

EXHIBIT A

Geotechnical Engineering Services Reports

- Geo-Test Geotechnical Engineering Services Report No. 1-10912A for Reach 10.1 Surge Tank
- Geo-Test Geotechnical Engineering Services Report No. 1-00908 for Reach 10.2 Pump Plant 12 and Addendum 1 for Increased Tank Size
- Geo-Test Geotechnical Engineering Services Report No. 1-00909 for Reach 10.2 Pump Plant 13 and Addendum 1 for Increased Tank Size
- Geo-Test Geotechnical Engineering Services Report No. 1-11001A for Nahodishgish Tank Site
- Geo-Test Geotechnical Engineering Services Report No. 1-11106 for Reach 10.1 Waterline
- IME Subsurface Exploration and Geotechnical Engineering Services Report No. 23171-ZX for the BBN9 Water Supply Project

Note:

The following clarification is made within Article 1.3.I of Section 01 00 00 of the Technical Specifications with regard to geotechnical reports.

Exhibit A to the Contract Documents contains geotechnical reports which include in-situ soil moisture measurements, and Standard Proctor test results (including optimal moisture content) from test holes at various locations within the project area. Contractor is advised that test holes reveal information about only a very small area, and sub-surface conditions between the test holes may vary. Contractor is wholly responsible for any assumptions made about sub-surface conditions between the test holes. Moreover, in-situ moisture content varies with time, and the Owner makes no representation that the in-situ moisture at the time the measurements were taken will be the same at the time of construction. The results of the Proctor and in-site moisture tests are provided for Contractor's convenience only; they are not considered "Technical Data", as defined in Article 5.03 of the General Conditions, upon which the Contractor is entitled to base his / her bid.

1. The Contractor is entitled, however, to rely upon the soil bearing capacity and other geotechnical design criteria for the pump station, surge tank building, water storage tank and chlorinator foundations. Moreover, the Contractor shall be required to follow the recommendations of the geotechnical report for building & tank foundation design, sub-foundation, and over excavation.

**GEOTECHNICAL ENGINEERING
SERVICES REPORT
NO. 1-10912A**

**NAVAJO GALLUP WATER SUPPLY
PROJECT**

**BEACON BISTI N9
REACH 10.1
SURGE TANK RELOCATION**

MCKINLEY COUNTY, NEW MEXICO

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PREPARED FOR:

SOUDER MILLER & ASSOCIATES

November 11, 2021
Job No. 1-10912A

**Souder Miller & Associates
Hwy 264 and Window Rock Loop
Window Rock, AZ 86515-0519**

ATTN: Ty Tsinnijinnie, PE

**RE: Geotechnical Engineering Services Report
Navajo Gallup Water Supply Project
Beacon Bisti N9 – Reach 10.1 Surge Tank Relocation
McKinley County, 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, laboratory testing and design recommendations for foundation design, slab support as well as criteria for excavation, backfill and general 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:
GEO-TEST, INC.

Patrick R. Whorton, PE



Reviewed By:

Robert D. Booth, PE

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INTRODUCTION

This report presents the results of our geotechnical engineering services investigation performed by this firm for the proposed new Surge Tank for the Reach 10.1 waterline project in McKinley County, New Mexico.

The objectives of this investigation were to:

- 1) Evaluate the nature and engineering properties of the subsurface soils underlying the site.
- 2) Provide design recommendations for foundations and slab support as well as criteria pertaining to excavation, backfill and 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 addition of a new surge tank to the Reach 10.1 waterline. The surge tank will be housed in a utility building approximately 500 square feet in area which is anticipated to be founded on shallow spread-type footings with loading not anticipated to exceed 1.0 kips per lineal foot. It is assumed that the surge tank will be relatively light and supported by the slab on-grade floor.

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

FIELD EXPLORATION

One (1) exploratory boring was drilled at the site to a depth of 15 feet below existing grades within the proposed building footprint. The location of the boring is shown on the attached Boring Location Map, Figure 1. The soils encountered in the boring were continuously examined, visually classified and logged during the drilling operation. The boring log is 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 or less utilizing an open tube split barrel 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 were determined to evaluate the various soil deposits with depth. The results of these tests are shown on the boring log.

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Sieve analysis and Atterberg limits tests were performed to aid in soil classification. To aid in corrosion analysis, pH and laboratory resistivity testing was performed on composite samples taken from the upper 10 feet of the site. Sulfate and chloride ion concentrations were determined by Hall Environmental Analysis Laboratory. 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

A brief surface reconnaissance was performed during our site exploration. The Reach 10.1 Surge Tank site is located on undeveloped land located at coordinates: 35°40'54.82"N 107°43'17.31"W.

At the time of this investigation the site was undisturbed and populated with native shrubs and grasses. The overall site is relatively flat with approximate grade changes of less than 2 feet across the site.

SUBSURFACE SOIL CONDITIONS

As indicated by the exploratory boring, the soils underlying the site consisted of medium dense to loose non-plastic silty sand which was encountered at the surface and extended to the full depth explored.

No free groundwater was encountered in the boring and soil moisture contents were relatively low throughout the extent of the boring.

CONCLUSIONS AND RECOMMENDATIONS

The near surface soils underlying the site were found to be medium dense in their present condition and are considered suitable to provide reliable support of the proposed structure. Accordingly, it is recommended that the structure be supported on shallow spread-type footings bearing directly on the native soils or on properly compacted structural fill, if required for grading purposes. Detailed recommendations for foundation design and the required site grading are presented in the following sections of this report.

Post-construction moisture increases in the supporting soils would cause some differential foundation settlement and could create excessive movement, at least in some areas of the site. 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.

FOUNDATIONS

Shallow spread-type footings bearing directly on prepared native soils, or on properly compacted structural fill, are recommended for the support of the structure. An allowable soil bearing pressure of 2,000 pounds per square foot is recommended for footing design. This bearing pressure applies to full dead

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loads plus realistic live loads and can be safely increased by one-third for total loads including wind and seismic forces.

Exterior footings should be established a minimum of 2.0 feet below lowest adjacent finished grade, while interior footings should be at least 12 inches below finished floor grade. The minimum recommended 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 $\frac{3}{4}$ 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 important for the satisfactory performance of the structure.

LATERAL EARTH PRESSURES

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, 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 375 pounds per cubic foot should be used for analysis.

SLABS ON GRADE

Concrete slabs on grade should be founded on prepared native soils, or on structural fill, and constructed in conformance with the methods outlined in ACI 302.1R-04.

Adequate support for lightly loaded slab-on-grade floors will be provided by native soils when prepared as recommended in the Site Grading 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 reaction, 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
$\frac{3}{4}$ Inch	70-100
No. 4	35-85
No. 200	0-10

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

Any heavily loaded slabs on the project bearing on structural fill should be designed using a modulus of subgrade reaction of 200 pounds per square inch per inch of deflection. If a 6 inch thickness of granular base is placed and compacted beneath the slabs, the modulus of subgrade reaction can be increased to 300 pounds per square inch per inch of deflection.

The granular base may act as a capillary barrier but will not totally eliminate the rise of moisture to the slabs. If floor coverings are proposed which are highly sensitive to moisture, or highly moisture sensitive equipment will be installed within the building, a synthetic vapor barrier should be installed to prevent moisture intrusion through the slab. A minimum of 4 inches of granular base as recommended above should be placed between the vapor barrier and the slab. Barriers should be overlapped a minimum of 6 inches at joints, should be carefully fitted around service openings and should conform with ACI 302.1R-04 specifications.

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 any required excavations, the existing site soils should be densified prior to the placement of structural fill or concrete.
- 2) Densification of the exposed 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 near surface soils will be suitable for use as structural fill provided proper blending to meet the specifications presented below. Any imported material must also meet the criteria for structural fill.
- 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:

Size	Percent Passing
3 inch	100
No. 4	80 - 100
No. 200	10- 45

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- 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.

EXCAVATIONS

Excavated slopes for foundation and utility construction should be designed and constructed in accordance with 29 CFR 1926, Subpart P, and any applicable state or local regulations. Excavated temporary slopes should not exceed 2:1 (horizontal to vertical).

Excavation of the onsite soils can be readily accomplished using normal earthmoving equipment, however, due to the loose sands across the site, tracked equipment may be advisable. The contractor should be responsible for all temporary excavation slopes excavated for the purpose of structural fill placement as well as the design of any required temporary shoring, as applicable. Shoring, bracing, and benching should be performed by the contractor in accordance with applicable safety standards. Spoil piles and heavy equipment should not be allowed within 5 feet of the top of the slopes.

MOISTURE PROTECTION

Precautions should be taken during and after construction to minimize moisture increase of foundation soils. Accumulations of excessive moisture could be harmful to some types of interior flooring, to HVAC ductwork beneath the slabs, and can weaken or cause other changes in the soils supporting the foundations and slabs. This can cause differential movement of the foundations and can result in cosmetic or structural damage to the structure.

Positive drainage should be established away from the exterior walls of the structure. A typical adequate slope is 6 inches in the first 5 feet with positive drainage being provided from those points to streets, pavement or natural

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water courses. If necessary to provide positive drainage, the building area should be raised above adjacent grades with structural fill.

Roof runoff from the structure should be collected by gutters and downspouts or roof canals and discharged to splash blocks which carry water rapidly away from the structure's foundation. Should lot size or other factors impede positive drainage away from the structure to less than 5 feet from foundations, a non-perforated drain system should be installed to carry water to a minimum of five feet away from foundations or to streets or natural water courses.

Utility backfill should be well compacted and should meet the specifications outlined in the Site Grading section of this report. Special care should be taken during installation of the subfloor sewer and water lines to reduce the possibility of future subsurface saturation.

Irrigation within 10 feet of foundations is discouraged or at the very least should be carefully controlled. Proper landscaping and drainage maintenance are required to preclude accumulation of excessive moisture in the soils below the structure and throughout the site. This should include but is not limited to routine maintenance checks of irrigation system to ensure no leakage and proper functionality and that irrigation is adjusted and maintained seasonally so that over watering does not occur. Native drought resistant plants are recommended for use in landscaping. Landscape features should not impede positive drainage away from foundations as recommended above.

Drainage control ponds or any other drainage/landscaping feature which allows for surface waters to infiltrate the subsurface soils should not be placed within 20 feet of building foundations.

The foregoing recommendations should only be considered minimum requirements for overall site development. It is recommended that a civil/drainage engineer be consulted for 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 earthwork portion of this project. Observation and testing should be performed during construction to confirm that suitable fill soils are placed upon competent materials and

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properly compacted and foundation elements penetrate the recommended soils

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.

This report has been prepared for the sole use of Souder Miller & Associates, specifically to aid in the design of the proposed Surge Tank building to be constructed for the Reach 10.1 pipeline in McKinley County, New Mexico and not for use by any third parties without consent.

We make no other warranty, either expressed 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.

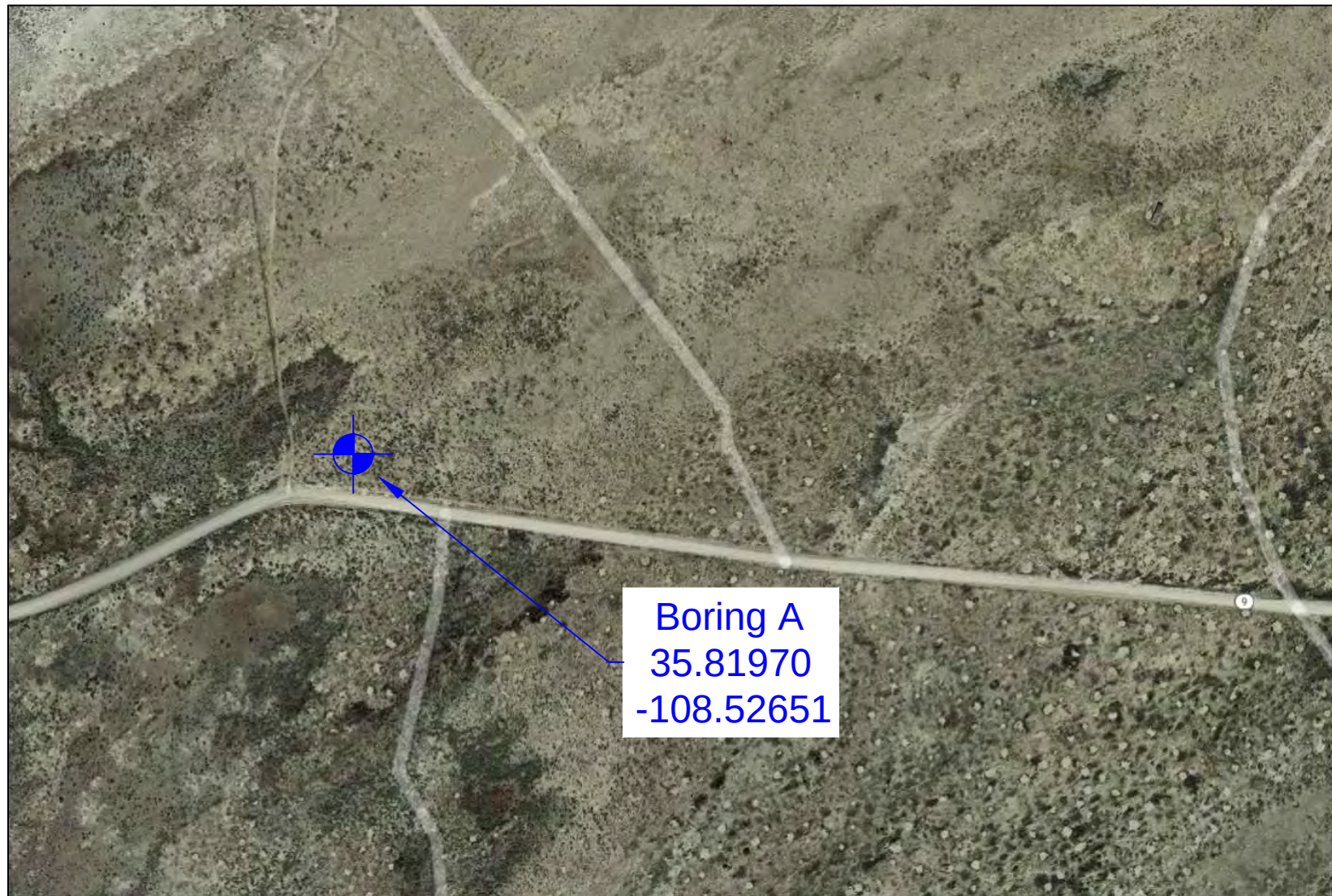
All soil samples will be discarded 60 days after the date of this report unless we receive a specific request to retain the samples for a longer period of time.

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BORING LOCATION MAP

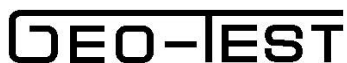


Beacon Bisti N9 - Reach 10.1 Surge Tank
McKinley County, New Mexico
Job No. 1-10912A

Figure 1



GEO-TEST
GEOTECHNICAL ENGINEERING
AND MATERIAL TESTING



Project: Beacon Bisti N9 - Reach 10.1 Surge Tank

Date: 10/19/2021

Project No: 1-10912A

Elevation:

Type: 5.5" OD HSA

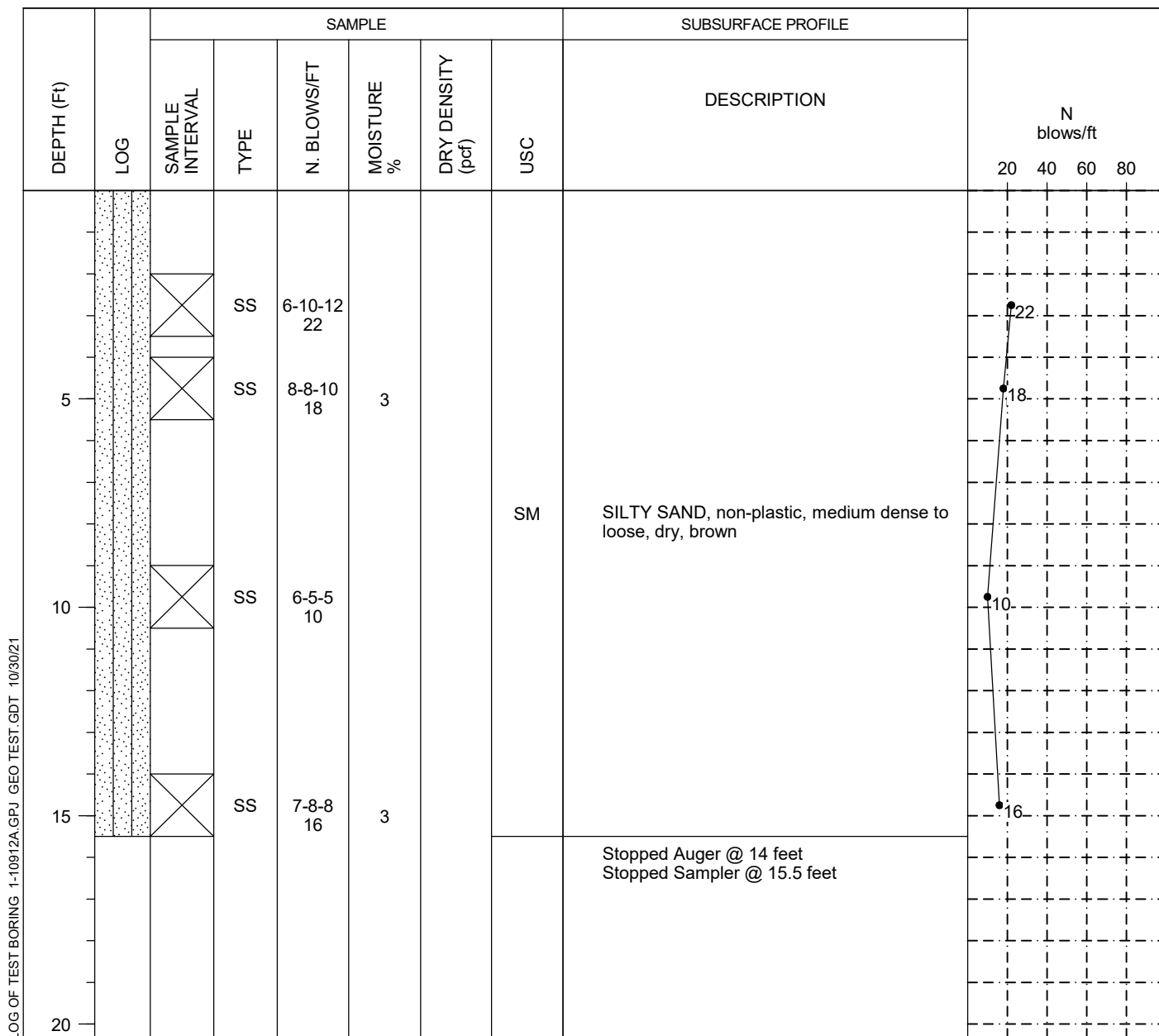
LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: A

During Drilling: none

After 24 Hours:



LEGEND

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

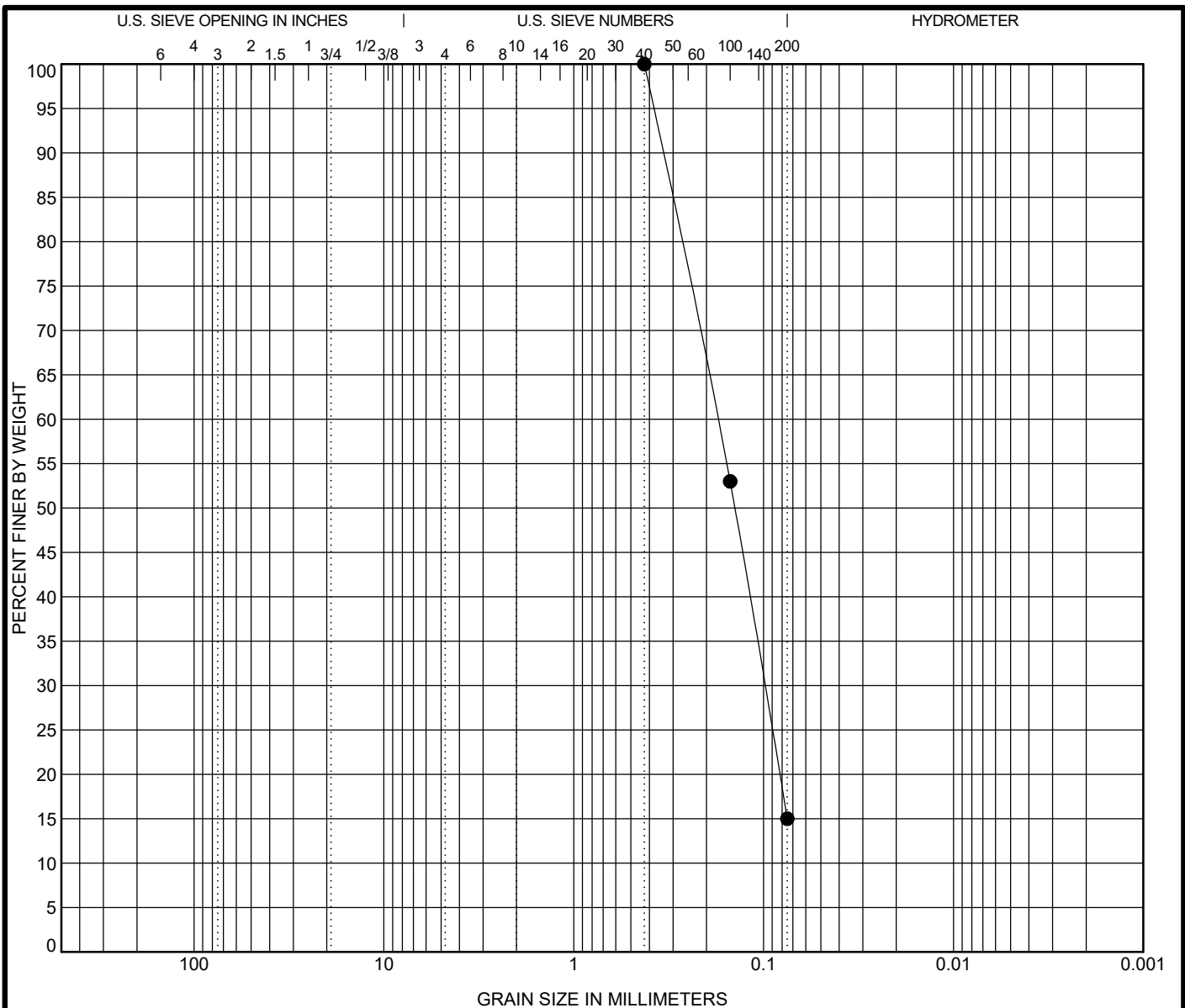
AMSL - Above Mean Sea Level
CS - Continuous Sampler
UD - Undisturbed
ST - Shelby Tube

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 measurements were made.

Sheet 1 of 1

GEO-TEST

Project: Beacon Bisti N9 - Reach 10.1 Surge Tank
Location: McKinley County, NM
Number: 1-10912A



Corrosion Data

Project: Beacon Bisti N9 - Reach 10.1 Surge Tank
Report # 1-10912A

Soil Resistivity (ASTM G-57)

Sample Location: Onsite Silty Sand (0-10 feet)

Wet Weight:	215.4 grams
Dry Weight:	208.4 grams
Water Content	3.36 %

<u>As-Received Condition</u>	
Potential Change	7.0 volts
Current:	0 amps
Resistivity:	∞ ohm-cm

<u>Saturated Condition</u>	
Potential Change:	16.0 volts
Current:	0.004 amps
Resistivity:	4000 ohm-cm

pH of Soil (ASTM G-51 & D-4972)

Sample Location: Onsite Silty Sand (0-10 feet)

Distilled Water Solution:	pH = 8.67
Calcium Chloride Solution:	pH = 7.96



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4901 Hawkins NE
Albuquerque, NM 87109
TEL: 505-345-3975 FAX: 505-345-4107
Website: clients.hallenvironmental.com

October 28, 2021

Patrick Whorton

Geo-Test

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Albuquerque, NM 87113

TEL: (505) 857-0933

FAX: (505) 857-0803

RE: Beacon Bisti Waterline

OrderNo.: 2110990

Dear Patrick Whorton:

Hall Environmental Analysis Laboratory received 2 sample(s) on 10/21/2021 for the analyses presented in the following report.

These were analyzed according to EPA procedures or equivalent. To access our accredited tests please go to www.hallenvironmental.com or the state specific web sites. In order to properly interpret your results, it is imperative that you review this report in its entirety. See the sample checklist and/or the Chain of Custody for information regarding the sample receipt temperature and preservation. Data qualifiers or a narrative will be provided if the sample analysis or analytical quality control parameters require a flag. When necessary, data qualifiers are provided on both the sample analysis report and the QC summary report, both sections should be reviewed. All samples are reported, as received, unless otherwise indicated. Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH and residual chlorine are qualified as being analyzed outside of the recommended holding time.

Please don't hesitate to contact HEAL for any additional information or clarifications.

ADHS Cert #AZ0682 -- NMED-DWB Cert #NM9425 -- NMED-Micro Cert #NM0901

Sincerely,

A handwritten signature in black ink, appearing to read "Andy Freeman", is written over a light blue horizontal line.

Andy Freeman

Laboratory Manager

4901 Hawkins NE

Albuquerque, NM 87109

Hall Environmental Analysis Laboratory, Inc.

Analytical Report

Lab Order 2110990

Date Reported: 10/28/2021

CLIENT: Geo-Test

Client Sample ID: 2 @ 9' (Reach 10.1 Surge Tank)

Project: Beacon Bisti Waterline

Collection Date: 10/19/2021 2:30:00 PM

Lab ID: 2110990-001

Matrix: SOIL

Received Date: 10/21/2021 8:35:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS							Analyst: JMT
Chloride	36	7.5		mg/Kg	5	10/25/2021 9:14:48 AM	63515
Sulfate	76	7.5		mg/Kg	5	10/25/2021 9:14:48 AM	63515

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	D	Sample Diluted Due to Matrix	E	Value above quantitation range
	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
	ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
	PQL	Practical Quantitative Limit	RL	Reporting Limit
	S	% Recovery outside of range due to dilution or matrix		

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: 2110990

28-Oct-21

Client: Geo-Test
Project: Beacon Bisti Waterline

Sample ID: MB-63515	SampType: mblk	TestCode: EPA Method 300.0: Anions								
Client ID: PBS	Batch ID: 63515	RunNo: 82306								
Prep Date: 10/22/2021	Analysis Date: 10/24/2021	SeqNo: 2918414	Units: mg/Kg							
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	ND	1.5								
Sulfate	ND	1.5								

Sample ID: LCS-63515	SampType: lcs	TestCode: EPA Method 300.0: Anions								
Client ID: LCSS	Batch ID: 63515	RunNo: 82306								
Prep Date: 10/22/2021	Analysis Date: 10/24/2021	SeqNo: 2918415	Units: mg/Kg							
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	14	1.5	15.00	0	93.2	90	110			
Sulfate	29	1.5	30.00	0	95.4	90	110			

Qualifiers:

* Value exceeds Maximum Contaminant Level.
D Sample Diluted Due to Matrix
H Holding times for preparation or analysis exceeded
ND Not Detected at the Reporting Limit
PQL Practical Quantitative Limit
S % Recovery outside of range due to dilution or matrix

B Analyte detected in the associated Method Blank
E Value above quantitation range
J Analyte detected below quantitation limits
P Sample pH Not In Range
RL Reporting Limit

**GEOTECHNICAL ENGINEERING
SERVICES REPORT
NO. 1-00908**

**NAVAJO GALLUP WATER SUPPLY
PROJECT**

**BEACON BISTI N9 - REACH 10.2
PUMP PLANT 12**

MCKINLEY COUNTY, NEW MEXICO

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PREPARED FOR:

SOUDER MILLER & ASSOCIATES

December 1, 2020
Job No. 1-00908

**Souder Miller & Associates
Hwy 264 and Window Rock Loop
Window Rock, AZ 86515-0519**

ATTN: Ty Tsinnijinnie, PE

**RE: Geotechnical Engineering Services Report
Navajo Gallup Water Supply Project
Beacon Bisti N9 – Reach 10.2 Pump Plant 12
McKinley County, 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, laboratory testing and recommendations for foundation design and slab support as well as criteria for excavation, backfill and general 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:
GEO-TEST, INC.

Patrick R. Whorton, PE



Reviewed By:

Robert D. Booth, PE

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INTRODUCTION

This report presents the results of our geotechnical engineering services investigation performed by this firm for the proposed new Pump Plant 12 for the Reach 10.2 waterline project in McKinley County, New Mexico.

The objectives of this investigation were to:

- 1) Evaluate the nature and engineering properties of the subsurface soils and/or rock underlying the site.
- 2) Provide recommendations for foundation design and slab support as well as criteria pertaining to excavation, backfill and site grading.

The investigation includes subsurface exploration, selected soil and 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 development of a new pump plant site. The new plant will consist of two 50,000 gallon above grade steel welded or glass-fused storage tanks as well as a pump station and surge tank building. The tanks will have a diameter of 20 feet with unit loading on the base of the tank anticipated to be on the order of 1,500 pounds per square foot. The utility buildings will be approximately 500 square feet in area and are anticipated to be founded on shallow spread-type footings with loading not anticipated to exceed 1.0 kips per lineal foot.

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

FIELD EXPLORATION

Three (3) exploratory borings were drilled at the site to depths ranging from 20 feet to 6.5 feet where practical auger refusal was encountered. The locations of the borings are shown on the attached Boring Location Map, Figure 1. The soils and rock 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 or less utilizing an open tube split barrel sampler driven by a standard penetration test hammer.

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LABORATORY TESTING

Selected samples were tested in the laboratory to determine certain engineering properties of the soils and rock. Moisture contents were determined to evaluate the various 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. To aid in corrosion analysis, pH and laboratory resistivity testing was performed on composite samples taken from the upper 10 feet of the site. Sulfate and chloride ion concentrations were determined by Hall Environmental Analysis Laboratory. 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

A brief surface reconnaissance was performed during our site exploration. The Reach 10.2 Pump Plant 12 site is located approximately 1.5 miles north of Navajo Service Route 9 along the proposed Reach 10.2 alignment at coordinates: 35°48'55.73"N 108°29'17.22"W.

At the time of this investigation the site was undisturbed and populated with native shrubs and grasses. The overall site is relatively flat with approximate grade changes of less than 2 feet across the site.

SUBSURFACE SOIL CONDITIONS

As indicated by the exploratory borings, the soils underlying the site consist of a surficial layer of medium dense low plasticity clayey sand and non-plastic very dense silty sand which extended to depths ranging from about 4 to 5 feet below surface grades. Below this surficial layer, hard sandstone bedrock was encountered on the western side of the site at the proposed tank locations which refused the auger. On the east side of the site at the proposed pump station building location, very firm to hard high plasticity weathered shale or mudstone was encountered and extended to a depth of about 20.25 feet where sampler refusal was encountered.

No free groundwater was encountered in the borings and soil and rock moisture contents were relatively low throughout the extent of the borings.

CONCLUSIONS AND RECOMMENDATIONS

The near surface soils underlying both the tank and building sites were found to be medium to very dense in their present condition and are considered suitable to provide reliable support of the proposed structures. Accordingly, it is recommended that the proposed structures be founded on shallow reinforced concrete footings bearing directly on densified native soils or properly compacted fill, if required for grading purposes. Detailed

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recommendations for foundation design and the required site grading are presented in the following sections of this report.

Based on the results of this investigation, the proposed tanks and utility buildings are anticipated to bear on at least 1.0 foot of medium dense to dense silty or clayey sand. However, the proposed sites are also underlain by sandstone bedrock and/or by medium plasticity potentially expansive bedrock. The building foundations should not bear directly onto the bedrock as it could cause excessive differential settlements and/or heave, particularly upon significant changes in moisture content. Should site grading place the footings directly on the bedrock, the building sites should be overexcavated to such an extent as to provide for a minimum of 1 foot of properly compacted structural fill beneath all footings and floor slabs. Detailed recommendations for building and tank foundation design and the required site grading are presented in the following sections of this report.

Post-construction moisture increases in the supporting soils would cause some differential foundation settlement and could create excessive movement, at least in some areas of the site. 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 storage 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 tanks should be supported on a sand cushion at least 3 inches thick placed directly on densified native soils or structural fill.

It is estimated that total settlement of the tanks and ring-wall footings, 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 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.

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BUILDING FOUNDATIONS

Shallow spread-type footings bearing directly on the native soils, or on properly compacted structural fill, are recommended for the support of the utility structures. An allowable soil bearing pressure of 2,000 pounds per square foot is recommended for footing design. This bearing pressure applies to full dead loads plus realistic live loads and can be safely increased by one-third for total loads including wind and seismic forces.

Exterior footings should be established a minimum of 2.0 feet below lowest adjacent finished grade, while interior footings should be at least 12 inches below finished floor grade. The minimum recommended 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 $\frac{3}{4}$ 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 could create excessive movements, at least in some areas of the site. Thus, the moisture protection provisions as recommended in a following section of this report are considered critical for the satisfactory performance of the structures.

LATERAL EARTH PRESSURES

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, 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 375 pounds per cubic foot should be used for analysis.

SLABS ON GRADE

Concrete slabs on grade should be founded on prepared native soils or properly compacted structural fill and constructed in conformance with the methods outlined in ACI 302.1R-04.

Adequate support for lightly loaded slab-on-grade floors will be provided by native soils when prepared as recommended in the Site Grading 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 reaction, 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:

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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 D-1557.

Any heavily loaded slabs on the project bearing on structural fill should be designed using a modulus of subgrade reaction of 200 pounds per square inch per inch of deflection. If a 6-inch thickness of granular base is placed and compacted beneath the slabs, the modulus of subgrade reaction can be increased to 300 pounds per square inch per inch of deflection.

The granular base may act as a capillary barrier but will not totally eliminate the rise of moisture to the slabs. If floor coverings are proposed which are highly sensitive to moisture, or highly moisture sensitive equipment will be installed within the building, a synthetic vapor barrier should be installed to prevent moisture intrusion through the slab. A minimum of 4 inches of granular base as recommended above should be placed between the vapor barrier and the slab. Barriers should be overlapped a minimum of 6 inches at joints, should be carefully fitted around service openings and should conform with ACI 302.1R-04 specifications.

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 any required excavations, the existing site soils should be densified prior to the placement of structural fill or concrete. Should any foundation or floor slab be placed on the underlying sandstone or shale bedrock, the bedrock should be overexcavated to such an extent as to provide for a minimum of 1 foot of properly compacted structural fill beneath all footings and floor slabs.
- 2) Densification of the exposed 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 or D-698 for clay soils.
- 3) The results of this investigation indicate that most of the near surface soils will be suitable for use as structural fill provided proper blending to meet the specifications presented below. Any imported material must

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also meet the criteria for structural fill. The native weathered shale is not suitable for use as structural fill.

- 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:

Size	Percent Passing
3 inch	100
No. 4	80 - 100
No. 200	20 - 45

- 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.

EXCAVATIONS

Excavated slopes for foundation and utility construction should be designed and constructed in accordance with 29 CFR 1926, Subpart P, and any applicable state or local regulations. Excavated temporary slopes should not exceed 2:1 (horizontal to vertical). Excavation of the near surface surficial soils can be readily accomplished using normal earthmoving equipment. Excavations into the underlying sandstone and shale bedrock will require heavy ripping and rock breaking (hoe ram) equipment.

The contractor should be responsible for all temporary excavation slopes excavated for the purpose of structural fill placement as well as the design of any required temporary shoring, as applicable. Shoring, bracing, and benching should be performed by the contractor in accordance with applicable safety standards. Spoil piles and heavy equipment should not be allowed within 5 feet of the top of the slopes.

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MOISTURE PROTECTION

Precautions should be taken during and after construction to minimize moisture increase of foundation soils. Accumulations of excessive moisture could be harmful to some types of interior flooring, to HVAC ductwork beneath the slabs, and can weaken or cause other changes in the soils supporting the foundations and slabs. This can cause differential movement of the foundations and can result in cosmetic or structural damage to the structures.

Positive drainage should be established away from the exterior walls of the structures. A typical adequate slope is 6 inches in the first 5 feet with positive drainage being provided from those points to streets, pavement or natural water courses. If necessary to provide positive drainage, the building areas should be raised above adjacent grades with structural fill.

Roof runoff from the structures should be collected by gutters and downspouts or roof canales and discharged to splash blocks which carry water rapidly away from the structure's foundation. Should lot size or other factors impede positive drainage away from the structures to less than 5 feet from foundations, a non-perforated drain system should be installed to carry water to a minimum of five feet away from foundations or to streets or natural water courses.

Utility backfill should be well compacted and should meet the specifications outlined in the Site Grading section of this report. Special care should be taken during installation of the subfloor sewer and water lines to reduce the possibility of future subsurface saturation.

Irrigation within 10 feet of foundations is discouraged or at the very least should be carefully controlled. Proper landscaping and drainage maintenance are required to preclude accumulation of excessive moisture in the soils below the structures and throughout the site. This should include but is not limited to routine maintenance checks of irrigation system to ensure no leakage and proper functionality and that irrigation is adjusted and maintained seasonally so that over watering does not occur. Native drought resistant plants are recommended for use in landscaping. Landscape features should not impede positive drainage away from foundations as recommended above.

Drainage control ponds or any other drainage/landscaping feature which allows for surface waters to infiltrate the subsurface soils should not be placed within 20 feet of building foundations.

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

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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 earthwork portion 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 soils

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.

This report has been prepared for the sole use of Souder Miller & Associates, specifically to aid in the design of the proposed Pump Plant 12 to be constructed for the Reach 10.2 pipeline in McKinley County, New Mexico and not for use by any third parties without consent.

We make no other warranty, either expressed 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.

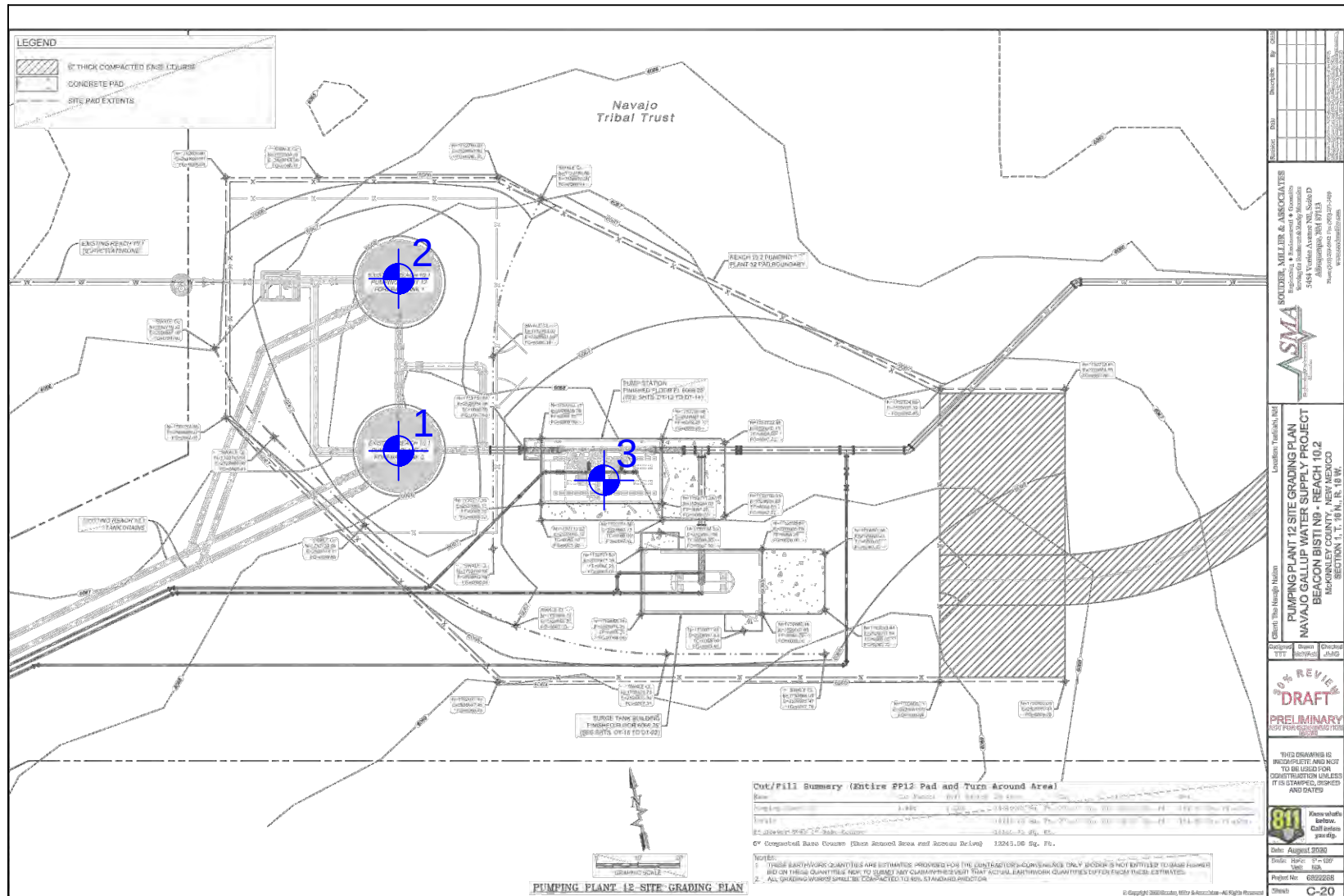
All soil samples will be discarded 60 days after the date of this report unless we receive a specific request to retain the samples for a longer period of time.

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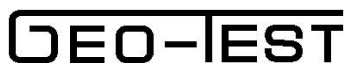
BORING LOCATION MAP



Beacon Bisti - Pump Plant 12
McKinley County, New Mexico
Job No. 1-00908

Figure 1

GEO-TEST
GEOTECHNICAL ENGINEERING
AND MATERIAL TESTING



Project: BBN9 Pump Plant 12

Date: 10/08/2020

Project No: 1-00908

Elevation:

Type: 5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 1

During Drilling: none

After 24 Hours:

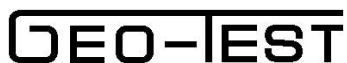
DEPTH (Ft)	LOG	SAMPLE						SUBSURFACE PROFILE	N blows/ft			
		SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION				
5			SS	11-12-17 29	4		SC	CLAYEY SAND, low plasticity, medium dense, dry, light brown				
			SS	50/3"	4							
							SANDSTONE	SANDSTONE, non-plastic, hard, dry, light brown/white				
								Auger REFUSAL @ 6.5 feet on SANDSTONE Sampler REFUSAL @ 4.25 feet				
10												
15												
20												
25												

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 measurements were made.



Project: BBN9 Pump Plant 12

Date: 10/08/2020

Elevation:

Project No: 1-00908

Type: 5.5" OD HSA

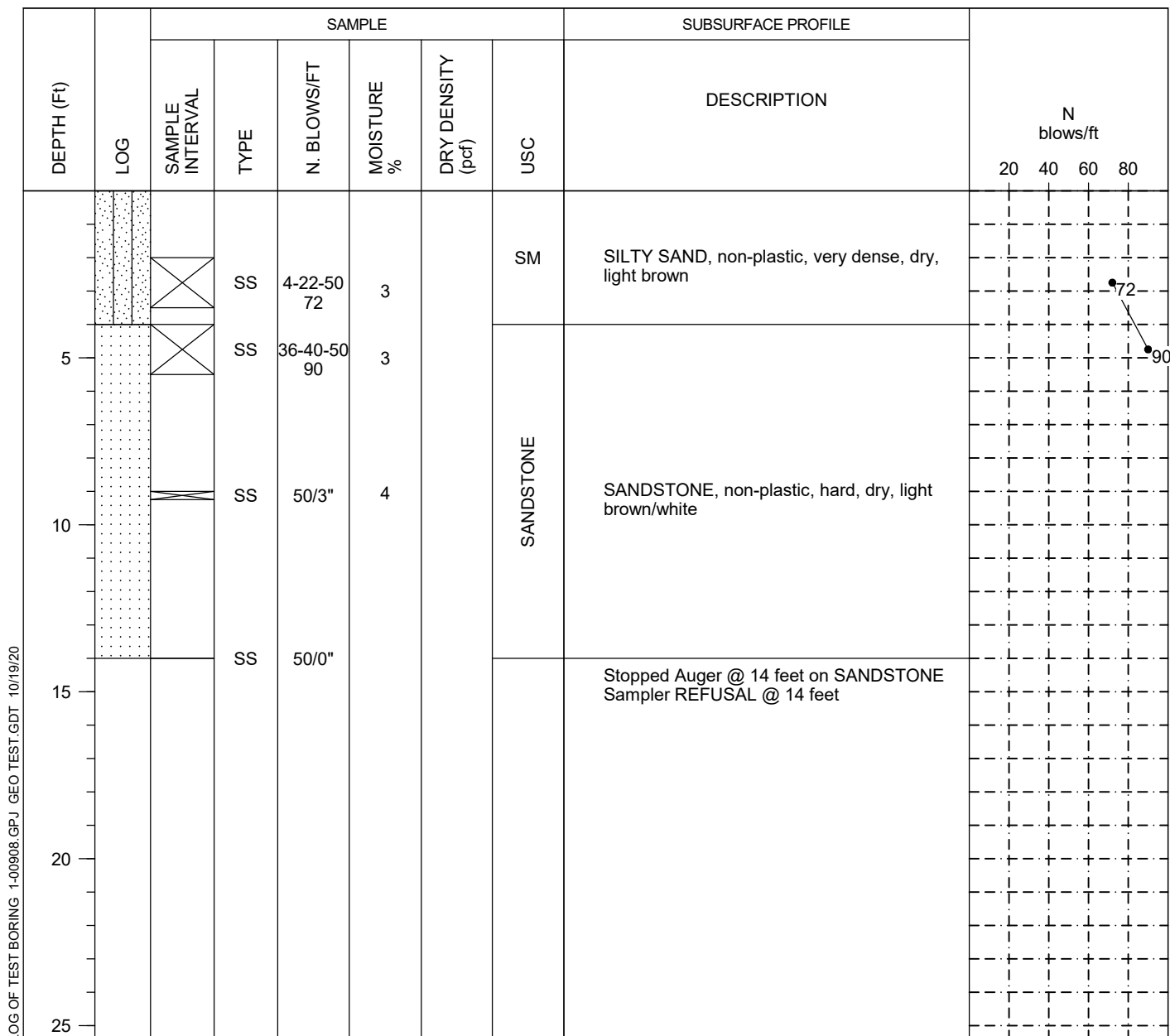
LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 2

During Drilling: none

After 24 Hours:

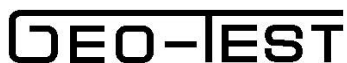


LEGEND

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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 measurements were made.



Project: BBN9 Pump Plant 12

Date: 10/08/2020

Elevation:

Project No: 1-00908

Type: 5.5" OD HSA

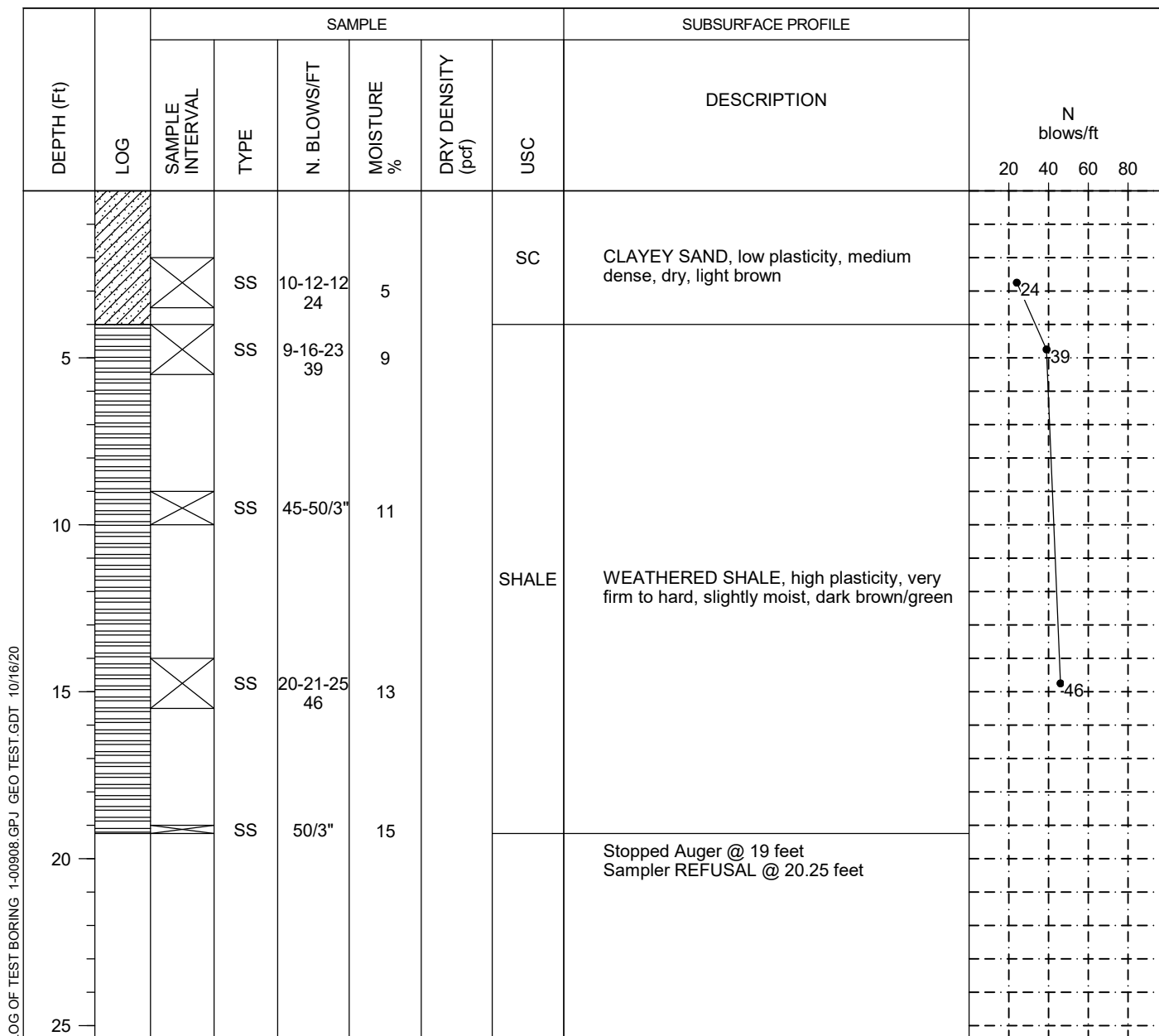
LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 3

During Drilling: none

After 24 Hours:



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 measurements were made.

SUMMARY OF LABORATORY RESULTS

Sheet 1 of 1

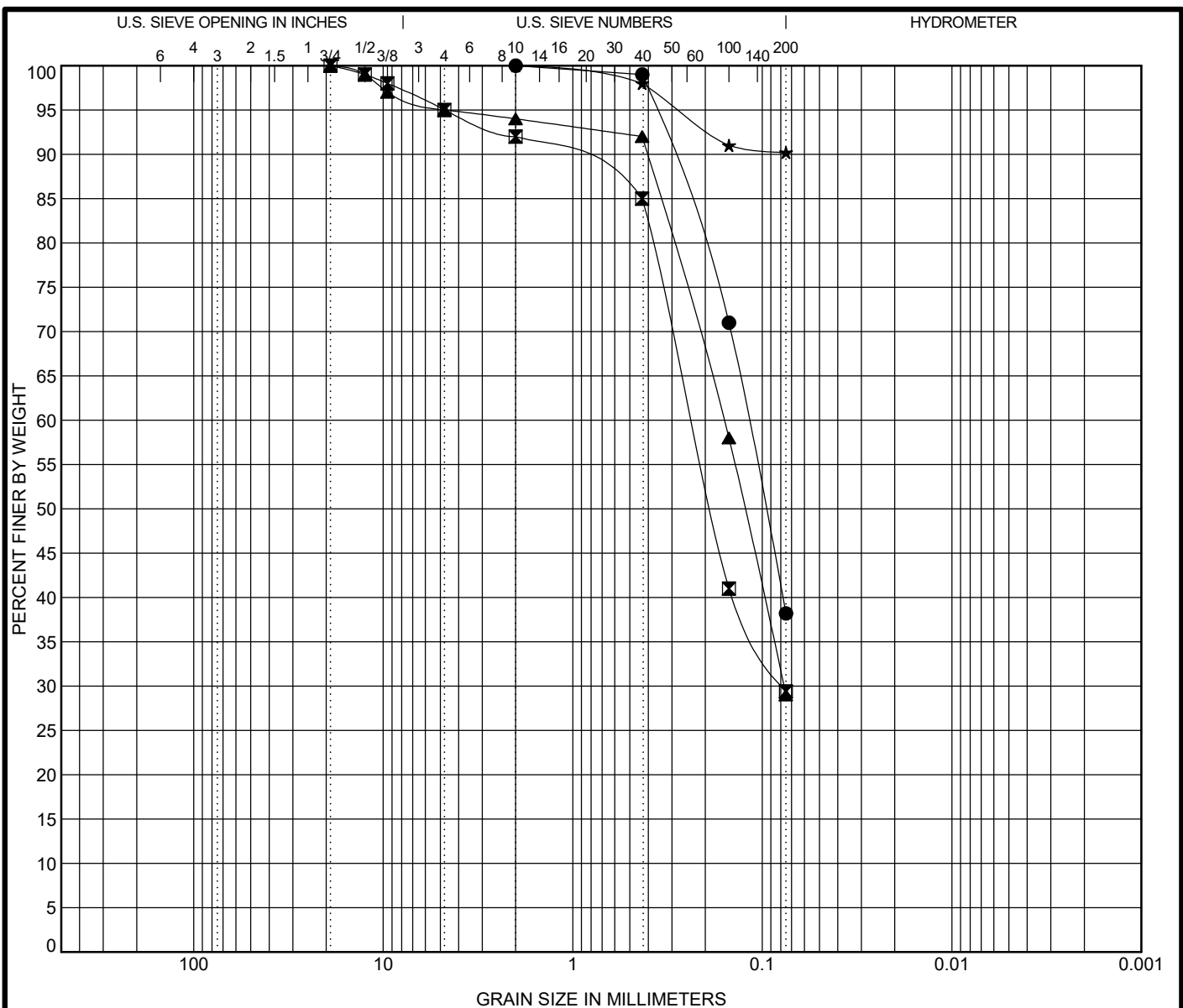
						SIEVE ANALYSIS PERCENT PASSING											
TEST HOLE	DEPTH (FEET)	UNIFIED CLASS	(%) MOIST	LL	PI	NO 200	NO 100	NO 40	NO 10	NO 4	3/8"	1/2"	3/4"	1"	1 1/2"	2"	4"
1	3.0	SC	4.4	28	8	38	71	99	100								
1	5.0		4.2														
2	3.0		3.1														
2	5.0	SM	3.2	NP	NP	29	41	85	92	95	98	99	100				
2	10.0		3.6														
3	3.0	SC	4.7	24	12	29	58	92	94	95	97	99	100				
3	5.0		8.5														
3	10.0		10.7														
3	15.0	CH	13.0	76	60	90	91	98	100								
3	20.0		14.5														

SUMMARY OF LABORATORY RESULTS 1-00908.GPJ GEO TEST.GDT 10/16/20

GEO-TEST

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

Project: BBN9 Pump Plant 12
Location: McKinley County, NM
Number: 1-00908



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification			LL	PL	PI	Cc	Cu
●	1	3.0	CLAYEY SAND(SC)			28	20	8		
⊠	2	5.0	SILTY SAND(SM)			NP	NP	NP		
▲	3	3.0	CLAYEY SAND(SC)			24	12	12		
★	3	15.0	FAT CLAY(CH)			76	16	60		

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	1	3.0	2	0.119			0.0	61.8	38.2	
⊠	2	5.0	19	0.236	0.078		5.0	65.6	29.4	
▲	3	3.0	19	0.16	0.077		5.0	66.0	29.0	
★	3	15.0	2				0.0	9.8	90.2	

GEO-TEST

GRAIN SIZE DISTRIBUTION

Project: BBN9 Pump Plant 12

Location: McKinley County, NM

Number: 1-00908

Corrosion Data

Project: BBN9 Pump Plant 12
Report # 1-00908

Soil Resistivity (ASTM G-57)

Sample Location: Composite Sample (0-5 ft)

Wet Weight:	137.8 grams
Dry Weight:	132.5 grams
Water Content	4.00 %

<u>As-Received Condition</u>	
Potential Change	4.0 volts
Current:	0.0001 amps
Resistivity:	40000 ohm-cm

<u>Saturated Condition</u>	
Potential Change:	16.0 volts
Current:	0.002 amps
Resistivity:	8000 ohm-cm

pH of Soil (ASTM G-51 & D-4972)

Sample Location: Composite Sample (0-5 ft)

Distilled Water Solution:	pH =	8.6
Calcium Chloride Solution:	pH =	8.04



Hall Environmental Analysis Laboratory
4901 Hawkins NE
Albuquerque, NM 87109
TEL: 505-345-3975 FAX: 505-345-4107
Website: clients.hallenvironmental.com

November 24, 2020

Patrick Whorton

Geo-Test

8528 Calle Alameda NE

Albuquerque, NM 87113

TEL: (505) 857-0933

FAX: (505) 857-0803

RE: BBN9 Pump Plant 12

OrderNo.: 2011849

Dear Patrick Whorton:

Hall Environmental Analysis Laboratory received 1 sample(s) on 11/17/2020 for the analyses presented in the following report.

These were analyzed according to EPA procedures or equivalent. To access our accredited tests please go to www.hallenvironmental.com or the state specific web sites. In order to properly interpret your results, it is imperative that you review this report in its entirety. See the sample checklist and/or the Chain of Custody for information regarding the sample receipt temperature and preservation. Data qualifiers or a narrative will be provided if the sample analysis or analytical quality control parameters require a flag. When necessary, data qualifiers are provided on both the sample analysis report and the QC summary report, both sections should be reviewed. All samples are reported, as received, unless otherwise indicated. Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH and residual chlorine are qualified as being analyzed outside of the recommended holding time.

Please don't hesitate to contact HEAL for any additional information or clarifications.

ADHS Cert #AZ0682 -- NMED-DWB Cert #NM9425 -- NMED-Micro Cert #NM0901

Sincerely,

A handwritten signature in black ink, appearing to read 'Andy Freeman', is written over a light blue horizontal line.

Andy Freeman

Laboratory Manager

4901 Hawkins NE

Albuquerque, NM 87109

Hall Environmental Analysis Laboratory, Inc.

Analytical Report

Lab Order 2011849

Date Reported: 11/24/2020

CLIENT: Geo-Test

Client Sample ID: 1-00908 0-3'

Project: BBN9 Pump Plant 12

Collection Date: 11/17/2020 7:10:00 AM

Lab ID: 2011849-001

Matrix: SOIL

Received Date: 11/17/2020 12:55:00 PM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS							Analyst: VP
Chloride	ND	7.5		mg/Kg	5	11/19/2020 2:56:20 AM	56531
Sulfate	32	7.5		mg/Kg	5	11/19/2020 2:56:20 AM	56531

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	D	Sample Diluted Due to Matrix	E	Value above quantitation range
	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
	ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
	PQL	Practical Quantitative Limit	RL	Reporting Limit
	S	% Recovery outside of range due to dilution or matrix		

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: 2011849

24-Nov-20

Client: Geo-Test
Project: BBN9 Pump Plant 12

Sample ID: MB-56531	SampType: MBLK	TestCode: EPA Method 300.0: Anions								
Client ID: PBS	Batch ID: 56531	RunNo: 73446								
Prep Date: 11/18/2020	Analysis Date: 11/18/2020	SeqNo: 2587416 Units: mg/Kg								
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	ND	1.5								
Sulfate	ND	1.5								

Sample ID: LCS-56531	SampType: LCS	TestCode: EPA Method 300.0: Anions								
Client ID: LCSS	Batch ID: 56531	RunNo: 73446								
Prep Date: 11/18/2020	Analysis Date: 11/18/2020	SeqNo: 2587417 Units: mg/Kg								
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	14	1.5	15.00	0	94.5	90	110			
Sulfate	29	1.5	30.00	0	96.6	90	110			

Sample ID: MB-56531	SampType: MBLK	TestCode: EPA Method 300.0: Anions								
Client ID: PBS	Batch ID: 56531	RunNo: 73526								
Prep Date: 11/18/2020	Analysis Date: 11/20/2020	SeqNo: 2589660 Units: mg/Kg								
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	ND	1.5								
Sulfate	ND	1.5								

Sample ID: LCS-56531	SampType: LCS	TestCode: EPA Method 300.0: Anions								
Client ID: LCSS	Batch ID: 56531	RunNo: 73526								
Prep Date: 11/18/2020	Analysis Date: 11/20/2020	SeqNo: 2589661 Units: mg/Kg								
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	14	1.5	15.00	0	95.8	90	110			
Sulfate	30	1.5	30.00	0	98.4	90	110			

Qualifiers:

* Value exceeds Maximum Contaminant Level.
D Sample Diluted Due to Matrix
H Holding times for preparation or analysis exceeded
ND Not Detected at the Reporting Limit
PQL Practical Quantitative Limit
S % Recovery outside of range due to dilution or matrix

B Analyte detected in the associated Method Blank
E Value above quantitation range
J Analyte detected below quantitation limits
P Sample pH Not In Range
RL Reporting Limit

September 24, 2021

Souder Miller & Associates
Hwy 264 and Window Rock Loop
Window Rock, AZ 86515-0519

Attn: Ty Tsinnijinnie

RE: Geotechnical Engineering Services Report
Navajo Gallup Water Supply Project
Beacon Bisti N9 – Reach 10.2 Pump Plant 12
Report No. 1-00908

Addendum 1 – Increased Tank Size

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 provide and update to the above referenced report with regard to an increase in the volume of the proposed reservoir tanks.

It is understood that the volume of the two proposed tanks for the site will be increased from 50,000 gallons to 75,000 gallons. The diameter of the new tanks will remain 20 feet with the increased volume provided by increasing the height of the tanks. Given an increase in volume, unit loading on the base of the tanks will be on the order of 2,000 pounds per square foot.

Given the subsurface conditions encountered as part of the original investigation, the soil and rock encountered beneath the tank sites will provide adequate support of the 75,000 gallon tanks such that all design recommendations provided in the original report pertaining to tank foundation design for a 50,000 gallon tank are also applicable to a 75,000 gallon tank.

All recommendations presented in the original report which are not specifically altered by this addendum remain valid and unchanged. 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.

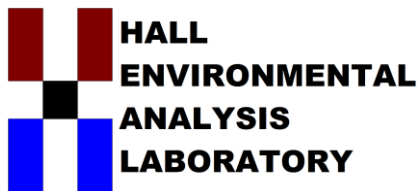
Patrick R. Whorton, PE



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October 22, 2020

Tory Tadano
Souder Miller & Associates
5454 Venice Ave. NE Suite D
Albuquerque, NM 87113
TEL: (505) 299-0942
FAX:

RE: BBN9 Pump Stations and Chlorinator Sites

OrderNo.: 2010765

Dear Tory Tadano:

Hall Environmental Analysis Laboratory received 7 sample(s) on 10/15/2020 for the analyses presented in the following report.

These were analyzed according to EPA procedures or equivalent. To access our accredited tests please go to www.hallenvironmental.com or the state specific web sites. In order to properly interpret your results, it is imperative that you review this report in its entirety. See the sample checklist and/or the Chain of Custody for information regarding the sample receipt temperature and preservation. Data qualifiers or a narrative will be provided if the sample analysis or analytical quality control parameters require a flag. When necessary, data qualifiers are provided on both the sample analysis report and the QC summary report, both sections should be reviewed. All samples are reported, as received, unless otherwise indicated. Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH and residual chlorine are qualified as being analyzed outside of the recommended holding time.

Please don't hesitate to contact HEAL for any additional information or clarifications.

ADHS Cert #AZ0682 -- NMED-DWB Cert #NM9425 -- NMED-Micro Cert #NM0901

Sincerely,

A handwritten signature in black ink, appearing to read 'Andy Freeman', is written over a light blue horizontal line.

Andy Freeman
Laboratory Manager
4901 Hawkins NE
Albuquerque, NM 87109

Hall Environmental Analysis Laboratory, Inc.

Analytical Report

Lab Order 2010765

Date Reported: 10/22/2020

CLIENT: Souder Miller & Associates

Client Sample ID: PP12-South Tank

Project: BBN9 Pump Stations and Chlorinator Si

Collection Date: 10/8/2020 12:40:00 PM

Lab ID: 2010765-005

Matrix: SOIL

Received Date: 10/15/2020 10:24:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS							Analyst: CAS
Chloride	ND	7.5		mg/Kg	5	10/19/2020 6:05:42 PM	55907
Sulfate	9.6	7.5		mg/Kg	5	10/19/2020 6:05:42 PM	55907
SM4500H+B/EPA 9040C							Analyst: JRR
pH	8.59			pH Units	1	10/21/2020 9:57:00 AM	R72810

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	D	Sample Diluted Due to Matrix	E	Value above quantitation range
	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
	ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
	PQL	Practical Quantitative Limit	RL	Reporting Limit
	S	% Recovery outside of range due to dilution or matrix		

Hall Environmental Analysis Laboratory, Inc.

Analytical Report

Lab Order 2010765

Date Reported: 10/22/2020

CLIENT: Souder Miller & Associates

Client Sample ID: PP12-North Tank

Project: BBN9 Pump Stations and Chlorinator Si

Collection Date: 10/8/2020 1:12:00 PM

Lab ID: 2010765-006

Matrix: SOIL

Received Date: 10/15/2020 10:24:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS							Analyst: CAS
Chloride	ND	7.5		mg/Kg	5	10/19/2020 6:30:32 PM	55907
Sulfate	8.0	7.5		mg/Kg	5	10/19/2020 6:30:32 PM	55907
SM4500H+B/EPA 9040C							Analyst: JRR
pH	8.60			pH Units	1	10/21/2020 9:57:00 AM	R72810

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	D	Sample Diluted Due to Matrix	E	Value above quantitation range
	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
	ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
	PQL	Practical Quantitative Limit	RL	Reporting Limit
	S	% Recovery outside of range due to dilution or matrix		

**GEOTECHNICAL ENGINEERING
SERVICES REPORT
NO. 1-00909**

**NAVAJO GALLUP WATER SUPPLY
PROJECT**

**BEACON BISTI N9 - REACH 10.2
PUMP PLANT 13**

MCKINLEY COUNTY, NEW MEXICO

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PREPARED FOR:

SOUDER MILLER & ASSOCIATES

December 1, 2020
Job No. 1-00909

**Souder Miller & Associates
Hwy 264 and Window Rock Loop
Window Rock, AZ 86515-0519**

ATTN: Ty Tsinnijinnie, PE

**RE: Geotechnical Engineering Services Report
Navajo Gallup Water Supply Project
Beacon Bisti N9 – Reach 10.2 Pump Plant 13
McKinley County, 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, laboratory testing and recommendations for foundation design and slab support as well as criteria for excavation, backfill and general 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:
GEO-TEST, INC.

Patrick R. Whorton, PE



Reviewed By:

Robert D. Booth, PE

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INTRODUCTION

This report presents the results of our geotechnical engineering services investigation performed by this firm for the proposed new Pump Plant 13 for the Reach 10.2 waterline project in McKinley County, New Mexico.

The objectives of this investigation were to:

- 1) Evaluate the nature and engineering properties of the subsurface soils and/or rock underlying the site.
- 2) Provide design recommendations for foundations and slab support as well as criteria pertaining to excavation, backfill and site grading.

The investigation includes subsurface exploration, selected soil and 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 development of a new pump plant site. The new plant will consist of two 50,000 gallon above grade steel welded or glass fused storage tanks as well as a pump station and surge tank building. The tanks will have a diameter of 20 feet with unit loading on the base of the tank anticipated to be on the order of 1,500 pounds per square foot. The utility buildings will be approximately 500 square feet in area and are anticipated to be founded on shallow spread-type footings with loading not anticipated to exceed 1.0 kips per lineal foot.

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

FIELD EXPLORATION

Three (3) exploratory borings were drilled at the site to depths ranging from 20 feet to 4.25 feet where practical auger refusal was encountered. The locations of the borings are shown on the attached Boring Location Map, Figure 1. The soils and rock 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 or less utilizing an open tube split barrel sampler driven by a standard penetration test hammer.

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LABORATORY TESTING

Selected samples were tested in the laboratory to determine certain engineering properties of the soils and rock. Moisture contents were determined to evaluate the various 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. To aid in corrosion analysis, pH and laboratory resistivity testing was performed on composite samples taken from the upper 10 feet of the site. Sulfate and chloride ion concentrations were determined by Hall Environmental Analysis Laboratory. 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

A brief surface reconnaissance was performed during our site exploration. The Reach 10.2 Pump Plant 13 site is located approximately 550 feet west of Navajo Service Route 9 along the proposed Reach 10.2 alignment at coordinates: 35° 46' 57.50" N -108° 21' 17.34" W.

At the time of this investigation the site was undisturbed and populated with native shrubs and grasses. The overall site is slopes downward to the southeast with an approximate grade change of 7 feet across the site.

SUBSURFACE SOIL CONDITIONS

As indicated by the exploratory borings, the soils underlying the site consist of a surficial layer of medium to very dense non-plastic silty sand which was encountered and extended to depths ranging from about 3 to 6½ feet below surface grades. Below this surficial layer, hard sandstone bedrock was encountered on the northern side of the site at the proposed tank locations which refused the auger. On the south side of the site at the proposed pump station building location, an approximate 1-foot thick layer of sandstone was encountered below the surficial sand. Below this sandstone lens, very firm to hard medium plasticity weathered shale or mudstone was encountered and extended to a depth of about 20½ feet, the full depth of the boring.

No free groundwater was encountered in the borings and soil and rock moisture contents were relatively low throughout the extent of the borings.

CONCLUSIONS AND RECOMMENDATIONS

The near surface soils underlying both the tank and building sites were found to be 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 structures be founded on shallow reinforced concrete footings bearing directly on densified native soils or properly compacted fill, if required for grading purposes. Detailed recommendations

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for foundation design and the required site grading are presented in the following sections of this report.

Based on the results of this investigation, the proposed tanks and utility buildings are anticipated to bear on at least 1.0 foot of medium dense to dense silty sand. However, the proposed sites are also underlain by sandstone bedrock and/or by medium plasticity potentially expansive bedrock. The building foundations should not bear directly onto the bedrock as it could cause excessive differential settlements and/or heave, particularly upon significant changes in moisture content. Should site grading place the footings directly on the bedrock, the building sites should be overexcavated to such an extent as to provide for a minimum of 1 foot of properly compacted structural fill beneath all footings and floor slabs. Detailed recommendations for building and tank foundation design and the required site grading are presented in the following sections of this report.

Post-construction moisture increases in the supporting soils would cause some differential foundation settlement and could create excessive movement, at least in some areas of the site. 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 storage 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.

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 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.

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BUILDING FOUNDATIONS

Shallow spread-type footings bearing directly on the native soils, or on properly compacted structural fill, are recommended for the support of the utility structures. An allowable soil bearing pressure of 2,000 pounds per square foot is recommended for footing design. This bearing pressure applies to full dead loads plus realistic live loads and can be safely increased by one-third for total loads including wind and seismic forces.

Exterior footings should be established a minimum of 2.0 feet below lowest adjacent finished grade, while interior footings should be at least 12 inches below finished floor grade. The minimum recommended 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 $\frac{3}{4}$ 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 important for the satisfactory performance of the structure.

LATERAL EARTH PRESSURES

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, 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 375 pounds per cubic foot should be used for analysis.

SLABS ON GRADE

Concrete slabs on grade should be founded on prepared native soils or properly compacted structural fill and constructed in conformance with the methods outlined in ACI 302.1R-04.

Adequate support for lightly loaded slab-on-grade floors will be provided by native soils when prepared as recommended in the Site Grading 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 reaction, 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:

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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 D-1557.

Any heavily loaded slabs on the project bearing on structural fill should be designed using a modulus of subgrade reaction of 200 pounds per square inch per inch of deflection. If a 6-inch thickness of granular base is placed and compacted beneath the slabs, the modulus of subgrade reaction can be increased to 300 pounds per square inch per inch of deflection.

The granular base may act as a capillary barrier but will not totally eliminate the rise of moisture to the slabs. If floor coverings are proposed which are highly sensitive to moisture, or highly moisture sensitive equipment will be installed within the building, a synthetic vapor barrier should be installed to prevent moisture intrusion through the slab. A minimum of 4 inches of granular base as recommended above should be placed between the vapor barrier and the slab. Barriers should be overlapped a minimum of 6 inches at joints, should be carefully fitted around service openings and should conform with ACI 302.1R-04 specifications.

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 any required excavations, the existing site soils should be densified prior to the placement of structural fill or concrete. Should any foundation or floor slab be placed on the underlying sandstone or shale bedrock, the bedrock should be overexcavated to such an extent as to provide for a minimum of 1 foot of properly compacted structural fill beneath all footings and floor slabs.
- 2) Densification of the exposed 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 or D-698 for clay soils.
- 3) The results of this investigation indicate that most of the near surface soils will be suitable for use as structural fill provided proper blending to meet the specifications presented below. Any imported material must

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also meet the criteria for structural fill. The native weathered shale is not suitable for use as structural fill.

- 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:

Size	Percent Passing
3 inch	100
No. 4	80 - 100
No. 200	20 - 45

- 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.

EXCAVATIONS

Excavated slopes for foundation and utility construction should be designed and constructed in accordance with 29 CFR 1926, Subpart P, and any applicable state or local regulations. Excavated temporary slopes should not exceed 2:1 (horizontal to vertical). Excavation of the near surface surficial soils can be readily accomplished using normal earthmoving equipment. Excavations into the underlying sandstone and/or shale bedrock will require heavy ripping and rock breaking (hoe ram) equipment.

The contractor should be responsible for all temporary excavation slopes excavated for the purpose of structural fill placement as well as the design of any required temporary shoring, as applicable. Shoring, bracing, and benching should be performed by the contractor in accordance with applicable safety standards. Spoil piles and heavy equipment should not be allowed within 5 feet of the top of the slopes.

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MOISTURE PROTECTION

Precautions should be taken during and after construction to minimize moisture increase of foundation soils. Accumulations of excessive moisture could be harmful to some types of interior flooring, to HVAC ductwork beneath the slabs, and can weaken or cause other changes in the soils supporting the foundations and slabs. This can cause differential movement of the foundations and can result in cosmetic or structural damage to the structures.

Positive drainage should be established away from the exterior walls of the structures. A typical adequate slope is 6 inches in the first 5 feet with positive drainage being provided from those points to streets, pavement or natural water courses. If necessary to provide positive drainage, the building areas should be raised above adjacent grades with structural fill.

Roof runoff from the structures should be collected by gutters and downspouts or roof canales and discharged to splash blocks which carry water rapidly away from the structure's foundation. Should lot size or other factors impede positive drainage away from the structures to less than 5 feet from foundations, a non-perforated drain system should be installed to carry water to a minimum of five feet away from foundations or to streets or natural water courses.

Utility backfill should be well compacted and should meet the specifications outlined in the Site Grading section of this report. Special care should be taken during installation of the subfloor sewer and water lines to reduce the possibility of future subsurface saturation.

Irrigation within 10 feet of foundations is discouraged or at the very least should be carefully controlled. Proper landscaping and drainage maintenance are required to preclude accumulation of excessive moisture in the soils below the structures and throughout the site. This should include but is not limited to routine maintenance checks of irrigation system to ensure no leakage and proper functionality and that irrigation is adjusted and maintained seasonally so that over watering does not occur. Native drought resistant plants are recommended for use in landscaping. Landscape features should not impede positive drainage away from foundations as recommended above.

Drainage control ponds or any other drainage/landscaping feature which allows for surface waters to infiltrate the subsurface soils should not be placed within 20 feet of building foundations.

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

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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 earthwork portion 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 soils

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.

This report has been prepared for the sole use of Souder Miller & Associates, specifically to aid in the design of the proposed Beacon Bisti Pump Plant 13 to be constructed for the Reach 10.2 pipeline in McKinley County, New Mexico and not for use by any third parties without consent.

We make no other warranty, either expressed 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.

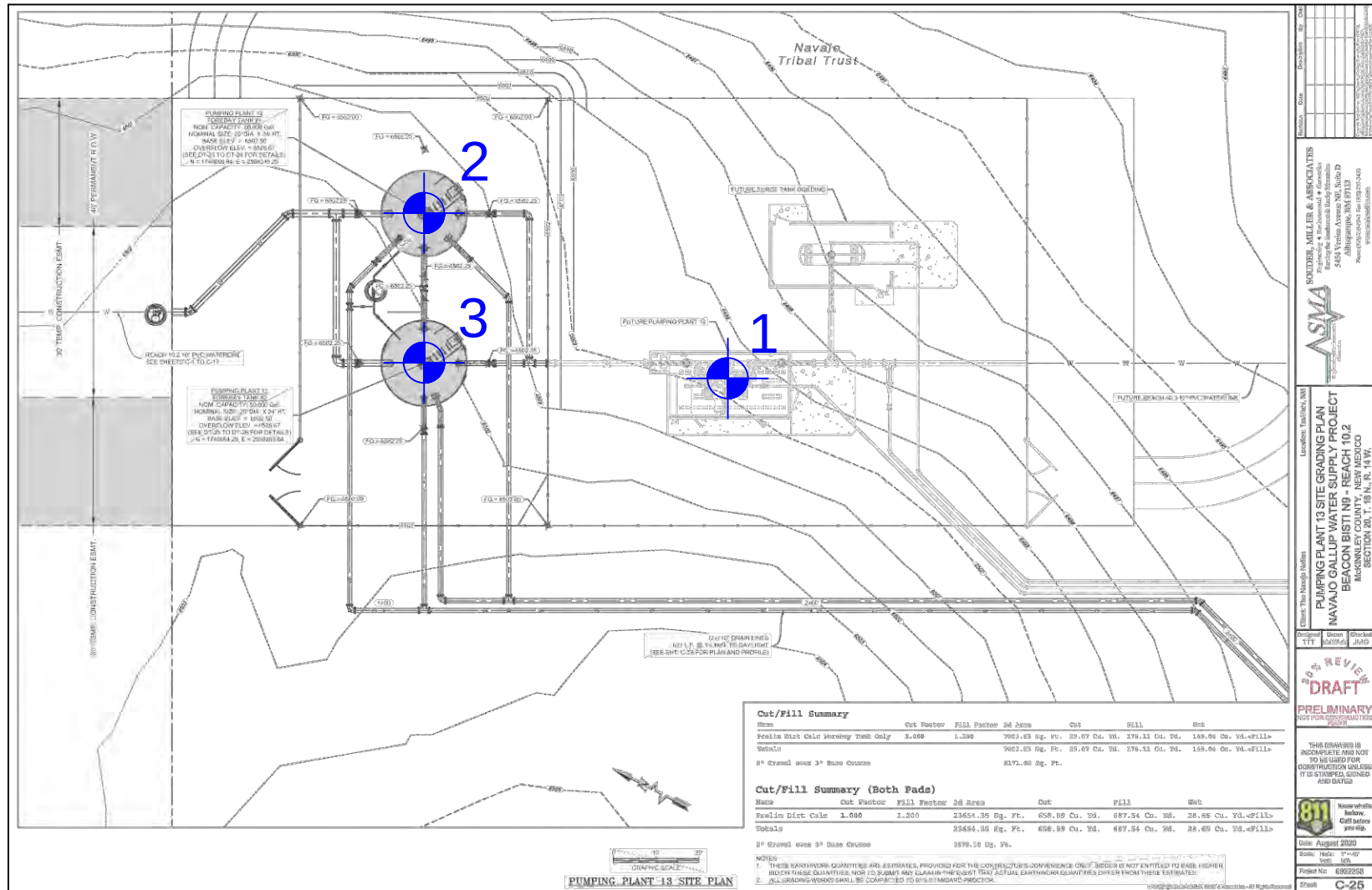
All soil samples will be discarded 60 days after the date of this report unless we receive a specific request to retain the samples for a longer period of time.

