GPD GROUP
Glaus, Pyle, Schomer, Burns & DeHaven, Inc.

GEOTECHNICAL ENGINEERING REPORT

SHEETZ MASSILLON OHIO – ORTT ROAD

Prepared For:

ABC Development, Inc.

GPD Project No. 2020096.04
June 15, 2022

06/15/2022

Delbert J. Channels, PE
Director of Geotechnical Services

Contents

SECTION 1

1.0 Introduction

GPD Group is pleased to submit this Geotechnical Report for the aforementioned project. The purpose of this study was to obtain information on the subsurface conditions at the proposed project site and based on this information, to provide geotechnical recommendations regarding the design and construction of pavements and development for Ortt Road. Three (3) borings extending to depths of 20.0 feet were drilled at the site. Individual boring logs and a Boring Location Plan are attached.

1.1 Project Description

The site for the proposed roadway is currently a partially paved township road located in Perry Township (Stark County), Ohio. We understand that Ortt Road will be developed as an entrance/exit drive access for a planned Sheetz Store & Diesel Refueling Station. Ortt Road will be the primary entrance & exit for all diesel refueling traffic. Ortt Road will be used as additional automobile access to a drive along Erie Street South (S.R.21) for all gas refueling and store traffic. Approximately 600 feet of roadway construction will take place extending east of Erie Street South. We are assuming the east end of the road will terminate as a cul-de-sac. Proposed cuts and fills are anticipated to be 2 feet or less.

An examination of site aerial views verified the presence of gas/oil well tanks within the proposed road right-of-way. Research shows that the road limits are not part of any known abandoned surface or underground mine. Research also showed that no karst topography exists at the property. ODNR bedrock maps show bedrock below the surface at depth in excess of 100 feet.

1.2 Purpose and Scope

The purposes of this report were to investigate subsurface conditions of the proposed development to provide geotechnical engineering recommendations for earthwork and pavements. Specifically, the scope of work included the following:

- Conducting a field exploration program consisting of site reconnaissance and drilling sample borings at selected locations within the proposed pavement locations to explore subsurface conditions and collect soil samples.
- Conducting geotechnical engineering laboratory test on sampled soils to assist with soil classifications and estimation of engineering properties.
- Develop geotechnical engineering recommendations for pavement and earthwork for site grading.

SECTION 2

2.0 Subsurface Exploration Program

The subsurface exploration consisted of drilling and sampling three (3) borings at the site to depths of 20 feet below existing grades. The boring locations were staked by GPD Group personnel using a hand-help GPS. The locations should be considered accurate only to the degree implied by the means and methods used to define them. The boring locations were cleared for existing utilities per an Ohio 811 call (OUPS).

The borings were drilled with a track-mounted Mobile B-54 rotary drill rig using hollow-stem augers and an automatic hammer to advance the boreholes. Representative soil samples were obtained by split-barrel sampling procedure in general accordance with the appropriate ASTM standards. In the split-barrel sampling procedure, the number of blows required to advance a standard 2-inch O.D. split-barrel sampler the last 12 inches of the typical total 18-inch penetration by means of a 140-pound hammer with a free fall of 30 inches, is the standard penetration resistance value (N-Value). This value is used to estimate the in-situ relative density of cohesion-less soils and the consistency of cohesive soils. The sampling depths and penetration distance, plus the standard penetration resistance values, are shown on the boring logs. The samples were sealed and returned to the laboratory for testing and classification.

The drill crew prepared field logs of each boring. These logs included visual classifications of the materials encountered during drilling as well as the driller's interpretation of the subsurface conditions between samples. Final boring logs included with this report represent an interpretation of the field logs and include modifications based on observations made by a Geotechnical Engineer and the results of laboratory testing.

2.1 Laboratory Testing

The samples were classified in the laboratory based on visual observation, texture, and plasticity. The descriptions of the soils indicated on the boring logs are in accordance with the enclosed General Notes and the Unified Soil Classification System. A brief description of this classification system is attached to this report. Information from these tests were used in conjunction with field penetration test data to evaluate soil strength in-situ, volume change potential, and soil classification.

