



Geotechnical Data Report

**MSDGC East Ohio Sewers
10240775 Gilbert Avenue at Casino Sewer Repair
Cincinnati, Hamilton County, Ohio**

March 8, 2023

Terracon Project No. N1195302

Prepared for:

Burgess & Niple, Inc.
Cincinnati, OH

Prepared by:

Terracon Consultants, Inc.
Cincinnati, Ohio



March 8, 2023

Burgess & Niple, Inc.
525 Vine Street Suite 1300
Cincinnati, OH 45202



Attn: Mr. Donald Bezold, P.E.
Civil Engineer
P: (513) 615-6040
E: don.bezold@burgessniple.com

Re: Geotechnical Data Report
MSDGC East Ohio Sewers
10240775 Gilbert Avenue at Casino Sewer Repair
Cincinnati, Hamilton County, Ohio
Terracon Project No. N1195302

Dear Mr. Bezold:

We have completed the Geotechnical Data services for the MSDGC Gilbert Avenue at Casino Sewer Repair project. This study was performed in general accordance with the Burgess & Niple-Terracon Agreement for Subconsultant Services dated January 10, 2020, and Geotechnical Study Proposal Acceptance Letter dated April 19, 2022. This report presents the findings of the subsurface exploration and provides our geotechnical data results. Development of geotechnical design recommendations is beyond the scope of this study.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

Nancy Dendramis, P.E.
Geotechnical Project Engineer

Rajan Viswanathan, P.E.
Senior Project Manager



REPORT TOPICS

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Note: This report was originally delivered in a web-based format. **Orange Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the **GeoReport** logo will bring you back to this page. For more interactive features, please view your project online at client.terracon.com.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES
SITE LOCATION AND EXPLORATION PLANS
EXPLORATION RESULTS
SUPPORTING INFORMATION

Note: Refer to each individual Attachment for a listing of contents.

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MSDGC East Ohio Sewers
10240775 Gilbert Avenue at Casino Sewer Repair
Cincinnati, Hamilton County, Ohio
Terracon Project No. N1195302
March 8, 2023

INTRODUCTION

This report presents the results of our subsurface exploration and geotechnical data developed for the proposed repair of the existing sewer line located along the west side of Gilbert Avenue near the Hard Rock Casino in Cincinnati, Hamilton County, Ohio. The purpose of this report is to provide geotechnical data relative to:

- Subsurface soil conditions
- Short-term groundwater conditions

The field exploration scope for this project included the advancement of four (4) test borings to depths ranging between about 20 feet to 60 feet below existing surface grades.

Maps showing the site and test boring locations are shown in the **Site Location** and **Exploration Plan** exhibits, respectively. The results of the laboratory testing performed on select soil samples obtained from the site during the field exploration are included on the boring logs in the **Exploration Results** section and summarized in the report.

SITE CONDITIONS

The following description of site conditions is derived from our site visit in association with the field exploration, our review of the 30% Plan & Profile Drawings developed by Burgess & Niple, and review of publicly available geologic and topographic maps.

Item	Description
Parcel Information	Gilbert Avenue between E. Court Street and Elsinore Place, Cincinnati, Hamilton County, Ohio Coordinates: 39.1115, -84.5022 (approximate). See Site Location

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MSDGC East Ohio Sewers - Gilbert Avenue - Casino ■ Cincinnati, Hamilton County, Ohio

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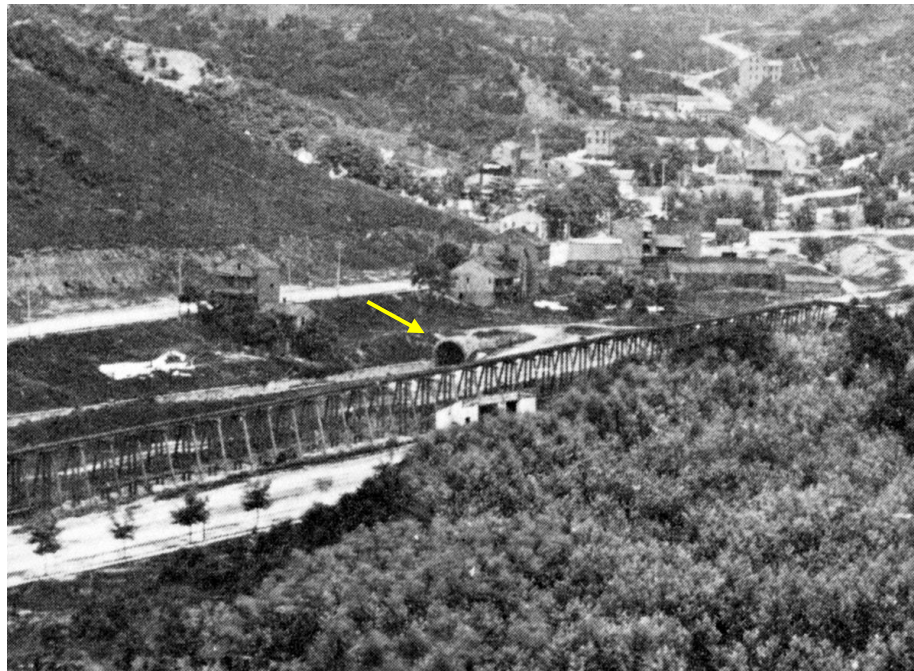
Item	Description
Existing Improvements	Existing improvements include the Hard Rock Casino north of E. Court Street, Greyhound Bus Station, and business enterprises at 1400 Reading Road, 721 Reading Road, and 615 Elsinore Place, with various surface parking lot and roadway pavements, concrete sidewalks, and drive apron pavements, buried utilities, overhead power lines, traffic signals and the following sewer line pipes and associated manholes/connections. 1. 720 LF of 114-inch diameter brick sewer along Gilbert Avenue (inside the Casino property) with invert elevations ranging between ± 504 feet (STA 0+00) near EX. 33510106 to El. ± 510 feet (STA 7+12.7) near EX. 33515063. 2. 1630 LF of 96-inch diameter brick sewer along Gilbert Avenue (about 780 LF in Casino property and remaining in other commercial properties north of Casino) with invert elevations ranging between El. ± 510 feet (STA 7+12.7) near EX. 33515063 to El. ± 538 feet (STA 23+42) near EX. 33603063 Available information indicates that the Casino has a lower-level finished floor elevation at El. ± 535 feet and is supported on deep foundations consisting of augercast piles. Specific details of the other commercial enterprise buildings (including lowest slab-on-grade elevation and foundations) are not available at the time of this report.
Current Ground Cover	Asphalt concrete pavements, Portland cement concrete sidewalks and driveways, grassy turf, landscape areas with trees/vegetation.
Existing Topography	Based on the East Ohio Sewer Bundle 10240775 - Gilbert Ave. sewer replacement; lining of existing sewer alternates drawings provided by Burgess & Niple, the existing ground surface elevations along the planned sewer repair alignment range from about El. ± 534 feet near E. Court Street up to about El. ± 604 feet near Elsinore Place.
Geology and Site History	The regional area in the vicinity of the Casino has had a complex geologic history including multiple profound drainage changes during glaciation of the Cincinnati area. The culmination of multiple glacier events resulted in the formation of Deer Creek, a major tributary draining the eastern portion of Downtown Cincinnati and points eastward. The 114-inch diameter combined sewer, which is in service today, is situated within the bottoms of the former Deer Creek. The 1904 Sanborn map and the 1912 City of Cincinnati Topographic Survey Map indicate significant fill was placed between 1880 and 1904 to establish surface grades for the previously existing the Pennsylvania Railroad yard, which formerly encompassed the area in the vicinity of the Hard Rock Casino. Historical test borings in the vicinity of the Casino have encountered a wide variety of fill materials including cinders, brick, sand and gravel, lean clay, fat clay, organic matter, and shale and limestone.

