Geotechnical Investigation for Navajo Gallup Water Supply Project Reach 26.3

- **Geo-Test Geotechnical Engineering Services Report No. 1-71108 for Reach 26.3 Tank Site**
- **Geo-Test Job No. 1-71108, Addendum No. 1 (Per increase in tanks' height from original Report No. 1-71108)**
- **Geo-Test Geotechnical Engineering Services Report No. 1-71109 for Reach 26.3 Water Line**

GEO-TEST

GEOTECHNICAL ENGINEERING SERVICES REPORT NO. 1-71108 NAVAJO GALLUP WATER SUPPLY PROJECT REACH 26.3 TANK SITE OJO ENCINO, NEW MEXICO

PREPARED FOR:

SOUDER MILLER & ASSOCIATES

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December 27, 2017 REVISED 1/8/2018
Job No. 1-71108

Souder Miller & Associates
5454 Venice Avenue NE
Albuquerque, New Mexico 87113

Attn: Ty Tsinnijinnie

RE: Geotechnical Engineering Services
Navajo Gallup Water Supply Project
Reach 26.3 Tank Site
Ojo Encino, New Mexico

Dear Mr. Tsinnijinnie:

Submitted herein is the Geotechnical Engineering Services Report for the above referenced project. The report contains the results of our field investigation and laboratory testing, and recommendations for foundation design as well as criteria for site grading.

It has been a pleasure to serve you on this project. If you should have any questions, please contact this office.

Respectfully submitted:

Patrick R. Whorton, EI

Reviewed by:

Robert D Booth, P

ROBERT D. BOOTH NEW MEXICO 5711 LICENSED PROFESSIONAL ENGINEER

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INTRODUCTION

This report presents the results of our geotechnical engineering services investigation performed by this firm for the proposed new Reach 26.3 Tank Site near Ojo Encino, NM as part of the greater Navajo Gallup Water Supply Project.

The objectives of this investigation were to:

1) Evaluate the nature and engineering properties of the subsurface soils underlying the site.

2) Provide recommendations for foundation design and general site grading.

The investigation includes subsurface exploration, selected soil sampling, laboratory testing of the samples, performing an engineering analysis and preparation of this report.

PROPOSED CONSTRUCTION

It is understood that the project consists of the design and construction of two new 250,000 gallon above ground welded steel water storage tanks along with a small single story chlorination building. Both of the tanks will be 36 feet in diameter and 32 feet in height. Unit loading at the base of the tanks will be on the order of 2 kips per square foot. The chlorination building will be a pre-cast concrete structure consisting of a pre-cast concrete floor slab with incorporated concrete walls and roof. Unit loading at the base of the slab is expected to be relatively light, not exceeding about 0.35 kips per square foot.

Should structural loads or other project details vary significantly from those outlined above, this firm should be notified for review and revision of recommendations contained herein.

FIELD EXPLORATION

Three (3) exploratory borings were drilled at the site. Two (2) borings were drilled to a depth of 30 feet below existing site grades within the footprints of the two water tanks. One (1) boring was drilled to a depth of 15 feet below existing grades within the footprint of the new chlorination building. The locations of the borings are shown on the attached Boring Location Map, Figure 1. The soils encountered in the borings were continuously examined, visually classified and logged during the drilling operation. The boring logs are presented in a following section of this report. Drilling was accomplished using a truck mounted drill rig equipped with 5.5 inch diameter continuous flight hollow stem auger. Subsurface materials were sampled at five foot intervals

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or less utilizing an open tube split barrel sampler or a ring-lined sampler driven by a standard penetration test hammer.

LABORATORY TESTING

Selected samples were tested in the laboratory to determine certain engineering properties of the soils. Moisture contents and dry densities were determined to evaluate the various soil deposits with depth. The results of these tests are shown on the boring logs.

Sieve analysis and Atterberg limits tests were performed to aid in soil classification. In addition, a consolidation test was performed on a select sample to evaluate the volume change characteristics of the soil upon moisture increases. The results of these tests are presented in the Summary of Laboratory Results and on the individual test reports presented in a following section of this report.

SURFACE CONDITIONS

The proposed site is located approximately 5 miles northwest of Ojo Encino. The approximate coordinates of the site are: 36º 01' 29.75" N by 107º 23' 03.54" W. The site is located on top of a small mesa. The site itself is relatively flat but the landscape slopes down significantly to the north and south of the site and slopes down gradually from east to west. The site is undeveloped and populated with native shrubs and grasses.

SUBSURFACE SOIL CONDITIONS

As indicated by the exploratory borings, the soils underlying the site consist of a surficial layer of dense to medium dense, low to medium plasticity clayey sand which extends to a depth of about 8 feet below existing grades. Below this surficial layer, medium to very dense, low to non-plastic silty, clayey sand was encountered and extended to depths ranging from about 20 to 27 feet below existing grades. Below this layer, very firm to hard, high plasticity clay was encountered to the full depths explored.

No free groundwater was encountered and soil moisture contents were low to moderate throughout the extent of the borings.

CONCLUSIONS AND RECOMMENDATIONS

As indicated by the standard penetration test data, the near surface soils encountered at the boring locations are dense to medium dense in their present condition and are considered suitable to provide reliable support of the proposed structures. Accordingly, it is recommended that the proposed water storage tanks be founded on a reinforced concrete ring-wall footings (AWWA Type 1) bearing directly on densified native soils or properly compacted fill if

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required for grading purposes. Alternatively, the tanks may be supported on a granular berm with steel retainer rings (AWWA Type 5 foundation) bearing directly on properly compacted structural fill.

It is recommended that the pre-cast chlorination building be supported on a minimum of 2 feet of properly compacted structural fill bearing directly on densified native soils. If a site-built structure is desired, the building may be supported by shallow spread-type footings bearing directly on densified native soils. Detailed recommendations for foundation design and the required site grading are presented in the following sections of this report.

Post-construction moisture increases beneath the structures could cause some differential foundation movements. Therefore, moisture protection is considered an important design consideration and should be reflected in overall site grading and drainage details as recommended in the Moisture Protection section of this report.

TANK FOUNDATIONS

The proposed water tanks may be supported on a reinforced concrete ring-wall footing (AWWA Type 1) bearing directly on native soils or structural fill prepared as recommended within the Site Grading section of this report. The footings should be designed using an allowable soil bearing pressure not exceeding 2,500 pounds per square foot. The recommended bearing pressure applies to full dead plus realistic live loads and may be increased by one-third for total loads including wind and seismic forces. The ring-wall footings should be established a minimum of 2 feet below the lowest adjacent finished grade. The minimum recommended width of the ring-wall footing is 16 inches. The floor of the tank should be supported on a sand cushion at least 3 inches thick placed directly on densified native soils or structural fill.

Alternatively, the tanks may be supported on granular berms with steel retainer rings (AWWA Type 5). With this alternative, the steel retainer rings should be established at least 12 inches from the tank shell and should allow for adequate drainage such that water is not allowed to permeate the granular berm or infiltrate the supporting subsurface soils. The granular berm should be founded directly on densified native soils. The granular berm should consist of structural fill meeting the requirements presented in the Site Grading section of this report.

It is estimated that total settlement of the tank and ring-wall footing, designed and constructed as recommended herein, will not exceed about 1.0 inch. Differential movement, or tilt across the entire tank bottom, is estimated to be less than 0.5 inches.

The above settlement estimates are based upon the soil moisture contents encountered during test drilling or moisture contents introduced during

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construction. Post construction moisture increases in the supporting soils could create additional movements and, thus, the moisture protection procedures as recommended in a following section of this report are considered important for the satisfactory performance of the tank structures.

BUILDING FOUNDATIONS

The pre-cast chlorination building should be founded on a minimum thickness of 2 feet of properly compacted structural fill placed and compacted as recommended in the Site Grading section of this report. The structural fill should extend a minimum of 2 feet laterally beyond the perimeter of the building.

Should a site-built chlorination building be desired, it should be supported on shallow spread-type footings and slabs-on-grade bearing directly on densified native soils or properly compacted fill if required for grading purposes. An allowable soil bearing pressure of 2,000 pounds per cubic foot is recommended for footing design. This bearing pressure applies to full dead loads plus realistic live loads and may be increased by one-third for total loads including wind and seismic forces. Exterior footing should be established a minimum of 2.0 feet below the lowest adjacent finish grade, while interior footings should be at least 12 inches below finish floor grade. The minimum width of square and continuous footings is 2.0 and 1.33 feet respectively.

Total settlements of foundations designed and constructed as recommended herein are estimated not to exceed ¾ inch for the soil moisture contents encountered during this investigation or moisture contents introduced during construction. Differential movements should be less than 75 percent of total movements. Significant post-construction moisture increases in the supporting soils would create additional movements, and thus, the moisture protection provisions as recommended in a following section of this report are considered critical for the satisfactory performance of the structure.

LATERAL LOADS

Resistance to lateral forces will be provided by soil friction between the base of floor slabs and footings and the soil and by passive earth resistance against the sides of the footings and stem walls. A coefficient of friction of 0.40 should be used for computing the lateral resistance between bases of footings and slabs and the soil. With backfill placed as recommended in the site grading section of this report, a passive soil resistance equivalent to a fluid weighing 325 pounds per cubic foot should be used for analysis.

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SLABS ON GRADE

Adequate support for lightly loaded slab-on-grade floors will be provided by the densified native soils or structural fill when compacted as recommended in a following section of this report. Thus, the use of granular base for structural support of lightly loaded slabs is not considered necessary. However, should it be desired as a working surface or to increase the modulus of subgrade, a course of granular base can be placed beneath concrete floor slabs.

Where granular base is used beneath the slabs, it should have a plasticity index of no greater than 3 and meet the following grading requirements:

Sieve Size Square Openings	Percent Passing by Dry Weight
1 Inch	100
¾ Inch	70-100
No. 4	35-85
No. 200	0-10

The granular base should be compacted to at least 95 percent of maximum dry density as determined in accordance with ASTM D1557.

SITE GRADING

The following general guidelines should be included in the project construction specifications to provide a basis for quality control during site grading. It is recommended that all structural fill and backfill be placed and compacted under engineering observation and in accordance with the following:

1) After site clearing and stripping, the native soils throughout the building areas should be densified prior to placement of foundations or structural fill.

2) Densification of the native soils should consist of scarifying to a depth of 8 inches, moisture conditioning to the optimum moisture content or above to as deep as practicable, and compacting the area to a minimum of 95 percent of maximum dry density as determined in accordance with ASTM D-1557.

3) The results of this investigation indicate that most of the native soils will be suitable for use as structural fill; however, some blending may be required. Import material may also be used as structural fill provided it meets the specifications presented below.

4) All structural fill and backfill should be free of vegetation and debris, and contain no rocks larger than 3 inches. Gradation of the backfill material, as determined in accordance with ASTM D-422, should be as follows:

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Size	Percent Passing
3 inch	100
No. 4	60 - 100
No. 200	20 - 50

5) The plasticity index of the structural fill should be no greater than 15 when tested in accordance with ASTM D-4318.

6) Fill or backfill, consisting of soil approved by the geotechnical engineer, shall be placed in 8 inch loose lifts and compacted with approved compaction equipment. Loose lifts should be reduced to 4 inches if hand held compaction equipment is used. All compaction of fill or backfill shall be accomplished to a minimum of 95 percent of the maximum dry density as determined in accordance with ASTM D-1557. The moisture content of the structural fill during compaction should be within 2 percent of the optimum moisture content.

7) Tests for degree of compaction should be determined by the ASTM D-1556 method or ASTM D-6938. Observation and field tests should be performed during fill and backfill placement by the geotechnical engineer to assist the contractor in obtaining the required degree of compaction. If less than 95 percent is indicated, additional compaction effort should be made with adjustment of the moisture content as necessary until 95 percent compaction is obtained.

MOISTURE PROTECTION

Precautions should be taken during and after construction to minimize moisture increases of foundation soils. Accumulations of excessive moisture can weaken or cause other changes in the soils supporting the foundations. This can cause differential movement of foundations and can result in structural damage to the tanks and building.

Proper drainage maintenance is required to preclude accumulation of excessive moisture in the soils supporting foundations. Positive drainage should be established away from the foundation perimeters of the tanks and building. The slope away from the perimeters should be a minimum of 5 percent for a minimum distance of 10 feet and be sloped to provide positive drainage beyond. If necessary to provide positive drainage, the building areas should be raised above adjacent grade with structural fill. All backfill should be well compacted and should meet the specifications outlined in the Site Grading section of this report. Irrigation within 10 feet of foundations is discouraged. All utility trenches leading into the tanks or building should be backfilled with compacted fill. If any water lines or tank leaks are detected, they should be promptly repaired. In addition, if any depressions develop from settlement of soils in utility trenches or other areas, they should be backfilled

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to maintain the grade so that surface water drains rapidly away from the tanks and building.