2.2 Subsurface Conditions

Asphalt – Existing pavement thicknesses at Borings OR-1 & OR-2 measured 3.5 inches and 2 inches, respectively.

Existing – Existing fill thicknesses at Boring OR-3 measured to a depth of 3 feet below the existing grade. Possible fill thicknesses at this location may extend to a depth of about 7 feet.

Native Soils – Site soils consist of silts and sands with varying levels of gravel. Consistencies across the boring locations for the sand & silt soils were generally very loose to dense. The soil moistures varied at all locations from damp to wet. Refer to the attached boring logs for additional soil information.

2.3.1 Groundwater Conditions

The borings were monitored while drilling and immediately after completion for the presence and level of groundwater. Groundwater was not encountered in any of the borings. Fluctuations of the groundwater level can occur due to seasonal variations in the amount of rainfall, runoff, and other factors not evident at the time the borings were performed. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

SECTION 3

3.0 Engineering Recommendations

The following engineering recommendations are based on information provided to GPD Group regarding the design of the proposed project, the field and laboratory testing performed on the soil encountered at this site, and other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, GPD should be immediately notified so that further evaluation and supplemental recommendations can be provided.

3.1 Geotechnical Considerations

Based on the information obtained during the course of this study, the following geotechnical considerations should be taken into account during the planning, design and construction phases of the project. These geotechnical considerations are provided as a summary of the primary issues we believe are associated with this site. This report must be read in its entirety for a full description of our geotechnical recommendations:

- Existing/possible fills were encountered at Boring OR-3 to depths of up to 7 feet below the existing grade**.** Existing fills can provide support for the road construction provided they pass a proof roll and do not contain significant amounts of organics or rubble. Areas that fail a proof-roll should be partially undercut and stabilized with Tensar NX-750 Geogrid that is overlain with 304 crushed limestone. Areas containing significant amounts of organics or rubble should be completely undercut under the direction of a Geotechnical Engineer or personnel under the direction of the Engineer.

- All existing asphalt pavement should be completely removed prior to new road construction.

The following report sections provide detailed recommendations regarding the geotechnical considerations presented above. In the event changes in the project design occur, GPD Group must review this report to determine if modifications to our recommendations are warranted.

3.2 Site Preparation

All vegetation, topsoil, tree roots, organic-containing soils, and any soft or otherwise unsuitable materials should be removed from the proposed roadway right-of-way limits. Subsequent to site clearing and asphalt/topsoil removal; proof-rolling with heavy construction equipment such as a loaded tandem axle dump truck (approximately 60,000-pound gross) is recommended in to aid in locating unstable subgrade materials. Proof-rolling is also recommended in cut areas, and areas left near existing grade after rough grading is completed. Unstable materials located by proof rolling should be removed and replaced with suitable compacted fill material. Areas of very loose to loose sand should be densified with a smooth drum vibratory roller.

It should be noted that the encountered silty soils may be moisture sensitive and susceptible to disturbance from construction activity, particularly if the soil is wetted by surface water or seepage. Given the nature of the soils at this site, it is anticipated that portions of the natural soils will likely pump and rut under the weight of heavy construction equipment, especially rubber-tired equipment. Therefore, care should be taken during the site grading operation to provide adequate site drainage and minimize disturbance of soils. Heavy equipment traffic directly on surfaces should be avoided in wet soil areas. It may also be necessary to aerate portions of the subgrade prior to placing additional fill.

Areas of unsuitable soil identified during proof-rolling or subsequent construction operations will need to be stabilized. Based on our borings and our experience during construction of similar structures, subgrade

stabilization may be required to facilitate construction. Alternatives for subgrade stabilization could include the following:

Scarification and Recompaction - It may be feasible to scarify, dry, and recompact the exposed soils that are higher in moisture and/or are very loose in consistency. The success of this procedure would depend primarily upon favorable weather and sufficient time to dry the soils. Even with adequate time and weather, however, stable subgrades may not be achievable if the thickness of the very loose soil is greater than 1 to 1-1/2 feet. Removing sections to greater depths and replacing the material in layers may be necessary.

