CTL Engineering, Inc.
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May 27, 2025

Choice One Engineering, Inc.
440 East Hoewisher Road
Sidney, Ohio 45365

Attention: Mr. Mitch Thobe, P.E.

Reference: **Report on Geotechnical Roadway Exploration - Final**
AUG-501/198-2.32/2.36; PID 120037
- South Leg of Defiance St. (SR 198)
- North Leg of Defiance St. (SR 198) & Lincoln Ave. (SR 501)
- Hamilton Rd., Stinebaugh Dr. and Cole Dr.

Wapakoneta, Auglaize County, Ohio
CTL Project No. 23050059WAP

Mr. Thobe:

CTL Engineering, Inc. has completed the Geotechnical Roadway Exploration Report for the above referenced project. The purpose of this exploration was to evaluate the subsurface conditions and provide recommendations and soil parameters for the pavement reconstruction of the referenced roadways in Wapakoneta, Ohio. Various empirical correlations have been made in analyzing the subsurface soils of the site. These correlations were made using generally accepted geotechnical engineering practice and published documents.

Thank you for the opportunity to be of service to you on this project. If you have any questions, please contact our office.

Respectfully Submitted,

**CTL ENGINEERING, INC.**

Frederick L. Schoen, P.E.
Geotechnical Project Manager

FLS/EWH
1c. mjt@choiceoneengineering.com

# REPORT ON GEOTECHNICAL
# ROADWAY EXPLORATION - FINAL

## AUG-501/198-2.32/2.36; PID 120037
## INTERSECTION IMPROVEMENT PROJECT

- NORTH LEG OF DEFIANCE ST (SR 198) & LINCOLN AVENUE (SR 501)
- SOUTH LEG OF DEFIANCE ST (SR 198)
- HAMILTON RD, STINEBAUGH DR, COLE DR

**WAPAKONETA**
**AUGLAIZE COUNTY, OHIO**

*CTL PROJECT NO.: 23050059WAP*

PREPARED FOR:
**CHOICE ONE ENGINEERING**
**440 EAST HOEWISHER ROAD**
**SIDNEY, OHIO 45365**

PREPARED BY:
**CTL ENGINEERING, INC.**
**102 COMMERCE DRIVE**
**P.O. BOX 44**
**WAPAKONETA, OH 45895**
**www.ctleng.com**

**May 27, 2025**

## RECORD OF REVISIONS

| Date of Transmittal | Description | Remarks |
|---|---|---|
| 12/08/2023 | 1st Submittal of Draft Report | -- |
| 2/20/2024 | 2nd Submittal of Draft Report | Added Appendix A Geotechnical Profile Sheets |
| 5/10/2024 | 3rd Submittal of Report | Modifications to Plan & Profiles Sheets per ODOT Comments |
| 5/27/2025 | Final Submittal of Report | Renumbered Plan & Profile Sheets to match Choice One plan set. |

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# I. EXECUTIVE SUMMARY

This project includes the reconstruction of the current intersection between Defiance Street, Lincoln Avenue, Hamilton Road, Cole Drive, and Stinebaugh Drive in Wapakoneta, Ohio.

Three (3) soil test borings were each advanced to a depth of 10.0 feet below existing surface grades within the proposed roadway and project limits.

Fine-grained cohesive materials consisting of silty clay (A-6b), and clay (A-7-6) were encountered beneath the pavement materials in each of the test borings.

Bedrock was not encountered.

Groundwater was not encountered in borings performed for this exploration.

Based on the subsurface conditions encountered in the borings, and the results of subgrade analyses, an estimated CBR value of 4 may be used in the pavement thickness design of the roadways.

According to requirements outlined in ODOT's Geotechnical Design Manual (GDM) portions of the subgrade soils are anticipated to require subgrade stabilization. Stabilization methods may include excavate and replace methods or chemical stabilization using lime. Please refer to the *Analyses and Recommendation* section of this report for additional details.

## II. INTRODUCTION

This project includes the reconstruction of the current intersection between Defiance Street, Lincoln Avenue, Hamilton Road, Cole Drive, and Stinebaugh Drive in Wapakoneta, Ohio. It is understood the following changes to the intersection are intended for this project:

- Cole Drive is planned to be removed from the intersection and a cul-de-sac installed, which will allow the stop line on Defiance Street to be moved approximately 100' north closer to the intersection.

- Stinebaugh Drive will be reconstructed and shifted north approximately 30-40 feet. Due to the relocation and reconstruction of the western end of Stinebaugh Drive tying into Lincoln Avenue, new sidewalk and storm sewer will be installed along the rebuilt section of roadway.

- The southbound lane at the stop lines on the north leg of Defiance Street and Lincoln Avenue will have some full depth pavement repair. The intersection will be milled, resurfaced, and restriped, along with the installation of new signs within the intersection.

## III. GEOLOGY AND OBSERVATIONS OF THE PROJECT

### A. Geology

According to the *Soil Survey of Auglaize County, Ohio*; surficial soils at the site include Glynwood-Urban land complex, 2 to 6 percent slopes (GdUXB), Blount-Urban Land Complex, 2 to 4 percent slopes (BdUXB), Urban Land-Glynwood Complex, 2 to 6 percent slopes (UeGXB) and Urban Land – Blount Complex, 2 to 4 percent slopes (UbBXB). The information presented is as defined by the *United States Department of Agriculture (USDA) - Natural Resources Conservation Service (NRCS).* These mapped soils are described as having a high potential for frost action, a low risk for corrosion to buried concrete, and a high risk of unprotected steel corrosion.

According to the *Ohio Division of Geologic Survey, 2006, Bedrock Geologic Map of Ohio: Ohio Department of Natural Resources, Division of Geological Survey Map BG-1; and the Ohio Division of Geologic Survey, 1998, Physiographic Regions of Ohio: Ohio Department of Natural Resources, Division of Geological Survey*; Auglaize County lies within the Central Ohio Clayey Till Plain physiographic region which falls inside the Central Lowlands Province of Ohio. Auglaize County is mainly characterized by clayey, well-defined terminal moraines with intervening flat-lying ground moraines and intermorainal lake basins.

Prior to the end of the Pleistocene Epoch, several glacial events occurred in west-central Ohio. Most recently, the Wisconsin ice sheet covered all of Auglaize County, and most of northern Ohio. The surficial glacial deposits of Auglaize County include till, lacustrine deposits, alluvium, kames, eskers, and outwash sand and gravel.

According to *Slucher, E.R., (principal compiler), Swinford, E.M., Larsen, G.E., and others, with GIS production and cartography by Pawers, D.M., 2006, Bedrock Geologic Map of Phio: Ohio Division of Geological Survey Map BG-1, version 6.0, scale 1:500,000*; the overburden soils within the project site are underlain by Lockport Dolomite of the Silurian Age. According to additional published mapping prepared by the ODNR Division of Geological Survey this rock formation may be found near elevations ±690 feet Above Mean Sea Level (AMSL). Ground surface elevations along the roadway are near ±925 feet. The rock consists of dolomite with minor components of limestone, chert, and shale and is characterized as having shades of bluish gray to gray.

No known karst or underground mine related incidents exist at the project site.

### B. Observations of the Project

The general topography of the project area is relatively flat with storm sewer catch basins collecting surface runoff during precipitation events. Each of the six legs of the existing intersection configuration consists of two-lane roadways without street side parking. The roadway surfaces consist of asphalt pavement which were noted to exhibit some areas of fatigue cracking, wheel-path depressions, pavement shoving, and isolated areas of depression. Land usage around the project is mostly residential and commercial properties.

## IV. EXPLORATION

No historic borings were found within the project limits when using the Ohio Department of Transportation's (ODOT) Transportation Information Mapping System (TIMS).

Three (3) soil test borings were each advanced to a depth of 10.0 feet below the pavement surface within the existing roadway and project limits. The number and location of the soil test borings where determined by Choice One Engineering, Inc. (COE) and the sampling intervals were determined by CTL Engineering, Inc. (CTL) to meet The Ohio Department of Transportation's (ODOT) guidelines and provide a general profile of the subsurface conditions across the site. The test borings were located in the field by CTL personnel and were positioned to avoid known underground and overhead utilities. Actual locations where test borings were drilled are shown on the Boring Location Plans (*Appendix A*) and Test Boring Records (*Appendix B*), and as presented in *Table 1*.

At the time of releasing this report, project plan and profile drawings were not available for review; hence, the test boring locations, and coordinates were determined by using Google Earth™ computer software, internet-based satellite imagery, and a handheld GPS unit. The ground surface elevations at the test borings locations were determined by referencing the Ohio Geology Interactive Map issued by the ODNR Division of Geological Survey (*https://gis.ohiodnr.gov/website/dgs/geologyviewer/#) and* the Auglaize County Auditor Map/GIS Mapping database (*https://gis.auglaizecounty.org/main/).*

**Table 1. Test Boring Locations, Elevations, Coordinates, and Depths**

| Boring No. | Ground Surface Elevation (ft.) | Latitude (N-Parallel) | Longitude (E-Meridian) | Boring Depth (ft.) |
|---|---|---|---|---|
| B-001-0-23 | 926.3 | 40.579946 | -84.202585 | 10.0 |
| B-002-0-23 | 923.9 | 40.579190 | - 84.202457 | 10.0 |
| B-003-0-23 | 923.6 | 40.579304 | -84.202004 | 10.0 |

Test borings were performed by CTL on October 30, 2023; using a truck-mounted rotary drill rig and hollow stem augers. Standard Penetration Tests were conducted in test borings during drilling using an automatic 140-pound hammer falling 30 inches to drive 2.0-inch outside diameter split-spoon samplers for 18 inches. Soil samples were obtained of the test borings in accordance with the Standard Penetration Test method at 1.5 feet and 2.5 feet intervals for the full depth of the borings. The automatic hammer used with the drill rig for the project was most recently calibrated on October 13, 2022, and has a drill rod energy ratio of 76.4 percent.

Drilling, sampling, and field testing were performed in accordance with standard geotechnical engineering practices and current ASTM procedures. Soil samples obtained from drilling operations were marked and preserved in glass jars, visually classified in the field, and delivered to CTL for laboratory testing and analysis. Each collected sample was the subject of moisture content determination and hand penetrometer testing, if practical. In addition, six (6) samples were subjected to laboratory testing consisting of Atterberg Limits and particle size analysis. Three (3) samples were tested for sulfate content.

## V. FINDINGS

### A. General Stratigraphy

Surface material in borings B-001-0-23 and B-002-0-23 consist of 8 to 10 inches of topsoil. Existing pavement materials in boring B-003-0-23 consist of 12 inches of asphalt.

Fine-grained cohesive materials consisting of silty clay (A-6b) and clay (A-7-6) were encountered beneath the pavement materials in each of the test borings; and were described as brown, brown with gray and grayish brown; and stiff to hard.

SPT $N_{60}$ values of the subgrade soils ranged from 6 to 56 blows per foot (bpf), while averaging 24 bpf. When comparing the lowest $N_{60}$ of each boring, $N_{60L}$ values ranged from 6 to 23 bpf, while averaging 15 bpf.

Bedrock was not encountered.

Groundwater was not encountered in borings during drilling.

Further details of the subsurface conditions are presented on the test boring records in *Appendix B*.

### B. Laboratory Test Results

Soil samples obtained from split spoon sampling were the subject of laboratory testing. Each sample was tested to identify its moisture content. Six (6) soil samples were also the subject of Atterberg Limits and grain size distribution testing.

A summary of our findings includes:

- Hand penetrometer values ranged from 1.75 to 4.50 tsf, averaging 3.75 tsf.
- Samples which were mechanically tested was classified as a fine-grained soils.
- Liquid Limit (LL) values ranged from 36 to 50 percent, averaging 43 percent.
- Plasticity Index (PI) values ranged 17 to 30 percent, averaging 22 percent.
- Moisture content values ranged from 13 to 27 percent, averaging 18 percent.
- Three (3) soil samples exhibited sulfate contents of less than 100 parts per million (ppm).