The foregoing recommendations should only be considered minimum requirements for overall site development. It is recommended that a civil/drainage engineer be consulted to provide more detailed grading and drainage recommendations.

FOUNDATION REVIEW AND INSPECTION

This report has been prepared to aid in the evaluation of this site and to assist in the design of this project. It is recommended that the geotechnical engineer be provided the opportunity to review the final design drawings and specifications in order to determine whether the recommendations in this report are applicable to the final design. Review of the final design drawings and specifications should be noted in writing by the geotechnical engineer.

In order to permit correlation between the conditions encountered during construction and to confirm recommendations presented herein, it is recommended that the geotechnical engineer be retained to perform continuous observations and testing during the foundation construction and earthwork portions of this project. Observation and testing should be performed during construction to confirm that suitable fill soils are placed upon competent materials and properly compacted and foundation elements penetrate the recommended materials.

CLOSURE

Our conclusions, recommendations and opinions presented herein are:

1) Based upon our evaluation and interpretation of the findings of the field and laboratory program.

2) Based upon an interpolation of soil conditions between and beyond the explorations.

3) Subject to confirmation of the conditions encountered during construction.

4) Based upon the assumption that sufficient observation will be provided during construction.

5) Prepared in accordance with generally accepted professional geotechnical engineering principles and practice.

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This report has been prepared for the sole use of Souder Miller & Associates, specifically to aid in the design of the proposed new Reach 26.3 Tank Site as part of the Navajo Gallup Water Supply Project near Ojo Encino, NM and not for use by any third parties.

We make no other warranty, either express or implied. Any person using this report for bidding or construction purposes should perform such independent investigation as they deem necessary to satisfy themselves as to the surface and subsurface conditions to be encountered and the procedures to be used in the performance of work on this project. If conditions encountered during construction appear to be different than indicated by this report, this office should be notified.

All soil samples will be discarded 60 days after the date of this report unless we receive a specific request to retain the samples for a longer period of time.

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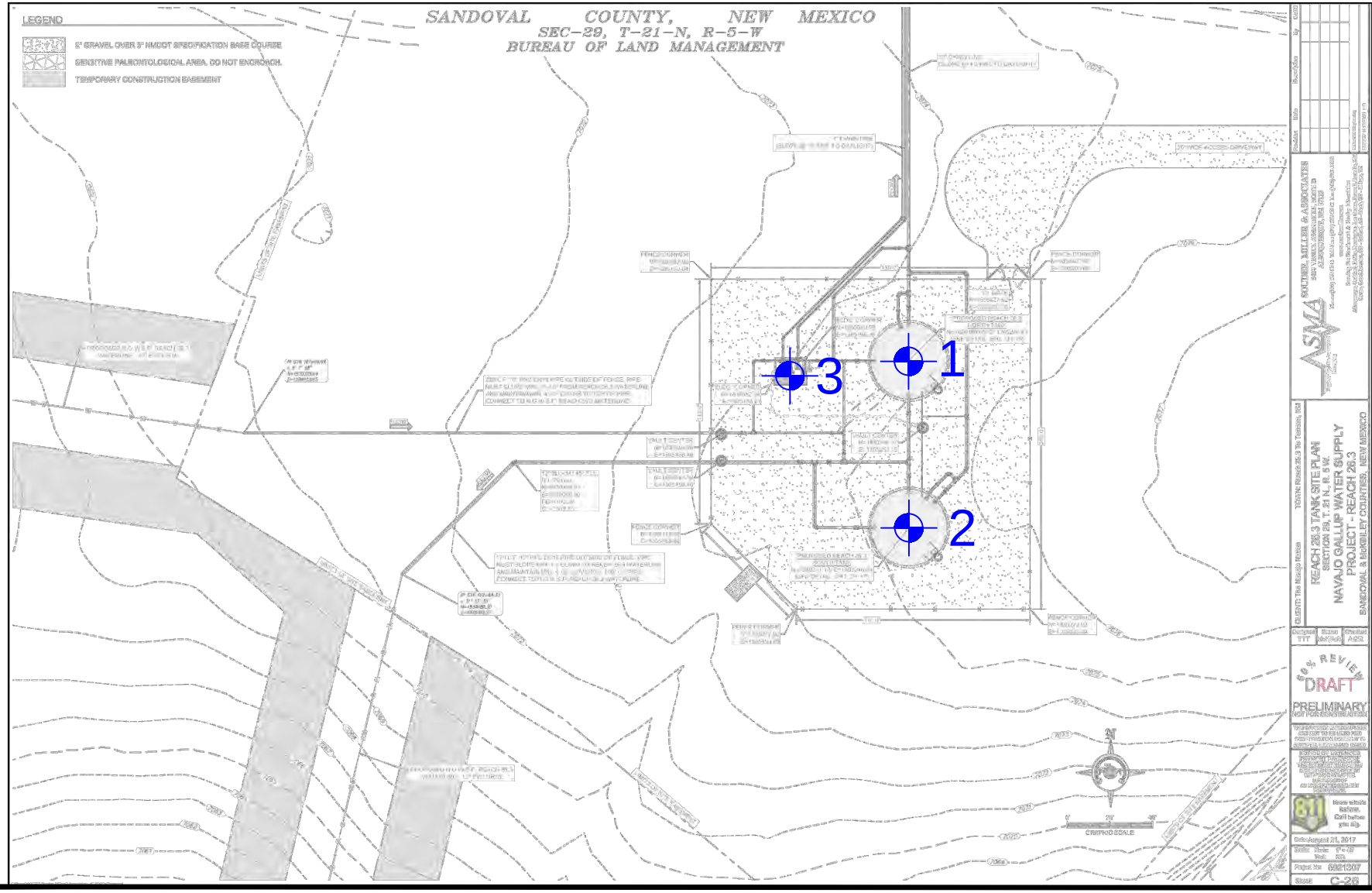
BORING LOCATION MAP



NGWS Reach 26.3 Tank Site
Ojo Encino, New Mexico
Job No. 1-71108

Figure 1

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GEOTECHNICAL ENGINEERING
AND MATERIAL TESTING

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Project: NGWS Reach 26.3 Tank Site
Date: 12/12/2017 Project No: 1-71108
Elevation: 7075.0 Type: 5.5" OD HSA

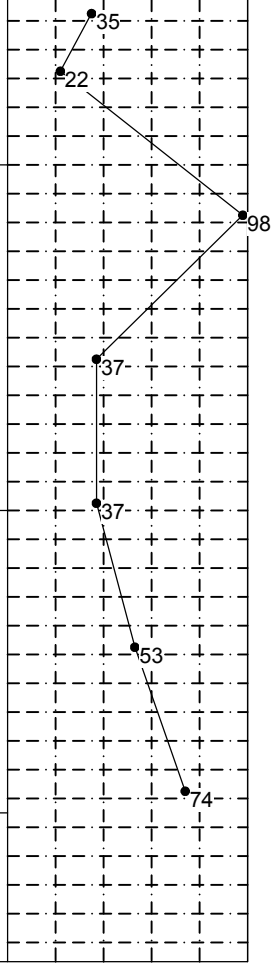
LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 1

During Drilling: none After 24 Hours:

DEPTH (Ft)	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION
0		SS	13-18-17 35	7		SC	CLAYEY SAND, low plasticity, dense to medium dense, slightly moist to dry, light brown
5		SS	8-13-9 22	5			
10		SS	18-48-50 98	4		SM	SILTY SAND, non-plastic, very dense to dense, dry, light brown
15		SS	11-18-19 37	4			
20		SS	13-18-19 37	22		CH	CLAY, high plasticity, very firm to hard, moist, dark brown/purple
25		SS	13-21-32 53	26			
30		SS	17-24-50 74	24			Stopped Auger @ 29 feet Stopped Sampler @ 30.5 feet
35							



LOG OF TEST BORING 1-71108 REACH 26.3 TANK SITE.GPJ GEO TEST.GDT 12/26/17

LEGEND

SS - Split Spoon
AC - Auger Cuttings
UD/SL - Undisturbed Sleeve
AMSL - Above Mean Sea Level
CS - Continuous Sampler
UD - Undisturbed
ST - Shelby Tube

Stratification lines represent approximate boundaries between soil types. Transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to factors other than those present at the time measurments were made.

GEO-TEST

Project: NGWS Reach 26.3 Tank Site
Date: 12/12/2017 Project No: 1-71108
Elevation: 7075.0 Type: 5.5" OD HSA

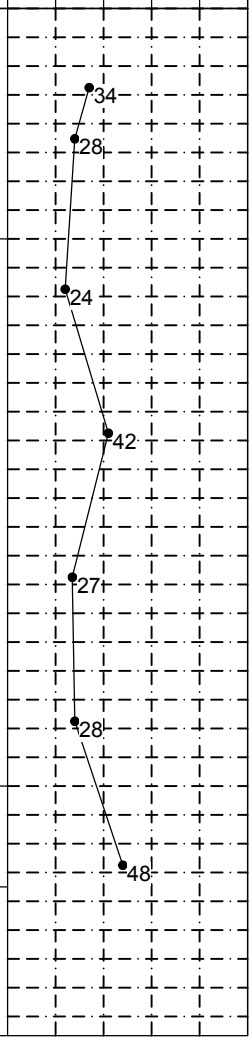
LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 2

During Drilling: none After 24 Hours:

DEPTH (Ft)	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION
0		SS	11-13-21 34	6		SC	CLAYEY SAND, low plasticity, medium dense, slightly moist to dry, light brown
5		UD	11-17 28	6	107		
10		SS	8-10-14 24	3		SM	SILTY, CLAYEY SAND, low plasticity, medium dense to dense, dry, light brown
15		SS	8-13-29 42	6			
20		SS	10-10-17 27	4			
25		SS	11-11-17 28	3			
30		SS	10-18-30 48	25		CH	CLAY, high plasticity, very firm, moist, dark brown/purple
35							Stopped Auger @ 29 feet Stopped Sampler @ 30.5 feet



LOG OF TEST BORING 1-71108 REACH 26.3 TANK SITE.GPJ GEO TEST.GDT 12/26/17

LEGEND

SS - Split Spoon
AC - Auger Cuttings
UD/SL - Undisturbed Sleeve
AMSL - Above Mean Sea Level
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Stratification lines represent approximate boundaries between soil types. Transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to factors other than those present at the time measurments were made.

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Project: NGWS Reach 26.3 Tank Site
Date: 12/12/2017 Project No: 1-71108
Elevation: 7074.0 Type: 5.5" OD HSA

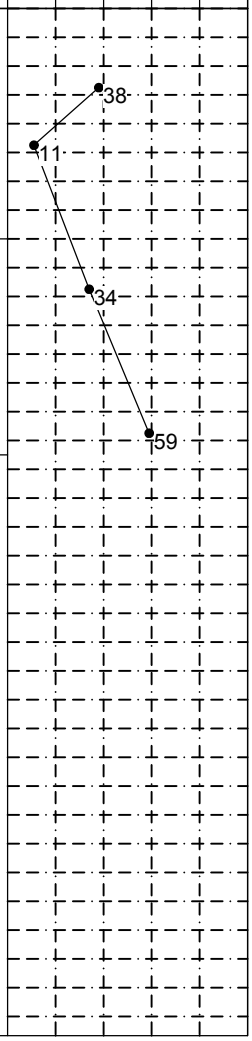
LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 3

During Drilling: none After 24 Hours:

DEPTH (Ft)	LOG	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION
5			SS	7-17-21 38	8		SC	CLAYEY SAND, medium plasticity, dense to medium dense, slightly moist, light brown
			SS	4-5-6 11	6			
10			SS	4-12-22 34	1		SM	SILTY SAND, non-plastic, medium to very dense, dry, light brown
15			SS	13-21-38 59	4			Stopped Auger @ 14 feet Stopped Sampler @ 15.5 feet
20								
25								
30								
35								



LOG OF TEST BORING 1-71108 REACH 26.3 TANK SITE.GPJ GEO TEST.GDT 12/26/17

LEGEND

SS - Split Spoon
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Stratification lines represent approximate boundaries between soil types. Transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to factors other than those present at the time measurments were made.