Crushed Stone - The use of crushed stone or gravel could be used to improve subgrade stability. The thickness and type of crushed stone will depend upon the conditions encountered and the location of the area to be improved. GPD's on-site Quality Control representative will provide this information as needed. Typical undercut depths would range from foot to 1-1/2 feet below finished subgrade elevation. The use of high modulus geotextiles (i.e., engineering fabric or geogrid) could also be considered after underground work such as utility construction is completed. Equipment should not be operated above the fabric or geogrid until one full lift of crushed stone fill is placed above it. The maximum particle size of granular material placed over geotextile fabric or geogrid should not exceed 1-1/2 inches.

3.3 Fill Material

Any fill or backfill required within pavement or right of way limits should be select material, as approved by a qualified geotechnical engineer. For all filling operations, the following should be observed:

1. Prior to use, the approved fill material should be tested as outlined in ASTM D-698 to determine the maximum dry density and optimum moisture content for silty or cohesive soils, or ASTM D-4253 and D-4254 for clean granular soils. For each change in borrow material, additional tests will be required.

2. For all fill or backfill used, the fill material should be placed on the approved subgrade in controlled lifts, with each lift compacted to a stable condition, and to a minimum of 98% maximum dry density per ASTM D-698 at a moisture content within 1.5% of optimum for cohesive or silty borrow. Controlled lifts of granular material should be compacted to 80% relative density per ASTM D-4254.

3. All filling operations should be observed by a qualified soils technician with field density tests made, to assure compaction to specification.

Proper moisture control of fine-grained silty soils is critical in attaining the required compaction. It should be noted that both in-situ soils and new fill composed of fine-grained soils are susceptible to disturbance by construction equipment traffic when wet. Thus, construction operations should be planned to prevent such disturbance and the resulting weakening of the subgrade soils. Such precautions would include, but not be limited to grading the site to prevent ponding of water, sealing the subgrade soils at the end of operations each day, and allowing wet subgrades to dry before operating heavy equipment on the soil.

The Contractor shall adhere to County or township earthwork specifications in the event the requirements are more stringent than those listed above.

3.4 Excavations

Where required, all excavation walls shall be sloped or shored per the requirements of OSHA regulations. Based on the borings performed at this site, we recommend that the excavations be designed using an OSHA Type "C" soil classification. Although not anticipated, any excavations that extend greater than 20 feet shall be designed and approved by a professional engineer. Any required dewatering should be accomplished via sump pits. Water should be discharged in a manner as not to introduce silt laden water into storm sewers or other local bodies of water.

3.5 Pavements

Conventional flexible pavement and rigid pavement sections for the proposed new road construction are considered appropriate for the proposed project pending proper site preparation as discussed herein. The pavement should be designed based on an estimated California Bearing Ratio (CBR) value of 4. We recommend a minimum of 6 inches of 304 crushed limestone base below all pavements. It is recommended that the final pavement section should conform to local municipal specifications.

Prior to paving, the prepared subgrade shall be proof-rolled using a loaded tandem axle dump truck. **Unstable materials located by proof rolling should be removed and replaced with suitable compacted fill material, or partially undercut and stabilized with Tensar NX-750 Geogrid overlain by properly compacted ODOT 304 limestone.** GPD recommends that granular aggregate base material, in compliance with Ohio Department of Transportation specifications, be used under all pavement and concrete surfaces. The material should be placed and compacted as discussed in Section 3.3. The pavement sections may be placed after the subgrade has been properly compacted, fine-graded, and proof-rolled. The work shall be done in accordance with local and state specifications. Furthermore, GPD or an Independent Testing Consultant (ITC) should be retained to provide testing on all subgrade, aggregate base, and asphalt/concrete materials.

SECTION 4

4.0 Subsurface Drainage

At the time of this investigation, groundwater was not encountered any of the boring locations. Conventional dewatering methods, such as pumping from sumps, should be adequate for temporary removal of any surface water or groundwater encountered during excavation at the site. If springs or other significant groundwater is exposed during the excavation process, it may be necessary to install permanent trench drains to remove this water away from the building and pavements. The location and design of any trench drains should be determined at the time of construction, if warranted.