## VI. ANALYSES AND RECOMMENDATIONS

Subgrade soils across the project site consists of cohesive soils described as A-6b and A-7-6 soils. 17 percent of the subgrade soils are estimated to have excessively high moisture contents, 44 percent of the proposed subgrade is anticipated to be unstable, and 0 percent of the subgrade consists of unsuitable soils.

Excavation of soils represented by the test borings can be accomplished using conventional earth moving equipment.

Surface drainage across the site may be altered with the proposed construction. It is recommended that all surface water run-off be collected or directed away from pavements into storm sewers or drainage ditches so that subgrade soils under pavements do not become saturated and lose strength. Any subgrade drainage tiles disturbed during construction should be reconnected, and groundwater flow should be redirected away from pavement areas.

Based upon the subsurface information obtained from the field and laboratory testing, the following recommendations are provided.

## A. Subgrade Considerations

A subgrade analyses was performed utilizing the subsurface information from the drilled borings along with ODOT GDM guidelines. A copy of the Subgrade Analysis spreadsheet is provided in Appendix D. A proposed pavement thickness of 15-inches was assumed for estimating cut/fill in the Subgrade Analyses spreadsheet.

The following summary was analyzed using the Subgrade Analysis Spreadsheet of the near surface subgrade soils.

- SPT $N_{60}$-values ranged from 6 to 56 blows per foot (bpf), averaging 26 bpf in the upper 6 feet of the existing soil profiles.
- The lowest $N_{60}$-value ($N_{60L}$) from each boring ranged from 6 to 30 blows per foot (bpf), averaging 20 bpf.
- The estimated Optimum Moisture Content (OMC) values, based on the soil types per ODOT's Specification for Geotechnical Explorations (SGE) and Geotechnical Design Manual (GDM), Section 604, ranged from 16 to 20 percent, averaging 17 percent.
- On average, the moisture contents of the samples tested were similar to the estimated optimum moisture content value.
- Group Index values were calculated for each of the subgrade samples tested. Group Index values for the samples tested ranged from 11 to 18, with an average value of 15.
- These Group Index values correspond to an estimated average California Bearing Ratio (CBR) value of 4.0 percent.

Based on the requirements outlined in the GDM, it is estimated that subgrade stabilization may be required along Cole Street east of station 11+50, near B-003-0-23. The subgrade stabilization may consist of excavate and replace per Item 204 with materials meeting the requirements of Item 703.16.C, Type B and/Type C Granular Material underlain by a geotextile fabric per Item 712.09, Type D. The approximate areas and depths are summarized in *Table 2*.

Furthermore, borings indicate subgrade soils may exhibit moisture contents greater than OMC for the soils, resulting in isolated areas of exceptionally weak, unstable soils. If during construction, such weak soils are identified, they may be undercut and the over-excavation backfilled with Item 703.16.C, Type B and/Type C Granular Material, and multi-axial geogrid per Items 204 and 712.15 and GDM.

The approximate depth of excavate and replace is measured from the top of the proposed pavement subgrade level. The locations and values are only an estimate.

The actual depths and horizontal limits of excavate and replace will be determined by the Project Engineer in the field based upon proofrolling.

**Table 3. Estimated Excavate and Replace Locations and Depths**

| Location | Area | Approximate Depth of Excavate and Replace |
|---|---|---|
| Cole St. | East of Sta. 11+50 in vicinity of B-003-0-23 | 12-inches |
| Stinebaugh Dr. | None Estimated | n/a |

Boring B-003-0-23 was performed at a location which was originally understood to be within the project limits. Based on a recent plan review, it is now understood that B-003-0-23 may be outside of the project limits, east of the planned cul-de-sac construction limits.

According to the GDM, Section 609, as an alternative to excavate and replace, chemical stabilization to a depth of 12-inches using lime is an option for this project. The GDM and subgrade analysis is based on the overall average soil condition of the entire project, incorporating the subgrade soils to a depth of 6 feet below planned subgrade elevations.

In general, chemical stabilization is more economical when stabilizing large areas (greater than 1 mile of roadway) and when existing underground utilities are infrequent. Based on the size and conditions of the project, the chemical stabilization option may not be cost effective for this project. It is recommended that both alternatives be considered, but is suspected that the "Excavate and Replace" method may be utilized for subgrade stabilization on this project.

## B. Groundwater Considerations

Groundwater was not encountered in the test borings during drilling. Therefore, significant groundwater is not anticipated during subgrade construction, but may be encountered during utility placements. Should isolated areas of groundwater be encountered, it is expected that groundwater could be controlled during earthwork using properly located sump pumps.

Numerous underground sewers and utilities lines transect the roadway within the project limits. This utilities trenches may act as underdrains, depending on the design and construction of the utilities and sewers. Subgrade soils in low lying areas (areas having lower topographic elevations compared to those of the surrounding area) may benefit by having newly installed subsurface drainage as part of roadway design.

It is recommended that underdrains are installed along the proposed roadways.

### C. General Construction and Earthwork

1. Site preparation and earthwork should be performed in accordance with the ODOT Construction and Material Specifications, and applicable Geotechnical Design requirements.

2. Landscaped areas should be seeded and vegetation growth permitted to limit erosion.

3. Temporary excavations in excess of 4 feet in depth, if required, should be sloped or shored according to OSHA requirements.

## VII. CHANGED CONDITIONS

The evaluations, conclusions, and recommendations in this report are based on our interpretation of the field and laboratory data obtained during the exploration, our understanding of the project, and our experience with similar sites and subsurface conditions using generally accepted geotechnical engineering practices. Although individual test borings are representative of the subsurface conditions at the boring locations on the dates drilled, they are not necessarily representative of the subsurface conditions between boring locations or subsurface conditions during other seasons of the year.

In the event that changes in the project are proposed, additional information becomes available, or if it is apparent that subsurface conditions are different from those provided in this report, CTL Engineering should be notified so that our recommendations can be modified, if required.

## VIII. TESTING AND OBSERVATION

During the design process, it is recommended that CTL Engineering work with the project designers to confirm that the geotechnical recommendations are properly incorporated into the final plans and specifications, and to assist with establishing criteria for the construction observation and testing.

## IX. CLOSING

The report was prepared by CTL Engineering, Inc. (Consultant) solely for the use of the Client in accordance with an executed contract. The Client's use of or reliance on this report is limited by the terms and conditions of the contract and by the qualifications and limitations stated in the report. It is also acknowledged that the Client's use of and reliance on this report is limited for reasons which include: actual site conditions that may change

with time; hidden conditions, not discoverable within the scope of the assessment, may exist at the site; and the scope of the investigation may have been limited by time, budget, and other constraints imposed by the Client.

Neither the report, nor its contents or conclusions or recommendations, are intended for the use of any party other than the Client. Consultant and the Client assume no liability for any reliance placed on this report by such party. The rights of the Client under contract may not be assigned to any person or entity, without the consent of the Consultant which consent shall not be unreasonably withheld.

This geotechnical report does not address the environmental conditions of the site. The Consultant is not responsible for consequences or conditions arising from facts that were concealed, withheld, or not fully disclosed at the time the assessment was conducted.

To the fullest extent permitted by law, the Consultant and Client agree to indemnify and hold each other, and their officers and employees harmless from and against claims, damages, losses, and expenses arising out of unknown or concealed conditions. Furthermore, neither the Consultant nor its employees shall be liable to the Owner in an amount in excess of the available professional liability insurance coverage of the Consultant. In addition, Client and Consultant agree neither shall be liable for any special, indirect, or consequential damages of any kind or nature.

The Consultant's services have been provided consistent with its professional standard of care. No other warranties are made, either expressed or implied.

Thank you for the opportunity to be of service to you on this project. If you have any questions regarding our services, please contact our office.

Respectfully Submitted,
**CTL ENGINEERING, INC.**

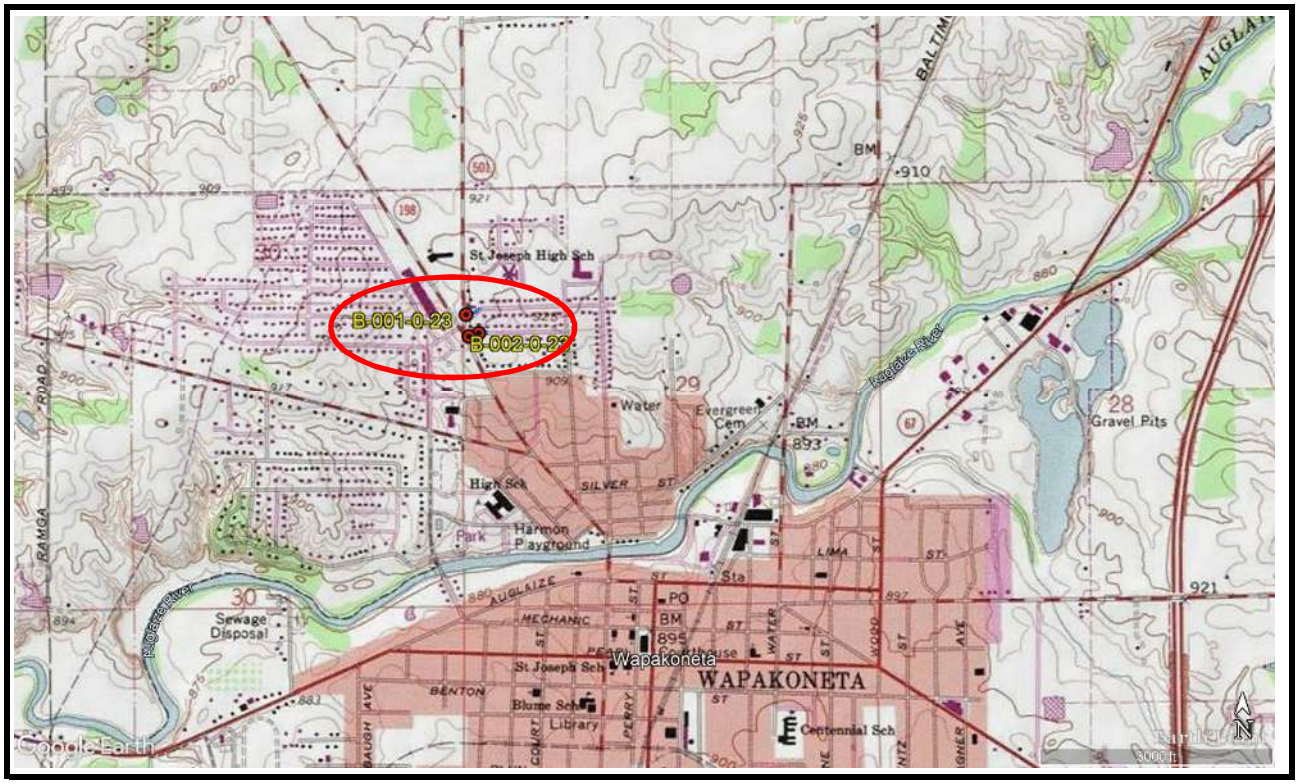
Frederick Schoen, P.E.
Geotechnical Project Manager
OH License, E-66510