SUMMARY OF LABORATORY RESULTS

						SIEVE ANALYSIS PERCENT PASSING											
TEST HOLE	DEPTH (FEET)	UNIFIED CLASS	(%) MOIST	LL	PI	NO 200	NO 100	NO 40	NO 10	NO 4	3/8"	1/2"	3/4"	1"	1 1/2"	2"	4"
1	3.0		7.2														
1	5.0		4.6														
1	10.0	SM	3.8	NP	NP	20	40	87	99	100							
1	15.0		4.2														
1	20.0		21.9														
1	25.0	CH	25.9	67	36	87	95	99	100								
1	30.0		24.0														
2	3.0		6.2														
2	5.0	SC	5.7	25	9	44	66	93	100								
2	10.0		3.4														
2	15.0	SC-SM	5.8	24	5	48	71	98	100								
2	20.0		3.7														
2	25.0		3.0														
2	30.0		25.3														
3	3.0	SC	7.8	32	13	42	63	86	97	100							
3	5.0		5.6														
3	10.0		1.0														
3	15.0		4.5														

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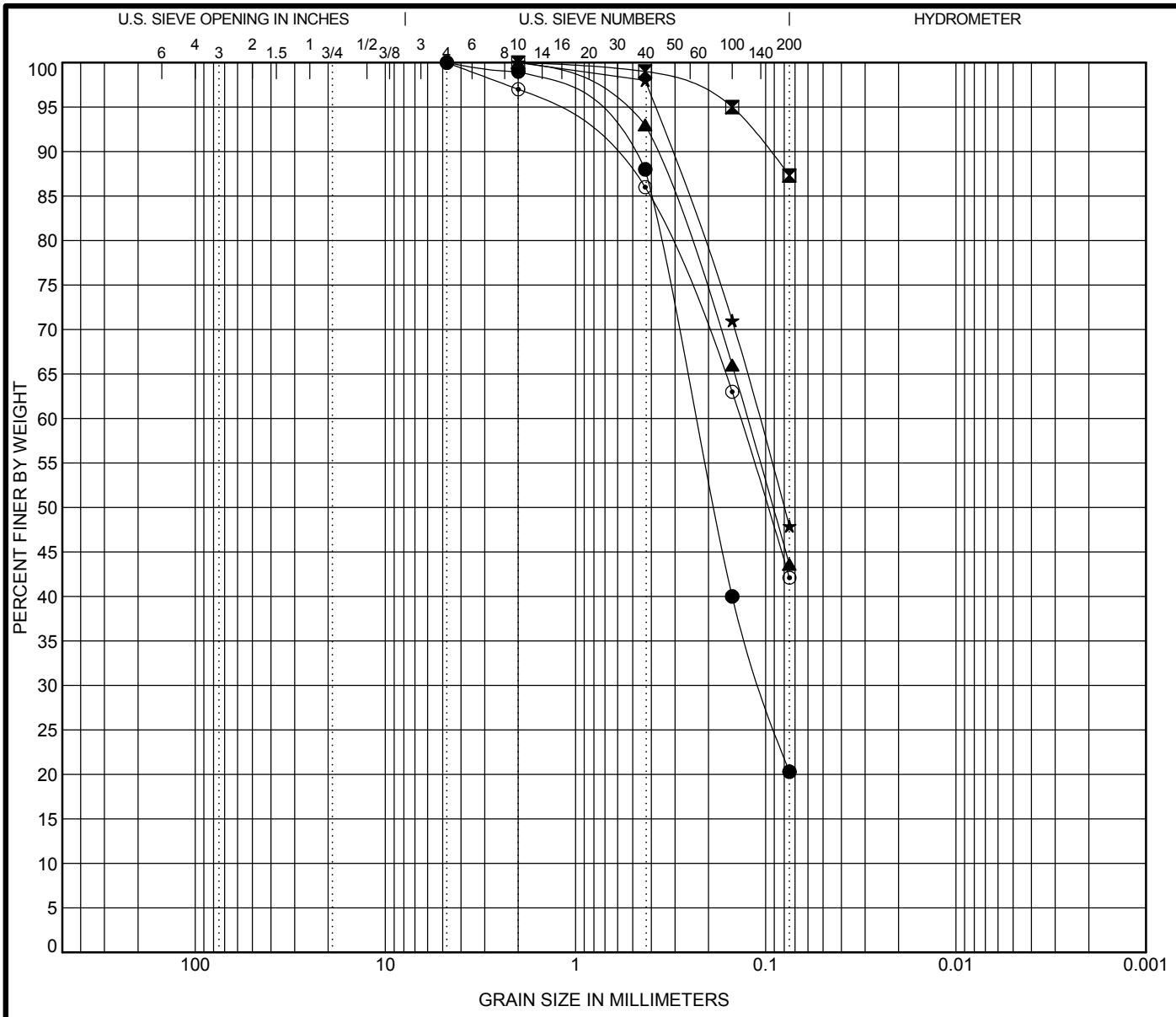
LL = LIQUID LIMIT
PI = PLASTICITY INDEX
NP = NON PLASTIC or NO VALUE

Project: NGWS Reach 26.3 Tank Site
Location: Ojo Encino, New Mexico
Number: 1-71108

SUMMARY OF LABORATORY RESULTS 1-71108 REACH 26.3 TANK SITE.GPJ GEO TEST.GDT 12/26/17



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	1	10.0	**SILTY SAND(SM)**	**NP**	**NP**	**NP**		
⊠	1	25.0	**FAT CLAY(CH)**	**67**	**31**	**36**		
▲	2	5.0	**CLAYEY SAND(SC)**	**25**	**16**	**9**		
★	2	15.0	**SILTY, CLAYEY SAND(SC-SM)**	**24**	**19**	**5**		
⊙	3	3.0	**CLAYEY SAND(SC)**	**32**	**19**	**13**		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	1	10.0	**4.75**	**0.233**	**0.106**		**0.0**	**79.7**	**20.3**	
⊠	1	25.0	**2**				**0.0**	**12.7**	**87.3**	
▲	2	5.0	**2**	**0.125**			**0.0**	**56.4**	**43.6**	
★	2	15.0	**2**	**0.108**			**0.0**	**52.1**	**47.9**	
⊙	3	3.0	**4.75**	**0.136**			**0.0**	**57.9**	**42.1**	

GEO-TEST

GRAIN SIZE DISTRIBUTION

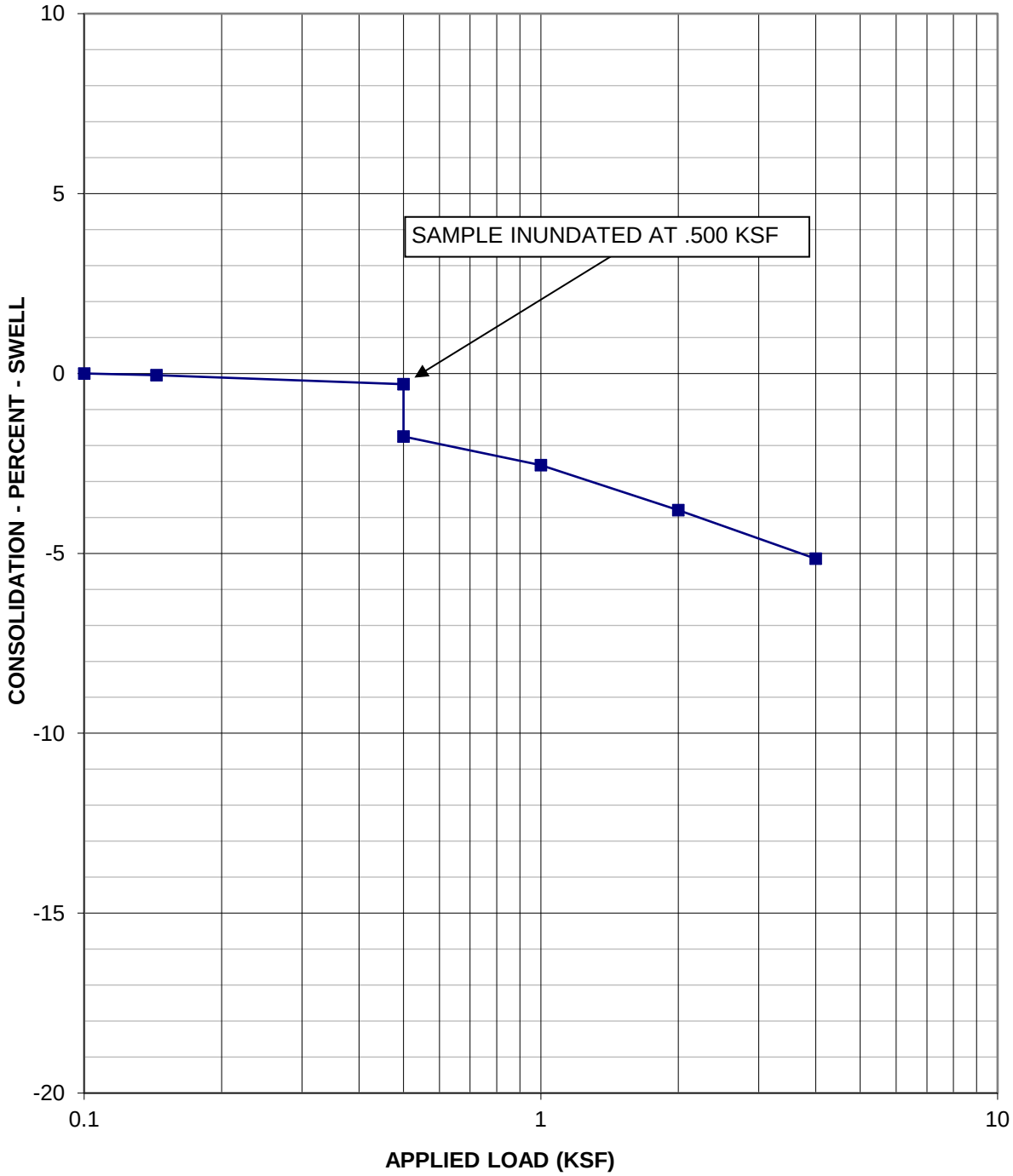
Project: NGWS Reach 26.3 Tank Site

Location: Ojo Encino, New Mexico

Number: 1-71108

US GRAIN SIZE 1-71108 REACH 26.3 TANK SITE.GPJ GEO TEST.GDT 12/26/17

CONSOLIDATION TEST RESULT
Reach 26.3 Tank Site
JOB NO. 1-71108
Boring #2 @ 5'
Clayey Sand



INITIAL MOISTURE CONTENT = 3.2 %
INITIAL DRY DENSITY = 107.4 PCF

GEO-TEST

GEO-TEST

February 6, 2018
Job No. 1-71108, Addendum No. 1

Souder Miller & Associates
5454 Venice Avenue NE
Albuquerque, New Mexico 87113

ATTN: Ty Tsinnijinnie

RE: Geotechnical Engineering Services Report
Navajo Gallup Water Supply Project
Reach 26.3 Tank Site
Ojo Encino, New Mexico

Dear Mr. Tsinnijinnie:

In accordance with your request, submitted herewith is Addendum No. 1 to our geotechnical engineering services report for the above referenced project. The objective of this addendum is to address changes in the proposed water tank construction and dimensions.

The tank design recommendations presented within the original report were for two new 250,000 gallon above ground welded steel water storage tanks. Both of the steel welded tanks were to be 36 feet in diameter and 32 feet in height with base unit loading on the order of 2 kips per square foot. It is now understood that Glass-Fused-to-Steel Tanks are now being considered for the project. The Glass-Fused-to-Steel Tanks will also each have a 250,000 gallon capacity, however, the diameter of the tanks will now be 42 feet and the height will be 24 feet. Unit loading on the base of the Glass-Fused-To-Steel tanks will be on the order of 1.5 kips per square foot.

The use of Glass-Fused-to-Steel tanks in lieu of welded steel tanks is acceptable for the site. The foundation recommendations presented within the original report for welded steel tanks will also apply to Glass-Fused-To-Steel tanks and do not require alteration.

This addendum should be attached to the original report and made a part thereof. If you should have any questions, please contact the undersigned in the Geo-Test, Inc. Albuquerque Office at (505) 857-0933.

Respectfully submitted:
GEO-TEST, INC.

Patrick R. Whorton, EI

Reviewed By:

Robert D Booth, P.E.

