Geotechnical Exploration - Revised
Franklin Street Improvement (CIP T-138)
Hilliard, Franklin County, Ohio
S&ME Project No. 1117-16-013

Prepared for:
Woolpert, Inc.
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May 3, 2017

May 3, 2017

Woolpert, Inc.
4454 Idea Center Blvd.
Dayton, OH 45430

Attention: Mr. Nathan Fischer, P.E.

Reference: **Geotechnical Exploration - Revised**
Franklin Street Improvement Project (CIP T-138)
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S&ME Project No. 1117-16-013

Mr. Fischer:

In accordance with our Change Order #1, Rev. #1 dated October 7, 2016, which was authorized on January 20, 2017, by Addendum 1 to the Woolpert Professional Services Subcontract executed on March 7, 2016, S&ME, Inc. (S&ME) is herewith submitting a revision to our Geotechnical Exploration report previously submitted on May 26, 2016.

The Franklin Street Improvement project includes providing a reconstructed pavement with curb and gutter, on-street parallel parking, sidewalks, improved drainage and storm water management, and a new waterline. The approximate site location is depicted on the Vicinity Map presented as Plate 1 in the Appendix of the report.

Our observations and recommendations associated with this Geotechnical Exploration are herewith submitted. This revised report includes updated subgrade remediation recommendations based on current profile information provided to S&ME on April 7, 2017, by Woolpert, and has been expanded to include pavement thickness recommendations based on anticipated traffic information provided by Woolpert.

We appreciate having been given the opportunity to be of continued service on this project. If you have any questions, please do not hesitate to contact our office.

Respectfully,

S&ME, Inc.

Richard S. Weigand, P.E.
Senior Engineer/Project Manager

STATE OF OHIO
Richard S. Weigand E-56910
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Appendix

1.0 Executive Summary

Based on the information provided to us by Woolpert, Inc., S&ME understands that the project consists of improvements to be made to the section of Franklin Street located between Main Street and roughly 900 feet southeast of Main Street in Hilliard, Ohio. The purpose of the Geotechnical Exploration is to obtain subsurface information, prepare an ODOT GB1 table for the revised roadway profile, provide recommendations for remediation of the roadway subgrade if required, present new pavement section alternatives, and provide discussion regarding utility construction.

S&ME performed three (3) borings, three (3) pavement cores, and two (2) field percolation/infiltration tests for this section of Franklin Street. In general, existing fill was encountered in all three (3) borings to depths of 2.5 to 8.0 feet below the existing ground surface, with the fill being described as stiff to hard CLAY (A-7-6), SILT AND CLAY (A-6a), and SILTY CLAY (A-6b). Beneath the fill, the natural soils consisted of SILTY CLAY (A-6b) and SILT AND CLAY (A-6a) which ranged widely in consistency, from medium-stiff to hard.

The following are items addressed in more detail in this report:

- Using the ODOT Geotechnical Bulletin (GB1) spreadsheet (ver.13.00), the average California Bearing Ratio (CBR) computed based on test results from the three (3) borings is 6%.
- New pavement section alternatives are presented in Section 6.3, based on anticipated traffic information provided by Woolpert.
- The natural soils should be suitable for support of the proposed utility pipes/structures. The soils to be excavated are anticipated to weigh more than the pipe or manhole/catch basin structure to be installed, so bearing should be adequate and settlement minimal.
- Two (2) field percolation tests were performed, with Test P-1 having a percolation rate of 120 minutes per inch (min/in), and Test P-2 seeing no drop in water level during the duration of the test.
- Borings B-1 through B-3 did not encounter seepage and/or groundwater below the existing pavement surface during drilling. The borings were also noted as being “dry” at the completion of drilling, that is to say, no measurable amount of water had collected in the borehole prior to backfilling. Extended water levels were not taken and the borings were backfilled upon completion.

2.0 Introduction

S&ME understands that it is proposed to improve approximately 900 feet of existing Franklin Street to the southeast of Main Street in Hilliard, Ohio. The proposed improvements are to include reconstruction of the existing pavement section, lowering the proposed profiles to incorporate curbs and gutters, providing on-street parallel parking, adding sidewalks, improving drainage and storm water management, and installing a new waterline. Based on revised profile information provided by Woolpert on April 7, 2017, we understand that the proposed improvements will require the roadway profile to be lowered 0.5 to 2.0 feet below existing grade. No information was available at this time regarding locations or invert elevations for utilities.

The purpose of the Geotechnical Exploration is to obtain subsurface information, prepare a revised ODOT GB1 table, provide recommendations addressing the roadway subgrade and new pavement section alternatives, and present discussions regarding utility construction. The general location of the project is shown on the Vicinity Map, included as Plate 1 of the Appendix.

3.0 Geology

Geologic references indicate that this site is located in a portion of Ohio which has been glaciated. The site lies along the edge of the Darby Plain and Columbus Lowland Physiographic region. The Darby Plain is a moderately low relief, broadly hummocky ground moraine with several broad, indistinct recessional moraines. Between hummocks are broad, poorly drained swales which previously held wet prairies/meadows and a few large streams. The overburden soils consist of predominantly Wiconsinan-age cohesive glacial till with a few areas of outwash over Silurian and Devonian-age carbonate rocks and Ohio shale in the southeast. The Columbus Lowland area is surrounded in all directions by relative uplands, having a broad regional slope toward the Scioto Valley with many larger streams. The overburden soils consist of predominantly loamy Wisconsinan-age till and extensive outwash in the Scioto Valley over Devonian to Mississippian-age carbonate rocks, shales, and siltstones. A review of available ODNR bedrock topography mapping indicates that bedrock may be present at depths in excess of 100 feet below the ground surface at this site.

The ODNR map of Ohio Karst Areas indicates that karst features are not known to be present in the immediate area of the site. Additionally, the ODNR Abandoned Underground Mines of Ohio map reveals that the site is not located over any mapped underground mines. Lastly, the ODNR Landslides in Ohio map does not indicate that the site is in a portion of the State having high susceptibility to landslides.

4.0 Exploration

4.1 Field Investigation

On March 21 and 22, 2016, S&ME personnel were on site to perform three (3) borings (B-1 through B-3), three (3) pavement cores (C-1 through C-3), and two (2) field percolation/infiltration tests (P-1 and P-2). Borings B-1 through B-3 were drilled to depths of 15 feet below the existing pavement surface. The approximate boring and core locations are shown on the Plan of Borings, submitted as Plate 2 of the Appendix. These locations of the borings/cores were selected and field marked by S&ME. Top of boring

elevations and profile information were provided by Woolpert. Photos taken during the site visit to field mark the boring and core locations are included as Plates 9 and 10 of the Appendix.

The borings were drilled by a truck-mounted drill rig using a 3¼-inch inside diameter (I.D.) hollow-stem auger to advance the boring between samples. Disturbed, but representative, soil samples were attempted continuously in the uppermost 6 feet of soil using a 2-inch O.D. split barrel sampler. The sampler was lowered through the auger stem to the bottom of the boring and then driven 18 inches into the soil with blows from a 140 pound hammer freely falling 30 inches (Standard Penetration Test, ASTM D-1586). Split-barrel samples were examined immediately after recovery and representative portions of each sample were placed in air-tight jars and retained for subsequent laboratory testing.

