUAL AND DRAWINGS TITLED FOR DESIGNS AND SPECIFICATIONS AS FOLLOWS- DRAWING NO. 40-D-6493. STANDARD DESCRIPTIONS AND DESCRIPTIVE CRITERIA FOR ROCK. DRAWING NO. 40-D-6499. STANDARD DESCRIPTORS AND DESCRIPTIVE CRITERIA FOR DISCONTINUITIES.

GEOLOGIC LOG OF DRILL HOLE NO. DHR21-14-E

FEATURE: REACH 22 PIPELINE
LOCATION: WATER TREATMENT PLANT
BEGUN: 9/4/14 FINISHED:
DEPTH AND ELEVATION OF WATER LEVEL: WLNE
AND DATE MEASURED: 43.2 (6592.7) 9/4/2014

PROJECT: NAVAJO GALLUP WATER SUPPLY PROJECT
COORDINATES: N 1,968,522.5 E 2,734,491.1
TOTAL DEPTH: 58.5
DEPTH TO BEDROCK: 49.2

STATE: NEW MEXICO
GROUND ELEVATION: 6635.9
ANGLE FROM HORIZONTAL: 90
HOLE LOGGED BY: J. GILBERT
REVIEWED BY:

NOTES

ALL MEASUREMENTS ARE FROM GROUND SURFACE AND ARE THE SAME AS THOSE USED BY THE DRILLER.

ALL MEASUREMENTS ARE REPORTED IN FEET EXCEPT WHERE NOTED.

DRILLED BY: U.C. REGION DRILL CREW; DRILLER; JEFF VAN AUSDALE, HELPERS; KYLE KILEBREW; DAVE NIELSON.

PURPOSE:
PRECONSTRUCTION SOIL AND BEDROCK FOUNDATION INVESTIGATIONS.

DRILL EQUIPMENT:
CME 85.

DRILL METHOD:
0- 58.5 FT 4 1/4" HSA AND DRY CORE SYSTEM WITH SPTs.
CASING RECORD:
NONE USED.

DRILLING MEDIUM:
NONE USED.

HOLE COMPLETION: HOLE BACKFILLED WITH CUTTINGS.

DEPTH	% CORE RECOVERY	% FINES	% SAND	% GRAVEL	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT	LABORATORY CLASSIFICATION	BLOWS / 0.5 FT	GEOLOGIC UNIT SYMBOL	VISUAL CLASSIFICATION / ELEVATION
5	24	10.3 10.3	89.7	0	NA	NP	1.7%	SP-SM	3/3/2	Qal	SM
	16	10.1 10.1	89.9	0	NA	NP	2.2%	SP-SM	6/8/11		
10	100	11.5 11.5	88.5	0	NA	NP	1.8%	SP-SM	4/10/12		
	60	59.3 59.3	40.7	0	32.70%	19.00%	8.2%	s(CL)	5/10/15		6623.2
											SC 6622.4
15	100	30.5 30.5	69.5	0	NA	NP	2.5%	SM	11/13/13		SM
	92	27.7 27.7	72.3	0	NA	NP	3.9%	SM	7/11/12		6617.7
20	46	15.9 15.9	84.1	0	NA	NP	2.2%	SM	4/9/13		SP
25	96	14.8 14.8	66.8	18.4	NA	NP	4.3%	(SM)g	8/18/16		
											6606.8
30	30	46.1 46.1	53.9	0	21.80%	3.90%	11.1%	SM	6/6/8		SC
35	32	18.6 18.6	75.8	5.6	21.70%	4.70%	6.6%	SC-SM	6/11/13		
		41 41	59	0	21.9%	6.1%	19.4%	SC-SM			6598.5
40	84								4/5/10		CL
											6593.3
											SC 6592.4
45	74	10 10	84.1	5.9	NA	NP	13.4%	SP-SM	6/16/32		SP
											6586.7
50	86									Tn	SS
55	100										
											6578.1
											CLSTNE 6577.4

CLASSIFICATION AND PHYSICAL CONDITION

0.0 - 49.2 FT QUATERNARY ALLUVIUM (Qal)

0.0 - 12.7 FT: SILTY SAND (SM): ABOUT 80% FINE SAND, MAXIMUM SIZE, FINE SAND; ABOUT 20% FINES WITH NO PLASTICITY, RAPID DILATANCY, LOW DRY STRENGTH, DRY, TAN IN COLOR; STRONG REACTION WITH HCl.

12.7 - 13.5 FT CLAYEY SAND (SC): ABOUT 80% FINE SAND; ABOUT 20% FINES WITH LOW PLASTICITY, LOW TO MEDIUM DRY STENGTH, LOW TOUGHNESS AND SLOW DILATANCY; GREY TO ORANGE IN COLOR, DRY, NO REACTION WITH HCl.

13.5 - 18.2 FT SILTY SAND (SM): ABOUT 80% FINE SAND, MAXIMUM SIZE, FINE SAND; ABOUT 20% FINES WITH NO PLASTICITY, RAPID DILATANCY, LOW DRY STRENGTH, DRY, TAN IN COLOR; STRONG REACTION WITH HCl.

18.2 - 29.1 FT POORLY GRADED SAND (SP): ABOUT 95% PREDOMINATELY FINE SAND, ABOUT 5% NONPLASTIC FINES WITH RAPID DILATANCY, AND NO DRY STRENGTH; TRACE GRAVEL, MAXIMUM SIZE, 25MM; NO REACTION WITH HCl.

29.1 - 37.4 FT CLAYEY SAND (SC): ABOUT 80% FINE SAND; ABOUT 20% FINES WITH LOW PLASTICITY, LOW TO MEDIUM DRY STENGTH, LOW TOUGHNESS AND SLOW DILATANCY; GREY TO ORANGE IN COLOR, DRY, NO REACTION WITH HCl.

37.4 - 42.6 FT LEAN CLAY WITH SAND (CL)s: ABOUT 80% FINES WITH MEDIUM TO HIGH PLASTICITY, MEDIUM TO HIGH DRY STRENGTH, NO DILATANCY AND MEDIUM TO HIGH TOUGHNESS; ABOUT 20% FINE SAND; MAXIUMUM SIZE, FINE SAND; DRY, TAN IN COLOR, NO REACTION WITH HCl.

42.6 - 43.5 FT CLAYEY SAND (SC): ABOUT 80% FINE SAND; ABOUT 20% FINES WITH LOW PLASTICITY, LOW TO MEDIUM DRY STENGTH, LOW TOUGHNESS AND SLOW DILATANCY; GREY TO ORANGE IN COLOR, DRY, NO REACTION WITH HCl.

43.5 - 49.2 FT POORLY GRADED SAND (SP): ABOUT 95% PREDOMINATELY FINE SAND, ABOUT 5% NONPLASTIC FINES WITH RAPID DILATANCY, AND NO DRY STRENGTH; TRACE GRAVEL, MAXIMUM SIZE, 25MM; NO REACTION WITH HCl.

49.2 - 58.5 FT TERTIARY NACIMIENTO FORMATION (TN)

49.2 - 57.8 FT SANDSTONE: FINE TO MEDIUM GRAINED, TAN IN COLOR, MODERATELY TO INTENSELY WEATHERED (W5-W7) MODERATELY SOFT (H5), THINLY BEDDED TO LAMINATED,TRACE OF SUBANGULAR TO SUBROUNDED GRAVELS, MAX SIZE 40 mm; NO REACTION WITH HCl

57.8 - 58.5 FT CLAYSTONE: GREY TO DARK GREY IN COLOR, VERY INTENSLEY WEATHERED TO DECOMPOSED (W8-W9) ,SOFT TO VERY SOFT (H6-H7), WEAK REACTION WITH HCl.

ROCK APPEARS TO BE BROKEN DURING DRILLING AND IS RECOVERED MOSTLY AS FRAGMENTS. MOST SURFACES ON THE

COMMENTS:

ALL ANGLES MEASURED FROM CORE AXIS AT ZERO DEGREES, UNLESS OTHERWISE NOTED.
THE DATA FOR THE CENTER COLUMN AND"CLASSIFICATION AND PHYSICAL CONDITIONS" COLUMN ARE BASED ON BUREAU OF RECLAMATION GEOLOGY FIELD MANUAL AND DRAWINGS TITLED FOR DESIGNS AND SPECIFICATIONS AS FOLLOWS- DRAWING NO. 40-D-6493. STANDARD DESCRIPTIONS AND DESCRIPTIVE CRITERIA FOR ROCK. DRAWING NO. 40-D-6499. STANDARD DESCRIPTORS AND DESCRIPTIVE CRITERIA FOR DISCONTINUITIES.

GEOLOGIC LOG OF DRILL HOLE NO. DHR21-14-E

FEATURE: REACH 22 PIPELINE
LOCATION: WATER TREATMENT PLANT
BEGUN: 9/4/14 FINISHED:
DEPTH AND ELEVATION OF WATER LEVEL: WLNE
AND DATE MEASURED: 43.2 (6592.7) 9/4/2014

PROJECT: NAVAJO GALLUP WATER SUPPLY PROJECT
COORDINATES: N 1,968,522.5 E 2,734,491.1
TOTAL DEPTH: 58.5
DEPTH TO BEDROCK: 49.2

STATE: NEW MEXICO
GROUND ELEVATION: 6635.9
ANGLE FROM HORIZONTAL: 90
HOLE LOGGED BY: J. GILBERT
REVIEWED BY:

NOTES	DEPTH	% CORE RECOVERY	LABORATORY DATA						LABORATORY CLASSIFICATION	BLOWS / 0.5 FT	GEOLOGIC UNIT SYMBOL	VISUAL CLASSIFICATION / ELEVATION	CLASSIFICATION AND PHYSICAL CONDITION
			% FINES	% SAND	% GRAVEL	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT					
									BOTTOM OF HOLE				FRAGMENTS APPEAR FRESHLY BROKEN. ORIENTATION AND DENSITY OF THE JOINTS AND FRACTURES COULD NOT BE DETERMINED.

STRATIGRAPHY:
0.0 - 49.2 FT: QUATERNARY ALLUVIUM (Qal)
49.2 - 58.5 FT: TERTIARY NACIMIENTO FORMATION (Tn)
ABBREVIATIONS:
WLNE = WATER LEVEL NOT ENCOUNTERED
I.D. = INSIDE DIAMETER
BNE = BEDROCK NOT ENCOUNTERED
NE=NOT ENCOUNTERED
FT=FEET
HSA=HOLLOW STEM AUGER
CME=CENTRAL MINING EQUIPMENT
SPT=STANDARD PENETRATION TEST.

GEOLOGIC LOG OF DRILL HOLE NO. DHR21-14-F

SHEET 1 OF 1

FEATURE: REACH 22 PIPELINE
LOCATION: WATER TREATMENT PLANT
BEGUN: 9/8/14 FINISHED: 9/8/14
DEPTH AND ELEVATION OF WATER LEVEL: WLNE
AND DATE MEASURED: 40.0 (6595.2) 9/8/2014

PROJECT: NAVAJO GALLUP WATER SUPPLY PROJECT
COORDINATES: N 1,968,602.1 E 2,734,549.6
TOTAL DEPTH: 53.5
DEPTH TO BEDROCK: 43.8

STATE: NEW MEXICO
GROUND ELEVATION: 6635.2
ANGLE FROM HORIZONTAL: 90
HOLE LOGGED BY: J. GILBERT
REVIEWED BY:

NOTES

ALL MEASUREMENTS ARE FROM GROUND SURFACE AND ARE THE SAME AS THOSE USED BY THE DRILLER.

ALL MEASUREMENTS ARE REPORTED IN FEET EXCEPT WHERE NOTED.

DRILLED BY: U.C. REGION DRILL CREW; DRILLER; JEFF VAN AUSDALE, HELPERS; KYLE KILEBREW; DAVE NIELSON.

PURPOSE:
PRECONSTRUCTION SOIL AND BEDROCK FOUNDATION INVESTIGATIONS.

DRILL EQUIPMENT:
CME 85.

DRILL METHOD:
0- 53.5 FT 4 1/4" HSA AND DRY CORE SYSTEM WITH SPTs.
CASING RECORD:
NONE USED.

DRILLING MEDIUM:
NONE USED.

HOLE COMPLETION: HOLE BACKFILLED WITH CUTTINGS.

DEPTH	% CORE RECOVERY	% FINES	% SAND	% GRAVEL	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT	LABORATORY CLASSIFICATION	BLOWS / 0.5 FT	GEOLOGIC UNIT SYMBOL	VISUAL CLASSIFICATION / ELEVATION
24.0	88	24.0	76.0	0	NA	NP	3.0%	SM	3/9/9	Qal	SM
16.7	100	16.7	83.3	0	NA	NP	1.9%	SM	3/6/6	Qal	SM
6.5	80	6.5	93.5	0	NA	NP	1.2%	SP-SM	3/7/10	Qal	SM
11.5	68	11.5	88.5	0	NA	NP	1.9%	SP-SM	8/18/21	Qal	SM
9.8	100	9.8	90.2	0	NA	NP	1.9%	SP-SM	6/13/14	Qal	SM
7.6	68	7.6	81.2	11.2	NA	NP	1.3%	SP-SM	7/14/16	Qal	SM
										Qal	6618.0
15.9	84	15.9	76.3	7.8	NA	NP	2.1%	SM	9/13/12	Qal	SP-SM
										Qal	SP-SM
										Qal	6611.7
20.0	94	20.0	80.0	0	22.6%	6.8%	4.5%	SC-SM	9/10/15	Qal	(SP-SM)g
23.0	100	23.0	70.2	6.8	NA	NP	5.6%	SM	7/12/15	Qal	(SP-SM)g
40.8	80	40.8	59.2	0	24.0%	7.9%	14.5%	SC	4/4/8	Qal	SC 6600.7
19.9	50	19.9	80.1	0	20.7%	4.5%	16.8%	SC-SM	4/9/9	Qal	SC
										Qal	6591.4
30.4	100	30.4	69.6	0	27.7%	12.3%	15.8%	SC	25/REFUSAL	Tn	SS
	80									Tn	SS
										Tn	6581.7

BOTTOM OF HOLE

CLASSIFICATION AND PHYSICAL CONDITION

0.0 - 43.8 FT QUATERNARY ALLUVIUM (Qal)

0.0 - 17.2 FT SILTY SAND (SM): ABOUT 80% FINE SAND, MAXIMUM SIZE, FINE SAND; ABOUT 20% FINES WITH NO PLASTICITY, RAPID DILATANCY, LOW DRY STRENGTH, DRY, TAN IN COLOR; STRONG REACTION WITH HCl.

17.2 - 23.5 FT POORLY GRADED SAND WITH SILT (SP-SM): ABOUT 90% FINE SAND; ABOUT 10% FINES WITH NO PLASTICITY, NO DRY STRENGTH, AND RAPID DILATANCY; DRY, LIGHT BROWN IN COLOR; NO REACTION WITH HCl.

23.5 - 34.5 FT POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM)g: ABOUT 70% PREDOMINATELY FINE SAND; ABOUT 20% FINE TO COARSE GRAVEL; ABOUT 10% NONPLASTIC FINES WITH RAPID DILATANCY, AND NO DRY STRENGTH; MAXIUMUM SIZE, 50MM; BROWN IN COLOR, NO REACTION WITH HCl.

34.5 - 43.8 FT CLAYEY SAND (SC): ABOUT 60% PREDOMINATELY FINE SAND; ABOUT 40% FINES WITH LOW PLASTICITY, LOW DRY STENGTH, LOW TOUGHNESS AND SLOW DILATANCY, DARK BROWN IN COLOR, MOIST; NO REACTION WITH HCl.

43.8 - 53.5 FT TERTIARY NACIMIENTO FORMATION (TN)

43.8 TO 53.5 FT SANDSTONE: FINE TO MEDIUM GRAINED, TAN IN COLOR, MODERATELY TO INTENSELY WEATHERED (W5-W7) MODERATELY SOFT TO SOFT (H5-H6), CONTAINS CLAY RIP UP CLASTS, FeOx STAINING THROUGHT; NO REACTION WITH HCl

ROCK APPEARS TO BE BROKEN DURING DRILLING AND IS RECOVERED MOSTLY AS ANGULAR FRAGMENTS FROM 1/2-INCH TO APPROXIMATELY 5- INCHES IN SIZE. MOST SURFACES ON THE FRAGMENTS APPEAR FRESHLY BROKEN. OCCASIONAL PLANAR SURFACES ARE STAINED WITH IRON OXIDE INDICATING SOME JOINTS AND FRACTURES EXISTING IN THE ROCK. ORIENTATION AND DENSITY OF THE JOINTS AND FRACTURES COULD NOT BE DETERMINED.

STRATIGRAPHY:
0.0 - 43.8 FT: QUATERNARY ALLUVIUM (Qal)
43.8 - 53.5 FT: TERTIARY NACIMIENTO FORMATION (Tn)
ABBREVIATIONS:
WLNE = WATER LEVEL NOT ENCOUNTERED
I.D. = INSIDE DIAMETER
BNE = BEDROCK NOT ENCOUNTERED
NE=NOT ENCOUNTERED
FT=FEET
HSA=HOLLOW STEM AUGER
CME=CENTRAL MINING EQUIPMENT
SPT=STANDARD PENETRATION TEST.

COMMENTS:

ALL ANGLES MEASURED FROM CORE AXIS AT ZERO DEGREES, UNLESS OTHERWISE NOTED.
THE DATA FOR THE CENTER COLUMN AND"CLASSIFICATION AND PHYSICAL CONDITIONS" COLUMN ARE BASED ON BUREAU OF RECLAMATION GEOLOGY FIELD MANUAL AND DRAWINGS TITLED FOR DESIGNS AND SPECIFICATIONS AS FOLLOWS- DRAWING NO. 40-D-6493. STANDARD DESCRIPTIONS AND DESCRIPTIVE CRITERIA FOR ROCK. DRAWING NO. 40-D-6499. STANDARD DESCRIPTORS AND DESCRIPTIVE CRITERIA FOR DISCONTINUITIES.

GEOLOGIC LOG OF DRILL HOLE NO. DHR21-14-G

SHEET 1 OF 1

FEATURE: REACH 22 PIPELINE
LOCATION: WATER TREATMENT PLANT
BEGUN: 9/7/14 FINISHED: 9/7/14
DEPTH AND ELEVATION OF WATER LEVEL: WLNE
AND DATE MEASURED: 9/7/2014

PROJECT: NAVAJO GALLUP WATER SUPPLY PROJECT
COORDINATES: N 1,968,336.0 E 2,735,072.1
TOTAL DEPTH: 53.5
DEPTH TO BEDROCK: 28.3

STATE: NEW MEXICO
GROUND ELEVATION: 6631.6
ANGLE FROM HORIZONTAL: 90
HOLE LOGGED BY: J. GILBERT
REVIEWED BY:

NOTES

ALL MEASUREMENTS ARE FROM GROUND SURFACE AND ARE THE SAME AS THOSE USED BY THE DRILLER.

ALL MEASUREMENTS ARE REPORTED IN FEET EXCEPT WHERE NOTED.

DRILLED BY: U.C. REGION DRILL CREW; DRILLER; JEFF VAN AUSDALE, HELPERS; KYLE KILEBREW; DAVE NIELSON.

PURPOSE:
PRECONSTRUCTION SOIL AND BEDROCK FOUNDATION INVESTIGATIONS.

DRILL EQUIPMENT:
CME 85.

DRILL METHOD:
0- 53.5 FT 4 1/4" HSA AND DRY CORE SYSTEM WITH SPTs.
CASING RECORD:
NONE USED.

DRILLING MEDIUM:
NONE USED.

HOLE COMPLETION: HOLE BACKFILLED WITH CUTTINGS.

DEPTH	% CORE RECOVERY	% FINES	% SAND	% GRAVEL	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT	LABORATORY CLASSIFICATION	BLOWS / 0.5 FT	GEOLOGIC UNIT SYMBOL	VISUAL CLASSIFICATION / ELEVATION
										Qal	SM 6630.5 / SC 6630.1
5	68	17.1 17.1	82.9	0	NA	NP	3.0%	SM	5/9/11		(CL)s
	80	88.5 88.5	11.5	0	46.3%	26.3%	12.5%	CL	8/14/18		
10	100	38.3 38.3	61.7	0	24.7	10.9	6.2%	SC	11/21/21		6622.4
	32	31.3 31.3	68.7	0	NA	NP	3.9%	SM	8/11/12		
15	100	14.7 14.7	85.3	0	NA	NP	2.0%	SM	6/10/12		
	32	11.7 11.7	78.2	10.1	NA	NP	1.9%	SP-SM	6/9/10		
20	50	14.9 14.9	80.1	5.0	NA	NP	2.5%	SM	9/12/14		SP-SM
25	90	17.3 17.3	82.7	0	NA	NP	4.2%	SM	5/10/9		6603.3
30	100	30.8 30.8	69.2	0	30.6%	10.8%	12.1%	SC	17/34/48	Tn	
35	100	32.5 32.5	67.5	0	28.5%	9.6%	9.3%	SC	25/REFUSAL		
40	100										SS
45	100										
50	100										6578.1

BOTTOM OF HOLE

CLASSIFICATION AND PHYSICAL CONDITION

0.0 - 28.3 FT QUATERNARY ALLUVIUM (Qal)

0.0 - 1.1 FT: SILTY SAND (SM): ABOUT 80% FINE SAND, MAXIMUM SIZE, FINE SAND; ABOUT 20% FINES WITH NO PLASTICITY, RAPID DILATANCY, LOW DRY STRENGTH, DRY, TAN IN COLOR; STRONG REACTION WITH HCl.

1.1 - 1.5 FT CLAYEY SAND (SC): ABOUT 80% FINE SAND; ABOUT 20% FINES WITH LOW PLASTICITY, LOW TO MEDIUM DRY STENGTH, LOW TOUGHNESS AND SLOW DILATANCY; GREY TO ORANGE IN COLOR, DRY, NO REACTION WITH HCl.

1.5 - 9.2 FT LEAN CLAY WITH SAND (CL)s: ABOUT 80% FINES WITH MEDIUM TO HIGH PLASTICITY, MEDIUM TO HIGH DRY STRENGTH, NO DILATANCY AND MEDIUM TO HIGH TOUGHNESS; ABOUT 20% FINE SAND; MAXIUMUM SIZE, FINE SAND; DRY, TAN IN COLOR, NO REACTION WITH HCl.

9.2 - 28.3 FT POORLY GRADED SAND WITH SILT (SP-SM): ABOUT 90% FINE SAND; ABOUT 10% FINES WITH NO PLASTICITY, NO DRY STRENGTH, AND RAPID DILATANCY; DRY, LIGHT BROWN IN COLOR; NO REACTION WITH HCl.

28.3 - 53.5 FT TERTIARY NACIMIENTO FORMATION (TN)

28.3 - 53.5 FT SANDSTONE: FINE TO MEDIUM GRAINED, TAN IN COLOR, MODERATELY TO INTENSELY WEATHERED (W5-W7) MODERATELY SOFT (H5), THINLY BEDDED TO LAMINATED; NO REACTION WITH HCl.

ROCK APPEARS TO BE BROKEN DURING DRILLING AND IS RECOVERED MOSTLY AS ANGULAR FRAGMENTS FROM 1/2-INCH TO APPROXIMATELY 4- INCHES IN SIZE. MOST SURFACES ON THE FRAGMENTS APPEAR FRESHLY BROKEN. OCCASIONAL PLANAR SURFACES ARE STAINED WITH IRON OXIDE INDICATING SOME JOINTS AND FRACTURES EXISTING IN THE ROCK. ORIENTATION AND DENSITY OF THE JOINTS AND FRACTURES COULD NOT BE DETERMINED.

STRATIGRAPHY:
0.0 - 28.3 FT: QUATERNARY ALLUVIUM (Qal)
28.3 - 53.5 FT: TERTIARY NACIMIENTO FORMATION (Tn)
ABBREVIATIONS:
WLNE = WATER LEVEL NOT ENCOUNTERED
I.D. = INSIDE DIAMETER
BNE = BEDROCK NOT ENCOUNTERED
NE=NOT ENCOUNTERED
FT=FEET
HSA=HOLLOW STEM AUGER
CME=CENTRAL MINING EQUIPMENT
SPT=STANDARD PENETRATION TEST.

COMMENTS:

ALL ANGLES MEASURED FROM CORE AXIS AT ZERO DEGREES, UNLESS OTHERWISE NOTED.
THE DATA FOR THE CENTER COLUMN AND"CLASSIFICATION AND PHYSICAL CONDITIONS" COLUMN ARE BASED ON BUREAU OF RECLAMATION GEOLOGY FIELD MANUAL AND DRAWINGS TITLED FOR DESIGNS AND SPECIFICATIONS AS FOLLOWS- DRAWING NO. 40-D-6493. STANDARD DESCRIPTIONS AND DESCRIPTIVE CRITERIA FOR ROCK. DRAWING NO. 40-D-6499. STANDARD DESCRIPTORS AND DESCRIPTIVE CRITERIA FOR DISCONTINUITIES.

GEOLOGIC LOG OF DRILL HOLE NO. DHR22B-14-129

SHEET 1 OF 1

FEATURE: REACH 22B
LOCATION: PIPELINE
BEGUN: 8/21/14 FINISHED: 8/21/14
DEPTH OF WATER LEVEL:
DATE MEASURED:

PROJECT: NAVAJO GALLUP WATER SUPPLY PROJECT
COORDINATES: N 1,968,006.8 E 2,733,190.5
TOTAL DEPTH: 25.0
DEPTH TO BEDROCK: BNE

STATE: NEW MEXICO
GROUND ELEVATION: 6658.5
ANGLE FROM HORIZONTAL: 90
HOLE LOGGED BY: J. GILBERT
REVIEWED BY:

NOTES

ALL MEASUREMENTS ARE FROM GROUND SURFACE AND ARE THE SAME AS THOSE USED BY THE DRILLER.

ALL MEASUREMENTS ARE REPORTED IN FEET EXCEPT WHERE NOTED.

DRILLED BY: U.C. REGION DRILL CREW; DRILLER; JEFF VAN AUSDAL, HELPERS; KYLE KILEBREW, DAVE NIELSEN.

PURPOSE:
PRECONSTRUCTION SOIL AND BEDROCK FOUNDATION INVESTIGATIONS.

