SPN & ASSOCIATES
ENGINEERS & SURVEYORS

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OCTOBER 28, 2024

RE: RAILROAD AVENUE IMPROVEMENTS
MT. VERNON, SOUTH DAKOTA
SPN #15070

BID LETTING: <u>Wednesday, OCTOBER 30, 2024, 2:00 PM</u>

ADDENDUM NUMBER 1

The following modifications are to be made to the plans and specifications for the Railroad Avenue Improvements Project.

<u>PLAN SHEET 4</u>

Add the following paragraph under the heading **<u>"GRAVEL BASE COURSE AND CUSHION MATERIAL":</u>**

> City furnished material is stockpiled at a gravel pit located approximately 8.5 miles from the project site. The gravel stockpile location is approximately 0.5 miles east of the intersection of 249th Street and 394th Avenue.

<u>GEOTECHNICAL REPORT</u>

A geotechnical report associated with this project is attached to this Addendum for information.

REGISTERED PROFESSIONAL ENGINEER
REG. NO.
15046
JACOB D.
SONNE
SOUTH DAKOTA

Jacob D. Sonne, Project Engineer
Schmucker, Paul, Nohr & Associates

The undersigned hereby acknowledges receipt of Addendum Number 1 to the plans and specifications for the RAILROAD AVENUE IMPROVEMENTS PROJECT.

FIRM NAME______________________________
BY______________________________
TITLE______________________________
DATE______________________________

<u>ATTACH THIS SIGNED ADDENDUM NO. 1 TO THE BID FORM WHEN SUBMITTING.</u>

Geotechnical • Materials
Forensic • Environmental
Building Technology
Petrography/Chemistry

REPORT OF GEOTECHNICAL EXPLORATION AND REVIEW

E. Railroad Avenue Improvement
Mount Vernon, South Dakota

AET Project No. P-0031517

Date:
April 19, 2024

Prepared for:

SPN & Associates
2100 North Sanborn Boulevard
P.O. Box 398
Mitchell, South Dakota 57301

American Engineering Testing
601 East 48th Street North
Sioux Falls, SD 57104
TeamAET.com • 605.332.5371

April 19, 2024

SPN & Associates
2100 North Sanborn Boulevard
P.O. Box 398
Mitchell, South Dakota 57301

Attn: Jacob Sonne, PE
jsonne@spn-assoc.com

RE: Report of Geotechnical Exploration
Street Improvement
E. Railroad Avenue
Mount Vernon, South Dakota
AET Project No. P-0031517

Dear Mr. Sonne,

American Engineering Testing, Inc. (AET) is pleased to present the results of our subsurface exploration program and geotechnical engineering review for your E. Railroad Avenue Improvement project in Mount Vernon, South Dakota. These services were performed according to our proposal to you dated March 6, 2024, which was authorized by you on March 20, 2024.

We are submitting one 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.

Zane L. Hiller, MS EIT
Project Manager
zhiller@teamaet.com
W: 605.332.5375
C: 605.595.8769

ZLH/GAG/zh

SIGNATURE PAGE

Prepared for:
SPN & Associates
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Mitchell, South Dakota 57301

Attn: Jeff McCormick, PE

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Senior Engineer

REGISTERED PROFESSIONAL ENGINEER
REG. NO.
9887
GREGORY
GUYER
4-19-24
SOUTH DAKOTA

TABLE OF CONTENTS

1.0 INTRODUCTION

You are proposing to reconstruct East Railroad Avenue, as well as install concrete valley gutters on both sides of the roadway in Mount Vernon, South Dakota. 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 March 6, 2024, which you authorized on March 20, 2024. The authorized scope consists of the following.

- Perform three standard penetration test borings (SPT) to a depth of 11 feet.
- Soil laboratory testing.
- Geotechnical engineering review based on the data and preparation of this report.

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

3.0 PROJECT INFORMATION

We understand from the information provided by Schmucker, Paul, Nohr & Associates (SPN), that you are planning to reconstruct East Railroad Avenue from South Main Street to South Haynes Street in Mount Vernon, South Dakota. Additionally, we understand that concrete valley gutters will be installed on both the north and south sides of the roadway, spanning the length of the proposed project site. The intersection of S. Main Street and E. Railroad Avenue will consist of a concrete pavement section.

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 three standard penetration test borings. The details of the methods used appear in Appendix A. The logs contain information concerning soil layering, soil classification, geologic origins, and moisture condition. A density description 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 2 in Appendix A. The borings were located and staked by SPN. Surface elevations were also provided by SPN at the time of the subsurface exploration. The surface elevations are located on their respective borings logs in Appendix A.

The surface elevation and thickness of the existing pavement are summarized in Table 4.1.1 below.

Table 4.1.1: Existing Gravel Surface Thickness

Boring Number	Surface Elevation (ft.)	Gravel Surfacing Thickness (in.)
B-1	1409.8	3.00
B-2	1408.8	6.00
B-3	1408.1	5.00

4.2 LABORATORY TESTING

The laboratory test program included moisture content, dry density, Atterberg limits, percent passing #200 sieve, and Standard Proctor tests. 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. Table 4.2.1 below summarizes the Standard Proctor tests.

Table 4.2.1 – Summary of Standard Proctor Test

Proctor #	Sample Location	Soil Type	Depth of Sample (ft.)	Maximum Density (pcf)	Optimum Moisture (%)
1	Boring #1	Sandy Lean Clay	1 to 5	116.0	12.5
2	Boring #2	Clayey Sand	1 to 5	117.8	13.1
3	Boring #3	Sandy Lean Clay	1 to 5	118.4	13.6
4	Off- Site Stockpile	Sand	---	116.6	10.2

5.0 SITE CONDITIONS

5.1 SURFACE OBSERVATIONS

The proposed project site is located on East Railroad Ave from S. Main Street to S. Haynes Street, in Mount Vernon, South Dakota. Nearby site features include residential housing and ball fields to the north, agricultural land to the east, commercial construction to the west, and grain bins and loading scale to the south. Current site vegetation consists of grass outside of the existing roadway.

The general site topography is level to gently rolling, with surface elevations decreasing from west to east. Based upon the surface elevation information provided by SPN, it appears that the existing ground surface in the proposed project area varies from elevation 1409.8' at boring B-1 to 1408.1' at boring B-3.

5.2 SUBSURFACE SOILS/ GEOLOGY

The site geology consists of a layer of gravel surfacing fill/general fill underlain by various alluvial deposits and glacial till soils at depth. As shown in Table 4.1.1 above, the existing gravel surfacing ranged in thickness from 3 to 6 inches.

Underlying the gravel surfacing, the bottom fill layer was approximately 1.75 feet deep at all the boring locations. The fill consisted of a mixture of brown, dark brown and black, lean clay and sandy lean clay, with a little gravel.