In the field, S&ME personnel provided overall supervision of the drilling and sampling procedures including the following specific duties: 1) examined all samples recovered from the borings; 2) preserved representative portions of all samples in airtight glass jars; 3) prepared a log of the borings; 4) made seepage and groundwater observations; 5) made hand-penetrometer measurements in specimens exhibiting cohesion; and, 6) provided liaison between the field work and the undersigned Senior Reviewer so that the exploration program could be modified in the event unusual or unexpected subsurface conditions were encountered.

At the completion of drilling, the borings were backfilled with cuttings, and the existing pavement surface was repaired with cold-patch asphalt. All recovered samples were then transported to the soils laboratory of S&ME for further examination and testing.

4.2 Laboratory Testing

In the laboratory, all samples were visually identified. Based upon the results of the laboratory visual identifications, soil descriptions contained on the field logs were modified, if necessary, and a laboratory-corrected logs are submitted as Plates 4 through 6 of the Appendix.

Soils have been classified in general accordance with Section 603 of the ODOT Specifications for Geotechnical Explorations (SGE), and described in general accordance with Section 602. An explanation of the symbols and terms used on the boring logs and definitions of the special adjectives used to denote the minor soil components are presented on Plate 3 of the Appendix.

Six (6) Atterberg limits tests were performed to provide engineering classification of the on-site soil. The liquid limit of the soil tested ranged from 29 to 46 percent and the plasticity index ranged from 13 to 27 percent. In addition, a grain size analysis was performed on six (6) soil samples, and the percentage of material finer than the No. 200 sieve ranged from 60 to 90 percent.

Natural moisture content testing was performed on all the samples. The moisture contents of the soils tested ranged from 10 to 28 percent, with moisture content values being above the corresponding plastic limit of the soil.

5.0 General Subsurface Conditions

5.1 Existing Pavement

Table 5-1 provides a summary of the existing pavement thicknesses recorded at the three borings and core location.

Table 5-1: Existing Pavement Thickness

Location	Asphalt Thickness (Inches)	Granular Base Thickness (Inches)
B-1	5	3.5
B-2/C-2	7	3.5
B-3	5.5	3.5
C-1	5	3.5
C-3	6	3.5

5.2 Soil Stratigraphy

Beneath the pavement, existing fill was encountered in all three (3) borings to depths of 2.5 to 8.0 feet below the existing ground surface, with the fill consisting of stiff to hard SILT AND CLAY (A-6a), CLAY (A-7-6), and SILTY CLAY (A-6b). Beneath the fill, the natural soils consisted of SILTY CLAY (A-6b) and SILT AND CLAY (A-6a), which ranged widely in consistency from medium-stiff to hard. For further detail of subsurface conditions encountered, refer to the individual boring logs presented on Plates 4 through 6 of the Appendix.

5.3 Groundwater Observations

Groundwater observations were made as each boring was being advanced and measurements were made at the completion of drilling. No seepage and/or groundwater was encountered in any of the borings during drilling operations. At the completion of drilling, all three (3) borings were noted as being "dry," that is to say, no measurable amount of water had collected in the borehole prior to backfilling.

6.0 Analyses and Recommendations

6.1 General Discussion

S&ME understands that improvements will be made to the approximate 900-foot-long section of Franklin Street located just southeast of Main Street in Hilliard. Some of the improvements will include completely replacing the existing pavement, along with adding curbs, sidewalks, on-street parallel parking, drainage and storm water improvements, and a waterline.

6.2 Pavement Subgrade

6.2.1 Pavement Subgrade Support Parameters

The table presented on Plate 11 of the Appendix is the ODOT Geotechnical Bulletin GB1 spreadsheet (Ver. 13.00, updated 03/16/16) distributed by the ODOT Office of Geotechnical Engineering (OGE) to summarize the soil type (by ODOT/HRB classification), group indices, depth, blow-counts, and Atterberg Limit values of the proposed subgrade soils encountered in the borings drilled for this project. This table also computes an average of the estimated values of the California Bearing Ratio (CBR) for the soils encountered at or below the anticipated subgrade level of the proposed roadway profile.

Based on the plan and profile information provided by Woolpert on April 7 2017, the following average California Bearing Ratio (CBR) is computed by the ODOT GB1 spreadsheet for the anticipated subgrade soils encountered during this investigation:

CBR: 6%

Based on this average value, and Section 203.1 of the ODOT Pavement Design Manual, the following value of Resilient Modulus (M_R) may be used during new pavement section design for this project.

M_R: 7,200 psi

These pavement subgrade support values may be used during pavement design on this project provided that the entire proposed pavement subgrade is prepared in strict accordance with Item 204 of the latest Ohio Department of Transportation (ODOT), Construction and Material Specifications (CMS) and that all borrow soil placed within 3 feet of the final subgrade level is capable of providing average subgrade support parameters which meet or exceed the above values. This subgrade evaluation also assumes that the subgrade for the new roadways is composed of the materials encountered in the borings. If, at the time of construction, it is determined that the subgrade consists of materials different than those encountered in the borings, the pavement design subgrade criteria should be reviewed and, if necessary, modified.

6.2.2 Unsuitable Subgrade Soils

Section H of ODOT Geotechnical Bulletin GB1, "Plan Subgrades", defines soil types that are considered unsuitable for pavement support and are recommended to be either removed and replaced, or chemically modified, regardless of their moisture content or blow counts. Unsuitable soil types include those with ODOT classifications of A-4b, A-2-5, A-5, A-7-5, A-8a, and A-8b, soil with a Liquid Limit greater than 65, or coal. **No soil types called out in GB1 Section H were encountered in the borings performed for this investigation**. If, however, any of these soil types are encountered during construction, they will need to be remediated.

Although no soil classified as SILT (A-4b) was encountered in any borings performed for this project, pockets of this material have been encountered by S&ME on other projects in the vicinity. If A-4b SILT is encountered during construction, the A-4b soil should be completely removed to a depth of at least three (3) feet below the anticipated subgrade level and replaced with compacted suitable borrow soil meeting the subgrade support requirements presented in the previous section of this report. If silt deposits are encountered within the project limits, S&ME recommends that test pits or hand sampling methods be

used to delineate the extent and depth of the silt deposits so that these unsuitable soils may be properly removed and replaced.

Because of the spacing of the explorations, it is possible that areas of unsuitable or organic subgrade materials not encountered in any of the borings may be encountered during proofrolling and earthwork operations. Visual observation of the proofrolling procedures by a geotechnical engineer or their designated representative may result in at least a partial reduction of undercutting of unsuitable soils in these areas. Additionally, S&ME recommends that construction traffic be minimized or restricted once the planned soil subgrade level has been exposed or attained.

6.2.3 GB1 Subgrade Remediation Recommendations

ODOT's Geotechnical Bulletin GB1 "Plan Subgrades" indicates that a comparison of the laboratory-measured moisture content to the estimated optimum moisture content of the subgrade soil, along with the normalized blow-count (N60) from SPT sampling, may be used as an indicator of the potential need for subgrade treatment or remediation of unstable subgrade soil. The acceptable options presented by GB1 to remediate and establish a stable soil subgrade are either to "excavate and replace", or chemically stabilize.

