AMERICAN ENGINEERING TESTING, INC.

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- MATERIALS
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REPORT OF GEOTECHNICAL EXPLORATION AND REVIEW

Fort Ridgely State Park Road

72158 County Road 30
Fairfax, Minnesota

Report No. 08-11600

Date:

July 18, 2014

Prepared for:

MN/DNR
Management Resources Bureau
261 Highway 15 South
New Ulm, MN 56073

www.amengtest.com

Consultant's Report

American Engineering Testing, Inc.

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July 18, 2014

MN/DNR
Management Resources Bureau
261 Highway 15 South
New Ulm, MN 56073

Attn: Mr. Jared DeMaster

RE: Geotechnical Exploration and Review
Fort Ridgely State Park
Park Road Rehabilitation
Fairfax, Minnesota
Report No. 08-11600

Dear Mr. DeMaster:

American Engineering Testing, Inc. (AET) is pleased to present the results of our subsurface exploration program and geotechnical engineering review for your Fort Ridgely State Park Road Rehabilitation project in Fairfax, Minnesota. These services were performed according to our proposal to you dated June 13, 2014.

We are submitting one (1) hard copy and one (1) electronic copy 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.

Gregory A. Guyer, PE
Manager – Mankato
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SIGNATURE PAGE

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Mn/DNR
Management Resources Bureau
261 Highway 15 South
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Attn: Mr. Jared DeMaster

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Report Authored By:

Gregory A. Guyer, PE
Manager, Mankato

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: 7/18/14 **License #44618**

Peer Review Conducted By:

Steven J. Ruesink, PE
Regional Manager

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1.0 INTRODUCTION

You are proposing to reconstruct the existing main entrance roadway at Fort Ridgely State Park near Fairfax, Minnesota. To assist planning and design, you have authorized American Engineering Testing, Inc. (AET) 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 to you dated June 13, 2014, which you authorized on July 1, 2014. The authorized scope consists of the following:

- Ten (10) flight auger test borings to depths ranging from 5' to 10'.
- 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

We understand that you are planning to reconstruct the existing main entrance road at Fort Ridgely State Park near Fairfax, Minnesota. Paved areas will be bituminous mat/granular base sections designed to support automobile and light truck traffic; the finished pavement grade will be at or slightly above existing site grade.

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 ten (10) flight auger 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.

The boring locations are shown on Figure 1 in Appendix A. The borings were located in the field by AET personnel by taping from nearby site features. Surface elevations were not recorded.

4.2 Laboratory Testing

The laboratory test program included moisture content. The test results appear in Appendix A on the individual boring logs adjacent to the samples upon which they were performed, or on the data sheets following the logs.

5.0 SITE CONDITIONS

5.1 Surface Observations

The proposed project site is located along the main camp ground entrance roadway at Fort Ridgely State Park near Fairfax, Minnesota. Nearby site features include the Minnesota River located to the south and Fort Ridgely Creek to the east with mainly wooded areas in all directions. Current site vegetation consists of trees and grass.

The general site topography slopes downward from the north to the south.

5.2 Subsurface Soils/Geology

The site geology consists of bituminous pavement underlain by fill/topsoil with coarse alluvium or fine alluvium present at depth.

The existing bituminous pavement varied from 2" to 2 ¼" in thickness at boring locations 1 through 4. The apparent existing aggregate base material varied from 5" to 10 ½" in thickness at the boring locations. The surficial fill layer was about 7" to 9' deep at the boring locations. The fill was variable in nature and consisted mostly of a mixture of black and brown, silty sand and clayey sand. Rubble fill mixed with soil was encountered within soil boring B-10 to a depth of 9'. The topsoil consisted mostly of black, sandy lean clay with numerous visible organics.

Underlying the surficial deposits, brown and brown mottled, mostly silty sand and clayey sand, alluvial deposits were encountered at some of the boring locations. Soil boring B-10 encountered Cretacous Shale Deposits at depth. The Cretacous Shale was texturally classified as clayey sand.

5.3 Ground Water

No subsurface water was noted at the boring locations at the time our field work was performed. The depth or lack of subsurface water noted at the boring locations should not be taken as an accurate representation of the actual subsurface water levels. A long period of time is generally required for groundwater to stabilize in the impermeable soils generally present at the site; this period of time is generally not available during a typical subsurface exploration program.

Based upon our previous experience with clayey soils in the general project area, it is our opinion that the subsurface water levels at the site could be quite near the ground surface during periods of significant precipitation, particularly during the spring of the year.

The surface level in the nearby Fort Ridgely Creek could be expected to affect the subsurface water levels present at the site.

5.4 Review of Soil Properties

- Strength - The existing fill and topsoil deposits were judged to have potentially low strengths. The natural alluvial deposits were judged to have low to moderate strengths.

- Compressibility - The existing fill and topsoil deposits are also judged to be compressible under anticipated loadings. Some of the upper natural soils will be moderately compressible under anticipated loads.

- Frost Susceptibility - It is our judgment that the near surface soils are at least moderately frost susceptible. If these soils remain in-place and are allowed to freeze, we anticipate heave may potentially be on the order of ¼" 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. Movements of exterior sidewalks/slabs are especially important in building 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 provided.

