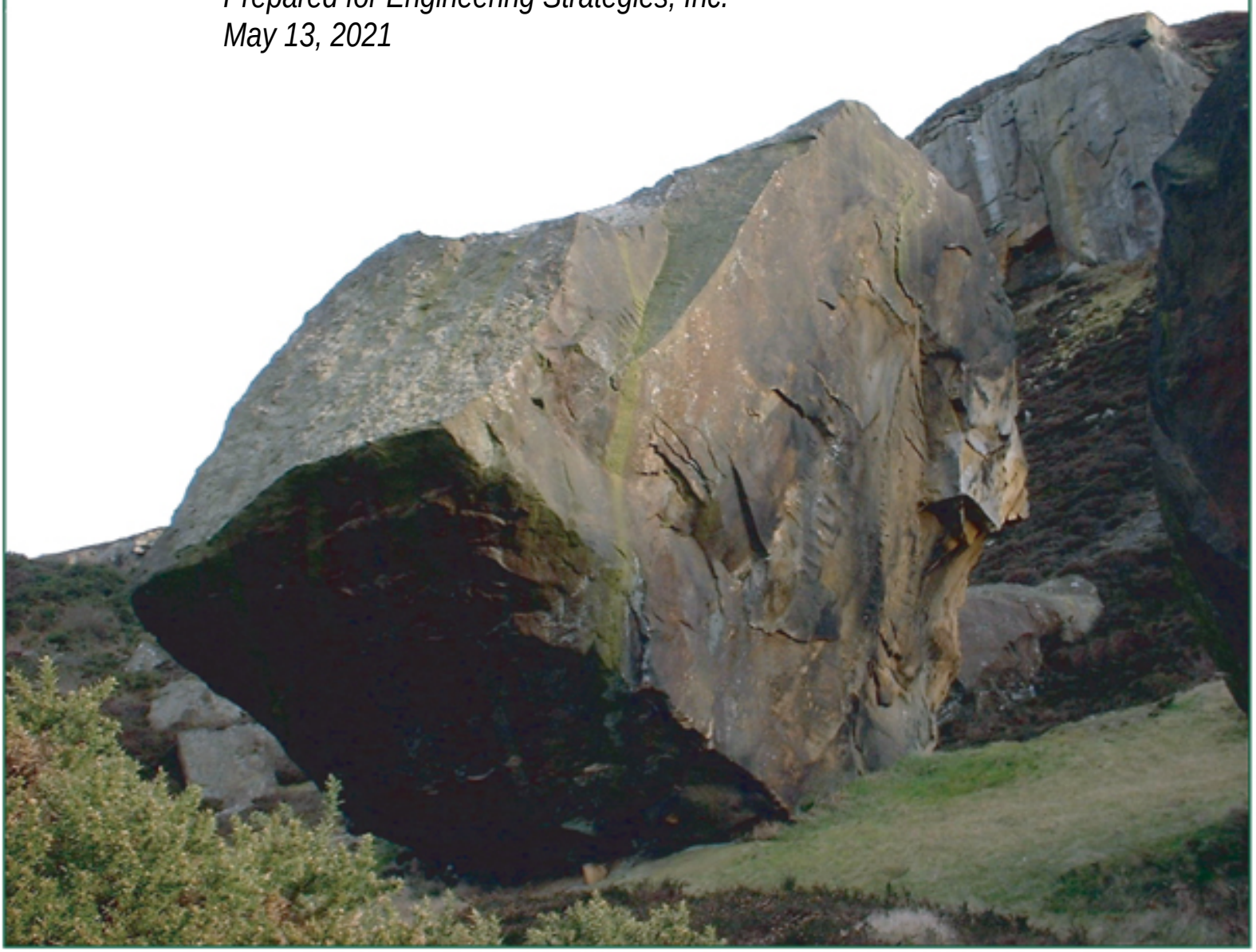
GEO HYDRO ENGINEERS

Report of Subsurface Exploration and Geotechnical Engineering Evaluation

Wyckoff Raw Water Pipeline Improvements
Cobb and Bartow Counties, Georgia
Geo-Hydro Project Number 210188.20

Prepared for Engineering Strategies, Inc.
May 13, 2021



Mr. David Erel
Engineering Strategies, Inc. (ESI)
3855 Shallowford Road, Suite 525
Marietta, Georgia 30062

May 13, 2021

Report of Subsurface Exploration
Cobb County-Marietta Water Authority
Wyckoff Raw Water Pipeline Improvements
Cobb and Bartow Counties, Georgia
Geo-Hydro Project Number 210188.20

Dear Mr. Erel:

Geo-Hydro Engineers, Inc. has completed the authorized subsurface exploration for the above referenced project. The scope of services for this project was outlined in our proposal number 25787.2 dated February 18, 2021. This report describes our understanding of the project and the subsurface conditions encountered, and contains our conclusions and recommendations regarding the geotechnical aspects of the proposed design and construction.

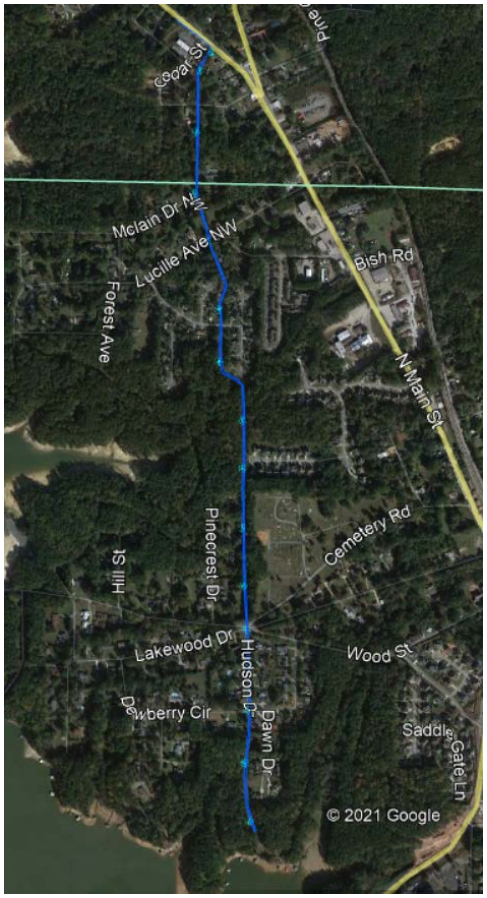
PROJECT INFORMATION

Proposed Water Main Replacement

The project involves improvements to the existing Wyckoff raw water line. The existing raw water line includes 30-inch diameter and 60-inch diameter pipe sections. The improvements include removing the existing 30-inch diameter line and installing a new 54-inch diameter water line. The planned alignment has a total length of about 7,200 feet, starting at Lake Acworth near the southern terminus of Dawn Drive paralleling or crossing several residential streets before terminating at the Old US Highway 41 righto-of-way near its intersection with Cedar Street.

Based on the information provided to us and our review of the proposed alignment, we do not anticipate any jack-and-bore installation or other trenchless crossings. We expect the bottom of the pipeline to be at a depth of about 10 to 12 feet below current grades.

The annotated aerial photograph to the right shows the planned alignment.



Current Site Conditions

The project alignment includes primarily residential properties with some commercial property at the north end of the alignment. The terrain along the alignment is typical for the Atlanta area with rolling upland areas separated by intermittent wet weather drainage features. The alignment crosses several rights-of-way, which include underground and overhead utilities.

EXPLORATORY PROCEDURES

Field Exploration

The subsurface exploration consisted of 30 machine-drilled borings performed at the approximate locations shown on Figures 2 through 4 included in the Appendix. The borings were located in the field during our site visit with you. In general, the boring locations should be considered approximate. Stationing is included on the test boring records and was estimated from the project drawings.

Standard penetration testing, as provided for in ASTM D1586, was performed at select depth intervals in the borings. Soil samples obtained from the drilling operation were examined and classified in general accordance with ASTM D-2488 (Visual-Manual Procedure for Description of Soils). Soil classifications include the use of the Unified Soil Classification System described in ASTM D2487 (Classification of Soils for Engineering Purposes). The soil classifications also include our evaluation of the geologic origin of the soils. Evaluations of geologic origin are based on our experience and may be subject to some degree of interpretation.

Laboratory Testing

Samples for laboratory testing related to the corrosive properties of the soils were obtained from the auger cuttings at seven boring locations. Corrosion laboratory testing included pH (ASTM G51), reduction/oxidation (ASTM G200), and resistivity testing using the soil-box method (ASTM G187). Bulk samples of representative soils were obtained at four locations for standard Proctor compaction testing (ASTM D698). Laboratory test results are included in the Appendix.

REGIONAL GEOLOGY

The project site is located within the Northern Piedmont geologic province of Georgia. Soils in this area have been formed by the in-place weathering of the underlying crystalline rock, which accounts for their classification as "residual" soils. Residual soils near the ground surface, which have experienced advanced weathering, frequently consist of red brown clayey silt (ML) or silty clay (CL). The thickness of this surficial clayey zone may range up to roughly 6 feet. For various reasons, such as erosion or local variation of mineralization, the upper clayey zone is not always present.

With increased depth, the soil becomes less weathered, coarser grained, and the structural character of the underlying parent rock becomes more evident. These residual soils are typically classified as sandy micaceous silt (ML) or silty micaceous sand (SM). With a further increase in depth, the soils eventually

become quite hard and take on an increasing resemblance to the underlying parent rock. When these materials have a standard penetration resistance of l00 blows per foot or greater, they are referred to as partially weathered rock. The transition from soil to partially weathered rock is usually a gradual one, and may occur at a wide range of depths. Lenses or layers of partially weathered rock are not unusual in the soil profile.

Partially weathered rock represents the zone of transition between the soil and the indurated metamorphic rocks from which the soils are derived. The subsurface profile is, in fact, a history of the weathering process which the crystalline rock has undergone. The degree of weathering is most advanced at the ground surface, where fine grained soil may be present. And the weathering process is in its early stages immediately above the surface of relatively sound rock, where partially weathered rock may be found.

The thickness of the zone of partially weathered rock and the depth to the rock surface have both been found to vary considerably over relatively short distances. The depth to the rock surface may frequently range from the ground surface to 80 feet or more. The thickness of partially weathered rock, which overlies the rock surface, may vary from only a few inches to as much as 40 feet or more.

Stream valleys in the Piedmont Region may contain alluvial (water deposited) soils, depending on ground surface topography, stream flow characteristics, and other factors. By nature, alluvial soils can be highly variable depending upon the energy regime at the time of deposition. Coarse materials such as sand or gravel are deposited in higher energy environments, while fine grained materials such as silt and clay are deposited in low energy environments. Alluvial soils may also contain significant organic materials, and are frequently in a loose, saturated condition. In many cases, fine grained alluvial soils will be highly compressible and have relatively low shear strength.

TEST BORING SUMMARY

Starting at the ground surface, borings SB-3, SB-4, SB-5, SB-10, SB-13, SB-14, and SB-16 encountered about 3 to 4 inches of asphalt underlain by about 3 to 8 inches of graded aggregate base. The total measured pavement section thickness ranged from about 7 to 12 inches. The remaining borings initially encountered about 1 to 3 inches of topsoil. Detailed measurements necessary for quantity estimation were not performed for this project and the thickness of surface materials should be expected to vary. For planning purposes, we recommend an arbitrary thickness of 6 inches for surface materials in grassed areas and 12 inches for pavement materials (asphalt+GAB) were applicable.

Beneath surface materials, borings SB-4, SB-5, SB-8 through SB-11, SB-13, SB-15, and SB-16 encountered fill materials extending to depths ranging from about 3 to 12 feet. The fill was classified as sandy clay, clayey sand, and silty sand with varying amounts of rock fragments and mica. Standard penetration resistances recorded in the fill ranged from 4 to 28 blows per foot.

Beneath surface materials or fill materials, all of the borings encountered residual soils typical of the Piedmont Region. The residual soils were classified as silty clay of varying plasticity, sandy clay, clayey sand, and silty sand with varying mica content. Standard penetration resistances recorded in the residual soils ranged from 2 to 51 blows per foot.

Borings SB-3 and SB-6 through SB-9 encountered partially weathered rock at depths ranging from about 6 to 12 feet. Partially weathered rock is locally defined as residual material having a standard penetration resistance of 100 blows per foot or greater.

Conditions causing auger refusal were encountered in borings SB-3 and SB-8 at depths of 10 and 12 feet, respectively. Auger refusal is the condition that prevents further advancement of the boring using conventional soil drilling techniques. The remaining borings were extended to their planned termination depths.

At the time of drilling, groundwater was encountered in boring SB-15 at a depth of 11 feet. It is important to note that groundwater levels will fluctuate depending on seasonal variations of precipitation and other factors, and may occur at higher elevations in the future.

For more detailed descriptions of subsurface conditions, please refer to the summary table on the following page and the test boring records included in the Appendix.

