AMERICAN ENGINEERING TESTING, INC.

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REPORT OF GEOTECHNICAL EXPLORATION AND REVIEW

FedEx Ground Distribution Center

Schumann Drive Northwest
Stewartville, Minnesota

Report No. 11-05638

Date:

January 11, 2012

Prepared for:

Ruedebusch Development and Construction
4605 Dovetail Drive
Madison, Wisconsin 53704

www.amengtest.com

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January 11, 2012

Ruedebusch Development and Construction
4605 Dovetail Drive
Madison, Wisconsin 53704

Attn: Dave Hull

RE: Geotechnical Exploration and Review
FedEx Ground Distribution Center
Schumann Drive Northwest
Stewartville, Minnesota
Report No. 11-05638

Dear Mr. Hull:

American Engineering Testing, Inc. (AET) is pleased to present the results of our subsurface exploration program and geotechnical engineering review for the FedEx Ground Distribution Center project. These services were performed according to our proposal to you dated December 9, 2011.

We are submitting two copies of the report to you.

Please contact me if you have any questions about the report. I can also be contacted for arranging construction observation and testing services during the earthwork phase.

Sincerely,
American Engineering Testing, Inc.

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I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under Minnesota Statute Section 326.02 to 326.15

Date: 1/11/12 **License #: 42675**

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1.0 INTRODUCTION

It is proposed to build a FedEx Ground Distribution Center on Schumann Drive Northwest in Stewartville, Minnesota. To assist with planning and design, American Engineering Testing, Inc. (AET) has been authorized to conduct a subsurface exploration program at the site, conduct soil laboratory testing, and perform a geotechnical engineering review for the project. This report presents the results of the above services, and provides our engineering recommendations based on this data.

2.0 SCOPE OF SERVICES

AET's services were performed according to our proposal dated December 9, 2011, which you authorized with Contract #2053 on December 13, 2011. The authorized scope consists of the following:

- Completion of eight standard penetration test borings to depths ranging from about 10 to 25 feet.
- Soil laboratory testing.
- Geotechnical engineering analysis based on the gained data and preparation of this report.

These services are intended for geotechnical purposes. The scope is not intended to explore for the presence or extent of environmental contamination.

3.0 PROJECT INFORMATION

Based on the information that you provided, it is proposed to construct one-story, slab-on-grade building with a footprint of about 58,000 square feet.

You indicated that isolated column loads would not exceed 100 kips (100,000 pounds). Wall loads were not provided for this structure. Therefore, we have assumed that wall loads will not exceed 7 kips (7,000 pounds) per lineal foot.

Traffic information that you provided indicated that Type I Pavements (heavy duty pavements) will have maximum traffic loads of about 318,000 Equivalent Single Axel Loads (ESAL)s and Type II Pavements (light duty pavements) will have maximum traffic loads of 280 ESALS.

Existing grades in the building pad range from about 1279 feet in the northeast to about 1286 feet in the southwest. The finished floor elevation for the building will be 1281 feet. Therefore, site grading for the building pad will result in about a 2 foot raise-in-grade in the northeast corner of the pad to about a 5 foot cut-in-grade in the southwest corner of the pad. We have assumed that grades in the parking and drive areas will generally be within 2 feet of existing grades.

Our foundation design assumptions include a minimum factor of safety of 3 with respect to localized shear or base failure of the foundations. We assume the structure will be able to tolerate total settlements of up to 1 inch, and differential settlements over a 30 foot distance of up to ½ inch.

The above stated information represents our understanding of the proposed construction. This information is an integral part of our engineering review. It is important that you contact us if there are changes from that described so that we can evaluate whether modifications to our recommendations are appropriate.

4.0 SUBSURFACE EXPLORATION AND TESTING

4.1 Field Exploration Program

The subsurface exploration program conducted for the project consisted of eight standard penetration test borings. The logs of the borings and details of the methods used appear in Appendix A. The logs contain information concerning soil layering, soil classification, geologic description, and moisture condition. Relative density or consistency is also noted for the natural soils, which is based on the standard penetration resistance (N-value).

The boring locations are shown on Figure 1 in Appendix A. The borings were located in the field by Yaggy Colby Associates. Surface elevations were provided by Yaggy Colby Associates.

4.2 Laboratory Testing

The laboratory test program included 24 moisture content tests, 2 sieve analyses (through a #200 sieve only) and 20 pocket penetrometer tests. The test results appear in Appendix A on the individual boring logs adjacent to the samples upon which they were performed.

5.0 SITE CONDITIONS

5.1 Surface Observations

The site is currently agricultural cropland on the northwest edge of Stewartville. Surrounding properties are primarily agricultural cropland. The site slopes to the northeast.

5.2 Subsurface Soils/Geology

The site geology consists of topsoil overlying glacial deposits. The topsoil extended from the surface to depths ranging from about 1 foot to 2 feet below grade and consisted of silt and clayey sand that was dark brown in color.

Below the topsoil, glacial deposits were encountered and extended to the termination depths of the borings. The glacial deposits primarily consisted of clayey sand and sandy lean clay, but some lenses of silty sand were also observed. The cohesive glacial deposits (sandy lean clay and clayey sand) were generally in a very stiff to hard condition, but locally some of these clayey glacial deposits were in a firm to stiff condition. The cohesionless glacial deposits (silty sand) were in a medium dense condition.

5.3 Groundwater

At the time of drilling, groundwater was observed in Boring B-6 at a depth of about 9 ½ feet (elevation of about 1272'). Groundwater was not observed at the remainder of the boring locations. Due to the cohesive nature of the soils, the boreholes were not likely left open long enough for groundwater to stabilize. It is also likely that groundwater is perched within the clayey soils seasonally. Piezometers would need to be installed to accurately determine the hydrostatic groundwater table at the site.

5.4 Review of Soil Properties

- Strength - Based upon resistance values of the sampling equipment, and our laboratory testing, the glacial deposits were judged to have moderate to high strength.

- Compressibility – Some of the shallow glacial deposits would be slightly compressible under the foundation loads. The glacial deposits at depth would largely be incompressible under the foundation loads.

- Frost Susceptibility - It is our judgment that the near surface soils have moderate to high frost susceptibility. If these soils remain in-place and are allowed to freeze, we anticipate heave may potentially be on the order of 1/4" to 3/8" for each foot of frost penetration within the soil, which could translate to 1" to 2" of total movement. This could be exaggerated further if free water were available such that ice lensing could be formed due to capillary action. Movements of exterior slabs are especially important in doorway areas. These exterior features should be designed to accommodate such frost movements, or the on-site soils should be subcut and replaced with low frost susceptible sands. Subsurface drainage should be also be provided.