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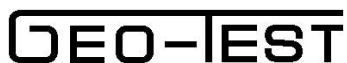
BORING LOCATION MAP



Beacon Bisti N9 - Pump Plant 13
McKinley County, New Mexico
Job No. 1-00809

Figure 1

GEO-TEST
GEOTECHNICAL ENGINEERING
AND MATERIAL TESTING



Project: Beacon Bisti N9 - Pump Plant 13

Date: 10/08/2020

Project No: 1-00909

Elevation:

Type: 5.5" OD HSA

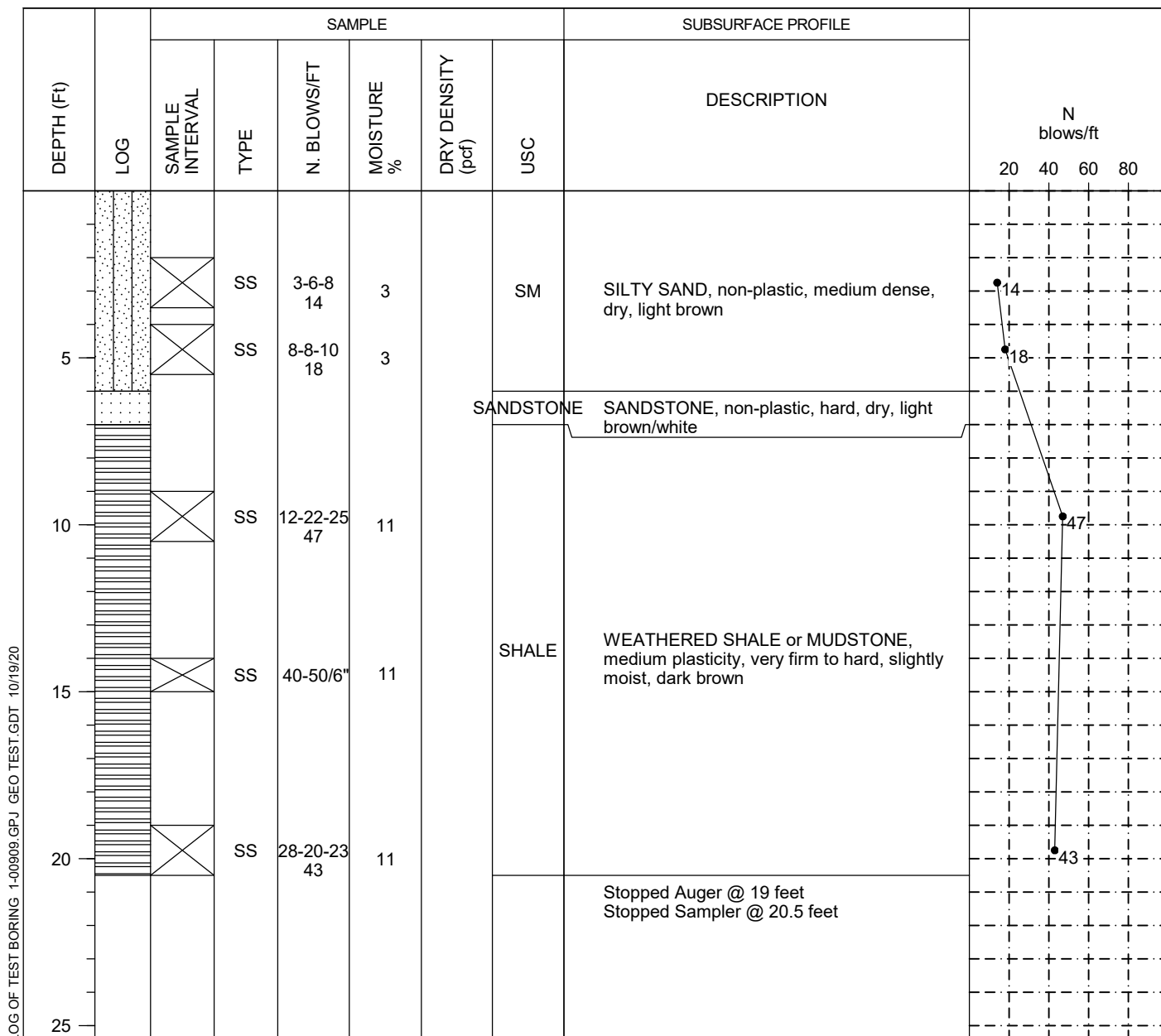
LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 1

During Drilling: none

After 24 Hours:

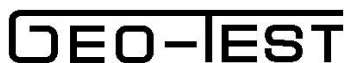


LEGEND

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 measurements were made.



Project: Beacon Bisti N9 - Pump Plant 13

Date: 10/08/2020

Project No: 1-00909

Elevation:

Type: 5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 2

During Drilling: none

After 24 Hours:

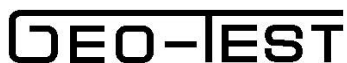
DEPTH (Ft)	LOG	SAMPLE					SUBSURFACE PROFILE		N blows/ft 20 40 60 80			
		SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION				
			SS	18-19-50/1"	3		SM	SILTY SAND, non-plastic, very dense, dry, light brown				
			SS	50/3"	3		SANDSTONE	SANDSTONE, non-plastic, hard, dry, light brown/white Auger REFUSAL @ 4.25 feet on SANDSTONE Sampler REFUSAL @ 4.25 feet				
5												
10												
15												
20												
25												

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 measurements were made.



Project: Beacon Bisti N9 - Pump Plant 13
 Date: 10/08/2020 Project No: 1-00909
 Elevation: Type: 5.5" OD HSA

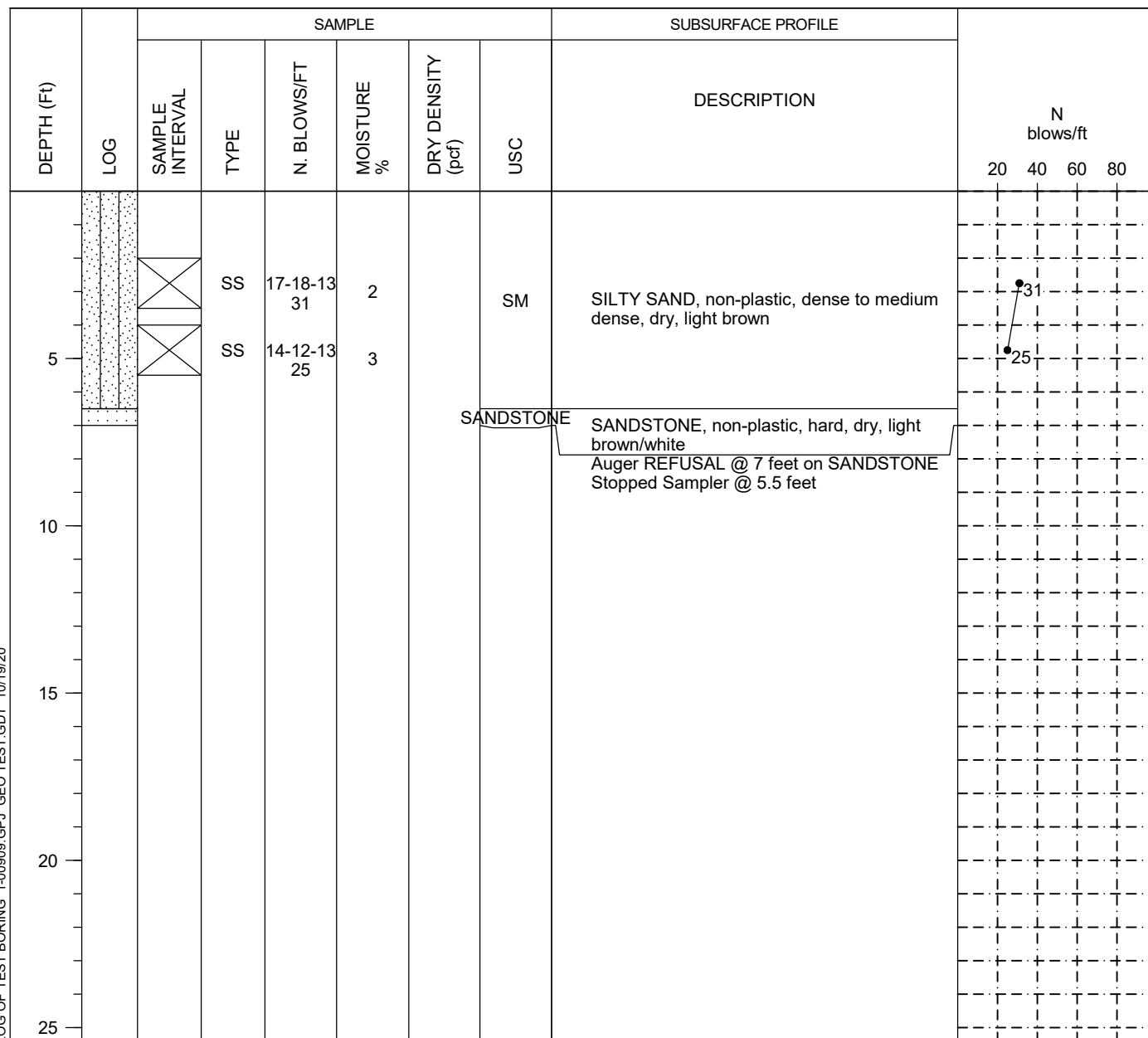
LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 3

During Drilling: none

After 24 Hours:



LEGEND

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

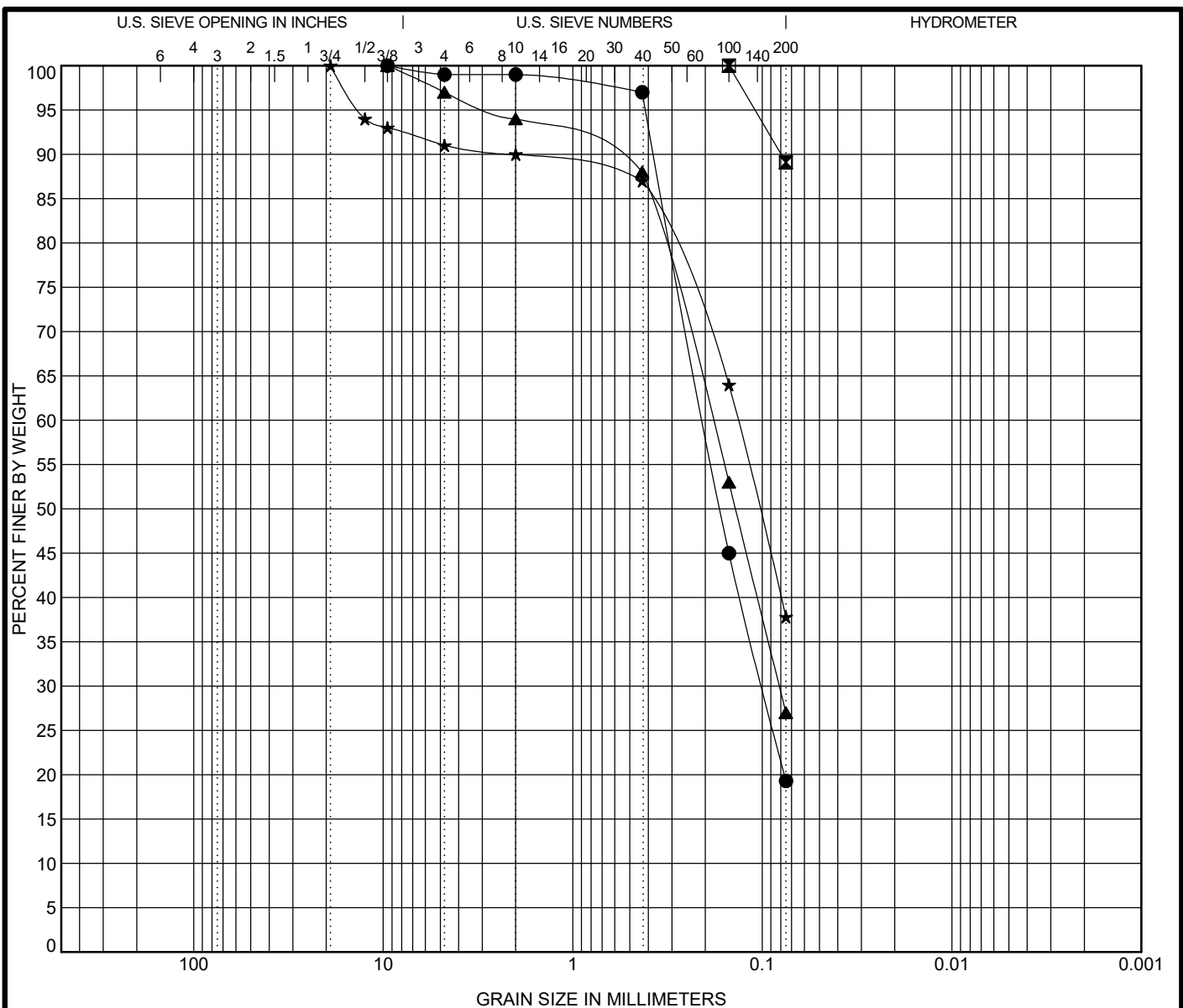
AMSL - Above Mean Sea Level
 CS - Continuous Sampler
 UD - Undisturbed
 ST - Shelby Tube

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 measurements 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	SM	3.2	NP	NP	19	45	96	99	99	100						
1	5.0		2.8														
1	10.0		10.8														
1	15.0		11.3														
1	20.0	CL	10.9	44	24	89	100										
2	3.0	SM	3.3	NP	NP	27	53	88	94	97	100						
2	5.0		2.7														
3	3.0		2.5														
3	5.0	SM	3.2	NP	NP	38	64	87	90	91	93	94	100				
						LL = LIQUID LIMIT PI = PLASTICITY INDEX NP = NON PLASTIC or NO VALUE						Project: Beacon Bisti N9 - Pump Plant 13					
												Location: McKinley County, NM Number: 1-00909					

SUMMARY OF LABORATORY RESULTS 1-00909.GPJ GEO TEST.GDT 10/19/20



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification			LL	PL	PI	Cc	Cu
●	1	3.0	SILTY SAND(SM)			NP	NP	NP		
☒	1	20.0	LEAN CLAY(CL)			44	20	24		
▲	2	3.0	SILTY SAND(SM)			NP	NP	NP		
★	3	5.0	SILTY SAND(SM)			NP	NP	NP		

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	1	3.0	9.5	0.203	0.1		1.0	79.7	19.3	
☒	1	20.0	0.15				0.0	10.9	89.1	
▲	2	3.0	9.5	0.185	0.081		3.0	70.0	27.0	
★	3	5.0	19	0.135			9.0	53.2	37.8	

GEO-TEST

GRAIN SIZE DISTRIBUTION

Project: Beacon Bisti N9 - Pump Plant 13

Location: McKinley County, NM Number:

1-00909

Corrosion Data

Project: BBN9 Pump Plant 13
Report # 1-00909

Soil Resistivity (ASTM G-57)

Sample Location: Composite Sample (0-5 ft)

Wet Weight:	134.1 grams
Dry Weight:	131.2 grams
Water Content	2.21 %

<u>As-Received Condition</u>	
Potential Change	2.0 volts
Current:	0 amps
Resistivity:	∞ ohm-cm

<u>Saturated Condition</u>	
Potential Change:	16.0 volts
Current:	0.033 amps
Resistivity:	485 ohm-cm

pH of Soil (ASTM G-51 & D-4972)

Sample Location: Composite Sample (0-5 ft)

Distilled Water Solution:	pH =	8.24
Calcium Chloride Solution:	pH =	8.19



Hall Environmental Analysis Laboratory
4901 Hawkins NE
Albuquerque, NM 87109
TEL: 505-345-3975 FAX: 505-345-4107
Website: clients.hallenvironmental.com

November 24, 2020

Patrick Whorton

Geo-Test

8528 Calle Alameda NE

Albuquerque, NM 87113

TEL: (505) 857-0933

FAX: (505) 857-0803

RE: BBN9 Pump Plant 13

OrderNo.: 2011850

Dear Patrick Whorton:

Hall Environmental Analysis Laboratory received 1 sample(s) on 11/17/2020 for the analyses presented in the following report.

These were analyzed according to EPA procedures or equivalent. To access our accredited tests please go to www.hallenvironmental.com or the state specific web sites. In order to properly interpret your results, it is imperative that you review this report in its entirety. See the sample checklist and/or the Chain of Custody for information regarding the sample receipt temperature and preservation. Data qualifiers or a narrative will be provided if the sample analysis or analytical quality control parameters require a flag. When necessary, data qualifiers are provided on both the sample analysis report and the QC summary report, both sections should be reviewed. All samples are reported, as received, unless otherwise indicated. Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH and residual chlorine are qualified as being analyzed outside of the recommended holding time.

Please don't hesitate to contact HEAL for any additional information or clarifications.

ADHS Cert #AZ0682 -- NMED-DWB Cert #NM9425 -- NMED-Micro Cert #NM0901

Sincerely,

A handwritten signature in black ink, appearing to read 'Andy Freeman', is written over a light blue horizontal line.

Andy Freeman

Laboratory Manager

4901 Hawkins NE

Albuquerque, NM 87109

Hall Environmental Analysis Laboratory, Inc.

Analytical Report

Lab Order 2011850

Date Reported: 11/24/2020

CLIENT: Geo-Test

Client Sample ID: 1-00909 0-3'

Project: BBN9 Pump Plant 13

Collection Date: 11/17/2020 8:15:00 AM

Lab ID: 2011850-001

Matrix: SOIL

Received Date: 11/17/2020 12:55:00 PM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS						Analyst: VP	
Chloride	36	7.5		mg/Kg	5	11/19/2020 3:21:08 AM	56531
Sulfate	92	7.5		mg/Kg	5	11/19/2020 3:21:08 AM	56531

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	D	Sample Diluted Due to Matrix	E	Value above quantitation range
	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
	ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
	PQL	Practical Quantitative Limit	RL	Reporting Limit
	S	% Recovery outside of range due to dilution or matrix		

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: 2011850

24-Nov-20

Client: Geo-Test

Project: BBN9 Pump Plant 13

Sample ID: MB-56531	SampType: MBLK	TestCode: EPA Method 300.0: Anions								
Client ID: PBS	Batch ID: 56531	RunNo: 73446								
Prep Date: 11/18/2020	Analysis Date: 11/18/2020	SeqNo: 2587416	Units: mg/Kg							
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	ND	1.5								
Sulfate	ND	1.5								

Sample ID: LCS-56531	SampType: LCS	TestCode: EPA Method 300.0: Anions								
Client ID: LCSS	Batch ID: 56531	RunNo: 73446								
Prep Date: 11/18/2020	Analysis Date: 11/18/2020	SeqNo: 2587417	Units: mg/Kg							
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	14	1.5	15.00	0	94.5	90	110			
Sulfate	29	1.5	30.00	0	96.6	90	110			

Sample ID: MB-56531	SampType: MBLK	TestCode: EPA Method 300.0: Anions								
Client ID: PBS	Batch ID: 56531	RunNo: 73526								
Prep Date: 11/18/2020	Analysis Date: 11/20/2020	SeqNo: 2589660	Units: mg/Kg							
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	ND	1.5								
Sulfate	ND	1.5								

Sample ID: LCS-56531	SampType: LCS	TestCode: EPA Method 300.0: Anions								
Client ID: LCSS	Batch ID: 56531	RunNo: 73526								
Prep Date: 11/18/2020	Analysis Date: 11/20/2020	SeqNo: 2589661	Units: mg/Kg							
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	14	1.5	15.00	0	95.8	90	110			
Sulfate	30	1.5	30.00	0	98.4	90	110			

Qualifiers:

* Value exceeds Maximum Contaminant Level.
D Sample Diluted Due to Matrix
H Holding times for preparation or analysis exceeded
ND Not Detected at the Reporting Limit
PQL Practical Quantitative Limit
S % Recovery outside of range due to dilution or matrix

B Analyte detected in the associated Method Blank
E Value above quantitation range
J Analyte detected below quantitation limits
P Sample pH Not In Range
RL Reporting Limit

September 24, 2021

Souder Miller & Associates
Hwy 264 and Window Rock Loop
Window Rock, AZ 86515-0519

Attn: Ty Tsinnijinnie

RE: Geotechnical Engineering Services Report
Navajo Gallup Water Supply Project
Beacon Bisti N9 – Reach 10.2 Pump Plant 13
Report No. 1-00909

Addendum 1 – Increased Tank Size

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 provide and update to the above referenced report with regard to an increase in the volume of the proposed reservoir tanks.

It is understood that the volume of the two proposed tanks for the site will be increased from 50,000 gallons to 75,000 gallons. The diameter of the new tanks will remain 20 feet with the increased volume provided by increasing the height of the tanks. Given an increase in volume, unit loading on the base of the tanks will be on the order of 2,000 pounds per square foot.

Given the subsurface conditions encountered as part of the original investigation, the soil and rock encountered beneath the tank sites will provide adequate support of the 75,000 gallon tanks such that all design recommendations provided in the original report pertaining to tank foundation design for a 50,000 gallon tank are also applicable to a 75,000 gallon tank.

All recommendations presented in the original report which are not specifically altered by this addendum remain valid and unchanged. 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, PE



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**GEOTECHNICAL ENGINEERING
SERVICES REPORT
NO. 1-11001A**

**BEACON BISTI N9
WATERLINE PROJECT**

**NAHODISHGISH TANK SITE
MCKINLEY COUNTY, NEW MEXICO**

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PREPARED FOR:

SOUDER MILLER & ASSOCIATES

December 14, 2021
Job No. 1-11001A

**Souder Miller & Associates
Hwy 264 and Window Rock Loop
Window Rock, AZ 86515-0519**

ATTN: Ty Tsinnijinnie, PE

RE: Geotechnical Engineering Services Report
Navajo Gallup Water Supply Project
Beacon Bisti N9 Waterline Project
Nahodishgish Tank Site
McKinley County, 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, laboratory testing and recommendations for foundation design as well as criteria for excavation, backfill and general 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:
GEO-TEST, INC.

Patrick R. Whorton, PE



Reviewed By:

Robert D. Booth, PE

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INTRODUCTION

This report presents the results of our geotechnical engineering services investigation performed by this firm for the proposed new Nahodishgish Tank Site project in McKinley County, New Mexico.

The objectives of this investigation were to:

- 1) Evaluate the nature and engineering properties of the subsurface soils and rock underlying the site.
- 2) Provide recommendations for foundation design as well as criteria pertaining to excavation, backfill and 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 construction of a new tank site which will include the installation of three new steel welded above ground reservoirs consisting of a new 125,000 gallon, 30 foot diameter tank (North Tank) and two 75,000 gallon 24 foot diameter tanks (South Tanks) and a 500 square foot chlorinator building. A preliminary site plan is included as Figure 1 in a later section of this report. Unit loading on the base of the tanks is not anticipated to exceed 1,500 pounds per square foot and building foundation loads are not anticipated to exceed 1.0 kips per lineal foot on load bearing walls.

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

FIELD EXPLORATION

Four (4) exploratory borings were drilled at the site to depths of about 14 to 24 feet below existing surface grade. The locations of the borings are shown on the attached Boring Location Map, Figure 2. The soils and rock 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 or less utilizing an open tube split barrel sampler driven by a standard penetration test hammer.

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LABORATORY TESTING

Selected samples were tested in the laboratory to determine certain engineering properties of the subsurface materials. Moisture contents were determined to evaluate the various soil/rock 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. To aid in corrosion analysis, pH and laboratory resistivity testing was performed on composite samples taken from the upper 10 feet of the site. Sulfate and chloride ion concentrations were determined by Hall Environmental Analysis Laboratory (specimen 4@0-2'). 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

A brief surface reconnaissance was performed during our site exploration. The Nahodishgish Tank Site is located at coordinates: 35°42'27.31"N 108°16'15.90"W.

At the time of this investigation the site was undisturbed and populated with native shrubs and grasses. The overall site slopes downward from the southeast to the northwest with an overall elevation change of approximately 12 feet.

SUBSURFACE SOIL/ROCK CONDITIONS

As indicated by the exploratory borings, the subsurface profile underlying the site consisted of a surficial layer of medium dense to dense low plasticity clayey sand and non-plastic silty sand. Below the surficial sands, hard weathered sandstone was encountered to the full depths explored. The depth to sandstone varied from each location explored from approximately 5 feet on the north side of the site to 2 feet on the southside and sandstone encountered at the surface at the Boring 3 location.

No free groundwater was encountered in the boring and soil/rock moisture contents were relatively low to moderate throughout the extent of the borings.

CONCLUSIONS AND RECOMMENDATIONS

The near surface soils underlying the site were found to be medium dense to dense in their present condition and are considered suitable to provide reliable support of the proposed tanks and chlorinator building. The weathered sandstone encountered below the near surface soils was found to be consistently hard throughout the depths explored and will also provide reliable support of the proposed structures. As such, the proposed tanks and chlorinator building may either be founded on either densified native soils, on

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exposed sandstone or on properly compacted structural fill if required for grading purposes. It is not recommended that a combination of bearing surfaces be used for the support of the structures due to the potential for excessive differential settlements. Each structure should be founded entirely on sandstone or entirely on compacted native soil or structural fill, not a combination of both.

Accordingly, given the subsurface conditions and tank sizes, it is recommended that all three proposed tanks be founded on reinforced concrete ring-wall footings (AWWA Type 1) bearing directly on densified native soils, sandstone or properly compacted fill, if required for grading purposes.

The near surface soil underlying the chlorinator building site was found to be dense in its present condition and is considered suitable to provide reliable support of the proposed structure. Accordingly, it is recommended that the chlorinator building be supported on shallow spread-type footings bearing directly on densified native soils, sandstone or properly compacted structural fill, if required for grading purposes.

Detailed recommendations for tank and building foundation design and the required site grading are presented in the following sections of this report.

Post-construction moisture increases in the supporting soils would cause some differential foundation settlement and could create excessive movement, at least in some areas of the site. 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 storage tanks may be supported on reinforced concrete ring-wall footings (AWWA Type 1) bearing directly on sandstone, densified 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 3,500 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 footings is 16 inches. The floor of the tanks should be supported on a sand cushion at least 3 inches thick placed directly on densified native soils or structural fill.

It is estimated that total settlement of the tanks and ring-wall footings, designed and constructed as recommended herein, will not exceed about 1.0 inch. Differential movement, or tilt across the entire tank bottoms, is estimated to be less than 0.5 inches. The above settlement estimates are based upon the soil

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moisture contents encountered during test drilling or moisture contents introduced during 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

Shallow spread-type footings bearing directly on densified native soil, sandstone, or on properly compacted structural fill, are recommended for the support of the chlorinator building. An allowable bearing pressure of 2,000 pounds per square foot is recommended for footing design. This bearing pressure applies to full dead loads plus realistic live loads and can be safely increased by one-third for total loads including wind and seismic forces.

Exterior footings should be established a minimum of 2.0 feet below lowest adjacent finished grade, while interior footings should be at least 12 inches below finished floor grade. The minimum recommended 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 $\frac{3}{4}$ inch for the soil/rock 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/rock would create additional movements, and thus, the moisture protection provisions as recommended in a following section of this report are considered important for the satisfactory performance of the structure.

LATERAL EARTH PRESSURES

Resistance to lateral forces will be provided by soil friction between the base 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, 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 375 pounds per cubic foot should be used for analysis.

SLABS ON GRADE

Concrete slabs on grade should be founded on a minimum of 1.0 foot of properly compacted, non-expansive structural fill and constructed in conformance with the methods outlined in the current addition of ACI 302.1R.

Adequate support for lightly loaded slab-on-grade floors will be provided by the structural fill when compacted as recommended in the Site Grading section

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of this report. Thus, the use of granular base for structural support of loaded slabs is not considered necessary. However, should it be desired as a working surface, or to increase the modulus of subgrade reaction, 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 D-1557.

The granular base may act as a capillary barrier but will not totally eliminate the rise of moisture to the slabs. If floor coverings are proposed which are highly sensitive to moisture, or highly moisture sensitive equipment will be installed within the buildings, a synthetic vapor barrier should be installed to prevent moisture intrusion through the slab. A minimum of 4 inches of granular base as recommended above should be placed between the vapor barrier and the slab. Barriers should be overlapped a minimum of 6 inches at joints, should be carefully fitted around service openings and should conform with ACI 302.1R specifications.

Floor slabs bearing directly on structural fill should be designed using a modulus of subgrade reaction of 200 pounds per square inch per inch of deflection. If a 6-inch thickness of granular base is placed and compacted beneath the slabs, the modulus of subgrade reaction can be increased to 300 pounds per square inch per inch of deflection.

EXCAVATIONS

Excavated slopes for foundation and utility construction should be designed and constructed in accordance with 29 CFR 1926, Subpart P, and any applicable state or local regulations. Excavated temporary slopes should not exceed 2:1 (horizontal to vertical).

Excavation of the near surface surficial soils can be readily accomplished using normal earthmoving equipment. Excavations into the underlying bedrock will require heavy ripping and rock breaking (hoe ram) equipment.

The contractor should be responsible for all temporary excavation slopes excavated for the purpose of structural fill placement as well as the design of

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any required temporary shoring, as applicable. Shoring, bracing, and benching should be performed by the contractor in accordance with applicable safety standards. Spoil piles and heavy equipment should not be allowed within 5 feet of the top of the slopes.

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 any required excavations, the existing site soils should be densified prior to the placement of structural fill or concrete.
- 2) Densification of the exposed 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 near surface soils will be suitable for use as structural fill provided proper blending to meet the specifications presented below. Any imported material must also meet the criteria for structural fill.
- 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:

Size	Percent Passing
3 inch	100
No. 4	80 - 100
No. 200	15- 45

- 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.

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- 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 increase of foundation soils. This may cause differential movement of the foundations and can result in cosmetic or structural damage to the tanks or chlorinator building.

Positive drainage should be established away from the foundation perimeters. A typical adequate slope is 6 inches in the first 5 feet with positive drainage being provided from those points to streets, pavement or natural water courses. If necessary to provide positive drainage, the building sites should be raised above adjacent grades with structural fill.

Utility backfill should be well compacted and should meet the specifications outlined in the Site Grading section of this report. Special care should be taken during installation of water lines to reduce the possibility of future subsurface saturation.

Irrigation within 10 feet of foundations is discouraged or at the very least should be carefully controlled. Proper landscaping and drainage maintenance are required to preclude accumulation of excessive moisture in the soils below the structure and throughout the site. This should include but is not limited to routine maintenance checks of irrigation system to ensure no leakage and proper functionality and that irrigation is adjusted and maintained seasonally so that over watering does not occur. Native drought resistant plants are recommended for use in landscaping. Landscape features should not impede positive drainage away from foundations as recommended above.

Drainage control ponds or any other drainage/landscaping feature which allows for surface waters to infiltrate the subsurface soils should not be placed within 20 feet of building foundations.

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

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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 earthwork portion 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 soils

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.

This report has been prepared for the sole use of Souder Miller & Associates, specifically to aid in the design of the proposed Nahodishgish Tank Site to be constructed in McKinley County, New Mexico and not for use by any third parties without consent.

We make no other warranty, either expressed 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

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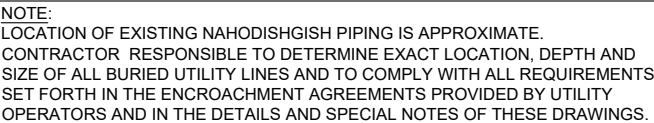
encountered during construction appear to be different than indicated by this report, this office should be notified.

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.

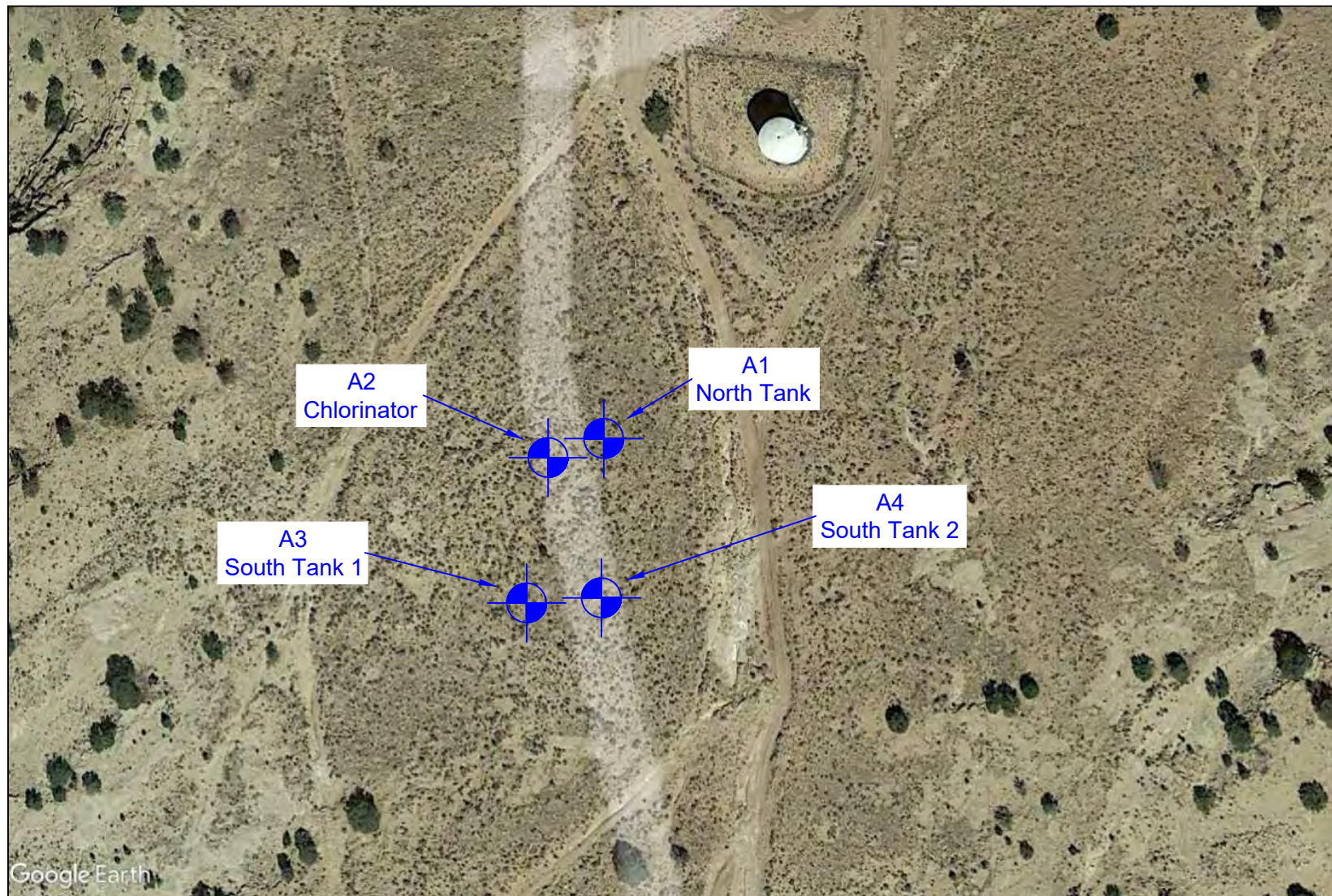
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BORING LOCATION MAP

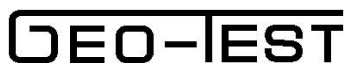


Nahodishgish Tank Site
McKinley County, New Mexico
Job No. 1-11001A

Figure 2



GEO-TEST
GEOTECHNICAL ENGINEERING
AND MATERIAL TESTING



Project: Beacon Bisti N9 - Nahodishgish Tank Site

Date: 10/19/2021

Project No: 1-11001A

Elevation:

Type: 5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: A1

During Drilling: none

After 24 Hours:

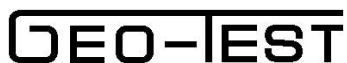
DEPTH (Ft)	LOG	SAMPLE						SUBSURFACE PROFILE	N blows/ft 20 40 60 80
		SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION	
5			SS	8-9-20 29	7		SC	CLAYEY SAND, low plasticity, medium dense, slightly moist, dark brown	29
			SS	21-50/6"	5				
10			SS	50/6"	6				
15			SS	50/3"	6				
20			SS	50/3"	7				
25			SS	50/3"	8				
24.25								Stopped Auger @ 24 feet Sampler REFUSAL @ 24.25 feet	
30									

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 measurements were made.



Project: Beacon Bisti N9 - Nahodishgish Tank Site

Date: 10/19/2021

Project No: 1-11001A

Elevation:

Type: 5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: A2

During Drilling: none

After 24 Hours:

DEPTH (Ft)	LOG	SAMPLE					SUBSURFACE PROFILE		N blows/ft 20 40 60 80
		SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION	
5			SS	10-13-18 31	10		SM	SILTY SAND, non-plastic, dense, moist, brown	31
			SS	18-50/6"	12		SC	CLAYEY SAND, low plasticity, very dense, moist, dark brown	
			AC		8		SANDSTONE	WEATHERED SANDSTONE, low plasticity, hard, slightly moist light brown to red	
10			SS	50/3"					
15			SS	50/3"	8			Stopped Auger @ 14 feet Sampler REFUSAL @ 14.25 feet	
20									
25									
30									

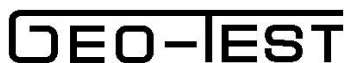
LOG OF TEST BORING 1-11001A.GPJ GEO TEST.GDT 11/3/21

LEGEND

SS - Split Spoon
AC - Auger Cuttings
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Project: Beacon Bisti N9 - Nahodishgish Tank Site

Date: 10/19/2021

Project No: 1-11001A

Elevation:

Type: 5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: A3

During Drilling: none

After 24 Hours:

DEPTH (Ft)	LOG	SAMPLE						SUBSURFACE PROFILE	N blows/ft			
		SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION				
									20	40	60	80
5			SS	50/6"	10							
			SS	50/6"	12							
10			SS	50/6"	12							
			SS	50/6"	13							
15			SS	50/6"	5							
20			SS	50/6"								
25												
30												

LEGEND

SS - Split Spoon

AC - Auger Cuttings

UD/SL - Undisturbed Sleeve

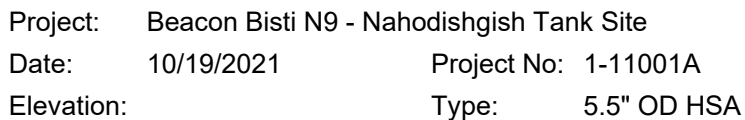
AMSL - Above Mean Sea Level

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 measurements were made.



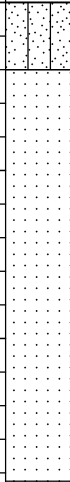
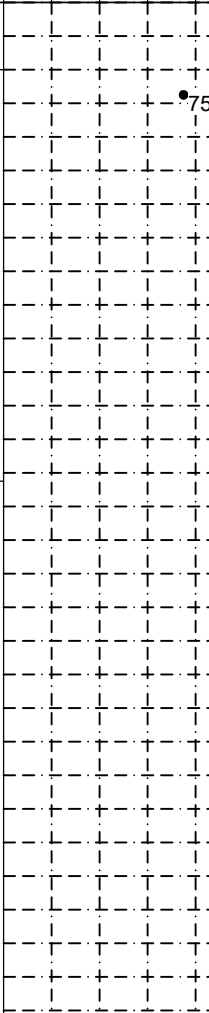
LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: A4

During Drilling: none

After 24 Hours:

DEPTH (Ft)	LOG	SAMPLE						SUBSURFACE PROFILE		N blows/ft 20 40 60 80			
		SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION					
5			AC	10-25-50 75 50/3"	7		SM	SILTY SAND with GRAVEL, non-plastic, slightly moist, brown					
			SS										
			SS										
			AC	9									
			SS	50/3"				6					
			SS	50/3"				7					
		15									Stopped Auger @ 14 feet Sampler REFUSAL @ 14.25 feet		
20													
25													
30													

LEGEND

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

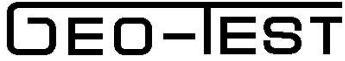
AMSL - Above Mean Sea Level
 CS - Continuous Sampler
 UD - Undisturbed
 ST - Shelby Tube

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 measurements were made.

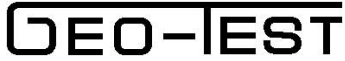
SUMMARY OF LABORATORY RESULTS

Sheet 1 of 2

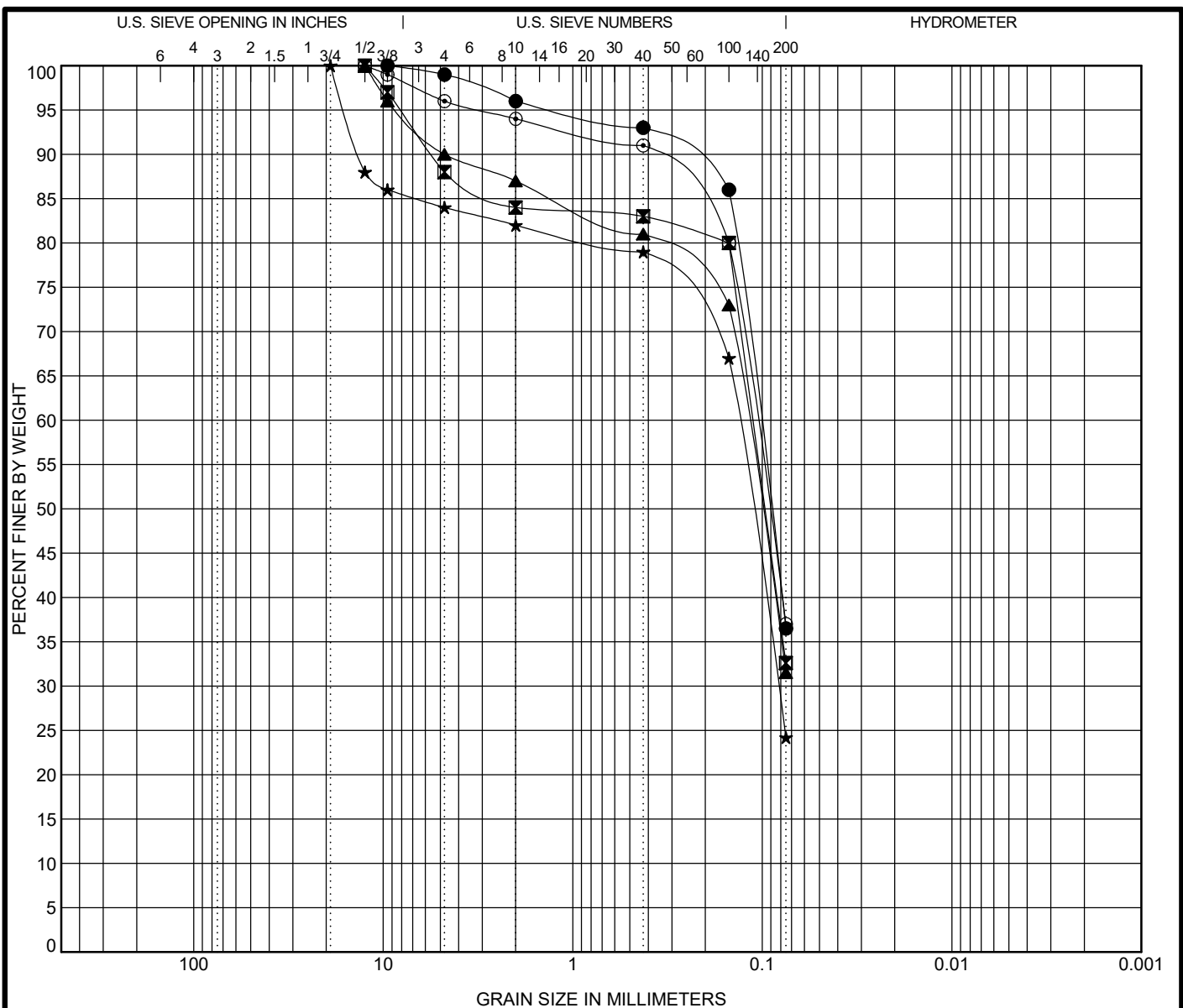
SUMMARY OF LABORATORY RESULTS 1-11001A.GPJ GEO TEST.GDT 11/3/21

						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"
A1	3.0	SC	7.1	26	8	37	86	93	96	99	100						
A1	5.0		4.7														
A1	10.0		5.6														
A1	15.0		6.2														
A1	20.0		7.2														
A1	22.0	SC-SM		23	6	33	80	83	84	88	97	100					
A1	25.0		8.2														
A2	3.0	SM	10.0	NP	NP	32	73	81	87	90	96	100					
A2	5.0		11.5														
A2	10.0		7.8														
A2	15.0		7.8														
A3	3.0		9.6														
A3	5.0		12.4														
A3	10.0		11.8														
A3	15.0		13.1														
A3	20.0		5.3														
A4	1.0	SM	6.7	NP	NP	24	67	79	82	84	86	88	100				
A4	6.0	SM	8.6	NP	NP	37	80	91	94	96	99	100					
A4	10.0		6.5														
						LL = LIQUID LIMIT PI = PLASTICITY INDEX NP = NON PLASTIC or NO VALUE						Project: Beacon Bisti N9 - Nahodishgish Tank Site					
												Location: McKinley County, NM					
												Number: 1-11001A					

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"
A4	15.0		6.7														
						LL = LIQUID LIMIT PI = PLASTICITY INDEX NP = NON PLASTIC or NO VALUE						Project: Beacon Bisti N9 - Nahodishgish Tank Site					
												Location: McKinley County, NM					
												Number: 1-11001A					

SUMMARY OF LABORATORY RESULTS 1-11001A.GPJ GEO TEST.GDT 11/3/21



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification			LL	PL	PI	Cc	Cu
●	A1	3.0	CLAYEY SAND(SC)			26	18	8		
⊠	A1	22.0	SILTY, CLAYEY SAND(SC-SM)			23	17	6		
▲	A2	3.0	SILTY SAND(SM)			NP	NP	NP		
★	A4	1.0	SILTY SAND with GRAVEL(SM)			NP	NP	NP		
⊙	A4	6.0	SILTY SAND(SM)			NP	NP	NP		
Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	A1	3.0	9.5	0.104			1.0	62.5	36.5	
⊠	A1	22.0	12.5	0.112			12.0	55.4	32.6	
▲	A2	3.0	12.5	0.121			10.0	58.5	31.5	
★	A4	1.0	19	0.134	0.082		16.0	59.8	24.2	
⊙	A4	6.0	12.5	0.109			4.0	59.0	37.0	

GEO-TEST

GRAIN SIZE DISTRIBUTION

Project: Beacon Bisti N9 - Nahodishgish Tank Site

Location: McKinley County, NM

Number: 1-11001A

Corrosion Data

Project: Beacon Bisti N9 - Nahodishgish Tank Site
Report # 1-11001A

Soil Resistivity (ASTM G-57)

Sample Location: Boring A4 (0-2 ft)

Wet Weight:	251.1 grams
Dry Weight:	235.3 grams
Water Content	6.71 %

<u>As-Received Condition</u>		
Potential Change	16.0	volts
Current:	0.009	amps
Resistivity:	1778	ohm-cm

<u>Saturated Condition</u>		
Potential Change:	16.0	volts
Current:	0.018	amps
Resistivity:	889	ohm-cm

pH of Soil (ASTM G-51 & D-4972)

Sample Location: Boring A4 (0-2 ft)

Distilled Water Solution:	pH =	8.40
Calcium Chloride Solution:	pH =	8.10



Hall Environmental Analysis Laboratory
4901 Hawkins NE
Albuquerque, NM 87109
TEL: 505-345-3975 FAX: 505-345-4107
Website: clients.hallenvironmental.com

October 28, 2021

Patrick Whorton

Geo-Test

8528 Calle Alameda NE

Albuquerque, NM 87113

TEL: (505) 857-0933

FAX: (505) 857-0803

RE: Beacon Bisti Waterline

OrderNo.: 2110989

Dear Patrick Whorton:

Hall Environmental Analysis Laboratory received 4 sample(s) on 10/21/2021 for the analyses presented in the following report.

These were analyzed according to EPA procedures or equivalent. To access our accredited tests please go to www.hallenvironmental.com or the state specific web sites. In order to properly interpret your results, it is imperative that you review this report in its entirety. See the sample checklist and/or the Chain of Custody for information regarding the sample receipt temperature and preservation. Data qualifiers or a narrative will be provided if the sample analysis or analytical quality control parameters require a flag. When necessary, data qualifiers are provided on both the sample analysis report and the QC summary report, both sections should be reviewed. All samples are reported, as received, unless otherwise indicated. Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH and residual chlorine are qualified as being analyzed outside of the recommended holding time.

Please don't hesitate to contact HEAL for any additional information or clarifications.

ADHS Cert #AZ0682 -- NMED-DWB Cert #NM9425 -- NMED-Micro Cert #NM0901

Sincerely,

A handwritten signature in black ink, appearing to read "Andy Freeman", with a stylized flourish at the end.

Andy Freeman

Laboratory Manager

4901 Hawkins NE

Albuquerque, NM 87109

Hall Environmental Analysis Laboratory, Inc.

Analytical Report

Lab Order 2110989

Date Reported: 10/28/2021

CLIENT: Geo-Test

Client Sample ID: 4 @ 0-2'

Project: Beacon Bisti Waterline

Collection Date: 10/19/2021 8:45:00 AM

Lab ID: 2110989-001

Matrix: SOIL

Received Date: 10/21/2021 8:35:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS							Analyst: JMT
Chloride	64	7.5		mg/Kg	5	10/25/2021 6:46:36 AM	63515
Sulfate	630	7.5		mg/Kg	5	10/25/2021 6:46:36 AM	63515

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	D	Sample Diluted Due to Matrix	E	Value above quantitation range
	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
	ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
	PQL	Practical Quantitative Limit	RL	Reporting Limit
	S	% Recovery outside of range due to dilution or matrix		

**GEOTECHNICAL ENGINEERING
SERVICES REPORT
NO. 1-11106**

**NAVAJO GALLUP WATER SUPPLY
PROJECT**

**BEACON BISTI N9
REACH 10.1
WATERLINE**

MCKINLEY COUNTY, NEW MEXICO

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PREPARED FOR:

SOUDER MILLER & ASSOCIATES

May 16, 2022
Job No. 1-11106

Souder Miller & Associates
Hwy 264 and Window Rock Loop
Window Rock, AZ 86515-0519

Attn: Ty Tsinnijinnie, PE

RE: Geotechnical Engineering Services Report
Navajo Gallup Water Supply Project
Beacon Bisti N9 – Reach 10.1 Waterline
McKinley County, 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 as well as recommendations pertaining to trench excavation and backfill.

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

Respectfully submitted:
GEO-TEST, INC.

Patrick R. Whorton, PE



Reviewed By:

Robert D. Booth, PE

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INTRODUCTION

This report presents the results of our geotechnical engineering services investigation performed by this firm for the proposed Beacon Bisti N9 Reach 10.1 Waterline project in McKinley County, New Mexico. The objectives of this investigation were to evaluate the nature and engineering properties of the subsurface soils and rock along the proposed alignment to provide recommendations for trenching and backfill.

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 installation of the new Reach 10.1 waterline. The proposed waterline will begin approximately 5 miles east of Tohatchi and travel southeast, see Figure 1. The waterline will be 10.75 miles long and will be installed between 4 and 10 feet below existing grades.

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

FIELD EXPLORATION

A total of thirty-eight (38) exploratory borings were drilled along the proposed waterline alignment to a depth of 10 feet below existing site grades along the proposed alignment at approximate 0.25 mile intervals. The locations of the borings are shown on the attached Figure 1 and listed on Figure 2 in a later section of this report.

The boring logs are presented in a following section of this report. Drilling was accomplished using both truck and track mounted drill rigs equipped with 2.25-inch inner diameter hollow stem auger and 4 inch diameter solid stem auger respectively. Exploratory borings are categorized as Type 1 or Type 2 on the Boring List, Figure 2. Subsurface soils in the Type 1 borings were sampled at two foot intervals utilizing an open tube split barrel sampler driven by a standard penetration test hammer with samples collected for laboratory testing. The soils encountered in all borings were continuously examined, visually classified and logged during the drilling operations, however, sampling was not conducted in Type 2 borings.

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LABORATORY TESTING

Selected samples were tested in the laboratory to determine certain engineering properties of the soils. Moisture contents and density 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.

SUBSURFACE CONDITIONS

As indicated by the exploratory borings, the general subsurface profile beneath the proposed alignment primarily consisted of non-plastic silty sand and low to medium plasticity sandy clay and clayey sand with lesser amounts of low plasticity sandy, silty clay and high plasticity clay. See boring logs for site specific soil profiles.

No free groundwater was encountered in the borings. Soil moisture contents fluctuated somewhat but were generally low throughout the extent of the borings.

TRENCH EXCAVATION & BACKFILL

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

- 1) Excavated slopes for foundation and utility construction should be designed and constructed in accordance with 29 CFR 1926, Subpart P, and any applicable state or local regulations. Excavated temporary and permanent slopes should not exceed 1.5 to 1 (horizontal to vertical).
- 2) Excavation of the native soils may be readily accomplished using normal earthmoving equipment. Based on the exploratory borings, rock is not present within the proposed alignment, however, sandstone outcroppings and surface rock were observed in the vicinity of the alignment in some locations. This rock may be encountered sporadically during excavation and may require additional effort to excavate as encountered.
- 3) Onsite soil conditions may be loose and dry during excavation, therefore, the use of tracked construction equipment is advisable.

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- 4) Bedding and pipe embedment materials to be used around the pipes should conform to the pipe manufacturer's recommendations and should be placed and compacted in accordance with project specifications, local requirements or governing jurisdiction.
- 5) Excavated soils may be used as trench backfill above bedding material.
- 6) Backfill should be placed in maximum 12-inch loose lifts and compacted with approved compaction equipment. Lifts should be reduced to 6-inch loose lifts if handheld compaction equipment is used. All compaction of fill shall be accomplished to a minimum of 90 percent of the maximum dry density as determined in accordance with ASTM D-1557 and the moisture content of the backfill, during compaction, should be within 2 percent of the optimum moisture content, or in accordance with project specifications, local requirements or governing jurisdiction.
- 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 90 percent is indicated, additional compaction effort should be made with adjustment of the moisture content as necessary until 90 percent compaction is obtained.

CLOSURE

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.

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

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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 Beacon Bisti N9 Reach 10.1 Waterline project located in McKinley County, New Mexico, and not for the use by any third party without consent.

We make no other warranty, either expressed 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.

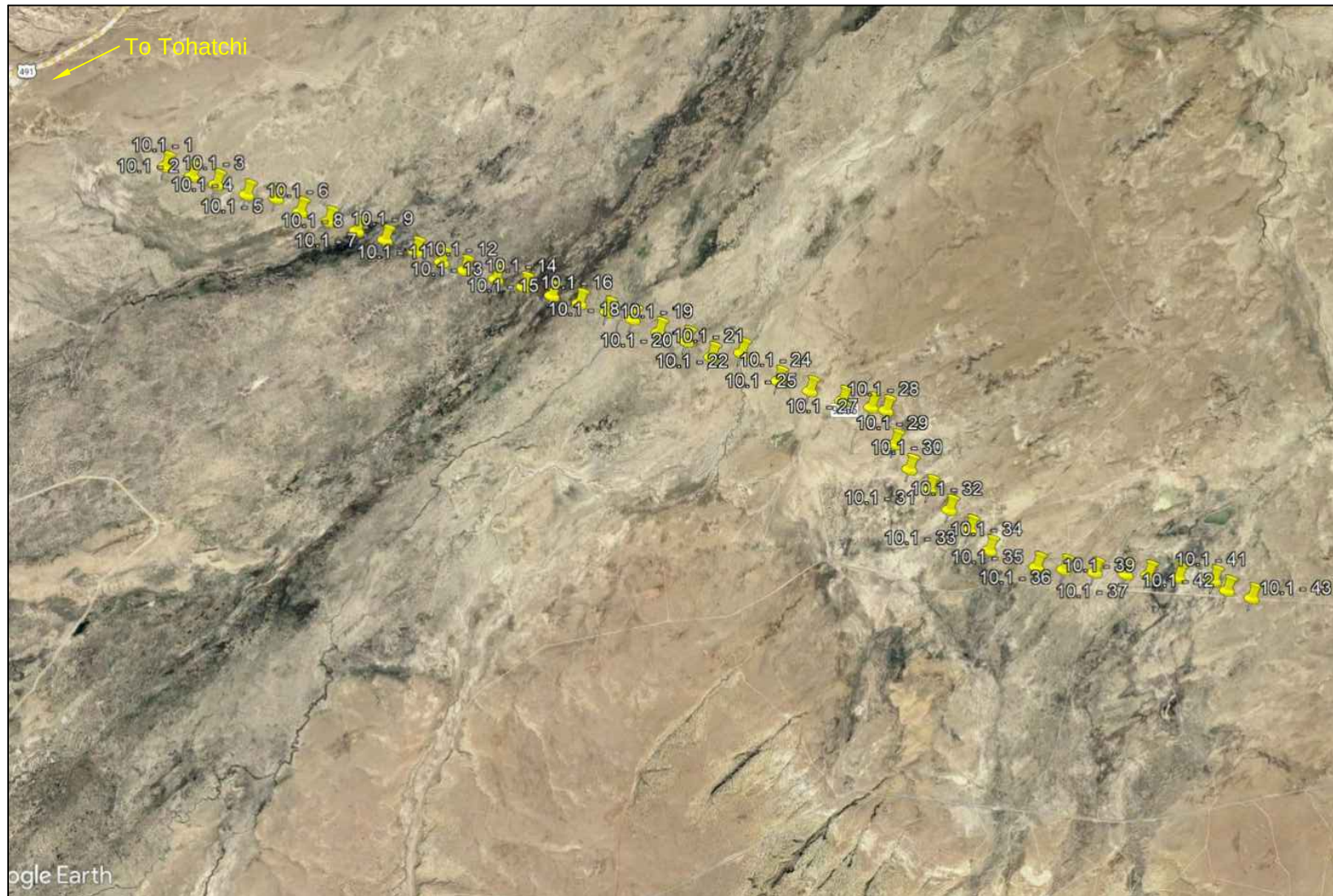
All soil/rock samples will be discarded 60 days after the date of this report unless we receive a specific request to retain the samples for a longer period of time.

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BORING LOCATION MAP



BBN9 Reach 10.1 Waterline
McKinley County, New Mexico
Job No. 1-11106

Figure 1



GEO-TEST
GEOTECHNICAL ENGINEERING
AND MATERIAL TESTING

Boring	Lat	Long	Type	Notes
1	35.869623°	-108.656980°	1	
2	35.868412°	-108.652860°	2	
3	35.867395°	-108.649164°	2	
4	35.866110°	-108.644458°	2	
5	35.865677°	-108.639908°	1	
6	35.863954°	-108.636249°	2	
7	35.862801°	-108.631848°	2	
8	35.861645°	-108.627488°	2	NO ACCESS - SALT CEDAR
9	35.860498°	-108.623105°	1	
10	35.859217°	-108.618739°	2	
11	35.857905°	-108.614624°	2	
12	35.856868°	-108.611122°	2	
13	35.855734°	-108.606157°	1	
14	35.854771°	-108.601808°	2	
15	35.853651°	-108.597398°	2	
16	35.852671°	-108.593121°	2	
17	35.851612°	-108.588707°	1	
18	35.850675°	-108.584760°	2	NO ACCESS
19	35.848997°	-108.580714°	2	
20	35.847887°	-108.576517°	2	
21	35.845883°	-108.572610°	1	ARCHAEOLOGICAL SITE
22	35.846392°	-108.567924°	2	
23			2	MISLABELED
24	35.842856°	-108.562170°	2	
25	35.841589°	-108.557210°	1	
26	35.840334°	-108.552115°	2	
27	35.839517°	-108.547633°	2	
28	35.839135°	-108.545335°	2	
29	35.834857°	-108.543965°	1	
30	35.831814°	-108.541655°	2	
31	35.829195°	-108.538573°	2	
32	35.826658°	-108.535445°	2	

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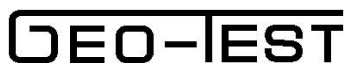
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Boring	Lat	Long	Type	Notes
33	35.824108°	-108.532312°	1	
34	35.821537°	-108.529218°	2	
35	35.819399°	-108.521847°	2	
36	35.819100°	-108.517555°	2	
37	35.818749°	-108.512784°	1	
38	35.818501°	-108.507925°	2	
39	35.818352°	-108.504436°	2	
40	35.818077°	-108.499698°	2	
41	35.817701°	-108.494185°	1	
42	35.816434°	-108.492123°	2	
43	35.815495°	-108.488341°	1	CHLORINATOR SITE

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Project: Reach 10.1 Waterline

Date: 03/15/2022

Project No: 1-11106

Elevation:

Type: 2.25" ID HSA

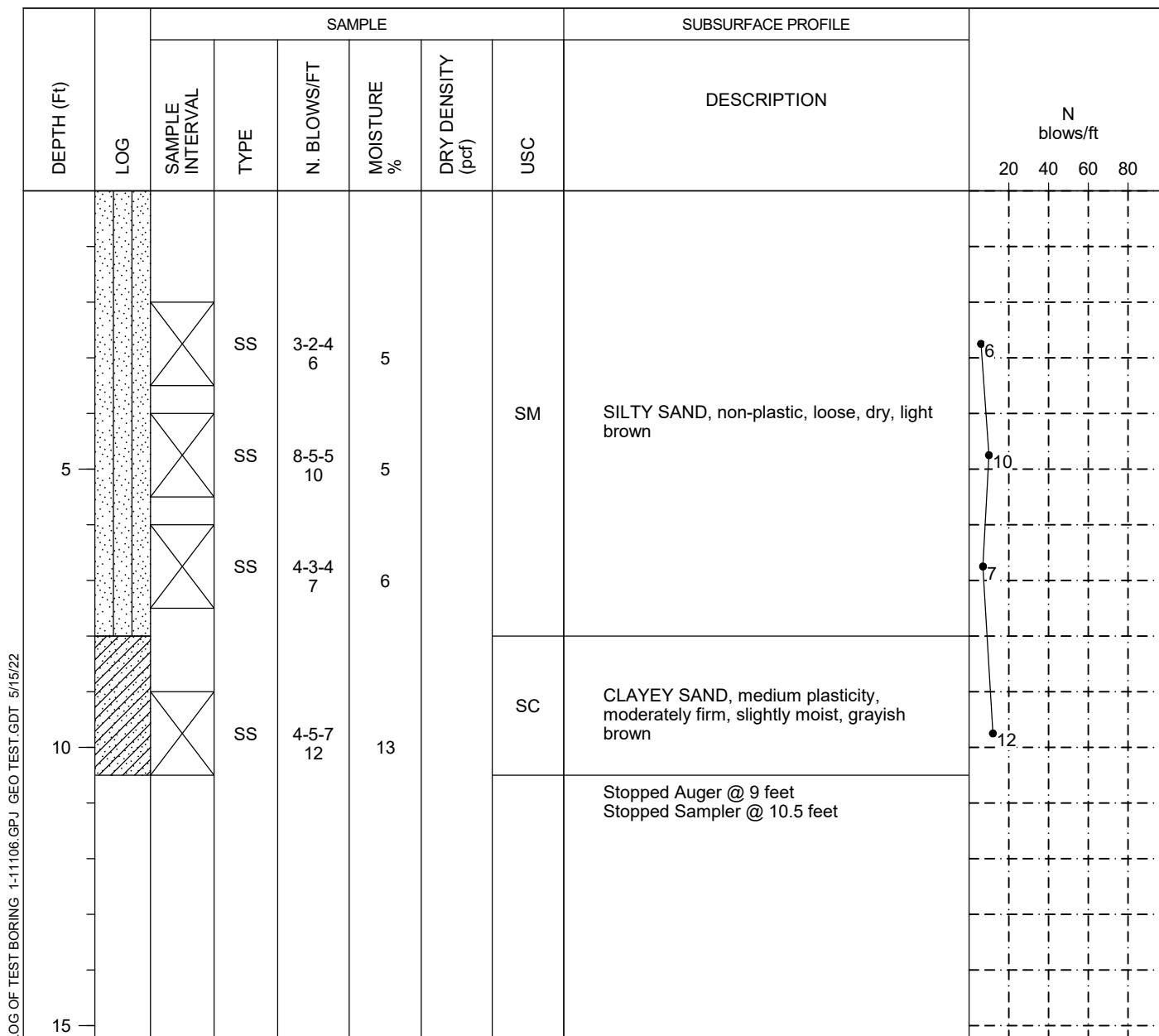
LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 01

During Drilling: none

After 24 Hours:

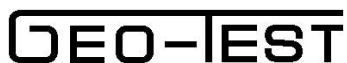


LEGEND

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 measurements were made.



Project: Reach 10.1 Waterline

Date: 03/15/2022

Project No: 1-11106

Elevation:

Type: 2.25" ID HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 02

During Drilling: none

After 24 Hours:

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

LOG OF TEST BORING 1-11106.GPJ GEO TEST.GDT 5/15/22

LEGEND

SS - Split Spoon

AC - Auger Cuttings

UD/SL - Undisturbed Sleeve

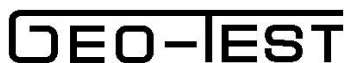
AMSL - Above Mean Sea Level

CS - Continuous Sampler

UD - Undisturbed

ST - Shelby Tube

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Project: Reach 10.1 Waterline

Date: 03/15/2022

Project No: 1-11106

Elevation:

Type: 2.25" ID HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 03

During Drilling: none

After 24 Hours:

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

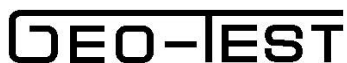
LOG OF TEST BORING 1-11106.GPJ GEO TEST.GDT 5/15/22

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 measurements were made.



Project: Reach 10.1 Waterline

Date: 03/15/2022

Project No: 1-11106

Elevation:

Type: 2.25" ID HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 04

During Drilling: none

After 24 Hours:

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

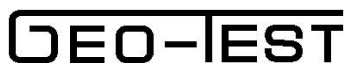
LOG OF TEST BORING 1-11106.GPJ GEO TEST.GDT 5/15/22

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 measurements were made.



Project: Reach 10.1 Waterline

Date: 03/15/2022

Project No: 1-11106

Elevation:

Type: 2.25" ID HSA

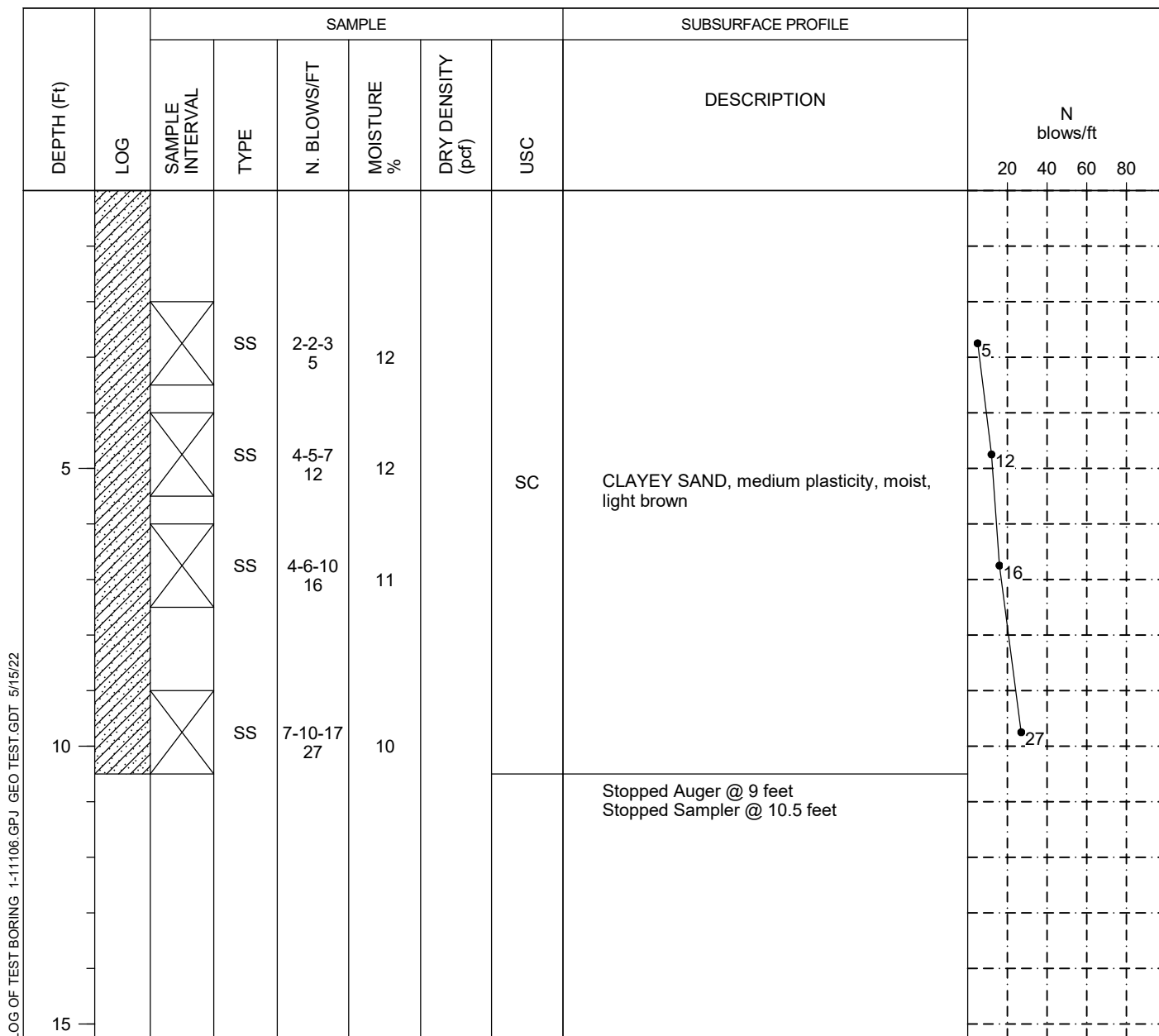
LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 05

During Drilling: none

After 24 Hours:

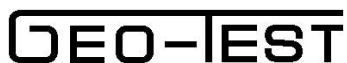


LEGEND

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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Project: Reach 10.1 Waterline

Date: 03/15/2022

Project No: 1-11106

Elevation:

Type: 2.25" ID HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 06

During Drilling: none

After 24 Hours:

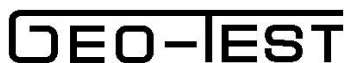
DEPTH (Ft)	LOG	SAMPLE						SUBSURFACE PROFILE	N blows/ft			
		SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION				
							SM	SILTY SAND, non-plastic, dry, light brown	20	40	60	80
5							SC	CLAYEY SAND, medium plasticity, dry, grayish brown				
10								Stopped Auger @ 10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

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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Project: Reach 10.1 Waterline

Date: 03/15/2022

Project No: 1-11106

Elevation:

Type: 2.25" ID HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 07

During Drilling: none

After 24 Hours:

DEPTH (Ft)	LOG	SAMPLE						SUBSURFACE PROFILE	N blows/ft			
		SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION				
							SM	SILTY SAND, non-plastic, dry, light brown	20	40	60	80
5							SC	CLAYEY SAND, medium plasticity, dry, grayish brown				
10							CL	SANDY CLAY, medium to high plasticity, dry, gray				
15								Stopped Auger @ 10 feet				

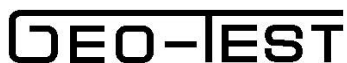
LOG OF TEST BORING 1-11106.GPJ GEO TEST.GDT 5/15/22

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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Project: Reach 10.1 Waterline

Date:

Project No: 1-11106

Elevation:

Type:

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 08

During Drilling:

After 24 Hours:

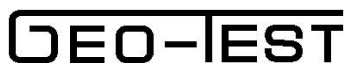
DEPTH (Ft)	LOG	SAMPLE						SUBSURFACE PROFILE	N blows/ft			
		SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION				
5								NO ACCESS - Salt Cedar	20	40	60	80
10												
15												

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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Project: Reach 10.1 Waterline

Date: 04/25/2022

Elevation:

Project No: 1-11106

Type: Solid Stem

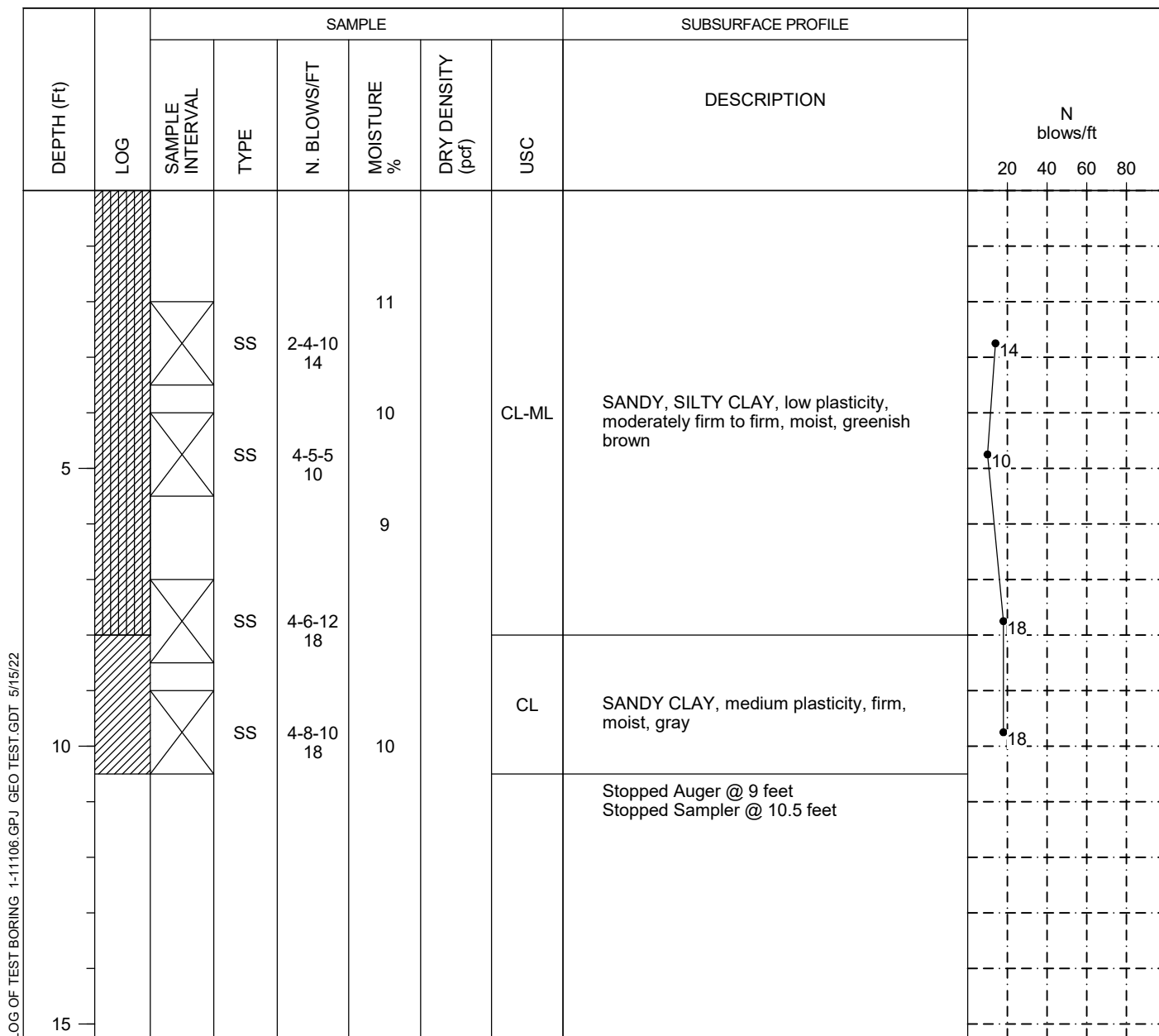
LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 09

During Drilling: none

After 24 Hours:

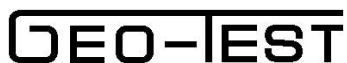


LEGEND

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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Project: Reach 10.1 Waterline

Date: 04/25/2022

Project No: 1-11106

Elevation:

Type: Solid Stem

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 10

During Drilling: none

After 24 Hours:

DEPTH (Ft)	LOG	SAMPLE						SUBSURFACE PROFILE	N blows/ft			
		SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION				
									20	40	60	80
							CL-ML	SILTY, CLAYEY SAND, low plasticity, dry, greenish brown				
5							CL	SANDY CLAY, medium plasticity, slightly moist, gray				
10								Stopped Auger @ 10 feet				
15												

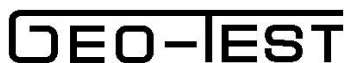
LOG OF TEST BORING 1-11106.GPJ GEO TEST.GDT 5/15/22

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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Project: Reach 10.1 Waterline

Date: 04/25/2022

Project No: 1-11106

Elevation:

Type: Solid Stem

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 11

During Drilling: none

After 24 Hours:

DEPTH (Ft)	LOG	SAMPLE						SUBSURFACE PROFILE	N blows/ft			
		SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION				
									20	40	60	80
							SC	CLAYEY SAND, low plasticity, dry, light brown				
5							CL	SANDY CLAY, medium plasticity, dry, gray				
10								Stopped Auger @ 10 feet				
15												

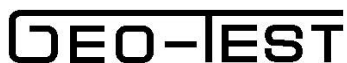
LOG OF TEST BORING 1-11106.GPJ GEO TEST.GDT 5/15/22

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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Project: Reach 10.1 Waterline

Date: 04/25/2022

Project No: 1-11106

Elevation:

Type: Solid Stem

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 12

During Drilling: none

After 24 Hours:

DEPTH (Ft)	LOG	SAMPLE						SUBSURFACE PROFILE	N blows/ft			
		SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION				
5							CL-ML	SANDY, SILTY CLAY, low plasticity, dry, light brown				
10							CL	SANDY CLAY, medium plasticity, dry, gray				
15								Stopped Auger @ 10 feet				

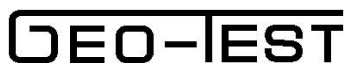
LOG OF TEST BORING 1-11106.GPJ GEO TEST.GDT 5/15/22

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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Project: Reach 10.1 Waterline

Date: 04/25/2022

Elevation:

Project No: 1-11106

Type: Solid Stem

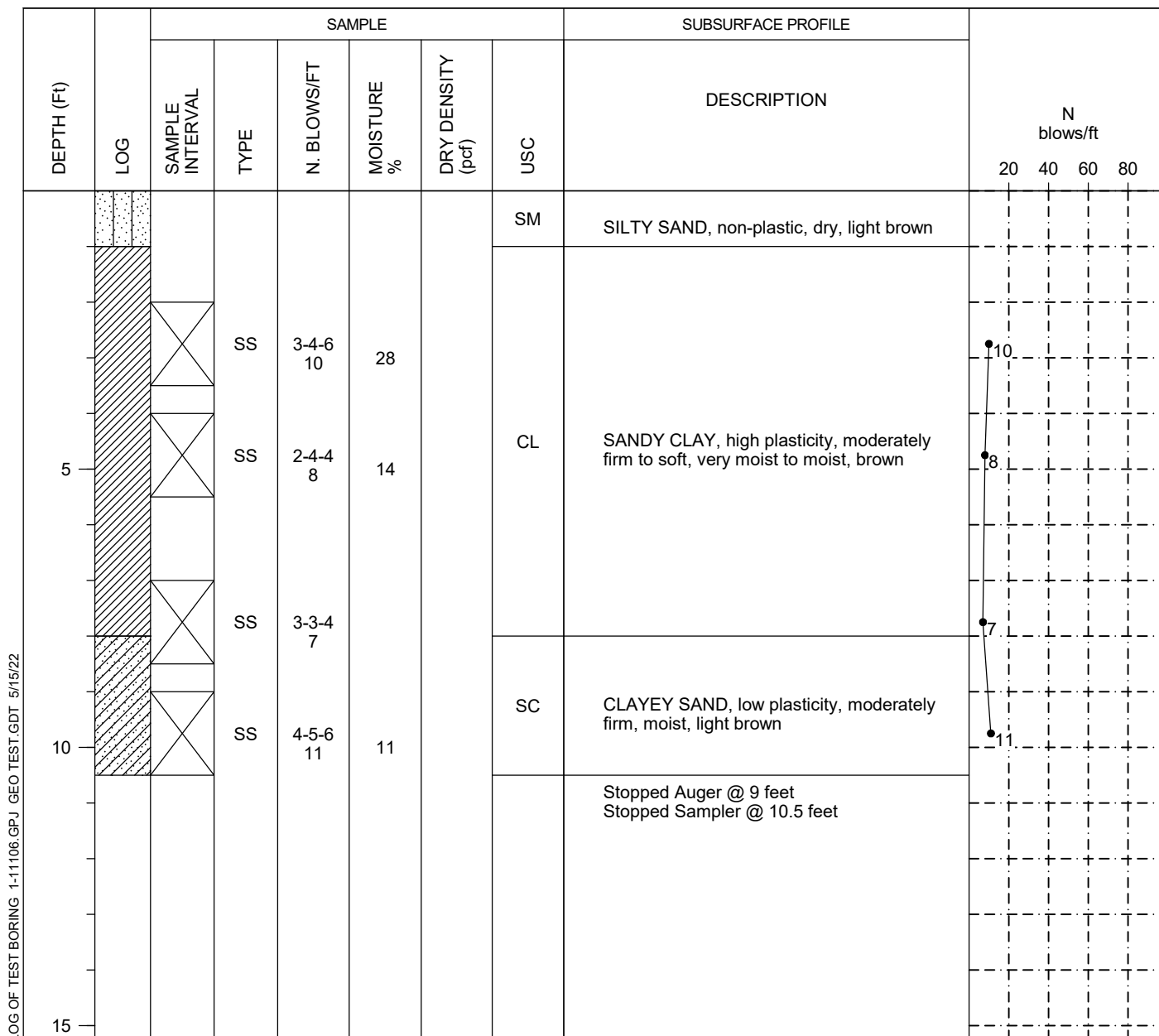
LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 13

During Drilling: none

After 24 Hours:

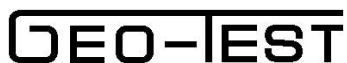


LEGEND

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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Project: Reach 10.1 Waterline

Date: 04/26/2022

Project No: 1-11106

Elevation:

Type: Solid Stem

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 14

During Drilling: none

After 24 Hours:

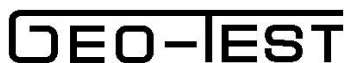
DEPTH (Ft)	LOG	SAMPLE						SUBSURFACE PROFILE	N blows/ft			
		SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION				
									20	40	60	80
5							SM	SILTY SAND, non-plastic, dry, light brown				
10							CH	CLAY, high plasticity, dry, gray				
15								Stopped Auger @ 10 feet				

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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Project: Reach 10.1 Waterline

Date: 04/26/2022

Project No: 1-11106

Elevation:

Type: Solid Stem

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 15

During Drilling: none

After 24 Hours:

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

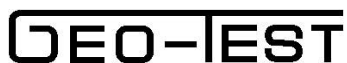
LOG OF TEST BORING 1-11106.GPJ GEO TEST.GDT 5/15/22

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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Project: Reach 10.1 Waterline

Date: 04/26/2022

Project No: 1-11106

Elevation:

Type: Solid Stem

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 16

During Drilling: none

After 24 Hours:

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

LOG OF TEST BORING 1-11106.GPJ GEO TEST.GDT 5/15/22

LEGEND

SS - Split Spoon

AC - Auger Cuttings

UD/SL - Undisturbed Sleeve

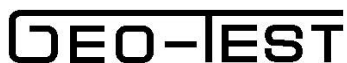
AMSL - Above Mean Sea Level

CS - Continuous Sampler

UD - Undisturbed

ST - Shelby Tube

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Project: Reach 10.1 Waterline

Date: 04/26/2022

Project No: 1-11106

Elevation:

Type: Solid Stem

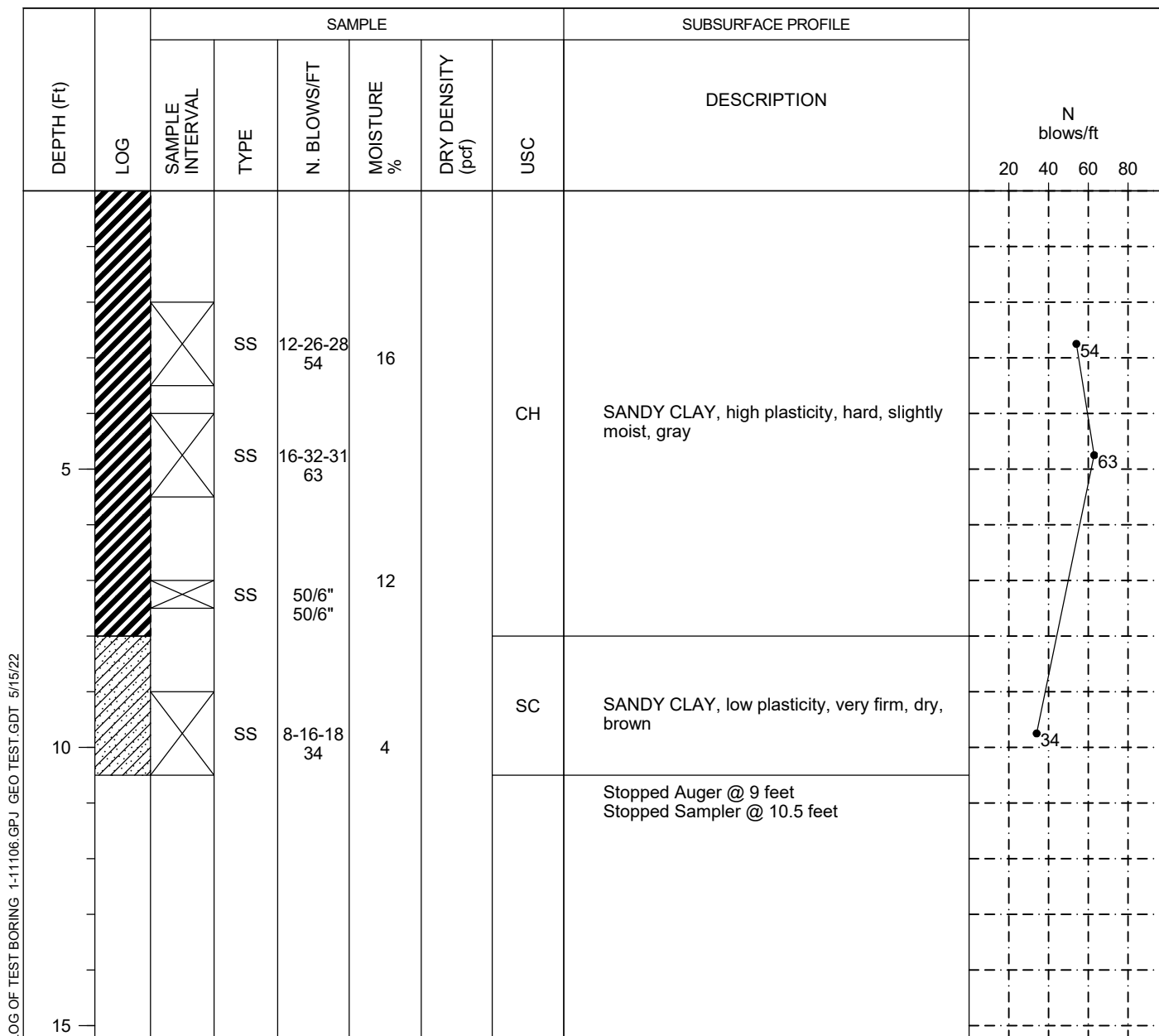
LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 17

During Drilling: none

After 24 Hours:

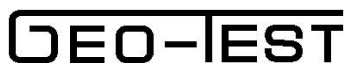


LEGEND

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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Project: Reach 10.1 Waterline

Date:

Project No: 1-11106

Elevation:

Type:

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 18

During Drilling:

After 24 Hours:

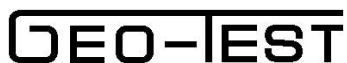
DEPTH (Ft)	LOG	SAMPLE						SUBSURFACE PROFILE	N blows/ft			
		SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION				
									20	40	60	80
5								NO ACCESS				
10												
15												

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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Project: Reach 10.1 Waterline

Date: 03/31/2022

Project No: 1-11106

Elevation:

Type: 2.25" ID HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 19

During Drilling: none

After 24 Hours:

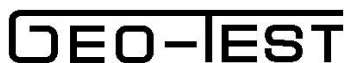
DEPTH (Ft)	LOG	SAMPLE						SUBSURFACE PROFILE	N blows/ft			
		SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION				
5							SC	CLAYEY SAND, medium plasticity, dry, light brown				
10								Stopped Auger @ 10 feet				
15												

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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Project: Reach 10.1 Waterline

Date: 03/31/2022

Project No: 1-11106

Elevation:

Type: 2.25" ID HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 20

During Drilling: none

After 24 Hours:

DEPTH (Ft)	LOG	SAMPLE						SUBSURFACE PROFILE	N blows/ft			
		SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION				
5							SC	CLAYEY SAND, medium plasticity, dry, light brown	20	40	60	80
10								Stopped Auger @ 10 feet				
15												

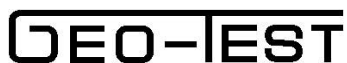
LOG OF TEST BORING 1-11106.GPJ GEO TEST.GDT 5/15/22

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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Project: Reach 10.1 Waterline

Date:

Project No: 1-11106

Elevation:

Type:

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 21

During Drilling:

After 24 Hours:

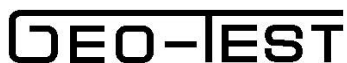
DEPTH (Ft)	LOG	SAMPLE						SUBSURFACE PROFILE	N blows/ft			
		SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION				
									20	40	60	80
5								NO ACCESS - ARCHAEOLOGICAL SITE				
10												
15												

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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Project: Reach 10.1 Waterline

Date: 03/31/2022

Project No: 1-11106

Elevation:

Type: 2.25" ID HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 22

During Drilling: none

After 24 Hours:

DEPTH (Ft)	LOG	SAMPLE						SUBSURFACE PROFILE	N blows/ft			
		SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION				
									20	40	60	80
5							CL	SANDY CLAY, medium plasticity, dry, grayish brown				
10								Stopped Auger @ 10 feet				
15												

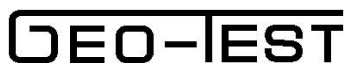
LOG OF TEST BORING 1-11106.GPJ GEO TEST.GDT 5/15/22

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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Project: Reach 10.1 Waterline

Date:

Project No: 1-11106

Elevation:

Type:

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 23

During Drilling:

After 24 Hours:

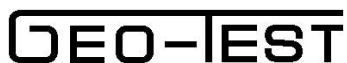
DEPTH (Ft)	LOG	SAMPLE						SUBSURFACE PROFILE	N blows/ft			
		SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION				
									20	40	60	80
5								MISLABELED - Boring Numbers skip from 22 to 24. There is no Boring 23.				
10												
15												

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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Project: Reach 10.1 Waterline

Date: 03/31/2022

Elevation:

Project No: 1-11106

Type: 2.25" ID HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 24

During Drilling: none

After 24 Hours:

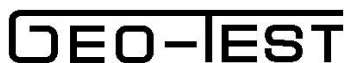
DEPTH (Ft)	LOG	SAMPLE						SUBSURFACE PROFILE	N blows/ft			
		SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION				
5							CL	SANDY CLAY, medium plasticity, dry, grayish brown	20	40	60	80
10								Stopped Auger @ 10 feet				
15												

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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Project: Reach 10.1 Waterline

Date: 03/31/2022

Project No: 1-11106

Elevation:

Type: 2.25" ID HSA

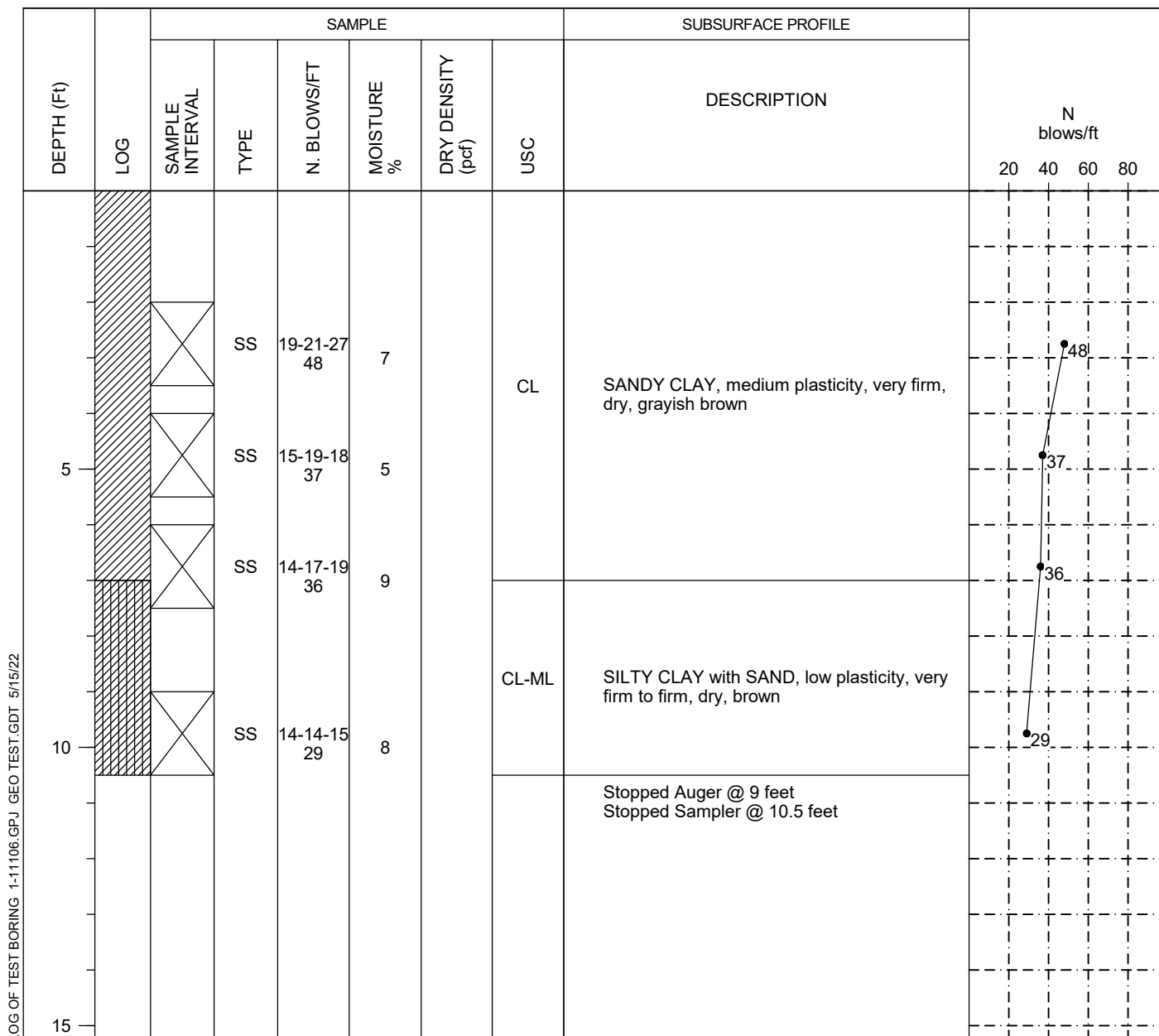
LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 25

During Drilling: none

After 24 Hours:

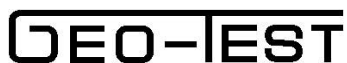


LEGEND

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 measurements were made.



Project: Reach 10.1 Waterline

Date: 03/31/2022

Project No: 1-11106

Elevation:

Type: 2.25" ID HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 26

During Drilling: none

After 24 Hours:

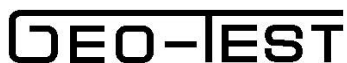
DEPTH (Ft)	LOG	SAMPLE						SUBSURFACE PROFILE	N blows/ft			
		SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION				
									20	40	60	80
5							SM	SILTY SAND, non-plastic, dry, light brown				
							CL-ML	SILTY CLAY with SAND, low plasticity, slightly moist, dark brown	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

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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Project: Reach 10.1 Waterline

Date: 04/27/2022

Project No: 1-11106

Elevation:

Type: Solid Stem

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 27

During Drilling: none

After 24 Hours:

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

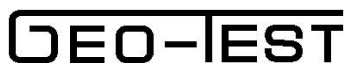
LOG OF TEST BORING 1-11106.GPJ GEO TEST.GDT 5/15/22

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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Project: Reach 10.1 Waterline

Date: 04/27/2022

Project No: 1-11106

Elevation:

Type: Solid Stem

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 28

During Drilling: none

After 24 Hours:

DEPTH (Ft)	LOG	SAMPLE						SUBSURFACE PROFILE	N blows/ft			
		SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION				
									20	40	60	80
							CL-ML	SANDY, SILTY CLAY, low plasticity, dry, light brown				
5							CH	SANDY CLAY, high plasticity, dry, gray				
10							SM	SILTY SAND, non-plastic, dry, light brown				
								Stopped Auger @ 10 feet				
15												

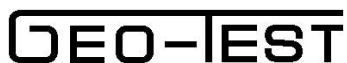
LOG OF TEST BORING 1-11106.GPJ GEO TEST.GDT 5/15/22

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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Project: Reach 10.1 Waterline

Date: 04/26/2022

Elevation:

Project No: 1-11106

Type: Solid Stem

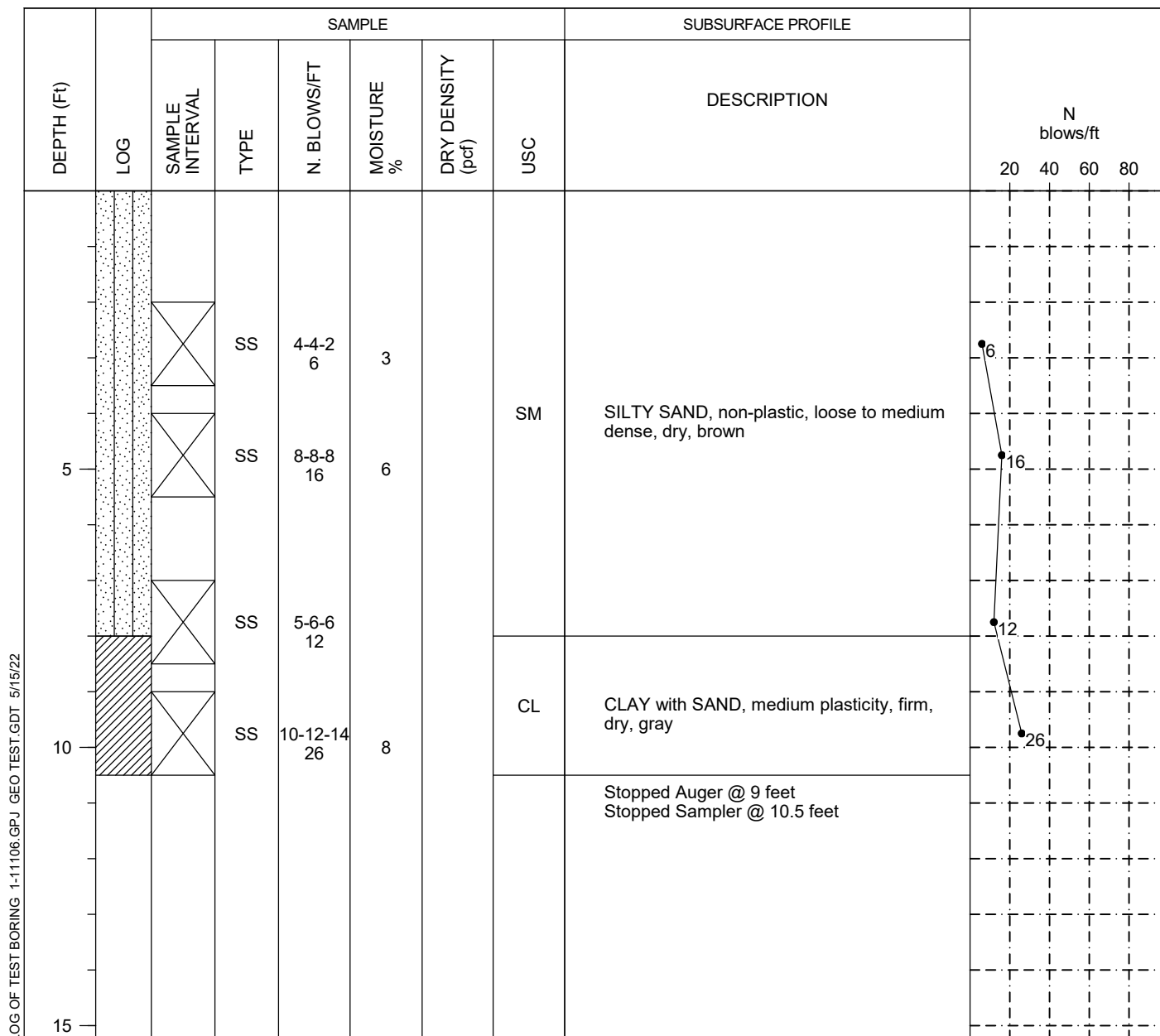
LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 29

During Drilling: none

After 24 Hours:

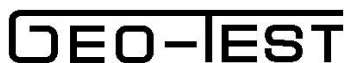


LEGEND

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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Project: Reach 10.1 Waterline

Date: 04/26/2022

Project No: 1-11106

Elevation:

Type: Solid Stem

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 30

During Drilling: none

After 24 Hours:

DEPTH (Ft)	LOG	SAMPLE						SUBSURFACE PROFILE	N blows/ft			
		SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION				
5							CL	SANDY CLAY, medium plasticity, dry, grayish brown	20	40	60	80
10								Stopped Auger @ 10 feet				
15												

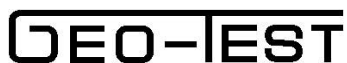
LOG OF TEST BORING 1-11106.GPJ GEO TEST.GDT 5/15/22

LEGEND

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

AMSL - Above Mean Sea Level
CS - Continuous Sampler
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Project: Reach 10.1 Waterline

Date: 04/26/2022

Project No: 1-11106

Elevation:

Type: Solid Stem

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 31

During Drilling: none

After 24 Hours:

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

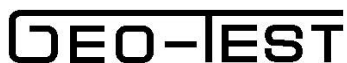
LOG OF TEST BORING 1-11106.GPJ GEO TEST.GDT 5/15/22

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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Project: Reach 10.1 Waterline

Date: 04/26/2022

Project No: 1-11106

Elevation:

Type: Solid Stem

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 32

During Drilling: none

After 24 Hours:

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

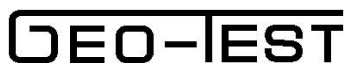
LOG OF TEST BORING 1-11106.GPJ GEO TEST.GDT 5/15/22

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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Project: Reach 10.1 Waterline

Date: 04/26/2022

Elevation:

Project No: 1-11106

Type: Solid Stem

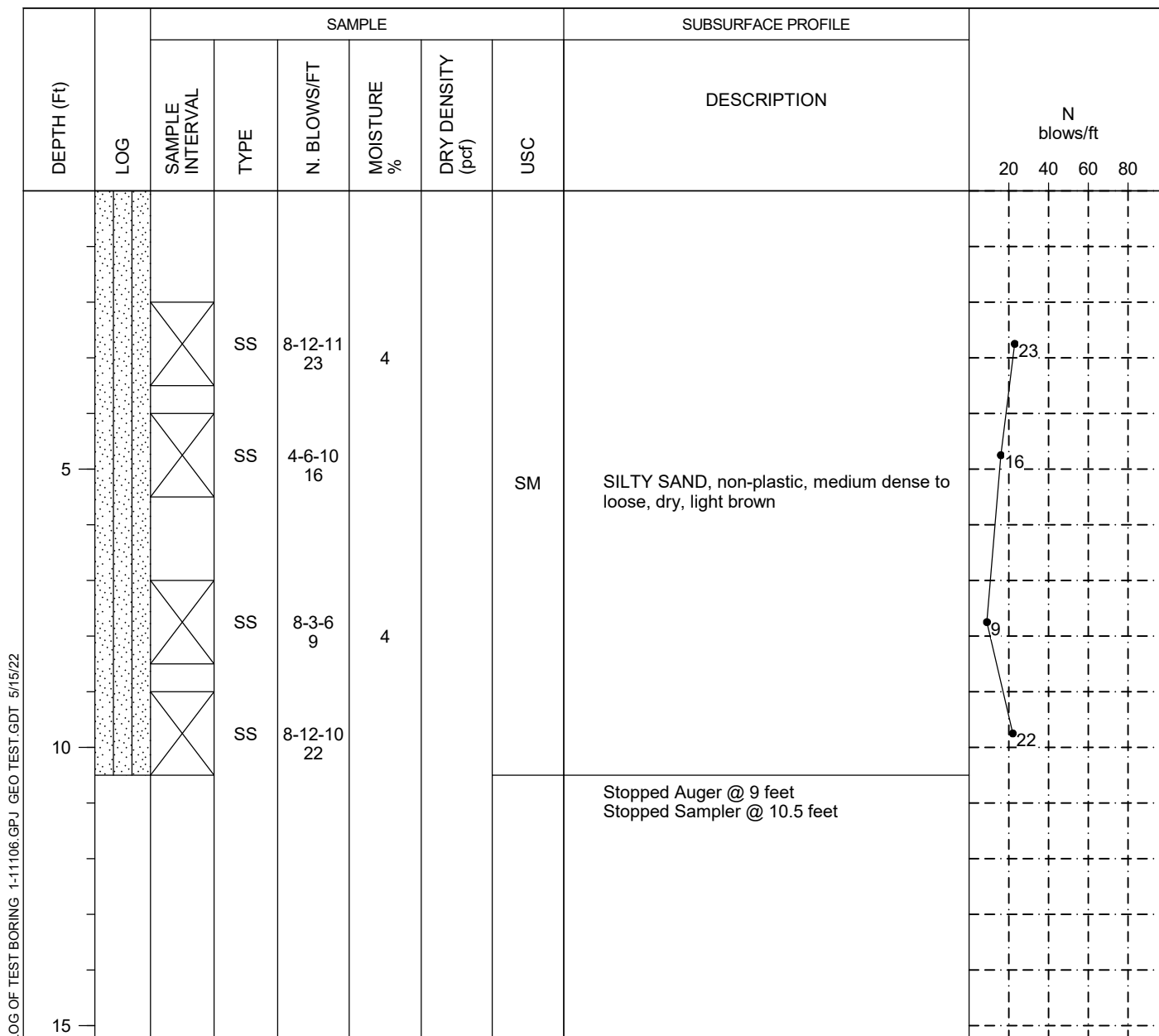
LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 33

During Drilling: none

After 24 Hours:

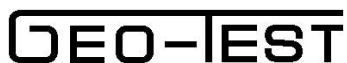


LEGEND

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

AMSL - Above Mean Sea Level
CS - Continuous Sampler
UD - Undisturbed
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Project: Reach 10.1 Waterline

Date: 04/26/2022

Project No: 1-11106

Elevation:

Type: Solid Stem

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 34

During Drilling: none

After 24 Hours:

DEPTH (Ft)	LOG	SAMPLE						SUBSURFACE PROFILE	N blows/ft			
		SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION				
5							CL-ML	SANDY, SILTY CLAY, low plasticity, dry, grayish brown	20	40	60	80
10								Stopped Auger @ 10 feet				
15												

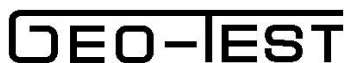
LOG OF TEST BORING 1-11106.GPJ GEO TEST.GDT 5/15/22

LEGEND

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

AMSL - Above Mean Sea Level
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Project: Reach 10.1 Waterline

Date: 03/15/2022

Project No: 1-11106

Elevation:

Type: 2.25" ID HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 35

During Drilling: none

After 24 Hours:

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

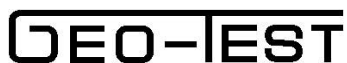
LOG OF TEST BORING 1-11106.GPJ GEO TEST.GDT 5/15/22

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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Project: Reach 10.1 Waterline

Date: 03/15/2022

Project No: 1-11106

Elevation:

Type: 2.25" ID HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 36

During Drilling: none

After 24 Hours:

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

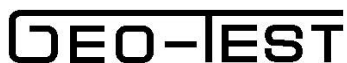
LOG OF TEST BORING 1-11106.GPJ GEO TEST.GDT 5/15/22

LEGEND

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

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CS - Continuous Sampler
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Project: Reach 10.1 Waterline

Date: 03/15/2022

Elevation:

Project No: 1-11106

Type: 2.25" ID HSA

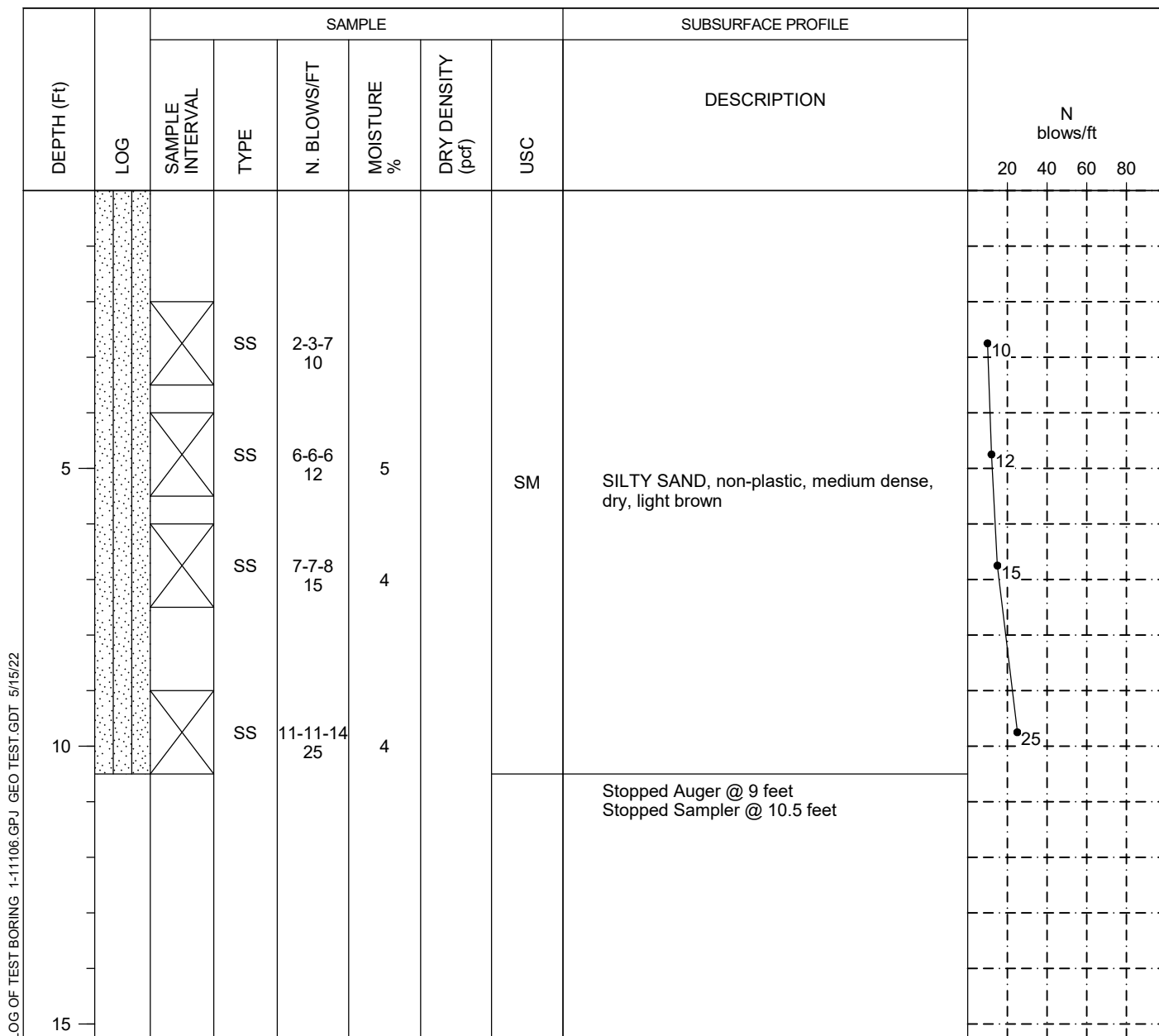
LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 37

During Drilling: none

After 24 Hours:

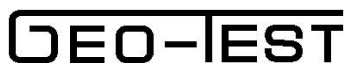


LEGEND

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

AMSL - Above Mean Sea Level
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Project: Reach 10.1 Waterline

Date: 03/15/2022

Project No: 1-11106

Elevation:

Type: 2.25" ID HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 38

During Drilling: none

After 24 Hours:

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

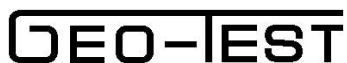
LOG OF TEST BORING 1-11106.GPJ GEO TEST.GDT 5/15/22

LEGEND

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

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Project: Reach 10.1 Waterline

Date: 03/31/2022

Project No: 1-11106

Elevation:

Type: 2.25" ID HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 39

During Drilling: none

After 24 Hours:

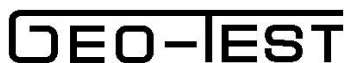
DEPTH (Ft)	LOG	SAMPLE						SUBSURFACE PROFILE	N blows/ft			
		SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION				
5							SC	CLAYEY SAND, medium plasticity, dry, light brown	20	40	60	80
10								Stopped Auger @ 10 feet				
15												

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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Project: Reach 10.1 Waterline

Date: 03/31/2022

Project No: 1-11106

Elevation:

Type: 2.25" ID HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 40

During Drilling: none

After 24 Hours:

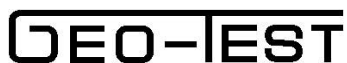
DEPTH (Ft)	LOG	SAMPLE						SUBSURFACE PROFILE	N blows/ft			
		SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION				
5							SC	CLAYEY SAND, medium plasticity, dry, light brown	20	40	60	80
10								Stopped Auger @ 10 feet				
15												

LEGEND

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

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Project: Reach 10.1 Waterline

Date: 03/31/2022

Project No: 1-11106

Elevation:

Type: 2.25" ID HSA

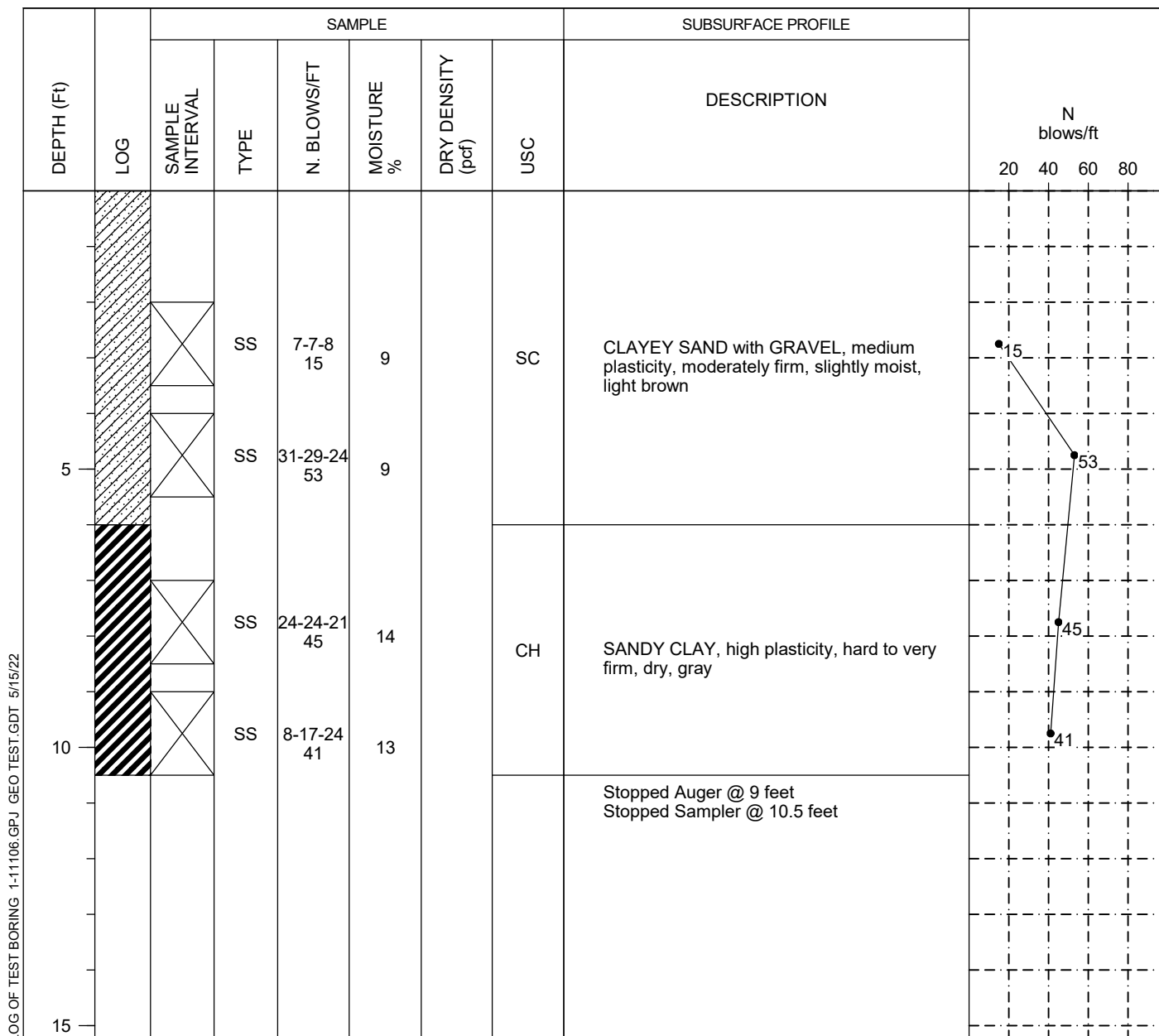
LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 41

During Drilling: none

After 24 Hours:

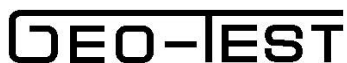


LEGEND

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

AMSL - Above Mean Sea Level
CS - Continuous Sampler
UD - Undisturbed
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Project: Reach 10.1 Waterline

Date: 03/31/2022

Project No: 1-11106

Elevation:

Type: 2.25" ID HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 42

During Drilling: none

After 24 Hours:

DEPTH (Ft)	LOG	SAMPLE						SUBSURFACE PROFILE	N blows/ft			
		SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION				
							SC	CLAYEY SAND, medium plasticity, slightly moist, light brown	20	40	60	80
5							CH	SANDY CLAY, high plasticity, dry, gray				
10								Stopped Auger @ 10 feet				
15												

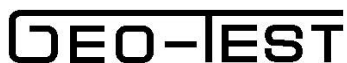
LOG OF TEST BORING 1-11106.GPJ GEO TEST.GDT 5/15/22

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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Project: Reach 10.1 Waterline

Date:

Project No: 1-11106

Elevation:

Type:

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 43

During Drilling:

After 24 Hours:

DEPTH (Ft)	LOG	SAMPLE						SUBSURFACE PROFILE	N blows/ft			
		SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION				
									20	40	60	80
5								CHLORINATOR SITE				
10												
15												

LOG OF TEST BORING 1-11106.GPJ GEO TEST.GDT 5/15/22

LEGEND

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

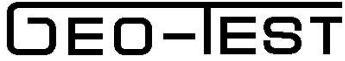
AMSL - Above Mean Sea Level
CS - Continuous Sampler
UD - Undisturbed
ST - Shelby Tube

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SUMMARY OF LABORATORY RESULTS

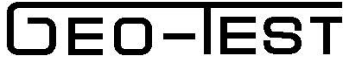
Sheet 1 of 2

SUMMARY OF LABORATORY RESULTS 1-11106.GPJ GEO TEST.GDT 5/15/22

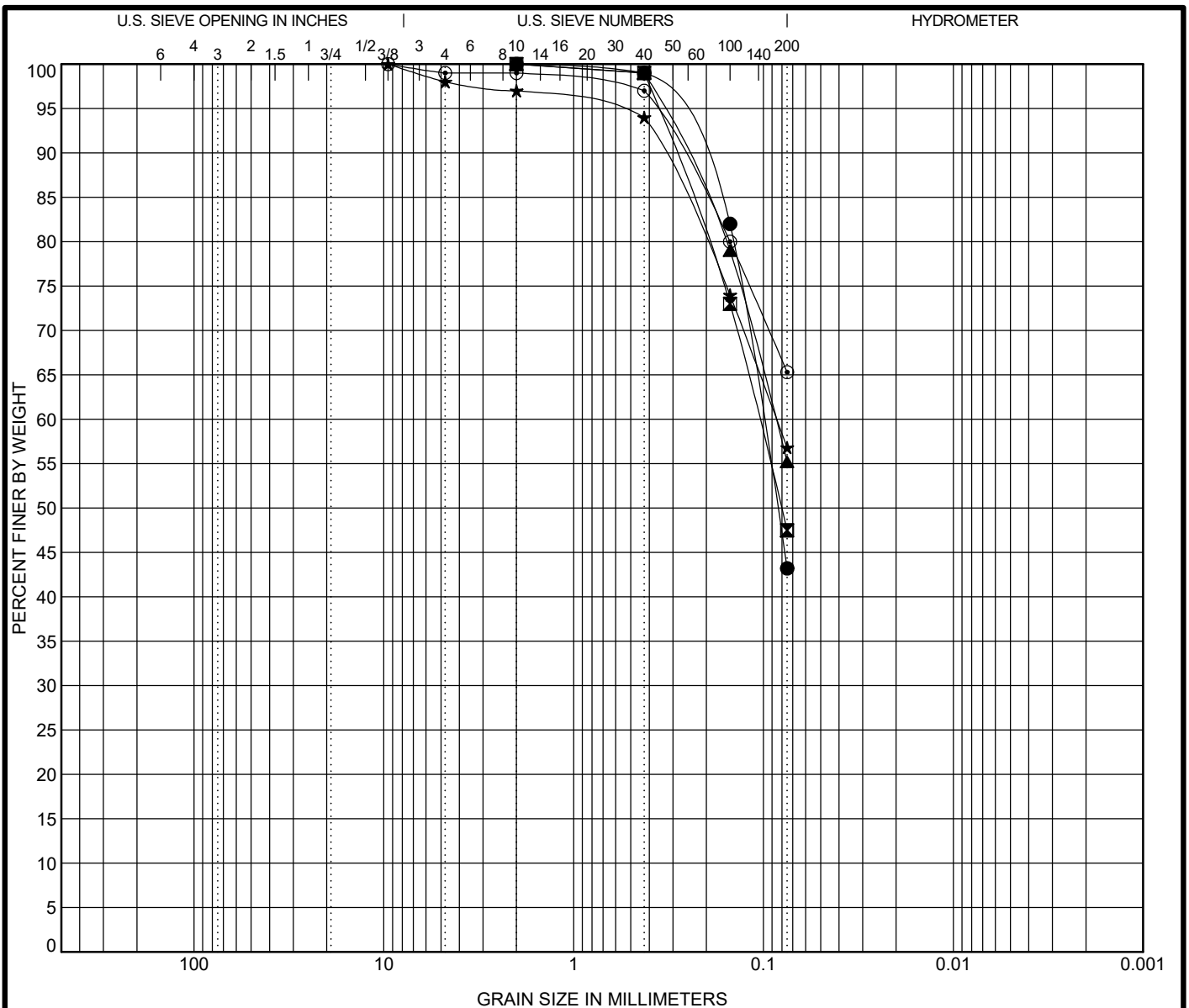
						SIEVE ANALYSIS PERCENT PASSING											
TEST HOLE	DEPTH (FEET)	UNIFIED CLASS	(%) MOIST	LL	PI	NO 200	NO 100	NO 40	NO 10	NO 4	3/8"	1/2"	3/4"	1"	1 1/2"	2"	4"
01	3.0		4.7														
01	5.0		5.0														
01	7.0	SM	5.6	NP	NP	43	82	99	100								
01	10.0		13.0														
05	3.0		11.6														
05	5.0		12.4														
05	7.0		10.5														
05	10.0	SC	9.8	35	19	48	73	99	100								
09	2.0		10.5														
09	4.0	CL-ML	9.6	27	6	55	79	99	100								
09	6.0		9.2														
09	10.0	CL	10.1	42	24	57	74	94	97	98	100						
13	3.0	CL	27.9	49	30	65	80	97	99	99	100						
13	5.0		13.7														
13	10.0	SC	10.6	24	8	42	67	98	100								
17	3.0	CH	15.8	54	31	79	90	99	100								
17	7.0		11.7														
17	10.0	SC	4.3	34	18	35	49	93	100								
25	3.0	CL	6.5	36	20	55	71	100									
						LL = LIQUID LIMIT PI = PLASTICITY INDEX NP = NON PLASTIC or NO VALUE						Project: Reach 10.1 Waterline					
												Location: McKinley County, NM					
												Number: 1-11106					

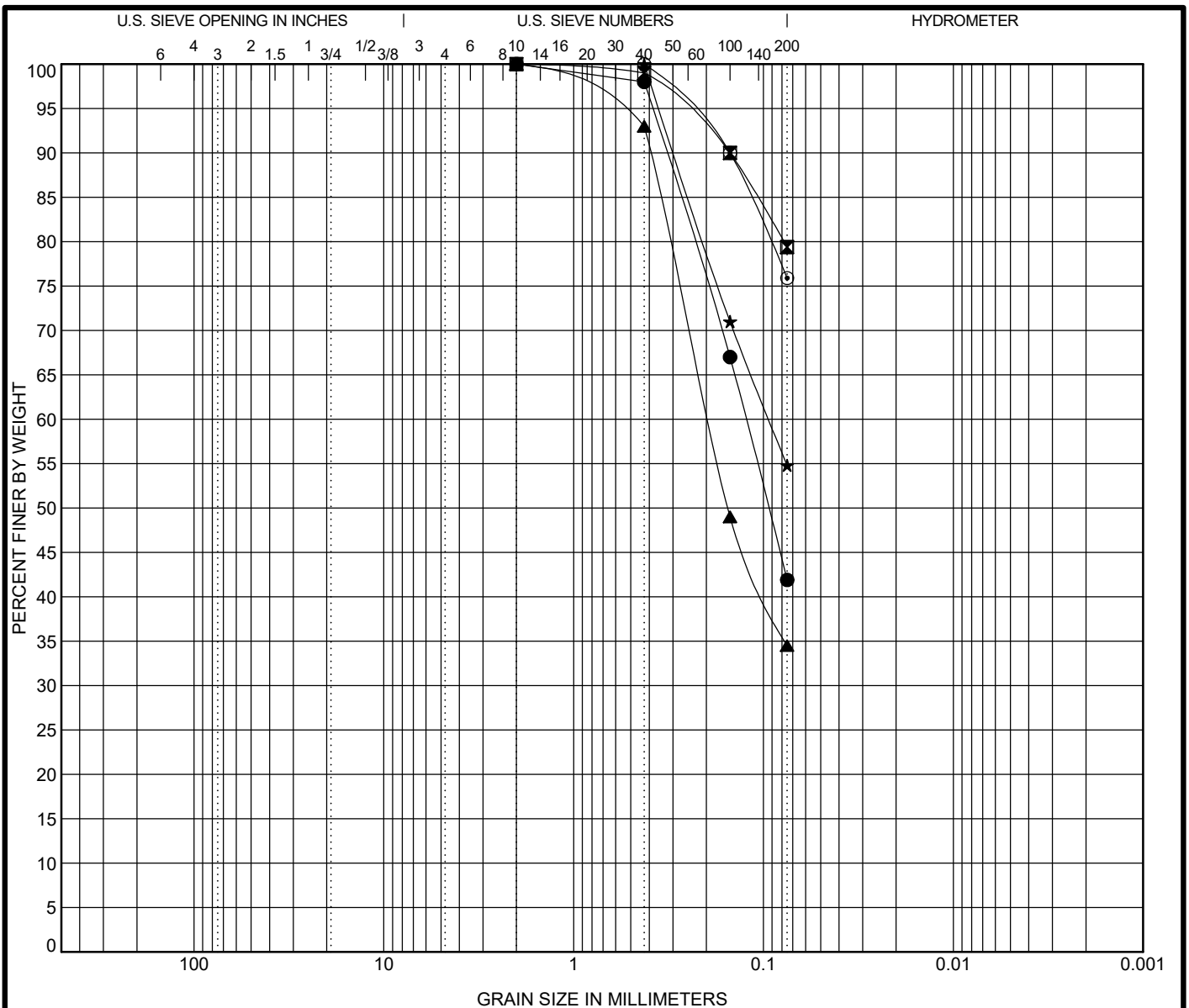
SUMMARY OF LABORATORY RESULTS

Sheet 2 of 2

						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"
25	5.0		5.5														
25	7.0	CL-ML	9.4	24	7	76	90	100									
25	10.0		7.8														
29	3.0		3.3														
29	5.0	SM	6.3	NP	NP	42	60	99	100								
29	10.0	CL	8.4	32	13	84	94	99	100								
33	3.0	SM	3.7	NP	NP	31	62	99	100								
33	8.0		4.3														
37	5.0	SM	5.4	NP	NP	38	71	99	100								
37	7.0		4.0														
37	10.0		4.2														
41	3.0		8.9														
41	5.0	SC	8.6	47	24	46	52	62	73	83	92	95	100				
41	8.0		13.9														
41	10.0	CH	13.3	73	47	66	73	88	98	100							
						LL = LIQUID LIMIT PI = PLASTICITY INDEX NP = NON PLASTIC or NO VALUE						Project: Reach 10.1 Waterline Location: McKinley County, NM Number: 1-11106					

SUMMARY OF LABORATORY RESULTS 1-11106.GPJ GEO TEST.GDT 5/15/22





COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification			LL	PL	PI	Cc	Cu
●	13	10.0	CLAYEY SAND(SC)			24	16	8		
☒	17	3.0	FAT CLAY with SAND(CH)			54	23	31		
▲	17	10.0	CLAYEY SAND(SC)			34	16	18		
★	25	3.0	SANDY LEAN CLAY(CL)			36	16	20		
◎	25	7.0	SILTY CLAY with SAND(CL-ML)			24	17	7		
Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	13	10.0	2	0.124			0.0	58.1	41.9	
☒	17	3.0	2				0.0	20.6	79.4	
▲	17	10.0	2	0.195			0.0	65.5	34.5	
★	25	3.0	0.425	0.094			0.0	45.2	54.8	
◎	25	7.0	0.425				0.0	24.1	75.9	

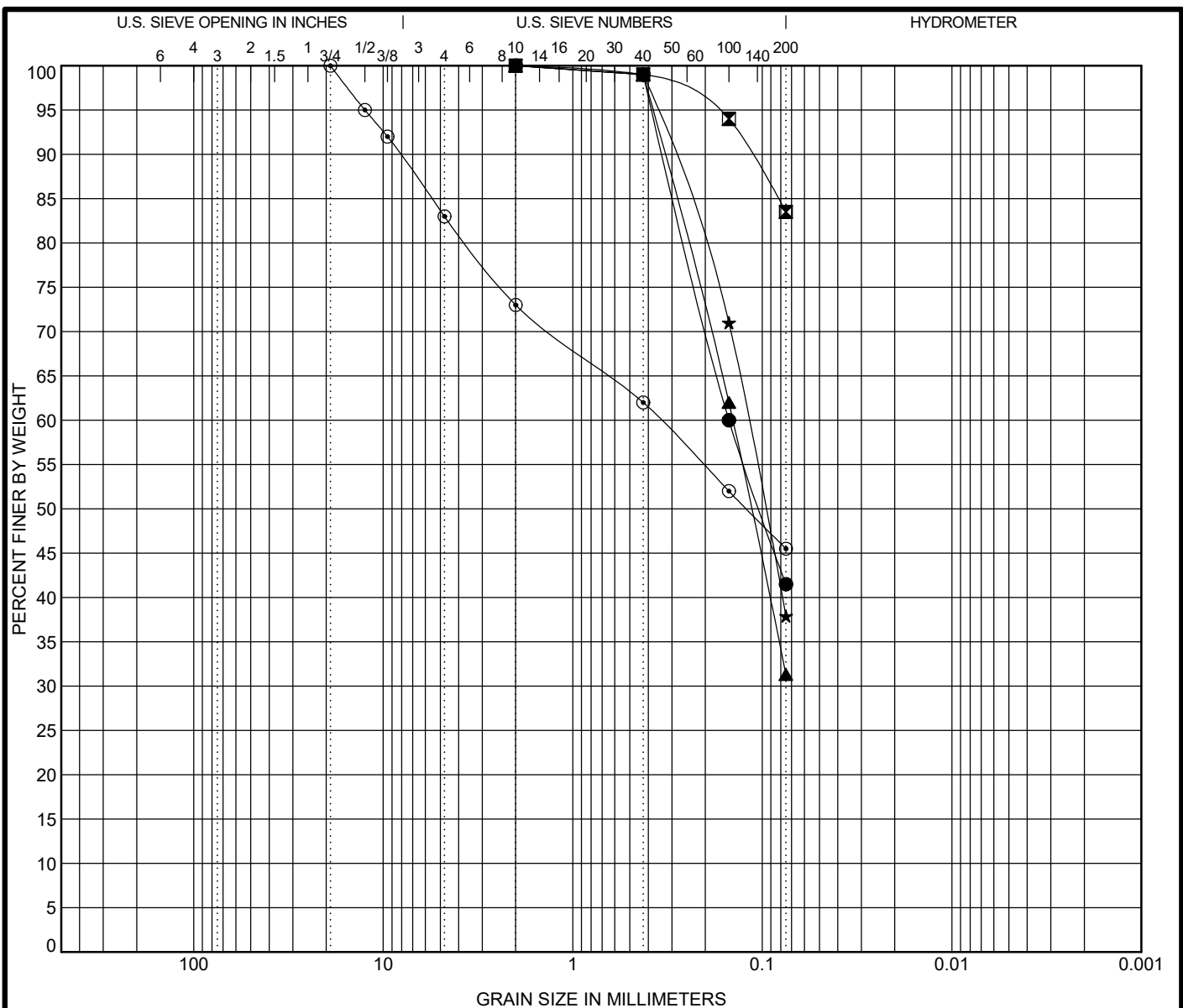
GEO-TEST

GRAIN SIZE DISTRIBUTION

Project: Reach 10.1 Waterline

Location: McKinley County, NM

Number: 1-11106



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification			LL	PL	PI	Cc	Cu
●	29	5.0	SILTY SAND(SM)			NP	NP	NP		
☒	29	10.0	LEAN CLAY with SAND(CL)			32	19	13		
▲	33	3.0	SILTY SAND(SM)			NP	NP	NP		
★	37	5.0	SILTY SAND(SM)			NP	NP	NP		
◎	41	5.0	CLAYEY SAND with GRAVEL(SC)			47	23	24		
Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	29	5.0	2	0.15			0.0	58.5	41.5	
☒	29	10.0	2				0.0	16.5	83.5	
▲	33	3.0	2	0.143			0.0	68.7	31.3	
★	37	5.0	2	0.119			0.0	62.1	37.9	
◎	41	5.0	19	0.345			17.0	37.5	45.5	

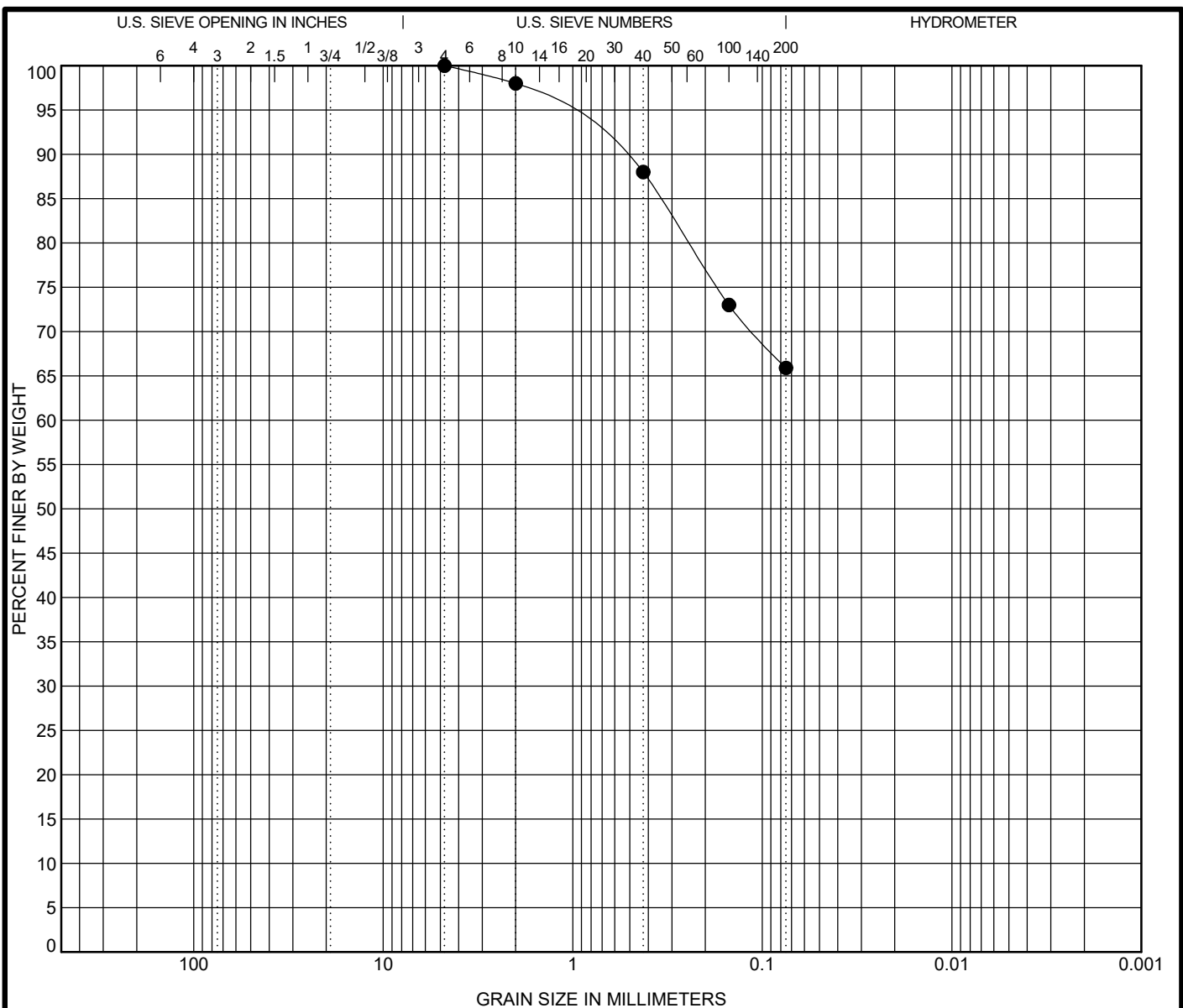
GEO-TEST

GRAIN SIZE DISTRIBUTION

Project: Reach 10.1 Waterline

Location: McKinley County, NM

Number: 1-11106



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification			LL	PL	PI	Cc	Cu
●	41	10.0	SANDY FAT CLAY(CH)			73	26	47		

Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	41	10.0	4.75			0.0	34.1	65.9	

GEO-TEST

GRAIN SIZE DISTRIBUTION

Project: Reach 10.1 Waterline

Location: McKinley County, NM

Number: 1-11106

TORY TADANO, P.E.

Souder, Miller & Associates
5454 Venice Ave NE, Suite D
Albuquerque, NM 87113



**SUBSURFACE EXPLORATION AND
GEOTECHNICAL DATA REPORT**

**BBN9 WATER SUPPLY DISTRICT
MCKINLEY COUNTY, NEW MEXICO**

March 28, 2023

INBERG-MILLER ENGINEERS

124 East Main Street
Riverton, WY 82501
(307) 856-8136
www.inberg-miller.com

23171-ZX



INBERG-MILLER ENGINEERS

Casper | Cheyenne | Douglas | Gillette | Green River | Riverton | Greeley, CO

March 28, 2023

23171-ZX

**PDF REPORT EMAILED: TORY.TADANO@SOUDERMILLER.COM
THIS CONSTITUTES THE ORIGINAL**

Tory Tadano, P.E.
Souder, Miller & Associates
5454 Venice Ave. NE, Suite D
Albuquerque, NM 87113

RE: SUBSURFACE EXPLORATION AND GEOTECHNICAL ENGINEERING REPORT
BBN9 WATER SUPPLY DISTRICT
MCKINLEY COUNTY, NM – NAVAJO NATION

Dear Souder, Miller & Associates:

This letter transmits our Subsurface Exploration and Geotechnical Engineering report for the above-referenced project. The work described in this report has been completed in accordance with our Service Agreement dated January 16, 2023.

It has been a pleasure participating in this project. Additional services we could provide include:

- environmental assessment
- civil engineering
- plan and specification review
- surveying
- construction materials testing
- observation of excavations and earthwork

If you have any questions or comments, please contact us at 307-856-8136.

Sincerely,

INBERG-MILLER ENGINEERS

Erich R. Hahn, E.I.T.
Geotechnical Field Engineer
ehahn@inberg-miller.com


3/28/23

REVIEWED BY:

Glen M. Bobnick, P.E.
Senior Geotechnical Engineer
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ERH:GMB:bb\P:23171-ZX SMA BBN9 Water Supply District\Geotech\23171-ZX SMA Subsurface Report.docx



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APPENDICES

Appendix A - FIELD EXPLORATION

Sample and Data Collection Information

Site and Exploration Location Map

Test Boring Logs

Appendix B - LABORATORY TESTING

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General Notes

Classification of Soils for Engineering Purposes

Important Information about your Geotechnical Engineering Report

1.0 INTRODUCTION

1.1 SUMMARY

Based on information obtained from our subsurface exploration and laboratory testing of recovered samples, it is our opinion that the site is suitable for construction of the proposed BBN9 Water Supply District project. In summary, this report will provide recommendations for the proposed waterline in 4 sections labeled as the following: 10.2 Borings, 10.2.1 Borings, 10.3 Borings, & 10.3.1 Borings.

In general, our subsurface exploration encountered the following types of soil deposits within 10 feet below ground surface (bgs):

Eolian Deposits

	Borings located within eolian deposits
Section 10.2	10.2-1, 10.2-3 to 10.2-8, & 10.2-11 to 10.2-16
Section 10.2.1	Not observed at boring locations
Section 10.3	10.3-11 to 10.3-13, 10.3-28
Section 10.3.1	Not observed at boring locations

The ground surface is covered by very loose wind-blown deposits with some native grasses, shrubs, and traces of organic matter. From the surface to 10 feet bgs, the subsurface contains very loose to medium dense fine-grained sand and silty clayey sand. The sand and silty clayey sand is characterized by low strength and high to moderate compressibility. The sand and silty clayey sand is considered eolian deposits forming sand dunes over bedrock. Density increases with depth, at least partly due to the continued accumulation of overburden above.

Slope Wash Deposits

	Borings located within slope wash deposits
Section 10.2	10.2-19 to 10.2-21 & 10.2-24 to 10.2-27
Section 10.2.1	10.2.1-4 to 10.2.1-5, 10.2.1-8 to 10.2.1-11, 10.2.1-13,
Section 10.3	10.3-8 to 10.3-10, 10.3-15 to 10.3-18, 10.3-19 to 10.3-23, & 10.3-26 to 10.3-27
Section 10.3.1	10.3.1-2 to 10.3.1-3, 10.3.1-5 to 10.3.1-7, 10.3.1-9 to 10.3.1-10, 10.3.1-14, 10.3.1-17, 10.3.1-21, 10.3.1-27 to 10.3.1-28, 10.3.1-32

The ground surface is exposed by soil deposited from the erosion of clay, sand, silt, and bedrock above in higher elevations and covered with some native grasses, shrubs, and organic matter throughout. From the surface to 10 feet bgs, the subsurface contains very loose to medium dense fine to coarse grained silt, sandy silt, and silty clayey sand. The fine to coarse grained soil is characterized by low to moderate strength and high compressibility. The silt, sandy silt, and silty clayey sand contains some coarse material that may consist of very dense

layers of sandstone or siltstone rock fragments, or weathered shale at various depths. This mix of material is considered slope wash. Density generally increases with depth due to the continued accumulation of slope wash above.

Drainage Deposits

	Borings located within natural drainage deposits
Section 10.2	10.2-2, 10.2-9 to 10.2-10, 10.2-17, 10.2-18 10.2-28, 10.2-HDD1, & HWY Bore
Section 10.2.1	10.2.1-1 to 10.2.1-3, 10.2.1-6 to 10.2.1-7, 10.2.1-12
Section 10.3	10.3-14, 10.3-HDD1, 10.3-24 to 10.3-25
Section 10.3.1	10.3.1-4, 10.3.1-8, 10.3.1-11 to 10.3.1-13, 10.3.1-18, 10.3.1-24 to 10.3.1-26, 10.3.1-8A, 10.3.1-HDD 1

The ground surface is covered with soil deposited by stormwater runoff from adjoining higher terrain. Very little to no organic material, grass, or shrubs exist within these drainages. From the surface to 10 feet bgs, the subsurface contains loose to medium dense fine-grained silt, and silty clayey sand. The fine-grained soils are characterized by low strength and high compressibility. Most of the fine-grained deposits occur within low drainages, near dry creek beds, or where moisture and/or precipitation spreads across flat topography.

Residuum

	Borings located within residual soils (residuum)
Section 10.2	Not observed at boring locations
Section 10.2.1	10.2.1-14 to 10.2.1-17
Section 10.3	10.3-29
Section 10.3.1	10.3.1-1 to 10.3.1-2, 10.3.1-15 to 10.3.1-16, 10.3.1-19 to 10.3.1-20, 10.3.1-22 to 10.3.1-23, 10.3.1-29 to 10.3.1-31

The ground surface is covered by native grasses, shrubs, trees, and some topsoil. From the surface to 10 feet bgs, the subsurface contains loose to very dense fine grained clayey sand and silty sand. Immediately below the clayey silty sand, the subsurface contains weathered sandstone, claystone, shale bedrock, or very dense sand or silt. The clayey sand and silty sand are characterized by moderate strength and moderate compressibility. These soils may not be in direct contact or located within erosional features but have weathered above bedrock over time.

Groundwater was not encountered while drilling within the top 10 feet bgs. Groundwater was encountered at 29.4 and 42.5 feet bgs within borings 10.2-HDD1 and HWY Bore respectively.

Specific geotechnical issues that were identified during the course of our subsurface exploration included the following:

1. Within the 4 waterline sections, very dense soil, rock fragments, and bedrock conditions were encountered while drilling that could affect the elevation, depth of excavation and/or

general difficulty in construction of the pipeline. In some cases, auger refusal was with a hand auger, which is not comparable to the Mobile Drill rig refusal and should be evaluated accordingly with regard to excavation difficulty. These conditions are tabulated below.

Section 10.2	Layer Depth	Description
10.2-2	6.0' to 6.5'	Drilling through sandstone
10.2-5	7.5'	Hand augering through silty sand – refusal @ 7.5'
10.2-6	2.0'	Hand augering through sand – refusal @ 2.0'
10.2-7	4.0'	Hand augering through sand – refusal @ 4.0'
10.2-11	4.5' to 5.5'	Drilling through sandstone
10.2-16	4.0'	Hand augering through sand – refusal @ 4.0'
10.2-19	2.5'	Hand augering through sandstone – refusal @ 2.5'
10.2-20	3.5'	Hand augering through silt – refusal @ 3.5'
10.2-24	4.0'	Hand augering through silty sand – refusal @ 4.0'
10.2-25	7.5'	Hand augering through sand – refusal @ 7.5'
10.2-26	1.0 to 1.5'	Hand augering through sandstone – refusal @ 1.5'
HWY Bore	36 to 50.5'	Drilling through very dense clayey sand
10.2-HDD 1	27.5 to 50.5'	Drilling through very dense silty sand

Section 10.2.1	Layer Depth	Description
10.2.1-9	2.5 to 3.0'	Hand augering through sandstone – refusal @ 3'
10.2.1-10	1.0 to 1.5'	Hand augering through sandstone – refusal @ 1.5'
10.2.1-15	5.0 to 5.5'	Drilling through sandstone
10.2.1-16	5.0 to 5.5'	Drilling through sandstone
10.2.1-17	10.5 to 11.5'	Drilling through claystone

Section 10.3	Layer Depth	Description
10.3-16	5.0 to 5.5'	Drilling through shale
10.3-17	6.0 to 11.5'	Drilling through sandy shale
10.3-18	4 to 6.5'	Drilling through sandy shale
10.3-19	4 to 6.5'	Drilling through sandy shale
10.3-20	6 to 6.5'	Drilling through sandy shale
10.3-21	4 to 11.5'	Drilling through sandy shale
10.3-22	3 to 6.5'	Drilling through sandy shale
10.3-23	5 to 6.0'	Drilling through sandstone
10.3-25	6.5 to 7.0'	Hand augering through sandstone – refusal @ 7'
10.3-26	5 to 5.5'	Drilling through sandstone
10.3-27	4 to 5.5'	Drilling through sandstone
10.3-HDD 1	4 to 28.5'	Drilling through sandy shale 4 to 23', siltstone to end of boring – refusal @ 28.5'

Section 10.3.1	Layer Depth	Description
10.3.1-5	5 to 11.5'	Drilling through shale
10.3.1-8	3 to 5.5'	Drilling through shale
10.3.1-14	5 to 5.5'	Drilling through sandstone
10.3.1-17	5 to 10.5'	Drilling through clayey sand w/sandstone & claystone
10.3.1-19	3.5 to 4'	Drilling through sandstone – refusal @ 4'
10.3.1-22	5 to 5.5'	Drilling through sandstone
10.3.1-27	2.5 to 6'	Drilling through claystone
10.3.1-28	3 to 6.5'	Drilling through claystone
10.3.1-29	1.5 to 2.0'	Hand augering through sandstone – refusal @ 2'
10.3.1-30	0 to 2.5'	Hand augering through sandy shale – refusal @ 2.5'
10.3.1-31	0 to 2.5'	Hand augering through sandy shale – refusal @ 2.5'
10.3.1-HDD 1	10 to 50.5'	Drilling through sandy clay from 10' to 31', shale to 50.5'

2. Drilling conditions and soils encountered while drilling at each boring do not represent conditions expected throughout the entire waterline. The variability of bedrock depth below the ground surface should be expected between boring locations. A ¼ mile distance between each boring will have changes in erosional features, exposed bedrock at the surface, and/or a variance of soil types. The region within the BBN9 Water Supply project is relatively semi-arid to desert environment where soil conditions may change drastically between flash floods, precipitation runoff, rock fall, wind erosion, and settlement of unconsolidated soils. The lack of organic topsoil, trees, and native grass make the soil conditions highly susceptible to erosion.
3. Coarse rock fragments and/or various layers in thickness of sandstone interbedded within the subgrade soils may not provide suitable on-site soil for re-use as compacted utility pipe backfill, particularly if more than 30 percent is larger than 3/4" diameter or there are frequent oversize (4" plus diameter) particles. Such soils will need to be screened to remove oversized particles for replacement with finer grained on-site material.
4. Expansive clay and shale was encountered within Section 10.3 and 10.3.1 borings. If expansive shale dries and is exposed to groundwater, it could swell and apply uneven pressures, distress, or deformation of buried pipes or conduits.
5. Groundwater occurrence is relatively dry across the project site and is largely influenced by the permeability of various types of soil within the range of subsurface exploration. We note that installation of pipes and permeable bedding materials may allow water to migrate and affect or change groundwater levels in various locations after the project is complete.
6. Within sections of Horizontal Directional Drilling (HDD), relatively soft, unstable clay and/or silt overburden within 30' from the surface was encountered while drilling. This material may squeeze or flow in horizontal drill holes or during trenching operations. Loose sand overburden within 30' from the surface was also encountered which may tend to flow while horizontally drilling if higher groundwater tables surface during installation.

In summary, key geotechnical recommendations that apply to this project include:

1. We anticipate possible soil cave-ins for the HDD crossings & utility pipe trenching operations within the upper 20 feet bgs. Due to this potential problem, shoring or sloping trench walls will be required. Sandy and clayey overburden material discussed in the subsoil conditions section is classified according to OSHA as Soil Type C. Slopes or other support for excavations extending through these layers should be based on OSHA Soil Type C conditions.
2. Any underground utilities that are placed, should be supported on Pipe Bedding according to specifications outlined within Section 701 of the 1.07 of the New Mexico Standard Specifications for Public Works Construction (NMSSPWC) and within Section 3.1 of this report. The native soil below the pipe bedding should be reconditioned by compaction prior to the placement of the pipe bedding. At least 12 inches below, 12 inches beyond the sides, and 12 inches above the outer pipe diameter should consist of pipe bedding. The remaining material above the pipe bedding to the existing ground surface should consist of Trench Backfill according to Section 701 of the New Mexico Standard Specifications for Public Works Construction (NMSSPWC) and within Section 3.1 of this report. Proper pipe bedding may help distribute stress on the pipe due to swelling or settling of soil when moisture conditions change.
3. Various layer depth of sandstone, siltstone, and shale encountered within the HDD borings will be difficult to drill through. A line item should be included in the bidding documents to account for difficult drilling characteristics through bedrock.
4. Any on-site soil, when placed as fill, should be devoid of large particles greater than 6.0 inches in diameter if present. The soil should be scarified, moisture conditioned, and compacted according to Section 3.1 of this report.

1.2 PURPOSE AND SCOPE OF SERVICE

Inberg-Miller Engineers was requested by Souder, Miller & Associates to perform a subsurface exploration and prepare this geotechnical engineering report for the purpose of providing recommendations for the design of a new pipeline for the BBN9 Water Supply District. Our specific scope of service is described by our January 16, 2023 Proposal.

2.0 CONDITIONS

2.1 SITE DESCRIPTION

The project site is located within the Navajo Nation starting approximately 4.0 miles west of Standing Rock, NM, heading east towards Crownpoint, NM, and ending in town at Chaco Blvd. The proposed waterline will be constructed parallel to BIA-9 along a 20 mile section of road, within a range of 1.75 miles north to 2.25 miles south of the highway. The proposed waterline is divided into sections: 10.2, 10.2.1, 10.3, and 10.3.1. Section 10.2.1 extends south and perpendicular to BIA-9 at approximately 3.4 miles west of the Standing Rock intersection. Most of the project sections consist of slope wash deposits, drainages, eolian deposits, and residuum associated with formational sedimentary bedrock at greater depth. Juniper trees,

sage brush, and native grass were observed within each section, however, are not present or are sporadic at locations of exposed bedrock, sand dunes, or locations within natural drainages. No surface water was observed within the drainages while drilling.

2.2 [PROJECT CONDITIONS](#)

Project conditions were either provided by Souder, Miller & Associates or were assumed based on our experience with similar types of construction. These conditions are tabulated below and form the basis for recommendations provided within this report. Please contact Inberg-Miller Engineers if conditions differ from those stated.

Maximum Cut (feet)	5 to 10'
Maximum Fill (feet)	5 to 10'
Utility Pipe	New waterline from Coyote Canyon Chapter to Crownpoint, NM (approx. 30 miles of new pipeline)

2.3 [SOIL/ROCK CONDITIONS](#)

A summary of soil or rock conditions that were encountered and recorded on the logs is provided below. For a more detailed description of conditions refer to the test boring logs presented in Appendix A.

	Silt	Sandy Clay	Sand	Silty Sand	Shale	Sandstone
USCS Classification	ML	CL	SP, SW	SM	CH, CL, ML	---
Geologic Site Descriptions	Drainages	Slope Wash	Eolian, Slope Wash, Drainages, Residuum	Eolian, Slope Wash, Drainages, Residuum	Slope Wash, Residuum	Slope Wash, Residuum
Density or Consistency	Soft to Hard	Soft to Very Stiff	Medium Dense to Very Dense	Medium Dense to Very Dense	Stiff to Hard	Very Dense
Boring Occurrence	All Boring Sections	All Boring Sections	All Boring Sections	All Boring Sections	Section 10.3 & 10.3.1	All Boring Sections
Vertical Limits	0 to 10'	0 to 10'	0 to 10'		2.5 to 10'	Various Layers
Strength	Low	Medium	Moderate to High	Low to Moderate	High to Moderate	High
Compressibility	High	High	Moderate to Low	Moderate to Low	Moderate	Low
Permeability	Low to Moderate	Low to Moderate	High	Moderate	Low	Low
Moisture Sensitivity	Moderate to High	Moderate to High	Low	Low to Moderate	High	Low
Frost Susceptibility	Moderate to High	Moderate to High	Low	Low to Moderate	High	Low
Shrink-Swell Potential	Low	Low to Moderate	Low	Low	High	Low
Collapse Potential	Low to Moderate	Low to Moderate	Low to Moderate	Low to Moderate	Low to Moderate	Low

HDD Crossings	Depth (bgs)	Soil Description	Estimated Range of Internal Friction Angles of Soil Layers
10.3-HDD1	0 to 4.0'	Silty Sand (SM)	25° to 30°
	4 to 23'	Sandy Shale	20° to 25°
	23 to 28.5'	Siltstone	40°
10.3.1-HDD1	0 to 10'	Silty Sand (SM)	25° to 30°
	10 to 31'	Sandy Clay (CL)	15° to 20°
	31 to 50.5'	Sandy Shale	30°
HWY Bore	0 to 15'	Sandy Silt (ML)	25° to 30°
	15 to 36'	Silty Sand (SM)	30° to 35°
	36 to 50.5'	Clayey Sand (SC)	35° to 40°
10.2-HDD1	0 to 27.5'	Silty Sand (SM)	30° to 35°
	27.5' to 50.5'	Silty Sand (SM)	35° to 40°

2.4 GROUNDWATER CONDITIONS

A summary of groundwater observations and measurements that were made during the subsurface exploration are provided below. Additional details are documented on the test boring logs presented in Appendix A.

Boring No.	Ground Surface Elevation	Observed Groundwater Depth	Date	Time
HWY Bore	6255	42.5 feet	January 26, 2023	While Drilling
10.2-HDD 1	6333	29.4 feet	January 11, 2023	While Drilling

At the time of our subsurface exploration, no groundwater was observed in the test borings 10-feet bgs or shorter before they were backfilled. Groundwater may be present at the site within the range of exploration depth but may not have been observable for numerous reasons such as low soil permeability or impeded drainage.

Groundwater conditions could change with seasonal or long-term changes in climatic conditions and post-construction changes in irrigation and surface water runoff. Generally, developed sites have a significantly greater volume of water available to percolate into the ground due to irrigation and storm water runoff from hard surfaces. Localized, perched groundwater tables may develop above clay layers or bedrock, or within the foundation backfill zone.

3.0 RECOMMENDATIONS

3.1 SITE PREPARATION AND EARTHWORK

Site Preparation

Stripping Depth (inches)	4.0 inches or until all organic material is removed
Uniform Placement	Native subgrade within excavations

1. Subgrades to receive structures, pavement, or fill material should respond uniformly to loading, and be free of organic materials, protruding rocks, debris, old fill, buried structures, or otherwise soft and compressible soil or material.
2. Weak or yielding subgrades should be repaired as recommended by the geotechnical engineer. Repairs may include soil excavation and replacement, possibly including proper geotextile fabric, depending on circumstances.

Fill and Backfill Materials

Classification	Suitable Materials	Source
Structural Fill	Envelope A	Imported
Pipe Bedding	NMSSPWC – Pipe Embedment	Imported or On-Site
Trench Backfill	NMSSPWC – Final Backfill	On-Site
Site Fill	Native Site Soil – SP, SW, SC, SM, CL, ML	On-site

1. Specification for recommended graded materials are as follows:

Structural Fill		NMSSPWC – Pipe Embedment	
Envelope A			
Sieve	Percent Finer	Sieve	Percent Finer
1½"	100	¾"	100
#4	50-100	#4	0 - 50
#8	30-90	#200	0 - 12
#30	15-75		
#50	10-60		
#200	0-20		
Liquid Limit < 40, PI < 15			

2. Specifications for recommended pipe bedding are as follows according to Section 701 of the NMSSPWC and additional recommendations stated below.

The width of the pipe bedding surrounding the utility pipe must be at least 12 inches wider than the outside diameter of the utility pipe with at least 12.0 inches of clearance below and 12 inches of clearance above the top of the outside diameter of the utility pipe. Pipe alignment must be centered within the trench excavation so that 12 inches of clearance is provided on all sides of the pipe.

Pipe Bedding should be selected on site soil or imported material that does not contain rock fragments or gravel/cobbles equal to or greater than ¾" diameter, dry soil clumps equal to or greater than ¾" diameter, frozen material, or any organic matter. All pipe bedding material must meet the following requirements: 100% passing the ¾" sieve, 0 to 50% passing #4 sieve, and 0 to 12% passing #200 sieve. Pipe bedding material must consist of CLASS I, II, & III soils according to Table 701.3.A.

Trench Backfill should consist of selected on-site soil that does not contain rock fragments or gravel/cobbles greater than 6.0" diameter, dry soil clumps greater than 6.0" in diameter, frozen material, or any organic matter. All trench backfill must consist of CLASS I, II, III, & IV soils according to Table 701.3.A. The upper portion of the trench backfill may have specific soil and compaction requirements immediately below structures or pavement sections.

Compaction

Below Foundations	6-inch layers, 95% ASTM D698
Below Pavements and Slabs	8-inch layers, 95% ASTM D698
Trenches	8-inch layers, 95% ASTM D698
Site Fill/Landscaped Areas	12-inch layers, 95% ASTM D698
Compaction Moisture Content	Moisture conditioned between -4 and +2 percentage points of the optimum moisture content

1. The contractor's equipment and procedures should produce a horizontal, uniformly mixed, and compacted lift. In-place density and water content of each lift of fill materials should be tested and approved, or as otherwise recommended by the geotechnical engineer.
2. If construction takes place during cold weather, care should be taken to prevent construction on frozen soil. In addition, fill materials should not contain snow and/or ice and should not be placed in a frozen condition.

Temporary and Permanent Slopes

Temporary Fill Slope	2.5 H: 1.0 V
Temporary Cut Slope	2.0 H: 1.0 V
Permanent Fill Slope	3.0 H: 1.0 V
Permanent Cut Slope	4.0 H: 1.0 V

1. Slopes, whether temporary (during construction) or permanent, will require careful management of surface water through design and maintenance to protect slopes from saturation.
2. Some slope conditions, especially when supporting structures or pavement loads, may have marginal safety factors against stability. Permanent and temporary slopes should be evaluated for stability when circumstances are better defined. Recommended values are provided for preliminary planning purposes only.
3. Slopes should be protected from erosion with vegetation, matting, or other measures.

3.2 GENERAL

Cement Type	Type I/II
International Building Code Seismic Site Class	Site Class D
Seepage Protection	Potential seepage should be captured and directed away from the excavation

Inberg-Miller Engineers should review final plans and specifications in order to determine whether the intent of our recommendations has been properly implemented. In addition, we should be retained as the geotechnical engineer and construction materials testing agency to provide the following services:

- a. Observe excavations to determine if subsurface conditions revealed are consistent with those discovered in the exploration.
- b. Identify if the proper bearing stratum is exposed at proposed foundation excavation depths.
- c. Observe that foundation excavations are properly prepared, cleaned, and dewatered prior to concrete placement.
- d. Test compaction of subgrades and fills.
- e. Perform field and laboratory testing of concrete and other materials as required by project specification and/or building code.