Summary of Subsurface Conditions

Boring	Approx. Station	Groundwater at Time of Drilling (feet)	Bottom of Fill (feet)	Top of PWR (feet)	Auger Refusal Depth (feet)	Boring Termination (feet)
SB-1	-0+53	NE	NE	NE	NE	15
SB-2	4+43	NE	NE	NE	NE	15
SB-3	8+95	NE	NE	8	10	10
SB-4	12+32	NE	3	NE	NE	15
SB-5	16+20	NE	3	NE	NE	15
SB-6	19+43	NE	NE	8	NE	15
SB-7	24+43	NE	NE	6	NE	15
SB-8	29+43	NE	3	8	12	12
SB-9	33+49	NE	8	12	NE	15
SB-10	37+10	NE	3	NE	NE	20
SB-11	42+20	NE	12	NE	NE	20
SB-12	49+99	NE	NE	NE	NE	15
SB-13	53+80	NE	3	NE	NE	15
SB-14	61+60	NE	NE	NE	NE	15
SB-15	63+85	11	3	NE	NE	15
SB-16	67+90	NE	3	NE	NE	15

Locations and Depths in this Summary Table are Approximate
PWR: Partially weathered rock
NE: Not Encountered

LABORATORY TESTING SUMMARY

The following tables summarize the results of laboratory testing performed for the project.

Standard Proctor (ASTM D698)

Boring	Depth	Approx. Station	Maximum Dry Density (pcf)	Optimum Moisture Content (%)	Natural Moisture Content (%)
SB-1	0'-10'	-0+53	106.8	17.3	15.3
SB-7	0'-10'	24+43	118.4	12.2	5.3
SB-11	0'-10'	42+20	108.8	16.2	16.5
SB-15	0'-10'	63+85	108.6	15.8	24.2

pH (ASTM G51), Reduction/Oxidation (ASTM G200), and Resistivity - Soil-Box Method (ASTM G187)

Boring	Approx. Station	Sample Depth (feet)	pH	ORP (mV)	Resistivity (ohm-cm)
SB-1	-0+53	0'-10'	7.2	320	42,478
SB-5	16+20	5'-10'	4.8	246	37,900
SB-7	24+43	0'-10'	7.3	345	15,410
SB-9	33+49	5'-10"	6.4	322	13,467
SB-11	42+20	0'-10'	6.0	266	9,330
SB-13	53+80	5'-10'	5.4	240	36,700
SB-15	63+85	0'-10'	6.1	319	12,194

EVALUATIONS AND RECOMMENDATIONS

The following evaluations are based on the information available on the proposed water main alignment, the data obtained from the exploratory borings and laboratory testing, and our experience with soils and subsurface conditions similar to those encountered at the explored locations. Because the subsurface exploration represents a statistically small sampling of subsurface conditions, it is possible that conditions between the test borings may be substantially different from those indicated by the borings.

Excavation Characteristics

Borings SB-3 and SB-6 through SB-9 encountered partially weathered rock at depths between about 6 and 12 feet. Based on our conversations with you, we expect the bottom of the water line to be about 10 feet below the ground surface, and removal of partially weathered rock will likely be necessary along portions of the alignment, particularly between stations 17+50 and 35+00. Removal of partially weathered rock typically requires large equipment capable of ripping. Due to the linear nature of the project, it may not be feasible to use large equipment for installation of the water line. In such cases, the use of rock hammers will be necessary to remove partially weathered rock from the trench excavations. Additionally, larger boulders, rock lenses, and dense seams within partially weathered rock can hinder excavation. A budget contingency should be included for rock excavation in sections where partially weathered rock is expected.

Conditions causing auger refusal were encountered in borings SB-3 and SB-8 at depths of 10 and 12 feet, respectively. The cause of auger refusal may be a boulder, lens or pinnacle of rock, or relatively massive rock. For planning purposes, we recommend assuming that rock removal will be necessary to achieve excavation below the depth of auger refusal.

It is important to note that the geology of the Piedmont is characterized by variable subsurface conditions. Due to the widely-spaced nature of the borings, it is likely that subsurface conditions intermediate of the borings will be different than suggested by direct interpolation between borings. Weathered rock, mass rock, boulders, and rock seams may all be encountered at locations intermediate of the borings along the alignment.

For construction bidding and field verification purposes it is common to provide a verifiable definition of rock in the project specifications. The following is a typical definition of trench rock:

- Trench Rock: Material occupying an original volume of at least one-half cubic yard which cannot be excavated with a hydraulic excavator having a minimum flywheel power rating of 123 kW (165 hp); such as a Caterpillar 322C L, John Deere 230C LC, or a Komatsu PC220LC-7; equipped with a short tip radius bucket not wider than 42 inches.

Earth Slopes

Temporary construction slopes should be designed in strict compliance with OSHA regulations. The exploratory borings indicate that most soils along the alignment are Type B or C as defined in 29 CFR 1926 Subpart P. In general, we recommend that temporary construction slopes be no steeper than

1.5H:1V for excavation depths of 20 feet or less. However, temporary excavation slopes in firm residual soils above the groundwater level can have a gradient of 1H:1V. Temporary construction slopes should be closely observed on a daily basis by the contractor's "competent person" for signs of mass movement: tension cracks near the crest, bulging at the toe of the slope, etc. The responsibility for excavation safety and stability of temporary slopes should lie solely with the contractor.

We recommend that extreme caution be observed in trench excavations. Several cases of loss of life due to trench collapses in Georgia point out the lack of attention given to excavation safety on some projects. We recommend that applicable local and federal regulations regarding temporary slopes, and shoring and bracing of trench excavations be closely followed.

Temporary Excavation Bracing

If at a given location a sloped excavation is not feasible, trench boxes or other temporary excavation bracing will be required. The most appropriate type of excavation bracing will be dictated by subsurface conditions at the specific excavation or pit location. Typically, the contractor will design and implement temporary excavation bracing as part of means and methods of construction.

Construction Dewatering

Based on the results of the test borings, groundwater is not expected to be a major hindrance for design or construction of the water main. However, groundwater may be encountered in localized areas not explored by the test borings. If necessary, dewatering should be performed to maintain the groundwater level approximately 2 to 3 feet below the lowest prevailing excavation depth. In most cases we expect that direct pumping from the excavation will provide satisfactory temporary construction dewatering. However, the actual dewatering approach will be dictated by conditions at the time of excavation. Sand layers or other more permeable soil layers may significantly increase the amount of water inflow into open excavations.

The amount of temporary dewatering actually required during construction is related not only to the prevailing weather conditions, but also the contractor's sequencing of construction activities. Construction specifications should include performance guidelines for temporary dewatering. Performance guidelines allow the contractor to select the actual means and methods of construction dewatering. The following sample specification[1] could be used as a guide for development of actual specifications.

> *Control of groundwater shall be accomplished in a manner that will preserve the strength of the subgrade soils, will not cause instability of the excavation slopes, and will not result in damage to existing structures. Where necessary to these purposes, the water level shall be lowered in advance of excavation, utilizing trenches, sumps, wells, well points, or similar methods. The water level, as measured in piezometers, shall be maintained a minimum of 3 feet below the prevailing excavation level. Open pumping from sumps and ditches, if it results in boils, loss of soil fines, softening of the ground, or instability of slopes, will not be permitted. Wells and well points shall be installed with suitable screens and filters so that continuous*

[1] The sample specification was adapted from Construction Dewatering - A Guide to Theory and Practice, John Wiley and Sons, and is not intended for direct use as a construction specification without modifications to reflect specific project conditions.

pumping of soil fines does not occur. The discharge shall be arranged to facilitate collection of samples by the Engineer.

We recommend that pipe bedding be used where groundwater is encountered. This will provide a level, stable base for pipe installation. We recommend #57 or #78 crushed stone meeting Georgia DOT specifications as pipe bedding. The bedding stone should be wrapped in non-woven, needle-punched geotextile fabric meeting the requirements of AASHTO M288 for Class 2 Geotextiles.

Structural Fill Placement

Materials selected for use as structural fill should be free of organic matter, waste construction debris, and other deleterious materials. In general, the material should not contain rocks having diameters over 4 inches. It is our opinion that the following soils represented by their USCS group symbols will typically be suitable for use as structural fill and are commonly found in abundance in the Piedmont region: (CL), (SM), and (ML). The following soil types are typically suitable but are not abundant in the Piedmont region: (SW), (SP), (SC), (SP-SM), and (SP-SC). The following soil types are considered unsuitable: (MH), (CH), (OL), (OH), and (Pt).

Laboratory Proctor compaction tests should be performed on representative samples of proposed fill materials to provide data necessary to determine acceptability and for quality control. The moisture content of suitable borrow soils should generally be no more than 3 percentage points above or below their optimum moisture contents at the time of compaction. Tighter moisture limits may be necessary with certain soils.

Suitable fill material should be placed in thin lifts. Lift thickness depends on type of compaction equipment; but in general lifts of 8 inches loose measurement are recommended. The soil should be compacted by heavy compaction equipment such as a self-propelled sheepsfoot roller. Within confined areas, such as around the pipe or manhole structures, we recommend the use of "wacker packers" or "Rammax" compactors to achieve the specified compaction. Loose lift thicknesses of 4 to 6 inches are recommended in small area fills.

In general, we recommend that structural fill be compacted to at least 95 percent of the standard Proctor maximum dry density (ASTM D698). Following Georgia DOT guidelines, the upper 12 inches of pavement subgrade soils should be compacted to at least 100 percent of the standard Proctor maximum dry density. Geo-Hydro should perform density tests during fill placement.

Soils excavated from elevations approaching and extending below the groundwater level will have moisture contents that will be too high to allow proper compaction. In portions of the water main alignment that will be outside the travel lanes, the compaction criteria can possibly be adjusted to allow the reuse of soils with higher moisture contents than those typically required for structural fill. However, proper compaction must be achieved beneath any roadways and other areas where pavements or other hardscapes will be supported by the fill.

It is important to establish as part of the construction contract whether soils having elevated moisture content will be considered suitable for reuse. We often find this issue to be a point of contention and a

source of delays and change orders. From a technical standpoint, soils with moisture contents wet of optimum as determined by the standard Proctor test (ASTM D698) can be reused provided that the moisture is properly adjusted to within the workable range. From a practical standpoint, wet soils can be very difficult to dry in small or congested sites and such difficulties should be considered during planning and budgeting. A clear understanding by the general contractor and grading subcontractor regarding the reuse of excavated soils will be important to avoid delays and unexpected cost overruns.

Pipe Support

Based on the results of the test borings and our observations, it is likely that conditions varying from loose fill to partially weathered rock or rock will be exposed at invert elevation for the water main. To limit potential differential settlement and stress concentrations at the interface of dissimilar bearing materials, soft soils should be removed and pipe bedding consisting of crushed stone should be placed as necessary. Bedding will likely be needed in conjunction with dewatering as discussed above. This approach will also provide a stable and relatively level working surface during installation of pipe sections.

We recommend that project plans require at least 6 inches of #57 or #78 crushed stone meeting Georgia DOT specifications for gradation as bedding for the pipe. This approach should result in satisfactory removal of the upper portion of loose soils, where present, and would establish a relatively uniform bearing surface. In areas where groundwater is present or expected to fluctuate within the pipe interval, the bedding stone should be wrapped using non-woven, needle-punched geotextile fabric meeting the requirements of AASHTO M288 for Class 2 Geotextiles.

Subsurface conditions will vary, and we recommend that a qualified geotechnical engineer be present during preparation of bearing surfaces for the pipeline.

Thrust Block Design

At the time of this report, locations along the alignment that will require a thrust block had not been provided to us. Once final locations are determined for any thrust blocks along the alignment, please allow us to revise our recommendations. The following paragraphs outline general thrust block recommendations that can be used for planning purposes. Depending on the actual thrust block locations, more favorable parameters and recommendations may be possible.

Passive earth pressure may be evaluated using the following equation:

$$p_h = K_p (D_w Z + q_s) + W_w(Z-d)$$

where: p_h = horizontal earth pressure at any depth below the ground surface (Z)
W_w = unit weight of water
Z = depth to any point below the ground surface
d = depth to groundwater surface
D_w = partially saturated unit weight of the soil backfill (depending on borrow sources). The partially saturated unit weight of most residual soils may be expected to range from

approximately 115 to 125 pcf. Below the groundwater level, D_w must be the buoyant weight.

q_s = uniform, permanent surcharge load

K = earth pressure coefficient as follows:

Earth Pressure Condition	Coefficient
Active (K_a)	0.33
Passive (K_p)	3.0

For analysis of sliding resistance at the base of the block, the coefficient of friction may be taken as 0.4 for most soils in contact with the bottom of the block. This is an ultimate value, and an adequate safety factor should be used in design. Full development of the frictional force could require deflection of roughly 0.1 to 0.3 inches.

The base of the thrust block should bear on relatively firm soils. Provided that a stable bearing surface is available, an allowable bearing pressure of 2,000 psf can be used in design of support for the block. The thrust block subgrade must be evaluated by Geo-Hydro to verify that the recommended bearing pressure is available. Also, the block location must be properly dewatered to reduce disturbance to the block subgrade. If the subgrade soils become water-softened, undercutting may be required to remove soft soils. If friction at the base of the block is used to resist sliding, lean concrete must be used to backfill any undercut areas.