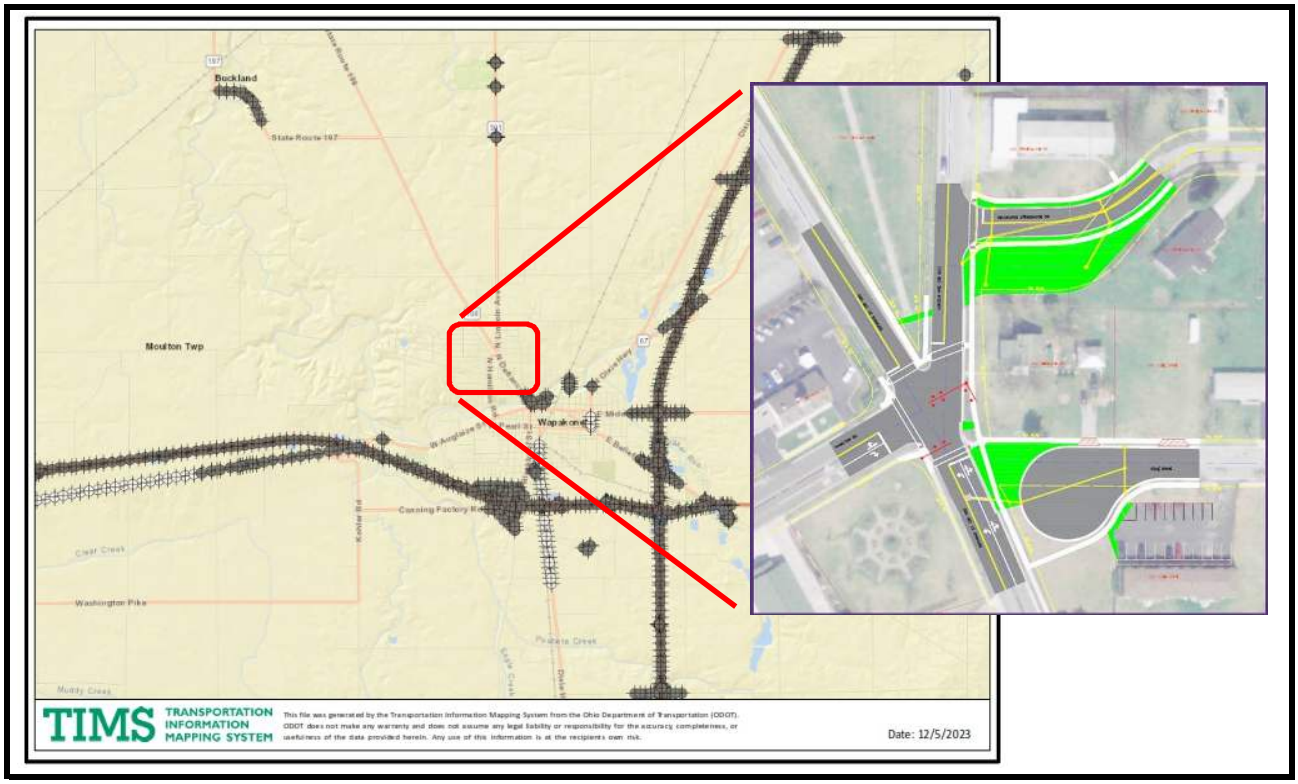
Evan Holcombe, P.E.
Technical Reviewer
OH License, E-86121

**APPENDIX A**

# PLANS & FIGURES

**PROJECT LOCATION PLAN**
**BORING LOCATION PLANS**
**SUBSURFACE DIAGRAM - ROADWAY**

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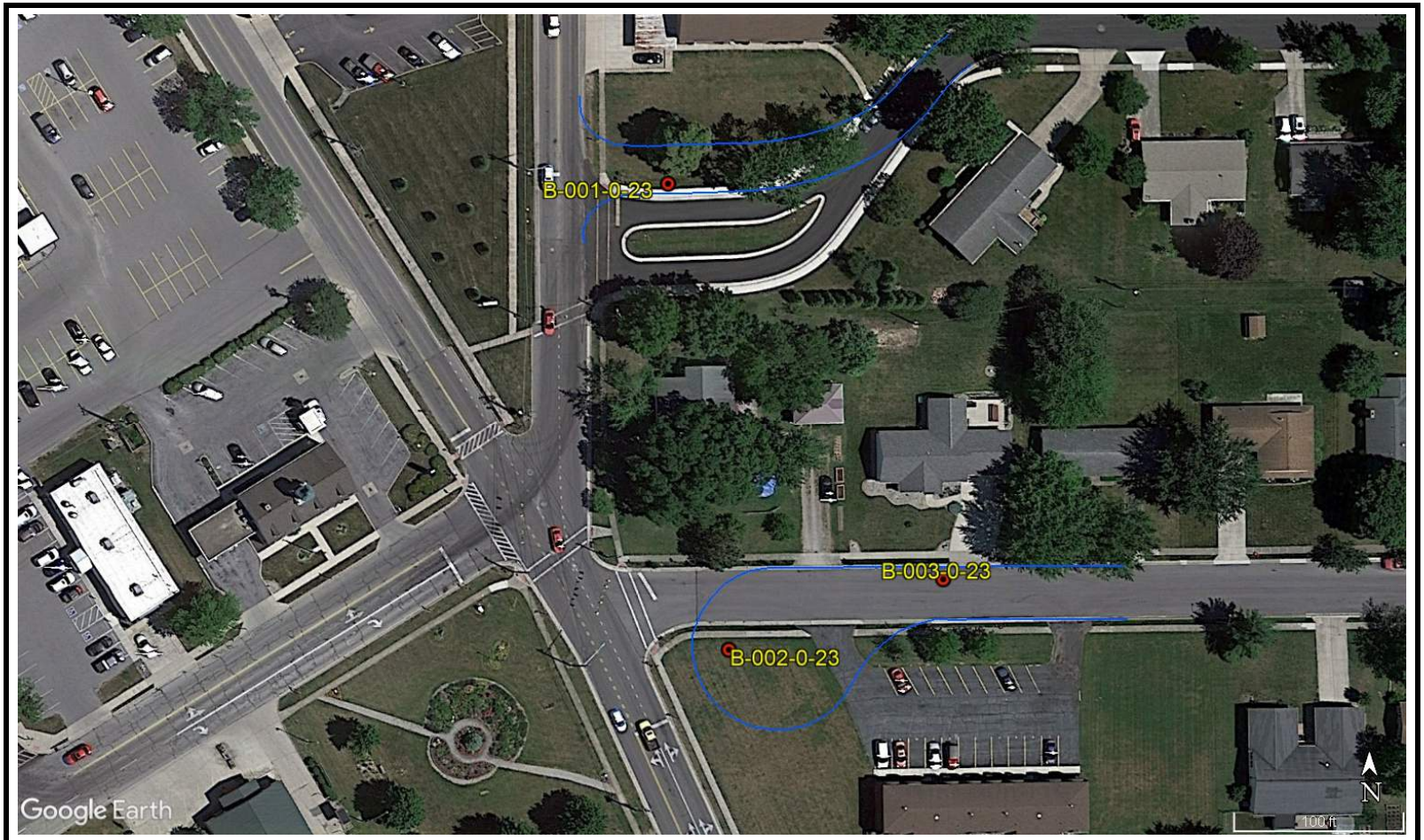
|---|---|---|---|---|---|
| | ***PROJECT LOCATION PLAN*** | | | | |
| | **Date** 12/5/2023 | Choice One Engineering<br>AUG-501/198-2.23/2.36 Intersection Improv.<br>PID 120037<br>Wapakoneta, OH - Auglaize County | | | |
| ***CTL ENGINEERING, INC.***<br>GEOTECHNICAL ENGINEERS<br>TESTING * INSPECTION<br>LABORATORY SERVICES | **Scale** None | | | | |
| | **Drawn By** FS | **Reviewed By** | **Page** 1 of 1 | **Project No.** 23050059WAP | |

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|---|---|---|---|---|
| | ***BORING LOCATION PLAN*** | | | |
| | **Date**<br>12/5/2023 | Choice One Engineering<br>AUG-501/198-2.23/2.36 Intersection Improv.<br>PID 120037<br>Wapakoneta, OH - Auglaize County | | |
| ***CTL ENGINEERING, INC.***<br>GEOTECHNICAL ENGINEERS<br>TESTING * INSPECTION<br>LABORATORY SERVICES | **Scale**<br>None | | | |
| | **Drawn By**<br>FS | **Reviewed By** | **Page**<br>1 of 2 | **Project No.**<br>23050059WAP |


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|---|---|---|---|---|
| | ***BORING LOCATION PLAN*** | | | |
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| ***CTL ENGINEERING, INC.***<br>GEOTECHNICAL ENGINEERS<br>TESTING * INSPECTION<br>LABORATORY SERVICES | **Scale**<br>None | | | |
| | **Drawn By**<br>FS | **Reviewed By** | **Page**<br>2 of 2 | **Project No.**<br>23050059WAP |

## PROJECT DESCRIPTION

PROJECT INCLUDES THE RECONSTRUCTION OF THE CURRENT INTERSECTION BETWEEN DEFIANCE STREET, LINCOLN AVENUE, HAMILTON ROAD, COLE DRIVE, AND STINEBAUGH DRIVE IN WAPAKONETA, OHIO. COLE DRIVE IS PLANNED TO BE REMOVED FROM THE INTERSECTION AND A CUL-DE-SAC INSTALLED, WHICH WILL ALLOW THE STOP LINE ON DEFIANCE STREET TO BE MOVED APPROXIMATELY 100' NORTH CLOSER TO THE INTERSECTION. STINEBAUGH DRIVE WILL BE RECONSTRUCTED AND SHIFTED NORTH APPROXIMATELY 55 FEET. DUE TO THE RELOCATION AND RECONSTRUCTION OF THE WESTERN END OF STINEBAUGH DRIVE TYING INTO LINCOLN AVENUE, NEW SIDEWALK AND STORM SEWER WILL BE INSTALLED ALONG THE REBUILT SECTION OF ROADWAY.

## HISTORIC RECORDS

NO HISTORICAL BORINGS WERE FOUND WITHIN THE PROJECT LIMITS WHEN USING THE OHIO DEPARTMENT OF TRANSPORTATION'S (ODOT) TRANSPORTATION INFORMATION MAPPING SYSTEM (TIMS).

## GEOLOGY

THE PROJECT SITE LIES WITHIN THE CENTRAL OHIO CLAYEY TILL PLAIN PHYSIOGRAPHIC REGION OF THE CENTRAL LOWLANDS PROVINCE OF OHIO, AND IS CHARACTERIZED BY CLAYEY, WELL-DEFINED TERMINAL MORAINES WITH INTERVENING FLAT-LYING GROUND MORAINES AND INTERMORAINAL LAKE BASINS. THE AREA IS PRE-GLACIATED AND INCLUDES GLACIAL TILL SOILS OVER DOLOMITE. THE PROJECT SITE IS UNDERLAIN BY LOCKPORT DOLOMITE OF THE SILURIAN AGE THAT MAY BE FOUND NEAR ELEVATION 690 FEET ABOVE MEAN SEA LEVEL. NO KNOWN KARST OR UNDERGROUND MINE RELATED INCIDENTS EXIST AT THE PROJECT SITE.

## RECONNAISSANCE

THE GENERAL TOPOGRAPHY OF THE PROJECT AREA IS RELATIVELY FLAT WITH STORM SEWER CATCH BASINS COLLECTING SURFACE RUNOFF DURING PRECIPITATION EVENTS. EACH OF THE SIX LEGS OF THE EXISTING INTERSECTION CONFIGURATION CONSISTS OF TWO-LANE ROADWAYS. THE ROADWAY SURFACES CONSIST OF ASPHALT PAVEMENT WHICH WERE NOTED TO EXHIBIT SOME AREAS OF FATIGUE CRACKING, WHEEL-PATH DEPRESSIONS, PAVEMENT SHOVING, AND ISOLATED AREAS OF DEPRESSION. LAND USAGE AROUND THE PROJECT INCLUDE RESIDENTIAL AND COMMERCIAL PROPERTIES.