ROBERT D. BOOTH
NEW MEXICO
5711
LICENSED PROFESSIONAL ENGINEER

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GEO-TEST

GEOTECHNICAL ENGINEERING SERVICES REPORT NO. 1-71109 NAVAJO GALLUP WATER SUPPLY PROJECT REACH 26.3 WATER LINE OJO ENCINO, NEW MEXICO

PREPARED FOR:

SOUDER MILLER & ASSOCIATES

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GEO-TEST

February 19, 2018
Job No. 1-71109

Souder Miller & Associates
5454 Venice Avenue NE
Albuquerque, New Mexico 87113

Attn: Ty Tsinnijinnie

RE: Geotechnical Engineering Services
Navajo Gallup Water Supply Project
Reach 26.3 Water Line
Ojo Encino, New Mexico

Dear Mr. Tsinnijinnie:

Submitted herein is the Geotechnical Engineering Services Report for the above referenced project. The report contains the results of our field investigation and laboratory testing.

It has been a pleasure to serve you on this project. If you should have any questions, please contact this office.

Respectfully submitted:

Patrick R. Whorton, EI

Reviewed by:

Robert D Booth, P.E.

ROBERT D. BOOTH NEW MEXICO 5711 LICENSED PROFESSIONAL ENGINEER

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Table of Contents

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INTRODUCTION

This report presents the results of our geotechnical engineering services investigation performed by this firm for the proposed new Reach 26.3 Water Line near Ojo Encino, NM as part of the greater Navajo Gallup Water Supply Project.

The objectives of this investigation were to evaluate the nature and engineering properties of the subsurface soils and/or rock underlying the proposed water line alignment.

The investigation includes subsurface exploration, selected soil and/or rock sampling, laboratory testing of the samples, performing an engineering analysis and preparation of this report.

PROPOSED CONSTRUCTION

It is understood that the project consists of the design and construction of approximately 10 miles of new water line. The proposed alignment is in a relatively undeveloped area. Portions of the proposed alignment were deemed inaccessible during a SMA and GTI joint site visit, therefore, the total number of borings was reduced to those included within this report. It is understood that the inaccessible portions of the alignment may be investigated at a later date.

Should project details vary significantly from those outlined above, this firm should be notified for review and revision of recommendations contained herein.

FIELD EXPLORATION

Twenty-four (24) exploratory borings were drilled along the proposed water line alignment. The borings are categorized by type as follows:

Type 1) **Arroyo Crossing** – Drilled 30 feet below existing grade. Standard penetration tests and split spoon or open end drive sampling conducted in the borings at 2.5 feet, 5.0 feet, and at 5 foot intervals thereafter. Sampling and laboratory testing was performed.

Type 2) **Density Measurements and Sampling** - Borings drilled to depths of about 10 feet below existing grade. In situ moisture and density testing conducted within the borings utilizing an open ring sampler at depths of 4 and 6 feet below existing grade. Subsurface soils were visually logged and classified. Sampling and laboratory testing was performed to confirm visual classification.

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Type 3) **Visual Classification** – Borings drilled to depths of about 10 feet below existing grade. Subsurface soils were visually logged and classified. No sampling or laboratory testing was performed.

The locations of the borings are shown on the attached Boring Location Map, Figure 1. A table detailing the type and location of each boring is also included. The boring logs are presented in a following section of this report. Drilling was accomplished using a truck mounted drill rig equipped with a 5.5 inch or 6.5 inch diameter continuous flight hollow stem auger.

LABORATORY TESTING

Selected samples were tested in the laboratory to determine certain engineering properties of the soils. Moisture contents and dry densities were determined to evaluate the various soil deposits with depth. The results of these tests are shown on the boring logs.

Sieve analysis and Atterberg limits tests were performed to aid in soil classification. The results of these tests are presented in the Summary of Laboratory Results and on the individual test reports presented in a following section of this report.

SURFACE CONDITIONS

The proposed water line alignment is located northwest of Ojo Encino and roughly parallels Indian Service Road 471, see Figure 1. The topography throughout the alignment varies from relatively flat to steep grade changes. Several arroyos cross the alignment and a portion of the alignment passes near a heavily eroded mesa formation. The alignment is located in a sparsely populated area, with a majority of the alignment located in undeveloped areas populated with native shrubs and grasses.

SUBSURFACE SOIL/ROCK CONDITIONS

As indicated by the exploratory borings, the soils underlying the site consist primarily of non-plastic silty sand, low plasticity clayey sand and medium plasticity sandy clay. At the base of the eroded mesa area (borings 21 and 22) weathered shale and sandstone bedrock was encountered. With the exception of the mesa area, the soils encountered along the water line alignment may be trenched using normal excavation equipment. The drill rig was able to penetrate the weathered bedrock in the mesa area without experiencing auger refusal. It is anticipated that these areas may also be excavatable, however, the bedrock is relatively hard and heavy ripping or rock breaking equipment (hoe-rams) may be required and should be available for excavations through the near mesa area.

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No free groundwater was encountered and soil moisture contents were low to moderate throughout the extent of the borings.

CLOSURE

Our conclusions, recommendations and opinions presented herein are:

1) Based upon our evaluation and interpretation of the findings of the field and laboratory program.

2) Based upon an interpolation of soil conditions between and beyond the explorations.

3) Prepared in accordance with generally accepted professional geotechnical engineering principles and practice.

This report has been prepared for the sole use of Souder Miller & Associates, specifically to aid in the design of the proposed new Reach 26.3 Water Line as part of the Navajo Gallup Water Supply Project near Ojo Encino, NM and not for use by any third parties.

We make no other warranty, either express or implied. Any person using this report for bidding or construction purposes should perform such independent investigation as they deem necessary to satisfy themselves as to the surface and subsurface conditions to be encountered and the procedures to be used in the performance of work on this project. If conditions encountered during construction appear to be different than indicated by this report, this office should be notified.

All soil samples will be discarded 60 days after the date of this report unless we receive a specific request to retain the samples for a longer period of time.

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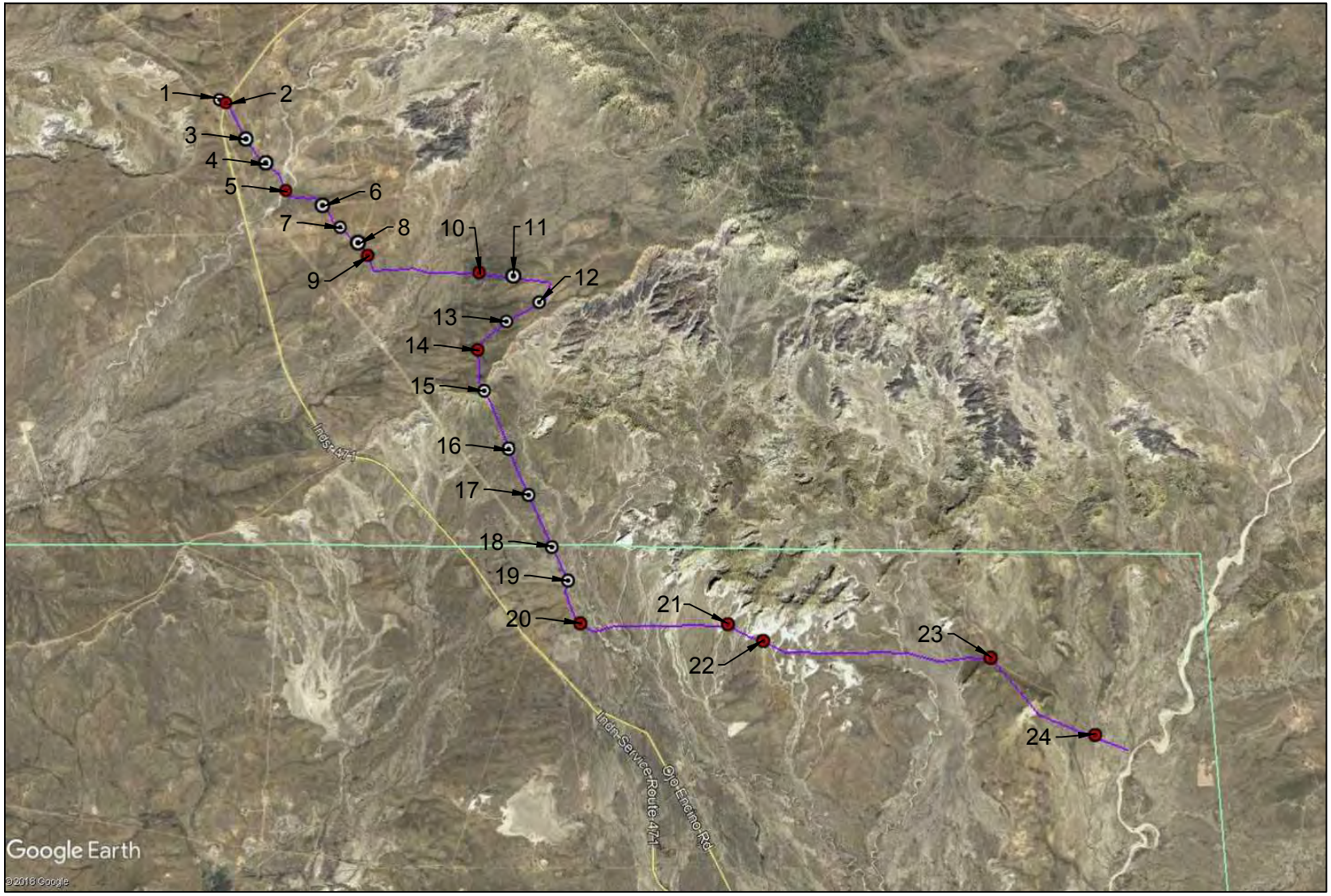
BORING LOCATION MAP



NGWS Reach 26.3 Water Line
Ojo Encino, New Mexico
Job No. 1-71109

Figure 1

N
W E
S

GEO-TEST
GEOTECHNICAL ENGINEERING
AND MATERIAL TESTING

Boring	Type	Depth (ft)	Location
1	3	10	36° 02' 39.48" N 107° 25' 34.49" W
2	2	10	36° 02' 39.71" N 107° 25' 32.35" W
3	3	10	36° 02' 24.30" N 107° 25' 21.16" W
4	3	10	36° 02' 15.14" N 107° 25' 11.51" W
5	1	30	36° 02' 04.73" N 107° 25' 01.77" W
6	3	10	36° 01' 58.48" N 107° 24' 44.71" W
7	3	10	36° 01' 50.36" N 107° 24' 36.35" W
8	3	10	36° 01' 44.41" N 107° 24' 28.26" W
9	2	10	36° 01' 39.68" N 107° 24' 23.63" W
10	2	10	36° 01' 33.49" N 107° 23' 34.57" W
11	3	10	36° 01' 31.97" N 107° 23' 19.41" W
12	3	10	36° 01' 22.41" N 107° 23' 07.78" W
13	3	10	36° 01' 15.39" N 107° 23' 21.80" W
14	2	10	36° 01' 05.12" N 107° 23' 33.81" W
15	3	10	36° 00' 50.51" N 107° 23' 30.09" W
16	3	10	36° 00' 30.74" N 107° 23' 19.23" W
17	3	10	36° 00' 14.71" N 107° 23' 10.38" W
18	3	10	36° 59' 56.95" N 107° 22' 59.69" W
19	3	10	36° 59' 45.63" N 107° 22' 52.90" W
20	2	10	36° 59' 31.31" N 107° 22' 47.39" W
21	2	10	36° 59' 31.11" N 107° 21' 46.51" W
22	2	10	36° 59' 25.59" N 107° 21' 32.30" W
23	2	10	36° 59' 20.18" N 107° 19' 58.99" W
24	2	10	36° 58' 55.09" N 107° 19' 17.86" W

GEO-TEST

Project: NGWS Reach 26.3 Water Line
Date: 01/24/2018 Project No: 1-71109
Elevation: Type: 5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 01

During Drilling: none After 24 Hours:

DEPTH (Ft)	LOG	SAMPLE INTERVAL	SAMPLE TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	SUBSURFACE PROFILE DESCRIPTION	N blows/ft 20 40 60 80
0							SC	CLAYEY SAND, low plasticity, moist, brown	
5							SM	SILTY SAND, non-plastic, moist, light brown	
10								Stopped Auger @ 10 feet	
15									
20									
25									
30									
35									
40									

LOG OF TEST BORING 1-71109 REACH 26.3 WATERLINE.GPJ GEO TEST.GDT 2/16/18

LEGEND

SS - Split Spoon
AC - Auger Cuttings
UD/SL - Undisturbed Sleeve
AMSL - Above Mean Sea Level
CS - Continuous Sampler
UD - Undisturbed
ST - Shelby Tube

Stratification lines represent approximate boundaries between soil types. Transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to factors other than those present at the time measurments were made.

