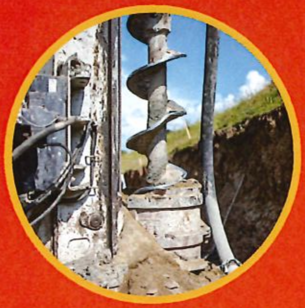

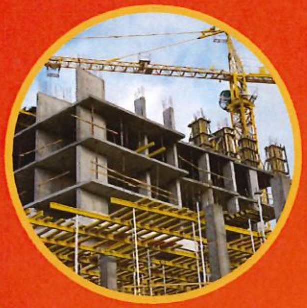

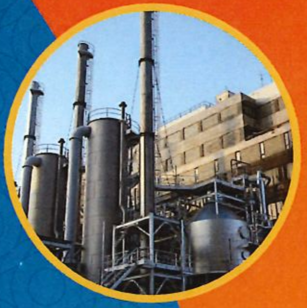

GEOTECHNICAL EVALUATION REPORT

LAKELAND COMMUNITY COLLEGE – PHASE 1B
KIRTLAND, OHIO

SME Project No. 078841.04

February 01, 2019

SME

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February 01, 2019

Ms. Lene Hill, P.E.
CT Consultants
8150 Sterling Court
Mentor, Ohio 44060

Via Email: lhill@ctconsultants.com (pdf file)

RE: Geotechnical Evaluation Report
LCC – Phase 1B
Kirtland, Ohio
SME Project 078841.04

Dear Ms. Hill:

We have completed our geotechnical evaluation for the Phase 1B of the planned site improvements to Lakeland Community College in Kirtland, Ohio. This report presents the results of our findings and recommendations for the planned loop roadway.

We appreciate the opportunity to be of service. If you have questions or require additional information, please do not hesitate to contact us.

Very truly yours,

SME

Brendan Lieske

BRENDAN PATRICK LIESKE
E-81254

For Alison K. Frye, PE
Project Engineer

JOHN E. DINGELDEIN
E-049667

REPORT PREPARED BY:
Alison K. Frye, PE
Project Engineer

REVIEWED BY:
John E. Dingeldein, PE
Principal Consultant

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GENERAL COMMENTS
LABORATORY TESTING PROCEDURES

1. INTRODUCTION

1.1 SITE CONDITIONS

The project site is located within the western half of the Lakeland Community College Park and Ride lot directly north of the main entrance drive from State Route 306 as shown on the figure below. The site currently consists of pavement with lawn areas to the south and west. Based on the CT Consultants site plan with reference elevations and our boring elevation measurements, the site varies from about elevation 766 to 774 from the northeast to southwest site corners.

1.2 PROJECT DESCRIPTION

Based on the preliminary site plan by CT Consultants dated January 4, 2019, the site will serve as the Laketran Intermodal Transit Station. The site consists of northern and southern drive loops for bus and shuttle access and a small building for waiting passengers. Estimated traffic volumes are based on the schedule information provided by CT Consultants. We anticipate that heavy-duty asphalt or heavy-duty concrete will be used for these drives. The building will consist of a single-story, slab-on-grade structure, with overall dimensions of approximately 106 by 32 feet. Per our email conversation with Lene Hill with CT Consultants on January 3 and 30, 2019, masonry walls will be used for the toilet, mechanical and equipment rooms. The assembly and waiting area will have structural steel and glazed curtain wall construction. Structural steel will support roof loads along with two cantilevered canopies located along the north and south exterior wall lines. The southern canopy will be cantilevered approximately 17 feet, and the northern canopy will be cantilevered approximately 5 feet. The canopies will be supported by interior structural columns. The preliminary maximum anticipated uplift force at the column base is 6.5 kips. The remaining maximum downward column and wall loads were not available.

We understand that there will be less than two feet of grade change throughout the majority of the site. An increase of up to four feet of grade change is anticipated at the southern entry drive connecting to the main campus access drive.

The preceding discussion represents our understanding of the proposed project and is an important part of our engineering interpretation. If this understanding is not correct or if project plans change, we will need to be given the opportunity to review our recommendations.

2. EVALUATION PROCEDURES

2.1 HISTORICAL INFORMATION REVIEW

Prior to beginning fieldwork, we reviewed the available soil boring information from SME's preliminary studies for the on-campus housing project and overall soils and pavement conditions study. The approximate boring locations and boring logs for the applicable information from these studies will be amended to this report. The subsurface information and relative location of the existing borings influenced the approximate location of the soil borings for this phase of evaluation.

2.2 FIELD EVALUATION

The field exploration included performing five borings at locations selected by SME to be representative of the planned pavement and building areas. At locations within the existing pavement, the pavement was cored and a sample of the existing base material was obtained before drilling. Two borings extended to a depth of 15 feet below the existing ground surface within the planned building footprint, and three borings extended to depths from 7½ to 9 feet below the existing ground surface within the planned pavement areas. A total of 55 lineal feet of drilling was completed.

SME laid out the boring locations referencing them to existing site features. The approximate boring locations and ground surface elevations measured by SME are shown on the attached Boring Location Plan (Figure No. 1).

The borings were drilled and sampled using a truck mounted rotary drill rig. The borings included soil sampling based upon the Split-Barrel Sampling procedure. The boreholes were backfilled with auger cuttings, and an EPCO hole plug was installed and the pavement was patched when the fieldwork was completed. Recovered split-barrel samples were sealed in glass jars by the driller.

Groundwater level observations in the boreholes were recorded during and immediately after completion of each boring. The boreholes were backfilled after completion and collection of groundwater readings. Therefore, long-term groundwater levels were not obtained from the borings.

Soil samples and pavement cores recovered from the field exploration were delivered to the SME laboratory for further observation and testing.

2.3 LABORATORY TESTING

The laboratory testing program consisted of visually classifying the recovered soil samples in accordance with ASTM D-2488. Moisture content and hand penetrometer tests were performed on portions of the cohesive samples recovered. One Atterberg limits tests and two loss-on-ignition tests (i.e., to determine organic content) were completed on split-barrel samples at the depths noted on the boring logs The Laboratory Testing Procedures in Appendix B provides general descriptions of the laboratory tests. Based on the laboratory testing, we developed a soil description and assigned a Unified Soil Classification System (USCS) group symbol to each of the soil strata encountered.

Upon completion of the laboratory testing, boring logs were prepared that include information on materials encountered, penetration resistances, pertinent field observations made during drilling operations, the soil descriptions, and the results of the laboratory testing. The boring logs also include the existing ground surface elevations as measured by SME. The boring logs are included in Appendix A. Explanations of symbols and terms used on the boring logs are provided on the Boring Log Terminology sheet included in Appendix A. The soil descriptions included on the logs were developed from the visual classifications.

The asphalt cores were photographed and are included the attached pavement core log.

Soil samples are normally retained in our laboratory for 60 days and are then disposed of, unless we are instructed otherwise.

3. SUBSURFACE CONDITIONS

3.1 SOIL CONDITIONS

The subsurface profile descriptions are based on the data from the five locations tested for this phase and from locations C-1 and C-2 taken from SME's preliminary site evaluation (SME Project No. 078841.00).

The profile at the boring locations generally consists of pavement or topsoil and concrete followed by lean clays identified as fill or lacustrine (glacial lake-bottomed) ending in lean clay identified as glacial ground moraine till. The surficial materials at C-1, C-2, B-1, B-2, B-4, and B-5 consisted of asphalt over aggregate base or placed directly onto the subgrade. The total pavement thickness varies from 8 to 19 inches. At B-3, the surficial materials consisted of topsoil followed by lean clay fill ending in concrete for a total thickness of 14 inches. At B-1, the surficial materials are followed by grayish brown lean clay identified as fill. This layer ends at a depth of 3 feet. Below the surficial materials at B-2, B-3, C-1, and C-2 and below the fill at B-1, lacustrine clays were encountered. These are brown and/or gray in color with varying amounts of sand and organics. These clays typically have a medium stiff consistency based on the encountered conditions and extend to depths of 2.4 to 5.7 feet below the existing ground surface. All of the borings end in glacial ground moraine till. The till consists of brown and gray or brown lean clay with varying amounts of sand and gravel. These clays have a medium to very stiff consistency.

The moisture content determined in the laboratory for the fill encountered at B-1 was 29 percent. This sample has a 2.8 percent organic matter content. The laboratory moisture content for the lacustrine clay ranged from 15 to 31 percent. The organic matter content of the lacustrine clay encountered at B-2 from 3½ to 5 feet below the existing ground surface at 4.1 percent. Finally, the moisture content determined in the laboratory for the glacial ground moraine till clay ranged from 15 to 21 percent.

The soil profile included on the boring logs is a generalized description of the conditions encountered. The stratification depths shown on the boring logs indicate a zone of transition from one soil type to another and do not show exact depths of change from one soil type to another. The soil descriptions are based on visual classification of the soils encountered. Soil conditions may vary between or away from the boring locations. Please refer to the boring logs for the soil conditions at the specific boring locations.

3.2 GROUNDWATER CONDITIONS

Groundwater was encountered during drilling at C-1 and B-1 at depths of 0.5 and 8.5 feet (elevation 760.5 and 759.9), respectively. Immediately after drilling, groundwater was encountered at depths of 0.7 and 12 feet (elevation 760.3 and 756.4 feet) at C-1 and B-1, respectively. Based on this information and the depth of brown to gray color change of the soil, we believe the groundwater level will likely be 10 feet or deeper from the existing ground surface within the project limits.

A long time can be required for groundwater levels to reach equilibrium in small diameter boreholes, particularly in low permeability clay and silt soils. Therefore, longer term monitoring of groundwater levels, and possibly deeper borings would be necessary to provide a more accurate estimate of the static groundwater level at this site.

Hydrostatic groundwater levels and perched groundwater levels should be expected to fluctuate throughout the year, based on variations in precipitation, evaporation, run-off, and other factors. The groundwater conditions indicated by the borings represent conditions at the time the readings were taken. The actual groundwater conditions at the time of construction may vary from those reported on the boring logs.

4. ANALYSIS AND RECOMMENDATIONS

In general, the existing clay fill and lacustrine clays encountered throughout the building area and at B-3 have elevated moisture contents and medium stiff consistencies which make them unsuitable for foundation support in their current condition. We recommend extending shallow foundations to bear onto stiff or better glacial ground moraine till clay. Floor slabs may be supported by this material provided the soils are prepared as described below.