The GB1 table included on Plate 11 of the Appendix summarizes the laboratory-measured moisture content of the samples obtained from each boring with respect to their estimated optimum moisture contents, along with the lowest N value (N60L) obtained from the Standard Penetration Tests performed in each of these borings. This table also indicates the recommended Item 204 "excavate and replace" depths per GB1 at each boring location, along with an overall assessment of the suitability of various types of chemical stabilization on this project.

The results of the GB1 analysis (see GB1 table on Plate 11 of the Appendix) indicate that subgrade soil encountered at and just below the proposed subgrade level in two (2) of the three (3) boring locations (67%) may be problematic for with respect to pavement support. The analysis indicates that the options that could be considered for subgrade remediation per GB1 include:

- Boring B-2 - Item 204 "excavate and replace" 12 inches, or chemically stabilize the subgrade using lime to a depth of 12 inches;
- Boring B-3 - Item 204 "excavate and replace" 12 inches, or chemically stabilize the subgrade using cement to a depth of 12 inches.

Boring B-1 did not encounter potentially problematic soil at the proposed subgrade. As Boring B-1 is in an area of the proposed roadway where the new profile is to be lowered, typical Item 204.03 "Compaction of the Subgrade" should be performed once the planned subgrade elevation is attained.

ODOT GB1 indicates that where 30% or more of the subgrade area encounters problematic soils requiring remediation, consideration should be given to stabilizing the entire project (global stabilization). However, when considering chemical stabilization, the type of soils encountered at the proposed subgrade level in Boring B-2 are typically more suitable for lime stabilization, whereas those encountered in Boring B-3 would generally more receptive to cement as the chemical additive. Therefore, based on the variability of the soils encountered, the relatively short length of project, future maintenance/utility considerations where penetrating the stabilized layer, and the need for precautions to control dust from

the chemical additive in this residential area, S&ME recommends that consideration be given to remediating the subgrade using an "excavate and replace" approach for portions of this project (see Section 6.2.4).

S&ME understands, however, from recent conversations with the ODOT Office of Geotechnical Engineering (OGE), that the chemical stabilization approach is becoming more cost effective in smaller areas as more contractors are providing the services of chemical stabilization. With that being said, it may be prudent for the design team to consider both approaches and make a final decision considering cost, maintenance of traffic, the presence of any shallow utilities, and future maintenance excavations having to penetrate a chemically stabilized subgrade.

Additionally, if strict adherence with ODOT specifications is not required for this project, there is an additional and generally less expensive chemical additive (Calciment, provided by Mintek Resources, Inc.) which may be considered when performing cost comparisons between chemical stabilization and "excavate" and replace" for subgrade remediation.

6.2.4 "Excavate and Replace" Subgrade Remediation

Based on the results of the borings, S&ME recommends that 12 inches of "excavate and replace" subgrade remediation be performed in the areas described in Table 6-1. The lateral limits of the subgrade remediation using "excavate and replace" should also extend to 18 inches outside the proposed pavement or paved shoulders, including beneath curbs and gutters.

Table 6-1: Summary of GB1 Subgrade Remediation Recommendations

Estimated Limits	Recommended Remediation	Approximate Lateral Extents
STA 12+75 to End Project	12 inches undercut	18 inches beyond the edge of the pavement, including under new curbs

The estimated subgrade remediation depths presented in this report are based on the conditions encountered in the borings during this subsurface investigation. However, because the required amount of remediation is dependent on the moisture content of the subgrade soil at the time of construction, the ultimate decision on required remediation depths and limits should be based on observations during either proofrolling or test-rolling operations.

Existing underground utility lines may present beneath and adjacent to existing Franklin Street, and the type of material used and the relative compactness of backfill within the utility trenches are unknown. Some instability of utility trench backfill may occur during proofrolling and some remediation and/or recompaction of granular trench backfill may be necessary. Additionally, if water has accumulated within the utility backfill, the subgrade soil in the vicinity of any saturated utility trenches may also have become weak, soft, and wet such that proofrolling may identify these additional areas as requiring "excavate and replace" remediation. In any case, care should be taken not to disturb any shallow utilities during proofrolling and overexcavation activities.

6.2.5 Additional Subgrade Remediation Considerations

Because of the moisture sensitive nature of the cohesive soils (A-6a, A-6b, & A-7-6) encountered in the borings, S&ME recommends that construction traffic be minimized once the required subgrade level has been attained. Construction traffic resulting from cyclical haul routes or limited access points may increase the quantity of soil identified by proof rolling as requiring removal, particularly during periods of moist weather.

In accordance with Section F of ODOT GB1, where "excavate and replace" is used for subgrade remediation, Item 712.09 Geotextile Fabric Type D is to be placed at the bottom of the undercuts, and Item 204 Granular Material is to be used to backfill the overexcavations. S&ME recommends that Item 204 Granular Material, Type B or C be utilized. It should also be noted, however, that ODOT GB1 specifies that Item 204 Granular Material Type B without a geotextile fabric be utilized to backfill undercuts performed in the vicinity of any underdrains.

It is recommended that overexcavated subgrade areas backfilled with granular soil be drained to an underdrain, catch basin, or pipe. Additionally, if "excavate and replace" is to be used, Plan Note G121 from the ODOT L&D Manual, Vol. 3, should be used in the General Notes.

S&ME understands that the depth of existing utilities are unknown and may be present at depths less than the recommended excavate and replace depth presented in Section 6.2.4 above. If the presence of shallow existing utilities requires a reduction in subgrade remediation depth, it may be possible to reduce the required undercut depth by a few inches with the inclusion of a geogrid. The amount of undercut reduction possible will depend on the condition of the underlying subgrade soil, and what reduced thickness of geogrid and replacement stone is still necessary to pass the required proofroll.

6.2.6 Subgrade Preparation

From the beginning of the project to STA 12+75, where the GB1 table indicates that subgrade remediation is not required, the current profile information indicates that up to 2 feet of cut below the existing ground surface will be required to attain the proposed subgrade elevation.

Once the desired subgrade elevation has been attained in cut areas, the subgrade soil beneath the entire roadway area should be scarified and re-compacted to a depth of 12 inches below the subgrade level in accordance with ODOT CMS Item 204.03. During recompaction, the moisture content of the subgrade soil should be maintained or adjusted in accordance with ODOT CMS Item 203.07.A.

S&ME recommends that compaction of the subgrade and any granular material used to backfill areas of subgrade remediation be performed in accordance with either ODOT Item 203.07.B, or with ODOT Item 204.03 when within 12 inches of the planned subgrade level. Although the City of Hilliard Engineering Design Manual Section 4.7.1.C permits subgrade compaction to a minimum 95% of the maximum unit weight required by ODOT, S&ME believes that this reduced level of subgrade compaction may lead to long term pavement distress, and recommends that ODOT compaction specifications be required.

Following the completion of the subgrade remediation and the Item 204.03 scarification and recompaction of the subgrade in cut areas, the entire subgrade should be proofrolled in accordance with Item 204.06 of the ODOT CMS, with any weak or unsuitable areas repaired in accordance with Item

204.07. Following the completion of proofrolling, it is strongly recommended that construction traffic be restricted from traveling on the compacted subgrade until final acceptance proofrolling has been performed. Cohesive subgrade soils subjected to repeated moisture fluctuations, which may occur as a result of exposure to rainfall and/or surface water runoff, may exhibit subgrade instability.