GEO-TEST

Project: NGWS Reach 26.3 Water Line
Date: 02/07/2018 Project No: 1-71109
Elevation: Type: 6.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 02

During Drilling: none After 24 Hours:

DEPTH (Ft)	LOG	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION
			SS	4-5-6 11	12		SC	CLAYEY SAND, low plasticity, medium dense, moist, brown
			UD	10-8 18	15	100		
5			UD	8-11 19	11	110	SM	SILTY SAND, non-plastic, medium dense, slightly moist, light brown
			SS	9-9-13 22	8			
10								Stopped Auger @ 9 feet Stopped Sampler @ 10.5 feet
15								
20								
25								
30								
35								
40								

N blows/ft
20 40 60 80
11
18
19
22

LOG OF TEST BORING 1-71109 REACH 26.3 WATERLINE.GPJ GEO TEST.GDT 2/16/18

LEGEND

SS - Split Spoon
AC - Auger Cuttings
UD/SL - Undisturbed Sleeve
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GEO-TEST

Project: NGWS Reach 26.3 Water Line
Date: 01/24/2018 Project No: 1-71109
Elevation: Type: 5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 03

During Drilling: none After 24 Hours:

DEPTH (Ft)	LOG	SAMPLE INTERVAL	SAMPLE TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION	N blows/ft 20 40 60 80
5							SM	SILTY SAND with GRAVEL, non-plastic, moist, light brown	
							SC	CLAYEY SAND, low plasticity, moist, brown to yellowish brown	
10								Stopped Auger @ 10 feet	
15									
20									
25									
30									
35									
40									

LOG OF TEST BORING 1-71109 REACH 26.3 WATERLINE.GPJ GEO TEST.GDT 2/16/18

LEGEND

SS - Split Spoon
AC - Auger Cuttings
UD/SL - Undisturbed Sleeve
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GEO-TEST

Project: NGWS Reach 26.3 Water Line
Date: 01/24/2018 Project No: 1-71109
Elevation: Type: 5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 04

During Drilling: none After 24 Hours:

DEPTH (Ft)	LOG	SAMPLE INTERVAL	SAMPLE TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	SUBSURFACE PROFILE DESCRIPTION	N blows/ft 20 40 60 80
5							SC	SILTY SAND, non-plastic, slightly moist, light brown	
10								Stopped Auger @ 10 feet	
15									
20									
25									
30									
35									
40									

LOG OF TEST BORING 1-71109 REACH 26.3 WATERLINE.GPJ GEO TEST.GDT 2/16/18

LEGEND

SS - Split Spoon
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GEO-TEST

Project: NGWS Reach 26.3 Water Line
Date: 02/07/2018 Project No: 1-71109
Elevation: Type: 5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 05

During Drilling: none After 24 Hours:

DEPTH (Ft)	LOG	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	SUBSURFACE PROFILE DESCRIPTION	N blows/ft (20 40 60 80)
			SS	5-5-5 10	19		SW-SM	WELL GRADED SAND, with SILT, non-plastic, medium dense to loose, wet to slightly moist, light brown/white	10
5			SS	5-6-8 14	18				14
10			SS	3-3-5 8	9				8
15			SS	1-3-8 11	23		CL	CLAY with SAND, medium plasticity, moderately firm, very moist, brown	11
20			SS	1-8-4 12	20				12
25			SS	5-7-8 15	12		SM	SILTY SAND, non-plastic, medium dense, moist, light brown	15
							CL	CLAY with SAND, medium plasticity, moderatelty firm, very moist, brown	
30			SS	5-8-5 13	20			Stopped Auger @ 29 feet Stopped Sampler @ 30.5 feet	13
35									
40									

LOG OF TEST BORING 1-71109 REACH 26.3 WATERLINE.GPJ GEO TEST.GDT 2/16/18

LEGEND

SS - Split Spoon
AC - Auger Cuttings
UD/SL - Undisturbed Sleeve
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Stratification lines represent approximate boundaries between soil types. Transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to factors other than those present at the time measurments were made.

GEO-TEST

Project: NGWS Reach 26.3 Water Line
Date: 01/24/2018 Project No: 1-71109
Elevation: Type: 5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 06

During Drilling: none After 24 Hours:

DEPTH (Ft)	LOG	SAMPLE INTERVAL	SAMPLE TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION	N blows/ft 20 40 60 80
							CL	SANDY CLAY, low to medium plasticity, moist, brown	
5							SM	SILTY SAND, non-plastic, moist, light brown to yellowish brown	
10								Stopped Auger @ 10 feet	
15									
20									
25									
30									
35									
40									

LOG OF TEST BORING 1-71109 REACH 26.3 WATERLINE.GPJ GEO TEST.GDT 2/16/18

LEGEND

SS - Split Spoon
AC - Auger Cuttings
UD/SL - Undisturbed Sleeve
AMSL - Above Mean Sea Level
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UD - Undisturbed
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GEO-TEST

Project: NGWS Reach 26.3 Water Line
Date: 01/24/2018 Project No: 1-71109
Elevation: Type: 5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 07

During Drilling: none After 24 Hours:

DEPTH (Ft)	LOG	SAMPLE INTERVAL	SAMPLE TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	SUBSURFACE PROFILE DESCRIPTION	N blows/ft 20 40 60 80
5							SM	SILTY SAND, non-plastic, moist, light brown	
10								Stopped Auger @ 10 feet	
15									
20									
25									
30									
35									
40									

LOG OF TEST BORING 1-71109 REACH 26.3 WATERLINE.GPJ GEO TEST.GDT 2/16/18

LEGEND

SS - Split Spoon
AC - Auger Cuttings
UD/SL - Undisturbed Sleeve
AMSL - Above Mean Sea Level
CS - Continuous Sampler
UD - Undisturbed
ST - Shelby Tube

Stratification lines represent approximate boundaries between soil types. Transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to factors other than those present at the time measurments were made.

GEO-TEST

Project: NGWS Reach 26.3 Water Line
Date: 01/24/2018 Project No: 1-71109
Elevation: Type: 5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 08

During Drilling: none After 24 Hours:

DEPTH (Ft)	LOG	SAMPLE INTERVAL	SAMPLE TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	SUBSURFACE PROFILE DESCRIPTION	N blows/ft 20 40 60 80
							SC	CLAYEY SAND with GRAVEL, low plasticity, moist, brown	
5							SM	SILTY SAND, non-plastic, slightly moist, grayish brown	
10								Stopped Auger @ 10 feet	
15									
20									
25									
30									
35									
40									

LOG OF TEST BORING 1-71109 REACH 26.3 WATERLINE.GPJ GEO TEST.GDT 2/16/18

LEGEND

SS - Split Spoon
AC - Auger Cuttings
UD/SL - Undisturbed Sleeve
AMSL - Above Mean Sea Level
CS - Continuous Sampler
UD - Undisturbed
ST - Shelby Tube

Stratification lines represent approximate boundaries between soil types. Transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to factors other than those present at the time measurments were made.

GEO-TEST

Project: NGWS Reach 26.3 Water Line
Date: 01/24/2018 Project No: 1-71109
Elevation: Type: 6.5" OD HSA

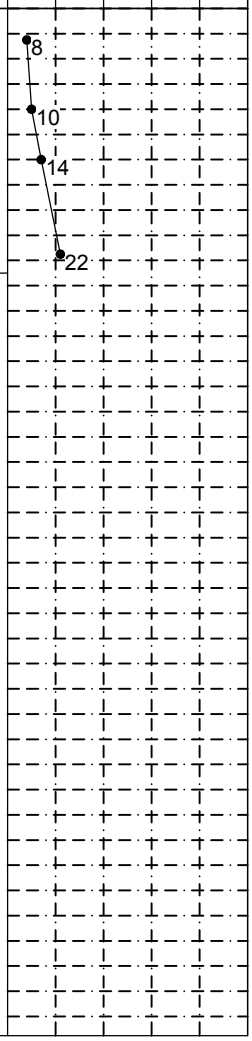
LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 09

During Drilling: none After 24 Hours:

DEPTH (Ft)	LOG	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION
			SS	4-5-3 8	3			
			UD	5-5 10	4	108		
5			UD	7-7 14	7	110	SC	CLAYEY SAND, medium plasticity, loose to medium dense, dry, brown to grayish brown
10			SS	7-11-11 22	7			
								Stopped Auger @ 9 feet Stopped Sampler @ 10.5 feet
15								
20								
25								
30								
35								
40								



LOG OF TEST BORING 1-71109 REACH 26.3 WATERLINE.GPJ GEO TEST.GDT 2/16/18

LEGEND

SS - Split Spoon
AC - Auger Cuttings
UD/SL - Undisturbed Sleeve
AMSL - Above Mean Sea Level
CS - Continuous Sampler
UD - Undisturbed
ST - Shelby Tube

Stratification lines represent approximate boundaries between soil types. Transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to factors other than those present at the time measurments were made.

GEO-TEST

Project: NGWS Reach 26.3 Water Line
Date: 01/17/2018 Project No: 1-71109
Elevation: Type: 6.5" OD HSA

LOG OF TEST BORINGS

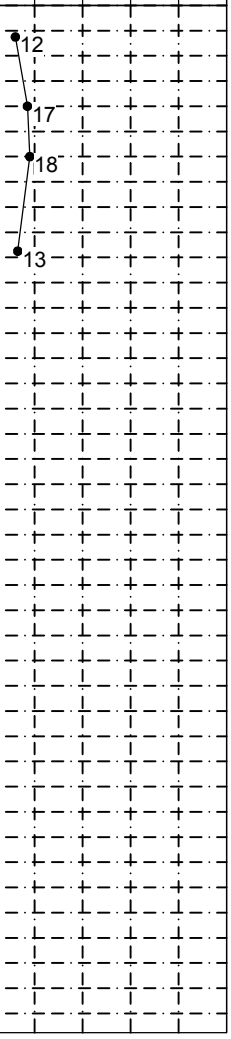
GROUNDWATER DEPTH

NO: 10

During Drilling: none After 24 Hours:

DEPTH (Ft)	LOG	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION
0			SS	2-4-8 12	5		SC	CLAYEY SAND, medium to low plasticity, medium dense, dry, brown to light brown
			UD	9-8 17	7	112		
5			UD	9-9 18	7	112		
			SS	6-8-5 13	6			
10								Stopped Auger @ 9 feet Stopped Sampler @ 10.5 feet
15								
20								
25								
30								
35								
40								

N blows/ft: 20 40 60 80



LOG OF TEST BORING 1-71109 REACH 26.3 WATERLINE.GPJ GEO TEST.GDT 2/16/18

LEGEND

SS - Split Spoon
AC - Auger Cuttings
UD/SL - Undisturbed Sleeve
AMSL - Above Mean Sea Level
CS - Continuous Sampler
UD - Undisturbed
ST - Shelby Tube

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GEO-TEST

Project: NGWS Reach 26.3 Water Line
Date: 01/17/2018 Project No: 1-71109
Elevation: Type: 5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 11

During Drilling: none After 24 Hours:

DEPTH (Ft)	LOG	SAMPLE INTERVAL	SAMPLE TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	SUBSURFACE PROFILE DESCRIPTION	N blows/ft 20 40 60 80
5							SM	SILTY SAND, non-plastic, slightly moist, light brown	
10							CL	CLAY, medium plasticity, slightly moist, dark brown	
								Stopped Auger @ 10 feet	
15									
20									
25									
30									
35									
40									

LOG OF TEST BORING 1-71109 REACH 26.3 WATERLINE.GPJ GEO TEST.GDT 2/16/18

LEGEND

SS - Split Spoon
AC - Auger Cuttings
UD/SL - Undisturbed Sleeve
AMSL - Above Mean Sea Level
CS - Continuous Sampler
UD - Undisturbed
ST - Shelby Tube

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GEO-TEST

Project: NGWS Reach 26.3 Water Line
Date: 01/17/2018 Project No: 1-71109
Elevation: Type: 5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 12

During Drilling: none After 24 Hours:

DEPTH (Ft)	LOG	SAMPLE INTERVAL	SAMPLE TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	SUBSURFACE PROFILE DESCRIPTION	N blows/ft 20 40 60 80
5							SM	SILTY SAND, non-plastic, moist, brown	
10								Stopped Auger @ 10 feet	
15									
20									
25									
30									
35									
40									

LOG OF TEST BORING 1-71109 REACH 26.3 WATERLINE.GPJ GEO TEST.GDT 2/16/18

LEGEND

SS - Split Spoon
AC - Auger Cuttings
UD/SL - Undisturbed Sleeve
AMSL - Above Mean Sea Level
CS - Continuous Sampler
UD - Undisturbed
ST - Shelby Tube