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Item	Description
	The photo below shows the south portal of the Deer Creek Tunnel (brick sewer) in approximately 1880. Gilbert Avenue and the CL&N are climbing to Walnut Hills from left to right and Reading Road, then known as Hunt Street, is in the background. From "Narrow Gauge in Ohio" by John W. Hauck.



PROJECT DESCRIPTION

Our understanding of the project conditions is as follows:

Item	Description
Information Provided	■ B&N East Ohio Bundle 10240775- Gilbert Ave. sewer replacement; lining of existing sewer alternates ■ B&N East Ohio Bundle 10240775- Gilbert Ave. sewer replacement; lining of existing sewer alternates with proposed test boring locations ■ Reading-Gilbert bypass Plan and Profile-060622 (sheet 2 of 2 printed 4-25-2022)
Project Description	The project will include the repair (lining) of approximately: ■ 720 lineal feet of 114-inch diameter brick sewer along Gilbert Avenue with invert elevations ranging between ±504 feet (STA 0+00) to El. ±510 feet (STA 7+12.7) ■ 1630 lineal feet of 96-inch diameter brick sewer along Gilbert Avenue with invert elevations ranging between El. ±510 feet (STA 7+12.7) to El. ±538 feet (STA 23+42)

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Item	Description
Estimated Start of Construction	2023- 2024

GEOTECHNICAL CHARACTERIZATION

With the exception of Test Boring B-1, all test borings encountered existing fill to the maximum depth explored and terminated within existing fill. Test Boring B-1 encountered about 58.5 feet of existing fill and terminated in natural lean clay at about 60 feet below existing grade. All test borings were terminated above the crown of the sewer.

We have developed a general characterization of the subsurface conditions based upon our review of the subsurface exploration, laboratory test data, geologic setting, and our understanding of the project. This characterization, termed GeoModel, forms the basis of our geotechnical evaluation and development of recommendations. Conditions encountered at our exploration point are indicated on the individual Test Boring log that can be found in the **Exploration Results** section and the GeoModel can be found in the **Figures** section of this report.

Model Layer	Layer Name	General Description
1	Fill - Granular Soils	Gravel and sand; brown and gray
2	Fill - Cohesive Soils	Lean clay, brown and gray
3	Natural Overburden	Lean clay, stiff, yellowish brown, olive brown, bluish gray, gray

Groundwater Conditions

Short-term groundwater levels were observed and recorded in the boreholes during drilling and sampling. The following table provides a summary of groundwater conditions encountered during the field exploration program. Short-term groundwater water levels observed in the boreholes can be found on the test boring logs provided in **Exploration Results**.

Boring ID	Groundwater Level During Drilling (±feet) ¹	Groundwater Level at Completion of Drilling (±feet) ¹	Borehole Caving Depth (±feet) ^{1,2}
B-1	Not encountered	Not encountered	48
B-2	43	47	-
B-3	32	30	28
B-4	Not encountered	Not encountered	18.3

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Boring ID	Groundwater Level During Drilling (±feet) ¹	Groundwater Level at Completion of Drilling (±feet) ¹	Borehole Caving Depth (±feet) ^{1,2}
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1. Below existing grade

2. Caving depths can be an indicator of longer-term water levels at the location

Due to the low permeability of the soils encountered in the borings, a relatively long period may be necessary for a groundwater level to develop and stabilize in a borehole. Long-term observations in piezometers or observation wells sealed from the influence of surface water are often required to define seasonal and annual average groundwater levels in fine-grained soils, which were predominantly encountered at the site. Caving depths can be an indicator of longer-term groundwater level. Monitoring with observation wells is recommended to characterize long-term groundwater conditions at the site. From experience, seepage is commonly encountered within existing fill (perched/trapped groundwater), at the fill/natural soil interface and at the interface of soils with differing permeability.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff, and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the sewer and associated structures may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater seepage and groundwater level fluctuations should be considered when developing the design and construction plans for the project.

Soil Unit Weight Analysis

At Test Borings B-2 and B-3, thin-walled tube samples were collected at select depth intervals. Where recovered sample specimens remained intact during sample extrusion from their respective tubes, a unit weight was determined from relatively undisturbed cohesive samples. The extruded samples were generally of poor quality due to the heterogeneous composition of the existing fill samples throughout the soil profile encountered at each of the test borings.

Results of unit weight determinations are provided in the table below.

Boring ID	Depth (±feet) ¹	Bulk Unit Weight (pcf)	Natural Moisture Content (%w) ²	Dry Unit Weight (pcf)
B-2	13.5 – 15.5	124	18	105
B-2	18.5 – 20	119	5	113
B-2	56 – 58	132	21	109
B-3	6 – 8	81	22	66

1. Below existing grade

2. Natural moisture content determination specimens excluded large gravel

GEOTECHNICAL OVERVIEW

The existing brick sewer will reportedly be repaired by lining. Test borings were performed along the existing sewer alignment to characterize the overburden soils and groundwater conditions above the crown of the existing brick sewer to aid lining design. The test borings were terminated above the crown of the existing brick sewer. The test borings, except for Test Boring B-1, encountered existing fill to the maximum depth explored. Test Boring B-1 encountered about 58.5 feet of existing fill and terminated in natural cohesive soils (residual soils formed from the complete weathering of the underlying shale and limestone bedrock) at about 60 feet below existing grade.

Based on observed variations in fill composition the existing fill has been interpreted as uncontrolled. We have not been provided field inspection reports documenting the controlled placement and compaction of existing fill. The tested bulk unit weight of select fill samples ranged from 81 pcf to 132 pcf. Based on observed variations in fill composition and SPT N-values, variations in bulk unit weight should be expected along the sewer alignment. Additional testing should be performed, as necessary, for lining design.

The short-term groundwater conditions observed during the field exploration program are indicated on the individual test boring logs and summarized in the **Groundwater** section above. The long-term groundwater conditions along the sewer alignment are expected to vary over the design life of the sewer. From local experience, the groundwater conditions along the sewer alignment are expected to be influenced by seasonal variations including rainfall and runoff and also depend on the regional hydrogeology (including hydraulic connectivity). The occurrence of perched/trapped water is common within undocumented fills. Long-term monitoring with a network of groundwater observation wells will be required to characterize groundwater conditions along the sewer alignment.

The **General Comments** section provides an understanding of the report limitations.

GENERAL COMMENTS

This report provides Geotechnical Data for the project. Development of Geotechnical design recommendations is beyond the scope of this study.

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Natural variations will occur between/away from exploration locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in the final report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

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Our scope of services for the geotechnical study does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If MSDGC/the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence or collaboration through this system are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