3.3 CONSTRUCTION

Excavation Difficulty	Low to Very Difficult – conventional excavation equipment should be sufficient to excavate the sand, silty sand, clay, and silt deposits. However, use of special excavation tools might be necessary to level the pipe bedding surface on bedrock below the bottom of pipe.
Dewatering Requirements	Not Anticipated unless the utility pipe is placed during wet seasonal months where surface water could drain into the excavations. Groundwater may be expected while drilling at HDD crossings.
Soil Sensitivity	Moderate – careful application of water for compaction is important to avoid over-wetting
OSHA Soil Type	OSHA Soil Type C
Potential for Buried Obstructions	Not Anticipated – unmapped underground utilities potentially in the area
Onsite Borrow Soil	Native Site Soil – SP, SW, SC, SM, CL, ML
Surface Drainage	Extreme care is recommended for construction activities that occur within drainage areas, and particularly where “drainage” conditions are noted on the logs. Flash flooding may occur that could present safety risks and potential damage.

Excavations should be sloped, benched, shored, or made safe for entry by the use of trench boxes, as required by the standards of 29 CFR Part 1926. As a safety measure, it is recommended that all vehicles and soil piles be kept at a minimum lateral distance equal to the slope height, from the crest of the slope. The contractor is solely responsible for designing and constructing stable excavations, the geometry of the excavation slopes, and the protective equipment and procedures employed by his forces. For the sole purpose of project planning, we recommend that clay and sandy soils are considered an OSHA Type C. Excavations, including utility trenches, extending to depths of greater than 20 feet are required to have side slopes, trench boxes, or shoring designed by a professional engineer licensed in the State of New Mexico.

4.0 TECHNICAL DATA

Our Sample and Data Collection Information, Site and Boring Location Map, and Test Boring Logs are included in Appendix A.

5.0 STANDARD REPORT INFORMATION

Our Field and Laboratory Testing Program and Testing Data (laboratory reports, infiltration, geophysical) are included in Appendix B.

Our Standard Report Information, including Terms and Definitions, Limitations, and Comments Form are included in Appendix C.

6.0 CLOSURE

This report has been prepared for the exclusive use of our client, Souder, Miller & Associates, for evaluation of the site, design, and construction planning purposes of the described project. All information referenced in the Table of Contents, as well as any future written documents that address comments or questions regarding this report, constitute the "entire report." Inberg-Miller Engineers' conclusions, opinions, and recommendations are based on the entire report. This report may contain insufficient information for applications other than those herein described. Our scope of services was specifically designed for and limited to the specific purpose of providing geotechnical recommendations for the design of the proposed BBN9 Water Supply District project. Consequently, this report may contain insufficient information for applications other than those herein described.

The readers of this geotechnical engineering report should realize that subsurface variations and anomalies can and will exist across the site and between the test borings. The readers should also realize that site conditions will change due to the modifying effects of seasonal, climatic and construction conditions.

The scope of services for this project does not include any environmental or biological assessment of the site. If requested, we would be pleased to assist you with developing a scope of services for environmental assessment for the subject site. Wherever structures are in contact with soil, there is potential that soil moisture may penetrate the building and provide an opportunity for mold growth. While this report identifies soil moisture/groundwater conditions and may provide geotechnical recommendations for drainage and construction, the design of drains, water proof/resistant building elements, equipment to remove moisture from the building, or additional measures to prevent the growth of mold are beyond the scope of our geotechnical services. Implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent the growth of mold in or on the proposed building.

We caution that this report was not written as a construction contract document, and therefore should either not be incorporated in contract documents or be accompanied by a statement similar to the following:

This report was used during the planning and design of the subject project and is provided in the contract documents for informational purposes only. This report may contain recommendations that were not implemented and terms that conflict with the contract documents, therefore the project plans and technical specifications and not this report should be followed for construction requirements.

We appreciate participating in your project. We can offer services under a separate contract to provide civil or environmental engineering services, review final plans and specifications, perform construction surveying, field and laboratory construction materials testing, and observe excavations, as may be required. Please call us at 307-856-8136 if you have any questions regarding this report.

Appendix A

SAMPLE AND DATA COLLECTION INFORMATION

Field-sampling techniques were employed in this exploration to obtain the data presented in the Final Logs and Report generally in accordance with ASTM D420, D1452, D1586 (where applicable), and D1587 (where applicable).

The drilling method utilized in most test borings is a dry-process, machine rotary auger type that advances hollow steel pipe surrounded by attached steel auger flights in 5-foot lengths. This method creates a continuously cased test hole that prevents the boring from caving in above each level of substrata to be tested. Sampling tools were lowered inside the hollow shaft for testing in the undisturbed soils below the lead auger. In some test borings, as appropriate to advance to the desired depth, air or wash rotary drilling methods were utilized. Air or wash rotary drilling methods allow for the extraction of rock core samples.

Samples were brought to the surface, examined by an IME field representative, and sealed in containers (or sealed in the tubes) to prevent a significant loss of moisture. They were returned to our laboratory for final classification per ASTM D2487 methods. Some samples were subjected to field or laboratory tests as described in the text of this report.

Groundwater observations were made in the open drill holes by IME field personnel at the times and dates stated on the Final Logs. Recorded groundwater levels may not reflect equilibrium groundwater conditions due to relatively low permeability of some soils. It must also be noted that fluctuations may occur in the groundwater level due to variations in precipitation, temperature, nearby site improvements, nearby drainage features, underdrainage, wells, severity of winter frosts, overburden weights, and the permeability of the subsoil. Because variations may be expected, final designs and construction planning should allow for the need to temporarily or permanently dewater excavations or subsoil.

A Final Log of each test pit or boring was prepared by IME. Each Final Log contains IME's interpretation of field conditions or changes in substrata between recovered samples based on the field data received, along with the laboratory test data obtained following the field work or on subsequent site observations. The final logs were prepared by assembling and analyzing field and laboratory data. Therefore, the Final Logs contain both factual and interpretive information. IME's opinions are based on the Final Logs.

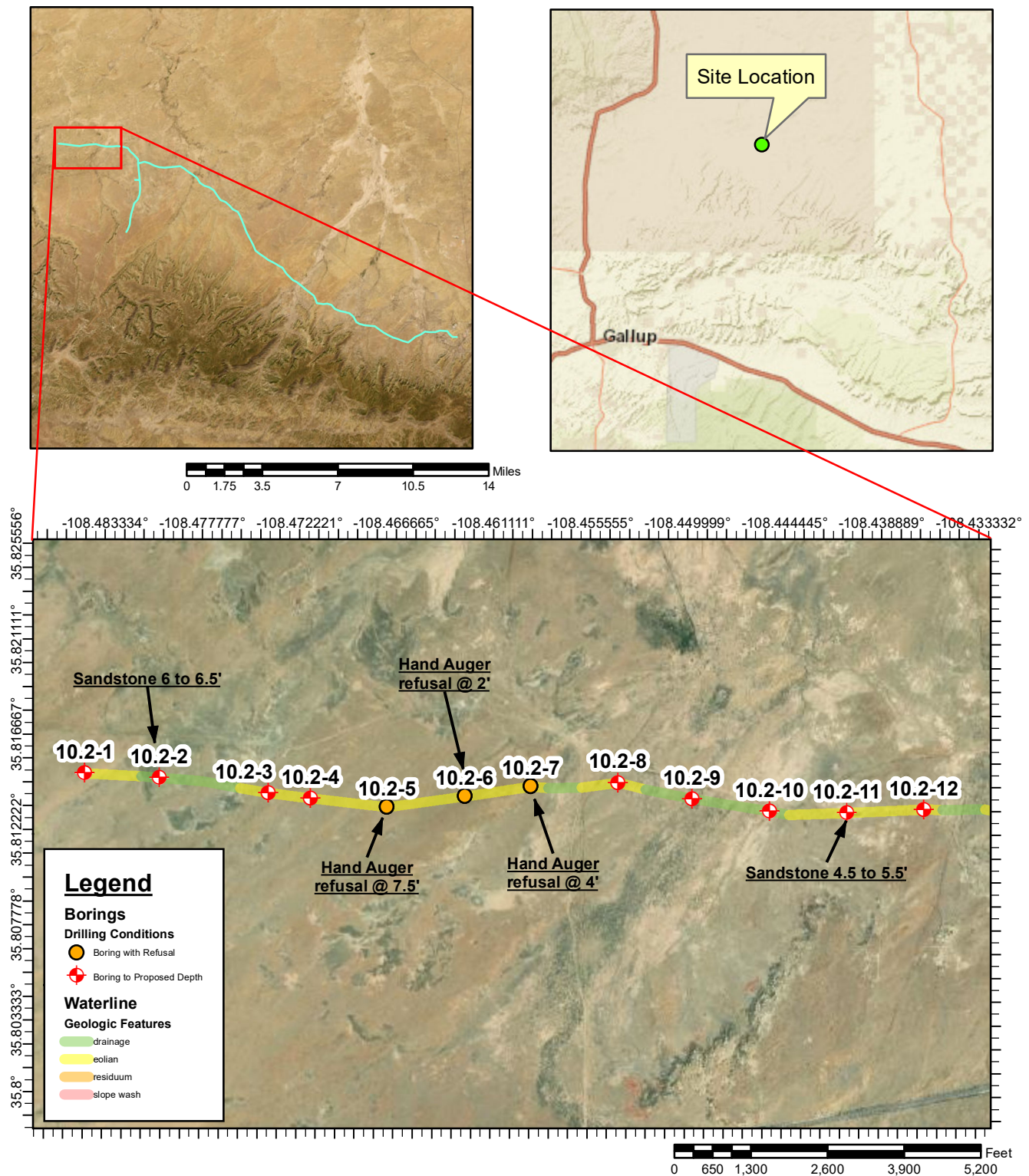
The Final Logs list boring methods, sampling methods, approximate depths sampled, amounts of recovery in sampling tools (where applicable), indications of the presence of subsoil types, and groundwater observations and measurements. Results of some laboratory tests are arrayed on the Final Logs at the appropriate depths below grade. The horizontal lines on the Final Logs designate the interface between successive layers (strata) and represent approximate boundaries. The transition between strata may be gradual.

We caution that the Final Logs alone do not constitute the report, and as such they should not be excerpted from the other appendix exhibits or from any of the written text. Without the written report, it is possible to misinterpret the meaning of the information reported on the Final Logs. If the report is

reproduced for reference purposes, the entire numbered report and appendix exhibits should be bound together as a separate document, or as a section of a specification booklet, including all drawings, maps, etc.

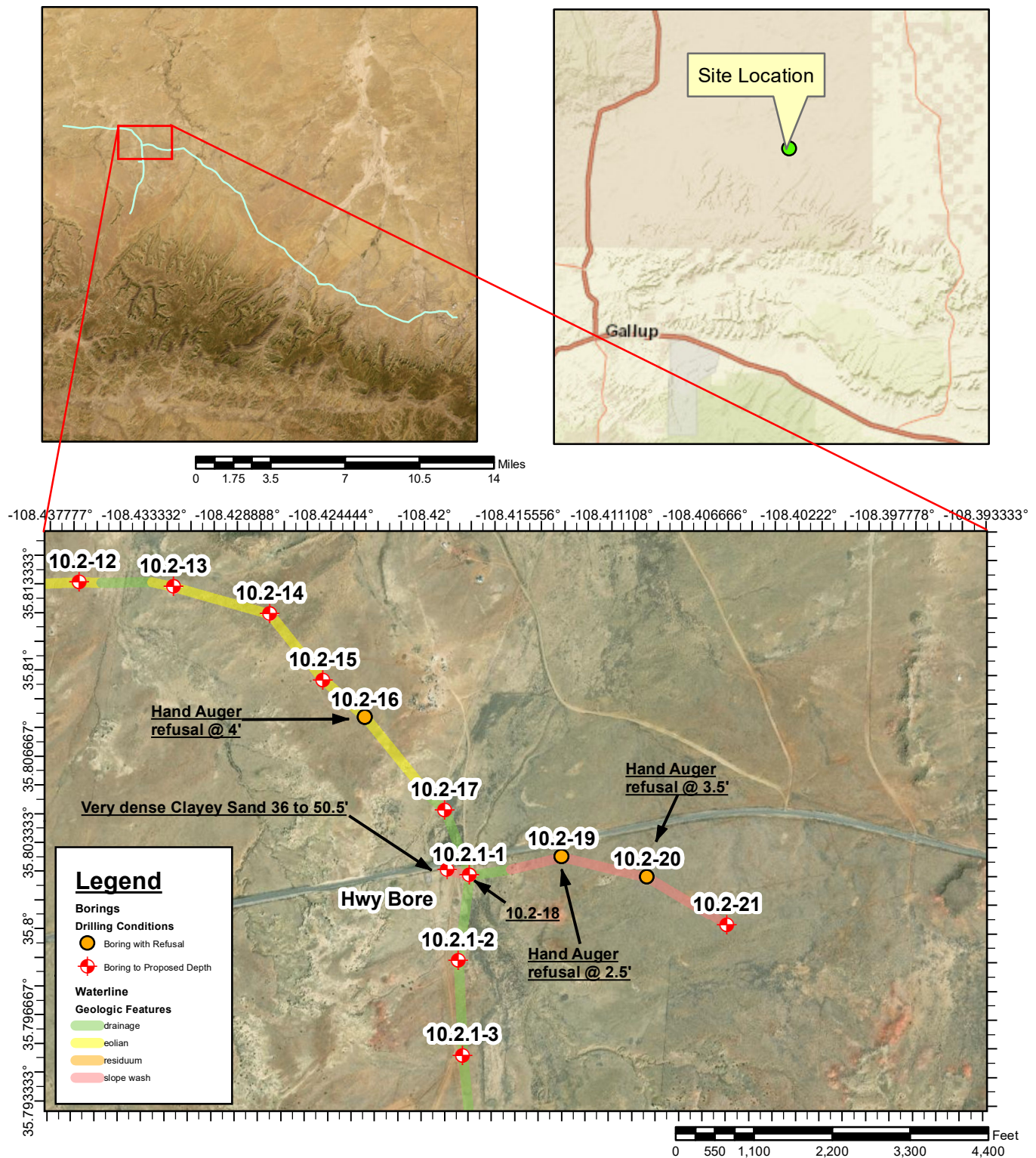
Pocket penetration tests taken in the field, or on samples examined in the laboratory are listed on the Final Logs in a column marked "qp." These tests were performed only to approximate unconfined strength and consistency when making comparisons between successive layers of cohesive soil. It is not recommended that the listed values be used to determine allowable bearing capacities. Bearing capacities of soil is determined by IME using test methods as described in the text of the report.

BBN9 Water Supply District - Site Location Map



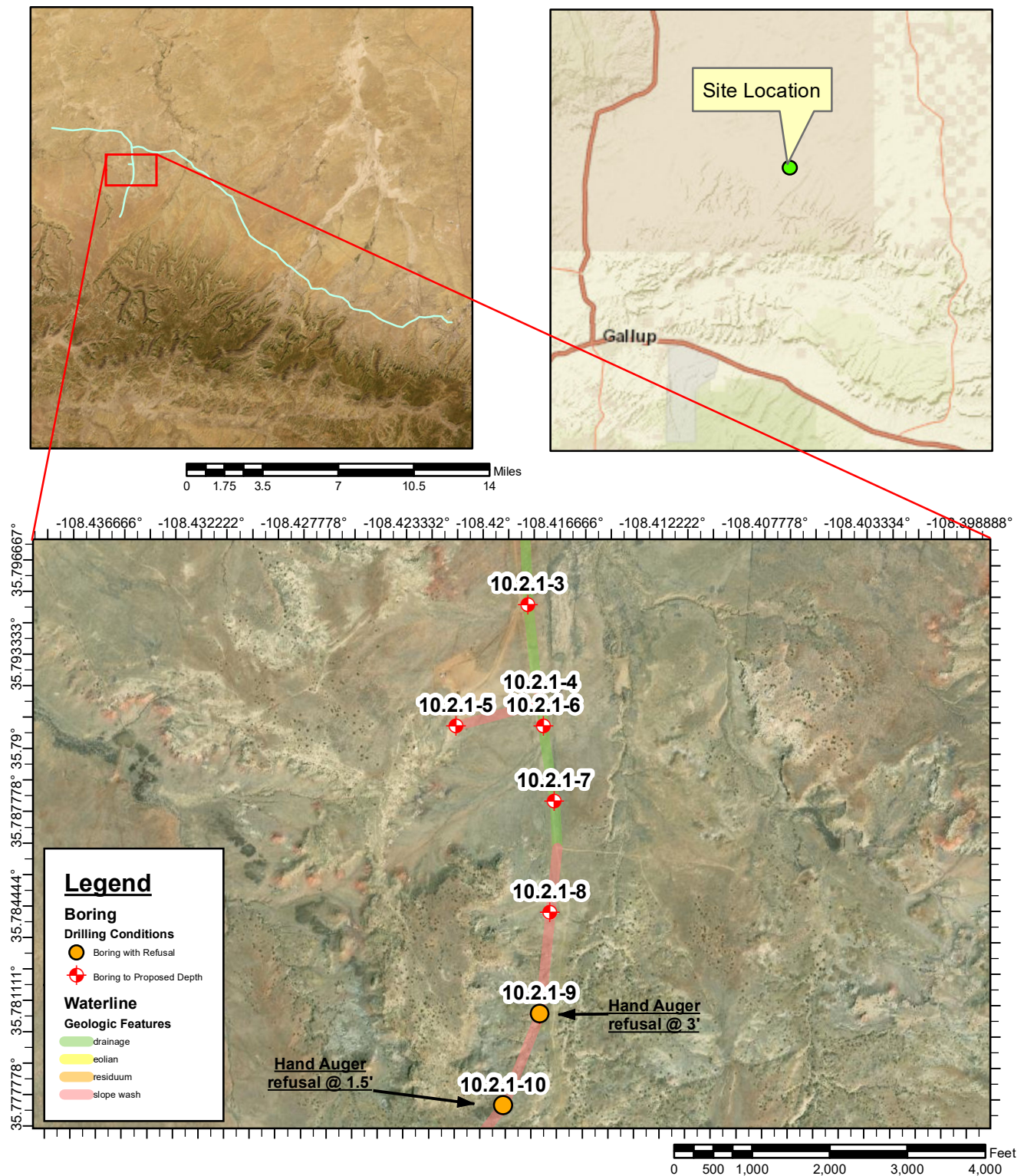
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 Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

BBN9 Water Supply District - Site Location Map



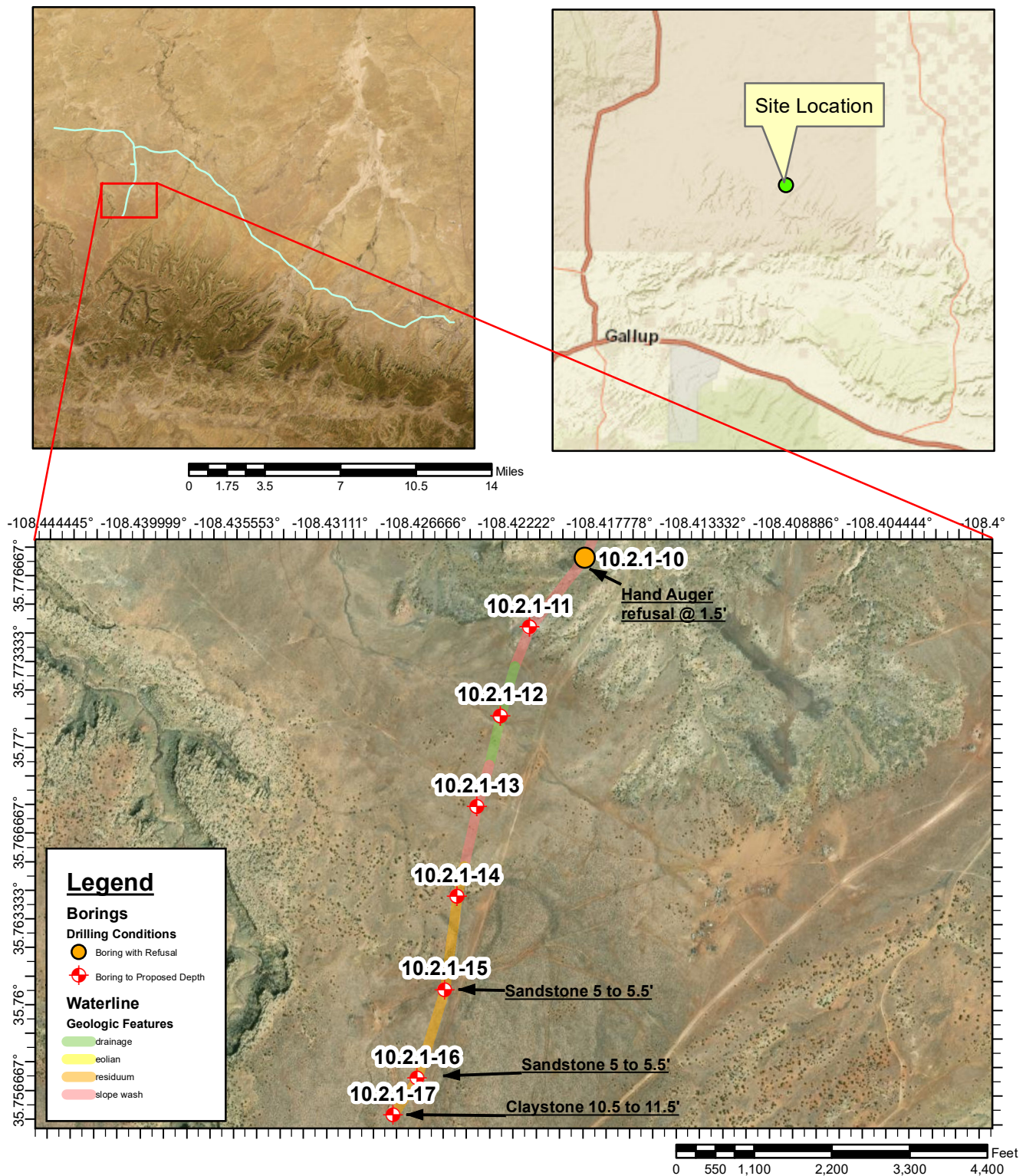
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 Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

BBN9 Water Supply District - Site Location Map



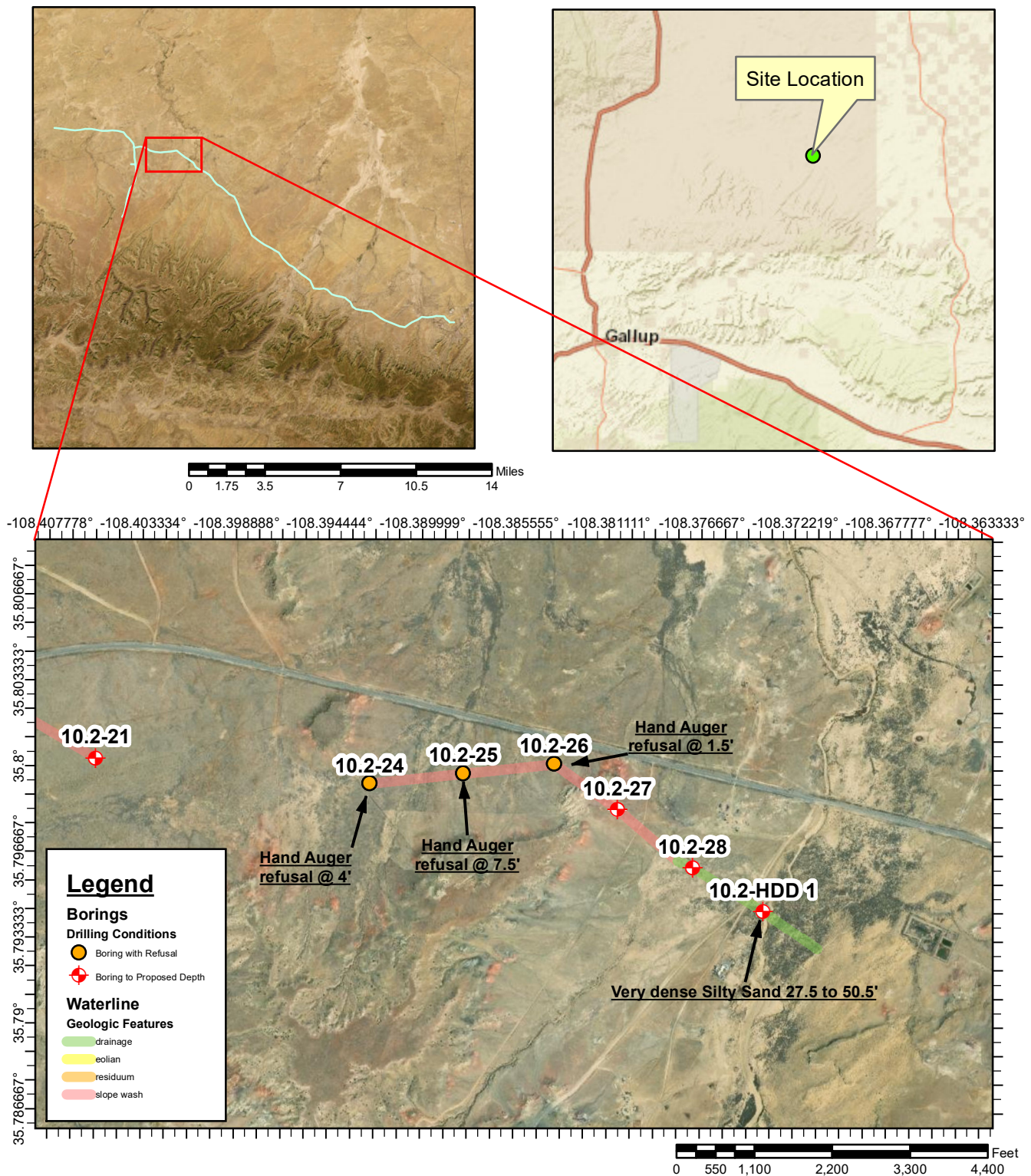
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BBN9 Water Supply District - Site Location Map



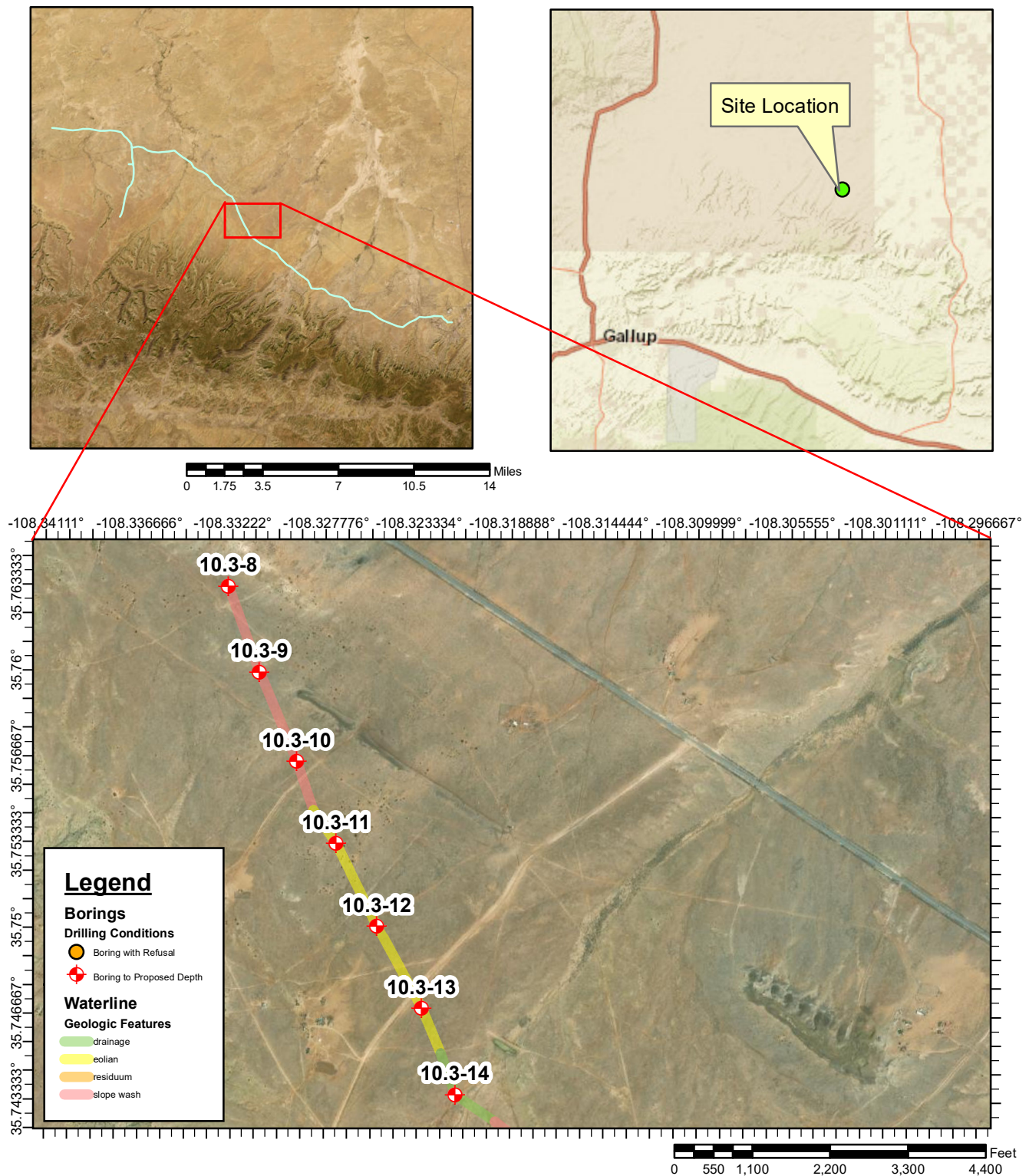
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BBN9 Water Supply District - Site Location Map



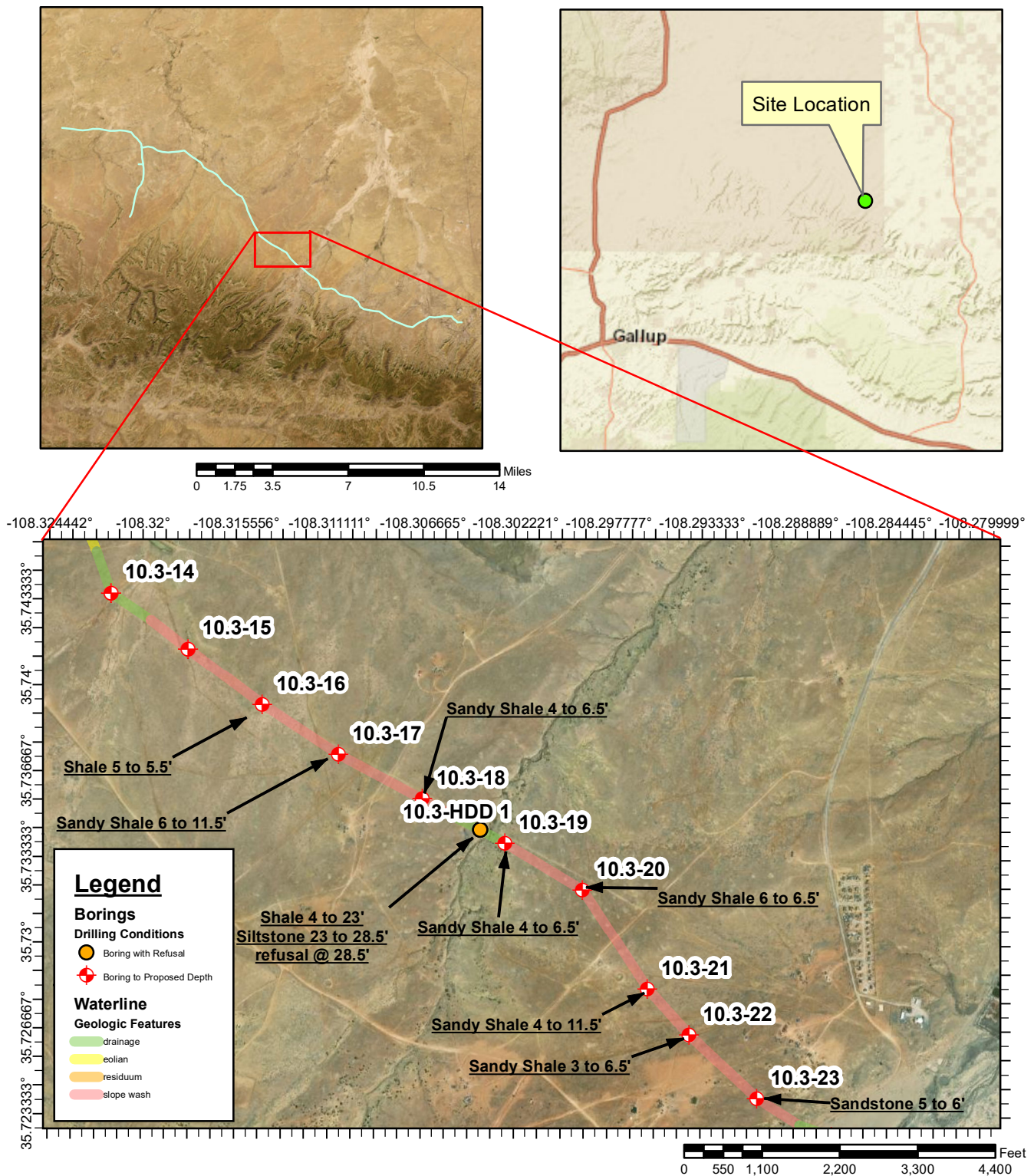
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BBN9 Water Supply District - Site Location Map



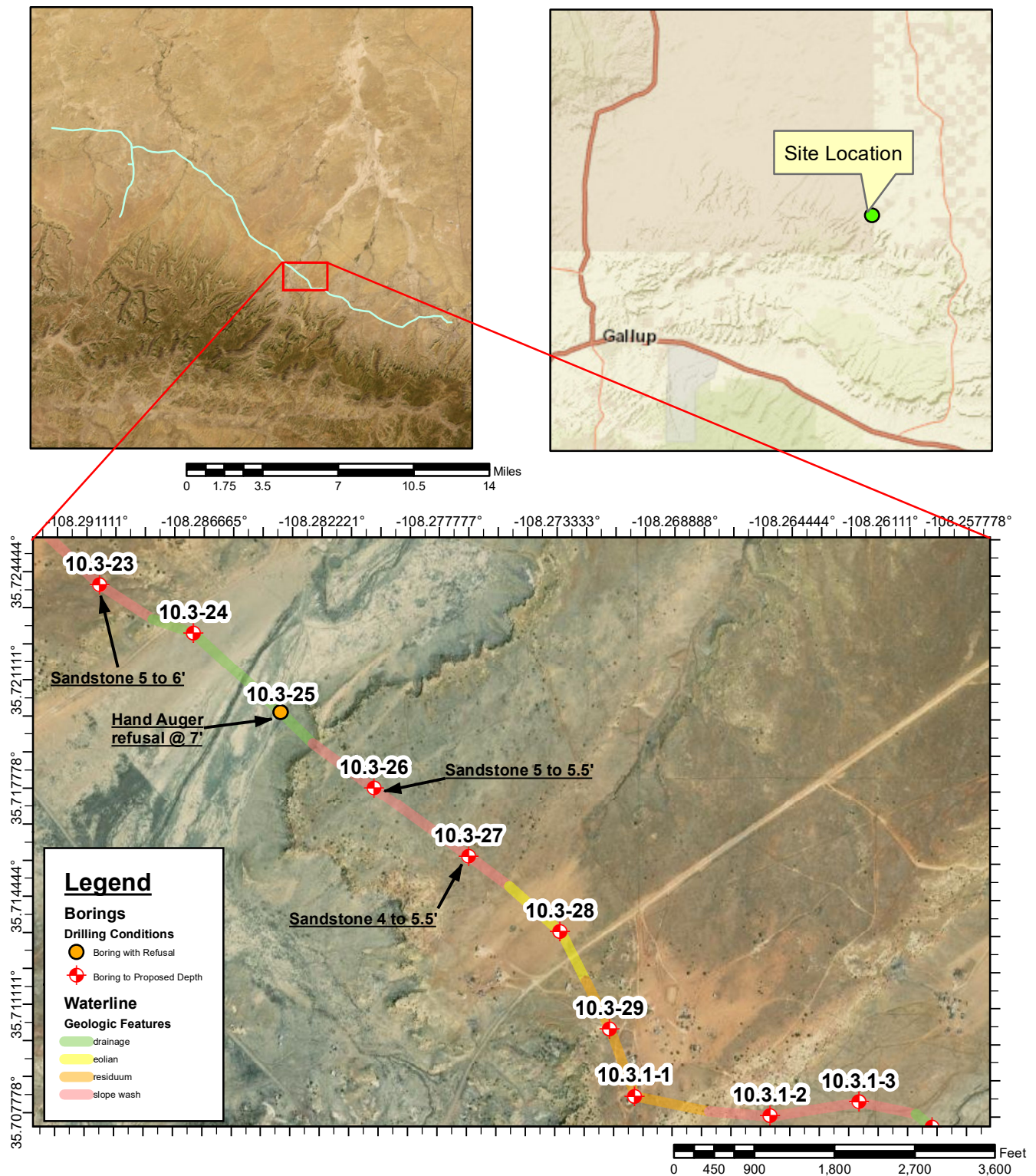
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BBN9 Water Supply District - Site Location Map



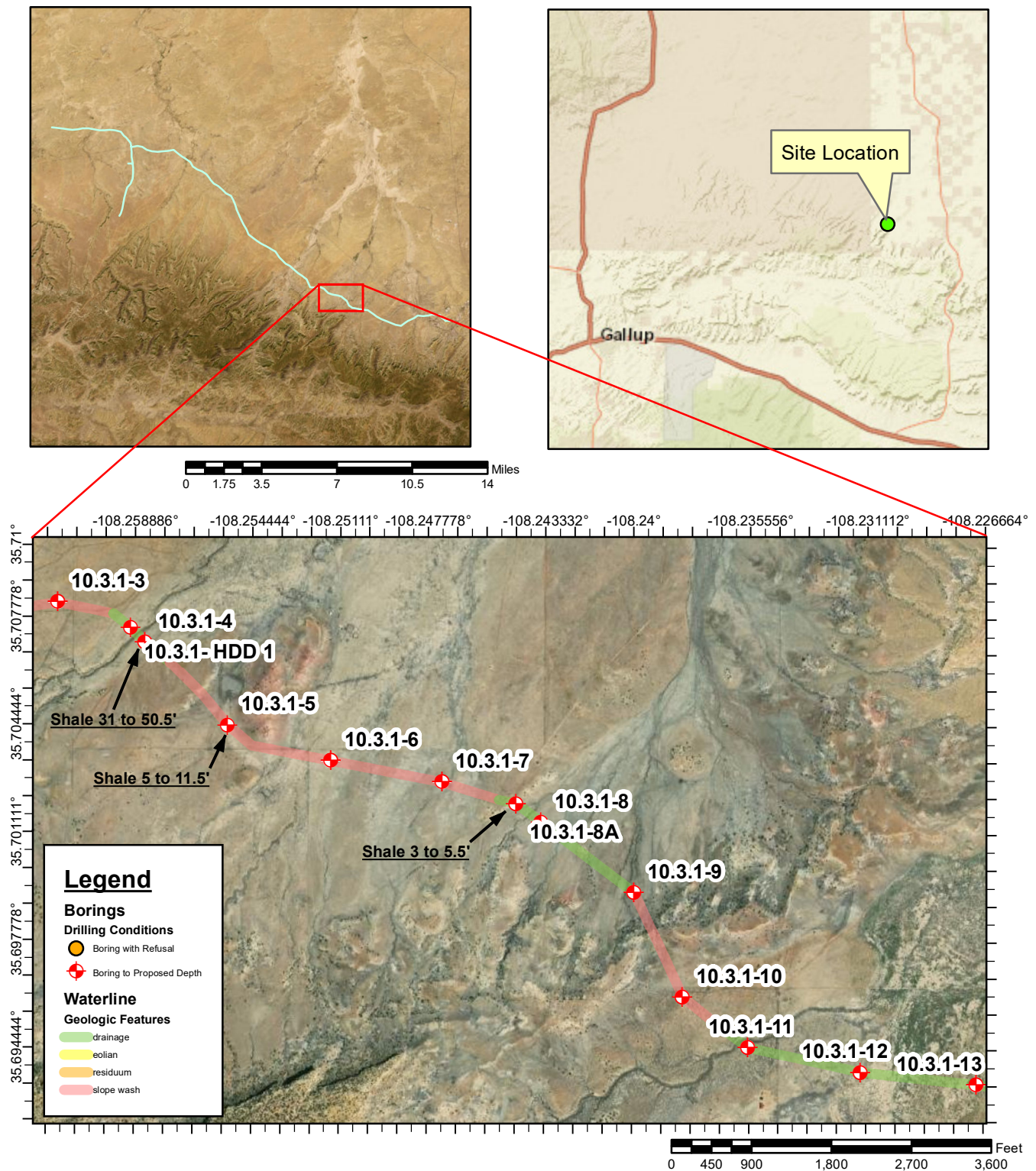
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BBN9 Water Supply District - Site Location Map



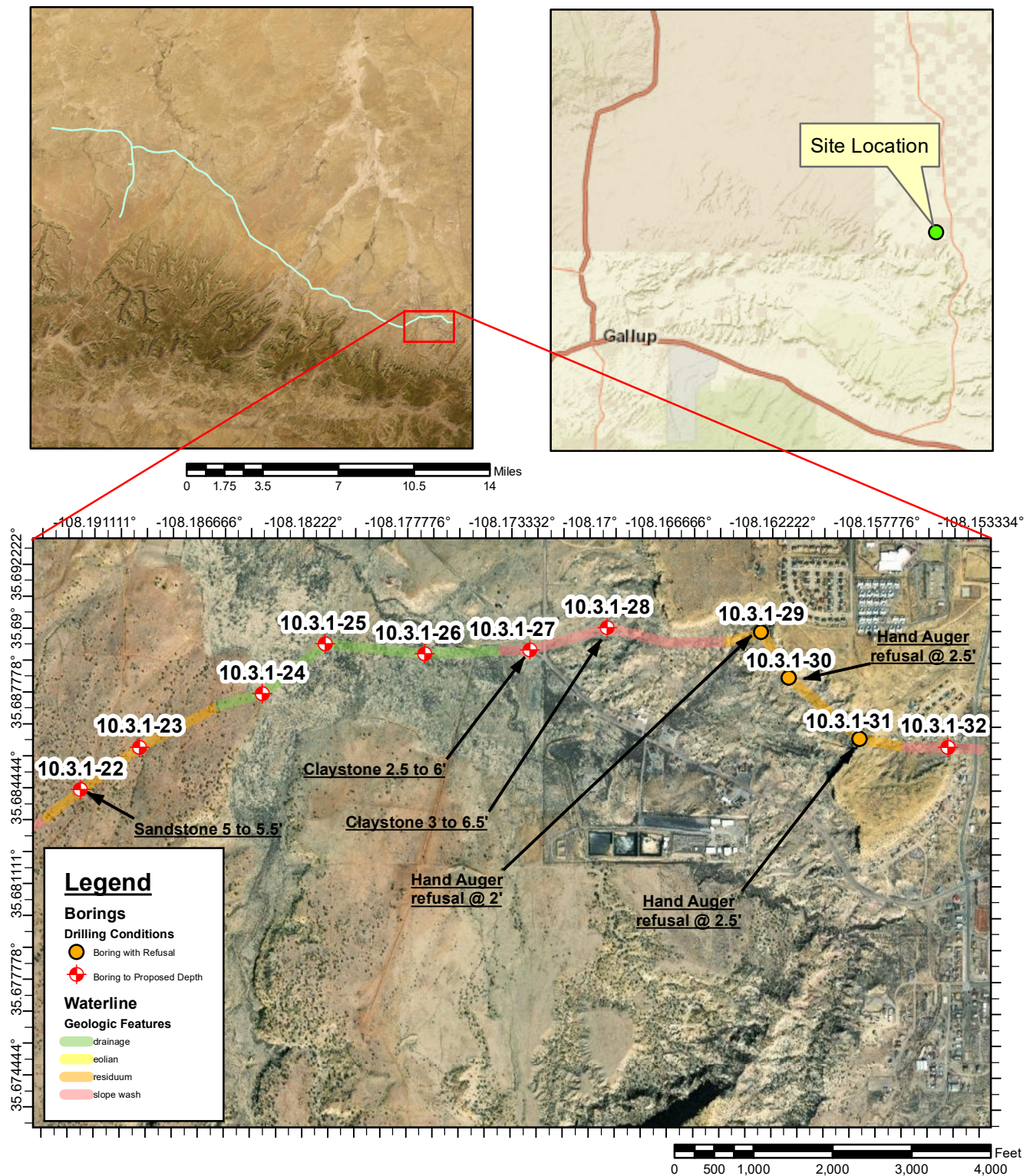
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BBN9 Water Supply District - Site Location Map



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TEST BORING 10.2-1

01 Page 1 of 1

Project: BBN9 Water Supply District
Location: Navajo Nation
 35.81486°, -108.48441°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% <200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6097.0								
6095	0	Medium dense to very dense, moist, brown to light brown, fine to medium grained SILTY CLAYEY SAND (SC-SM)		13						Located within Eolian Deposits
		with layers of sandstone throughout		72	0	64	34	5	△	SC-SM LL= 26 PL= 20 PI= 6
	5			50/5"						
6090				50/3"						
	10			50/5"						
	10.5	END OF BORING @ 10.5 FEET								

Remarks: Weather: Sunny, 43F, SW wind 5-10mph

Date Begun: 1/9/23
 Date Completed: 1/9/23
 Termination Depth (ft): 10.5
 Crew: DAP, CPP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft) dry
 ≡ End of Drilling(ft) dry

Depth to Cave In (Ft): 7.2

LOG OF TEST BORING OR TEST PIT: 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23



TEST BORING 10.2-3

03 Page 1 of 1

Project: BBN9 Water Supply District

Job No.: 23171-ZX

Location: Navajo Nation

Client: Souder, Miller & Associates

35.81402°, -108.47389°

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% <200	WATER CONTENT X PL — LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6121.0								
6120	0	Loose to medium dense, moist, brown to light brown, SAND		0 50 100					0 20 40 60	Located within Eolian Deposits
	5	END OF BORING @ 5.0 FEET								

Remarks:

Date Begun: 1/31/23
 Date Completed: 1/31/23
 Termination Depth (ft): 5.0
 Crew: DAP, CPP, ERH
 Rig: Hand Auger
 Method: Hand Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

Bag Sample

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft) dry
 ≡ End of Drilling(ft) dry

Depth to Cave In (Ft): 5

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23



TEST BORING 10.2-4

04 Page 1 of 1

Project: BBN9 Water Supply District

Job No.: 23171-ZX

Location: Navajo Nation

Client: Souder, Miller & Associates

35.81377°, -108.47148°

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% >200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6134.0								
6130	0	Loose to medium dense, moist, brown to light brown, SAND		0 50 100				0 20 40 60		Located within Eolian Deposits
	5	END OF BORING @ 5.0 FEET	B							

Remarks:

Date Begun: 1/31/23
 Date Completed: 1/31/23
 Termination Depth (ft): 5.0
 Crew: DAP, CPP, ERH
 Rig: Hand Auger
 Method: Hand Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

B Bag Sample

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft) dry
 ≡ End of Drilling(ft) dry

Depth to Cave In (Ft): 5



TEST BORING 10.2-5

05 Page 1 of 1

Project: BBN9 Water Supply District
Location: Navajo Nation
 35.81338°, -108.4671°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% >200	WATER CONTENT X PL — LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6154.0								
	0	Loose to medium dense, moist, brown to light brown, SAND		0 50 100					0 20 40 60	Located within Eolian Deposits
	5	Medium dense to very dense, moist, brown, SILTY SAND (SM) with sandstone throughout			0	67	33	X 5	△	SM LL= 20 PL= 18 PI= 3
	7.5	REFUSAL @ 7.5 FEET								

Remarks:

Date Begun: 1/31/23 Date Completed: 1/31/23 Termination Depth (ft): 7.5 Crew: DAP, CPP, ERH Rig: Hand Auger Method: Hand Auger Benchmark/Datum (Ft): Handheld GPS	SAMPLE TYPES Bag Sample	WATER LEVEL OBSERVATIONS ∇ While Drilling (ft) dry ∇ End of Drilling(ft) dry Depth to Cave In (Ft): 7.5

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10 GDT 3/28/23



TEST BORING 10.2-6

06 Page 1 of 1

Project: BBN9 Water Supply District
Location: Navajo Nation
 35.8139°, -108.46263°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% >200	WATER CONTENT X PL — LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6179.0								
	0	Loose to very dense, moist to dry, light brown, SAND		0 50 100 					0 20 40 60 	Located within Eolian Deposits
	2.0	REFUSAL @ 2.0 FEET								

Remarks:

Date Begun: 1/31/23 Date Completed: 1/31/23 Termination Depth (ft): 2.0 Crew: DAP, CPP, ERH Rig: Hand Auger Method: Hand Auger Benchmark/Datum (Ft): Handheld GPS	SAMPLE TYPES Bag Sample	WATER LEVEL OBSERVATIONS ≡ While Drilling (ft) dry ≡ End of Drilling(ft) dry Depth to Cave In (Ft): 2

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23



TEST BORING 10.2-7

07 Page 1 of 1

Project: BBN9 Water Supply District

Job No.: 23171-ZX

Location: Navajo Nation

Client: Souder, Miller & Associates

35.81438°, -108.45885°

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% >200	WATER CONTENT X PL — LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6158.0								
6155	0	Loose to very dense, moist to dry, light brown, SAND		0 50 100					0 20 40 60	Located within Eolian Deposits
	4.0	REFUSAL @ 4.0 FEET								

Remarks:

Date Begun: 1/31/23
 Date Completed: 1/31/23
 Termination Depth (ft): 4.0
 Crew: DAP, CPP, ERH
 Rig: Hand Auger
 Method: Hand Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

Bag Sample

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft) dry
 ≡ End of Drilling(ft) dry

Depth to Cave In (Ft): 4

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23



TEST BORING 10.2-8

08 Page 1 of 1

Project: BBN9 Water Supply District
Location: Navajo Nation
 35.81459°, -108.45387°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6125.0								
6125	0	Loose to medium dense, moist, brown, fine grained SILTY SAND (SM)		0 50 100					0 20 40 60	Located within Eolian Deposits
6120	5			10						
	6.5	END OF BORING @ 6.5 FEET								

Remarks: Weather: Sunny, 43F, SW wind 5-10mph

Date Begun: 1/9/23
 Date Completed: 1/9/23
 Termination Depth (ft): 6.5
 Crew: DAP, CPP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

☒ Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft)
 ▼ End of Drilling(ft)

Depth to Cave In (Ft):

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23



TEST BORING 10.2-9

09 Page 1 of 1

Project: BBN9 Water Supply District
Location: Navajo Nation
 35.81385°, -108.44964°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6154.0								
6150	0	Very loose, moist to dry, light brown, fine grained SILTY SAND (SM)		2						Located within Drainage Deposits
				9						
	5.0	Very stiff, moist, brown, CLAY		24	0	14	85		CH LL= 55 PL= 25 PI= 29	
	7.0	Loose to medium dense, moist, light brown, fine grained SAND		7						
6145				11						
	11.5	END OF BORING @ 11.5 FEET								

Remarks: Weather: Sunny, 45F, SW wind @ 10-15mph

Date Begun: 1/9/23
 Date Completed: 1/9/23
 Termination Depth (ft): 11.5
 Crew: DAP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES
☒ Split Spoon
☐ Drive Sampler, 2.41-I.D.

WATER LEVEL OBSERVATIONS
 ∇ While Drilling (ft) dry
 ▼ End of Drilling(ft) dry
 Depth to Cave In (Ft): 7.3

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23



TEST BORING 10.2-10

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.81329°, -108.4452°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% <200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6120.0								
6120	0	Loose, moist, brown, fine grained SAND		0 50 100					0 20 40 60	Located within Drainage Deposits
6115	5			15						
	6.5	END OF BORING @ 6.5 FEET								

Remarks: Weather: Sunny, 45F, SW wind @ 10-15mph

Date Begun: 1/9/23
 Date Completed: 1/9/23
 Termination Depth (ft): 6.5
 Crew: DAP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

☒ Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft)
 ▼ End of Drilling(ft)

Depth to Cave In (Ft):

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23



TEST BORING 10.2-11

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.81325°, -108.44077°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6148.0								
6145	0	Loose, moist, light brown, SAND		0 50 100					0 20 40 60	Located within Eolian Deposits
	4.5									
	5	Very dense, moist to dry, light brown, SANDSTONE		50/5"						
	5.5	END OF BORING @ 5.5 FEET								

Remarks: Weather: Sunny, 45F, SW wind @ 10-15mph

Date Begun: 1/9/23
 Date Completed: 1/9/23
 Termination Depth (ft): 5.5
 Crew: DAP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

☒ Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft)
 ▼ End of Drilling(ft)

Depth to Cave In (Ft):



TEST BORING 10.2-12

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.81343°, -108.43637°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT X PL — LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6162.0								
6160	0	Loose, moist, light brown, SAND		0 50 100					0 20 40 60	Located within Eolian Deposits
	5			6						
	6.5	END OF BORING @ 6.5 FEET								

Remarks: Weather: Sunny, 45F, SW wind @ 10-15mph

Date Begun: 1/9/23
 Date Completed: 1/9/23
 Termination Depth (ft): 6.5
 Crew: DAP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

☒ Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft)
 ▼ End of Drilling(ft)

Depth to Cave In (Ft):



TEST BORING 10.2-13

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.81326°, -108.43189°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% <200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6170.0								
6170	0	Medium dense to dense, moist, brown, fine grained SAND with some silt, trace of white precipitates		0 50 100					0 20 40 60	Located within Eolian Deposits
				10						
				11						
6165	5	Very dense, moist, brown to orange, fine to coarse grained SANDY SILT (ML), weathered, layers of sandstone throughout		37	0	40	59	△ X 8		ML LL= 0 PL= 0 PI= 0
				50/5"						
6160	10			50/4"						
		END OF BORING @ 11.5 FEET								

Remarks: Weather: Sunny, 41F, SW wind @ 10-15mph

Date Begun: 1/9/23
 Date Completed: 1/9/23
 Termination Depth (ft): 11.5
 Crew: DAP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft) dry
 ≡ End of Drilling(ft) dry

Depth to Cave In (Ft): 7.4

LOG OF TEST BORING OR TEST PIT: 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23



TEST BORING 10.2-14

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.81223°, -108.4273°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6225.0								
6225	0	Loose to medium dense, moist, brown, SAND		0 50 100					0 20 40 60	Located within Eolian Deposits
6220	5	END OF BORING @ 5.5 FEET								

Remarks:

Date Begun: 1/31/23
 Date Completed: 1/31/23
 Termination Depth (ft): 5.5
 Crew: DAP, CPP, ERH
 Rig: Hand Auger
 Method: Hand Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

Bag Sample

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft) dry
 ≡ End of Drilling(ft) dry

Depth to Cave In (Ft): 5

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10 GDT 3/28/23



TEST BORING 10.2-15

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.80967°, -108.42477°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6255.0								
6255	0	Medium dense to dense, moist, brown, fine grained SAND with sandstone layers throughout		0 50 100					0 20 40 60	Located within Eolian Deposits
6250	5			50/5"						
		END OF BORING @ 6.5 FEET								

Remarks:

Date Begun: 1/31/23
 Date Completed: 1/31/23
 Termination Depth (ft): 6.5
 Crew: DAP, CPP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

☒ Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft) dry
 ≡ End of Drilling(ft) dry

Depth to Cave In (Ft): 3.5

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23



TEST BORING 10.2-16

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.80824°, -108.42275°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% >200	WATER CONTENT X PL — LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6276.0								
6275	0	Loose to very dense, moist, brown, fine grained SAND		0 50 100				0 20 40 60		Located within Eolian Deposits
		with layers of sandstone throughout	4.0							
		REFUSAL @ 4.0 FEET								

Remarks:

Date Begun: 1/31/23
 Date Completed: 1/31/23
 Termination Depth (ft): 4.0
 Crew: DAP, CPP, ERH
 Rig: Hand Auger
 Method: Hand Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

☒ Bag Sample

WATER LEVEL OBSERVATIONS

☐ While Drilling (ft) dry
 ☒ End of Drilling(ft) dry

Depth to Cave In (Ft): 4



TEST BORING 10.2-17

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.80468°, -108.41893°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% <200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6246.0								
6245	0	Medium dense to dense, dry, light brown, fine grained SAND with some silt layered throughout		8						Located within Drainage Deposits
				14						
6240	5			30						
	7.5	Dense to medium dense, dry, orange to brown, fine to coarse grained SILTY SAND (SM)		32	9	56	28	X 5	△	
6235	10			25						SM LL= 19 PL= 17 PI= 2
	11.5	END OF BORING @ 11.5 FEET								

Remarks:
 Weather: Sunny, 41F, S wind @ 10-15mph

Date Begun: 1/10/23
 Date Completed: 1/10/23
 Termination Depth (ft): 11.5
 Crew: DAP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES
☒ Split Spoon
☐ Drive Sampler, 2.41-I.D.

WATER LEVEL OBSERVATIONS
 ∇ While Drilling (ft) dry
 ▼ End of Drilling(ft) dry
 Depth to Cave In (Ft): 7.0

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23



TEST BORING 10.2-18

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.80216°, -108.41775°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6253.0								
0	0	Very loose to medium dense, moist, light brown, SAND		0 50 100				0 20 40 60		Located within Drainage Deposits (same as 10.2.1-1)
6250										
5										
	6.5	END OF BORING @ 6.5 FEET		9						

Remarks:
 Weather: Sunny, 41F, S wind @ 10-15mph

Date Begun: 1/10/23
 Date Completed: 1/10/23
 Termination Depth (ft): 6.5
 Crew: DAP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

☒ Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft)
 ▼ End of Drilling(ft)

Depth to Cave In (Ft):



TEST BORING HWY Bore

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.80237°, -108.41881°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% <200	WATER CONTENT PL ——— X LL ———	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6255.0								
6255	0	Stiff to very stiff, dry to moist, light brown, SANDY SILT, with some white precipitates throughout		14					X 13	Located within Drainage Deposits
6250	5			23					X 12	
6245	10			22					X 5	
6240	15	Medium dense, light brown to gray, fine to coarse grained SILTY SAND (SM), with orange weathered stains throughout		12	0	73	27	X 5	X 5	
6235	20			15					X 3	SM LL= 0 PL= 0 PI= 0
6230	25			17					X 6	
6225										

Remarks:

Date Begun: 1/26/23
 Date Completed: 1/26/23
 Termination Depth (ft): 50.5
 Crew: DAP, CPP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

No Recovery

Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft) 42.5

≡ End of Drilling(ft) ---

Depth to Cave In (Ft): 45.6

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23

(Log Continued on Next Page)



TEST BORING HWY Bore

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.80237°, -108.41881°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% <200	WATER CONTENT PL X LL △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6255.0								
6225	30	Medium dense, light brown to gray, fine to coarse grained SILTY SAND (SM), with orange weathered stains throughout		24					7	
6220	35	36.0 Very dense, dry to wet, light gray to brown, fine grained CLAYEY SAND (SC)		20					18	
6215	40			50/3"	0	66	34		15	SC LL= 36 PL= 19 PI= 17
6210	45			50/5"					16	
6205	50	50.5 END OF BORING @ 50.5 FEET		50/5"					17	

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23



TEST BORING 10.2-19

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.80289°, -108.41339°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% >200	WATER CONTENT PL X LL △——△	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6279.0								
	0	Soft to stiff, moist, dark brown, SILT		0 50 100				0 20 40 60		Located within Slope Wash Deposits
	2.0									
	2.5	Very dense, moist, brown, SANDSTONE								
		REFUSAL @ 2.5 FEET								

Remarks:

Date Begun: 1/31/23
 Date Completed: 1/31/23
 Termination Depth (ft): 2.5
 Crew: DAP, CPP, ERH
 Rig: Hand Auger
 Method: Hand Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

Bag Sample

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft) dry
 ≡ End of Drilling(ft) dry

Depth to Cave In (Ft): 2.0

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23

Project: BBN9 Water Supply District

Job No.: 23171-ZX

Location: Navajo Nation

Client: Souder, Miller & Associates

35.80213°, -108.40931°

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT X PL LL Δ-----Δ	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6289.0								
	0-	Soft to firm, moist, brown to dark brown, SILT								Located within Slope Wash Deposits
		REFUSAL @ 3.5 FEET	B							

Remarks:

Date Begun:	1/31/23
Date Completed:	1/31/23
Termination Depth (ft):	3.5
Crew:	DAP, CPP, ERH
Rig:	Hand Auger
Method:	Hand Auger
Benchmark/Datum (Ft):	Handheld GPS

SAMPLE TYPES

B Bag Sample

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft)	dry
▼ End of Drilling(ft)	dry

Depth to Cave In (Ft): 3.5



TEST BORING 10.2-21

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.80031°, -108.40551°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT X PL — LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6333.0								
0	0	Medium dense, moist, brown, fine grained SILTY CLAYEY SAND (SC-SM)		0 50 100					0 20 40 60	Located within Slope Wash Deposits
6330										
5										
6325										
10	10.0	END OF BORING @ 10 FEET			1	64	35	7	X △	SC LL= 25 PL= 17 PI= 8

Remarks:

Date Begun: 1/31/23
 Date Completed: 1/31/23
 Termination Depth (ft): 10.0
 Crew: DAP, CPP, ERH
 Rig: Hand Auger
 Method: Hand Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

Bag Sample

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft) dry
 ≡ End of Drilling(ft) dry

Depth to Cave In (Ft): 10

LOG OF TEST BORING OR TEST PIT: 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23



TEST BORING 10.2-24

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.72258°, -108.28704°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% >200	WATER CONTENT X PL — LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6361.0								
6360	0	Medium dense to very dense, moist, brown, fine grained SILTY SAND (SM)		0 50 100					0 20 40 60	Located within Slope Wash Deposits
	4.0	REFUSAL @ 4.0 FEET								

Remarks:

Date Begun: 2/1/23
 Date Completed: 2/1/23
 Termination Depth (ft): 4.0
 Crew: DAP, CPP, ERH
 Rig: Hand Auger
 Method: Hand Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

Bag Sample

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft) dry
 ▼ End of Drilling(ft) dry

Depth to Cave In (Ft): 3.5



TEST BORING 10.2-25

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.79978°, -108.38797°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% <200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6350.0								
6350	0	Medium dense, moist, brown, fine grained SILTY SAND (SM)		0 50 100					0 20 40 60	Located within Slope Wash Deposits
						0	70	30	△ X 5	SM LL= 0 PL= 0 PI= 0
6345	5									
	6.5									
		Dense to very dense, moist, brown, SAND, with layers of sandstone throughout								
	7.5	REFUSAL @ 7.5 FEET								

Remarks:

Date Begun: 2/1/23
 Date Completed: 2/1/23
 Termination Depth (ft): 7.5
 Crew: DAP, CPP, ERH
 Rig: Hand Auger
 Method: Hand Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

Bag Sample

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft) dry
 ≡ End of Drilling(ft) dry

Depth to Cave In (Ft): 7.0

LOG OF TEST BORING OR TEST PIT: 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23



TEST BORING 10.2-26

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.80017°, -108.38364°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% >200	WATER CONTENT PL X LL △——△	OTHER TESTS AND NOTES
6360	0-	Surface Elevation (Ft): 6360.0		0 50 100					0 20 40 60	
	1.0	Loose to medium dense, moist, brown, fine grained SILTY SAND (SM)								Located within Slope Wash Deposits
	1.5	Very dense, moist, brown, SANDSTONE REFUSAL @ 1.5 FEET								

Remarks:

Date Begun: 1/31/23
 Date Completed: 1/31/23
 Termination Depth (ft): 1.5
 Crew: DAP, CPP, ERH
 Rig: Hand Auger
 Method: Hand Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

Bag Sample

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft) dry
 ≡ End of Drilling(ft) dry

Depth to Cave In (Ft): 1.0



TEST BORING 10.2-27

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.79841°, -108.38061°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT X PL — LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6368.0								
6365	0	Loose to very dense, moist, brown, fine grained SILTY SAND (SM) with sandstone throughout		0 50 100				0 20 40 60		Located within Slope Wash Deposits
	5	END OF BORING @ 5.0 FEET	5.0 [B]							

Remarks:

Date Begun: 1/31/23
 Date Completed: 1/31/23
 Termination Depth (ft): 5.0
 Crew: DAP, CPP, ERH
 Rig: Hand Auger
 Method: Hand Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

[B] Bag Sample

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft) dry
 ≡ End of Drilling(ft) dry

Depth to Cave In (Ft): 5

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10 GDT 3/28/23



TEST BORING 10.2-28

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.79618°, -108.377°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT X PL — LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6345.0								
6345	0	Loose, moist, brown, fine grained SAND		0 50 100					0 20 40 60	Located within Drainage Deposits
6340	5			44						
	6.5	END OF BORING @ 6.5 FEET								

Remarks: Weather: Sunny, 31F, SW Wind @ 10-15mph

Date Begun: 1/11/23
 Date Completed: 1/11/23
 Termination Depth (ft): 6.5
 Crew: DAP, CPP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

☒ Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft)
 ▼ End of Drilling(ft)

Depth to Cave In (Ft):



TEST BORING 10.2-HDD1

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.79449°, -108.37366°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% <200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6333.0								
6330	0	Medium dense, moist, brown to light brown, fine grained SILTY SAND (SM) with white precipitates		28					16	Located within Drainage Deposits
6325	5			23					9	
6320	10			17	0	0	32	5	5	SM LL= 0 PL= 0 PI= 0
6315	15			17					5	
6310	20	becomes dark brown to orange, weathered silty sand, with some fine gravel		14	4	64	32	14	14	SM LL= 0 PL= 0 PI= 0
6305	25	with 2.0' layer of coarse grained sand and gravel		9					19	low sample in D&M ring
		becomes very dense, moist, light brown to gray, fine grained silty sand, with some layers of shale								

Remarks: Weather: Sunny, 31F, SW Wind @ 10-15mph

Date Begun: 1/11/23
 Date Completed: 1/11/23
 Termination Depth (ft): 50.5
 Crew: DAP, CPP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES
 Split Spoon
 Drive Sampler, 2.41-I.D.
 No Recovery

WATER LEVEL OBSERVATIONS
 While Drilling (ft) 29.4
 End of Drilling(ft) ---
 Depth to Cave In (Ft): 34

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23



TEST BORING 10.2-HDD1

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.79449°, -108.37366°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6333.0								
6300	30	and coal throughout Medium dense, moist, brown to light brown, fine grained SILTY SAND (SM) with white precipitates		0 50 100 50/5"	0	69	27	0 20 40 60 19		
6295	35			50/1"				18		
6290	40			50/4"				16		
6285	45			50/5"				12		
	50	50.5 END OF BORING @ 50.5 FEET		50/3"				17		

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10 GDT 3/28/23



TEST BORING 10.2.1-1

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.80216°, -108.41775°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6253.0								
0	0	Very loose to medium dense, moist, light brown, SAND		0 50 100					0 20 40 60	Located within Drainage Deposits (same as 10.2-18)
6250										
5										
	6.5	END OF BORING @ 6.5 FEET		9						

Remarks:
 Weather: Sunny, 41F, S wind @ 10-15mph

Date Begun: 1/10/23
 Date Completed: 1/10/23
 Termination Depth (ft): 6.5
 Crew: DAP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

☒ Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft)
 ▼ End of Drilling(ft)

Depth to Cave In (Ft):



TEST BORING 10.2.1-2

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.79887°, -108.41826°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% <200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6270.0								
6270	0	Very loose to medium dense, moist, light brown, SAND		0 50 100					0 20 40 60	Located within Drainage Deposits
6265	5			23						
		END OF BORING @ 6.5 FEET	6.5							

Remarks:
 Weather: Sunny, 41F, S wind @ 10-15mph

Date Begun: 1/10/23
 Date Completed: 1/10/23
 Termination Depth (ft): 6.5
 Crew: DAP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

☒ Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft)
 ▼ End of Drilling(ft)

Depth to Cave In (Ft):



TEST BORING 10.2.1-3

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.7952°, -108.41803°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT X PL — LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6297.0								
6295	0	Loose, moist, brown, fine grained SAND		0 50 100				0 20 40 60		Located within Drainage Deposits
	5			19						
	6.5	END OF BORING @ 6.5 FEET								

Remarks:
 Weather: Sunny, 43F, S wind @ 10-15mph

Date Begun: 1/10/23
 Date Completed: 1/10/23
 Termination Depth (ft): 6.5
 Crew: DAP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

☒ Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft)
 ▼ End of Drilling(ft)

Depth to Cave In (Ft):

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23



TEST BORING 10.2.1-4

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.79172°, -108.41745°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6314.0								
6310	0	Medium dense to very dense, moist, brown, fine grained SILTY SAND (SM)		14						Located within Slope Wash Deposits
				44		0	56	43	9	SM LL= 0 PL= 0 PI= 0
	5.0	Very dense, moist to dry, light brown, SAND with layers of weathered sandstone throughout		60						broken sample in D&M ring
		grades to brown to orange color		50/5"						
6305				54						
	11.5	END OF BORING @ 11.5 FEET								

Remarks:
 Weather: Sunny, 43F, S wind @ 10-15mph

Date Begun: 1/10/23
 Date Completed: 1/10/23
 Termination Depth (ft): 11.5
 Crew: DAP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES
 Split Spoon
 Drive Sampler, 2.41-I.D.

WATER LEVEL OBSERVATIONS
 While Drilling (ft) dry
 End of Drilling(ft) dry
 Depth to Cave In (Ft): 7.2

LOG OF TEST BORING OR TEST PIT: 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23



TEST BORING 10.2.1-5

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.7909°, -108.4211°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% <200	WATER CONTENT X PL — LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6368.0								
0	0	Loose, moist, brown, fine grained SILTY SAND		0 50 100				0 20 40 60		Located within Slope Wash Deposits
	1.0	Hard, moist, brown, SANDY SHALES, weathered yellow stains throughout, with some coal								
6365	5									
	6.5	END OF BORING @ 6.5 FEET		41						

Remarks:
 Weather: Sunny, 43F, S wind @ 10-15mph

Date Begun: 1/10/23
 Date Completed: 1/10/23
 Termination Depth (ft): 6.5
 Crew: DAP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

☒ Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft)
 ▼ End of Drilling(ft)

Depth to Cave In (Ft):

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10 GDT 3/28/23



TEST BORING 10.2.1-6

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.79091°, -108.41732°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6319.0								
6315	0	Loose, moist, brown, fine to coarse grained SAND		0 50 100				0 20 40 60		Located within Drainage Deposits
	5			26						
	6.5	END OF BORING @ 6.5 FEET								

Remarks:
 Weather: Sunny, 43F, S wind @ 10-15mph

Date Begun: 1/10/23
 Date Completed: 1/10/23
 Termination Depth (ft): 6.5
 Crew: DAP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

☒ Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft)
 ▼ End of Drilling(ft)

Depth to Cave In (Ft):

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23



TEST BORING 10.2.1-7

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.78826°, -108.41681°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6343.0								
6340	0	Loose, moist, brown, fine grained SAND		0 50 100				0 20 40 60		Located within Drainage Deposits
	5			12						
	6.5	END OF BORING @ 6.5 FEET								

Remarks:
 Weather: Sunny, 43F, S wind @ 10-15mph

Date Begun: 1/10/23
 Date Completed: 1/10/23
 Termination Depth (ft): 6.5
 Crew: DAP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

☒ Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft)
 ▼ End of Drilling(ft)

Depth to Cave In (Ft):



TEST BORING 10.2.1-8

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.78432°, -108.41698°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6382.0								
6380	0	Loose, moist, light brown, fine grained SAND		6						Located within Slope Wash Deposits
	2.5	Very dense, dry, light brown to dark brown, fine to coarse grained SANDSTONE		50/1"						
	4.0	Very dense, dry to moist, light brown, fine grained CLAYEY SAND		50/4"						
6375	5			50/4"						SC LL= 47 PL= 22 PI= 25
		becomes weathered with orange staining throughout		50/3"	0	55	45	10	△ — △	
	10			50/3"						
	11.0	END OF BORING @ 11 FEET								

Remarks:
 Weather: Sunny, 45F, S wind @ 10-15mph

Date Begun: 1/10/23
 Date Completed: 1/10/23
 Termination Depth (ft): 11.0
 Crew: DAP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft) dry
 ≡ End of Drilling(ft) dry

Depth to Cave In (Ft): 7.1

LOG OF TEST BORING OR TEST PIT: 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23



TEST BORING 10.2.1-9

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.78072°, -108.4174°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% >200	WATER CONTENT PL X LL △——△	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6384.0								
	0	Loose to medium dense, moist, brown, fine grained SAND with sandstone layers throughout		0 50 100				0 20 40 60		Located within Slope Wash Deposits
	2.5	Very dense, dry, light brown, SANDSTONE	B							
	3.0	REFUSAL @ 3.0 FEET								

Remarks:

Date Begun: 1/31/23
 Date Completed: 1/31/23
 Termination Depth (ft): 3.0
 Crew: DAP, CPP, ERH
 Rig: Hand Auger
 Method: Hand Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

B Bag Sample

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft) dry
 ≡ End of Drilling(ft) dry

Depth to Cave In (Ft): 2.5

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23



TEST BORING 10.2.1-10

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.77749°, -108.41896°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% >200	WATER CONTENT PL X LL △——△	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6455.0								
6455	0-	Loose, dry to moist, light brown, fine grained SAND 1.0		0 50 100					0 20 40 60	Located within Slope Wash Deposits
	1.5	Very dense, dry, light brown, SANDSTONE REFUSAL @ 1.5 FEET								

Remarks:

Date Begun: 1/31/23
 Date Completed: 1/31/23
 Termination Depth (ft): 1.5
 Crew: DAP, CPP, ERH
 Rig: Hand Auger
 Method: Hand Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

Bag Sample

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft) dry
 ≡ End of Drilling(ft) dry

Depth to Cave In (Ft): 1.0

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23



TEST BORING 10.2.1-11

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.77478°, -108.42157°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT X PL — LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6498.0								
6495	0	Very loose to very dense, moist, brown to gray, fine grained SAND with layers of sandstone throughout		0 50 100				0 20 40 60		Located within Slope Wash Deposits
	5									
	6.0	END OF BORING @ 6.0 FEET		50/5						

Remarks:
 Weather: Sunny, 45F, S wind @ 10-15mph

Date Begun: 1/10/23
 Date Completed: 1/10/23
 Termination Depth (ft): 6.0
 Crew: DAP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

☒ Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft)
 ▼ End of Drilling(ft)

Depth to Cave In (Ft):

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23



TEST BORING 10.2.1-12

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.77135°, -108.42291°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6511.0								
6510	0	Medium dense to very dense, moist, brown to light brown, fine to medium grained CLAYEY SAND (SC)		20						Located within Drainage Deposits
	4.0			72	0	57	43		10	SC LL= 42 PL= 21 PI= 22
	5	Very dense, moist, light brown, fine to medium grained SAND with sandstone layers throughout								
6505				50/5						
				50/5						
	10									
6500	11.0	END OF BORING @ 11 FEET		50/4						

Remarks:
 Weather: Sunny, 29F, SW wind @ 15-20mph

Date Begun: 1/11/23
 Date Completed: 1/11/23
 Termination Depth (ft): 11.0
 Crew: DAP, CPP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft) dry
 ≡ End of Drilling(ft) dry

Depth to Cave In (Ft): 7.6

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23



TEST BORING 10.2.1-13

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.7678°, -108.424°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6557.0								
6555	0	Loose, moist, brown, fine grained CLAYEY SAND (SC), weathered staining		0 50 100					0 20 40 60	Located within Slope Wash Deposits
	5			15						
	6.5	END OF BORING @ 6.5 FEET								

Remarks:
 Weather: Sunny, 29F, SW wind @ 15-20mph

Date Begun: 1/11/23
 Date Completed: 1/11/23
 Termination Depth (ft): 6.5
 Crew: DAP, CPP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

☒ Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft)
 ▼ End of Drilling(ft)

Depth to Cave In (Ft):

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23



TEST BORING 10.2.1-14

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.76432°, -108.42494°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% <200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6555.0								
6555	0	Loose, moist, brown to orange, fine grained CLAYEY SAND (SC), weathered		0 50 100					0 20 40 60	Located within Residuum
6550	5			23						
		END OF BORING @ 6.5 FEET								

Remarks:
 Weather: Sunny, 29F, SW wind @ 15-20mph

Date Begun: 1/11/23
 Date Completed: 1/11/23
 Termination Depth (ft): 6.5
 Crew: DAP, CPP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

☒ Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft)
 ▼ End of Drilling(ft)

Depth to Cave In (Ft):

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10 GDT 3/28/23



TEST BORING 10.2.1-15

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.76069°, -108.42551°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6594.0								
6590	0	Loose, moist, brown, fine grained SILTY SAND (SC)		0 50 100				0 20 40 60		Located within Residuum
	5	Very dense, moist to dry, brown, SANDSTONE END OF BORING @ 5.5 FEET	5.0 5.5	50/5						

Remarks:
 Weather: Sunny, 29F, SW wind @ 15-20mph

Date Begun: 1/11/23
 Date Completed: 1/11/23
 Termination Depth (ft): 5.5
 Crew: DAP, CPP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

☒ Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft)
 ▼ End of Drilling(ft)

Depth to Cave In (Ft):

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10 GDT 3/28/23



TEST BORING 10.2.1-16

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Project: BBN9 Water Supply District

Job No.: 23171-ZX

Location: Navajo Nation

Client: Souder, Miller & Associates

35.75722°, -108.42678°

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6632.0								
6630	0	Loose, moist, brown, fine grained CLAYEY SAND (SC)		0 50 100				0 20 40 60		Located within Residuum
	5	Very dense, moist to dry, brown, SANDSTONE END OF BORING @ 5.5 FEET	5.0 5.5	50/5						

Remarks:

Weather: Sunny, 29F, SW wind @ 15-20mph

Date Begun: 1/11/23
 Date Completed: 1/11/23
 Termination Depth (ft): 5.5
 Crew: DAP, CPP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft)
 ▼ End of Drilling(ft)

Depth to Cave In (Ft):

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10 GDT 3/28/23



TEST BORING 10.2.1-17

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.75581°, -108.42793°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6654.0								
	0	Loose, moist, reddish brown, fine grained SILTY SAND (SM)		8		0	80	20	△ X	Located within Residuum SM LL= 0 PL= 0 PI= 0
	2.0									
		Very dense, dry to moist, light brown, fine to coarse grained SAND, with layers of sandstone throughout		50/5"						broken sample in D&M ring;
6650										
	5			50/4"						
				50/3"						
6645										
	10									
		Very hard, moist to dry, dark brown, CLAYSTONE, weathered, fissured structure		50/5"						
	10.5									
	11.5	END OF BORING @ 11.5 FEET								

Remarks: Weather: Sunny, 38F, SW wind @ 15-20mph

Date Begun: 1/11/23
 Date Completed: 1/11/23
 Termination Depth (ft): 11.5
 Crew: DAP, CPP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES
 Split Spoon
 Drive Sampler, 2.41-I.D.