- Drainage Properties - The majority of the soils are considered to be poorly draining materials. Water can temporarily perch over the on-site soils during wet weather. This is an important consideration beneath exterior slab and pavement areas, particularly when overlain by new sand fill. Trapped water can lead to exaggerated abrupt frost heaving and softening of the subgrade. Where the potential for perched water exists, you should consider the placement of drain tile lines or other means of drainage to relieve water buildup.

- Expansive/Shrinkage Potential - Although no Atterberg limits or expansion tests were performed, the soils encountered were judged to be "lean", which refers to soils having liquid limits less than 50%. Based on this, we judge that the on-site soils have a relatively low potential for expansion or shrinkage due to corresponding changes in moisture content.

6.0 RECOMMENDATIONS

6.1 Approach Discussion

The topsoil is not suitable for support of foundations, slabs and pavements and therefore should be removed from the footprint and oversize area of the building and pavement areas. The underlying glacial deposits are well suited to support the proposed construction.

6.2 Building Grading

6.2.1 Excavation

To prepare the building areas for foundation and slab support, we recommend removal of the topsoil, thereby exposing the underlying glacial deposits. Excavation depths at the boring locations will likely be as shown in Table A.

Table A – Recommended Excavation Depths For the Building Pad

Boring	Surface Elevation (ft)	Excavation Depth (ft)	Approximate Excavation Elevation (ft) [1]
B-4	1282.8	1	1281 ½
B-5	1285.9	1	1285
B-6	1281.4	2	1279 1/2
B-7	1279.2	1	1278

[1] Rounded to the nearest one-half foot.

The depth/elevation indicated in Table A is based on the soil conditions encountered at the specific boring locations. Since conditions will vary away from the boring locations, it is recommended that AET geotechnical personnel observe and confirm the competency of the soils in the entire excavation bottom prior to new fill or footing placement.

Where the excavation extends below foundation grade, the excavation bottom and resultant engineered fill system must be oversized laterally beyond the planned outside edges of the foundations to properly support the lateral loads exerted by that foundation. This excavation/engineered fill lateral extension should at least be equal to the vertical depth of fill needed to attain foundation grade at that location (i.e., 1:1 lateral oversize).

6.2.2 Fill Placement and Compaction

For ease of compaction, we recommend that any fill placed in the building pad consist of granular soils meeting the MnDOT definition of 3149.2.B. for Select Granular Borrow.

The existing on-site glacial deposits can be considered for reuse as backfill and fill, however, they may require moisture conditioning in order to achieve the recommended compaction.

The topsoil removed from the building pads should be reserved for reuse in landscape areas.

We recommend spreading backfill and fill in 8-inch lifts, depending on the composition of the material and type of compactor used. Backfill and fill should be compacted such that the entire lift achieves a minimum compaction level of 98% of the standard maximum dry unit weight per ASTM:D698 (Standard Proctor test).

6.3 Foundation Design

The structure can be supported on conventional spread foundations bearing on engineered fill. We recommend perimeter foundations for heated building space is placed such that the bottom is a minimum of 42 inches below exterior grade. We recommend foundations for unheated building space (such as canopy foundations) be extended to a minimum of 60 inches below exterior grade.

Based on the conditions encountered, it is our opinion the building foundations can be designed based on a net maximum allowable soil bearing pressure of 3,000 psf. It is our judgment this design pressure will have a factor of safety of at least 3 against localized shear or base failure. We judge that total settlements under this loading should not exceed 1 inch. We also judge that differential settlements of conditions depicted by the borings should not exceed ½ inch.

6.4 Floor Slab Design

We assume that the predominant slab subgrade will consist of clayey sand or sandy lean clay. Therefore, we recommend you assume a Modulus of Subgrade Reaction (k-value) of 100 pci.

For recommendations pertaining to moisture and vapor protection of interior floor slabs, we refer you to the attached standard sheet entitled "Floor Slab Moisture/Vapor Protection."

6.5 Exterior Building Backfilling

Many of the on-site soils are at least moderately frost susceptible. Because of this, certain design considerations are need to mitigate these frost effects. For details, we refer you to the attached sheet entitled "Freezing Weather Effects on Building Construction."

6.6 Pavements

6.6.1 Excavations

We recommend stripping the topsoil from beneath all pavements. Based on the soil borings, the underlying glacial deposits appear to be suitable for support of the pavements.

6.6.2 Preparation of Cuts and Surfaces to Receive Fill

After removal of unsuitable soils, and prior to placement of fill or backfill to attain design grades, we recommend scarifying the upper 1-foot of the exposed excavation, moisture conditioning the soils, and then recompacting those soils. We recommend the subgrade soil be surface compacted with a large self-propelled non-vibratory compactor. If areas become unstable due to compactive effort, they should be subcut and suitable material placed and compacted to attain grade.

If the subgrade soils cannot be stabilized through scarification and moisture conditioning, additional measures may be required to provide a firm base for subsequent fill placement. Excavation of unstable soils and replacement with crushed aggregate is one alternative to provide stability to poor soil conditions.

6.6.3 Selecting Replacement Backfill and Additional Required Fill

Topsoil should be reserved for green areas of the site, or areas that will not support structures or roadways.

On-site materials free of organics and debris can be considered for reuse as backfill and fill. However, the fine grained clay soil on site may be difficult to compact if wet or allowed to become wet, or if spread and compacted over wet or marginally stable subgrades. The on-site soils may require some drying to facilitate compaction if they will be reused as fill.

6.6.4 Placement and Compaction of Backfill and Fill

We recommend spreading backfill and fill in 8-inch lifts, depending on the composition of the material and type of compactor used. We recommend compacting backfill and fill per the recommendations provided in Table B.

Table B – Pavement Compaction Recommendations

Location	Compaction Recommendation (%)	Moisture Recommendation (%)
Within 3 feet of Pavement Subgrade	100	-3 to +1, clays -2 to +2, silts and sands
Below 3 feet of Pavement Subgrade	95	-3 to +1, clays -2 to +2, silts and sands

6.6.5 Bituminous Pavement Section Thicknesses

Based on our borings, the predominant subgrade soils will consist of clayey sand. Based on a clayey sand subgrade, we recommend assuming an R-value of 15.

Heavy duty (Type I) and light duty (Type II) pavements will be constructed at the site. Based on information that you provided, we understand that light duty pavements will be subject to only 280 ESALs (equivalent 18 kip single axle loads) and heavy duty pavements would be subject to no more than about 318,000 ESALs.

Our asphalt pavement design for light and heavy duty pavements are provided below in Table C.