6.3 Replacement Pavement Sections

Based on Section 4.7.3 of the City of Hilliard Engineering Design Manual, Franklin Street is classified as a Local Street in Old Hilliard. As such, the pavement section used for Franklin Street should have the minimum thickness designated for a "Neighborhood Collector". Therefore, in accordance with the Hilliard Engineering Design Manual, an acceptable new flexible pavement section for Franklin Street is presented in Table 6.3-1:

Table 6.3-1: Flexible Pavement Section - Hilliard Neighborhood Collector

Material	Thickness
ODOT Item 441 Asphalt Concrete Surface Course, Type 1, PG64-22 (448)	1½ inches
ODOT Item 407 Task Coat	--
ODOT Item 441 Asphalt Concrete Intermediate Course, Type 2 (448)	1½ inches
ODOT Item 301 Asphalt Concrete Base, PG64-22	4 inches
ODOT Item 304 Aggregate Base	6 inches

The Hilliard Engineering Design Manual also presents a minimum "Neighborhood Collector" pavement section for a rigid pavement including roller-compacted concrete (City of Columbus Supplemental Specification 1523). However, based on the anticipated traffic information provided by Woolpert, S&ME recommends the following roller-compacted concrete pavement section be provided as a minimum:

Table 6.3-2: Roller-Compacted Concrete Pavement Section

Material (2016 ODOT CMS)	Thickness
ODOT Item 441 Asphalt Concrete Surface Course, Type 1, PG64-22 (448)	1½ inches
ODOT Item 407 Task Coat	--
ODOT Item 441 Asphalt Concrete Intermediate Course, Type 2 (448)	1½ inches
City of Cols SS1523 Roller-compacted Concrete	6 inches
ODOT Item 304 Aggregate Base	6 inches

6.4 Cost Savings Considerations - Flexible Pavement Section

The Hilliard Engineering Design Manual indicates that the flexible pavement section presented previously in Table 6.3-1 is the *minimum* allowable pavement section for a Neighborhood Collector street. However, based on the anticipated traffic information provided by Woolpert, S&ME believes that the thickness of Item 301 Asphalt Concrete Base could be reduced to a thickness of 3 inches, and still provide the Structural Number required to support the anticipated traffic.

6.5 Utility Installation

6.5.1 Excavation Considerations

Existing utilities and pavement maybe present in the vicinity of the new utility alignment. In general, any existing underground utilities, pavement, or structures within the influence zone of an open-cut trench may be susceptible to lateral movements if the excavations are not fully braced as the excavations are performed. The influence zone of the trench may be determined by extending an imaginary line from the base of the excavation to the ground surface using an inclination of approximately 45 degrees with the horizontal. Therefore, provided the lateral distance to and the depth of the existing utility or structure are known, a determination may be made as to whether the utility or structure is in the zone which may be affected by the proposed excavation. The risk of lateral movement within the influence zone increases with both the length of the excavation and the time the trench remains open. Thus, requiring the contractor to limit open trench excavation length to that which can be backfilled the same day as the excavation is performed would reduce the risk of lateral movement of the trench side walls.

If there is no tolerance for lateral movement of an existing underground utility or above ground structure located within the influence zone of an excavation, S&ME recommends that the trench excavations be directly braced at the time of the excavation. To be effective, the bracing must be designed to minimize deflection along the entire height and be constructed "tight" against the retained soil, such as sheeting driven prior to excavation with bracing added as the excavation is lowered. If lateral movement cannot be tolerated, a bracing system must be installed before the excavation is made.

6.5.2 Pipe/Structure Support

In general, the natural soils exhibiting a stiff to hard consistency for cohesive soils (A-6b, A-6a, A-7-6), should be suitable for support of the proposed utility pipes and any manhole/catch basin structures. The soils excavated are anticipated to weigh more than the pipe/structure to be installed, so bearing should be adequate and settlement minimal.

If weaker cohesive soils or soil disturbed by construction activity are present at pipe and/or structure invert elevations, then theses unsuitable soils should be removed and replaced with compacted suitable fill.

If an overexcavation of 2 feet is not enough to stabilize the bottoms of the excavation, then we recommend stabilizing the bearing/invert level by overexcavating a maximum of 2 feet of the weak/unsuitable soil, and then placing a layer of geogrid and stone (such as Tensar Geogrid BX 1300 with No. 2 stone). If desired, the No. 2 stone may be choked off with a layer of ODOT Item 304 stone. Any required granular bedding material may then be placed on top of the stone backfill.

6.5.3 Backfilling Recommendations

In areas where backfill will be placed within utility excavations that are below or within the zone of influence of pavement or buildings/structures (as described in Section 6.5.1 "Excavation Considerations" of this report), the backfill should be placed and compacted in accordance with Item 203, "Embankment Compaction", of the ODOT CMS. All utility trench backfill lying outside the zone of influence of pavement

loads and any future building/structure loads may be compacted to a dry unit weight of no less than 95% of the maximum dry unit weight as determined by ASTM D698.

Regardless of the compactive effort applied, S&ME recommends that the moisture content of all backfill be maintained within -2% to +2% of the optimum moisture content during all compaction operations. All soil to be used as backfill should consist of non-organic soil free of miscellaneous debris, cobbles, and boulders. The backfill should not be in a frozen condition during placement and should not be placed on a frozen subgrade. The final determination of whether a soil is suitable for structural backfill should be made in the field as construction proceeds.

6.6 Infiltration Results

During the field exploration, S&ME performed two (2) field percolation tests (P-1 and P-2). Following an overnight saturation period, the water level in P-1 was adjusted to 7 inches above the bottom of the gravel and P-2 still had water remaining from the saturation period. Measurements were recorded at half hour increments for a four hour period.

Test P-1: After two of the measurements (30 minute and 60 minute) water was added to maintain the initial water level. Total drop in water over the test period was roughly 16¼ inches. The water level dropped ¼ inch over the last half hour of the test. Therefore, the percolation rate at the location of Test P-1 was measured to be 120 minutes/inch.

Test P-2: After two measurements (30 minutes and 60 minutes), the water was still remaining from the saturation period. The water level did not drop over the last half hour of the test.

6.7 Groundwater Considerations

During this investigation, Borings B-1 through B-3 did not encounter seepage and/or groundwater below the pavement surface. The borings were noted as being "dry," that is to say no measurable amount of water had collected in the borehole prior to backfilling. Extended water levels were not taken and borings were backfilled upon completion.

Based on these observations, significant groundwater problems are not anticipated in connection with roadway improvements. Depending on the time of year for construction, it should be anticipated that a limited amount of groundwater may be encountered during excavation for the utilities. Additionally, other existing underground utilities are present in the vicinity of the proposed utilities, and water may be present in the existing backfill for these lines, and where encountered, result in additional water inflow. If pumping from a system of sumps cannot sufficiently maintain the water level below utility invert elevations, then more extensive dewatering techniques, may be necessary.