* * * * * *

We appreciate the opportunity to serve as your geotechnical consultant for this project. If you have any questions concerning this report or any of our services, please call us.

Sincerely,

GEO-HYDRO ENGINEERS, INC.

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Senior Geotechnical Engineer
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Luis E. Babler, P.E.
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AMP/LEB/210188.20 - Wyckoff Raw Water Line Improvements - Geotechnical Report leb

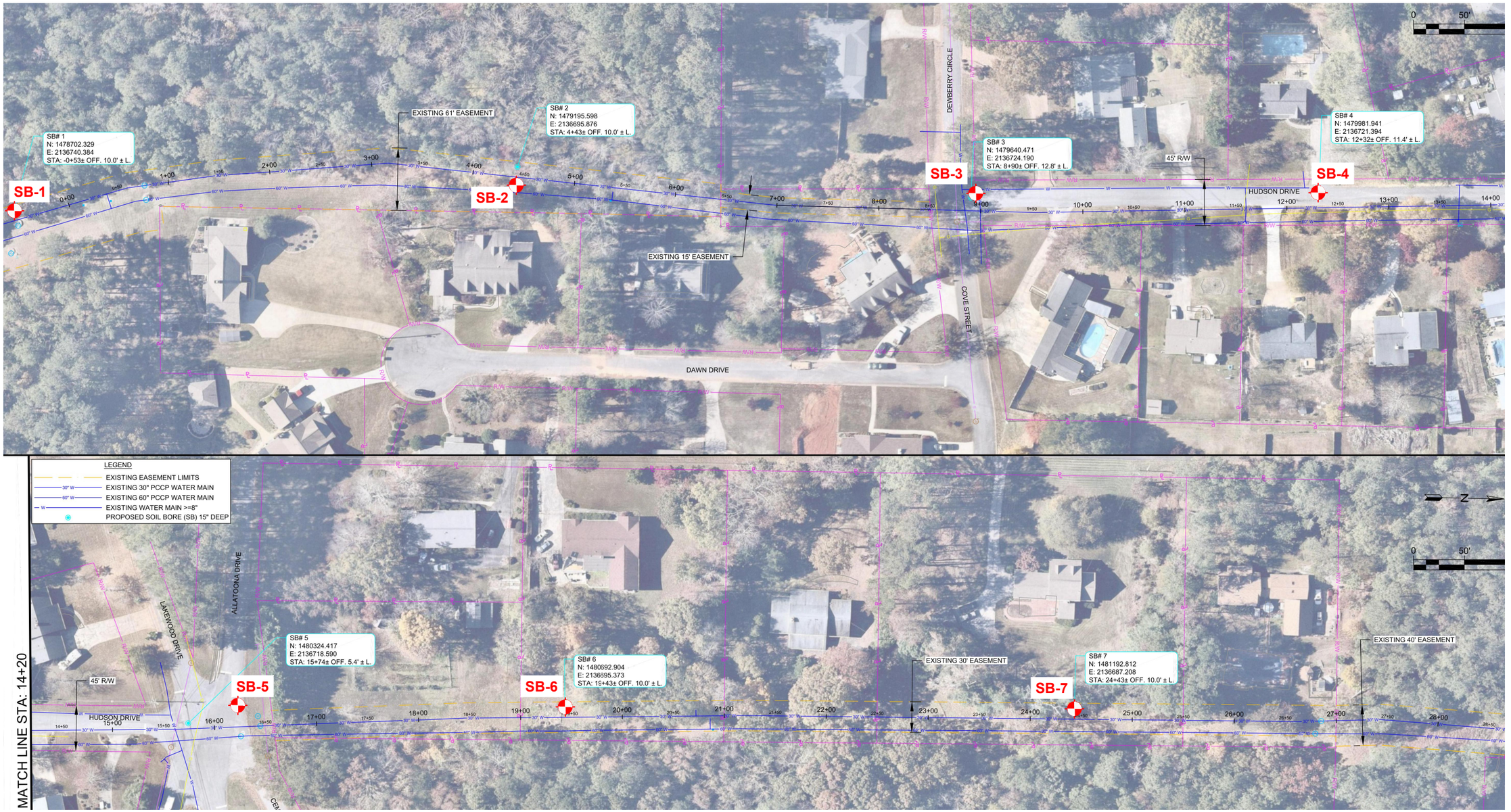
APPENDIX

0 0.25 0.5 1 1.5

Approximate Scale, Miles

Figure 1: Site Location Plan

Wyckoff Raw Water Pipeline Improvements
Cobb & Bartow Counties, Georgia
Geo-Hydro Project Number 210188.00



LEGEND: Soil Test Boring

Figure 2: Boring Location Plan

Wyckoff Raw Water Pipeline Improvements
Cobb & Bartow Counties, Georgia
Geo-Hydro Project Number 210188.00

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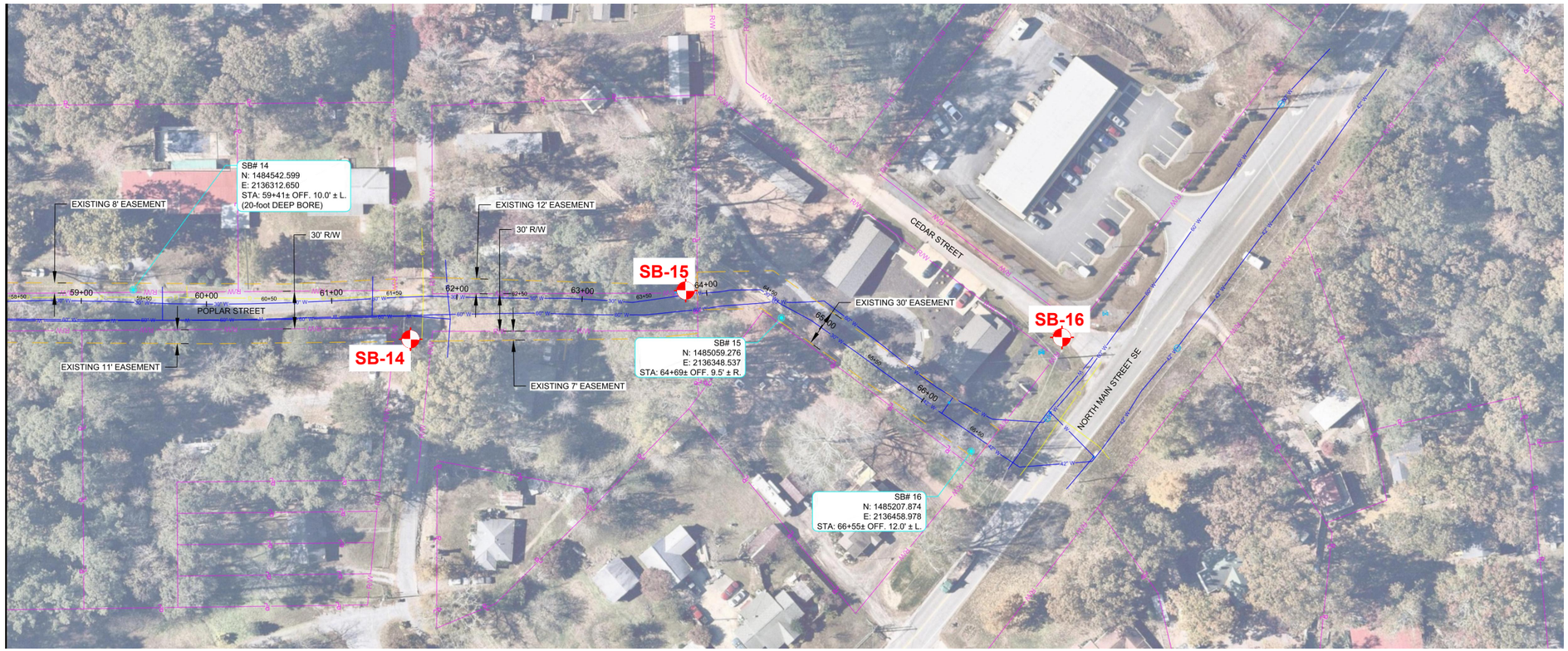
LEGEND: Soil Test Boring

Figure 3: Boring Location Plan

Wyckoff Raw Water Pipeline Improvements
Cobb & Bartow Counties, Georgia
Geo-Hydro Project Number 210188.00



0 50 100 200 300

Approximate Scale: 1"= 100'

LEGEND: Soil Test Boring

Figure 4: Boring Location Plan

Wyckoff Raw Water Pipeline Improvements
Cobb & Bartow Counties, Georgia
Geo-Hydro Project Number 210188.00

Symbols and Nomenclature

Symbols

▌	Thin-walled tube (TWT) sample recovered
▯	Thin-walled tube (TWT) sample not recovered
●	Standard penetration resistance (ASTM D1586)
50/2”	Number of blows (50) to drive the split-spoon a number of inches (2)
65%	Percentage of rock core recovered
RQD	Rock quality designation - % of recovered core sample which is 4 or more inches long
GW	Groundwater
	Water level at least 24 hours after drilling
	Water level one hour or less after drilling
ALLUV	Alluvium
TOP	Topsoil
PM	Pavement Materials
CONC	Concrete
FILL	Fill Material
RES	Residual Soil
PWR	Partially Weathered Rock
SPT	Standard Penetration Testing

Penetration Resistance Results	Number of Blows, N	Approximate Relative Density
Sands	0-4	very loose
	5-10	loose
	11-20	firm
	21-30	very firm
	31-50	dense
	Over 50	very dense

	Number of Blows, N	Approximate Consistency
Silts and	0-1	very soft
Clays	2-4	soft
	5-8	firm
	9-15	stiff
	16-30	very stiff
	31-50	hard
	Over 50	very hard

Drilling Procedures

Soil sampling and standard penetration testing performed in accordance with ASTM D 1586. The standard penetration resistance is the number of blows of a 140-pound hammer falling 30 inches to drive a 2-inch O.D., 1.4-inch I.D. split-spoon sampler one foot. Rock coring is performed in accordance with ASTM D 2113. Thin-walled tube sampling is performed in accordance with ASTM D 1587.

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SB-1

Test Boring Record

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Project: **Wyckoff Raw Water Pipeline Improvements**		Project No: **210188.20**
Location: **Cobb & Bartow Counties, Georgia**		Date: **4/23/21**
Method: **HSA- ASTM D1586**	GWT at Drilling: **Not Encountered**	G.S. Elev:
Driller: **Freedom (Auto Hammer)**	GWT at 24 hrs: **N/A: Boring Backfilled**	Logged By: **AMP**

Elev. (Ft)	Depth (Ft)	GWT	Symbol	Description	N
	0			Topsoil (Approximately 2 inches)	
				Firm to stiff dark brown silty clay (CL) (RESIDUUM)	7
	5				11
					10
				Very firm orange and red clayey fine sand (SM)	
	10				26
				Firm tan and red silty fine sand (SM)	
	15			Boring Terminated at 15 feet	11
	20				
	25				

Standard Penetration Test (Blows/Foot)

0 10 20 30 40 50 60 70 80 90 100

Remarks: Approximate Station -0+53

TEST BORING RECORD BORING LOGS WYCKOFF RAW WATER.GPJ GEO HYDRO.GDT 5/13/21

SB-2

Test Boring Record

GEO HYDRO ENGINEERS

Project: **Wyckoff Raw Water Pipeline Improvements**		Project No: **210188.20**
Location: **Cobb & Bartow Counties, Georgia**		Date: **4/23/21**
Method: **HSA- ASTM D1586**	GWT at Drilling: **Not Encountered**	G.S. Elev:
Driller: **Freedom (Auto Hammer)**	GWT at 24 hrs: **N/A: Boring Backfilled**	Logged By: **AMP**

Elev. (Ft)	Depth (Ft)	GWT	Symbol	Description	N	Standard Penetration Test (Blows/Foot)
				Topsoil (Approximately 2 inches)		
				Soft orange-brown silty clay (CL) (RESIDUUM)	4	
	5				2	
				Very loose to loose tan to orange-red silty fine sand (SM)	4	
	10				5	
	15			Boring Terminated at 15 feet	4	
	20					
	25					

Standard Penetration Test (Blows/Foot): 0 10 20 30 40 50 60 70 80 90 100

Remarks: Approximate Station 4+43

TEST BORING RECORD BORING LOGS WYCKOFF RAW WATER.GPJ GEO HYDRO.GDT 5/13/21

SB-3

Test Boring Record

GEO HYDRO ENGINEERS

Project: **Wyckoff Raw Water Pipeline Improvements**		Project No: **210188.20**
Location: **Cobb & Bartow Counties, Georgia**		Date: **3/29/21**
Method: **HSA- ASTM D1586**	GWT at Drilling: **Not Encountered**	G.S. Elev:
Driller: **GCD (Rope & Cathead)**	GWT at 24 hrs: **N/A: Boring Backfilled**	Logged By: **GLS**