The pavements will be supported by a combination of existing fill, lacustrine clay, glacial ground moraine till clay, and engineered fill. The existing fill and lacustrine clays have poor to fair pavement support capacity, and the glacial till clay and engineered fill will have good pavement support capacity. To reduce the potential for differential settlement of the pavements, the subgrade resilient modulus presented later in this report was estimated based upon the consistency of the lacustrine clay and existing fill.

4.1 SITE PREPARATION AND EARTHWORK

4.1.1 EXISTING FILL CONSIDERATIONS

In the floor slab and pavement areas, as with any construction on existing fill, there is a risk for poor structural performance (e.g. settlement, cracking). However, based upon the available data, we believe the risk is low assuming proper subgrade preparation is performed during construction, along with the removal of any unsuitable subgrade soils and the localized areas of fill. Proper subgrade preparation includes removing unsuitable fill, organics, buried organic soils, and other unsuitable materials, uniformly compacting existing suitable fill with appropriate compaction equipment, proofrolling, undercutting overly soft/loose subgrade, and replacing undercuts with suitable engineered fill.

SME should be onsite during site earthwork operations to further assess the extent and condition of the fill. The project budget should include a contingency for additional earthwork (e.g. undercutting, in-place compaction, removal of unsuitable fill, importing suitable fill, etc.) that may be required to improve subsurface conditions for floor slab and pavement support.

4.1.2 GENERAL SITE SUBGRADE PREPARATION

We recommend the site earthwork operations include removal of topsoil, buried topsoil, construction debris, unsuitable fill and other undesirable materials to expose suitable existing subgrade within construction areas.

We recommend site clearing extend a minimum 5 feet beyond the limits of the proposed improvement areas to help achieve adequate space for properly preparing the subgrade.

Take care during construction to limit subgrade disturbances especially during wetter periods of the year. For areas of disturbed subgrade, it will be necessary to improve the disturbed soils or remove and replace them with engineered fill. Expect moisture conditioning, which could include discing, aerating and/or drying the site soils. To reduce the amount of potential subgrade improvements required at this site, we recommend the contractor establish positive site drainage as soon as possible and remove ponded water from exposed and prepared subgrades.

Once the subgrade is compacted, we recommend checking the subgrade for stability. Where areas are accessible for proofrolling, we recommend using a fully loaded tandem axle truck (50,000 lbs. minimum) to perform the proofroll test. We recommend an SME representative be on-site to observe and test the exposed subgrade. Based on the results of the field tests and observations (and lab tests, as applicable), the SME representative can provide recommendations in the field as to the suitability of the subgrade for structural support. Areas of unsuitably loose/wet subgrade will need to be either improved in-place (e.g., dried and re-compacted) or be removed and replaced with engineered fill.

After the exposed subgrade has been evaluated (as mentioned above) and improved as necessary, place engineered fill on the exposed subgrade to establish final subgrade levels. Refer to Section 4.1.3 of this report for materials and compaction requirements for engineered fill.

4.1.3 ENGINEERED FILL REQUIREMENTS

Any fill placed within the construction area, including utility trench backfill, should be an approved material, free of frozen soil, organics, or other unsuitable materials. The fill should be placed on suitably prepared subgrade. The fill should also be spread in level layers which are 8 to 10 inches in loose thickness and moisture conditioned to within 2% of its optimum content be compacted to at least 98 percent of the maximum dry density as determined in accordance with the standard Proctor test (ASTM D698). Fills placed below the foundation bearing elevation and within 12 inches of the floor slab and pavement subgrade surfaces should be compacted to 100 percent of the standard Proctor maximum dry density. We recommend vibratory equipment such as a steel-drum roller or plate compactor be used to compact granular fill, while cohesive fill be compacted with a sheepsfoot roller.

We expect that any engineered fill will consist of clays generated from on-site cuts. Coarse crushed aggregate (or crushed stone) used to backfill utility trenches or where drainage is required should consist of ODOT #57 crushed limestone or ODOT #304 base material with a modified gradation as described in Section 5.4.3 Aggregate Base Material Recommendations. To limit the potential for the surrounding subgrade to migrate into the crushed stone, we recommend the coarse crushed material be wrapped with an approved non-woven geotextile.

4.2 FLOOR SLAB CONSTRUCTION

We anticipate the final subgrade for the floor slabs will consist of existing clay or engineered fill placed over properly prepared soils. For floor slab subgrades prepared and verified as discussed herein, we recommend a modulus of subgrade reaction, k of 100 pounds per cubic-inch (pci) for design.

We recommend the top 4 inches of the slab subbase consist of an approved free draining, aggregate material. The purpose of this is to provide a leveling surface for construction of the slab and a moisture capillary break between the slab and the underlying soils. The thickness of aggregate base layer needed to provide a stable construction platform will depend on the condition of subgrade soils during construction and the type and volume of construction equipment expected to traffic the prepared subgrade. Slag or shale must not be used as base material. We do not recommend using the leveling course as a means of protecting the underlying subgrade from disturbances. Therefore, place the concrete slab soon after the leveling course, and ensure proper placement and compaction of the underlying subgrade.

We recommend installing a vapor retarder below floor slabs that receive a moisture sensitive floor finish or covering. Even where slab surfaces consist of exposed concrete, we recommend installing a vapor retarder to slow moisture loss from the underlying subgrade. We recommend the vapor retarder consist of 10 mil (minimum) plastic sheets that cover the entire floor slab area and with each sheet overlapped or sealed per the manufactures specifications. Please note that the location of a vapor retarder (below the concrete or below the leveling/capillary break aggregate layer) affects construction of the floor slab, concrete curing, warping, and the rate of moisture loss as the concrete dries.

We recommend floor slabs be separated by isolation joints from structural walls and columns bearing on their own foundations to permit relative movement. Provide a minimum of 6 inches of engineered fill between the bottom of the slab and the top of the shallow spread foundation below.

Protect the slab-on-grade subgrade soils from frost action during winter construction. Any frozen soils have to be thawed and compacted, or removed and replaced prior to slab-on-grade construction.

4.3 FOUNDATIONS

We recommend using isolated spread footings to support columns and continuous strip footings to support walls. Foundations should be constructed to bear on medium stiff or better glacial till lean clay should be proportioned for a net allowable soil bearing pressure not exceeding 3,000 psf. Based on the results of our field exploration, glacial till clay should be encountered between 5½ and 6 feet below the existing ground surface (approximate elevation 762 feet).

Depending upon the magnitude of the uplift and lateral loads for the canopy structures, short drilled piers may be preferred over isolated column pads to provide more resistance to these loading types. A unit side-friction resistance, fs, of 1,500 psf may be used per foot of embedment into the glacial till clay. The net allowable end-bearing pressure of 3,000 psf is also recommended for design of drilled piers.

Footing trenches and drilled pier shafts should be excavated to a level bearing surface. Bearing surfaces should be cleaned of mud and loose cuttings and should be protected against water accumulation from rainfall, surface drainage, or excavation sidewall seepage prior to placing concrete. Bearing soils should be protected from freezing if there is a delay in placing concrete during cold weather.

Exterior footings surrounding continuously heated areas should have an embedment of at least 3 feet below the lowest adjacent exterior grade for protection against frost-related heave, and embedment of footings in or surrounding unheated areas should be increased to at least 3½ feet. Depending upon the final finished floor elevation, the minimum embedment may increase based on the depth where glacial till clay is encountered.

5. PRELIMINARY PAVEMENT RECOMMENDATIONS

Based upon the limited information currently available, we anticipate the new pavement will consist of conventional (standard-duty) asphalt pavement for parking areas, and heavy-duty asphalt pavement for drives.

Based on the existing and planned grades provided by CT Consultants, we have assumed cuts and fills less than 2½ feet for the pavement areas. For purposes of this report, we have assumed the final site grades around the pavement perimeter will slope away from the new pavements.

As the final paving plan is not yet available, consider the pavement recommendations preliminary and subject to change based on actual pavement locations, traffic conditions, final grades, site drainage, etc.

5.1 PAVEMENT DESIGN CRITERIA

The pavements for this project were preliminarily designed based on our experience with sites with similar subgrade conditions while using the design parameters in the table below using the AASHTO Guide for Design of Pavement Structures. In addition, ESALs were calculated based on the following traffic information from CT Consultants

TRAFFIC INFORMATION

VEHICLE TYPE	DAILY COUNT	AXLE CONFIGURATION AND WEIGHT	
		FRONT AXLE	REAR AXLE
LakeTran Bus	60	Single, 16 kips	Tandem 32.5 kips
Park N' Ride	4	Single, 16 kips	Tandem 32.5 kips
LakeTran Shuttle	90	Single, 4.6 kips	Single, 5.3 kips

DESIGN PARAMETERS

PARAMETER	VALUE
Design Period	20 years
Heavy Duty Traffic (HMA)	720,000 ESALs
Heavy Duty Traffic (Concrete)	1,020,000 ESALs
Design Reliability	85%
CBR, average	4.1
Standard Deviation	0.49 (flexible pavements)
Standard Deviation	0.35 (rigid pavements)
Subgrade Resilient Modulus (HMA)	2,400 pounds per square inch (psi)
Modulus of Subgrade Reaction (Concrete)	100 pounds per square inch (psi)
Initial Serviceability Index	4.25
Terminal Serviceability Index	2.25
Drainage Coefficient (aggregate base)	1.0

*NOTES: We request the Owner and project team review the assumed traffic count values and provide comments/questions regarding traffic conditions. If there are differences with the assumed traffic count and anticipated design conditions, we may need to alter the pavement section thicknesses and recommendations.

5.2 SUBGRADE CONDITIONS AND SUBGRADE PREPARATION

Based on the current borings performed for this project in proposed pavement areas, the general subgrade conditions are expected to consist mostly of existing clays or engineered fill clay.

Subgrade preparation for all pavement should consist of complete removal of the existing topsoil and trees/tree mats, removal of old pavements, subgrade assessment (i.e., a field evaluation of the condition of the exposed subgrade with thorough compaction, proofrolling, fine grading, and occasional undercutting to remove and replace low-strength subgrade), and placement of new pavement layers. We recommend subgrade preparation and the aggregate base layer extend out to at least 12 inches beyond the edge of pavement or curbs to provide support for the outer edges of pavement. Protect utilities, curbs, and other existing structures to remain. Field locate existing utilities prior to excavation and/or trafficking and take the necessary precautions to work safely around active utilities.