WATER LEVEL OBSERVATIONS
 ∇ While Drilling (ft) dry
 ∇ End of Drilling(ft) dry
 Depth to Cave In (Ft): 8.0



TEST BORING 10.3-8

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.76329°, -108.33239°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% <200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6606.0								
6605	0	Loose, moist, brown, fine grained CLAYEY SAND (SC)		0 50 100				0 20 40 60		Located within Slope Wash Deposits
6600	5			28						
	6.5	END OF BORING @ 6.5 FEET								

Remarks: Weather: Sunny, 31F, SW Wind @ 10-15mph

Date Begun: 1/11/23 Date Completed: 1/11/23 Termination Depth (ft): 6.5 Crew: DAP, CPP, ERH Rig: Hand Auger Method: Hand Auger Benchmark/Datum (Ft): Handheld GPS	SAMPLE TYPES ☒ Split Spoon	WATER LEVEL OBSERVATIONS ≡ While Drilling (ft) ▼ End of Drilling(ft) Depth to Cave In (Ft):

LOG OF TEST BORING OR TEST PIT: 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23



TEST BORING 10.3-9

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.75996°, -108.33089°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% >200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6646.0								
6645	0	Very dense, dry, light brown to tan, fine grained CLAYEY SAND (SC), with white precipitates throughout		50/5"						Located within Slope Wash Deposits
				50/2"						
6640	5	becomes gray to light brown		50/3"	0	53	45		10	SC LL= 58 PL= 23 PI= 35
				50/4"						
	10	END OF BORING @ 10.5 FEET		50/5"						

Remarks:
 Weather: Sunny, 40F, N wind @ 0-5mph

Date Begun: 1/12/23
 Date Completed: 1/12/23
 Termination Depth (ft): 10.5
 Crew: DAP, CPP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft) dry
 ≡ End of Drilling(ft) dry

Depth to Cave In (Ft): 6.0

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23



TEST BORING 10.3-10

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.75651°, -108.3291°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6670.0								
6670	0	Loose to very dense, moist, light brown to gray, fine grained SAND		0 50 100					0 20 40 60	Located within Slope Wash Deposits
6665	5	END OF BORING @ 5.5 FEET		50/2"						

Remarks: Weather: Sunny, 40F, N wind @ 0-5mph

Date Begun: 1/12/23
 Date Completed: 1/12/23
 Termination Depth (ft): 5.5
 Crew: DAP, CPP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

☒ Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft)
 ▼ End of Drilling(ft)

Depth to Cave In (Ft):



TEST BORING 10.3-11

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.75333°, -108.3272°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6709.0								
	0	Loose, moist, brown to light brown, fine grained SAND		0 50 100				0 20 40 60		Located within Eolian Deposits
	3.5	Medium dense, moist, brown, fine grained CLAYEY SAND (SC)								
6705										
	5			43						
	6.5	END OF BORING @ 6.5 FEET								

Remarks: Weather: Sunny, 40F, N wind @ 0-5mph

Date Begun: 1/12/23
 Date Completed: 1/12/23
 Termination Depth (ft): 6.5
 Crew: DAP, CPP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

☒ Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft)
 ▼ End of Drilling(ft)

Depth to Cave In (Ft):

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23



TEST BORING 10.3-12

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.75011°, -108.32524°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6748.0								
6745	0	Loose to very dense, moist, light brown to gray, fine grained SAND		0 50 100				0 20 40 60		Located within Eolian Deposits
	5	END OF BORING @ 5.5 FEET	5.5	50/4"						

Remarks: Weather: Sunny, 40F, N wind @ 0-5mph

Date Begun: 1/12/23
 Date Completed: 1/12/23
 Termination Depth (ft): 5.5
 Crew: DAP, CPP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

☒ Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft)
 ▼ End of Drilling(ft)

Depth to Cave In (Ft):



TEST BORING 10.3-13

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.74694°, -108.3231°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6761.0								
6760	0	Loose to medium dense, moist, brown to light brown, fine grained SILTY SAND (SM)		0 50 100					0 20 40 60	Located within Eolian Deposits
	5			5						
	9			9		0	77	23	△ X 5	SM LL= 0 PL= 0 PI= 0
6755	13			13						
	7.5	Very dense, moist, light brown, fine to coarse grained SAND & GRAVEL		54						loose sample in D&M rings;
	10									
6750	11.5	END OF BORING @ 11.5 FEET		57						

Remarks:
 Weather: Sunny, 40F, NE wind @ 0-5mph

Date Begun: 1/13/23
 Date Completed: 1/13/23
 Termination Depth (ft): 11.5
 Crew: DAP, CPP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES
 Split Spoon
 Drive Sampler, 2.41-I.D.

WATER LEVEL OBSERVATIONS
 ∇ While Drilling (ft) dry
 ▼ End of Drilling(ft) dry
 Depth to Cave In (Ft): 7.0

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23



TEST BORING 10.3-14

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.74359°, -108.32148°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6756.0								
6755	0	Loose, moist, brown, fine grained SILTY SAND (SM)		0 50 100				0 20 40 60		Located within Drainage Deposits
6750	5			15						
	6.5	END OF BORING @ 6.5 FEET								

Remarks:
 Weather: Sunny, 40F, NE wind @ 0-5mph

Date Begun: 1/13/23
 Date Completed: 1/13/23
 Termination Depth (ft): 6.5
 Crew: DAP, CPP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

☒ Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft)
 ▼ End of Drilling(ft)

Depth to Cave In (Ft):

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23



TEST BORING 10.3-15

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.74143°, -108.31781°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6778.0								
0	0	Loose, moist, brown, fine grained SILTY SAND (SM)		0 50 100				0 20 40 60		Located within Slope Wash Deposits
6775										
5				52						
	6.5	END OF BORING @ 6.5 FEET								

Remarks: Weather: Sunny, 40F, NE wind @ 0-5mph		
Date Begun: 1/13/23 Date Completed: 1/13/23 Termination Depth (ft): 6.5 Crew: DAP, CPP, ERH Rig: Mobile B-57 Method: 3 1/4 Hollow Stem Auger Benchmark/Datum (Ft): Handheld GPS	SAMPLE TYPES ☒ Split Spoon	WATER LEVEL OBSERVATIONS ☐ While Drilling (ft) ☐ End of Drilling(ft) Depth to Cave In (Ft):

LOG OF TEST BORING OR TEST PIT: 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10 GDT 3/28/23



TEST BORING 10.3-16

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.73927°, -108.31424°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6804.0								
6800	0	Stiff, moist, brown, SANDY SILT (ML)		0 50 100				0 20 40 60		Located within Slope Wash Deposits
	5	Very dense, moist to dry, brown, SHALE	5.0							
	6.0	END OF BORING @ 6.0 FEET	6.0	50/2"						

Remarks: Weather: Sunny, 40F, NE wind @ 0-5mph

Date Begun: 1/13/23
 Date Completed: 1/13/23
 Termination Depth (ft): 6.0
 Crew: DAP, CPP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

☒ Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft)
 ▼ End of Drilling(ft)

Depth to Cave In (Ft):

LOG OF TEST BORING OR TEST PIT: 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10 GDT 3/28/23



TEST BORING 10.3-17

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.73735°, -108.31063°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% <200	WATER CONTENT X PL — LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6819.0								
6815	0	Very stiff to very hard, dry, brown to light brown, SANDY SILT (ML), with layers of red silt throughout		21						Located within Slope Wash Deposits
				39						
	5			45						CL LL= 28 PL= 20 PI= 9
6810		Hard, moist, light brown to dark brown, weathered SANDY SHALE, with layers of sandstone & white precipitates throughout		36	0	28	71		X 11 △ △	
	10			49						
	11.5	END OF BORING @ 11.5 FEET								

Remarks: Weather: Sunny, 46F, NW wind 0-5mph

Date Begun: 1/13/23
 Date Completed: 1/13/23
 Termination Depth (ft): 11.5
 Crew: DAP, CPP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft) dry
 ≡ End of Drilling(ft) dry

Depth to Cave In (Ft): 7.7

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23



TEST BORING 10.3-18

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.73563°, -108.3066°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT X PL — LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6812.0								
6810	0	Loose, moist, brown, fine grained SILTY SAND (SM)		0 50 100					0 20 40 60	Located within Slope Wash Deposits
	4.0									
	5	Very hard, moist, brown to dark brown, SANDY SHALE with layers of medium grained sand throughout		93						
	6.5	END OF BORING @ 6.5 FEET								

Remarks:
 Weather: Sunny, 50F, NW wind 0-5mph

Date Begun: 1/13/23
 Date Completed: 1/13/23
 Termination Depth (ft): 6.5
 Crew: DAP, CPP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

☒ Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft)
 ▼ End of Drilling(ft)

Depth to Cave In (Ft):

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10 GDT 3/28/23



TEST BORING 10.3-HDD1

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.73443°, -108.30383°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL Δ	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6778.0								
6775	0	Loose, moist, brown, fine grained, SILTY SAND (SM)		6					X 6	Located within Drainage Deposits
	4.0									
6770	5	Very hard, moist, dark gray to brown, SANDY SHALE		52	6	42	50		X 13	
6765	10			62					X 17	LL= 27 PL= 20 PI= 7
6760	15	becomes gray, orange and brown color with layers of medium to coarse grained sand throughout		70					X 13 Δ	
6755	20			44						good D&M sample
6750	23.0	Very dense, moist to dry, fine grained SILTSTONE		50/2"						
	25			50/1"						
	28.5	REFUSAL @ 28.5 FEET							X 2	

Remarks:
 Weather: Sunny, 50F, NW wind 0-5mph

Date Begun: 1/13/23
 Date Completed: 1/13/23
 Termination Depth (ft): 28.5
 Crew: DAP, CPP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES
 Split Spoon
 Drive Sampler, 2.41-I.D.

WATER LEVEL OBSERVATIONS
 ∇ While Drilling (ft) dry
 ▼ End of Drilling(ft) dry
 Depth to Cave In (Ft): 22.8

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23



TEST BORING 10.3-19

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.73393°, -108.30265°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL Δ	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6806.0								
6805	0	Loose, moist, brown, fine grained SILTY SAND (SM)		0 50 100					0 20 40 60	Located within Slope Wash Deposits
	4.0									
6800	5	Very hard, moist, brown to dark brown, SANDY SHALE with layers of sandstone and siltstone throughout		50/5"						
	6.5	END OF BORING @ 6.5 FEET								

Remarks: Weather: Sunny, 50F, NW wind 0-5mph

Date Begun: 1/13/23
 Date Completed: 1/13/23
 Termination Depth (ft): 6.5
 Crew: DAP, CPP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

☒ Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft)
 ▼ End of Drilling(ft)

Depth to Cave In (Ft):



TEST BORING 10.3-20

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.73212°, -108.29895°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6837.0								
6835	0	Soft, moist, brown, SANDY SILT (ML)		0 50 100				0 20 40 60		Located within Slope Wash Deposits
	5									
	6.0	Stiff, moist, brown to gray, SANDY SHALE		22						
	6.5	END OF BORING @ 6.5 FEET								

Remarks:
 Weather: Sunny, 50F, NW wind 0-5mph

Date Begun: 1/13/23
 Date Completed: 1/13/23
 Termination Depth (ft): 6.5
 Crew: DAP, CPP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

☒ Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft)
 ▼ End of Drilling(ft)

Depth to Cave In (Ft):

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10 GDT 3/28/23

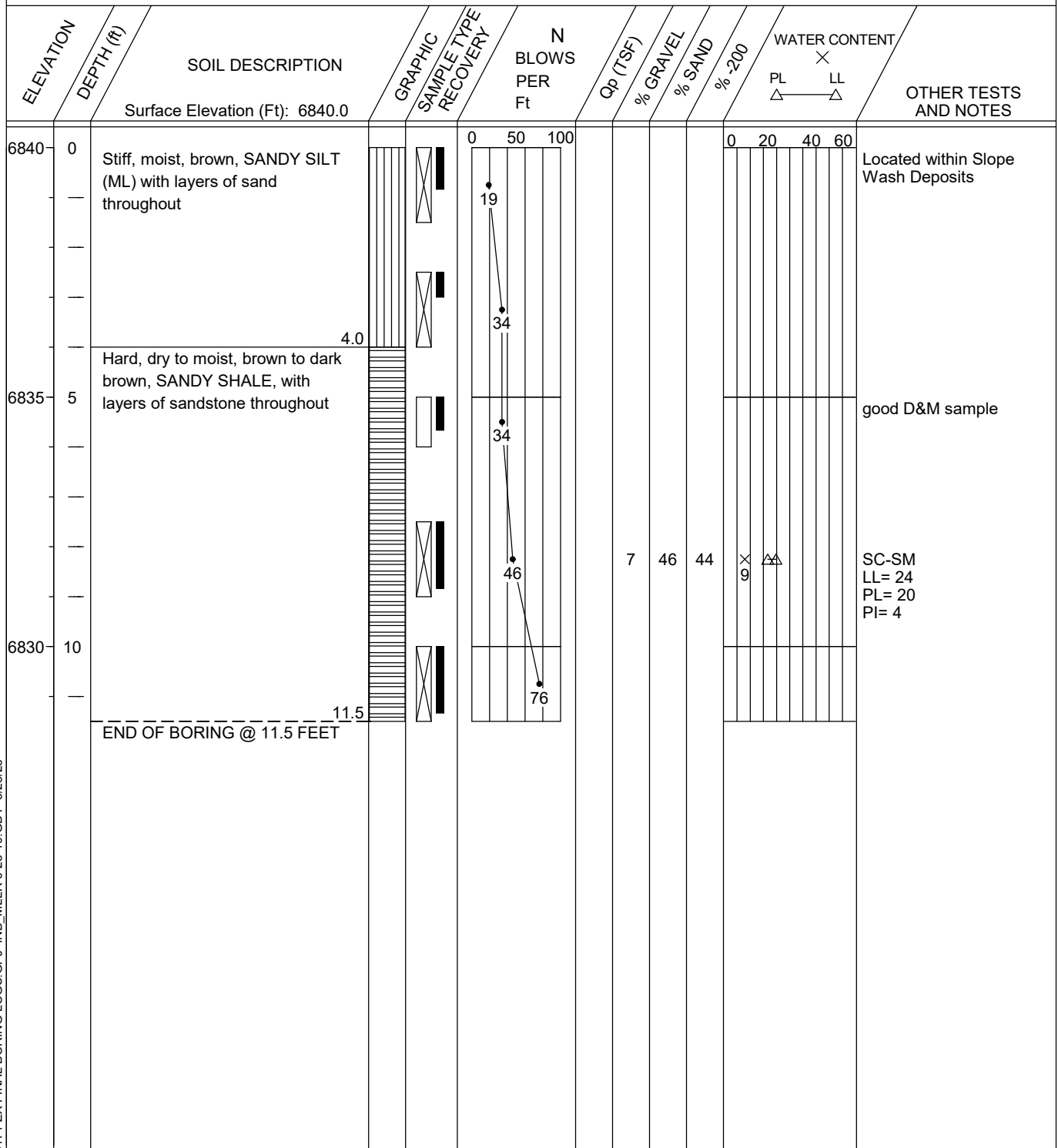


TEST BORING 10.3-21

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.72829°, -108.29585°

Job No.: 23171-ZX
Client: Souder, Miller & Associates



Remarks: Weather: Partly Cloudy, 41F, S wind @ 5-10mph

Date Begun: 1/14/23
 Date Completed: 1/14/23
 Termination Depth (ft): 11.5
 Crew: DAP, CPP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES
 Split Spoon
 Drive Sampler, 2.41-I.D.

WATER LEVEL OBSERVATIONS
 ∇ While Drilling (ft) dry
 ∇ End of Drilling(ft) dry
 Depth to Cave In (Ft): 6.9

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10 GDT 3/28/23



TEST BORING 10.3-22

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.72651°, -108.29384°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6813.0								
	0	Stiff to hard, moist, light brown, fine grained SANDY SILT (ML)		0 50 100				0 20 40 60		Located within Slope Wash Deposits
6810	3.0	Stiff, moist, brown to gray, SANDY SHALE with layers of sandstone throughout								
	5									
	6.5	END OF BORING @ 6.5 FEET		61						

Remarks:

Weather: Partly Cloudy, 41F, S wind @ 5-10mph

Date Begun: 1/14/23
 Date Completed: 1/14/23
 Termination Depth (ft): 6.5
 Crew: DAP, CPP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

☒ Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft)
 ▼ End of Drilling(ft)

Depth to Cave In (Ft):



TEST BORING 10.3-23

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.72405°, -108.2906°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6779.0								
6775	0	Loose, moist, brown, fine grained SILTY SAND (SM)		0 50 100				0 20 40 60		Located within Slope Wash Deposits
	5	Very dense, moist to dry, fine to medium grained SANDSTONE		50/5						
	6.0	END OF BORING @ 6.0 FEET								

Remarks:
 Weather: Partly Cloudy, 41F, S wind @ 5-10mph

Date Begun: 1/14/23
 Date Completed: 1/14/23
 Termination Depth (ft): 6.0
 Crew: DAP, CPP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

☒ Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft)
 ▼ End of Drilling(ft)

Depth to Cave In (Ft):



TEST BORING 10.3-24

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.72258°, -108.28704°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT X PL — LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6719.0								
6715	0	Loose, moist, dark brown to gray, SILT (ML)		0 50 100				0 20 40 60		Located within Drainage Deposits (Flash Flood Area)
	5	END OF BORING @ 5.0 FEET	B							

Remarks: Weather: Partly Cloudy, 41F, S wind @ 5-10mph		
Date Begun: 1/14/23 Date Completed: 1/14/23 Termination Depth (ft): 5.0 Crew: DAP, CPP, ERH Rig: Hand Auger Method: Hand Auger Benchmark/Datum (Ft): Handheld GPS	SAMPLE TYPES B Bag Sample	WATER LEVEL OBSERVATIONS ∇ While Drilling (ft) ▼ End of Drilling(ft) Depth to Cave In (Ft):

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10 GDT 3/28/23



TEST BORING 10.3-25

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.72015°, -108.28373°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% >200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6723.0								
	0	Loose to medium dense, moist, brown, SILTY SAND (SM)		0 50 100					0 20 40 60	Located within Drainage Deposits (Flash Flood Area)
	6720									
	5									SM LL= 0 PL= 0 PI= 0
	6.5	Very dense, moist to dry, light brown, SANDSTONE			0	73	27	Δ X 7		
	7.0	REFUSAL @ 7.0 FEET								

Remarks:

Date Begun: 2/1/23
 Date Completed: 2/1/23
 Termination Depth (ft): 7.0
 Crew: DAP, CPP, ERH
 Rig: Hand Auger
 Method: Hand Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

Bag Sample

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft) dry
 ≡ End of Drilling(ft) dry

Depth to Cave In (Ft): 7.0

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23



TEST BORING 10.3-26

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.71783°, -108.28019°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6848.0								
6845	0	Loose, moist, brown, fine grained SILTY SAND (SM)		0 50 100				0 20 40 60		Located within Slope Wash Deposits
	5	Very dense, moist, brown, SANDSTONE with layers of silt throughout END OF BORING @ 5.5 FEET	5.0 5.5	50/2"						

Remarks: Weather: Partly Cloudy, 41F, S wind @ 5-10mph		
Date Begun: 1/14/23 Date Completed: 1/14/23 Termination Depth (ft): 5.5 Crew: DAP, CPP, ERH Rig: Mobile B-57 Method: 3 1/4 Hollow Stem Auger Benchmark/Datum (Ft): Handheld GPS	SAMPLE TYPES ☒ Split Spoon	WATER LEVEL OBSERVATIONS ☐ While Drilling (ft) ☐ End of Drilling(ft) Depth to Cave In (Ft):

LOG OF TEST BORING OR TEST PIT: 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23



TEST BORING 10.3-27

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.71574°, -108.2766°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6863.0								
6860	0	Loose, moist, brown, fine grained SILTY SAND (SM)		0 50 100				0 20 40 60		Located within Slope Wash Deposits
	4.0									
	5	Very dense, dry, brown, SANDSTONE with layers of silt throughout		50/1"						
	5.5	END OF BORING @ 5.5 FEET								

Remarks:

Weather: Partly Cloudy, 41F, S wind @ 5-10mph

Date Begun: 1/14/23
 Date Completed: 1/14/23
 Termination Depth (ft): 5.5
 Crew: DAP, CPP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

☐ No Recovery

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft)
 ▼ End of Drilling(ft)

Depth to Cave In (Ft):

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10 GDT 3/28/23



TEST BORING 10.3-28

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.71343°, -108.27314°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6832.0								
6830	0	Loose, moist, brown, fine grained SILTY SAND (SM)		0 50 100				0 20 40 60		Located within Eolian Deposits
	3.0	Dense to very dense, moist, brown to gray, SAND with layers of sandstone throughout								
	5	END OF BORING @ 5.5 FEET		50/2"						

Remarks: Weather: Partly Cloudy, 41F, S wind @ 5-10mph

Date Begun: 1/14/23
 Date Completed: 1/14/23
 Termination Depth (ft): 5.5
 Crew: DAP, CPP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

☐ No Recovery

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft)

≡ End of Drilling(ft)

Depth to Cave In (Ft):

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10 GDT 3/28/23



TEST BORING 10.3-29

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.71045°, -108.27124°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6906.0								
6905	0	Medium dense to very dense, moist, light brown, fine to medium grained SILTY SAND (SM) with sandstone layers throughout		15						Located within Residuum
				50/5"						
	5									
6900	6.0	Very dense to loose, dry, light brown, fine to coarse grained SAND, with layers of sandstone throughout		33						
				50/3"						not enough sample in D&M rings
	10									
6895	11.5	END OF BORING @ 11.5 FEET		5						

Remarks: Weather: Sunny, 49F, SW wind @ 5-10mph

Date Begun: 1/14/23
 Date Completed: 1/14/23
 Termination Depth (ft): 11.5
 Crew: DAP, CPP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES
 Split Spoon
 Drive Sampler, 2.41-I.D.

WATER LEVEL OBSERVATIONS
 ∇ While Drilling (ft) dry
 ▼ End of Drilling (ft) dry
 Depth to Cave In (Ft): 6.9

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23



TEST BORING 10.3.1-1

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.70838°, -108.2703°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6937.0								
6935	0	Medium dense, moist, brown, fine grained SILTY SAND (SM)		12	2	70	26	6	△ X	Located within Residuum SM LL= 0 PL= 0 PI= 0
	4.0	Very dense, moist to dry, reddish brown, fine grained SAND, with layers of sandstone throughout		13						
6930	5			50/5"						no sample in D&M rings
		layers of red siltstone		50/4"						
	10			50/2"						
	10.5	END OF BORING @ 10.5 FEET								

Remarks: Weather: Partly Cloudy, 49F, SW wind @ 10-15mph

Date Begun: 1/14/23
 Date Completed: 1/14/23
 Termination Depth (ft): 10.5
 Crew: DAP, CPP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES
 Split Spoon
 Drive Sampler, 2.41-I.D.
 No Recovery

WATER LEVEL OBSERVATIONS
 ∇ While Drilling (ft) dry
 ▼ End of Drilling(ft) dry
 Depth to Cave In (Ft): 6.9

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23



TEST BORING 10.3.1-3

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.70824°, -108.26182°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% <200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6822.0								
6820	0	Soft, moist, brown, fine grained SILTY SAND (SM)		0 50 100				0 20 40 60		Located within Slope Wash Deposits
	5			9						
	6.5	END OF BORING @ 6.5 FEET								

Remarks: Weather: Partly Cloudy, 49F, SW wind @ 10-15mph

Date Begun: 1/14/23
 Date Completed: 1/14/23
 Termination Depth (ft): 6.5
 Crew: DAP, CPP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

☒ Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft)
 ▼ End of Drilling(ft)

Depth to Cave In (Ft):



TEST BORING 10.3.1-HDD1

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Project: BBN9 Water Supply District

Job No.: 23171-ZX

Location: Navajo Nation

Client: Souder, Miller & Associates

35.70745°, -108.25905°

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% >200	WATER CONTENT PL — LL	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6790.0								
6790	0	Loose to medium dense, dry, light brown, fine grained SILTY SAND (SM)		7					X 7	Located within Drainage Deposits
6785	5			10					X 5	
6780	10	Very stiff, moist, light brown, SANDY CLAY (CL)		24	0	40	60		X 7	CL LL= 26 PL= 18 PI= 7
6775	15			20					X 8	
6770	20			51	1	44	56		X 9	CL LL= 28 PL= 15 PI= 13
6765	25			49					X 9	
6760										

Remarks:

Date Begun: 1/26/23
 Date Completed: 1/26/23
 Termination Depth (ft): 50.5
 Crew: DAP, CPP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

- Split Spoon
- Drive Sampler, 2.41-I.D.

WATER LEVEL OBSERVATIONS

- ≡ While Drilling (ft) dry
- ≡ End of Drilling(ft) dry

Depth to Cave In (Ft): 31.5

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23

(Log Continued on Next Page)



TEST BORING 10.3.1-HDD1

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.70745°, -108.25905°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6790.0								
6760	30	31.0 Hard, moist, dark brown to gray, SANDY SHALE		74					7	
6755	35			50/3"					9	
6750	40			50/5"					11	
6745	45			50/1"	0	27	73		12	CL LL= 40 PL= 20 PI= 20
6740	50	50.5 END OF BORING @ 50.5 FEET		50/2"						

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23



TEST BORING 10.3.1-5

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.70443°, -108.25536°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% <200	WATER CONTENT PL ——— X △ ——— △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6796.0								
6795	0	Stiff to hard, dry, light brown, SANDY SILT (ML)		18						Located within Slope Wash Deposits
				46						
6790	5	Very hard, moist, dark gray to brown, SHALE		38	1	46	53	8	△ ——— △	
				29						
6785	10			54						CL LL= 29 PL= 16 PI= 13
	11.5	END OF BORING @ 11.5 FEET								

Remarks:

Date Begun: 1/27/23
 Date Completed: 1/26/23
 Termination Depth (ft): 11.5
 Crew: DAP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft) dry
 ≡ End of Drilling(ft) dry

Depth to Cave In (Ft): 8.1

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23



TEST BORING 10.3.1-6

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.70335°, -108.25145°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6793.0								
6790	0	Loose, moist, brown, SANDY SILT (ML)		0 50 100				0 20 40 60		Located within Slope Wash Deposits
	4.0									
	5	Very dense, moist to dry, light gray, fine grained SILTY SAND								
	6.0	END OF BORING @ 6.0 FEET		50/3"						

Remarks:

Date Begun: 1/27/23
 Date Completed: 1/27/23
 Termination Depth (ft): 6.0
 Crew: DAP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

☒ Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft) dry
 ≡ End of Drilling(ft) dry

Depth to Cave In (Ft): 2.9

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10 GDT 3/28/23



TEST BORING 10.3.1-7

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.7027°, -108.24722°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6789.0								
	0	Soft to firm, moist, light gray, SILT		0 50 100				0 20 40 60		Located within Slope Wash Deposits
	3.0	Dense, moist, brown, fine grained SILTY SAND (SM), with trace of fine gravel								
6785										
	5			22						
	6.5	END OF BORING @ 6.5 FEET								

Remarks:

Date Begun: 1/27/23
 Date Completed: 1/27/23
 Termination Depth (ft): 6.5
 Crew: DAP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

☒ Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft) dry
 ≡ End of Drilling(ft) dry

Depth to Cave In (Ft): 3.1

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10 GDT 3/28/23



TEST BORING 10.3.1-8A

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Project: BBN9 Water Supply District

Job No.: 23171-ZX

Location: Navajo Nation

Client: Souder, Miller & Associates

35.70205°, -108.24441°

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% <200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6792.0								
6790	0	Soft, moist, gray to brown, SANDY SILT (ML)		0 50 100				0 20 40 60		Located within Drainage Deposits
	4.0									
	5	Very hard, moist to dry, black to dark gray, SILTY SHALE, with traces of white precipitates								
	6.0	END OF BORING @ 6.0 FEET		50/3"						

Remarks:

Date Begun: 1/27/23
 Date Completed: 1/27/23
 Termination Depth (ft): 6.0
 Crew: DAP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

☒ Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft) dry
 ▼ End of Drilling(ft) dry

Depth to Cave In (Ft): 3.2

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10 GDT 3/28/23



TEST BORING 10.3.1-8

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.70147°, -108.24346°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6783.0								
0		Loose, moist, dark gray, SANDY SILT (ML)		0 50 100				0 20 40 60		Located within Drainage Deposits
3.0										
6780		Very stiff, moist, light gray, SILTY SHALE								
5										
5.5		END OF BORING @ 5.5 FEET								

Remarks:

Date Begun: 1/27/23
 Date Completed: 1/27/23
 Termination Depth (ft): 5.5
 Crew: DAP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

☒ Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft) dry
 ▼ End of Drilling(ft) dry

Depth to Cave In (Ft): 3



TEST BORING 10.3.1-9

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.6993°, -108.23992°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6792.0								
6790	0	Firm, moist, dark brown, SANDY CLAY with some silt and fine gravel throughout		9						Located within Slope Wash Deposits
	3.0	Very dense, dry, light brown, fine to medium grained SILTY CLAYEY SAND (SC-SM)		50/5"						
6785	5			50/5"						
				50/5"						
	10	END OF BORING @ 10.5 FEET		50/4"	37	39	23	4	△	SC-SM LL= 20 PL= 16 PI= 4

Remarks:

Date Begun: 1/27/23
 Date Completed: 1/27/23
 Termination Depth (ft): 10.5
 Crew: DAP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft) dry
 ≡ End of Drilling(ft) dry

Depth to Cave In (Ft): 6.9

LOG OF TEST BORING OR TEST PIT: 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23



TEST BORING 10.3.1-10

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.69608°, -108.23807°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT X PL — LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6869.0								
	0	Loose, moist, brown, fine grained SILTY SAND (SM)		0 50 100				0 20 40 60		Located within Slope Wash Deposits
	4.0									
6865	5	Very hard, moist to dry, brown to gray, SAND, with layers of sandstone and silt throughout		50/5"						
	6.5	END OF BORING @ 6.5 FEET								

Remarks:

Date Begun: 1/28/23
 Date Completed: 1/28/23
 Termination Depth (ft): 6.5
 Crew: DAP, CPP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

☐ No Recovery

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft) dry
 ≡ End of Drilling(ft) dry

Depth to Cave In (Ft): 3.1

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10 GDT 3/28/23



TEST BORING 10.3.1-11

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.69453°, -108.23558°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6841.0								
6840	0	Soft, moist, brown to dark brown, SANDY SILT (ML)		0 50 100				0 20 40 60		Located within Drainage Deposits
	5									
6835	6.5	END OF BORING @ 6.5 FEET		8						

Remarks:

Date Begun: 1/28/23
 Date Completed: 1/28/23
 Termination Depth (ft): 6.5
 Crew: DAP, CPP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

☒ Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft) dry
 ≡ End of Drilling(ft) dry

Depth to Cave In (Ft): 3

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23



TEST BORING 10.3.1-12

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.69377°, -108.23131°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% <200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6821.0								
6820	0	Stiff, moist, brown to dark brown, SANDY SILT (ML)		0 50 100				0 20 40 60		Located within Drainage Deposits
6815	5			14						
	6.5	END OF BORING @ 6.5 FEET								

Remarks:

Date Begun: 1/28/23
 Date Completed: 1/28/23
 Termination Depth (ft): 6.5
 Crew: DAP, CPP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

☒ Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft) dry
 ▼ End of Drilling(ft) dry

Depth to Cave In (Ft): 2.9

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10 GDT 3/28/23



TEST BORING 10.3.1-13

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.69339°, -108.22691°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% >200	WATER CONTENT PL — LL	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6817.0								
6815	0	Stiff, dry, brown, SANDY SILT (ML)		0 50 100						Located within Drainage Deposits
	1.1			11						
	2.3									
	2.3			13						
	5.0									
	5.0			11						
6810	7.0	Medium dense, dry to moist, brown, fine grained SILTY SAND (SM) with layers of sandstone throughout								
	7.0			20	1	66	33	Δx 5		SM LL= 0 PL= 0 PI= 0
	10.0									
	10.0			50/4"						
	11.5	END OF BORING @ 11.5 FEET								

Remarks:

Date Begun: 1/28/23 Date Completed: 1/28/23 Termination Depth (ft): 11.5 Crew: DAP, CPP, ERH Rig: Mobile B-57 Method: 3 1/4 Hollow Stem Auger Benchmark/Datum (Ft): Handheld GPS	SAMPLE TYPES Split Spoon	WATER LEVEL OBSERVATIONS ∇ While Drilling (ft) dry ∇ End of Drilling(ft) dry Depth to Cave In (Ft): 6.5

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23



TEST BORING 10.3.1-14

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.69302°, -108.2224°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6812.0								
6810	0	Loose, moist, brown, fine grained SILTY SAND (SM)		0 50 100				0 20 40 60		Located within Slope Wash Deposits
	5	Very dense, moist to dry, brown to light brown, SANDSTONE END OF BORING @ 5.5 FEET	5.0 5.5	50/3"						

Remarks:

Date Begun: 1/28/23
 Date Completed: 1/28/23
 Termination Depth (ft): 5.5
 Crew: DAP, CPP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

☒ Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft) dry
 ≡ End of Drilling(ft) dry

Depth to Cave In (Ft): 3.1

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23



TEST BORING 10.3.1-15

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.69059°, -108.21827°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6837.0								
6835	0	Loose to very dense, dry to moist, light brown, fine grained SILTY SAND (SM)		0 50 100				0 20 40 60		Located within Residuum
	5									
	6.5	END OF BORING @ 6.5 FEET		53						

Remarks:

Date Begun: 1/28/23 Date Completed: 1/28/23 Termination Depth (ft): 6.5 Crew: DAP, CPP, ERH Rig: Mobile B-57 Method: 3 1/4 Hollow Stem Auger Benchmark/Datum (Ft): Handheld GPS	SAMPLE TYPES ☒ Split Spoon	WATER LEVEL OBSERVATIONS ∇ While Drilling (ft) dry ∇ End of Drilling(ft) dry Depth to Cave In (Ft): 3.1

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23



TEST BORING 10.3.1-16

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.6887°, -108.21537°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6867.0								
6865	0	Loose, moist, brown, fine grained SILTY SAND (SM)		0 50 100				0 20 40 60		Located within Residuum
	5	Very dense, dry, orange to brown, fine to medium grained SAND with layers of sandstone throughout		78						
	6.5	END OF BORING @ 6.5 FEET								

Remarks:

Date Begun: 1/28/23
 Date Completed: 1/28/23
 Termination Depth (ft): 6.5
 Crew: DAP, CPP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

☒ Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft) dry
 ▼ End of Drilling(ft) dry

Depth to Cave In (Ft): 3.2

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23



TEST BORING 10.3.1-17

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Project: BBN9 Water Supply District

Job No.: 23171-ZX

Location: Navajo Nation

Client: Souder, Miller & Associates

35.68714°, -108.21174°

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% <200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6885.0								
6885	0	Medium dense to very dense, moist to dry, brown to light brown, fine grained CLAYEY SAND (SM)		22						Located within Slope Wash Deposits
				58						
6880	5	becomes very dense with layers of sandstone and claystone throughout		50/1"	1	32	67		12	CL LL= 24 PL= 15 PI= 10
				50/2"						
6875	10	END OF BORING @ 10.5 FEET		50/2"						

Remarks:

Date Begun: 1/28/23
 Date Completed: 1/28/23
 Termination Depth (ft): 10.5
 Crew: DAP, CPP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

Split Spoon

WATER LEVEL OBSERVATIONS

▽ While Drilling (ft) dry
 ▼ End of Drilling(ft) dry

Depth to Cave In (Ft): 6.9

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23



TEST BORING 10.3.1-18

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.68563°, -108.20755°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6858.0								
6855	0	Very dense, dry, light brown, fine grained CLAYEY SAND (SC) with layers of sandstone throughout		0 50 100					0 20 40 60	Located within Drainage Deposits
	5	END OF BORING @ 5.5 FEET		50/3"						

Remarks:

Date Begun: 1/30/23 Date Completed: 1/30/23 Termination Depth (ft): 5.5 Crew: DAP, CPP, ERH Rig: Mobile B-57 Method: 3 1/4 Hollow Stem Auger Benchmark/Datum (Ft): Handheld GPS	SAMPLE TYPES ☒ Split Spoon	WATER LEVEL OBSERVATIONS ∇ While Drilling (ft) dry ∇ End of Drilling(ft) dry Depth to Cave In (Ft): 2.9

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10 GDT 3/28/23



TEST BORING 10.3.1-19

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.68438°, -108.20344°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% >200	WATER CONTENT X PL — LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6869.0								
	0	Medium dense, moist, light brown, fine to coarse grained SAND		0 50 100				0 20 40 60		Located within Residuum
	3.5	Very dense, moist, light brown, SANDSTONE		50/5"						
6865	4.0	REFUSAL @ 4.0 FEET								

Remarks:

Date Begun: 1/30/23
 Date Completed: 1/30/23
 Termination Depth (ft): 4.0
 Crew: DAP, CPP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

☒ Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft) dry
 ▼ End of Drilling(ft) dry

Depth to Cave In (Ft): 2.4

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23



TEST BORING 10.3.1-20

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.68323°, -108.19932°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% <200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6900.0								
6900	0	Medium dense, moist, tan to brown, fine to coarse grained SAND with layers of sandstone throughout		0 50 100					0 20 40 60	Located within Residuum
6895	5			21						
	6.5	END OF BORING @ 6.5 FEET								

Remarks:

Date Begun: 1/30/23 Date Completed: 1/30/23 Termination Depth (ft): 6.5 Crew: DAP, CPP, ERH Rig: Mobile B-57 Method: 3 1/4 Hollow Stem Auger Benchmark/Datum (Ft): Handheld GPS	SAMPLE TYPES ☒ Split Spoon	WATER LEVEL OBSERVATIONS ∇ While Drilling (ft) dry ∇ End of Drilling(ft) dry Depth to Cave In (Ft): 3.4

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10 GDT 3/28/23



TEST BORING 10.3.1-21

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.68239°, -108.19496°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6884.0								
6880	0	Dense, moist, tan to light brown, fine to medium grained SILTY SAND (SM) with layers of sandstone throughout		47						Located within Slope Wash Deposits
				50/4"	10	73	18	3		SM LL= 0 PL= 0 PI= 0
	5			50/3"						
				50/2"						
6875	10	END OF BORING @ 10.5 FEET		50/3"						

Remarks:

Date Begun: 1/30/23
 Date Completed: 1/30/23
 Termination Depth (ft): 10.5
 Crew: DAP, CPP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft) dry
 ≡ End of Drilling(ft) dry

Depth to Cave In (Ft): 7.8

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23



TEST BORING 10.3.1-22

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.68439°, -108.19168°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6869.0								
6865	0	Loose, moist, tan to light brown, fine to medium grained SAND		0 50 100				0 20 40 60		Located within Residuum
	5	Very dense, moist, tan, SANDSTONE END OF BORING @ 5.5 FEET	5.0 5.5	50/3"						

Remarks:

Date Begun: 1/30/23
 Date Completed: 1/30/23
 Termination Depth (ft): 5.5
 Crew: DAP, CPP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

☒ Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft) dry
 ▼ End of Drilling(ft) dry

Depth to Cave In (Ft): 3



TEST BORING 10.3.1-23

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Project: BBN9 Water Supply District

Job No.: 23171-ZX

Location: Navajo Nation

Client: Souder, Miller & Associates

35.68588°, -108.18917°

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% >200	WATER CONTENT PL X LL △——△	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6839.0								
6835	0	Medium dense, moist, tan to light brown, fine to medium grained SAND		0 50 100					0 20 40 60	Located within Residuum
	5			25						
	6.5	END OF BORING @ 6.5 FEET								

Remarks:

Date Begun: 1/30/23
 Date Completed: 1/30/23
 Termination Depth (ft): 6.5
 Crew: DAP, CPP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

☒ Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft) dry
 ≡ End of Drilling(ft) dry

Depth to Cave In (Ft): 2.5

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10 GDT 3/28/23



TEST BORING 10.3.1-24

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.68776°, -108.18395°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6794.0								
6790	0	Loose to very dense, moist, brown to light brown, fine grained SILTY SAND		0 50 100				0 20 40 60		Located within Drainage Deposits
	5	END OF BORING @ 5.5 FEET		50/3"						

Remarks:

Date Begun: 1/30/23
 Date Completed: 1/30/23
 Termination Depth (ft): 5.5
 Crew: DAP, CPP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

 Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft) dry
 ▼ End of Drilling(ft) dry

Depth to Cave In (Ft): 3.1



TEST BORING 10.3.1-25

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.68949°, -108.18126°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6786.0								
6785	0	Loose to medium dense, dry to moist, light brown to gray, fine grained SILTY SAND (SM)		0 50 100					0 20 40 60	Located within Drainage Deposits
				8						
				9						
6780	5			8						
				10		0	60	40	X 6 △ △	SC-SM LL= 22 PL= 17 PI= 5
6775	10			16						
	11.5	END OF BORING @ 11.5 FEET								

Remarks:

Date Begun: 1/30/23
 Date Completed: 1/30/23
 Termination Depth (ft): 11.5
 Crew: DAP, CPP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft) dry
 ≡ End of Drilling(ft) dry

Depth to Cave In (Ft): 2.8

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23



TEST BORING 10.3.1-26

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.68917°, -108.17701°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6793.0								
6790	0	Loose, dry to moist, light brown, fine grained SAND with silt throughout		0 50 100					0 20 40 60	Located within Drainage Deposits
	5			7						
	6.5	END OF BORING @ 6.5 FEET								

Remarks:

Date Begun: 1/28/23
 Date Completed: 1/28/23
 Termination Depth (ft): 6.5
 Crew: DAP, CPP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

☒ Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft) dry
 ≡ End of Drilling(ft) dry

Depth to Cave In (Ft): 3

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23



TEST BORING 10.3.1-27

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.68932°, -108.17254°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL Δ	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6814.0								
	0	Loose, dry, light brown, fine grained SILTY SAND (SM)		0 50 100					0 20 40 60	Located within Slope Wash Deposits
	2.5									
6810		Very stiff, dry to moist, dark brown, CLAYSTONE, with some fine sand throughout								
5				50/5						
	6.0	END OF BORING @ 6.0 FEET								

Remarks:

Date Begun: 1/28/23
 Date Completed: 1/28/23
 Termination Depth (ft): 6.0
 Crew: DAP, CPP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

☒ Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft) dry
 ≡ End of Drilling(ft) dry

Depth to Cave In (Ft): 3.1

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10 GDT 3/28/23



TEST BORING 10.3.1-28

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.69009°, -108.16925°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6864.0								
	0	Loose, moist, light brown, fine grained SILTY SAND (SM)		0 50 100				0 20 40 60		Located within Slope Wash Deposits
	3.0									
6860		Very hard, moist, gray to brown, CLAYSTONE								
	5									
	6.5	END OF BORING @ 6.5 FEET		71						

Remarks:

Date Begun: 1/30/23
 Date Completed: 1/30/23
 Termination Depth (ft): 6.5
 Crew: DAP, CPP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

☒ Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft) dry
 ≡ End of Drilling(ft) dry

Depth to Cave In (Ft): 3

LOG OF TEST BORING OR TEST PIT: 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23



TEST BORING 10.3.1-29

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Project: BBN9 Water Supply District
Location: Navajo Nation
 35.68994°, -108.16267°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% >200	WATER CONTENT PL X LL △——△	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6941.0								
6940	0	Medium dense, moist, brown, fine grained SILTY SAND (SM)		0 50 100				0 20 40 60		Located within Residuum
	1.5									
	2.0	Very dense, dry, light brown, SANDSTONE	B							
		REFUSAL @ 2.0 FEET								

Remarks:

Date Begun: 1/30/23
 Date Completed: 1/30/23
 Termination Depth (ft): 2.0
 Crew: DAP, CPP, ERH
 Rig: Hand Auger
 Method: Hand Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

B Bag Sample

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft) dry
 ▼ End of Drilling(ft) dry

Depth to Cave In (Ft): 2.0

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23



TEST BORING 10.3.1-30

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Project: BBN9 Water Supply District

Job No.: 23171-ZX

Location: Navajo Nation

Client: Souder, Miller & Associates

35.68835°, -108.1615°

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% >200	WATER CONTENT X PL — LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6944.0								
	0	Very stiff, moist, dark brown, SANDY SHALE		0 50 100					0 20 40 60	Located within Residuum
	2.5	REFUSAL @ 2.5 FEET								

Remarks:

Date Begun: 1/30/23
 Date Completed: 1/30/23
 Termination Depth (ft): 2.5
 Crew: DAP, CPP, ERH
 Rig: Hand Auger
 Method: Hand Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

Bag Sample

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft) dry
 ≡ End of Drilling(ft) dry

Depth to Cave In (Ft): 0.5



TEST BORING 10.3.1-31

100 Page 1 of 1

Project: BBN9 Water Supply District
Location: Navajo Nation
 35.68623°, -108.15846°

Job No.: 23171-ZX
Client: Souder, Miller & Associates

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% >200	WATER CONTENT X PL — LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 7011.0								
7010	0	Very stiff, moist, light brown, SANDY SHALE with sandstone throughout		0 50 100					0 20 40 60	Located within Residuum
	2.5	REFUSAL @ 2.5 FEET								

Remarks:

Date Begun: 1/30/23
 Date Completed: 1/30/23
 Termination Depth (ft): 2.5
 Crew: DAP, CPP, ERH
 Rig: Hand Auger
 Method: Hand Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

Bag Sample

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft) dry
 ≡ End of Drilling(ft) dry

Depth to Cave In (Ft): 0.5

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10 GDT 3/28/23



TEST BORING 10.3.1-32

101 Page 1 of 1

Project: BBN9 Water Supply District

Job No.: 23171-ZX

Location: Navajo Nation

Client: Souder, Miller & Associates

35.68598°, -108.1547°

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL X LL △ — △	OTHER TESTS AND NOTES
		Surface Elevation (Ft): 6974.0								
	0	Medium dense, moist, brown to light brown, SANDY SILT (ML)		0 50 100					0 20 40 60	Located within Slope Wash Deposits
6970	4.0	Hard, moist, brown to light gray, CLAYSTONE, with white precipitates, blocky structure								
	5			69						
	6.5	END OF BORING @ 6.5 FEET								

Remarks:

Date Begun: 1/30/23
 Date Completed: 1/30/23
 Termination Depth (ft): 6.5
 Crew: DAP, CPP, ERH
 Rig: Mobile B-57
 Method: 3 1/4 Hollow Stem Auger
 Benchmark/Datum (Ft): Handheld GPS

SAMPLE TYPES

☒ Split Spoon

WATER LEVEL OBSERVATIONS

≡ While Drilling (ft) dry
 ≡ End of Drilling(ft) dry

Depth to Cave In (Ft): 3.8

LOG OF TEST BORING OR TEST PIT 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 3/28/23

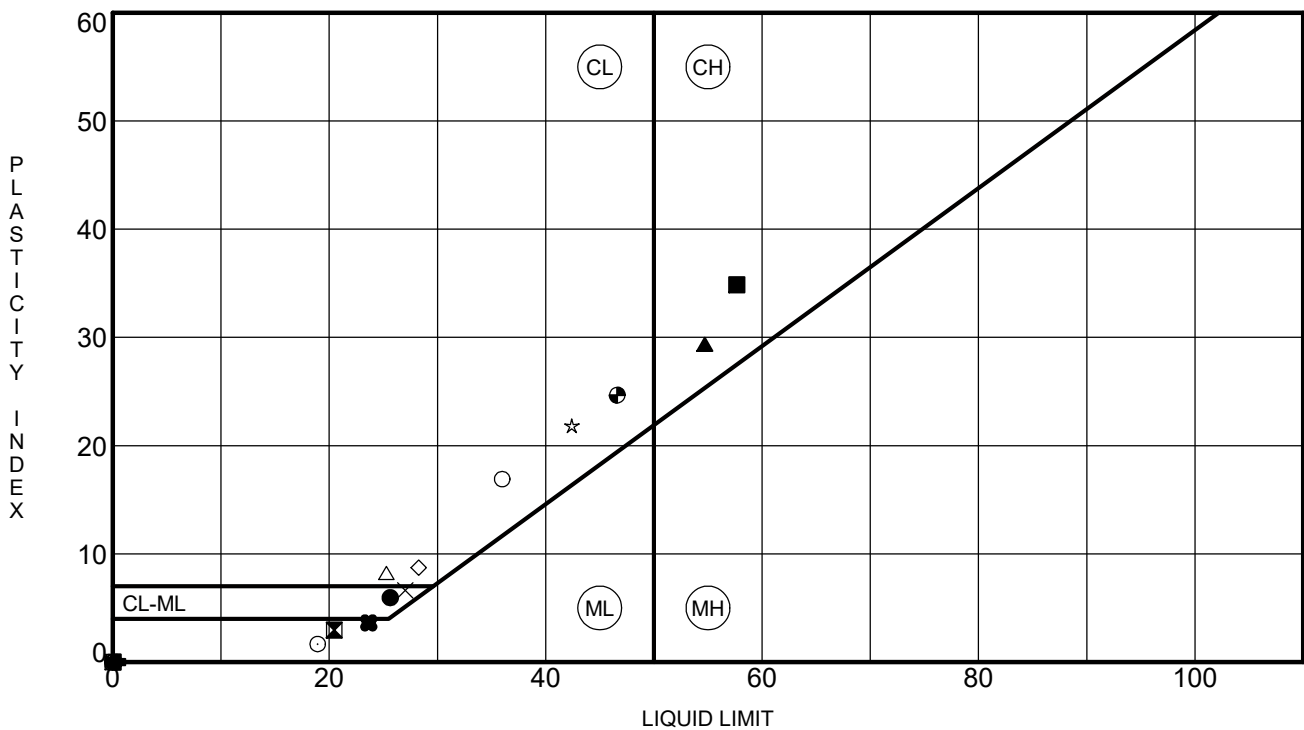
Appendix B

LABORATORY TESTING **PROGRAM**

Soil samples were transported to our laboratory where they were subject to further evaluation, which may include visual classification according to ASTM D2488 or other analysis to determine certain engineering properties. Tests were performed in accordance with the test methods listed below.

Laboratory Test	Test Method
Moisture Content	ASTM D2216
Liquid Limit, Plastic Limit and Plasticity Index	ASTM D4318
Sieve Analysis	ASTM C117
Sieve Analysis with Hydrometer	ASTM D422
Sieve Analysis (200 Sieve only)	ASTM D1140
Water Soluble Sulfate	Comparative
Unconfined Compressive Strength	ASTM D2166
Moisture-Density Relationship (Standard Proctor)	ASTM D698
Moisture-Density Relationship (Modified Proctor)	ASTM D1557
California Bearing Ratio (CBR)	ASTM D1883
Hydraulic Conductivity	ASTM D5084
Minimum Resistivity	AASHTO T288
pH	AASHTO T288
Tube Density	ASTM D2937
Direct Shear	ASTM D3080
Consolidation-Swell	ASTM D2435

Test results that are not displayed on the test boring logs are presented in Appendix B of this report.



	Specimen Identification		LL	PL	PI	Fines	Classification
●	10.2-1	2.5	26	20	6	34	SILTY, CLAYEY SAND(SC-SM)
⊠	10.2-5	5.0	20	18	2	33	SILTY SAND(SM)
▲	10.2-9	5.0	55	25	30	85	FAT CLAY(CH)
★	10.2-13	5.0	NP	NP	NP	59	SANDY SILT(ML)
○	10.2-17	7.5	19	17	2	28	SILTY SAND with GRAVEL(SM)
⊕	HWY Bore	15.0	NP	NP	NP	27	SILTY SAND(SM)
○	HWY Bore	40.0	36	19	17	34	CLAYEY SAND(SC)
△	10.2-21	9.5	25	17	8	35	CLAYEY SAND(SC)
⊗	10.2-25	3.5	NP	NP	NP	30	SILTY SAND(SM)
⊕	10.2-HDD1	10.0	NP	NP	NP	32	SILTY SAND(SM)
□	10.2-HDD1	20.0	NP	NP	NP	32	SILTY SAND(SM)
⊕	10.2.1-4	2.5	NP	NP	NP	43	SILTY SAND(SM)
⊕	10.2.1-8	7.5	47	22	25	45	CLAYEY SAND(SC)
☆	10.2.1-12	2.5	42	21	21	43	CLAYEY SAND(SC)
⊗	10.2.1-17	0.0	NP	NP	NP	20	SILTY SAND(SM)
■	10.3-9	5.0	58	23	35	45	CLAYEY SAND(SC)
◆	10.3-13	2.5	NP	NP	NP	23	SILTY SAND(SM)
◇	10.3-17	7.5	28	20	8	71	LEAN CLAY with SAND(CL)
×	10.3-HDD1	15.0	27	20	7		
⬛	10.3-21	7.5	24	20	4	44	SILTY, CLAYEY SAND(SC-SM)

PROJECT: BBN9 Water Supply District
 JOB NO.: 23171-ZX
 CLIENT: Souder, Miller & Associates
 TEST METHOD: ASTM D422

ATTERBERG LIMITS' RESULTS

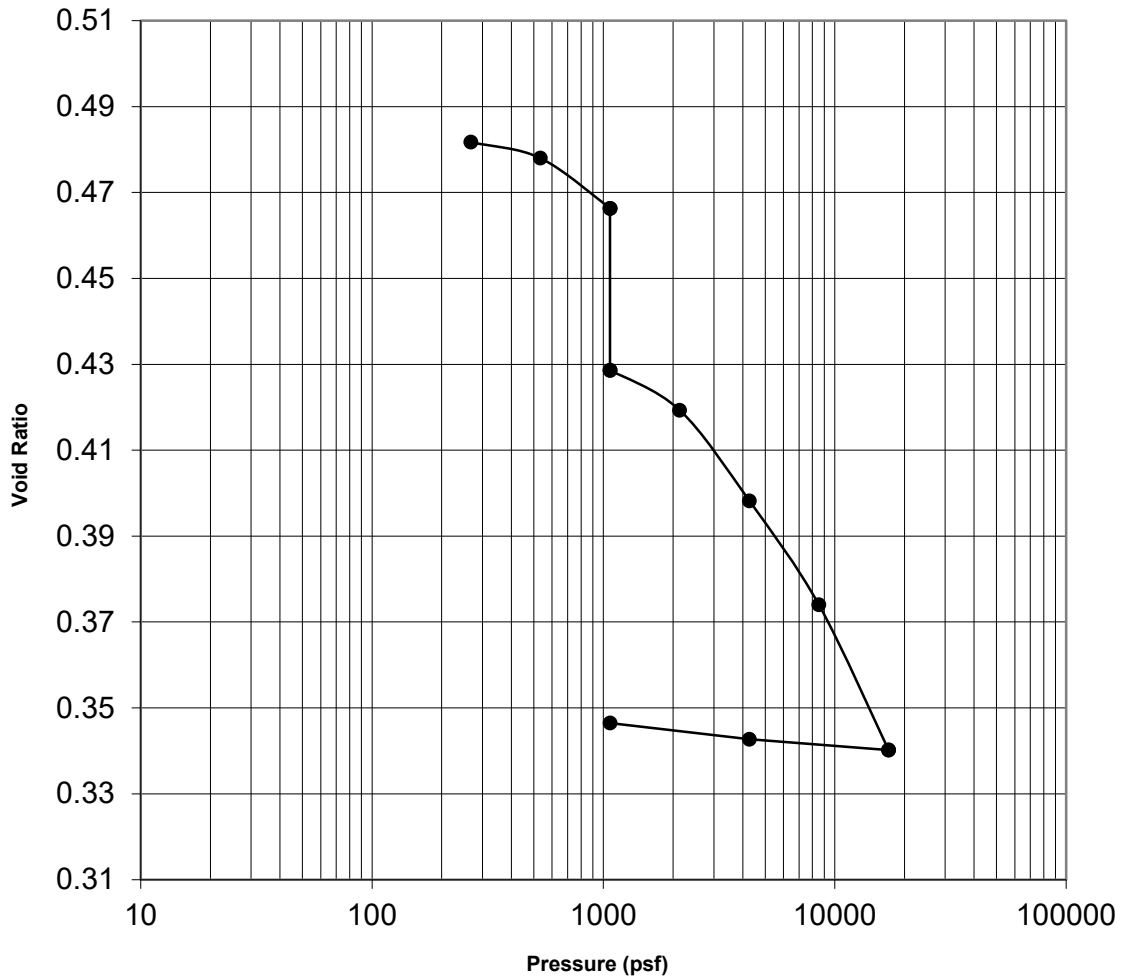


CONSOLIDATION-SWELL TEST

INBERG-MILLER ENGINEERS

CLIENT: Souder, Miller & Associates
PROJECT: BBN9 Water Supply District
JOB NO.: 23171-ZX
TEST METHOD: D2345

TEST DATE: 2/9/2023
TESTED BY: JPM
SAMPLE NO.: 10.3.1-HDD1-SS6
DEPTH (ft): 25'



Swell Pressure(psf): 0

Percent Consolidation: 2.6

Overburden Pres.(psf):	3070	Moisture Content(%):	Initial	Final
Preconsol. Pres.(psf):	1100	Dry Density(pcf):	109.9	112.6
Comp. Index(Cc):	0.112	Void Ratio:	0.496	0.340
Rebound Index(Cr):	0.005	Saturation(%):	63.3	100.0

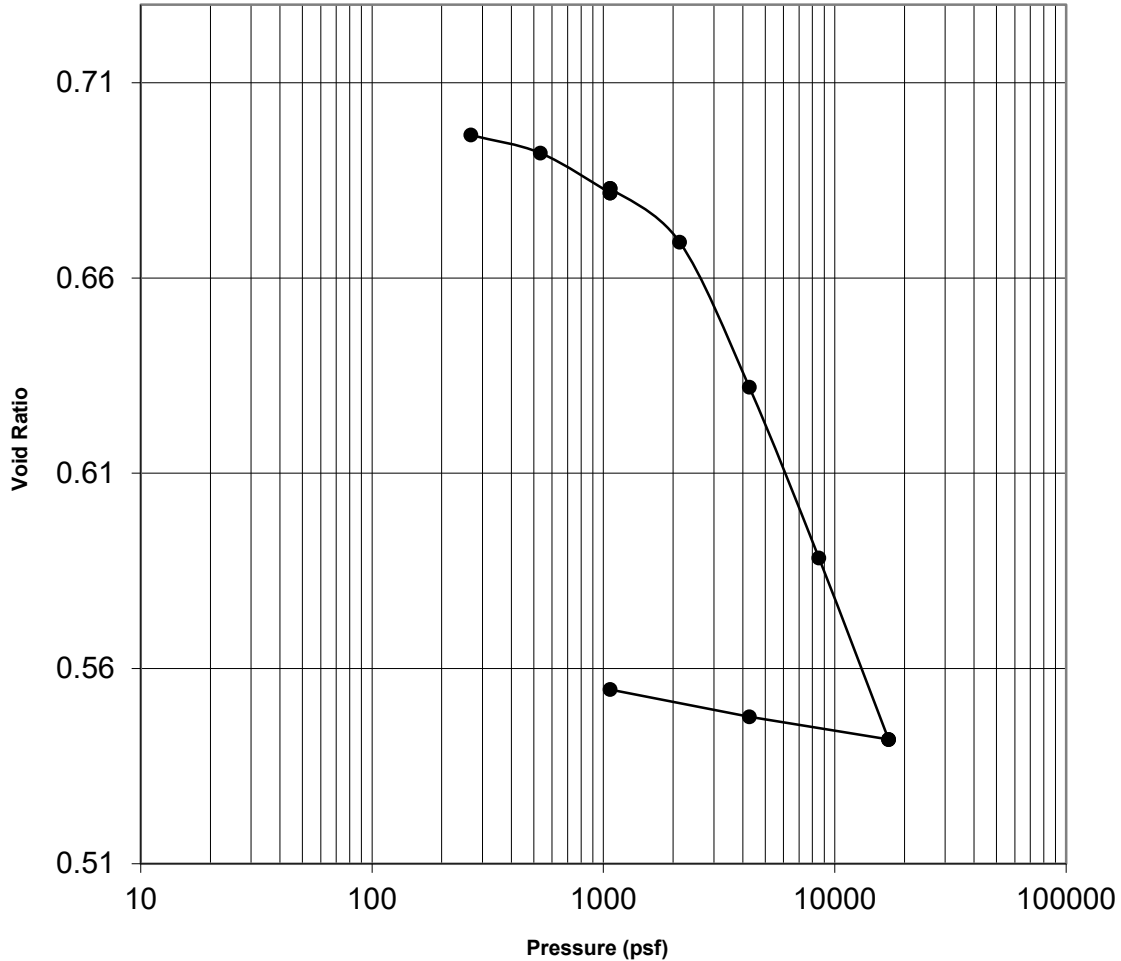
Soil Description: Reddish Brown Silt

CONSOLIDATION-SWELL TEST

INBERG-MILLER ENGINEERS

CLIENT: Souder, Miller & Associates
PROJECT: BBN9 Water Supply District
JOB NO.: 23171-ZX
TEST METHOD: D2345

TEST DATE: 2/23/2023
TESTED BY: JPM
SAMPLE NO.: 10.3 HDD1 SS5
DEPTH (ft): 20'



Swell Pressure(psf): 1133

Percent Swell: 0.1

Overburden Pres.(psf):	2420	Moisture Content(%):	Initial	Final
Preconsol. Pres.(psf):	2100	Dry Density(pcf):	3.5	25.4
Comp. Index(Cc):	0.154	Void Ratio:	116.7	99.0
Rebound Index(Cr):	0.011	Saturation(%):	0.703	0.542
			13.4	100.0

Soil Description: Dark Brown Clay

PARTICLE SIZE ANALYSIS

ASTM C136/C117/D422



PROJECT: BBN9 Water Supply District

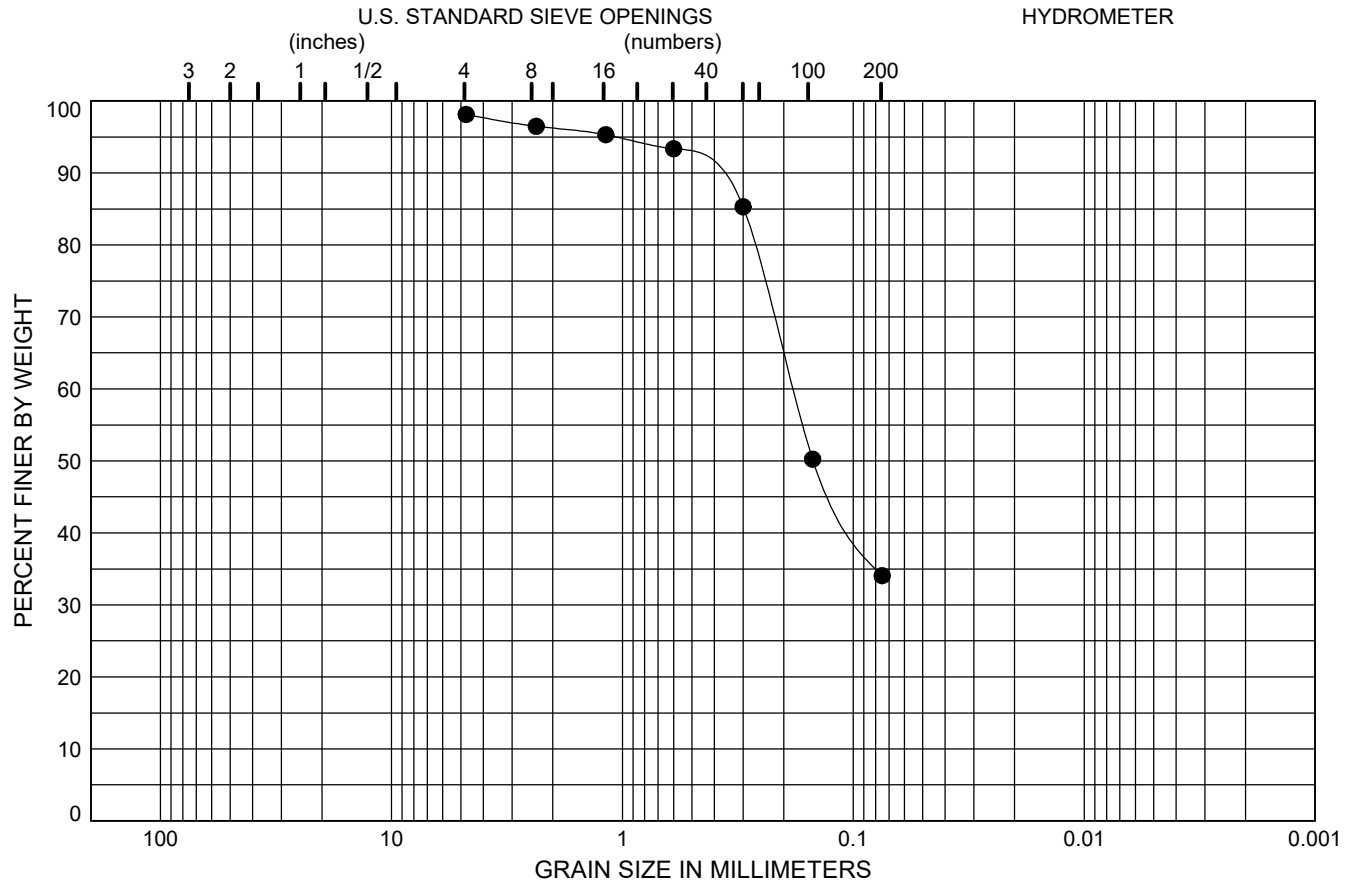
TEST DATE: 1/20/2023

JOB NO.: 23171-ZX

TESTED BY: JPM

CLIENT: Souder, Miller & Associates

TEST METHOD: ASTM D422



COBBLES	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT	CLAY

SOIL DESCRIPTION: Silty Clayey Sand (SC-SM)

SAMPLE NO.: B10.2-1-2

SOURCE: Boring 10.2-1

SAMPLED BY: ERH

DEPTH: 2.5

LIQUID LIMIT: 26

PERCENT GRAVEL: 0.0

PLASTIC LIMIT: 20

PERCENT SAND: 64.1

PLASTICITY INDEX: 6

PERCENT SILT & CLAY: 34.1

PARTICLE SIZE ANALYSIS

ASTM C136/C117/D422



PROJECT: BBN9 Water Supply District

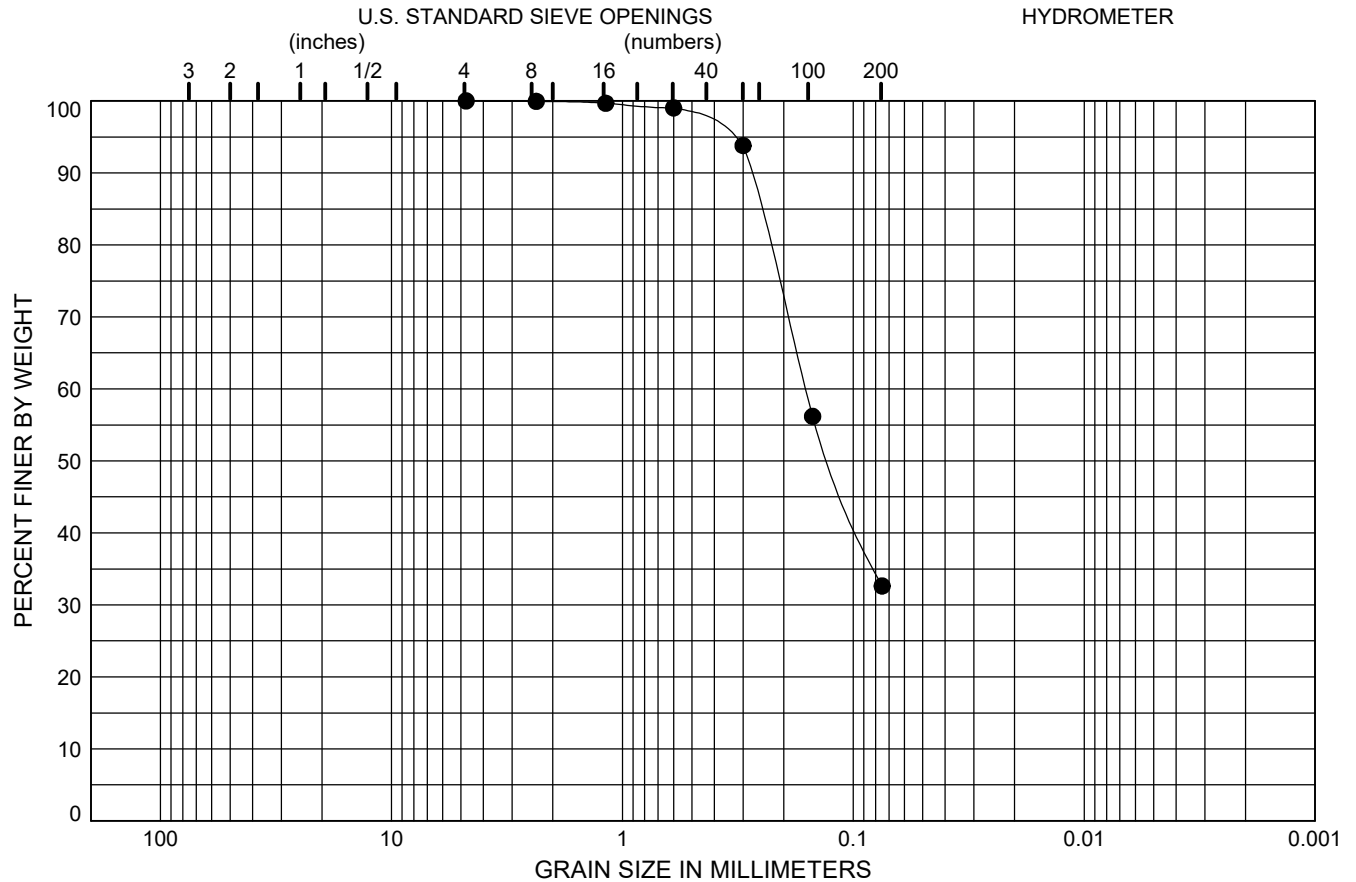
TEST DATE: 2/14/2023

JOB NO.: 23171-ZX

TESTED BY: JPM

CLIENT: Souder, Miller & Associates

TEST METHOD: ASTM D422



COBBLES	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT	CLAY

SOIL DESCRIPTION: Silty Sand (SM)

SAMPLE NO.: 10.2-5-3

SOURCE: Boring 10.2-5

SAMPLED BY: ERH

DEPTH: 5

LIQUID LIMIT: 20

PERCENT GRAVEL: 0.0

PLASTIC LIMIT: 18

PERCENT SAND: 67.4

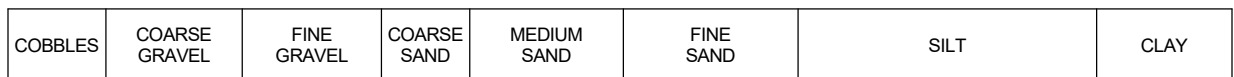
PLASTICITY INDEX: 2

PERCENT SILT & CLAY: 32.6

TEST DATE: 1/20/2023

TESTED BY: JPM

TEST METHOD: ASTM D422



SAMPLE NO.:	10.2-9-3
SAMPLED BY:	ERH
DEPTH:	5

PERCENT GRAVEL:	<u>0.0</u>
PERCENT SAND:	<u>14.3</u>
PERCENT SILT & CLAY:	85.3

PARTICLE SIZE ANALYSIS

ASTM C136/C117/D422



PROJECT: BBN9 Water Supply District

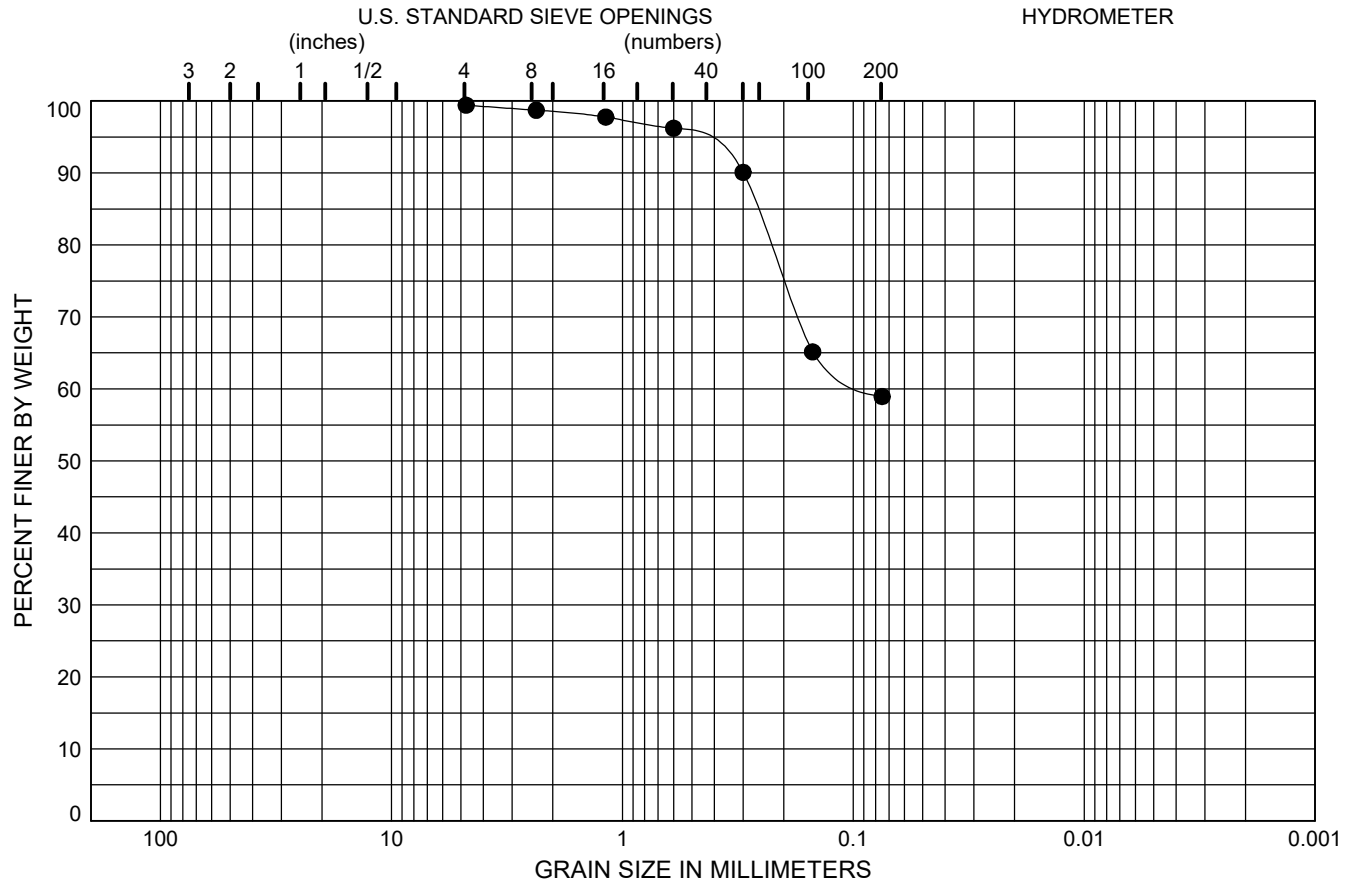
TEST DATE: 1/20/2023

JOB NO.: 23171-ZX

TESTED BY: JPM

CLIENT: Souder, Miller & Associates

TEST METHOD: ASTM D422



COBBLES	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT	CLAY

SOIL DESCRIPTION: Sandy Silt (ML)

SAMPLE NO.: 10.2-13-3

SOURCE: Boring 10.2-13

SAMPLED BY: ERH

DEPTH: 5

LIQUID LIMIT: NP

PERCENT GRAVEL: 0.0

PLASTIC LIMIT: NP

PERCENT SAND: 40.5

PLASTICITY INDEX: NP

PERCENT SILT & CLAY: 58.9

SIZE ANALYSIS-1 23171-ZX FINAL BORING LOGS.GPJ INB MLR.GDT 3/28/23

PARTICLE SIZE ANALYSIS

ASTM C136/C117/D422



PROJECT: BBN9 Water Supply District

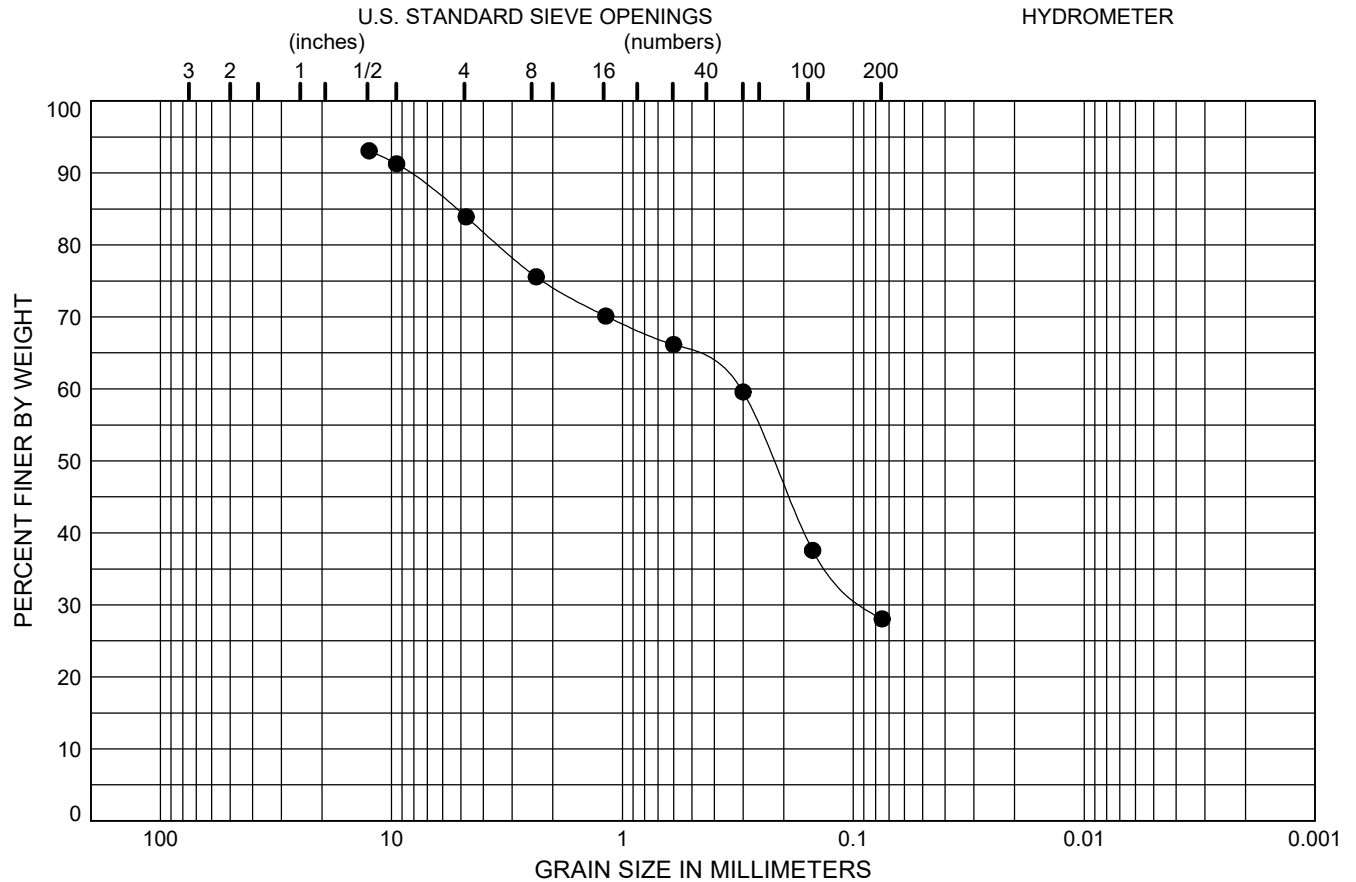
TEST DATE: 1/20/2023

JOB NO.: 23171-ZX

TESTED BY: ERH

CLIENT: Souder, Miller & Associates

TEST METHOD: ASTM D422



COBBLES	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT	CLAY

SOIL DESCRIPTION: Silty Sand (SM)

SAMPLE NO.: 10.2-17-4

SOURCE: Boring 10.2-17

SAMPLED BY: ERH

DEPTH: 7.5

LIQUID LIMIT: 19

PERCENT GRAVEL: 9.2

PLASTIC LIMIT: 17

PERCENT SAND: 55.9

PLASTICITY INDEX: 2

PERCENT SILT & CLAY: 28.1

PARTICLE SIZE ANALYSIS

ASTM C136/C117/D422



PROJECT: BBN9 Water Supply District

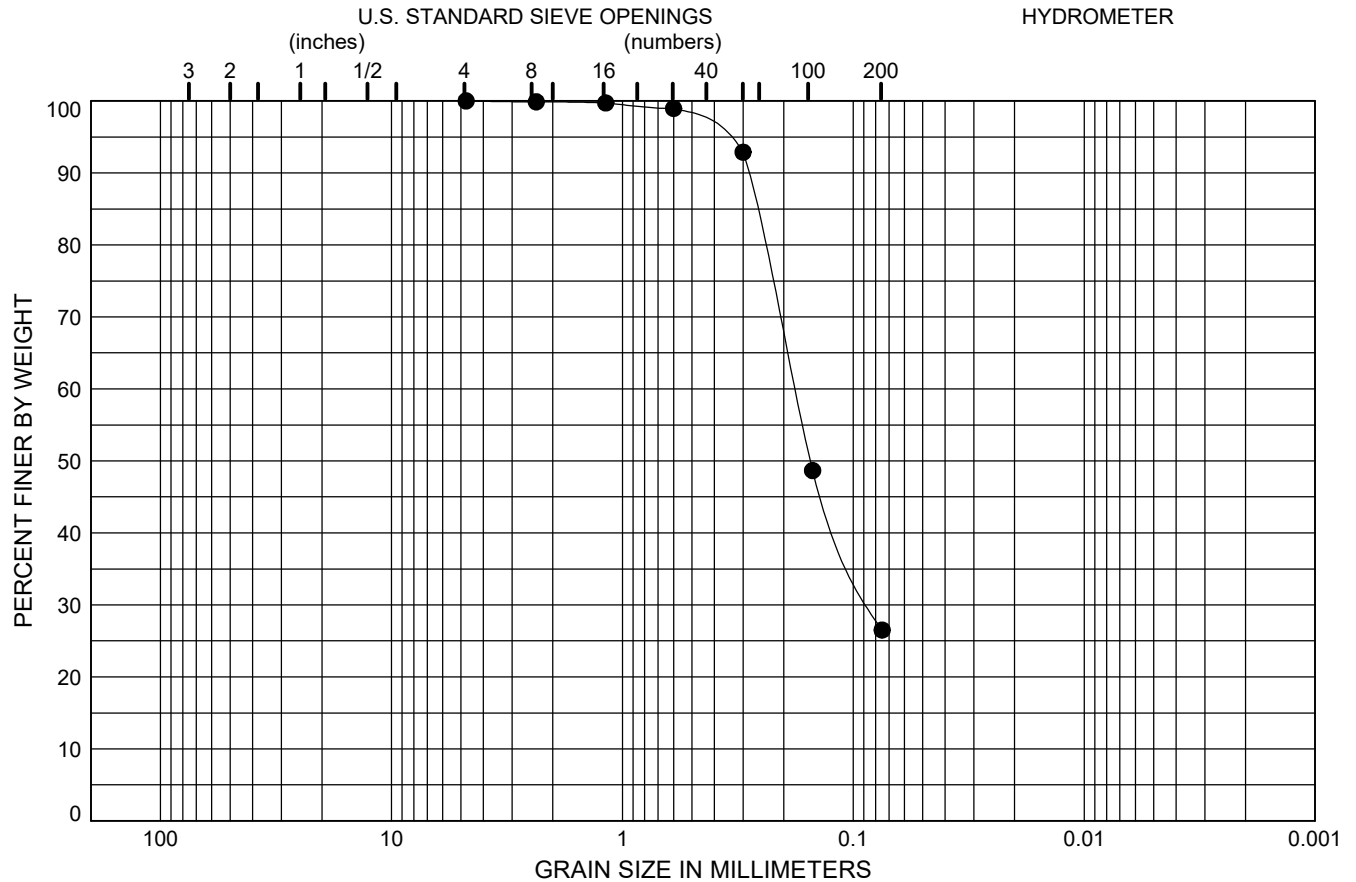
TEST DATE: 1/15/2023

JOB NO.: 23171-ZX

TESTED BY: JPM

CLIENT: Souder, Miller & Associates

TEST METHOD: ASTM D422



COBBLES	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT	CLAY

SOIL DESCRIPTION: Silty Sand (SM)