Underlying the fill soils, grayish brown and brown mottled, lean clay, fine alluvial soils were encountered in borings B-1 and B-2. Based on the penetration resistance, N-values, the consistency of the fine alluvial soils was firm. Brown mottled, sandy lean clay, mixed alluvium soils were encountered underneath the surficial fill soils in boring B-3. The consistency of the mixed alluvium varied from soft to firm.

The main geologic deposit encountered at the site consisted of brown mottled, sandy lean clay, glacial till deposits. Additionally, the till contained a little gravel. The consistency of the till soils varied from firm to stiff.

5.3 GROUNDWATER

Subsurface water was not encountered in any of the borings at the time our field work was performed. The borings were monitored for groundwater seepage during drilling operations and were measured for groundwater accumulation shortly after completion of drilling. The boreholes remained dry during drilling and when measured for groundwater accumulation shortly after completing the borings. Groundwater levels fluctuate due to varying seasonal and annual rainfall and snow melt amounts, as well as other factors.

Based upon our previous experience with clay 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. It should also be recognized that groundwater levels can fluctuate due to natural seasonal variations in rainfall and snowmelt amounts.

5.4 REVIEW OF SOIL PROPERTIES

5.4.1 SUBGRADE FILL SOILS

The surficial gravel surfacing soils consisted of brown, clayey sand fill soils. The underlying fill layer consisted of a mixture of brown, dark brown and black, lean clay and sandy lean clay soils. Lean clay and sandy lean clay are fine-grained soils that are slow-draining and susceptible to freeze-thaw movements. Clayey sand is a moderately slow draining soil that is moderately susceptible to freeze-thaw movements.

5.4.2 FINE ALLUVIUM

The fine alluvium encountered at the site consisted of grayish brown and brown mottled lean clay (CL). The N-values recorded in the fine alluvium soils ranged from 6 to 7 bpf; indicating these soils exhibit a firm consistency. We judge the lean clay soils to have low to moderate strength and compressibility characteristics. Lean clay soils are a slow-draining soil type that is susceptible to freeze-thaw movements when subject to freezing temperatures.

5.4.3 MIXED ALLUVIUM

The mixed alluvium soils encountered at the site consisted of brown mottled, sandy lean clay (CL). The N-values recorded in the mixed alluvium ranged from 4 to 6; indicating these soils exhibit a soft to firm consistency. We judge the sandy lean clay soils to have low strength and compressibility characteristics. Sandy lean clay soils are a slow-draining soil type that is susceptible to freeze-thaw movements when subject to freezing temperatures.

5.4.4 GLACIAL TILL

The main geologic deposit consisted of sandy lean clay (CL), glacial till deposits. The till was brown mottled in color and contained a little gravel. The N-values recorded in the glacial till ranged from 5 to 12 bpf; indicating these soils exhibit a firm to stiff consistency. Accordingly, we judge the glacial till to have low to moderate strength and low compressibility when subject to the anticipated structural loads. The sandy lean clay is a slow-draining soil type that is susceptible to freeze-thaw movements when subject to freezing temperatures.

6.0 RECOMMENDATIONS

6.1 APPROACH DISCUSSION

The shallow fill and natural soils present at this site are considered slow draining and are susceptible to frost movements and softening during spring thaw months. To provide optimum support of any new pavement, complete excavation of the existing fine-grained soils within the frost zone would be required, however, this depth of excavation is not generally practical. Therefore, we recommend replacing a portion of the clay soils with new granular fill.

We wish to note that the clay soils encountered at the site may be sensitive to disturbance and potential strength loss under construction traffic and/or excessive moisture. The soils can lose strength with the combination of additional moisture and construction traffic. Disturbance of these soils should be prohibited. Water should not be allowed to pond on these soils for any length of time.

6.2 GRAVEL SURFACE RECOMMENDATIONS

6.2.1 DEFINITIONS

The ensuing sections use italicized words, 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 Sub-cut is the construction of a uniform thickness sub-cut below a designated grade to provide uniformity and compaction within the sub-cut zone. Replacement fill can be the inorganic materials sub-cut, although the reused soils should be blended to a uniform soil condition and recompacted to at least 95% of the Standard Proctor density. 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 judgement 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 EXCAVATION AND 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.

To prepare the subgrade for new gravel surfacing (and concrete pavement, discussed in Section 6.3), we recommend a subcut be performed in order to place the recommended gravel surfacing section. Prior to the placement of the geogrid/geotextile material, we recommend the subgrade soils be prepared in accordance with SDDOT Specification 210.3.C "Heavy Roadway Shaping", which requires reworking and recompacting the upper 12 inches in two separate lifts.

Following subgrade preparation, we recommend a geotextile separation fabric be incorporated into the design between the clayey subgrade soils and the gravel surface layer to reduce the migration of fined-grained soils into the gravel section. A geotextile reinforcing geogrid material could be placed as a construction aid, in areas of wet or unstable soils, to facilitate compaction of soils placed above. In low-lying widening areas or at the top of subgrade in areas where additional subcutting and sand subbase placement is not practical, from a drainage standpoint, the use of a geogrid could help reduce pumping and migration or loss of the sand subbase or drainage layer into the underlying fine-grained soils during compaction.

6.2.3 SUBGRADE STABILITY

All prepared subgrades should be proof rolled to verify a firm and unyielding subgrade has been obtained prior to the placement of geotextile fabric/geogrid and gravel surface materials. Based on the in-place soil moisture contents we expect the fine-grained soils will likely be over optimum moisture content based on the Standard Proctors. We recommend moisture conditioning these soils to provide proper stability.

Any areas that "pump" or rut under the loaded dump truck should be evaluated by the engineer to determine whether additional excavation and replacement with granular soils or the use of a stabilizing geogrid material is necessary. These granular soils should meet the specification shown in Section 6.2.4 of this report. Once the subgrade has been proof rolled and approved by the geotechnical engineer, the geotextile and aggregate base course materials may be placed.

6.2.4 FILL PLACEMENT AND COMPACTION

The non-organic, on-site clayey soils can be used for subgrade backfill and grading below the aggregate base course material. It is recommended fill that is placed to attain bottom of gravel surface or base course elevation be consistent in type and thickness to limit differential frost movements within the surface layer as much as possible.

We do not recommend reusing the existing gravel surface material as new gravel surfacing or base course material, as it appears that the underlying fine-grained fill soils migrated upward into the existing gravel surfacing, deeming it unsuitable to meet SD/DOT Section 882 standards. The existing gravel surface material can be used as subgrade backfill to attain bottom of gravel surface/base course elevation. See below for granular backfill compaction recommendations.

