DRAFT REPORT
SUBGRADE EXPLORATION REPORT
ASD-250-12.74
ASHLAND COUNTY, OHIO
PID#: 109129

Prepared For:

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NEAS PROJECT 20-0045

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National Engineering & Architectural Services Inc.

EXECUTIVE SUMMARY

The Ohio Department of Transportation (ODOT) has proposed an intersection improvement project (ASD-250-12.74, PID 109129) in the City of Ashland, Ashland County, Ohio. The proposed project is located at the US-250/SR-60/Faultless Drive intersection in the northwest of the City of Ashland and consists of the construction of a single-lane roundabout to replace the existing intersection. The overall project objective is to reconfigure and improve the safety of the intersection.

National Engineering and Architectural Services Inc. (NEAS) has been contracted to perform geotechnical engineering services for the project. The purpose of the geotechnical engineering services is to perform geotechnical explorations within the project limits to obtain information concerning the subsurface soil and groundwater conditions relevant to the design and construction of the project. Between June 4, 2020 and July 15, 2020, NEAS performed the site reconnaissance and exploration program for the project. The project included 6 borings drilled to a depth of 10.5 ft below ground surface (bgs) for subgrade characterization purposes.

The subgrade conditions in the project area are relatively consistent and are generally comprised of cohesive natural overburden soils (A-6a, A-6b, and A-7-6) and non-cohesive overburden soils (A-1-b, A-2-4, and A-2-6). With respect to sulfate within the subgrade soil, based on the project laboratory testing program, each subgrade soil sample tested was determined to have a sulfate content of less than 5,000 parts per million (i.e., lower than the level which ODOT considers high and may prevent the use of chemical stabilization).

Based on our evaluation of the subsurface conditions and our geotechnical engineering analyses of the proposed roundabout project, it is our opinion that subgrade conditions are generally satisfactory; and pavement can be designed without the need for extreme levels of remediation. Neither unsuitable or unstable subgrade conditions were encountered within the project roadway limits. Therefore, NEAS recommends spot stabilization be performed on the unstable subgrade which is identified by performing Item 204 Proof Rolling for the entire project. Spot stabilization should be in the form of Excavate and Replace (Item 204 with Geotextile). Excavations are estimated to extend to the depth of 12 inches, with the excavated material being replaced with material in accordance with Section F "Excavate and Replace (Item 204)" of the ODOT GB1. Stabilization limits should extend 18-inches beyond the edge of the proposed paved roadway, shoulder or median and it is recommended removing any topsoil, existing pavement materials or abandoned structure foundation materials. NEAS’s opinion that the subgrade soils will provide adequate pavement support assuming it is designed and constructed in accordance with the recommendations provided within this report, as well as all applicable ODOT standards and specifications.

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1. INTRODUCTION

1.1. General

NEAS presents our Subgrade Exploration Report for the proposed ASD-250-12.74 (PID 109129) project in the City of Ashland, Ashland County, Ohio. The proposed project is located at the US-250/SR-60/Faultless Drive intersection in the northwest of the City of Ashland and consists of the construction of a single-lane roundabout to replace the existing intersection. The overall project objective is to reconfigure and improve the safety of the intersection. This report presents a summary of the project encountered surficial and subsurface conditions and our recommendations for subgrade stabilization and pavement design parameters for proposed ASD-250-12.74 roundabout project in accordance with ODOT's *Geotechnical Bulletin 1* (GB1) (ODOT, 2019) and *Pavement Design Manual* (PDM) (ODOT, 2019).

The exploration was conducted in general accordance with NEAS, Inc.'s proposal to Carpenter Marty Transportation, dated November 22, 2019 and with the provisions of ODOT's *Specifications for Geotechnical Explorations* (SGE) (ODOT, 2019).

The scope of work to be performed includes: 1) a review of published geotechnical information; 2) performing 6 total soil test borings and 3 pavement cores; 3) laboratory testing of soil samples in accordance with the SGE; 4) performing geotechnical engineering analysis to assess subgrade stabilization requirements and pavement design parameters; and, 5) development of a summary report.

2. GEOLOGY AND OBSERVATIONS OF THE PROJECT

2.1. Geology and Physiography

The project site is located within the Killbuck-Glaciated Pittsburgh Plateau. The Killbuck-Glaciated Pittsburgh Plateau region is characterized by ridges and flat uplands of moderate relief generally above 1,200 ft, covered with thin drift and dissected by steep valleys. Valley segments alternate between broad drift-filled and narrow rock-walled reaches. Elevations of the region ranges from 600 to 1,505 ft amsl, with moderate relief (200 ft). The geology within this region is described as thin to thick Wisconsinan-age clay to loam till over Mississippian- and Pennsylvanian-age shales, sandstones, conglomerates and coals (ODGS, 1998).

The bedrock underlying the project site is mapped as Mississippian-age Undivided Maxville Limestone and Rushville, Logan, and Cuyahoga Formations (USGS & ODGS, 2006). Shale, siltstone and sandstone are interbedded with various shades of gray, yellow to brown. The sandstone is typically silty to granular with local stringers of quartz pebbles. The shale within this formation is typically clayey to silty and can be locally fossiliferous. Based on the ODNR bedrock-topography data for Ohio (ODNR DGS, 2004), bedrock elevations at the proposed project site can be expected to range from 1050 ft to 1100 ft amsl, putting bedrock at a depth of 10 to 30 ft below ground surface (bgs).

The soils at the proposed project site have been mapped (Web Soil Survey) by the Natural Resources Conservation Service as being occasionally flooded Shoals silt loam with 0 to 2 percent slopes (Sh), Wadsworth silt loam with 2 to 6 percent slopes (WaB), Rittman silt loam with 2 to 6 percent slopes (RsB), Rittman silt loam with 6 to 12 percent slopes (RC2), eroded Rittman silt loam with 6 to 12 percent

slopes (RsC2). The project area is considered as prime farmland and those units are described as being moderately well drained.

2.2. Hydrology/Hydrogeology

Groundwater can be expected at an elevation consistent with that of the major local surface water bodies. There are two lakes, Sprinkle Lake and Emmons Lake, located approximately 1 mile east of the project. The flow line elevation is from 993 ft to 1008 ft and likely represents the local groundwater table.

Local variations in the groundwater table may exist in one of two reasons. First, if there has been extensive groundwater abstraction, water levels may be depressed by tens of feet over significantly large areas. Second, the presence of discontinuous bodies of glacial till provides the opportunity for localized pockets of perched groundwater to form.

The proposed project site is partially located within 1% annual chance flood hazard zone (a small area west of the intersection) based on available mapping by the Federal Emergency Management Agency's National Flood Hazard mapping program (FEMA, 2019).

2.3. Mining and Oil/Gas Production

No abandoned mines are noted on ODNR's Abandoned Underground Mine Locator within 1 mile distance of the proposed project site (ODNR [1]).

No oil or gas wells are noted on ODNR's Ohio Oil & Gas Locator within 1 mile distance of the proposed project site (ODNR [2]).

2.4. Historical Records

A historical record search was performed through ODOT's Transportation Information Mapping System (TIMS). Two historical projects were found within the project area:

- ASD-250-12.75, Subgrade Investigation, PID 24355, 2003
- ASD-250-12.75, Structure Foundation Exploration, Job No. 03279, 1980

The historical borings used in this report are depicted on the Boring & Coring Location Plan provided in Appendix A. Latitude/longitude and elevations of the historical borings are shown on Table 1.

Table 1: Historical Boring Summary

Boring Number	Latitude	Longitude	Elevation (NAVD 88) (ft)	Alignment	Depth (ft)	Substructure
B-001-0-80	40.886595	-82.326026	1066.7	SR-60	15.0	Roadway
B-002-0-80	40.886683	-82.325940	1066.9	SR-60	15.0	Roadway
B-003-0-03	40.887211	-82.326060	1081.0	US-250	5.5	Subgrade
B-004-0-03	40.887496	-82.326027	1097.8	US-250	6.0	Subgrade
B-005-0-03	40.887144	-82.324879	1073.6	US-250	6.0	Subgrade

Note:
1. *Station and Offset are in reference to Proposed US-250, SR-60 and Faultless Drive.*

2.5. Field Reconnaissance

Field reconnaissance for the project area was conducted on June 4, 2020. The proposed project location is at the intersection of US 250 / SR 60 / Faultless Drive in Ashland County, Ohio. Site conditions,

including existing pavement conditions, were noted, and photographed during the visit. During our field reconnaissance, no geohazards were observed within the immediate vicinity of the proposed project location. The summary of the pavement condition by roadway segment is provided below.

US 250 / SR 60 / Faultless Drive Intersection

Land utilization near the US 250 / SR 60 / Faultless Drive intersection can be described as commercial properties and cultivated fields. The area around the proposed project location is primarily level. Observed vegetation mainly consists of grass. No drainage issues were observed in the land surrounding the proposed project location.

The pavement of existing US 250, to the west of intersection is newly constructed and pavement along US 250 to the east of intersection is severely weathered with signs of longitudinal and transverse cracking.