DRILL EQUIPMENT:
CME 85

DRILL METHOD:
0- 25.0 FT 4 1/4" HSA AND DRY CORE SYSTEM WITH SPTs.

CASING RECORD:
NONE USED

DRILLING MEDIUM:
NONE

HOLE COMPLETION:
BACKFILLED WITH AUGER CUTTINGS

DEPTH	% CORE RECOVERY	% FINES	% SAND	% GRAVEL	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT	LABORATORY CLASSIFICATION	BLOWS / 0.5 FT	GEOLOGIC UNIT SYMBOL	VISUAL CLASSIFICATION / ELEVATION
										Qal	SM
5	28	10.6	89.4	0	NA	NP	1.6	SP-SM	3/4/6		
	100	8.2	90.8	0	NA	NP	2.4	SP-SM	12/15/14		
10	100	16.3	83.7	0	NA	NP	3.0	SM	7/8/26		
	72	16.2	83.8	0	NA	NP	2.2	SM	13/16/16		6647.3 SP-SM
15	100	54.4	45.6	0	32.6	16.2	8.8	s(CL)	8/12/26		6644.8 SC 6643.6
	96	49.7	50.3	0	24.1	9.5	5.4	SC	16/25/22		
20	90	20.9	79.1	0	NA	NP	3.1	SM	11/16/16		SP-SM
25		18.7	78.8	0	NA	NP	3.4	SM	13/18/17		6633.5

BOTTOM OF HOLE

CLASSIFICATION AND PHYSICAL CONDITION

0.0 - 25.0 FT: QUATERNARY ALLUVIUM (Qal):

0.0 - 11.2 FT: SILTY SAND (SM): ABOUT 80% FINE SAND; ABOUT 20% FINES WITH NO PLASTICITY, RAPID DILATANCY, LOW DRY STRENGTH; MAXIMUM SIZE, FINE SAND; DRY, TAN IN COLOR; STRONG REACTION WITH HCl.

11.2 - 13.7 FT: POORLY GRADED SAND WITH SILT (SP-SM): ABOUT 90% FINE SAND; ABOUT 10% NONPLASTIC FINES WITH RAPID DILATANCY AND NO DRY STRENGTH; MAXIMUM SIZE, FINE SAND; TAN IN COLOR, INTERMITTENT ROOTS; NO REACTION WITH HCl.

13.7 - 14.9 FT: CLAYEY SAND (SC): ABOUT 60% FINE SAND; ABOUT 40% FINES WITH LOW TO MEDIUM PLASTICITY, NO DILATANCY, LOW DRY STRENGTH, LOW TOUGHNESS; MAXIMUM SIZE, FINE SAND; DRY, TAN IN COLOR, INTERMITTENT CALCITE NODULES, ROOTS IN TOP 0.5 FT, STRONG REACTION WITH HCl.

14.9 - 25.0 FT: POORLY GRADED SAND WITH SILT (SP-SM): ABOUT 90% FINE SAND; ABOUT 10% NONPLASTIC FINES WITH RAPID DILATANCY AND NO DRY STRENGTH; MAXIMUM SIZE, FINE SAND; TAN IN COLOR; NO REACTION WITH HCl.

STRATIGRAPHY:
0.0 - 25.0 FT QUATERNARY ALLUVIUM (Qal).

ABBREVIATIONS.
WLNE = WATER LEVEL NOT ENCOUNTERED
I.D. = INSIDE DIAMETER SS = SANDSTONE
SLST = SILTSTONE CLSTNE = CLAYSTONE
FeOx = IRON OXIDE MnOx = MANGANESE OXIDE

COMMENTS:

ALL ANGLES MEASURED FROM CORE AXIS AT ZERO DEGREES, UNLESS OTHERWISE NOTED.
THE DATA FOR THE CENTER COLUMN AND"CLASSIFICATION AND PHYSICAL CONDITIONS" COLUMN ARE BASED ON BUREAU OF RECLAMATION GEOLOGY FIELD MANUAL AND DRAWINGS TITLED FOR DESIGNS AND SPECIFICATIONS AS FOLLOWS- DRAWING NO. 40-D-6493. STANDARD DESCRIPTIONS AND DESCRIPTIVE CRITERIA FOR ROCK. DRAWING NO. 40-D-6499. STANDARD DESCRIPTORS AND DESCRIPTIVE CRITERIA FOR DISCONTINUITIES.

GEOLOGIC LOG OF DRILL HOLE NO. DHR22B-14-133

SHEET 1 OF 1

FEATURE: REACH 22B
LOCATION: PIPELINE
BEGUN: 8/21/14 FINISHED: 8/21/14
DEPTH OF WATER LEVEL:
DATE MEASURED:

PROJECT: NAVAJO GALLUP WATER SUPPLY PROJECT
COORDINATES: N 1,967,503.4 E 2,728,408.4
TOTAL DEPTH: 24.5
DEPTH TO BEDROCK: BNE

STATE: NEW MEXICO
GROUND ELEVATION: 6755.4
ANGLE FROM HORIZONTAL: 90
HOLE LOGGED BY: J. GILBERT
REVIEWED BY:

NOTES

ALL MEASUREMENTS ARE FROM GROUND SURFACE AND ARE THE SAME AS THOSE USED BY THE DRILLER.

ALL MEASUREMENTS ARE REPORTED IN FEET EXCEPT WHERE NOTED.

DRILLED BY: U.C. REGION DRILL CREW; DRILLER; JEFF VAN AUSDAL, HELPERS; KYLE KILEBREW, DAVE NIELSEN.

PURPOSE:
PRECONSTRUCTION SOIL AND BEDROCK FOUNDATION INVESTIGATIONS.

DRILL EQUIPMENT:
CME 85

DRILL METHOD:
0- 24.5 FT 4 1/4" HSA AND DRY CORE SYSTEM WITH SPTs.

CASING RECORD:
NONE USED

DRILLING MEDIUM:
NONE

HOLE COMPLETION:
BACKFILLED WITH AUGER CUTTINGS

DEPTH	% CORE RECOVERY	% FINES	% SAND	% GRAVEL	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT	LABORATORY CLASSIFICATION	BLOWS / 0.5 FT	GEOLOGIC UNIT SYMBOL	VISUAL CLASSIFICATION / ELEVATION
	60	29.9	70.1	0	21.7	7.3	3.4	SC	10/15/14	Qal	
5											
	100	37	63	0	27.4	14.0	5.4	SC	11/19/15		SM
	100	26.8	73.2	0	NA	NP	3.8	SM	12/18/16		
10											
	92	24.9	75.1	0	NA	NP	3.5	SM	7/11/13		
	100	23.3	76.7	0	NA	NP	2.8	SM	10/14/16		6740.5
15											SC 6740.2
	92	28	72	0	NA	NP	3.6	SM	11/20/19		
	100	8.8	91.2	0	NA	NP	1.8	SP-SM	4/10/12		
20											SM
	100	11.6	88.4	0	NA	NP	1.7	SP-SM	6/20/26		
		26.8	73.1	0	NA	NP	4.0	SM	9/21/25		6730.9

BOTTOM OF HOLE

CLASSIFICATION AND PHYSICAL CONDITION

0.0 - 24.5 FT: QUATERNARY ALLUVIUM (Qal):

0.0 - 14.9 FT: SILTY SAND (SM): ABOUT 80% FINE SAND; ABOUT 20% FINES WITH NO PLASTICITY, RAPID DILATANCY, LOW DRY STRENGTH; MAXIMUM SIZE, FINE SAND; DRY, TAN IN COLOR; STRONG REACTION WITH HCl.

14.9 - 15.2 FT: CLAYEY SAND (SC): ABOUT 70% FINE SAND; ABOUT 30% FINES WITH LOW TO MEDIUM PLASTICITY, NO DILATANCY, LOW DRY STRENGTH; MAXIMUM SIZE, FINE SAND; LOW TOUGHNESS; DRY, TAN IN COLOR, INTERMITTENT CALCITE NODULES, ROOTS IN TOP 0.5 FT; STRONG REACTION WITH HCl.

15.2 - 24.5 FT: SILTY SAND (SM): ABOUT 80% FINE SAND; ABOUT 20% FINES WITH NO PLASTICITY, RAPID DILATANCY, LOW DRY STRENGTH; MAXIMUM SIZE, FINE SAND; DRY, TAN IN COLOR; STRONG REACTION WITH HCl.

STRATIGRAPHY:
0.0 - 24.5 FT QUATERNARY ALLUVIUM (Qal).

ABBREVIATIONS WLNE = WATER LEVEL NOT ENCOUNTERED I.D. = INSIDE DIAMETER SS = SANDSTONE SLST = SILTSTONE CLSTNE = CLAYSTONE FeOx = IRON OXIDE MnOx = MANGANESE OXIDE

COMMENTS:

ALL ANGLES MEASURED FROM CORE AXIS AT ZERO DEGREES, UNLESS OTHERWISE NOTED.
THE DATA FOR THE CENTER COLUMN AND"CLASSIFICATION AND PHYSICAL CONDITIONS" COLUMN ARE BASED ON BUREAU OF RECLAMATION GEOLOGY FIELD MANUAL AND DRAWINGS TITLED FOR DESIGNS AND SPECIFICATIONS AS FOLLOWS- DRAWING NO. 40-D-6493. STANDARD DESCRIPTIONS AND DESCRIPTIVE CRITERIA FOR ROCK. DRAWING NO. 40-D-6499. STANDARD DESCRIPTORS AND DESCRIPTIVE CRITERIA FOR DISCONTINUITIES.

GEOLOGIC LOG OF DRILL HOLE NO. DHR22B-14-137

SHEET 1 OF 1

FEATURE: REACH 22B
LOCATION: PIPELINE
BEGUN: 8/20/14 FINISHED: 8/20/14
DEPTH OF WATER LEVEL:
DATE MEASURED:

PROJECT: NAVAJO GALLUP WATER SUPPLY PROJECT
COORDINATES: N 1,967,014.8 E 2,723,702.4
TOTAL DEPTH: 25.0
DEPTH TO BEDROCK: 4.5

STATE: NEW MEXICO
GROUND ELEVATION: 6875.1
ANGLE FROM HORIZONTAL: 90
HOLE LOGGED BY: J. GILBERT
REVIEWED BY:

NOTES

ALL MEASUREMENTS ARE FROM GROUND SURFACE AND ARE THE SAME AS THOSE USED BY THE DRILLER.

ALL MEASUREMENTS ARE REPORTED IN FEET EXCEPT WHERE NOTED.

DRILLED BY: U.C. REGION DRILL CREW; DRILLER; JEFF VAN AUSDAL, HELPERS; KYLE KILEBREW, DAVE NIELSEN.

PURPOSE:
PRECONSTRUCTION SOIL AND BEDROCK FOUNDATION INVESTIGATIONS.

DRILL EQUIPMENT:
CME 85

DRILL METHOD:
0- 25.0 FT 4 1/4" HSA AND DRY CORE SYSTEM WITH SPTs.

CASING RECORD:
NONE USED

DRILLING MEDIUM:
NONE

DEPTH	% CORE RECOVERY	LABORATORY DATA: % FINES	% SAND	% GRAVEL	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT	LABORATORY CLASSIFICATION	BLOWS / 0.5 FT	GEOLOGIC UNIT SYMBOL	VISUAL CLASSIFICATION / ELEVATION
										Qal	SM
	100	23.6	74.7	1.7	NA	NP	2.6	SM	6/9/11		6870.6
5										Tn	
	100	66.6	33.4	0	39.3	24.2	9.2	s(CL)	16/20/23		
	100	87.1	12.9	0	41.8	26.3	10.2	CL	17/25/26		CLSTNE
10											
	100	91.1	8.9	0	41.7	20.6	10.4	CL	20/28/45		
	100	63.6	36.4	0	33.8	19.9	7.7	s(CL)	27/REFUSAL		6861.0
15	100										SS 6858.5
20	100										CLSTNE
25	100										6850.1

BOTTOM OF HOLE

CLASSIFICATION AND PHYSICAL CONDITION

0.0 - 4.5 FT: QUATERNARY ALLUVIUM (Qal):

0.0 - 4.5 FT SILTY SAND SM: ABOUT 80% FINE SAND, MAXIMUM SIZE, FINE SAND; ABOUT 20% FINES WITH NO PLASTICITY, RAPID DILATANCY, LOW DRY STRENGTH; DRY, TAN IN COLOR; STRONG REACTION WITH HCl.

4.5 -25.0 FT.: TERTIARY NACIMIENTO FORMATION (Tn):

4.5 - 14.1 FT CLAYSTONE: INTENSELY WEATHERED TO DECOMPOSED (W7-W9), MODERATELY SOFT TO SOFT (H5-H6), GRAY IN COLOR, NO REACTION WITH HCl.

14.1 - 16.6 FT SANDSTONE: INTENSELY WEATHERED (W7), MODERATELY SOFT TO SOFT (H5-H6), LIGHT GREY IN COLOR; NO REACTION WITH HCl.

16.6 - 25.0 FT CLAYSTONE: INTENSELY WEATHERED TO DECOMPOSED (W7-W9), MODERATELY SOFT TO SOFT (H5-H6), GRAY IN COLOR, SANDSTONE INTERBED FROM 20.0 TO 20.4 FEET; NO REACTION WITH HCl.

STRATIGRAPHY: 0.0 - 4.5 FT QUATERNARY ALLUVIUM (Qal). 4.5 - 25.0 FT TERTIARY NACIMIENTO FORMATION (TN)
ABBREVIATIONS WLNE = WATER LEVEL NOT ENCOUNTERED I.D. = INSIDE DIAMETER SS = SANDSTONE SLST = SILTSTONE CLSTNE = CLAYSTONE FeOx = IRON OXIDE MnOx = MANGANESE OXIDE

COMMENTS:

ALL ANGLES MEASURED FROM CORE AXIS AT ZERO DEGREES, UNLESS OTHERWISE NOTED.
THE DATA FOR THE CENTER COLUMN AND"CLASSIFICATION AND PHYSICAL CONDITIONS" COLUMN ARE BASED ON BUREAU OF RECLAMATION GEOLOGY FIELD MANUAL AND DRAWINGS TITLED FOR DESIGNS AND SPECIFICATIONS AS FOLLOWS- DRAWING NO. 40-D-6493. STANDARD DESCRIPTIONS AND DESCRIPTIVE CRITERIA FOR ROCK. DRAWING NO. 40-D-6499. STANDARD DESCRIPTORS AND DESCRIPTIVE CRITERIA FOR DISCONTINUITIES.

GEOLOGIC LOG OF DRILL HOLE NO. DHR22RT3A-14-1

SHEET 1 OF 1

FEATURE: REACH 22B
LOCATION: REGULATING TANK TANK 3A
BEGUN: 12/3/14 FINISHED: 12/5/14
DEPTH OF WATER LEVEL:
DATE MEASURED:

PROJECT: NAVAJO GALLUP WATER SUPPLY PROJECT
COORDINATES: N 1,967,529.5 E 2,721,596.4
TOTAL DEPTH: 60.0
DEPTH TO BEDROCK: 0.0

STATE: NEW MEXICO
GROUND ELEVATION: 6964.9
ANGLE FROM HORIZONTAL: 90
HOLE LOGGED BY: J. GILBERT
REVIEWED BY:

NOTES

ALL MEASUREMENTS ARE FROM GROUND SURFACE AND ARE THE SAME AS THOSE USED BY THE DRILLER.

ALL MEASUREMENTS ARE REPORTED IN FEET EXCEPT WHERE NOTED.

DRILLED BY: U.C. REGION DRILL CREW; DRILLER; JEFF VAN AUSDAL, HELPERS; KYLE KILLEBREW, BRIAN HART.

PURPOSE:
PRECONSTRUCTION SOIL AND BEDROCK FOUNDATION INVESTIGATIONS.

DRILL EQUIPMENT:
CME 850 TRACK MOUNTED DRILL RIG

DRILL METHOD:
0.0 - 60.0 FT HQ3 WIRELINE CORING SYSTEM WITH A 3' SPLIT TUBE SAMPLER AND DIAMOND SURFACE- SET BIT.

CASING RECORD:
NONE USED

DRILLING MEDIUM:
0.0 - 60.0 FT, WATER

HOLE COMPLETION:
BACKFILLED WITH DRILL CUTTINGS

DEPTH	% CORE RECOVERY	% FINES	% SAND	% GRAVEL	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT	LABORATORY CLASSIFICATION	BLOWS / 0.5 FT	GEOLOGIC UNIT SYMBOL	VISUAL CLASSIFICATION / ELEVATION
	76										
5											
	100										
10											
	100										CLSTNE
15											
	100										
20											
	100										
25											
	50										6937.4
30										Tn	SS
	100										6933.5
	100										
35											
	100										CLSTNE
40											
	100										
45											6918.8
	100										SS 6916.9
											CLSTNE 6914.9
50											
	100										
55											SLTSN
	100										
60											6905.2 SHALE 6901.9

BOTTOM OF HOLE

CLASSIFICATION AND PHYSICAL CONDITION

0.0 - 60.0 FT TERTIARY NACIMIENTO FORMATION (Tn)

0.0 - 27.5 FT CLAYSTONE: DARK GREY IN COLOR, FINE GRAINED, VERY INTENSELEY WEATHERED TO DECOMPOSED (W8-W9), VERY SOFT (H7); NO REACTION WITH HCL.

JOINT MEASUREMENTS:

DEPTH	INCL	R	M	T	HL	INFILLING
13.3	90	4	2	1	5	CL
18.0	80	4	2	1	5	CL
18.7	55	4	2	1	5	CL

27.5 - 31.4 FT SANDSTONE: LIGHT GREY IN COLOR, FINE TO MEDIUM GRAINED, LAMINATED TO THINLY BEDDED, MODERATELY WEATHERED (W4), MODERATELY HARD (H4); NO REACTION WITH HCL.

31.4 - 46.1 FT CLAYSTONE: DARK GREY IN COLOR, FINE GRAINED, MODERATELY TO SLIGHTLY WEATHERED (W4), MODERATELY HARD (H4); NO REACTION WITH HCL.

JOINT MEASUREMENTS:

DEPTH	INCL	R	M	T	HL	INFILLING
38.6	80	4	2	1	5	CL

46.1 - 48.0 FT SANDSTONE: LIGHT GREY IN COLOR, FINE TO MEDIUM GRAINED, LAMINATED TO THINLY BEDDED, MODERATELY WEATHERED (W4), MODERATELY HARD (H4); NO REACTION WITH HCL.

48.0 - 50.0 FT CLAYSTONE: DARK GREY IN COLOR, FINE GRAINED, MODERATELY TO SLIGHTLY WEATHERED (W4), MODERATELY HARD (H4); NO REACTION WITH HCL.

50.0 - 59.7 FT SILTSTONE: GREY TO DARK GREY IN COLOR, FINE GRAINED, MODERATELY TO SLIGHTLY WEATHERED (W4), MODERATELY HARD (H5); NO REACTION WITH HCL.

59.7 - 60.0 FT SHALE: BLACK IN COLOR, VERY FINE GRAINED, MODERATELY TO SLIGHTLY WEATHERED (W4), MODERATELY SOFT TO SOFT (H5-H6); NO REACTION WITH HCL.

STRATIGRAPHY:
0.0 - 60.0 FT: TERTIARY NACIMIENTO FORMATION (TN)

ABBREVIATIONS:
WLNE = WATER LEVEL NOT ENCOUNTERED
I.D. = INSIDE DIAMETER BNE = BEDROCK NOT ENCOUNTERED.

COMMENTS:

ALL ANGLES MEASURED FROM CORE AXIS AT ZERO DEGREES, UNLESS OTHERWISE NOTED.
THE DATA FOR THE CENTER COLUMN AND"CLASSIFICATION AND PHYSICAL CONDITIONS" COLUMN ARE BASED ON BUREAU OF RECLAMATION GEOLOGY FIELD MANUAL AND DRAWINGS TITLED FOR DESIGNS AND SPECIFICATIONS AS FOLLOWS- DRAWING NO. 40-D-6493. STANDARD DESCRIPTIONS AND DESCRIPTIVE CRITERIA FOR ROCK. DRAWING NO. 40-D-6499. STANDARD DESCRIPTORS AND DESCRIPTIVE CRITERIA FOR DISCONTINUITIES.

GEOLOGIC LOG OF DRILL HOLE NO. DHR22RT3A-14-4

SHEET 1 OF 1

FEATURE: REACH 22B
LOCATION: REGULATING TANK 3A
BEGUN: 12/6/14 FINISHED: 12/6/14
DEPTH OF WATER LEVEL:
DATE MEASURED:

PROJECT: NAVAJO GALLUP WATER SUPPLY PROJECT
COORDINATES: N 1,967,552.3 E 2,721,606.8
TOTAL DEPTH: 40.0
DEPTH TO BEDROCK: 0.0

STATE: NEW MEXICO
GROUND ELEVATION: 6964.8
ANGLE FROM HORIZONTAL: 90
HOLE LOGGED BY: J. GILBERT
REVIEWED BY:

NOTES

ALL MEASUREMENTS ARE FROM GROUND SURFACE AND ARE THE SAME AS THOSE USED BY THE DRILLER.

ALL MEASUREMENTS ARE REPORTED IN FEET EXCEPT WHERE NOTED.

DRILLED BY: U.C. REGION DRILL CREW; DRILLER; JEFF VAN AUSDAL, HELPERS; KYLE KILLEBREW, BRIAN HART.

PURPOSE:
PRECONSTRUCTION SOIL AND BEDROCK FOUNDATION INVESTIGATIONS.

DRILL EQUIPMENT:
CME 850 TRACK MOUNTED DRILL RIG

DRILL METHOD:
0.0 - 40.0 FT HQ3 WIRELINE CORING SYSTEM WITH A 3' SPLIT TUBE SAMPLER AND DIAMOND SURFACE- SET BIT.

CASING RECORD:
NONE USED

DRILLING MEDIUM:
0.0 - 40.0 FT, WATER

HOLE COMPLETION:
BACKFILLED WITH DRILL CUTTINGS

OBSERVATION WELL INSTALLED BGS:
NONE USED

DEPTH	% CORE RECOVERY	% FINES	% SAND	% GRAVEL	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT	LABORATORY CLASSIFICATION	BLOWS / 0.5 FT	GEOLOGIC UNIT SYMBOL	VISUAL CLASSIFICATION / ELEVATION
	100										CLSTN
5											
	100										6956.2
											SLTSTN 6955.6
10											
	18										
15											
	92										
20										Tn	CLSTN
	100										
25											
	100										
											6935.0
30											SS 6933.9
	100										
35											CLSTN
	100										
40											6924.8

BOTTOM OF HOLE

CLASSIFICATION AND PHYSICAL CONDITION

0.0 - 40.0 FT TERTIARY NACIMIENTO FORMATION (Tn)

0.0 - 8.6 FT CLAYSTONE: DARK GREY IN COLOR, FINE GRAINED, VERY INTENSELY WEATHERED TO DECOMPOSED (W8-W9), VERY SOFT (H7); NO REACTION WITH HCl.

8.6 - 9.2 FT SILTSTONE: GREY TO DARK GREY IN COLOR, FINE GRAINED, MODERATELY TO SLIGHTLY WEATHERED (W4), MODERATELY HARD TO HARD (H3-H4); NO REACTION WITH HCl.

9.2 - 29.8 FT CLAYSTONE: DARK GREY IN COLOR, FINE GRAINED, VERY INTENSELY WEATHERED TO DECOMPOSED (W8-W9), VERY SOFT (H7); NO REACTION WITH HCl.

29.8 - 30.9 FT SANDSTONE: LIGHT GREY IN COLOR, FINE TO MEDIUM GRAINED, LAMINATED TO THINLY BEDDED, MODERATELY WEATHERED (W4), MODERATELY HARD (H4); NO REACTION WITH HCl.

30.9 - 40.0 FT CLAYSTONE: DARK GREY IN COLOR, FINE GRAINED, MODERATELY WEATHERED (W4), MODERATELY HARD (H4); NO REACTION WITH HCl.

JOINT MEASUREMENTS:

DEPTH	INCL	R	M	T	HL	INFILLING
34.9	80	4	2	1	5	CALCITE

STRATIGRAPHY:
0.0 - 40.0 FT: TERTIARY NACIMIENTO FORMATION (Tn)

ABBREVIATIONS:
WLNE = WATER LEVEL NOT ENCOUNTERED
I.D. = INSIDE DIAMETER BNE = BEDROCK NOT ENCOUNTERED.

COMMENTS:

ALL ANGLES MEASURED FROM CORE AXIS AT ZERO DEGREES, UNLESS OTHERWISE NOTED.
THE DATA FOR THE CENTER COLUMN AND"CLASSIFICATION AND PHYSICAL CONDITIONS" COLUMN ARE BASED ON BUREAU OF RECLAMATION GEOLOGY FIELD MANUAL AND DRAWINGS TITLED FOR DESIGNS AND SPECIFICATIONS AS FOLLOWS- DRAWING NO. 40-D-6493. STANDARD DESCRIPTIONS AND DESCRIPTIVE CRITERIA FOR ROCK. DRAWING NO. 40-D-6499. STANDARD DESCRIPTORS AND DESCRIPTIVE CRITERIA FOR DISCONTINUITIES.

GEOLOGIC LOG OF DRILL HOLE NO. DHR22RT3A-15-1B

SHEET 1 OF 1

FEATURE: REACH 22B
LOCATION: REGULATING TANK 3A
BEGUN: 3/12/15 FINISHED: 3/12/15
DEPTH OF WATER LEVEL:
DATE MEASURED:

PROJECT: NAVAJO GALLUP WATER SUPPLY PROJECT
COORDINATES: N 1,967,415.2 E 2,721,512.8
TOTAL DEPTH: 60.8
DEPTH TO BEDROCK: 2.5

STATE: NEW MEXICO
GROUND ELEVATION: 6966.4
ANGLE FROM HORIZONTAL: 90
HOLE LOGGED BY: J. GILBERT
REVIEWED BY:

NOTES

ALL MEASUREMENTS ARE FROM GROUND SURFACE AND ARE THE SAME AS THOSE USED BY THE DRILLER.

ALL MEASUREMENTS ARE REPORTED IN FEET EXCEPT WHERE NOTED.