The on-site cohesive soils used as fill for grading, should consist of sandy lean clay (CL), clayey sand (SC), or lean clay (CL). A sheep's foot roller is recommended to compact these types of fill soils. If these soils are used, we recommend the moisture content be in the range of -3% to +3% of the optimum moisture content (OMC) during compaction. Additionally, these soils should be compacted to a minimum of 95% of the soil's standard maximum dry density, in general accordance with ASTM: D698 (Standard Proctor test).

Proper stability should be achieved before the placement of any granular engineered fill or aggregate base.

If a more granular fill is used for grading/backfilling, it should consist, of sand (SP), silty/clayey sand (SM/SC), or sand with silt/clay (SP-SM/SP-SC). A heavy vibratory steel drum roller is recommended to compact these types of fill soils. If these soils are used, we recommend the moisture content be in the range of -2% to +3% of the OMC and compacted to a minimum of 95% of the soil's maximum dry density.

In many site areas, the gravel surface material will overlie slow draining fine grained soil; therefore, subsurface drainage must be provided to minimize build-up of water within the gravel layer. We recommend the subsurface drains outlet to the ditch or storm sewer. The drain lines should be placed to provide drainage at the bottom of the aggregate base layer or sand subbase layer, if utilized.

If there is a need to vary the thickness of the sand subbase layer (if utilized), we recommend the thickness have longitudinal tapers along the roadway of 20H:1V or flatter. Where intersecting cross streets, we recommend a transverse taper of 4H:1V, with the aggregate base or sand subbase overlaying the adjacent soils.

The gravel surface material should meet the requirements of SD/DOT specification 882. The material should be compacted to a minimum of 97% of Standard Proctor density. A heavy vibratory steel drum roller is recommended to compact the aggregate base course.

6.2.5 GRAVEL SURFACE SECTION THICKNESS DESIGN

Table 6.2.5 provides pavement section options based on an assumed design CBR value of 2. Specific traffic volume data was not provided. We are providing a standard residential gravel surface section assuming a moderate volume of heavy truck traffic.

Table 6.2.5 – Gravel Surfacing Recommendation

Layer	Thickness (in.)
SD/DOT Aggregate Base (SD/DOT specification 882)	18
Geotextile	Woven Separator Fabric

6.2.6 SURFACE DRAINAGE
We recommend that adequate drainage be provided for the reconstructed roads. We understand that concrete valley gutters are planned to be utilized for surface drainage on both sides of the roadway after the roadway reconstruction. Utilizing a storm sewer system or drain tiles, combined with the valley gutters, are also ways for handling surface drainage.

6.2.7 SUBSURFACE DRAINAGE
Wherever free draining sand or gravel layers overlie clay layers, it is important that subsurface drainage be provided for the sand or gravel layer to prevent buildup of water. Subsurface drainage can be provided by parallel drain tile lines and perimeter drain tile lines. To aid in preventing clogging of the perforated tile lines, we recommend that the lines be wrapped with a geotextile fabric designed for that purpose. The drain tile lines should be connected to a suitable outfall.

6.3 CONCRETE PAVEMENT RECOMMENDATIONS
6.3.1 DISCUSSION
We understand that the intersection of S. Main Street and E. Railroad Avenue will consist of a concrete pavement section. We suggest using small panel areas (8’ to 10’) to better deal with any differential movements within the slab. Concrete mat reinforcement and dowel locations should be designed by the project civil engineer.

6.3.2 SUBGRADE PREPARATION
We recommend subgrade preparation be performed in the same manner as outlined in Section 6.2.2 of this report.

6.3.3 ESTMATED SUBGRADE CBR

No actual CBR tests were conducted to define subgrade soil strength. However, based on our experience with clay soils in this area, we estimate a CBR for the gravel surface and concrete pavement section thickness designs of about 2 for the softer clays present. If you desire, additional field and laboratory testing can be performed to better define the CBR for the soils present.

6.3.4 CONCRETE PAVEMENT SECTION THICKNESS DESIGN

We understand that the intersection of S. Main Street and E. Railroad Avenue will consist of a concrete pavement section. The thicknesses of the pavement sections will depend on the type of materials present within the upper portion of the subgrade and also on the traffic.

We understand traffic considerations include a standard duty pavement, which consists of automobile and moderate truck traffic. Table 6.3.4 below details the recommended pavement section thicknesses.

Table 6.3.4 – Concrete Pavement Recommendation

Pavement Material	Thickness (in.)
Concrete Mat	8
Aggregate Base (SD/DOT Base Course)	12
Woven Geotextile Fabric	Yes

Wherever free draining sand layers overlie clay layers, it is important that subsurface drainage be provided for the sand layer to prevent buildup of water. Subsurface drainage can be provided by either installing finger drains, parallel drain tile lines, or premanufactured edge drains. We would recommend the installation of drain tile at a minimum of 50’ on center or at the edge of the pavement area. The drain tile should be installed at the base of the granular layer.

To aid in preventing clogging of the perforated tile lines, we recommend that the lines be wrapped with a geotextile fabric designed for that purpose. Reduced pavement design life and increased maintenance costs may result from reductions in proper pavement section drainage.

Joint spacings should be limited to 8' to 10' on center to better deal with differential movements. Depending upon the applied loadings, greased dowels at the joints may be warranted.

The above designs could be reduced if the project owner is willing to assume the additional maintenance costs.

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 can be handled with conventional sump pumping.

7.1.2 DISTURBANCE OF SOILS

The on-site soils can be disturbed under construction traffic, especially if the soils are wet. If soils become disturbed, they should be sub-cut to the underlying undisturbed soils. The sub-cut 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. We recommend that a special pre-construction meeting be held to discuss the procedures and precautions that must be followed.

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 side-slope erosion or sloughing which could require slope maintenance.

7.3 OBSERVATIONS 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 ASTM STANDARDS

When we refer to an ASTM Standard in this report, we mean that our services were performed in general accordance with that standard. Compliance with any other standards referenced within the specified standard is neither inferred nor implied.

9.0 LIMITATIONS

Within the limitations of scope, budget, and schedule, we have endeavored to provide our services according to generally accepted geotechnical engineering practices at this time and location. Other than this, no warranty, express 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

Bituminous Pavement Subgrade Preparation and Design
Definitions Relating to Pavement Construction

BITUMINOUS PAVEMENT SUBGRADE PREPARATION AND DESIGN

GENERAL

Bituminous pavements are considered layered "flexible" systems. Dynamic wheel loads transmit high local stresses through the bituminous/base onto the subgrade. Because of this, the upper portion of the subgrade requires high strength/stability to reduce deflection and fatigue of the bituminous/base system. The wheel load intensity dissipates through the subgrade such that the high level of soil stability is usually not needed below about 2' to 4' (depending on the anticipated traffic and underlying soil conditions). This is the primary reason for specifying a higher level of compaction within the upper subgrade zone versus the lower portion. Moderate compaction is usually desired below the upper critical zone, primarily to avoid settlements/sags of the roadway. However, if the soils present below the upper 3' subgrade zone are unstable, attempts to properly compact the upper 3' zone to the 100% level may be difficult or not possible. Therefore, control of moisture just below the 3' level may be needed to provide a non-yielding base upon which to compact the upper subgrade soils.