Elev. (Ft)	Depth (Ft)	GWT	Symbol	Description	N
	0			Asphalt (Approximately 4 inches)	
				Gravel (Approximately 3 inches)	
				Firm to very firm red-brown clayey fine sand (SC) (RESIDUUM)	13
	5				20
					21
				Partially weathered rock - No sampled recovered	
	10				50/1"
				Auger Refusal at 10 feet	
	15				
	20				
	25				

Standard Penetration Test (Blows/Foot)

0 10 20 30 40 50 60 70 80 90 100

Remarks: Approximate Station 8+95

TEST BORING RECORD BORING LOGS WYCKOFF RAW WATER.GPJ GEO HYDRO.GDT 5/13/21

SB-4

Test Boring Record

GEO HYDRO ENGINEERS

Project: **Wyckoff Raw Water Pipeline Improvements**		Project No: **210188.20**
Location: **Cobb & Bartow Counties, Georgia**		Date: **3/29/21**
Method: **HSA- ASTM D1586**	GWT at Drilling: **11 feet**	G.S. Elev:
Driller: **GCD (Rope & Cathead)**	GWT at 24 hrs: **N/A: Boring Backfilled**	Logged By: **GLS**

Elev. (Ft)	Depth (Ft)	GWT	Symbol	Description	N	Standard Penetration Test (Blows/Foot) 0 10 20 30 40 50 60 70 80 90 100
				Asphalt (Approximately 4 inches)		
				Gravel (Approximately 4 inches)		
				Firm dark brown clayey fine to medium sand (SC) with rock fragments (FILL)	16	●
	5			Hard red-brown fine to medium sandy clay (CL) (RESIDUUM)	35	●
				Very stiff tan silty clay (CH)	17	●
	10	▽			17	●
				Firm tan and black silty fine sand (SM)		
	15			Boring Terminated at 15 feet	12	●
	20					
	25					

Remarks: Approximate Station 12+32

SB-5

Test Boring Record

GEO HYDRO ENGINEERS

Project: **Wyckoff Raw Water Pipeline Improvements**		Project No: **210188.20**
Location: **Cobb & Bartow Counties, Georgia**		Date: **3/29/21**
Method: **HSA- ASTM D1586**	GWT at Drilling: **Not Encountered**	G.S. Elev:
Driller: **GCD (Rope & Cathead)**	GWT at 24 hrs: **N/A: Boring Backfilled**	Logged By: **GLS**

Elev. (Ft)	Depth (Ft)	GWT	Symbol	Description	N
	0			Asphalt (Approximately 4 inches)	
				Gravel (Approximately 8 inches)	
				Firm dark brown silty fine to medium sand (SM) with rock fragments (FILL)	16
				Firm pink and gray silty fine sand (SM) (RESIDUUM)	
	5				18
					16
	10				17
	15			Boring Terminated at 15 feet	20
	20				
	25				

Standard Penetration Test (Blows/Foot)

0 10 20 30 40 50 60 70 80 90 100

Remarks: Approximate Station 16+20

TEST BORING RECORD BORING LOGS WYCKOFF RAW WATER.GPJ GEO HYDRO.GDT 5/13/21

SB-6

Test Boring Record

GEO HYDRO ENGINEERS

Project: **Wyckoff Raw Water Pipeline Improvements**		Project No: **210188.20**
Location: **Cobb & Bartow Counties, Georgia**		Date: **4/23/21**
Method: **HSA- ASTM D1586**	GWT at Drilling: **Not Encountered**	G.S. Elev:
Driller: **Freedom (Auto Hammer)**	GWT at 24 hrs: **N/A: Boring Backfilled**	Logged By: **AMP**

Elev. (Ft)	Depth (Ft)	GWT	Symbol	Description	N
	0			Topsoil (Approximately 2 inches)	
				Loose gray and brown clayey fine sand (SC) (RESIDUUM)	5
	5				8
					7
				Partially weathered rock sampled as gray-brown silty fine sand (SM)	
	10				50/4"
	15			Boring Terminated at 15 feet	50/3"
	20				
	25				

Standard Penetration Test (Blows/Foot)

0 10 20 30 40 50 60 70 80 90 100

Remarks: Approximate Station 19+43

TEST BORING RECORD BORING LOGS WYCKOFF RAW WATER.GPJ GEO HYDRO.GDT 5/13/21

SB-7

Test Boring Record

GEO HYDRO ENGINEERS

Project: **Wyckoff Raw Water Pipeline Improvements**		Project No: **210188.20**
Location: **Cobb & Bartow Counties, Georgia**		Date: **4/23/21**
Method: **HSA- ASTM D1586**	GWT at Drilling: **Not Encountered**	G.S. Elev:
Driller: **Freedom (Auto Hammer)**	GWT at 24 hrs: **N/A: Boring Backfilled**	Logged By: **AMP**

Elev. (Ft)	Depth (Ft)	GWT	Symbol	Description	N	Standard Penetration Test (Blows/Foot)
				Topsoil (Approximately 2 inches)		
				Stiff light tan fine sandy clay (CL) (RESIDUUM)	9	
	5				10	
				Partially weathered rock sampled as light tan and white silty fine to coarse sand (SM)	50/3"	
	10				50/5"	
	15			Boring Terminated at 15 feet	50/1"	
	20					
	25					

Standard Penetration Test (Blows/Foot): 0 10 20 30 40 50 60 70 80 90 100

Remarks: Approximate Station 24+43

TEST BORING RECORD BORING LOGS WYCKOFF RAW WATER.GPJ GEO HYDRO.GDT 5/13/21

SB-8

Test Boring Record

GEO HYDRO ENGINEERS

Project: **Wyckoff Raw Water Pipeline Improvements**		Project No: **210188.20**
Location: **Cobb & Bartow Counties, Georgia**		Date: **4/23/21**
Method: **HSA- ASTM D1586**	GWT at Drilling: **Not Encountered**	G.S. Elev:
Driller: **Freedom (Auto Hammer)**	GWT at 24 hrs: **N/A: Boring Backfilled**	Logged By: **AMP**

Elev. (Ft)	Depth (Ft)	GWT	Symbol	Description	N	Standard Penetration Test (Blows/Foot)
				Topsoil (Approximately 1 inch)		
				Loose dark brown and gray silty fine sand (SM) (FILL)	7	
				Stiff to very stiff tan clayey fine sand (SC) (RESIDUUM)	16	
	5				14	
				Partially weathered rock sampled as gray and tan silty fine sand (SM)	50/3"	
	10			Auger Refusal at 12 feet		
	15					
	20					
	25					

Standard Penetration Test (Blows/Foot): 0 10 20 30 40 50 60 70 80 90 100

Remarks: Approximate Station 29+43

TEST BORING RECORD BORING LOGS WYCKOFF RAW WATER.GPJ GEO HYDRO.GDT 5/13/21

SB-9

Test Boring Record

GEO HYDRO ENGINEERS

Project: **Wyckoff Raw Water Pipeline Improvements**		Project No: **210188.20**
Location: **Cobb & Bartow Counties, Georgia**		Date: **4/23/21**
Method: **HSA- ASTM D1586**	GWT at Drilling: **Not Encountered**	G.S. Elev:
Driller: **Freedom (Auto Hammer)**	GWT at 24 hrs: **N/A: Boring Backfilled**	Logged By: **AMP**

Elev. (Ft)	Depth (Ft)	GWT	Symbol	Description	N
	0			Topsoil (Approximately 2 inches)	
				Firm to stiff dark gray to brown fine sandy clay (CL) (FILL)	10
	5				10
					8
				Very dense gray and tan silty fine sand (SM) (RESIDUUM)	51
	10				
				Partially weathered rock sampled as tan silty fine sand (SM)	
	15			Boring Terminated at 15 feet	50/2"
	20				
	25				

Standard Penetration Test (Blows/Foot)

0 10 20 30 40 50 60 70 80 90 100

Remarks: Approximate Station 33+49

TEST BORING RECORD BORING LOGS WYCKOFF RAW WATER.GPJ GEO HYDRO.GDT 5/13/21

SB-10

Test Boring Record

GEO HYDRO ENGINEERS

Project: **Wyckoff Raw Water Pipeline Improvements**		Project No: **210188.20**
Location: **Cobb & Bartow Counties, Georgia**		Date: **3/29/21**
Method: **HSA- ASTM D1586**	GWT at Drilling: **Not Encountered**	G.S. Elev:
Driller: **GCD (Rope & Cathead)**	GWT at 24 hrs: **N/A: Boring Backfilled**	Logged By: **GLS**

Elev. (Ft)	Depth (Ft)	GWT	Symbol	Description	N
				Asphalt (Approximately 4 inches)	
				Gravel (Approximately 6 inches)	
				Firm red-brown and gray micaceous clayey fine to medium sand (SC) (FILL)	17
	5			Very firm to dense red-brown and tan micaceous silty fine to medium sand (SM) (RESIDUUM)	31
					21
				Firm to very firm light gray silty fine to medium sand (SM)	
	10				20
	15				26
	20			Boring Terminated at 20 feet	28
	25				

Standard Penetration Test (Blows/Foot)

0 10 20 30 40 50 60 70 80 90 100

Remarks: Approximate Station 37+10

TEST BORING RECORD BORING LOGS WYCKOFF RAW WATER.GPJ GEO HYDRO.GDT 5/13/21

SB-11

Test Boring Record

GEO HYDRO ENGINEERS

Project: **Wyckoff Raw Water Pipeline Improvements**		Project No: **210188.20**
Location: **Cobb & Bartow Counties, Georgia**		Date: **3/29/21**
Method: **HSA- ASTM D1586**	GWT at Drilling: **Not Encountered**	G.S. Elev:
Driller: **GCD (Rope & Cathead)**	GWT at 24 hrs: **N/A: Boring Backfilled**	Logged By: **GLS**

Elev. (Ft)	Depth (Ft)	GWT	Symbol	Description	N
	0			Topsoil (Approximately 2 inches)	
				Firm to very firm gray clayey fine to coarse sand (SC) (FILL)	17
	5				28
				Very stiff gray fine to medium sandy clay (CL) (FILL)	19
	10				21
				Dense tan and brown clayey fine to coarse sand (SC) (RESIDUUM)	34
	15				
	20			Boring Terminated at 20 feet	30
	25				

Standard Penetration Test (Blows/Foot)

0 10 20 30 40 50 60 70 80 90 100

Remarks: Approximate Station 42+20

TEST BORING RECORD BORING LOGS WYCKOFF RAW WATER.GPJ GEO HYDRO.GDT 5/13/21

SB-12

Test Boring Record

GEO HYDRO ENGINEERS

Project: **Wyckoff Raw Water Pipeline Improvements**		Project No: **210188.20**
Location: **Cobb & Bartow Counties, Georgia**		Date: **4/23/21**
Method: **HSA- ASTM D1586**	GWT at Drilling: **Not Encountered**	G.S. Elev:
Driller: **Freedom (Auto Hammer)**	GWT at 24 hrs: **N/A: Boring Backfilled**	Logged By: **AMP**

Elev. (Ft)	Depth (Ft)	GWT	Symbol	Description	N	Standard Penetration Test (Blows/Foot) 0 10 20 30 40 50 60 70 80 90 100
				Topsoil (Approximately 2 inches)		
				Firm dark brown silty clay (CL) (RESIDUUM)	7	●
	5				8	●
				Loose light brown micaceous silty fine sand (SM)	7	●
	10				6	●
	15			Boring Terminated at 15 feet	7	●
	20					
	25					

Remarks: Approximate Station 49+99

TEST BORING RECORD BORING LOGS WYCKOFF RAW WATER.GPJ GEO HYDRO.GDT 5/13/21

SB-13

Test Boring Record

GEO HYDRO ENGINEERS

Project: **Wyckoff Raw Water Pipeline Improvements**		Project No: **210188.20**
Location: **Cobb & Bartow Counties, Georgia**		Date: **3/29/21**
Method: **HSA- ASTM D1586**	GWT at Drilling: **Not Encountered**	G.S. Elev:
Driller: **GCD (Rope & Cathead)**	GWT at 24 hrs: **N/A: Boring Backfilled**	Logged By: **GLS**

Elev. (Ft)	Depth (Ft)	GWT	Symbol	Description	N	Standard Penetration Test (Blows/Foot)
	0			Asphalt (Approximately 4 inches)		
				Gravel (Approximately 4 inches)		
				Firm gray to red-brown micaceous clayey fine to coarse sand (SC) (FILL)	16	
	5			Firm to very firm red-brown to gray micaceous silty fine to medium sand (SM) (RESIDUUM)	28	
					21	
	10				19	
	15			Boring Terminated at 15 feet	25	
	20					
	25					

0 10 20 30 40 50 60 70 80 90 100

Remarks: Approximate Station 53+80

TEST BORING RECORD BORING LOGS WYCKOFF RAW WATER.GPJ GEO HYDRO.GDT 5/13/21

SB-14

Test Boring Record

GEO HYDRO ENGINEERS

Project: **Wyckoff Raw Water Pipeline Improvements**		Project No: **210188.20**
Location: **Cobb & Bartow Counties, Georgia**		Date: **3/29/21**
Method: **HSA- ASTM D1586**	GWT at Drilling: **Not Encountered**	G.S. Elev:
Driller: **GCD (Rope & Cathead)**	GWT at 24 hrs: **N/A: Boring Backfilled**	Logged By: **GLS**