DRILLED BY: U.C. REGION DRILL CREW; DRILLER; JEFF VAN AUSDAL, HELPERS; KYLE KILLEBREW, STEVE COCHRAN.

PURPOSE:
PRECONSTRUCTION SOIL AND BEDROCK FOUNDATION INVESTIGATIONS.

DRILL EQUIPMENT:
CME 850 TRACK MOUNTED DRILL RIG

DRILL METHOD:
0.0 -7.5 4 1/4 INCH HOLLOW STEM AUGER WIH CALIFONIA SAMPLER, REACHED AUGER REFUSAL AT 7.5 FT, SWICHED TO CORING SETUP.
7.5 - 60.8 FT HQ3 WIRELINE CORING SYSTEM WITH A 3' SPLIT TUBE SAMPLER AND DIAMOND SURFACE- SET BIT.

CASING RECORD:
NONE USED

DRILLING MEDIUM:
0.0 - 7.5 FT NONE USED
7.5 - 60.8 FT, WATER

HOLE COMPLETION:
BACKFILLED WITH DRILL BENTONITE.

OBSERVATION WELL INSTALLED BGS:
NONE USED

DEPTH	% CORE RECOVERY	% FINES	% SAND	% GRAVEL	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT	LABORATORY CLASSIFICATION	BLOWS / 0.5 FT	GEOLOGIC UNIT SYMBOL	VISUAL CLASSIFICATION / ELEVATION
										Qal	SC 6963.9
									19/31		
											SS 6961.4
5									19/50		
	75										
10											
	96										
15											CLSTNE
	100										
20											
	4										
25											6941.2
	100										SS
30										Tn	6934.8
	96										
35											
	100										
40											CLSTNE
	94										
45											
	22										6918.4
	100										
50											
55											SS
	100										
60											6905.6

BOTTOM OF HOLE

CLASSIFICATION AND PHYSICAL CONDITION

0.0 - 2.5 QUATERNARY ALLUVIUM (Qal):

0.0 TO 2.5 FT, CLAYEY SAND (SC): ABOUT 80% FINE SAND; ABOUT 20% FINES WITH MEDIUM TO HIGH PLASTICITY, MEDIUM TOUGHNESS AND MEDIUM DRY STRENGTH; GREY, NO REACTION WITH HCl.

2.5 TO 60.8 TERTIARY NACIMIENTO FORMATION.

2.5 TO 5.0 FT SANDSTONE: MODERATELY WEATHERED (W5), SOFT (H6), GREY IN COLOR, FINE GRAINED, NO REACTION WITH HCL.

5.0 TO 25.2 FT CLAYSTONE: INTENSELY WEATHERED (W7), SOFT (H6), LIGHT GREY TO DARK GREY IN COLOR, GYPSUM VEINS AND NODULES, IRON OXIDE STAINING THROUGHOUT. 1 GALLON BAG SAMPLE COLLECTED FROM AUGER CUTTING FROM 2.5 TO 6.0 FT FOR CORROSION TESTING

JOINT MEASUREMENTS:

DEPTH	INCL	R	W	O	T	HL	INFILLING
13.1	80	4	1	1	6		FeOx
13.4	40	4	1	1	6		FeOx
14.9	65	4	1	1	6		FeOx

25.2 TO 31.6 FT SANDSTONE: SLIGHTLY WEATHERED (W3), HARD (H3), GREY IN COLOR, FINE GRAINED, NO REACTION WITH HCL.

31.6 TO 48.0 FT CLAYSTONE: INTENSELY WEATHERED (W7), SOFT (H6), LIGHT GREY TO DARK GREY IN COLOR, GYPSUM VEINS AND NODULES, IRON OXIDE STAINING THROUGHOUT.

48.0 TO 60.8 SANDSTONE: MODERATELY WEATHERED (W5), SOFT (H6), GREY IN COLOR, FINE GRAINED, NO REACTION WITH HCL.

COMMENTS:

ALL ANGLES MEASURED FROM CORE AXIS AT ZERO DEGREES, UNLESS OTHERWISE NOTED.
THE DATA FOR THE CENTER COLUMN AND"CLASSIFICATION AND PHYSICAL CONDITIONS" COLUMN ARE BASED ON BUREAU OF RECLAMATION GEOLOGY FIELD MANUAL AND DRAWINGS TITLED FOR DESIGNS AND SPECIFICATIONS AS FOLLOWS- DRAWING NO. 40-D-6493. STANDARD DESCRIPTIONS AND DESCRIPTIVE CRITERIA FOR ROCK. DRAWING NO. 40-D-6499. STANDARD DESCRIPTORS AND DESCRIPTIVE CRITERIA FOR DISCONTINUITIES.

GEOLOGIC LOG OF DRILL HOLE NO. DHR22RT3A-15-3B

SHEET 1 OF 1

FEATURE: REACH 22B
LOCATION: REGULATING TANK TANK 3A
BEGUN: 3/14/15 FINISHED: 3/14/15
DEPTH OF WATER LEVEL:
DATE MEASURED: 3/14/2015

PROJECT: NAVAJO GALLUP WATER SUPPLY PROJECT
COORDINATES: N 1,967,391.6 E 2,721,492.8
TOTAL DEPTH: 40.7
DEPTH TO BEDROCK: 2.0

STATE: NEW MEXICO
GROUND ELEVATION: 6965.3
ANGLE FROM HORIZONTAL: 90
HOLE LOGGED BY: C. BEYER
REVIEWED BY:

NOTES

ALL MEASUREMENTS ARE FROM GROUND SURFACE AND ARE THE SAME AS THOSE USED BY THE DRILLER.

ALL MEASUREMENTS ARE REPORTED IN FEET EXCEPT WHERE NOTED.

DRILLED BY: U.C. REGION DRILL CREW; DRILLER; JEFF VAN AUSDAL, HELPERS; KYLE KILLEBREW, STEVE COCHRAN.

PURPOSE:
PRECONSTRUCTION SOIL AND BEDROCK FOUNDATION INVESTIGATIONS.

DRILL EQUIPMENT:
CME 850 TRACK MOUNTED DRILL RIG

DRILL METHOD:
0.0 - 5.7 4 1/4 INCH HOLLOW STEM AUGER WITH CALIFONIA SAMPLER, REACHED AUGER REFUSAL AT 5.7 FT, SWICHED TO CORING SETUP.
5.7 - 40.7 FT HQ3 WIRELINE CORING SYSTEM WITH A 3' SPLIT TUBE SAMPLER AND DIAMOND SURFACE- SET BIT.

CASING RECORD:
NONE USED

DRILLING MEDIUM:
0.0 - 5.7 FT NONE USED
5.7 - 40.7 FT, WATER

HOLE COMPLETION:
BACKFILLED WITH DRILL BENTONITE.

OBSERVATION WELL INSTALLED BGS:
NONE USED

DEPTH	% CORE RECOVERY	% FINES	% SAND	% GRAVEL	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT	LABORATORY CLASSIFICATION	BLOWS / 0.5 FT	GEOLOGIC UNIT SYMBOL	VISUAL CLASSIFICATION / ELEVATION
										Qal	SC 6963.3
									16/28		
5									27/REFUSAL		
	100										
10											CLST
	100										
15											
	82										6946.3
20										Tn	SS
	22										6940.4
25											CLST 6939.6
	100										SS 6936.1
30											
	100										
35											CLST
	100										
40											6924.6

BOTTOM OF HOLE

CLASSIFICATION AND PHYSICAL CONDITION

0.0 - 2.0 QUATERNARY ALLUVIUM (Qal):

O.O TO 2.0 FT, CLAYEY SAND (SC): ABOUT 80% FINE SAND; ABOUT 20% FINES WITH MEDIUM TO HIGH PLASTICITY, MEDIUM TOUGHNESS AND MEDIUM DRY STRENGTH; GREY, NO REACTION WITH HCl.

2.0 TO 40.7 TERTIARY NACIMIENTO FORMATION.

2.0 TO 19.0 FT, CLAYSONE: SANDY, LAMINATED TO THINLY BEDDED, GREY IN COLOR, INTERMITTENT PURPLE SPOTS, DECOMPOSED (W9) AND VERY SOFT (H7) IN TOP 1.5 FEET, BECOMES INTENSELY WEATHERED (W7) AND SOFT (H6) BELOW 1.5 FEET, CORE STICKS TO SAMPLER, VERY DIFFICULT TO REMOVE, SAMPLE FALLS APART UPON REMOVAL FROM SPLIT SPOON. SILTSTONE INTERBED FROM 14.6 TO 15.0 FT MODERATELY SOFT (H5) INTENSELY TO MODERATELY WEATHERED (W6), LIGHT GREY, NO REACTION WITH HCL.

19.0 TO 24.9 FT SANDSTONE: FINE GRAINED ARGILLACEOUS, TAN TO GREY IN COLOR, SOFT (H6) MODERATELY WEATHERED (W5), MICACEOUS, THINLY TO MODERATELY BEDDED, GYPSUM VEINS, NO REACTION WITH HCL. SANDSTONE WASHED AWAY BY DRILL RESULTING IN POOR RECOVERY.

24.9 TO 25.7 CLAYSTONE: SANDY, LAMINATED TO THINLY BEDDED, GREY IN COLOR, INTERMITTENT PURPLE SPOTS, INTENSELY WEATHERED (W7) AND SOFT (H6) CORE STICKS TO SAMPLER, VERY DIFFICULT TO REMOVE, SAMPLE FALLS APART UPON REMOVAL FROM SPLIT SPOON.

25.7 TO 29.2 FT SANDSTONE: FINE GRAINED ARGILLACEOUS, TAN TO GREY IN COLOR, MODERATELY SOFT (H5) SLIGHTILY WEATHERED (W3), THINLY TO MODERATELY BEDDED, NO REACTION WITH HCL.

29.2 TO 40.7 FT CLAYSONE: LAMINATED TO THINLY BEDDED, DARK GREY TO BLACK IN COLOR, SLIGHTLY WEATHERED (W3) AND MODERATELY SOFT (H5) CORE STICKS TO SAMPLER, VERY DIFFICULT TO REMOVE, SAMPLE FALLS APART UPON REMOVAL FROM SPLIT SPOON. INTERMITTENT SILTSTONE/SANDSTONE INTERBEDS 0.3 FT THICK.

STRATIGRAPHY:
0.0 - 2.0 FT QUATERNARY ALLUVIUM (Qal)
2.0 - 40.7 FT TERTIARY NACIMIENTO FORMATION

COMMENTS:

ALL ANGLES MEASURED FROM CORE AXIS AT ZERO DEGREES, UNLESS OTHERWISE NOTED.
THE DATA FOR THE CENTER COLUMN AND"CLASSIFICATION AND PHYSICAL CONDITIONS" COLUMN ARE BASED ON BUREAU OF RECLAMATION GEOLOGY FIELD MANUAL AND DRAWINGS TITLED FOR DESIGNS AND SPECIFICATIONS AS FOLLOWS- DRAWING NO. 40-D-6493. STANDARD DESCRIPTIONS AND DESCRIPTIVE CRITERIA FOR ROCK. DRAWING NO. 40-D-6499. STANDARD DESCRIPTORS AND DESCRIPTIVE CRITERIA FOR DISCONTINUITIES.

GEOLOGIC LOG OF DRILL HOLE NO. DHR22RT3A-15-4B

SHEET 1 OF 1

FEATURE: REACH 22B
LOCATION: REGULATING TANK TANK 3A
BEGUN: 3/11/15 FINISHED: 3/11/15
DEPTH OF WATER LEVEL:
DATE MEASURED: 3/11/2015

PROJECT: NAVAJO GALLUP WATER SUPPLY PROJECT
COORDINATES: N 1,967,394.9 E 2,721,535.2
TOTAL DEPTH: 40.7
DEPTH TO BEDROCK: 2.2

STATE: NEW MEXICO
GROUND ELEVATION: 6965.5
ANGLE FROM HORIZONTAL: 90
HOLE LOGGED BY: C. BEYER
REVIEWED BY:

NOTES

ALL MEASUREMENTS ARE FROM GROUND SURFACE AND ARE THE SAME AS THOSE USED BY THE DRILLER.

ALL MEASUREMENTS ARE REPORTED IN FEET EXCEPT WHERE NOTED.

DRILLED BY: U.C. REGION DRILL CREW; DRILLER; JEFF VAN AUSDAL, HELPERS; KYLE KILLEBREW, STEVE COCHRAN.

PURPOSE:
PRECONSTRUCTION SOIL AND BEDROCK FOUNDATION INVESTIGATIONS.

DRILL EQUIPMENT:
CME 850 TRACK MOUNTED DRILL RIG

DRILL METHOD:
0.0 - 40.7 FT HQ3 WIRELINE CORING SYSTEM WITH A 3' SPLIT TUBE SAMPLER AND DIAMOND SURFACE- SET BIT.

CASING RECORD:
NONE USED

DRILLING MEDIUM:
0.0 - 40.7 FT, WATER

HOLE COMPLETION:
BACKFILLED WITH DRILL CUTTINGS AND BENTONITE.

OBSERVATION WELL INSTALLED BGS:
NONE USED

DEPTH	% CORE RECOVERY	LABORATORY DATA: % FINES	% SAND	% GRAVEL	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT	LABORATORY CLASSIFICATION	BLOWS / 0.5 FT	GEOLOGIC UNIT SYMBOL	VISUAL CLASSIFICATION / ELEVATION
										Qal	(CL)s 6963.3
	100									Tn	
5											
	96										
10											CLST
	100										
15											
	42										6946.3
20											
	64										SS
25											
	50										6936.4
30											CLST 6935.3
											SS 6934.8
	50										
35											CLST
	92										
40											6924.8

BOTTOM OF HOLE

CLASSIFICATION AND PHYSICAL CONDITION

0.0 - 2.2 QUATERNARY ALLUVIUM (Qal):

O.O TO 2.2 FT, LEAN CLAY WITH SAND (CL)S: ABOUT 80% FINES WITH MEDIUM TO HIGH PLASTICITY, MEDIUM TOUGHNESS AND MEDIUM DRY STRENGTH; ABOUT 20% FINE SAND; GREY, NO REACTION WITH HCL.

2.2 TO 40.7 TERTIARY NACIMIENTO FORMATION.

2.2 TO 19.2 FT, CLAYSONE: SANDY, LAMINATED TO THINLY BEDDED, GREY IN COLOR, INTERMITTENT PURPLE SPOTS, DECOMPOSED (W9) AND VERY SOFT (H7) IN TOP 1.5 FEET, BECOMES VERY INTENSELY WEATHERED (W8) AND SOFT (H6) BELOW 1.5 FEET, CORE STICKS TO SAMPLER, VERY DIFFICULT TO REMOVE, SAMPLE FALLS APART UPON REMOVAL FROM SPLIT SPOON.

19.2 TO 29.1 SANDSTONE: FINE GRAINED ARGILLACEOUS, TAN TO GREY IN COLOR, SOFT (H6) MODERATELY WEATHERED (W5), MICACEOUS, THINLY TO MODERATELY BEDDED, NO REACTION WITH HCL. SANDSTONE WASHED AWAY BY DRILL RESULTING IN POOR RECOVERY.

29.1 TO 30.2 FT CLAYSTONE: BLACK IN COLOR, MODERATELY WEATHERED (W5), SOFT (H6), LAMINATED TO THINLY BEDDED, GYPSUM VEINS AND IRON OXIDE CONCRETIONS.

30.2 TO 30.7 SANDSTONE: HARD (H3) SLIGHTLY WEATHERED TO FRESH (W2), MODERATELY BEDDED, GREY IN COLOR, NO REACTION WITH HCL.

30.7 TO 40.7 CLAYSTONE: SANDY, SOFT (H6) INTENSELY TO MODERATELY WEATHERED (W6), GYPSUM VEINS, INTERMITTENT IRON OXIDE VEINS, DARK GREY TO BLACK IN COLOR, THINLY TO MODERATELY BEDDED.

STRATIGRAPHY:
0.0 - 2.2 FT QUATERNARY ALLUVIUM (Qal)
2.2 - 40.7 FT TERTIARY NACIMIENTO FORMATION

COMMENTS:

ALL ANGLES MEASURED FROM CORE AXIS AT ZERO DEGREES, UNLESS OTHERWISE NOTED.
THE DATA FOR THE CENTER COLUMN AND"CLASSIFICATION AND PHYSICAL CONDITIONS" COLUMN ARE BASED ON BUREAU OF RECLAMATION GEOLOGY FIELD MANUAL AND DRAWINGS TITLED FOR DESIGNS AND SPECIFICATIONS AS FOLLOWS- DRAWING NO. 40-D-6493. STANDARD DESCRIPTIONS AND DESCRIPTIVE CRITERIA FOR ROCK. DRAWING NO. 40-D-6499. STANDARD DESCRIPTORS AND DESCRIPTIVE CRITERIA FOR DISCONTINUITIES.

GEOLOGIC LOG OF DRILL HOLE NO. DHR22RT3B-14-1

SHEET 1 OF 1

FEATURE: REACH 22B
LOCATION: REGULATING TANK 3B
BEGUN: 12/17/14 FINISHED: 12/20/14
DEPTH OF WATER LEVEL:
DATE MEASURED: 12/20/2014

PROJECT: NAVAJO GALLUP WATER SUPPLY PROJECT
COORDINATES: N 1,967,529.4 E 2,721,508.0
TOTAL DEPTH: 60.0
DEPTH TO BEDROCK: 0.0

STATE: NEW MEXICO
GROUND ELEVATION: 6969.5
ANGLE FROM HORIZONTAL: 90
HOLE LOGGED BY: C. BEYER
REVIEWED BY:

NOTES

ALL MEASUREMENTS ARE FROM GROUND SURFACE AND ARE THE SAME AS THOSE USED BY THE DRILLER.

ALL MEASUREMENTS ARE REPORTED IN FEET EXCEPT WHERE NOTED.

DRILLED BY: U.C. REGION DRILL CREW; DRILLER; JEFF VAN AUSDAL, HELPERS; KYLE KILLEBREW, JOE PROCTOR.

PURPOSE:
PRECONSTRUCTION SOIL AND BEDROCK FOUNDATION INVESTIGATIONS.

DRILL EQUIPMENT:
CME 85 TRACK MOUNTED DRILL RIG

DRILL METHOD:
0.0 - 25.7 FT 4 1/4 INCH HOLLOW STEM AUGER WITH CALIFORNIA SAMPLER
25.7 60.0 FT HQ3 WIRELINE CORING SYSTEM WITH A 3' SPLIT TUBE SAMPLER AND DIAMOND SURFACE- SET BIT.

CASING RECORD:
NONE USED

DRILLING MEDIUM:
0.0 - 25.7 FT, NONE USED
25.7 - 60.0 FT, WATER

HOLE COMPLETION:
BACKFILLED WITH DRILL CUTTINGS AND BENTONITE.

DEPTH	% CORE RECOVERY	% FINES	% SAND	% GRAVEL	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT	LABORATORY CLASSIFICATION	BLOWS / 0.5 FT	GEOLOGIC UNIT SYMBOL	VISUAL CLASSIFICATION / ELEVATION
									17/25		
5									30/50		
									50/REFUSAL		
10									50/REFUSAL		
									37/REFUSAL		
15											CLST
									REFUSAL		
20									REFUSAL		
									REFUSAL		
25									50/REFUSAL		
	100										
30										Tn	6939.4
	56										
35											SS
	36										6930.5
40											
	100										CLST
45											
	100										6921.3
50											SLTS
	100										6914.5
55											SS
	98										6909.5
60											

BOTTOM OF HOLE

CLASSIFICATION AND PHYSICAL CONDITION

0.0 TO 60.0 TERTIARY NACIMIENTO FORMATION.

0.0 TO 30.1 FT, CLAYSTONE: SANDY, LAMINATED TO THINLY BEDDED, GREY IN COLOR, DECOMPOSED (W9) AND VERY SOFT (H7) IN TOP 1.5 FEET, BECOMES INTENSELY WEATHERED (W7) TO MODERATELY TO INTENSELY WEATHERED (W6) AND SOFT (H6) INTERMITTENT IRON OXIDE STAINING,DIFFICULT AUGERING ABOVE 25.0 FT, CORE STICKS TO SAMPLER, VERY DIFFICULT TO REMOVE, SAMPLE FALLS APART UPON REMOVAL FROM SPLIT SPOON FROM 25.0 TO 30.0 FT.

30.1 TO 39.0 SANDSTONE: FINE GRAINED, ARGILLACEOUS, LIGHT GREY IN COLOR, MODERATELY SOFT (H5) INTENSELY TO MODERATELY WEATHERED (W6), MODERATELY BEDDED, THIN CLAYSTONE INTERBEDS 0.3 FT THICK, NO REACTION WITH HCL.

39.0 TO 48.2 FT CLAYSONE: SANDY, LAMINATED TO THINLY BEDDED, DARK GREY IN COLOR, MODERATELY WEATHERED (W5), SOFT (H6), INTERMITTENT IRON OXIDE STAINING, CORE STICKS TO SAMPLER, VERY DIFFICULT TO REMOVE, SAMPLE FALLS APART UPON REMOVAL FROM SPLIT SPOON.

48.2 TO 55.0 FT SILTSTONE: LIGHT GREY IN COLOR, MODERATELY HARD (H5), SLIGHTLY WEATHERED (W3), MODERATELY BEDDED, THIN CLAYSTONE INTERBEDS, 0.2 FT THICK. NO REACTION WITH HCL.

55.0 TO 60.0 SANDSTONE; GREY IN COLOR, MODERATELY HARD (H4) TO MODERATELY SOFT (H5) SLIGHTLY WEATHERED (W3), MODERATELY TO THICKLY BEDDED, NO REACTION WITH HCL.

COMMENTS:

ALL ANGLES MEASURED FROM CORE AXIS AT ZERO DEGREES, UNLESS OTHERWISE NOTED.
THE DATA FOR THE CENTER COLUMN AND"CLASSIFICATION AND PHYSICAL CONDITIONS" COLUMN ARE BASED ON BUREAU OF RECLAMATION GEOLOGY FIELD MANUAL AND DRAWINGS TITLED FOR DESIGNS AND SPECIFICATIONS AS FOLLOWS- DRAWING NO. 40-D-6493. STANDARD DESCRIPTIONS AND DESCRIPTIVE CRITERIA FOR ROCK. DRAWING NO. 40-D-6499. STANDARD DESCRIPTORS AND DESCRIPTIVE CRITERIA FOR DISCONTINUITIES.

GEOLOGIC LOG OF DRILL HOLE NO. DHR22RT3B-15-2

SHEET 1 OF 1

FEATURE: REACH 22B
LOCATION: REGULATING TANK 3B
BEGUN: 1/29/15 FINISHED: 1/29/15
DEPTH OF WATER LEVEL:
DATE MEASURED: 1/29/2015

PROJECT: NAVAJO GALLUP WATER SUPPLY PROJECT
COORDINATES: N 1,967,531.2 E 2,721,532.8
TOTAL DEPTH: 40.7
DEPTH TO BEDROCK: 0.0

STATE: NEW MEXICO
GROUND ELEVATION: 6968.0
ANGLE FROM HORIZONTAL: 90
HOLE LOGGED BY: C. BEYER
REVIEWED BY:

NOTES

ALL MEASUREMENTS ARE FROM GROUND SURFACE AND ARE THE SAME AS THOSE USED BY THE DRILLER.

ALL MEASUREMENTS ARE REPORTED IN FEET EXCEPT WHERE NOTED.

DRILLED BY: U.C. REGION DRILL CREW; DRILLER; JEFF VAN AUSDAL, HELPERS; KYLE KILLEBREW, JOE PROCTOR.

PURPOSE:
PRECONSTRUCTION SOIL AND BEDROCK FOUNDATION INVESTIGATIONS.

DRILL EQUIPMENT:
CME 85 TRACK MOUNTED DRILL RIG

DRILL METHOD:
0.0 - 40.7 FT HQ3 WIRELINE CORING SYSTEM WITH A 3' SPLIT TUBE SAMPLER AND DIAMOND SURFACE- SET BIT.

CASING RECORD:
NONE USED

DRILLING MEDIUM:
0.0 - 40.7 FT, WATER

HOLE COMPLETION:
BACKFILLED WITH DRILL CUTTINGS AND BENTONITE.

DEPTH	% CORE RECOVERY	LABORATORY DATA: % FINES	% SAND	% GRAVEL	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT	LABORATORY CLASSIFICATION	BLOWS / 0.5 FT	GEOLOGIC UNIT SYMBOL	VISUAL CLASSIFICATION / ELEVATION
	75										
5											
	100										
10											
	80										CLAYSTONE
15											
	100										
20										Tn	
	62										
25											
	100										6939.9 SILTSTONE
30											
	100										SANDSTONE
35											6931.1
	100										CLAYSTONE
40											6927.3

BOTTOM OF HOLE

CLASSIFICATION AND PHYSICAL CONDITION

0.0 TO 40.7 TERTIARY NACIMIENTO FORMATION.

0.0 TO 28.1 FT CLAYSTONE: GREY IN COLOR, DECOMPOSED (W9) AND VERY SOFT (H7) FROM 0.0 TO 1.4 FT, INTENSELY WEATHERED (W7) AND SOFT (H6) BELOW 1.4 FT. INTERMITTENT GYPSUM VEINS, ROOTS AND IRON OXIDE STAINING. MODERATELY BEDDED, NO REACTION WITH HCL. CORE WASHED BY DRILLING, CORE DIFFICULT TO RECOVER FROM 20.7 TO 25.7 FT. CORE DIFFICULT TO REMOVE FROM SPLIT SPOON. CLASTONE BECOMES DARK GREY TO BLACK FROM 25.7 TO 28.1 FT.

28.1 TO 28.6 FT SILTSTONE: GREY IN COLOR, MODERATELY WEATHERED (W5) SOFT (H6) THINLY BEDDED, NO REACTION WITH HCL.

28.6 TO 36.9 FT SANDSTONE: GREY IN COLOR, MODERATELY WEATHERED (W5) SOFT (H6) GREY IN COLOR, FINE GRAINED, AND THILY BEDDED. BECOMES HARD (H3) SLIGHTLY WEATHERED (W3) LIGHT GREY, AND MODERATELY BEDDED, WITH GYPUSM VEINS AND ROUNDED MUDSTONE GRVEL 20MM IN DIAMATER BELOW 29.4 FT.