  In bituminous parking and drive areas, frost heaving is less of a problem unless the heave occurs as an abrupt differential movement. For this reason, consistency of soil conditions or gradual changes of conditions across the pavement area is desirable.

- 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 draintile 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

We understand that you are planning to rehabilitate the existing Fort Ridgely Campground roadway. We understand portions of the existing park road are bituminous surfaced and portions are just gravel. We understand you plan to remove the existing bituminous pavement and perform some site grading followed by construction of new bituminous pavement. We were not provided with any traffic counts or loading values assume generally light automobile and light truck traffic on the proposed roadway.

6.2 Pavements

6.2.1 Definitions

The ensuing sections use the following words or phrases, which have the following definitions:

> ***Top of grading grade*** is defined as the grade which contacts the bottom of the aggregate base layer.
>
> ***Sand subbase*** is a uniform thickness sand layer placed as the top of subgrade (directly below top of grading grade) which is intended to improve the frost and drainage characteristics of the pavement system by better draining excess water in the aggregate base and subbase, by reducing and "bridging" frost heaving, and by reducing spring thaw weakening effects.

Granular Material shall be a pit-run or crusher-run product which shall all pass a 3-inch sieve, and of the portion passing a 1-inch sieve, not more than 10% by weight will pass a #200 sieve and not more than 50% by weight will pass a #40 sieve.

Compaction Subcut is the construction of a uniform thickness subcut below a designated grade to provide uniformity and compaction within the subcut zone. Replacement fill can be the inorganic materials subcut, although the reused soils should be blended to a uniform soil condition and re-compacted to at least of 95% of the standard Proctor density (ASTM:D698). Compaction may need to be higher in order to pass a test roll.

Test roll is a means of evaluating the near-surface stability of subgrade soils (usually non-granular). Suitability is determined by the depth of rutting or deflection caused by passage of heavy rubber-tired construction equipment, such as a loaded dump truck, over the test area. Yielding of less than 1-inch is normally considered acceptable, although engineering judgment may be applied depending on equipment used and soil conditions present.

Organic soils are those soils which have sufficient organic content such that engineering properties/stability are affected (generally more than 3% organic content).

6.2.2 Subgrade Preparation

As a background to this section, we refer you to the attached data sheet entitled "Bituminous Pavement Subgrade Preparation and Design," which presents considerations and recommendations for pavement subgrade preparation.

Following removal of the existing bituminous pavement, the stability of the exposed soils should then be evaluated using a test roll procedure, as described on the attached sheet. Soils found to be unstable should either be moisture conditioned and compacted back into place, or they should be removed and replaced with compacted fill.

The on-site inorganic soils can be used for subgrade fill, although the use of granular materials is preferred. Compaction of new fill supporting pavements should meet the requirements of

Mn/DOT Specification 2105.3F1 (Specified Density Method). This specification requires soils placed within the upper 3' of the subgrade be compacted to a minimum of 100% of the Standard Proctor Density (ASTM:D698). The soil placed below the upper 3' zone can have a reduced minimum compaction level of 95%.

Sand Subbase

The existing clayey sand and sandy lean clay present in the pavement areas have at least moderate frost heave potential and they are moderately slow to slow draining. Soil with poor drainage characteristics may lead to trapped water within the upper portion of the subgrade or the aggregate base layer. This condition can accelerate subgrade softening, resulting in alligator cracking, frost distortion and pothole formation.

Improved long-term pavement performance can be achieved by placing a draining sand subbase layer as the top portion of the subgrade where granular materials are not already present. The sand subbase layer will better control infiltrating water, as well as the associated frost movements. Placement of a sand subbase layer will increase initial costs. However, the use of a drained sand subbase should reduce future maintenance; extend the pavement life; and improve constructability. The decision to use a sand subbase should take into consideration the initial costs versus the expected pavement performance.

As a minimum, we recommend using a 1' thick sand subbase in areas where granular soils are not already present at pavement subgrade elevations. Where there is a need to vary the thickness of the subbase, we recommend the thickness have a taper of no steeper than 20:1 (horizontal to vertical). The subcut and sand layer placement should extend slightly beyond the outer edge of the curb/paved edge, in order to maintain frost uniformity.

Sand subbase materials should at least meet the requirement of a Select Granular Borrow per Mn/DOT specification 3149.2B2. This refers to sand containing less than 12% by weight passing the #200 sieve. However, this specification allows for the possibility of a fine grained sand material, which does not necessarily allow for free drainage. Because stability can be affected by the presence of water, we recommend the use of a Modified Select Granular Borrow, if the project budget allows. This includes material which contains less than 5% by weight passing the #200 sieve and less than 40% by weight passing the #40 sieve. Value engineering judgments of intermediate gradation can also be considered; we are available for review on this issue.

The subbase layer should be provided with a means of subsurface drainage, in order to prevent build up of water within the sand subbase. This can be accomplished by placing "finger drains", which are segments of properly engineered drainage lines connected to catch basins in low elevation areas. Where grades are relatively level and finger drains are infrequent, consideration should be given to placing a longer parallel drainage line through the level areas, to better remove infiltrating water. Shorter paths to draintile lines should be provided as the subbase materials becomes less permeable. Therefore, less draintile lines will be needed if Modified Select Granular Borrow materials are utilized instead of Select Granular Borrow.