Long-term pavement performance is dependent on the soil subgrade drainage and frost characteristics. Poor to moderate draining soils tend to be susceptible to frost heave and subsequent weakening upon thaw. This condition can result in irregular frost movements and "popouts," as well as an accelerated softening of the subgrade. Frost problems become more pronounced when the subgrade is layered with soils of varying permeability. In this situation, the free-draining soils provide a pathway and reservoir for water infiltration which exaggerates the movements. The placement of a well drained granular subbase layer at the top of subgrade can minimize trapped water, smooth frost movements and significantly reduce subgrade softening. In wet, layered and/or poor drainage situations, the long-term performance gain should be significant. If a granular subbase is placed, we recommend it be a "Subbase" which meets SD/DOT Specification 882.

PREPARATION

Subgrade preparation should include stripping surficial vegetation and organic soils. Where the exposed soils are within the upper "critical" subgrade zone (generally 2½' deep for "auto only" areas and 3' deep for "heavy duty" areas), they should be evaluated for stability. Excavation equipment may make such areas obvious due to deflection and rutting patterns. Final evaluation of soils within the critical subgrade zone should be done by test rolling with heavy rubber-tired construction equipment, such as a loaded dump truck. Soils which rut or deflect 1" or more under the test roll should be corrected by either subcutting and replacement, or by scarification, drying and recompaction. Reworked soils and new fill should be compacted per the "Specified Density Method" outlined in SD/DOT Specification 120 (a minimum of 100% of Standard Proctor density in the upper 3' subgrade zone and a minimum of 95% below this).

Subgrade preparation scheduling can be an important consideration. Fall and Spring seasons usually have unfavorable weather for soil drying. Stabilizing non-sand subgrades during these seasons may be difficult and attempts often result in compromising the pavement quality. Where construction scheduling requires subgrade preparation during these times, the use of a granular subbase becomes even more beneficial for constructability reasons.

SUBGRADE DRAINAGE

If a granular subbase layer is used, it should be provided with a means of subsurface drainage to prevent water build-up. This can be in the form of draintile lines which dispose into storm sewer systems or outlets into ditches. Where granular subbase layers include sufficient sloping and water can migrate to lower areas, draintile lines can be limited to finger drains at the catch basins. Even if a granular subbase layer is not placed, strategically placed draintile lines can aid in improving pavement performance. This would be most important in areas where adjacent non-paved areas slope towards the pavement. Perimeter edge drains can aid in intercepting water which may infiltrate below the pavement.

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 - Approximate Boring Locations
Subsurface Boring Logs
Laboratory Test Reports

Appendix A
Geotechnical Field Exploration and Testing
Report No. P-0031517

A.1 FIELD EXPLORATION

The subsurface conditions at the site were explored by drilling and sampling three (3) standard penetration 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)

Standard penetration (split-spoon) samples were collected in general accordance with ASTM: D1586. 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.

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.

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 groundwater 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.5.7 Organic Content Tests

Conducted per AET Procedure 20-SOI-010, which is performed in general accordance with ASTM D2974, Test Method C.

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 nomial diameter in inches
CC:	Crew Chief
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
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 symols
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 california-spoon, split-spoon (see notes) and thin-walled tube sample, 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
2L:	California-spoon sampler (stee; 2" inside diameter with 4" long brass liners; 3" outside diameter)
SS:	Standard split-spoon sample (steel; 1⅜" 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 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 permeablility (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 precent (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 the 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 intial 6" set (unless partial penentration defined in ASTM:D1586 is encountered) whereas the length of sample recoveres is for the entire sampler driver (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 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]

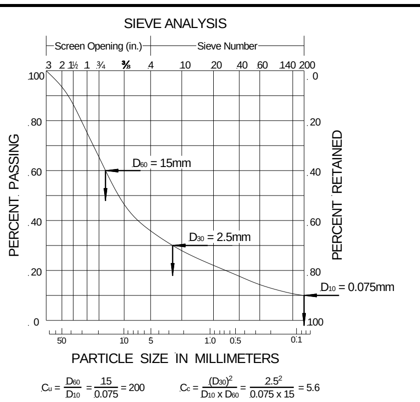
Notes

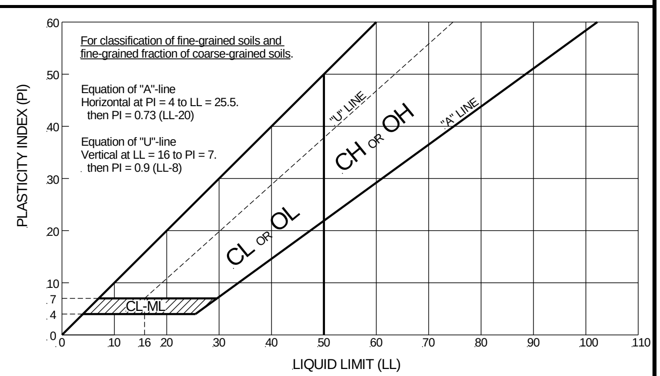
[A]Based on the material passing the 3-in (75-mm) sieve.
[B]If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
[C]Gravels with 5 to 12% fines require dual symbols:
- GW-GM well-graded gravel with silt
- GW-GC well-graded gravel with clay
- GP-GM 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]$Cu = D_{60} / D_{10}$, $Cc = (D_{30})^2 / D_{10} \times D_{60}$

[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): Absence 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.