36.9 TO 40.7 FT CLAYSTONE: MODERATELY WEATHERED (W5) AND SOFT (H6) DARK GREY TO BLACK IN COLOR, INTERMITTENT GYPSUM VEINS, AND IRON OXIDE STAINING, MODERATELY BEDDED, NO REACTION WITH HCL, CORE DIFFIULT TO REMOVE FROM SPLIT SPOON.

STRATIGRAPY:
0.0 - 40.7 FT TERTIARY NACIMIENTO FORMATION

COMMENTS:

ALL ANGLES MEASURED FROM CORE AXIS AT ZERO DEGREES, UNLESS OTHERWISE NOTED.
THE DATA FOR THE CENTER COLUMN AND"CLASSIFICATION AND PHYSICAL CONDITIONS" COLUMN ARE BASED ON BUREAU OF RECLAMATION GEOLOGY FIELD MANUAL AND DRAWINGS TITLED FOR DESIGNS AND SPECIFICATIONS AS FOLLOWS- DRAWING NO. 40-D-6493. STANDARD DESCRIPTIONS AND DESCRIPTIVE CRITERIA FOR ROCK. DRAWING NO. 40-D-6499. STANDARD DESCRIPTORS AND DESCRIPTIVE CRITERIA FOR DISCONTINUITIES.

GEOLOGIC LOG OF DRILL HOLE NO. DHR22RT3B-15-3

SHEET 1 OF 1

FEATURE: REACH 22B
LOCATION: REGULATING TANK 3B
BEGUN: 3/14/15 FINISHED: 3/14/15
DEPTH OF WATER LEVEL:
DATE MEASURED: 3/14/2015

PROJECT: NAVAJO GALLUP WATER SUPPLY PROJECT
COORDINATES: N 1,967,549.0 E 2,721,527.8
TOTAL DEPTH: 7.3
DEPTH TO BEDROCK: 0.0

STATE: NEW MEXICO
GROUND ELEVATION: 6967.8
ANGLE FROM HORIZONTAL: 90
HOLE LOGGED BY: C. BEYER
REVIEWED BY:

NOTES

ALL MEASUREMENTS ARE FROM GROUND SURFACE AND ARE THE SAME AS THOSE USED BY THE DRILLER.

ALL MEASUREMENTS ARE REPORTED IN FEET EXCEPT WHERE NOTED.

DRILLED BY: U.C. REGION DRILL CREW; DRILLER; JEFF VAN AUSDAL, HELPERS; KYLE KILLEBREW, STEVE COCHRAN.

PURPOSE:
PRECONSTRUCTION SOIL AND BEDROCK FOUNDATION INVESTIGATIONS.

DRILL EQUIPMENT:
CME 85 TRACK MOUNTED DRILL RIG

DRILL METHOD:
0.0 - 7.3 4 1/4 INCH HOLLOW STEM AUGER WIH CALIFONIA SAMPLER, REACHED AUGER REFUSAL AT 7.3 FT.
DID NOT CONTINUE WITH CORING SETUP BECAUSE OF CULTURAL RESOURCE COMPLIANCE.

CASING RECORD:
NONE USED

DRILLING MEDIUM:
0.0 - 7.3 FT NONE USED

HOLE COMPLETION:
BACKFILLED WITH DRILL CUTTINGS AND BENTONITE.

DEPTH	% CORE RECOVERY	LABORATORY DATA: % FINES	% SAND	% GRAVEL	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT	LABORATORY CLASSIFICATION	BLOWS / 0.5 FT	GEOLOGIC UNIT SYMBOL	VISUAL CLASSIFICATION / ELEVATION
									12/24		
										Tn	Clst
									27/40		
5									50/REFUSAL		
											6960.5

BOTTOM OF HOLE

CLASSIFICATION AND PHYSICAL CONDITION

0.0 TO 7.3 FT TERTIARY NACIMIENTO FORMATION.

0.0 TO 7.3 FT CLAYSTONE: GREY IN COLOR, DECOMPOSED (W9) AND VERY SOFT (H7) FROM 0.0 TO 1.5 FT, BECOMING INTENSELY WEATHERED (W7) AND SOFT (H6) BELOW, NO REACTION WITH HCL. DIFFICULT AUGERING BELOW 5.0 FT, REACHED AUGER REFUSAL AT 7.3 FT. DID NOT CORE FOR CULTURAL RESOURCE COMPLINANCE. DISCONTINUED HOLE.

STRATIGRAPY:
0.0 - 7.3 FT TERTIARY NACIMIENTO FORMATION

COMMENTS:

ALL ANGLES MEASURED FROM CORE AXIS AT ZERO DEGREES, UNLESS OTHERWISE NOTED.
THE DATA FOR THE CENTER COLUMN AND"CLASSIFICATION AND PHYSICAL CONDITIONS" COLUMN ARE BASED ON BUREAU OF RECLAMATION GEOLOGY FIELD MANUAL AND DRAWINGS TITLED FOR DESIGNS AND SPECIFICATIONS AS FOLLOWS- DRAWING NO. 40-D-6493. STANDARD DESCRIPTIONS AND DESCRIPTIVE CRITERIA FOR ROCK. DRAWING NO. 40-D-6499. STANDARD DESCRIPTORS AND DESCRIPTIVE CRITERIA FOR DISCONTINUITIES.

GEOLOGIC LOG OF DRILL HOLE NO. DHR22RT3B-15-4

SHEET 1 OF 1

FEATURE: REACH 22B
LOCATION: REGULATING TANK 3B
BEGUN: 1/29/15 FINISHED: 3/11/15
DEPTH OF WATER LEVEL:
DATE MEASURED: 1/29/2015

PROJECT: NAVAJO GALLUP WATER SUPPLY PROJECT
COORDINATES: N 1,967,514.7 E 2,721,526.9
TOTAL DEPTH: 40.3
DEPTH TO BEDROCK: 0.0

STATE: NEW MEXICO
GROUND ELEVATION: 6967.7
ANGLE FROM HORIZONTAL: 90
HOLE LOGGED BY: C. BEYER
REVIEWED BY:

NOTES

ALL MEASUREMENTS ARE FROM GROUND SURFACE AND ARE THE SAME AS THOSE USED BY THE DRILLER.

ALL MEASUREMENTS ARE REPORTED IN FEET EXCEPT WHERE NOTED.

DRILLED BY: U.C. REGION DRILL CREW; DRILLER; JEFF VAN AUSDAL, HELPERS; KYLE KILLEBREW, JOE PROCTOR.

PURPOSE:
PRECONSTRUCTION SOIL AND BEDROCK FOUNDATION INVESTIGATIONS.

DRILL EQUIPMENT:
CME 85 TRACK MOUNTED DRILL RIG

DRILL METHOD:
0.0 - 40.3 FT HQ3 WIRELINE CORING SYSTEM WITH A 3' SPLIT TUBE SAMPLER AND DIAMOND SURFACE- SET BIT.

NOTES:
DISCONTINUED DRILLING AT 20.3 FT AT END OF DAY. SNOWSTORM MOVED IN OVER NIGHT, SNOWED 1.5 FT CREATING DIFFICULT ACCES TO SITE. CAME BACK ON 3/11/2015 AND FINISHED HOLE.

CASING RECORD:
NONE USED

DRILLING MEDIUM:
0.0 - 40.3 FT, WATER

HOLE COMPLETION:
BACKFILLED WITH DRILL CUTTINGS AND BENTONITE.

DEPTH	% CORE RECOVERY	LABORATORY DATA: % FINES	% SAND	% GRAVEL	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT	LABORATORY CLASSIFICATION	BLOWS / 0.5 FT	GEOLOGIC UNIT SYMBOL	VISUAL CLASSIFICATION / ELEVATION
	77										
5											
	94										
10											
	100										
15											CLST
	90										
20										Tn	
25											
											6938.3 SLTS 6936.0
30											
											SS
											6934.2 CLST 6933.5 SS 6933.1
35											SLTS 6931.4
											CLST
40											6927.4

BOTTOM OF HOLE

CLASSIFICATION AND PHYSICAL CONDITION

0.0 TO 40.3 FT TERTIARY NACIMIENTO FORMATION.

0.0 TO 29.4 FT CLAYSTONE: GREY IN COLOR, DECOMPOSED (W9) AND VERY SOFT (H7) FROM 0.0 TO 1.5 FT, INTENSELY WEATHERED (W7) AND SOFT (H6) BELOW 1.4 FT. INTERMITTENT GYPSUM VEINS, ROOTS AND IRON OXIDE STAINING. THINLY TO MODERATELY BEDDED, NO REACTION WITH HCL. CORE WASHED BY DRILLING, CORE DIFFICULT TO REMOVE FROM SPLIT SPOON.

JOINT MEASUREMENTS:

DEPTH	INCL	R	M	T	HL	INFILLING
17.2	20	5	1	3		IRON OXIDE
19.5	20	5	1	3		IRON OXIDE
20.0	60	5	1	3		IRON OXIDE
20.6	30	5	1	3		IRON OXIDE
21.1	30	5	1	3		IRON OXIDE
22.3	30	5	1	3		IRON OXIDE

29.4 TO 29.7 SILTSTONE: GREY, MODERATELY SOFT (H5), MODERATELY TO SLIGHTLY WEATHERED (W4), NO REACTION WITH HCL.

29.7 TO 33.5 SANDSTONE: GREY TO TAN IN COLOR SOFT (H6) MODERATELY TO SLIGHTLY WEATHERED (W4), FINE GRAINED, THINLY BEDDED, NO REACTION WITH HCL, CORE WASHED BY DRILL.

33.5 TO 34.2 FT CLAYSTONE: GREY IN COLOR, INTENSELY WEATHERED (W7), SOFT (H6) INTERMITTENT GYPSUM VEINS, AND IRON OXIDE STAINING. THINLY TO MODERATELY BEDDED, NO REACTION WITH HCL. CORE WASHED BY DRILLING, CORE DIFFICULT TO REMOVE FROM SPLIT SPOON.

34.2 TO 34.6 SANDSTONE: GREY TO TAN IN COLOR SOFT (H6) MODERATELY TO SLIGHTLY WEATHERED (W4), FINE GRAINED, THINLY BEDDED, NO REACTION WITH HCL.

34.6 TO 36.3 SILTSTONE: MODERATELY HARD (H4), SLIGHTLY WEATHERED TO FRESH (W2), GREY IN COLOR, NO REACTION WITH HCL.

36.3 TO 40.3 FT CLAYSTONE: GREY IN COLOR, MODERATELY WEATHERED (W5), SOFT (H6) INTERMITTENT AND IRON OXIDE STAINING. THINLY BEDDED, NO REACTION WITH HCL. CORE DIFFICULT TO REMOVE FROM SPLIT SPOON.

STRATIGRAPY:
0.0 - 40.3 FT TERTIARY NACIMIENTO FORMATION

COMMENTS:

ALL ANGLES MEASURED FROM CORE AXIS AT ZERO DEGREES, UNLESS OTHERWISE NOTED.
THE DATA FOR THE CENTER COLUMN AND"CLASSIFICATION AND PHYSICAL CONDITIONS" COLUMN ARE BASED ON BUREAU OF RECLAMATION GEOLOGY FIELD MANUAL AND DRAWINGS TITLED FOR DESIGNS AND SPECIFICATIONS AS FOLLOWS- DRAWING NO. 40-D-6493. STANDARD DESCRIPTIONS AND DESCRIPTIVE CRITERIA FOR ROCK. DRAWING NO. 40-D-6499. STANDARD DESCRIPTORS AND DESCRIPTIVE CRITERIA FOR DISCONTINUITIES.

7-1336-A (1-86)
Bureau of Reclamation

LOG OF TEST-PIT/HAND-AUGER NO. TPR21-14-A

SHEET 1 OF 1

FEATURE: Reach 22
PROJECT: Navajo Gallup Water Supply Project
LOCATION: REACH 21 WATER TREATMENT PLANT
GROUND ELEVATION: 6634.6
COORDINATES: N 1,968,369 E 2,734,955
METHOD OF EXPLORATION: CASE 580N BACKHOE
APPROXIMATE DIMENSIONS: 12'x14'x12.1'
LOGGED BY: J. GILBERT
DEPTH TO WATER: NE DATE: 10/14/2014
DATE EXCAVATED: 10/14/2014

DEPTH	CLASSIFICATION GROUP SYMBOL	CLASSIFICATION AND DESCRIPTION OF MATERIAL (SEE USBR 5000, 5005)	% PLUS 3 in (BY VOLUME) 3 - 5 in	5 - 12 in	PLUS 12 in
1	SC	0.0 - 4.2 FT CLAYEY SAND (SC): About 60% fine sand; about 40% fines with low plasticity, no dilatancy, medium dry strength, medium toughness; maximum size, fine sand; no reaction with HCl.			
2	Density taken at 6.0 ft.	IN-PLACE CONDITION: dry, dark brown in color, homogeneous, root casts present.			
		GEOLOGIC INTERPRETATION: Quaternary Alluvium (Qal)			
3		4.2 - 6.2 FT SILTY SAND (SM): About 85% fine to medium sand; about 15% non plastic fines, rapid dilatency, no dry strength, no toughness; maximum size, medium sand; no reaction with HCl.			
4	4.2 ft (6630.4)	IN-PLACE CONDITION: dry, tan in color, homogeneous.			
5	SM (visual) SC (lab class)	IN-PLACE UNIT WEIGHT AND MOISTURE FROM 6.0 ft. Total: 105.4 lbs. / cu ft., 4.6%. (101.0% compaction) LAB TEST DATA: 51.9 % sand, 48.1 % fines, LL=25.3%, PI=8.1%, SPG=2.70 Maximum dry density =104.4 lbs. / cu ft., optimum water content = 12.2% Laboratory classification CLAYEY SAND (SC).			
6	6.2 ft (6628.4)				
	SC	GEOLOGIC INTERPRETATION: Quaternary Alluvium (Qal)			
7		6.2 - 11.0 FT CLAYEY SAND (SC): About 60% fine sand; about 40% fines with low plasticity, no dilatancy, medium dry strength, medium toughness; maximum size, fine sand; no reaction with HCl			
8	Corrosion samples taken at 10.0 ft	IN-PLACE CONDITION: dry, tan in color, homogeneous.			
9		GEOLOGIC INTERPRETATION: Quaternary Alluvium (Qal)			
10		11.0 - 12.1 FT LEAN CLAY (CL): About 80% fines with medium plasticity, high dry strength, medium toughness; about 20% fine sand; maximum size, fine sand; no reaction with HCl.			
11	11.0 ft (6623.6)	IN-PLACE CONDITION: dry, brown in color, homogeneous.			
	CL	GEOLOGIC INTERPRETATION: Quaternary Alluvium (Qal)			
12	12.1 ft (6622.5)				

COMMENTS: SURFACE VEGETATED WITH SAGE BRUSH AND GRASS. DISCONTINUED EXCAVATION DUE TO LIMIT OF EQUIPMENT.
ABBREVIATION
NE= NOT ENCOUNTERED.

7-1336-A (1-86)
Bureau of Reclamation

LOG OF TEST-PIT/HAND-AUGER NO. TPR21-14-B

SHEET 1 OF 1

FEATURE: Reach 22
PROJECT: Navajo Gallup Water Supply Project
LOCATION: WATER TREATMENT PLANT
GROUND ELEVATION: 6639.5
COORDINATES: N 1,968,234 E 2,734,589
METHOD OF EXPLORATION: CASE 580N BACKHOE
APPROXIMATE DIMENSIONS: 12'x14'x14.8'
LOGGED BY: J. GILBERT
DEPTH TO WATER: NE DATE: 10/14/2014
DATE EXCAVATED: 10/14/2014

DEPTH	CLASSIFICATION GROUP SYMBOL	CLASSIFICATION AND DESCRIPTION OF MATERIAL (SEE USBR 5000, 5005)	% PLUS 3 in (BY VOLUME) 3 - 5 in	5 - 12 in	PLUS 12 in
1, 2, 3	SC Density taken at 6.0 ft. 3.5 ft (6636.0)	0.0 - 3.5 FT CLAYEY SAND (SC): About 60% fine sand; about 40% fines with low plasticity, no dilatancy, medium dry strength, medium toughness; maximum size, fine sand; no reaction with HCl. IN-PLACE CONDITION: dry, dark brown in color, homogeneous, root casts present. GEOLOGIC INTERPRETATION: Quaternary Alluvium (Qal)			
4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14	SM (visual) SP-SM (lab class) Corrosion samples taken at 10.0 ft 14.8 ft (6624.7)	3.5 -14.8 FT SILTY SAND (SM): About 80% fine to medium sand; about 20% non plastic fines, rapid dilatency, no dry strength, no toughness; maximum size, medium sand; lense of caliche 13.5' to 14.2'; no reaction with HCl. IN-PLACE CONDITION: dry, tan in color, homogeneous. IN-PLACE UNIT WEIGHT AND MOISTURE FROM 6.0 ft. Total: 96.7 lbs. / cu ft., 2.5%. (92.6% relative compaction) LAB TEST DATA: 89.8 % sand, 10.2 % fines, LL=NA, PI=NP, SPG=2.66 Maximum dry density =104.4 lbs. / cu ft., optimum water content = NA Laboratory classification POORLY GRADED SAND WITH SILT (SP-SM). GEOLOGIC INTERPRETATION: Quaternary Alluvium (Qal)			

COMMENTS: SURFACE VEGETATION CONSISTS OF SAGEBRUSH. DISCONTINUED HOLE DUE TO THE LIMIT OF THE EQUIPMENT.
ABBREVIATION
NE= NOT ENCOUNTERED.

7-1336-A (1-86)
Bureau of Reclamation

LOG OF TEST-PIT/HAND-AUGER NO. TPR21-14-C

SHEET 1 OF 1

FEATURE: Reach 22
PROJECT: Navajo Gallup Water Supply Project
LOCATION: REACH 21 WATER TREATMENT PLANT
GROUND ELEVATION: 6635.6
COORDINATES: N 1,968,234 E 2,734,777
METHOD OF EXPLORATION: CASE 580N BACKHOE
APPROXIMATE DIMENSIONS: 12'x14'x14'
LOGGED BY: J. GILBERT
DEPTH TO WATER: NE DATE: 7/31/2014
DATE EXCAVATED: 7/31/2014

DEPTH	CLASSIFICATION GROUP SYMBOL	CLASSIFICATION AND DESCRIPTION OF MATERIAL (SEE USBR 5000, 5005)	% PLUS 3 in (BY VOLUME) 3 - 5 in	5 - 12 in	PLUS 12 in
1 2 3 4 5 6 7 8 9 10 11 12 13 14	SM Density taken at 6.0 ft, Corrosion samples taken at 10.0 ft 14.0 ft (6621.6)	0.0 to 14.0 ft SILTY SAND (SM): About 80% fine sand; about 20% nonplastic fines with rapid dilatancy, no dry strength; maximum size, fine sand; no reaction with HCl. IN-PLACE CONDITION: Tan in color, dry, homogeneous. IN-PLACE UNIT WEIGHT AND MOISTURE FROM 6.0 ft. Total: 103.8 lbs. / cu ft., 4.3%. (92.3% compaction) LAB TEST DATA: 80.4 % sand, 19.6 % fines, LL=N/A, PI=NP, SPG=2.63 Maximum dry density = 112.5 lbs. / cu ft., optimum water content = 12.5% Laboratory classification SILTY SAND (SM). GEOLOGIC INTERPRETATION: Quaternary Alluvium (Qal)			

COMMENTS: SURFACE VEGETATED WITH SAGE BRUSH AND GRASS. DISCONTINUED EXCAVATION DUE TO LIMIT OF EQUIPMENT.
ABBREVIATION
NE= NOT ENCOUNTERED.

7-1336-A (1-86)
Bureau of Reclamation

LOG OF TEST-PIT/HAND-AUGER NO. TPR21-14-D

SHEET 1 OF 1

FEATURE: Reach 22
PROJECT: Navajo Gallup Water Supply Project
LOCATION: WATER TREATMENT PLANT
GROUND ELEVATION: 6632.0
COORDINATES: N 1,968,430 E 2,734,819
METHOD OF EXPLORATION: CASE 580N BACKHOE
APPROXIMATE DIMENSIONS: 12'x16'x14.2'
LOGGED BY: J. GILBERT
DEPTH TO WATER: NE DATE: 10/14/2014
DATE EXCAVATED: 10/14/2014

DEPTH	CLASSIFICATION GROUP SYMBOL	CLASSIFICATION AND DESCRIPTION OF MATERIAL (SEE USBR 5000, 5005)	% PLUS 3 in (BY VOLUME) 3 - 5 in	5 - 12 in	PLUS 12 in
1 2 3 4	SM	0.0 to 4.8 ft SILTY SAND (SM): About 80% fine sand; about 20% nonplastic fines with rapid dilatancy, no dry strength; maximum size, fine sand; no reaction with HCl. IN-PLACE CONDITION: Tan in color, dry, homogeneous. GEOLOGIC INTERPRETATION: Quaternary Alluvium (Qal) 4.8 to 14.2 FT POORLY GRADED SAND WITH SILT (SP-SM): About 90% fine sand; about 10% nonplastic fines with slow dilatancy, low dry strength; maximum size, fine sand; no reaction with HCl.			
4.8 ft (6627.2)		IN-PLACE CONDITION: tan in color, homogenous.			
5 6 7 8 9 10 11 12 13	SP-SM (visual) SM (lab class) Density taken at 6.0 ft. Corrosion samples taken at 10.0 ft.	IN-PLACE UNIT WEIGHT AND MOISTURE FROM 6.0 ft. Total: 77.8 lbs. / cu ft., 3.0%. (64.8% compaction) LAB TEST DATA: 77.3 % sand, 14.7 % fines, 8.0% gravels, LL=NA, PI=NP, SPG=2.64 Maximum dry density =120.0 lbs. / cu ft., optimum water content = 11.2% Laboratory classification SILTY SAND (SM). GEOLOGIC INTERPRETATION: Quaternary Alluvium (Qal)			
14	14.2 ft (6617.8)				

COMMENTS: SURFACE VEGETATED WITH SAGE BRUSH AND GRASS. DISCONTINUED EXCAVATION DUE TO LIMIT OF EQUIPMENT.
ABBREVIATION
NE= NOT ENCOUNTERED.

7-1336-A (1-86)
Bureau of Reclamation

LOG OF TEST-PIT/HAND-AUGER NO. TPR21-14-E

SHEET 1 OF 1

FEATURE: Reach 22
PROJECT: Navajo Gallup Water Supply Project
LOCATION: REACH 21 WATER TREATMENT PLANT
GROUND ELEVATION: 6635.7
COORDINATES: N 1,968,598 E 2,734,725
METHOD OF EXPLORATION: CASE 580N BACKHOE
APPROXIMATE DIMENSIONS: 12'x14'x13'
LOGGED BY: J. GILBERT
DEPTH TO WATER: NE DATE: 7/31/2014
DATE EXCAVATED: 7/31/2014

DEPTH	CLASSIFICATION GROUP SYMBOL	CLASSIFICATION AND DESCRIPTION OF MATERIAL (SEE USBR 5000, 5005)	% PLUS 3 in (BY VOLUME) 3 - 5 in	5 - 12 in	PLUS 12 in
1	SM (visual) SP-SM (lab class.)	0.0 to 13.0 ft SILTY SAND (SM): About 85% fine sand; about 15% nonplastic fines with rapid dilatancy, no dry strength; maximum size, fine sand; no reaction with HCl. IN-PLACE CONDITION: Tan in color, dry, homogeneous, root casts present. IN-PLACE UNIT WEIGHT AND MOISTURE FROM 6.0 ft. Total: 99.8 lbs. / cu ft., 1.9%. (97.7% compaction) LAB TEST DATA: 94.8 % sand, 5.2 % fines, LL=N/A, PI=NP, SPG=2.65 Maximum dry density =102.2 lbs. / cu ft., optimum water content = 15.0% Laboratory classification POORLY GRADED SAND WITH SILT (SP-SM). GEOLOGIC INTERPRETATION: Quaternary Alluvium (Qal)			
2					
3					
4					
5					
6	Density taken at 6.0 ft. Corrosion samples taken at 10.0 ft.				
7					
8					
9					
10					
11					
12					
13	13.0 ft (6622.7)				

COMMENTS: SURFACE VEGETATED WITH SAGE BRUSH AND GRASS. DISCONTINUED EXCAVATION DUE TO LIMIT OF EQUIPMENT.
ABBREVIATION
NE= NOT ENCOUNTERED.