The pavement of existing SR 60 is severely weathered with signs of low to high severity longitudinal and transverse cracking.

Photograph 1: Faultless Drive (West of US 250 / SR 60 / Faultless Drive Intersection)

Photograph 2: US 250 / SR 60 / Faultless Drive Intersection (facing North)

Photograph 3: East of US 250 / SR 60 / Faultless Drive Intersection (facing West)

Photograph 4: South of US 250 / SR 60 / Faultless Drive Intersection (facing North)

3. GEOTECHNICAL EXPLORATION

3.1. Subgrade Exploration Program

The project subsurface exploration was conducted by NEAS on July 15, 2020 and consisted of 5 borings drilled to a depth of 10.5 ft bgs. The boring locations were selected by NEAS in general accordance with the guidelines contained in the SGE with the intent to evaluate subsurface soil and groundwater conditions. The borings were located in areas that were not restricted by underground or overhead utilities or dictated by terrain (i.e. steep embankment slopes). The project boring locations were located in the field by NEAS prior to drilling and were surveyed by the project surveyor after drilling. The boring logs (included in Appendix B) will include the boring latitude and longitude locations (based on the surveyed Ohio State Plane North, NAD83, location) and the corresponding ground surface elevations. The boring locations are depicted on the Boring & Coring Location Plan provided in Appendix A. Latitude/longitude and elevations of the borings are shown on Table 2.

Table 2: Project Boring Summary

Boring Number	Latitude	Longitude	Elevation (NAVD 88) (ft)	Alignment	Station	Offset	Depth (ft)	Substructure
B-001-0-19	40.887276	-82.327413	1076.6	US 250	46+98	5' LT	10.5	Roadway
B-002-0-19	40.887135	-82.326463	1075.6	US 250	49+56	57' RT	10.5	Roadway
B-003-0-19	40.887079	-82.324389	1063.8	US-250	55+42	21' RT	10.5	Roadway
B-004-0-19	40.886774	-82.326036	1073.0	SR 60	13+40	31' RT	10.5	Roadway
B-005-0-19	40.887736	-82.326520	1081.2	SR 60	17+23	18' RT	10.5	Roadway
B-006-0-19	40.888458	-82.327055	1085.4	SR 60	20+22	16' LT	10.5	Roadway

Note:
1. Station and Offset are in reference to Proposed US-250, SR-60 and Faultless Drive.

The project borings were drilled using a CME 55X truck-mounted drilling rig utilizing 3.25-inch (inner diameter) hollow stem augers. The soil samples were recovered at 2.5 ft or continuously using an 18-inch split spoon sampler (AASHTO T-206 "Standard Method for Penetration Test and Split Barrel Sampling of Soils."). The soil samples obtained from the exploration program were visually observed in the field by the NEAS field representative and preserved for review by a Geologist for possible laboratory testing. Standard penetration tests (SPT) were conducted using CME auto hammers that have been calibrated to be 81.9% efficient, as indicated on the individual boring logs (Appendix B).

The project field boring logs were prepared by drilling personnel and include soil description, SPT results recorded as blows per 6-inch increment of penetration and estimated unconfined shear strength values on specimens exhibiting cohesion (using a hand-penetrometer). Groundwater level observations were recorded both during and after the completion of drilling.

After completing the borings, the boreholes were backfilled with either auger cuttings, bentonite chips, or a combination of these materials and patched accordingly with the cold patch asphalt and/or cement when drilling through the roadway.

3.2. Coring Investigation Program

The pavement coring for the project was conducted by NEAS on July 15, 2020 and included three (3) pavement cores drilled along the existing pavement of US-250/SR-60/Faultless Drive within the project limits. See Appendix A for Boring & Coring Location Plan.

Core locations were drilled using a truck mounted, electric powered coring machine utilizing a 4-inch outside diameter diamond tipped drill bit. The drill bit was water cooled with a 200-gallon water tank/pump mounted on the truck. Following coring, each core sample was photographed, logged and placed in a core box for transportation to NEAS's laboratory. Once in the laboratory the cores were: 1) Re-measured for thickness verification; 2) Checked for composition; and 3) Prepared for any planned laboratory testing. Detailed information and photographs of each core sample are included in the Pavement Core Report included within Appendix C. After completing the coring, the pavement core holes were backfilled and patched with asphalt cold patch.

3.3. Laboratory Testing Program

The laboratory testing program consisted of classification testing, moisture content determinations and sulfate content testing. Soil samples are retained at the laboratory for 60 days following report submittal, after which time they will be discarded.

3.3.1. Classification Testing

Representative soil samples were selected for index property (Atterberg Limits) and gradation testing for classification purposes on 50% of the samples. At the subgrade boring location, a sample representing each distinctive strata obtained below the proposed top of subgrade elevation was generally tested while additional samples were selected for testing with the intent of properly classifying the subsurface soil and groundwater conditions within the planned project limits. Soils not selected for testing were compared to laboratory tested samples/strata and classified visually. Moisture content testing was conducted on all samples. The laboratory testing was performed in general accordance with applicable AASHTO specifications and ODOT Supplements.

Final classification of soil strata in accordance with AASHTO M-145 "Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes," as modified by ODOT "Classification of Soils" was made once laboratory test results became available. The results of the soil classification are presented on the boring logs in Appendix B.

3.3.2. Standard Penetration Test Results

Standard Penetration Tests (SPT) and split-barrel (commonly known as split-spoon) sampling of soils were performed in the project borings. To account for the high efficiency (automatic) hammers used during SPT sampling, field SPT N-values were converted based on the calibrated efficiency (energy ratio) of the specific drill rig's hammer. Field N-values were converted to an equivalent rod energy of 60% (N_{60}) for use in analysis or for correlation purposes. The resulting N_{60} values are shown on the boring logs provided in Appendix B.

3.3.3. Sulfate Testing

Sulfate testing was generally performed on one sample for each subgrade or roadway boring performed for pavement/subgrade design purposes. The selected samples were tested in accordance with ODOT Supplement 1122, "Determining Sulfate Content in Soils" dated July 17, 2015. In general, the upper most sample (within 3 ft of the proposed subgrade elevation) from each boring was tested when feasible. Testing results are summarized in ODOT Sulfate Supplement 1122 Table within Appendix E and also presented on the boring logs within Appendix B.

4. GEOTECHNICAL FINDINGS

The subsurface conditions encountered during NEAS's explorations are described in the following subsections and/or on each boring log presented in Appendix B. The boring logs represent NEAS's interpretation of the subsurface conditions encountered at each boring location based on our site observations, field logs, visual review of the soil samples by NEAS's geologist, and laboratory test results. The lines designating the interfaces between various soil strata on the boring logs represent the approximate interface location; the actual transition between strata may be gradual and indistinct. The subsurface soil and groundwater characterizations included herein, including summary test data, are based on the subsurface findings from the geotechnical explorations performed by NEAS as part of the referenced project. At the time of the composition of this report, pavement grade information has been assumed to be consistent with the plan and profile basemap provided by Carpenter Marty Transportation dated September 15, 2020. It should be noted that for the purposes of this report and our analysis the term 'subgrade' has been assumed to represent soils and/or soil conditions from 1.5 ft below proposed final pavement grades to a depth of 7.5 ft below the proposed pavement grades.

4.1. Existing Pavement

The thicknesses of the pavement cores were measured during the core exploration and re-measured after in the laboratory for thickness verification. The core locations are shown on the Boring & Coring Location Plan within Appendix A. A summary of these measurements, along with a description of the deck material encountered, number of layers encountered, and measurement observations are summarized on Table 3. Laboratory photographs of each of the cores are presented in Appendix C.

Table 3: Measured Pavement Thicknesses Based on Pavement Cores

Core ID	Proposed Alignment	Core Diameter (in)	Top Layer Asphalt Thickness (in)	Second Layer Asphalt Thickness (in)	Total Asphalt Thickness (in)
P.C.-1	US 250	4.00	3.00	9.75	12.75
P.C.-2	SR 60	4.00	3.00	8.50	11.50
P.C.-3	US 250	4.00	4.25	9.50	13.75

4.2. Subgrade Conditions

The subgrade conditions in the project area are relatively consistent and are generally comprised of cohesive natural overburden soils (A-6a, A-6b, and A-7-6) and non-cohesive overburden soils (A-2-4). With respect to sulfate within the subgrade soil, based on the project laboratory testing program, each subgrade soil sample tested was determined to have a sulfate content of less than 5,000 parts per million (i.e., lower than the level which ODOT considers high and may prevent the use of chemical stabilization).

The following subsections present a brief summary of the subsurface conditions by ramp/roadway segment with problem areas highlighted where present.