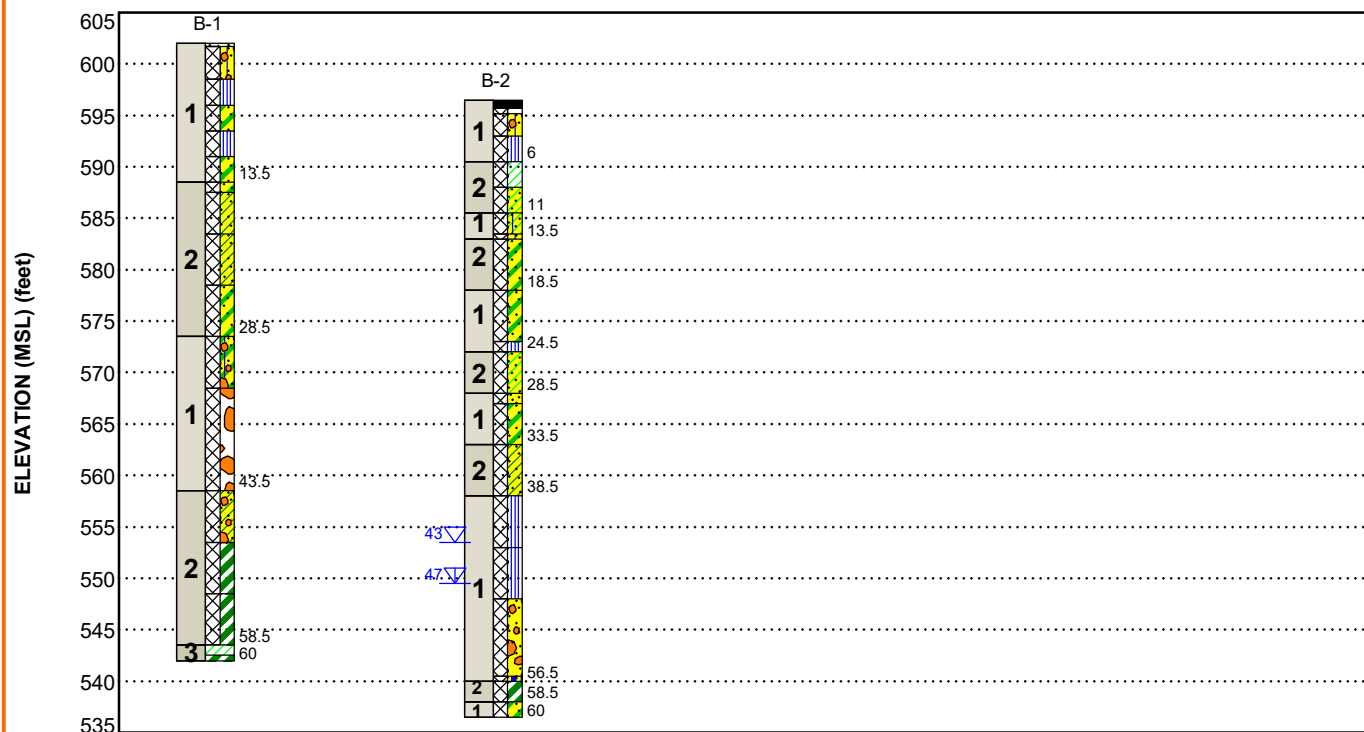
Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

FIGURES

Contents:

GeoModel (2 pages)

MSDGC East Ohio Sewers ■ Cincinnati, Hamilton County, OH
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This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
1	Fill - Granular Soils	Gravel and sand; brown and gray
2	Fill - Cohesive Soils	Lean clay, brown and gray
3	Natural Overburden	Lean clay, stiff, yellowish brown, olive brown, bluish gray, gray

LEGEND



- ▽ First Water Observation
- ▽ Second Water Observation

Groundwater levels are temporal. The levels shown are representative of the date and time of our exploration. Significant changes are possible over time. Water levels shown are as measured during and/or after drilling. In some cases, boring advancement methods mask the presence/absence of groundwater. See individual logs for details.

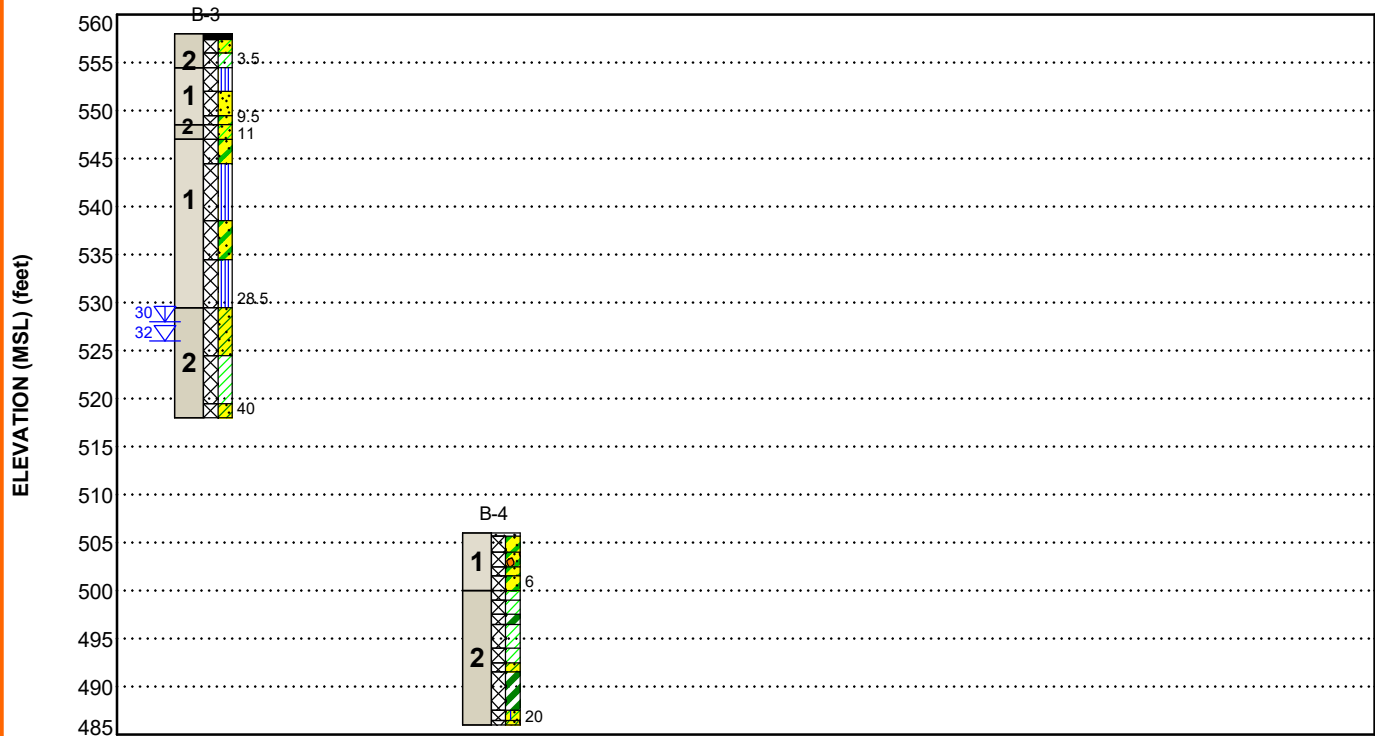
NOTES:

Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project.

Numbers adjacent to soil column indicate depth below ground surface.

GEOMODEL

MSDGC East Ohio Sewers ■ Cincinnati, Hamilton County, OH
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This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
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3	Natural Overburden	Lean clay, stiff, yellowish brown, olive brown, bluish gray, gray

LEGEND

Asphalt	Poorly-graded Sand with Silt	Sandy Lean Clay	Fat Clay
Lean Clay with Sand	Poorly-graded Sand	Topsoil	Sandy Silty Clay
Lean Clay	Clayey Sand	Clayey Sand with Gravel	Sandy Lean Clay with Gravel

- ▽ First Water Observation
▽ Second Water Observation

Groundwater levels are temporal. The levels shown are representative of the date and time of our exploration. Significant changes are possible over time. Water levels shown are as measured during and/or after drilling. In some cases, boring advancement methods mask the presence/absence of groundwater. See individual logs for details.

NOTES:

Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project. Numbers adjacent to soil column indicate depth below ground surface.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES

Field Exploration

Boring ID	Exploration Depth ¹ (feet)	Location ²
B-1	60	Near 615 Elsinore Place
B-2	60	Near 1400 Reading Road
B-3	40	Near 1009 Gilbert Ave (Casino Surface Parking Lot)
B-4	20	Near E Court Street (Casino Property)

1. Below existing surface grades. Test Borings were terminated above the crown of the existing sewer.

2. See **Exploration Plan**

Boring Layout and Elevations: The Test Boring was marked in the field by Terracon at accessible locations near planned sewer repair locations. The final location of each test boring was influenced by existing site features and the location of overhead power lines and underground utilities. Coordinates and ground surface elevation at the “as drilled” boring location were obtained by referencing the Hamilton County CAGIS Topographic Survey Map. The location and surface elevation of the test boring should be considered approximate, being accurate only to the degree implied by the means and methods used to define them. The as-drilled locations can be surveyed by the Project Surveyor.