7-1336-A (1-86)
Bureau of Reclamation

LOG OF TEST-PIT/HAND-AUGER NO. TPR21-14-F

SHEET 1 OF 1

FEATURE: Reach 22
PROJECT: Navajo Gallup Water Supply Project
LOCATION: WATER TREATMENT PLANT
GROUND ELEVATION: 6635.7
COORDINATES: N 1,968,594 E 2,734,558
METHOD OF EXPLORATION: CASE 580N BACKHOE
APPROXIMATE DIMENSIONS: 12'x15'x14.9'
LOGGED BY: J. GILBERT
DEPTH TO WATER: NE DATE: 10/15/2014
DATE EXCAVATED: 10/15/2014

DEPTH	CLASSIFICATION GROUP SYMBOL	CLASSIFICATION AND DESCRIPTION OF MATERIAL (SEE USBR 5000, 5005)	% PLUS 3 in (BY VOLUME) 3 - 5 in	5 - 12 in	PLUS 12 in
1, 2, 3, 4, 5, 6, 7, 8, 9, 10	SM Density taken at 6.0 ft. Corrosion samples taken at 10.0 ft. 10.5 ft (6625.2)	0.0 to 10.5 ft SILTY SAND (SM): About 80% fine sand; about 20% nonplastic fines with rapid dilatancy, no dry strength; maximum size, fine sand; no reaction with HCl. IN-PLACE CONDITION: Tan in color, dry, homogeneous. IN-PLACE UNIT WEIGHT AND MOISTURE FROM 6.0 ft. Total: 100.1 lbs. / cu ft., 2.1%. (90.3% relative compaction) LAB TEST DATA: 84.9% sand, 15.1 % fines, 0% gravels, LL=N/A, PI=NP, SPG=2.64 Maximum dry density =110.9 lbs. / cu ft., optimum water content = N/A Laboratory classification SILTY SAND (SM). GEOLOGIC INTERPRETATION: Quaternary Alluvium (Qal)			
11, 12, 13, 14	SP-SM 14.9 ft (6620.8)	10.5 to 14.9 FT POORLY GRADED SAND WITH SILT (SP-SM): About 90% fine sand; about 10% nonplastic fines with slow dilatancy, low dry strength; maximum size, fine sand; no reaction with HCl. IN-PLACE CONDITION: tan in color, homogeneous. GEOLOGIC INTERPRETATION: Quaternary Alluvium (Qal)			

COMMENTS: SURFACE VEGETATION CONSISTS OF SAGE BRUSH AND GRASSES. DISCONTINUED HOLE DUE TO LIMIT OF EQUIPMENT. NE = NOT ENCOUNTERED

7-1336-A (1-86)
Bureau of Reclamation

LOG OF TEST-PIT/HAND-AUGER NO. TPR21-14-G

SHEET 1 OF 1

FEATURE: Reach 22
PROJECT: Navajo Gallup Water Supply Project
LOCATION: WATER TREATMENT PLANT
GROUND ELEVATION: 6629.9
COORDINATES: N 1,968,440 E 2,735,069
METHOD OF EXPLORATION: CASE 580N BACKHOE
APPROXIMATE DIMENSIONS: 12'x14'x14.9'
LOGGED BY: J. GILBERT
DEPTH TO WATER: NE DATE: 10/14/2014
DATE EXCAVATED: 10/14/2014

DEPTH	CLASSIFICATION GROUP SYMBOL	CLASSIFICATION AND DESCRIPTION OF MATERIAL (SEE USBR 5000, 5005)	% PLUS 3 in (BY VOLUME) 3 - 5 in	5 - 12 in	PLUS 12 in
1 2 3 4 5 6 7 8 9 10 11 12 13 14	SM (visual) SP-SM (lab class)	0.0 to 14.9 ft SILTY SAND (SM): About 80% fine sand; about 20% nonplastic fines with rapid dilatancy, no dry strength; maximum size, fine sand; no reaction with HCl. IN-PLACE CONDITION: Tan in color, dry, homogeneous, root casts present. IN-PLACE UNIT WEIGHT AND MOISTURE FROM 6.0 ft. Total: 112.2 lbs. / cu ft., 2.3%. (96.9% compaction) LAB TEST DATA: 84.8 % sand, 11.6% fines, gravel, 3.6%, LL=N/A, PI=NP, SPG=2.63 Maximum dry density =115.8 lbs. / cu ft., optimum water content = 12.5% Laboratory classification POORLY GRADED SAND WITH SILT (SP-SM). GEOLOGIC INTERPRETATION: Quaternary Alluvium (Qal)			
	Density taken at 6.0 ft. Corrosion samples taken at 10.0 ft.				
	14.9 ft (6615.0)				

COMMENTS: SURFACE VEGETATION CONSISTS OF SAGE BRUSH AND GRASSES. DISCONTINUED HOLE DUE TO LIMIT OF EQUIPMENT.
ABBREVIATION
NE= NOT ENCOUNTERED.

7-1336-A (1-86)
Bureau of Reclamation

LOG OF TEST-PIT/HAND-AUGER NO. TPR22B-14-131

SHEET 1 OF 1

FEATURE: Reach 22B
PROJECT: Navajo Gallup Water Supply Project
LOCATION: PIPELINE
GROUND ELEVATION: 6706.4
COORDINATES: N 1,967,721 E 2,730,794
METHOD OF EXPLORATION: CASE 580N BACKHOE
APPROXIMATE DIMENSIONS: 6.0' x 10.0' x 14.0'
LOGGED BY: J. GILBERT
DEPTH TO WATER: NE DATE:
DATE EXCAVATED: 7/29/2014

DEPTH	CLASSIFICATION GROUP SYMBOL	CLASSIFICATION AND DESCRIPTION OF MATERIAL (SEE USBR 5000, 5005)	% PLUS 3 in (BY VOLUME) 3 - 5 in	5 - 12 in	PLUS 12 in
	SM (visual)	0.0 to 0.7 ft SILTY SAND: About 80% fine sand; about 20% nonplastic fines with slow dilatancy, low dry strength; maximum size, fine sand; no reaction with HCl.			
0.7 ft (6705.7)					
1	s(CL) (visual) SM (lab class)	IN-PLACE CONDITION: Tan in color, dry			
2					
		GEOLOGIC INTERPRETATION: Quaternary Alluvium (Qal)			
3	In-Place Density taken at 6.0 ft.	0.7 to 6.5 ft SANDY LEAN CLAY: About 65% fines with medium to high plasticity, medium toughness, medium to high dry strength; about 35% fine sand; maximum size, fine sand; no reaction with HCL			
4		IN-PLACE CONDITION: Tan in color, moist			
5		IN-PLACE UNIT WEIGHT AND MOISTURE FROM 6.0 ft. Total: 100.7 lbs. / cu ft., 3.0%. (91.3% compaction) LAB TEST DATA: 82.8 % sand, 17.2 % fines, LL= N/A, PI= NP, SPG= 2.67 Maximum dry density =110.3 lbs. / cu ft., optimum water content = 13.4% Laboratory classification is SILTY SAND			
6					
6.5 ft (6699.9)					
7	SM				
		GEOLOGIC INTERPRETATION: Quaternary Alluvium (Qal)			
8		6.5 to 14.0 ft SILTY SAND: About 80% fine sand; about 20% nonplastic fines with slow dilatancy, low dry strength; maximum size, fine sand; no reaction with HCl.			
9		IN-PLACE CONDITION: Tan in color, dry.			
10	Corrosion samples taken at 10.0 ft.	GEOLOGIC INTERPRETATION: Quaternary Alluvium (Qal)			
11					
12					
13					
14.0 ft (6692.4)					
14					

COMMENTS: SURFACE VEGETATED WITH SAGE BRUSH, DISCONTINUED AT 14.0 FEET DUE TO LIMIT OF EQUIPMENT.

7-1336-A (1-86)
Bureau of Reclamation

LOG OF TEST-PIT/HAND-AUGER NO. TPR22B-14-132

SHEET 1 OF 1

FEATURE: Reach 22B
PROJECT: Navajo Gallup Water Supply Project
LOCATION: PIPELINE
GROUND ELEVATION: 6727.8
COORDINATES: N 1,967,627 E 2,729,657
METHOD OF EXPLORATION: CASE 580N BACKHOE
APPROXIMATE DIMENSIONS: 6.0' x 10.0' x 16.0'
LOGGED BY: J. GILBERT
DEPTH TO WATER: NE DATE:
DATE EXCAVATED: 7/29/2014

DEPTH	CLASSIFICATION GROUP SYMBOL	CLASSIFICATION AND DESCRIPTION OF MATERIAL (SEE USBR 5000, 5005)	% PLUS 3 in (BY VOLUME) 3 - 5 in	5 - 12 in	PLUS 12 in
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16	SP-SM (visual) SM (lab class)	0.0 to 16.0 ft POORLY GRADED SAND WITH SILT: About 90% fine sand; about 10% nonplastic fines with rapid dilatancy, no dry strength; maximum size, fine sand; weak reaction with HCl. IN-PLACE CONDITION: Tan in color, dry. IN-PLACE UNIT WEIGHT AND MOISTURE FROM 6.0 ft. Total: 96.2 lbs. / cu ft. 3.0% (84.5% compaction) LAB TEST DATA: 80.8 % sand, 19.2 % fines, LL= NA, PI= NP, SPG= 2.64 Maximum dry density =113.8 lbs. / cu ft., optimum water content = 11.8% Laboratory classification is SILTY SAND GEOLOGIC INTERPRETATION: Quaternary Alluvium (Qal)			
	Density taken at 6.0 ft, Corrosion samples taken at 10.0 ft.				
	16.0 ft (6711.8)				

COMMENTS: SURFACE VEGETATED WITH SAGE BRUSH, DISCONTINUED AT 16.0 FEET DUE TO LIMIT OF EQUIPMENT.

7-1336-A (1-86)
Bureau of Reclamation

LOG OF TEST-PIT/HAND-AUGER NO. TPR22B-14-134

SHEET 1 OF 1

FEATURE: Reach 22B
PROJECT: Navajo Gallup Water Supply Project
LOCATION: PIPELINE
GROUND ELEVATION: 6785.1
COORDINATES: N 1,967,484 E 2,727,251
METHOD OF EXPLORATION: CASE 580N BACKHOE
APPROXIMATE DIMENSIONS: 6.0' x 10.0' x 10.0'
LOGGED BY: J. GILBERT
DEPTH TO WATER: DATE:
DATE EXCAVATED: 7/29/2014

DEPTH	CLASSIFICATION GROUP SYMBOL	CLASSIFICATION AND DESCRIPTION OF MATERIAL (SEE USBR 5000, 5005)	% PLUS 3 in (BY VOLUME) 3 - 5 in	5 - 12 in	PLUS 12 in
1 2 3 4	SM	0.0 to 5.0 ft SILTY SAND: About 80% fine sand; about 20% nonplastic fines with rapid dilatancy, no dry strength; no reaction with HCl. IN-PLACE CONDITION: Tan to brown in color. GEOLOGIC INTERPRETATION: Quaternary Alluvium (Qal)			
5	5.0 ft (6780.1)				
6 7 8 9	s(CL) (visual) SC (lab class) In-Place Density taken at 6.0 ft. Corrosion samples taken at 10.0 ft.	5.0 to 10.0 ft SANDY LEAN CLAY: About 55% fines with medium to high plasticity, high toughness, medium to high dry strength; about 45% fine sand; maximum size, fine sand; no reaction with HCL IN-PLACE CONDITION: Tan in color, moist. IN-PLACE UNIT WEIGHT AND MOISTURE FROM 6.0 ft. Total: 108.1 lbs. / cu ft. 6.5% (93.4% compaction) LAB TEST DATA: 61.0 % sand, 39.0 % fines, LL= 25.0, PI= 9.7, SPG= NA Maximum dry density =115.7 lbs. / cu ft., optimum water content = 12.8% Laboratory classification is CLAYEY SAND GEOLOGIC INTERPRETATION: Quaternary Alluvium (Qal)			
10	10.0 ft (6775.1)				

COMMENTS: SURFACE VEGETATED WITH SAGE BRUSH, DISCONTINUED AT 10.0 FEET DUE TO LIMIT OF EQUIPMENT.

7-1336-A (1-86)
Bureau of Reclamation

LOG OF TEST-PIT/HAND-AUGER NO. TPR22B-14-135

SHEET 1 OF 1

FEATURE: Reach 22B
PROJECT: Navajo Gallup Water Supply Project
LOCATION: PIPELINE
GROUND ELEVATION: 6812.1
COORDINATES: N 1,967,307 E 2,726,000
METHOD OF EXPLORATION: CASE 580N BACKHOE
APPROXIMATE DIMENSIONS: 12'x14'x14.2'
LOGGED BY: J. GILBERT
DEPTH TO WATER: NE DATE:
DATE EXCAVATED: 7/29/2014

DEPTH	CLASSIFICATION GROUP SYMBOL	CLASSIFICATION AND DESCRIPTION OF MATERIAL (SEE USBR 5000, 5005)	% PLUS 3 in (BY VOLUME) 3 - 5 in	5 - 12 in	PLUS 12 in
1 2 3 4 5 6 7 8 9	SM In-Place Density taken at 6.0 ft. 9.5 ft (6802.6)	0.0 to 9.5 ft SILTY SAND: About 80% fine sand; about 20% nonplastic fines with rapid dilatancy, no dry strength; trace of coarse gravel, max size 60 mm; no reaction with HCl. IN-PLACE CONDITION: Tan to brown in color. IN-PLACE UNIT WEIGHT AND MOISTURE FROM 6.0 ft. Total: 93.0 lbs. / cu ft., 4.1%. (78.5% compaction) LAB TEST DATA: 60.8 % sand, 39.1 % fines, 0.1% gravel, LL= N/A, PI= NP, SPG= 2.63 Maximum dry density = 118.5 lbs. / cu ft., optimum water content = 11.5% Laboratory classification is SILTY SAND GEOLOGIC INTERPRETATION: Quaternary Alluvium (Qal)	t		
10 11 12 13 14	s(CL) Corrosion samples taken at 10.0 ft. 14.2 ft (6797.9)	9.5 to 14.2 SANDY LEAN CLAY: About 55% fines with medium to high plasticity, high toughness, medium to high dry strength; about 45% fine sand; maximum size, fine sand; no reaction with HCL. IN-PLACE CONDITION: Tan in color, moist GEOLOGIC INTERPRETATION: Quaternary Alluvium (Qal)			

COMMENTS: SURFACE VEGETATED WITH SAGE BRUSH AND PRICKLY PEAR CACTUS. DISCONTINUED EXCAVATION DUE TO LIMIT OF EQUIPMENT.

7-1336-A (1-86)
Bureau of Reclamation

LOG OF TEST-PIT/HAND-AUGER NO. TPR22B-14-136

SHEET 1 OF 1

FEATURE: Reach 22B
PROJECT: Navajo Gallup Water Supply Project
LOCATION: PIPELINE
GROUND ELEVATION: 6844.3
COORDINATES: N 1,967,301 E 2,724,803
METHOD OF EXPLORATION: CASE 580N BACKHOE
APPROXIMATE DIMENSIONS: 12'x14'x14.3'
LOGGED BY: J. GILBERT
DEPTH TO WATER: NE DATE:
DATE EXCAVATED: 7/28/2014

DEPTH	CLASSIFICATION GROUP SYMBOL	CLASSIFICATION AND DESCRIPTION OF MATERIAL (SEE USBR 5000, 5005)	% PLUS 3 in (BY VOLUME) 3 - 5 in	5 - 12 in	PLUS 12 in
1 2 3 4 5 6 7 8 9	SM In-Place Density taken at 6.0 ft. 9.5 ft (6834.8)	0.0 to 9.5 ft SILTY SAND: About 80% fine sand; about 20% nonplastic fines with rapid dilatancy, no dry strength; no reaction with HCl. IN-PLACE CONDITION: Tan to brown in color, dry, roots throughout. IN-PLACE UNIT WEIGHT AND MOISTURE FROM 6.0 ft. Total: 97.7 lbs. / cu ft., 2.4%. (91.2% compaction) LAB TEST DATA: 85.5 % sand, 14.5 % fines, LL= N/A, PI= NP, SPG= 2.64 Maximum dry density = 107.1 lbs. / cu ft., optimum water content = 13.1% Laboratory classification is SILTY SAND GEOLOGIC INTERPRETATION: Quaternary Alluvium (Qal)			
10 11 12	SM Corrosion samples taken at 10.0 ft. 12.0 ft (6832.3)	9.5 to 12.0 ft SILTY SAND: About 65% fine to medium sand; about 35% medium plastic fines, medium dry strength, medium to low toughness, rapid dilatancy; no reaction to HCl. N-PLACE CONDITION: Tan to brown in color, dry, roots throughout. GEOLOGIC INTERPRETATION: Quaternary Alluvium (Qal)			
13 14	SM 14.3 ft (6830.0)	12.0 to 14.3 ft SILTY SAND: About 80% fine sand; about 20% nonplastic fines with rapid dilatancy, no dry strength; no reaction with HCl. IN-PLACE CONDITION: Tan to brown in color, dry, roots throughout. GEOLOGIC INTERPRETATION: Quaternary Alluvium (Qal)			

COMMENTS: SURFACE VEGETATED WITH SAGE BRUSH AND GRASS. DISCONTINUED EXCAVATION DUE TO LIMIT OF EQUIPMENT, IN-PLACE DENSITY TAKEN AT 6.0 FEET.

7-1336-A (1-86)
Bureau of Reclamation

LOG OF TEST-PIT/HAND-AUGER NO. TPR22B-14-138

SHEET 1 OF 1

FEATURE: Reach 22B
PROJECT: Navajo Gallup Water Supply Project
LOCATION: PIPELINE
GROUND ELEVATION: 6940.3
COORDINATES: N 1,966,981 E 2,722,308
METHOD OF EXPLORATION: CASE 580N BACKHOE
APPROXIMATE DIMENSIONS: 12'x14'x14'
LOGGED BY: J. GILBERT
DEPTH TO WATER: NE DATE:
DATE EXCAVATED: 7/28/2014

DEPTH	CLASSIFICATION GROUP SYMBOL	CLASSIFICATION AND DESCRIPTION OF MATERIAL (SEE USBR 5000, 5005)	% PLUS 3 in (BY VOLUME) 3 - 5 in	5 - 12 in	PLUS 12 in
1	SM (visual) SP-SM (lab class)	0.0 to 14.0 ft SILTY SAND: About 80% fine sand; about 20% nonplastic fines with slow dilatancy, low dry strength; maximum size, fine sand; no reaction with HCl. IN-PLACE CONDITION: Tan in color, dry. IN-PLACE UNIT WEIGHT AND MOISTURE FROM 6.0 ft. Total: 100.7 lbs. / cu ft., 2.4%. (93.9% compaction) LAB TEST DATA: 90.9 % sand, 9.1 % fines, LL= N/A, PI= NP, SPG= 2.65 Maximum dry density = 107.2 lbs. / cu ft., optimum water content = 12.0% Laboratory classification is POORLY GRADED SAND WITH SILT GEOLOGIC INTERPRETATION: Quaternary Alluvium (Qal)			
2					
3					
4					
5					
6	In-Place Density taken at 6.0 ft. Corrosion samples taken at 10.0 ft.				
7					
8					
9					
10					
11					
12					
13					
14	14.0 ft (6926.3)				

COMMENTS: SURFACE VEGETATED WITH SAGE BRUSH AND GRASS. DISCONTINUED EXCAVATION DUE TO LIMIT OF EQUIPMENT AT 14.0 FEET

7-1336-A (1-86)
Bureau of Reclamation

LOG OF TEST-PIT/HAND-AUGER NO. TPR22B-14-139

SHEET 1 OF 1

FEATURE: Reach 22B
PROJECT: Navajo Gallup Water Supply Project
LOCATION: PIPELINE
GROUND ELEVATION: 6965.2
COORDINATES: N 1,967,422 E 2,721,546
METHOD OF EXPLORATION: CASE 580N BACKHOE
APPROXIMATE DIMENSIONS: 12'x14'x8.6'
LOGGED BY: J. GILBERT
DEPTH TO WATER: NE DATE:
DATE EXCAVATED: 7/28/2014

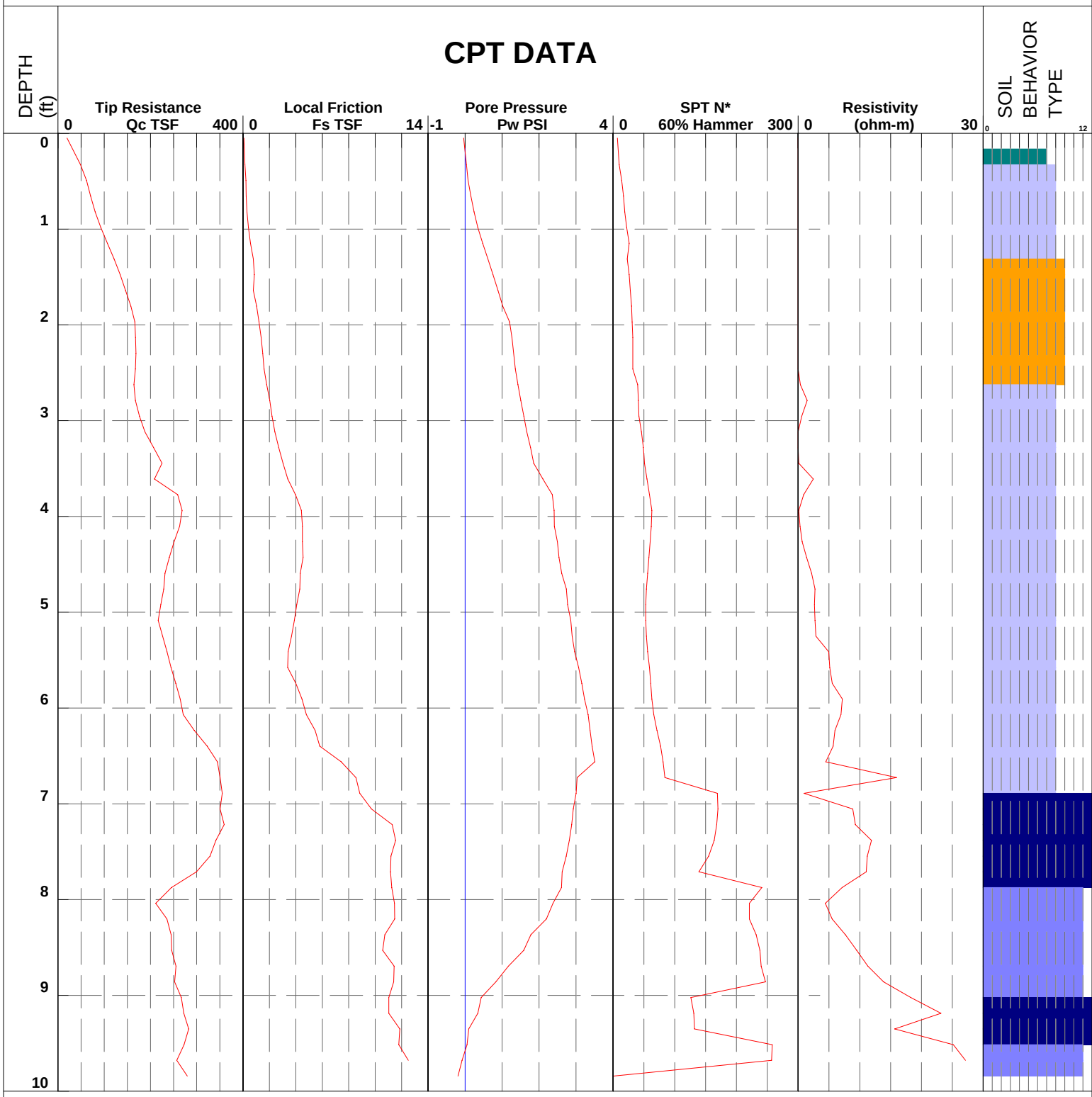
DEPTH	CLASSIFICATION GROUP SYMBOL	CLASSIFICATION AND DESCRIPTION OF MATERIAL (SEE USBR 5000, 5005)	% PLUS 3 in (BY VOLUME) 3 - 5 in	5 - 12 in	PLUS 12 in
1, 2	SM	0.0 to 2.9 ft SILTY SAND: About 80% fine sand; about 20% nonplastic fines with rapid dilatancy, no dry strength; no reaction with HCl. IN-PLACE CONDITION: Tan to brown in color, dry, roots throughout. GEOLOGIC INTERPRETATION: Quaternary Alluvium (Qal)			
2.9 ft (6962.3)					
3, 4, 5, 6, 7, 8	CLAYSTONE	2.9 to 8.6 ft CLAYSTONE: Dark grey in color, very soft (H7), very intensely weathered to decomposed (W8-W9); no reaction with HCl. GEOLOGIC INTERPRETATION: Tertiary Nacimiento Formation (Tn)			
8.6 ft (6956.6)					

COMMENTS: SURFACE VEGETATED WITH SAGE BRUSH AND GRASS. DISCONTINUED EXCAVATION DUE TO ENCOUNTERING BEDROCK

BUREAU OF RECLAMATION

Hole #	CPT21-14-A	Cone #	DSA1142	Date/Time	9/6/2014 9:15:53 AM
Project	NGWSP	Location	REACH 21	Operator	L ROBINSON
Station		Offset		Elevation	
		Northing		Easting	

CPT DATA



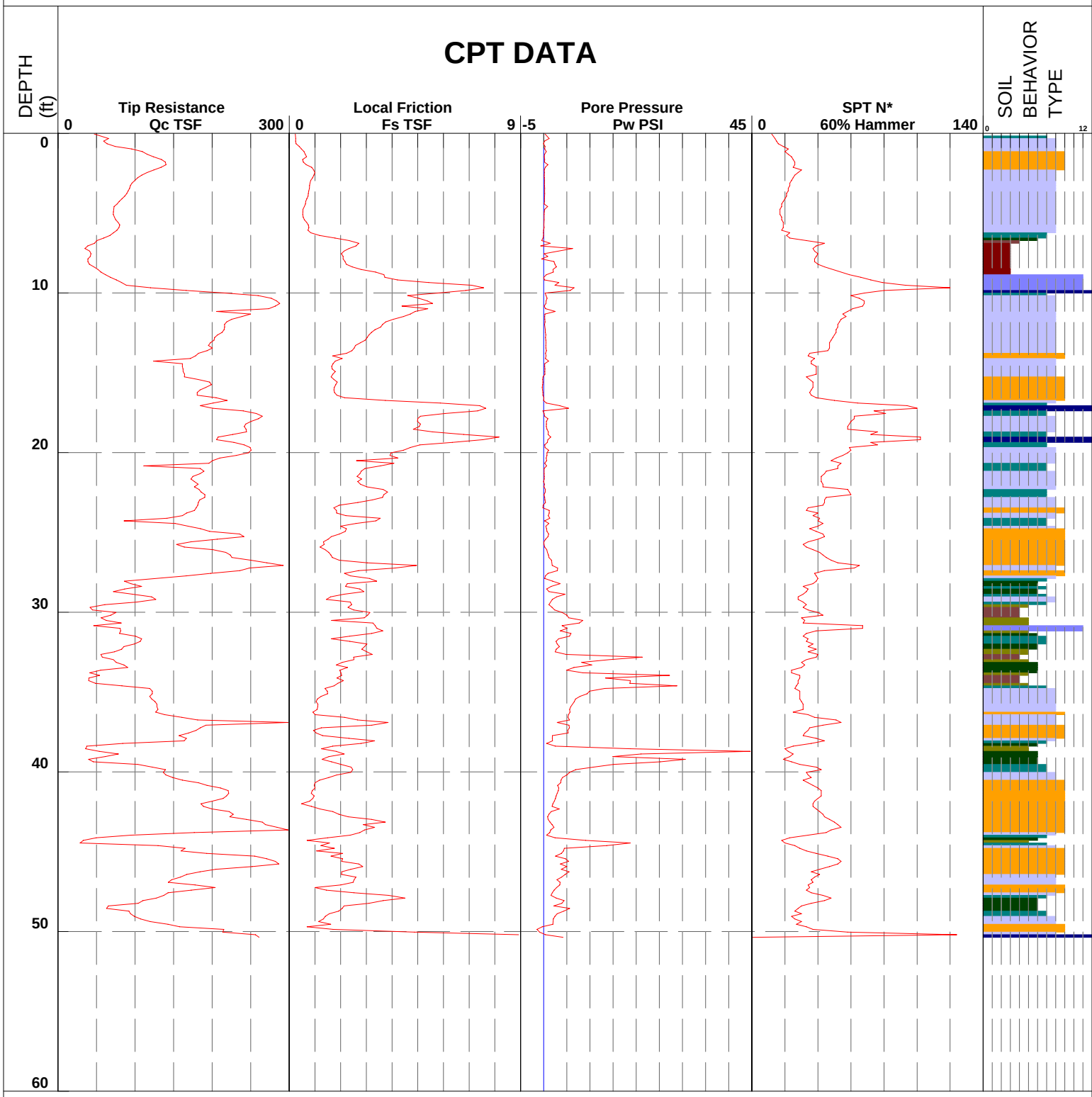
1 - sensitive fine grained	4 - silty clay to clay	7 - silty sand to sandy silt	10 - gravelly sand to sand
2 - organic material	5 - clayey silt to silty clay	8 - sand to silty sand	11 - very stiff fine grained (*)
3 - clay	6 - sandy silt to clayey silt	9 - sand	12 - sand to clayey sand (*)