4.2.1. US 250

Along US 250, eighty-four percent (84%) of the soil samples were identified as fine-grained soils and were comprised of: 1) Silt and Clay (A-6a, 42% of samples); 2) Sandy Silt (A-4a, 25% of samples); and 3) Silty Clay (A-6b, 17% of samples); With respect to the consistency of the fine-grained soils, the descriptions varied from stiff to hard correlating to N_{60} values between 10 and 51 bpf. Natural moisture contents ranged from 9 to 20 percent. Based on Atterberg Limit tests performed on representative samples of the fine-grained subgrade soils obtained along the project portions of US 250, the liquid and plastic limits ranged from 23 to 36 percent and from 15 to 19 percent, respectively.

Sixteen percent (16%) of the samples taken along the proposed US 250 were classified as non-cohesive soils and were comprised of: 1) Stone Fragments with Sand (A-1-b, 5% of samples); and 2) Gravel and Stone Fragments with Sand and Silt (A-2-4, 19% of samples). With respect to the relative compactness of the coarse-grained soils, the description varies from dense to very dense correlating to converted SPT-N values (N_{60}) values between 11 and 79 bpf. Natural moisture content ranged from 10 to 15 percent.

4.2.2. SR 60

Along SR 60, eighty-eight percent (88%) of the soil samples were identified as fine-grained soils and were comprised of: 1) Sandy Silt (A-4a, 57 % of samples); 2) Silt and Clay (A-6a, 22% of samples); and 2) Silt (A-4b, 9% of samples). With respect to the consistency of the fine-grained soils, the descriptions varied from medium stiff to hard correlating to N_{60} values between 4 and 59 bpf. Natural moisture contents ranged from 9 to 29 percent. Based on Atterberg Limit tests performed on representative samples of the fine-grained subgrade soils obtained along the project portions of SR 60, the liquid and plastic limits ranged from 23 to 33 percent and from 15 to 21 percent, respectively.

Eight percent (8%) of the samples taken along the proposed SR 60 were classified as non-cohesive soils and were comprised of: 1) Gravel and Stone Fragments with Sand and Silt (A-2-4, 5% of samples); and 2) Gravel and Stone Fragments with Sand, Silt and Clay (A-2-7, 5% of samples). With respect to the

relative compactness of the coarse-grained soils, the description is dense correlating to converted SPT-N values (N_{60}) value of 31 bpf. Natural moisture content ranged from 13 to 19 percent.

Four percent (4%) of the samples taken from the historical boring along the proposed SR 60 were classified as rock - weathered shale.

4.2.3. Groundwater

Groundwater measurements were taken during the boring drilling procedures and/or immediately following the completion of each borehole. Groundwater was not observed in any of the five project borings drilled during and/or upon completion of drilling.

It should be noted that groundwater is affected by many hydrologic characteristics in the area and may vary from those measured at the time of the exploration.

4.2.4. Bedrock

Bedrock was only encountered in the historical borings B-001-0-80 and B-002-0-80, not in any of the project borings.

5. ANALYSES AND RECOMMENDATIONS

We understand that the construction of a single-lane roundabout to replace the existing intersection is planned as part of the ASD-250-12.74 (PID 109129) project in the City of Ashland, Ashland County, Ohio. For this purpose, a subgrade exploration and subsequent subgrade analysis was completed for the referenced project. The subgrade analysis was performed in accordance with ODOT's GB1 criteria utilizing the ODOT provided *GB1: Subgrade Analysis Spreadsheet* (GB1_SubgradeAnalysis.xls, Version 14.5 dated January 18, 2019). Input information for the spreadsheet was based on the soil characteristics gathered during NEAS's subgrade exploration (i.e., SPT results, laboratory test results, etc.), our geotechnical experience and the historical borings and testing. A GB1 analysis was performed for the entire project as well as for each of the referenced roadway segments individually.

Based on our evaluation of the subsurface conditions and our geotechnical engineering analyses of the proposed intersection improvement project, it is our opinion that the subgrade conditions encountered are generally satisfactory and pavement can be designed without the need for extreme levels of remediation, especially with the use of global stabilization per the GB1. In general, the subgrade soils throughout the project will be globally stabilized in the form of Excavate and Replace (Item 204 with Geotextile). The following sections provide further details about the analysis performed and the recommended remediation.

5.1. Pavement Design Analysis

A GB1 analysis was performed to identify the method, location, and dimensions (including depth) of required subgrade stabilization for the project. In addition to identifying stabilization recommendations, pavement design parameters are also determined to aid in pavement section design. The subsections below present the results of our GB1 analysis including pavement design parameters and unsuitable and/or unstable subgrade conditions if any are identified within the project limits. A GB1 analysis spreadsheet is provided in Appendix D.

Again, it should be noted that for the purposes of this report and our analysis, the term 'proposed subgrade' has been assumed to represent soils and/or soil conditions from 1.5 ft below proposed final pavement grades to a depth of 7.5 ft below the proposed pavement grades.

5.1.1. Pavement Design Recommendations

A GB1 analysis was performed using the subgrade soil data obtained during our field exploration program and the historical field exploration data to evaluate the soil characteristics and develop pavement parameters for use in pavement design. The subgrade analysis parameters recommended for use in pavement design are presented in Table 3 below. Provided in the table are ranges of maximum, minimum and average N_{60L} values for the indicated segments as well as the design CBR value recommended for use in pavement design.

Table 4: Pavement Design Values

Proposed Alignment	Maximum N_{60L}	Minimum N_{60L}	Average N_{60L}	Average PI Values	Design CBR
US 250	30	10	19	13	7
SR 60	30	0	15	9	8

5.1.2. Unsuitable Subgrade

Per ODOT's GB1, the presence of select subgrade conditions is prohibited within the subgrade zone for new pavement construction. These prohibited subgrade conditions generally include the presence of rock or specific soil types. With respect to the planned roadway, these subgrade conditions are further discussed in the following subsections.

5.1.2.1. Rock

Bedrock was only encountered in the historical borings B-001-0-80 and B-002-0-80, located at the south of the intersection. However, bedrock was encountered below 2 feet of the top of subgrade.

5.1.2.2. Prohibited Soils

Prohibited soil types per the GB1, which include A-4b, A-2-5, A-5, A-7-5, A-8a, A-8b, and soils with liquid limits greater than 65. Prohibited soils A-4b were encountered in the historical boring B-002-0-80 and the project boring B-004-0-19, located at the south of the intersection. However, prohibited soils A-4b were encountered below 3 feet of the top of subgrade.

5.1.3. Unstable Subgrade

The unstable subgrade conditions generally include the presence of weak soil conditions and overly moist soil conditions. With respect to the planned roadway, these subgrade conditions are further discussed in the following subsections.

5.1.3.1. Weak Soils

The GB1 recommends subgrade stabilization for soils considered unstable in which the N_{60} value of a particular soil sample (SS) at a referenced boring location is less than 12 bpf and in some cases less than 15 bpf (i.e., where moisture content is greater than optimum plus 3 percent). Weak soils were not encountered within 3 feet of the top of subgrade.

5.1.3.2. High Moisture Content Soils

High moisture content soils are defined by the GB1 as soils that exceed the estimated optimum moisture content (per Figure A - Optimum Moisture Content within the GB1) for a given classification by 3 percent or more. High moisture content soils were not encountered within 3 feet of the top of subgrade.

5.1.3.3. High Sulfate Content Soils

High sulfate content soils are defined by the GB1 as soils in which a sulfate content greater than 5000 ppm is present. High sulfate content soils were not encountered in any of the project borings.

5.2. Stabilization Recommendations

5.2.1. Summary of Stabilization

Unsuitable and unstable subgrade conditions were not encountered throughout more than 30 percent of the project area as previously indicated in Section 5.1 of this report. Therefore, NEAS recommends spot stabilization be performed on the unstable subgrade which is identified by performing Item 204 Proof Rolling for the entire project. Spot stabilization should be in the form of Excavate and Replace (Item 204 with Geotextile). Excavations are estimated to extend to the depth of 12 inches, with the excavated material being replaced with material in accordance with Section F "Excavate and Replace (Item 204)" of the ODOT GB1. Stabilization limits should extend 18-inches beyond the edge of the proposed paved roadway, shoulder or median and it is recommended removing any topsoil, existing pavement materials or abandoned structure foundation materials.

6. QUALIFICATIONS

This investigation was performed in accordance with accepted geotechnical engineering practice for the purpose of characterizing the subgrade conditions along the referenced portion of roadway. This report has been prepared for Carpenter Marty Transportation, ODOT and their design consultants to be used solely in evaluating the roadway subgrade soils within the project limits and presenting geotechnical engineering recommendations specific to this project. The assessment of general site environmental conditions or the presence of pollutants in the soil, rock and groundwater of the site was beyond the scope of this geotechnical exploration. Our recommendations are based on the results of our field exploration, laboratory test results from representative soil samples, and geotechnical engineering analyses. The results of the field exploration and laboratory tests, which form the basis of our recommendations, are presented in the appendices as noted. This report does not reflect any variations that may occur between the borings or elsewhere on the site, or variations whose nature and extent may not become evident until a later stage of construction. In the event that any changes occur in the nature, design or location of the proposed pavement work, the conclusions and recommendations contained in this report should not be considered valid until they are reviewed, and have been modified or verified in writing by a geotechnical engineer.