Table C – Asphalt Pavement Thickness Designs

Material	Thickness (inches)	
	Light Duty	Heavy Duty
Bituminous Wear	1 1/2	1 1/2
Bituminous Non-Wear	1 1/2	2 1/2
Class 5 Aggregate Base	8	12

6.6.6 Concrete Pavement Section Thicknesses

We recommend concrete pavements be underlain with a minimum of 6 inches of Class 5 Aggregate Base to provide a uniform base for the pavement. Based on the reported traffic levels, we recommend the concrete pavements are a minimum of 8 inches thick. We recommend the concrete have a minimum compressive strength of 4,000 psi.

7.0 CONSTRUCTION CONSIDERATIONS

7.1 Potential Difficulties

7.1.1 Runoff Water in Excavation

Water can be expected to collect in the excavation bottom during times of inclement weather or snow melt. To allow observation of the excavation bottom, to reduce the potential for soil disturbance, and to facilitate filling operations, we recommend water be removed from within the excavation during construction. Based on the soils encountered, we anticipate the groundwater (if encountered) can be handled with conventional sump pumping.

7.1.2 Disturbance of Soils

The on-site soils can become disturbed under construction traffic, especially if the soils are wet. If soils become disturbed, they should be subcut to the underlying undisturbed soils. The subcut soils can then be dried and recompacted back into place, or they should be removed and replaced with drier imported fill.

7.2 Excavation Backsloping

If excavation faces are not retained, the excavations should maintain maximum allowable slopes in accordance with *OSHA Regulations (Standards 29 CFR), Part 1926, Subpart P,* *"Excavations"* (can be found on www.osha.gov). Even with the required OSHA sloping, water seepage or surface runoff can potentially induce sideslope erosion or running which could require slope maintenance.

7.3 Observation and Testing

The recommendations in this report are based on the subsurface conditions found at our test boring locations. Since the soil conditions can be expected to vary away from the soil boring locations, we recommend on-site observation by a geotechnical engineer/technician during construction to evaluate these potential changes. Soil density testing should also be performed on new fill placed in order to document that project specifications for compaction have been satisfied.

8.0 LIMITATIONS

Within the limitations of scope, budget, and schedule, our services have been conducted according to generally accepted geotechnical engineering practices at this time and location. Other than this, no warranty, either expressed or implied, is intended.

Important information regarding risk management and proper use of this report is given in Appendix B entitled "Geotechnical Report Limitations and Guidelines for Use".

Standard Data Sheets

FLOOR SLAB MOISTURE/VAPOR PROTECTION

Floor slab design relative to moisture/vapor protection should consider the type and location of two elements, a granular layer and a vapor membrane (vapor retarder, water resistant barrier or vapor barrier). In the following sections, the pros and cons of the possible options regarding these elements will be presented, such that you and your specifier can make an engineering decision based on the benefits and costs of the choices.

GRANULAR LAYER

In American Concrete Institute (ACI) 302.1R-04, a "base material" is recommended over the vapor membrane, rather than the conventional clean "sand cushion" material. The base layer should be a minimum of 4 inches (100 mm) thick, trimmable, compactable, granular fill (not sand), a so-called crusher-run material. Usually graded from 1½ inches to 2 inches (38 to 50 mm) down to rock dust is suitable. Following compaction, the surface can be choked off with a fine-grade material. We refer you to ACI 302.1R-04 for additional details regarding the requirements for the base material.

In cases where potential static water levels or significant perched water sources appear near or above the floor slab, an under floor drainage system may be needed wherein a draintile system is placed within a thicker clean sand or gravel layer. Such a system should be properly engineered depending on subgrade soil types and rate/head of water inflow.

VAPOR MEMBRANE

The need for a vapor membrane depends on whether the floor slab will have a vapor sensitive covering, will have vapor sensitive items stored on the slab, or if the space above the slab will be a humidity controlled area. If the project does not have this vapor sensitivity or moisture control need, placement of a vapor membrane may not be necessary. Your decision will then relate to whether to use the ACI base material or a conventional sand cushion layer. However, if any of the above sensitivity issues apply, placement of a vapor membrane is recommended. Some floor covering systems (adhesives and flooring materials) require installation of a vapor membrane to limit the slab moisture content as a condition of their warranty.

VAPOR MEMBRANE/GRANULAR LAYER PLACEMENT

A number of issues should be considered when deciding whether to place the vapor membrane above or below the granular layer. The benefits of placing the slab on a granular layer, with the vapor membrane placed **below** the granular layer, include **reduction** of the following:

- Slab curling during the curing and drying process.
- Time of bleeding, which allows for quicker finishing.
- Vapor membrane puncturing.
- Surface blistering or delamination caused by an extended bleeding period.
- Cracking caused by plastic or drying shrinkage.

The benefits of placing the vapor membrane over the granular layer include the following:

- A lower moisture emission rate is achieved faster.
- Eliminates a potential water reservoir within the granular layer above the membrane.
- Provides a "slip surface", thereby reducing slab restraint and the associated random cracking.

If a membrane is to be used in conjunction with a granular layer, the approach recommended depends on slab usage and the construction schedule. The vapor membrane should be placed above the granular layer when:

- Vapor sensitive floor covering systems are used or vapor sensitive items will be directly placed on the slab.
- The area will be humidity controlled, but the slab will be placed before the building is enclosed and sealed from rain.
- Required by a floor covering manufacturer's system warranty.

The vapor membrane should be placed below the granular layer when:

- Used in humidity controlled areas (without vapor sensitive coverings/stored items), with the roof membrane in place, and the building enclosed to the point where precipitation will not intrude into the slab area. Consideration should be given to slight sloping of the membrane to edges where draintile or other disposal methods can alleviate potential water sources, such as pipe or roof leaks, foundation wall damp proofing failure, fire sprinkler system activation, etc.

There may be cases where membrane placement may have a detrimental effect on the subgrade support system (e.g., expansive soils). In these cases, your decision will need to weigh the cost of subgrade options and the performance risks.

FREEZING WEATHER EFFECTS ON BUILDING CONSTRUCTION

GENERAL

Because water expands upon freezing and soils contain water, soils which are allowed to freeze will heave and lose density. Upon thawing, these soils will not regain their original strength and density. The extent of heave and density/strength loss depends on the soil type and moisture condition. Heave is greater in soils with higher percentages of fines (silts/clays). High silt content soils are most susceptible, due to their high capillary rise potential which can create ice lenses. Fine grained soils generally heave about 1/4" to 3/8" for each foot of frost penetration. This can translate to 1" to 2" of total frost heave. This total amount can be significantly greater if ice lensing occurs.