Subsurface Exploration Procedures: The Test Borings were advanced with a track-mounted rotary drill rig using continuous-flight hollow-stem augers. Soil sampling was performed primarily using split-barrel samplers. Split-barrel samples of soil were obtained at 2.5-foot intervals within the upper 15 feet and at 5-foot intervals after that to the maximum exploration depth. In the split-barrel sampling procedure, a standard 2-inch outer diameter split-barrel sampling spoon is driven into the ground by a 140-pound automatic hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration is recorded as the Standard Penetration Test (SPT) resistance value. The SPT resistance values, also referred to as N-values, are indicated on the boring log at the test depth. In addition to the split-barrel samples, relatively undisturbed soil samples were obtained using a thin-walled (Shelby) tube sampler at select borings and depths. The Shelby tube samples were obtained by hydraulically advancing a seamless, thin-walled steel tube with a sharp cutting edge.

We observed and recorded short-term groundwater levels in the borehole during drilling and sampling. For safety purposes, the test borings were backfilled with compacted auger cuttings immediately after completion of drilling. At test boring B-4, the near-surface portion of the borehole was plugged with quick-setting concrete and the disturbed lawn areas were covered over with topsoil, seed, and straw. At the remainder of the test borings, the near-surface portion of the

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borehole was plugged with quick-setting concrete and the asphalt concrete pavement was patched with an asphalt patch.

The sampling depths, penetration distances, and other sampling information were recorded during drilling on the field boring logs. The samples were placed in appropriate containers and taken to our soils laboratory for testing and classification by a Geotechnical Engineer. Our exploration team prepared field boring logs as part of the drilling operations. These field logs include visual classifications of the materials encountered during drilling and our interpretation of the subsurface conditions between samples. Final boring logs were prepared from the field logs. The final boring logs represent the geotechnical engineer's interpretation of the field logs and include modifications based on observations and tests of the samples in our laboratory.

Laboratory Testing

The project Geotechnical Engineer reviewed the field data and assigned various laboratory tests to better understand the engineering properties of the various soil strata as appropriate for this project. Procedural standards noted below are for reference to methodology in general. In some cases, variations to methods are applied because of local practice or professional judgment. Standards noted below include reference to other, related standards. Such references are not necessarily applicable to describe the specific test performed.

- ASTM D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- ASTM D7263 Standard Test Methods for Laboratory Determination of Density and Unit Weight of Soil Specimens

The laboratory testing program included examination of soil samples by the Geotechnical Engineer. Based on the material's texture and plasticity, we have described and classified the soil samples in accordance with the Unified Soil Classification System (USCS). Hand penetrometer readings were obtained for select cohesive soil samples to provide an estimate of the unconfined compressive strength.

SITE LOCATION AND EXPLORATION PLANS

Contents:

Site Location

Exploration Plan (3 pages)

Note: All attachments are one page unless noted above.

SITE LOCATION

MSDGC East Ohio Sewers- Gilbert Ave.-Casino ■ Cincinnati, Hamilton County, Ohio
March 8, 2023 ■ Terracon Project No. N1195302



DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION PLAN

MSDGC East Ohio Sewers, Gilbert Ave.-Casino ■ Cincinnati, Hamilton County, Ohio
March 8, 2023 ■ Terracon Project No. N1195302



DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION PLAN

MSDGC East Ohio Sewers 10240775 Gilbert Ave.-Casino ■ Cincinnati, Hamilton County, OH
March 8, 2023 ■ Terracon Project No. N1195302



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AERIAL PHOTOGRAPHY PROVIDED
BY MICROSOFT BING MAPS

EXPLORATION PLAN

MSDGC East Ohio Sewers 10240775 Gilbert Ave-Casino ■ Cincinnati, Hamilton County, OH
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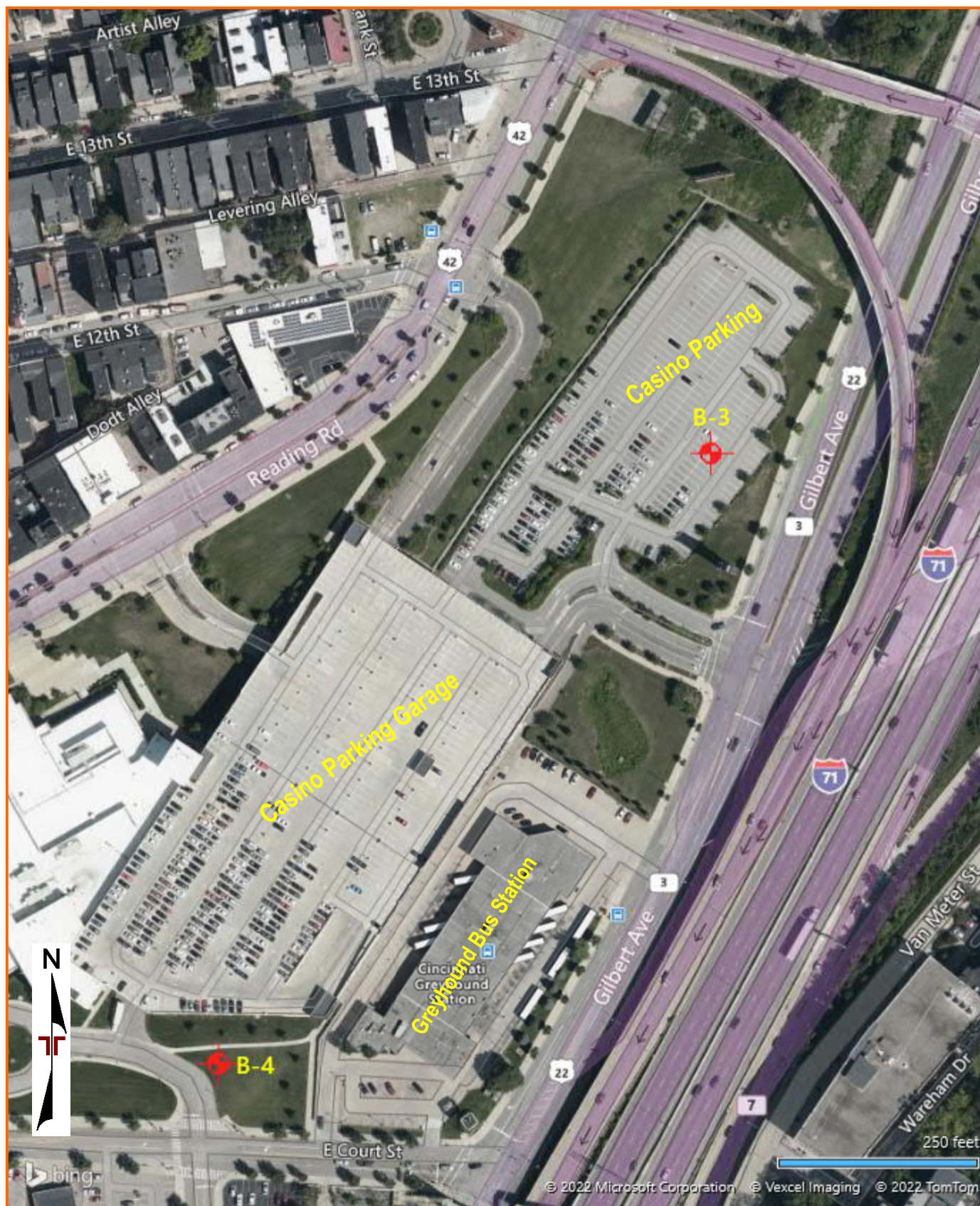