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GEO-TEST

Project: NGWS Reach 26.3 Water Line
Date: 01/17/2018 Project No: 1-71109
Elevation: Type: 5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 13

During Drilling: none After 24 Hours:

DEPTH (Ft)	LOG	SAMPLE INTERVAL	SAMPLE TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	SUBSURFACE PROFILE DESCRIPTION	N blows/ft 20 40 60 80
							SC	CLAYEY SAND, low plasticity, moist, dark brown	
							SM	SILTY SAND, non-plastic, slightly moist, light brown	
5							SP	POORLY GRADED SAND, non-plastic, some gravel, slightly moist, brown	
							SM	SILTY SAND, non-plastic, slightly moist, light brown	
10								Stopped Auger @ 10 feet	
15									
20									
25									
30									
35									
40									

LOG OF TEST BORING 1-71109 REACH 26.3 WATERLINE.GPJ GEO TEST.GDT 2/16/18

LEGEND

SS - Split Spoon
AC - Auger Cuttings
UD/SL - Undisturbed Sleeve
AMSL - Above Mean Sea Level
CS - Continuous Sampler
UD - Undisturbed
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GEO-TEST

Project: NGWS Reach 26.3 Water Line
Date: 01/17/2018 Project No: 1-71109
Elevation: Type: 6.5" OD HSA

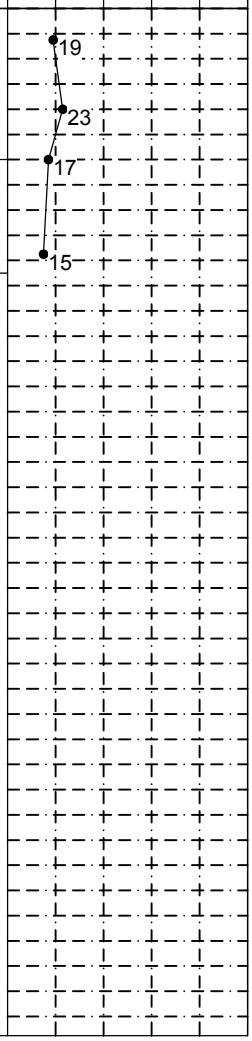
LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 14

During Drilling: none After 24 Hours:

DEPTH (Ft)	LOG	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION
0			SS	4-9-10 19	6		CL	CLAY with SAND, medium plasticity, firm, dry, brown
			UD	14-9 23	6	113		
5			UD	9-8 17	8	104	SM	SILTY SAND, non-plastic, medium dense, slightly moist, light brown
			SS	8-7-8 15	4			Stopped Auger @ 9 feet Stopped Sampler @ 10.5 feet
10								
15								
20								
25								
30								
35								
40								



LOG OF TEST BORING 1-71109 REACH 26.3 WATERLINE.GPJ GEO TEST.GDT 2/16/18

LEGEND

SS - Split Spoon
AC - Auger Cuttings
UD/SL - Undisturbed Sleeve
AMSL - Above Mean Sea Level
CS - Continuous Sampler
UD - Undisturbed
ST - Shelby Tube

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GEO-TEST

Project: NGWS Reach 26.3 Water Line
Date: 01/17/2018 Project No: 1-71109
Elevation: Type: 5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 15

During Drilling: none After 24 Hours:

DEPTH (Ft)	LOG	SAMPLE INTERVAL	SAMPLE TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	SUBSURFACE PROFILE DESCRIPTION	N blows/ft 20 40 60 80
5							SM	SILTY SAND, non-plastic, slightly moist to dry, light brown	
10								Stopped Auger @ 10 feet	
15									
20									
25									
30									
35									
40									

LOG OF TEST BORING 1-71109 REACH 26.3 WATERLINE.GPJ GEO TEST.GDT 2/16/18

LEGEND

SS - Split Spoon
AC - Auger Cuttings
UD/SL - Undisturbed Sleeve
AMSL - Above Mean Sea Level
CS - Continuous Sampler
UD - Undisturbed
ST - Shelby Tube

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GEO-TEST

Project: NGWS Reach 26.3 Water Line
Date: 02/08/2018 Project No: 1-71109
Elevation: Type: 5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 16

During Drilling: none After 24 Hours:

DEPTH (Ft)	LOG	SAMPLE INTERVAL	SAMPLE TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	SUBSURFACE PROFILE DESCRIPTION	N blows/ft 20 40 60 80
5							SM	SILTY SAND with GRAVEL, non-plastic, slightly moist, light brown	
10								Stopped Auger @ 10 feet	
15									
20									
25									
30									
35									
40									

LOG OF TEST BORING 1-71109 REACH 26.3 WATERLINE.GPJ GEO TEST.GDT 2/16/18

LEGEND

SS - Split Spoon
AC - Auger Cuttings
UD/SL - Undisturbed Sleeve
AMSL - Above Mean Sea Level
CS - Continuous Sampler
UD - Undisturbed
ST - Shelby Tube

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GEO-TEST

Project: NGWS Reach 26.3 Water Line
Date: 02/08/2017 Project No: 1-71109
Elevation: Type: 5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 17

During Drilling: none After 24 Hours:

DEPTH (Ft)	LOG	SAMPLE INTERVAL	SAMPLE TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	SUBSURFACE PROFILE DESCRIPTION	N blows/ft 20 40 60 80
5							SM	SILTY SAND, non-plastic, slightly moist, light brown	
10								Stopped Auger @ 10 feet	
15									
20									
25									
30									
35									
40									

LOG OF TEST BORING 1-71109 REACH 26.3 WATERLINE.GPJ GEO TEST.GDT 2/16/18

LEGEND

SS - Split Spoon
AC - Auger Cuttings
UD/SL - Undisturbed Sleeve
AMSL - Above Mean Sea Level
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GEO-TEST

Project: NGWS Reach 26.3 Water Line
Date: 02/08/2017 Project No: 1-71109
Elevation: Type: 5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 18

During Drilling: none After 24 Hours:

DEPTH (Ft)	LOG	SAMPLE INTERVAL	SAMPLE TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	SUBSURFACE PROFILE DESCRIPTION	N blows/ft 20 40 60 80
5							SM	SILTY SAND, non-plastic, moist, light brown	
10								Stopped Auger @ 10 feet	
15									
20									
25									
30									
35									
40									

LOG OF TEST BORING 1-71109 REACH 26.3 WATERLINE.GPJ GEO TEST.GDT 2/16/18

LEGEND

SS - Split Spoon
AC - Auger Cuttings
UD/SL - Undisturbed Sleeve
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CS - Continuous Sampler
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GEO-TEST

Project: NGWS Reach 26.3 Water Line
Date: 02/08/2017 Project No: 1-71109
Elevation: Type: 5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 19

During Drilling: none After 24 Hours:

DEPTH (Ft)	LOG	SAMPLE INTERVAL	SAMPLE TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	SUBSURFACE PROFILE DESCRIPTION	N blows/ft 20 40 60 80
5							SM	SILTY SAND, non-plastic, moist, light brown	
10								Stopped Auger @ 10 feet	
15									
20									
25									
30									
35									
40									

LOG OF TEST BORING 1-71109 REACH 26.3 WATERLINE.GPJ GEO TEST.GDT 2/16/18

LEGEND

SS - Split Spoon
AC - Auger Cuttings
UD/SL - Undisturbed Sleeve
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GEO-TEST

Project: NGWS Reach 26.3 Water Line
Date: 02/08/2017 Project No: 1-71109
Elevation: Type: 6.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 20

During Drilling: none After 24 Hours:

DEPTH (Ft)	LOG	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION
0			SS	2-3-3 6	7		SM	SILTY SAND, non-plastic, loose to medium dense, slightly moist, light brown
			UD	5-7 12	8	101		
5			UD	4-9 13	6	105		
							CL	SANDY CLAY, medium plasticity, firm, moist, dark brown
10			SS	6-8-8 16	12			Stopped Auger @ 9 feet Stopped Sampler @ 10.5 feet
15								
20								
25								
30								
35								
40								

N blows/ft: 20 40 60 80

6
12
13
16

LOG OF TEST BORING 1-71109 REACH 26.3 WATERLINE.GPJ GEO TEST.GDT 2/16/18

LEGEND

SS - Split Spoon
AC - Auger Cuttings
UD/SL - Undisturbed Sleeve
AMSL - Above Mean Sea Level
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GEO-TEST

Project: NGWS Reach 26.3 Water Line
Date: 02/06/2018 Project No: 1-71109
Elevation: Type: 6.5" OD HSA

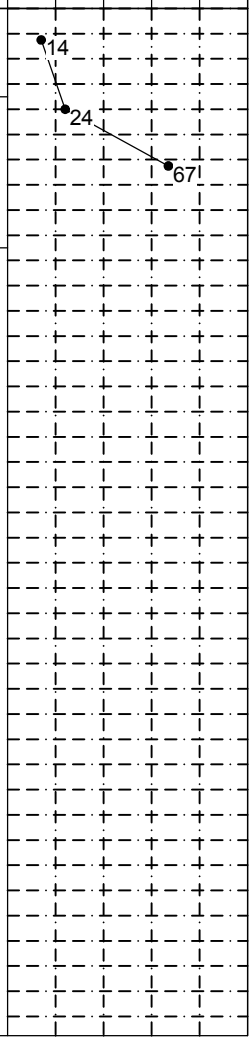
LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 21

During Drilling: none After 24 Hours:

DEPTH (Ft)	LOG	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION
			SS	6-6-8 14	4		SM	SANDY, SILTY CLAY, low plasticity, firm, dry, light brown/white
			UD	9-15 24	6			
5			SS	24-27-40 67	20		SHALE	WEATHERED SHALE, high plasticity, hard, moist, dark gray
			SS	50/6"	12			
10								Stopped Auger @ 9 feet Sampler REFUSAL @ 9.5 feet on HARD SHALE
15								
20								
25								
30								
35								
40								



LOG OF TEST BORING 1-71109 REACH 26.3 WATERLINE.GPJ GEO TEST.GDT 2/16/18

LEGEND

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UD/SL - Undisturbed Sleeve
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GEO-TEST

Project: NGWS Reach 26.3 Water Line
Date: 02/06/2018 Project No: 1-71109
Elevation: Type: 6.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 22

During Drilling: none After 24 Hours:

DEPTH (Ft)	LOG	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION	N blows/ft (20 40 60 80)
			SS	2-3-46 49	4		SC	CLAYEY SAND, medium plasticity, loose, dry, light brown/white	49
5			SS	50/6"	3		SANDSTONE	WEATHERED SANDSTONE, non-plastic, hard, dry, light brown/white	
			SS	50/6"	4				
10			SS	50/6"	3			Stopped Auger @ 9 feet Sampler REFUSAL @ 10 feet on HARD SANDSTONE	
15									
20									
25									
30									
35									
40									

LOG OF TEST BORING 1-71109 REACH 26.3 WATERLINE.GPJ GEO TEST.GDT 2/16/18

LEGEND

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UD/SL - Undisturbed Sleeve
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GEO-TEST

Project: NGWS Reach 26.3 Water Line
Date: 02/06/2018 Project No: 1-71109
Elevation: Type: 6.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 23

During Drilling: none After 24 Hours:

DEPTH (Ft)	LOG	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	SUBSURFACE PROFILE DESCRIPTION	N blows/ft (20 40 60 80)
			SS	3-4-2 6	3		SM	SILTY SAND, non-plastic, loose to very loose, dry to slightly moist, brown to light brown	6
			UD	2-2 4	8	84			4
5			UD	2-2 4	7	86			4
			SS	3-3-8 11	18		CL	SANDY CLAY, medium plasticity, moderately firm, moist, brown	11
10								Stopped Auger @ 9 feet Stopped Sampler @ 10.5 feet	
15									
20									
25									
30									
35									
40									

LOG OF TEST BORING 1-71109 REACH 26.3 WATERLINE.GPJ GEO TEST.GDT 2/16/18

LEGEND

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UD/SL - Undisturbed Sleeve
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GEO-TEST

Project: NGWS Reach 26.3 Water Line
Date: 02/06/2018 Project No: 1-71109
Elevation: Type: 6.5" OD HSA

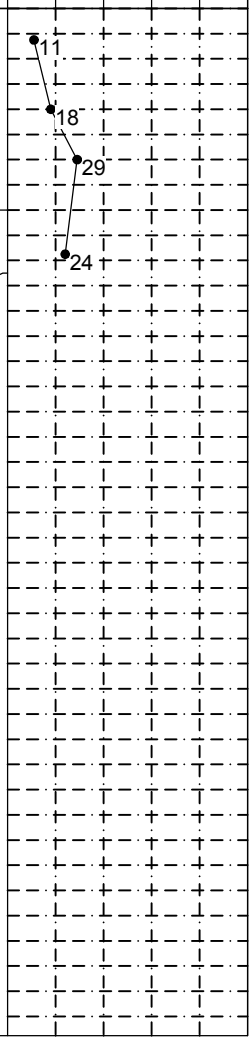
LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 24