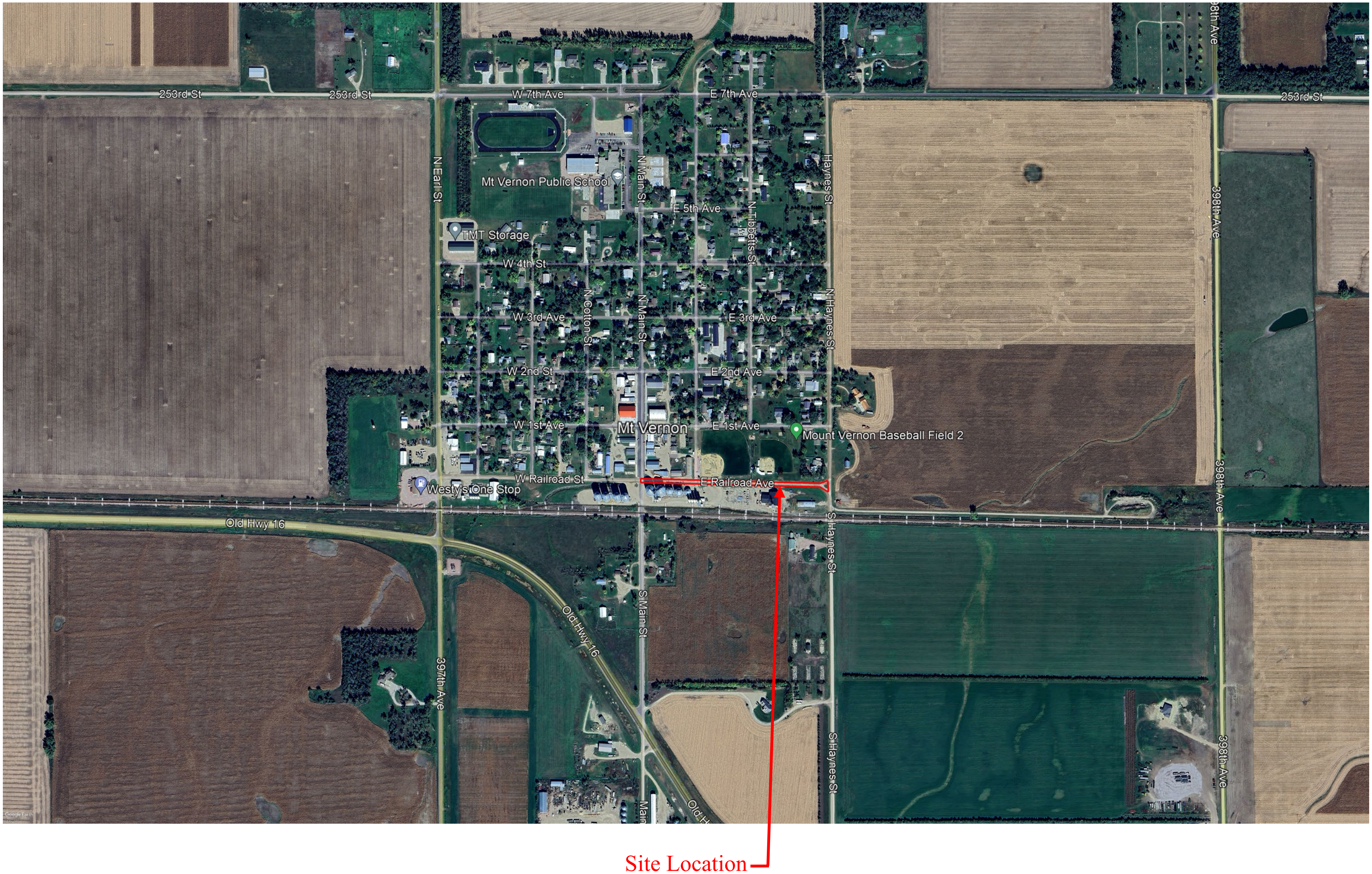
Fiber Content of Peat

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.



Project	Street Improvement Mount Vernon, SD	Subject:	Site Location	AET Job No:	P-0031517	Date:	April 18, 2024
Scale:	NTS	Drawn By:	ZLH	Checked By:	GG	Figure 1	

AMERICAN ENGINEERING TESTING

Project	Street Improvement Mount Vernon, SD	Subject:	Boring Locations	AET Job No:	P-0031517	Date:	April 18, 2024
Scale:	NTS	Drawn By:	ZLH	Checked By:	GG	Figure 2	

AMERICAN ENGINEERING TESTING

SUBSURFACE BORING LOG

AET No: **P-0031517** Log of Boring No. **1 (p. 1 of 1)**

Project: **Mt. Vernon Road Reconstruction; Mt. Vernon, South Dakota**

Surface Elevation **1409.8'**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	Dens	LL	PL	%-#200
0	FILL, 3" of CLAYEY SAND, with gravel, brown, moist	FILL									
1	FILL, mixture of SANDY LEAN CLAY and LEAN CLAY, with a little gravel, dark brown and brown, moist to very moist		16	M	SS	16	8				
2	LEAN CLAY, grayish brown, very moist, firm (CL)	FINE ALLUVIUM	7	M	SS	12	22	100	39	19	
3	LEAN CLAY, brown mottled, very moist, firm (CL)										
5			6	M	SS	18	22				
6	SANDY LEAN CLAY, with a little gravel, brown mottled, very moist to moist, firm to stiff (CL)	TILL									
8			7	M	SS	18	22				
10			9	M	SS	18					
11	**END OF BORING**										

Bag sample taken from 1'-5'.

DEPTH:	DRILLING METHOD	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
0-9½'	**3.25" HSA**	**4/4/24**	**10:34**	**11'**	**9.5'**	**11'**		**None**

WATER LEVEL MEASUREMENTS

BORING COMPLETED: **4/4/24**

DR: **MH** LG: **RH** Rig: **63**

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

AET_CORP P-0031517.GPJ AET+CPT+WELL.GDT 4/10/24

SUBSURFACE BORING LOG

AET No: **P-0031517** Log of Boring No. **2 (p. 1 of 1)**

Project: **Mt. Vernon Road Reconstruction; Mt. Vernon, South Dakota**

Surface Elevation **1408.8'**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DEN	LL	PL	%-#200
0–0.5	FILL, 6" of CLAYEY SAND, with gravel, brown, moist	FILL									
1	FILL, mixture of SANDY LEAN CLAY and LEAN CLAY, with a little gravel, dark brown, black and brown, moist to very moist		20	M	SS	20	6				13
2	LEAN CLAY, brown mottled, very moist, firm (CL)	FINE ALLUVIUM									
3			6	M	SS	16	24	96			
4	SANDY LEAN CLAY, with a little gravel, brown mottled, very moist to moist, firm to stiff (CL)	TILL									
5			5	M	SS	18	23				
6											
7											
8			10	M	SS	18	22				
9											
10			12	M	SS	18					
11	**END OF BORING**										
	Bag sample taken from 1'-5'.										