SAMPLE NO.: HWY Bore-4

SOURCE: HWY Bore

SAMPLED BY: ERH

DEPTH: 15

LIQUID LIMIT: NP

PERCENT GRAVEL: 0.0

PLASTIC LIMIT: NP

PERCENT SAND: 73.5

PLASTICITY INDEX: NP

PERCENT SILT & CLAY: 26.5

SIZE ANALYSIS-1 23171-ZX FINAL BORING LOGS.GPJ INB MLLR.GDT 3/28/23

PARTICLE SIZE ANALYSIS

ASTM C136/C117/D422



PROJECT: BBN9 Water Supply District

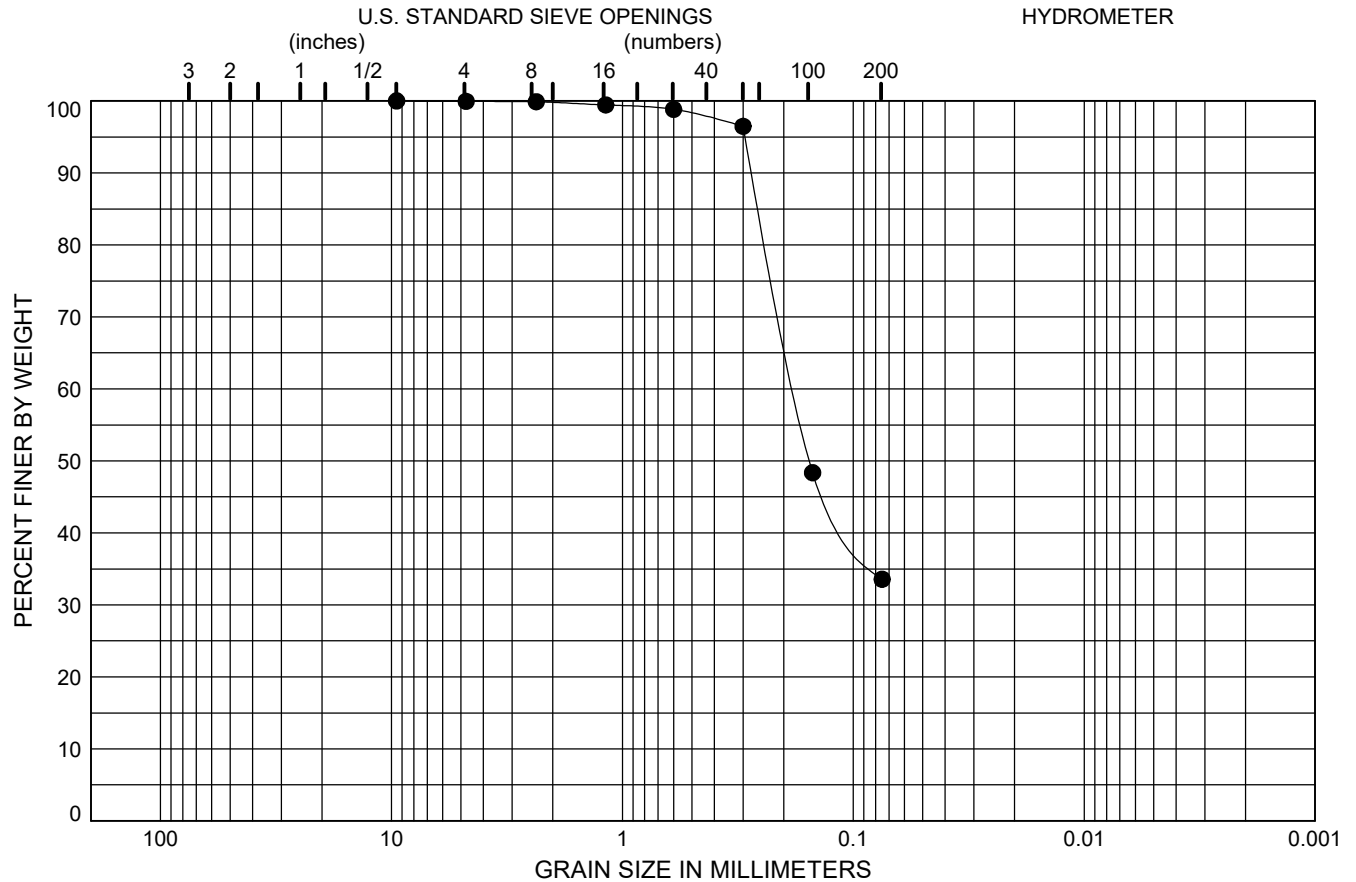
TEST DATE: 1/15/2023

JOB NO.: 23171-ZX

TESTED BY: JPM

CLIENT: Souder, Miller & Associates

TEST METHOD: ASTM D422



COBBLES	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT	CLAY

SOIL DESCRIPTION: Clayey Sand (SC)

SAMPLE NO.: HWY Bore-9

SOURCE: HWY Bore

SAMPLED BY: ERH

DEPTH: 40

LIQUID LIMIT: 36

PERCENT GRAVEL: 0.1

PLASTIC LIMIT: 19

PERCENT SAND: 66.4

PLASTICITY INDEX: 17

PERCENT SILT & CLAY: 33.6

PARTICLE SIZE ANALYSIS

ASTM C136/C117/D422



PROJECT: BBN9 Water Supply District

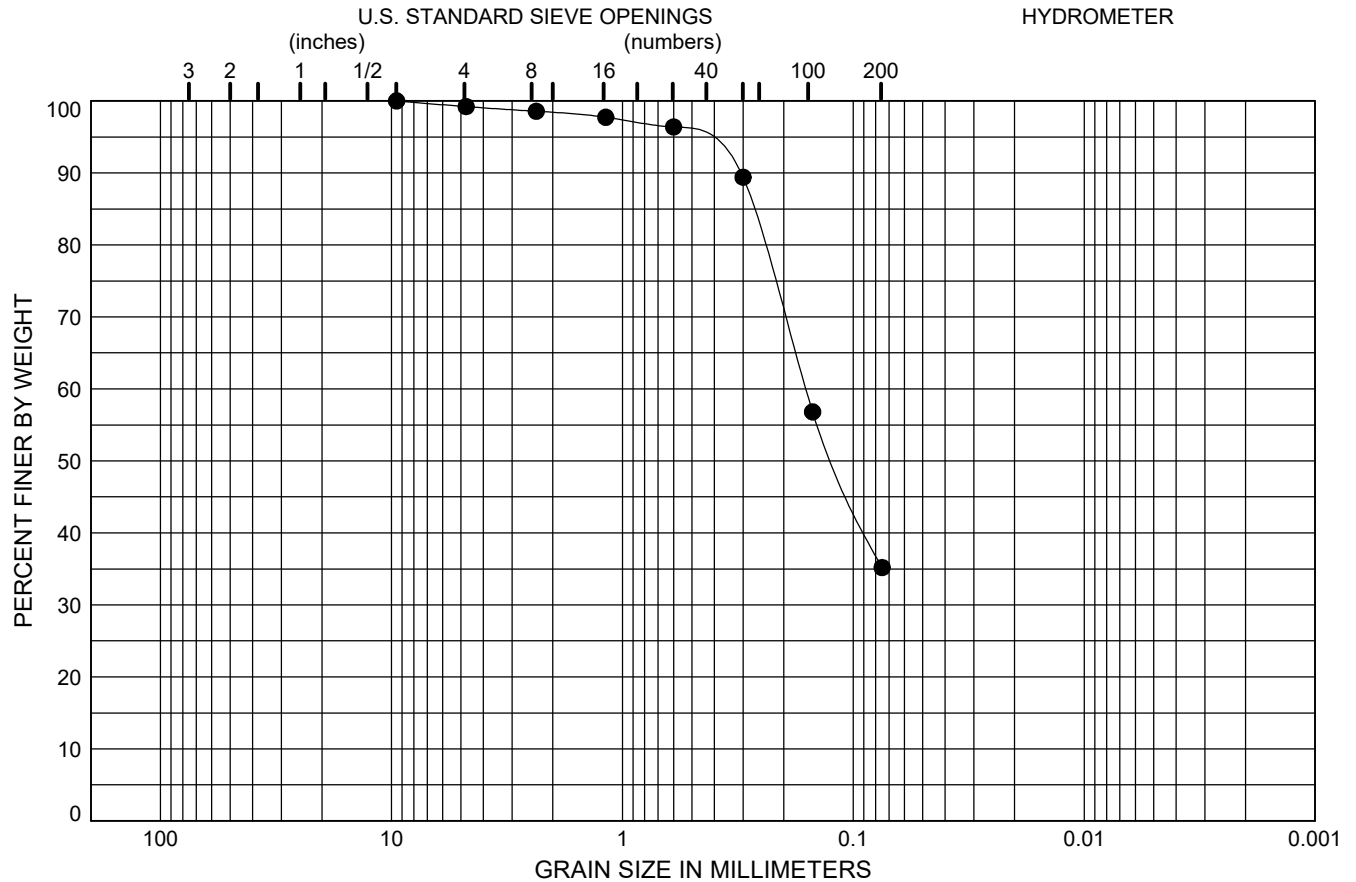
TEST DATE: 2/14/2023

JOB NO.: 23171-ZX

TESTED BY: JPM

CLIENT: Souder, Miller & Associates

TEST METHOD: ASTM D422



COBBLES	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT	CLAY

SOIL DESCRIPTION: Clayey Sand (SC)

SAMPLE NO.: 10.2-21-5

SOURCE: Boring 10.2-21

SAMPLED BY: ERH

DEPTH: 9.5

LIQUID LIMIT: 25

PERCENT GRAVEL: 0.8

PLASTIC LIMIT: 17

PERCENT SAND: 64.0

PLASTICITY INDEX: 8

PERCENT SILT & CLAY: 35.2

PARTICLE SIZE ANALYSIS

ASTM C136/C117/D422



PROJECT: BBN9 Water Supply District

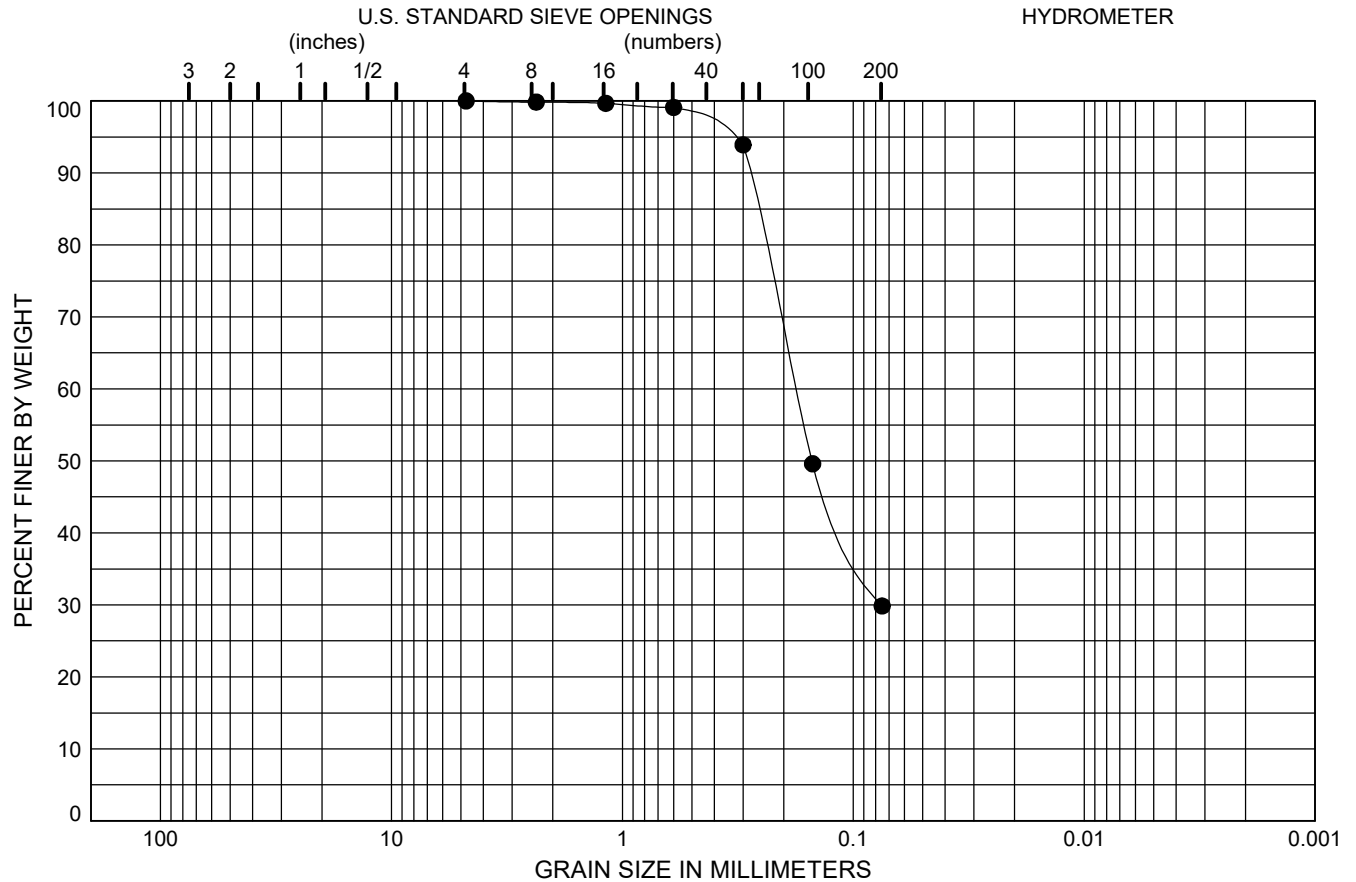
TEST DATE: 2/14/2023

JOB NO.: 23171-ZX

TESTED BY: JPM

CLIENT: Souder, Miller & Associates

TEST METHOD: ASTM D422



COBBLES	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT	CLAY

SOIL DESCRIPTION: Silty Sand (SM)

SAMPLE NO.: 10.2-25-2

SOURCE: Boring 10.2-25

SAMPLED BY: ERH

DEPTH: 3.5

LIQUID LIMIT: NP

PERCENT GRAVEL: 0.0

PLASTIC LIMIT: NP

PERCENT SAND: 70.1

PLASTICITY INDEX: NP

PERCENT SILT & CLAY: 29.9

PARTICLE SIZE ANALYSIS

ASTM C136/C117/D422



PROJECT: BBN9 Water Supply District

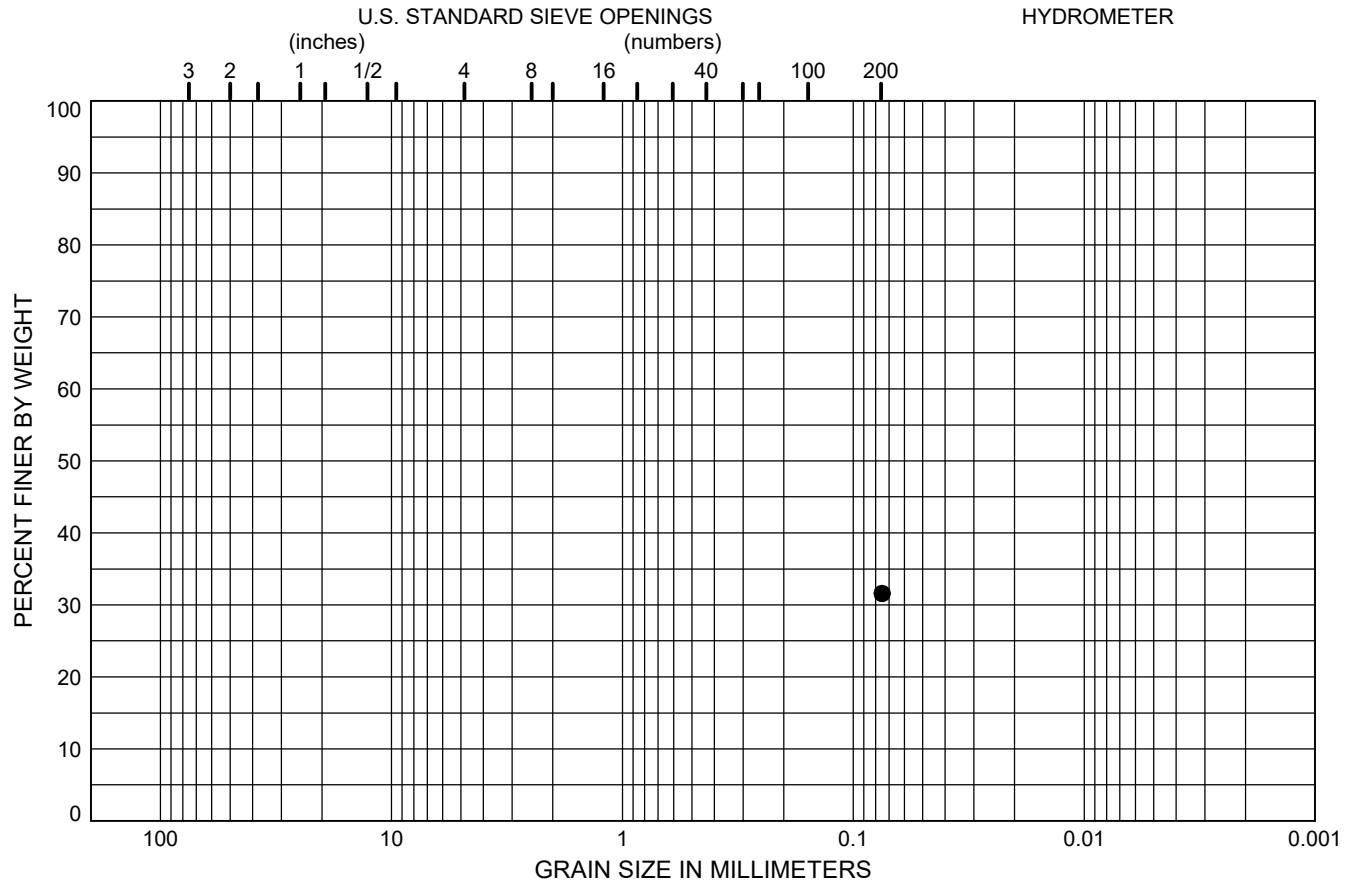
TEST DATE: 2/1/2023

JOB NO.: 23171-ZX

TESTED BY: JPM

CLIENT: Souder, Miller & Associates

TEST METHOD: ASTM D422



COBBLES	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT	CLAY

SOIL DESCRIPTION: Silty Sand (SM)

SAMPLE NO.: 10.2-HDD1-3

SOURCE: 10.2-HDD1

SAMPLED BY: ERH

DEPTH: 10

LIQUID LIMIT: NP

PERCENT GRAVEL: 0.0

PLASTIC LIMIT: NP

PERCENT SAND: 0.0

PLASTICITY INDEX: NP

PERCENT SILT & CLAY: 31.6

PARTICLE SIZE ANALYSIS

ASTM C136/C117/D422



PROJECT: BBN9 Water Supply District

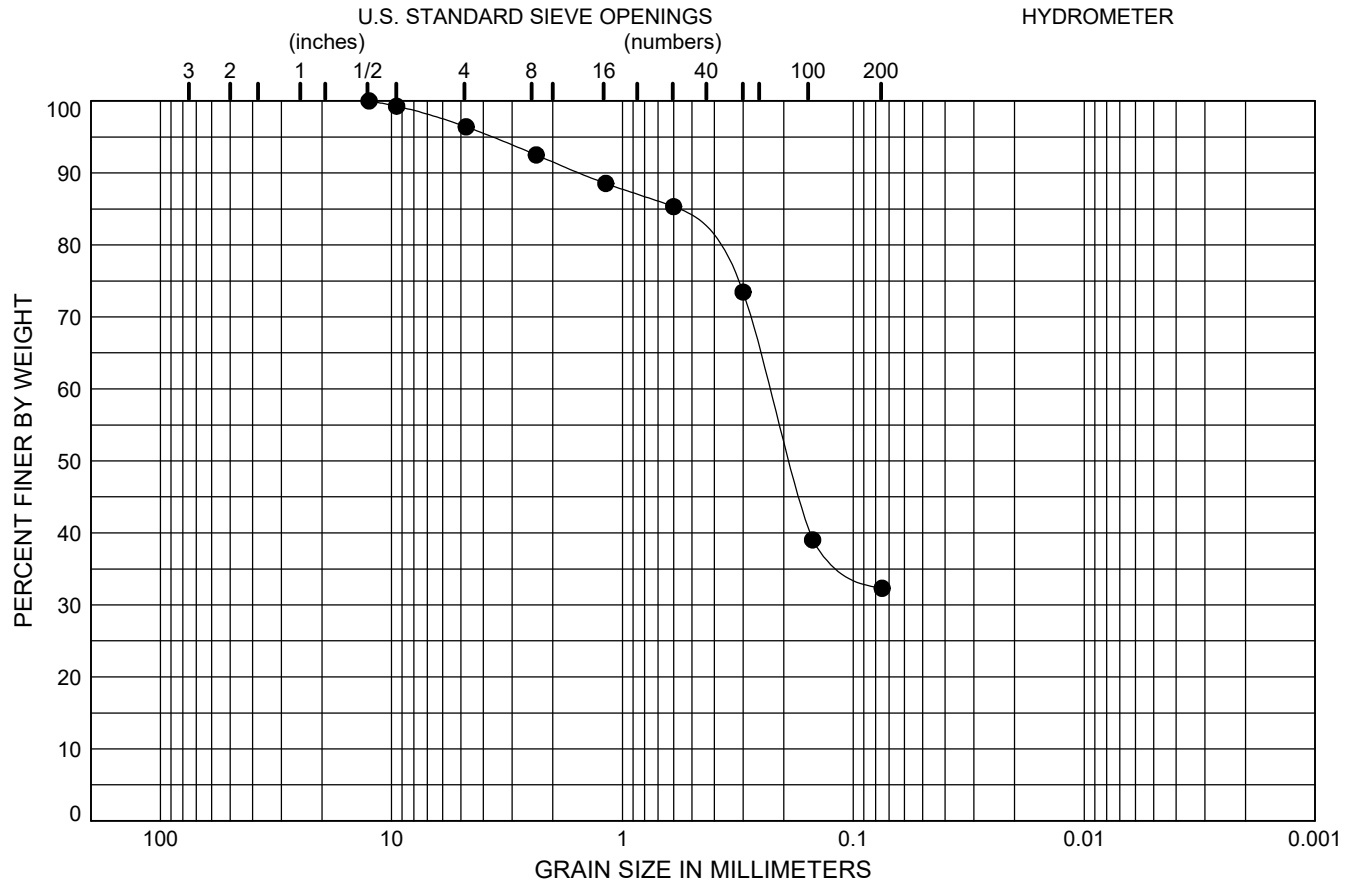
TEST DATE: 2/22/2023

JOB NO.: 23171-ZX

TESTED BY: JPM

CLIENT: Souder, Miller & Associates

TEST METHOD: ASTM D422



COBBLES	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT	CLAY

SOIL DESCRIPTION: Silty Sand (SM)

SAMPLE NO.: 10.2-HDD1-5

SOURCE: 10.2-HDD1

SAMPLED BY: ERH

DEPTH: 20

LIQUID LIMIT: NP

PERCENT GRAVEL: 3.6

PLASTIC LIMIT: NP

PERCENT SAND: 64.1

PLASTICITY INDEX: NP

PERCENT SILT & CLAY: 32.3

SIZE ANALYSIS-1 23171-ZX FINAL BORING LOGS.GPJ INB MILLR.GDT 3/28/23

PARTICLE SIZE ANALYSIS

ASTM C136/C117/D422



PROJECT: BBN9 Water Supply District

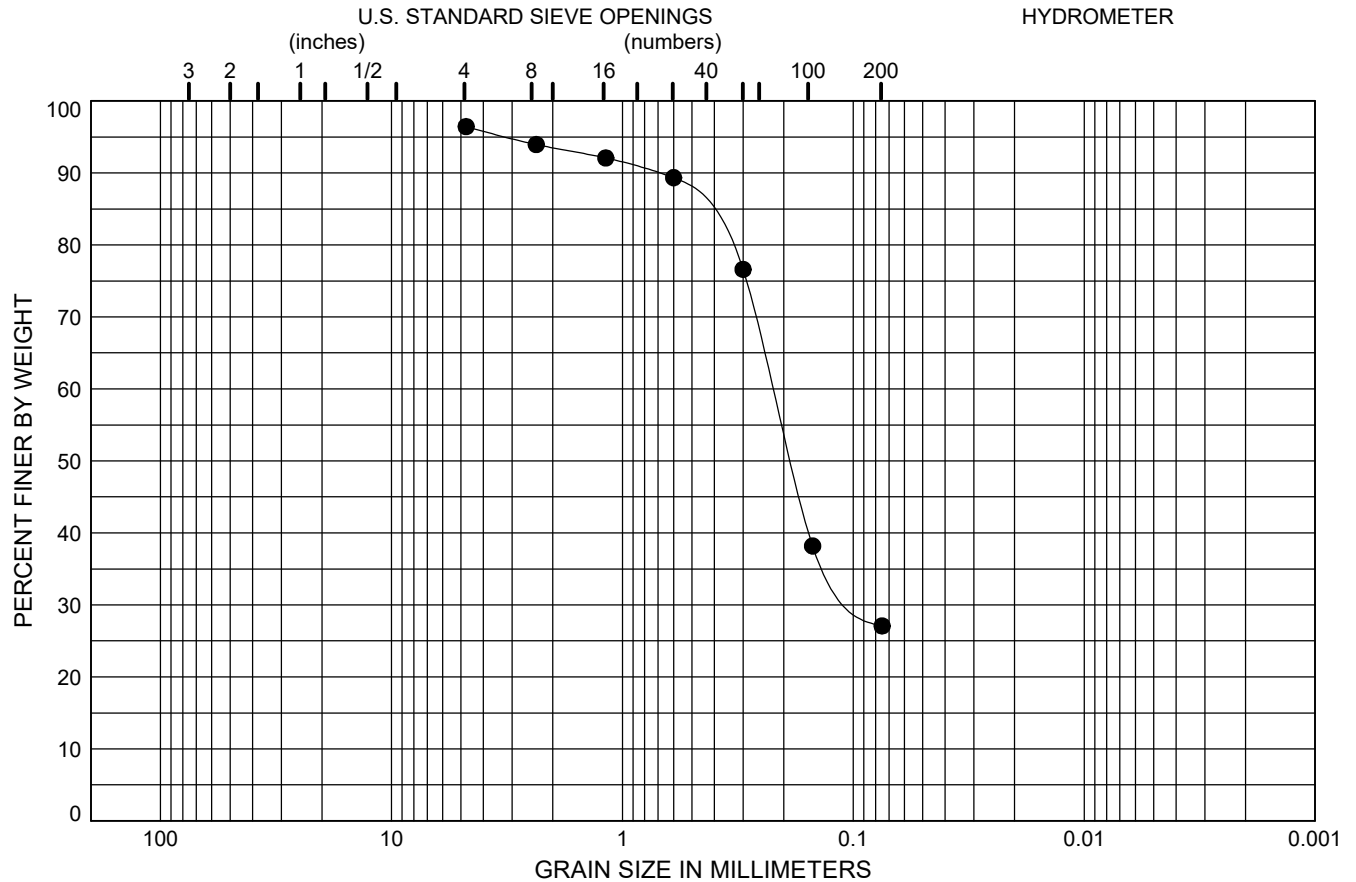
TEST DATE: 2/1/2023

JOB NO.: 23171-ZX

TESTED BY: JPM

CLIENT: Souder, Miller & Associates

TEST METHOD: ASTM D422



COBBLES	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT	CLAY

SOIL DESCRIPTION: Silty Sand (SM)

SAMPLE NO.: 10.2-HDD1-7

SOURCE: 10.2-HDD1

SAMPLED BY: ERH

DEPTH: 30

LIQUID LIMIT: _____

PERCENT GRAVEL: 0.0

PLASTIC LIMIT: _____

PERCENT SAND: 69.4

PLASTICITY INDEX: _____

PERCENT SILT & CLAY: 27.1

SIZE ANALYSIS-1 23171-ZX FINAL BORING LOGS.GPJ INB MLR.GDT 3/28/23

PARTICLE SIZE ANALYSIS

ASTM C136/C117/D422



PROJECT: BBN9 Water Supply District

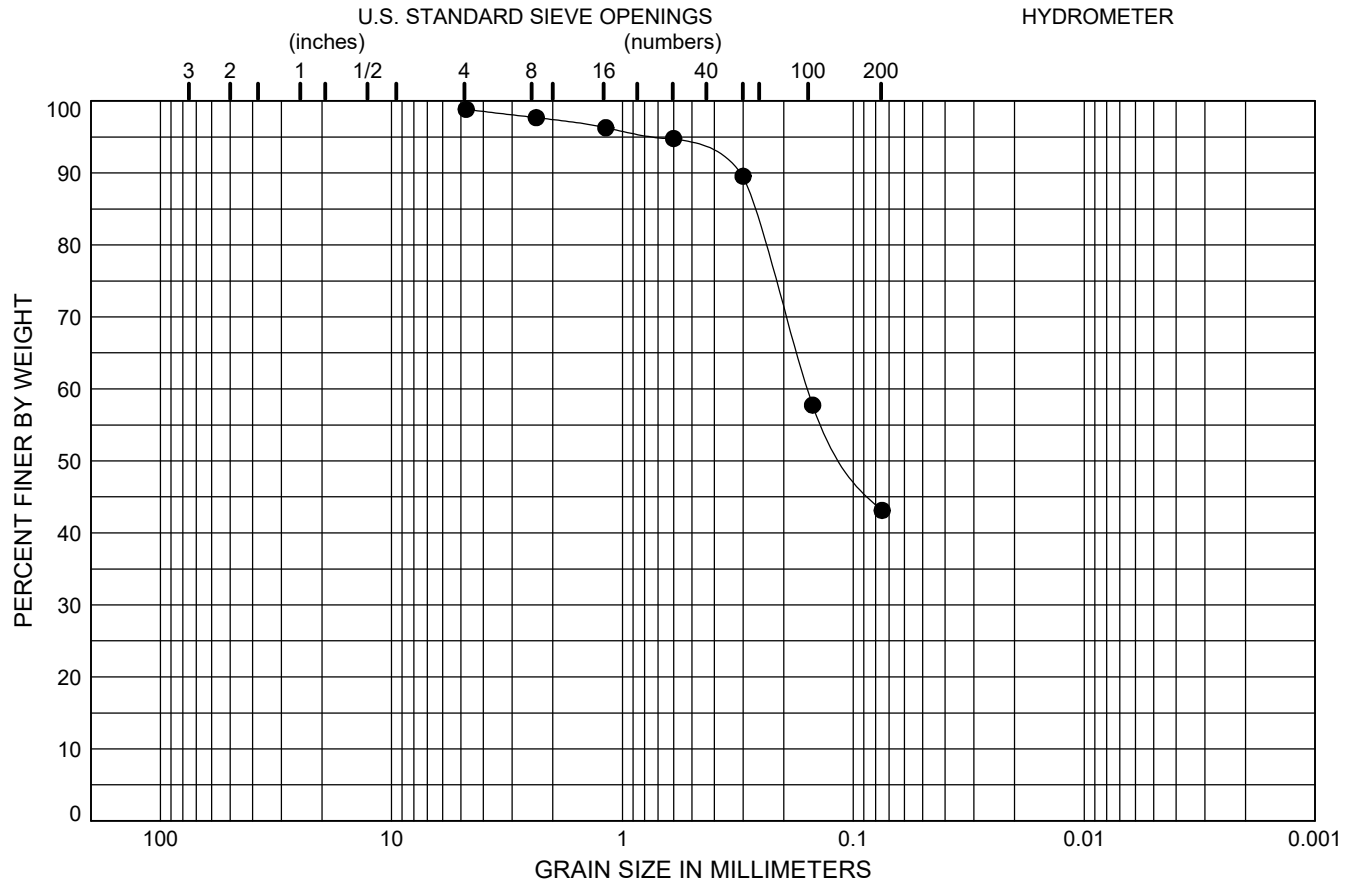
TEST DATE: 1/20/2023

JOB NO.: 23171-ZX

TESTED BY: JPM

CLIENT: Souder, Miller & Associates

TEST METHOD: ASTM D422



COBBLES	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT	CLAY

SOIL DESCRIPTION: Silty Sand (SM)

SAMPLE NO.: 10.2.1-4-2

SOURCE: Boring 10.2.1-4

SAMPLED BY: ERH

DEPTH: 2.5

LIQUID LIMIT: NP

PERCENT GRAVEL: 0.0

PLASTIC LIMIT: NP

PERCENT SAND: 55.7

PLASTICITY INDEX: NP

PERCENT SILT & CLAY: 43.1

PARTICLE SIZE ANALYSIS

ASTM C136/C117/D422



PROJECT: BBN9 Water Supply District

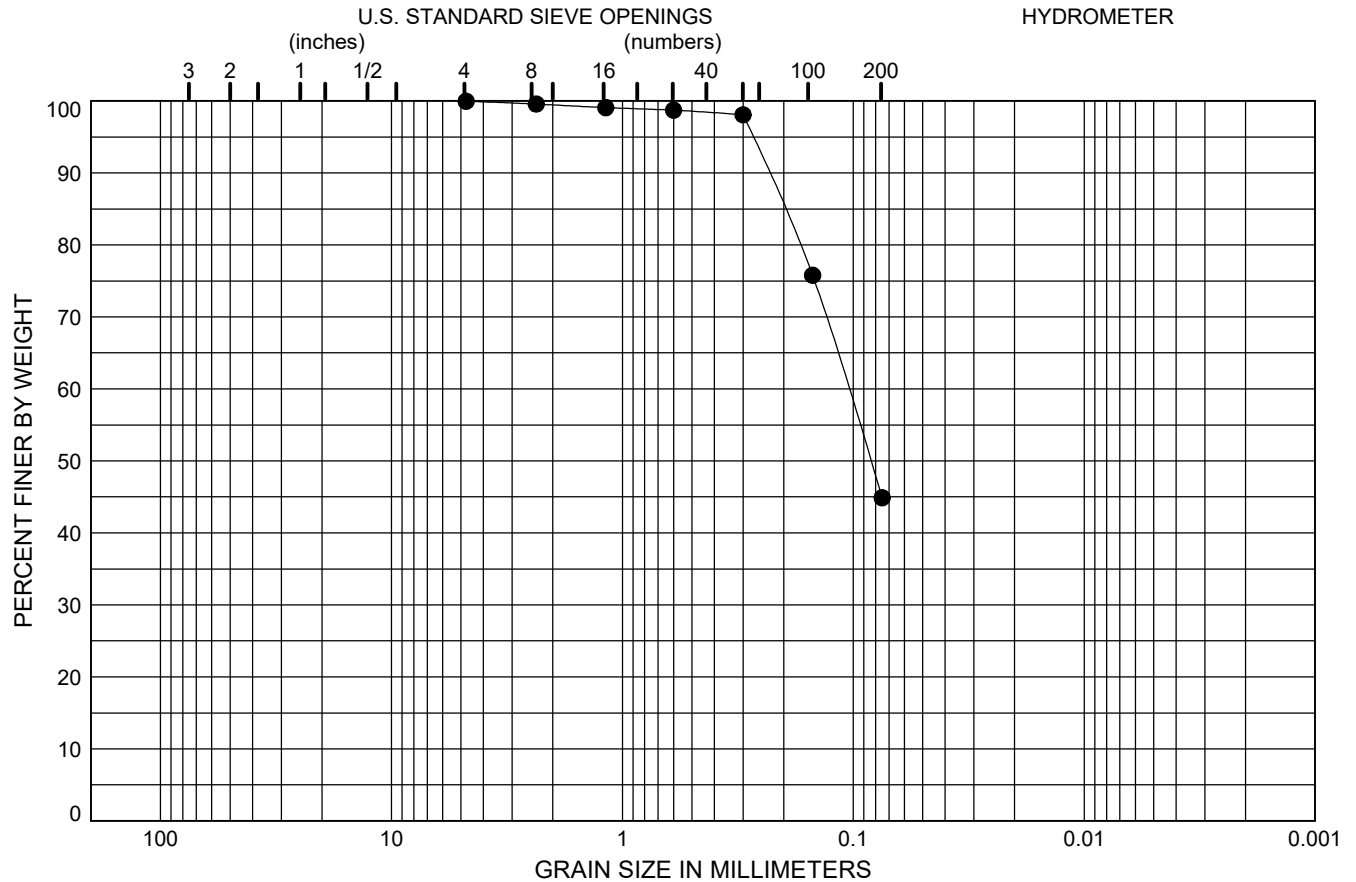
TEST DATE: 1/20/2023

JOB NO.: 23171-ZX

TESTED BY: JPM

CLIENT: Souder, Miller & Associates

TEST METHOD: ASTM D422



COBBLES	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT	CLAY

SOIL DESCRIPTION: Clayey Sand (SC)

SAMPLE NO.: 10.2.1-8-4

SOURCE: Boring 10.2.1-8

SAMPLED BY: ERH

DEPTH: 7.5

LIQUID LIMIT: 47

PERCENT GRAVEL: 0.0

PLASTIC LIMIT: 22

PERCENT SAND: 55.1

PLASTICITY INDEX: 25

PERCENT SILT & CLAY: 44.9

PARTICLE SIZE ANALYSIS

ASTM C136/C117/D422



PROJECT: BBN9 Water Supply District

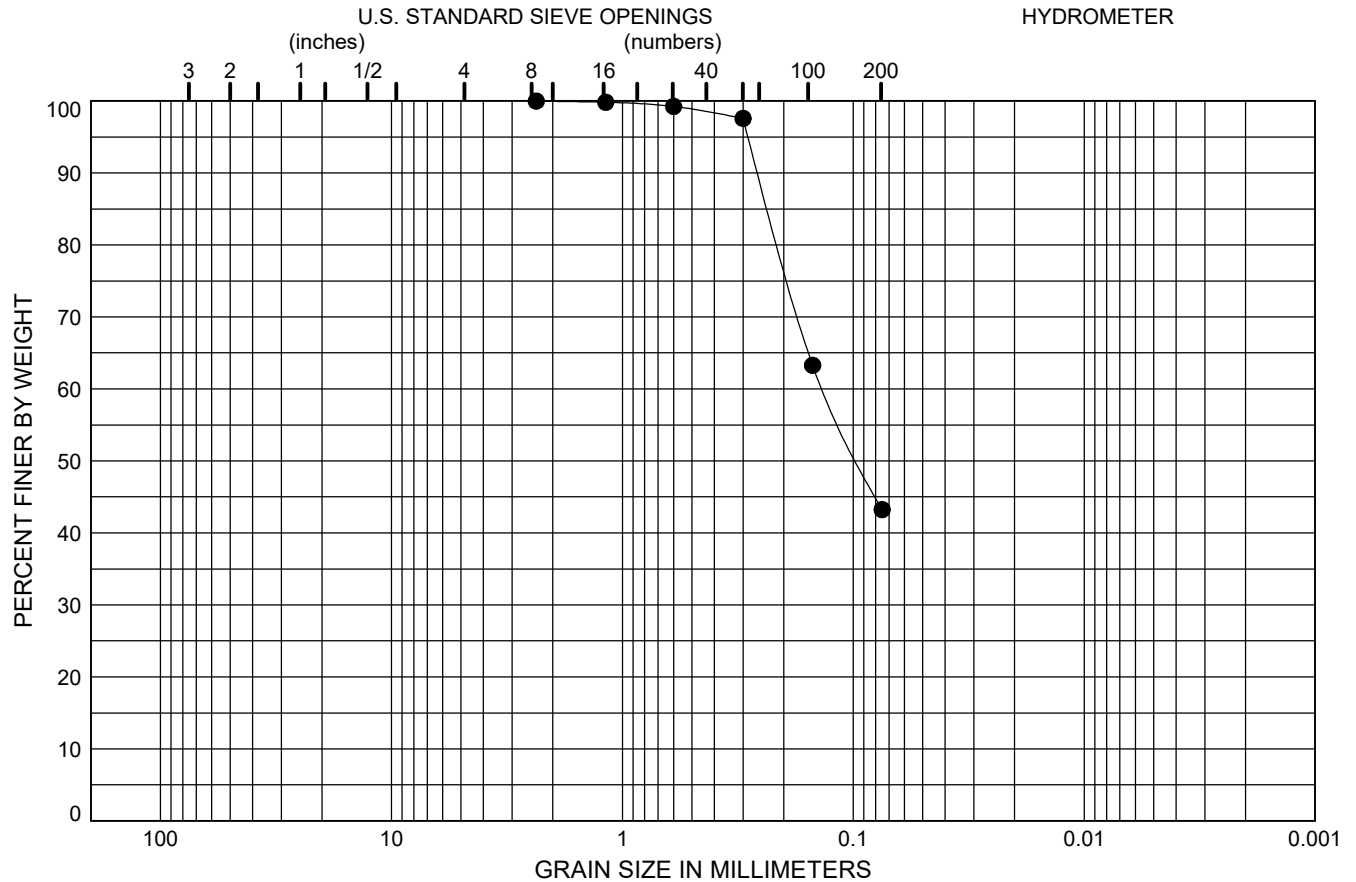
TEST DATE: 2/1/2023

JOB NO.: 23171-ZX

TESTED BY: JPM

CLIENT: Souder, Miller & Associates

TEST METHOD: ASTM D422



COBBLES	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT	CLAY

SOIL DESCRIPTION: Clayey Sand (SC)

SAMPLE NO.: 10.2.1-12-2

SOURCE: Boring 10.2.1-12

SAMPLED BY: ERH

DEPTH: 2.5

LIQUID LIMIT: 42

PERCENT GRAVEL: 0.0

PLASTIC LIMIT: 21

PERCENT SAND: 56.7

PLASTICITY INDEX: 21

PERCENT SILT & CLAY: 43.2

PARTICLE SIZE ANALYSIS

ASTM C136/C117/D422



PROJECT: BBN9 Water Supply District

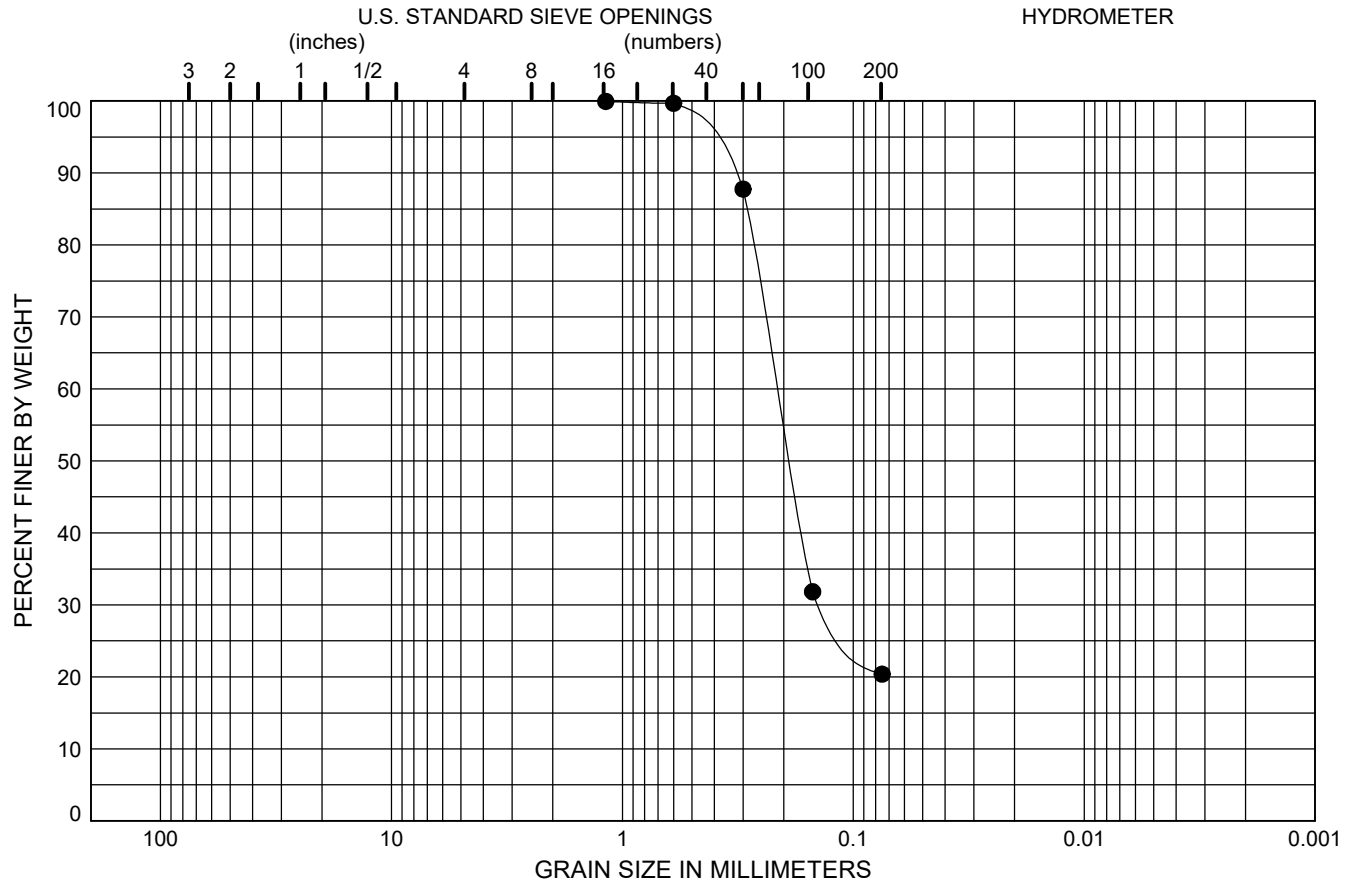
TEST DATE: 2/1/2023

JOB NO.: 23171-ZX

TESTED BY: JPM

CLIENT: Souder, Miller & Associates

TEST METHOD: ASTM D422



COBBLES	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT	CLAY

SOIL DESCRIPTION: Silty Sand (SM)

SAMPLE NO.: 10.2.1-17-1

SOURCE: Boring 10.2.1-17

SAMPLED BY: ERH

DEPTH: 0

LIQUID LIMIT: NP

PERCENT GRAVEL: 0.0

PLASTIC LIMIT: NP

PERCENT SAND: 79.5

PLASTICITY INDEX: NP

PERCENT SILT & CLAY: 20.4

SIZE ANALYSIS-1 23171-ZX FINAL BORING LOGS.GPJ INB MLLR.GDT 3/28/23

PARTICLE SIZE ANALYSIS

ASTM C136/C117/D422



PROJECT: BBN9 Water Supply District

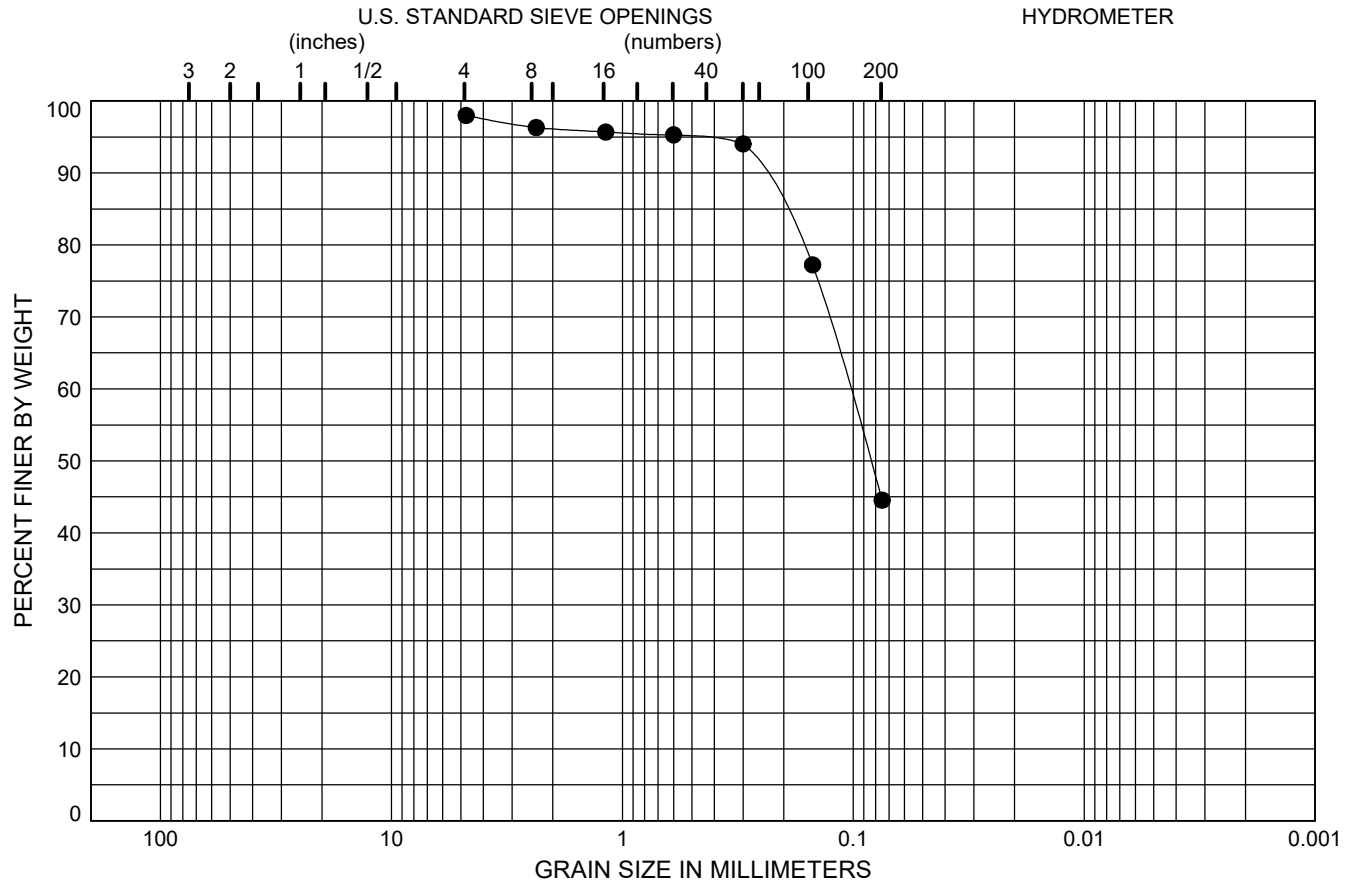
TEST DATE: 1/20/2023

JOB NO.: 23171-ZX

TESTED BY: JPM

CLIENT: Souder, Miller & Associates

TEST METHOD: ASTM D422



COBBLES	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT	CLAY

SOIL DESCRIPTION: Clayey Sand (SC)

SAMPLE NO.: 10.3-9-3

SOURCE: Boring 10.3-9

SAMPLED BY: ERH

DEPTH: 5

LIQUID LIMIT: 58

PERCENT GRAVEL: 0.0

PLASTIC LIMIT: 23

PERCENT SAND: 53.4

PLASTICITY INDEX: 35

PERCENT SILT & CLAY: 44.5

SIZE ANALYSIS-1 23171-ZX FINAL BORING LOGS.GPJ INB MILLR.GDT 3/28/23

PARTICLE SIZE ANALYSIS

ASTM C136/C117/D422



PROJECT: BBN9 Water Supply District

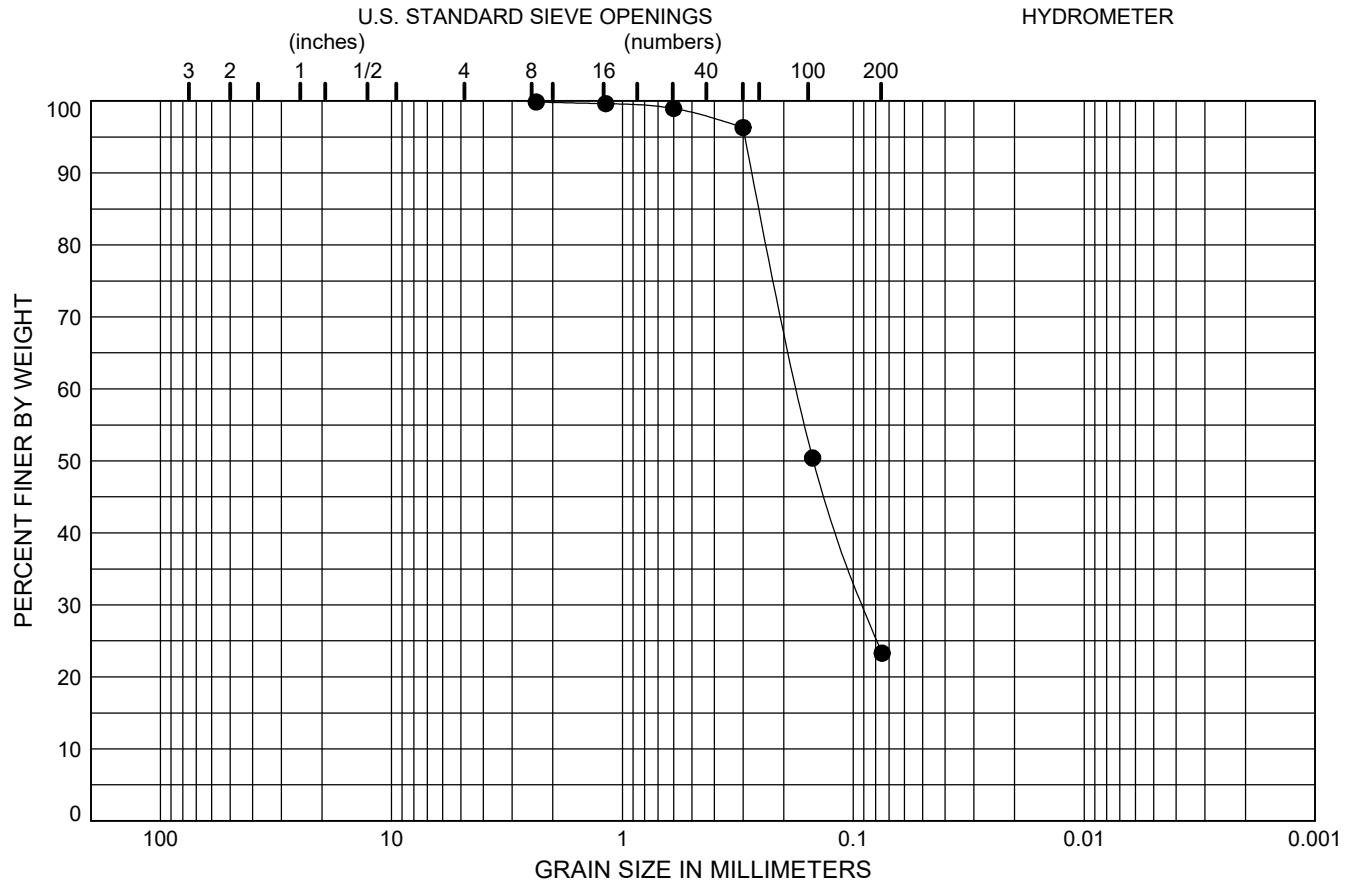
TEST DATE: 1/24/2023

JOB NO.: 23171-ZX

TESTED BY: JPM

CLIENT: Souder, Miller & Associates

TEST METHOD: ASTM D422



COBBLES	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT	CLAY

SOIL DESCRIPTION: Silty Sand (SM)

SAMPLE NO.: 10.3-13-2

SOURCE: Boring 10.3-13

SAMPLED BY: ERH

DEPTH: 2.5

LIQUID LIMIT: NP

PERCENT GRAVEL: 0.0

PLASTIC LIMIT: NP

PERCENT SAND: 76.6

PLASTICITY INDEX: NP

PERCENT SILT & CLAY: 23.3

PARTICLE SIZE ANALYSIS

ASTM C136/C117/D422



PROJECT: BBN9 Water Supply District

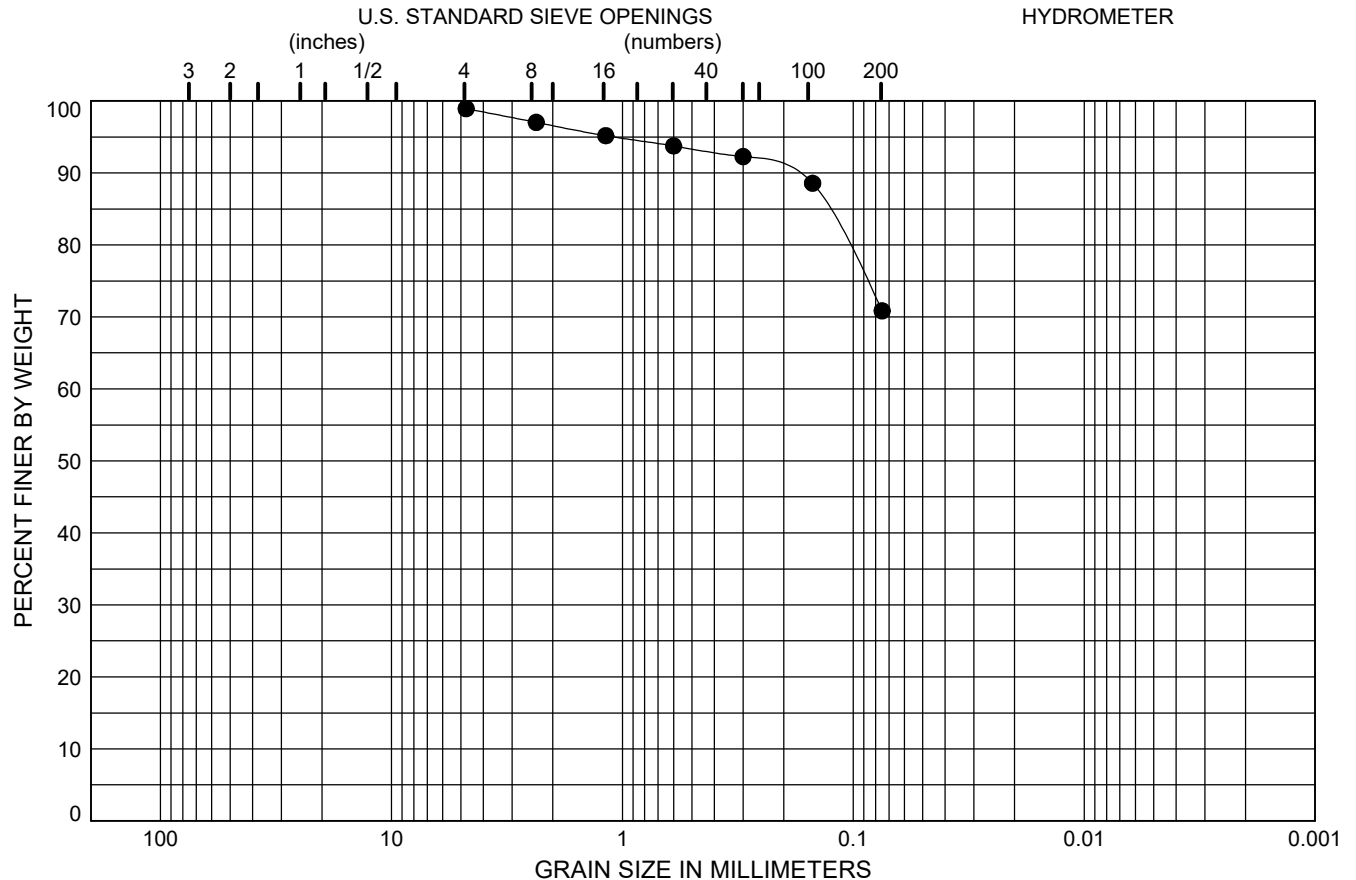
TEST DATE: 1/24/2023

JOB NO.: 23171-ZX

TESTED BY: JPM

CLIENT: Souder, Miller & Associates

TEST METHOD: ASTM D422



COBBLES	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT	CLAY

SOIL DESCRIPTION: Sandy Shale (CL)

SAMPLE NO.: 10.3-17-4

SOURCE: Boring 10.3-17

SAMPLED BY: ERH

DEPTH: 7.5

LIQUID LIMIT: 28

PERCENT GRAVEL: 0.0

PLASTIC LIMIT: 20

PERCENT SAND: 28.1

PLASTICITY INDEX: 8

PERCENT SILT & CLAY: 70.8

PARTICLE SIZE ANALYSIS

ASTM C136/C117/D422



PROJECT: BBN9 Water Supply District

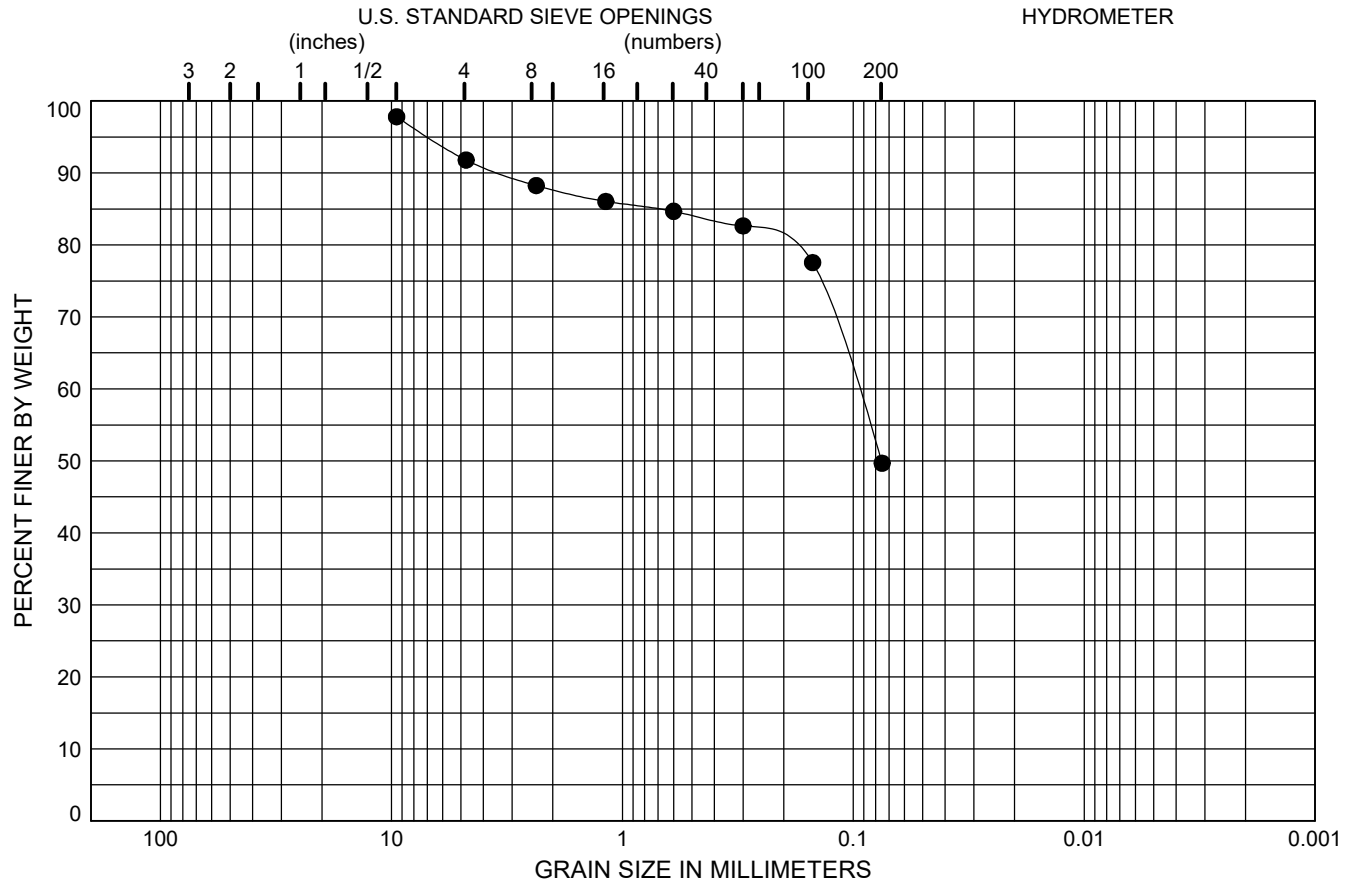
TEST DATE: 1/24/2023

JOB NO.: 23171-ZX

TESTED BY: JPM

CLIENT: Souder, Miller & Associates

TEST METHOD: ASTM D422



COBBLES	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT	CLAY

SOIL DESCRIPTION: Silty Shale (CL-ML)

SAMPLE NO.: 10.3-HDD1-2

SOURCE: Boring 10.3-HDD1

SAMPLED BY: ERH

DEPTH: 5

LIQUID LIMIT: _____

PERCENT GRAVEL: 6.0

PLASTIC LIMIT: _____

PERCENT SAND: 42.1

PLASTICITY INDEX: _____

PERCENT SILT & CLAY: 49.7

SIZE ANALYSIS-1 23171-ZX FINAL BORING LOGS.GPJ INB MLR.GDT 3/28/23

PARTICLE SIZE ANALYSIS

ASTM C136/C117/D422



PROJECT: BBN9 Water Supply District

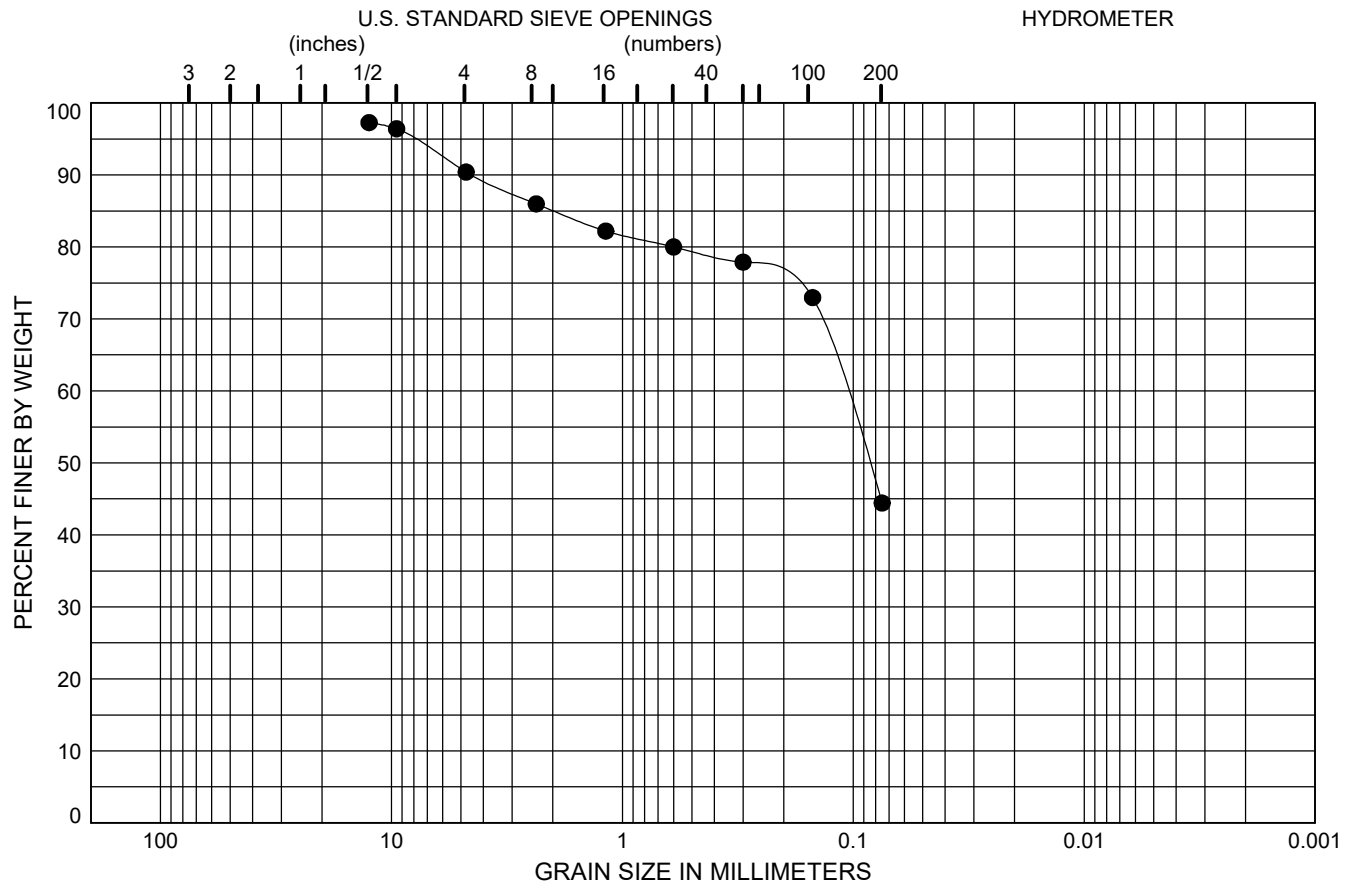
TEST DATE: 1/24/2023

JOB NO.: 23171-ZX

TESTED BY: 1-24

CLIENT: Souder, Miller & Associates

TEST METHOD: ASTM D422



COBBLES	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT	CLAY

SOIL DESCRIPTION: Silty Clayey Sand (SC-SM)

SAMPLE NO.: 10.3-21-4

SAMPLED BY: ERH

SOURCE: Boring 10.3-21

DEPTH: 7.5

LIQUID LIMIT: 24

PERCENT GRAVEL: 6.9

PLASTIC LIMIT: 20

PERCENT SAND: 46.0

PLASTICITY INDEX: 4

PERCENT SILT & CLAY: 44.4

SIZE ANALYSIS-1 23171-ZX FINAL BORING LOGS.GPJ INB_MLLR.GDT 3/28/23

PARTICLE SIZE ANALYSIS

ASTM C136/C117/D422



PROJECT: BBN9 Water Supply District

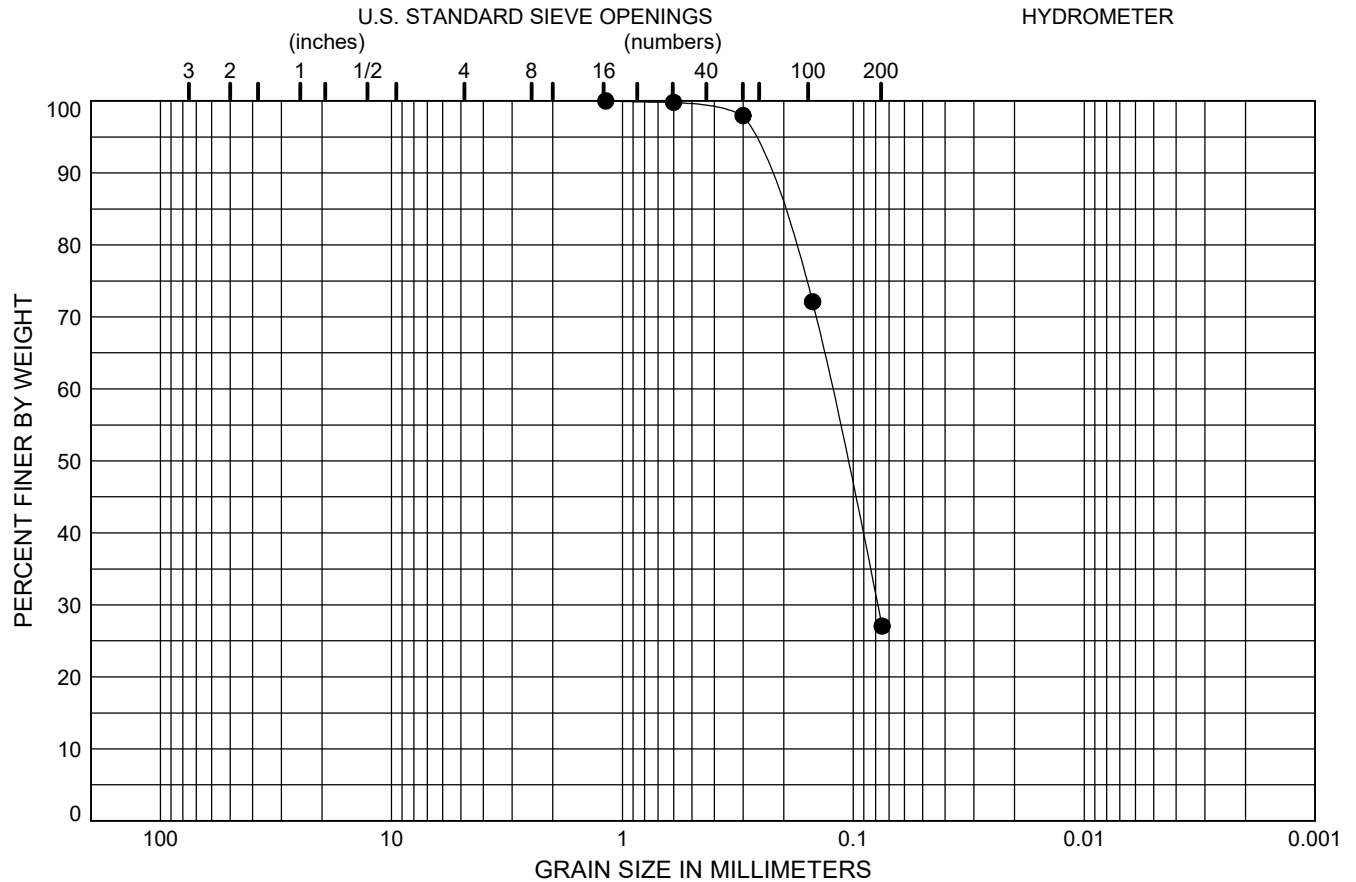
TEST DATE: 2/14/2023

JOB NO.: 23171-ZX

TESTED BY: JPM

CLIENT: Souder, Miller & Associates

TEST METHOD: ASTM D422



COBBLES	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT	CLAY

SOIL DESCRIPTION: Silty Sand (SM)

SAMPLE NO.: 10.3-25-3

SOURCE: Boring 10.3-25

SAMPLED BY: ERH

DEPTH: 5

LIQUID LIMIT: NP

PERCENT GRAVEL: 0.0

PLASTIC LIMIT: NP

PERCENT SAND: 72.9

PLASTICITY INDEX: NP

PERCENT SILT & CLAY: 27.1

SIZE ANALYSIS-1 23171-ZX FINAL BORING LOGS.GPJ INB MLR.GDT 3/28/23

PARTICLE SIZE ANALYSIS

ASTM C136/C117/D422



PROJECT: BBN9 Water Supply District

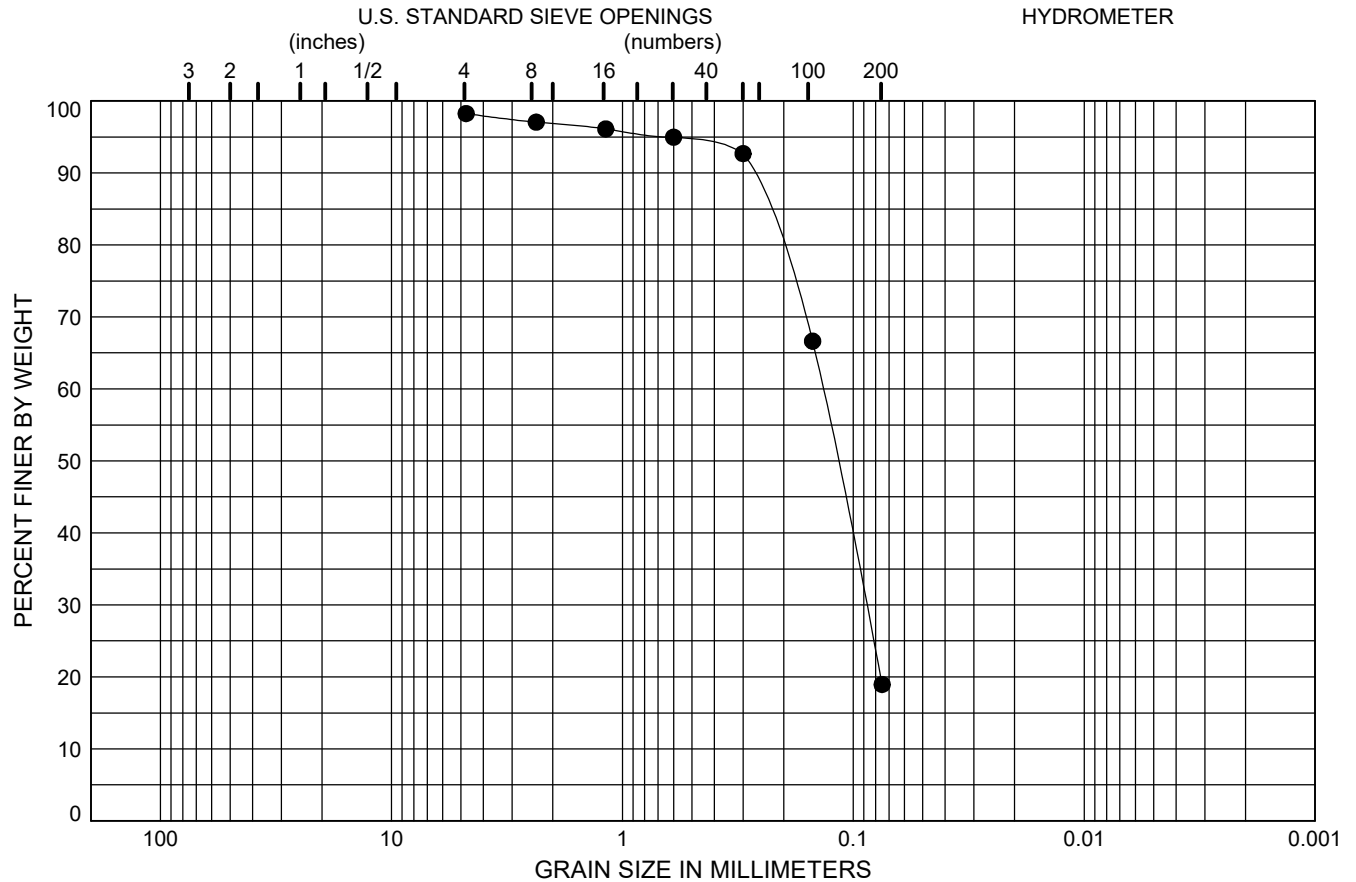
TEST DATE: 1/24/2023

JOB NO.: 23171-ZX

TESTED BY: JPM

CLIENT: Souder, Miller & Associates

TEST METHOD: ASTM D422



COBBLES	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT	CLAY

SOIL DESCRIPTION: Silty Sand (SM)