During Drilling: none After 24 Hours:

DEPTH (Ft)	LOG	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION
0			SS	6-6-5 11	5			
			UD	8-10 18	7	112	CL-ML	SILTY CLAY with SAND, low plasticity, firm, dry, light brown
5			UD	10-19 29	7	111		
			SS	5-10-14 24	5		SM	SILTY SAND, non-plastic, medium dense, dry, light brown
10								Stopped Auger @ 9 feet Stopped Sampler @ 10.5 feet
15								
20								
25								
30								
35								
40								



LOG OF TEST BORING 1-71109 REACH 26.3 WATERLINE.GPJ GEO TEST.GDT 2/16/18

LEGEND

SS - Split Spoon
AC - Auger Cuttings
UD/SL - Undisturbed Sleeve
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SUMMARY OF LABORATORY RESULTS

						SIEVE ANALYSIS PERCENT PASSING											
TEST HOLE	DEPTH (FEET)	UNIFIED CLASS	(%) MOIST	LL	PI	NO 200	NO 100	NO 40	NO 10	NO 4	3/8"	1/2"	3/4"	1"	1 1/2"	2"	4"
02	1.0		12.1														
02	4.0	SC	14.6	23	8	34	43	88	96	100							
02	6.0	SM	11.4	NP	NP	23	46	88	100								
02	10.0		7.8														
05	3.0	SW-SM	19.2	NP	NP	12	17	60	99	99	99	100					
05	5.0		18.1														
05	10.0		9.3														
05	15.0	CL	23.2	35	20	81	91	98	99	100							
05	20.0		19.8														
05	25.0	SM	12.4	NP	NP	40	65	96	99	99	100						
05	30.0	CL	20.3	29	12	83	92	98	100								
09	1.0		3.2														
09	4.0	SC	3.9	24	11	41	56	94	100								
09	6.0	SC	6.8	27	11	34	53	93	100								
09	10.0		6.8														
10	1.0		4.5														
10	4.0	SC	7.3	27	12	45	61	89	100								
10	6.0		7.3														
10	10.0	SC	6.0	24	9	40	58	92	100								

GEO-TEST

LL = LIQUID LIMIT
PI = PLASTICITY INDEX
NP = NON PLASTIC or NO VALUE

Project: NGWS Reach 26.3 Water Line

Location: Ojo Encino, NM

Number: 1-71109

SUMMARY OF LABORATORY RESULTS 1-71109 REACH 26.3 WATERLINE.GPJ GEO TEST.GDT 2/16/18

SUMMARY OF LABORATORY RESULTS

						SIEVE ANALYSIS PERCENT PASSING											
TEST HOLE	DEPTH (FEET)	UNIFIED CLASS	(%) MOIST	LL	PI	NO 200	NO 100	NO 40	NO 10	NO 4	3/8"	1/2"	3/4"	1"	1 1/2"	2"	4"
14	1.0		6.4														
14	4.0		6.4														
14	6.0	CL	8.0	34	16	80	94	99	100								
14	10.0	SM	4.4	NP	NP	31	51	74	98	99	100						
20	1.0		6.8														
20	4.0	SM	8.4	NP	NP	34	46	83	98	100							
20	6.0		6.3														
20	10.0	CL	12.4	35	11	65	83	97	100								
21	1.0		4.5														
21	4.0	CL-ML	5.8	24	4	66	79	99	100								
21	6.0	CH	20.0	68	43	83	90	98	100								
21	10.0		12.4														
22	1.0	SC	4.1	37	13	25	37	95	98	99	100						
22	4.0		3.2														
22	6.0		3.6														
22	9.0		3.2														
23	1.0		3.2														
23	4.0	SM	8.3	NP	NP	17	41	98	100								
23	6.0		6.7														

GEO-TEST

LL = LIQUID LIMIT
PI = PLASTICITY INDEX
NP = NON PLASTIC or NO VALUE

Project: NGWS Reach 26.3 Water Line

Location: Ojo Encino, NM

Number: 1-71109

SUMMARY OF LABORATORY RESULTS 1-71109 REACH 26.3 WATERLINE.GPJ GEO TEST.GDT 2/16/18

SUMMARY OF LABORATORY RESULTS

						SIEVE ANALYSIS PERCENT PASSING											
TEST HOLE	DEPTH (FEET)	UNIFIED CLASS	(%) MOIST	LL	PI	NO 200	NO 100	NO 40	NO 10	NO 4	3/8"	1/2"	3/4"	1"	1 1/2"	2"	4"
23	10.0	CL	18.4	34	13	52	83	100									
24	1.0		5.4														
24	4.0	CL-ML	7.2	25	6	73	89	99	100								
24	6.0		7.4														
24	10.0		4.9														

GEO-TEST

LL = LIQUID LIMIT
PI = PLASTICITY INDEX
NP = NON PLASTIC or NO VALUE

Project: NGWS Reach 26.3 Water Line

Location: Ojo Encino, NM

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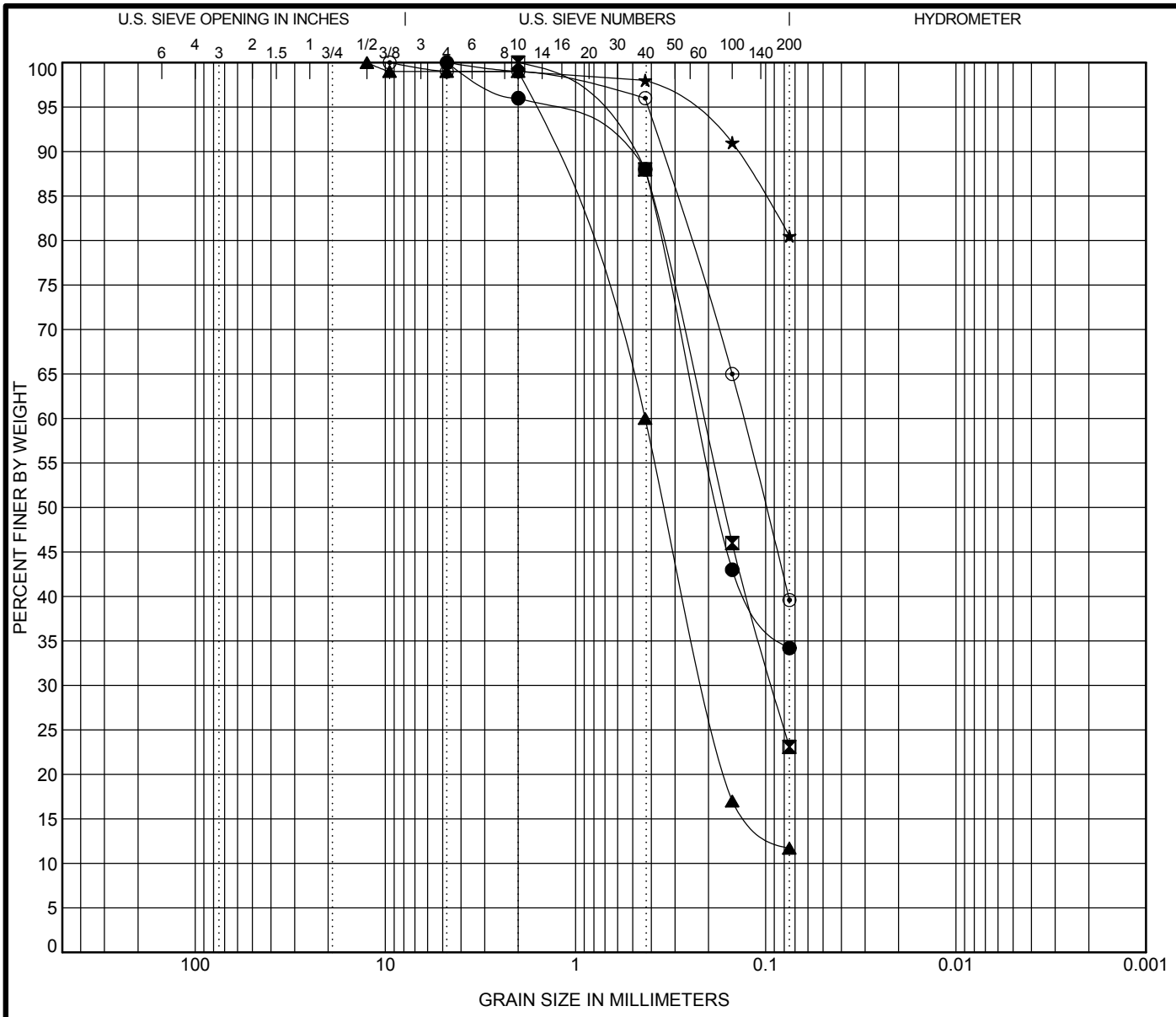


COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	02	4.0	**CLAYEY SAND(SC)**	**23**	**15**	**8**		
⊠	02	6.0	**SILTY SAND(SM)**	**NP**	**NP**	**NP**		
▲	05	3.0	**WELL-GRADED SAND with SILT(SW-SM)**	**NP**	**NP**	**NP**	**1.65**	**7.16**
★	05	15.0	**LEAN CLAY with SAND(CL)**	**35**	**15**	**20**		
⊙	05	25.0	**SILTY SAND(SM)**	**NP**	**NP**	**NP**		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	02	4.0	**4.75**	**0.223**			**0.0**	**65.8**	**34.2**	
⊠	02	6.0	**2**	**0.213**	**0.092**		**0.0**	**76.9**	**23.1**	
▲	05	3.0	**12.5**	**0.43**	**0.206**		**1.0**	**87.3**	**11.7**	
★	05	15.0	**4.75**				**0.0**	**19.5**	**80.5**	
⊙	05	25.0	**9.5**	**0.131**			**1.0**	**59.4**	**39.6**	