DESIGN CONSIDERATIONS

Clayey and silty soils can be used as perimeter backfill, although the effect of their poor drainage and frost properties should be considered. Basement areas will have special drainage and lateral load requirements which are not discussed here. Frost heave may be critical in doorway areas. Stoops or sidewalks adjacent to doorways could be designed as structural slabs supported on frost footings with void spaces below. With this design, movements may then occur between the structural slab and the adjacent on-grade slabs. Non-frost susceptible sands (with less than 12% passing a #200 sieve) can be used below such areas. Depending on the function of surrounding areas, the sand layer may need a thickness transition away from the area where movement is critical. With sand placement over slower draining soils, subsurface drainage would be needed for the sand layer. High density extruded insulation could be used within the sand to reduce frost penetration, thereby reducing the sand thickness needed. We caution that insulation placed near the surface can increase the potential for ice glazing of the surface.

The possible effects of adfreezing should be considered if clayey or silty soils are used as backfill. Adfreezing occurs when backfill adheres to rough surfaced foundation walls and lifts the wall as it freezes and heaves. This occurrence is most common with masonry block walls, unheated or poorly heated building situations and clay backfill. The potential is also increased where backfill soils are poorly compacted and become saturated. The risk of adfreezing can be decreased by placing a low friction separating layer between the wall and backfill.

Adfreezing can occur on exterior piers (such as deck, fence or other similar pier footings), even if a smooth surface is provided. This is more likely in poor drainage situations where soils become saturated. Additional footing embedment and/or widened footings below the frost zones (which include tensile reinforcement) can be used to resist uplift forces. Specific designs would require individual analysis.

CONSTRUCTION CONSIDERATIONS

Foundations, slabs and other improvements which may be affected by frost movements should be insulated from frost penetration during freezing weather. If filling takes place during freezing weather, all frozen soils, snow and ice should be stripped from areas to be filled prior to new fill placement. The new fill should not be allowed to freeze during transit, placement or compaction. This should be considered in the project scheduling, budgeting and quantity estimating. It is usually beneficial to perform cold weather earthwork operations in small areas where grade can be attained quickly rather than working larger areas where a greater amount of frost stripping may be needed. If slab subgrade areas freeze, we recommend the subgrade be thawed prior to floor slab placement. The frost action may also require reworking and recompaction of the thawed subgrade.

Appendix A

Geotechnical Field Exploration and Testing
Boring Log Notes
Unified Soil Classification System
Figure 1 – Boring Locations
Subsurface Boring Logs

A.1 FIELD EXPLORATION

The subsurface conditions at the site were explored by drilling and sampling eight standard penetration test borings. The locations of the borings appear on Figure 1, preceding the Subsurface Boring Logs in this appendix.

A.2 SAMPLING METHODS

A.2.1 Split-Spoon Samples (SS) - Calibrated to N_{60} Values

Standard penetration (split-spoon) samples were collected in general accordance with ASTM: D1586 with one primary modification. The ASTM test method consists of driving a 2-inch O.D. split-barrel sampler into the in-situ soil with a 140-pound hammer dropped from a height of 30 inches. The sampler is driven a total of 18 inches into the soil. After an initial set of 6 inches, the number of hammer blows to drive the sampler the final 12 inches is known as the standard penetration resistance or N-value. Our method uses a modified hammer weight, which is determined by measuring the system energy using a Pile Driving Analyzer (PDA) and an instrumented rod.

In the past, standard penetration N-value tests were performed using a rope and cathead for the lift and drop system. The energy transferred to the split-spoon sampler was typically limited to about 60% of its potential energy due to the friction inherent in this system. This converted energy then provides what is known as an N_{60} blow count.

The most recent drill rigs incorporate an automatic hammer lift and drop system, which has higher energy efficiency and subsequently results in lower N-values than the traditional N_{60} values. By using the PDA energy measurement equipment, we are able to determine actual energy generated by the drop hammer. With the various hammer systems available, we have found highly variable energies ranging from 55% to over 100%. Therefore, the intent of AET's hammer calibrations is to vary the hammer weight such that hammer energies lie within about 60% to 65% of the theoretical energy of a 140-pound weight falling 30 inches. The current ASTM procedure acknowledges the wide variation in N-values, stating that N-values of 100% or more have been observed. Although we have not yet determined the statistical measurement uncertainty of our calibrated method to date, we can state that the accuracy deviation of the N-values using this method is significantly better than the standard ASTM Method.

A.2.2 Disturbed Samples (DS)/Spin-up Samples (SU)

Sample types described as "DS" or "SU" on the boring logs are disturbed samples, which are taken from the flights of the auger. Because the auger disturbs the samples, possible soil layering and contact depths should be considered approximate.

A.2.3 Sampling Limitations

Unless actually observed in a sample, contacts between soil layers are estimated based on the spacing of samples and the action of drilling tools. Cobbles, boulders, and other large objects generally cannot be recovered from test borings, and they may be present in the ground even if they are not noted on the boring logs.

Determining the thickness of "topsoil" layers is usually limited, due to variations in topsoil definition, sample recovery, and other factors. Visual-manual description often relies on color for determination, and transitioning changes can account for significant variation in thickness judgment. Accordingly, the topsoil thickness presented on the logs should not be the sole basis for calculating topsoil stripping depths and volumes. If more accurate information is needed relating to thickness and topsoil quality definition, alternate methods of sample retrieval and testing should be employed.

A.3 CLASSIFICATION METHODS

Soil descriptions shown on the boring logs are based on the Unified Soil Classification (USC) system. The USC system is described in ASTM: D2487 and D2488. Where laboratory classification tests (sieve analysis or Atterberg Limits) have been performed, accurate classifications per ASTM: D2487 are possible. Otherwise, soil descriptions shown on the boring logs are visual-manual judgments. Charts are attached which provide information on the USC system, the descriptive terminology, and the symbols used on the boring logs.

Visual-manual judgment of the AASHTO Soil Group is also noted as a part of the soil description. A chart presenting details of the AASHTO Soil Classification System is also attached.

The boring logs include descriptions of apparent geology. The geologic depositional origin of each soil layer is interpreted primarily by observation of the soil samples, which can be limited. Observations of the surrounding topography, vegetation, and development can sometimes aid this judgment.

A.4 WATER LEVEL MEASUREMENTS

The ground water level measurements are shown at the bottom of the boring logs. The following information appears under "Water Level Measurements" on the logs:

- Date and Time of measurement
- Sampled Depth: lowest depth of soil sampling at the time of measurement
- Casing Depth: depth to bottom of casing or hollow-stem auger at time of measurement
- Cave-in Depth: depth at which measuring tape stops in the borehole
- Water Level: depth in the borehole where free water is encountered
- Drilling Fluid Level: same as Water Level, except that the liquid in the borehole is drilling fluid

The true location of the water table at the boring locations may be different than the water levels measured in the boreholes. This is possible because there are several factors that can affect the water level measurements in the borehole. Some of these factors include: permeability of each soil layer in profile, presence of perched water, amount of time between water level readings, presence of drilling fluid, weather conditions, and use of borehole casing.