6.2.3 Section Thicknesses

The bituminous pavement design is intended for pavements which will experience automobile and light truck traffic at relatively low volumes. Bituminous pavement thickness designs for the on-site clays and for a 1' thick drained sand subbase place over these soils are provided in the following table B.

Table B – Pavement Thickness Designs

Pavement Material	
Bituminous Wear	1 ½"
Bituminous Base	2"
Aggregate Base (MnDOT Class 5)	7"
Sand Subbase* (MnDOT Select Granular Borrow)	12"

*An alternative to the sand subbase would be to provide an additional 6" of MnDOT Class 5 aggregate base. This would provide an equivalent GE value.

The existing aggregate base material should be able to be to be reused within new pavement section either as sand subbase or as aggregate base if the gradation meets the requirements. Again, since subsurface drainage is critical to long term performance, we recommend providing finger drains or tile lines as previously discussed.

The above designs could be reduced if the project owner is willing to assume the additional maintenance costs. Also, the site conditions are suited for the use of an engineering fabric and some reduction in the pavement section may be possible depending on the subgrade conditions encountered and the amount of sand subbase provided.

Estimated Subgrade R-Value

No actual R-value testing was conducted to define subgrade soil strength. However, based on our experience we estimate a conservative R-value for the pavement section thickness design of about 12 for the softer clays present. If you desire additional field and laboratory testing can be performed to better define the R-value for the soils present. Any additional sand provided would increase the estimated R-value or could be accounted for by assigning a granular equivalent (GE) value of about 0.5.

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 ground water 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.

7.1.3 Cobbles and Boulders

The soils at this site can include cobbles and boulders. This may make excavating procedures somewhat more difficult than normal if they are encountered.

7.1.4 Winter Construction

If construction occurs during the winter, it is necessary for the contractor to protect the base soils from freezing each day and each night before new fill is placed. Fill should not be placed over frozen soils, snow, or ice, nor should the use of frozen fill soils be permitted. The contractor must protect base soils from freezing before and after fill placement, and before, during, and after concrete placement. If the interior footings will be exposed to freezing temperatures during construction, we recommend that you consider lowering the footings to protect against frost penetration into the footing subgrade soils. We recommend that a special pre-construction meeting be held to discuss the procedures and precautions that must be followed.

7.1.5 Rubble/Old Construction Fill

One of the soil borings indicated the presence of rubble/old construction fill. The fill may include construction debris, concrete, wood, brick, or steel. Such items cannot be recovered using standard sampling techniques from the test hole. The extent of the possible rubble fill may not be limited to a specific boring and could exist over the entire site.

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.

We recommend that all pavement bearing surfaces be observed by a Geotechnical Engineer immediately prior to sand subbase or base aggregate placement. Soil density testing should also be performed on all fill placed at the site to document that our recommendations, and the specifications, for compaction and moisture, have been satisfied. Where fill material type is important, laboratory sieve analysis should be performed to document that the actual fill meets the recommended gradation criteria. The building materials should also be tested in accordance with the project specifications and the building codes.

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

Freezing Weather Effects on Building Construction
Definitions Relating to Pavement Construction

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.

DEFINITIONS RELATING TO PAVEMENT CONSTRUCTION

TOP OF SUBGRADE
Grade which contacts the bottom of the aggregate base layer.

SAND SUBBASE
Uniform thickness sand layer placed as the top of subgrade which is intended to improve the frost and drainage characteristics of the pavement system by better draining excess water in the base/subbase, by reducing and "bridging" frost heaving and by reducing spring thaw weakening effects.

CRITICAL SUBGRADE ZONE
The subgrade portion beneath and within three vertical feet of the top of subgrade. A sand subbase, if placed, would be considered the upper portion of the critical subgrade zone.

GRANULAR BORROW
Soils meeting Mn/DOT Specification 3149.2B1. This refers to granular soils which, of the portion passing the 1" sieve, contain less than 20% by weight passing the #200 sieve.

SELECT GRANULAR BORROW
Soils meeting Mn/DOT Specification 3149.2B2. This refers to granular soils which, of the portion passing the 1" sieve, contain less than 12% by weight passing the #200 sieve.

MODIFIED SELECT GRANULAR BORROW
Clean, medium grained sands which, of the portion passing the 1" sieve, contain less than 5% by weight passing the #200 sieve and less than 40% by weight passing the #40 sieve.

GEOTEXTILE STABILIZATION FABRIC
Geotextile meeting Type V requirements defined in Mn/DOT Specification 3733. When using fabric, installation should also meet the requirements outlined in Mn/DOT Specification 3733.

COMPACTION SUBCUT
Construction of a uniform thickness subcut below a designated grade to provide uniformity and compaction within the subcut zone. Replacement fill can be the materials subcut, although the reused soils should be blended to a uniform soil condition and recompacted per the Specified Density Method (Mn/DOT Specification 2105.3F1).

TEST ROLL
A means of evaluating the near-surface stability of subgrade soils (usually non-granular). Suitability is determined by the depth of rutting or deflection caused by passage of heavy rubber-tired construction equipment, such as a loaded dump truck, over the test area. Yielding of less than 1" is normally considered acceptable, although engineering judgment may be applied depending on equipment used, soil conditions present, and/or pavement performance expectations.