Prior to the placement of the aggregate base, we recommend fine-grading the subgrade to slope downward toward the stormwater drainage structures. Fine-grading of the underlying subgrade will be critical to minimize low-spots below the aggregate base where water can pond, likely resulting in moisture changes and undesirable early pavement distress. Fine-grading the subgrade is important for drainage of perched groundwater, and to achieve a uniform thickness of base course to be placed throughout each of the pavement sections. Also, we recommend installing underdrains at/through low-spots in the prepared subgrade to facilitate drainage of perched groundwater. See Section 5.4 for additional information regarding drainage.

We recommend testing the exposed subgrade for stability. See Section 4.1.2 for additional information about proofrolling. We recommend the criteria for the proofroll be a maximum of 1/2 inch of deflection or rutting below the aggregate base layer, and a maximum 1/4 inch of deflection or rutting on the aggregate base layer. Site specific conditions may require adjusting the proofroll criteria, which would only be considered if agreed upon in writing by the Owner and Engineer. A qualified geotechnical engineering firm must be on-site to observe the proofroll and make judgments as to the suitability of the subgrade for pavement support.

Any loose or soft areas identified from the proofrolling will need to be recompacted, or undercut and replaced with additional engineered fill, or stabilized by other means as dictated by the site conditions at the time of construction. Once the subgrade passes the final proofroll, we recommend fine-grading the subgrade again and then placing the pavement layers soon thereafter to avoid further subgrade disturbance. If subgrade disturbance occurs, we recommend the subgrade be proofrolled again to evaluate the severity of disturbance and undercuts (where required) be performed to re-establish a suitably stable subgrade. It may be necessary to use crushed stone backfill, possibly in combination with a high-strength woven geotextile fabric or geogrid, to stabilize the subgrade. A qualified geotechnical engineering firm will need to determine the type and quantity of stabilization required based on field conditions during construction.

5.3 RECOMMENDED PRELIMINARY PAVEMENT SECTIONS

The recommended layer materials refer to standard material designations listed in the latest edition of the "Construction and Materials Specifications" prepared by the Ohio Department of Transportation (ODOT). Typical routine maintenance such as crack sealing, patching, joint sealing (concrete pavements), spall repairs and localized slab replacement (concrete pavements), and overlays should be anticipated and performed over the service life of the pavement system.

5.3.1 FLEXIBLE PAVEMENT SECTION AND MATERIALS

When using a heavy-duty asphalt section, we recommend a pavement section that results in a Structural Number (AASHTO based design) of approximately 4.7 or greater based on the estimated traffic loading and anticipated environmental impact conditions.

The recommended heavy-duty asphalt pavement cross section below would result in an estimated service loading of approximately 909,000 Equivalent Single Axle Loads (ESALs) and an estimated structural number of 4.8, meeting the recommended minimum design structural number of 4.7.

Utilizing the previously described design parameters and the American Association of State Highway Transportation Officials (AASHTO) "Guide for Design of Pavement Structures" 1993 edition, the following tables present the layer material and thickness recommendations for light and heavy-duty the flexible pavement sections:

HEAVY-DUTY HMA PAVEMENT

LAYER	MATERIAL	MINIMUM THICKNESS (inches)
Bituminous Wearing	ODOT 441 Type 1, Surface Course (One Lift)	1.5
Bituminous Leveling	ODOT 441 Type 2, Intermediate Course (One Lift)	2.5
Bituminous Base Course	ODOT 301 Base Course (One Lift)*	4.0
Aggregate Base	ODOT 304 Crushed Limestone**	12.0

NOTE: Structural coefficients assumed for HMA and aggregate base material are 0.42 and 0.12, respectively.
*If desired, ODOT 441, Type 2, Intermediate Course may be substituted for ODOT 301 base course. If the substitution is selected, the layer should be placed in two lifts with approximately the same thickness.
**See Section 5.4.3 (Aggregate Base Material Recommendations) for material details

We recommend the final grade of asphalt cement be PG64-22 in the production of all the bituminous mixtures. We recommend Reclaimed Asphalt Pavement (RAP) be limited to 15 percent in the surface (wearing) course and 30 percent in leveling course. We recommend the asphalt concrete mixtures be designed for a target air void of 3.0 percent and compacted to 94 to 97 percent of maximum theoretical density as determined by the Rice Method. We also recommend a bond coat of SS-1h emulsion be applied between asphalt concrete layers. The recommend rate for the bond coat is 0.1 gallons/s.y.

Partial construction of the pavements and use of the leveling course as a construction platform will likely result in premature damage that would require repairs prior to placing the final lift. We recommend developing specific haul and delivery routes and prepare separate staging areas. In these areas, we recommend the leveling course thickness be increased to minimize damage and placement of the final lift be delayed until the majority of the construction activities have been completed. This action will allow repair of localized failure, if any does occur.

5.3.2 PORTLAND CEMENT CONCRETE PAVEMENT SECTION AND MATERIALS

When using a concrete pavement section, we recommend utilizing a plain jointed concrete pavement for the proposed Portland cement concrete pavement areas. The table below presents the layer materials and thickness recommendations for the PCC pavement section.

PORTLAND CEMENT CONCRETE – RECOMMENDED MATERIALS AND LAYERS

LAYER	MATERIAL	MINIMUM THICKNESS (INCHES)
Surface	ODOT Class C Portland Cement Concrete	8.0
Aggregate Base	ODOT 304 Crushed Limestone*	8.0

*See Section 5.4.3 (Aggregate Base Material Recommendations) for material details

Gravel or slag aggregates should not be allowed in the concrete coarse aggregate. We recommend ASTM C1567 to determine the potential of Alkali Silica Reactivity (ASR). The blend should provide less than 0.1 percent of expansion following 14 days of immersion. The mix design should contain the results of the ASTM C1567 test program. Ground granulated blast furnace slag (GGBFS) may be used as a mitigation agent for ASR at cement replacement rate of 20 to 40 percent. The cement type should be Type 1 with air content specified at 5 to 8 percent (%). The minimum specified unconfined compressive strength should be 4,000 psi at 28 days.

Contraction joints should be spaced at a maximum of 15 feet, based on the design thickness of 8 inches. The length to width ratio (slenderness ratio) of slabs should not exceed 1.25. We recommend 1.25-inch diameter, 18-inch long smooth epoxy coated dowel bars spaced 12 inches apart at contraction joints. We recommend tie bars be No. 5, 30-inch long epoxy coated deformed bars spaced 30 inches apart at longitudinal joints. Tie bars should not be placed within 15 inches of contraction joints so they do not interfere with joint movement. Tie bars and dowel bars should be epoxy coated and installed mid-depth within the slabs in accordance to ODOT requirements. Expansion and isolation joints need to be incorporated in the final joint layout plan by the design engineer and should take into account the overall pavement layout (phasing) and the site civil design. The contractor should be required to submit a pavement installation and jointing plan to the design engineer for review and approval prior to proceeding with the concrete pavement installation.

We recommend a broom finish and installation of a uniform curing compound meeting requirements of ASTM C309 Type 2 at a rate of one gallon per 225 square feet. Saw cutting should be completed as soon as possible after concrete placement depending upon the weather temperature and without damaging the finish of the pavement. We recommend a saw cut depth of 2.5 inches. We recommend joints be sealed with hot poured rubber per ODOT requirements.

5.3.3 AGGREGATE BASE MATERIAL RECOMMENDATIONS

For underdrains to function properly, it is necessary for the aggregate base beneath the pavements to be free draining. This is not the case with virtually all of the locally available ODOT item #304 crushed aggregate because of the high percentages of fine size particles allowed by the specification. We recommend that a restricted blend of 304 base material be used which is marketed as "Modified 304" in order to provide the required permeability. The final blend used will fall within the broader ODOT #304 specification but restricts or limits the sizes used to produce a more drainable 304. The gradation of the base used should fall between the "Restricted Maximum" and the standard "304 Minimum" as shown in Table 5 and the following graph. Before any pavement base materials are delivered to the jobsite, they should be sampled at the source and the material approved in advance by the geotechnical engineer.

RESTRICTED ODOT #304 CRUSHED AGGREGATE BASE

SIEVE	SIZE, mm	ODOT ITEM #304 SPECIFICATION		RESTRICTED ODOT ITEM #304 MAX
		MIN	MAX	
2"	50.80	100	--	--
1"	25.00	70	100	**100**
¾"	19.00	50	90	**90**
½"	12.70	--	--	**75**
3/8"	9.50	--	--	**65**
No. 4	4.75	30	60	**40**
No. 30	0.60	9	33	**15**
No. 200	0.075	0	15	**6.0**

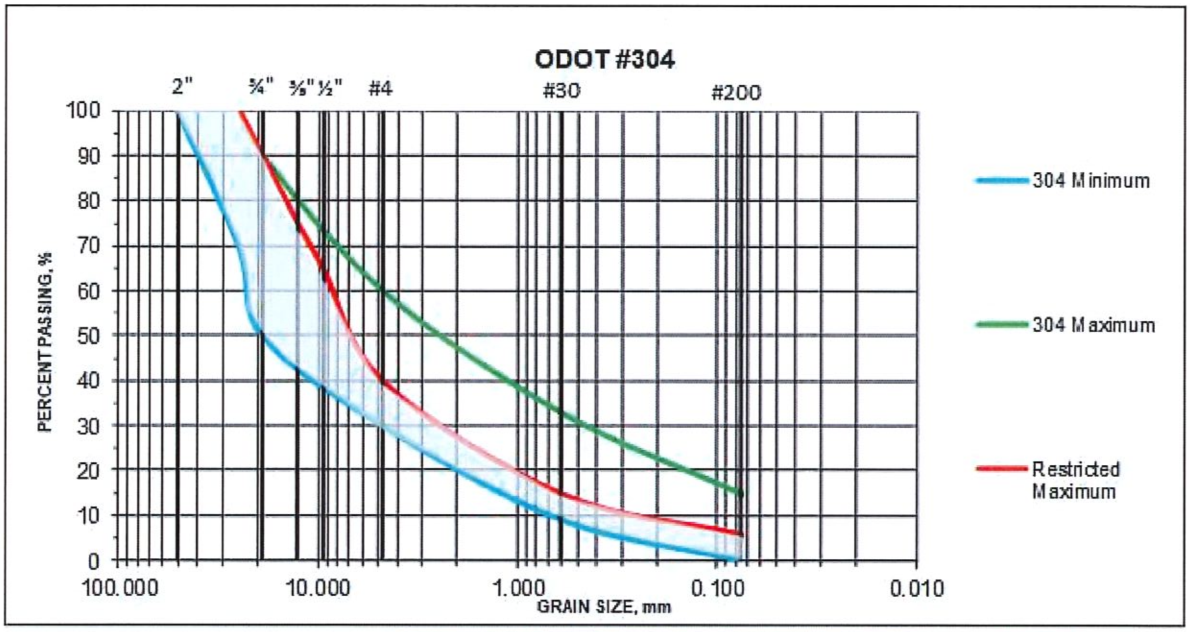


Figure No. 2: ODOT Item #304 and Restricted ODOT #304 Maximum

5.4 DRAINAGE

Pavement subgrades should be graded to eliminate surface depressions and sloped to promote drainage of the granular base, without areas that will pond water. We recommend that underdrains be installed along the perimeter and internal to pavement areas.