## SUBSURFACE EXPLORATION

THREE (3) SOIL TEST BORINGS WERE EACH ADVANCED TO A DEPTH OF 10.0 FEET BELOW THE EXISTING GROUND OR PAVEMENT SURFACE. TEST BORINGS WERE PERFORMED BY CTL ENGINEERING, INC. ON OCTOBER 30, 2023; USING A TRUCK-MOUNTED ROTARY DRILL RIG AND 3.25-INCH INSIDE DIAMETER HOLLOW STEM AUGERS. SOIL SAMPLES WERE OBTAINED OF THE TEST BORINGS IN ACCORDANCE WITH THE STANDARD PENETRATION TEST METHOD AT 1.5 FEET AND 2.5 FEET INTERVALS FOR THE FULL DEPTH OF THE BORINGS. THE AUTOMATIC HAMMER USED WITH THE DRILL RIG FOR THE PROJECT WAS PREVIOUSLY CALIBRATED ON OCTOBER 13, 2022, AND HAS A DRILL ROD ENERGY RATIO OF 76.4 PERCENT.

## EXPLORATION FINDINGS

EXISTING SURFACE MATERIALS CONSISTED OF 8 INCHES TO 10 INCHES OF TOPSOIL; OR AT B-003-0-23, 12 INCHES OF ASPHALT PAVEMENT. FINE-GRAINED COHESIVE MATERIALS CONSISTING OF SILTY CLAY (A-6b) AND CLAY (A-7-6) WERE ENCOUNTERED BENEATH THE SURFACE MATERIALS IN EACH OF THE TEST BORINGS; AND WERE DESCRIBED AS BROWN, BROWN WITH GRAY AND GRAYISH BROWN; AND STIFF TO HARD. BEDROCK WAS NOT ENCOUNTERED. GROUNDWATER WAS NOT ENCOUNTERED.

## SPECIFICATIONS

THIS GEOTECHNICAL EXPLORATION WAS PERFORMED IN ACCORDANCE WITH THE STATE OF OHIO, DEPARTMENT OF TRANSPORTATION, OFFICE OF GEOTECHNICAL ENGINEERING, SPECIFICATIONS FOR GEOTECHNICAL EXPLORATIONS, DATED JANUARY 2024.

## AVAILABLE INFORMATION

THE SOIL, BEDROCK, AND GROUNDWATER INFORMATION COLLECTED FOR THIS SUBSURFACE EXPLORATION THAT CAN BE CONVENIENTLY DISPLAYED ON THE SOIL PROFILE SHEETS HAS BEEN PRESENTED. GEOTECHNICAL REPORTS, IF PREPARED, ARE AVAILABLE FOR REVIEW ON THE OFFICE OF CONTRACT SALES WEBSITE.

## LEGEND

| DESCRIPTION | ODOT CLASS | CLASSIFIED MECH./VISUAL | |
|---|---|---|---|
| SILTY CLAY | A-6b | 3 | 8 |
| CLAY | A-7-6 | 3 | 1 |
| | TOTAL | 6 | 9 |

XXXXXX PAVEMENT OR BASE =X= APPROXIMATE THICKNESS

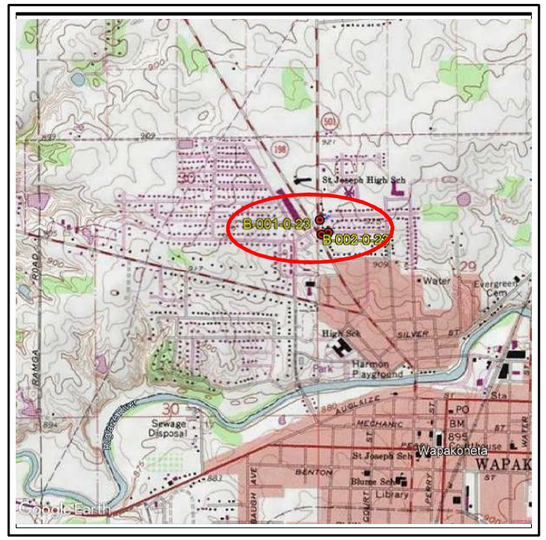
PROJECT BORING LOCATION - PLAN VIEW

DRIVE SAMPLE PLOTTED TO VERTICAL SCALE ONLY. HORIZONTAL BAR INDICATES A CHANGE IN STRATIGRAPHY.

WC INDICATES WATER CONTENT IN PERCENT.

$N_{60}$ INDICATES STANDARD PENETRATION RESISTANCE NORMALIZED TO 60% DRILL ROD ENERGY RATIO.

SS INDICATES A SPLIT SPOON SAMPLE.




LOCATION MAP

SCALE IN MILES

0 1 2 3 4

N

| INDEX OF SHEETS | | | |
|---|---|---|---|
| LOCATION FROM STA. | TO STA. | PLAN VIEW SHEET | PROFILE SHEET |
| COVER SHEET 1 | | | |
| SUMMARY OF SOIL TEST DATA SHEET 2 | | | |
| COLE STREET | | | |
| 10+00.00 | 15+00.00 | 3 | 3 |
| STINEBAUGH DRIVE | | | |
| 120+00.00 | 125+00.00 | 4 | 4 |

### PARTICLE SIZE DEFINITIONS

| 12" | 3" | 2.0 mm | 0.42 mm | 0.074 mm | 0.005 mm |
|---|---|---|---|---|---|
| BOULDERS | COBBLES | GRAVEL | COARSE SAND | FINE SAND | SILT | CLAY |
| | | No. 10 SIEVE | No. 40 SIEVE | No. 200 SIEVE | | |

**RECON. - FLS 10/25/2023**
**DRILLING - CTL ENG. - 10/30/2023**
**DRAWN - N.K.S 05/24/2025**
**REVIEWED - FLS 05/24/2025**

# GEOTECHNICAL PROFILE - ROADWAY

AUG-501/198-02.32


DESIGN AGENCY
CTL ENGINEERING
2860 FISHER ROAD
COLUMBUS, OHIO 43204
PHONE: (614)276-8123
FAX: (614)276-6377


DESIGNER N.K.S
REVIEWER FS 05-24-25
PROJECT ID 120037
SUBSET 1 TOTAL 4
SHEET P.68 TOTAL 71

## SUMMARY OF SOIL TEST DATA

### COLE STREET

| EXPLORATION NO., STATION & OFFSET | FROM TO | SAMPLE ID | $N_{60}$ | % REC | HP tsf | % GR | % CS | % FS | % SILT | % CLAY | LL | PL | PI | % WC | ODOT CLASS (GI) | ppm $SO_4$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| B-002-0-23<br>STA. 10+87, 25' RT.<br>LATITUDE = 40.579190<br>LONGITUDE = -84.202457 | 01.00-02.50 | SS-1 | 29 | 67 | 4.50 | 2 | 4 | 3 | 16 | 75 | 47 | 23 | 24 | 13 | A-7-6 (15) | - |
| | 02.50-04.00 | SS-2 | 23 | 67 | 4.50 | 6 | 6 | 8 | 20 | 60 | 40 | 20 | 20 | 15 | A-6b (12) | <100 |
| | 04.00-05.50 | SS-3 | 24 | 78 | 4.50 | SAME AS SS-2 | | | | | | | | 14 | A-6b (VISUAL) | - |
| | 05.50-07.00 | SS-4 | 39 | 89 | 4.50 | SAME AS SS-2 | | | | | | | | 16 | A-6b (VISUAL) | - |
| | 08.50-10.00 | SS-5 | 42 | 100 | 4.50 | SAME AS SS-2 | | | | | | | | 16 | A-6b (VISUAL) | - |
| B-003-0-23<br>STA. 12+20, 13' LT.<br>LATITUDE = 40.579304<br>LONGITUDE = -84.202004 | 01.00-02.50 | SS-1 | 8 | 67 | 2.00 | 2 | 3 | 10 | 29 | 56 | 50 | 20 | 30 | 17 | A-7-6 (18) | <100 |
| | 02.50-04.00 | SS-2 | 6 | 56 | 2.00 | 18 | 7 | 10 | 24 | 41 | 45 | 19 | 26 | 19 | A-7-6 (13) | - |
| | 04.00-05.50 | SS-3 | 13 | 78 | 1.75 | SAME AS SS-2 | | | | | | | | 19 | A-7-6 (VISUAL) | - |
| | 05.50-07.00 | SS-4 | 28 | 78 | 4.50 | BROWN AND GRAY SILTY CLAY, LITTLE SAND, TRACE GRAVEL, DAMP | | | | | | | | 15 | A-7-6 (VISUAL) | - |
| | 08.50-10.00 | SS-5 | 47 | 100 | 4.50 | SAME AS SS-4 | | | | | | | | 16 | A-7-6 (VISUAL) | - |