A.5 LABORATORY TEST METHODS

A.5.1 Water Content Tests

Conducted per AET Procedure 01-LAB-010, which is performed in general accordance with ASTM: D2216 and AASHTO: T265.

A.5.2 Atterberg Limits Tests

Conducted per AET Procedure 01-LAB-030, which is performed in general accordance with ASTM: D4318 and AASHTO: T89, T90.

A.5.3 Sieve Analysis of Soils (thru #200 Sieve)

Conducted per AET Procedure 01-LAB-040, which is performed in general conformance with ASTM: D6913, Method A.

A.5.4 Particle Size Analysis of Soils (with hydrometer)

Conducted per AET Procedure 01-LAB-050, which is performed in general accordance with ASTM: D422 and AASHTO: T88.

A.5.5 Unconfined Compressive Strength of Cohesive Soil

Conducted per AET Procedure 01-LAB-080, which is performed in general accordance with ASTM: D2166 and AASHTO: T208.

A.5.6 Laboratory Soil Resistivity using the Wenner Four-Electrode Method

Conducted per AET Procedure 01-LAB-090, which is performed using Soil Box apparatus in the laboratory in general accordance with ASTM: G57

A.6 TEST STANDARD LIMITATIONS

Field and laboratory testing is done in general conformance with the described procedures. Compliance with any other standards referenced within the specified standard is neither inferred nor implied.

A.7 SAMPLE STORAGE

Unless notified to do otherwise, we routinely retain representative samples of the soils recovered from the borings for a period of 30 days.

BORING LOG NOTES

DRILLING AND SAMPLING SYMBOLS

Symbol	Definition
B,H,N:	Size of flush-joint casing
CA:	Crew Assistant (initials)
CAS:	Pipe casing, number indicates nominal diameter in inches
CC:	Crew Chief (initials)
COT:	Clean-out tube
DC:	Drive casing; number indicates diameter in inches
DM:	Drilling mud or bentonite slurry
DR:	Driller (initials)
DS:	Disturbed sample from auger flights
FA:	Flight auger; number indicates outside diameter in inches
HA:	Hand auger; number indicates outside diameter
HSA:	Hollow stem auger; number indicates inside diameter in inches
LG:	Field logger (initials)
MC:	Column used to describe moisture condition of samples and for the ground water level symbols
N (BPF):	Standard penetration resistance (N-value) in blows per foot (see notes)
NQ:	NQ wireline core barrel
PQ:	PQ wireline core barrel
RD:	Rotary drilling with fluid and roller or drag bit
REC:	In split-spoon (see notes) and thin-walled tube sampling, the recovered length (in inches) of sample. In rock coring, the length of core recovered (expressed as percent of the total core run). Zero indicates no sample recovered.
REV:	Revert drilling fluid
SS:	Standard split-spoon sampler (steel; 1d" is inside diameter; 2" outside diameter); unless indicated otherwise
SU	Spin-up sample from hollow stem auger
TW:	Thin-walled tube; number indicates inside diameter in inches
WASH:	Sample of material obtained by screening returning rotary drilling fluid or by which has collected inside the borehole after Afalling@ through drilling fluid
WH:	Sampler advanced by static weight of drill rod and 140-pound hammer
WR:	Sampler advanced by static weight of drill Rod
94mm:	94 millimeter wireline core barrel
?:	Water level directly measured in boring
∉:	Estimated water level based solely on sample appearance

TEST SYMBOLS

Symbol	Definition
CONS:	One-dimensional consolidation test
DEN:	Dry density, pcf
DST:	Direct shear test
E:	Pressuremeter Modulus, tsf
HYD:	Hydrometer analysis
LL:	Liquid Limit, %
LP:	Pressuremeter Limit Pressure, tsf
OC:	Organic Content, %
PERM:	Coefficient of permeability (K) test; F - Field; L - Laboratory
PL:	Plastic Limit, %
q_p:	Pocket Penetrometer strength, tsf (approximate)
q_c:	Static cone bearing pressure, tsf
q_u:	Unconfined compressive strength, psf
R:	Electrical Resistivity, ohm-cms
RQD:	Rock Quality Designator in percent (aggregate length of core pieces 4" or more in length as a percent of total core run)
SA:	Sieve analysis
TRX:	Triaxial compression test
VSR:	Vane shear strength, remoulded (field), psf
VSU:	Vane shear strength, undisturbed (field), psf
WC:	Water content, as percent of dry weight
%-200:	Percent of material finer than #200 sieve

STANDARD PENETRATION TEST NOTES

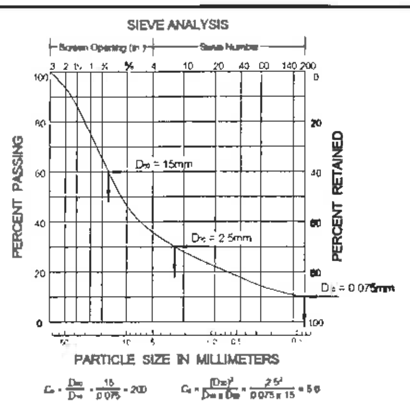
The standard penetration test consists of driving the sampler with a 140 pound hammer and counting the number of blows applied in each of three 6" increments of penetration. If the sampler is driven less than 18" (usually in highly resistant material), permitted in ASTM:D1586, the blows for each complete 6" increment and for each partial increment is on the boring log. For partial increments, the number of blows is shown to the nearest 0.1' below the slash.

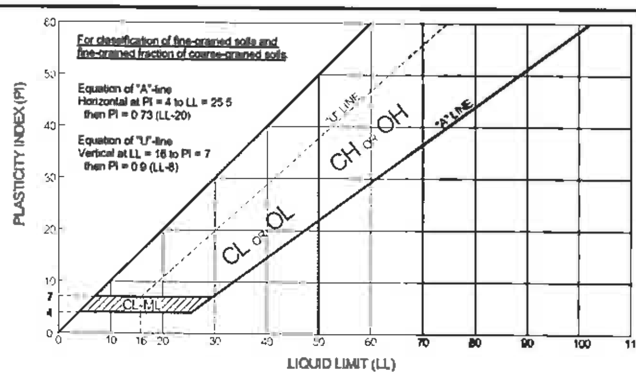
The length of sample recovered, as shown on the AREC@ column, may be greater than the distance indicated in the N column. The disparity is because the N-value is recorded below the initial 6" set (unless partial penetration defined in ASTM:D1586 is encountered) whereas the length of sample recovered is for the entire sampler drive (which may even extend more than 18").

UNIFIED SOIL CLASSIFICATION SYSTEM
ASTM Designations: D 2487, D2488

AMERICAN ENGINEERING TESTING, INC.