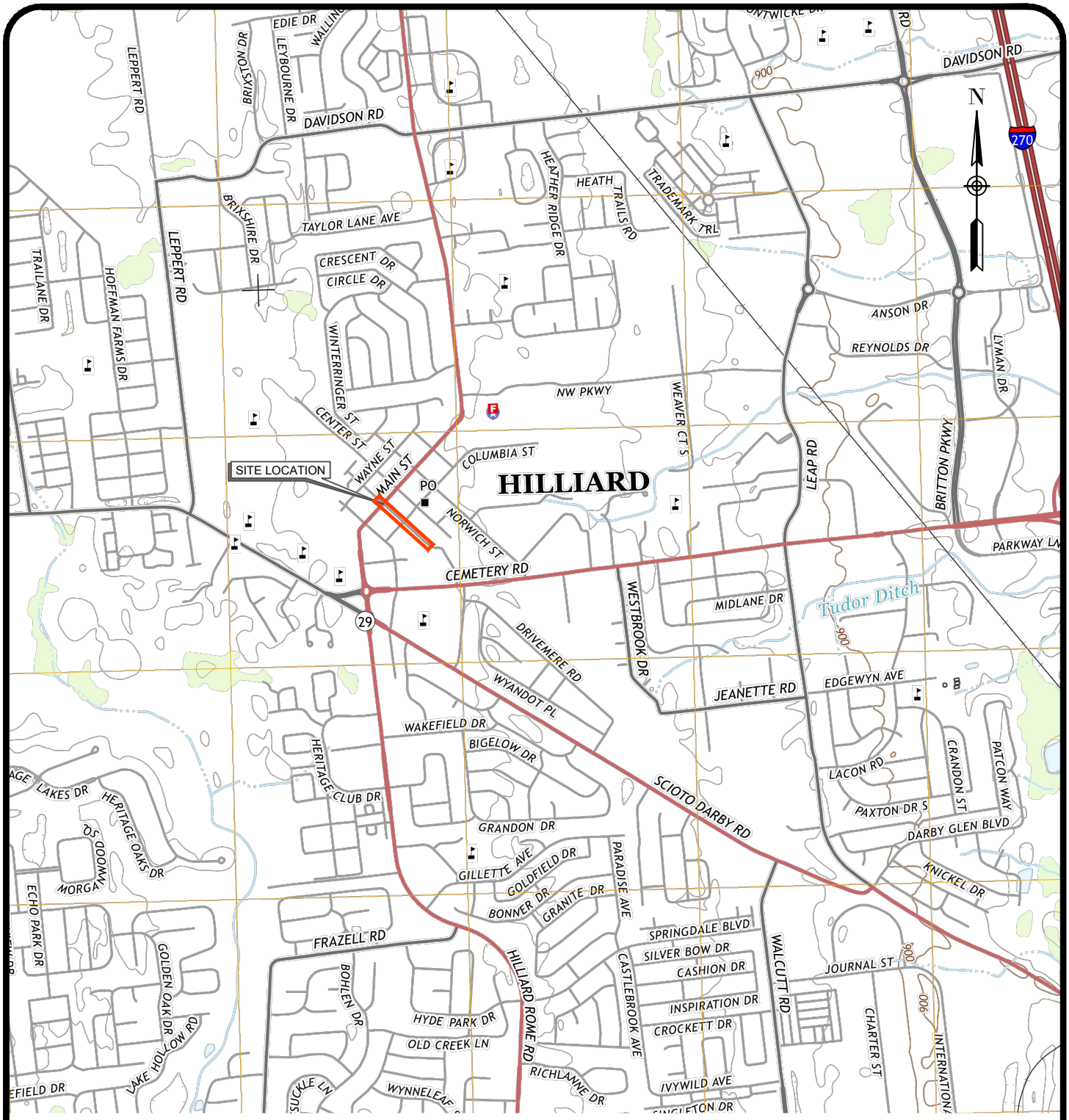
The presence of water in trenches, coupled with construction activity, will soften and weaken any cohesive soils present at the bottom of the excavations, and these affected materials may cause settlement beneath a pipe or structure following backfilling. Therefore, the bottom of all excavations should be kept free of standing water, and any softened, weakened, or disturbed materials should be removed and replaced with select granular backfill.

7.0 Final Considerations

The analyses, conclusions and recommendations presented in this report are based on project information provided by Woolpert. We request that S&ME be retained to review the final design plans and specifications to verify that the intent of our engineering recommendations have been properly incorporated into the design documents. It is also recommended that S&ME be retained to observe the subgrade proofrolling and roadway subgrade construction for the project to confirm that our recommendations are valid or to modify them accordingly. S&ME cannot assume responsibility or liability for the adequacy of recommendations if S&ME is not retained to observe construction.

The contents of this report are also based on the subsurface conditions as they existed at the time of our field investigation, and further on the assumption that the exploratory borings are representative of actual subsurface conditions throughout the area investigated. It should be noted that actual subsurface conditions between and beyond the borings might differ from those encountered at the boring locations. If subsurface conditions varying from those discussed in this report are encountered during construction, S&ME should be notified immediately so that we may evaluate the effects, if any, on design and construction.

Appendix



USGS Mapping:
Northwest Columbus Quad

0 2000 4000
GRAPHIC SCALE Feet

SCALE:	1"=2000'
DATE:	5-18-2016
DRAWN BY:	DCV
PROJECT NO:	1117-16-013

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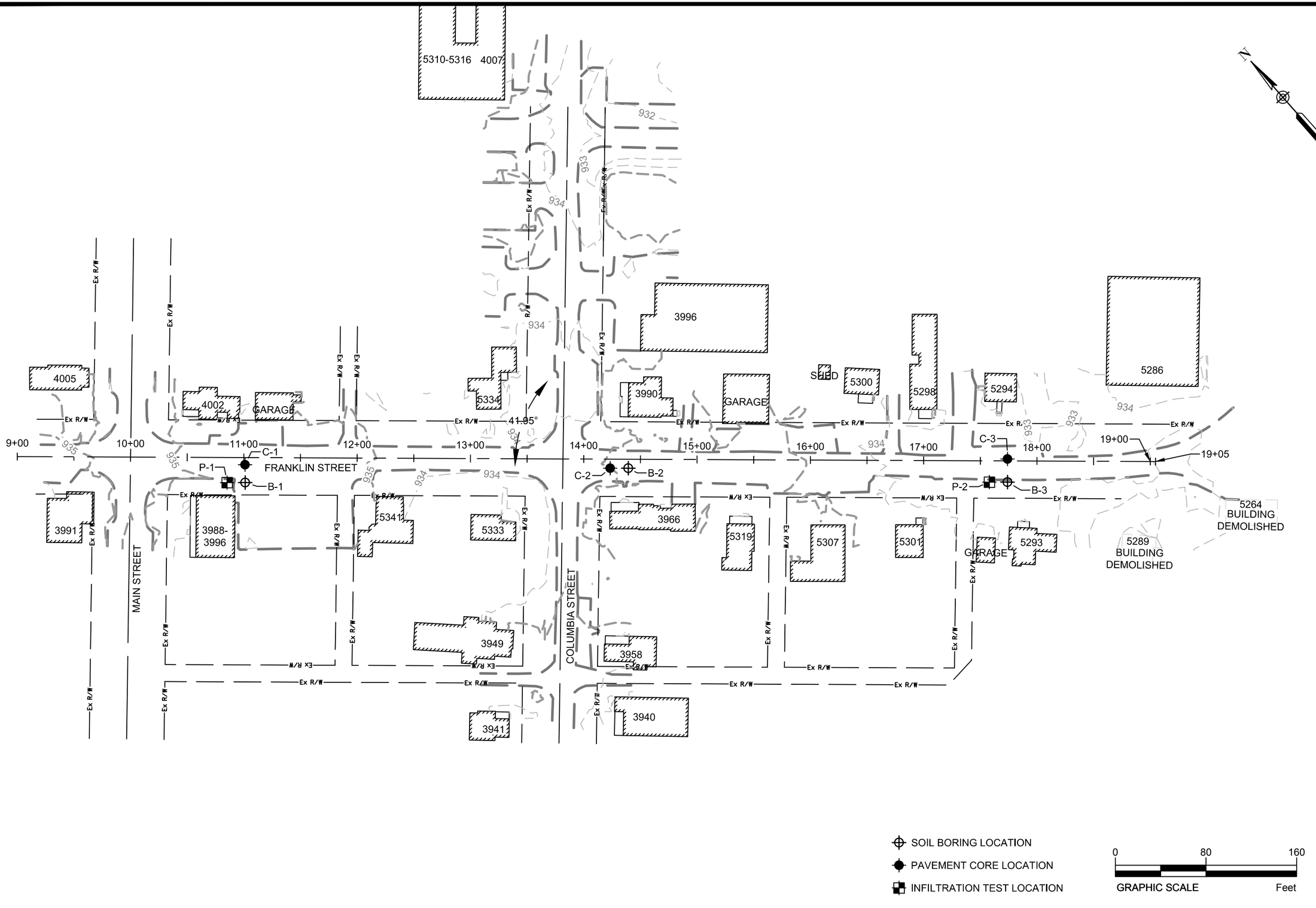
VICINITY MAP
HILLIARD FRANKLIN STREET