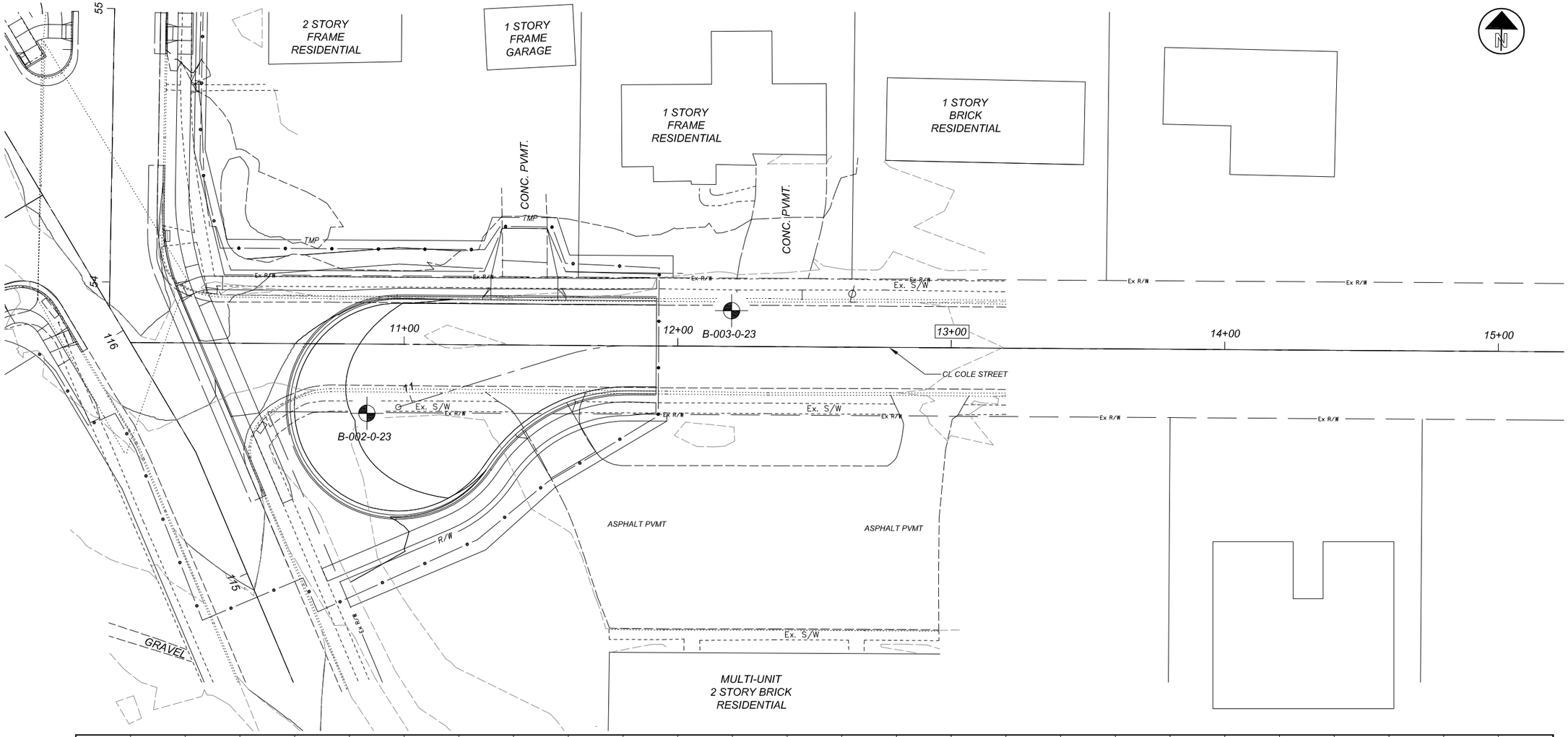
### STINEBAUGH DRIVE

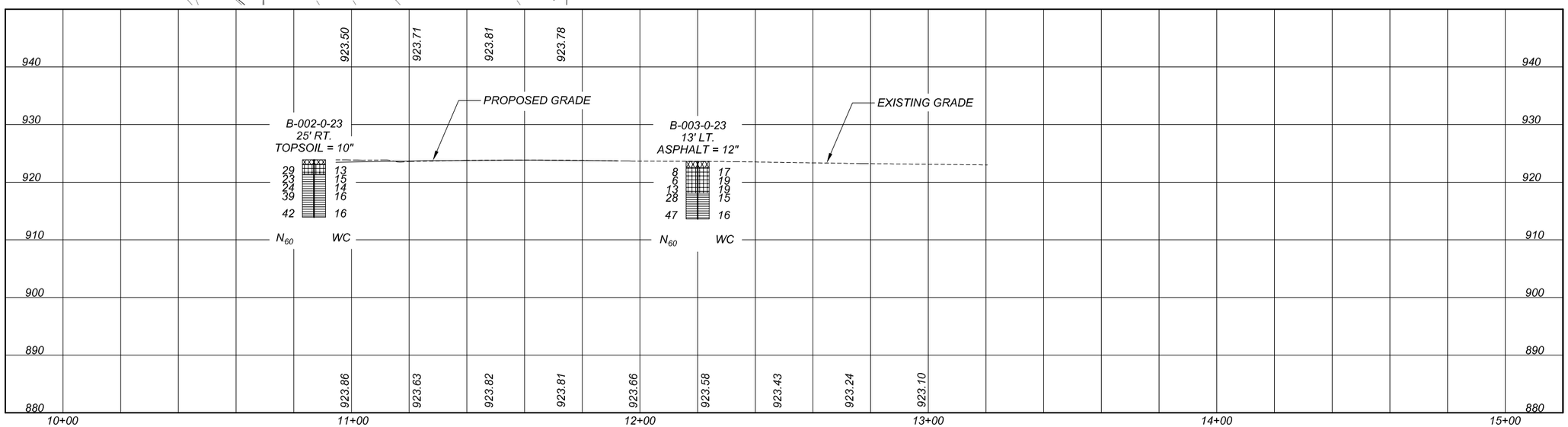
| EXPLORATION NO., STATION & OFFSET | FROM TO | SAMPLE ID | $N_{60}$ | % REC | HP tsf | % GR | % CS | % FS | % SILT | % CLAY | LL | PL | PI | % WC | ODOT CLASS (GI) | ppm $SO_4$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| B-001-0-23<br>STA. 120+97, 19' RT.<br>LATITUDE = 40.579946<br>LONGITUDE = -84.202585 | 01.00-02.50 | SS-1 | 15 | 56 | 3.75 | 4 | 6 | 13 | 35 | 42 | 36 | 19 | 17 | 27 | A-6b (11) | <100 |
| | 02.50-04.00 | SS-2 | 18 | 100 | 4.00 | 5 | 6 | 14 | 36 | 39 | 38 | 21 | 17 | 23 | A-6b (11) | - |
| | 04.00-05.50 | SS-3 | 33 | 89 | 4.50 | SAME AS SS-2 | | | | | | | | 23 | A-6b (VISUAL) | - |
| | 05.50-07.00 | SS-4 | 56 | 78 | 4.50 | BROWN AND GRAY SILTY CLAY, SOME SAND, TRACE GRAVEL DAMP | | | | | | | | 16 | A-6b (VISUAL) | - |
| | 08.50-10.00 | SS-5 | 42 | 100 | 4.50 | SAME AS SS-4 | | | | | | | | 16 | A-6b (VISUAL) | - |


ENGINEERING 2
COLUMBUS, OHIO 43204
PHONE (614)276-8577
FAX (614)276-8577

# GEOTECHNICAL PROFILE - ROADWAY
## STA.10+00.00 TO STA. 15+00.00 - COLE STREET

HORIZONTAL SCALE IN FEET
0 10 20 40



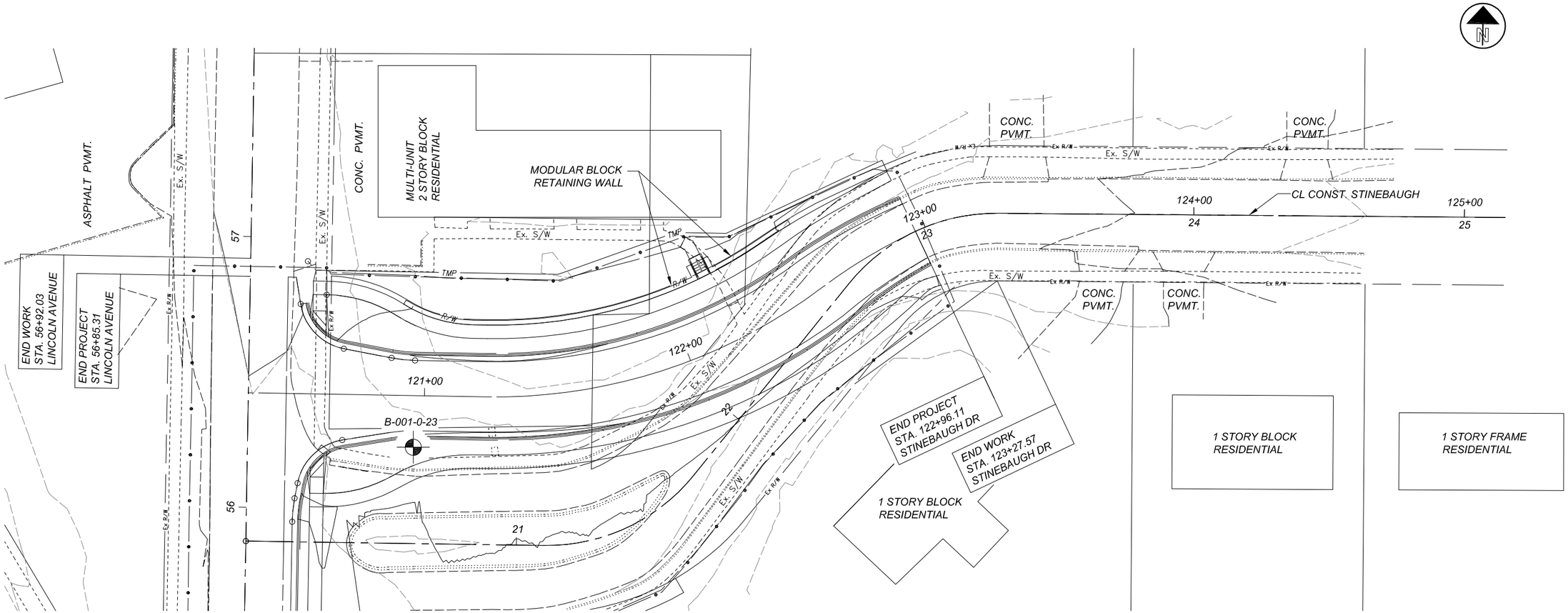

AUG-501/198-02.32

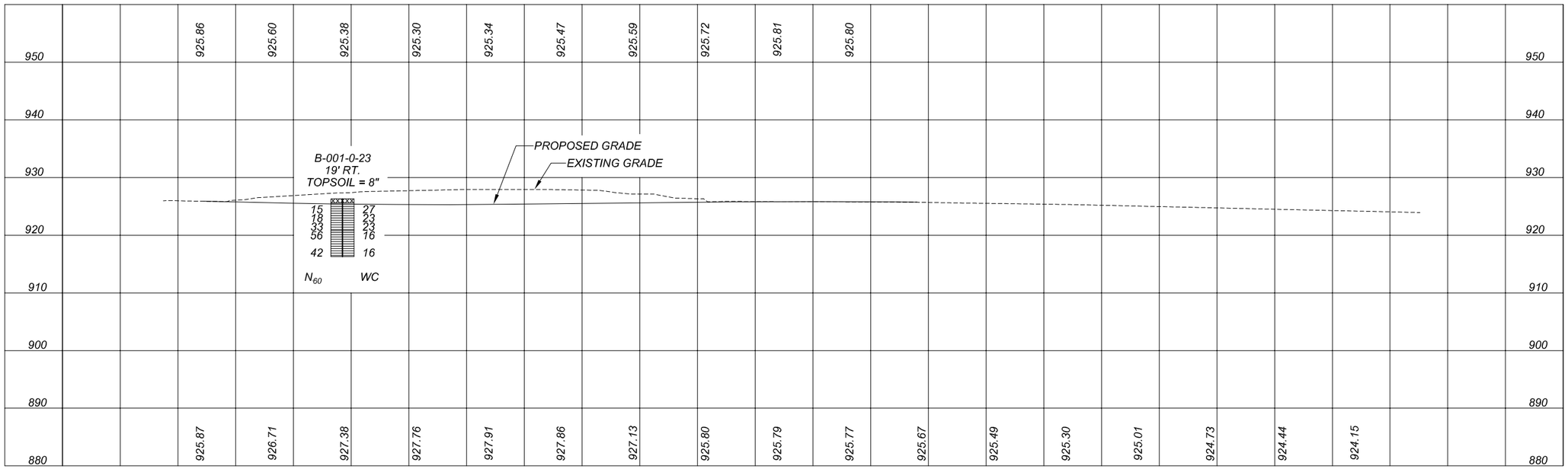
DESIGN AGENCY

GTL ENGINEERING

2860 FISHER ROAD
COLUMBUS, OHIO 43204
PHONE: (614)276-8123
FAX: (614)276-6377

| | |
|---|---|
| DESIGNER | N.K.S. |
| REVIEWER | FS 05-24-25 |
| PROJECT ID | 120037 |
| SUBSET | 3 |
| TOTAL | 4 |
| SHEET | P.70 |
| TOTAL | 71 |




# GEOTECHNICAL PROFILE - ROADWAY
## STA.120+00.00 TO STA. 125+00.00 - STINEBAUGH DRIVE

AUG-501/198-02.32

DESIGN AGENCY
GTL ENGINEERING
2860 FISHER ROAD
COLUMBUS, OHIO 43204
PHONE: (614)276-8123
FAX: (614)276-6377

DESIGNER N.K.S.
REVIEWER FS 05-24-25
PROJECT ID 120037
SUBSET 4 TOTAL 4
SHEET P.71 TOTAL 71

# APPENDIX B

## TEST BORING RECORDS

# EXPLANATION OF TERMS AND SOIL DESCRIPTIONS
## (ODOT Specifications of Geotechnical Explorations)

### CONSISTENCY AND RELATIVE DENSITY DESCRIPTIONS

Descriptors for soil consistency used in this report are based upon the Standard Penetration Test (SPT), ASTM D 1587, with the penetration (N) values corrected to $N_{60}$, based upon the efficiency of the SPT Hammer (Energy Ratio) used for the soil sampling.