Elev. (Ft)	Depth (Ft)	GWT	Symbol	Description	N
				Asphalt (Approximately 3 inches)	
				Gravel (Approximately 8 inches)	
				Firm to very firm tan clayey fine to coarse sand (SC) (RESIDUUM)	19
	5				26
				Firm tan and gray micaceous silty fine to medium sand (SM)	12
	10				11
	15			Boring Terminated at 15 feet	16
	20				
	25				

Standard Penetration Test (Blows/Foot)

0 10 20 30 40 50 60 70 80 90 100

Remarks: Approximate Station 61+60

TEST BORING RECORD BORING LOGS WYCKOFF RAW WATER.GPJ GEO HYDRO.GDT 5/13/21

SB-15

Test Boring Record

GEO HYDRO ENGINEERS

Project: **Wyckoff Raw Water Pipeline Improvements**		Project No: **210188.20**
Location: **Cobb & Bartow Counties, Georgia**		Date: **4/23/21**
Method: **HSA- ASTM D1586**	GWT at Drilling: **11 feet**	G.S. Elev:
Driller: **Freedom (Auto Hammer)**	GWT at 24 hrs: **N/A: Boring Backfilled**	Logged By: **AMP**

Elev. (Ft)	Depth (Ft)	GWT	Symbol	Description	N	Standard Penetration Test (Blows/Foot)
				Topsoil (Approximately 3 inches)		
				Very loose dark brown silty fine to coarse sand (SM) (FILL)	4	
				Firm light brown silty clay (CL) (RESIDUUM)	6	
	5			Loose to very loose tan and gray silty fine sand (SM)	3	
	10	▽			2	
	15			Boring Terminated at 15 feet	5	
	20					
	25					

0 10 20 30 40 50 60 70 80 90 100

Remarks: Approximate Station 63+85

TEST BORING RECORD BORING LOGS WYCKOFF RAW WATER.GPJ GEO HYDRO.GDT 5/13/21

SB-16

Test Boring Record

GEO HYDRO ENGINEERS

Project: **Wyckoff Raw Water Pipeline Improvements**		Project No: **210188.20**
Location: **Cobb & Bartow Counties, Georgia**		Date: **3/29/21**
Method: **HSA- ASTM D1586**	GWT at Drilling: **Not Encountered**	G.S. Elev:
Driller: **GCD (Rope & Cathead)**	GWT at 24 hrs: **N/A: Boring Backfilled**	Logged By: **GLS**

Elev. (Ft)	Depth (Ft)	GWT	Symbol	Description	N
	0			Asphalt (Approximately 3 inches)	
				Gravel (Approximately 4 inches)	
				Firm dark brown silty fine to medium sand (SM) (FILL)	13
				Very firm red-brown micaceous clayey fine to medium sand (SC) (RESIDUUM)	
	5				28
				Firm to very firm pink-gray to gray micaceous silty fine to coarse sand (SM)	22
	10				22
	15			Boring Terminated at 15 feet	17
	20				
	25				

Standard Penetration Test (Blows/Foot)

0 10 20 30 40 50 60 70 80 90 100

Remarks: Approximate Station 67+90

TEST BORING RECORD BORING LOGS WYCKOFF RAW WATER.GPJ GEO HYDRO.GDT 5/13/21

LABORATORY TEST RESULTS

GEO HYDRO ENGINEERS

TIMELY
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TESTS, LLC

1874 Forge Street Tucker, GA 30084
Phone: 770-938-8233
Fax: 770-923-8973
Web: www.test-llc.com

Tested By	KP
Date	04/20/21
Checked By	

Client Pr. #	210188.20	Lab. PR. #	2107A-05-1
Pr. Name	Wyckoff Raw Water Line Improvements	S. Type	Bulk
Sample ID	37556/B-5	Depth/Elev.	5-10'
Location	-	Add. Info	-

AASHTO T289

Standard Test Method for Determining pH of Soil for Use in Corrosion Testing

SAMPLE PREPARATION

Air dried Material passing #10 sieve was used for testing.

TEST DATA

T.E.S.T. Sample ID	Client Sample ID	pH meter Reading #1	pH meter Reading #2	pH meter Reading #3	**Reported pH value**
37556	See Above	4.78	4.76	4.79	**4.8**

REMARKS

NIST TRACEABLE BUFFER SOLUTIONS (4.0; 7.0; 10.0 pH) were used for CALIBRATION of pH METER prior to testing.

pH Meter ID 375/732/733

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1874 Forge Street Tucker, GA 30084
Phone: 770-938-8233
Fax: 770-923-8973
Web: www.test-llc.com

AASHTO ACCREDITED

Tested By	KP
Date	04/20/21
Checked By	LB

Client Pr. #	210188.20	Lab. PR. #	2107A-05-1
Pr. Name	Wyckoff Raw Water Line Improvements	S. Type	Bulk
Sample ID	37556/B-5	Depth/Elev.	5-10'
Location	-	Add. Info	-

ASTM G 57/G187/AASHTO T 288

Standard Test Method for Determining Minimum Laboratory Soil Resistivity

Determination of Resistivity at as-received moisture content

As-received Moisture Content	
Mass of Wet Sample & Tare, g	
Mass of Dry Sample & Tare, g	
Mass of Tare, g	
Moisture Content, %	NA

Remarks

TEST DATA

Mass of Soil Box, g	-	Meter Dial Reading, ohms	-
Mass of Soil Box + Soil, g	-	Reading of Meter Range Multiplier	-
Mass of Soil, g	-	Measured Resistance, ohms	NA
Calibrated Volume of Soil Box, ft^3	0.0027	Calibrated Soil Box Multiplier, cm	1.0
Wet Density of as-placed Soil, pcf	-		
Dry Density of as-placed Soil, pcf	-	**Reported Soil Resistivity, ohms-cm**	**NA**

Determination of Minimum Soil Resistivity

TEST DATA

	Trials at Various Moisture Content								
TRIAL #	1	2	3	4	5	6	7	8	9
Meter Dial Reading, ohms	71.5	44.3	38.9	37.9	37.9				
Reading of Meter Range Multiplier	K	K	K	K	K				
Measured Resistance, ohms	71500	44300	38900	37900	37900				
Calibrated Soil Box Multiplier, cm	1.0	1.0	1.0	1.0	1.0				
Measured Resistivity, ohms-cm	71500	44300	38900	37900	37900				

Reported Soil Minimum Resistivity, ohms-cm **37900**

Note: Material passed # 10 sieve used for testing

Oven ID #	496/610
Balance ID #	563/700
Soil Box ID #	612/613/707
Resistivity Meter ID #	706

Description

NA

USCS (D2487; D2488)	NA
AASHTO (M145)	NA

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Phone: 770-938-8233
Fax: 770-923-8973
Web: www.test-llc.com

AASHTO ACCREDITED

Tested By	EB
Date	04/16/21
Checked By	

Client Pr. #	210188.20	Lab. PR. #	2107A-05-1
Pr. Name	Wyckoff Raw Water Line Improvements	S. Type	Bulk
Sample ID	37556/B-5	Depth/Elev.	5-10'
Location	-	Add. Info	-

ASTM G200

Standard Test Method for Measurement of Oxidation Reduction Potential (ORP) of Soil

SAMPLE PREPARATION

Roots, Stones, Gravel and other deleterious material was removed prior to testing

Measurements performed ar room temperature condition: 21.5 °C

TEST DATA

T.E.S.T. Sample ID	Client Sample ID	ORP meter Reading #1, mV	ORP meter Reading #2, mV	ORP meter Reading #3, mV	**Reported ORP value, mV**
37556	See Above	247	248	243	**246**

REMARKS

Standard ORP calibration solution (155-275mV) used to standardize ORP meter: 967901 Exp.05/21

ORP Meter ID: 742/813

ORP Probe ID: 417

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TESTS, LLC

1874 Forge Street Tucker, GA 30084
Phone: 770-938-8233
Fax: 770-923-8973
Web: www.test-llc.com

Tested By	KP
Date	04/20/21
Checked By	

Client Pr. #	210188.20	Lab. PR. #	2107A-05-1
Pr. Name	Wyckoff Raw Water Line Improvements	S. Type	Bulk
Sample ID	37557/B-11	Depth/Elev.	0-10'
Location	-	Add. Info	-

AASHTO T289

Standard Test Method for Determining pH of Soil for Use in Corrosion Testing

SAMPLE PREPARATION

Air dried Material passing #10 sieve was used for testing.

TEST DATA

T.E.S.T. Sample ID	Client Sample ID	pH meter Reading #1	pH meter Reading #2	pH meter Reading #3	**Reported pH value**
37557	See Above	6.01	5.99	5.99	**6.0**

REMARKS

NIST TRACEABLE BUFFER SOLUTIONS (4.0; 7.0; 10.0 pH) were used for CALIBRATION of pH METER prior to testing.

pH Meter ID 375/732/733

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1874 Forge Street Tucker, GA 30084
Phone: 770-938-8233
Fax: 770-923-8973
Web: www.test-llc.com

AASHTO ACCREDITED

Tested By	KP
Date	04/20/21
Checked By	LB

Client Pr. #	210188.20	Lab. PR. #	2107A-05-1
Pr. Name	Wyckoff Raw Water Line Improvements	S. Type	Bulk
Sample ID	37557/B-11	Depth/Elev.	0-10'
Location	-	Add. Info	-

ASTM G 57/G187/AASHTO T 288

Standard Test Method for Determining Minimum Laboratory Soil Resistivity

Determination of Resistivity at as-received moisture content

As-received Moisture Content	
Mass of Wet Sample & Tare, g	
Mass of Dry Sample & Tare, g	
Mass of Tare, g	
Moisture Content, %	NA

Remarks

TEST DATA

Mass of Soil Box, g	-	Meter Dial Reading, ohms	-
Mass of Soil Box + Soil, g	-	Reading of Meter Range Multiplier	-
Mass of Soil, g	-	Measured Resistance, ohms	NA
Calibrated Volume of Soil Box, ft^3	0.0027	Calibrated Soil Box Multiplier, cm	1.0
Wet Density of as-placed Soil, pcf	-		
Dry Density of as-placed Soil, pcf	-	**Reported Soil Resistivity, ohms-cm**	**NA**

Determination of Minimum Soil Resistivity

TEST DATA

	Trials at Various Moisture Content								
TRIAL #	1	2	3	4	5	6	7	8	9
Meter Dial Reading, ohms	10.2	9.71	9.33	9.33					
Reading of Meter Range Multiplier	K	K	K	K					
Measured Resistance, ohms	10200	9710	9330	9330					
Calibrated Soil Box Multiplier, cm	1.0	1.0	1.0	1.0					
Measured Resistivity, ohms-cm	10200	9710	9330	9330					

Reported Soil Minimum Resistivity, ohms-cm **9330**

Note: Material passed # 10 sieve used for testing

Oven ID #	496/610
Balance ID #	563/700
Soil Box ID #	612/613/707
Resistivity Meter ID #	706

Description

NA

USCS (D2487; D2488)	NA
AASHTO (M145)	NA

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Phone: 770-938-8233
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Web: www.test-llc.com

AASHTO ACCREDITED

Tested By	EB
Date	04/16/21
Checked By	

Client Pr. #	210188.20	Lab. PR. #	2107A-05-1
Pr. Name	Wyckoff Raw Water Line Improvements	S. Type	Bulk
Sample ID	37557/B-11	Depth/Elev.	0-10'
Location	-	Add. Info	-

ASTM G200

Standard Test Method for Measurement of Oxidation Reduction Potential (ORP) of Soil

SAMPLE PREPARATION

Roots, Stones, Gravel and other deleterious material was removed prior to testing

Measurements performed ar room temperature condition: 21.5 °C

TEST DATA

T.E.S.T. Sample ID	Client Sample ID	ORP meter Reading #1, mV	ORP meter Reading #2, mV	ORP meter Reading #3, mV	**Reported ORP value, mV**
37557	See Above	272	264	261	**266**

Standard ORP calibration solution (155-275mV) used to standardize ORP meter: 967901 Exp.05/21

REMARKS

ORP Meter ID: 742/813

ORP Probe ID: 417

TIMELY ENGINEERING SOIL TESTS, LLC
1874 Forge Street Tucker, GA 30084
Phone: 770-938-8233
Fax: 770-923-8973
Web: www.test-llc.com
AASHTO ACCREDITED

Tested By	AK
Date	04/16/21
Checked By	

Client Pr. #	210188.20	Lab. PR. #	2107A-05-1
Pr. Name	Wyckoff Raw Water Line Improvements	S. Type	Bulk
Sample ID	37557/B-11	Depth/Elev.	0-10'
Location	-	Add. Info	-

ASTM D 698
Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600kN-m/m^3))

DETERMINATION OF TEST PROCEDURE

	wet	dry
Mass of Soil before sieving, g	23300.0	20000.0
Mass of Mat. Retained on No. 4 sieve, g		
Mass of Mat. Retained on 3/8" sieve, g	400.4	400.4
Mass of Mat. Retained on 3/4" sieve, g		