The underdrain inverts should set at least three feet below the pavement surface. A 4-inch diameter perforated PVC pipe should be placed at the bottom of the trench, and the trench backfilled with ODOT #57 crushed limestone or washed gravel. The backfill should extend up to the bottom of and maintain contact with the free-draining, aggregate base material. Backfill for the underdrains should be spread in horizontal lifts not exceeding 12 inches in loose thickness, with each lift being consolidated until no further densification is observed.

5.5 CONSTRUCTION NOTES

To provide adequate service life and protect the pavement investment, we present the following construction notes. These notes need to be included in the project specifications and we recommend they be implemented during the construction activities:

1. Earthwork and pavement construction must be performed in accordance with the 2016 ODOT Standard Specifications for Construction unless otherwise noted in this letter.
2. Earthwork and pavement construction is recommended during the summer months of June through September. Summer conditions are preferred to allow for more efficient discing and drying of the clay subgrade and reduce the potential for disturbance of the subgrade soils due to relatively cold temperatures and precipitation. Remove any existing topsoil, organic soils, unsuitable fill and other undesirable materials to expose a suitable subgrade. Tree roots must be removed. Existing structures (if encountered) must be removed and replaced with engineered fill a minimum of 3 feet below the proposed pavement layer to provide a uniform subgrade.
3. Excavate to the depth of the final subgrade elevation to allow for grade changes and the placement of the recommended pavement system.
4. On site fill material can be used if the specified compaction requirements can be achieved. If on site material is used, it must be clean and free of frozen soil, organics, or other unsuitable materials.
5. The top 12 inches of the exposed subgrade as well as individual fill layers shall be compacted to achieve a minimum of 100 percent of the Standard Proctor maximum dry density (ASTM D698). Manipulate the moisture content to within (plus or minus) 2 percentage points of optimum moisture.
6. The final subgrade shall be thoroughly proofrolled using a loaded tandem axle truck under the observation of a geotechnical/pavement engineer. Loose or yielding areas that cannot be mechanically stabilized must be removed and replaced with engineered fill or as dictated by field conditions and recommended by a geotechnical/pavement engineer.
7. The aggregate base shall be compacted to achieve a minimum of 100 percent of the Standard Proctor maximum dry density. The base and subgrade compaction must extend a minimum of 12 inches beyond the paved edge or back of new concrete curb.
8. All bituminous material shall be compacted to a density of 94 to 97 percent of the maximum theoretical density as determined by the Rice Method.
9. A bond coat of SS-1h emulsion is required between the leveling course and the wearing course. The bond coat must be applied in a uniform manner over the surface at a rate of 0.1 gallons/s.y.

10. Performance grade PG64-22 asphalt cement shall be used in the production of all bituminous mixtures. The amount of recycled asphalt pavement (RAP) must be limited to 30 percent for leveling course layers. RAP must be limited to 15 percent in the surface course.
11. Final pavement elevations shall be designed to provide positive surface drainage. A minimum surface slope of 1.5 percent is recommended.

Install interceptor drains along the perimeter of paved areas were runoff from higher ground would flow towards the pavement. Finger drains must be installed at catch basins and gutter inlets, and interior of large pavement areas.

APPENDIX A

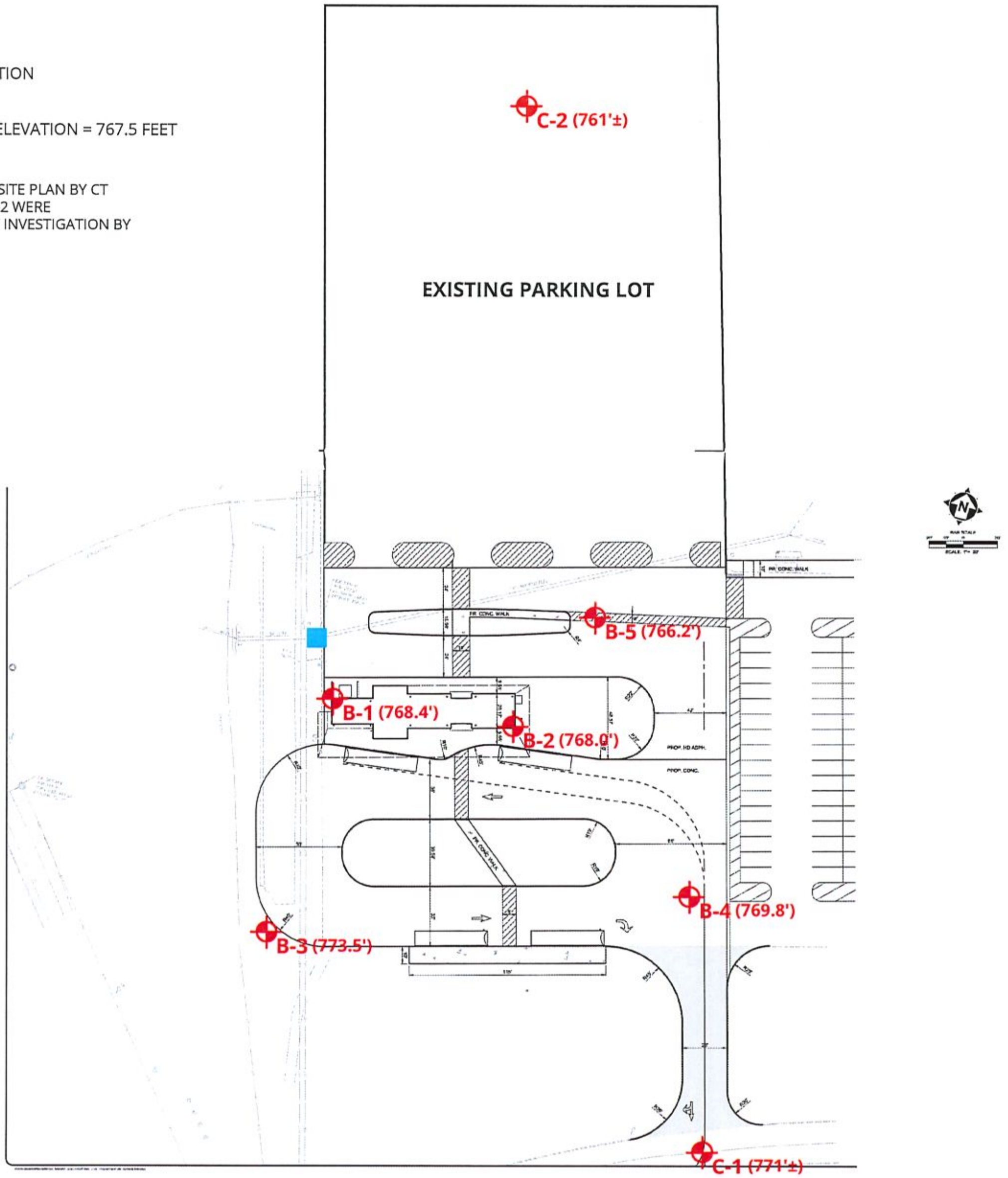
BORING LOCATION PLAN
BORING LOG TERMINOLOGY
PAVEMENT CORE LOG
BORING LOGS – CURRENT EXPLORATION (5)
BORING LOGS – PREVIOUS EXPLORATIONS (2)

LEGEND

⌖ APPROXIMATE BORING LOCATION

🟦 BM : EXISTING CATCH BASIN, ELEVATION = 767.5 FEET

NOTE:
DRAWING INFORMATION TAKEN FROM SITE PLAN BY CT CONSULTANTS. LOCATIONS C-1 AND C-2 WERE COMPLETED DURING THE PRELIMINARY INVESTIGATION BY SME (SME PROJECT NO. 078841.00)



SME
www.sme-usa.com

Project
LCC - PHASE 1B

Project Location
7700 CLOCKTOWER DRIVE KIRTLAND, OH

Sheet Name
BORING LOCATION PLAN

No.	Revision Date
1	01/14/2019

Date	01/14/2019
CADD	JF
CHCKD	AKF
Scale	NTS
Project	078841.04
Figure No.	1

DRAWING NOTE: SCALE DEPICTED IS MEANT FOR 11" X 17" AND WILL SCALE INCORRECTLY IF PRINTED ON ANY OTHER SIZE MEDIA

FILE LOCATION:

PLOT DATE:

BORING LOG TERMINOLOGY

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

COARSE-GRAINED SOIL
(more than 50% of material is larger than No. 200 sieve size.)

	Clean Gravel (Less than 5% fines)		
GRAVEL More than 50% of coarse fraction larger than No. 4 sieve size	▨	GW	Well-graded gravel; gravel-sand mixtures, little or no fines
	▨	GP	Poorly-graded gravel; gravel-sand mixtures, little or no fines
	Gravel with fines (More than 12% fines)		
	▨	GM	Silty gravel; gravel-sand-silt mixtures
	▨	GC	Clayey gravel; gravel-sand-clay mixtures
	Clean Sand (Less than 5% fines)		
SAND 50% or more of coarse fraction smaller than No. 4 sieve size	▨	SW	Well-graded sand; sand-gravel mixtures, little or no fines
	▨	SP	Poorly graded sand; sand-gravel mixtures, little or no fines
	Sand with fines (More than 12% fines)		
	▨	SM	Silty sand; sand-silt-gravel mixtures
	▨	SC	Clayey sand; sand–clay-gravel mixtures

FINE-GRAINED SOIL
(50% or more of material is smaller than No. 200 sieve size)

SILT AND CLAY Liquid limit less than 50%	▨	ML	Inorganic silt; sandy silt or gravelly silt with slight plasticity
	▨	CL	Inorganic clay of low plasticity; lean clay, sandy clay, gravelly clay
	▨	OL	Organic silt and organic clay of low plasticity
SILT AND CLAY Liquid limit 50% or greater	▨	MH	Inorganic silt of high plasticity, elastic silt
	▨	CH	Inorganic clay of high plasticity, fat clay
	▨	OH	Organic silt and organic clay of high plasticity
HIGHLY ORGANIC SOIL	▨	PT	Peat and other highly organic soil