**NON-COHESIVE SOILS**

| Consistency | SPT-$N_{60}$ (bpf) |
|---|---|
| Very Loose | < 5 |
| Loose | 5 – 10 |
| Medium Dense | 11 – 30 |
| Dense | 31 - 50 |
| Very Dense | > 50 |

**COHESIVE SOILS**

| Consistency | SPT-$N_{60}$ (bpf) | Qu (tsf) |
|---|---|---|
| Very Soft | < 2 | < 0.25 |
| Soft | 2 – 4 | 0.25 – 0.5 |
| Medium Stiff | 5 – 8 | 0.5 – 1.0 |
| Stiff | 9 – 15 | 1.0 – 2.0 |
| Very Stiff | 16 – 30 | 2.0 – 4.0 |
| Hard | > 30 | > 4.0 |

### COMPONENT MODIFIERS

**SOIL MODIFIERS**

| Modifier | % by Weight |
|---|---|
| Trace | 0 – 10 |
| Little | 10 – 20 |
| Some | 20 – 35 |
| "And" | 35 – 50 |

**ORGANIC CONTENT**

| Modifier | % by Weight |
|---|---|
| Organic | $LL_{oven}/LL_{air}$ < 0.75 |
| Slightly | 2 – 4 |
| Moderately | 4 – 10 |
| Highly | > 10 |

### MOISTURE DESCRIPTIONS

| Terms | Non-Cohesive Soils | Cohesive Soils |
|---|---|---|
| Dry | Moisture Absent | Powdery |
| Damp | Some Moisture | Below Plastic Limit |
| Moist | Damp to the Touch | Between Plastic and Liquid Limits |
| Wet | Visible Water | Above Liquid Limit |

### PARTICLE SIZE DESCRIPTIONS

| Component | AASHTO Particle Size |
|---|---|
| Boulders | ≥ 12-in. (300 mm) |
| Cobbles | < 12-in. (300 mm) to 3-in. (75 mm) |
| Coarse Gravel | < 3-in. (75 mm) to ¾-in. (19 mm) |
| Fine Gravel | < ¾-in. (19 mm) to #10 Sieve (2.0 mm) |
| Coarse Sand | < #10 Sieve (2.0 mm) to #40 Sieve (0.42 mm) |
| Fine Sand | < #40 Sieve (0.42 mm) to #200 Sieve (0.074 mm) |
| Silt | < #200 Sieve (0.074 mm) to 0.005 mm |
| Clay | < 0.005 mm |

GTL ENGINEERING

# KEY TO SYMBOLS

**OHIO DEPARTMENT OF TRANSPORTION**
**OFFICE OF GEOTECHNICAL ENGINEERING**

**PROJECT** AUG-501/198-02.32 **PID** 120037

**OGE NUMBER** 23050059WAP **PROJECT TYPE** SUBGRADE

## *LITHOLOGIC SYMBOLS*
## *(Unified Soil Classification System)*

A-6B: Ohio DOT: A-6b, silty clay

A-7-6: Ohio DOT: A-7-6, clay

PAVEMENT OR BASE: Ohio DOT: Pavement or Aggregate base

## *SAMPLER SYMBOLS*

## *WELL CONSTRUCTION SYMBOLS*

Soil Cuttings Backfill mixed with Bentonite Pellets or Chips

Asphalt or Concrete Pavement Patch

## *ABBREVIATIONS*

LL - LIQUID LIMIT (%)
PI - PLASTIC INDEX (%)
W - MOISTURE CONTENT (%)
DD - DRY DENSITY (PCF)
NP - NON PLASTIC
-200 - PERCENT PASSING NO. 200 SIEVE
PP - POCKET PENETROMETER (TSF)
TV - TORVANE
PID - PHOTOIONIZATION DETECTOR
UC - UNCONFINED COMPRESSION
ppm - PARTS PER MILLION
▽ Water Level at Time Drilling, or as Shown
▼ Water Level at End of Drilling, or as Shown
▼ Water Level After 24 Hours, or as Shown

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: AUG-501/198-02.32 | DRILLING FIRM / OPERATOR: CTL / C. WARNER | DRILL RIG: CME 55 TRUCK | STATION / OFFSET: 120+97, 19' RT. | EXPLORATION ID B-001-0-23 |
| TYPE: SUBGRADE | SAMPLING FIRM / LOGGER: CTL / M. HUGHES | HAMMER: CME AUTOMATIC | ALIGNMENT: STINEBAUGH DR. | |
| PID: 120037 SFN: N/A | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 10/13/22 | ELEVATION: 926.3 (MSL) EOB: 10.0 ft. | PAGE 1 OF 1 |
| START: 10/30/23 END: 10/30/23 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 76.4 | LAT / LONG: 40.579946, -84.202585 | |

| MATERIAL DESCRIPTION AND NOTES | ELEV. | DEPTHS | SPT/ RQD | $N_{60}$ | REC (%) | SAMPLE ID | HP (tsf) | GRADATION (%) GR | CS | FS | SI | CL | ATTERBERG LL | PL | PI | WC | ODOT CLASS (GI) | SO4 ppm | HOLE SEALED |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TOPSOIL (8") | 926.3 / 925.6 | | | | | | | | | | | | | | | | | | |
| VERY STIFF, BROWN, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, MOIST | | 1 | 4 6 6 | 15 | 56 | SS-1 | 3.75 | 4 | 6 | 13 | 35 | 42 | 36 | 19 | 17 | 27 | A-6b (11) | <100 | |
| | | 2 | | | | | | | | | | | | | | | | | |
| | | 3 | 6 5 9 | 18 | 100 | SS-2 | 4.00 | 5 | 6 | 14 | 36 | 39 | 38 | 21 | 17 | 23 | A-6b (11) | - | |
| | | 4 | | | | | | | | | | | | | | | | | |
| HARD @ 4.0 FT. | 920.8 | 5 | 8 11 15 | 33 | 89 | SS-3 | 4.50 | - | - | - | - | - | - | - | - | 23 | A-6b (V) | - | |
| HARD, BROWN AND GRAY, **SILTY CLAY**, SOME SAND, TRACE GRAVEL, DAMP | | 6 | 9 19 25 | 56 | 78 | SS-4 | 4.50 | - | - | - | - | - | - | - | - | 16 | A-6b (V) | - | |
| | | 7 | | | | | | | | | | | | | | | | | |
| | | 8 | | | | | | | | | | | | | | | | | |
| | | 9 | 9 11 22 | 42 | 100 | SS-5 | 4.50 | - | - | - | - | - | - | - | - | 16 | A-6b (V) | - | |
| | 916.3 | EOB 10 | | | | | | | | | | | | | | | | | |

NOTES: BOREHOLE CAVE-IN AT 3.0 FT.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH HOLE PLUG

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: AUG-501/198-02.32 | DRILLING FIRM / OPERATOR: CTL / C. WARNER | DRILL RIG: CME 55 TRUCK | STATION / OFFSET: 10+87, 25' RT. | EXPLORATION ID B-002-0-23 |
| TYPE: SUBGRADE | SAMPLING FIRM / LOGGER: CTL / M. HUGHES | HAMMER: CME AUTOMATIC | ALIGNMENT: COLE ST. | |
| PID: 120037 SFN: N/A | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 10/13/22 | ELEVATION: 923.9 (MSL) EOB: 10.0 ft. | PAGE 1 OF 1 |
| START: 10/30/23 END: 10/30/23 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 76.4 | LAT / LONG: 40.579190, -84.202457 | |

| MATERIAL DESCRIPTION AND NOTES | ELEV. | DEPTHS | SPT/ RQD | $N_{60}$ | REC (%) | SAMPLE ID | HP (tsf) | GRADATION (%) GR | CS | FS | SI | CL | ATTERBERG LL | PL | PI | WC | ODOT CLASS (GI) | SO4 ppm | HOLE SEALED |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TOPSOIL (10") | 923.1 | | | | | | | | | | | | | | | | | | |
| HARD, BROWN AND GRAY, **CLAY**, LITTLE SILT, TRACE SAND, TRACE GRAVEL, DAMP | 921.4 | 1 | 5 10 13 | 29 | 67 | SS-1 | 4.50 | 2 | 4 | 3 | 16 | 75 | 47 | 23 | 24 | 13 | A-7-6 (15) | - | |
| HARD, GRAYISH BROWN, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, DAMP | | 2 | | | | | | | | | | | | | | | | | |
| | | 3 | 10 10 8 | 23 | 67 | SS-2 | 4.50 | 6 | 6 | 8 | 20 | 60 | 40 | 20 | 20 | 15 | A-6b (12) | <100 | |
| | | 4 | | | | | | | | | | | | | | | | | |
| | | 5 | 3 7 12 | 24 | 78 | SS-3 | 4.50 | - | - | - | - | - | - | - | - | 14 | A-6b (V) | - | |
| | | 6 | 9 14 17 | 39 | 89 | SS-4 | 4.50 | - | - | - | - | - | - | - | - | 16 | A-6b (V) | - | |
| | | 7 | | | | | | | | | | | | | | | | | |
| | | 8 | | | | | | | | | | | | | | | | | |
| | 913.9 | 9 | 9 14 19 | 42 | 100 | SS-5 | 4.50 | - | - | - | - | - | - | - | - | 16 | A-6b (V) | - | |
| | | EOB 10 | | | | | | | | | | | | | | | | | |

NOTES: BOREHOLE CAVE-IN AT 2.0 FT.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH HOLE PLUG

| | | | | |
|---|---|---|---|---|
| PROJECT: AUG-501/198-02.32 | DRILLING FIRM / OPERATOR: CTL / C. WARNER | DRILL RIG: CME 55 TRUCK | STATION / OFFSET: 12+20, 13' LT. | EXPLORATION ID B-003-0-23 |
| TYPE: SUBGRADE | SAMPLING FIRM / LOGGER: CTL / M. HUGHES | HAMMER: CME AUTOMATIC | ALIGNMENT: COLE ST. | |
| PID: 120037 SFN: N/A | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 10/13/22 | ELEVATION: 923.6 (MSL) EOB: 10.0 ft. | PAGE 1 OF 1 |
| START: 10/30/23 END: 10/30/23 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 76.4 | LAT / LONG: 40.579304, -84.202004 | |

| MATERIAL DESCRIPTION AND NOTES | ELEV. 923.6 | DEPTHS | SPT/ RQD | $N_{60}$ | REC (%) | SAMPLE ID | HP (tsf) | GRADATION (%) GR | CS | FS | SI | CL | ATTERBERG LL | PL | PI | WC | ODOT CLASS (GI) | SO4 ppm | HOLE SEALED |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASPHALT (12") | 922.6 | | | | | | | | | | | | | | | | | | |
| STIFF, BROWN AND GRAY, **CLAY**, SOME SILT, LITTLE SAND, TRACE GRAVEL, EX. FILL, DAMP | | 1 | 3 3 3 | 8 | 67 | SS-1 | 2.00 | 2 | 3 | 10 | 29 | 56 | 50 | 20 | 30 | 17 | A-7-6 (18) | <100 | |
| LITTLE GRAVEL @ 3.0 FT. | | 2 3 4 | 2 3 3 | 6 | 56 | SS-2 | 2.00 | 18 | 7 | 10 | 24 | 41 | 45 | 19 | 26 | 19 | A-7-6 (13) | - | |
| | 918.1 | 5 | 4 6 | 13 | 78 | SS-3 | 1.75 | - | - | - | - | - | - | - | - | 19 | A-7-6 (V) | - | |
| HARD, BROWN AND GRAY, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, DAMP | | 6 7 8 | 9 13 | 28 | 78 | SS-4 | 4.50 | - | - | - | - | - | - | - | - | 15 | A-6b (V) | - | |
| | 913.6 | EOB 10 | 7 15 22 | 47 | 100 | SS-5 | 4.50 | - | - | - | - | - | - | - | - | 16 | A-6b (V) | - | |

NOTES: BOREHOLE CAVE-IN AT 0.5 FT.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH HOLE PLUG