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]				Soil Classification: Group Symbol	Soil Classification: Group Name[B]
Coarse-Grained Soils More than 50% retained on No. 200 sieve	Gravels More than 50% coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines[C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$[E]	GW	Well graded gravel[F]
			$Cu<4$ and/or $1>Cc>3$[E]	GP	Poorly graded gravel[F]
		Gravels with Fines more than 12% fines[C]	Fines classify as ML or MH	GM	Silty gravel[F,G,H]
			Fines classify as CL or CH	GC	Clayey gravel[F,G,H]
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines[D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$[E]	SW	Well-graded sand[I]
			$Cu<6$ and $1>Cc>3$[E]	SP	Poorly-graded sand[I]
		Sands with Fines more than 12% fines[D]	Fines classify as ML or MH	SM	Silty sand[G,H,I]
			Fines classify as CL or CH	SC	Clayey sand[G,H,I]
Fine-Grained Soils 50% or more passes the No. 200 sieve (see Plasticity Chart below)	Silts and Clays Liquid limit less than 50	inorganic	PI>7 and plots on or above "A" line[J]	CL	Lean clay[K,L,M]
			PI<4 or plots below "A" line[J]	ML	Silt[K,L,M]
		organic	**Liquid limit–oven dried** <0.75 Liquid limit – not dried	OL	Organic clay[K,L,M,N] Organic silt[K,L,M,O]
	Silts and Clays Liquid limit 50 or more	inorganic	PI plots on or above "A" line	CH	Fat clay[K,L,M]
			PI plots below "A" line	MH	Elastic silt[K,L,M]
		organic	**Liquid limit–oven dried** <0.75 Liquid limit – not dried	OH	Organic clay[K,L,M,P] Organic silt[K,L,M,Q]
Highly organic soil			Primarily organic matter, dark in color, and organic in odor	PT	Peat[R]





Plasticity Chart

Notes

[A]Based on the material passing the 3-in (75-mm) sieve.
[B]If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
[C]Gravels with 5 to 12% fines require dual symbols:
- GW-GM well-graded gravel with silt
- GW-GC well-graded gravel with clay
- GP-GM poorly graded gravel with silt
- GP-GC poorly graded gravel with clay

[D]Sands with 5 to 12% fines require dual symbols:
- SW-SM well-graded sand with silt
- SW-SC well-graded sand with clay
- SP-SM poorly graded sand with silt
- SP-SC poorly graded sand with clay

[E]$Cu = D_{60}/D_{10}$, $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$

[F]If soil contains ≥15% sand, add "with sand" to group name.
[G]If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
[H]If fines are organic, add "with organic fines" to group name.
[I]If soil contains ≥15% gravel, add "with gravel" to group name
[J]If Atterberg limits plot is hatched area, soils is a CL-ML silty clay.
[K]If soil contains 15 to 29% plus No. 200 add "with sand" or "with gravel", whichever is predominant.
[L]If soil contains ≥30% plus No. 200, predominantly sand, add "sandy" to group name.
[M]If soil contains ≥30% plus No. 200, predominantly gravel, add "gravelly" to group name.
[N]PI≥4 and plots on or above "A" line.
[O]PI<4 or plots below "A" line.
[P]PI plots on or above "A" line.
[Q]PI plots below "A" line.
[R]Fiber Content description shown below.

ADDITIONAL TERMINOLOGY NOTES USED BY AET FOR SOIL IDENTIFICATION AND DESCRIPTION

Grain Size

Term	Particle Size
Boulders	Over 12"
Cobbles	3" to 12"
Gravel	#4 sieve to 3"
Sand	#200 to #4 sieve
Fines (silt & clay)	Pass #200 sieve

Gravel Percentages

Term	Percent
A Little Gravel	3% - 14%
With Gravel	15% - 29%
Gravelly	30% - 50%

Consistency of Plastic Soils

Term	N-Value, BPF
Very Soft	less than 2
Soft	2 - 4
Firm	5 - 8
Stiff	9 - 15
Very Stiff	16 - 30
Hard	Greater than 30

Relative Density of Non-Plastic Soils

Term	N-Value, BPF
Very Loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	Greater than 50

Moisture/Frost Condition (MC Column)

D (Dry):	Absense of moisture, dusty, dry to touch.
M (Moist):	Damp, although free water not visible. Soil may still have a high water content (over "optimum").
W (Wet/ Waterbearing):	Free water visible intended to describe non-plastic soils. Waterbearing usually relates to sands and sand with silt.
F (Frozen):	Soil frozen

Layering Notes

Laminations:	Layers less than ½" thick of differing material or color.
Lenses:	Pockets or layers greater than ½" thick of differing material or color.