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AERIAL PHOTOGRAPHY PROVIDED
BY MICROSOFT BING MAPS

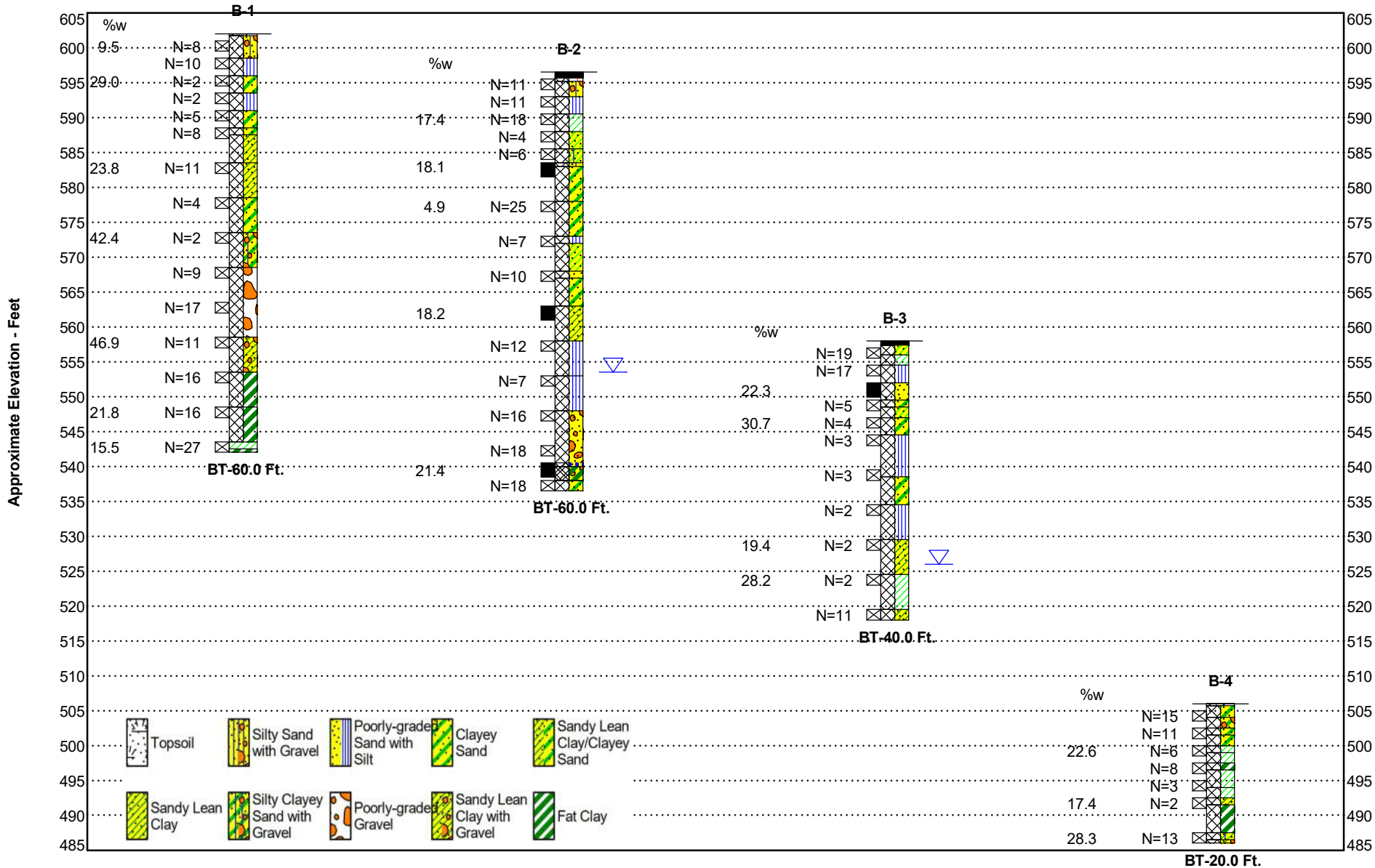
EXPLORATION RESULTS

Contents:

Subsurface Profile

Test Boring Logs (B-1 to B-4)

Note: All attachments are one page unless noted above.



Explanation

B-1 — Borehole Number
Moisture Content — %w
Sampling — LL PL — Liquid and Plastic Limits
AR — Borehole Termination Type
BT — Borehole Termination Type
Water Level Reading at time of drilling.
Water Level Reading after drilling.

See [Exploration Plan](#) for orientation of soil profile.
See General Notes in [Supporting Information](#) for symbols and soil classifications.
Soils profile provided for illustration purposes only.
Soils between borings may differ
AR - Auger Refusal
BT - Boring Termination

Project No.: N1195302
Project Manager: NCD
Scale: NTS
Date: 10/20/2022

Terracon
611 Lunken Park Dr
Cincinnati, OH
PH. 513-321-5816 FAX 513-321-0294

SUBSURFACE PROFILE

MSDGC EAST OHIO SEWERS
GILBERT AVE. AT CASINO SEWER REPAIR (10240775)
CINCINNATI, HAMILTON COUNTY, OH

BORING LOG NO. B-1

Page 1 of 2

PROJECT: MSDGC East Ohio Sewers

CLIENT: Burgess & Niple Inc
Cincinnati, OH

SITE: Gilbert Ave. at Casino Sewer Repair (10240775)
Cincinnati, Hamilton County, OH

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL N1195302 MSDGC EAST OHIO S - CASINO GPJ TERRACON_DATATEMPLATE.GDT 10/20/22

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 39.1127° Longitude: -84.5016° Approximate Surface Elev.: 602 (Ft.) +/-	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)
		DEPTH ELEVATION (Ft.)							
		0.3 TOPSOIL (3¾") 601.7+/-							
		FILL - SILTY SAND WITH GRAVEL , sand is mostly fine, trace brick fragments, very dark brown				28	2-4-4 N=8		9.5
		3.5 598.5+/-							
		FILL - POORLY GRADED SAND WITH SILT , sand is fine to medium, trace gravel, trace brick fragments, trace mortar fragments, very dark brown				28	4-5-5 N=10		
		6.0 596+/-	5						
		FILL - CLAYEY SAND , sand is mostly fine to medium, trace gravel, trace wood fibers, trace petroleum odor, very dark brown				22	1-1-1 N=2		29.0
		8.5 593.5+/-							
		FILL - POORLY GRADED SAND WITH SILT , sand is mostly fine to medium, trace gravel, black				22	2-1-1 N=2		
		11.0 591+/-	10						
		FILL - CLAYEY SAND , mostly fine to medium, trace petroleum odor,, black				11	1-4-1 N=5		
		13.5 588.5+/-							
		FILL - SANDY LEAN CLAY/CLAYEY SAND , trace gravel, sand is mostly fine to medium, trace dimensional wood fibers, black and very dark gray				44	2-3-5 N=8	0.5 (HP)	
		14.5 587.5+/-	15						
		FILL - SANDY LEAN CLAY , trace petroleum odor, trace wood fibers, very dark gray							
		18.5 583.5+/-							
		FILL - SANDY LEAN CLAY , very dark gray				11	2-6-5 N=11	0.25 (HP)	23.8
		23.5 578.5+/-	20						
		FILL - SANDY LEAN CLAY/CLAYEY SAND , trace gravel, sand is mostly fine to medium, strong petroleum odor, black				28	3-2-2 N=4		
		28.5 573.5+/-	25						
		FILL - SILTY CLAYEY SAND WITH GRAVEL , sand is mostly fine to medium, very dark brown				17	1-1-1 N=2		42.4
			30						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25-inch Continuous-Flight Hollow-Stem Augers
2-inch Split-Barrel Sampler

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).