It has been a pleasure to be of service to Carpenter Marty Transportation in performing this geotechnical exploration for the ASD-250-12.74 project. Please call if there are any questions, or if we can be of further service.

Respectfully Submitted,

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Geotechnical Engineer

Chunmei (Melinda) He, Ph.D., P.E.
Project Manager

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APPENDIX A

SOIL BORING LOCATION PLAN

0 20 40 80
HORIZONTAL SCALE IN FEET

DRAWN MJ
CHECKED CH

TARGET BORING LOCATION

ASD-250-12.74

1/1

P:\PROPOSALS\ASD-250-12.74\Geotech Fee Proposal\FeeProposal 112119\TargetBoringPlan_andKMZs\ASD-250-12.74 Target Boring Plan.dgn 11/22/2019 11:33:17 AM che

APPENDIX B

BORING LOGS

NEAS Inc.
National Engineering & Architectural Services Inc.

LEGEND

SYMBOL	DESCRIPTION	ODOT CLASSIFICATION
	Gravel and/or Stone Fragments	A-1-a
	Gravel and/or Stone Fragments with Sand	A-1-b
F.S.	Fine Sand	A-3
	Coarse and Fine Sand	A-3a
	Gravel and/or Stone Fragments with Sand and Silt	A-2-4 A-2-5
	Gravel and/or Stone Fragments with Sand, Silt and Clay	A-2-6 A-2-7
	Sandy Silt	A-4a
	Silt	A-4b
	Elastic Silt and Clay	A-5
	Silt and Clay	A-6a
	Silty Clay	A-6b
	Elastic Clay	A-7-5
	Clay	A-7-6
	Organic Silt	A-8a
	Organic Clay	A-8b

SYMBOL	DESCRIPTION	ODOT CLASSIFICATION
	Shale	Visual
	Weathered Shale	Visual
	Sandstone	Visual

GRADATION (%)

GR Gravel
CS Coarse Sand
MS Medium Sand
FS Fine Sand
SI Silt
CL Clay (<5 micron)

SAMPLER SYMBOLS

Shelby Tube

Rock Core

Split Spoon Sample (SS)

* Indicates a Sample Taken Within 3 ft of Proposed Grade

ABBREVIATIONS

LL	LIQUID LIMIT (%)	HP	HAND PENETROMETER
PI	PLASTIC INDEX (%0	PID	PHOTOIONIZATION DETECTOR
WC	MOISTURE CONTENT (%)	UC	UNCONFINED COMPRESSION
SPT	STANDARD PENETRATION TEST	ppm	PARTS PER MILLION
NP	NON PLASTIC	$\mathcal{W}$	WATER FIRST ENCOUNTERED
-200	PERCENT PASSING NO. 200 SIEVE	▼	WATER LEVEL UPON COMPLETION
N_{60}	ADJUSTED SPT RESULT		
EOB	END OF BORING		

MATERIAL CLASSIFIED BY VISUAL INSPECTION

Sod and Topsoil
Pavement or Base
Concrete

Uncontrolled Fill (Describe)

Bouldery Zone

Peat, S-Sedimentary
W-Woody F-Fibrous
L-Loamy & etc

PROJECT: ASD-250-12.74	DRILLING FIRM / OPERATOR: NEAS / J. HODGES	DRILL RIG: CME 55X	STATION / OFFSET:
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: NEAS / J. HODGES	HAMMER: CME AUTOMATIC	ALIGNMENT:
PID: 109129 SFN:	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 12/5/19	ELEVATION: 0.0 (MSL) EOB: 10.5 ft.
START: 7/15/20 END: 7/15/20	SAMPLING METHOD: SPT	ENERGY RATIO (%): 81.9	COORD: Not Recorded

EXPLORATION ID B-001-0-19

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 0.0	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	BACK FILL
HARD, BROWN, **SILT AND CLAY**, SOME SAND, LITTLE GRAVEL, DAMP		1																	
		2																	
		3	4 5 9	19	28	SS-1	4.50	20	17	10	34	19	30	18	12	9	A-6a (4)	110	
	-4.5	4																	
VERY STIFF, BROWN AND GRAY, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, MOIST		5	4 3 4	10	50	SS-2	2.75	7	6	12	41	34	36	18	18	19	A-6b (11)	-	
	-7.0	6																	
HARD, BROWN AND GRAY, **SILT AND CLAY**, SOME SAND, SOME GRAVEL AND STONE FRAGMENTS, DAMP		7																	
	-9.0	8	4 6 8	19	67	SS-3	4.50	-	-	-	-	-	-	-	-	13	A-6a (V)	-	
VERY DENSE, BROWN, **STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, DAMP	-10.5	9	12 22 36	79	61	SS-4	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	-	
EOB		10																	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: SHOVELED SOIL CUTTINGS

PROJECT: ASD-250-12.74	DRILLING FIRM / OPERATOR: NEAS / J. HODGES	DRILL RIG: CME 55X	STATION / OFFSET:
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: NEAS / J. HODGES	HAMMER: CME AUTOMATIC	ALIGNMENT:
PID: 109129 SFN:	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 12/5/19	ELEVATION: 0.0 (MSL) EOB: 10.5 ft.
START: 7/15/20 END: 7/15/20	SAMPLING METHOD: SPT	ENERGY RATIO (%): 81.9	COORD: Not Recorded

EXPLORATION ID B-002-0-19

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 0.0	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	BACK FILL
HARD, BROWN, **SILT AND CLAY**, SOME SAND, LITTLE GRAVEL, DAMP		1																	
		2																	
		3	5 5 12	23	44	SS-1	4.50	20	17	14	29	20	26	15	11	9	A-6a (3)	130	
	-4.5	4																	
HARD, BROWN, **SANDY SILT**, SOME CLAY, LITTLE GRAVEL, DAMP		5	8 8 11	26	67	SS-2	4.50	11	10	16	38	25	25	17	8	13	A-4a (6)	-	
		6																	
		7																	
	-9.0	8	7 8 12	27	56	SS-3	4.50	-	-	-	-	-	-	-	-	14	A-4a (V)	-	
DENSE, BROWN, **STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, DAMP	-10.5	9																	
EOB		10	8 11 12	31	78	SS-4	-	-	-	-	-	-	-	-	-	13	A-2-4 (V)	-	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: SHOVELED SOIL CUTTINGS

PROJECT: ASD-250-12.74	DRILLING FIRM / OPERATOR: NEAS / J. HODGES	DRILL RIG: CME 55X	STATION / OFFSET:
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: NEAS / J. HODGES	HAMMER: CME AUTOMATIC	ALIGNMENT:
PID: 109129 SFN:	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 12/5/19	ELEVATION: 0.0 (MSL) EOB: 10.5 ft.
START: 7/15/20 END: 7/15/20	SAMPLING METHOD: SPT	ENERGY RATIO (%): 81.9	COORD: Not Recorded

EXPLORATION ID B-003-0-19

PAGE 1 OF 1

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	BACK FILL
HARD, BROWN, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, CONTAINS TRACE IRON STAINING, DAMP	0.0																		
		1																	
		2																	
		3	2 4 6	14	56	SS-1	4.50	3	5	14	40	38	35	19	16	16	A-6b (10)	150	
	-4.5	4																	
HARD, BROWN, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, CONTAINS TRACE IRON STAINING, DAMP		5																	
		6	6 10 15	34	100	SS-2	4.50	7	8	15	37	33	31	18	13	14	A-6a (8)	-	
		7																	
	-9.0	8	4 6 10	22	100	SS-3	4.50	-	-	-	-	-	-	-	-	13	A-6a (V)	-	
HARD, GRAY AND ORANGISH BROWN, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, CONTAINS IRON STAINING, DAMP		9																	
	-10.5	10	6 10 11	29	100	SS-4	4.50	-	-	-	-	-	-	-	-	14	A-4a (V)	-	
	EOB																		

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: SHOVELED SOIL CUTTINGS

PROJECT: ASD-250-12.74	DRILLING FIRM / OPERATOR: NEAS / J. HODGES	DRILL RIG: CME 55X	STATION / OFFSET:
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: NEAS / J. HODGES	HAMMER: CME AUTOMATIC	ALIGNMENT:
PID: 109129 SFN:	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 12/5/19	ELEVATION: 0.0 (MSL) EOB: 10.5 ft.
START: 7/15/20 END: 7/15/20	SAMPLING METHOD: SPT	ENERGY RATIO (%): 81.9	COORD: Not Recorded