OTHER MATERIAL SYMBOLS

■	Topsoil	□	Void	▨	Sandstone
▨	Asphalt	▨	Glacial Till	▨	Siltstone
▨	Base	■	Coal	▨	Limestone
▨	Concrete	▨	Shale	▨	Fill

LABORATORY CLASSIFICATION CRITERIA

GW	$C_U = \frac{D_{60}}{D_{10}}$ greater than 4; $C_C = \frac{D_{30}{}^2}{D_{10} \times D_{60}}$ between 1 and 3	
GP	Not meeting all gradation requirements for GW	
GM	Atterberg limits below "A" line or PI less than 4	Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols
GC	Atterberg limits above "A" line with PI greater than 7	
SW	$C_U = \frac{D_{60}}{D_{10}}$ greater than 6; $C_C = \frac{D_{30}{}^2}{D_{10} \times D_{60}}$ between 1 and 3	
SP	Not meeting all gradation requirements for SW	
SM	Atterberg limits below "A" line or PI less than 4	Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols
SC	Atterberg limits above "A" line with PI greater than 7	

Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

Less than 5 percent……………………………..GW, GP, SW, SP
More than 12 percent…………………………..GM, GC, SM, SC
5 to 12 percent……………………..Cases requiring dual symbols

- SP-SM or SW-SM (SAND with Silt or SAND with Silt and Gravel)
- SP-SC or SW-SC (SAND with Clay or SAND with Clay and Gravel)
- GP-GM or GW-GM (GRAVEL with Silt or GRAVEL with Silt and Sand)
- GP-GC or GW-GC (GRAVEL with Clay or GRAVEL with Clay and Sand)

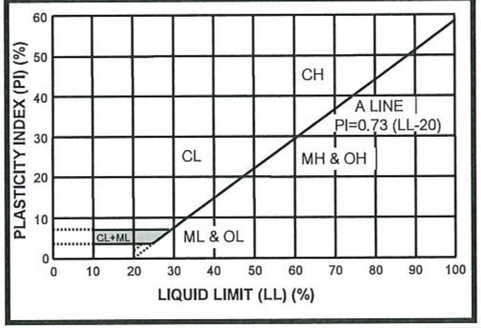
If the fines are CL-ML:

- SC-SM (SILTY CLAYEY SAND or SILTY CLAYEY SAND with Gravel)
- SM-SC (CLAYEY SILTY SAND or CLAYEY SILTY SAND with Gravel)
- GC-GM (SILTY CLAYEY GRAVEL or SILTY CLAYEY GRAVEL with Sand)
- GM-GC (CLAYEY SILTY GRAVEL or CLAYEY SILTY GRAVEL with Sand)

PARTICLE SIZES

Boulders	-	Greater than 12 inches
Cobbles	-	3 inches to 12 inches
Gravel- Coarse	-	3/4 inches to 3 inches
Fine	-	No. 4 to 3/4 inches
Sand- Coarse	-	No. 10 to No. 4
Medium	-	No. 40 to No. 10
Fine	-	No. 200 to No. 40
Silt and Clay	-	Less than (0.0074 mm)

PLASTICITY CHART



VISUAL MANUAL PROCEDURE

When laboratory tests are not performed to confirm the classification of soils exhibiting borderline classifications, the two possible classifications would be separated with a slash, as follows:

For soils where it is difficult to distinguish if it is a coarse or fine-grained soil:

- SC/CL (CLAYEY SAND to Sandy LEAN CLAY)
- SM/ML (SILTY SAND to SANDY SILT)
- GC/CL (CLAYEY GRAVEL to Gravelly LEAN CLAY)
- GM/ML (SILTY GRAVEL to Gravelly SILT)

For soils where it is difficult to distinguish if it is sand or gravel, poorly or well-graded sand or gravel; silt or clay; or plastic or non-plastic silt or clay:

- SP/GP or SW/GW (SAND with Gravel to GRAVEL with Sand)
- SC/GC (CLAYEY SAND with Gravel to CLAYEY GRAVEL with Sand)
- SM/GM (SILTY SAND with Gravel to SILTY GRAVEL with Sand)
- SW/SP (SAND or SAND with Gravel)
- GP/GW (GRAVEL or GRAVEL with Sand)
- SC/SM (CLAYEY to SILTY SAND)
- GM/GC (SILTY to CLAYEY GRAVEL)
- CL/ML (SILTY CLAY)
- ML/CL (CLAYEY SILT)
- CH/MH (FAT CLAY to ELASTIC SILT)
- CL/CH (LEAN to FAT CLAY)
- MH/ML (ELASTIC SILT to SILT)
- OL/OH (ORGANIC SILT or ORGANIC CLAY)

DRILLING AND SAMPLING ABBREVIATIONS

2ST	–	Shelby Tube – 2" O.D.
3ST	–	Shelby Tube – 3" O.D.
AS	–	Auger Sample
GS	–	Grab Sample
LS	–	Liner Sample
NR	–	No Recovery
PM	–	Pressure Meter
RC	–	Rock Core diamond bit. NX size, except where noted
SB	–	Split Barrel Sample 1-3/8" I.D., 2" O.D., except where noted
VS	–	Vane Shear
WS	–	Wash Sample

OTHER ABBREVIATIONS

WOH	–	Weight of Hammer
WOR	–	Weight of Rods
SP	–	Soil Probe
PID	–	Photo Ionization Device
FID	–	Flame Ionization Device

DEPOSITIONAL FEATURES

Parting	–	as much as 1/16 inch thick
Seam	–	1/16 inch to 1/2 inch thick
Layer	–	1/2 inch to 12 inches thick
Stratum	–	greater than 12 inches thick
Pocket	–	deposit of limited lateral extent
Lens	–	lenticular deposit
Hardpan/Till	–	an unstratified, consolidated or cemented mixture of clay, silt, sand and/or gravel, the size/shape of the constituents vary widely
Lacustrine	–	soil deposited by lake water
Mottled	–	soil irregularly marked with spots of different colors that vary in number and size
Varved	–	alternating partings or seams of silt and/or clay
Occasional	–	one or less per foot of thickness
Frequent	–	more than one per foot of thickness
Interbedded	–	strata of soil or beds of rock lying between or alternating with other strata of a different nature

CLASSIFICATION TERMINOLOGY AND CORRELATIONS

Cohesionless Soils

Relative Density	N-Value (Blows per foot)
Very Loose	0 to 4
Loose	4 to 10
Medium Dense	10 to 30
Dense	30 to 50
Very Dense	50 to 80
Extremely Dense	Over 80

Cohesive Soils

Consistency	N-Value (Blows per foot)	Undrained Shear Strength ($kips/ft^2$)
Very Soft	0 - 2	0.25 or less
Soft	2 - 4	0.25 to 0.50
Medium	4 - 8	0.50 to 1.0
Stiff	8 - 15	1.0 to 2.0
Very Stiff	15 - 30	2.0 to 4.0
Hard	> 30	4.0 or greater

Standard Penetration 'N-Value' = Blows per foot of a 140-pound hammer falling 30 inches on a 2-inch O.D. split barrel sampler, except where noted.

LCC - PHASE 1B - PAVEMENT CORES
SME PROJECT NO.: 078841.04

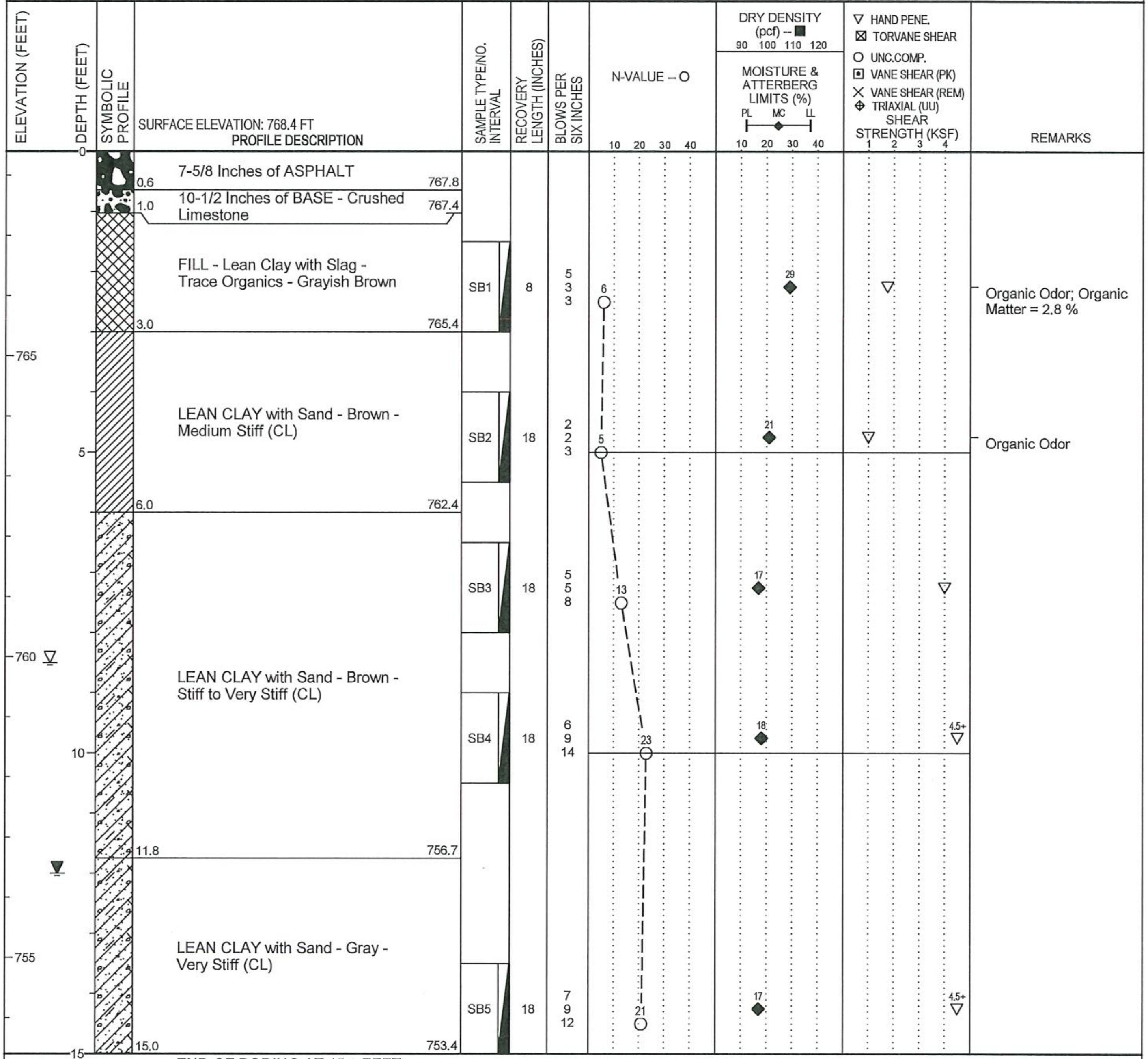
				
CORE/LOCATION	B-1	B-2	B-4	B-5
ASPHALT, in.	7-5/8	10-3/4	10-1/2	8-3/4
BASE, in.	10-1/2	-	-	6-1/4
BASE MATERIAL	Crushed Limestone	-	-	Cinders, Asphalt, and Sand
TOTAL PAVEMENT, in.	18-1/8	10-3/4	10-1/2	15