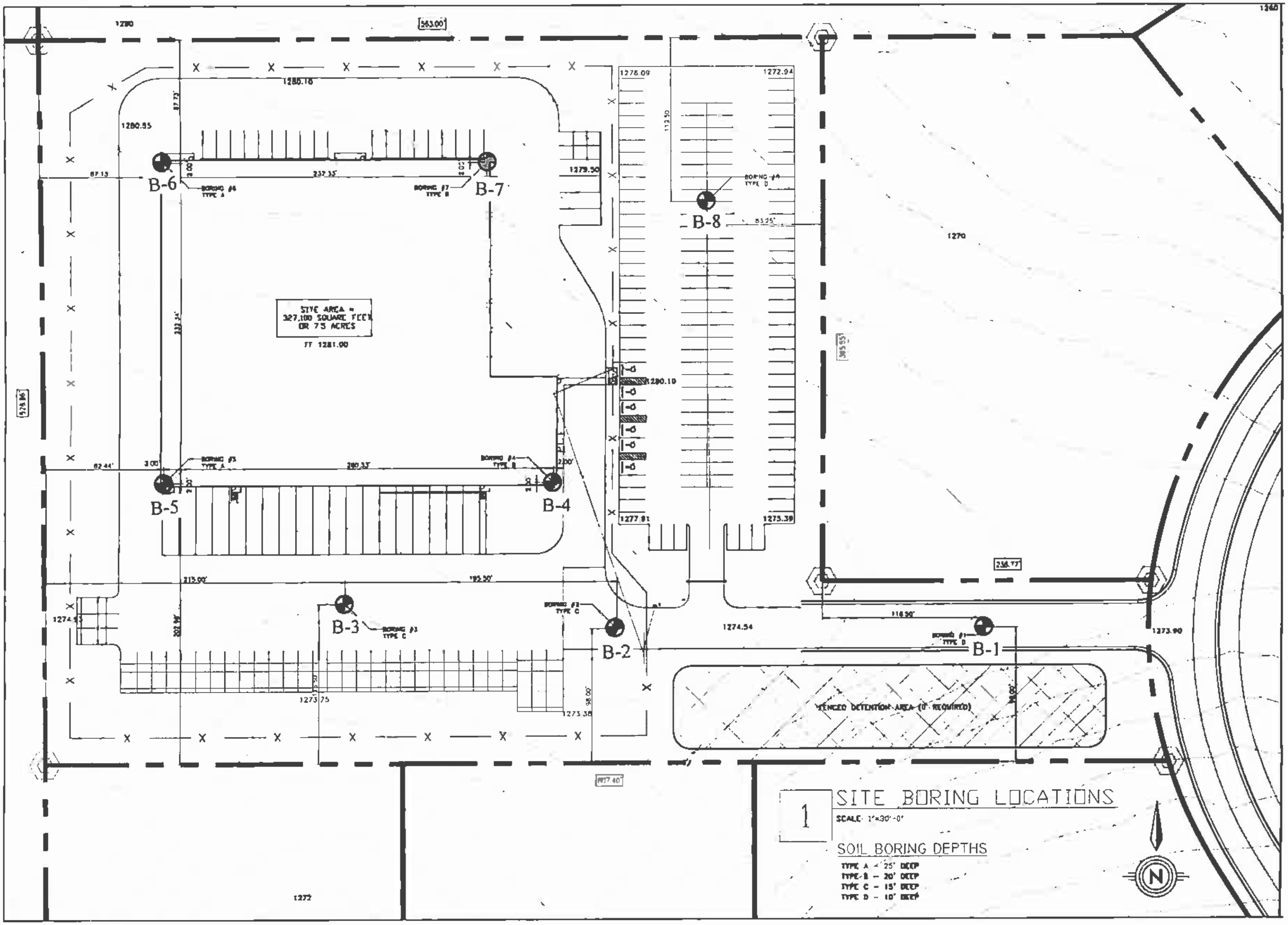
Fiber Content of Peat

Term	Fiber Content (Visual Estimate)
Fibric Peat:	Greater than 67%
Hemic Peat:	33 – 67%
Sapric Peat:	Less than 33%

Organic/Roots Description (if no lab tests)

Soils are described as *organic*, if soil is not peat and is judged to have sufficient organic fines content to influence the soil properties. *Slightly organic* used for borderline cases.

With roots:	Judged to have sufficient quantity of roots to influence the soil properties.
Trace roots:	Small roots present, but not judged to be in sufficient quantity to significantly affect soil properties.



AMERICAN ENGINEERING TESTING, INC.	Project FedEx Builidng	Subject: Boring Locations	AET Job No: 11-05638	Date: 1/11/12
	Scale: See Above	Drawn By: Ruedebush Dev.	Checked By: KS	Figure 1

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET JOB NO: **11-05638** LOG OF BORING NO. **B-1 (p. 1 of 1)**

PROJECT: **FedEx; Stewartville, MN**

SURFACE ELEVATION: **1275.6'**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	qp	LL	PL
0–1.5	SILT, dark brown (ML)	TOPSOIL		M	DS					
1.5–7	CLAYEY SAND, trace gravel, brown, very stiff (SC)	TILL	21	M	SS	10	5			
			21	M	SS	6	12			
7–11	CLAYEY SAND, trace gravel, brown to gray, stiff (SC)		11	M	SS	10				
			15	M	SS	12				
11	**END OF BORING**									

DEPTH:	DRILLING METHOD
0-9½'	3.25" HSA

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
1/9/12	9:30	11'	9.5'	11'		None

BORING COMPLETED: **1/9/12**

DR: **DM** LG: **BP** Rig: **43**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

06/04

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET JOB NO: 11-05638 LOG OF BORING NO. B-2 (p. 1 of 1)

PROJECT: FedEx; Stewartville, MN

DEPTH IN FEET	SURFACE ELEVATION: 1282.8' MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	qp	LL	PL	-200
0–1.5	SILT, dark brown (ML)	TOPSOIL		M	DS						
1.5–4	CLAYEY SAND, trace gravel, brown, stiff (SC)	TILL	12	M	SS	12	9	>4			48
4–16	CLAYEY SAND, trace gravel, brown to gray, very stiff to hard (SC)		40	M	SS	6	7	>4			
			36	M	SS	10		>4			
			43	M	SS	12					
			29	M	SS	12					
16	**END OF BORING**										

DEPTH:	DRILLING METHOD
0-14½'	3.25" HSA

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
1/6/12	1:40	16'	14.5'	16'		None

BORING COMPLETED: 1/6/12

DR: BP LG: KS Rig: 43

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

06/04

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET JOB NO: **11-05638** LOG OF BORING NO. **B-3 (p. 1 of 1)**

PROJECT: **FedEx; Stewartville, MN**

DEPTH IN FEET	SURFACE ELEVATION: 1282.1' MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	qp	LL	PL
0–2	SILT, dark brown (ML)	TOPSOIL		M	DS					
2–4	CLAYEY SAND, trace gravel, brown, very stiff (SC)	TILL	17	M	SS	10	9	>4		
4–9	SILTY SAND, fine to medium grained, brown, medium dense (SM)		13	M	SS	12	7			
			19	M	SS	8				
9–16	SANDY LEAN CLAY, trace gravel, brown to gray, very stiff to hard (CL)		28	M	SS	10				
			39	M	SS	12				
16	**END OF BORING**									

DEPTH:	DRILLING METHOD
0-14½'	3.25" HSA

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
1/6/12	2:40	16'	14.5'	16'		None

BORING COMPLETED: **1/6/12**

DR: **BP** LG: **KS** Rig: **43**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

06/04

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET JOB NO: **11-05638** LOG OF BORING NO. **B-4 (p. 1 of 1)**

PROJECT: **FedEx; Stewartville, MN**

SURFACE ELEVATION: **1282.8'**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	qp	LL	PL
0–1	SILT, dark brown (ML)	TOPSOIL								
1–4	CLAYEY SAND, trace gravel, brown, very stiff (SC)	TILL		M	DS					
			18	M	SS	14	11	>4		
4–6	SILTY SAND, trace gravel, fine to medium grained, brown, medium dense (SM)		21	M	SS	12				
6–9	CLAYEY SAND, trace gravel, brown, hard (SC)		35	M	SS	12	10	>4		
9–11	SILTY SAND, fine to medium grained, brown, very dense (SM)		80	M	SS	14				
11–21	SANDY LEAN CLAY, trace gravel, brown to dark gray, hard (CL)		39	M	SS	14				
			33	M	SS	16	12			
			53	M	SS	14	9			

DEPTH:	DRILLING METHOD
0-19½'	3.25" HSA

BORING COMPLETED: 1/6/12

DR: BP LG: KS Rig: 43

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
1/6/12	12:40	21'	19.5'	21'		None

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET JOB NO: **11-05638** LOG OF BORING NO. **B-5 (p. 1 of 1)**