EXPLORATION ID B-004-0-19

PAGE 1 OF 1

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	BACK FILL
HARD, BROWN, **SILT AND CLAY**, LITTLE SAND, LITTLE GRAVEL, DAMP **(FILL)**	0.0																		
	-4.5	1 2 3 4	4 4 5	12	44	SS-1	4.50	11	6	14	38	31	31	18	13	15	A-6a (8)	<100	
HARD, BROWN AND DARK BROWN, **SANDY SILT**, LITTLE TO SOME GRAVEL AND STONE FRAGMENTS, LITTLE CLAY, SS-3 CONTAINS COAL FRAGMENTS, DAMP **(FILL)**		5 6 7	4 5 6	15	56	SS-2	4.50	26	18	15	28	13	23	18	5	10	A-4a (1)	-	
	-9.0	8 9	6 13 15	38	67	SS-3	4.50	-	-	-	-	-	-	-	-	15	A-4a (V)	-	
MEDIUM STIFF, BROWN AND GRAY, **SILT**, SOME CLAY, LITTLE SAND, TRACE GRAVEL, WET	-10.5	10 EOB	4 1 2	4	100	SS-4	0.75	1	4	11	63	21	28	20	8	26	A-4b (8)	-	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: SHOVELED SOIL CUTTINGS

PROJECT: ASD-250-12.74	DRILLING FIRM / OPERATOR: NEAS / J. HODGES	DRILL RIG: CME 55X	STATION / OFFSET:
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: NEAS / J. HODGES	HAMMER: CME AUTOMATIC	ALIGNMENT:
PID: 109129 SFN:	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 12/5/19	ELEVATION: 0.0 (MSL) EOB: 10.5 ft.
START: 7/15/20 END: 7/15/20	SAMPLING METHOD: SPT	ENERGY RATIO (%): 81.9	COORD: Not Recorded

EXPLORATION ID B-005-0-19

PAGE 1 OF 1

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	BACK FILL
HARD, BROWN, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, DAMP	0.0																		
	-4.5	1 2 3 4	5 7 6	18	100	SS-1	4.50	10	10	16	38	26	23	15	8	12	A-4a (6)	190	
HARD, BROWN, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, DAMP	-7.0	5 6 7	4 5 7	16	100	SS-2	4.50	5	8	14	45	28	30	19	11	16	A-6a (8)	-	
HARD, BROWN, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, DAMP	-10.5	8 9 10	5 6 7	18	100	SS-3	4.50	-	-	-	-	-	-	-	-	11	A-4a (V)	-	
	EOB		6 7 10	23	100	SS-4	4.50	-	-	-	-	-	-	-	-	15	A-4a (V)	-	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: SHOVELED SOIL CUTTINGS

PROJECT: ASD-250-12.74	DRILLING FIRM / OPERATOR: NEAS / J. HODGES	DRILL RIG: CME 55X	STATION / OFFSET:
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: NEAS / J. HODGES	HAMMER: CME AUTOMATIC	ALIGNMENT:
PID: 109129 SFN:	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 12/5/19	ELEVATION: 0.0 (MSL) EOB: 10.5 ft.
START: 7/15/20 END: 7/15/20	SAMPLING METHOD: SPT	ENERGY RATIO (%): 81.9	COORD: Not Recorded

EXPLORATION ID B-006-0-19

PAGE 1 OF 1

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	BACK FILL
HARD, BROWN, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, DAMP	0.0																		
		1																	
		2																	
		3	5 4 5	12	100	SS-1	4.50	8	9	17	37	29	29	17	12	10	A-6a (7)	<100	
	-4.5	4																	
VERY STIFF TO HARD, BROWN, **SANDY SILT**, LITTLE TO SOME CLAY, LITTLE TO SOME GRAVEL AND STONE FRAGMENTS, DAMP		5	5 5 5	14	100	SS-2	4.50	15	14	17	34	20	27	17	10	11	A-4a (4)	-	
		6																	
		7																	
		8	5 6 5	15	89	SS-3	4.50	-	-	-	-	-	-	-	-	13	A-4a (V)	-	
		9	5 4 4	11	67	SS-4	3.00	-	-	-	-	-	-	-	-	16	A-4a (V)	-	
	-10.5	10																	
	EOB																		

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: SHOVELED SOIL CUTTINGS

LOG OF BORING

Date Started 4-17-80 | Sampler Type SS | Dia. 2" & 3 3/8" | Water Elev. _____

Date Completed 4-18-80 | Casing: Length _____ | Dia. _____

Boring No. B-1 | Station & Offset 112+30, 15' RT (CULVERT) | Surface Elev. _____

NAVD 88 = 1066.713

Elev.	Depth	Std. Pen. (N)	Rec. ft.	Loss ft.	Description	Sample No.	Physical Characteristics								SHTL Class.
							% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	
1067.33	0														
1064.88	2														
	4	AUGERED			BROWN AND GRAY CLAYEY GRAVEL - TOP OF ROCK?	1	56	55	11	20	12	28	13	11.9	A-2-6
1062.33															
1061.33	6	57/0.5			BROWN SANDY CLAY WITH STONE FRAGMENTS	2	16	10	1	44	29	32	11	11	A-6a
1059.88	8				CLAY SHALE, WEATHERED - DRILLER'S DESCRIPTION										
	10		2.4	0.1	CLAY SHALE, BROWN AND GRAYISH-BROWN, GENERALLY CRUMBLY, WEATHERED WITH THICK CLAY SEAMS, FISSILE, BROKEN. CORE LOSS 7%.										
1056.55	12		4.8	0.2	SILTSTONE, GRAY, FIRM WITH SCATTERED INTERVALS OF GRAY, WEATHERED FISSILE CLAY SHALE, BROKEN. NO CORE LOSS.										
1052.33	14				BOTTOM OF BORING										

LOG OF BORING

Date Started 4-16-80 | Sampler Type SS | Dia. 1 3/8" | Water Elev.
Date Completed 4-16-80 | Casing: Length | Dia. | NAVD 88 = 1066.913
Boring No. CB-2 | Station & Offset 13+00, 20' RT. (CULVERT Road) | Surface Elev.

Elev.	Depth	Std. Pen. (N)	Rec. ft.	Loss ft.	Description	Sample No.	Physical Characteristics: % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	SHTL Class.
1067.5	0														
1065.0	2														
	4	AUGERED			GRAY WITH BROWN GRAVELLY SANDY SILT Soil	1	18	11	16	26	29	28	8	22	A-4a
1062.5	6	1/1/3 (013)			BROWN WITH GRAY SILT Soil	2	9	22	27	34	28	25	7	29	A-4b
1060.0	8	50/3" (50/1")			GRAY WITH BROWN SANDY SILTSTONE FRAGMENTS	3	30	18	10	30	20	28	7	20	A-4a
1057.5	10	50/0"			TOP OF ROCK										
	12		4.9	0.1	SILTSTONE, GRAY, FIRM WITH SCATTERED INTERVAL OF GRAY, WEATHERED FISSILE CLAY SHALE, BROKEN. CORE LOSS 10%.										
1052.5	14				BOTTOM OF BORING										

* GRAY, SANDY SHALE

VISUAL

State of Ohio
Department of Transportation
Office of Geotechnical Engineering

LOG OF BORING

Date Started 12/16/03 Sampler: Type SS Dia. ____ Water Elev. - Project Identification: ASHLAND
Date completed 12/16/03 Approx. ASD-250-12.75
Boring No. B-3 Station & Offset 674+00, 22' RT. Surface Elev. 1081.0' SUBGRADE INVESTIGATION

N = 444,707.52 & E = 2,016,756.17

Elev.	Depth	Std. Pen./ R.Q.D.	Rec. ft	Loss ft	Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
1081.0	0														
1080.0		AUGERED			ASPHALT	-	-	-	-	-	-	-	-	-	VISUAL
1078.5	2	7/10/12			BROWN GRAVELLY SANDY SILT (REC. 1.5')	1	21	10	13	30	26	26	9	15	A-4a
1077.0	4	12/17/19			BROWN AND GRAY GRAVELLY SANDY SILT (REC. 1.5')	2	-	-	-	-	-	-	-	15	VISUAL
1075.5		21/27/24			BROWN GRAVELLY SANDY SILT (REC. 1.5')	3	18	9	15	33	25	26	9	14	A-4a

BOTTOM OF BORING

Particle Sizes: Agg= >2.00mm, Coarse Sand= 2.00-0.42mm, Fine Sand= 0.42-0.074mm, Silt= 0.074-0.005mm, Clay= <0.005mm

State of Ohio
Department of Transportation
Office of Geotechnical Engineering

LOG OF BORING

Date Started 12/30/03 Sampler: Type SS Dia. — Water Elev. — Project Identification: ASHLAND
Date completed 12/30/03 674+00, 2' L. OF RAMP A SOUTH Approx. ASD-250-12.75
Boring No. B-4 Station & Offset SIDE EOP Surface Elev. 1097.8' SUBGRADE INVESTIGATION

N = 444,820.48 & E = 2,016,602.23

Elev. 1097.8	Depth 0	Std. Pen./ R.O.D.	Rec. ft	Loss ft	Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
1096.3	2	AUGERED			1.2' ASPHALT & 0.3' SUBBASE	-	-	-	-	-	-	-	-	-	VISUAL
1094.8	4	2/3/4			BROWN SANDY CLAY (REC. 1.5')	91	14	10	12	33	31	29	11	20	A-6a
1093.3	6	6/10/9			BROWN SANDY SILT & CLAY W/GRAVEL & ASPHALT FRAGS. (FILL MATL.) (REC. 1.5')	92	-	-	-	-	-	-	-	18	VISUAL
1091.8		9/10/14			BROWN SANDY GRAVELLY CLAY (REC. 1.5')	93	20	6	10	32	32	33	14	18	A-6a