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
4/4/24	11:17	11'	9.5'	11'		None

BORING COMPLETED: **4/4/24**

DR: **MH** LG: **RH** Rig: **63**

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

AET_CORP P-0031517.GPJ AET+CPT+WELL.GDT 4/10/24

SUBSURFACE BORING LOG

AET No: **P-0031517** Log of Boring No. **3 (p. 1 of 1)**

Project: **Mt. Vernon Road Reconstruction; Mt. Vernon, South Dakota**

Surface Elevation **1408.1'**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DEN	LL	PL	%-#200
	FILL, 5" of CLAYEY SAND, with gravel, brown, moist	FILL	14	M	SS	10	7				16
1	FILL, mixture of SANDY LEAN CLAY and LEAN CLAY, with a little gravel, dark brown, brown and black, moist to very moist		8	M	SS	10	23	105			
2	SANDY LEAN CLAY, brown mottled, very moist, firm to soft (CL)	MIXED ALLUVIUM	6	M	SS	18	22				
3–5			4	M	SS	18	24				
6	SANDY LEAN CLAY, with a little gravel, brown mottled, moist, stiff (CL)	TILL	10	M	SS	18	22				
7–10			10	M	SS	18					
11	**END OF BORING** Bag sample taken from 2'-5'.										

DEPTH:	DRILLING METHOD	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
0-9½'	**3.25" HSA**	**4/4/24**	**11:50**	**11'**	**9.5'**	**11'**		**None**

WATER LEVEL MEASUREMENTS

BORING COMPLETED: **4/4/24**

DR: **MH** LG: **RH** Rig: **63**

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

AET_CORP P-0031517.GPJ AET+CPT+WELL.GDT 4/10/24

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601 E. 48th St. N.
Sioux Falls, SD 57104
(605) 332-5371
www.teamAET.com

Proctor Report

Report No: PTR:AET-152888-S1
Issue No: 1

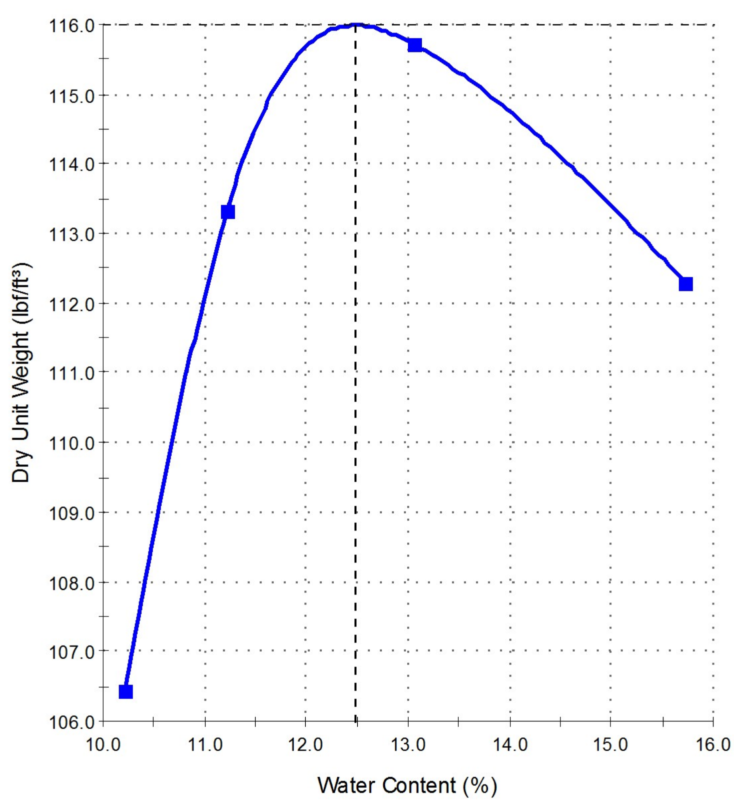
Client:	SPN & Associates	**CC:**	Jacob Sonne
Project:	Mount Vernon Road Reconstruction		
	Mount Vernon SD		
Job No:	P-0031517		

Date of Issue: 4/8/2024
Reviewed By: Zane Hiller
Project Manager, E.I.T.

Sample Details

Sample ID:	AET-152888-S1	**Field ID:**	Boring 1
Date Sampled:	4/4/2024		
Date Received:	4/8/2024		
Sampling Method:	Auger		
Source:	In-Place Material		
Material:	Sandy Lean Clay, Brown (CL)		
General Location:	E Railroad Avenue		
Location:	Boring 1		
Depth:	1' - 5'		
Sampled By:	Matt Hanson		

Dry Unit Weight - Water Content Relationship



Test Results

ASTM D 698

Maximum Dry Unit Weight (lbf/ft³):	**116.0**
Optimum Water Content (%):	**12.5**
Method:	A
Preparation Method:	Moist
Rammer Type:	standard
Tested By:	Mason Hoskinson
Date Tested:	4/8/2024

Comments

50% -#200

American Engineering Testing, Inc.
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Sioux Falls, SD 57104
(605) 332-5371
www.teamAET.com

Proctor Report

Report No: PTR:AET-152921-S1
Issue No: 1

Client: SPN & Associates
CC: Jacob Sonne

Project: Mount Vernon Road Reconstruction

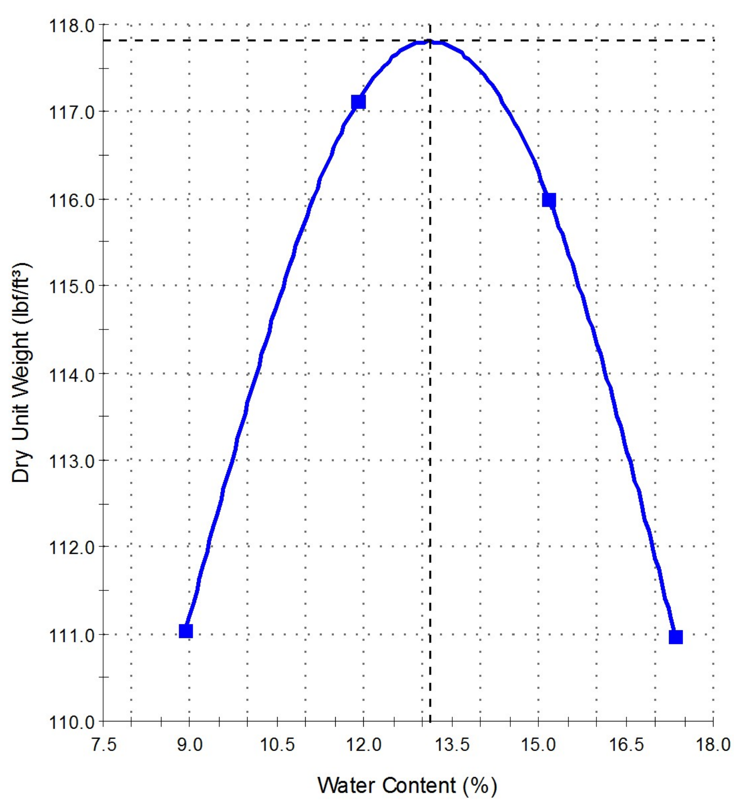
Mount Vernon SD
Job No: P-0031517

Date of Issue: 4/8/2024
Reviewed By: Zane Hiller
Project Manager, E.I.T.