# APPENDIX C

## LABORATORY TEST RESULT(S)

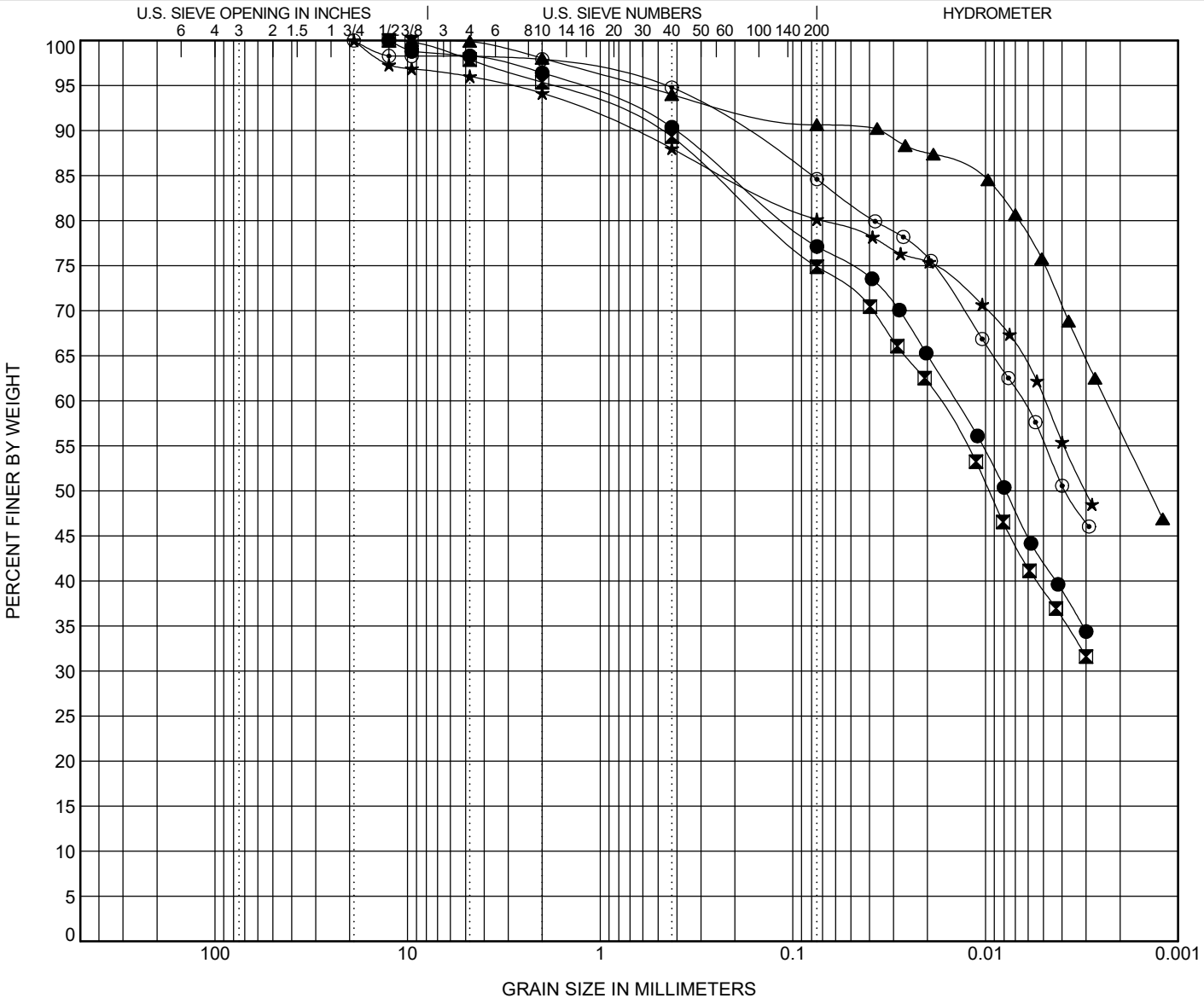
**SOIL GRAINSIZE DISTRIBUTION**
**SULFATE CONTENT OF SOILS**

# GRAIN SIZE DISTRIBUTION

**CTL ENGINEERING, INC.**
**WWW.CTLENG.COM**

**PROJECT** AUG-501/198-02.32 **PID** 120037

**OGE NUMBER** 23050059WAP **PROJECT TYPE** SUBGRADE




| COBBLES | GRAVEL | SAND | | SILT | CLAY |
|---|---|---|---|---|---|
| | | coarse | fine | | |

| Specimen Identification | | | ODOT (Modified AASHTO) ~ USCS Classification | LL | PL | PI |
|---|---|---|---|---|---|---|
| ● | B-001-0-23 | 1.0 | **A-6b ~ LEAN CLAY with SAND(CL)** | 36 | 19 | 17 |
| ⊠ | B-001-0-23 | 2.5 | **A-6b ~ LEAN CLAY with SAND(CL)** | 38 | 21 | 17 |
| ▲ | B-002-0-23 | 1.0 | **A-7-6 ~ LEAN CLAY(CL)** | 47 | 23 | 24 |
| ★ | B-002-0-23 | 2.5 | **A-6b ~ LEAN CLAY with SAND(CL)** | 40 | 20 | 20 |
| ⊙ | B-003-0-23 | 1.0 | **A-7-6 ~ FAT CLAY with SAND(CH)** | 50 | 20 | 30 |

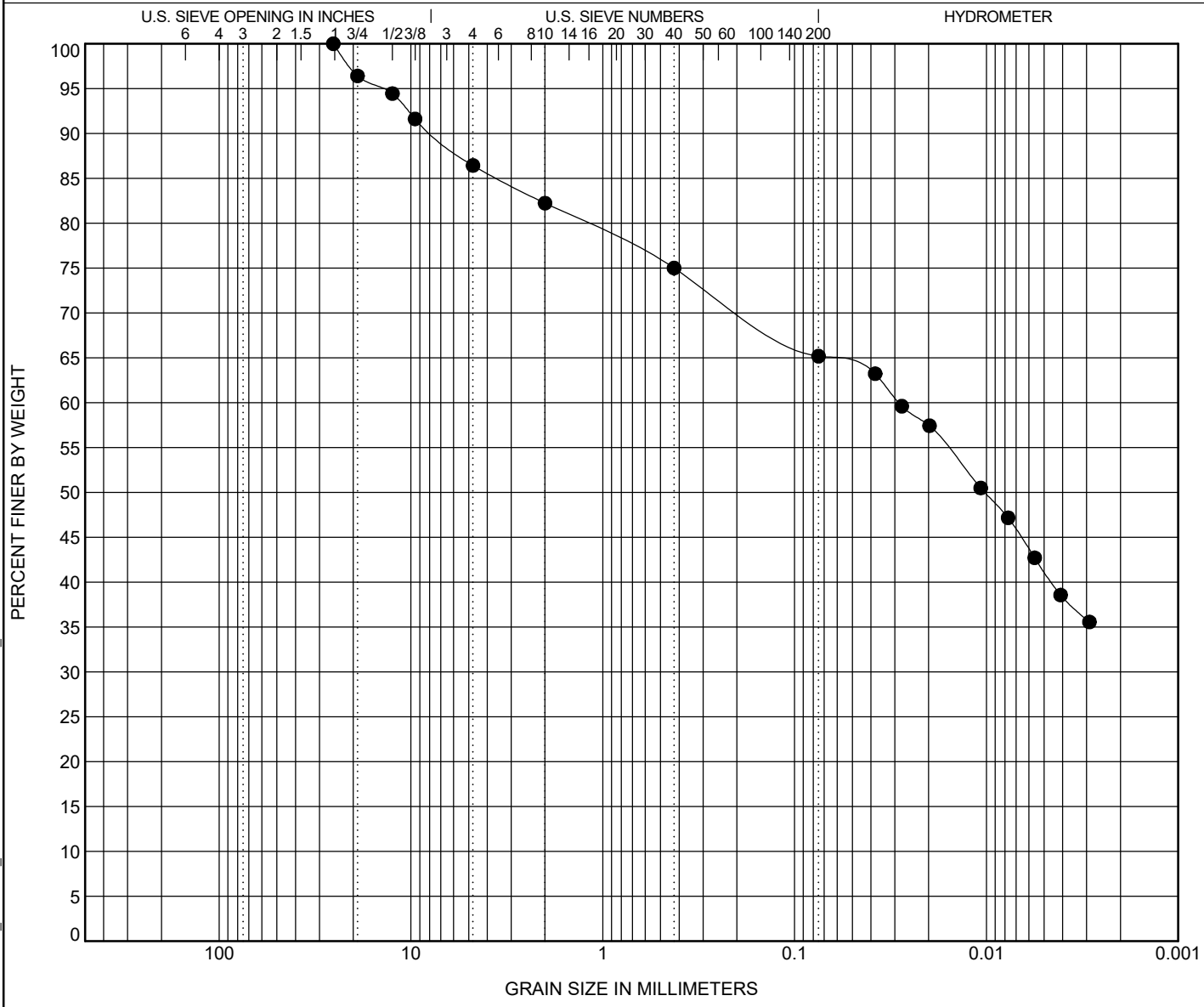
| Specimen Identification | | | D90 | D50 | D30 | D10 | %G | %CS | %FS | %M | %C | Cc | Cu |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ● | B-001-0-23 | 1.0 | 0.405 | 0.008 | | | 4 | 6 | 13 | 35 | 42 | | |
| ⊠ | B-001-0-23 | 2.5 | 0.506 | 0.01 | | | 5 | 6 | 14 | 36 | 39 | | |
| ▲ | B-002-0-23 | 1.0 | 0.035 | 0.001 | | | 2 | 4 | 3 | 16 | 75 | | |
| ★ | B-002-0-23 | 2.5 | 0.702 | 0.003 | | | 6 | 6 | 8 | 20 | 60 | | |
| ⊙ | B-003-0-23 | 1.0 | 0.188 | 0.004 | | | 2 | 3 | 10 | 29 | 56 | | |

# GRAIN SIZE DISTRIBUTION

**CTL ENGINEERING, INC.**
**WWW.CTLENG.COM**

**PROJECT** AUG-501/198-02.32 **PID** 120037

**OGE NUMBER** 23050059WAP **PROJECT TYPE** SUBGRADE




| COBBLES | GRAVEL | SAND | | SILT | CLAY |
|---|---|---|---|---|---|
| | | coarse | fine | | |

| | Specimen Identification | | ODOT (Modified AASHTO) ~ USCS Classification | LL | PL | PI |
|---|---|---|---|---|---|---|
| ● | **B-003-0-23** | **2.5** | **A-7-6 ~ SANDY LEAN CLAY(CL)** | **45** | **19** | **26** |

| | Specimen Identification | | D90 | D50 | D30 | D10 | %G | %CS | %FS | %M | %C | Cc | Cu |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ● | **B-003-0-23** | **2.5** | **7.666** | **0.01** | | | **18** | **7** | **10** | **24** | **41** | | |

GRAIN SIZE - OH DOT.GDT - 23/12/4 20:11 - O:\PROJECT\2023\WAP-05\23050059WAP_AUG-501_198 INTERSECTION - PID 120037_CHOICE ONE ENGINEERING\REPORTS\GINT\23050059WAP ODOT.GPJ

CTL ENGINEERING, INC.
102 COMMERCE DR. P.O. BOX 44
WAPAKONETA, OHIO 45895
PHONE: (419) 738-1447
FAX: (419) 738-7670

Project C-R-S: AUG-501/198-2.32/2.36

PID No: 120037

Report Date: 11/30/2023

Consultant: Choice One Engineering

Technician: RV/JT

| Sample or Boring ID | Station | Offset | Latitude & Longitude or State Plane Coordinates | | Elevation | Soaking Time (hr) | Replicate Sample Readings | | | | | | Sulfate Content (ppm) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 1 | | 2 | | 3 | | |
| | | | | | | | Dilution | Reading | Dilution | Reading | Dilution | Reading | |
| B-001 SS-1 | | | 40.579946 | -84.202585 | 926.5 | 18 | 20 | < 5 | 20 | < 5 | 20 | < 5 | < 100 |
| B-002 SS-2 | | | 40.579190 | -84.202457 | 922.0 | 18 | 20 | < 5 | 20 | < 5 | 20 | < 5 | < 100 |
| B-003 SS-1 | | | 40.579304 | -84.202004 | 922.5 | 18 | 20 | < 5 | 20 | < 5 | 20 | < 5 | < 100 |

# APPENDIX D

# CALCULATIONS

## SUBGRADE ANALYSES

# OHIO DEPARTMENT OF TRANSPORTATION

## OFFICE OF GEOTECHNICAL ENGINEERING

## PLAN SUBGRADES
## Geotechnical Bulletin GB1

**AUG-501/198-2.32/2.36**
**120037**

**Intersection Improvement Project - South leg of Defiance St. (SR 198), North leg of Defiance St & Lincoln Ave. (SR 501), Hamilton Rd., Stinebaugh Dr., and Cole Dr.**

**CTL Engineering, Inc.**

**Prepared By:** Fred Schoen, P.E.
**Date prepared:** Friday, February 16, 2024

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**NO. OF BORINGS:** 3

| # | Boring ID | Alignment | Station | Offset | Dir | Drill Rig | ER | Boring EL. | Proposed Subgrade EL | Cut Fill |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | B-001-0-23 | Stinebaugh Dr. | 120+97 | 19 | Right | CME 55 Truck 292 | 76 | 926.3 | 922.3 | 4.0 C |
| 2 | B-002-0-23 | Cole St. | 10+87 | 25 | Right | CME 55 Truck 292 | 76 | 923.9 | 922.3 | 1.6 C |
| 3 | B-003-0-23 | Cole St. | 12+20 | 13 | Left | CME 55 Truck 292 | 76 | 923.6 | 922.4 | 1.2 C |

Assumes new pavement thickness of 1.2 ft.