UNSTABLE SOILS
Subgrade soils which do not pass a test roll. Unstable soils typically have water content exceeding the "standard optimum water content" defined in ASTM: D698 (Standard Proctor test).

ORGANIC SOILS
Soils which have sufficient organic content such that engineering properties/stability are affected. These soils are usually black to dark brown in color.

Appendix A

Geotechnical Field Exploration and Testing
Boring Log Notes
Unified Soil Classification System
Figure 1 – Site Location
Figure 2&3 - Boring Locations
Subsurface Boring Logs

Appendix A
Geotechnical Field Exploration and Testing
Report No. 08-11600

A.1 FIELD EXPLORATION

The subsurface conditions at the site were explored by drilling and sampling ten (10) flight auger test borings. The locations of the borings appear on Figure 2, 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
AR:	Sample of material obtained from cuttings blown out the top of the borehole during air rotary procedure.
B, H, N:	Size of flush-joint casing
CAS:	Pipe casing, number indicates nominal diameter in inches
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
DP:	Direct push drilling; a 2.125 inch OD outer casing with an inner 1½ inch ID plastic tube is driven continuously into the ground.
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
RDA:	Rotary drilling with compressed air and roller or drag bit.
RDF:	Rotary drilling with drilling fluid and roller or drag bit
REC:	In split-spoon (see notes), direct push 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.
SS:	Standard split-spoon sampler (steel; 1.5" 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 "falling" through drilling fluid
WH:	Sampler advanced by static weight of drill rod and 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 Designation of Rock Core, 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, remolded (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
(Calibrated Hammer Weight)

The standard penetration test consists of driving a split-spoon sampler with a drop hammer (calibrated weight varies to provide N_{60} values) 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 "REC" 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.

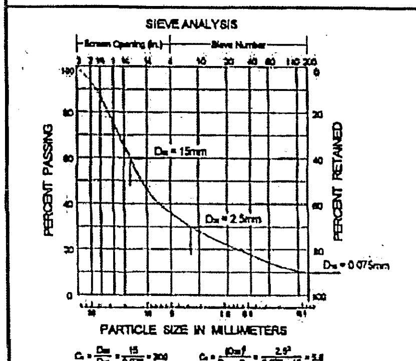
Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]				Soil Classification: Group Symbol	Soil Classification: Group Name[B]
Coarse-Grained Soils More than 50% retained on No. 200 sieve	Gravels More than 50% coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines[C]	Cu≥4 and 1≤Cc≤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≥6 and 1≤Cc≤3[E]	SW	Well-graded sand[I]
			Cu<6 and/or 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 / Liquid limit – not dried <0.75	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 / Liquid limit – not dried <0.75	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]

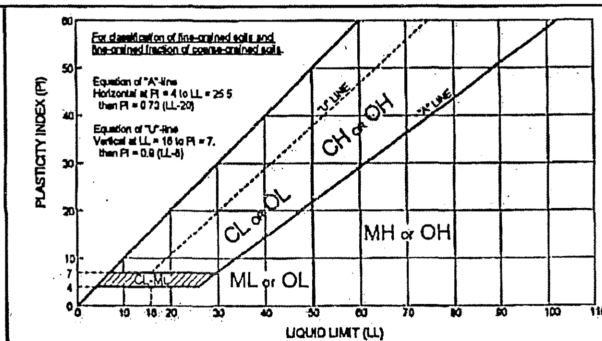
Notes

[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.





Plasticity Chart

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.