Material Retained on No. 4 Sieve, %	
Material Retained on 3/8" Sieve, %	2.0
Material Retained on 3/4" Sieve, %	
Total, % (oversized)	2.0

MOISTURE CONTENT

	Coarse + Fine Fraction	Coarse Fraction
Mass of Wet Sample & Tare, g	933.8	400.4
Mass of Dry Sample & Tare, g	844.6	400.4
Mass of Tare, g	304.0	0.0
Moisture Content, %	16.5	0.0

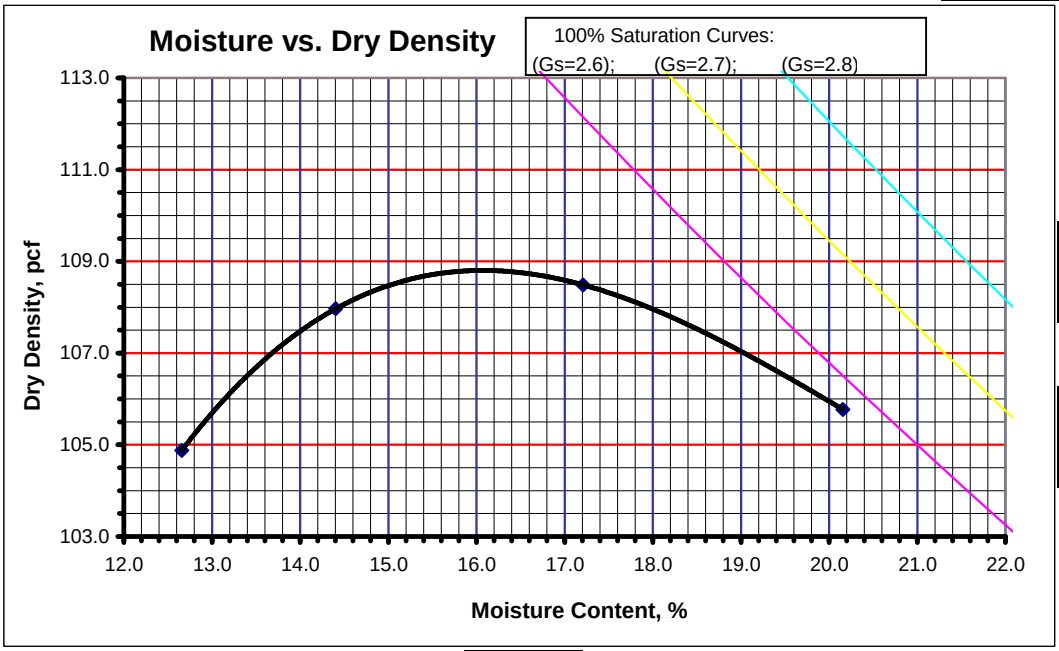
Procedure: B

TEST DATA

Points	1	2	3	4	5
Mass of Mold and Soil, g	6023.0	6104.0	6159.0	6158.0	
Mass of Wet Sample & Tare, g	423.9	472.2	422.8	484.7	
Mass of Dry Sample & Tare, g	396.9	428.4	379.5	433.5	
Mass of Tare, g	183.6	124.3	127.9	179.5	
Moisture Content, %	12.7	14.4	17.2	20.2	
Wet Density, pcf	118.2	123.5	127.2	127.1	
Dry Density, pcf	104.9	108.0	108.5	105.8	

Mold ID Number	798
Mass of Mold, g	4238.3
Volume of Mold, ft^3	0.0333
Hammer ID Number	743
Number of Blows per layer	25
Number of Layers	3
Mechanical Compactor ID Number	317

Method A: Material retained on No. 4 Sieve≤25%
Method B: Material retained on 3/8" Sieve ≤25%
Method C: Material retained on 3/4" Sieve ≤30%



REMARKS

DESCRIPTION
NA

USCS (ASTM D2487; D2488)
NA

AASHTO M145
NA

Maximum Dry Density, pcf	108.8	**Corrected Maximum Dry Density, pcf**	**NA**
Optimum Moisture Content, %	16.2	**Corrected Optimum Moisture Content, %**	**NA**

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Tested By	KP
Date	04/20/21
Checked By	

Client Pr. #	210188.20	Lab. PR. #	2107A-05-1
Pr. Name	Wyckoff Raw Water Line Improvements	S. Type	Bulk
Sample ID	37558/B-13	Depth/Elev.	5-10'
Location	-	Add. Info	-

AASHTO T289

Standard Test Method for Determining pH of Soil for Use in Corrosion Testing

SAMPLE PREPARATION

Air dried Material passing #10 sieve was used for testing.

TEST DATA

T.E.S.T. Sample ID	Client Sample ID	pH meter Reading #1	pH meter Reading #2	pH meter Reading #3	**Reported pH value**
37558	See Above	5.42	5.42	5.44	**5.4**

REMARKS

NIST TRACEABLE BUFFER SOLUTIONS (4.0; 7.0; 10.0 pH) were used for CALIBRATION of pH METER prior to testing.

pH Meter ID 375/732/733

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Tested By	KP
Date	04/20/21
Checked By	LB

Client Pr. #	210188.20	Lab. PR. #	2107A-05-1
Pr. Name	Wyckoff Raw Water Line Improvements	S. Type	Bulk
Sample ID	37558/B-13	Depth/Elev.	5-10'
Location	-	Add. Info	-

ASTM G 57/G187/AASHTO T 288

Standard Test Method for Determining Minimum Laboratory Soil Resistivity

Determination of Resistivity at as-received moisture content

As-received Moisture Content	
Mass of Wet Sample & Tare, g	
Mass of Dry Sample & Tare, g	
Mass of Tare, g	
Moisture Content, %	NA

Remarks

TEST DATA

Mass of Soil Box, g	-	Meter Dial Reading, ohms	-
Mass of Soil Box + Soil, g	-	Reading of Meter Range Multiplier	-
Mass of Soil, g	-	Measured Resistance, ohms	NA
Calibrated Volume of Soil Box, ft^3	0.0027	Calibrated Soil Box Multiplier, cm	1.0
Wet Density of as-placed Soil, pcf	-		
Dry Density of as-placed Soil, pcf	-	**Reported Soil Resistivity, ohms-cm**	**NA**

Determination of Minimum Soil Resistivity

TEST DATA

	Trials at Various Moisture Content								
TRIAL #	1	2	3	4	5	6	7	8	9
Meter Dial Reading, ohms	39.2	38.6	37.8	36.7	36.7				
Reading of Meter Range Multiplier	K	K	K	K	K				
Measured Resistance, ohms	39200	38600	37800	36700	36700				
Calibrated Soil Box Multiplier, cm	1.0	1.0	1.0	1.0	1.0				
Measured Resistivity, ohms-cm	39200	38600	37800	36700	36700				

Reported Soil Minimum Resistivity, ohms-cm **36700**

Note: Material passed # 10 sieve used for testing

Oven ID #	496/610
Balance ID #	563/700
Soil Box ID #	612/613/707
Resistivity Meter ID #	706

Description

NA

USCS (D2487; D2488)	NA
AASHTO (M145)	NA

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Tested By	EB
Date	04/16/21
Checked By	

Client Pr. #	210188.20	Lab. PR. #	2107A-05-1
Pr. Name	Wyckoff Raw Water Line Improvements	S. Type	Bulk
Sample ID	37558/B-13	Depth/Elev.	5-10'
Location	-	Add. Info	-

ASTM G200

Standard Test Method for Measurement of Oxidation Reduction Potential (ORP) of Soil

SAMPLE PREPARATION

Roots, Stones, Gravel and other deleterious material was removed prior to testing

Measurements performed ar room temperature condition: 21.5 °C

TEST DATA

T.E.S.T. Sample ID	Client Sample ID	ORP meter Reading #1, mV	ORP meter Reading #2, mV	ORP meter Reading #3, mV	**Reported ORP value, mV**
37558	See Above	245	240	235	**240**

REMARKS

Standard ORP calibration solution (155-275mV) used to standardize ORP meter: 967901 Exp.05/21

ORP Meter ID: 742/813

ORP Probe ID: 417

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Tested By	EB
Date	04/28/21
Checked By	

Client Pr. #	210188.20	Lab. PR. #	2107A-05-2
Pr. Name	Wyckoff Raw Water Line Improvements	S. Type	Bulk
Sample ID	37635/B-1	Depth/Elev.	0-10'
Location	-	Add. Info	-

AASHTO T289

Standard Test Method for Determining pH of Soil for Use in Corrosion Testing

SAMPLE PREPARATION

Air dried Material passing #10 sieve was used for testing.

TEST DATA

T.E.S.T. Sample ID	Client Sample ID	pH meter Reading #1	pH meter Reading #2	pH meter Reading #3	**Reported pH value**
37635	See Above	7.28	7.25	7.18	**7.2**

REMARKS

NIST TRACEABLE BUFFER SOLUTIONS (4.0; 7.0; 10.0 pH) were used for CALIBRATION of pH METER prior to testing.

pH Meter ID 375/732/733

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Tested By	EB
Date	04/28/21
Checked By	LB

Client Pr. #	210188.20	Lab. PR. #	2107A-05-2
Pr. Name	Wyckoff Raw Water Line Improvements	S. Type	Bulk
Sample ID	37635/B-1	Depth/Elev.	0-10'
Location	-	Add. Info	-

ASTM G187/AASHTO T 288

Standard Test Method for Determining Minimum Laboratory Soil Resistivity

Determination of Resistivity at as-received moisture content

As-received Moisture Content	
Mass of Wet Sample & Tare, g	
Mass of Dry Sample & Tare, g	
Mass of Tare, g	
Moisture Content, %	NA

Remarks

TEST DATA

Mass of Soil Box, g	-	Meter Dial Reading, ohms	-
Mass of Soil Box + Soil, g	-	Reading of Meter Range Multiplier	-
Mass of Soil, g	-	Measured Resistance, ohms	NA
Calibrated Volume of Soil Box, ft^3	0.00274	Calibrated Soil Box Multiplier, cm	0.67
Wet Density of as-placed Soil, pcf	-		
Dry Density of as-placed Soil, pcf	-	**Reported Soil Resistivity, ohms-cm**	**NA**

Determination of Minimum Soil Resistivity

TEST DATA

	Trials at Various Moisture Content								
TRIAL #	1	2	3	4	5	6	7	8	9
Meter Dial Reading, ohms	284	88.6	75.4	63.4	63.4				
Reading of Meter Range Multiplier	K	K	K	K	K				
Measured Resistance, ohms	284000	88600	75400	63400	63400				
Calibrated Soil Box Multiplier, cm	0.67	0.67	0.67	0.67	0.67				
Measured Resistivity, ohms-cm	190280	59362	50518	42478	42478				

Reported Soil Minimum Resistivity, ohms-cm **42478**

Note: Material passed # 10 sieve used for testing

Oven ID #	496/610
Balance ID #	563/700
Soil Box ID #	612
Resistivity Meter ID #	706

Description

NA

USCS (D2487; D2488)	NA
AASHTO (M145)	NA

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Tested By	EB
Date	04/27/21
Checked By	

Client Pr. #	210188.20	Lab. PR. #	2107A-05-2
Pr. Name	Wyckoff Raw Water Line Improvements	S. Type	Bulk
Sample ID	37635/B-1	Depth/Elev.	0-10'
Location	-	Add. Info	-

ASTM G200

Standard Test Method for Measurement of Oxidation Reduction Potential (ORP) of Soil

SAMPLE PREPARATION

Roots, Stones, Gravel and other deleterious material was removed prior to testing

Measurements performed ar room temperature condition: 22.4 °C

TEST DATA

T.E.S.T. Sample ID	Client Sample ID	ORP meter Reading #1, mV	ORP meter Reading #2, mV	ORP meter Reading #3, mV	**Reported ORP value, mV**
37635	See Above	315	320	324	**320**

REMARKS

Standard ORP calibration solution (155-275mV) used to standardize ORP meter: 967901 Exp.05/21

ORP Meter ID: 742/813

ORP Probe ID: 417

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Tested By	AK
Date	04/27/21
Checked By	

Client Pr. #	210188.20	Lab. PR. #	2107A-05-2
Pr. Name	Wyckoff Raw Water Line Improvements	S. Type	Bulk
Sample ID	37635/B-1	Depth/Elev.	0-10'
Location	-	Add. Info	-

ASTM D 698
Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600kN-m/m^3))

DETERMINATION OF TEST PROCEDURE

	wet	dry
Mass of Soil before sieving, g	15700.0	13610.8
Mass of Mat. Retained on No. 4 sieve, g		
Mass of Mat. Retained on 3/8" sieve, g	47.8	47.8
Mass of Mat. Retained on 3/4" sieve, g		

MOISTURE CONTENT

	Coarse + Fine Fraction	Coarse Fraction
Mass of Wet Sample & Tare, g	1066.4	47.8
Mass of Dry Sample & Tare, g	964.2	47.8
Mass of Tare, g	298.4	0.0
Moisture Content, %	15.3	0.0