Sample Details

Sample ID: AET-152921-S1
Field ID: Boring 2
Date Sampled: 4/4/2024
Date Received: 4/8/2024
Sampling Method: Auger
Source: In-Place Material
Material: Clayey Sand, F to M Grained, Brown (SC)
General Location: E Railroad Ave
Location: Boring 2
Depth: 1' - 5'
Sampled By: Matt Hanson

Dry Unit Weight - Water Content Relationship



Test Results

ASTM D 698

Maximum Dry Unit Weight (lbf/ft³):	**117.8**
Optimum Water Content (%):	**13.1**
Method:	A
Preparation Method:	Moist
Rammer Type:	standard
Tested By:	Terrell Lampkin
Date Tested:	4/8/2024

Comments

46% -#200

American Engineering Testing, Inc.
Sioux Falls
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Sioux Falls, SD 57104
(605) 332-5371
www.teamAET.com

Proctor Report

Report No: PTR:AET-152888-S2
Issue No: 1

Client: SPN & Associates
CC: Jacob Sonne

Project: Mount Vernon Road Reconstruction

Mount Vernon SD
Job No: P-0031517

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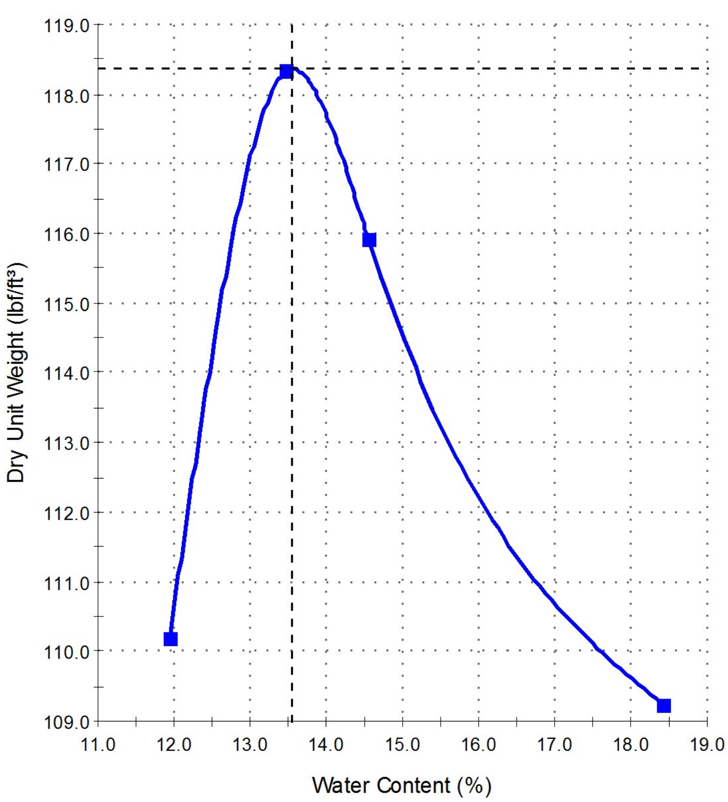
Date of Issue: 4/8/2024
Reviewed By: Zane Hiller
Project Manager, E.I.T.

Sample Details

Sample ID:	AET-152888-S2	**Field ID:**	Boring 3
Date Sampled:	4/4/2024		
Date Received:	4/8/2024		
Sampling Method:	Auger		
Source:	In-Place Material		
Material:	Sandy Lean Clay, Brown (CL)		
General Location:	E Railroad Avenue		
Location:	Boring 3		
Depth:	1' - 5'		
Sampled By:	Matt Hanson		

Dry Unit Weight - Water Content Relationship



Test Results

ASTM D 698

Maximum Dry Unit Weight (lbf/ft³):	**118.4**
Optimum Water Content (%):	**13.6**
Method:	A
Preparation Method:	Moist
Rammer Type:	standard
Tested By:	Mason Hoskinson
Date Tested:	4/8/2024

Comments

54% -#200

American Engineering Testing, Inc.
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Sioux Falls, SD 57104
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www.teamAET.com

Proctor Report

Report No: PTR:AET-152897-S1
Issue No: 1

Client:	SPN & Associates
CC:	Jacob Sonne
Project:	Mount Vernon Road Reconstruction
	Mount Vernon SD
Job No:	P-0031517

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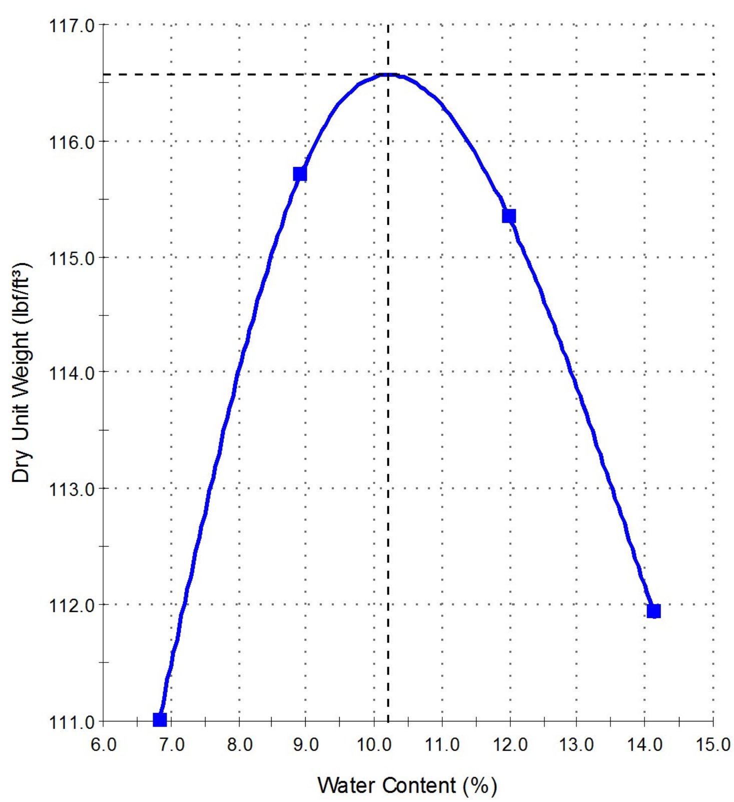
Date of Issue:	4/9/2024
Reviewed By:	Zane Hiller
	Project Manager, E.I.T.