Peat Description

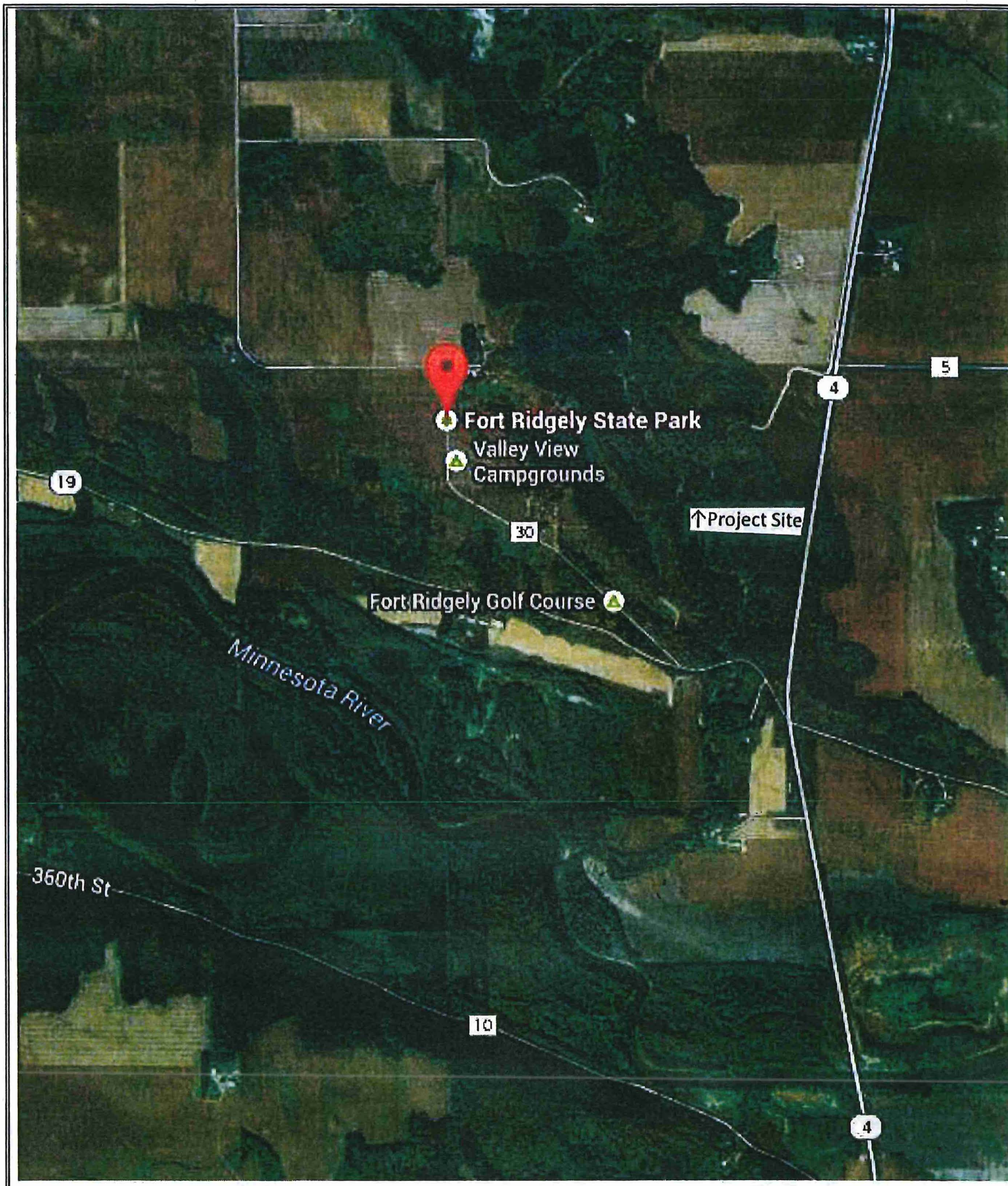
Term	Fiber Content (Visual Estimate)
Fibric Peat:	Greater than 67%
Hemic Peat:	33 – 67%
Sapric Peat:	Less than 33%

Organic 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 Liquid Limit properties. *Slightly organic* used for borderline cases.

Root Inclusions

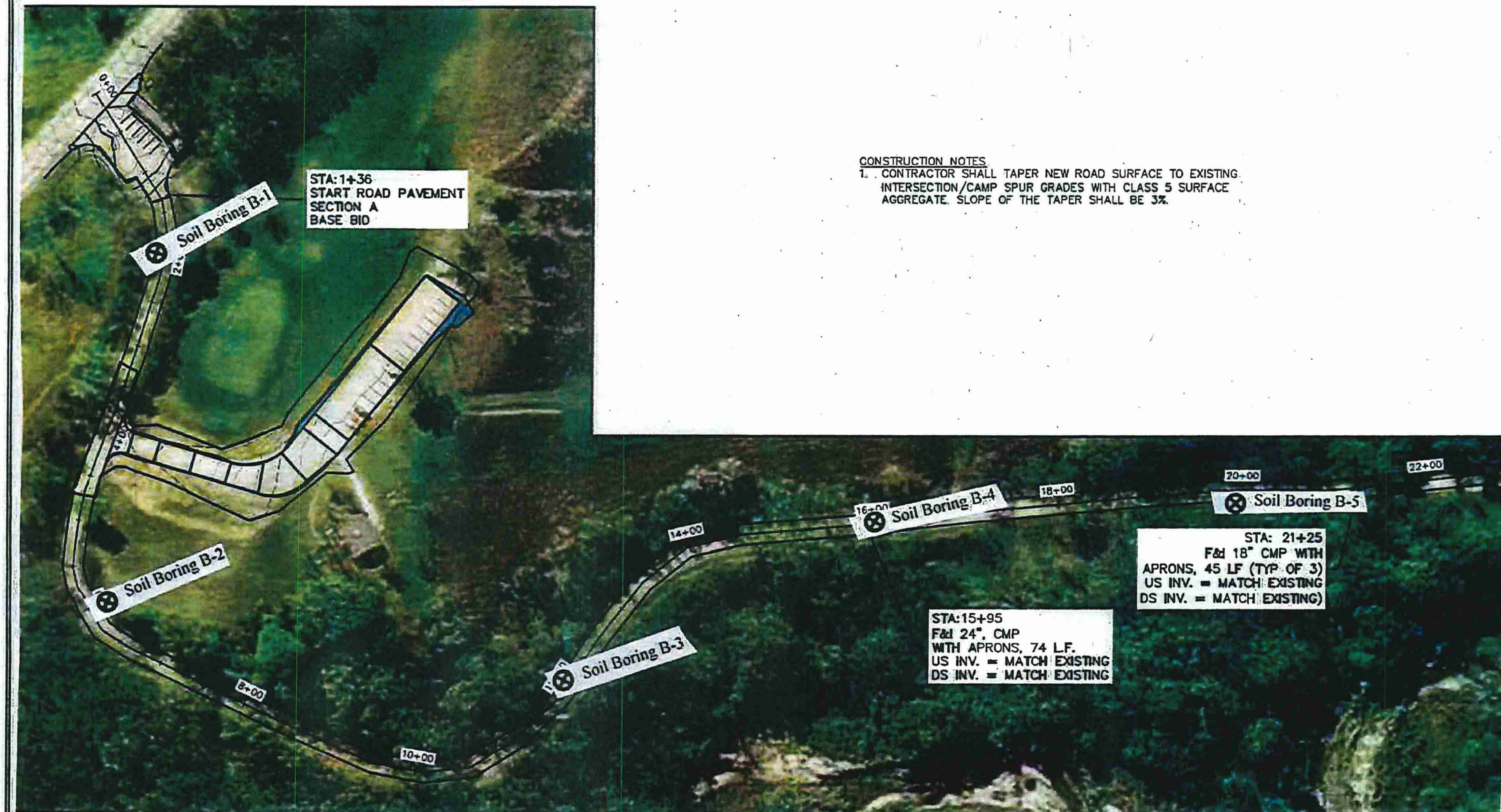
With roots:	Judged to have sufficient quantity of roots to influence the soil properties.
Trace roots:	Small roots present, but not judged to be in sufficient quantity to significantly affect soil properties.