Total Depth 10.1' Fs>13

BUREAU OF RECLAMATION

Hole #	CPT21-14-B	Cone #	DSA0739	Date/Time	9/6/2014 11:47:19 AM
Project	NGWSP	Location	REACH 21	Operator	L ROBINSON
Station		Offset		Elevation	
		Northing		Easting	

CPT DATA



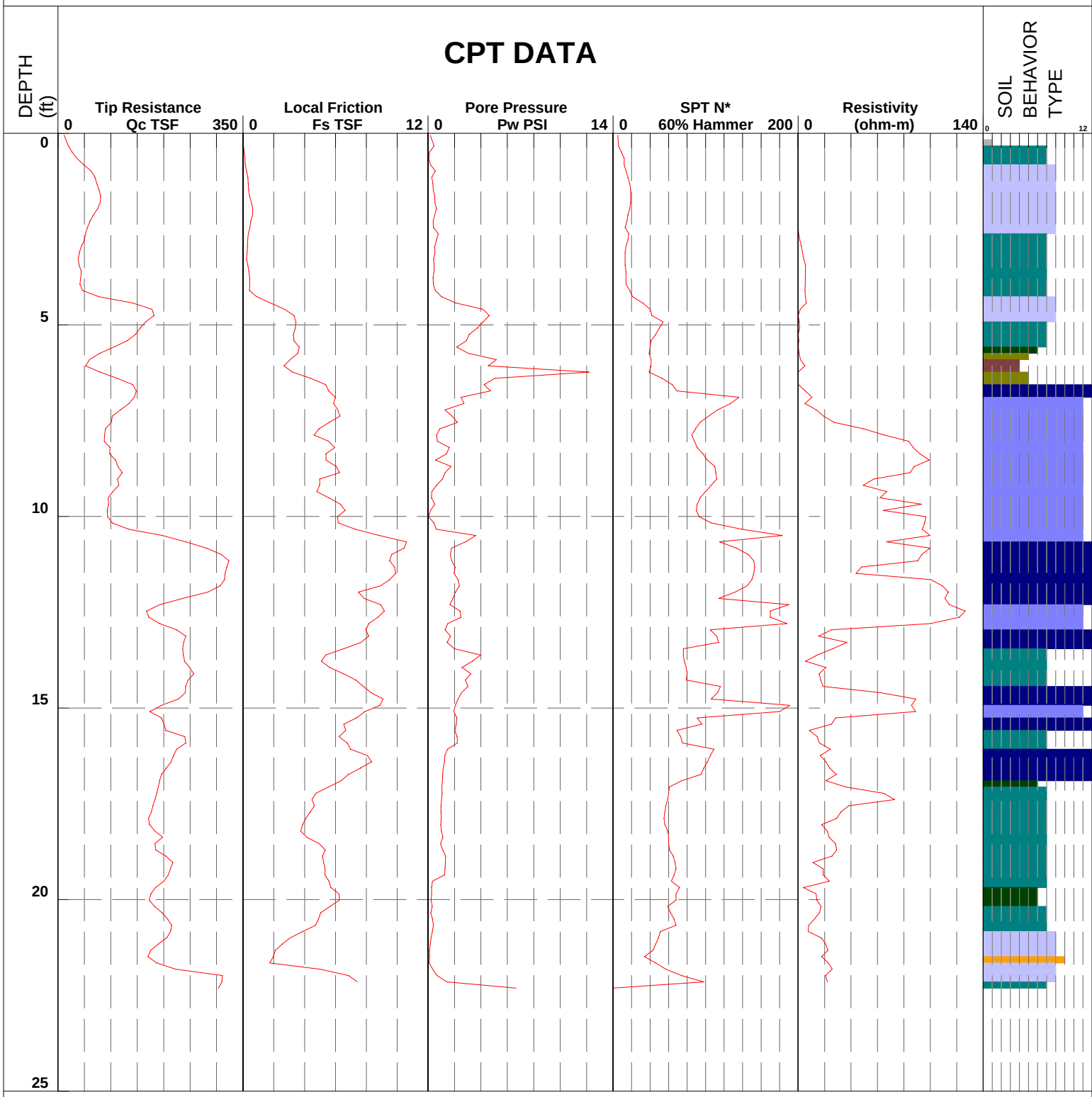
1 - sensitive fine grained	4 - silty clay to clay	7 - silty sand to sandy silt	10 - gravelly sand to sand
2 - organic material	5 - clayey silt to silty clay	8 - sand to silty sand	11 - very stiff fine grained (*)
3 - clay	6 - sandy silt to clayey silt	9 - sand	12 - sand to clayey sand (*)

Total Depth 50.7' Fs>12 Inc>12

BUREAU OF RECLAMATION

Hole #	CPT21-14-C	Cone #	DSA1142	Date/Time	9/6/2014 12:57:12 PM
Project	NGWSP	Location	REACH 21	Operator	L ROBINSON
Station		Offset		Elevation	
		Northing		Easting	

CPT DATA



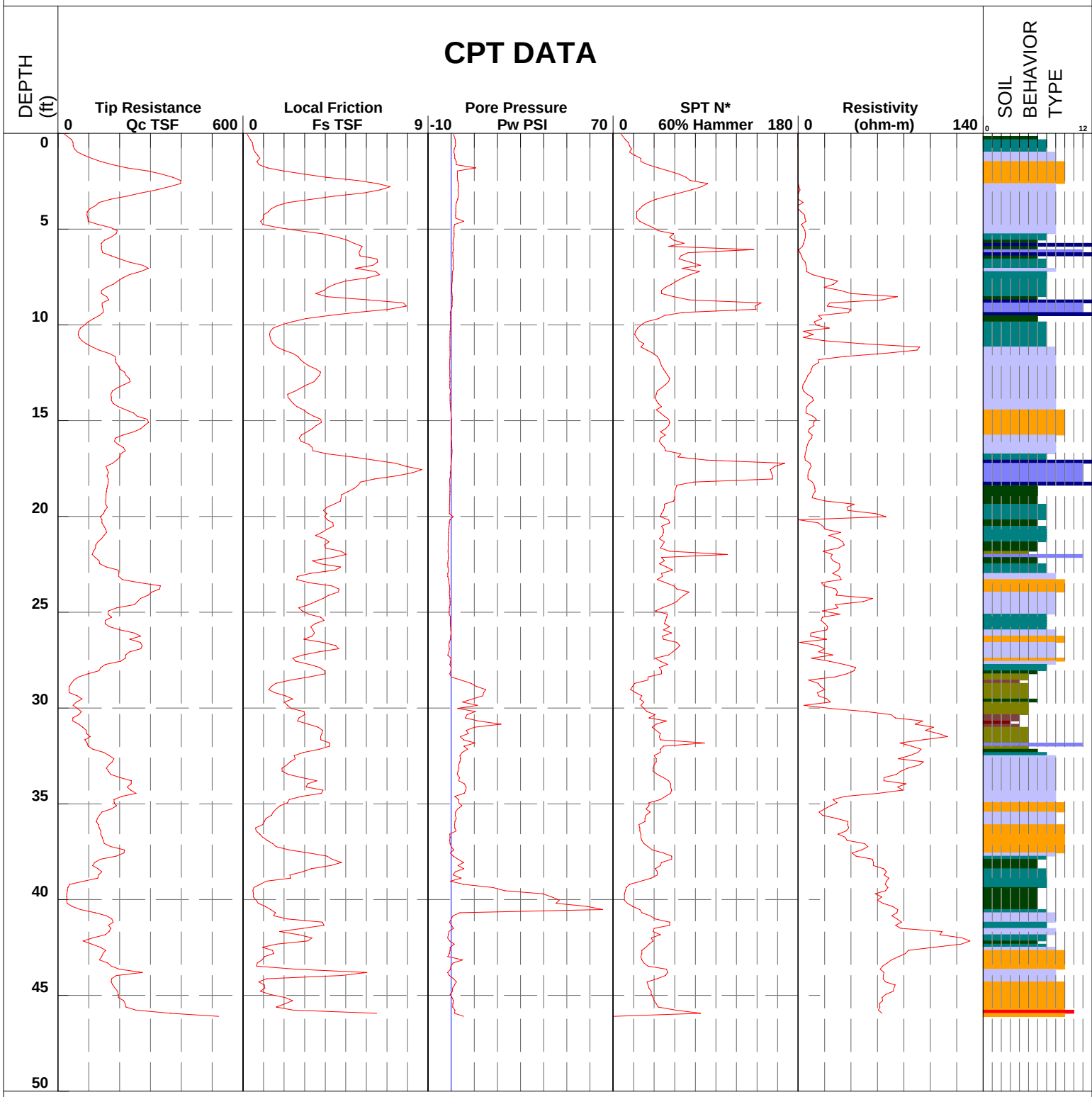
- 1 - sensitive fine grained
- 2 - organic material
- 3 - clay
- 4 - silty clay to clay
- 5 - clayey silt to silty clay
- 6 - sandy silt to clayey silt
- 7 - silty sand to sandy silt
- 8 - sand to silty sand
- 9 - sand
- 10 - gravelly sand to sand
- 11 - very stiff fine grained (*)
- 12 - sand to clayey sand (*)

Total Depth 22.3' POPPING NOISE

BUREAU OF RECLAMATION

Hole #	CPT21-14-D	Cone #	DSA1142	Date/Time	9/7/2014 10:00:02 AM
Project	NGWSP	Location	REACH 21	Operator	L ROBINSON
Station		Offset		Elevation	
		Northing		Easting	

CPT DATA



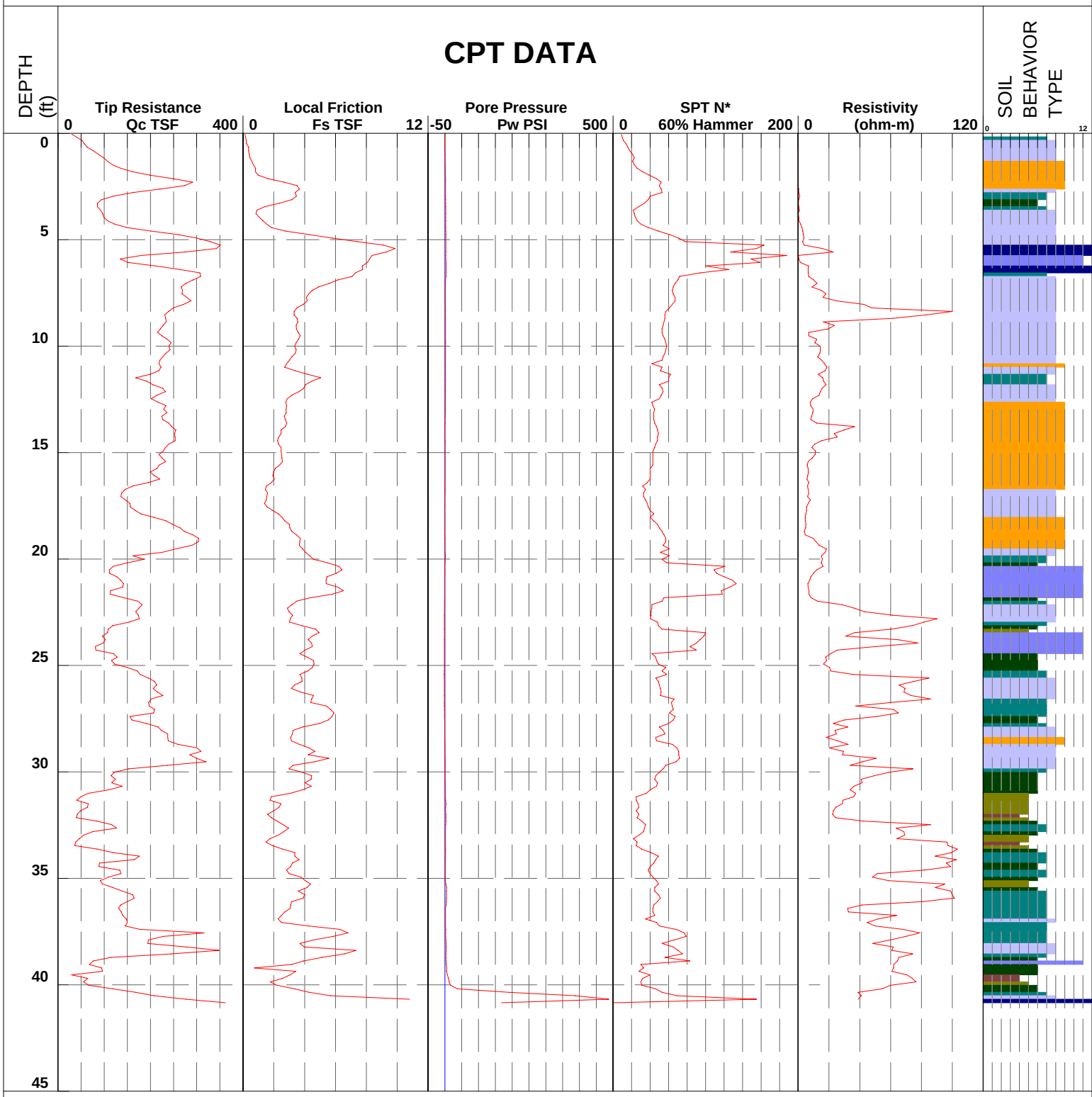
1 - sensitive fine grained	4 - silty clay to clay	7 - silty sand to sandy silt	10 - gravelly sand to sand
2 - organic material	5 - clayey silt to silty clay	8 - sand to silty sand	11 - very stiff fine grained (*)
3 - clay	6 - sandy silt to clayey silt	9 - sand	12 - sand to clayey sand (*)

Total Depth 46.4' Qc>500 Fs>12

BUREAU OF RECLAMATION

Hole #	CPT21-14-E	Cone #	DSA1142	Date/Time	9/7/2014 8:32:14 AM
Project	NGWSP	Location	REACH 21	Operator	L ROBINSON
Station		Offset		Elevation	
		Northing		Easting	

CPT DATA



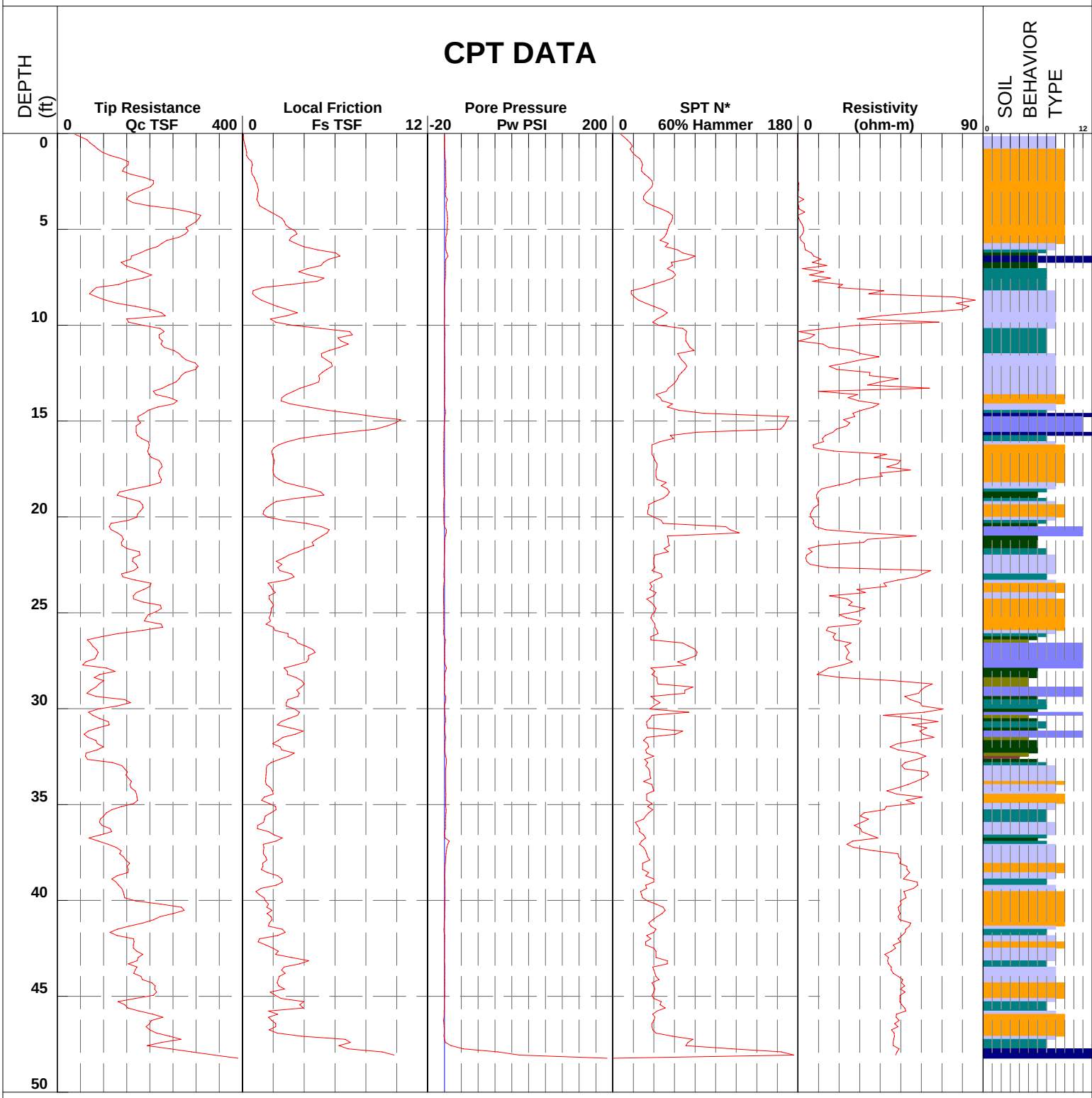
1 - sensitive fine grained	4 - silty clay to clay	7 - silty sand to sandy silt	10 - gravelly sand to sand
2 - organic material	5 - clayey silt to silty clay	8 - sand to silty sand	11 - very stiff fine grained (*)
3 - clay	6 - sandy silt to clayey silt	9 - sand	12 - sand to clayey sand (*)

Total Depth 41' Fs>12

BUREAU OF RECLAMATION

Hole #	CPT21-14-F	Cone #	DSA1142	Date/Time	9/7/2014 12:27:47 PM
Project	NGWSP	Location	REACH 21	Operator	L ROBINSON
Station		Offset		Elevation	
		Northing		Easting	

CPT DATA



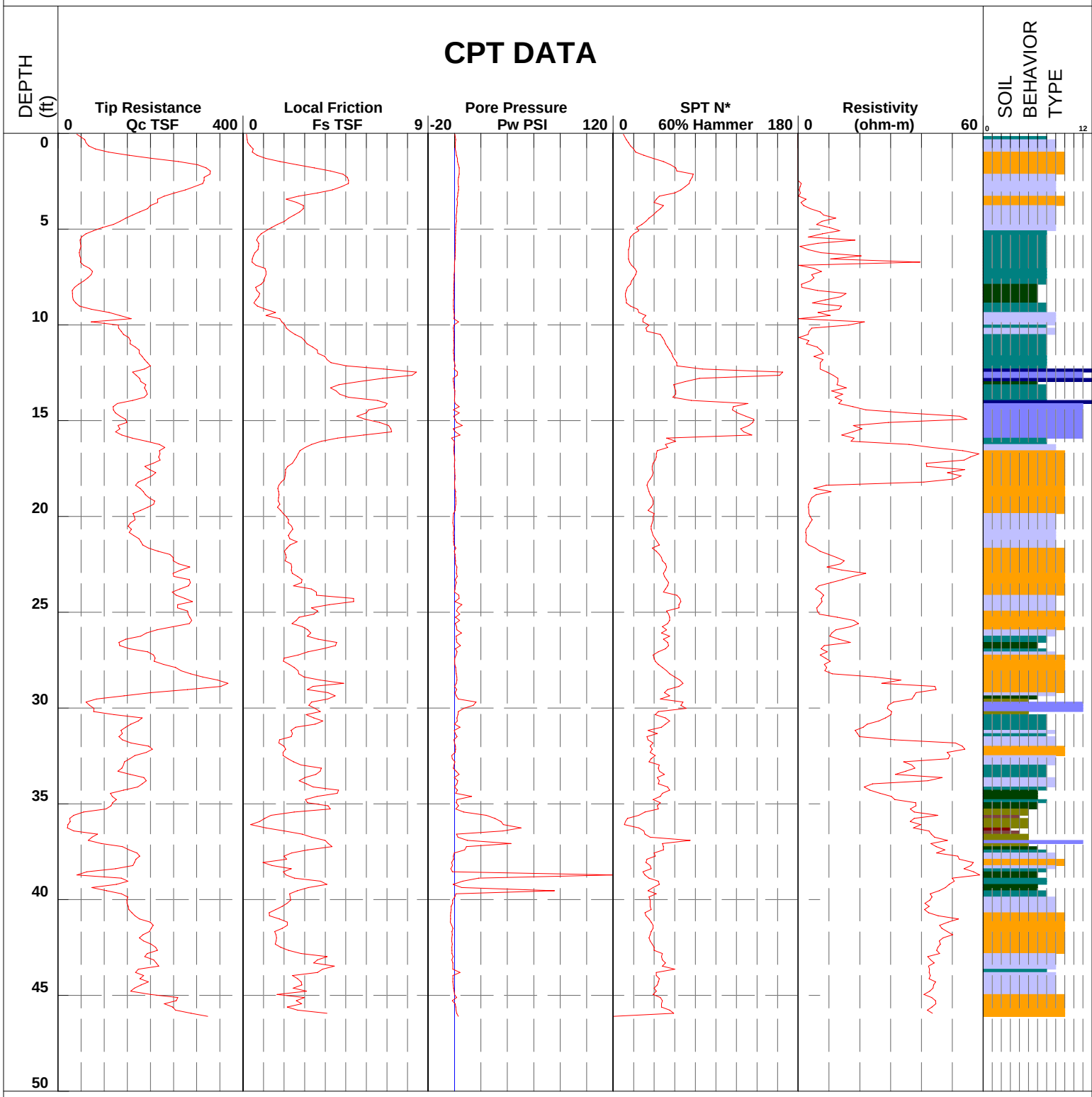
1 - sensitive fine grained	4 - silty clay to clay	7 - silty sand to sandy silt	10 - gravelly sand to sand
2 - organic material	5 - clayey silt to silty clay	8 - sand to silty sand	11 - very stiff fine grained (*)
3 - clay	6 - sandy silt to clayey silt	9 - sand	12 - sand to clayey sand (*)

Total Depth 48.4' Fs>12

BUREAU OF RECLAMATION

Hole #	CPT21-14-G	Cone #	DSA1142	Date/Time	9/7/2014 1:13:26 PM
Project	NGWSP	Location	REACH 21	Operator	L ROBINSON
Station		Offset		Elevation	
		Northing		Easting	