4.1 General Comments

GPD Group should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Subsequent to initial grading operations, GPD should also be retained to provide testing and observation during site preparation and fill placement operations as well as during the pavement construction phases of the project.

The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of weather or between borings. The nature and extent of such variations may not become evident until during or after construction. If variations appear, GPD should be immediately notified so that further evaluation and supplemental recommendations can be provided.

The scope of services for this project does not include either specifically or by implication any environmental assessment of the site or identification of contaminated or hazardous materials or conditions. If the owner is concerned about the potential for such contamination, other studies should be undertaken.

This report has been prepared for the exclusive use of **ABC Development, Inc.** for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless GPD Group reviews the changes and either verifies or modifies the conclusions of this report in writing.

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MN (8.6° W)

0 600 1200 1800 2400 3000 3600 ft

Data Zoom 13-2

GPD GROUP

Glaus, Pyle, Schomer, Burns & DeHaven, Inc.

SITE LOCATION MAP

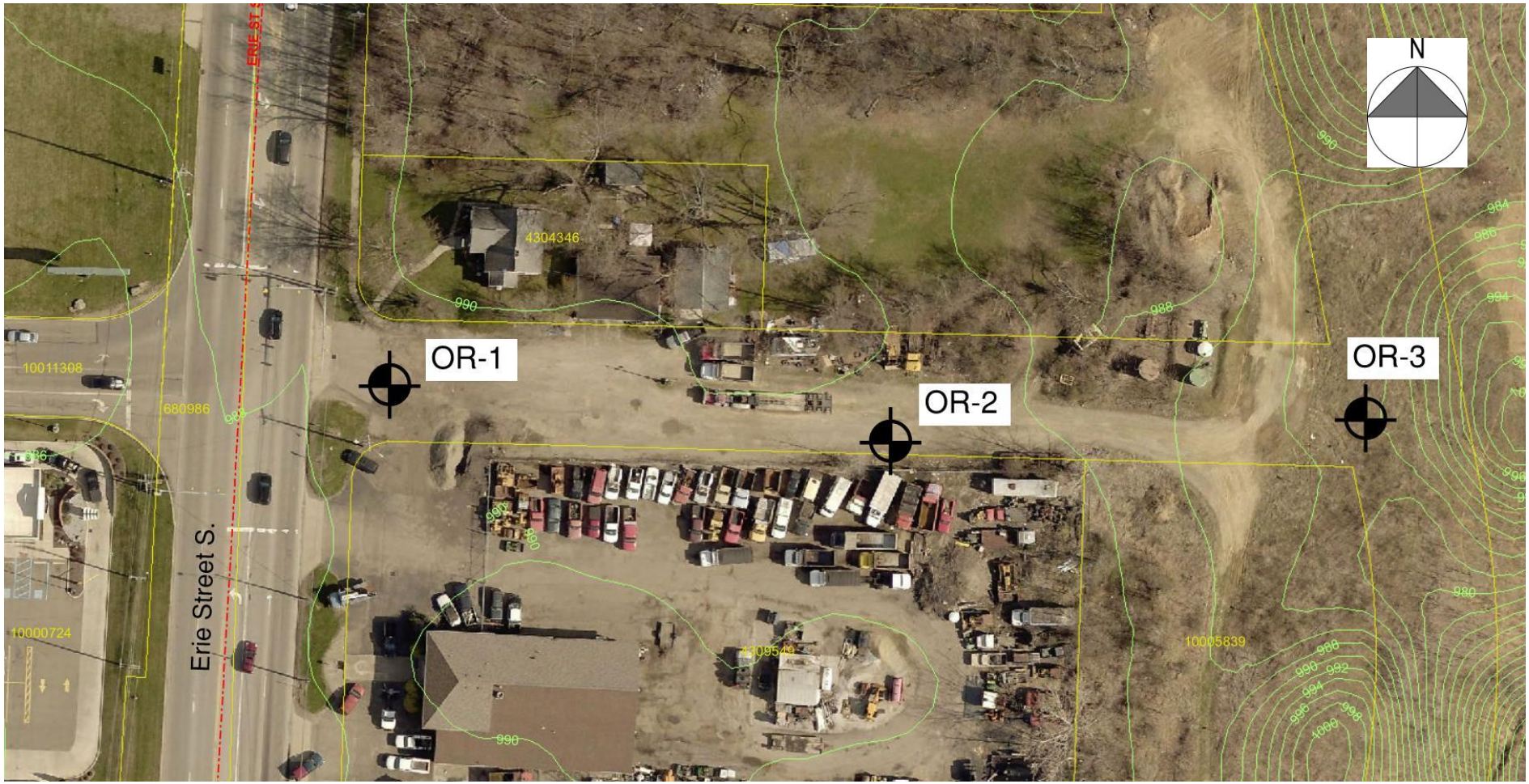
Sheetz Massillon Ohio - Ortt Road

Ortt Road, Massillon, Ohio

GPD Project Number: 2020096.04

Date: May 2022

LOCATION PLAN



Legend

Soil Boring: ⌖

PROJECT: Sheetz Massillon Ohio – Ortt Road
PROJECT NUMBER: 2020096.04 **DATE**: 6/13/2022
LOCATION: Ortt Road, Massillon, Ohio

520 South Main Street, Suite 2531 ☐ Akron, Ohio 44311 ☐ (330)572-2100

Boring Number: OR-1

CLIENT ABC Development, LLC
PROJECT NAME Sheetz Massillon Ohio
PROJECT NUMBER 2020096.04
PROJECT LOCATION Ortt Road, Massillon, Ohio
DATE STARTED May 20, 2022 **COMPLETED** May 20, 2022
GROUND ELEVATION 989 ft **HOLE SIZE** 6 in