American Engineering Testing, Inc.	Project: Fort Ridgely Road Fairfax, MN			AET Job No. 08-11600
	Subject: Site Location			Date: July 15, 2014
	Scale: NTS	Drawn By: GG	Checked By: SR	Figure: 1

CONSTRUCTION NOTES

1. CONTRACTOR SHALL TAPER NEW ROAD SURFACE TO EXISTING INTERSECTION/CAMP SPUR GRADES WITH CLASS 5 SURFACE AGGREGATE. SLOPE OF THE TAPER SHALL BE 3%.



VERIFY ALL DIMENSIONS AND LOCATIONS ON THE JOB. REPORT ALL DISCREPANCIES TO MANAGEMENT RESOURCES

DO NOT SCALE DRAWINGS

0 100' 200'

PRELIMINARY 06-05-14

Minnesota DEPARTMENT OF NATURAL RESOURCES

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 THE LAWS OF THE STATE OF MINNESOTA

M. SHANE RUSTIN 43368 6.5.2014

Management Resources — Safety, Facilities

DNR Division of Parks Trails
Fort Ridgely State Park
Park Road Rehabilitation
Nicollet County, Near Fairfax, Section 5,6, Township 111 N, Range 32 W

Revisions — Date, By

Title: Plan Sheet - STA 0+00 TO STA 22+00

Survey XX, Drawn XX, Checked XX, Designed XX, Drawn XX, Checked XX

Horz datum NAD 83 (96 Adj) Vert datum NAVD 88

C3.1

8P189

SPK00151 00 21

	Project	Fort Ridgely Road Fairfax, MN	Subject:	Boring Locations	AET Job No:	08-11600	Date:	July 15, 2014
AMERICAN ENGINEERING TESTING, INC.	Scale:	NTS	Drawn By:	GG	Checked By:	SR	Figure 2	

CONSTRUCTION NOTES
1. CONTRACTOR SHALL TAPER NEW ROAD SURFACE TO EXISTING INTERSECTION/CAMP SPUR GRADES WITH CLASS 5 SURFACE AGGREGATE. SLOPE OF THE TAPER SHALL BE 3%.

VERIFY ALL DIMENSIONS AND LOCATIONS ON THE JOB. REPORT ALL DISCREPANCIES TO MANAGEMENT RESOURCES.
DO NOT SCALE DRAWINGS

0 100' 200'

PRELIMINARY 06-05-14

Minnesota Department of Natural Resources

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 THE LAWS OF THE STATE OF MINNESOTA
M. SHANE RUSTIN 43368 6.5.2014

Management Resources — Facilities

DNR Division of Parks Trails
Fort Ridgely State Park
Park Road Rehabilitation
Nicollet County — Section 5,6 — Township 111 N — Range 32 W — Fairfax

Revisions — Date — By

Title Plan Sheet - STA. 22+00 TO STA 41+89
Survey XX — Designed XX
Drawn XX — Drawn XX
Checked XX — Checked XX

C3.2
BP189

AMERICAN ENGINEERING TESTING, INC.	Project	Fort Ridgely Road Fairfax, MN	Subject:	Boring Locations	AET Job No:	08-11600	Date:	July 15, 2014
	Scale:	NTS	Drawn By:	GG	Checked By:	SR	Figure 3	

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET JOB NO: **08-11600** LOG OF BORING NO. **B-1 (p. 1 of 1)**

PROJECT: **Fort Ridgely State Park - Park Road Rehab; Fairfax, Minnesota**

DEPTH IN FEET	SURFACE ELEVATION: ___ MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DEN	LL	PL	qp
	2 1/4" bituminous mat at surface	FILL		M	DS						
	7 3/4" FILL, silty sand, a little gravel, fine to medium grained, brown			M	FA						
1	SILTY SAND, brown (SM)	COARSE ALLUVIUM									
2				M	FA						
3											
4	SILT, brown and gray mottled (ML)	FINE ALLUVIUM		M	FA		34				
5	**END OF BORING**										