GEO-TEST

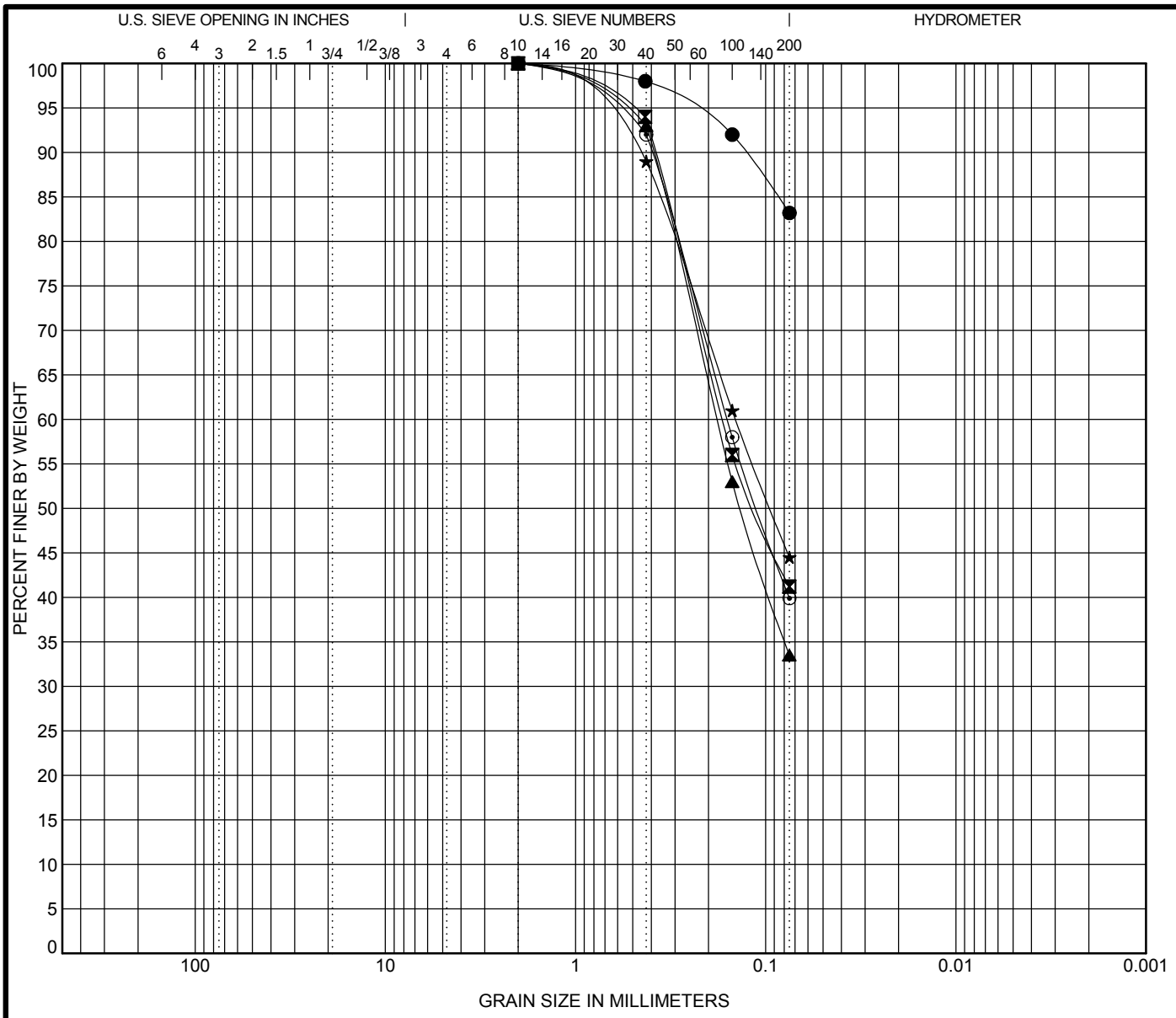
GRAIN SIZE DISTRIBUTION

Project: NGWS Reach 26.3 Water Line

Location: Ojo Encino, NM

Number: 1-71109

US GRAIN SIZE 1-71109 REACH 26.3 WATERLINE.GPJ GEO TEST.GDT 2/16/18



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	05	30.0	**LEAN CLAY with SAND(CL)**	29	17	12		
⊠	09	4.0	**CLAYEY SAND(SC)**	24	13	11		
▲	09	6.0	**CLAYEY SAND(SC)**	27	16	11		
★	10	4.0	**CLAYEY SAND(SC)**	27	15	12		
⊙	10	10.0	**CLAYEY SAND(SC)**	24	15	9		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	05	30.0	2				0.0	16.8	83.2	
⊠	09	4.0	2	0.168			0.0	58.8	41.2	
▲	09	6.0	2	0.18			0.0	66.5	33.5	
★	10	4.0	2	0.144			0.0	55.5	44.5	
⊙	10	10.0	2	0.159			0.0	60.1	39.9	

GEO-TEST

GRAIN SIZE DISTRIBUTION

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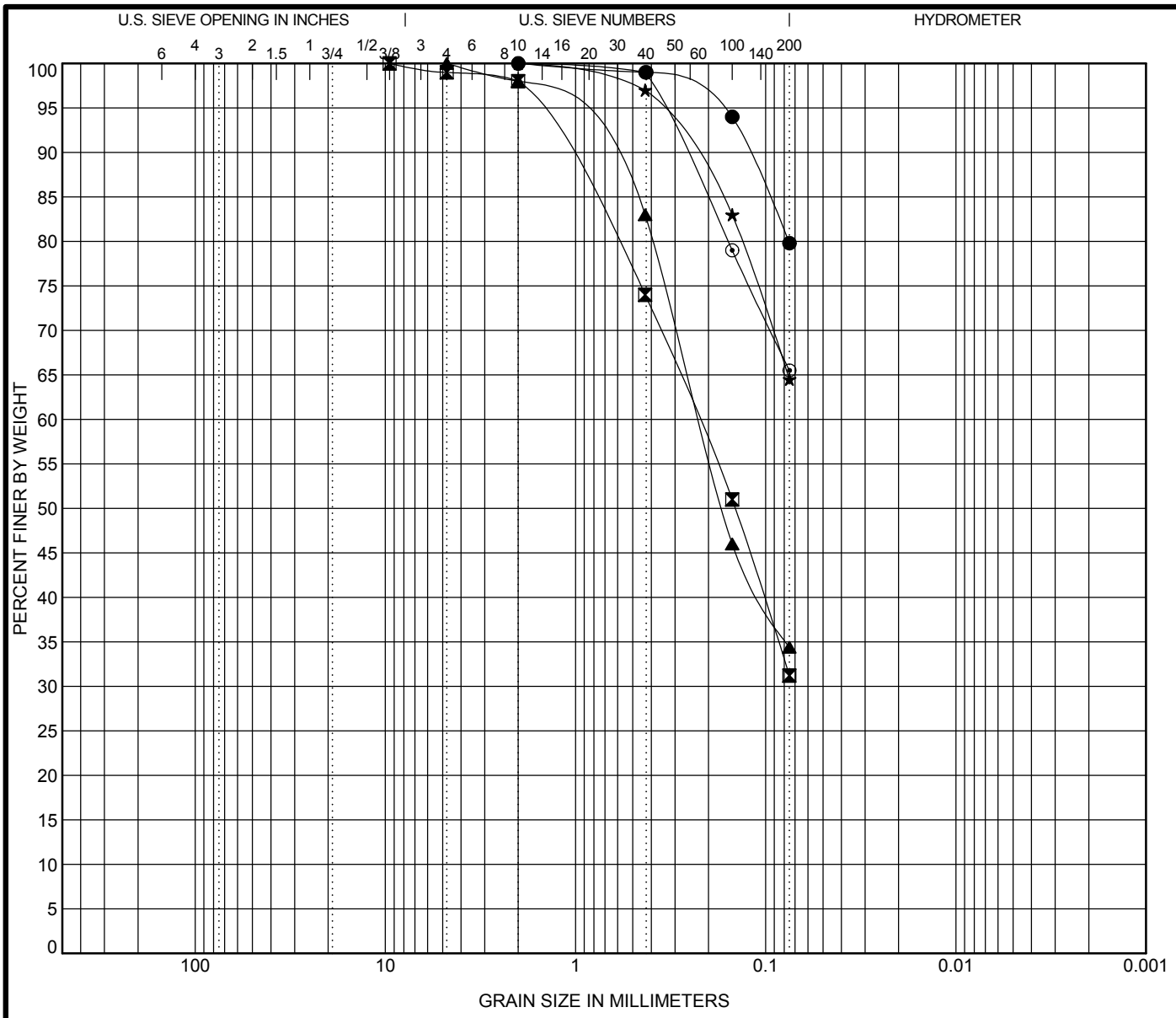
US GRAIN SIZE 1-71109 REACH 26.3 WATERLINE.GPJ GEO TEST.GDT 2/16/18



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	14	6.0	**LEAN CLAY with SAND(CL)**	**34**	**18**	**16**		
⊠	14	10.0	**SILTY SAND(SM)**	**NP**	**NP**	**NP**		
▲	20	4.0	**SILTY SAND(SM)**	**NP**	**NP**	**NP**		
★	20	10.0	**SANDY LEAN CLAY(CL)**	**35**	**24**	**11**		
⊙	21	4.0	**SANDY SILTY CLAY(CL-ML)**	**24**	**20**	**4**		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	14	6.0	**2**				**0.0**	**20.2**	**79.8**	
⊠	14	10.0	**9.5**	**0.226**			**1.0**	**67.8**	**31.2**	
▲	20	4.0	**4.75**	**0.223**			**0.0**	**65.6**	**34.4**	
★	20	10.0	**2**				**0.0**	**35.5**	**64.5**	
⊙	21	4.0	**2**				**0.0**	**34.5**	**65.5**	

GEO-TEST

GRAIN SIZE DISTRIBUTION

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Location: Ojo Encino, NM

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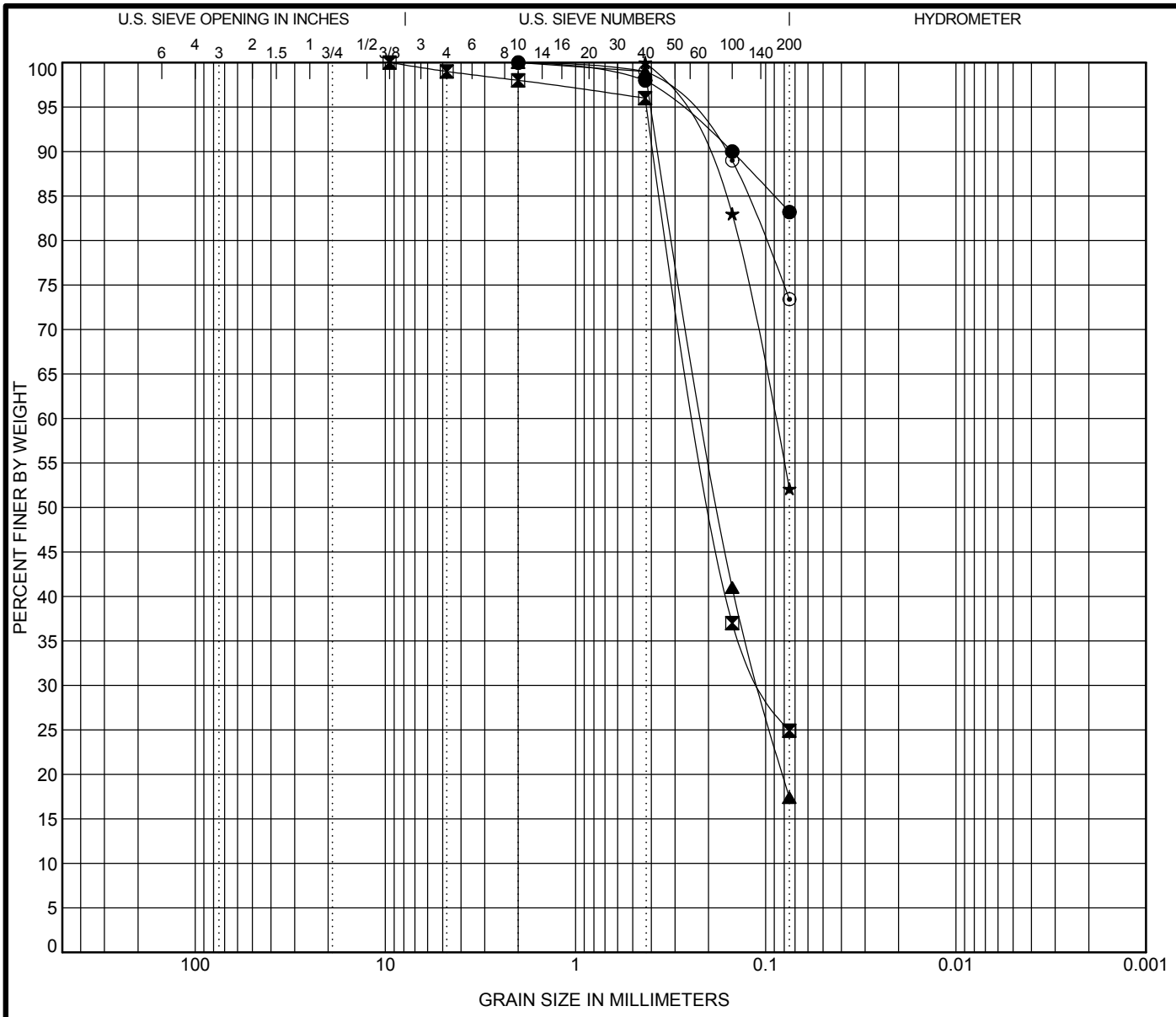
US GRAIN SIZE 1-71109 REACH 26.3 WATERLINE.GPJ GEO TEST.GDT 2/16/18



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	21	6.0	**FAT CLAY with SAND(CH)**	**68**	**25**	**43**		
⊠	22	1.0	**CLAYEY SAND(SC)**	**37**	**24**	**13**		
▲	23	4.0	**SILTY SAND(SM)**	**NP**	**NP**	**NP**		
★	23	10.0	**SANDY LEAN CLAY(CL)**	**34**	**21**	**13**		
⊙	24	4.0	**SILTY CLAY with SAND(CL-ML)**	**25**	**19**	**6**		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	21	6.0	**2**				**0.0**	**16.8**	**83.2**	
⊠	22	1.0	**9.5**	**0.226**	**0.1**		**1.0**	**74.1**	**24.9**	
▲	23	4.0	**2**	**0.212**	**0.109**		**0.0**	**82.6**	**17.4**	
★	23	10.0	**0.43**	**0.09**			**0.0**	**47.9**	**52.1**	
⊙	24	4.0	**2**				**0.0**	**26.6**	**73.4**	

GEO-TEST

GRAIN SIZE DISTRIBUTION

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US GRAIN SIZE 1-71109 REACH 26.3 WATERLINE.GPJ GEO TEST.GDT 2/16/18