BORING B-1

PAGE 1 OF 1

PROJECT NAME: LCC - Phase 1B
PROJECT NUMBER: 078841.04
CLIENT: CT Consultants Inc
PROJECT LOCATION: Kirtland, Ohio

DATE STARTED: 1/11/19
COMPLETED: 1/11/19
BORING METHOD: 3-3/4" Hollow Stem Auger
DRILLER: RH/RM
RIG NO.: 293-CME55CPT-TRUCK
LOGGED BY: JF
CHECKED BY: AKF



SURFACE ELEVATION: 768.4 FT

DEPTH (FEET)	PROFILE DESCRIPTION		SAMPLE TYPE/NO. INTERVAL	RECOVERY LENGTH (INCHES)	BLOWS PER SIX INCHES	N-VALUE	MOISTURE (%)	SHEAR STRENGTH (KSF)	REMARKS
0.6	7-5/8 Inches of ASPHALT	767.8							
1.0	10-1/2 Inches of BASE - Crushed Limestone	767.4							
3.0	FILL - Lean Clay with Slag - Trace Organics - Grayish Brown	765.4	SB1	8	5 3 3	6	29		Organic Odor; Organic Matter = 2.8 %
6.0	LEAN CLAY with Sand - Brown - Medium Stiff (CL)	762.4	SB2	18	2 2 3	5	21		Organic Odor
11.8	LEAN CLAY with Sand - Brown - Stiff to Very Stiff (CL)	756.7	SB3 SB4	18 18	5 5 8 6 9 14	13 23	17 18	 4.5+	
15.0	LEAN CLAY with Sand - Gray - Very Stiff (CL)	753.4	SB5	18	7 9 12	21	17	4.5+	

END OF BORING AT 15.0 FEET.

GROUNDWATER & BACKFILL INFORMATION

	DEPTH (FT)	ELEV (FT)
▽ **DURING BORING:**	8.5	759.9
▼ **AT END OF BORING:**	12.0	756.4
CAVE-IN OF BOREHOLE AT:	11.0	757.4

BACKFILL METHOD: Auger Cuttings & Cold Patch

NOTES: 1. The indicated stratification lines are approximate. In situ, the transition between materials may be gradual.

SME

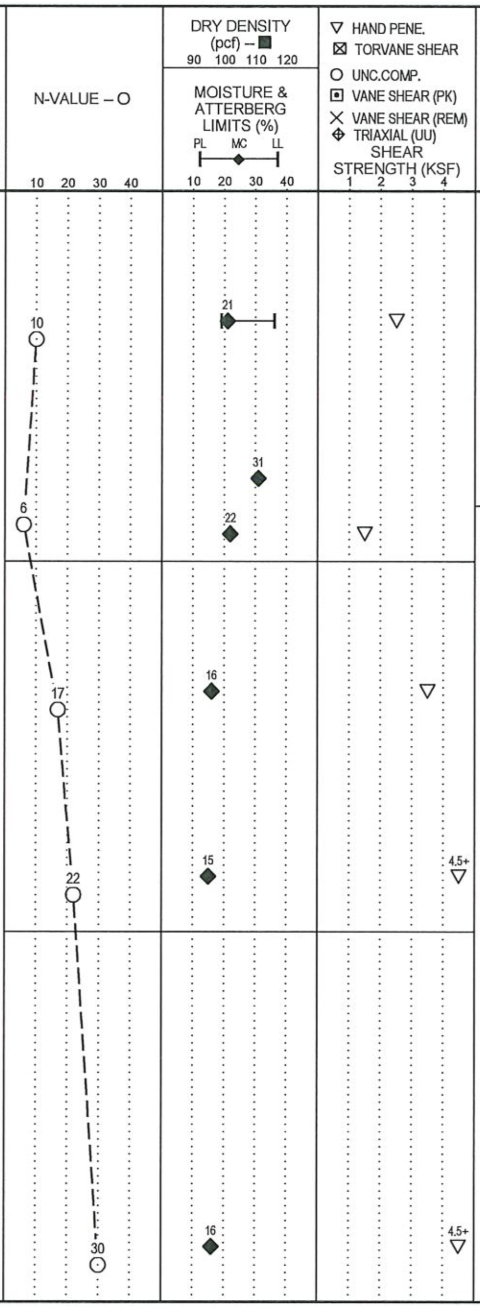
BORING B-2

PAGE 1 OF 1

PROJECT NAME: LCC - Phase 1B
PROJECT NUMBER: 078841.04
CLIENT: CT Consultants Inc
PROJECT LOCATION: Kirtland, Ohio
DATE STARTED: 1/11/19
COMPLETED: 1/11/19
BORING METHOD: 3-3/4" Hollow Stem Auger
DRILLER: RH/RM
RIG NO.: 293-CME55CPT-TRUCK
LOGGED BY: JF
CHECKED BY: AKF

SURFACE ELEVATION: 768 FT

DEPTH (FEET)	PROFILE DESCRIPTION	ELEVATION (FEET)
0–0.9	10-3/4 Inches of ASPHALT	767.1
0.9–2.5	LEAN CLAY with Sand - Brown - Stiff (CL)	765.5
2.5–5.5	LEAN CLAY - Trace Sand - Trace Organics - Gray - Medium Stiff (CL)	762.5
5.5–15.0	LEAN CLAY with Sand - Brown - Very Stiff (CL)	753.0



SAMPLE TYPE/NO. INTERVAL	RECOVERY LENGTH (INCHES)	BLOWS PER SIX INCHES	N-VALUE	MOISTURE (%)	REMARKS
SB1	8	4 5 5	10	21	
SB2	14	2 3 3	6	31 22	Organic Odor; Organic Matter = 4.1 %
SB3	18	6 7 10	17	16	
SB4	18	7 11 11	22	15	
SB5	18	9 14 16	30	16	

END OF BORING AT 15.0 FEET.

GROUNDWATER & BACKFILL INFORMATION

GROUNDWATER WAS NOT ENCOUNTERED

	DEPTH (FT)	ELEV (FT)
CAVE-IN OF BOREHOLE AT:	12.5	755.5

BACKFILL METHOD: Auger Cuttings & Cold Patch

NOTES: 1. The indicated stratification lines are approximate. In situ, the transition between materials may be gradual.

SME

BORING B-3

PAGE 1 OF 1

PROJECT NAME: LCC - Phase 1B
PROJECT NUMBER: 078841.04
CLIENT: CT Consultants Inc
PROJECT LOCATION: Kirtland, Ohio
DATE STARTED: 1/11/19
COMPLETED: 1/11/19
BORING METHOD: 4" Solid Stem Auger
DRILLER: RH/RM
RIG NO.: 293-CME55CPT-TRUCK
LOGGED BY: JF
CHECKED BY: AKF

SURFACE ELEVATION: 773.5 FT

ELEVATION (FEET)	DEPTH (FEET)	PROFILE DESCRIPTION	SAMPLE TYPE/NO. INTERVAL	RECOVERY LENGTH (INCHES)	BLOWS PER SIX INCHES	N-VALUE – ○	MOISTURE & ATTERBERG LIMITS (%) PL MC LL	▽ HAND PENE. ☒ TORVANE SHEAR ○ UNC.COMP. ⊡ VANE SHEAR (PK) × VANE SHEAR (REM) ⊕ TRIAXIAL (UU) SHEAR STRENGTH (KSF)	REMARKS
773.3	0.2	2 Inches of TOPSOIL	SB1	6	3 50/1"		22		
772.8	0.7	FILL - Lean Clay with Sand - Trace Organics - Brown							
772.3	1.2	6 Inches of CONCRETE							
770.5	3.0	LEAN CLAY - Trace Sand - Trace Organics - Brown and Gray - Medium Stiff (CL)	SB2	12	2 2 4	6	21	▽	
767.8	5.7	LEAN CLAY - Trace Sand - Brown - Medium Stiff to Stiff (CL)	SB3	6	2 3 5	8	19	▽	
			SB4	12	4 5 7	12	17	4.5+ ▽	
766.0	7.5	LEAN CLAY - Trace Sand - Trace Gravel - Brown - Stiff (CL)	SB5	18	5 5 8	13	17	▽	

END OF BORING AT 7.5 FEET.

GROUNDWATER & BACKFILL INFORMATION	
GROUNDWATER WAS NOT ENCOUNTERED	
	DEPTH (FT)	ELEV (FT)
CAVE-IN OF BOREHOLE AT:	7.5	766.0
BACKFILL METHOD:	Auger Cuttings	

NOTES: 1. The indicated stratification lines are approximate. In situ, the transition between materials may be gradual.