DRILLING CONTRACTOR GPD Geotechnical Services, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger - 2 1/4" ID
AT TIME OF DRILLING --- None
LOGGED BY Dave Campana **CHECKED BY** Thomas Kratz
AT END OF DRILLING --- None
NOTES Drill Rig: Mobile B-54

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		3.5" ASPHALT										
		Moist, medium dense, brown, fine to medium SAND, some silt.	SS 1	89	6-7-8 (15)							
		Damp to moist, loose, brown, fine to coarse SAND, little gravel, some silt.	SS 2	78	5-4-3 (7)							
5												
		Damp, dense, brown, fine to coarse SAND & GRAVEL.	SS 3	67	14-16-16 (32)							
10												
		Damp, medium dense, tan, fine to coarse SAND, little gravel.	SS 4	56	7-8-7 (15)							
15												
		Damp, medium dense, tan, fine to coarse SAND, some gravel.	SS 5	94	10-9-7 (16)							
20												

Boring terminated at 20.0 feet

GENERALIZED SUBSURFACE PROFILE - GINT STD US LAB.GDT - 6/13/22 15:03 - F:\GPD GILCHRIST\JOBS\2022\GPD\DRILLING\2020096.04 - ABC - SHEETZ MASSILLON, OH\OR-1 THROUGH OR-3.GPJ

Boring Number: OR-2

CLIENT ABC Development, LLC
PROJECT NAME Sheetz Massillon Ohio
PROJECT NUMBER 2020096.04
PROJECT LOCATION Ortt Road, Massillon, Ohio
DATE STARTED May 20, 2022 **COMPLETED** May 20, 2022
GROUND ELEVATION 990 ft **HOLE SIZE** 6 in
DRILLING CONTRACTOR GPD Geotechnical Services, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger - 2 1/4" ID
AT TIME OF DRILLING --- None
LOGGED BY Dave Campana **CHECKED BY** Thomas Kratz
AT END OF DRILLING --- None
NOTES Drill Rig: Mobile B-54

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		2" ASPHALT										
		Damp, medium dense, brown, fine to coarse SAND, some silt & gravel.	SS 1	83	5-5-9 (14)							
		Damp to moist, brown, medium to coarse SAND, some gravel.	SS 2	72	3-4-6 (10)							
5												
		Damp, loose, brown, fine to coarse SAND, little gravel.	SS 3	78	3-3-1 (4)							
10												
		Damp, medium dense, tan, fine to coarse SAND & GRAVEL.	SS 4	89	6-7-8 (15)							
15												
		Damp, dense, tan, fine to coarse SAND, some gravel.	SS 5	67	10-13-19 (32)							
20												