BOTTOM OF BORING

Particle Sizes: Agg= >2.00mm, Coarse Sand= 2.00-0.42mm, Fine Sand= 0.42-0.074mm, Silt= 0.074-0.005mm, Clay= <0.005mm

Form TE-45 Revised 5/95

State of Ohio
Department of Transportation
Office of Geotechnical Engineering

LOG OF BORING

Date Started 12/16/03 Sampler: Type SS Dia. Water Elev. - Project Identification: ASHLAND
Date completed 12/16/03 Approx. ASD-250-12.75
Boring No. B-5 Station & Offset 677+10, 9' RT. Surface Elev. 1073.6' SUBGRADE INVESTIGATION
N = 444,693.49 & E = 2,016,920.52

Elev.	Depth	Std. Pen./ R.Q.D.	Rec. ft	Loss ft	Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
1073.6	0	AUGERED			ASPHALT	-	-	-	-	-	-	-	-	-	VISUAL
1072.4															
1072.1	2														
1070.6		10/14/10			BROWN SILTY GRAVELLY SAND (REC. 1.5')	1	33	17	16	23	11	23	4	12	A-2-4
1069.1	4	10/7/8			BROWN SILTY GRAVELLY SAND (REC. 1.3')	2	-	-	-	-	-	-	-	11	VISUAL
1067.6	6	9/5/6			BROWN SILTY GRAVELLY SAND (REC. 1.3')	3	32	23	15	21	9	23	5	11	A-2-4

BOTTOM OF BORING

Particle Sizes: Agg= >2.00mm, Coarse Sand= 2.00-0.42mm Fine Sand= 0.42-0.074mm, Silt= 0.074-0.005mm, Clay= <0.005mm

APPENDIX C

PAVEMENT CORE REPORT

Core Photo: P.C.-1

Pavement Photo

Core Information				
Core Diameter (in):			**4.00**	
Core Total Length (in):			**12.75**	
Layers	Core Composition & Thickness (in)			Remarks
	Asphalt	Concrete	Brick	
1	3.00			
2	9.75			
3				
4				
Rebar Encountered	N/E			

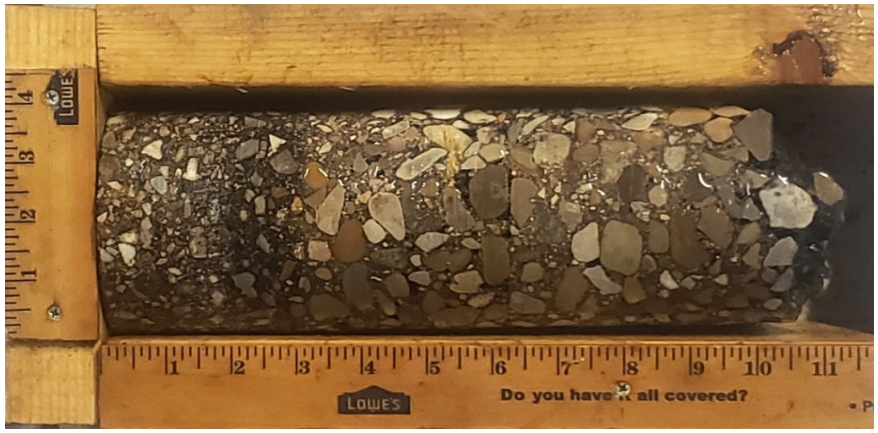
Pavement & Core Photo Log

National Engineering & Architectural Services Inc.

Roadway Project

NEAS Project No.: ASD-250-12.74
Date: 9/23/2020
Taken By: MJ
Scale: N/A

Core Photo: P.C.-2



Pavement Photo

Core Information				
Core Diameter (in):			**4.00**	
Core Total Length (in):			**11.5**	
Layers	Core Composition & Thickness (in)			Remarks
	Asphalt	Concrete	Brick	
1	3.00			
2	8.50			
3				
4				
Rebar Encountered	N/E			

Pavement & Core Photo Log

National Engineering & Architectural Services Inc.

Roadway Project

NEAS Project No.: ASD-250-12.74
Date: 9/23/2020
Taken By: MJ
Scale: N/A

Core Photo: P.C.-3

Pavement Photo

Core Information				
Core Diameter (in):			**4.00**	
Core Total Length (in):			**13.75**	
Layers	Core Composition & Thickness (in)			Remarks
	Asphalt	Concrete	Brick	
1	4.25			
2	9.50			
3				
4				
Rebar Encountered	N/E			

Pavement & Core Photo Log

National Engineering & Architectural Services Inc.

Roadway Project

NEAS Project No.: ASD-250-12.74
Date: 9/23/2020
Taken By: MJ
Scale: N/A

APPENDIX D

GEOTECHNICAL BULLETIN 1 (GB1) ANALYSIS SPREADSHEETS

OHIO DEPARTMENT OF TRANSPORTATION

OFFICE OF GEOTECHNICAL ENGINEERING

PLAN SUBGRADES
Geotechnical Bulletin GB1

ASD-250-12.74
PID 109129

Construction of a single-lane roundabout - Faultless Drive / US-250

NEAS, Inc.

Prepared By: Zhao Mankoci
Date prepared: Thursday, October 01, 2020

Melinda He
2800 Corporate Exchange Drive
Ste 240
Columbus, OH 43231
(216)258-4072
che@neasinc.com

NO. OF BORINGS: 6

#	Boring ID	Alignment	Station	Offset	Dir	Drill Rig	ER	Boring EL.	Proposed Subgrade EL	Cut Fill
1	B-001-0-19	US-250	46+98	5	LT	CME 55X	82	1076.6	1074.8	1.8 C
2	B-002-0-19	US-250	49+56	57	RT	CME 55X	82	1075.6	1076.0	0.4 F
3	B-003-0-03	US-250	50+78	31	RT		60	1081.0	1075.0	6.0 C
4	B-004-0-03	US-250	50+74	73	LT		60	1097.8	1075.1	22.7 C
5	B-005-0-03	US-250	54+05	11	RT		60	1073.6	1066.9	6.7 C
6	B-003-0-19	US-250	55+42	21	RT	CME 55X	82	1063.8	1063.4	0.4 C

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	2.5	4.0	0.7	2.2	19		4.5	30	18	12	34	19	53	9	14	A-6a	4	113					
	001-0	SS-2	5.0	6.5	3.2	4.7	10		2.75	36	18	18	41	34	75	19	16	A-6b	11						
	19	SS-3	7.5	9.0	5.7	7.2	19		4.5							13	14	A-6a							
		SS-4	9.0	10.5	7.2	8.7	79	10								10	6	A-1-b							
2	B	SS-1	2.5	4.0	2.9	4.4	23		4.5	26	15	11	29	20	49	9	14	A-6a	3	133					
	002-0	SS-2	5.0	6.5	5.4	6.9	26		4.5	25	17	8	38	25	63	13	12	A-4a							
	19	SS-3	7.5	9.0	7.9	9.4	27		4.5							14	10	A-4a							
		SS-4	9.0	10.5	9.4	10.9	31	23								13	10	A-2-4							
3	B	SS-1	1.0	2.5	-5.0	-3.5	22			26	17	9	30	26	56	15	12	A-4a	4						
	003-0	SS-2	2.5	4.0	-3.5	-2.0	36									15	10	A-4a	8						
	03	SS-3	4.0	5.5	-2.0	-0.5	51			26	17	9	33	25	58	14	12	A-4a	5						
								30																	
4	B	SS-1	1.5	3.0	-21.2	-19.7	7			29	18	11	33	31	64	20	14	A-6a	6						
	004-0	SS-2	3.0	4.5	-19.7	-18.2	19									18	14	A-6a	10						
	03	SS-3	4.5	6.0	-18.2	-16.7	24			33	19	14	32	32	64	18	14	A-6a	7						
								24																	
5	B	SS-1	1.5	3.0	-5.2	-3.7	24			23	19	4	23	11	34	12	10	A-2-4	0						
	005-0	SS-2	3.0	4.5	-3.7	-2.2	15									11	10	A-2-4	0						
	03	SS-3	4.5	6.0	-2.2	-0.7	11			23	18	5	21	9	30	11	10	A-2-4	0						
								11																	
6	B	SS-1	2.5	4.0	2.1	3.6	14		4.5	35	19	16	40	38	78	16	16	A-6b	10	153					
	003-0	SS-2	5.0	6.5	4.6	6.1	34		4.5	31	18	13	37	33	70	14	14	A-6a	8						
	19	SS-3	7.5	9.0	7.1	8.6	22		4.5							13	14	A-6a							
		SS-4	9.0	10.5	8.6	10.1	29	14	4.5							14	10	A-4a							

PID: PID 109129

County-Route-Section: ASD-250-12.74

No. of Borings: 6

Geotechnical Consultant: NEAS, Inc.