Notes:

Abandonment Method:
At completion, boring backfilled with compacted auger cuttings and capped with an asphalt patch.

See [Supporting Information](#) for explanation of symbols and abbreviations.

Hamilton County CAGIS Topographic Survey Map

WATER LEVEL OBSERVATIONS

Water not observed during drilling.
Water not observed at completion of drilling.

Cave in encountered at 48 feet

Terracon

611 Lunken Park Dr
Cincinnati, OH

Boring Started: 08-19-2022

Boring Completed: 08-19-2022

Drill Rig: 932

Driller: Matt Lansing

Project No.: N1195302

BORING LOG NO. B-1

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PROJECT: MSDGC East Ohio Sewers

CLIENT: Burgess & Niple Inc
Cincinnati, OH

SITE: Gilbert Ave. at Casino Sewer Repair (10240775)
Cincinnati, Hamilton County, OH

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 39.1127° Longitude: -84.5016° Approximate Surface Elev.: 602 (Ft.) +/-	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)
		DEPTH ELEVATION (Ft.)							
2		FILL - SILTY CLAYEY SAND WITH GRAVEL , sand is mostly fine to medium, very dark brown (<i>continued</i>) 33.5 568.5+/-							
1		FILL - GRAVEL , up to 1¼ inches, trace sandy clay, trace brick fragments, very dark brown 43.5 558.5+/-	35		X	22	3-5-4 N=9		
			40		X	28	5-8-9 N=17		
		FILL - SANDY LEAN CLAY WITH GRAVEL , trace petroleum odor, black 48.5 553.5+/-	45		X	33	4-4-7 N=11		46.9
2		FILL - FAT CLAY , trace wire fragment, bluish gray with olive gray, (shale fill) 53.5 548.5+/-	50		X	39	6-8-8 N=16	2.5/ 1.75 (HP)	
		FILL - FAT CLAY , trace gravel, trace limestone fragments, (shale fill) 58.5 543.5+/-	55		X	28	9-8-8 N=16	2.0 (HP)	21.8
3		LEAN CLAY (CL) , with limestone fragments, yellowish brown, hard, (Residuum) 59.5 542.5+/-	60		X	33	15-17-10 N=27	4.5 (HP)	15.5
		FAT CLAY (CH) , with shale fragments, yellowish brown, hard, (Residuum) 60.0 542+/-							
		Boring Terminated at 60 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25-inch Continuous-Flight Hollow-Stem Augers
2-inch Split-Barrel Sampler

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).

Notes:

Abandonment Method:
At completion, boring backfilled with compacted auger cuttings and capped with an asphalt patch.

See [Supporting Information](#) for explanation of symbols and abbreviations.

Hamilton County CAGIS Topographic Survey Map

WATER LEVEL OBSERVATIONS

Water not observed during drilling.
Water not observed at completion of drilling.

Terracon

611 Lunken Park Dr
Cincinnati, OH

Boring Started: 08-19-2022

Boring Completed: 08-19-2022

Drill Rig: 932

Driller: Matt Lansing

Project No.: N1195302

Cave in encountered at 48 feet

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL N1195302 MSDGC EAST OHIO S - CASINO GPJ TERRACON_DATATEMPLATE.GDT 10/20/22

BORING LOG NO. B-2

Page 1 of 2

PROJECT: MSDGC East Ohio Sewers

CLIENT: Burgess & Niple Inc
Cincinnati, OH

SITE: Gilbert Ave. at Casino Sewer Repair (10240775)
Cincinnati, Hamilton County, OH

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL N1195302 MSDGC EAST OHIO S - CASINO GPJ TERRACON_DATATEMPLATE.GDT 10/20/22

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 39.1115° Longitude: -84.5022° Approximate Surface Elev.: 596.5 (Ft.) +/-	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)
		DEPTH ELEVATION (Ft.)								
		0.8 ASPHALT CONCRETE (9") 595.7+/-								
		1.3 FILL - AGGREGATE BASE COURSE (7") 595.2+/-								
1		FILL - SILTY SAND WITH GRAVEL , sand is mostly fine to medium, trace mortar fragments, very dark brown 593+/-			X	28	5-5-6 N=11			
		FILL - POORLY GRADED SAND WITH SILT , trace gravel, black 590.5+/-	5		X	28	7-7-4 N=11			
2		FILL - LEAN CLAY , trace gravel, yellowish brown and gray 588+/-			X	28	8-8-10 N=18	2.25 (HP)	17.4	
		FILL - LEAN CLAY WITH SAND , with black sand layers, brown 585.5+/-	10		X	56	2-2-2 N=4	1.25 (HP)		
		FILL - SANDY SILTY CLAY/SILTY CLAYEY SAND , sand is mostly fine, yellowish brown 583.5+/-			X	100	2-3-3 N=6			
1		FILL - SILTY SAND , with sandy silt, sand is mostly fine, brown 583+/-								
		FILL - SANDY LEAN CLAY/CLAYEY SAND , sand is mostly fine to medium, yellowish brown 578+/-	15			75		1.75 (HP)	18.1	105
2		FILL - CLAYEY SAND , sand is mostly fine, black 573+/-			X	100	12-13-12 N=25		4.9	113
1		FILL - POORLY GRADED SAND WITH SILT , sand is mostly fine to medium, yellowish brown 572+/-			X	83	3-4-3 N=7	1.5 (HP)		
		FILL - LEAN CLAY WITH SAND , trace wood fibers, brown 568+/-	25							
2		FILL - POORLY GRADED SAND , sand is mostly fine to medium, trace brick fragments, trace coal fragments, brown 567+/-			X	50	3-4-6 N=10			
1		FILL - CLAYEY SAND , trace gravel, sand is mostly fine to medium, trace brick fragments, brown	30							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25-inch Continuous-Flight Hollow-Stem Augers
3-inch Thin-Walled Tube
2-inch Split-Barrel Sampler

Abandonment Method:
At completion, boring backfilled with compacted auger cuttings and capped with an asphalt patch.

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (if any).

See [Supporting Information](#) for explanation of symbols and abbreviations.

Hamilton County CAGIS Topographic Survey Map

Notes:

WATER LEVEL OBSERVATIONS

- Water observed at 43 feet during drilling
- At completion of drilling, water observed at 47 feet

Terracon

611 Lunken Park Dr
Cincinnati, OH

Boring Started: 08-16-2022

Boring Completed: 08-16-2022

Drill Rig: 932

Driller: Matt Lansing

Project No.: N1195302

BORING LOG NO. B-2

Page 2 of 2

PROJECT: MSDGC East Ohio Sewers

CLIENT: Burgess & Niple Inc
Cincinnati, OH

SITE: Gilbert Ave. at Casino Sewer Repair (10240775)
Cincinnati, Hamilton County, OH

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 39.1115° Longitude: -84.5022° Approximate Surface Elev.: 596.5 (Ft.) +/-	DEPTH (Ft.)	ELEVATION (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)
1		FILL - CLAYEY SAND , trace gravel, sand is mostly fine to medium, trace brick fragments, brown (<i>continued</i>)	33.5	563+/-							
2		FILL - SANDY LEAN CLAY , trace gravel, trace brick, brown -1-inch layer of sandy limestone and brick fragments plugging the bottom of the tube	35				8			18.2	
		FILL - POORLY GRADED SAND WITH SILT , trace gravel, sand is mostly fine to medium, trace glass fragments, black and dark brown	38.5	558+/-							
		FILL - POORLY GRADED SAND WITH SILT , trace gravel, sand is mostly fine to medium, free water, black	43.5	553+/-							
1		FILL - POORLY GRADED SAND WITH GRAVEL , sand is mostly fine to medium, free water, black	48.5	548+/-							
		FILL - SANDY SILT , trace wire fragments, trace glass fragments, trace petroleum odor, free water, black with dark blackish gray	56.0	540.5+/-							
2		FILL - FAT CLAY , trace shale fragments, trace wire fragments, trace brick fragments, bluish gray with olive gray	56.5	540+/-			60			<0.25/ 1.75/ 1.5 (HP)	109
1		FILL - CLAYEY SAND , sand is mostly fine to medium, free water, black	58.5	538+/-							
			60.0	536.5+/-							
		Boring Terminated at 60 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25-inch Continuous-Flight Hollow-Stem Augers
3-inch Thin-Walled Tube
2-inch Split-Barrel Sampler

Abandonment Method:
At completion, boring backfilled with compacted auger cuttings and capped with an asphalt patch.