Material Retained on No. 4 Sieve, %	
Material Retained on 3/8" Sieve, %	0.4
Material Retained on 3/4" Sieve, %	
Total, % (oversized)	0.4

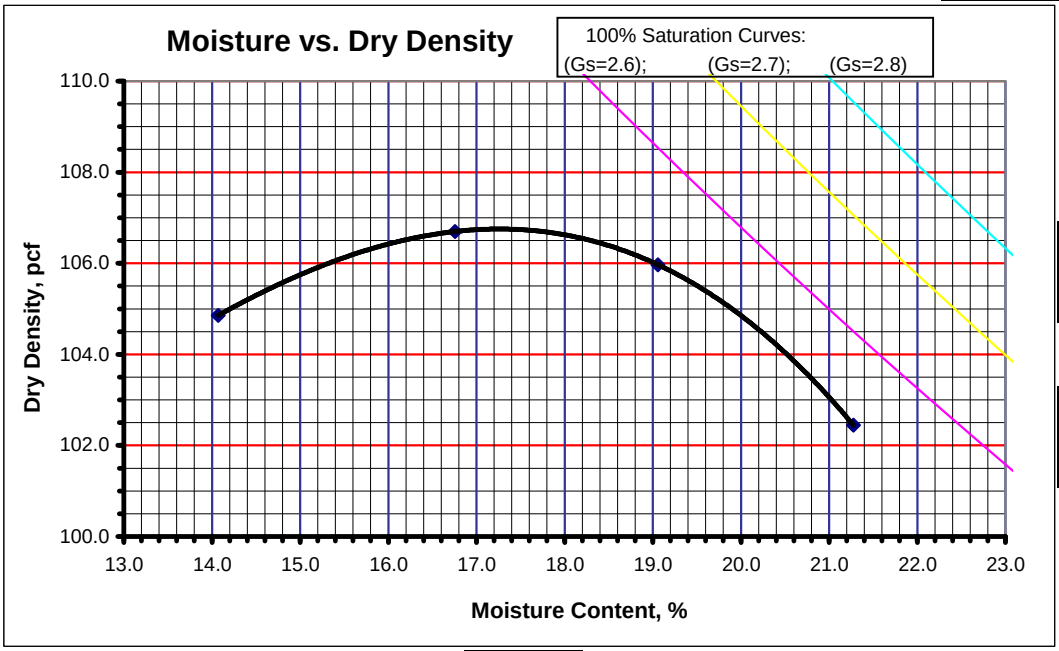
Procedure: B

TEST DATA

Points	1	2	3	4	5
Mass of Mold and Soil, g	6045.0	6120.0	6144.0	6115.0	
Mass of Wet Sample & Tare, g	432.1	463.8	429.4	428.8	
Mass of Dry Sample & Tare, g	394.7	422.9	380.8	384.4	
Mass of Tare, g	128.9	178.8	125.8	175.7	
Moisture Content, %	14.1	16.8	19.1	21.3	
Wet Density, pcf	119.6	124.6	126.2	124.2	
Dry Density, pcf	104.9	106.7	106.0	102.4	

Mold ID Number	798
Mass of Mold, g	4238.3
Volume of Mold, ft^3	0.0333
Hammer ID Number	743
Number of Blows per layer	25
Number of Layers	3
Mechanical Compactor ID Number	317

Method A: Material retained on No. 4 Sieve≤25%
Method B: Material retained on 3/8" Sieve ≤25%
Method C: Material retained on 3/4" Sieve ≤30%



REMARKS

DESCRIPTION
NA

USCS (ASTM D2487; D2488)
NA

AASHTO M145
NA

Maximum Dry Density, pcf	106.8	**Corrected Maximum Dry Density, pcf**	**NA**
Optimum Moisture Content, %	17.3	**Corrected Optimum Moisture Content, %**	**NA**

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Tested By	EB
Date	04/28/21
Checked By	

Client Pr. #	210188.20	Lab. PR. #	2107A-05-2
Pr. Name	Wyckoff Raw Water Line Improvements	S. Type	Bulk
Sample ID	37636/B-7	Depth/Elev.	0-10'
Location	-	Add. Info	-

AASHTO T289

Standard Test Method for Determining pH of Soil for Use in Corrosion Testing

SAMPLE PREPARATION

Air dried Material passing #10 sieve was used for testing.

TEST DATA

T.E.S.T. Sample ID	Client Sample ID	pH meter Reading #1	pH meter Reading #2	pH meter Reading #3	**Reported pH value**
37636	See Above	7.35	7.33	7.36	**7.3**

REMARKS

NIST TRACEABLE BUFFER SOLUTIONS (4.0; 7.0; 10.0 pH) were used for CALIBRATION of pH METER prior to testing.

pH Meter ID 375/732/733

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Tested By	EB
Date	04/28/21
Checked By	LB

Client Pr. #	210188.20	Lab. PR. #	2107A-05-2
Pr. Name	Wyckoff Raw Water Line Improvements	S. Type	Bulk
Sample ID	37636/B-7	Depth/Elev.	0-10'
Location	-	Add. Info	-

ASTM G187/AASHTO T 288

Standard Test Method for Determining Minimum Laboratory Soil Resistivity

Determination of Resistivity at as-received moisture content

As-received Moisture Content	
Mass of Wet Sample & Tare, g	
Mass of Dry Sample & Tare, g	
Mass of Tare, g	
Moisture Content, %	NA

Remarks

TEST DATA

Mass of Soil Box, g	-	Meter Dial Reading, ohms	-
Mass of Soil Box + Soil, g	-	Reading of Meter Range Multiplier	-
Mass of Soil, g	-	Measured Resistance, ohms	NA
Calibrated Volume of Soil Box, ft^3	0.00274	Calibrated Soil Box Multiplier, cm	0.67
Wet Density of as-placed Soil, pcf	-		
Dry Density of as-placed Soil, pcf	-	**Reported Soil Resistivity, ohms-cm**	**NA**

Determination of Minimum Soil Resistivity

TEST DATA

	Trials at Various Moisture Content								
TRIAL #	1	2	3	4	5	6	7	8	9
Meter Dial Reading, ohms	65.1	23.9	23	23					
Reading of Meter Range Multiplier	K	K	K	K					
Measured Resistance, ohms	65100	23900	23000	23000					
Calibrated Soil Box Multiplier, cm	0.67	0.67	0.67	0.67					
Measured Resistivity, ohms-cm	43617	16013	15410	15410					

Reported Soil Minimum Resistivity, ohms-cm **15410**

Note: Material passed # 10 sieve used for testing

Oven ID #	496/610
Balance ID #	563/700
Soil Box ID #	612
Resistivity Meter ID #	706

Description

NA

USCS (D2487; D2488)	NA
AASHTO (M145)	NA

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Tested By	EB
Date	04/28/21
Checked By	

Client Pr. #	210188.20	Lab. PR. #	2107A-05-2
Pr. Name	Wyckoff Raw Water Line Improvements	S. Type	Bulk
Sample ID	37636/B-7	Depth/Elev.	0-10'
Location	-	Add. Info	-

ASTM G200

Standard Test Method for Measurement of Oxidation Reduction Potential (ORP) of Soil

SAMPLE PREPARATION

Roots, Stones, Gravel and other deleterious material was removed prior to testing

Measurements performed ar room temperature condition: 22.4 °C

TEST DATA

T.E.S.T. Sample ID	Client Sample ID	ORP meter Reading #1, mV	ORP meter Reading #2, mV	ORP meter Reading #3, mV	**Reported ORP value, mV**
37636	See Above	346	342	348	**345**

REMARKS

Standard ORP calibration solution (155-275mV) used to standardize ORP meter: 967901 Exp.05/21

ORP Meter ID: 742/813

ORP Probe ID: 417

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Tested By	AK
Date	04/27/21
Checked By	

Client Pr. #	210188.20	Lab. PR. #	2107A-05-2
Pr. Name	Wyckoff Raw Water Line Improvements	S. Type	Bulk
Sample ID	37636/B-7	Depth/Elev.	0-10'
Location	-	Add. Info	-

ASTM D 698
Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600kN-m/m^3))

DETERMINATION OF TEST PROCEDURE

	wet	dry
Mass of Soil before sieving, g	15060.0	14296.0
Mass of Mat. Retained on No. 4 sieve, g		
Mass of Mat. Retained on 3/8" sieve, g	11.6	11.6
Mass of Mat. Retained on 3/4" sieve, g		

Material Retained on No. 4 Sieve, %	
Material Retained on 3/8" Sieve, %	0.1
Material Retained on 3/4" Sieve, %	
Total, % (oversized)	0.1

MOISTURE CONTENT

	Coarse + Fine Fraction	Coarse Fraction
Mass of Wet Sample & Tare, g	824.2	11.6
Mass of Dry Sample & Tare, g	797.9	11.6
Mass of Tare, g	305.8	0.0
Moisture Content, %	5.3	0.0

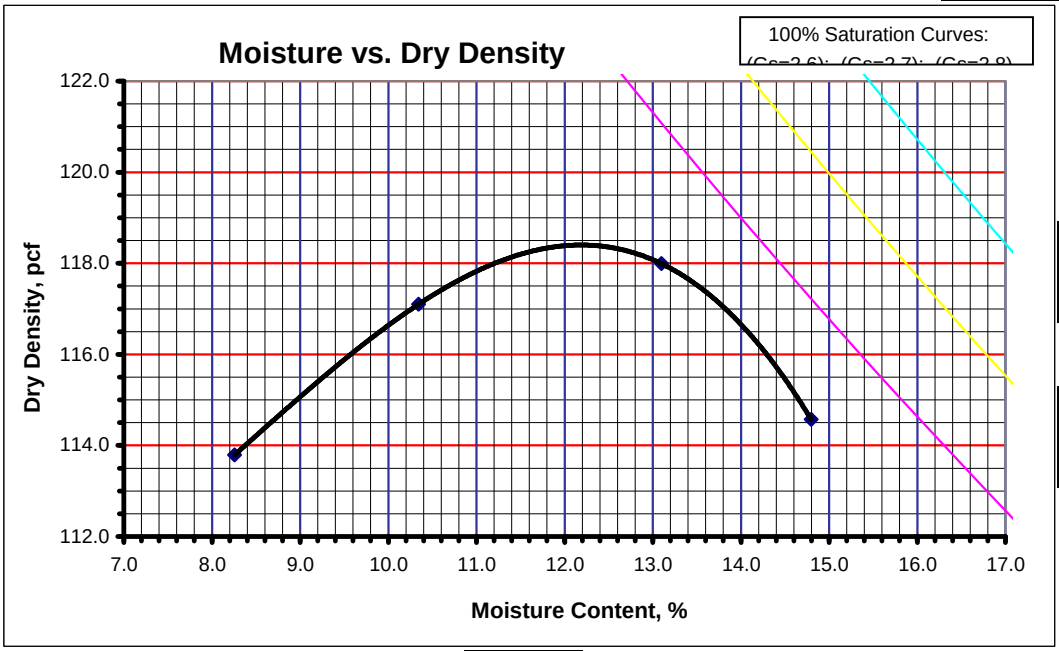
Procedure: B

TEST DATA

Points	1	2	3	4	5
Mass of Mold and Soil, g	6099.0	6190.0	6254.0	6225.0	
Mass of Wet Sample & Tare, g	443.9	430.4	418.9	433.4	
Mass of Dry Sample & Tare, g	423.7	401.7	385.2	393.6	
Mass of Tare, g	179.0	124.2	127.9	124.6	
Moisture Content, %	8.3	10.3	13.1	14.8	
Wet Density, pcf	123.2	129.2	133.4	131.5	
Dry Density, pcf	113.8	117.1	118.0	114.6	

Mold ID Number	798
Mass of Mold, g	4238.3
Volume of Mold, ft^3	0.0333
Hammer ID Number	743
Number of Blows per layer	25
Number of Layers	3
Mechanical Compactor ID Number	317

Method A: Material retained on No. 4 Sieve≤25%
Method B: Material retained on 3/8" Sieve ≤25%
Method C: Material retained on 3/4" Sieve ≤30%



REMARKS

DESCRIPTION
NA

USCS (ASTM D2487; D2488)
NA

AASHTO M145
NA

Maximum Dry Density, pcf	118.4	**Corrected Maximum Dry Density, pcf**	**NA**
Optimum Moisture Content, %	12.2	**Corrected Optimum Moisture Content, %**	**NA**

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Tested By	EB
Date	04/28/21
Checked By	

Client Pr. #	210188.20	Lab. PR. #	2107A-05-2
Pr. Name	Wyckoff Raw Water Line Improvements	S. Type	Bulk
Sample ID	37637/B-9	Depth/Elev.	5-10'
Location	-	Add. Info	-

AASHTO T289

Standard Test Method for Determining pH of Soil for Use in Corrosion Testing

SAMPLE PREPARATION

Air dried Material passing #10 sieve was used for testing.