FRANKLIN COUNTY
HILLIARD, OHIO

FIGURE NO.
1

Drawing Path: Q:\Projects\1117-Geotech Columbus\1117-16-013\V-Map_Hill-Frank Rd_1117-16-013.dwg



DATE: 5-18-2016
DRAWN BY: DCV
SCALE: 1" = 80'
PROJECT NO. 1117-16-013

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PLAN OF BORINGS
HILLIARD FRANKLIN STREET

FRANKLIN COUNTY
HILLIARD, OHIO

FIGURE NO.
2

Drawing path: Q:\Projects\1117-Geotech Columbus\1117-16-013\POB_Hill-Frank Rd_1117-16-013.dwg

EXPLANATION OF SYMBOLS AND TERMS USED ON BORING LOGS FOR SAMPLING AND DESCRIPTION OF SOIL

SAMPLING DATA

 - Indicates sample was attempted within this depth interval.

2
3
5 - The number of blows required for each 6-inch increment of penetration of a "Standard" 2-inch O.D. split-barrel sampler, driven a distance of 18 inches by a 140-pound hammer freely falling 30 inches (SPT). The raw "blowcount" or "N" is equal to the sum of the second and third 6-inch increments of penetration.

N_{60} - Corrected Blowcount = [(Drill Rod Energy Ratio) / (0.60 Standard)] X N

SS - Split-barrel sampler, any size.

ST - Shelby tube sampler, 3″ O.D., hydraulically pushed.

R - Refusal of sampler in very-hard or dense soil, or on a resistant surface.

50-0.3′ - Number of blows (50) to drive a split-barrel sampler a certain distance (0.3 feet), other than the normal 6-inch increment.

DEPTH DATA

W - Depth of water or seepage encountered during drilling.

▼ AD - Depth to water in boring after drilling (AD) is teminated.

▼ 5 days - Depth to water in monitoring well or piezometer in boring a certain number of days (5) after termination of drilling.

TR - Depth to top of rock.

SOIL DESCRIPTIONS

Soils have been classified in general accordance with Section 603 of the most recent ODOT SGE, and described in general accordance with Section 602, including the use of special adjectives to designate approximate percentages of minor components as follows:

Adjective	Percent by Weight
trace	1 to 10
little	10 to 20
some	20 to 35
"and"	35 to 50

The following terms are used to describe density and consistency of soils:

Term (Granular Soils)	Blows per foot (N_{60})
Very-loose	Less than 5
Loose	5 to 10
Medium-dense	11 to 30
Dense	31 to 50
Very-dense	Over 50

Term (Cohesive Soils)	Qu (tsf)
Very-soft	Less than 0.25
Soft	0.25 to 0.5
Medium-stiff	0.5 to 1.0
Stiff	1.0 to 2.0
Very-stiff	2.0 to 4.0
Hard	Over 4.0

S&ME JOB: 1117-16-013

S&ME

PROJECT: HILLIARD FRANKLIN ST.	DRILLING FIRM / OPERATOR: S&ME / GODWIN	DRILL RIG: S&ME D-50 TRUCK	STATION / OFFSET: 11+01.33, 22.1' RT
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: S&ME / GODWIN	HAMMER: CME AUTOMATIC	ALIGNMENT: FRANKLIN ST.
PID: BR ID:	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 9/21/15	ELEVATION: 935.3 (MSL) EOB: 15.0 ft.
START: 3/21/16 END: 3/21/16	SAMPLING METHOD: SPT	ENERGY RATIO (%): 84.7	LAT / LONG: Not Recorded

EXPLORATION ID **B-01**

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)	HOLE SEALED
ASPHALT - 5 INCHES	935.3 / 934.9																	
GRANULAR BASE - 3-1/2 INCHES	934.6																	
Fill: Stiff brown, dark-brown and gray **CLAY**, some fine to coarse sand, little fine gravel, contains brick fragments.	932.8	1	2 3 2	7	89	SS-1	1.0-2.0	15	13	12	27	33	43	26	17	28	A-7-6 (8)	
Stiff to very-stiff brown mottled with gray **SILT AND CLAY**, some fine to coarse sand, trace fine gravel.	931.3	2																
		3	0 4 7	16	83	SS-2	1.5-3.0	9	9	13	34	35	29	16	13	17	A-6a (8)	
Hard brown **SILTY CLAY**, some fine to coarse sand, little fine gravel.		4																
		5	5 7 10	24	89	SS-3	4.5	-	-	-	-	-	-	-	-	12	A-6b (V)	
		6	4 5 8	18	100	SS-4	4.5	-	-	-	-	-	-	-	-	14	A-6b (V)	
	927.3	7																
Medium-stiff to stiff brown **SILTY CLAY**, some fine to coarse sand, little fine gravel.	924.8	8																
		9	2 4 5	13	89	SS-5	0.7-1.5	-	-	-	-	-	-	-	-	12	A-6b (V)	
Very-stiff brown **SILTY CLAY**, some fine to coarse sand, little fine gravel.	922.3	10																
		11																
		12	5 6 5	16	89	SS-6	3.5	-	-	-	-	-	-	-	-	16	A-6b (V)	
Very-stiff to hard brown **SILT AND CLAY**, some fine to coarse sand, little fine to coarse gravel.	920.3	13																
		14																
EOB		15	6 6 7	18	39	SS-7	3.0-4.5	-	-	-	-	-	-	-	-	10	A-6a (V)	

- No seepage encountered.
- Borings located using field pacing and taping methods and should be considered approximate.
- Elevations provided by Woolpert, Inc.