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).

See [Supporting Information](#) for explanation of symbols and abbreviations.

Hamilton County CAGIS Topographic Survey Map

Notes:

WATER LEVEL OBSERVATIONS

Water observed at 43 feet during drilling
 At completion of drilling, water observed at 47 feet

Terracon

611 Lunken Park Dr
Cincinnati, OH

Boring Started: 08-16-2022

Boring Completed: 08-16-2022

Drill Rig: 932

Driller: Matt Lansing

Project No.: N1195302

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL N1195302 MSDGC EAST OHIO S - CASINO GPJ TERRACON_DATATEMPLATE.GDT 10/20/22

BORING LOG NO. B-3

Page 1 of 2

PROJECT: MSDGC East Ohio Sewers

CLIENT: Burgess & Niple Inc
Cincinnati, OH

SITE: Gilbert Ave. at Casino Sewer Repair (10240775)
Cincinnati, Hamilton County, OH

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL N1195302 MSDGC EAST OHIO S - CASINO GPJ TERRACON_DATATEMPLATE GDT 10/20/22

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)
		Latitude: 39.1097° Longitude: -84.5032°		Approximate Surface Elev.: 558 (Ft.) +/-								
			0.6	557.4+/-								
		FILL - LEAN CLAY WITH SAND , trace brick fragments, black with gray										
2			2.0	556+/-			X	100	10-8-11 N=19	4.5/ 4.0 (HP)		
		FILL - LEAN CLAY , trace coal fragments, trace brick fragments, very dark bluish gray										
			3.5	554.5+/-								
		FILL - POORLY GRADED SAND WITH SILT , trace gravel, sand is mostly fine to medium, trace glass fragments, trace brick fragments, black			5		X	100	12-9-8 N=17			
			6.0	552+/-								
		FILL - SAND , trace gravel, trace cinders, trace clinkers, trace ash, trace coal, black									22.3	66
			8.5	549.5+/-								
1		FILL - CLAYEY SAND , sand is mostly fine to medium, trace gravel, black					X	100	1-2-3 N=5	2.0 (HP)		
		FILL - LEAN CLAY WITH SAND , trace gravel, very dark bluish gray, (shale fill)			10							
2			9.5	548.5+/-								
		FILL - CLAYEY SAND , trace gravel, sand is mostly fine to medium, trace coal fragments, black with very dark gray					X	100	2-2-2 N=4		30.7	
			11.0	547+/-								
		FILL - CLAYEY SAND , trace gravel, sand is mostly fine to medium, trace coal fragments, black with very dark gray					X	100	1-2-1 N=3			
			13.5	544.5+/-								
		FILL - POORLY GRADED SAND WITH SILT , trace gravel, sand is mostly fine to medium, trace ash, gray to black and gray			15		X	100	1-1-2 N=3			
1												
		FILL - CLAYEY SAND , sand is mostly fine to medium, trace gravel, very dark gray, (swale sediments)			20		X	100	1-1-2 N=3			
			19.5	538.5+/-								
		FILL - POORLY GRADED SAND WITH SILT , trace gravel, sand is mostly fine to medium, trace wood fibers, black and gray			25		X	50	1-1-1 N=2			
			23.5	534.5+/-								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25-inch Continuous-Flight Hollow-Stem Augers
3-inch Thin-Walled Tube
2-inch Split-Barrel Sampler

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).

Notes:
Water added at 32 feet to manage heave.

Abandonment Method:
At completion, boring backfilled with compacted auger cuttings and capped with an asphalt patch.

See [Supporting Information](#) for explanation of symbols and abbreviations.

Hamilton County CAGIS Topographic Survey Map

WATER LEVEL OBSERVATIONS

Water observed at 32 feet during drilling
At completion of drilling, water observed at 30 feet

Cave in encountered at 28 feet

Terracon

611 Lunken Park Dr
Cincinnati, OH

Boring Started: 08-18-2022

Boring Completed: 08-18-2022

Drill Rig: 932

Driller: Matt Lansing

Project No.: N1195302

BORING LOG NO. B-3

Page 2 of 2

PROJECT: MSDGC East Ohio Sewers

CLIENT: Burgess & Niple Inc
Cincinnati, OH

SITE: Gilbert Ave. at Casino Sewer Repair (10240775)
Cincinnati, Hamilton County, OH

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 39.1097° Longitude: -84.5032° Approximate Surface Elev.: 558 (Ft.) +/-	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)
1		FILL - POORLY GRADED SAND WITH SILT , trace gravel, sand is mostly fine to medium, trace wood fibers, black and gray (<i>continued</i>)	28.5	529.5+/-	28		X	28	2-1-1 N=2	<0.25	19.4
2		FILL - SANDY LEAN CLAY , trace coal fragments (swale sediments), dark grayish brown	33.5	524.5+/-	35		X	28	1-1-1 N=2	<0.25	28.2
		FILL - LEAN CLAY , bluish greenish gray, (shale fill)	38.5	519.5+/-	40		X	28	5-5-6 N=11	<0.25	
		FILL - SANDY LEAN CLAY , trace gravel, trace organics, trace brick fragments, trace anaerobic odor, dark brownish gray	40.0	518+/-							
		Boring Terminated at 40 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25-inch Continuous-Flight Hollow-Stem Augers
3-inch Thin-Walled Tube
2-inch Split-Barrel Sampler

Abandonment Method:
At completion, boring backfilled with compacted auger cuttings and capped with an asphalt patch.

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).

See [Supporting Information](#) for explanation of symbols and abbreviations.

Hamilton County CAGIS Topographic Survey Map

Notes:

WATER LEVEL OBSERVATIONS

Water observed at 32 feet during drilling
 At completion of drilling, water observed at 30 feet

Cave in encountered at 28 feet

Terracon

611 Lunken Park Dr
Cincinnati, OH

Boring Started: 08-18-2022

Drill Rig: 932

Project No.: N1195302

Boring Completed: 08-18-2022

Driller: Matt Lansing

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL N1195302 MSDGC EAST OHIO S - CASINO GPJ TERRACON_DATATEMPLATE.GDT 10/20/22

BORING LOG NO. B-4

Page 1 of 1

PROJECT: MSDGC East Ohio Sewers

CLIENT: Burgess & Niple Inc
Cincinnati, OH

SITE: Gilbert Ave. at Casino Sewer Repair (10240775)
Cincinnati, Hamilton County, OH

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL N1195302 MSDGC EAST OHIO S - CASINO GPJ TERRACON_DATATEMPLATE.GDT 10/20/22