SAMPLE NO.: 10.3-29-2

SOURCE: Boring 10.3-29

SAMPLED BY: ERH

DEPTH: 2.5

LIQUID LIMIT: NP

PERCENT GRAVEL: 0.0

PLASTIC LIMIT: NP

PERCENT SAND: 79.3

PLASTICITY INDEX: NP

PERCENT SILT & CLAY: 18.9

SIZE ANALYSIS-1 23171-ZX FINAL BORING LOGS.GPJ INB MILLR.GDT 3/28/23

PARTICLE SIZE ANALYSIS

ASTM C136/C117/D422



PROJECT: BBN9 Water Supply District

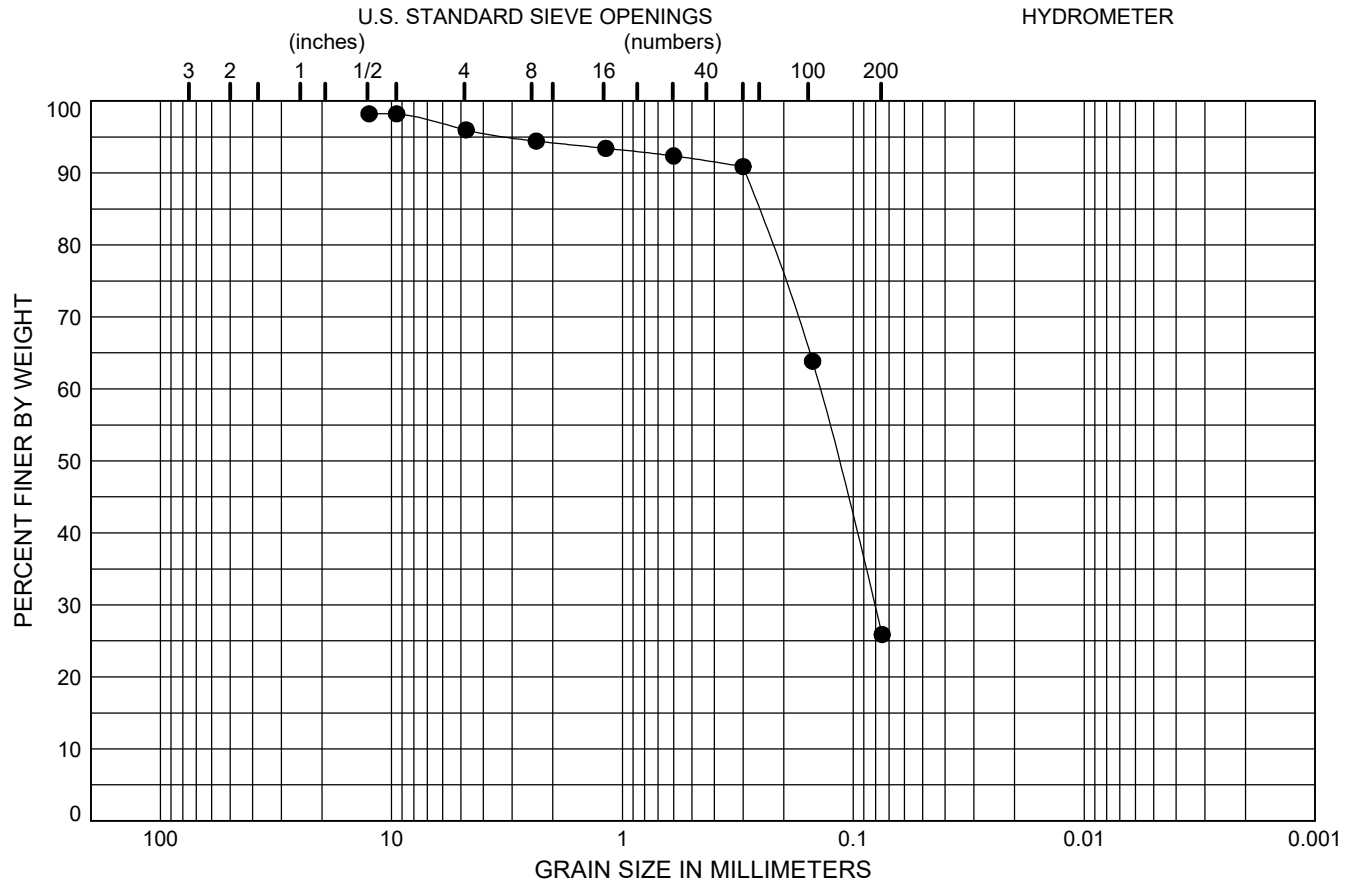
TEST DATE: 1/24/2023

JOB NO.: 23171-ZX

TESTED BY: JPM

CLIENT: Souder, Miller & Associates

TEST METHOD: ASTM D422



COBBLES	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT	CLAY

SOIL DESCRIPTION: Silty Sand (SM)

SAMPLE NO.: 10.3.1-1-1

SOURCE: Boring 10.3.1-1

SAMPLED BY: ERH

DEPTH: 0

LIQUID LIMIT: NP

PERCENT GRAVEL: 2.2

PLASTIC LIMIT: NP

PERCENT SAND: 70.1

PLASTICITY INDEX: NP

PERCENT SILT & CLAY: 25.9

SIZE ANALYSIS-1 23171-ZX FINAL BORING LOGS.GPJ INB MILLR.GDT 3/28/23

PARTICLE SIZE ANALYSIS

ASTM C136/C117/D422



PROJECT: BBN9 Water Supply District

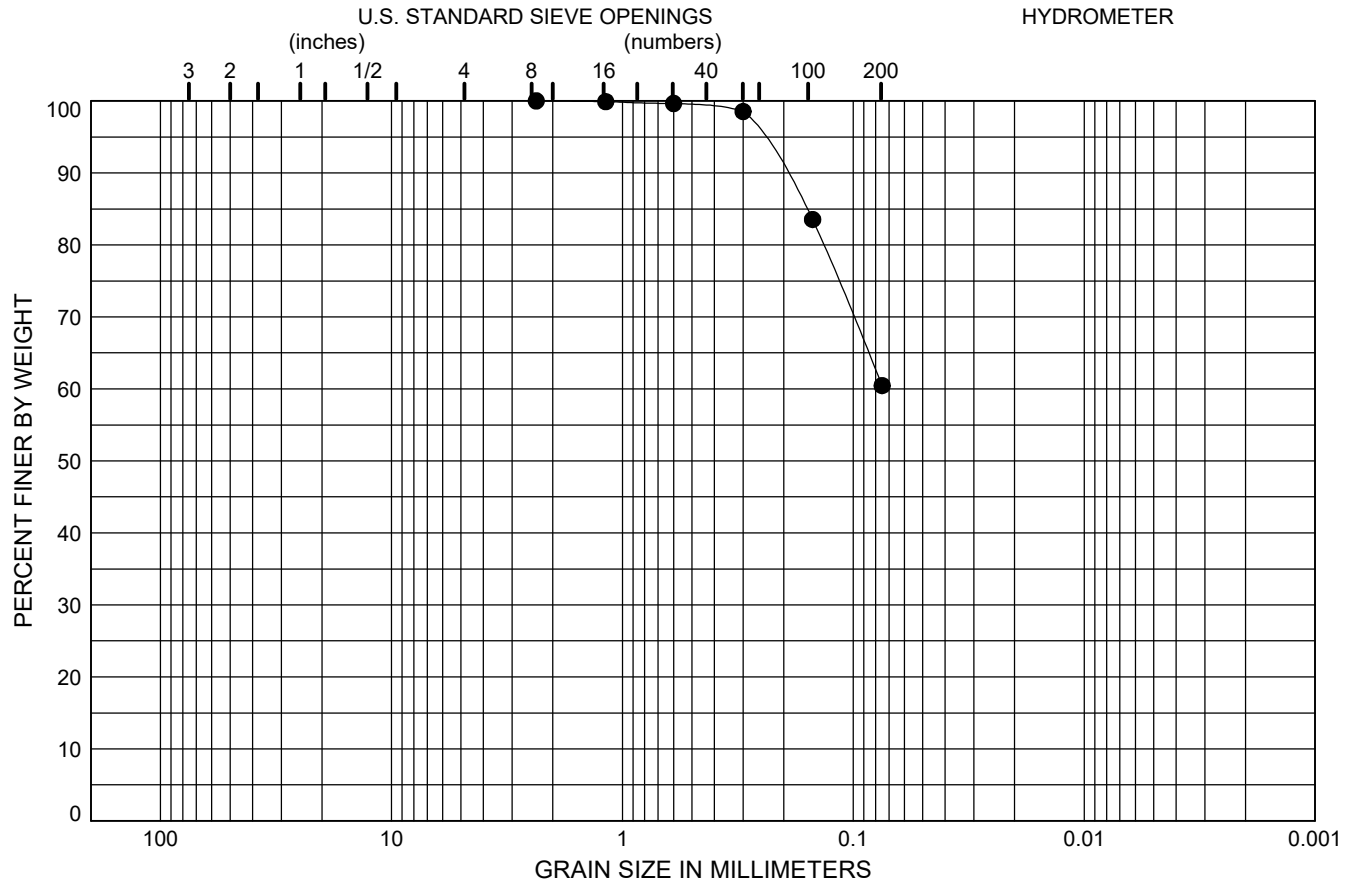
TEST DATE: 2/14/2023

JOB NO.: 23171-ZX

TESTED BY: JPM

CLIENT: Souder, Miller & Associates

TEST METHOD: ASTM D422



COBBLES	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT	CLAY

SOIL DESCRIPTION: Sandy Silty Clay (CL-ML)

SAMPLE NO.: 10.3.1-HDD1-3

SOURCE: Boring 10.3.1-HDD1

SAMPLED BY: ERH

DEPTH: 10

LIQUID LIMIT: 26

PERCENT GRAVEL: 0.0

PLASTIC LIMIT: 18

PERCENT SAND: 39.5

PLASTICITY INDEX: 8

PERCENT SILT & CLAY: 60.5

PARTICLE SIZE ANALYSIS

ASTM C136/C117/D422



PROJECT: BBN9 Water Supply District

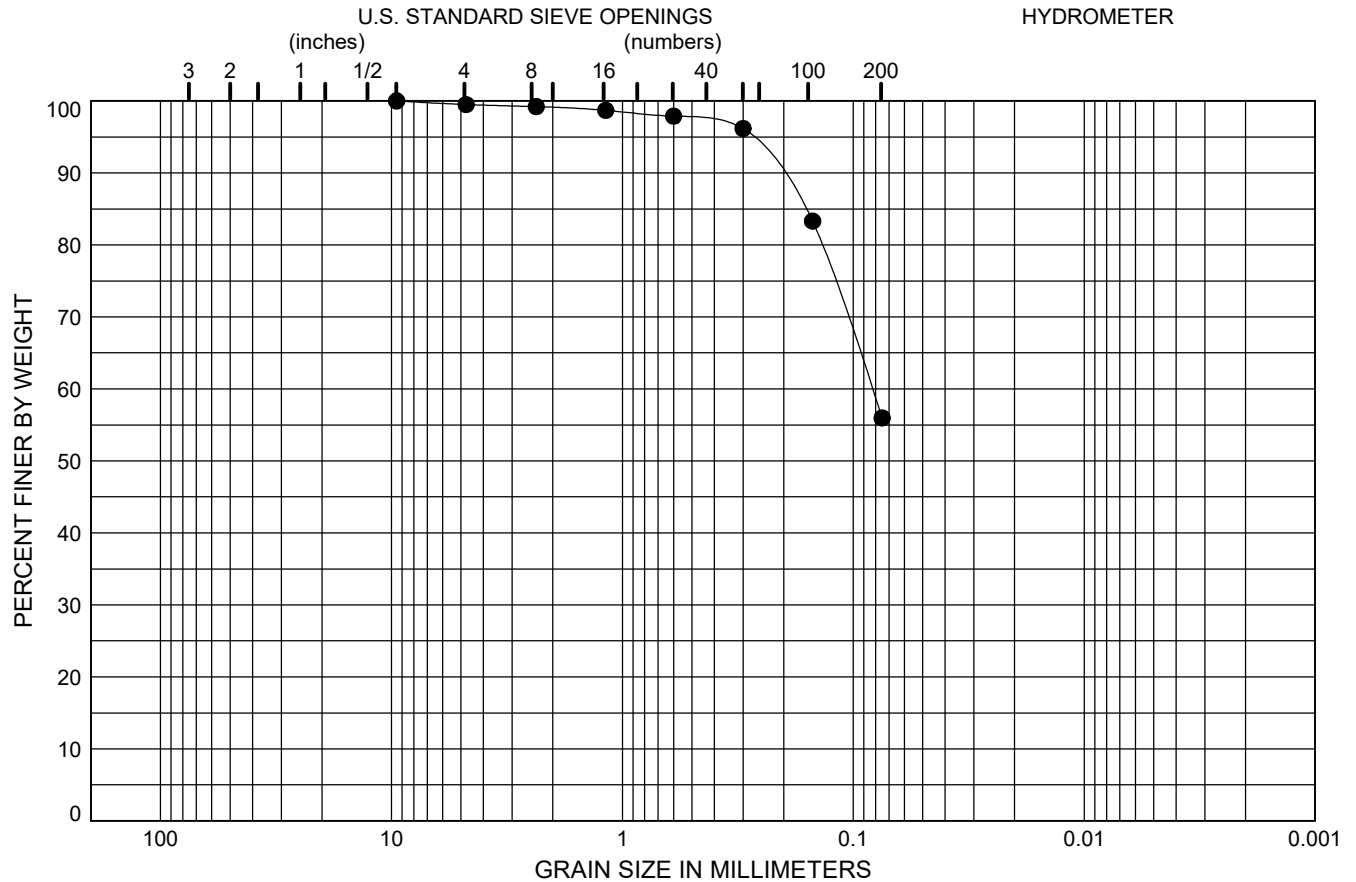
TEST DATE: 2/14/2023

JOB NO.: 23171-ZX

TESTED BY: JPM

CLIENT: Souder, Miller & Associates

TEST METHOD: ASTM D422



PARTICLE SIZE ANALYSIS

ASTM C136/C117/D422



PROJECT: BBN9 Water Supply District

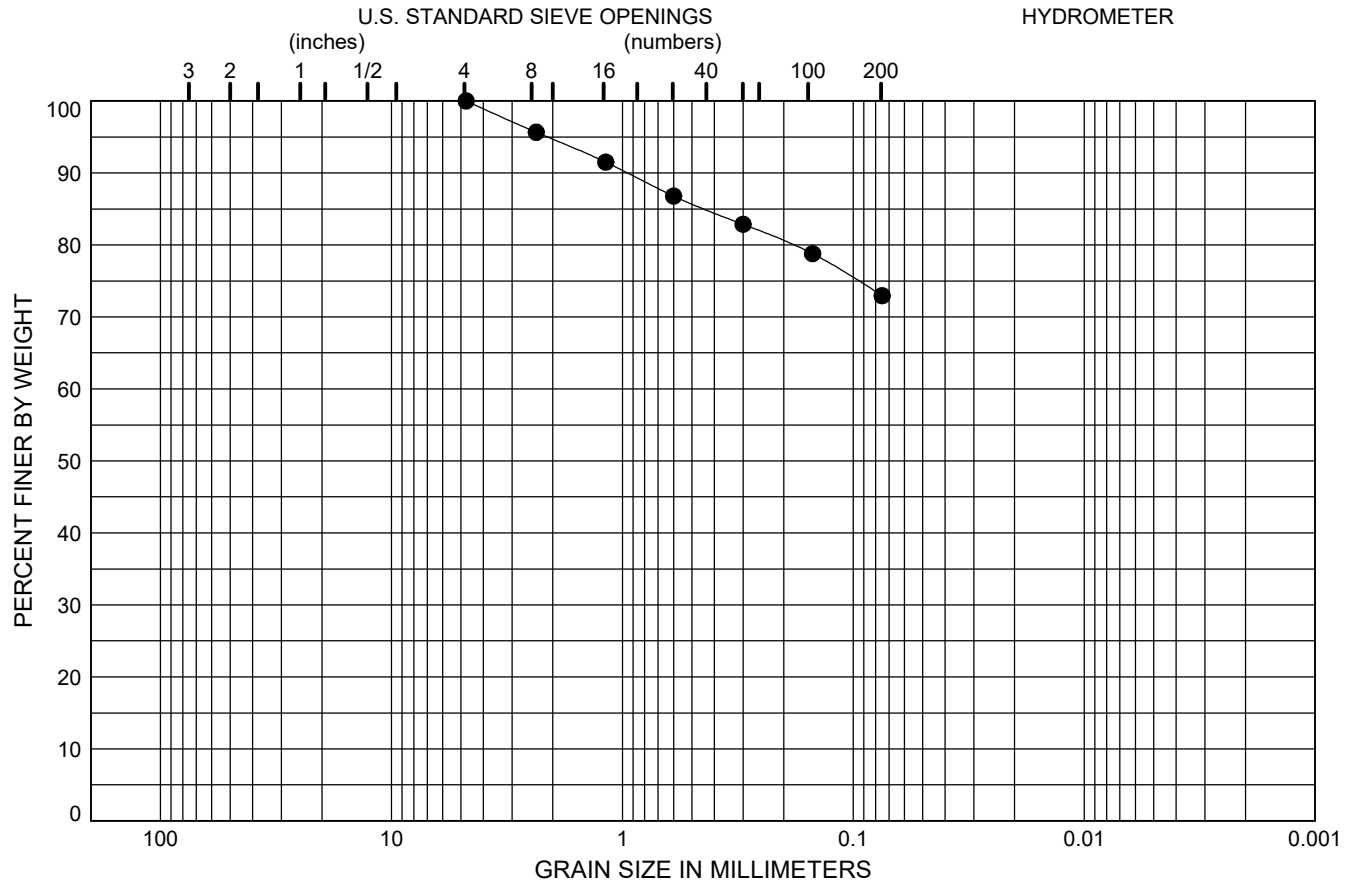
TEST DATE: 2/14/2023

JOB NO.: 23171-ZX

TESTED BY: JPM

CLIENT: Souder, Miller & Associates

TEST METHOD: ASTM D422



COBBLES	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT	CLAY

SOIL DESCRIPTION: Sandy Shale (CL)

SAMPLE NO.: 10.3.1-HDD1-10

SOURCE: Boring 10.3.1-HDD1

SAMPLED BY: ERH

DEPTH: 45

LIQUID LIMIT: 40

PERCENT GRAVEL: 0.0

PLASTIC LIMIT: 20

PERCENT SAND: 27.1

PLASTICITY INDEX: 20

PERCENT SILT & CLAY: 72.9

PARTICLE SIZE ANALYSIS

ASTM C136/C117/D422



PROJECT: BBN9 Water Supply District

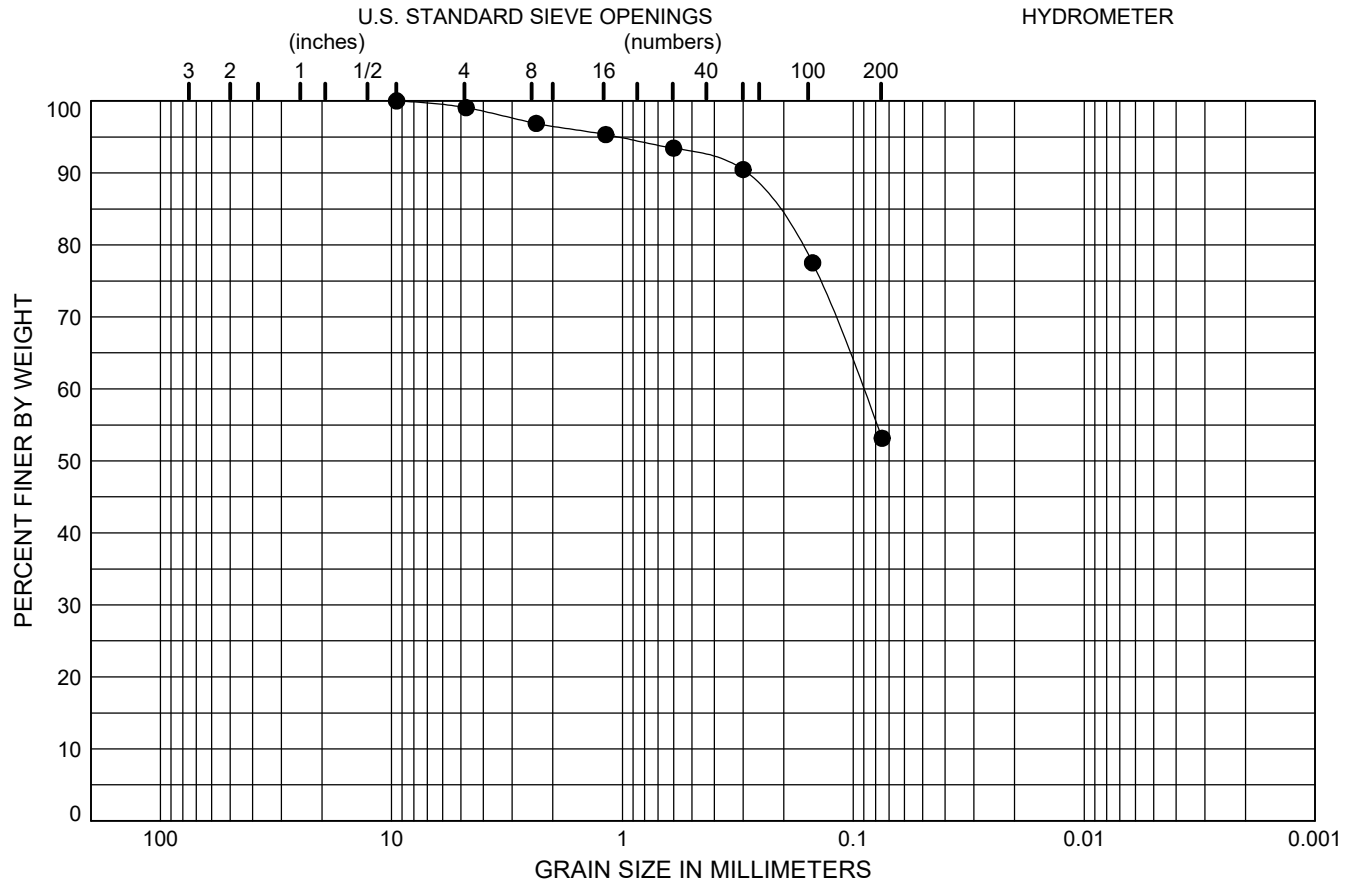
TEST DATE: 2/14/2023

JOB NO.: 23171-ZX

TESTED BY: JPM

CLIENT: Souder, Miller & Associates

TEST METHOD: ASTM D422



COBBLES	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT	CLAY

SOIL DESCRIPTION: Sandy Clay (CL)

SAMPLE NO.: 10.3.1-5-3

SOURCE: Boring 10.3.1-5

SAMPLED BY: ERH

DEPTH: 5

LIQUID LIMIT: 29

PERCENT GRAVEL: 0.9

PLASTIC LIMIT: 16

PERCENT SAND: 45.9

PLASTICITY INDEX: 13

PERCENT SILT & CLAY: 53.1

PARTICLE SIZE ANALYSIS

ASTM C136/C117/D422



PROJECT: BBN9 Water Supply District

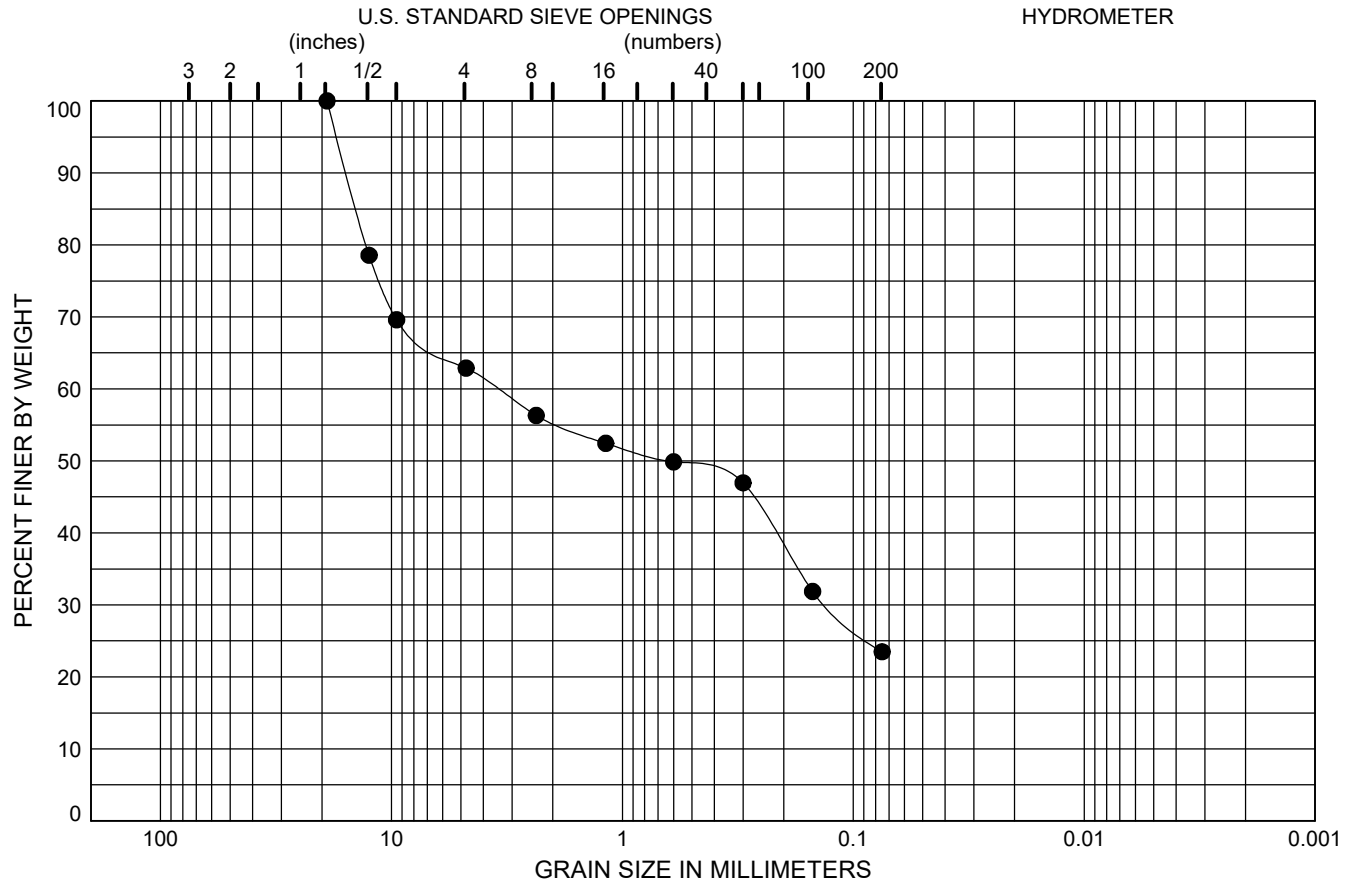
TEST DATE: 2/14/2023

JOB NO.: 23171-ZX

TESTED BY: JPM

CLIENT: Souder, Miller & Associates

TEST METHOD: ASTM D422



COBBLES	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT	CLAY

SOIL DESCRIPTION: Silty Clayey Sand (SC-SM)

SAMPLE NO.: 10.3.1-9-5

SOURCE: Boring 10.3.1-9

SAMPLED BY: ERH

DEPTH: 10

LIQUID LIMIT: 20

PERCENT GRAVEL: 37.1

PLASTIC LIMIT: 16

PERCENT SAND: 39.4

PLASTICITY INDEX: 4

PERCENT SILT & CLAY: 23.5

PARTICLE SIZE ANALYSIS

ASTM C136/C117/D422



PROJECT: BBN9 Water Supply District

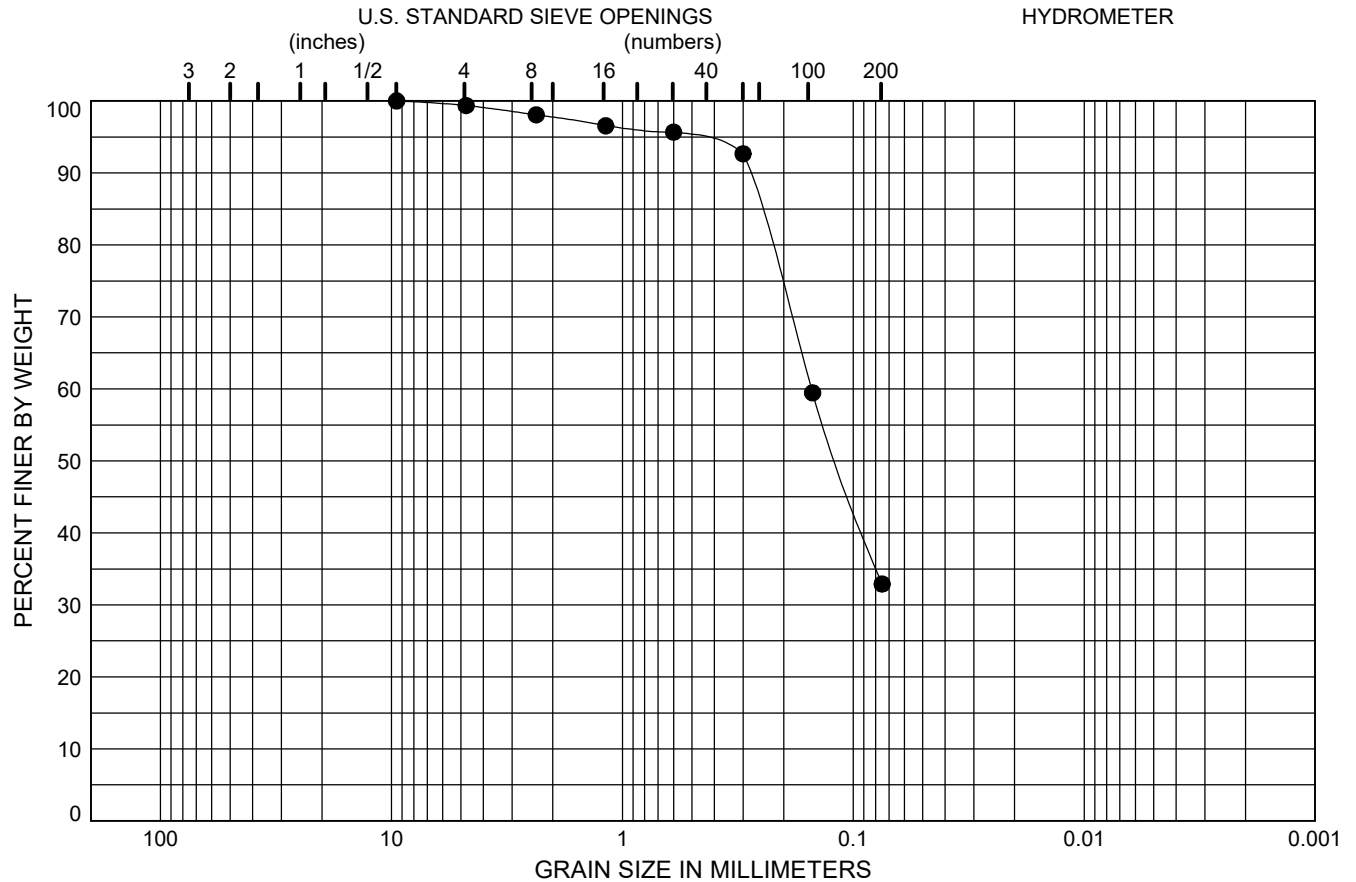
TEST DATE: 2/14/2023

JOB NO.: 23171-ZX

TESTED BY: JPM

CLIENT: Souder, Miller & Associates

TEST METHOD: ASTM D422



COBBLES	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT	CLAY

SOIL DESCRIPTION: Silty Sand (SM)

SAMPLE NO.: 10.3.1-13-4

SOURCE: Boring 10.3.1-13

SAMPLED BY: ERH

DEPTH: 7.5

LIQUID LIMIT: NP

PERCENT GRAVEL: 0.6

PLASTIC LIMIT: NP

PERCENT SAND: 66.5

PLASTICITY INDEX: NP

PERCENT SILT & CLAY: 32.9

PARTICLE SIZE ANALYSIS

ASTM C136/C117/D422



PROJECT: BBN9 Water Supply District

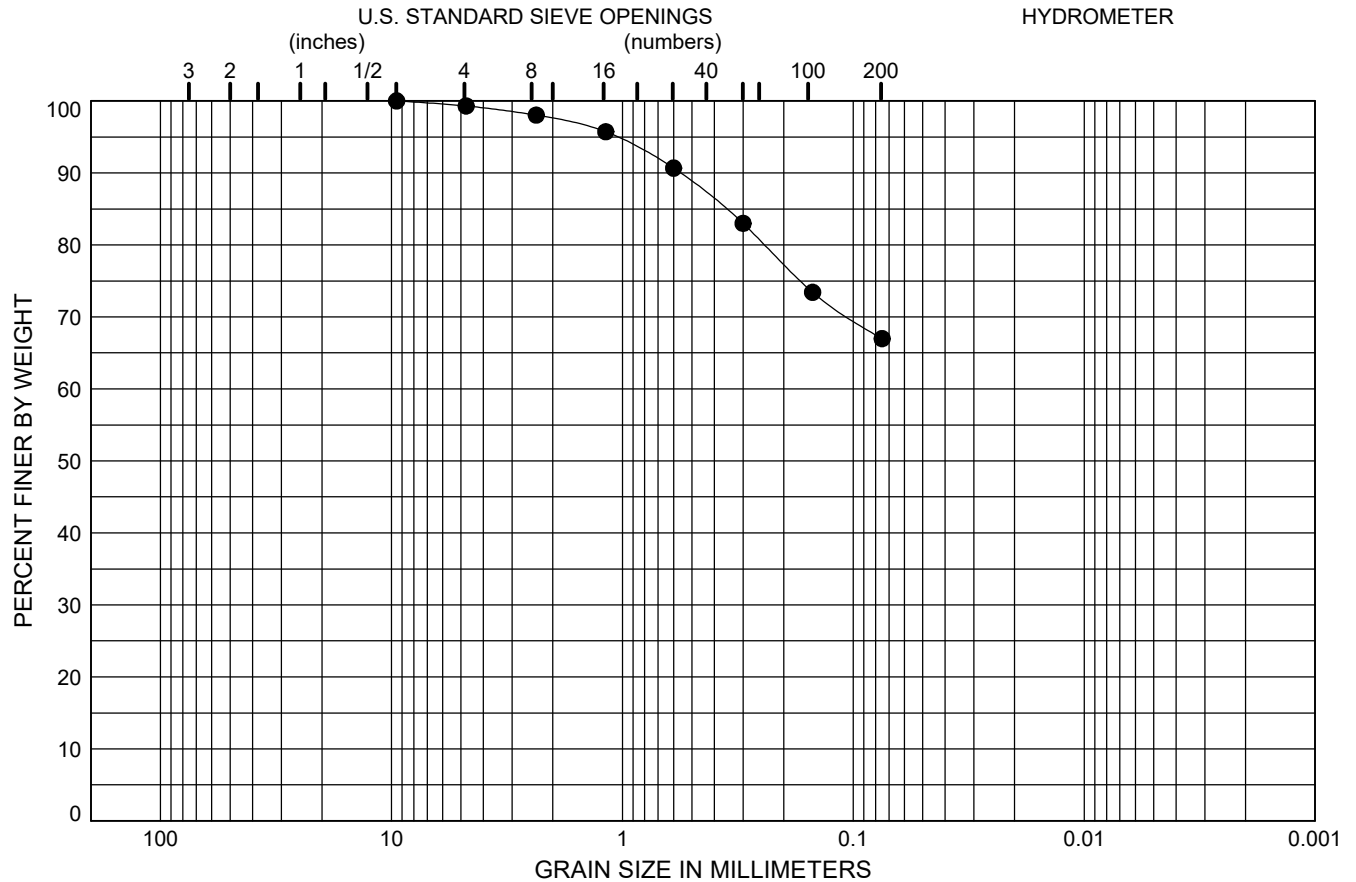
TEST DATE: 2/14/2023

JOB NO.: 23171-ZX

TESTED BY: JPM

CLIENT: Souder, Miller & Associates

TEST METHOD: ASTM D422



COBBLES	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT	CLAY

SOIL DESCRIPTION: Sandy Clay (CL)

SAMPLE NO.: 10.3.1-17-3

SOURCE: Boring 10.3.1-17

SAMPLED BY: ERH

DEPTH: 5

LIQUID LIMIT: 24

PERCENT GRAVEL: 0.7

PLASTIC LIMIT: 15

PERCENT SAND: 32.3

PLASTICITY INDEX: 9

PERCENT SILT & CLAY: 67.0

ASTM C136/C117/D422



PROJECT: BBN9 Water Supply District

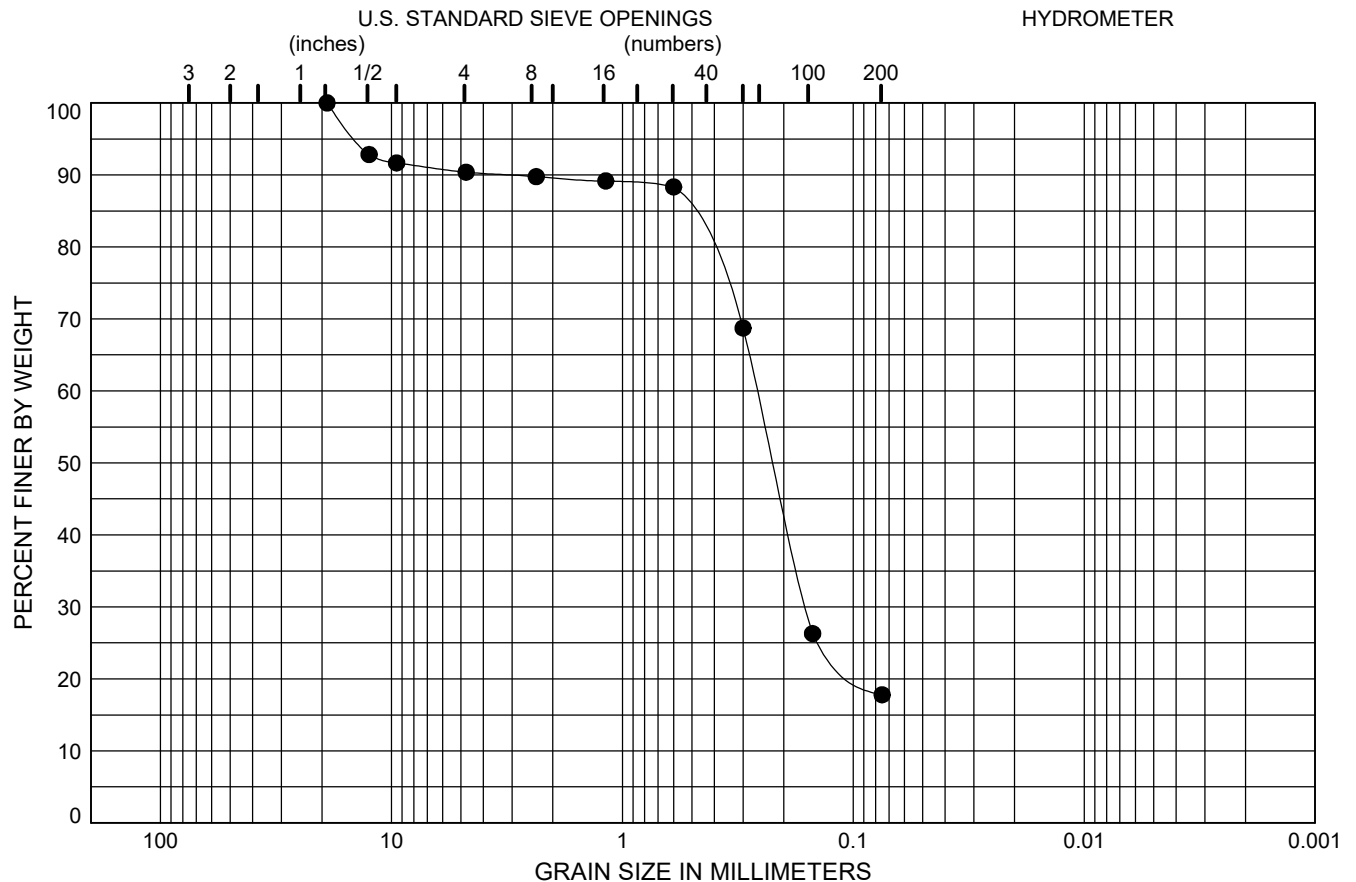
TEST DATE: 2/14/2023

JOB NO.: 23171-ZX

TESTED BY: JPM

CLIENT: Souder, Miller & Associates

TEST METHOD: ASTM D422



COBBLES	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT	CLAY

SOIL DESCRIPTION: Silty Sand (SM)

SAMPLE NO.: 10.3.1-21-2

SAMPLED BY: ERH

SOURCE: Boring 10.3.1-21

DEPTH: 2.5

LIQUID LIMIT: NP

PERCENT GRAVEL: 9.6

PLASTIC LIMIT: NP

PERCENT SAND: 72.6

PLASTICITY INDEX: NP

PERCENT SILT & CLAY: 17.8

PARTICLE SIZE ANALYSIS

ASTM C136/C117/D422



PROJECT: BBN9 Water Supply District

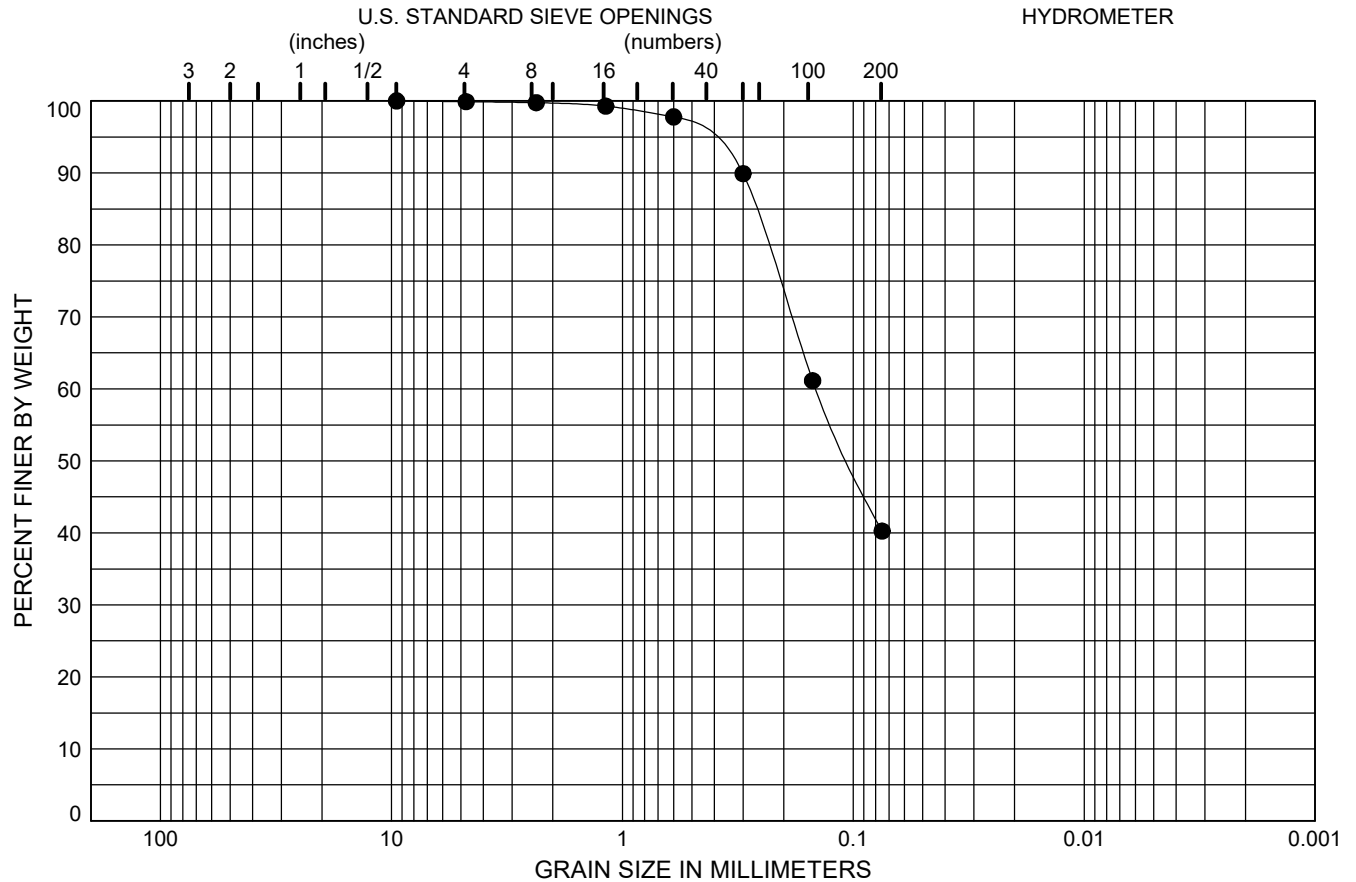
TEST DATE: 2/14/2023

JOB NO.: 23171-ZX

TESTED BY: JPM

CLIENT: Souder, Miller & Associates

TEST METHOD: ASTM D422



COBBLES	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT	CLAY

SOIL DESCRIPTION: Silty Sand (SM)

SAMPLE NO.: 10.3.1-25-4

SOURCE: Boring 10.3.1-25

SAMPLED BY: ERH

DEPTH: 7.5

LIQUID LIMIT: 22

PERCENT GRAVEL: 0.1

PLASTIC LIMIT: 17

PERCENT SAND: 59.6

PLASTICITY INDEX: 5

PERCENT SILT & CLAY: 40.3

Tube Density &/or Unconfined Compressive Strength (ASTM D2166)

IME Project # 23171 BBiV9 Waterline, SMA

[illegible]

Appendix C

GLOSSARY

Definition of certain words, terms or phrases that are used in this report are provided below, to help the reader to interpret the intent of Inberg Miller Engineers. These definitions:

- 1. May differ from other published versions*
- 2. Have not been vetted by any organization outside of Inberg-Miller Engineers*
- 3. May not present a complete understanding of the term*

The reader is encouraged to seek additional interpretation of important terms and consult with Inberg- Miller Engineers as necessary where discrepancies may be discovered, or a definition has not been provided.

Active Lateral Soil Pressure – Horizontal pressure applied by soil to a wall that sufficiently yields or rotates about its base to allow the full soil shear strength to be mobilized

Allowable End Bearing Pressure – Recommended maximum pressure on soil or rock expressed as load per unit area that can be applied across the full bottom bearing surface of a pier or pile deep foundation within a given settlement tolerance

Allowable Skin Friction – Recommended maximum frictional resistance of soil or rock as load per unit area that can be applied over the vertical side surface of a pier or pile deep foundation within a given settlement tolerance.

Alluvium – Soil that has been transported and deposited in a moving water environment

At-Rest Lateral Soil Pressure - Horizontal pressure applied by soil to a wall or the vertical face of a structure that is restrained from movement and soil is not allowed to deform

Backfill – Soil that is used to replace some or all of soil that was excavated, and is usually subject to material specifications and density requirements

Base – Either 1: the bottom surface of a structure or excavation, or 2: soil or aggregate that is placed immediately below a structure or pavement

Bearing Elevation – A subsurface level where the base of foundations rest and transmit applied load to the soil or rock

Bearing Stratum – A specific soil layer defined by soil description and depth below ground surface, or elevation, to which foundations transmit applied load

Claystone – Consolidated sedimentary bedrock comprised chiefly of clay sized particles

Collapse – Loss of inter-particle soil friction, usually as a result of the effects of excessive moisture or water, and often leading to large subsidence or settlement of supported structures

Colluvium – Soil that has accumulated as a result of gravitational transport, commonly found near the base of slopes

Compaction/Compacted – Process or the result of a process where soil density is increased, soil voids are decreased, and usually resulting in an increased strength and reduced settlement potential

Compressibility – Relative term applied to soil or soil layer to describe how much it may yield to expected applied load or pressure

Conglomerate – A mixture of clay through gravel-size particles, commonly cemented with calcium carbonate

Consistency – Term applied to cohesive soils to describe relative stiffness, often defined by either ASTM D1586 Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils or as indicated by unconfined compressive strength

Continuous Footing – A long narrow footing usually supporting a linear structure such as a wall. Length to width ratio may vary but is commonly taken as 10.

Contraction Joints – Formed or sawn joints in concrete slabs or pavements used to control crack patterns that result from thermal contraction or shrinkage

Crushed Aggregate Base – Processed gravel at a specified grading and quantity of fractured faces, and sometimes certain durability requirements, that is used below slabs or pavements

Cut – Term applied to the volume or depth of soil that has been excavated to a certain design grade

Cut Slope – Soil or rock slope that results from cut or excavation

Density – The weight of soil for a unit volume, which may be stated in a dry condition, or a moist to saturated condition with weight of water included

Dewatering – Process of removing water from an excavation or lowering the groundwater elevation usually via drains or pumps

Differential Settlement – The difference in subsidence of a soil surface, or structure resting on soil, between two points spaced a certain distance apart

Disturbed Soil – Soil that has been loosened usually as a result of excavation activity, traffic, vibration

Embedment – The portion of a structure buried within a specific stratum, usually measured as a vertical distance

Engineered Fill – Soil that meets a specific gradation criteria and/or other quality requirements and that is placed at a specified thickness and moisture content and compacted to meet certain minimum density requirements, for the purpose of consistently obtaining certain minimum engineering properties for design

Envelope A – Specified gradation criteria that describes reasonably well graded sand and gravel mixtures, with less than 20 percent silt and clay.

ESAL – Criteria that describes traffic loading equivalent to a certain number of passes from an 18 kip single axle

Excavation Subgrade – The bottom of an excavation

Expansion Joints – Joints that are formed in a concrete pavement or slab that allow for thermal expansion of the concrete. Joints are usually filled with an elastic material to prevent entry of foreign particles

Factor of Safety – A multiplier for recommended allowable values that provides a margin for safety against failure, considering uncertainty and risk

Fill – Soil or rock that has been placed to raise the ground surface elevation

Footing/Foundation Subgrade – The surface of soil or rock to receive a structure which is usually a reinforced cast-in-place concrete

Friction Angle – A measure of physical resistance against sliding between soil or rock particles, usually ranging between 0 and 45 degrees

Frost Heave – A phenomenon that occurs in certain soil types where soil-moisture may concentrate and freeze as ice layers, causing upward swelling of the soil

Frost Protection – Any measure used to prevent frost-heave from affecting a structure

Frost Susceptibility – Soil types that are prone to frost heave

Geotechnical Engineer – An engineer trained through education and experience in soil mechanics and earth-structure systems

Grade Beam – A horizontal structural element that spans between foundations which may carry a portion of load from a structure above, but usually doesn't rely upon support from the soil below

Heave – The upward swelling of soil or rock, usually as a result of freezing or moisture adsorption

Helical Screw Pile/Pier – A foundation type that consists of a steel shaft with steel helices welded to the shaft, so that the system will pull itself into the ground when torque is applied

Hydraulic Conductivity – The rate at which water passes through soil under a certain pressure, usually expressed in the units of centimeters per second

Hydrostatic Pressure – The hydraulic pressure at a certain depth below the surface of a water body or water in saturated soil equivalent to the weight of water multiplied by the depth

Isolated Pad Footing – A single footing for the support of a leg, column, stanchion or other vertical structural element

Lifts – Layers of material that are placed as fill, backfill or pavement

Mat Foundation – A large, shallow spread footing that may support any combination of multiple point or area loads

Maximum Allowable Bearing Pressure – The recommended maximum pressure that may be applied to soil or rock, including a factor of safety, within estimated settlement tolerances

Maximum Dry Density – The peak soil density that is determined in a laboratory using a drop-hammer and mold over a range of varying moisture contents, expressed in terms of dry weight per unit volume

Moisture Sensitivity – A characteristic of soil that describes how the strength or compressibility is affected by increasing moisture content

Moisture Vapor Control – A design measure to limit the upward movement of soil moisture, usually through a concrete floor slab resting on the soil

Native Soil – Soil that is present naturally at a subject site

On-Site Fill – Soil used as fill or backfill that originates from a source located at the subject site

Optimum Moisture Content – The moisture content at which the maximum dry density is achieved in laboratory testing

Organic Materials – Matter contained in soil that is subject to decomposition

Overburden – Soil or rock that is present above an ore body, sedimentary bedrock or certain deposit such as gravel

Overexcavation – A process by which usually unsuitable or unwanted soil or rock is removed or excavated below the bottom of a structure or minimum required excavation limits

Passive Lateral Soil Pressure – Available resisting soil pressure when a structure is forced against the soil

Pavement Subbase – A specified soil type, often described by gradation that is placed below base, which in turn supports flexible or rigid pavement

Perched Groundwater – A subsurface condition where water collects above a relatively low permeability stratum

Permeability – The rate at which a liquid or gas may pass through soil, rock or other material

Pile/Pier Cap – A reinforced concrete block designed to distribute load from a structure to multiple deep foundation elements

Proof-Rolling – A process by which a subgrade is subjected to wheel loading to locate relative soft or yielding areas that might be repaired before covering with structures, soil, pavement etc.

Raft Foundation – See Mat Foundation

Residual Soil – Soil that has resulted from the in-place weathering of rock

Rigid Pavement – Usually reinforced or unreinforced Portland cement concrete, which when cured exhibits high compressive strength but is relatively inflexible

Sandstone - Sedimentary bedrock comprised chiefly of sand sized particles

Saturation – A condition where the pores of soil or rock are completely filled with water

Sedimentary Bedrock – Consolidated sediments of clay, silt or sand

Shrink-Swell Potential – Likelihood that soil or rock may increase or decrease in volume, usually as result of water adsorption and indicated by high plasticity index and/or measured response to inundation

Siltstone - Sedimentary bedrock comprised chiefly of silt sized particles

Site Fill – Soil used to raise the grade of all or a portion of a site to a design elevation, exclusive of structures or buildings

Slab Fill – Soil used to fill above the foundation bearing elevation to the bottom of any special subbase or base soil/aggregate that supports a concrete slab-on-grade

Slab Subbase – Soil that meets a specified gradation requirement or other criteria for placement below a base aggregate

Spread Footing/Foundations – A foundation type that usually consists of a reinforced, cast-in-place concrete that is formed in a round, square, rectangle or continuous strip shape for transferring structural loads to the soil and is placed at certain minimum depths for frost protection or confinement

Stripping Depth – The depth below ground surface that unsatisfactory soil or other materials should be removed before placement of engineered fill or structures

Structural Fill – Soil that meets a specified gradation or other quality or strength criteria for the purpose of raising the ground surface elevation or improving bearing conditions to receive a structure

Subgrade – Soil surface or substrate that will receive pavement, structure, engineered fill, backfill etc.

Synthetic Reinforcement – Specially manufactured fabric, usually as a woven or extruded plastic, used for the purpose of forming a composite with soil or aggregate and adding strength

Synthetic Separation - Specially manufactured fabric, usually as a woven plastic or non-woven fibrous plastic, used for the purpose creating a barrier for the migration of fine-grained soil

Topsoil – Soil that contains organic matter, usually as decayed vegetation and roots, in sufficient quantity that it is compressible, moisture sensitive, or subject to settlement with continued decay

Total Settlement – An estimate of the amount of settlement that may occur over the life of a structure as a result of compression of underlying soil due to the pressure imposed by the structure

Transient Loading – Short term loads applied to a structure, such as from seismic force or wind pressure.

Ultimate Bearing Capacity – An estimate of the bearing pressure applied to a soil stratum that would induce shear failure, without consideration of a factor of safety or limiting settlement

Undisturbed Soil – Soil that is allowed to remain in its natural state without changing moisture content or density

Void Form – A concrete form material for casting a structure which provides support long enough for the concrete to complete curing and gain sufficient strength for the structure to support itself, leaving a void when the form disintegrates with weathering and moisture.

Water Table – The surface of groundwater within saturated soil or rock layers

Weathered Bedrock – Native rock formation that has become delaminated or shows evidence of disintegration as determined and defined by the geotechnical engineer to distinguish a certain stratum for the purposes of the report

GENERAL NOTES - LOG OF TEST BORING/TEST PIT

DESCRIPTIVE SOIL CLASSIFICATION

Grain Size Terminology

Soil Fraction	Particle Size	U.S. Standard Sieve Size
Boulders	Larger than 12"	Larger than 12"
Cobbles	3" to 12"	3" to 12"
Gravel: Coarse	3/4" to 3"	3/4" to 3"
Fine	4.76mm to 3/4"	#4 to 3/4"
Sand: Coarse	2.00mm to 4.76mm	#10 to #4
Medium	0.42mm to 2.00mm	#40 to #10
Fine	0.074mm to 0.42mm	#200 to #40
Silt	0.005mm to 0.074mm	Smaller than #200
Clay	Smaller than 0.005mm	Smaller than #200
Plasticity characteristics differentiate between silt and clay		

Relative Density		Consistency	
Term	"N" Value*	Term	q _u -tons/sq. ft.
Very Loose	0-4	Very Soft	0.0 to 0.25
Loose	4-10	Soft	0.25 to 0.5
Medium Dense	10-30	Firm	0.5 to 1.0
Dense	30-50	Stiff	1.0 to 2.0
Very Dense	Over 50	Very Stiff	2.0 to 4.0
		Hard	Over 4.0

*Note: The penetration number, N, is the summation of blows required to effect two successive 6" penetrations of the 2" split-barrel sampler. The sampler is driven with a 140-pound weight falling 30", and is seated to a depth of 6" before commencing the standard penetration test.

DESCRIPTIVE ROCK CLASSIFICATION

Engineering Hardness Description of Rock

(not to be confused with MOH's scale for minerals)

Very Soft	Can be carved with a knife. Can be excavated readily with point of pick. Pieces one inch or more in thickness can be broken with finger pressure. Can be scratched readily by fingernail.
Soft	Can be gouged or grooved readily with knife or pick point. Can be excavated in chips to pieces several inches in size by moderate blows of a pick point. Small thin pieces can be broken by finger pressure.
Medium Soft	Can be grooved or gouged 1/16-inch deep by firm pressure on knife or pick point. Can be excavated in small chips to pieces about 1-inch-maximum size by hard blows of the point of a geologist's pick.
Medium Hard	Can be scratched with knife or pick. Gouges or grooves to 1/4-inch deep. Can be excavated by hard blow of a geologist's pick. Hand specimens can be detached by moderate blow.
Hard	Can be scratched with knife or pick only with difficulty. Hard blow of hammer required to detach hand specimen.
Very Hard	Cannot be scratched with knife or sharp pick. Breaking of hand specimens requires several hard blows of geologist's pick.

NOMENCLATURE

Drilling and Sampling

SS	--	Split Barrel (spoon) Sampler
N	--	Standard Penetration Test Number, blows/foot*
ST	--	Thin-walled Tube (Shelby Tube) Sampler
DC	--	Thick-wall, ring lined, drive sampler
C	--	Coring
DP	--	Direct Push Sampler
CS	--	Continuous Sampler (used in conjunction with hollow stem auger drilling)
D	--	Disturbed Sample (auger cuttings, air/wash rotary cuttings, backhoe, shovel, etc.)

Laboratory Tests

USCS	--	Unified Soil Classification System (soil type)
W	--	Water Content (%)
LL	--	Liquid Limit (%)
PL	--	Plastic Limit (%)
PI	--	Plasticity Index (LL-PL) (%)
q _u	--	Unconfined Strength, TSF
q _p	--	Penetrometer Reading (estimate of unconfined strength), TSF
γ _m	--	Moist Unit Weight, PCF
γ _d	--	Dry Unit Weight, PCF
WSS	--	Water Soluble Sulfate (%)
Φ	--	Angle of Internal Friction (degrees)
c	--	Soil Cohesion, TSF
SG	--	Specific gravity of soil solids
S	--	Degree of Saturation (%)
e	--	Void Ratio
n	--	Porosity
k	--	Permeability (cm/sec)

Water Level Measurement



--	Water Level at Time Shown
Note: Water level measurements shown on the boring logs represent conditions at the time indicated, and may not reflect static levels, especially in cohesive soils. The available water level information is given at the bottom of each log.	

CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES

ASTM Designation: D2487-69 and D2488-69 (Unified Soil Classification System)

Major Divisions			Group Symbols		Typical Names		Laboratory Classification Criteria			
Coarse-Grained Soils (More than half of material is larger than No. 200 sieve size)	Gravels (More than half of coarse fraction is larger than No. 4 sieve size)	Clean Gravels (Little or no fines)	GW		Well graded gravels, gravel-sand mixtures, little or no fines		Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows: GW, GP, SW, SP GM, GC, SM, SC	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(C_{30})^2}{D_{10} \times D_{60}}$ between 1 & 3		
			GP		Poorly Graded gravels, gravel-sand mixtures, little or no fines			Not meeting all gradation requirements for GW		
		Gravels w/ Fines (Appreciable amount of fines)	GM ^a	d	Silty gravels, gravel-sand-silt mixtures			Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols	
				u				Atterberg limits below "A" line or P.I. greater than 7		
		GC		Clayey gravels, gravel-sand-clay mixtures						
	Sands (More than half of coarse fraction is smaller than No. 4 sieve size)	Clean Sands (Little or no fines)	SW		Well-graded sands, gravelly sands, little or no fines			$C_u = \frac{D_{60}}{D_{10}}$ greater than 6; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 & 3	Not meeting all gradation requirements for SW	
			SP		Poorly graded sands, gravelly sands, little or no fines					
		Sands w/ Fines (Appreciable amount of fines)	SM ^a	d	Silty sands, sand-silt mixtures				Atterberg limits above "A" line or P.I. less than 4	Limits plotting in hatched zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
				u					Atterberg limits above "A" line or P.I. greater than 7	
		SC		Clayey sands, sand-clay mixtures						
Fine-Grained Soils (More than half material is smaller than No. 200 sieve size)	Silts and Clays (Liquid limit less than 50)	ML		Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity		Plasticity Chart				
		CL		Inorganic clays of low to medium plasticity, gravelly, clays, sandy clays, silty clays, lean clays						
		OL		Organic silts and organic silty clays of low plasticity						
	Silts and Clays (Liquid limit greater than 50)	MH		Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts						
		CH		Inorganic clays of high plasticity, fat clays						
		OH		Organic clays of medium to high plasticity, organic silts						
	Highly Organic Soils	P _t		Peat and other highly organic soils						

^a Division of GM and SM groups into subdivision of d and u are for roads and airfields only. Subdivision is based on Atterberg limits; suffix d used when L.L. is 28 or less and the P.I. is 6 or less; the suffix u used when L.L. is greater than 28.

^b Borderline classifications, used for 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.

Important Information about Your Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you — should apply the report for any purpose or project except the one originally contemplated.*

Read the Full Report

Serious problems have occurred because those relying on a geotechnical-engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical-Engineering Report Is Based on a Unique Set of Project-Specific Factors

Geotechnical engineers consider many unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk-management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical-engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse,

- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical-engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical-engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, droughts, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final*, because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations *only* by observing actual

subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical-engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical-engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time to perform additional study.* Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that

have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical-engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold-prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold-prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical-engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold-prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely on Your GBA-Member Geotechnical Engineer for Additional Assistance

Membership in the GEOPROFESSIONAL BUSINESS ASSOCIATION exposes geotechnical engineers to a wide array of risk confrontation techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your GBA-member geotechnical engineer for more information.



**GEOPROFESSIONAL
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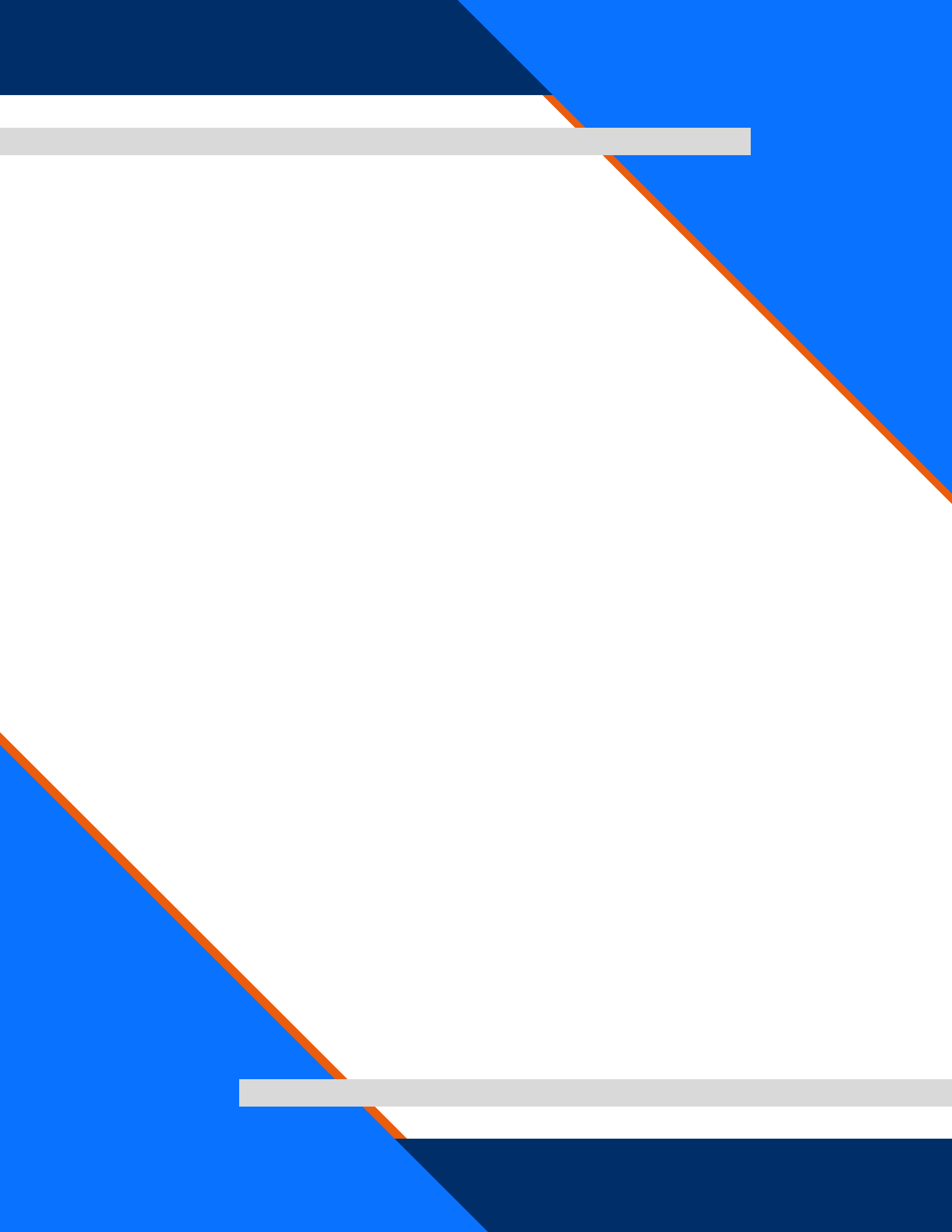


EXHIBIT B

Soil and Rock Potholing Information

Navajo Gallup Water Supply Project Beacon Bisti N9 Reach 10.1 "Pot-Holing" Information

Hole #	Station	Latitude	Longitude	Subsurface Conditions	Depth to Rock
1	1+30.0	35° 52' 10.48" N	108° 39' 24.66" W	Silt sand with Clay	None at 10 Feet
2	13+80.0	35° 52' 6.28" N	108° 39' 10.29" W	Sand	None at 10 Feet
3	25+40.0	35° 52' 2.62" N	108° 38' 56.99" W	Sand	None at 10 Feet
4	40+10.0	35° 51' 58.00" N	108° 38' 40.05" W	Sand	None at 10 Feet
5	53+90.0	35° 51' 56.44" N	108° 38' 23.67" W	Sand	None at 10 Feet
6	66+80.0	35° 51' 50.24" N	108° 38' 10.50" W	Sand	None at 10 Feet
7	80+50.0	35° 51' 46.08" N	108° 37' 54.65" W	Sand	None at 10 Feet
9	107+70.0	35° 51' 37.79" N	108° 37' 23.18" W	Sand with Clay	None at 10 Feet
10	121+50.0	35° 51' 33.18" N	108° 37' 7.46" W	Sand with Clay	None at 10 Feet
11	134+60.0	35° 51' 28.46" N	108° 36' 52.65" W	Sand with Clay	None at 10 Feet
12	145+60.0	35° 51' 24.73" N	108° 36' 40.04" W	Sand with Clay	None at 10 Feet
13	161+00.0	35° 51' 20.64" N	108° 36' 22.16" W	Sand with Clay	None at 10 Feet
14	174+30.0	35° 51' 17.17" N	108° 36' 6.51" W	Sand with Clay	None at 10 Feet
15	188+10.0	35° 51' 13.14" N	108° 35' 50.63" W	Sand with Clay	None at 10 Feet
16	201+30.0	35° 51' 9.62" N	108° 35' 35.23" W	Sand with Clay	None at 10 Feet
17	214+90.0	35° 51' 5.80" N	108° 35' 19.35" W	Sand with Clay	None at 10 Feet
19	241+00.0	35° 50' 56.39" N	108° 34' 50.57" W	Sand with Clay	None at 10 Feet
20	254+10.0	35° 50' 52.39" N	108° 34' 35.46" W	Sand with Clay	None at 10 Feet
22	283+20.0	35° 50' 47.01" N	108° 34' 4.53" W	Sand with Clay	None at 10 Feet
24	305+10.0	35° 50' 34.28" N	108° 33' 43.81" W	Sand with Clay	None at 10 Feet
25	321+90.0	35° 50' 29.72" N	108° 33' 25.96" W	Sand with Clay	None at 10 Feet
26	337+70.0	35° 50' 25.20" N	108° 33' 7.62" W	Sand with Clay	None at 10 Feet
27	351+40.0	35° 50' 22.26" N	108° 32' 51.48" W	Sand with Clay	None at 10 Feet
28	358+40.0	35° 50' 20.89" N	108° 32' 43.20" W	Sand with Clay	None at 10 Feet
29	375+20.0	35° 50' 5.49" N	108° 32' 38.27" W	Sand with Clay	None at 10 Feet
30	388+25.0	35° 49' 54.53" N	108° 32' 29.96" W	Sand with Clay	None at 10 Feet
31	401+30.0	35° 49' 45.10" N	108° 32' 18.86" W	Sand with Clay	None at 10 Feet
32	414+40.0	35° 49' 35.97" N	108° 32' 7.60" W	Sand with Clay	None at 10 Feet
33	427+50.0	35° 49' 26.79" N	108° 31' 56.32" W	Sand with Clay	None at 10 Feet
34	440+60.0	35° 49' 17.53" N	108° 31' 45.18" W	Sand with Clay	None at 10 Feet
Surge Tank	451+00.0	35° 49' 11.07" N	108° 31' 35.92" W	See Surge Tank Report	
35	465+40.0	35° 49' 9.84" N	108° 31' 18.65" W	Sandy	None at 10 Feet
36	478+10.0	35° 49' 8.76" N	108° 31' 3.20" W	Sandy	None at 10 Feet
37	492+30.0	35° 49' 7.50" N	108° 30' 46.02" W	Sandy	None at 10 Feet
38	506+80.0	35° 49' 6.60" N	108° 30' 28.53" W	Sandy and Clay	None at 10 Feet
39	517+20.0	35° 49' 6.07" N	108° 30' 15.97" W	Sandy and Clay	None at 10 Feet
40	532+20.0	35° 49' 5.08" N	108° 29' 58.91" W	Sandy and Clay	None at 10 Feet
41	548+60.0	35° 49' 3.72" N	108° 29' 39.07" W	Shale	Shale
42	557+90.0	35° 48' 59.16" N	108° 29' 31.64" W	Shale	Shale
PP12	569+50.0	35° 48' 55.41" N	108° 29' 16.88" W	See PP12 Report	

Navajo Gallup Water Supply Project Beacon Bisti N9 Reach 10.2 "Pot-Holing" Information

Hole #	Station	Latitude	Longitude	Subsurface Conditions	Depth to Rock
1	11+70.0	35° 48' 53.41" N	108° 29' 3.94" W	Silty Sand to 2'; Sandstone to 10.5'	10.5 feet
2	22+45.0	35° 48' 52.91" N	108° 28' 48.43" W	Sand to 6'; Sandstone to 6.5'	6.5 feet
3	43+10.0	35° 48' 50.48" N	108° 28' 26.04" W	Sand to 5'	None at 5 Feet
4	50+30.0	35° 48' 49.58" N	108° 28' 17.33" W	Sand to 5'	None at 5 Feet
5	63+45.0	35° 48' 48.17" N	108° 28' 1.56" W	Sand to 5'; Silty Sand 7.5'	None at 7.5 Feet ²
6	76+80.0	35° 48' 50.03" N	108° 27' 45.46" W	Sand to 2'	2 Feet ²
7	88+25.0	35° 48' 51.73" N	108° 27' 31.81" W	Sand to 4'	4 feet ²
8	103+40.0	35° 48' 57.60" N	108° 27' 13.91" W	Silty Sand to 6.5'	None at 6.5 feet
9	116+20.0	35° 48' 52.56" N	108° 27' 13.91" W	Silty Sand to 7'; Sand to 11.5'	None at 11.5 Feet
10	129+60.0	35° 48' 47.91" N	108° 26' 42.67" W	Sand to 6.5'	None at 6.5 feet
11	142+75.0	35° 48' 47.67" N	108° 26' 26.73" W	Sand to 4.5'; Sandstone to 5.5'	5.5 feet
12	155+80.0	35° 48' 48.30" N	108° 26' 10.86" W	Sand to 6.5'	None at 6.5 feet
13	169+10.0	35° 48' 47.73" N	108° 25' 54.82" W	Sand to 6'; Sandstone to 11.5'	11.5 Feet
14	183+80.0	35° 48' 44.03" N	108° 25' 38.29" W	Sand to 5.5'	None at 5.5 feet
15	195+80.0	35° 48' 34.84" N	108° 25' 29.18" W	Sand to 6.5'	None at 6.5 feet
16	203+75.0	35° 48' 29.64" N	108° 25' 21.93" W	Sand to 4'	4 feet ²
17	222+45.0	35° 48' 16.77" N	108° 25' 8.16" W	Sand to 11.5'	None at 11.5 feet
HWY BORE	231+20.0	35° 48' 08.46" N	108° 25' 07.59" W	Silt to 15'; Sand to 36'; Clayey Sand to 50.5'	None at 50.5 feet
18	235+25.0	35° 48' 7.79" N	108° 25' 3.91" W	Sand to 6.5'	None at 6.5 feet
19	248+50.0	35° 48' 10.37" N	108° 24' 48.20" W	Silt to 2.5'	2.5 feet ²
20	261+75.0	35° 48' 07.70" N	108° 24' 33.52" W	Silt to 3.5'	3.5 feet ²
21	274+80.0	35° 48' 01.12" N	108° 24' 19.83" W	Silt Clayey Sand to 10'	None at 10 feet
24	314+40.0	35° 47' 57.75" N	108° 23' 32.78" W	Silty Sand to 4'	4 feet ²
25	327+75.0	35° 47' 59.26" N	108° 23' 16.65" W	Sand to 7.5'	None at 7.5 feet ²
26	340+65.0	35° 48' 00.60" N	108° 23' 01.05" W	Silty Sand to 1.5'	1.5 feet ²
27	353+85.0	35° 47' 54.32" N	108° 22' 50.19" W	Silty Sand to 5'	None at 5 feet
28	367+30.0	35° 47' 46.23" N	108° 22' 37.21" W	Sand to 6.5'	None at 6.5 feet
10.2 HDD	378+90.0	35° 47' 40.22" N	108° 22' 25.22" W	Sand to 12.5'; Silty Sand to 37.5'; Silty Sand to 50.5'	None at 50.5 feet

¹ These potholes were hand-augered due to no access for the drill rig.

² SMA did not have land owner consent to drill holes 22-23 and 30-35.

Navajo Gallup Water Supply Project Beacon Bisti N9 Reach 10.3 "Pot-Holing" Information

Hole # ²	Station	Latitude	Longitude	Subsurface Conditions	Depth to Rock
8	102+30.0	35° 45' 47.87" N	108° 19' 56.62" W	Silty Sand to 6.5'	None at 6.5 Feet
9	115+25.0	35° 45' 35.92" N	108° 19' 51.20" W	Silty Sand to 10.5'	None at 10.5 Feet
10	129+00.0	35° 45' 23.35" N	108° 19' 44.87" W	Sand to 6.5'	None at 6.5 Feet
11	141+80.0	35° 45' 11.96" N	108° 19' 37.89" W	Sand to 3.5'; Clayey Sand to 6.5'	None at 6.5 Feet
12	154+80.0	35° 45' 0.46" N	108° 19' 30.83" W	Sand to 6.5'	None at 6.5 Feet
13	168+25.0	35° 44' 48.97" N	108° 19' 23.10" W	Silty Sand to 2'; Sand to 7.5'; Sand and Gravel to 11.5'	None at 11.5 Feet
14	181+50.0	35° 44' 36.89" N	108° 19' 17.38" W	Silty Sand to 6.5'	None at 6.5 Feet
15	194+95.0	35° 44' 29.08" N	108° 19' 04.08" W	Silty Sand to 6.5'	None at 6.5 Feet
16	208+10.0	35° 44' 21.35" N	108° 18' 51.28" W	Silty Sand to 2'; Sandy Silt to 5'; Sandstone to 5.5'	5.5 Feet
17	220+90.0	35° 44' 14.46" N	108° 18' 38.26" W	Silty Sand to 2'; Sandy Silt to 6'; Silty Shale to 11.5'	None at 11.5 Feet
18	234+35.0	35° 44' 8.35" N	108° 18' 23.76" W	Silty Sand to 4'; Silty Shale to 6.5'	None at 6.5 Feet
10.3 HDD	243+60.0	35° 44' 03.97" N	108° 18' 13.95" W	Silty Sand to 4'; Silty Shale to 23'; Siltstone to 28.5'	None at 23 Feet
19	247+70.0	35° 44' 02.18" N	108° 18' 09.61" W	Silty Sand to 4'; Silty Shale to 6.5'	None at 6.5 Feet
20	260+70.0	35° 43' 55.61" N	108° 17' 56.23" W	Sandy Silt to 6'; Silty Shale to 6.5'	None at 6.5 Feet
21	278+25.0	35° 43' 41.82" N	108° 17' 45.06" W	Sandy Silt to 4'; Sandy Shale to 11.5'	None at 11.5 Feet
22	287+00.0	35° 43' 35.42" N	108° 17' 37.86" W	Silty Sand to 3'; Sandy Shale to 6.5'	None at 6.5 Feet
23	300+20.0	35° 43' 26.54" N	108° 17' 26.13" W	Silty Sand to 5'; Sandstone to 6'	6 Feet
24	313+30.0	35° 43' 21.27" N	108° 17' 13.36" W	Silt to 5'	None at 5 Feet ¹
25	326+55.0	35° 43' 12.54" N	108° 17' 01.42" W	Sandstone at 7'	7 Feet ¹
26	339+95.0	35° 43' 04.16" N	108° 16' 48.78" W	Silty Sand to 5'; Sandstone to 5.5'	5.5 Feet
27	353+10.0	35° 42' 56.69" N	108° 16' 35.84" W	Silty Sand to 4'; Sandstone to 5.5'	5.5 Feet
28	366+40.0	35° 42' 48.48" N	108° 16' 23.25" W	Silty Sand to 3'; Sandstone to 5.5'	5.5 Feet
29	379+40.0	35° 42' 37.57" N	108° 16' 16.41" W	Sand to 6'; Sandstone at 9.5'; Sand to 11.5'	9.5 Feet

¹ These potholes were hand-augured due to no access for the drill rig.

² SMA did not have land owner consent to drill holes 1-7.

EXHIBIT C

Soil Chemical Analysis

Soil Chemistry Analysis

Cast-in-place concrete site work for Reach 10.1

The south and north tanks located at the Pumping Plant 12 Forebay Tanks site and Reach 10.1 Surge Tank located at Station 451+46 are three of the structures that may require cast-in-place concrete site work as part of the BBN9 Reach 10.1 project. To determine the Type of cement to use, soil from the south tank, north tank and surge tank building locations were analyzed. The soil samples were tested for chloride, sulfate, and pH levels. The results were compared to the American Concrete Institute's Building Code Requirements for Structural Concrete (ACI 318-11) manual standards. The report from Hall Environmental Analysis Laboratory, Inc. with testing results is included after this summary, and is summarized in Table 1 below.

Table 1. Reach 10.1 Soil Sample Results

Test Location	Chloride		Sulfate		pH
	mg/Kg (or ppm)	Percent by mass in soil	mg/Kg (or ppm)	Percent by mass in soil	
PP12 South Tank	ND	N/A	9.6	0.00096	8.59
PP12 North Tank	ND	N/A	8.0	0.0008	8.60
Reach 10.1 Surge Tank	36	0.0036	76	0.0076	8.67

Per ACI 318-11, depending on the amount of water-soluble sulfate (SO_4) in the soil in which the concrete is in contact, there may be restrictions on the Type of cement used in the concrete. See Table 2 for these restrictions based on ACI 318-11 Tables 4.2.1 and 4.3.1.

Table 2. Cement Type Restrictions Based on Water-Soluble Sulfate in Soil

Water-soluble sulfate (SO_4) in soil, percent by mass	Cement Type restriction
$\text{SO}_4 < 0.10$	No Type Restriction
$0.10 \leq \text{SO}_4 < 0.20$	II
$0.20 \leq \text{SO}_4 < 2.00$	V
$\text{SO}_4 > 2.00$	V + pozzolan or slag

Comparing the soil sample results in Table 1 to the standards in Table 2, there are no cement Type restrictions for the concrete at the locations of the south tank, north tank, and Reach 10.1 Surge Tank.

Per ACI 318-11, depending on the amount of water-soluble chloride ion (Cl^-) in the cement in which may cause corrosion restrictions based on the Exposure Class in the concrete. See Table 3 for these restrictions based on ACI 318-11 Tables 4.2.1 and 4.3.1.

Table 3. Corrosion Restrictions Based on Water-Soluble Chloride Ion in Concrete

Water-soluble Chloride Ion (Cl^-) in concrete, percent by weight of Cement	
Exposure Class	Reinforced Concrete
C0	1.00
C1	0.30
C2	0.15

Comparing the sample results in Table 1 to the standards in Table 3, there are no corrosion restrictions for the concrete at all locations of PP12 Forebay Tanks site and Reach 10.1 Surge Tank site.

Hall Environmental Analysis Laboratory, Inc.