DEPTH:	DRILLING METHOD	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
0-5'	**6" FA**	**7/1/14**		**5'**	**None**	**5'**	**None**	**None**

WATER LEVEL MEASUREMENTS

BORING COMPLETED: **7/1/14**

DR: **BP** LG: **TW** Rig: **R43R**

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

AET_CORP 11600.GPJ AET+CPT+WELL.GDT 7/15/14

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET JOB NO: **08-11600** LOG OF BORING NO. **B-2 (p. 1 of 1)**

PROJECT: **Fort Ridgely State Park - Park Road Rehab; Fairfax, Minnesota**

DEPTH IN FEET	SURFACE ELEVATION: MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DEN	LL	PL	qp
	2 1/4" bituminous mat at surface	FILL		M	DS						
	5 3/4" FILL, silty sand, a little gravel, medium to fine grained, brown			M	FA						
1	FILL, clayey sand mixed with silty sand, dark brown			M	FA						
2	FILL, silt, light brown			M	FA						
3	FILL, silty clay, brown and black mixture			M	FA						
4	SILTY SAND, a little gravel, brown (SM)	COARSE ALLUVIUM		M	FA						
5	**END OF BORING**										

DEPTH:	DRILLING METHOD	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
0-5'	**6" FA**	**7/1/14**		**5'**	**None**	**5'**	**None**	**None**
BORING COMPLETED: **7/1/14**								
DR: **BP** LG: **TW** Rig: **R43R**								

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

AET_CORP 11600.GPJ AET+CPT+WELL.GDT 7/15/14

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET JOB NO: **08-11600** LOG OF BORING NO. **B-3 (p. 1 of 1)**

PROJECT: **Fort Ridgely State Park - Park Road Rehab; Fairfax, Minnesota**

DEPTH IN FEET	SURFACE ELEVATION: ______ MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DEN	LL	PL	qp
	2 1/4" bituminous mat at surface	FILL		M	DS						
	6 3/4" FILL, silty sand with gravel, medium to fine grained, brown			M	FA						
1	FILL, clayey sand, a little gravel, brown and black mixture										
2				M	FA						
3	FILL, silty clay, black and brown mixture										
4				M	FA						
5	**END OF BORING**										

DEPTH:	DRILLING METHOD	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
0-5'	**6" FA**							
		7/1/14		**5'**	**None**	**5'**	**None**	**None**

WATER LEVEL MEASUREMENTS

BORING COMPLETED: **7/1/14**

DR: **BP** LG: **TW** Rig: **R43R**

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

AET_CORP 11600.GPJ AET+CPT+WELL.GDT 7/15/14

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET JOB NO: **08-11600** LOG OF BORING NO. **B-4 (p. 1 of 1)**

PROJECT: **Fort Ridgely State Park - Park Road Rehab; Fairfax, Minnesota**

DEPTH IN FEET	SURFACE ELEVATION: MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DEN	LL	PL	qp
	2" bituminous mat at surface	FILL		M	DS						
	5" FILL, silty sand with gravel, medium to fine grained, brown			M	FA						
1	FILL, clayey sand, brown and black mixture			M	FA						
2	FILL, clayey sand, dark brown and black mixture			M	FA						
3											
4	SILTY SAND, fine grained, dark brown (SM)	COARSE ALLUVIUM		M	FA						
5	**END OF BORING**										

DEPTH:	DRILLING METHOD	WATER LEVEL MEASUREMENTS							NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG
0-5'	**6" FA**	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL	
		7/1/14		**5'**	**None**	**5'**	**None**	**None**	
BORING COMPLETED: **7/1/14**									
DR: **BP** LG: **TW** Rig: **R43R**									

AET_CORP 11600.GPJ AET+CPT+WELL.GDT 7/15/14

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AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET JOB NO: **08-11600** LOG OF BORING NO. **B-5 (p. 1 of 1)**

PROJECT: **Fort Ridgely State Park - Park Road Rehab; Fairfax, Minnesota**

DEPTH IN FEET	SURFACE ELEVATION: MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DEN	LL	PL	qp
	10 1/2" FILL, silty sand with gravel, medium to fine grained, brown	FILL		M	DS						
1	FILL, clayey sand, a little gravel, brown			M	FA						
3	FILL, sand with silt, a little gravel, medium to fine grained, brown			M	FA						
	SANDY LEAN CLAY with visible organics, black	TOPSOIL		M	FA						
5	**END OF BORING**										

DEPTH:	DRILLING METHOD
0-5'	6" FA

BORING COMPLETED: 7/1/14

DR: BP LG: TW Rig: R43R

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
7/1/14		5'	None	5'	None	None

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

AET_CORP 11600.GPJ AET+CPT+WELL.GDT 7/15/14

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET JOB NO: **08-11600** LOG OF BORING NO. **B-6 (p. 1 of 1)**