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 39.1076° Longitude: -84.5053° Approximate Surface Elev.: 506 (Ft.) +/-	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)
		DEPTH ELEVATION (Ft.)							
		0.3 TOPSOIL (4 1/2") 505.7+/-							
1		FILL - CLAYEY SAND , sandy is mostly fine to medium, trace brick fragments, brown 504+/-				100	7-5-10 N=15		
		2.0 FILL - CLAYEY SAND WITH GRAVEL , sand is mostly fine to medium, trace brick fragments, brown 502.5+/-							
		3.5 FILL - CLAYEY SAND , trace gravel, sand is mostly fine to medium, trace glass fragments, black 501.5+/-				100	3-4-7 N=11		
		4.5 FILL - CLAYEY SAND , trace gravel, sand is mostly fine to medium, trace wood fibers, very dark brown 500+/-	5						
		6.0 FILL - LEAN CLAY , trace gravel, bluish gray, (shale fill) 499+/-				100	3-3-3 N=6	0.75/ 0.5 (HP)	22.6
		7.0 FILL - LEAN CLAY , trace gravel, bluish gray with olive gray, (shale fill) 497.5+/-							
		8.5 FILL - FAT CLAY , trace shale fragments, bluish gray with olive gray, (shale fill) 496.5+/-				100	3-5-3 N=8	3.5/ 1.25 (HP)	
		9.5 FILL - LEAN CLAY , moderately plastic, bluish gray, (shale fill) 494+/-	10						
		12.0 FILL - LEAN CLAY , with clayey sand and gravel pockets, trace wood fibers, bluish gray to very dark gray, (shale fill) 492.5+/-				100	1-2-1 N=3	1.25/ 0.25 (HP)	
2		13.5 FILL - SANDY LEAN CLAY , trace gravel, trace decomposing dark brown wood fibers, very dark bluish gray, (shale fill) 491.5+/-				100	3-1-1 N=2	0.25/ 1.25 (HP)	17.4
		14.5 FILL - FAT CLAY , trace shale fragments, bluish gray, (shale fill) 487.5+/-	15						
		18.5 FILL - SANDY SILTY CLAY , trace anaerobic odor, very dark grayish brown, (swale sediments) 486.5+/-				100	5-5-8 N=13	1.0/ 0.5 (HP)	28.3
		19.5 FILL - SANDY LEAN CLAY WITH GRAVEL , trace brick fragments, very dark brownish gray with bluish gray, (shale fill) 486+/-	20						
		20.0 Boring Terminated at 20 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25-inch Continuous-Flight Hollow-Stem Augers
2-inch Split-Barrel Sampler

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (if any).

Notes:

Abandonment Method:
At completion, boring backfilled with compacted auger cuttings, capped with a concrete plug and soil/seed/straw covering.

See [Supporting Information](#) for explanation of symbols and abbreviations.

Hamilton County CAGIS Topographic Survey Map

WATER LEVEL OBSERVATIONS

Water not observed during drilling.
Water not observed at completion of drilling.

 Cave in encountered at 18.3 feet

Terracon

611 Lunken Park Dr
Cincinnati, OH

Boring Started: 08-19-2022

Boring Completed: 08-19-2022

Drill Rig: 932

Driller: Matt Lansing

Project No.: N1195302

SUPPORTING INFORMATION

Contents:

General Notes

Unified Soil Classification System

Note: All attachments are one page unless noted above.

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

MSDGC East Ohio Sewers ■ Cincinnati, Hamilton County, OH
Terracon Project No. N1195302

SAMPLING	WATER LEVEL	FIELD TESTS
 Shelby Tube  Standard Penetration Test	 Water Initially Encountered  Water Level After a Specified Period of Time  Water Level After a Specified Period of Time  Cave In Encountered Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.	N Standard Penetration Test Resistance (Blows/Ft.) (HP) Hand Penetrometer (T) Torvane (DCP) Dynamic Cone Penetrometer UC Unconfined Compressive Strength (PID) Photo-Ionization Detector (OVA) Organic Vapor Analyzer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification as noted on the soil boring logs is based Unified Soil Classification System. Where sufficient laboratory data exist to classify the soils consistent with ASTM D2487 "Classification of Soils for Engineering Purposes" this procedure is used. ASTM D2488 "Description and Identification of Soils (Visual-Manual Procedure)" is also used to classify the soils, particularly where insufficient laboratory data exist to classify the soils in accordance with ASTM D2487. In addition to USCS classification, coarse grained soils are classified on the basis of their in-place relative density, and fine-grained soils are classified on the basis of their consistency. See "Strength Terms" table below for details. The ASTM standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

LOCATION AND ELEVATION NOTES

Exploration point locations as shown on the Exploration Plan and as noted on the soil boring logs in the form of Latitude and Longitude are approximate. See [Exploration and Testing Procedures](#) in the report for the methods used to locate the exploration points for this project. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		
Descriptive Term (Density)	Standard Penetration or N-Value Blows/Ft.	Descriptive Term (Consistency)	Unconfined Compressive Strength Qu, (tsf)	Standard Penetration or N-Value Blows/Ft.
Very Loose	0 - 3	Very Soft	less than 0.25	0 - 1
Loose	4 - 9	Soft	0.25 to 0.50	2 - 4
Medium Dense	10 - 29	Medium Stiff	0.50 to 1.00	4 - 8
Dense	30 - 50	Stiff	1.00 to 2.00	8 - 15
Very Dense	> 50	Very Stiff	2.00 to 4.00	15 - 30
		Hard	> 4.00	> 30

RELEVANCE OF SOIL BORING LOG

The soil boring logs contained within this document are intended for application to the project as described in this document. Use of these soil boring logs for any other purpose may not be appropriate.

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests ^A					Soil Classification	
					Group Symbol	Group Name ^B
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	Gravels: More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels: Less than 5% fines ^C	$Cu \geq 4$ and $1 \leq Cc \leq 3$ ^E	GW	Well-graded gravel ^F	
			$Cu < 4$ and/or $[Cc < 1$ or $Cc > 3.0]$ ^E	GP	Poorly graded gravel ^F	
		Gravels with Fines: More than 12% fines ^C	Fines classify as ML or MH	GM	Silty gravel ^{F, G, H}	
			Fines classify as CL or CH	GC	Clayey gravel ^{F, G, H}	
	Sands: 50% or more of coarse fraction passes No. 4 sieve	Clean Sands: Less than 5% fines ^D	$Cu \geq 6$ and $1 \leq Cc \leq 3$ ^E	SW	Well-graded sand ^I	
			$Cu < 6$ and/or $[Cc < 1$ or $Cc > 3.0]$ ^E	SP	Poorly graded sand ^I	
		Sands with Fines: More than 12% fines ^D	Fines classify as ML or MH	SM	Silty sand ^{G, H, I}	
			Fines classify as CL or CH	SC	Clayey sand ^{G, H, I}	
Fine-Grained Soils: 50% or more passes the No. 200 sieve	Silts and Clays: Liquid limit less than 50	Inorganic:	$PI > 7$ and plots on or above “A”	CL	Lean clay ^{K, L, M}	
			$PI < 4$ or plots below “A” line ^J	ML	Silt ^{K, L, M}	
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay ^{K, L, M, N}
			Liquid limit - not dried			Organic silt ^{K, L, M, O}
	Silts and Clays: Liquid limit 50 or more	Inorganic:	PI plots on or above “A” line	CH	Fat clay ^{K, L, M}	
			PI plots below “A” line	MH	Elastic Silt ^{K, L, M}	
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay ^{K, L, M, P}
			Liquid limit - not dried			Organic silt ^{K, L, M, Q}
Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat	

^A Based on the material passing the 3-inch (75-mm) sieve.

^B If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

^C Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

^D Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.

$$Cu = D_{60}/D_{10} \quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$$

^F If soil contains $\geq 15\%$ sand, add "with sand" to group name.

^G If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

^H If fines are organic, add "with organic fines" to group name.

^I If soil contains $\geq 15\%$ gravel, add "with gravel" to group name.

^J If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

^K If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

^L If soil contains $\geq 30\%$ plus No. 200 predominantly sand, add "sandy" to group name.

^M If soil contains $\geq 30\%$ plus No. 200, predominantly gravel, add "gravelly" to group name.

^N $PI \geq 4$ and plots on or above "A" line.

^O $PI < 4$ or plots below "A" line.

^P PI plots on or above "A" line.

^Q PI plots below "A" line.