SME

BORING B-4

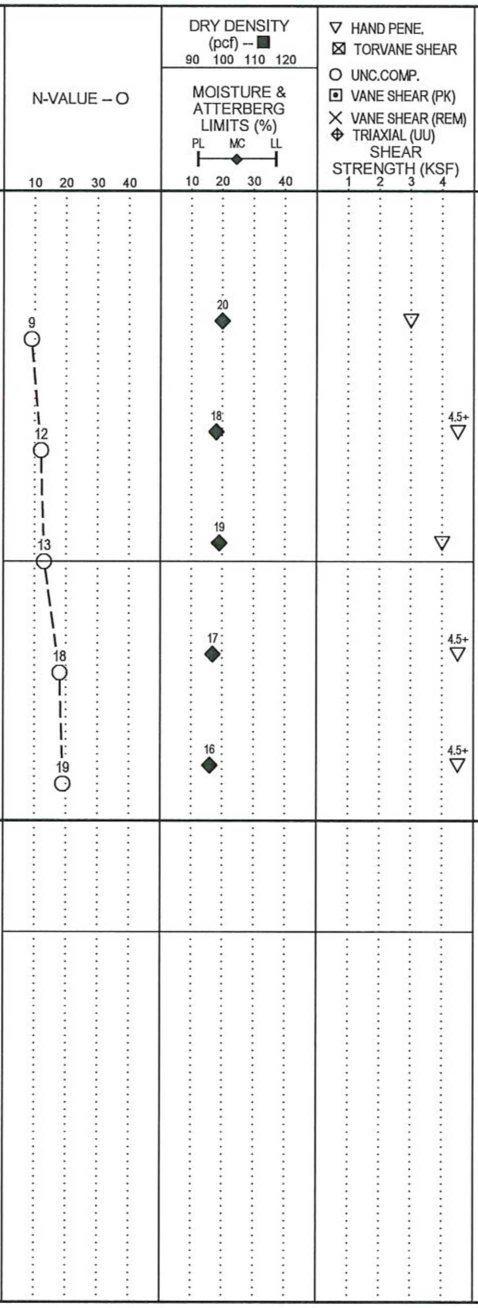
PAGE 1 OF 1

PROJECT NAME: LCC - Phase 1B
PROJECT NUMBER: 078841.04
CLIENT: CT Consultants Inc
PROJECT LOCATION: Kirtland, Ohio
DATE STARTED: 1/11/19
COMPLETED: 1/11/19
BORING METHOD: 4" Solid Stem Auger
DRILLER: RH/RM
RIG NO.: 293-CME55CPT-TRUCK
LOGGED BY: JF
CHECKED BY: AKF

SURFACE ELEVATION: 769.8 FT

DEPTH (FEET)	PROFILE DESCRIPTION	ELEVATION (FEET)	SAMPLE TYPE/NO. INTERVAL	RECOVERY LENGTH (INCHES)	BLOWS PER SIX INCHES	N-VALUE	MOISTURE (%)	REMARKS
0 - 0.9	10-1/2 Inches of ASPHALT	768.9						
0.9 - 8.5	LEAN CLAY with Sand - Brown - Stiff to Very Stiff (CL)	761.3	SB1	18	3 4 5	9	20	
			SB2	18	4 5 7	12	18	
			SB3	18	4 5 8	13	19	
			SB4	18	7 8 10	18	17	
			SB5	18	5 8 11	19	16	

END OF BORING AT 8.5 FEET.



Elevation scale: 765, 760, 755; depth scale: 0, 5, 10, 15

GROUNDWATER & BACKFILL INFORMATION

GROUNDWATER WAS NOT ENCOUNTERED

	DEPTH (FT)	ELEV (FT)
CAVE-IN OF BOREHOLE AT:	8.5	761.3

BACKFILL METHOD: Auger Cuttings & Cold Patch

NOTES: 1. The indicated stratification lines are approximate. In situ, the transition between materials may be gradual.

SME

BORING B-5

PAGE 1 OF 1

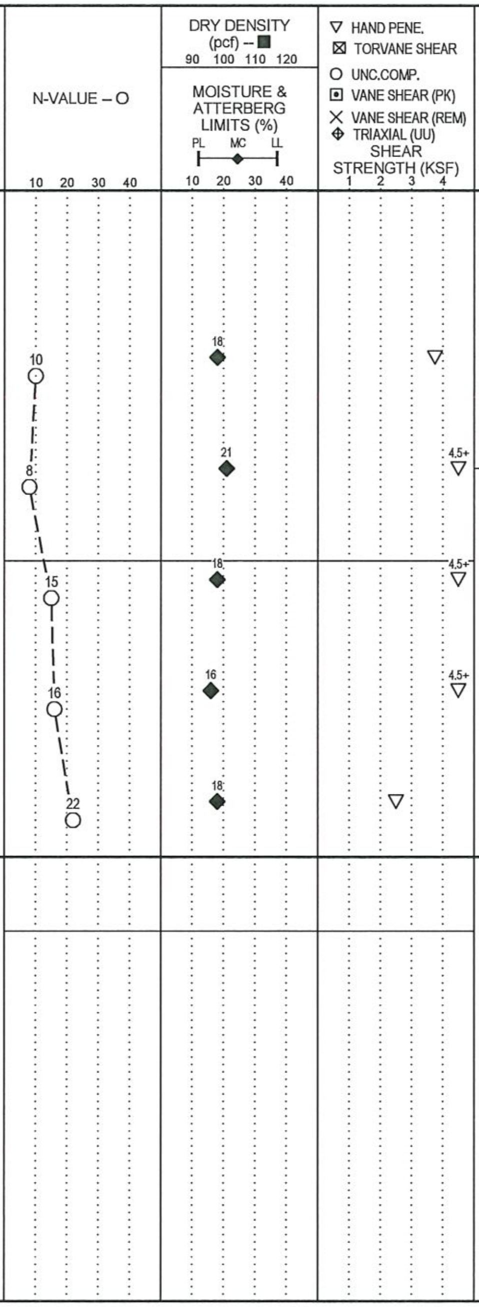
PROJECT NAME: LCC - Phase 1B
PROJECT NUMBER: 078841.04
CLIENT: CT Consultants Inc
PROJECT LOCATION: Kirtland, Ohio
DATE STARTED: 1/11/19
COMPLETED: 1/11/19
BORING METHOD: 4" Solid Stem Auger
DRILLER: RH/RM
RIG NO.: 293-CME55CPT-TRUCK
LOGGED BY: JF
CHECKED BY: AKF

SURFACE ELEVATION: 766.2 FT

PROFILE DESCRIPTION	DEPTH (FEET)	ELEVATION (FEET)
8-3/4 Inches of ASPHALT	0.7	765.5
6-1/4 Inches of FILL - Cinders, Pulverized Asphalt, and Sand	1.3	765.0
LEAN CLAY with Sand - Brown - Stiff (CL)	3.0	763.2
LEAN CLAY - Trace Sand - Trace Organics - Brown and Gray - Medium Stiff (CL)	4.5	761.7
LEAN CLAY - Trace to with Sand - Trace Gravel - Brown - Stiff to Very Stiff (CL)	9.0	757.2

END OF BORING AT 9.0 FEET.

SAMPLE TYPE/NO. INTERVAL	RECOVERY LENGTH (INCHES)	BLOWS PER SIX INCHES	N-VALUE	MOISTURE (%)	HAND PENE. SHEAR STRENGTH (KSF)	REMARKS
SB1	15	5 5 5	10	18		
SB2	18	2 3 5	8	21	4.5+	Organic Odor
SB3	18	4 6 9	15	18	4.5+	
SB4	18	6 7 9	16	16	4.5+	
SB5	18	10 10 12	22	18		



GROUNDWATER & BACKFILL INFORMATION

GROUNDWATER WAS NOT ENCOUNTERED

	DEPTH (FT)	ELEV (FT)
CAVE-IN OF BOREHOLE AT:	9.0	757.2

BACKFILL METHOD: Auger Cuttings & Cold Patch

NOTES: 1. The indicated stratification lines are approximate. In situ, the transition between materials may be gradual.

SME

BORING C- 1

PAGE 1 OF 1

PROJECT NAME: Lakeland CC - Site, Roads, Parking Lot
PROJECT NUMBER: 078841.00
CLIENT: CT Consultants Inc
PROJECT LOCATION: Kirtland, Ohio
DATE STARTED: 5/4/18
COMPLETED: 5/4/18
BORING METHOD: 4" Solid Stem Auger
DRILLER: RH/RM
RIG NO.: 293-CME55CPT-TRUCK
LOGGED BY: JF
CHECKED BY: AKF

DEPTH (FEET)	SURFACE ELEVATION: 771± FT PROFILE DESCRIPTION	ELEVATION (FEET)	SAMPLE TYPE/NO. INTERVAL	RECOVERY LENGTH (INCHES)	BLOWS PER SIX INCHES	N-VALUE – ○	MOISTURE & ATTERBERG LIMITS (%) PL MC LL	▽ HAND PENE. ⊠ TORVANE SHEAR ○ UNC.COMP. ⊡ VANE SHEAR (PK) × VANE SHEAR (REM) ⊕ TRIAXIAL (UU) SHEAR STRENGTH (KSF)	REMARKS
0.8	10 inches of ASPHALT	770.2							
1.6	9 inches of BASE - Fine sand to gravel-sized Crushed Limestone, Slag, Sand, and Silt	769.4	SB1	18	9 4 6	10	15	4.5+ ▽	Organic Odor
4.6	LEAN CLAY - Trace Sand - Brown and Gray - Stiff (CL)	766.4	SB2	18	5 4 6	10	26	▽	
8.1	LEAN CLAY - Trace Sand - Brown and Gray - Stiff (CL)	762.9	SB3	18	5 7 8	15	16	▽	
10.0	LEAN CLAY with Sand - Brown - Medium Stiff (CL)	761.0	SB5	18	2 3 4	7	21	▽	

END OF BORING AT 10.0 FEET.

GROUNDWATER & BACKFILL INFORMATION

GROUNDWATER WAS NOT ENCOUNTERED

	DEPTH (FT)	ELEV (FT)
CAVE-IN OF BOREHOLE AT:	10.0	761.0

BACKFILL METHOD: Auger Cuttings capped with Concrete Cold Patch

NOTES: 1. The indicated stratification lines are approximate. In situ, the transition between materials may be gradual.