Analytical Report

Lab Order 2010765

Date Reported: 10/22/2020

CLIENT: Souder Miller & Associates

Client Sample ID: PP12-South Tank

Project: BBN9 Pump Stations and Chlorinator Si

Collection Date: 10/8/2020 12:40:00 PM

Lab ID: 2010765-005

Matrix: SOIL

Received Date: 10/15/2020 10:24:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS							Analyst: CAS
Chloride	ND	7.5		mg/Kg	5	10/19/2020 6:05:42 PM	55907
Sulfate	9.6	7.5		mg/Kg	5	10/19/2020 6:05:42 PM	55907
SM4500H+B/EPA 9040C							Analyst: JRR
pH	8.59			pH Units	1	10/21/2020 9:57:00 AM	R72810

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:	*	Value exceeds Maximum Contaminant Level.
	D	Sample Diluted Due to Matrix
	H	Holding times for preparation or analysis exceeded
	ND	Not Detected at the Reporting Limit
	PQL	Practical Quantitative Limit
	S	% Recovery outside of range due to dilution or matrix

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
P	Sample pH Not In Range
RL	Reporting Limit

Hall Environmental Analysis Laboratory, Inc.

Analytical Report

Lab Order 2010765

Date Reported: 10/22/2020

CLIENT: Souder Miller & Associates

Client Sample ID: PP12-North Tank

Project: BBN9 Pump Stations and Chlorinator Si

Collection Date: 10/8/2020 1:12:00 PM

Lab ID: 2010765-006

Matrix: SOIL

Received Date: 10/15/2020 10:24:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS							Analyst: CAS
Chloride	ND	7.5		mg/Kg	5	10/19/2020 6:30:32 PM	55907
Sulfate	8.0	7.5		mg/Kg	5	10/19/2020 6:30:32 PM	55907
SM4500H+B/EPA 9040C							Analyst: JRR
pH	8.60			pH Units	1	10/21/2020 9:57:00 AM	R72810

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	D	Sample Diluted Due to Matrix	E	Value above quantitation range
	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
	ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
	PQL	Practical Quantitative Limit	RL	Reporting Limit
	S	% Recovery outside of range due to dilution or matrix		

Hall Environmental Analysis Laboratory, Inc.

Analytical Report

Lab Order 2110990

Date Reported: 10/28/2021

CLIENT: Geo-Test

Client Sample ID: 2 @ 9' (Reach 10.1 Surge Tank)

Project: Beacon Bisti Waterline

Collection Date: 10/19/2021 2:30:00 PM

Lab ID: 2110990-001

Matrix: SOIL

Received Date: 10/21/2021 8:35:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS							Analyst: JMT
Chloride	36	7.5		mg/Kg	5	10/25/2021 9:14:48 AM	63515
Sulfate	76	7.5		mg/Kg	5	10/25/2021 9:14:48 AM	63515

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	D	Sample Diluted Due to Matrix	E	Value above quantitation range
	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
	ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
	PQL	Practical Quantitative Limit	RL	Reporting Limit
	S	% Recovery outside of range due to dilution or matrix		

Corrosion Data

Project: Beacon Bisti N9 - Reach 10.1 Surge Tank
Report # 1-10912A

Soil Resistivity (ASTM G-57)

Sample Location: Onsite Silty Sand (0-10 feet)

Wet Weight:	215.4 grams
Dry Weight:	208.4 grams
Water Content	3.36 %

<u>As-Received Condition</u>	
Potential Change	7.0 volts
Current:	0 amps
Resistivity:	∞ ohm-cm

<u>Saturated Condition</u>	
Potential Change:	16.0 volts
Current:	0.004 amps
Resistivity:	4000 ohm-cm

pH of Soil (ASTM G-51 & D-4972)

Sample Location: Onsite Silty Sand (0-10 feet)

Distilled Water Solution:	pH = 8.67
Calcium Chloride Solution:	pH = 7.96



June 16, 2025

#6922268

Souder, Miller & Associates
Albuquerque, NM 87113
Phone: (505) 299-0942

**RE: Navajo Gallup Water Supply Project
Beacon Bisti N9 – Reach 10.2
Soil Chemistry Analysis for Structural Concrete**

To whom it may concern:

The following exposure classifications for structural concrete at this site are based on ACI 318-19 and the site soil chemistry data included in the following geotechnical reports:

**Geo-Test Inc. Report #1-00908 dated December 1, 2020
Geo-Test Inc. Report #1-00909 dated December 1, 2020**

Based on the concentrations of sulfates and chlorides reported, the following exposure classes apply at the **Pump Plant Building #13 West Tank**:

- S0** – Sulfate Exposure Class – Based on the reported maximum sulfate concentration of 87 mg/Kg (**87 ppm**) and Tables 19.3.1.1 & 19.3.2.1 of ACI 318-19, the following apply:
- a. Maximum w/cm Ratio = **N/A**
 - b. Minimum $f'c$ = **2,500 psi**
 - c. ASTM C150 Cement Type = **No Restriction**
- C1** – Chloride Exposure Class – Based on the reported maximum chloride concentration of 26 ppm (**0.026 Cl^- concentration**) and Tables 19.3.1.1 & 19.3.2.1 of ACI 318-19, the following apply:
- a. Maximum w/cm Ratio = **N/A**
 - b. Minimum $f'c$ = **2,500 psi**
 - c. Protective Measures: **None**

Based on the concentrations of sulfates and chlorides reported, the following exposure classes apply at the **Pump Plant Building #13 East Tank**:

- S1** – Sulfate Exposure Class – Based on the reported maximum sulfate concentration of 1300 mg/Kg (**1300 ppm**) and Tables 19.3.1.1 & 19.3.2.1 of ACI 318-19, the following apply:
- d. Maximum w/cm Ratio = **0.50**
 - e. Minimum $f'c$ = **4,000 psi**
 - f. ASTM C150 Cement Type = **II**

C1 – Chloride Exposure Class – Based on the reported maximum chloride concentration of 14 ppm (**0.014 Cl⁻ concentration**) and Tables 19.3.1.1 & 19.3.2.1 of ACI 318-19, the following apply:

- d. Maximum w/cm Ratio = **N/A**
- e. Minimum f'_c = **2,500 psi**
- f. Protective Measures: **None**

Based on the laboratory analysis concentrations of sulfates and chlorides reported for the **Pump Plant Building #12**: The results were returned as “No Detections for the reporting limits”.

These classifications are based on the known reports for this site at the time of the writing of this letter. If it becomes available, please provide any new or changed data with respect to these reports.

Sincerely,

**MILLER ENGINEERS, INC. d/b/a
SOUDER, MILLER & ASSOCIATES**



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Hall Environmental Analysis Laboratory, Inc.

Analytical Report

Lab Order 2010765

Date Reported: 10/22/2020

CLIENT: Souder Miller & Associates

Client Sample ID: PP12-Buildings

Project: BBN9 Pump Stations and Chlorinator Si

Collection Date: 10/8/2020 11:57:00 AM

Lab ID: 2010765-004

Matrix: SOIL

Received Date: 10/15/2020 10:24:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS							Analyst: CAS
Chloride	ND	7.5		mg/Kg	5	10/19/2020 5:40:53 PM	55907
Sulfate	ND	7.5		mg/Kg	5	10/19/2020 5:40:53 PM	55907
SM4500H+B/EPA 9040C							Analyst: JRR
pH	8.96			pH Units	1	10/21/2020 9:57:00 AM	R72810

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	D	Sample Diluted Due to Matrix	E	Value above quantitation range
	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
	ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
	PQL	Practical Quantitative Limit	RL	Reporting Limit
	S	% Recovery outside of range due to dilution or matrix		

Hall Environmental Analysis Laboratory, Inc.

Analytical Report

Lab Order 2010765

Date Reported: 10/22/2020

CLIENT: Souder Miller & Associates

Client Sample ID: PP13-West Tank

Project: BBN9 Pump Stations and Chlorinator Si

Collection Date: 10/8/2020 10:20:00 AM

Lab ID: 2010765-002

Matrix: SOIL

Received Date: 10/15/2020 10:24:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS							Analyst: CAS
Chloride	26	7.5		mg/Kg	5	10/19/2020 4:26:26 PM	55907
Sulfate	87	7.5		mg/Kg	5	10/19/2020 4:26:26 PM	55907
SM4500H+B/EPA 9040C							Analyst: JRR
pH	8.62			pH Units	1	10/21/2020 9:57:00 AM	R72810

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	D	Sample Diluted Due to Matrix	E	Value above quantitation range
	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
	ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
	PQL	Practical Quantitative Limit	RL	Reporting Limit
	S	% Recovery outside of range due to dilution or matrix		

Hall Environmental Analysis Laboratory, Inc.

Analytical Report

Lab Order 2010765

Date Reported: 10/22/2020

CLIENT: Souder Miller & Associates

Client Sample ID: PP13-East Tank

Project: BBN9 Pump Stations and Chlorinator Si

Collection Date: 10/8/2020 10:44:00 AM

Lab ID: 2010765-003

Matrix: SOIL

Received Date: 10/15/2020 10:24:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS							Analyst: CAS
Chloride	14	7.5		mg/Kg	5	10/19/2020 5:16:04 PM	55907
Sulfate	1300	30		mg/Kg	20	10/19/2020 5:28:28 PM	55907
SM4500H+B/EPA 9040C							Analyst: JRR
pH	8.63			pH Units	1	10/21/2020 9:57:00 AM	R72810

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	D	Sample Diluted Due to Matrix	E	Value above quantitation range
	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
	ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
	PQL	Practical Quantitative Limit	RL	Reporting Limit
	S	% Recovery outside of range due to dilution or matrix		

Soil Chemistry Analysis

Cast-in-place concrete site work for Reach 10.3

The PP13 buildings and Nahodishgish Regulating Tank are located at the Pumping Plant 13 Forebay Tanks site and Nahodishgish Tank site, respectively, are the structures that may require cast-in-place concrete site work on BBN9 Reach 10.3. To determine the Type of cement to use, soil from the PP13 buildings and Nahodishgish Tank locations were analyzed. The soil samples were tested for chloride, sulfate, and pH levels. The results were compared to the American Concrete Institute's Building Code Requirements for Structural Concrete (ACI 318-11) manual standards. The report from Hall Environmental Analysis Laboratory, Inc. with testing results is included after this summary, and is summarized in Table 1 below.

Table 1. Reach 10.3 Soil Sample Results

Test Location	Chloride		Sulfate		pH
	mg/Kg (or ppm)	Percent by mass in soil	mg/Kg (or ppm)	Percent by mass in soil	
PP13 Buildings	34	0.0034	91	0.0091	8.28
Nahodishgish Tank Site	64	0.0064	630	0.063	8.40

Per ACI 318-11, depending on the amount of water-soluble sulfate (SO_4) in the soil in which the concrete is in contact, there may be restrictions on the Type of cement used in the concrete. See Table 2 for these restrictions based on ACI 318-11 Tables 4.2.1 and 4.3.1.

Table 2. Cement Type Restrictions Based on Water-Soluble Sulfate in Soil

Water-soluble sulfate (SO_4) in soil, percent by mass	Cement Type restriction
$\text{SO}_4 < 0.10$	No Type Restriction
$0.10 \leq \text{SO}_4 < 0.20$	II
$0.20 \leq \text{SO}_4 < 2.00$	V
$\text{SO}_4 > 2.00$	V + pozzolan or slag

Comparing the soil sample results in Table 1 to the standards in Table 2, there are no cement Type restrictions for the concrete at the location of the PP13 site or Nahodishgish Tank site.

Per ACI 318-11, depending on the amount of water-soluble chloride ion (Cl^-) in the cement in which may cause corrosion restrictions based on the Exposure Class in the concrete. See Table 3 for these restrictions based on ACI 318-11 Tables 4.2.1 and 4.3.1.

Table 3. Corrosion Restrictions Based on Water-Soluble Chloride Ion in Concrete

Water-soluble Chloride Ion (Cl^-) in concrete, percent by weight of Cement	
Exposure Class	Reinforced Concrete
C0	1.00
C1	0.30
C2	0.15

Comparing the sample results in Table 1 to the standards in Table 3, there are no corrosion restrictions for the concrete at the Pumping Plant 13 site and Nahodishgish Tank site.

Hall Environmental Analysis Laboratory, Inc.

Analytical Report

Lab Order 2010765

Date Reported: 10/22/2020

CLIENT: Souder Miller & Associates

Client Sample ID: PP13-Buildings

Project: BBN9 Pump Stations and Chlorinator Si

Collection Date: 10/8/2020 9:30:00 AM

Lab ID: 2010765-001

Matrix: SOIL

Received Date: 10/15/2020 10:24:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS							Analyst: CAS
Chloride	34	7.5		mg/Kg	5	10/19/2020 4:01:37 PM	55907
Sulfate	91	7.5		mg/Kg	5	10/19/2020 4:01:37 PM	55907
SM4500H+B/EPA 9040C							Analyst: JRR
pH	8.28			pH Units	1	10/21/2020 9:57:00 AM	R72810

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	D	Sample Diluted Due to Matrix	E	Value above quantitation range
	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
	ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
	PQL	Practical Quantitative Limit	RL	Reporting Limit
	S	% Recovery outside of range due to dilution or matrix		

Hall Environmental Analysis Laboratory, Inc.

Analytical Report

Lab Order 2110989

Date Reported: 10/28/2021

CLIENT: Geo-Test

Client Sample ID: 4 @ 0-2'

Project: Beacon Bisti Waterline

Collection Date: 10/19/2021 8:45:00 AM

Lab ID: 2110989-001

Matrix: SOIL

Received Date: 10/21/2021 8:35:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS							Analyst: JMT
Chloride	64	7.5		mg/Kg	5	10/25/2021 6:46:36 AM	63515
Sulfate	630	7.5		mg/Kg	5	10/25/2021 6:46:36 AM	63515

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	D	Sample Diluted Due to Matrix	E	Value above quantitation range
	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
	ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
	PQL	Practical Quantitative Limit	RL	Reporting Limit
	S	% Recovery outside of range due to dilution or matrix		

Corrosion Data

Project: Beacon Bisti N9 - Nahodishgish Tank Site
Report # 1-11001A

Soil Resistivity (ASTM G-57)

Sample Location: Boring A4 (0-2 ft)

Wet Weight:	251.1 grams
Dry Weight:	235.3 grams
Water Content	6.71 %

<u>As-Received Condition</u>		
Potential Change	16.0	volts
Current:	0.009	amps
Resistivity:	1778	ohm-cm

<u>Saturated Condition</u>		
Potential Change:	16.0	volts
Current:	0.018	amps
Resistivity:	889	ohm-cm

pH of Soil (ASTM G-51 & D-4972)

Sample Location: Boring A4 (0-2 ft)

Distilled Water Solution:	pH =	8.40
Calcium Chloride Solution:	pH =	8.10

Exhibit D

Utility Companies Encroachment Agreements and Requirements

- **Design One-Call Information**
- **NTUA Encroachment Agreements**

Design One-Call Information 10.1, 10.2, and 10.3

Note: The following information was obtained by the Engineer through a NM 811 Design One-Call locate request and other coordination with utilities during design. The information presented here, and throughout the bidding documents does not relieve the Contractor of their responsibility to complete their own One-Call prior to excavation and coordinate with and meet the requirements of existing utility owners/operators. Additionally, the Contractor is responsible for informing the Engineer if any utilities are identified that were not previously included in the design.

NM 811 Design One-Call Information:

SMA submitted a NM 811 Design One-Call locate request for the BBN9 Reaches 10.1, 10.2, and 10.3 in one ticket. Attached is the NM 811 ticket for these three Reaches. The utilities listed in the ticket are crossed by Reach 10.2 only. Reaches 10.1 and 10.3 do not cross any utilities per the attached One-Call ticket. The Contractor is responsible for submitting NM 811 One-Call locate requests throughout the duration of the project.

Buried Water and Gas Infrastructure:

Navajo Tribal Utility Authority (NTUA) owns & operates existing waterlines and gaslines throughout the BBN9 project area. Note that NTUA does not participate in NM 811 One-Call. NTUA should be contacted separately for location of existing utility lines. Contact information and additional details regarding coordination with NTUA are provided throughout these bidding documents.

NM811 LOCATE REQUEST

TICKET NUMBER:	19JA250530	Update of:	
Ticket Type:	Design Locate	For Code:	AUTOEMAIL
Creation Date:	01/25/19 14:36	Seq Num:	1

Excavator Information

Company:	Souder, Miller and Associates	Main Contact Phone:	(505) 299-0942
Address:	5454 Venice Ave NE, Suite D	Secondary Phone:	
City, St, Zip:	Albuquerque, NM 87113	Main Contact Email:	ty.tsinnijinnie@soudermiller.com
Company Phone:	(505) 299-0942	Alternate Contact:	Tory Tadano
Company Fax:		Alternate Contact Phone:	(505) 299-0942
Main Contact:	Ty Tsinnijinnie	Alternate Contact Email:	tory.tadano@soudermiller.com

Work Information

State:	NM	Work To Begin:	01/29/19 AT 14:15
County:	MCKINLEY	Expire Date:	02/12/19 AT 14:15
Place:	RURAL MCKINLEY		
Address:	PROPOSED WATER LINE		
Intersection:	**		
Latitude:	35.696448	Longitude:	-108.651695
Secondary Lat:	35.871122	Secondary Long:	-108.268706
Work Type:	Proposed Design	Working For:	Navajo Nation
Pre-marked:	No	Mechanical Boring:	No
Contact Prior to Locating:	Yes	Contact After Locating:	No

Driving Directions

From intersection US Hwy 491 and BIA Route 9, drive north approximately 14.3 miles. Turn right (heading east) on unnamed road. Drive 0.35 miles. Turn right (heading south) on unnamed road. Drive 0.24 miles. Turn right (heading south) on unnamed road. Drive 1.40 miles. Arrive at start of proposed waterline.

Spotting Instructions

The Proposed waterline is expected to traverse across open country in the sections described below. Sections 21, 22, 23, 26, 25 of Township 19 North, Range 17 West Sections 29, 30, 32, 33, 34 of Township 19 North, Range 16 West Sections 1, 2, 3 of Township 18 North, Range 16 West Sections 4, 5, 6, 9, 10, 11, 12, 13 of Township 18 North, Range 15 West Sections 17, 18, 20, 28, 29, 33 of Township 18 North, Range 14 West Sections 2, 3, 4, 11, 12, 13 of Township 17 North, Range 14 West

Remarks

Proposed waterline is to start at approximately: Latitude: 35.871936 N Longitude: 108.656158 W
TRSQ: [W8T17NR13WS07NW] [W8T17NR13WS07SW] [W8T17NR13WS18NW] [W8T17NR13WS18SW]
[W8T17NR13WS19NW] [W8T17NR14WS01NW] [W8T17NR14WS01SE] [W8T17NR14WS01SW]
[W8T17NR14WS02NE] [W8T17NR14WS02NW]

There are 249 grids not shown. Please contact the center for the rest of them

Utilities Notified:

<u>Code</u>	<u>Name</u>	<u>Manually Added</u>
TW11	TRANSWESTERN PIPELINE - GALLUP	False
WNR1	WESTERN REFINING PIPELINE COMPANY - [OLD CINI] ...	False

Design One-Call Information 10.2

Note: The following information was obtained by the Engineer through a NM 811 Design One-Call locate request and other coordination with utilities during design. The information presented here, and throughout the bidding documents does not relieve the Contractor of their responsibility to complete their own One-Call prior to excavation and coordinate with and meet the requirements of existing utility owners/operators. Additionally, the Contractor is responsible for informing the Engineer if any utilities are identified that were not previously included in the design.

NM 811 Design One-Call Information:

SMA submitted a NM 811 Design One-Call locate request for the BBN9 Reach 10.2 waterline. Attached is the NM 811 ticket for this Reach. The Contractor is responsible for submitting NM 811 One-Call locate requests throughout the duration of the project.

Gas Line Infrastructure:

The NM 811 Design One-Call locate request for the BBN9 Reach 10.2 waterline identified four gas lines in the project vicinity. Two are owned by Marathon Petroleum Corporation and two by Energy Transfer Partners. The Reach 10.2 Project crosses these utility lines in one location. It is the construction contractor's responsibility to notify the gas company of construction activity around and under the existing gas pipeline.

Navajo Tribal Utility Authority (NTUA) owns & operates existing gas lines throughout the BBN9 project area. The Reach 10.2 Project crosses one of NTUA's gas lines. Note that NTUA does not participate in NM 811 One-Call. NTUA should be contacted separately for the location of existing utility lines. It is the construction contractor's responsibility to notify NTUA of construction activity around and under the existing gas line. Contact information and additional details regarding coordination with NTUA are provided throughout these bidding documents.

Buried Water Infrastructure:

Navajo Tribal Utility Authority (NTUA) owns & operates existing waterlines throughout the BBN9 project area. The Reach 10.2 Project crosses two of NTUA's waterlines. Note that NTUA does not participate in NM 811 One-Call. NTUA should be contacted separately for the location of existing utility lines. It is the construction contractor's responsibility to notify NTUA of construction activity around and under the existing waterlines. Contact information and additional details regarding coordination with NTUA are provided throughout these bidding documents.

NM811 CONFERENCE NOTIFICATIONS

TICKET NUMBER: 23JA230510
Ticket Type: Design Conference
Creation Date: 01/23/23 AT 13:43

Update of:

Excavator Information

Company:	Navajo Nation	Main Contact Phone:	(505) 215-2807
Address:	5454 Venice Ave NE, Suite D	Secondary Phone:	
City, St, Zip:	Albuquerque, NM 87113	Main Contact Email:	tory.dadano@soudermiller.com
Company Phone:	9282996887	Alternate Contact:	Ty Tsinnijinnie
Company Fax:		Alternate Contact Phone:	(928) 612-8686
Main Contact:	Tory Dadano	Alternate Contact Email:	ty.tsinnijinnie@soudermiller.com

Work Information

State:	NM	Confirm By:	01/26/23 AT 00:01
County:	MCKINLEY		
Place:	RURAL MCKINLEY		
Address:	Navajo Service Route 9 Highway		
Intersection:	Navajo Service Route 9		
Latitude:	35.776162	Longitude:	-108.495255
Secondary Lat:	35.82007	Secondary Long:	-108.349997
Work Type:	Proposed Design	Working For:	Navajo Nation
Pre-marked:	NO	Mechanical Boring:	NO
Contact Prior to Locating:	YES	Contact After Locating:	YES

Driving Directions

1. Start from US HWY 491 and Navajo Service Route 9 intersection. 2. Drive 9.4 miles. 3. Turn left on to "Old BLM Road" 4. Drive 9.2 miles on "Old BLM Road" 5. Destination on the right. Township 18 North Range 14 West - SW1/4 of Section 17 - Section 18 - NW1/4 of Section 20 Township 18 North Range 15 West - SW1/4 of Section 3 - S1/2 of Section 4 - S1/2 of Section 5 - S1/2 of Section 6 - Section 10 - S1/2 of Section 11 - S1/2 of Section 12 Township 18 North Range 16 West - SE1/4 of Section 1

Spotting Instructions

CONFERENCE DATE: 1/27/2023// CONFERENCE TIME: 10am mst// CONFERENCE LOCATION: TEAMS microsoftMeeting ID: 246 084 328 428 Passcode: PoUVb3

Remarks

This proposed design locate is for a waterline that is approximately 8.5 miles. RECENT CHANGES IN NEW MEXICO LAW REQUIRES THAT ALL WIDE AREA, PLANNING AND BID CONFERENCE NOTIFIED PARTICIPANTS ARE NOW REQUIRED TO PHYSICALLY ATTEND THE CONFERENCE AS SET FORTH IN THIS TICKET. PLANNERS MAY CHOOSE IN PERSON EVENTS OR ELCTRONIC CONFERENCE, AND ALL UTILITIES ARE REQUIRED TO ATTEND, APPROVE AND SIGN THE WORK PLAN, AND ANY OTHER NECESSARY DOCUMENTATION REQUIRED TO BE IN COMPLIANCE WITH THE LAW. PLEASE BE AWARE THAT EMAIL OR PHONE RESPONSES TO THE PROJECT OWNER DO NOT CONSTITUTE A POSITIVE RESPONSE. YOU MUST SUBMIT AN "OFFICIAL" RESPONSE IN THE 811 POSITIVE RESPONSE SYSTEM INDICATING AS YOUR CHOICE "CONFERENCE ATTENDED" OR "CONFERENCE RESCHEDULED", IN THE DROP BOX CHOICES, WITH THE DATE THAT YOU ATTEND THE CONFERENCE FOR THE RESPONSE TO BE CONSIDERED VALID.

TRSQ: [W8T18NR14WS07NE] [W8T18NR14WS07NW] [W8T18NR14WS07SE] [W8T18NR14WS07SW] [W8T18NR14WS08SW] [W8T18NR14WS17NE] [W8T18NR14WS17NW] [W8T18NR14WS17SE] [W8T18NR14WS17SW] [W8T18NR14WS18NE]

Utilities Notified:

Code	Name	Added Manually?
2NMP50	NM PIPELINE SAFETY BUREAU (PSB) - DAMAGES - CENTRAL WEST	True
TW11	TRANSWESTERN PIPELINE - GALLUP	False
WNR1	MPLX/WESTERN REFINING PIPELINE COMPANY - SJ/MCKINLEY	False

Response Status As Of Tuesday, June 24, 2025 9:13 AM

Status	Code	Name	Facilities
Closed	WNR1	MPLX/WESTERN REFINING PIPELINE COMPANY - SJ/MCKINLEY • January 25, 2023 1:04 PM by NMKORTERRA: Conference Attended Conference Attended on 01/25/2023	Pipeline
Closed	TW11	TRANSWESTERN PIPELINE - GALLUP • January 24, 2023 3:00 PM by ETBLUNM: UFO Cleared Spoke with excavator, notified that we are clear. This project is just in design stage and the contractor will send a new onecall when it is ready for construction	Gas, Pipeline

NM811 LOCATE REQUEST

TICKET NUMBER:	25JU170574	Update of:	
Ticket Type:	Design Locate	For Code:	AUTOEMAIL
Creation Date:	07/17/25 11:15	Seq Num:	1

Excavator Information

Company:	Souder, Miller & Associates	Main Contact Phone:	(850) 322-1722
Address:	5454 Venice Avenue NE, Suite D	Secondary Phone:	
City, St, Zip:	Albuquerque, NM 87113	Main Contact Email:	Agustin.LeonSaenz@soudermiller.com
Company Phone:	(850) 322-1722	Alternate Contact:	Tory Tadano
Company Fax:		Alternate Contact Phone:	(505) 215-2807
Main Contact:	Agustin Leon Saenz	Alternate Contact Email:	tory.tadano@soudermiller.com

Work Information

State:	NM	Work To Begin:	07/22/25 AT 00:01
County:	MCKINLEY	Expire Date:	08/11/25 AT 23:59
Place:	RURAL MCKINLEY		
Address:	NA Navajo Service Rte 9 Highway		
Intersection:	NA		
Work Type:	Proposed Design	Working For:	Souder, Miller & Associates
Pre-marked:	Yes	Mechanical Boring:	No
Contact Prior to Locating:	No	Contact After Locating:	No

Driving Directions

Heading North on US 491 from Gallup, head East on Navajo Service Rte 9 for approximately 21 miles, head North 0.15 miles toward the white-flagged location.

Spotting Instructions

Drive heading North on 491 from Gallup, head East on Navajo Service Rte 9 for approximately 21 miles, head North 0.15 miles toward the white-flagged location. The location with white flags is between two dirt roads North of Navajo Service Rte 9. Latitude: 35°48'18.14"N. Longitude: 108°25'8.03"W. Souder, Miller & Associates believes there might be a gasline at this location and would like further information.

Remarks

Between two dirt roads North of Navajo Service Rte 9. Latitude: 35°48'18.14"N. Longitude: 108°25'8.03"W. Souder, Miller & Associates believes there might be a gasline at this location and would like further information.

TRSQ: [W8T18NR15WS10SE]

Utilities Notified:

Code	Name	Manually Added
TW11	TRANSWESTERN PIPELINE - GALLUP	False
WNR1	MPLX/WESTERN REFINING PIPELINE COMPANY - SJ/MCK...	False



6/2/2025

Reach 10.2 BBN9 Project

David White
Navajo Tribal Utility Authority
david.white@ntua.com

RE: Request for Encroachment Permit Approval

Dear Mr. White:

Souder, Miller & Associates (SMA) is seeking your approval for encroachment of new water infrastructure related to the Reach 10.2 proposed pipeline project, which crosses existing Navajo Nation Utility Authority (NTUA) waterlines at designated locations. We are submitting this formal request to obtain NTUA's permission for these specific crossings to proceed with the implementation of the project.

We have provided detailed maps, plans, and specifications for the proposed pipeline crossings, along with the necessary technical documentation for your review. We are committed to ensuring compliance with all NTUA requirements and standards, and we will coordinate closely with NTUA to address any concerns or adjustments needed to protect the integrity of NTUA's infrastructure.

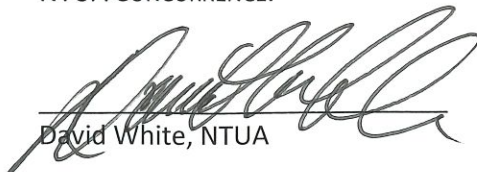
As part of the process, we kindly ask you to sign this encroachment permit request and return the signed approval to SMA. This signed letter will act as the encroachment permit for this project.

We appreciate your attention to this request and look forward to your response.

Sincerely,

Michelle Stevens
Staff Engineer
michelle.stevens@soudermiller.com
SOUDER, MILLER & ASSOCIATES, INC.

NTUA CONCURRENCE:



David White, NTUA



6/2/2025

Reach 10.3 BBN9 Project

David White
Navajo Tribal Utility Authority
david.white@ntua.com

RE: Request for Encroachment Permit Approval

Dear Mr. White:

Souder, Miller & Associates (SMA) is seeking your approval for encroachment of new water infrastructure related to the Reach 10.3 proposed pipeline project, which crosses existing Navajo Nation Utility Authority (NTUA) waterlines at designated locations. We are submitting this formal request to obtain NTUA's permission for these specific crossings to proceed with the implementation of the project.

We have provided detailed maps, plans, and specifications for the proposed pipeline crossings, along with the necessary technical documentation for your review. We are committed to ensuring compliance with all NTUA requirements and standards, and we will coordinate closely with NTUA to address any concerns or adjustments needed to protect the integrity of NTUA's infrastructure.

As part of the process, we kindly ask you to sign this encroachment permit request and return the signed approval to SMA. This signed letter will act as the encroachment permit for this project.

We appreciate your attention to this request and look forward to your response.

Sincerely,

Michelle Stevens
Staff Engineer
michelle.stevens@soudermiller.com
SOUDER, MILLER & ASSOCIATES, INC.

NTUA CONCURRENCE:



David White, NTUA

EXHIBIT E

**Filling, Hydrostatic Testing, Flushing, and
Disinfection Plan and Hydrostatic Pressure and
Leakage Test Calculations**

**Filling, Hydrostatic Testing, Flushing, and
Disinfection Plan and Hydrostatic Pressure and
Leakage Test Calculations
NGWSP Beacon Bisti N9
Reaches 10.1, 10.2 and 10.3**

August 2025

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Acronyms and Abbreviations

ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
NTUA	Navajo Tribal Utility Authority

Introduction

After construction is completed, the following procedures shall be performed: initial filling, hydrostatic pressure and leakage testing and predisinfection flushing. Disinfection of all segments of the new pipeline, disinfection of the proposed forebay tanks at the Pumping Plant 12 Site at the end of Reach 10.1, disinfection of the PP13 tanks at the end of Reach 10.2, disinfection of the Nahodishgish regulating tanks at the end of Reach 10.3, and bacteriological testing of the new pipeline will occur after the San Juan Lateral Water Treatment Plant is brought online. These procedures shall be performed according to the industry standards referenced in each of the following plans for filling, testing, flushing, and disinfection.

Note: Coordination shall be made with the Bureau of Reclamation (Reclamation) and NTUA prior to filling, testing, flushing or disinfecting the pipeline.

1. Initial Filling

As specified in AWWA C605 Sec. 10.1, “prior to filling, testing, and disinfecting the installed line, the constructor shall ensure that the line is clean in conformance with ANSI/AWWA C651. Initial filling shall be such that the line is filled gradually to allow air to be vented through Air Valves. Flow velocity during filling should not exceed 1 foot per second (fps). Flushing will not occur until after hydrostatic testing, in the case of leak is found and a repair is needed.

1. Notify Reclamation and NTUA 28 days before filling. Include initial filling on contractor’s four-week look-ahead project schedule.
2. Water source for initial fill will be potable water from the Standing Rock NTUA CWS via Reach 10.2.1 connection or water treated at the San Juan Lateral Water Treatment Plant delivered through the San Juan Lateral and any upstream BBN9 Reaches if applicable.
3. Utilize the 4” By-Pass valves on butterfly assemblies for initial fill of pipeline.

2. Hydrostatic Pressure and Leakage Testing

The pipeline shall undergo hydrostatic pressure and leakage testing prior to flushing and disinfection. Test pressure parameters and the maximum allowable leakage for each testing section of the pipeline have been determined in the Hydrostatic Pressure and Leakage Test Calculations, and are summarized briefly below.

For sections of PVC pipe, the maximum test pressure (at the lowest point in the test section) is the greater of: the DR pressure rating, or 1.25-times the actual maximum working pressure. The max allowable leakage for PVC pipe during pressure testing is determined by Equation 1 from Section 10.3.6 of AWWA C605-13. See the attached Test Hydrostatic Pressure and Leakage Calculations for more details.

See the following filling and testing plan and reference AWWA C605-13 (Underground Installation of PVC and PVC Pressure Pipe Fittings), AWWA M23-02 (PVC Pipe Design and Installation), and this project's technical specification 33 11 13 (Public Water Transmission Systems).

1. Notify Reclamation and NTUA 28 days before hydrostatic pressure and leakage testing. Include pressure testing on contractor's four-week look-ahead project schedule.
2. Do not perform leak tests when water is ponded on ground surface from major rain or snowstorms, unless approved by Reclamation.
3. Vent all air from the pipeline prior to pressurization.
4. Exercise all isolation and air valves.
5. Fully restrain the pipeline, including permanently installed items and any temporary appurtenances used for testing, prior to pressurization.
6. Perform testing in accordance with applicable standards:
 - a. Test pressure: In accordance with the Hydrostatic Pressure and Leakage Test Calculations (see attached).
 - a. PVC pipe: Simultaneous hydrostatic pressure and leakage test. The system shall be pressure tested in-ground in accordance with AWWA C605 and M23, with the exceptions noted below:
 - i. Prior to starting test, maintain pressure in pipe for 24 hours.
 - ii. Test duration: 2 hours.
 1. Engineer may require longer duration test if there is any doubt as to integrity of a particular section of pipe or appurtenances.
7. In no case shall the test pressure exceed the manufacturers' recommended maximum safe test pressure for the pipe, fittings or appurtenances.
8. No observable leakage is allowed, if leakage is detected halt test. Measurable leakage must be within the maximum allowable limits set forth by applicable AWWA and ASTM standards including AWWA C605 Sec. 10.3.6 and as presented in the attached Hydrostatic Pressure and Leakage Test Calculations.
9. Any leaks detected during testing shall be repaired after pipe is depressurized. After repairs are completed, another full duration test shall be performed on the section of the pipeline to which the repairs were made.
10. All hydrostatic pressure and leakage tests will be witnessed by Reclamation and NTUA personnel.
11. Repeat test until acceptance criteria is achieved.
12. Do not pressure test surge tank. Over pressurization of the surge tank can damage the tank.

3. Predisinfection Flushing

To facilitate effective disinfection and minimize the chlorine dosage needed, predisinfection flushing will occur and continue until the discharge turbidity drops below 5 NTU, using measurement procedures described in AWWA Manual M12 (ANSI/AWWA C605-13, 2013). Predisinfection flushing shall be performed in accordance with AWWA C605 Sec. 10.2 and AWWA C651 Sec. 4.4.2. A minimum flow velocity of 2.5 feet per second (fps) is required, or as otherwise approved by Engineer.

1. Notify NTUA and Reclamation 28 days before flushing. Include flushing on contractor's four-week look-ahead project schedule.
2. Flush Reach 10.1 by gravity from the San Juan Lateral or by flowing via gravity from PP12 Forebay Tanks. Flush Reach 10.2 by pumping from PP12 or by flowing via gravity from the PP13 Tanks. Flush Reach 10.3 by pumping from PP13 or by flowing via gravity from Nahodishgish Regulating Tanks.
3. Continue flushing until discharge turbidity drops below 5 NTU.
4. After pipeline flushing has been completed, the Pumping Plant 12 Forebay, Pumping Plant 13 and Nahodishgish Regulating Tanks shall be drained and any sediment removed.

4. Pipeline Disinfection Plan

BBN9 Reaches 10.1, 10.2 and 10.3 and the Pumping 12 Forebay, Pumping Plant 13 and Nahodishgish Tanks shall be thoroughly flushed at the time of construction in accordance with the flushing protocol previously outlined. However, disinfection and bacteriological testing will not occur at the time of construction. The disinfection and testing protocol outlined in this section are to be used during the commissioning of Reaches 10.1, 10.2 and 10.3, after the San Juan Lateral Water Treatment Plant is operational.

Disinfection of the pipeline shall be performed in accordance with the continuous-feed method of chlorination as set-forth in AWWA C651. Only properly designed and constructed equipment for this method shall be used.

At least two sets of bacteriological samples shall be collected from 1,200 LF of new waterline (if sampling locations are more than 1,200 LF apart, sample at the next nearest sampling location, do not install tapping saddles solely for the purpose of bacteriological sampling), plus two sets at each end of the line, unless otherwise approved by NTUA, Reclamation and the Engineer.

The disinfection chemicals may be one of the following, with regard to the corresponding standard: Hypochlorite (AWWA B300-10), Liquid Chlorine (AWWA B301-10), and Sodium Chlorite (AWWA B303-10). All disinfection chemicals shall meet the requirements of NSF/ANSI 60.

Testing Plan: Contractor must submit schedule and proposed testing procedures specific to the project including laboratory name and contact information, testing/sampling locations, location where flushing

water will be obtained for the pipeline flushing, disinfection, and final flushing, method for disposal of dechlorinated water and equipment to be employed for disinfection for approval by Engineer and Reclamation.

See the following disinfection and post-disinfection flushing procedure and reference AWWA C651-14 (Disinfecting Water Mains), AWWA C605-13 (Underground Installation of PVC and PVCO Pressure Pipe Fittings), AWWA M12 (Simplified Procedure for Water Examination), AWWA C655-09 (Field Dechlorination), and this project's Technical Specification 33 13 00 (Disinfection of Water Utility Transmission Systems).

1. Introduce treatment into piping system and perform disinfection in accordance with AWWA C651 Sec. 4.4.3 which states that at a point not more than 10 feet downstream from the beginning of the new main, water entering the new main shall receive a dose of chlorine fed at a constant rate such that the water has no less than 25 mg/L (ppm) free chlorine.
 - a. Measure chlorine concentration at all sampling ports provided on the drawings including air valve vaults.
 - b. Per AWWA C651 Sec. 4.4.3, the free chlorine concentration shall be measured at regular time intervals in accordance with the procedures described in Standard Methods for the Examination of Water and Wastewater or AWWA Manual M12.
2. Maintain disinfectant in system for 24 hours, or 48 hours if the temperature is less than 41 degrees Fahrenheit.
 - a. During this period, valves and hydrants in the treated section shall be operated to ensure disinfection of the appurtenances.
 - i. Valves to be operated at least twice.
 - ii. Operate the valves immediately after filling with chlorinated water.
 - iii. Second operation, shall be at least an hour later, but not at the end of the soak period.
 - b. At the end of this period, the treated water in all portions of the main shall have a residual of not less than 10 mg/L (10 ppm) of free chlorine.
 - c. Complete a disinfection report documenting that the requirements for the initial and residual free chlorine concentrations (stated above) were met. Include the items listed below:
 - i. Type and form of disinfectant used.
 - ii. Date and time of disinfectant injection start and time of completion.
 - iii. Test locations.
 - iv. Name of person collecting samples.

- v. Final disinfectant residuals in treated water in ppm for each outlet tested.
 - vi. Date and time of flushing start and completion.
 - vii. Disinfectant residual after flushing in ppm for each outlet tested.
- 3. Flush, circulate, and clean using potable water.
 - a. Neutralize residual chlorine to levels normally associated with potable water (4 ppm) prior to discharging water to the environment.
 - i. Refer to AWWA C655 (Field Dechlorination) for the procedure.
 - b. Flush pipeline until chlorine concentration in water leaving pipeline is no higher than that of the water used for flushing or 0.4 ppm, whichever is greater.
- 4. After final flushing and before pipeline is placed in service, sample, test and certify that water quality is suitable for human consumption, in accordance with AWWA C651.
 - a. The two sets shall be taken at least 24 hours apart and pass before disinfection is acceptable.
 - b. Complete a bacteriological report documenting that the water quality is suitable for human consumption. Include the items listed below:
 - i. Date issued, project name, and testing laboratory name, address, and telephone number.
 - ii. Time and date of water sample collection.
 - iii. Name of person collecting samples.
 - iv. Test locations.
 - v. Final disinfectant residuals in ppm for each outlet tested.
 - vi. Coliform bacteria test results for each outlet tested.
 - vii. Certify water conforms, or fails to conform, to bacterial standards of authority having jurisdiction.
 - c. Certify that the water conforms to the quality standards of the authority having jurisdiction and is suitable for human consumption.
 - d. In the event that the performed water quality testing fails, the affected portions of the system will be flushed, disinfected again, and retested.
 - e. The new pipeline shall not be put in service until all testing and disinfection is completed, and all bacteriological test results certifying that the water is free of coliform bacteria contamination.
- 5. Replace any permanent system devices removed for disinfection. Devices shall be spray-disinfected or swabbed with a minimum of 1–5 percent solution of chlorine just prior to being installed.

5. Storage Tank Flushing and Disinfection Plan

BBN9 Reaches 10.1, 10.2 and 10.3 and the Pumping 12 Forebay, Pumping Plant 13 and Nahodishgish Tanks shall be thoroughly flushed at the time of construction in accordance with the flushing protocol previously outlined. However, disinfection and bacteriological testing will not occur at the time of construction. The disinfection and testing protocol outlined in this section are to be used during the commissioning of Reaches 10.1, 10.2 and 10.3, after the San Juan Lateral Water Treatment Plant is operational.

Disinfection of the Pumping Plant 12 Forebay, Pumping Plant 13 and Nahodishgish Tanks shall be performed in accordance with AWWA C652 (Disinfection of Water-Storage Facilities). Only properly designed and constructed equipment for this method shall be used.

The disinfection chemicals may be one of the following per AWWA C652 Section 4.2, with regard to the corresponding standard: Liquid Chlorine (AWWA B301), Sodium or Calcium Hypochlorite (AWWA B300). All disinfection chemicals shall meet the requirements of NSF/ANSI 60.

See the following flushing and disinfection plan and reference AWWA C652 (Disinfection of Water-Storage Facilities) and Technical Specification 33 13 13 (Water Storage Tank Disinfection).

1. Conduct inspection of tank interior before beginning disinfection.
 - a. Verify tank is clean and free of polluting materials.
 - b. Verify tank pipe and vent connections are properly made and clear of obstructions.
2. For Welded steel water tanks: Use Chlorination Method 1, 2 or 3 as described in AWWA C652 Section 4.3.
 - a. Method 1: Fill storage tank to overflow level with water to which enough chlorine shall be added to provide a free chlorine residual in the full facility of not less than 10 mg/L at the end of the retention period. Retain contact between the disinfected surfaces and the chlorine solution for a period of not less than 6 hr. Chlorine shall be introduced to the system via chemical pump to ensure adequate mixing. Utilize Method 3, below, if chemical pump not used to introduce chlorine.
 - b. Method 2: Apply a solution of 200 mg/L available chlorine to the surfaces of all parts of the storage tank that will be in contact with water when the tank is full to the overflow elevation. The solution shall be applied to any separate drain piping such that it will have available chlorine of not less than 10 mg/L when filled with water. All surfaces to be treated shall be thoroughly coated with the solution. Overflow piping need not be disinfected. Retain contact between the disinfected surfaces and the chlorine solution for at least 30 minutes, at which point the drain piping shall be purged of the 10-mg/L chlorinated water, and the storage tank shall be filled to its overflow level with water treated at the water treatment plant.
 - c. Method 3: Water and chlorine shall be added to the facility that will initially contain 50 mg/L available chlorine and will fill 5% of the total storage volume. The solution shall be held for a period of 6 hr. Fill storage tank to the overflow level with potable

water. Retain mixture for 24 hr. After 24 hr retention period there shall be a free chlorine residual of 2 mg/L.

3. Protect aquatic life and vegetation from damage from disinfectant solution purged from tank.
4. Following this procedure and subject to satisfactory bacteriological testing and acceptable aesthetic quality, the water may be delivered into the system.
5. Collect samples of water from filled tank for bacteriological analysis in accordance with AWWA C652 Sec. 5.1; take inlet and outlet water samples.
6. Test water samples for bacterial contamination, residual chlorine, in accordance with Navajo Nation Environmental Protection Agency standards for potable water.
 - a. Complete a disinfection and bacteriological report documenting that the water quality is suitable for human consumption. Include the items listed below:
 - i. Date and time of disinfectant start and time of completion.
 - ii. Type and form of disinfectant used.
 - iii. Name of person collecting samples.
 - iv. Final disinfectant residuals in treated water in ppm for each outlet tested.
 - v. Date issued, project name, and testing laboratory name, address, and telephone number.
 - vi. Coliform bacteria test results for each outlet tested.
 - vii. Certify water conforms, or fails to conform, to bacterial standards of authority having jurisdiction.
 - b. If water samples fail to meet Navajo Nation Environmental Protection Agency standards for potable water, repeat sampling, if second sample fails, perform the following corrective measures until water quality conforms to Navajo Nation Environmental Protection Agency standards:
 - i. Inlet and Outlet Water Sample Failure: Eliminate source of contamination in water supply, repeat disinfection, and retest water quality.
 - ii. Outlet Water Sample Failure: Repeat disinfection, and retest water quality.
 - c. Storage tank to be online within 30 days of second passed bacteriological test.
 - d. Storage tank to be disinfected after pipeline has been disinfected.

References:

1. AWWA B300-10 – Hypochlorites
2. AWWA B301-10 – Liquid Chlorine
3. AWWA B303-10 – Sodium Chlorite
4. AWWA C605-13 – Underground Installation of PVC and PVCO Pressure Pipe Fittings
5. AWWA C651-14 – Disinfecting Water Mains
6. AWWA C655-09 – Field Dechlorination
7. AWWA M12 – Simplified Procedures for Water Examination
8. AWWA M23-02 – PVC Pipe Design and Installation
9. Specification 33 11 13 - Public Water Transmission Systems
10. Technical Specification 33 13 00 – Disinfection of Water Utility Transmission Systems
11. Technical Specification 33 13 13 – Water Storage Tank Disinfection

Attachments:

- Reach 10.1 Hydrostatic Pressure and Leakage Test Calculation
- Reach 10.2 Hydrostatic Pressure and Leakage Test Calculation
- Reach 10.3 Hydrostatic Pressure and Leakage Test Calculation

BBN9 Reach 10.1 Hydrostatic Pressure Test Calculations

Pumping Plant 07 Reg. Tank Overflow Ele	6,240.00	ft AMSL
Max HGL at BBN9 TO from SJL	6,326.90	ft AMSL
Pumping Plant 12 Reg. Tank Overflow Ele	6,099.00	ft AMSL

Description -	Testing Range						High Point / Testing ARV		Low Point			Static Pressure Difference Low to High ¹ psi	Original Test Pressure at Low Point psi	Max Test Pressure ² at Low Point psi	Min Test Pressure ² (High Point / Testing ARV) psi
	Beginning Station LF	Ending Station LF	Distance Testing Range LF	Pipe Diameter in	Pipe DR -	DR Pressure Rating -	Sta. LF	Elevation ft-AMSL	Sta. LF	Elevation ft-AMSL	Max WP psi				
BFV --> GV	0+46	48+76	4831	16	18	235	00+63	6043	47+00	5995	144	21	235	235	214
GV --> GV	48+76	75+72	2696	16	18	235	48+94	5996	74+71	5971	154	11	235	235	224
GV --> GV	75+72	101+28	2556	16	18	235	75+89	5973	100+50	5960	159	6	235	235	229
GV --> GV	101+28	136+34	3506	16	18	235	101+45	5961	135+00	5941	167	9	235	235	226
GV --> GV	136+34	187+82	5148	16	18	235	136+51	5942	176+00	5926	173	7	235	235	228
GV --> GV	187+82	233+20	4538	16	18	235	188+00	5930	231+56	5916	178	6	235	235	229
GV --> GV	233+20	268+67	3547	16	18	235	235+91	5923	260+00	5915	178	3	235	235	232
GV --> GV	268+67	286+50	1783	16	18	235	268+84	5924	284+78	5901	184	10	235	235	225
GV --> GV	286+50	316+05	2955	16	18	235	292+29	5912	294+75	5882	193	13	235	241	228
GV --> GV	316+05	356+12	4007	16	18	235	340+63	5943	317+43	5924	174	8	235	235	227
GV --> GV	356+12	371+78	1566	16	18	235	362+58	5971	358+25	5948	164	10	235	235	225
GV --> GV	371+78	404+57	3280	16	18	235	378+50	5959	371+78	5956	160	1	235	235	234
GV --> GV	404+57	451+30	4673	16	18	235	445+95	6011	408+00	5980	150	13	235	235	222
GV --> GV ³	451+30	501+11	4981	16 and 8	18	235	475+24	6026	451+30	6012	136	6	235	235	229
GV --> GV	501+11	524+55	2344	16	18	235	501+29	6022	523+50	6016	135	3	235	235	232
GV --> GV	524+55	549+28	2473	16	18	235	524+73	6016	530+00	6015	135	1	235	235	234
GV --> BFV ⁴	549+28	Master Shutoff BFV Inside Control Valve Vault	2037	16 and 8	18	235	569+48	6061	550+50	6019	133	18	235	235	217
BFV --> GV & GV	Site Piping			16 and 8	18	235	ARV Inside Control Valve Vault	6061	Site Piping	6061	115	0	235	235	235

Notes:

¹ Highlighted if static pressure difference is greater than 25 psi. *In the case of Reach 10.1, the static pressure difference is less than 25 psi in all testing ranges.*

² Maximum test pressure at low point is based on the following criteria: (1) Use either pipe WP rating or 1.25 X actual max. working pressure, whichever is greater; and (2) If using pipe WP rating, and if the static pressure difference between high and low point is greater than 25 psi, increase test pressure to maintain minimum test pressure at high point of 25 psi below WP rating. Cell highlighted if pressure greater than the pipe DR working pressure rating (original test pressure).

³ Install temporary 8-inch ANSI Class 125/150 Blind Flange to surge tank outlet prior to filling, flushing and testing pipeline. Complete hydrostatic testing of piping underneath and within surge tank building prior to removing blind flange. Remove blind flange and install 8-inch PROCO fitting after this section of line's flushing and hydrostatic pressure testing is complete, but prior to starting up surge tank.

⁴ Ensure that the 1" ball valve on the 1" steel line is closed prior to pressure testing of this section.

BBN9 Reach 10.1 Hydrostatic Pressure and Leakage Test Summary

Test Section ¹					Testing ARV Location			Allowable Leakage Calculations ²		
Beginning Station LF	Ending Station LF	Length of Test Section LF	Nominal Pipe Diameter in	Pipe DR -	Station LF	Elevation ft-AMSL	Test Pressure psi	Number of Joints Tested (N) -	Inner Diameter of Pipe (D) in	Allowable Leakage, 2 Hour Test (2Q) gal.
0+46	48+76	4831	16	18	00+63	6043	214	242	15.35	15.4
48+76	75+72	2696	16	18	48+94	5996	224	135	15.35	8.6
75+72	101+28	2556	16	18	75+89	5973	229	128	15.35	8.1
101+28	136+34	3506	16	18	101+45	5961	226	175	15.35	11.1
136+34	187+82	5148	16	18	136+51	5942	228	257	15.35	16.4
187+82	233+20	4538	16	18	188+00	5930	229	227	15.35	14.4
233+20	268+67	3547	16	18	235+91	5923	232	177	15.35	11.3
268+67	286+50	1783	16	18	268+84	5924	225	89	15.35	5.7
286+50	316+05	2955	16	18	292+29	5912	228	148	15.35	9.4
316+05	356+12	4007	16	18	340+63	5943	227	200	15.35	12.7
356+12	371+78	1566	16	18	362+58	5971	225	78	15.35	5.0
371+78	404+57	3280	16	18	378+50	5959	234	164	15.35	10.4
404+57	451+30	4673	16	18	445+95	6011	222	234	15.35	14.9
451+30	501+11	4981	16 and 8	18	475+24	6026	229	249	15.35	15.8
501+11	524+55	2344	16	18	501+29	6022	232	117	15.35	7.5
524+55	549+28	2473	16	18	524+73	6016	234	124	15.35	7.9
549+28	Master Shutoff BfV Inside Control Valve Vault	2037	16 and 8	18	569+48	6061	217	102	15.35	6.5
Site Piping			16 and 8	18	ARV Inside Control Valve Vault	6061	235	NA	Varies	0.0

Notes:

¹ Pipe used on Reach 10.1 is DR18 PVC (pressure rating of 235 psi), and has a diameter of 16".

² Where the AWWA M23 Allowable Leakage **per Hour** (Q) = $\frac{ND(P^{1/2})}{7400}$. Allowable Leakage values above are for 2 hour tests, 2*(Q).

BBN9 Reach 10.2 Hydrostatic Pressure Test Calculations

Pumping Plant 13 Reg. Tank Overflow Elev.	6,533.50	ft AMSL
Max HGL at Pumping Plant 12 Outlet	6,595.00	ft AMSL
Pumping Plant 12 Base Elev.	6,068.00	ft AMSL

Description -	Testing Range						High Point / Testing ARV		Low Point			Static Pressure Difference Low to High ¹ psi	Original Test Pressure at Low Point psi	Max Test Pressure ² at Low Point psi	Min Test Pressure ² (High Point / Testing ARV) psi
	Beginning Station LF	Ending Station LF	Distance Testing Range LF	Pipe Diameter in	Pipe DR -	DR Pressure Rating -	Sta. LF	Elevation ft-AMSL	Sta. LF	Elevation ft-AMSL	Max WP psi				
PP12 Forebay Tank 2 Existing BFV --> Suction isolation valve inside pump station	PP12 Tanks BFV	PP12 Pump Station	~30	16	14	305	Inside Pump Station	6076	PP12 Pump Site	6067	229	4	305	305	301
PP12 Pump Station --> PP12 Pump Site BFV just inside site fenceline ³	PP12 Pump Station	PP12 Site BFV just inside fenceline	~70	16	14	305	Inside Pump Station	6076	PP12 Pump Site BFV	6067	229	4	305	305	301
PP12 Pump Site BFV just inside site fenceline --> GV	PP12 Site BFV just inside fenceline	42+93	4185	16	14	305	42+75	6105	03+75	6061	231	19	305	305	286
GV --> GV	42+93	95+57	5265	16	18	235	74+65	6178	45+25	6103	213	33	235	267	234
GV --> GV	95+57	127+33	3175	16	18	235	95+75	6117	127+33	6108	211	4	235	263	260
GV --> GV	127+33	168+05	4073	16	18	235	153+73	6155	128+25	6106	212	21	235	265	243
GV --> GV	168+05	216+50	4845	16	21	200	209+50	6281	168+05	6154	191	55	200	239	184
GV --> GV	216+50	231+19	1469	16	21	200	216+68	6244	220+25	6225	160	8	200	200	192
GV --> GV	231+19	278+49	4730	16	21	200	278+31	6340	236+25	6240	154	43	200	218	175
GV --> GV	278+49	297+25	1876	16	21	200	297+07	6370	280+00	6338	111	14	200	200	186
GV --> GV	297+25	342+20	4495	16	21	200	297+42	6371	323+75	6337	112	15	200	200	185
GV --> GV	342+20	381+94	3975	16	21	200	349+79	6387	380+00	6297	129	39	200	214	175
GV --> GV	381+94	424+13	4218	16	21	200	423+95	6431	389+00	6316	121	50	200	225	175
GV --> PP13 Tank Site	424+13	PP13 Site	2685	16	21	200	450+48	6497	426+00	6429	72	29	200	204	175

Notes:

- ¹ Highlighted if static pressure difference is greater than 25 psi.
- ² Maximum test pressure at low point is based on the following criteria: (1) Use either pipe WP rating or 1.25 X actual max. working pressure, whichever is greater; and (2) If using pipe WP rating, and if the static pressure difference between high and low point is greater than 25 psi, increase test pressure to maintain minimum test pressure at high point of 25 psi below WP rating. Cell highlighted if pressure greater than the pipe DR working pressure rating (original test pressure).
- ³ Ensure that the Surge Tank Building Isolation Valve (Isolation valve 14 on sht. C-26) is closed prior to pressure testing of this section.

BBN9 Reach 10.2 Hydrostatic Pressure and Leakage Test Summary

Test Section ¹					Testing ARV Location			Allowable Leakage Calculations ²		
Beginning Station LF	Ending Station LF	Length of Test Section LF	Nominal Pipe Diameter in	Pipe DR -	Station LF	Elevation ft-AMSL	Test Pressure psi	Number of Joints Tested (N) -	Inner Diamter of Pipe (D) in	Allowable Leakage, 2 Hour Test (2Q) gal.
PP12 Tanks BFV	PP12 Pump Station	~30	16	14	Inside Pump Station	6076	301	2	14.85	0.1
PP12 Pump Station	PP12 Site BFV just inside fenceline	~70	16	14	Inside Pump Station	6076	301	4	14.85	0.2
PP12 Site BFV just inside fenceline	42+93	4185	16	14	42+75	6105	286	209	14.85	14.2
42+93	95+57	5265	16	18	74+65	6178	234	263	15.35	16.7
95+57	127+33	3175	16	18	95+75	6117	260	159	15.35	10.6
127+33	168+05	4073	16	18	153+73	6155	243	204	15.35	13.2
168+05	216+50	4845	16	21	209+50	6281	184	242	15.64	13.9
216+50	231+19	1469	16	21	216+68	6244	192	73	15.64	4.3
231+19	278+49	4730	16	21	278+31	6340	175	236	15.64	13.2
278+49	297+25	1876	16	21	297+07	6370	186	94	15.64	5.4
297+25	342+20	4495	16	21	297+42	6371	185	225	15.64	12.9
342+20	381+94	3975	16	21	349+79	6387	175	199	15.64	11.1
381+94	424+13	4218	16	21	423+95	6431	175	211	15.64	11.8
424+13	PP13 Site	2685	16	21	450+48	6497	175	134	15.64	7.5

Notes:

¹ Pipe used on Reach 10.2 are DR 14, DR 18, and DR 21 PVC (pressure rating of 305 psi, 235 psi, and 200 psi, respectively), and has a diameter of 16".

² Where the AWWA M23 Allowable Leakage per Hour (Q) = $\frac{ND(P^{1/2})}{7400}$. Allowable Leakage values above are for 2 hour tests, 2*(Q).

BBN9 Reach 10.3 Hydrostatic Pressure Test Calculations

Pumping Plant 13 Reg. Tank Overflow Elev.	6,533.67	ft AMSL
Max HGL at Pumping Plant 13 Outlet	7,054.26	ft AMSL
Nahodishgish Reg. Tank Overflow Elev.	6,983.92	ft AMSL

Description -	Testing Range						High Point / Testing ARV		Low Point			Static Pressure Difference Low to High ¹ psi	Original Test Pressure at Low Point psi	Max Test Pressure ² at Low Point psi	Min Test Pressure ² (High Point / Testing ARV) psi
	Beginning Station LF	Ending Station LF	Distance Testing Range LF	Pipe Diameter in	Pipe DR -	DR Pressure Rating -	Sta. LF	Elevation ft-AMSL	Sta. LF	Elevation ft-AMSL	Max WP psi				
PP13 Site Suction-Side of Pump	PP13 Tanks BFV (Isolation valve #11 on sht. C-25)	PP13 Pump Station (Isolation valve inside pump station)	~40	24	21	200	Inside Pump Station	6500	PP13 Pump Site	6492	18	4	200	200	196
PP13 Site Discharge-Side of Pump ³	PP13 Pump Station (Isolation valve inside pump station)	PP13 Site BFV just inside fenceline (Isolation valve #14 on sht. C-25)	~70	16	14	305	Inside Pump Station	6500	PP13 Pump Site BFV	6491	244	4	305	305	301
PP13 Pump Site BFV --> GV	PP13 Site BFV just inside fenceline (Isolation valve #14 on sht. C-25)	52+70	5270	16	14	305	52+53	6549	08+00	6478	249	31	305	312	281
GV --> GV	52+70	82+25	2955	16	14	305	77+74	6571	60+00	6526	229	19	305	305	286
GV --> GV	82+25	104+05	2180	16	18	235	92+66	6622	78+75	6561	214	27	235	267	240
GV --> GV	104+05	126+00	2195	16	18	235	125+83	6650	104+05	6598	198	23	235	247	225
GV --> GV	126+00	163+69	3769	16	21	200	163+51	6750	126+00	6650	175	43	200	219	176
GV --> GV	163+69	187+50	2381	16	21	200	174+65	6757	183+00	6740	136	7	200	200	193
GV --> GV	187+50	240+23	5273	16	21	200	228+57	6827	187+50	6746	133	35	200	210	175
GV --> GV	240+23	251+14	1091	16	21	200	250+96	6803	245+25	6737	137	28	200	203	175
GV --> GV	251+14	290+35	3922	16	21	200	270+92	6853	287+25	6796	112	25	200	200	175
GV --> GV	290+35	312+54	2219	16	21	200	290+53	6802	311+75	6704	152	43	200	218	175
GV --> GV	312+54	363+58	5104	16	21	200	349+54	6865	321+00	6700	154	71	200	246	175
GV --> GV	363+58	390+09	2570	16	21	200	389+92	6947	363+58	6812	105	59	200	234	175
GV --> Nahodishgish Regulating Tank Site Upstream of Tanks	390+09	Nahodishgish Regulating Tank Site (Isolation valves #1 and #2 on sht. C-37)	148	16	21	200	Site Piping	6958	390+09	6949	46	4	200	200	196
Nahodishgish Chlorinator Waterline and Reach 10.3.1 Connection Waterline	Nahodishgish Regulating Tank Site (Isolation valves #3, #4 and #6 on sht. C-37)	Chlorinator Inlet (Isolation valve #2 on sht. C-37) and Reach 10.3.1 Connection Waterline Sta. 2+72	499	24, 12 and 6	21 and 18	200 and 235	Reach 10.3.1 Connection Waterline Sta. 00+05	6942	02+90	6924	26	8	200	200	192
Nahodishgish Chlorinator and pipe to tie-in with the existing Nahodishgish CWS	Chlorinator Inlet (Isolation valve #2 on sht. C-37)	Nahodishgish CWS Shutoff Valve (Isolation valve #5 on sht. C-37)	70	6 and 4	Varies	Varies	CI2 ARV	6934	CI2 site piping GV #4	6928	24	2	150	150	148

Notes:

¹ Highlighted if static pressure difference is greater than 25 psi.

² Maximum test pressure at low point is based on the following criteria: (1) Use either pipe WP rating or 1.25 X actual max. working pressure, whichever is greater; and (2) If using pipe WP rating, and if the static pressure difference between high and low point is greater than 25 psi, increase test pressure to maintain minimum test pressure at high point of 25 psi below WP rating. Cell highlighted if pressure greater than the pipe DR working pressure rating (original test pressure).

³ Ensure that the Surge Tank Building Isolation Valve (Isolation valve #13 on sht. C-25) is closed prior to pressure testing of this section.

BBN9 Reach 10.3 Hydrostatic Pressure and Leakage Test Summary

Test Section ¹					Testing ARV Location			Allowable Leakage Calculations ²		
Beginning Station LF	Ending Station LF	Length of Test Section LF	Nominal Pipe Diameter in	Pipe DR -	Station LF	Elevation ft-AMSL	Test Pressure psi	Number of Joints Tested (N) -	Inner Diamter of Pipe (D) in	Allowable Leakage, 2 Hour Test (2Q) gal.
PP13 Tanks BFV (Isolation valve #11 on sht. C-25)	PP13 Pump Station (Isolation valve inside pump station)	~40	24	21	Inside Pump Station	6500	196	2	23.19	0.2
PP13 Pump Station (Isolation valve inside pump station)	PP13 Site BFV just inside fenceline (Isolation valve #14 on sht. C-25)	~70	16	14	Inside Pump Station	6500	301	4	14.85	0.2
PP13 Site BFV just inside fenceline (Isolation valve #14 on sht. C-25)	52+70	5270	16	14	52+53	6549	281	264	14.85	17.8
52+70	82+25	2955	16	14	77+74	6571	286	148	14.85	10.0
82+25	104+05	2180	16	18	92+66	6622	240	109	15.35	7.0
104+05	126+00	2195	16	18	125+83	6650	225	110	15.35	6.8
126+00	163+69	3769	16	21	163+51	6750	176	189	15.64	10.6
163+69	187+50	2381	16	21	174+65	6757	193	120	15.64	7.0
187+50	240+23	5273	16	21	228+57	6827	175	264	15.64	14.8
240+23	251+14	1091	16	21	250+96	6803	175	55	15.64	3.1
251+14	290+35	3922	16	21	270+92	6853	175	197	15.64	11.0
290+35	312+54	2219	16	21	290+53	6802	175	111	15.64	6.2
312+54	363+58	5104	16	21	349+54	6865	175	256	15.64	14.3
363+58	390+09	2570	16	21	389+92	6947	175	129	15.64	7.2
390+09	Nahodishgish Regulating Tank Site (Isolation valves #1 and #2 on sht. C-37)	148	16	21	Site Piping	6958	196	8	15.64	0.5
Nahodishgish Regulating Tank Site (Isolation valves #3, #4 and #6 on sht. C-37)	Chlorinator Inlet (Isolation valve #2 on sht. C-37) and Reach 10.3.1 Connection Waterline Sta. 2+72	499	24, 12 and 6	21 and 18	Reach 10.3.1 Connection Waterline Sta. 00+05	6942	192	25	6.09	0.6
Chlorinator Inlet (Isolation valve #2 on sht. C-37)	Nahodishgish CWS Shutoff Valve (Isolation valve #5 on sht. C-37)	70	6 and 4	Varies	CI2 ARV	6934	148	NA	Varies	0.0

Notes:

¹ Pipe used on Reach 10.3 is DR 14, DR 18 PVC, DR 21 PVC (pressure rating of 305 psi, 235 psi, 200 psi, respectively), and has a diameter of 16".

² Where the AWWA M23 Allowable Leakage **per Hour** (Q) = $\frac{ND(P^{1/2})}{7400}$. Allowable Leakage values above are for 2 hour tests, 2*(Q).

EXHIBIT F

**NTUA Application for Permission to Tap an
Existing Waterline
includes
Utility Transfer Agreement for Water
and Wastewater Facilities**

NAVAJO TRIBAL UTILITY AUTHORITY

WATER & WASTEWATER FACILITIES PERMISSION TO TAP



NAME:_____

LOCATION:_____

DISTRICT:_____

_____ **For**
_____ **FACILITIES**

NTUA Project No. _____

NTUA WATER SERVICE TAP PROCEDURES

The following procedures are to be adhered to by customer(s) and/or private contractor(s) for all water and wastewater taps and line constructions involving NTUA systems.

Approval of the permission to tap form will be granted upon full compliance with NTUA's requirements. Non-compliance of these requirements and/or NTUA's construction and material standards will result in disapproval to tap and/or construction; and service will not be initiated until all discrepancies are corrected.

Listed below are the necessary steps (check list) for all concerned parties to follow. When construction is completed and all pertinent information and documents are compiled and submitted; the District Manager and Water/Wastewater Foreman will approve and submit a copy of the final transfer package to the NTUA HQ Civil Engineering Dept. NOTE: The NTUA does not accept operation and maintenance responsibilities for customer sewer service lines or septic tank systems. These will be the customer's responsibility.

1. ☐ Permission to tap forms initiated at the local NTUA District office. The respective NTUA District office shall provide the necessary information and plans required to the customer/requestor; and assist the requestor in completing the forms. All the necessary information required from the customer to complete the form should be obtained at this point.

2. ☐ Proposed Construction Plans and Specifications: The completed permission to tap form and the proposed construction plan(s) are to be submitted to the District Manager and Water/Wastewater Foreman for their review and approval, at least 10 working days prior to construction. Utilize the attached forms provided, WS-1d or WWS-1d, for the "Proposed Construction" plans and use the NTUA legends; with direction indicated by the North arrow. Include the location of septic systems. The forms are for residential installations only. Commercial projects shall submit three (3) sets of plans for both the water and sewer combined.

3. ☐ Standard Material Listing: The respective NTUA District Office will review the standard drawings (WS-1, WS-2, WS-3, SS-1) and select the drawing(s) that apply. Please note the standard drawings are for 1" and 2" water services and 4" wastewater services only. Water service(s) over 2" and wastewater service(s) over 4", will require deviation from the standard construction drawings and material listings. Contact NTUA HQ Civil Engineering Dept. for any deviation. Note: The NTUA does not compensate customers for any donated materials.

4. ☐ Rights-of-Ways: the customer and/or contractor will be responsible for obtaining Rights-of-Ways and/or clear Grants of Easements; to be submitted with the permission to tap forms.

5. (___) The customer(s) shall provide copies of home-site lease or land use permits, archeological clearances, deposits, service applications, customer meter requests, and etc.
6. (___) Pressure readings, elevations, and system as-built ties information: these are to be provided on both the proposed and the as-built drawings. Flow requirements and demand should be submitted to size the meter and/or verify wastewater system capacity. The NTUA can assist customer(s) in determining these requirements.
7. (___) Open Trench Policy: NTUA may monitor the tap and construction of water and wastewater facilities. It is important to notify one of the main contact persons at NTUA at least three working days prior to actual construction.
8. (___) Final Inspection: All discrepancies/deficiencies shall be corrected by the customer and /or contractor and verified by NTUA.
9. (___) As-built requirements and cost of plant: Very Important! The NTUA requires as-constructed as-built drawings with swing ties and all pertinent information, to be submitted upon completion. Please submit a cost of plant list up to the metering point, of the following: (The cost of plant should be attached to the TA as Exhibit "A".)

- A. MATERIALS (List of items installed.)
- B. LABOR
- C. EQUIPMENT
- * D. TOTAL

* Total cost of plant to be included on transfer agreement.

10. (___) The customer(s) and/or contractor(s) shall provide NTUA a one-year warranty period on workmanship and materials. The Transfer Agreement will document the beginning date of the warranty period and it will authorize the NTUA to incorporate the capitalized portion of the project (see Item 9, the cost of plant) into the plant records; and to operate and maintain such facilities. (See attached Transfer Agreement.)
11. (___) Initiation of service by the NTUA.
12. (___) Submit a copy of the **Transfer Package** to NTUA HQ Civil Engineering. Provide copies to customer(s) and respective NTUA District Office.

- A. **Complete Construction As-Built drawings with NTUA system tie information.**
- B. **R.O.W. Agreement/Grant of Easement**
- C. **Final Inspection Certifications**
- D. **Completed Transfer Agreement w/Cost of Plant**

Instructions-Permission to Tap an existing NTUA Water line

This form is to be filled out and submitted to NTUA at least ten (10) working days prior to the requested date of construction of the tap. The ten (10) working days is to allow for the scheduling of an NTUA inspector and this does not imply that a full review with permission to tap being approved or disapproved will be issued in that time period.

Upon approval, a copy of the approved permission to tap form will be sent to the requestor with the local NTUA office retaining the original copy.

All addresses shall include the Zip Code. All telephone numbers shall include the Area Code.

1. a. Permanent addresses and telephone number of the requestor. In some cases this will be a contractor, if not the customer.

 b. Local address and telephone number.

 c. Vicinity location of the tap and/or project.
2. If the person to coordinate with NTUA is the same as item 1a, then write the appropriate number and letter in the name space. In most cases, this is the customer and not a contractor. If other than 1a, complete the information required.
3. Complete information required.
4. Self-explanatory.
5. Self-explanatory.
6. One copy of the PTT with the specifications and drawings is to remain at the local NTUA District Office. After review by the District Office, the original request form and copies of both the specifications and drawings are to be forwarded to the NTUA Headquarters Civil Engineering Department, unless this is an I.H.S./O.E.H. P.L. 86-121 project or a N.H.A. project.

If this is a P.L. 86-121 project, the documents will be sent to the NTUA Headquarters Special Operations Department. If this is a N.H.A. project, the documents will be sent to the NTUA NHA Projects Coordinator, NTUA Headquarters, Civil Engineering Department.

If both sewer and water taps are requested and covered in the same set of drawings and specifications, the original copy of the PTT and copies of the drawings and specifications are to be forwarded to the NTUA Headquarters Civil Engineering Department. Reproducible Mylar's or Sepias may be substituted for drawings forwarded to NTUA Headquarters since the Engineering Department can reproduce the copies required.

Under any “NO” conditions, other than P.L. 86-121 projects, attach a note of explanation.

Before forwarding the documentations to NTUA Headquarters, Civil Engineering Department, the local NTUA District Office will check the drawing(s) for:

- A. The basis of elevation as given by showing the bench-mark identification, location, and elevation;
 - B. A description of the tap point that gives specific ties to existing facilities and drawings in the NTUA files.
 - C. Detail drawing of tap point and materials to be used; may require submittals.
 - D. The portion of the proposed system that is to be transferred to NTUA for operations and maintenance is indicated, per attached ROW and/or Grant of Easement Documentation(s). Item “D” does not apply to P.L. 86-121 projects since this is covered in detail in other documents.
- 7. The type of service requested such as Residential Domestic, Commercial, or Industrial and Permanent or Temporary Service, (e.g., “Permanent Residential Domestic”), will be stated plus the meter size. If questions arise contact the NTUA Civil Engineering for assistance on information required for these entries on the request forms.
 - 8. Provide customer requested flows rates and demands required.
 - 9. If the customer requires both domestic and fire flow services, the NTUA may require a single or dual meter set up for this purpose based on flow rates required. Flow rates required shall be submitted.
 - 10. The hour of the day as well as the date, are expected entries in this space. Provide enough lead-time for tap approval and to schedule an inspector, a minimum of ten (10) working days.
 - 11. Signatures of customer(s) and/or contractor(s) responsible for tap construction and acceptance by NTUA.
 - 12. Self-explanatory.
 - 13. The District Engineering will do a complete review of the PTT with the assistance of the District Water Department.

14. The District Water Foreman will do a complete review of the PTT with the assistance of the District Engineering Dept. Attach a list of District operational constraints and current operating problems that affect or will be caused by the approval of this permission to tap. If there are no operational constraints or problems, write “NOP” beside the date of the signature.
15. Self-explanatory
16. The District Manager will do a complete review of the permission to tap forms and related documents.
17. Self-explanatory, per the local NTUA District office schedule.
18. Self-explanatory.
19. Unless otherwise noted, a list of restrictions, recommendations, conditions, notes, and etc. on the approval will be stated.

PERMISSION TO TAP AN EXISTING N.T.U.A. WATER LINE

1. Requester

a. NAME : _____
 TITLE : _____
 ORGANIZATION : _____
 PERMANENT : _____
 ADDRESS : _____
 TELEPHONE # : _____

b. LOCAL ADDRESS : _____

 LOCAL PHONE # : _____

c. VICINITY/LOCATION: _____
OF TAP/PROJECT _____

2. Person responsible for tap construction and its acceptance by the Navajo Tribal Utility Authority.

NAME : _____
 TITLE : _____
 ORGANIZATION : _____
 ADDRESS : _____

 TELEPHONE # : _____

3. Person responsible for paying the Navajo Tribal Utility Authority for service after the construction is completed and accepted.

NAME : _____
 TITLE : _____
 ORGANIZATION : _____
 ADDRESS : _____

 TELEPHONE # : _____

4. Date request is submitted to the Navajo Tribal Utility Authority.

DATE : _____

5. Submitted to:

NAME : _____
 TITLE : _____
 NTUA OFFICE : _____

12. Is this service downstream from a previous Master Metered area? ____ (Yes/No).

13. Specifications and proposed construction drawings reviewed by:

District Engineering Dept.

Date

14. Specifications and proposed construction drawings reviewed and approved by:

District W/WW Foreman

Date

*OCP? (Yes/No)

* "OC/P" = Operational constraints/problems. If YES, attach list of current operating problems that will affect PTT.

15. Assigned NTUA inspector's name.

Name/Title

16. Reviewed by District Manager.

Signature

Date

17. Approved time and date of construction of tap.

Time and Date: _____

18. Permission to Tap reviewed and approved by.

NTUA HQ, Civil Engineering Dept./Title

Date

19. Comments / Remarks:

FINAL INSPECTION FOR INDIVIDUAL FACILITIES

Homeowner's Name: _____

Address: _____

Location of Service: _____

Water System Name/Project No: _____

Description of Building Served: _____

Facilities Installed: ☐ Water line/Water tap
☐ Sewer line/Sewer tap
☐ Sewer septic system. Note: For information only.

Construction Completion Date: _____

Construction As-Built provided
To Operating Utility: Date: _____ By: _____

Final Inspection Date: _____

Attendees: NAME(S) REPRESENTING:

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

The facilities indicated above have been completed and inspected, with all deficiencies (if any) corrected to NTUA's requirements and such facilities have been transferred to NTUA per the **"Transfer Agreement"** for normal operation and maintenance.

_____ will warranty these facilities against defects in material and workmanship for one year, beginning _____ and ending _____.

Customer's Signature/Date

NTUA Representative/Title/Date

WATER/WASTEWATER TEST CERTIFICATIONS

DISTRICT: _____ DATE: _____

WATER SYSTEM

CUSTOMER: _____

LOCATION: _____

LOCATION OF LINE TESTED: _____

LENGTH, SIZE, & TYPE OF PIPE: _____

DATE OF TEST(s): _____ PASSED : _____ *FAILED: _____

*If FAILED, waterline must be re-tested.

PRESSURE TEST RESULTS: (Attach work sheets)

1.	Test Pressure	:	_____	PSI..
2.	Duration of Test	:	_____	HRS.
3.	Allowable Leakage	:	_____	Gals.
4.	Total Leakage	:	_____	Gals.

DATE (Water Sample to Lab) : _____ Lab no.: _____

RESULTS OF BACTEE: _____ PASSED : _____ *FAILED: _____

*If FAILED, water must be re-sampled.

TEST RESULTS CERTIFIED BY: _____

NTUA REPRESENTATIVE / TITLE DATE

WASTEWATER SYSTEM

CUSTOMER: _____

LOCATION: _____

DATE OF TEST(s): _____

LOCATION OF LINE TESTED: _____ SECTION OF _____

LENGTH, SIZE, & TYPE OF PIPE: _____

SIZE, & TYPE OF MANHOLE (S): _____

WASTEWATER TESTS: (Attach work sheets)

1.	Line Test*	:	_____	Gal/Section/2 hrs.
2.	Manhole Test**:	:	_____	Gal/MH/2 Hrs.

TEST RESULTS CERTIFIED BY: _____

NTUA REPRESENTATIVE / TITLE DATE

* Allowable Leakage: ≤ 1 Gal./Section/2hrs. for 8" to 12" lines, regardless of length, with 4 feet of head test pressure.

** Allowable Exfiltration: ≤ 5 gal/MH/2 hrs. regardless of height.

UTILITY TRANSFER AGREEMENT
for
WATER AND WASTEWATER FACILITIES

This agreement is made between _____, hereinafter called the Grantor and the **NAVAJO TRIBAL UTILITY AUTHORITY**, hereinafter called the Grantee.

WHEREAS, the Grantor has constructed or caused to have constructed water and wastewater facilities located at or near _____ as shown on the plans titled _____, designed by _____, and dated _____ and said facilities and related final as-built plans already have been inspected, accepted and approved by the Grantee, and;

WHEREAS, the Grantor wishes to convey to the Grantee all his interest in these facilities and appurtenances constructed at the above-mentioned location on or about the above-mentioned time, along with all rights, rights of way, and privileges so that the Grantee may own, operate, and maintain all such facilities and appurtenances.

NOW THEREFORE IT IS AGREED:

For consideration of \$1.00 the receipt of which already has been acknowledged, the Grantor transfers, assigns, grants, and conveys to the Grantee all rights, titles, interests, easements, and rights of way in the aforementioned facilities, and;

The Grantee agrees to accept such aforementioned facilities, and further agrees to own, operate, and maintain such facilities in a reasonable and prudent manner until such facilities are determined to be no longer of any value. Further, the Grantor hereby warranties all such facilities against defects in workmanship and materials, and for design deficiencies, errors and omissions for the period of one year beginning on _____ and ending on _____.

A listing of the total inventory and Cost of Plant determined by the Grantor to be transferred to the Grantee is attached as EXHIBIT____ and made a part of this Utility Transfer Agreement. The total Cost of Plant as appears on this document is \$_____.

IN WITNESS THEREOF, both parties have signed and dated this agreement.

Grantor

Signature

Date:

Print Name/Title

Navajo Tribal Utility Authority: _____

Signature

Date

Print Name/Title

EXHIBIT G

Survey Authorization Forms

- **Owner Provided Survey Request Form**
- **Also Located at:**
<https://www.soudermiller.com/forms/survey-request>

Survey Request

Requestor Information

Requestor Name

Requestor Company

Requestor Phone

Requestor Email Address

Project Information

Select the office closest to you

Project Title

Date/Time requested for Survey crew to arrive onsite

Please describe exactly what is needed using stations and page numbers in the plans if possible, please describe what kind of offsets are needed.

Please use the field below to upload pictures of the plans, preferably highlighting what you need.

Choose Files

No file chosen



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Submit

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