Sample Details

Sample ID:	AET-152897-S1
Field ID:	Gravel Stockpile
Date Sampled:	4/4/2024
Date Received:	4/8/2024
Sampling Method:	Field
Source:	OFF-SITE STOCKPILE
Material:	Sand, F to M Grained, Dark Brown (SP)
Specification:	SDDOT GRAVEL SURFACING
General Location:	Mount Vernon
Location:	Off-Site Gravel Stockpile
Sampled By:	Matt Hanson

Dry Unit Weight - Water Content Relationship



Test Results

ASTM D 698

Maximum Dry Unit Weight (lbf/ft³):	**116.6**
Optimum Water Content (%):	**10.2**
Method:	B
Preparation Method:	Moist
Rammer Type:	standard
Tested By:	Paul DeWeese
Date Tested:	4/8/2024

Comments

4% -#200

American Engineering Testing, Inc.
Sioux Falls
601 E. 48th St. N.
Sioux Falls, SD 57104
(605) 332-5371
www.teamAET.com

Material Test Report

Report No: MAT:AET-152897-S1
Issue No: 1

Client: SPN & Associates **CC:** Jacob Sonne

Project: Mount Vernon Road Reconstruction

Mount Vernon SD

Job No: P-0031517

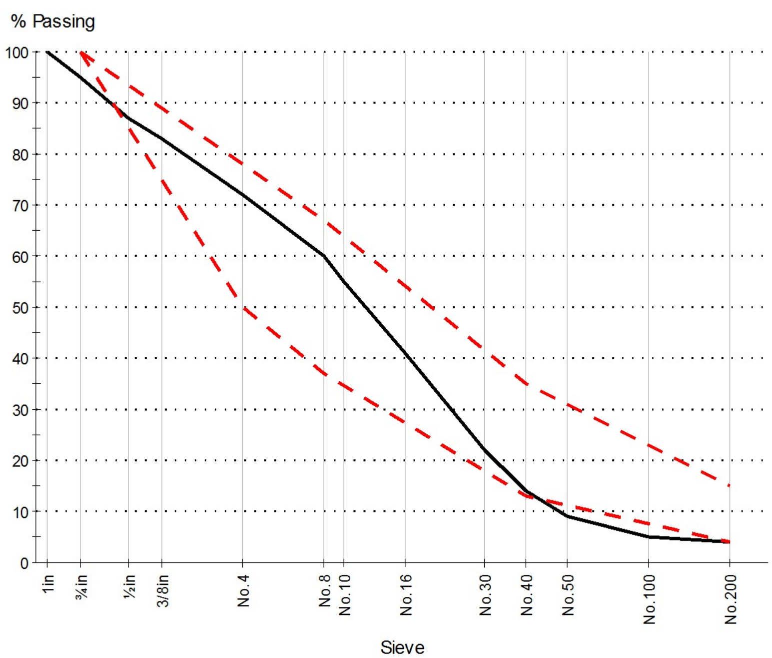
Date of Issue: 4/9/2024
Reviewed By: Zane Hiller
Project Manager, E.I.T.

Sample Details

Sample ID	AET-152897-S1
Field Sample ID	Gravel Stockpile
Date Sampled	4/4/2024
Source	OFF-SITE STOCKPILE
Material	Sand, F to M Grained, Dark Brown (SP)
Specification	SDDOT GRAVEL SURFACING
Sampling Method	Field
General Location	Mount Vernon
Location	Off-Site Gravel Stockpile
Date Submitted	4/8/2024

Sample Description:

Particle Size Distribution



COBBLES	GRAVEL		SAND			FINES (4.1%)	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
(0.0%)	(5.4%)	(22.4%)	(17.0%)	(41.4%)	(9.8%)		

Grading: ASTM C 136, ASTM C 117

Date Tested: 4/8/2024
Tested By: Paul DeWeese

Sieve Size	% Passing	Limits
1in (25.0mm)	100	
¾in (19.0mm)	95*	100
½in (12.5mm)	87	
3/8in (9.5mm)	83	
No.4 (4.75mm)	72	50 – 78
No.8 (2.36mm)	60	37 – 67
No.10 (2.0mm)	55	
No.16 (1.18mm)	41	
No.30 (600µm)	22	
No.40 (425µm)	14	13 – 35
No.50 (300µm)	9	
No.100 (150µm)	5	
No.200 (75µm)	4.1	4.0 – 15.0

D85: 10.8972 **D60:** 2.3600 **D50:** 1.6565
D30: 0.7977 **D15:** 0.4437 **D10:** 0.3216
Cu: 7.34 **Cc:** 0.84

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Sampling Method	Field
General Location	Mount Vernon
Location	Off-Site Gravel Stockpile
Date Submitted	4/8/2024

Other Test Results

Description	Method	Result	Limits
Fineness Modulus	ASTM C 136, ASTM C 117	4.13	
Curvature Coefficient		0.84	
Uniformity Coefficient		7.34	
Maximum Dry Unit Weight (lbf/ft³)	ASTM D 698	116.6	
Corrected Maximum Dry Unit Weight (lbf/ft³)		116.6	
Optimum Water Content (%)		10.2	
Corrected Optimum Water Content (%)		10.2	
Method		B	
Preparation Method		Moist	
Rammer Type		standard	
Date Tested		4/8/2024	

Comments

* = Result does not meet the specification

Appendix B

Geotechnical Report Limitations and Guidelines for Use

Appendix B
Geotechnical Report Limitations and Guidelines for Use
Report No. P-0031517

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 GBA[1], of which, we are a member firm.

B.2 RISK MANAGEMENT INFORMATION

B.2.1 Understand the Geotechnical Engineering Services Provided for this Report

Geotechnical engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical engineering services is typically a geotechnical engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

B.2.2 Geotechnical Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared solely for the client.

Likewise, geotechnical engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

Do <u>not</u> rely on this report if your geotechnical engineer prepared it:

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

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. If you are the least bit uncertain about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

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1 Geoprofessional Business Association, 1300 Piccard Drive, LL14, Rockville, MD 20850
Telephone: 301/565-2733: www.geoprofessional.org, 2019

B.2.3 Read the Full Report

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. Read and refer to the report in full.

B.2.4 You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

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

B.2.5 Most of the "Findings" Related in This Report Are Professional Opinions

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

B.2.6 This Report's Recommendations Are Confirmation-Dependent

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

B.2.7 This Report Could Be Misinterpreted

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

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

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

B.2.8 Give Constructors a Complete Report and Guidance

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

B.2.9 Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. Read these provisions closely. Ask questions. Your geotechnical engineer should respond fully and frankly.

B.2.10 Geo-environmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical engineering study. For that reason, a geotechnical engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. Unanticipated subsurface environmental problems have led to project failures. If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

B.2.11 Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. Geotechnical engineers are not building-envelope or mold specialists.