Prepared By: Zhao Mankoci

Date prepared: 10/1/2020

Chemical Stabilization Options		
320	Rubblize & Roll	Option
206	Cement Stabilization	Option
	Lime Stabilization	No
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	7

% Samples within 6 feet of subgrade			
$N_{60} \leq 5$	0%	HP ≤ 0.5	0%
$N_{60} < 12$	14%	0.5 < HP ≤ 1	0%
$12 \leq N_{60} < 15$	14%	1 < HP ≤ 2	0%
$N_{60} \geq 20$	43%	HP > 2	100%
M+	0%		
Rock	0%		
Unsuitable	0%		

Excavate and Replace at Surface	
Average	0"
Maximum	0"
Minimum	0"

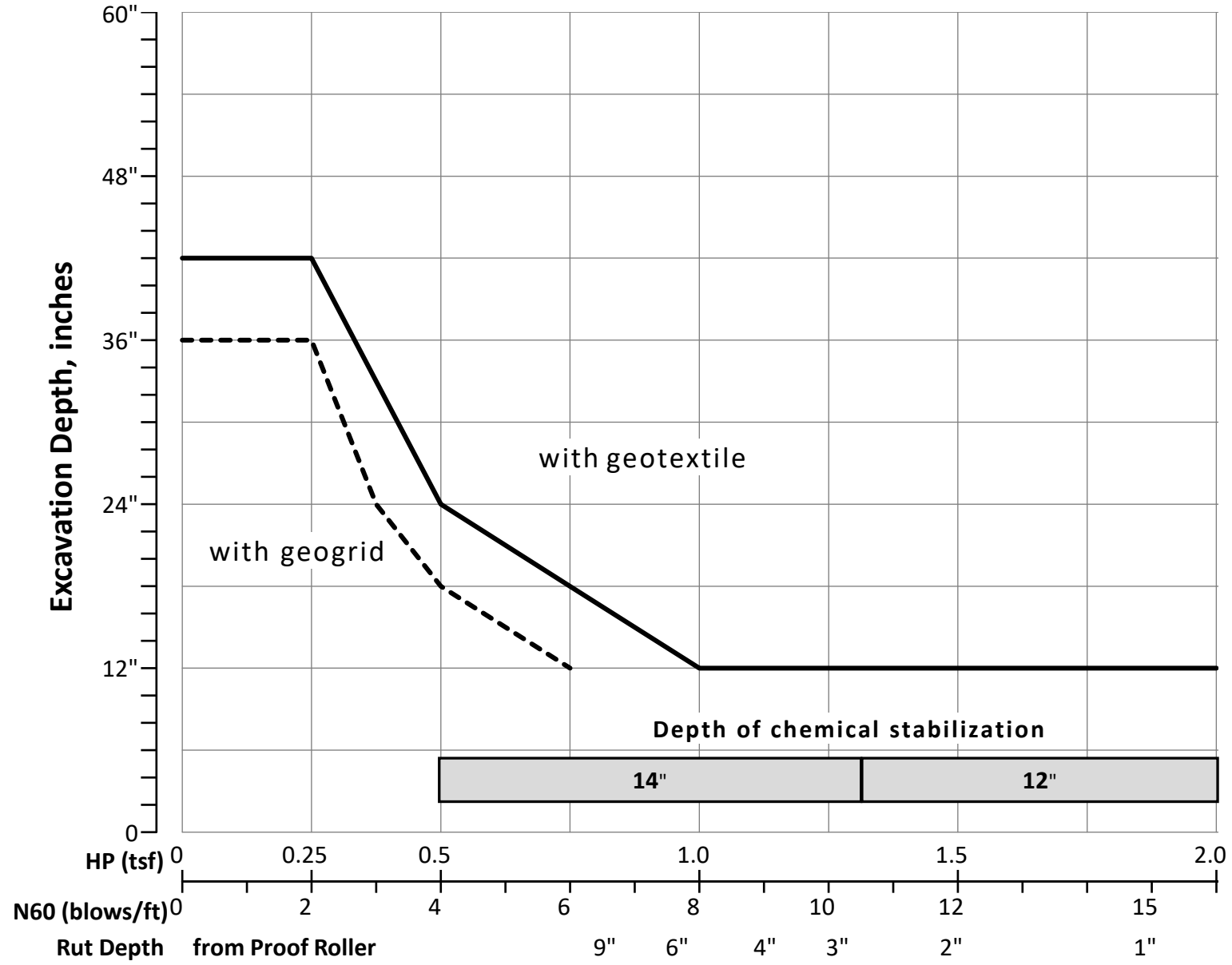
% Proposed Subgrade Surface	
Unstable & Unsuitable	0%
Unstable	0%
Unsuitable	0%

	N_{60}	N_{60L}	HP	LL	PL	PI	Silt	Clay	P 200	M_C	M_{OPT}	GI
Average	28	19	4.33	31	18	13	37	28	65	13	13	7
Maximum	79	30	4.50	36	19	18	41	38	78	20	16	11
Minimum	7	10	2.75	23	15	4	21	9	30	9	6	0

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	1	1	0	0	0	0	0	3	0	0	5	2	0	0	0	0	12
Percent	0%	0%	8%	8%	0%	0%	0%	0%	0%	25%	0%	0%	42%	17%	0%	0%	0%	0%	100%
% Rock|Granular|Cohesive	0%	42%									58%								100%
Surface Class Count	0	0	0	3	0	0	0	0	0	3	0	0	4	1	0	0	0	0	11
Surface Class Percent	0%	0%	0%	27%	0%	0%	0%	0%	0%	27%	0%	0%	36%	9%	0%	0%	0%	0%	100%

GB1 Figure B – Subgrade Stabilization



OVERRIDE TABLE

Calculated Average	New Values	Check to Override
4.33	0.50	☐ HP
18.67	6.00	☐ N60L

Average HP
Average N_{60L}

OHIO DEPARTMENT OF TRANSPORTATION

OFFICE OF GEOTECHNICAL ENGINEERING

PLAN SUBGRADES
Geotechnical Bulletin GB1

ASD-250-12.74
PID 109129

Construction of a single-lane roundabout - SR-60 / US-250

NEAS, Inc.

Prepared By: Zhao Mankoci
Date prepared: Thursday, October 01, 2020

Melinda He
2800 Corporate Exchange Drive
Ste 240
Columbus, OH 43231
(216)258-4072
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NO. OF BORINGS: 8

#	Boring ID	Alignment	Station	Offset	Dir	Drill Rig	ER	Boring EL.	Proposed Subgrade EL	Cut Fill
1	B-001-0-80	SR 60	12+84	5	LT		60	1066.7	1070.6	3.9 F
2	B-002-0-80	SR 60	12+96	33	RT		60	1066.9	1070.9	4.0 F
3	B-004-0-19	SR 60	13+40	31	RT	CME 55X	82	1073.0	1072.2	0.8 C
4	B-002-0-19	SR 60	15+08	37	LT	CME 55X	82	1075.6	1075.7	0.1 F
5	B-003-0-03	SR 60	15+07	78	RT		60	1081.0	1075.7	5.3 C
6	B-004-0-03	SR 60	16+01	113	RT		60	1097.8	1076.7	21.1 C
7	B-005-0-19	SR 60	17+23	18	RT	CME 55X	82	1081.2	1079.9	1.3 C
8	B-006-0-19	SR 60	20+22	16	LT	CME 55X	82	1085.4	1084.3	1.1 C