NOTES: SEE ABOVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: NOT RECORDED

S&ME STANDARD ODOT LOG (8.5X11) - 2015 - OH DOT.GDT - 5/26/16 16:29 - T:\RESOURCES\CS\GINTW\PROJECTS\1117116013A.GPJ

PLATE 4

S&ME JOB: 1117-16-013

S&ME

PROJECT: HILLIARD FRANKLIN ST.	DRILLING FIRM / OPERATOR: S&ME / GODWIN	DRILL RIG: S&ME D-50 TRUCK	STATION / OFFSET: 14+39.37, 8.0' RT
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: S&ME / GODWIN	HAMMER: CME AUTOMATIC	ALIGNMENT: FRANKLIN ST.
PID: BR ID:	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 9/21/15	ELEVATION: 935.1 (MSL) EOB: 15.0 ft.
START: 3/21/16 END: 3/21/16	SAMPLING METHOD: SPT	ENERGY RATIO (%): 84.7	LAT / LONG: Not Recorded

EXPLORATION ID **B-02**

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 935.1	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
ASPHALT - 7 INCHES	934.5																	
GRANULAR BASE - 3-1/2 INCHES	934.3																	
Fill: Very-stiff brown mottled with gray **CLAY**, trace fine to coarse sand, trace fine gravel, contains silt lenses.	932.6	1	3 4 5	13	67	SS-1	2.5-3.0	1	2	8	34	55	46	19	27	24	A-7-6 (16)	
Fill: Stiff to very-stiff brown and dark-brown **CLAY**, little fine to coarse sand, trace fine gravel.	931.1	2 3	6 12 12	34	100	SS-2	1.5-3.0	4	7	12	34	43	44	21	23	24	A-7-6 (14)	
Hard brown mottled with gray **SILTY CLAY**, some fine to coarse sand, little fine to coarse gravel, dessiccated.	927.1	4 5 6	6 8 10	25	78	SS-3	4.5	-	-	-	-	-	-	-	-	14	A-6b (V)	
		6 7	7 7 9	23	89	SS-4	4.5	-	-	-	-	-	-	-	-	14	A-6b (V)	
Very-stiff to hard brown **SILTY CLAY**, some fine to coarse sand, some fine to coarse gravel.	924.6	8 9	5 7 12	27	78	SS-5	2.0-4.5	-	-	-	-	-	-	-	-	13	A-6b (V)	
Stiff to very-stiff brown **SILTY CLAY**, some fine to coarse sand, little fine to coarse gravel.	920.1	10 11 12	3 4 5	13	67	SS-6	1.7-3.0	-	-	-	-	-	-	-	-	14	A-6b (V)	
	EOB	13 14 15	2 11 12	32	83	SS-7	2.0-4.0	-	-	-	-	-	-	-	-	11	A-6b (V)	

- No seepage encountered.
- Borings located using field pacing and taping methods and should be considered approximate.
- Elevations provided by Woolpert, Inc.

NOTES: SEE ABOVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: NOT RECORDED

S&ME STANDARD ODOT LOG (8.5X11) - 2015 - OH DOT.GDT - 5/26/16 16:29 - T:\RESOURCES\CS\GINTW\PROJECTS\1117116013A.GPJ

PLATE 5

S&ME JOB: 1117-16-013

S&ME

PROJECT: HILLIARD FRANKLIN ST.	DRILLING FIRM / OPERATOR: S&ME / GODWIN	DRILL RIG: S&ME D-50 TRUCK	STATION / OFFSET: 17+74.09, 18.8' RT	EXPLORATION ID B-03
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: S&ME / GODWIN	HAMMER: CME AUTOMATIC	ALIGNMENT: FRANKLIN ST.	
PID: BR ID:	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 9/21/15	ELEVATION: 933.3 (MSL) EOB: 15.0 ft.	PAGE 1 OF 1
START: 3/21/16 END: 3/21/16	SAMPLING METHOD: SPT	ENERGY RATIO (%): 84.7	LAT / LONG: Not Recorded	

MATERIAL DESCRIPTION AND NOTES	ELEV. 933.3	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
ASPHALT - 5-1/2 INCHES	932.8																	
GRANULAR BASE - 3 INCHES	932.6																	
Fill: Very-stiff brown mottled with gray **SILTY CLAY**, trace to little fine to coarse sand, trace fine gravel.	930.8	1	3 2 4	8	89	SS-1	2.5	1	3	6	47	43	37	19	18	23	A-6b (11)	
Fill: Very-stiff brown mottled with gray **SILT AND CLAY**, little fine to coarse sand, trace fine gravel.	929.3	2	2 5 8	18	83	SS-2	2.5	4	8	13	32	43	33	18	15	21	A-6a (10)	
Fill: Very-stiff to hard brown and gray **SILTY CLAY**, some fine to coarse sand, little fine gravel.	925.3	3	4 8 7	21	94	SS-3	4.5	-	-	-	-	-	-	-	-	14	A-6b (V)	
		4	2 4 6	14	89	SS-4	3.5-4.5	-	-	-	-	-	-	-	-	16	A-6b (V)	
Stiff brown **SILTY CLAY**, some fine to coarse sand, trace fine gravel.	922.8	5																
		6	2 5 9	20	33	SS-5	1.5	-	-	-	-	-	-	-	-	14	A-6b (V)	
Medium-stiff to very-stiff brown **SILTY CLAY**, some fine to coarse sand, little fine to coarse gravel.	918.3	7																
		8	0 2 4	8	78	SS-6	0.7-1.5	-	-	-	-	-	-	-	-	11	A-6b (V)	
EOB		9																
		10	4 6 7	18	94	SS-7	3.0-3.5	-	-	-	-	-	-	-	-	11	A-6b (V)	
		11																
		12																
		13																
		14																
		15																

- No seepage encountered.
- Borings located using field pacing and taping methods and should be considered approximate.
- Elevations provided by Woolpert, Inc.

NOTES: SEE ABOVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: NOT RECORDED

S&ME STANDARD ODOT LOG (8.5X11) - 2015 - OH DOT.GDT - 5/26/16 16:29 - T:\RESOURCES\CS\GINTW\PROJECTS\1117116013A.GPJ

PLATE 6

Pavement Core Photos
Hilliard-Franklin Street Improvements
S&ME Project #: 1117-16-013

6190 Enterprise Ct.
Dublin, OH 43016

Date: 4/13/2016

Photographer: E. Goodyear

C-001-0-16	**Location:**	Franklin Street
	Remarks:	5 inches asphalt, over 3 ½ inches of concrete.