OHIO DEPARTMENT OF TRANSPORTATION

# Subgrade Analysis

V. 14.5 1/18/2019

| # | Boring | Sample | Sample Depth | | Subgrade Depth | | Standard Penetration | | HP (tsf) | Physical Characteristics | | | | | | Moisture | | Ohio DOT | | Sulfate Content (ppm) | Problem | | Excavate and Replace (Item 204) | | Recommendation (Enter depth in inches) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | From | To | From | To | $N_{60}$ | $N_{60L}$ | | LL | PL | PI | % Silt | % Clay | P200 | $M_C$ | $M_{OPT}$ | Class | GI | | Unsuitable | Unstable | Unsuitable | Unstable | |
| 1 | B | SS-1 | 1.0 | 2.5 | -3.0 | -1.5 | 15 | | 3.75 | 36 | 19 | 17 | 35 | 42 | 77 | 27 | 16 | A-6b | 11 | 99 | | | | | |
| | 001-0 | SS-2 | 2.5 | 4.0 | -1.5 | 0.0 | 18 | | 4 | 38 | 21 | 17 | 36 | 39 | 75 | 23 | 16 | A-6b | 11 | | | | | | |
| | 23 | SS-3 | 4.0 | 5.5 | 0.0 | 1.5 | 33 | | 4.5 | | | | | | | 23 | 16 | A-6b | 16 | | | Mc | | | |
| | | SS-4 | 5.5 | 7.0 | 1.5 | 3.0 | 56 | 30 | 4.5 | | | | | | | 16 | 16 | A-6b | 16 | | | | | | |
| 2 | B | SS-1 | 1.0 | 2.5 | -0.6 | 0.9 | 26 | | 4.5 | 47 | 23 | 24 | 16 | 75 | 91 | 13 | 20 | A-7-6 | 15 | | | | | | |
| | 002-0 | SS-2 | 2.5 | 4.0 | 0.9 | 2.4 | 23 | | 4.5 | 40 | 20 | 20 | 20 | 60 | 80 | 15 | 16 | A-6b | 12 | 99 | | | | | |
| | 23 | SS-3 | 4.0 | 5.5 | 2.4 | 3.9 | 24 | | 4.5 | | | | | | | 14 | 16 | A-6b | 16 | | | | | | |
| | | SS-4 | 5.5 | 7.0 | 3.9 | 5.4 | 39 | 23 | 4.5 | | | | | | | 16 | 16 | A-6b | 16 | | | | | | |
| 3 | B | SS-1 | 1.0 | 2.5 | -0.2 | 1.3 | 8 | | 2 | 50 | 20 | 30 | 29 | 56 | 85 | 17 | 18 | A-7-6 | 18 | 99 | | $N_{60}$ | | 12" | 12" Undercut w/ 204 Geotextile |
| | 003-0 | SS-2 | 2.5 | 4.0 | 1.3 | 2.8 | 6 | | 2 | 45 | 19 | 26 | 24 | 41 | 65 | 19 | 18 | A-7-6 | 13 | | | $N_{60}$ | | | |
| | 23 | SS-3 | 4.0 | 5.5 | 2.8 | 4.3 | 13 | | 1.75 | | | | | | | 19 | 18 | A-7-6 | 16 | | | | | | |
| | | SS-4 | 5.5 | 7.0 | 4.3 | 5.8 | 28 | 6 | 4.5 | | | | | | | 15 | 16 | A-6b | 16 | | | | | | |

OHIO DEPARTMENT OF TRANSPORTATION

# Subgrade Analysis

V. 14.5 1/18/2019

**PID:** 120037

**County-Route-Section:** AUG-501/198-2.32/2.36
**No. of Borings:** 3

**Geotechnical Consultant:** CTL Engineering, Inc.
**Prepared By:** Fred Schoen, P.E.
**Date prepared:** 2/16/2024

| Chemical Stabilization Options | | |
|---|---|---|
| 320 | Rubblize & Roll | Option |
| 206 | Cement Stabilization | No |
| | Lime Stabilization | Option |
| 206 | Depth | NA |

| Excavate and Replace Stabilization Options | |
|---|---|
| Global Geotextile Average(N60L): | 0'' |
| Average(HP): | 0'' |
| Global Geogrid Average(N60L): | 0'' |
| Average(HP): | 0'' |

| Design CBR | 4 |
|---|---|

| % Samples within 6 feet of subgrade | | | |
|---|---|---|---|
| $N_{60} \leq 5$ | 0% | HP ≤ 0.5 | 0% |
| $N_{60} < 12$ | 20% | 0.5 < HP ≤ 1 | 0% |
| $12 \leq N_{60} < 15$ | 10% | 1 < HP ≤ 2 | 30% |
| $N_{60} \geq 20$ | 70% | HP > 2 | 70% |
| M+ | 10% | | |
| Rock | 0% | | |
| Unsuitable | 0% | | |

| Excavate and Replace at Surface | |
|---|---|
| Average | 0'' |
| Maximum | 0'' |
| Minimum | 0'' |

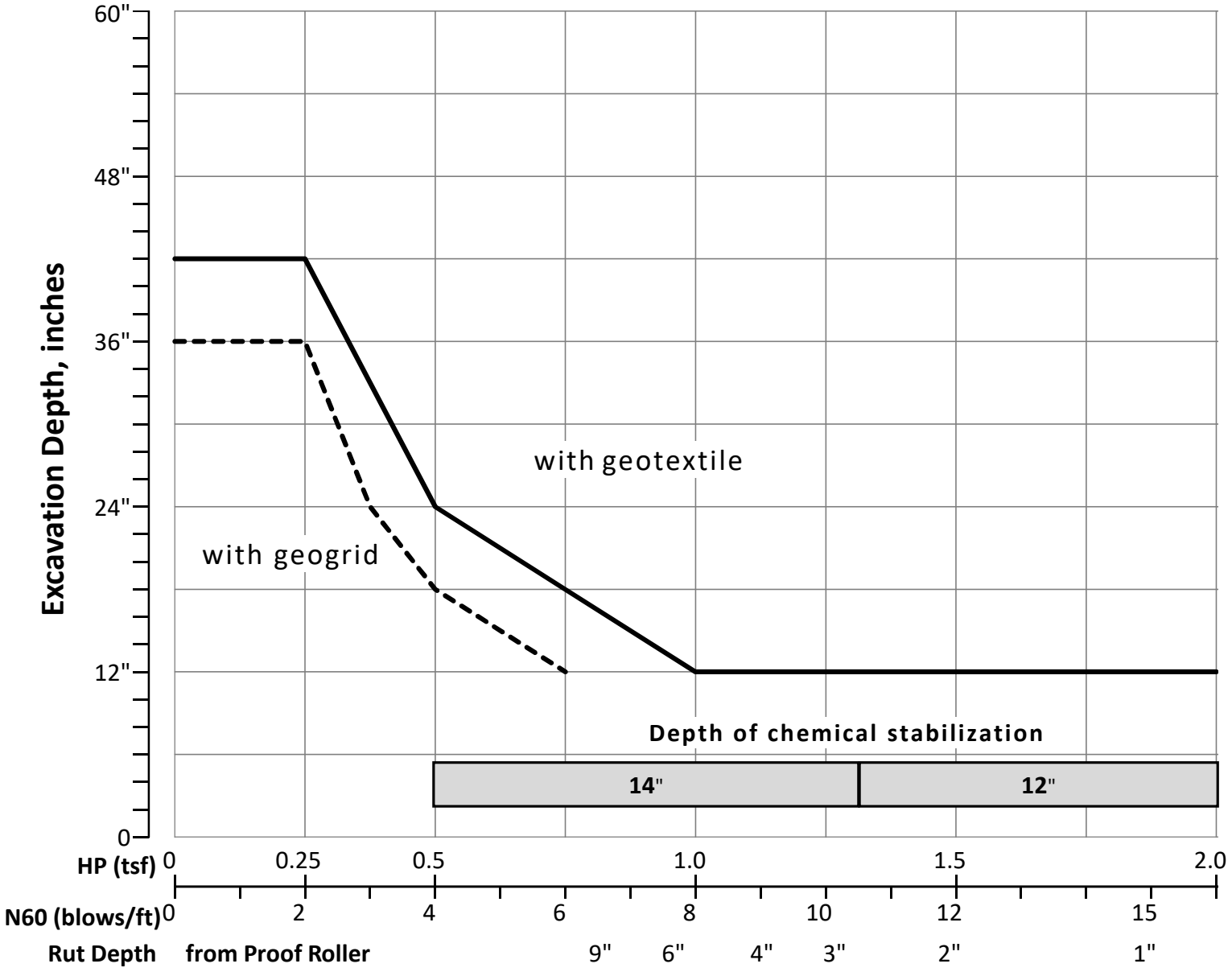
| % Proposed Subgrade Surface | |
|---|---|
| Unstable & Unsuitable | 33% |
| Unstable | 33% |
| Unsuitable | 0% |

| | $N_{60}$ | $N_{60L}$ | HP | LL | PL | PI | Silt | Clay | P 200 | $M_C$ | $M_{OPT}$ | GI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 26 | 20 | 3.73 | 46 | 21 | 25 | 22 | 58 | 80 | 17 | 17 | 15 |
| Maximum | 56 | 30 | 4.50 | 50 | 23 | 30 | 36 | 75 | 91 | 27 | 20 | 18 |
| Minimum | 6 | 6 | 1.75 | 36 | 19 | 17 | 16 | 39 | 65 | 13 | 16 | 11 |

**Classification Counts by Sample**

| ODOT Class | Rock | A-1-a | A-1-b | A-2-4 | A-2-5 | A-2-6 | A-2-7 | A-3 | A-3a | A-4a | A-4b | A-5 | A-6a | A-6b | A-7-5 | A-7-6 | A-8a | A-8b | Totals |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Count | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 0 | 4 | 0 | 0 | 10 |
| Percent | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 60% | 0% | 40% | 0% | 0% | 100% |
| % Rock\|Granular\|Cohesive | 0% | 0% | | | | | | | | | 100% | | | | | | | | 100% |
| Surface Class Count | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 0 | 3 | 0 | 0 | 9 |
| Surface Class Percent | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 67% | 0% | 33% | 0% | 0% | 100% |

## GB1 Figure B – Subgrade Stabilization




OVERRIDE TABLE

| Calculated Average | New Values | Check to Override |
|---|---|---|
| 3.73 | 1.75 | ☐ HP |
| 19.67 | 6.00 | ☐ N60L |

Average HP
Average $N_{60L}$