PROJECT: **Fort Ridgely State Park - Park Road Rehab; Fairfax, Minnesota**

DEPTH IN FEET	SURFACE ELEVATION: MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DEN	LL	PL	qp
	10" FILL, sand with gravel, medium to fine grained, brown	FILL		M	DS						
1	FILL, sandy lean clay, a little gravel, brown and gray										
2				M	FA						
3											
4	FILL, clayey sand, black and brown mixture			M	FA						
	FILL, silty sand, a little gravel, fine to medium grained, dark brown			M	FA						
5	**END OF BORING**										

DEPTH:	DRILLING METHOD	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
0-5'	**6" FA**	**7/1/14**		**5'**	**None**	**5'**	**None**	**None**

WATER LEVEL MEASUREMENTS

BORING COMPLETED: **7/1/14**

DR: **BP** LG: **TW** Rig: **R43R**

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

AET_CORP 11600.GPJ AET+CPT+WELL.GDT 7/15/14

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET JOB NO: **08-11600** LOG OF BORING NO. **B-7 (p. 1 of 1)**

PROJECT: **Fort Ridgely State Park - Park Road Rehab; Fairfax, Minnesota**

DEPTH IN FEET	SURFACE ELEVATION: MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DEN	LL	PL	qp
	7 1/2" FILL, silty sand, a little gravel, medium to fine grained, brown	FILL		M	DS						
1	FILL, silty sand mixed with areas of clay, fine grained, brown										
2				M	FA						
3	FILL, clayey sand, a little gravel, dark brown										
4				M	FA						
5	**END OF BORING**										

DEPTH:	DRILLING METHOD
0-5'	6" FA

BORING COMPLETED: 7/1/14

DR: **BP** LG: **TW** Rig: **R43R**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
7/1/14		5'	None	5'	None	None

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

AET_CORP 11600.GPJ AET+CPT+WELL.GDT 7/15/14

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET JOB NO: **08-11600** LOG OF BORING NO. **B-8 (p. 1 of 1)**

PROJECT: **Fort Ridgely State Park - Park Road Rehab; Fairfax, Minnesota**

DEPTH IN FEET	SURFACE ELEVATION: ____ MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DEN	LL	PL	qp
	8" FILL, silty sand, a little gravel, medium to fine grained, brown	FILL		M	DS						
1	FILL, clayey sand, a little gravel, dark brown										
2				M	FA						
3											
4	SILTY SAND, fine to medium grained, brown (SM)	COARSE ALLUVIUM		M	FA						
5	**END OF BORING**										

DEPTH:	DRILLING METHOD
0-5'	6" FA

BORING COMPLETED: 7/1/14

DR: BP LG: TW Rig: R43R

WATER LEVEL MEASUREMENTS						
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
7/1/14		5'	None	5'	None	None

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

AET_CORP 11600.GPJ AET+CPT+WELL.GDT 7/15/14

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET JOB NO: **08-11600** LOG OF BORING NO. **B-9 (p. 1 of 1)**

PROJECT: **Fort Ridgely State Park - Park Road Rehab; Fairfax, Minnesota**

DEPTH IN FEET	SURFACE ELEVATION: MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DEN	LL	PL	qp
	6" FILL, silty sand, a little gravel, medium to fine grained, dark brown	FILL		M	DS						
1–2	FILL, clayey sand, a little gravel, dark brown			M	FA						
	SANDY LEAN CLAY with visible organics, black	TOPSOIL		M	FA						
3	CLAYEY SAND, dark gray (SC)	MIXED ALLUVIUM		M	FA		20				
4	SILTY SAND, fine grained, gray (SM)	COARSE ALLUVIUM		M	FA						
5	**END OF BORING**										

DEPTH: DRILLING METHOD	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
0-5' **6" FA**	**7/1/14**		**5'**	**None**	**5'**	**None**	**None**
BORING COMPLETED: **7/1/14**							
DR: **BP** LG: **TW** Rig: **R43R**							

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

AET_CORP 11600.GPJ AET+CPT+WELL.GDT 7/15/14

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET JOB NO: **08-11600** LOG OF BORING NO. **B-10 (p. 1 of 1)**

PROJECT: **Fort Ridgely State Park - Park Road Rehab; Fairfax, Minnesota**

DEPTH IN FEET	SURFACE ELEVATION: MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DEN	LL	PL	qp
0	7" FILL, silty sand with gravel, medium to fine grained, brown	FILL		M	DS						
1	FILL, clayey sand with gravel, black and gray mixture										
2				M	FA						
3	FILL, clayey sand, black, with rubble including brick, plastic, wire, glass, foil										
4–5											
6				M	FA						
7–8											
9	CRETACEOUS SHALE: (Textural Classification: CLAYEY SAND, white and bluish gray (SC))	CRETACEOUS DEPOSITS		M	FA		25				
10	**END OF BORING**										

DEPTH:	DRILLING METHOD	WATER LEVEL MEASUREMENTS							NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG
0-10'	**6" FA**	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL	
		7/1/14		**10'**	**None**	**10'**	**None**	**None**	
BORING COMPLETED: **7/1/14**									
DR: **BP** LG: **TW** Rig: **R43R**									

AET_CORP 11600.GPJ AET+CPT+WELL.GDT 7/15/14

Appendix B

Geotechnical Report Limitations and Guidelines for Use

Appendix B
Geotechnical Report Limitations and Guidelines for Use
Report No. 08-11600

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.