Boring terminated at 20.0 feet

GENERALIZED SUBSURFACE PROFILE - GINT STD US LAB.GDT - 6/13/22 15:03 - F:\GPD GILCHRIST\JOBS\2022\GPD\DRILLING\2020096.04 - ABC - SHEETZ MASSILLON, OH\OR-1 THROUGH OR-3.GPJ

Boring Number: OR-3

CLIENT ABC Development, LLC
PROJECT NAME Sheetz Massillon Ohio
PROJECT NUMBER 2020096.04
PROJECT LOCATION Ortt Road, Massillon, Ohio
DATE STARTED May 20, 2022 **COMPLETED** May 20, 2022
GROUND ELEVATION 984 ft **HOLE SIZE** 6 in
DRILLING CONTRACTOR GPD Geotechnical Services, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger - 2 1/4" ID
AT TIME OF DRILLING --- None
LOGGED BY Dave Campana **CHECKED BY** Thomas Kratz
AT END OF DRILLING --- None
NOTES Drill Rig: Mobile B-54

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		Moist, loose, brown & black SILT, little sand, trace of organics. (Fill)										
			SS 1	72	2-3-4 (7)							
		Moist to wet, very loose, brown SILT, some sand. (Possible fill)										
5			SS 2	100	2-1-2 (3)							
		Moist, medium dense, brown, fine to coarse SAND, some silt, little gravel.										
			SS 3	44	4-4-6 (10)							
10		Damp to moist, loose, brown, medium to coarse SAND, some gravel.										
			SS 4	56	4-4-5 (9)							
15		Damp, loose, tan, fine SAND.										
			SS 5	83	4-4-5 (9)							
20												

Boring terminated at 20.0 feet

GENERALIZED SUBSURFACE PROFILE - GINT STD US LAB.GDT - 6/13/22 15:03 - F:\GPD GILCHRIST\JOBS\2022\GPD\DRILLING\2020096.04 - ABC - SHEETZ MASSILLON, OH\OR-1 THROUGH OR-3.GPJ

GENERAL NOTES

SAMPLE IDENTIFICATION

The Unified Soil Classification System (USCS), AASHTO 1988 and ASTM designations D2487 and D-2488 are used to identify the encountered materials unless otherwise noted. Coarse-grained soils are defined as having more than 50% of their dry weight retained on a #200 sieve (0.075mm); they are described as: boulders, cobbles, gravel or sand. Fine-grained soils have less than 50% of their dry weight retained on a #200 sieve; they are defined as silts or clay depending on their Atterberg Limit attributes. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size.

DRILLING AND SAMPLING SYMBOLS

SFA: Solid Flight Auger - typically 4" diameter flights, except where noted.
HSA: Hollow Stem Auger - typically 3¼" or 4¼ I.D. openings, except where noted.
M.R.: Mud Rotary - Uses a rotary head with Bentonite or Polymer Slurry
R.C.: Diamond Bit Core Sampler
H.A.: Hand Auger
P.A.: Power Auger - Handheld motorized auger

SS: Split-Spoon - 1 3/8" I.D., 2" O.D., except where noted.
ST: Shelby Tube - 3" O.D., except where noted.
BS: Bulk Sample
PM: Pressuremeter
CPT-U: Cone Penetrometer Testing with Pore-Pressure Readings

SOIL PROPERTY SYMBOLS

N: Standard "N" penetration: Blows per foot of a 140 pound hammer falling 30 inches on a 2-inch O.D. Split-Spoon.
N_{60}: A "N" penetration value corrected to an equivalent 60% hammer energy transfer efficiency (ETR)
Q_u: Unconfined compressive strength, TSF
Q_p: Pocket penetrometer value, unconfined compressive strength, TSF
w%: Moisture/water content, %
LL: Liquid Limit, %
PL: Plastic Limit, %
PI: Plasticity Index = (LL-PL),%
DD: Dry unit weight, pcf
▼,▽,▼ Apparent groundwater level at time noted