BORING C- 2

PAGE 1 OF 1

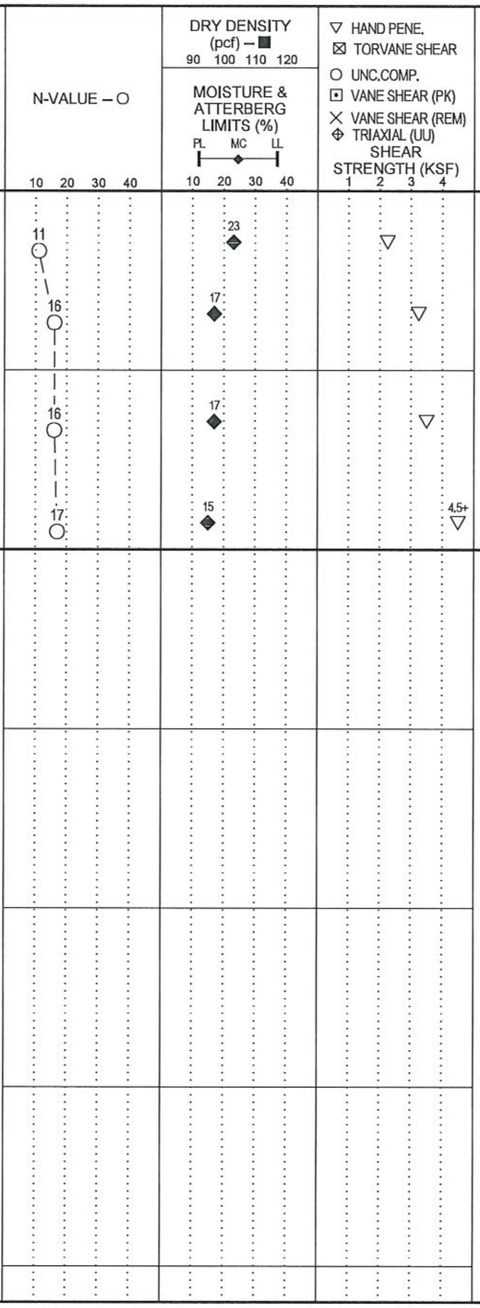
PROJECT NAME: Lakeland CC - Site, Roads, Parking Lot
PROJECT NUMBER: 078841.00
CLIENT: CT Consultants Inc
PROJECT LOCATION: Kirtland, Ohio

DATE STARTED: 5/4/18
COMPLETED: 5/4/18
BORING METHOD: 4" Solid Stem Auger
DRILLER: RH/RM
RIG NO.: 293-CME55CPT-TRUCK
LOGGED BY: JF
CHECKED BY: AKF

SURFACE ELEVATION: 761± FT

DEPTH (FEET)	ELEVATION (FEET)	PROFILE DESCRIPTION	SAMPLE TYPE/NO. INTERVAL	RECOVERY LENGTH (INCHES)	BLOWS PER SIX INCHES	N-VALUE	MOISTURE (%)	SHEAR STRENGTH (KSF)	REMARKS
0.4	760.6	4 3/4 inches of ASPHALT							
0.7	760.3	3 1/4 inches of BASE - Medium sand to coarse gravel-sized Crushed Limestone	SB1	18	3 4 7	11	23		
2.4	758.6	LEAN CLAY - Some Sand - Brown and Gray - Stiff to Very Stiff (CL)	SB2	18	5 7 9	16	17		
		LEAN CLAY with Sand - Brown - Very Stiff (CL)	SB3	18	5 7 9	16	17		
10.0	751.0		SB4	18	8 7 10	17	15	4.5+	

END OF BORING AT 10.0 FEET.



GROUNDWATER & BACKFILL INFORMATION

	DEPTH (FT)	ELEV (FT)
▽ DURING BORING:	0.5	760.5
▼ AT END OF BORING:	0.7	760.3
CAVE-IN OF BOREHOLE AT:	10.0	751.0

BACKFILL METHOD: Auger Cuttings capped with Concrete Cold Patch

NOTES: 1. The indicated stratification lines are approximate. In situ, the transition between materials may be gradual.

APPENDIX B

IMPORTANT INFORMATION ABOUT THIS GEOTECHNICAL ENGINEERING REPORT
GENERAL COMMENTS
LABORATORY TESTING PROCEDURES

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, clients can benefit from a lowered exposure to the subsurface problems that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed below, contact your GBA-member geotechnical engineer. Active involvement in the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Geotechnical-Engineering Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. *Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled.* No one except authorized client representatives should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one – not even you – should apply this report for any purpose or project except the one originally contemplated.*

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read it *in its entirety*. Do not rely on an executive summary. Do not read selected elements only. *Read this report in full.*

You Need to Inform Your Geotechnical Engineer about Change

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:

- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

This Report May Not Be Reliable

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be*, and, in general, *if you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying it. A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface through various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing were performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team from project start to project finish, so the individual can provide informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, *they are not final*, because the geotechnical engineer who developed them relied heavily on judgment and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* revealed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a full-time member of the design team, to:

- confer with other design-team members,
- help develop specifications,
- review pertinent elements of other design professionals' plans and specifications, and
- be on hand quickly whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction observation.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for informational purposes only*. To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report, but they may rely on the factual data relative to the specific times, locations, and depths/elevations referenced. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old.*

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, none of the engineer's services were designed, conducted, or intended to prevent uncontrolled migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration.*** Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

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GENERAL COMMENTS

BASIS OF GEOTECHNICAL REPORT

This report has been prepared in accordance with generally accepted geotechnical engineering practices to assist in the design and/or evaluation of this project. If the project plans, design criteria, and other project information referenced in this report and utilized by SME to prepare our recommendations are changed, the conclusions and recommendations contained in this report are not considered valid unless the changes are reviewed, and the conclusions and recommendations of this report are modified or approved in writing by our office.

The discussions and recommendations submitted in this report are based on the available project information, described in this report, and the geotechnical data obtained from the field exploration at the locations indicated in the report. Variations in the soil and groundwater conditions commonly occur between or away from sampling locations. The nature and extent of the variations may not become evident until the time of construction. If significant variations are observed during construction, SME should be contacted to reevaluate the recommendations of this report. SME should be retained to continue our services through construction to observe and evaluate the actual subsurface conditions relative to the recommendations made in this report.

In the process of obtaining and testing samples and preparing this report, procedures are followed that represent reasonable and accepted practice in the field of soil and foundation engineering. Specifically, field logs are prepared during the field exploration that describe field occurrences, sampling locations, and other information. Samples obtained in the field are frequently subjected to additional testing and reclassification in the laboratory and differences may exist between the field logs and the report logs. The engineer preparing the report reviews the field logs, laboratory classifications, and test data and then prepares the report logs. Our recommendations are based on the contents of the report logs and the information contained therein.

REVIEW OF DESIGN DETAILS, PLANS, AND SPECIFICATIONS

SME should be retained to review the design details, project plans, and specifications to verify those documents are consistent with the recommendations contained in this report.

REVIEW OF REPORT INFORMATION WITH PROJECT TEAM

Implementation of our recommendations may affect the design, construction, and performance of the proposed improvements, along with the potential inherent risks involved with the proposed construction. The client and key members of the design team, including SME, should discuss the issues covered in this report so that the issues are understood and applied in a manner consistent with the owner's budget, tolerance of risk, and expectations for performance and maintenance.

FIELD VERIFICATION OF GEOTECHNICAL CONDITIONS

SME should be retained to verify the recommendations of this report are properly implemented during construction. This may avoid misinterpretation of our recommendations by other parties and will allow us to review and modify our recommendations if variations in the site subsurface conditions are encountered.

PROJECT INFORMATION FOR CONTRACTOR

This report and any future addenda or other reports regarding this site should be made available to prospective contractors prior to submitting their proposals for their information only and to supply them with facts relative to the subsurface evaluation and laboratory test results. If the selected contractor encounters subsurface conditions during construction, which differ from those presented in this report, the contractor should promptly describe the nature and extent of the differing conditions in writing and SME should be notified so that we can verify those conditions. The construction contract should include provisions for dealing with differing conditions and contingency funds should be reserved for potential problems during earthwork and foundation construction. We would be pleased to assist you in developing the contract provisions based on our experience.

The contractor should be prepared to handle environmental conditions encountered at this site, which may affect the excavation, removal, or disposal of soil; dewatering of excavations; and health and safety of workers. Any Environmental Assessment reports prepared for this site should be made available for review by bidders and the successful contractor.

THIRD PARTY RELIANCE/REUSE OF THIS REPORT

This report has been prepared solely for the use of our Client for the project specifically described in this report. This report cannot be relied upon by other parties not involved in the project, unless specifically allowed by SME in writing. SME also is not responsible for the interpretation by other parties of the geotechnical data and the recommendations provided herein.

LABORATORY TESTING PROCEDURES

VISUAL ENGINEERING CLASSIFICATION

Visual classification was performed on recovered samples. The appended General Notes and Unified Soil Classification System (USCS) sheets include a brief summary of the general method used visually classify the soil and assign an appropriate USCS group symbol. The estimated group symbol, according to the USCS, is shown in parentheses following the textural description of the various strata on the boring logs appended to this report. The soil descriptions developed from visual classifications are sometimes modified to reflect the results of laboratory testing.

MOISTURE CONTENT

Moisture content tests were performed by weighing samples from the field at their in-situ moisture condition. These samples were then dried at a constant temperature (approximately 110º C) overnight in an oven. After drying, the samples were weighed to determine the dry weight of the sample and the weight of the water that was expelled during drying. The moisture content of the specimen is expressed as a percent and is the weight of the water compared to the dry weight of the specimen.

HAND PENETROMETER TESTS

In the hand penetrometer test, the unconfined compressive strength of a cohesive soil sample is estimated by measuring the resistance of the sample to the penetration of a small calibrated, spring-loaded cylinder. The maximum capacity of the penetrometer is 4.5 tons per square-foot (tsf). Theoretically, the undrained shear strength of the cohesive sample is one-half the unconfined compressive strength. The undrained shear strength (based on the hand penetrometer test) presented on the boring logs is reported in units of kips per square-foot (ksf).

TORVANE SHEAR TESTS

In the Torvane test, the shear strength of a low strength, cohesive soil sample is estimated by measuring the resistance of the sample to a torque applied through vanes inserted into the sample. The undrained shear strength of the samples is measured from the maximum torque required to shear the sample and is reported in units of kips per square-foot (ksf).

LOSS-ON-IGNITION (ORGANIC CONTENT) TESTS

Loss-on-ignition (LOI) tests are conducted by first weighing the sample and then heating the sample to dry the moisture from the sample (in the same manner as determining the moisture content of the soil). The sample is then re-weighed to determine the dry weight and then heated for 4 hours in a muffle furnace at a high temperature (approximately 440º C). After cooling, the sample is re-weighed to calculate the amount of ash remaining, which in turn is used to determine the amount of organic matter burned from the original dry sample. The organic matter content of the specimen is expressed as a percent compared to the dry weight of the sample.

ATTERBERG LIMITS TESTS

Atterberg limits tests consist of two components. The plastic limit of a cohesive sample is determined by rolling the sample into a thread and the plastic limit is the moisture content where a 1/8-inch thread begins to crumble. The liquid limit is determined by placing a ½-inch thick soil pat into the liquid limits cup and using a grooving tool to divide the soil pat in half. The cup is then tapped on the base of the liquid limits device using a crank handle. The number of drops of the cup to close the gap formed by the grooving tool ½ inch is recorded along with the corresponding moisture content of the sample. This procedure is repeated several times at different moisture contents and a graph of moisture content and the corresponding number of blows is plotted. The liquid limit is defined as the moisture content at a nominal 25 drops of the cup. From this test, the plasticity index can be determined by subtracting the plastic limit from the liquid limit.