TEST DATA

T.E.S.T. Sample ID	Client Sample ID	pH meter Reading #1	pH meter Reading #2	pH meter Reading #3	**Reported pH value**
37637	See Above	6.42	6.45	6.37	**6.4**

REMARKS

NIST TRACEABLE BUFFER SOLUTIONS (4.0; 7.0; 10.0 pH) were used for CALIBRATION of pH METER prior to testing.

pH Meter ID 375/732/733

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Tested By	EB
Date	04/28/21
Checked By	LB

Client Pr. #	210188.20	Lab. PR. #	2107A-05-2
Pr. Name	Wyckoff Raw Water Line Improvements	S. Type	Bulk
Sample ID	37637/B-9	Depth/Elev.	5-10'
Location	-	Add. Info	-

ASTM G187/AASHTO T 288

Standard Test Method for Determining Minimum Laboratory Soil Resistivity

Determination of Resistivity at as-received moisture content

As-received Moisture Content	
Mass of Wet Sample & Tare, g	
Mass of Dry Sample & Tare, g	
Mass of Tare, g	
Moisture Content, %	NA

Remarks

TEST DATA

Mass of Soil Box, g	-	Meter Dial Reading, ohms	-
Mass of Soil Box + Soil, g	-	Reading of Meter Range Multiplier	-
Mass of Soil, g	-	Measured Resistance, ohms	NA
Calibrated Volume of Soil Box, ft^3	0.00274	Calibrated Soil Box Multiplier, cm	0.67
Wet Density of as-placed Soil, pcf	-		
Dry Density of as-placed Soil, pcf	-	**Reported Soil Resistivity, ohms-cm**	**NA**

Determination of Minimum Soil Resistivity

TEST DATA

	Trials at Various Moisture Content								
TRIAL #	1	2	3	4	5	6	7	8	9
Meter Dial Reading, ohms	40.7	38.5	27.4	20.1	20.1				
Reading of Meter Range Multiplier	K	K	K	K	K				
Measured Resistance, ohms	40700	38500	27400	20100	20100				
Calibrated Soil Box Multiplier, cm	0.67	0.67	0.67	0.67	0.67				
Measured Resistivity, ohms-cm	27269	25795	18358	13467	13467				

Reported Soil Minimum Resistivity, ohms-cm **13467**

Note: Material passed # 10 sieve used for testing

Oven ID #	496/610
Balance ID #	563/700
Soil Box ID #	612
Resistivity Meter ID #	706

Description

NA

USCS (D2487; D2488)	NA
AASHTO (M145)	NA

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ENGINEERING
SOIL
TESTS, LLC

1874 Forge Street Tucker, GA 30084
Phone: 770-938-8233
Fax: 770-923-8973
Web: www.test-llc.com

AASHTO ACCREDITED

Tested By	EB
Date	04/27/21
Checked By	

Client Pr. #	210188.20	Lab. PR. #	2107A-05-2
Pr. Name	Wyckoff Raw Water Line Improvements	S. Type	Bulk
Sample ID	37637/B-9	Depth/Elev.	5-10'
Location	-	Add. Info	-

ASTM G200

Standard Test Method for Measurement of Oxidation Reduction Potential (ORP) of Soil

SAMPLE PREPARATION

Roots, Stones, Gravel and other deleterious material was removed prior to testing

Measurements performed ar room temperature condition: 22.4 °C

TEST DATA

T.E.S.T. Sample ID	Client Sample ID	ORP meter Reading #1, mV	ORP meter Reading #2, mV	ORP meter Reading #3, mV	**Reported ORP value, mV**
37637	See Above	326	323	318	**322**

REMARKS

Standard ORP calibration solution (155-275mV) used to standardize ORP meter: 967901 Exp.05/21

ORP Meter ID: 742/813

ORP Probe ID: 417

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Tested By	EB
Date	04/28/21
Checked By	

Client Pr. #	210188.20	Lab. PR. #	2107A-05-2
Pr. Name	Wyckoff Raw Water Line Improvements	S. Type	Bulk
Sample ID	37638/B-15	Depth/Elev.	0-10'
Location	-	Add. Info	-

AASHTO T289

Standard Test Method for Determining pH of Soil for Use in Corrosion Testing

SAMPLE PREPARATION

Air dried Material passing #10 sieve was used for testing.

TEST DATA

T.E.S.T. Sample ID	Client Sample ID	pH meter Reading #1	pH meter Reading #2	pH meter Reading #3	**Reported pH value**
37638	See Above	6.10	6.08	6.14	**6.1**

REMARKS

NIST TRACEABLE BUFFER SOLUTIONS (4.0; 7.0; 10.0 pH) were used for CALIBRATION of pH METER prior to testing.

pH Meter ID 375/732/733

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AASHTO ACCREDITED

Tested By	EB
Date	04/28/21
Checked By	LB

Client Pr. #	210188.20	Lab. PR. #	2107A-05-2
Pr. Name	Wyckoff Raw Water Line Improvements	S. Type	Bulk
Sample ID	37638/B-15	Depth/Elev.	0-10'
Location	-	Add. Info	-

ASTM G187/AASHTO T 288

Standard Test Method for Determining Minimum Laboratory Soil Resistivity

Determination of Resistivity at as-received moisture content

As-received Moisture Content	
Mass of Wet Sample & Tare, g	
Mass of Dry Sample & Tare, g	
Mass of Tare, g	
Moisture Content, %	NA

Remarks

TEST DATA

Mass of Soil Box, g	-	Meter Dial Reading, ohms	-
Mass of Soil Box + Soil, g	-	Reading of Meter Range Multiplier	-
Mass of Soil, g	-	Measured Resistance, ohms	NA
Calibrated Volume of Soil Box, ft^3	0.00274	Calibrated Soil Box Multiplier, cm	0.67
Wet Density of as-placed Soil, pcf	-		
Dry Density of as-placed Soil, pcf	-	**Reported Soil Resistivity, ohms-cm**	**NA**

Determination of Minimum Soil Resistivity

TEST DATA

	Trials at Various Moisture Content								
TRIAL #	1	2	3	4	5	6	7	8	9
Meter Dial Reading, ohms	102	74.2	56.2	37.1	18.2	18.2			
Reading of Meter Range Multiplier	K	K	K	K	K	K			
Measured Resistance, ohms	102000	74200	56200	37100	18200	18200			
Calibrated Soil Box Multiplier, cm	0.67	0.67	0.67	0.67	0.67	0.67			
Measured Resistivity, ohms-cm	68340	49714	37654	24857	12194	12194			

Reported Soil Minimum Resistivity, ohms-cm **12194**

Note: Material passed # 10 sieve used for testing

Oven ID #	496/610
Balance ID #	563/700
Soil Box ID #	612
Resistivity Meter ID #	706

Description

NA

USCS (D2487; D2488)	NA
AASHTO (M145)	NA

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AASHTO ACCREDITED

Tested By	EB
Date	04/27/21
Checked By	

Client Pr. #	210188.20	Lab. PR. #	2107A-05-2
Pr. Name	Wyckoff Raw Water Line Improvements	S. Type	Bulk
Sample ID	37638/B-15	Depth/Elev.	0-10'
Location	-	Add. Info	-

ASTM G200

Standard Test Method for Measurement of Oxidation Reduction Potential (ORP) of Soil

SAMPLE PREPARATION

Roots, Stones, Gravel and other deleterious material was removed prior to testing

Measurements performed ar room temperature condition: 22.4 °C

TEST DATA

T.E.S.T. Sample ID	Client Sample ID	ORP meter Reading #1, mV	ORP meter Reading #2, mV	ORP meter Reading #3, mV	**Reported ORP value, mV**
37638	See Above	323	320	315	**319**

REMARKS

Standard ORP calibration solution (155-275mV) used to standardize ORP meter: 967901 Exp.05/21

ORP Meter ID: 742/813

ORP Probe ID: 417

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Tested By	AK
Date	04/27/21
Checked By	

Client Pr. #	210188.20	Lab. PR. #	2107A-05-2
Pr. Name	Wyckoff Raw Water Line Improvements	S. Type	Bulk
Sample ID	37638/B-15	Depth/Elev.	0-10'
Location	-	Add. Info	-

ASTM D 698
Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600kN-m/m^3))

DETERMINATION OF TEST PROCEDURE

	wet	dry
Mass of Soil before sieving, g	22600.0	18192.7
Mass of Mat. Retained on No. 4 sieve, g		
Mass of Mat. Retained on 3/8" sieve, g		
Mass of Mat. Retained on 3/4" sieve, g		

Material Retained on No. 4 Sieve, %	
Material Retained on 3/8" Sieve, %	
Material Retained on 3/4" Sieve, %	
Total, % (oversized)	0.0

MOISTURE CONTENT

	Coarse + Fine Fraction	Coarse Fraction
Mass of Wet Sample & Tare, g	960.8	
Mass of Dry Sample & Tare, g	831.7	
Mass of Tare, g	298.8	
Moisture Content, %	24.2	

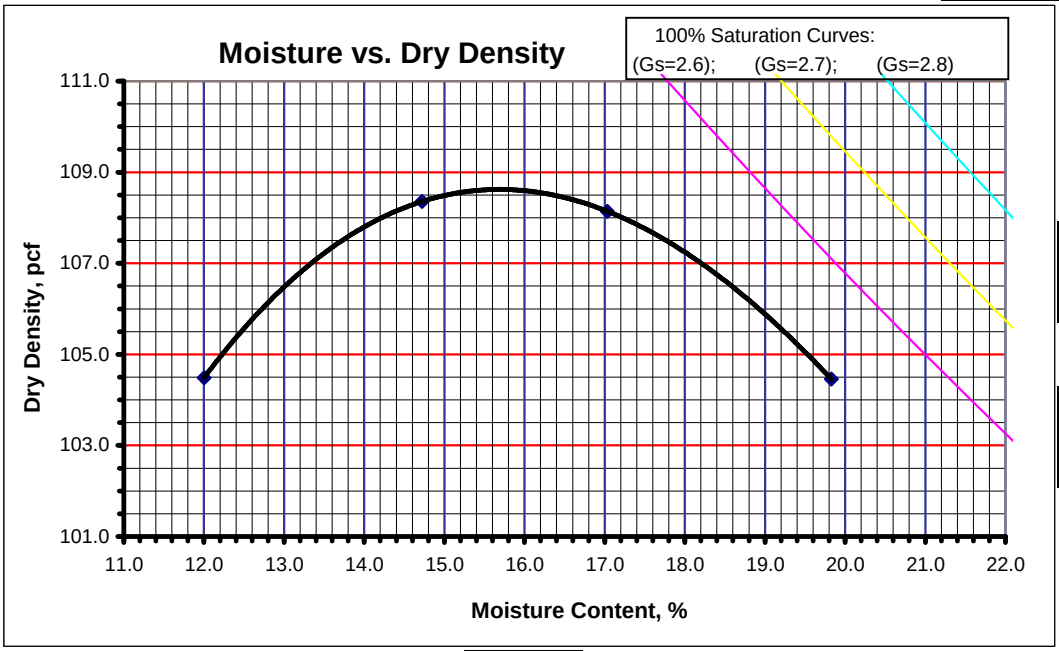
Procedure: B

TEST DATA

Points	1	2	3	4	5
Mass of Mold and Soil, g	6006.0	6116.0	6150.0	6129.0	
Mass of Wet Sample & Tare, g	428.2	424.3	423.1	435.3	
Mass of Dry Sample & Tare, g	397.2	392.5	379.8	384.9	
Mass of Tare, g	138.9	176.5	125.6	130.7	
Moisture Content, %	12.0	14.7	17.0	19.8	
Wet Density, pcf	117.0	124.3	126.6	125.2	
Dry Density, pcf	104.5	108.4	108.1	104.5	

Mold ID Number	798
Mass of Mold, g	4238.3
Volume of Mold, ft^3	0.0333
Hammer ID Number	743
Number of Blows per layer	25
Number of Layers	3
Mechanical Compactor ID Number	317

Method A: Material retained on No. 4 Sieve ≤ 25%
Method B: Material retained on 3/8" Sieve ≤ 25%
Method C: Material retained on 3/4" Sieve ≤ 30%



REMARKS

DESCRIPTION
NA

USCS (ASTM D2487; D2488)
NA

AASHTO M145
NA

Maximum Dry Density, pcf	108.6	**Corrected Maximum Dry Density, pcf**	**NA**
Optimum Moisture Content, %	15.8	**Corrected Optimum Moisture Content, %**	**NA**

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AASHTO ACCREDITED

Tested By	KP
Date	04/16/21
Checked By	

Client Pr. #	210188.20	Lab. PR. #	2107A-05-1
Pr. Name	Wyckoff Raw Water Line Improvements	S. Type	Bulk
Sample ID	Various (See below)	Depth/Elev.	-
Location	-	Add. Info	-

ASTM D 2216; MOISTURE CONTENT DETERMINATION

Sample ID	Sample Depth, ft	Mass of Wet Sample & Tare, g	Mass of Dry Sample & Tare, g	Mass of Tare, g	Moisture Content, %	Comments
37556/B-5	5-10	670.70	614.30	300.70	18.0	
37558/B-13	5-10	698.00	613.10	304.10	27.5	

REMARKS

Balance ID Number	556/139/566
Oven ID Number	496/610