RELATIVE DENSITY OF COARSE-GRAINED SOILS

Relative Density	N - Blows/foot
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	50 - 80
Extremely Dense	80+

ANGULARITY OF COARSE-GRAINED PARTICLES

Description	Criteria
Angular:	Particles have sharp edges and relatively plane sides with unpolished surfaces
Subangular:	Particles are similar to angular description, but have rounded edges
Subrounded:	Particles have nearly plane sides, but have well-rounded corners and edges
Rounded:	Particles have smoothly curved sides and no edges

GRAIN-SIZE TERMINOLOGY

Component	Size Range
Boulders:	Over 300 mm (>12 in.)
Cobbles:	75 mm to 300 mm (3 in. to 12 in.)
Coarse-Grained Gravel:	19 mm to 75 mm (¾ in. to 3 in.)
Fine-Grained Gravel:	4.75 mm to 19 mm (No.4 to ¾ in.)
Coarse-Grained Sand:	2 mm to 4.75 mm (No.10 to No.4)
Medium-Grained Sand:	0.42 mm to 2 mm (No.40 to No.10)
Fine-Grained Sand:	0.075 mm to 0.42 mm (No. 200 to No.40)
Silt:	0.005 mm to 0.075 mm
Clay:	<0.005 mm

PARTICLE SHAPE

Description	Criteria
Flat:	Particles with width/thickness ratio > 3
Elongated:	Particles with length/width ratio > 3
Flat & Elongated:	Particles meet criteria for both flat and elongated

RELATIVE PROPORTIONS OF FINES

Descriptive Term	% Dry Weight
Trace:	< 5%
With:	5% to 12%
Modifier:	>12%

GENERAL NOTES

(Continued)

CONSISTENCY OF FINE-GRAINED SOILS

Q_U - TSF	N - Blows/foot	Consistency
0 - 0.25	0 - 2	Very Soft
0.25 - 0.50	2 - 4	Soft
0.50 - 1.00	4 - 8	Firm (Medium Stiff)
1.00 - 2.00	8 - 15	Stiff
2.00 - 4.00	15 - 30	Very Stiff
4.00 - 8.00	30 - 50	Hard
8.00+	50+	Very Hard

MOISTURE CONDITION DESCRIPTION

Description	Criteria
Dry:	Absence of moisture, dusty, dry to the touch
Moist:	Damp but no visible water
Wet:	Visible free water, usually soil is below water table

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term	% Dry Weight
Trace:	< 15%
With:	15% to 30%
Modifier:	>30%

STRUCTURE DESCRIPTION

Description	Criteria
Stratified:	Alternating layers of varying material or color with layers at least ¼-inch (6 mm) thick
Laminated:	Alternating layers of varying material or color with layers less than ¼-inch (6 mm) thick
Fissured:	Breaks along definite planes of fracture with little resistance to fracturing
Slickensided:	Fracture planes appear polished or glossy, sometimes striated
Blocky:	Cohesive soil that can be broken down into small angular lumps which resist further breakdown
Lensed:	Inclusion of small pockets of different soils
Layer:	Inclusion greater than 3 inches thick (75 mm)
Seam:	Inclusion 1/8-inch to 3 inches (3 to 75 mm) thick extending through the sample
Parting:	Inclusion less than 1/8-inch (3 mm) thick

SCALE OF RELATIVE ROCK HARDNESS

Q_U - TSF	Consistency
2.5 - 10	Extremely Soft
10 - 50	Very Soft
50 - 250	Soft
250 - 525	Medium Hard
525 - 1,050	Moderately Hard
1,050 - 2,600	Hard
>2,600	Very Hard