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	1.5	4.0	5.4	7.9				28	15	13	20	12	32	19	10	A-2-6							
	001-0	SS-2	5.0	6.0	8.9	9.9	40			32	21	11	44	23	67	11	16	A-6a							
	80	SS-3	6.0	7.8	9.9	11.7											0	Rock							
								0																	
2	B	SS-1	1.5	4.0	5.5	8.0				28	20	8	28	29	57	22	15	A-4a							
	002-0	SS-2	5.0	6.5	9.0	10.5	5			25	18	7	54	28	82	29	13	A-4b							
	80	SS-3	7.5	9.0	11.5	13.0	59			28	21	7	30	20	50	20	16	A-4a							
								0																	
3	B	SS-1	2.5	4.0	1.7	3.2	12		4.5	31	18	13	38	31	69	15	14	A-6a	8	93					
	004-0	SS-2	5.0	6.5	4.2	5.7	15		4.5	23	18	5	28	13	41	10	13	A-4a	1						
	19	SS-3	7.5	9.0	6.7	8.2	38		4.5							15	10	A-4a							
		SS-4	9.0	10.5	8.2	9.7	4	12	0.75	28	20	8	63	21	84	26	15	A-4b							
4	B	SS-1	2.5	4.0	2.6	4.1	23		4.5	26	15	11	29	20	49	9	14	A-6a	3	133					
	002-0	SS-2	5.0	6.5	5.1	6.6	26		4.5	25	17	8	38	25	63	13	12	A-4a							
	19	SS-3	7.5	9.0	7.6	9.1	27		4.5							14	10	A-4a							
		SS-4	9.0	10.5	9.1	10.6	31	23								13	10	A-2-4							
5	B	SS-1	1.0	2.5	-4.3	-2.8	22			26	17	9	30	26	56	15	12	A-4a	4						
	003-0	SS-2	2.5	4.0	-2.8	-1.3	36									15	10	A-4a	8						
	03	SS-3	4.0	5.5	-1.3	0.2	51			26	17	9	33	25	58	14	12	A-4a	5						
								30																	
6	B	SS-1	1.5	3.0	-19.6	-18.1	7			29	18	11	33	31	64	20	14	A-6a	6						
	004-0	SS-2	3.0	4.5	-18.1	-16.6	19									18	14	A-6a	10						
	03	SS-3	4.5	6.0	-16.6	-15.1	24			33	19	14	32	32	64	18	14	A-6a	7						
								24																	
7	B	SS-1	2.5	4.0	1.2	2.7	18		4.5	23	15	8	38	26	64	12	10	A-4a	6	193					
	005-0	SS-2	5.0	6.5	3.7	5.2	16		4.5	30	19	11	45	28	73	16	14	A-6a	8						
	19	SS-3	7.5	9.0	6.2	7.7	18		4.5							11	10	A-4a							
		SS-4	9.0	10.5	7.7	9.2	23	16	4.5							15	10	A-4a							
8	B	SS-1	2.5	4.0	1.4	2.9	12		4.5	29	17	12	37	29	66	10	14	A-6a	7	0					
	006-0	SS-2	5.0	6.5	3.9	5.4	14		4.5	27	17	10	34	20	54	11	12	A-4a	4						
	19	SS-3	7.5	9.0	6.4	7.9	15		4.5							13	10	A-4a							
		SS-4	9.0	10.5	7.9	9.4	11	12	3							16	10	A-4a							

PID: PID 109129

County-Route-Section: ASD-250-12.74

No. of Borings: 8

Geotechnical Consultant: NEAS, Inc.

Prepared By: Zhao Mankoci

Date prepared: 10/1/2020

Chemical Stabilization Options		
320	Rubblize & Roll	Option
206	Cement Stabilization	Option
	Lime Stabilization	No
206	Depth	12''

Excavate and Replace Stabilization Options	
Global Geotextile Average(N60L):	12''
Average(HP):	0''
Global Geogrid Average(N60L):	0''
Average(HP):	0''

Design CBR	8

% Samples within 6 feet of subgrade			
$N_{60} \leq 5$	0%	HP ≤ 0.5	0%
$N_{60} < 12$	0%	0.5 < HP ≤ 1	0%
$12 \leq N_{60} < 15$	27%	1 < HP ≤ 2	0%
$N_{60} \geq 20$	27%	HP > 2	73%
M+	0%		
Rock	0%		
Unsuitable	13%		

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

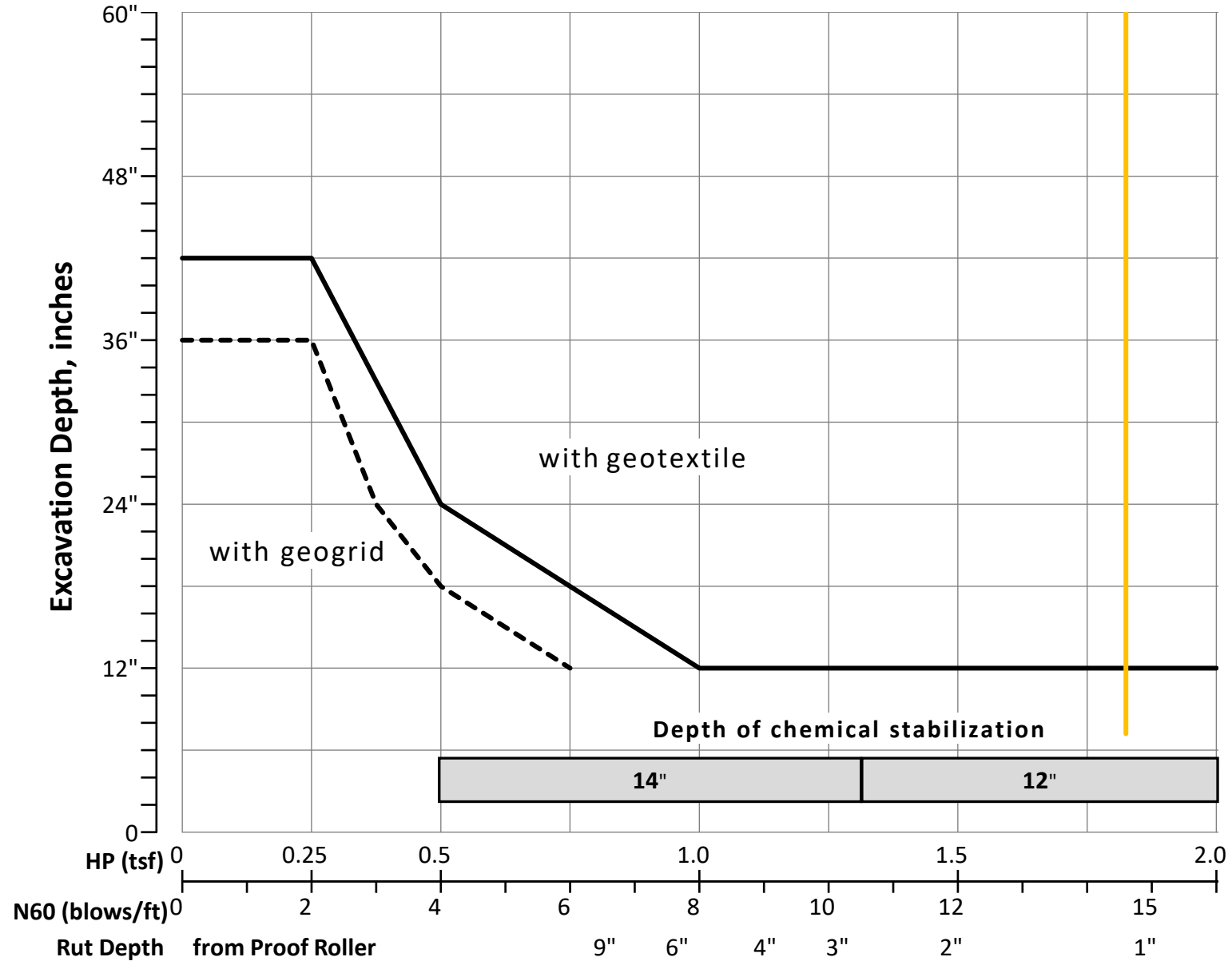
% Proposed Subgrade Surface	
Unstable & Unsuitable	0%
Unstable	0%
Unsuitable	0%

	N_{60}	N_{60L}	HP	LL	PL	PI	Silt	Clay	P 200	M_C	M_{OPT}	GI
Average	23	15	4.15	27	18	9	37	23	61	15	12	5
Maximum	59	30	4.50	33	21	14	63	32	84	29	16	10
Minimum	4	0	0.75	23	15	5	20	12	32	9	0	1

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	1	0	0	1	0	1	0	0	0	13	2	0	5	0	0	0	0	0	23
Percent	4%	0%	0%	4%	0%	4%	0%	0%	0%	57%	9%	0%	22%	0%	0%	0%	0%	0%	100%
% Rock|Granular|Cohesive	4%	65%									30%								100%
Surface Class Count	0	0	0	0	0	0	0	0	0	4	0	0	6	0	0	0	0	0	10
Surface Class Percent	0%	0%	0%	0%	0%	0%	0%	0%	0%	40%	0%	0%	60%	0%	0%	0%	0%	0%	100%

GB1 Figure B – Subgrade Stabilization



OVERRIDE TABLE

Calculated Average	New Values	Check to Override
4.15	0.50	☐ HP
14.63	6.00	☐ N60L

Average HP
Average N_{60L}

APPENDIX E

SULFATE CONTENT DATA

OHIO DEPARTMENT OF TRANSPORTATION

DETERMINING SULFATE CONTENT IN SOILS

SUPPLEMENT 1122

Project C-R-S:	ASD-250-12.74
PID No:	109129
Report Date:	9/29/2020
Consultant:	NEAS Inc.
Technician:	L. Rosenbeck

Boring ID & Sample #	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-001-0-20 SS-1					18.92	20	6	20	5	20	6	**113**
B-002-0-20 SS-1					16.25	20	6	20	8	20	6	**133**
B-003-0-20 SS-1					18.93	20	8	20	7	20	8	**153**
B-004-0-20 SS-1					16.25	20	4	20	5	20	5	**93**
B-005-0-20 SS-1					16.25	20	10	20	9	20	10	**193**
B-006-0-20 SS-1					16.25	20	0	20	0	20	0	**0**