CPT DATA



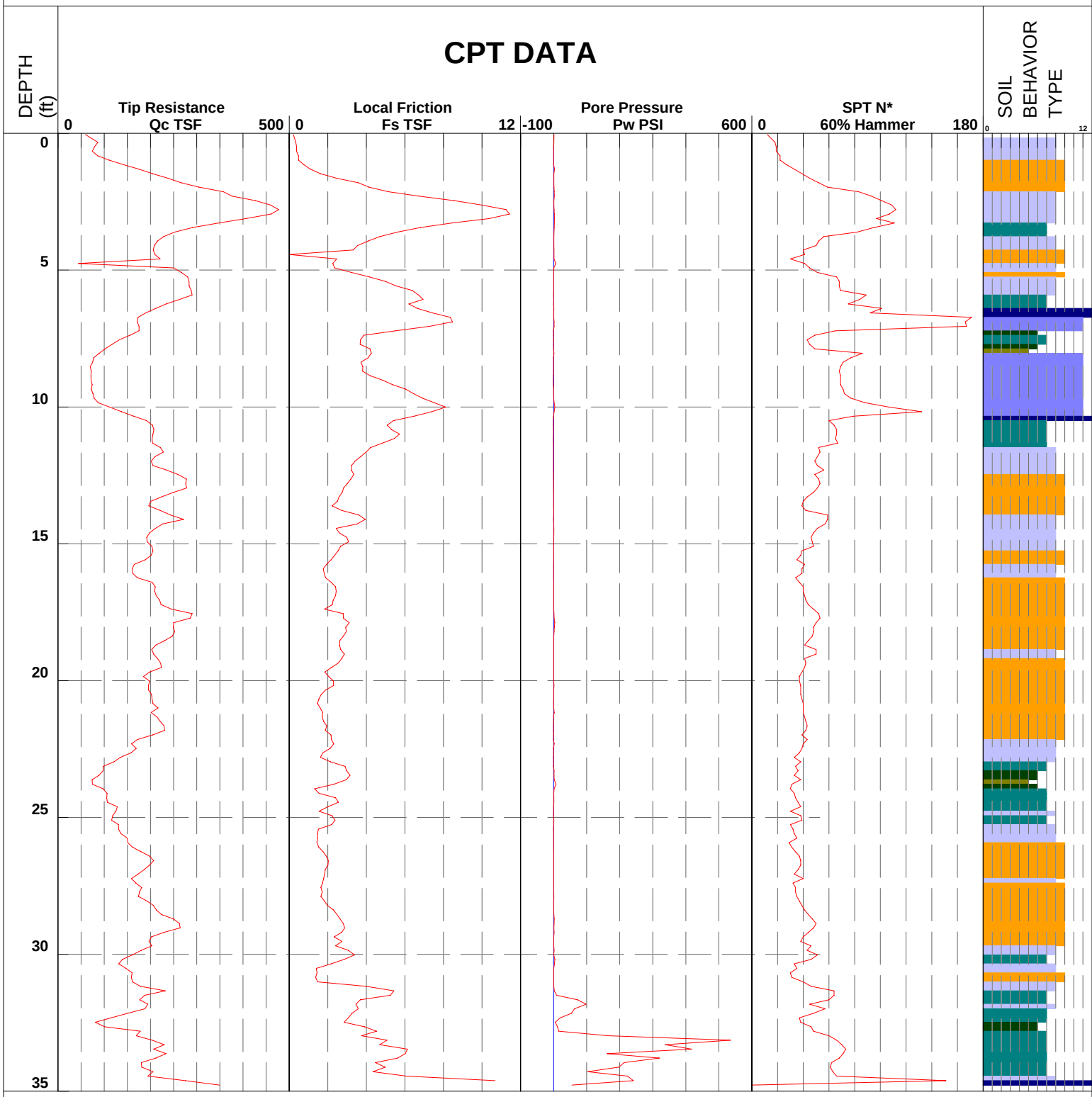
1 - sensitive fine grained	4 - silty clay to clay	7 - silty sand to sandy silt	10 - gravelly sand to sand
2 - organic material	5 - clayey silt to silty clay	8 - sand to silty sand	11 - very stiff fine grained (*)
3 - clay	6 - sandy silt to clayey silt	9 - sand	12 - sand to clayey sand (*)

Total Depth 46.3' Qc>700

BUREAU OF RECLAMATION

Hole #	CPT22B-14-38	Cone #	DSA0739	Date/Time	9/8/2014 11:59:08 AM
Project	NGWSP	Location	REACH 22B	Operator	L ROBINSON
Station		Offset		Elevation	
		Northing		Easting	

CPT DATA



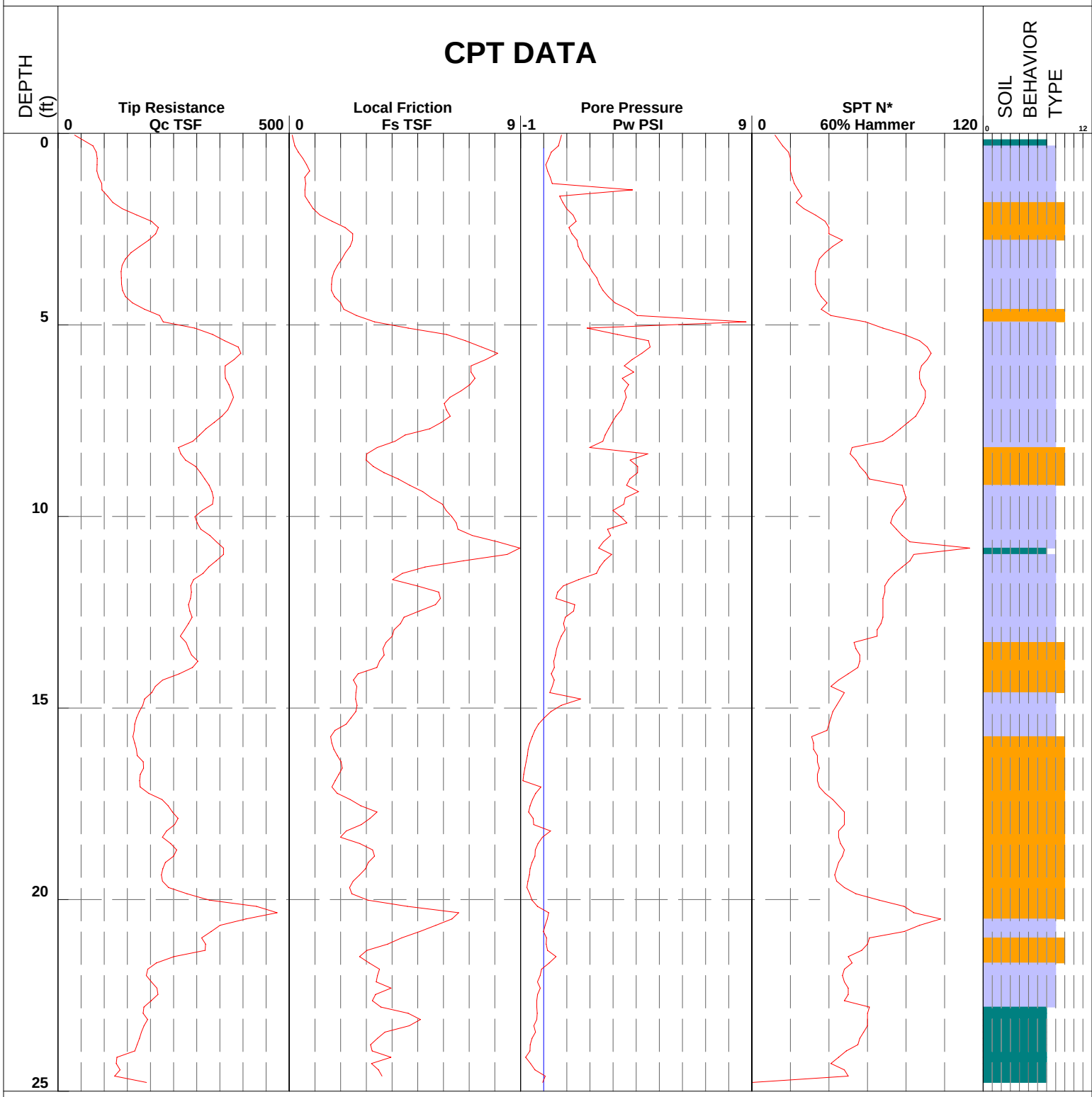
1 - sensitive fine grained	4 - silty clay to clay	7 - silty sand to sandy silt	10 - gravelly sand to sand
2 - organic material	5 - clayey silt to silty clay	8 - sand to silty sand	11 - very stiff fine grained (*)
3 - clay	6 - sandy silt to clayey silt	9 - sand	12 - sand to clayey sand (*)

Total Depth 35' Fs>12

BUREAU OF RECLAMATION

Hole #	CPT22B-14-39	Cone #	DSA0739	Date/Time	9/8/2014 1:35:48 PM
Project	NGWSP	Location	REACH 22B	Operator	L ROBINSON
Station		Offset		Elevation	
		Northing		Easting	

CPT DATA

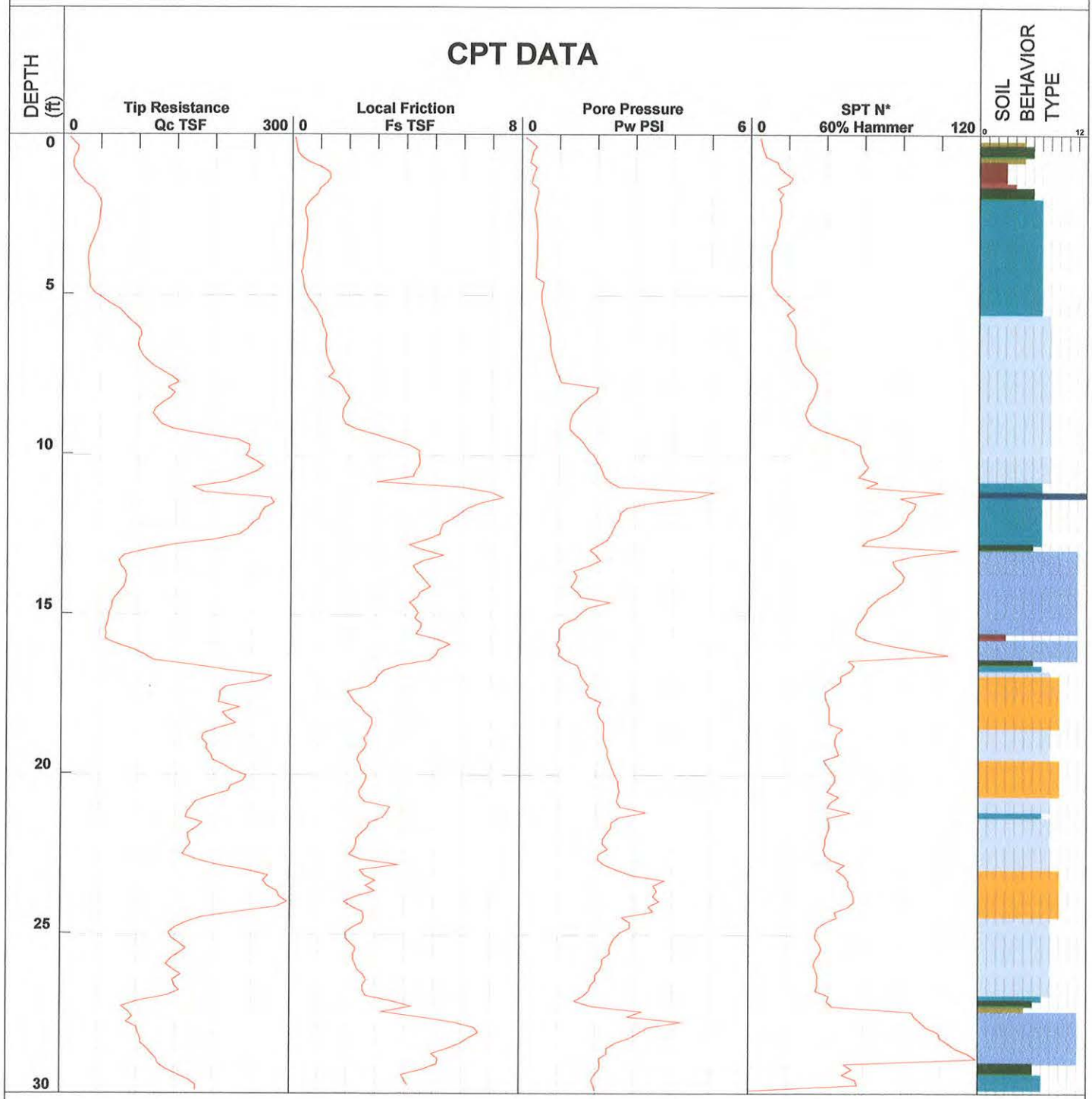


1 - sensitive fine grained	4 - silty clay to clay	7 - silty sand to sandy silt	10 - gravelly sand to sand
2 - organic material	5 - clayey silt to silty clay	8 - sand to silty sand	11 - very stiff fine grained (*)
3 - clay	6 - sandy silt to clayey silt	9 - sand	12 - sand to clayey sand (*)

Total Depth 25'

BUREAU OF RECLAMATION

Hole #	CPT22B-14-40	Cone #	DSA0739	Date/Time	7/29/2014 10:37:42 AM
Project	NGWSP	Location	REACH 22B	Operator	L ROBINSON
Station	ADJACENT TO	Offset	TEST PIT 130	Elevation	
		Northing		Easting	



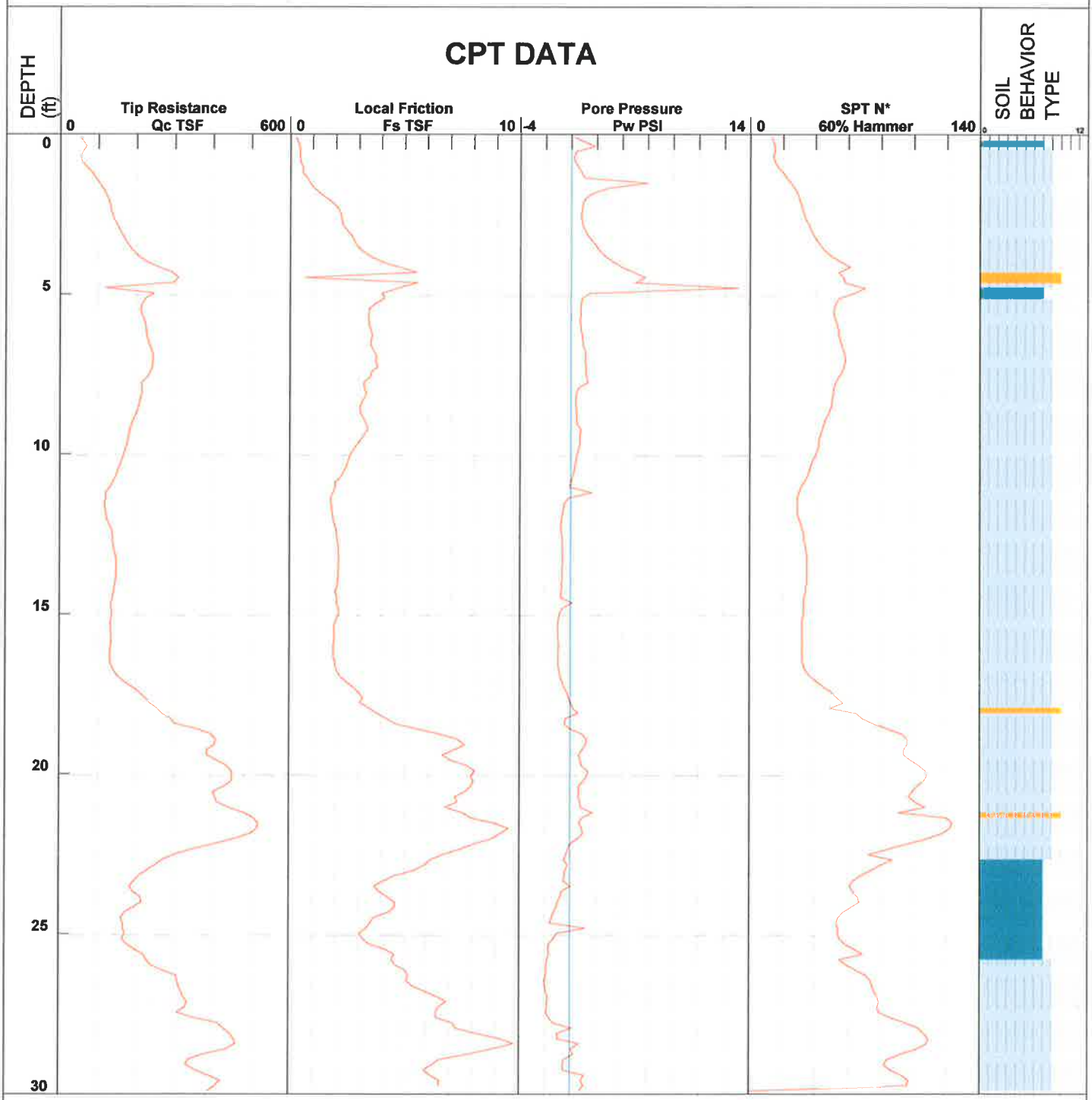
1 - sensitive fine grained
2 - organic material
3 - clay
4 - silty clay to clay
5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

Total Depth 30'

BUREAU OF RECLAMATION

Hole #	CPT22B-14-41	Cone #	DSA0739	Date/Time	7/29/2014 9:20:41 AM
Project	NGWSP	Location	REACH 22B	Operator	L ROBINSON
Station	ADJACENT TO	Offset	TEST PIT 132	Elevation	
		Northing		Easting	

CPT DATA



1 - sensitive fine grained	4 - silty clay to clay	7 - silty sand to sandy silt	10 - gravelly sand to sand
2 - organic material	5 - clayey silt to silty clay	8 - sand to silty sand	11 - very stiff fine grained (*)
3 - clay	6 - sandy silt to clayey silt	9 - sand	12 - sand to clayey sand (*)

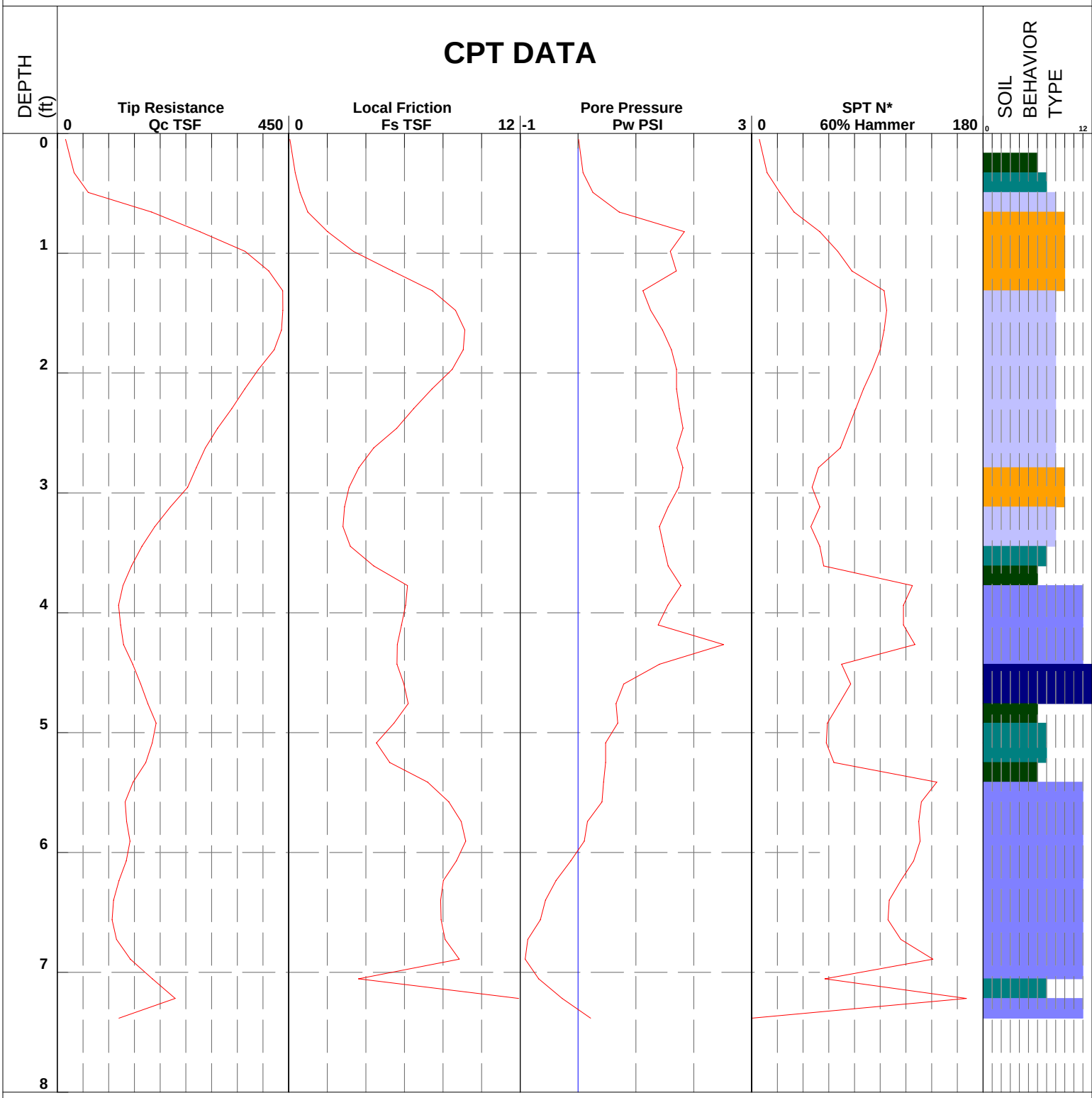
Total Depth 30'

29.9 ft HC

BUREAU OF RECLAMATION

Hole #	CPT22B-14-43	Cone #	DSG1028	Date/Time	7/28/2014 3:42:45 PM
Project	NGWSP	Location	REACH 22B	Operator	L ROBINSON
Station	ADJACENT TO	Offset	TEST PIT 134	Elevation	
		Northing		Easting	

CPT DATA



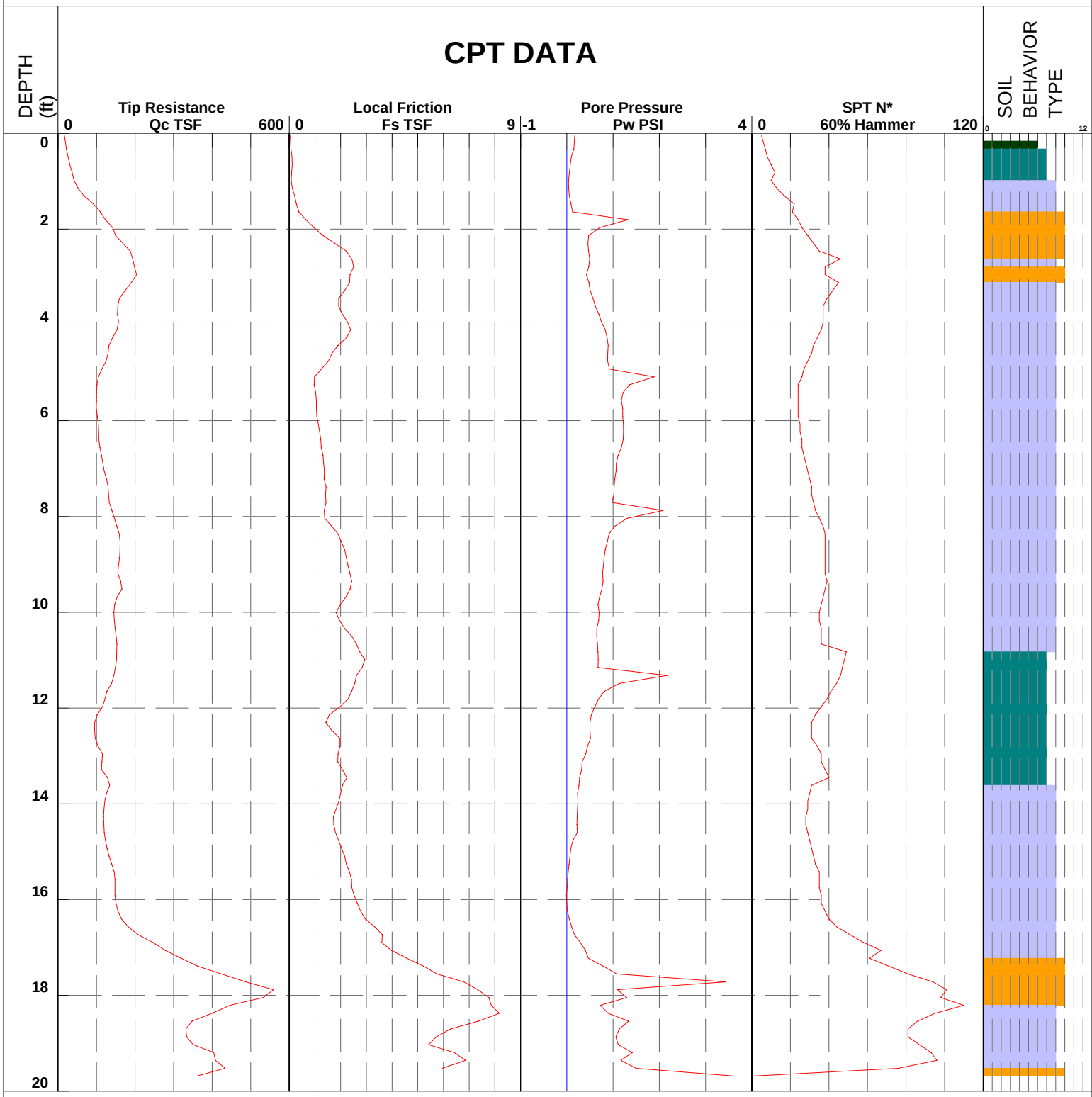
1 - sensitive fine grained	4 - silty clay to clay	7 - silty sand to sandy silt	10 - gravelly sand to sand
2 - organic material	5 - clayey silt to silty clay	8 - sand to silty sand	11 - very stiff fine grained (*)
3 - clay	6 - sandy silt to clayey silt	9 - sand	12 - sand to clayey sand (*)

Total Depth 7.5'Qc>500 Fs>12

BUREAU OF RECLAMATION

Hole #	CPT22B-14-44	Cone #	DSG1028	Date/Time	7/28/2014 1:44:33 PM
Project	NGWSP	Location	REACH 22B	Operator	L ROBINSON
Station	ADJACENT TO	Offset	TEST PIT 136	Elevation	
		Northing		Easting	

CPT DATA



1 - sensitive fine grained	4 - silty clay to clay	7 - silty sand to sandy silt	10 - gravelly sand to sand
2 - organic material	5 - clayey silt to silty clay	8 - sand to silty sand	11 - very stiff fine grained (*)
3 - clay	6 - sandy silt to clayey silt	9 - sand	12 - sand to clayey sand (*)