ROCK BEDDING THICKNESSES

Description	Criteria
Very Thick Bedded	Greater than 3-foot (>1.0 m)
Thick Bedded	1-foot to 3-foot (0.3 m to 1.0 m)
Medium Bedded	4-inch to 1-foot (0.1 m to 0.3 m)
Thin Bedded	1¼-inch to 4-inch (30 mm to 100 mm)
Very Thin Bedded	½-inch to 1¼-inch (10 mm to 30 mm)
Thickly Laminated	1/8-inch to ½-inch (3 mm to 10 mm)
Thinly Laminated	1/8-inch or less "paper thin" (<3 mm)

ROCK VOIDS

Voids	Void Diameter
Pit	<6 mm (<0.25 in)
Vug	6 mm to 50 mm (0.25 in to 2 in)
Cavity	50 mm to 600 mm (2 in to 24 in)
Cave	>600 mm (>24 in)

GRAIN-SIZED TERMINOLOGY

(Typically Sedimentary Rock)

Component	Size Range
Very Coarse Grained	>4.76 mm
Coarse Grained	2.0 mm - 4.76 mm
Medium Grained	0.42 mm - 2.0 mm
Fine Grained	0.075 mm - 0.42 mm
Very Fine Grained	<0.075 mm

ROCK QUALITY DESCRIPTION

Rock Mass Description	RQD Value
Excellent	90 -100
Good	75 - 90
Fair	50 - 75
Poor	25 -50
Very Poor	Less than 25

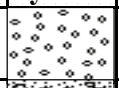
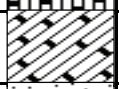
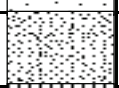
DEGREE OF WEATHERING

Slightly Weathered: Rock generally fresh, joints stained and discoloration extends into rock up to 25 mm (1 in), open joints may contain clay, core rings under hammer impact.

Weathered: Rock mass is decomposed 50% or less, significant portions of the rock show discoloration and weathering effects, cores cannot be broken by hand or scraped by knife.

Highly Weathered: Rock mass is more than 50% decomposed, complete discoloration of rock fabric, core may be extremely broken and gives clunk sound when struck by hammer, may be shaved with a knife.

Unified Soil Classification System

Major Divisions			Letter	Symbol	Description
Coarse-grained Soils More than ½ retained on the No. 200 Sieve	**Gravels** More than ½ coarse fraction retained on the No. 4 sieve	Clean Gravels	GW		Well-graded gravels and gravel-sand mixtures, little or no fines.
			GP		Poorly-graded gravels and gravel-sand mixtures, little or no fines.
		Gravels With Fines	GM		Silty gravels, gravel-sand-silt mixtures.
			GC		Clayey gravels, gravel-sand-clay mixtures.
	Sands More than ½ passing through the No. 200 sieve	Clean Sands	SW		Well-graded sands and gravelly sands, little or no fines.
			SP		Poorly-graded sands and gravelly sands, little or no fines.
		Sands With Fines	SM		Silty sands, sand-silt mixtures
			SC		Clayey sands, sandy-clay mixtures.
Fine-grained Soils More than ½ passing through the No. 200 Sieve	**Silts and Clays** Liquid Limit less than 50%		ML		Inorganic silts, very fine sands, rock flour, silty or clayey fine sands.
			CL		Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
			OL		Organic clays of medium to high plasticity.
	Silts and Clays Liquid Limit greater than 50%		MH		Inorganic silts, micaceous or diatomaceous fines sands or silts, elastic silts.
			CH		Inorganic clays of high plasticity, fat clays.
			OH		Organic clays of medium to high plasticity.
Highly Organic Soils			PT		Peat, muck, and other highly organic soils.

Consistency Classification

Granular Soils			*Cohesive Soils*		
Description - Blows Per Foot (Corrected)			Description - Blows Per Foot (Corrected)		
	MCS	SPT		MCS	SPT
Very loose	<5	<4	Very soft	<3	<2
Loose	5 - 15	4 - 10	Soft	3 - 5	2 - 4
Medium dense	16 - 40	11 - 30	Firm	6 - 10	5 - 8
Dense	41 - 65	31 - 50	Stiff	11 - 20	9 - 15
Very dense	>65	>50	Very Stiff	21 - 40	16 - 30
			Hard	>40	>30

MCS = Modified California Sampler SPT = Standard Penetration Test Sampler