PROJECT: **FedEx; Stewartville, MN**

SURFACE ELEVATION: **1285.9'**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	qp	LL	PL
0–1	CLAYEY SAND, dark brown (SC)	TOPSOIL								
1–4	SILTY SAND, trace gravel, fine to medium grained, brown, medium dense (SM)	TILL		M	DS					
			13	M	SS	10				
4–18	CLAYEY SAND, trace gravel, brown, very stiff to hard (SC)		21	M	SS	10	10	>4		
			32	M	SS	12	10	>4		
			40	M	SS	14		>4		
			43	M	SS	14	10	>4		
			33	M	SS	16		>4		
18–26	SANDY LEAN CLAY, trace gravel, brown to dark gray, hard (CL)		63	M	SS	14	13	>4		
			54	M	SS	16		>4		
26	**END OF BORING**									

DEPTH:	DRILLING METHOD
0-24½'	3.25" HSA

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
1/4/12	2:10	26'	24.5'	26'		None

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

BORING COMPLETED: **1/4/12**

DR: **DM** LG: **BP** Rig: **43**

06/04

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET JOB NO: **11-05638** LOG OF BORING NO. **B-6 (p. 1 of 1)**

PROJECT: **FedEx; Stewartville, MN**

SURFACE ELEVATION: **1281.4'**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	qp	LL	PL
0–2	SILT, dark brown (ML)	TOPSOIL		M	DS					
2–4	CLAYEY SAND, trace gravel, brown, stiff (SC)	TILL	14	M	SS	10	12	>4		
4–7	SILTY SAND, fine to medium grained, brown, medium dense (SM)		11	M	SS	12				
7–9	CLAYEY SAND, trace gravel, brown, firm (SC)		8	M	SS	10	13			
9–12	CLAYEY SAND, cobbles and gravel, brown, firm (SC)		100/3	M	SS	8				
12–26	SANDY LEAN CLAY, trace gravel, gray, very stiff to hard (CL)		29	M	SS	12	14	>4		
			36	M	SS	16				
			51	M	SS	16	11			
			64	M	SS	16		>4		
26	**END OF BORING**									

DEPTH:	DRILLING METHOD
0-24½'	3.25" HSA

BORING COMPLETED: **1/4/12**

DR: **DM** LG: **BP** Rig: **43**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
1/4/12	2:40	11'	9.5'	10.3'		9.5
1/4/12	3:20	26'	24.5'	26'		None

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

06/04

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET JOB NO: **11-05638** LOG OF BORING NO. **B-7 (p. 1 of 1)**

PROJECT: **FedEx; Stewartville, MN**

DEPTH IN FEET	SURFACE ELEVATION: 1279.2' MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS: WC	qp	LL	PL
0–1	SILT, dark brown (ML)	TOPSOIL								
1–4	SANDY LEAN CLAY, trace gravel, brown, hard (CL)	TILL		M	DS					
			49	M	SS	12	10	>4		
4–7	SANDY LEAN CLAY, trace gravel, brown, very stiff (CL)		18	M	SS	12	11	>4		
7–12	SANDY LEAN CLAY, trace gravel, brown, very stiff (CL)		24	M	SS	10		>4		
			28	M	SS	12	12	>4		
12–14	SANDY LEAN CLAY, trace gravel, gray, hard (CL)		48	M	SS	18	11			
14–18	CLAYEY SAND, trace gravel, brown to gray, hard (SC)		63	M	SS	16				
18–21	SANDY LEAN CLAY, trace gravel, gray, hard (CL)		35	M	SS	14				
21	**END OF BORING**									

DEPTH:	DRILLING METHOD
0-19½'	3.25" HSA

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
1/6/12	11:10	21'	19.5'	21'		None

BORING COMPLETED: **1/6/12**

DR: **BP** LG: **KS** Rig: **43**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

06/04

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET JOB NO: **11-05638** LOG OF BORING NO. **B-8 (p. 1 of 1)**

PROJECT: **FedEx; Stewartville, MN**

DEPTH IN FEET	SURFACE ELEVATION: 1274.1' MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	qp	LL	PL	-200
	SILT, dark brown (ML)	TOPSOIL									
1				M	DS						
	SILTY SAND, fine to medium grained, brown, medium dense (SM)	TILL									
2											
3			16	M	SS	10	10				41
4	CLAYEY SAND, trace gravel, brown, stiff (SC)										
5			10	M	SS	10	9				
6											
7	SANDY LEAN CLAY, trace gravel, brown, stiff to hard (CL)										
8			9	M	SS	12					
9											
10			33	M	SS	16					
11	**END OF BORING**										

DEPTH:	DRILLING METHOD
0-9½'	3.25" HSA

BORING COMPLETED: **1/9/12**

DR: **DM** LG: **BP** Rig: **43**

WATER LEVEL MEASUREMENTS DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
1/9/12	10:00	11'	9.5'	11'		None

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

Appendix B

Geotechnical Report Limitations and Guidelines for Use

Appendix B
Geotechnical Report Limitations and Guidelines for Use
Report No. 11-05638

B.1 REFERENCE

This appendix provides information to help you manage your risks relating to subsurface problems which are caused by construction delays, cost overruns, claims, and disputes. This information was developed and provided by ASFE[1], of which, we are a member firm.

B.2 RISK MANAGEMENT INFORMATION

B.2.1 Geotechnical 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 civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared solely for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. And no one, not even you, should apply the report for any purpose or project except the one originally contemplated.

B.2.2 Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

B.2.3 A Geotechnical Engineering Report is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typically factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- 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,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- 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. Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.

B.2.4 Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. Do not rely on a geotechnical engineering report whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. Always contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

1 ASFE, 8811 Colesville Road/Suite G106, Silver Spring, MD 20910
Telephone: 301/565-2733: www.asfe.org

B.2.5 Most Geotechnical Findings Are Professional Opinions
Site exploration identified subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ, sometimes significantly, from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

B.2.6 A Report's Recommendations Are Not Final
Do not overrely on the construction recommendations included in your report. Those recommendations are not final, because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.

B.2.7 A Geotechnical Engineering Report Is Subject to Misinterpretation
Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

B.2.8 Do Not Redraw the Engineer's Logs
Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should never be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, but recognizes that separating logs from the report can elevate risk.

B.2.9 Give Contractors a Complete Report and Guidance
Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, but preface it with a clearly written letter of transmittal. In the letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. Be sure contractors have sufficient time to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

B.2.10 Read Responsibility Provisions Closely
Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their report. 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.

B.2.11 Geoenvironmental Concerns Are Not Covered
The equipment, techniques, and personnel used to perform a geoenvironmental study differ significantly from those used to perform a geotechnical study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. Unanticipated environmental problems have led to numerous project failures. If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. Do not rely on an environmental report prepared for someone else.