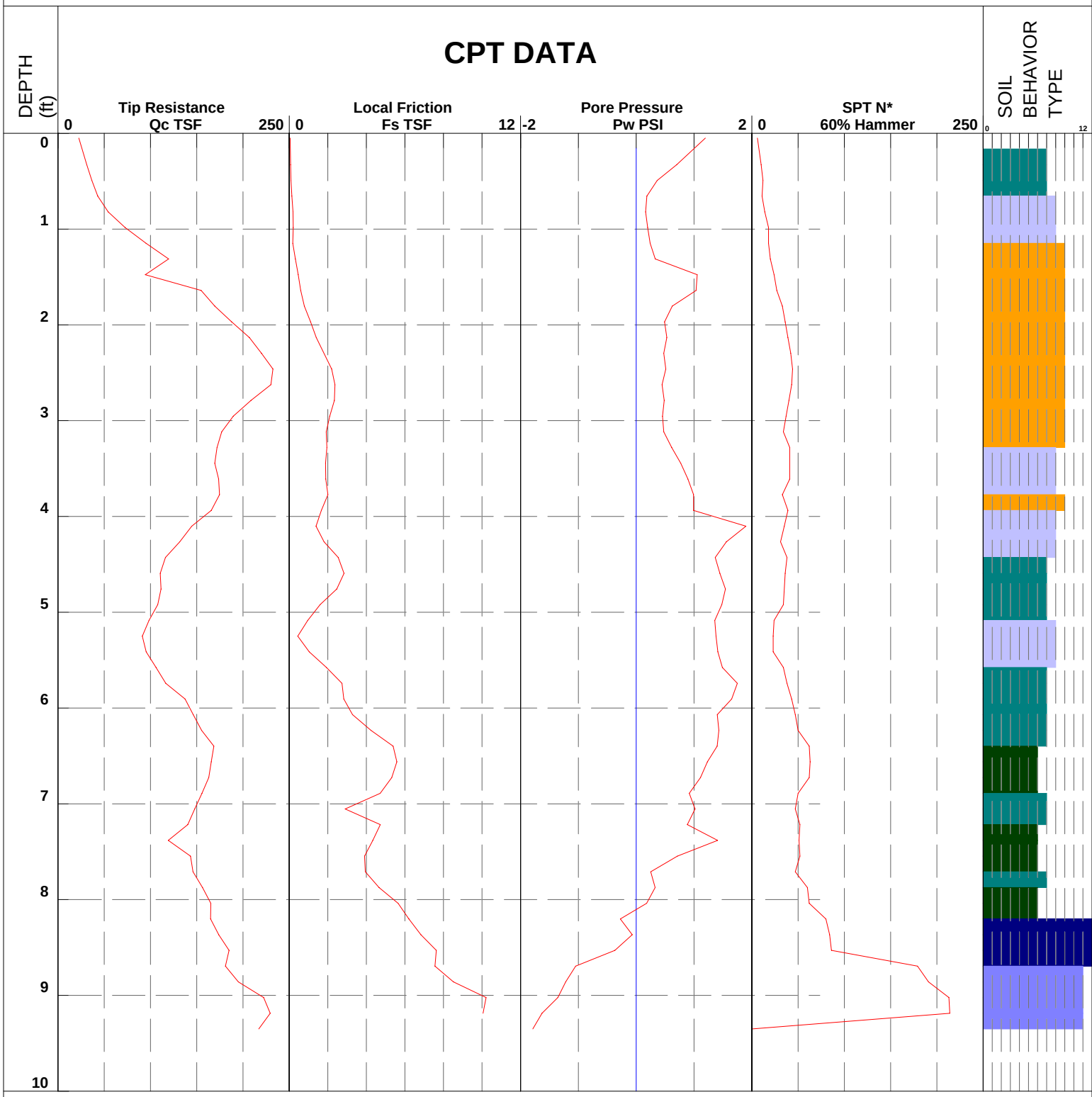
Total Depth 19.8' Qc>500 Fs>6

BUREAU OF RECLAMATION

Hole #	CPT22B-14-45	Cone #	DSG1028	Date/Time	7/28/2014 11:34:15 AM
Project	NGWSP	Location	REACH 22B	Operator	L ROBINSON
Station		Offset		Elevation	
		Northing		Easting	

9.6' Fs>12

CPT DATA



1 - sensitive fine grained	4 - silty clay to clay	7 - silty sand to sandy silt	10 - gravelly sand to sand
2 - organic material	5 - clayey silt to silty clay	8 - sand to silty sand	11 - very stiff fine grained (*)
3 - clay	6 - sandy silt to clayey silt	9 - sand	12 - sand to clayey sand (*)

Total Depth

SUMMARY OF PHYSICAL PROPERTIES TEST RESULTS

PROJECT: NAVAJO GALLUP WATER SUPPLY PROJECT **FEATURE:** REACH 22B

Drill Hole Number: DHR22B-14-129

IDENTIFICATION			PARTICLE SIZE FRACTIONS IN PERCENT						CONSISTENCY LIMITS			SPECIFIC GRAVITY				IN-PLACE DENSITY				
			FINES																	
TEST PIT NUMBER (DHR22B-14-129)	DEPTH – feet	CLASSIFICATION SYMBOL	SMALLER THAN 0.005 mm	0.005 to 0.074 mm	SAND #200 (.074mm) to #4 (4.76mm)	GRAVEL #4 (4.76mm) to 3" (76.2mm)	COBBLES 3" (76.2mm) to 5" (127mm)	OVERSIZE Larger than 5" (127mm)	LIQUID LIMIT - %	PLASTICITY INDEX - %	SHRINKAGE LIMIT - %	SPECIFIC GRAVITY MINUS NO.4	SPECIFIC GRAVITY PLUS NO. 4 BULK	APPARENT	ABSORPTION - %	FILL WATER CONTENT % MINUS No. 4	FILL WATER CONTENT % PLUS No. 4			
SPT# 1	3.5 – 5.0	SP-SM	5.5	5.1	89.4	0	0	0	-	NP	-	2.63	-	-	-	1.6				
SPT# 2	6.0 – 7.5	SP-SM	6.0	3.2	90.8	0	0	0	-	NP	-	2.65	-	-	-	2.4				
SPT# 3	8.5 – 10.0	SM	8.0	8.3	83.7	0	0	0	-	NP	-	2.62	-	-	-	3.0				
SPT# 4	11.0 – 12.5	SM	11.4	4.8	83.8	0	0	0	-	NP	-	2.65	-	-	-	2.2				
SPT# 5	13.5 – 15.0	s(CL)	32.6	21.8	45.6	0	0	0	32.6	16.2	-	2.60	-	-	-	8.8				
SPT# 6	16.0 – 17.5	SC	22.2	27.5	50.3	0	0	0	24.1	9.5	-	2.57	-	-	-	5.4				
SPT# 7	18.5 – 20.0	SM	12.5	8.4	79.1	0	0	0	-	NP	-	2.64	-	-	-	3.1				
SPT# 8	23.5 – 25.0	SM	12.0	6.7	78.8	2.5	0	0	-	NP	-	2.62	2.42	-	5.1	3.4				

SUMMARY OF PHYSICAL PROPERTIES TEST RESULTS

PROJECT: NAVAJO GALLUP WATER SUPPLY PROJECT **FEATURE:** REACH 22B

Drill Hole Number: DHR22B-14-133

IDENTIFICATION			PARTICLE SIZE FRACTIONS IN PERCENT						CONSISTENCY LIMITS			SPECIFIC GRAVITY				IN-PLACE DENSITY				
			FINES																	
TEST PIT NUMBER (DHR22B-14-133)	DEPTH – feet	CLASSIFICATION SYMBOL	SMALLER THAN 0.005 mm	0.005 to 0.074 mm	SAND #200 (.074mm) to #4 (4.76mm)	GRAVEL #4 (4.76mm) to 3" (76.2mm)	COBBLES 3" (76.2mm) to 5" (127mm)	OVERSIZE Larger than 5" (127mm)	LIQUID LIMIT - %	PLASTICITY INDEX - %	SHRINKAGE LIMIT - %	SPECIFIC GRAVITY MINUS NO.4	SPECIFIC GRAVITY PLUS NO. 4 BULK	APPARENT	ABSORPTION - %	DRY DENSITY - pcf	FILL WATER CONTENT % MINUS NO.4	FILL WATER CONTENT % PLUS NO.4		
SPT# 1	3.0 – 4.5	SC	16.9	13.0	70.1	0	0	0	21.7	7.3	-	2.60	-	-	-	-	3.4	-		
SPT# 2	5.5 – 7.0	SC	23.0	14.0	63.0	0	0	0	27.4	14.0	-	2.64	-	-	-	-	5.4	-		
SPT# 3	8.0 – 9.5	SM	15.9	10.9	73.2	0	0	0	-	NP	-	2.63	-	-	-	-	3.8	-		
SPT# 4	10.5 – 12.0	SM	15.4	9.5	75.1	0	0	0	-	NP	-	2.65	-	-	-	-	3.5	-		
SPT# 5	13.0 – 14.5	SM	13.4	9.9	76.7	0	0	0	-	NP	-	2.65	-	-	-	-	2.8	-		
SPT# 6	15.5 – 17.0	SM	17.1	10.9	72.0	0	0	0	-	NP	-	2.66	-	-	-	-	3.6	-		
SPT# 7	18.0 – 19.5	SP-SM	5.0	3.8	91.2	0	0	0	-	NP	-	2.66	-	-	-	-	1.8	-		
SPT# 8	20.5 – 22.0	SP-SM	5.0	6.6	88.4	0	0	0	-	NP	-	2.64	-	-	-	-	1.7	-		
SPT# 9	23.0 – 24.5	SM	16.5	10.4	73.1	0	0	0	-	NP	-	2.63	-	-	-	-	4.0	-		

SUMMARY OF PHYSICAL PROPERTIES TEST RESULTS

PROJECT: NAVAJO GALLUP WATER SUPPLY PROJECT **FEATURE:** REACH 22B

Drill Hole Number: DHR22B-14-137

IDENTIFICATION			PARTICLE SIZE FRACTIONS IN PERCENT						CONSISTENCY LIMITS			SPECIFIC GRAVITY				IN-PLACE DENSITY				
			FINES																	
TEST PIT NUMBER (DHR22B-14-137)	DEPTH – feet	CLASSIFICATION SYMBOL	SMALLER THAN 0.005 mm	0.005 to 0.074 mm	SAND #200 (.074mm) to #4 (4.76mm)	GRAVEL #4 (4.76mm) to 3" (76.2mm)	COBBLES 3" (76.2mm) to 5" (127mm)	OVERSIZE Larger than 5" (127mm)	LIQUID LIMIT - %	PLASTICITY INDEX - %	SHRINKAGE LIMIT - %	SPECIFIC GRAVITY MINUS NO.4	SPECIFIC GRAVITY PLUS NO. 4 BULK	APPARENT	ABSORPTION - %	FILL WATER CONTENT% MINUS No. 4	FILL WATER CONTENT% PLUS No. 4			
SPT# 1	3.5 – 5.0	SM	10.8	12.8	74.7	1.7	0	0	-	NP	-	2.65	2.52	-	3.3	2.6	-			
SPT# 2	6.0 – 7.5	s(CL)	36.9	29.7	33.4	0	0	0	39.3	24.2	-	2.57	-	-	-	9.2	-			
SPT# 3	8.5 – 10.0	CL	37.7	49.4	12.9	0	0	0	41.8	26.3	11.0	2.57	-	-	-	10.2	-			
SPT# 4	11.0 – 12.5	CL	37.2	53.9	8.9	0	0	0	41.7	20.6	11.2	2.58	-	-	-	10.4	-			
SPT# 5	13.5 – 14.3	s(CL)	34.8	28.8	36.4	0	0	0	33.8	19.9	-	2.60	-	-	-	7.7	-			

SUMMARY OF PHYSICAL PROPERTIES TEST RESULTS

PROJECT: NAVAJO GALLUP WATER SUPPLY PROJECT **FEATURE:** REACH 22B

IDENTIFICATION			PARTICLE SIZE FRACTIONS IN PERCENT						CONSISTENCY LIMITS			IN-PLACE DENSITY				COMPACTION TESTS			
			FINES																
TEST PIT NUMBER	DEPTH – feet	CLASSIFICATION SYMBOL	SMALLER THAN 0.005 mm	0.005 to 0.074 mm	SAND #200 (.074mm) to #4 (4.76mm)	GRAVEL #4 (4.76mm) to 3" (76.2mm)	COBBLES 3" (76.2mm) to 5" (127mm)	OVERSIZE Larger than 5" (127mm)	LIQUID LIMIT - %	PLASTICITY INDEX - %	SHRINKAGE LIMIT - %	DRY DENSITY - PCF	FILL WATER CONTENT - %	SPECIFIC GRAVITY PLUS NO. 4	SPECIFIC GRAVITY MINUS NO.4	MAXIMUM DRY DENSITY - pcf	OPTIMUM WATER CONTENT - %	PENETRATION RESISTANCE psi	D-Value %
TPR22B-14-131	6.0	SM	11.0	6.2	82.8	0	0	0	NA	NP	-	100.7	3.0	-	2.67	110.3	13.4	-	91.3
TPR22B-14-132	6.0	SM	8.0	11.2	80.8	0	0	0	NA	NP	-	96.2	3.0	-	2.64	113.8	11.8	600	84.5
TPR22B-14-134	6.0	SC	26.7	12.3	61.0	0	0	0	25.0	9.7	-	108.1	6.5	-	2.66	115.7	12.8	520	93.4
TPR22B-14-135	6.0	SM	17.4	21.7	60.8	0.1	0	0	NA	NP	-	93.0	4.1	2.55	2.63	118.5	11.5	-	78.5
TPR22B-14-136	6.0	SM	8.0	6.5	85.5	0	0	0	NA	NP	-	97.7	2.4	-	2.64	107.1	13.1	433	91.2
TPR22B-14-138	6.0	SP-SM	6.5	2.6	90.9	0	0	0	NA	NP	-	100.7	2.4	-	2.65	107.2	12.0	-	93.9

NOTE: Numbers in parentheses are metric equivalents of numbers directly above.
**Denotes In-place density and 5-point curve.*

SUMMARY OF PHYSICAL PROPERTIES TEST RESULTS

PROJECT: NAVAJO GALLUP WATER SUPPLY PROJECT **FEATURE:** REACH 21WTP

TPR21-14-A,B,C,D,E,F,G

IDENTIFICATION			PARTICLE SIZE FRACTIONS IN PERCENT						CONSISTENCY LIMITS			IN-PLACE DENSITY				COMPACTION TESTS				
			FINES																	
TEST PIT NUMBER	DEPTH – feet	CLASSIFICATION SYMBOL	SMALLER THAN 0.005 mm	0.005 to 0.074 mm	SAND #200 (.074mm) to #4 (4.76mm)	GRAVEL #4 (4.76mm) to 3" (76.2mm)	COBBLES 3" (76.2mm) to 5" (127mm)	OVERSIZE Larger than 5" (127mm)	LIQUID LIMIT - %	PLASTICITY INDEX - %	SHRINKAGE LIMIT - %	DRY DENSITY - pcf	FILL WATER CONTENT -%	SPECIFIC GRAVITY PLUS NO. 4	SPECIFIC GRAVITY MINUS NO.4	MAXIMUM DRY DENSITY - pcf	OPTIMUM WATER CONTENT - %	PENETRATION RESISTANCE psi	D-VALUE %	RELATIVE COMPACTION %
TPR21-14-A	6.0	SC	24.4	23.7	51.9	0.0	0.0	0.0	25.3	8.1	-	105.4	4.6	-	2.70	104.4	12.2	245.0	101.0	-
TPR21-14-B	6.0	SP-SM	6.5	3.7	89.8	0.0	0.0	0.0	NA	NP	-	96.7	2.5	-	2.66	104.4	-	-	-	92.6
TPR21-14-C	6.0	SM	12.0	7.6	80.4	0.0	0.0	0.0	NA	NP	-	103.8	4.3	-	2.63	112.5	12.5	380	92.3	-
TPR21-14-D	6.0	SM	9.2	5.5	77.3	8.0	0.0	0.0	NA	NP	-	77.8	3.0	2.18	2.64	120.0	11.2	1000.0	64.8	-
TPR21-14-E	6.0	SP-SM	3.5	1.7	94.8	0.0	0.0	0.0	NA	NP	-	99.8	1.9	-	2.65	102.2	15.0	-	97.7	-
TPR21-14-F	6.0	SM	7.0	8.1	84.9	0.0	0.0	0.0	NA	NP	-	100.1	2.1	-	2.64	110.9	-	-	-	90.3
TPR21-14-G	6.0	SP-SM	7.2	4.4	84.8	3.6	0.0	0.0	NA	NP	-	112.2	2.3	2.20	2.63	115.8	12.5	625.0	96.9	-

REACH 21 WATER TREATMENT PLANT PHOTOS

Photograph No. 1

Photograph No. 2

Photograph No. 3

Photograph No. 4

Photograph No. 5

Photograph No. 6

Photograph No. 7

Photograph No. 8

Photograph No. 9

Photograph No. 10

Photograph No. 11

Photograph No. 12

Photograph No. 13

Photograph No. 14

Photograph No. 15

Photograph No. 16

Photograph No. 17

Photograph No. 18

Photograph No. 19

Photograph No. 20

Photograph No. 21

Photograph No. 22

Photograph No. 23

Photograph No. 24

Photograph No. 25

Photograph No. 26

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Photograph No. 29

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Photograph No. 58

Photograph No. 59

Photograph No. 60

Photograph No. 61

Photograph No. 62

Photograph No. 63

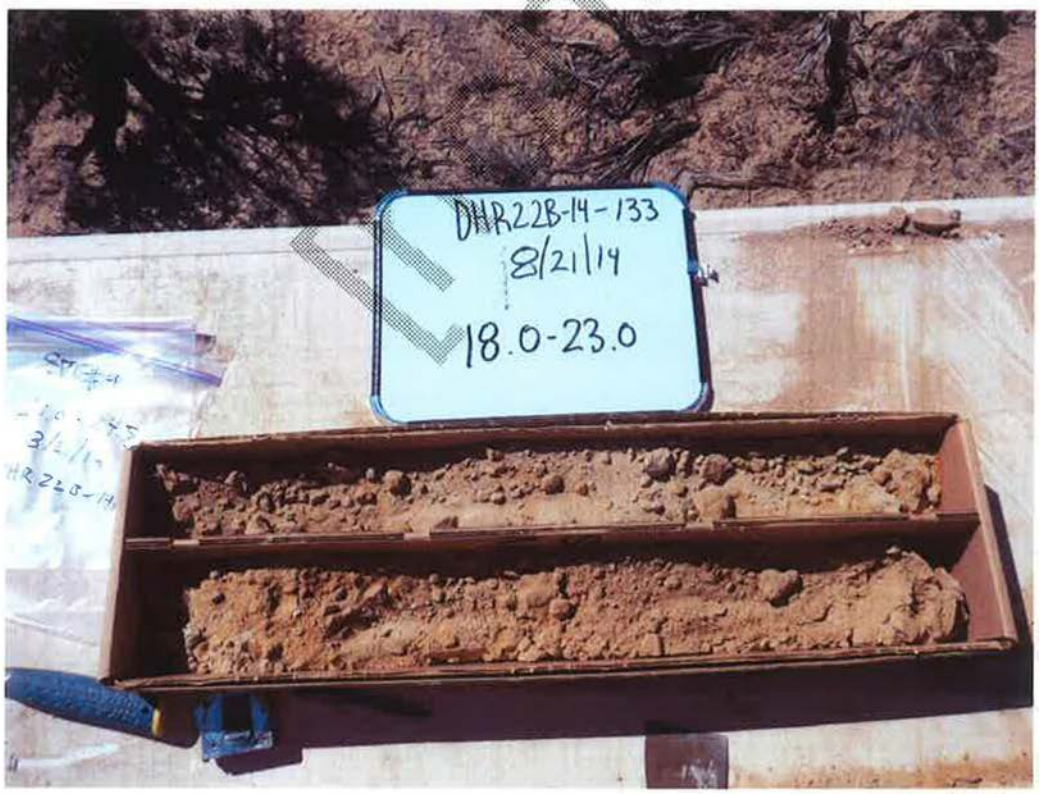
Photograph No. 64

Photograph No. 65

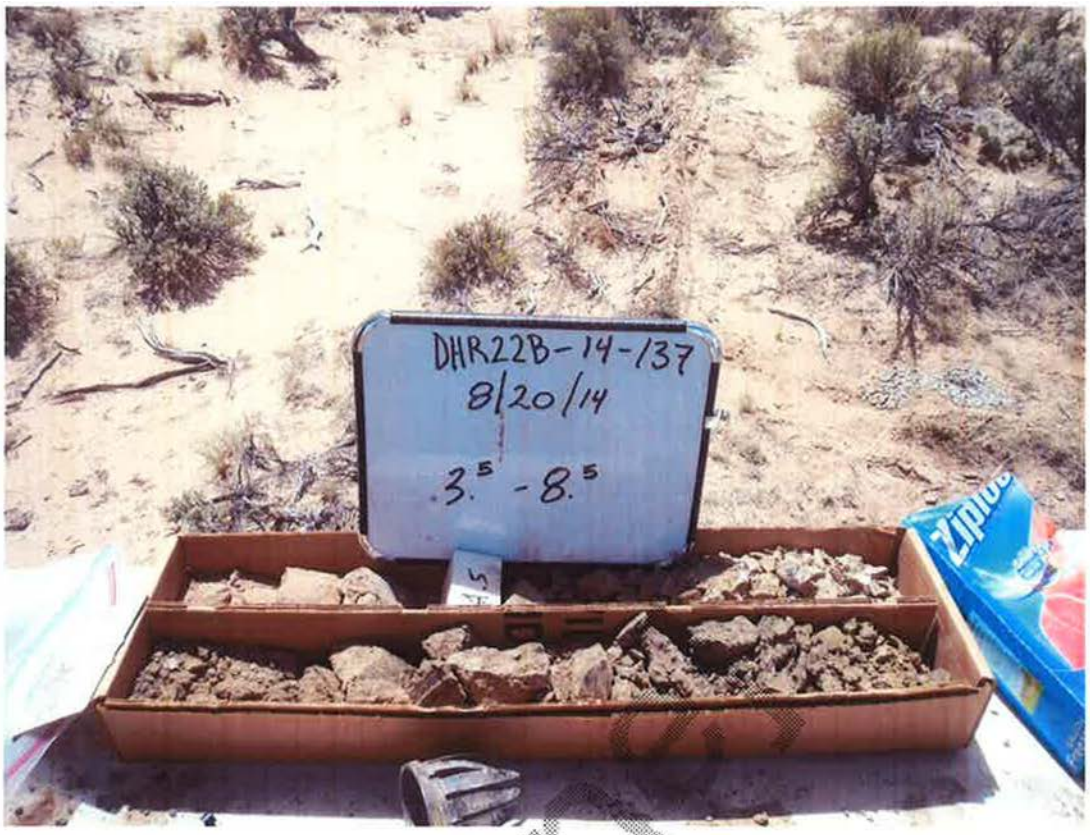
Photograph No. 66 and 67

Photograph No. 68 and 69

Photograph No. 70 and 71



Photograph No. 72 and 73



Photograph No. 74 and 75

Photograph No. 76 and 77

Photograph No. 78

REGULATING TANK 3A AND 3B

DHR22RT3B-14-1 (PREVIOUSLY LABELED DHR22ST1B-14-1)

Photograph No. 79

Photograph No. 80

DHR22RT3B-15-4

Photograph No. 81

Photograph No. 82

Photograph No. 83

DHR22RT3B-15-2

Photograph No. 84

Photograph No. 85

Photograph No. 86

Photograph No. 87

Photograph No. 88

Photograph No. 89

Photograph No. 90

Photograph No. 91

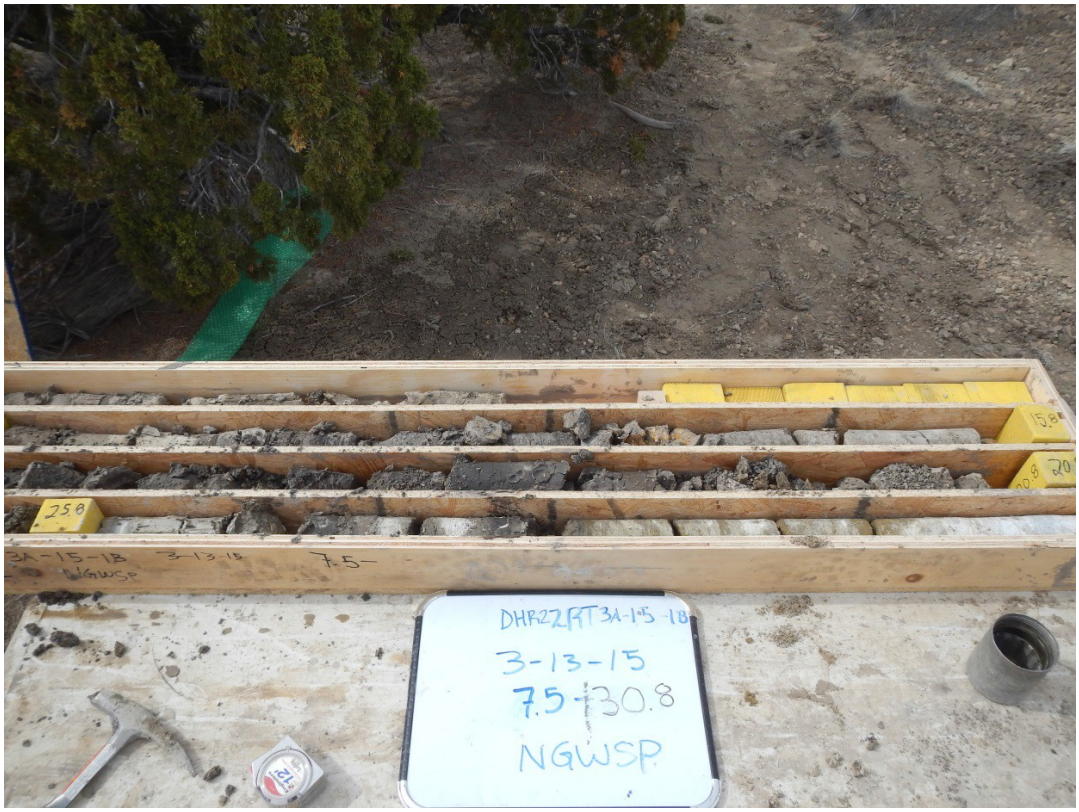
Photograph No. 92

DHR22RT3A-14-4 (PREVIOUSLY LABELED DHST1A-4)

Photograph No. 93

DHR22RT3A-15-1B

Photograph No. 94



Photograph No. 95

Photograph No. 96

Photograph No. 97

DHR22RT3A-15-3B

Photograph No. 98

Photograph No. 99

Photograph No. 100

Photograph No. 101

Photograph No. 102

Photograph No. 103

Photograph No. 104

Photograph No. 105

Photograph No. 106

DHR22RT3A-15-4B

Photograph No. 107

Photograph No. 108

Photograph No. 109 and 110

Photograph No. 111 and 112

Photograph No. 113 and 114

Inon

Photograph No. 115

Photograph No. 116

Photograph No. 117

Photograph No. 118

Photograph No. 119

Photograph No. 120