Date: 4/13/16

Photographer: E. Goodyear

C-002-0-16	**Location:**	Franklin Street
	Remarks:	7 inches asphalt over 3 ½ inches of concrete

Pavement Core Photos
Hilliard-Franklin Street Improvements
S&ME Project #: 1117-16-013

S&ME
6190 Enterprise Ct.
Dublin, OH 43016

Date: 4/13/2016

Photographer: E. Goodyear

C-003-0-16	**Location:**	Franklin Street
	Remarks:	6 inches asphalt over 3 ½ inches of concrete

1	Looking west toward Main Street – Core C-1 in west bound lane. Boring B-1 and Perc Test P-1 located in ROW on south side of Franklin Street

2	Looking north from south side of Franklin Street – B-1, P-1, and C-1

3	Core C-1 near intersection with Main Street

4	Looking west toward Columbia Street – C-2 and B-2 at same location

S&ME	**Franklin Street Improvements Hilliard, Ohio**	1117-16-013	
		Taken by: BLM	Date Taken: 3-6-16

5 Core C-1 and Boring B-2 near intersection with Columbia Street

6 Standing near east end of project looking west – Boring B-3 and Perc Test P-2 located in ROW on south side of Franklin Street. Core C-3 located in west bound lane

7 Boring B-3 and Perc Test P-2 near east end of project

8 Core C-3 near east end of project

S&ME	Franklin Street Improvements Hilliard, Ohio	1117-16-013	
		Taken by: BLM	Date Taken: 3-6-16

ODOT Geotechnical Bulletin GB1 Subgrade Analysis Spreadsheet
Franklin Street, Hilliard, Ohio

Subgrade Analysis V. 13.00 01/15/16

Design CBR 6

Global Options		
320	R&R	No
206	CS	Option
	LS	Option
206	Depth	12

Classification Counts by Sample																
R	1a	1b	3	3a	2-4	2-5	2-6	2-7	4a	4b	5	6a	6b	7-5	7-6	8a	8b
0	0	0	0	0	0	0	0	0	0	0	0	2	7	0	3	0	0
												17%	58%		25%		
0%	0%								100%								

Surface Class		
2-5	0	
4b	0	
5	0	
7-5	0	
7-6	2	67%
8a	0	
8b	0	
R	0	

% Borings	
N_{60L} <= 5	0%
<=10	67%
>=20	0%
M+	100%
R	0%

% Surface	
100%	
0%	100%

UC @ Surface
Undercut
13.0
15
12

Rig	ER
A	84
B	
C	
D	
E	
F	
G	
H	

Total Borings	3
PID	T-138
Location	Franklin Street, Hilliard, OH

	N_{60}	N_{60L}			PI		Clay		M	M_{OPT}		GI
Average	18.3	9.3			18.8		42.0		18.4	16.6		10.58
Maximum	34	13	46	26	27	47	55	90	28	23		16
Minimum	7	7	29	16	13	27	33	60	12	14		8

	Boring				Cut	Subgrade		Standard Penetration						Physical Characteristics						Moisture		Class		Sulfate		Problem		Undercuts		Analysis /
#	B #	Boring Location	Depth	To	Fill	Depth	To	n_2	n_3	N	Rig	N_{60}	N_{60L}	LL	PL	PI	% Silt	% Clay	P 200	M	M_{OPT}	Ohio DOT	GI			w/ Class	w/ MN	UC Class	UC MN	Comments
1	B-1	STA 11+01, 22' Rt.	1.0	2.5	-2.5	-1.5	0.0	3	2	5	A	7		43	26	17	27	33	60	28	23	7-6	8				N		15	
			2.5	4.0		0.0	1.5	4	7	11		15		29	16	13	34	35	69	17	14	6a	8							Item 204.03
			4.0	5.5		1.5	3.0	7	10	17		24								12	16	6b	10							
			5.5	7.0		3.0	4.5	5	8	13		18	7							14	16	6b	10							
2	B-2	STA 14+39, 8' Rt.	1.0	2.5	-1.3	-0.3	1.2	4	5	9	A	13		46	19	27	34	55	89	24	18	7-6	16				MN		12	
			2.5	4.0		1.2	2.7	12	12	24		34		44	21	23	34	43	77	24	18	7-6	14				M			UC 12", or
			4.0	5.5		2.7	4.2	8	10	18		25								14	16	6b	10							LS 12"
			5.5	7.0		4.2	5.7	7	9	16		22	13							14	16	6b	10							
3	B-3	STA 17+74, 19' Rt.	1.0	2.5	-2.1	-1.1	0.4	2	4	6	A	8		37	19	18	47	43	90	23	16	6b	11				N		12	
			2.5	4.0		0.4	1.9	5	8	13		18		33	18	15	32	43	75	21	14	6a	10				M			UC 12", or
			4.0	5.5		1.9	3.4	8	7	15		21								14	16	6b	10							CS 12"
			5.5	7.0		3.4	4.9	4	6	10		14	8							16	16	6b	10							

PLATE 11

Important Information About Your Geotechnical Engineering Report

Variations in subsurface conditions can be a principal cause of construction delays, cost overruns and claims. The following information is provided to assist you in understanding and managing the risk of these variations.

Geotechnical Findings Are Professional Opinions

Geotechnical engineers cannot specify material properties as other design engineers do. Geotechnical material properties have a far broader range on a given site than any manufactured construction material, and some geotechnical material properties may change over time because of exposure to air and water, or human activity.

Site exploration identifies subsurface conditions at the time of exploration and only at the points where subsurface tests are performed or samples obtained. Geotechnical engineers review field and laboratory data and then apply their judgment to render professional opinions about site subsurface conditions. Their recommendations rely upon these professional opinions. Variations in the vertical and lateral extent of subsurface materials may be encountered during construction that significantly impact construction schedules, methods and material volumes. While higher levels of subsurface exploration can mitigate the risk of encountering unanticipated subsurface conditions, no level of subsurface exploration can eliminate this risk.

Scope of Geotechnical Services

Professional geotechnical engineering judgment is required to develop a geotechnical exploration scope to obtain information necessary to support design and construction. A number of unique project factors are considered in developing the scope of geotechnical services, such as the exploration objective; the location, type, size and weight of the proposed structure; proposed site grades and improvements; the construction schedule and sequence; and the site geology.

Geotechnical engineers apply their experience with construction methods, subsurface conditions and exploration methods to develop the exploration scope. The scope of each exploration is unique based on available project and site information. Incomplete project information or constraints on the scope of exploration increases the risk of variations in subsurface conditions not being identified and addressed in the geotechnical report.

Services Are Performed for Specific Projects

Because the scope of each geotechnical exploration is unique, each geotechnical report is unique. Subsurface conditions are explored and recommendations are made for a specific project. Subsurface information and recommendations may not be adequate for other uses. Changes in a proposed structure location, foundation loads, grades, schedule, etc. may require additional geotechnical exploration, analyses, and consultation. The geotechnical engineer should be consulted to determine if additional services are required in response to changes in proposed construction, location, loads, grades, schedule, etc.

Geo-Environmental Issues

The equipment, techniques, and personnel used to perform a geo-environmental study differ significantly from those used for a geotechnical exploration. Indications of environmental contamination may be encountered incidental to performance of a geotechnical exploration but go unrecognized. Determination of the presence, type or extent of environmental contamination is beyond the scope of a geotechnical exploration.

Geotechnical Recommendations Are Not Final

Recommendations are developed based on the geotechnical engineer's understanding of the proposed construction and professional opinion of site subsurface conditions. Observations and tests must be performed during construction to confirm subsurface conditions exposed by construction excavations are consistent with those assumed in development of recommendations. It is advisable to retain the geotechnical engineer that performed the exploration and developed the geotechnical recommendations to conduct tests and observations during construction. This may reduce the risk that variations in subsurface conditions will not be addressed as recommended in the geotechnical report.