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SUBSURFACE EXPLORATION AND FOUNDATION EVALUATION

Proposed Bridge Reconstruction

County Road "B"

Town of Byron, Wisconsin

Prepared for

Mr. Tom Janke

Fond du Lac County Highway Department

301 Dixie Street

Fond du Lac, WI 54936

MES Project No. 12-63026-1

June 13, 2006

midwest engineering services, inc.

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June 13, 2006

Mr. Tom Janke
Fond du Lac County Highway Department
301 Dixie Street
Fond du Lac, WI 54936

SUBJECT: Subsurface Exploration and Foundation Evaluation
Proposed Bridge Reconstruction
County Road "B"
Town of Byron, Wisconsin
MES Project No. 12-63026-1

Dear Mr. Janke,

The subsurface exploration and foundation analysis for the referenced project has been completed. Two (2) copies of the report are included herein. After you have had the opportunity of reading the report, please call at any time with any questions or comments you may have. Midwest Engineering Services, Inc. appreciates the opportunity to be of service on this project, and looks forward to continuing as your geotechnical consultant during the design and construction phases, as well as your upcoming projects.

Sincerely yours,

MIDWEST ENGINEERING SERVICES, INC.

Jeffrey L. Fischer | SKD

Jeffrey L. Fischer
Branch Manager

James M. Becco | SKD

James M. Becco
Region Manager

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INTRODUCTION

General

This report presents the results of the subsurface exploration and analysis for the proposed replacement of the bridge on County Road "B", over Parson's Creek, in the Town of Byron, Wisconsin. The work was performed for Fond du Lac County Highway Department, at the request of Mr. Tom Janke.

Purpose

The purpose of this study was to evaluate the subsurface conditions at the site, and to establish parameters for use by the design engineers in preparing the foundation and approach slab designs for the proposed project.

Scope

The scope of services included a site reconnaissance, the subsurface exploration, a determination of soil characteristics by field and laboratory testing, and an evaluation and analysis of the data obtained.

Authorization

The description of services and authorization to perform this subsurface exploration and foundation evaluation study were in the form of a signed proposal agreement, MES Proposal No. 12-6082, between Midwest Engineering Services, Inc. and the Fond du Lac County Highway Department. This Subsurface Exploration and Foundation Analysis has been prepared for the sole use of the Fond du Lac County Highway Department. It cannot be relied upon by other parties without the express written consent of Midwest Engineering Services, Inc. and the Fond du Lac County Highway Department.

SITE AND PROJECT DESCRIPTION

Site Features

The project site is located on County Road "B", where it passes over Parsons Creek, in Fond du Lac County, Town of Byron, Wisconsin. The existing bridge is located between 950 feet west of the intersection of Hickory Road and County Road "B". The existing bridge is approximately 16 feet long, 25 feet wide, and 6 feet high, with the road surface elevation at about EL. 860.7±. The bridge structure appeared to be in poor condition, with some deterioration of the concrete observed. The asphaltic concrete approaches are generally in fair condition. It is understood that the existing bridge is founded upon spread footings, however, bearing elevations are not known.

The topography of the general area is sloping towards Parsons Creek, with the horizontal alignment of the roadway generally flat in the area of the borings. The banks are covered with brush and long grass.

Project Description

From the information provided by Mr. Tom Janke of Fond du Lac County Highway Department, it is understood that the proposed project will consist of complete replacement of the existing bridge. The bridge system will be constructed of a new prefabricated concrete arch structure, planned to be supported on conventional spread footings. The new bridge is proposed to be approximately 40 feet long, and the deck is planned to be approximately 20 feet wide. The centerline of the new bridge will be at (or very close to) the existing roadway centerline.

The existing and proposed finished surface elevation of the new bridge deck is approximately EL. 861.0± at the centerline. The existing surface elevation at the boring locations (located on the approach slabs) is EL. 860.5± and EL. 860.6±. Based on the proposed deck surface elevation, the new approach slabs will be constructed at approximately the existing grades.

EXPLORATION AND LABORATORY PROCEDURES

Scope Summary

The field and laboratory data utilized in the evaluation and analysis of the foundation materials was obtained by drilling exploratory test borings, securing soil samples by the split-spoon sampling method, and subjecting the samples to laboratory testing.

Field Exploration

Two (2) soil test borings were drilled for this project, to a depth of 20 feet below the existing pavement surface. The borings were located in the field by MES personnel. Elevations were provided by Gremmer and Asscoiates.

The soil test borings were performed with a truck-mounted rotary drilling rig utilizing continuous flight hollow stem augers to advance the holes. Representative samples were obtained by the Standard Penetration Test (SPT) method in general accordance with ASTM D-1586. The samples were obtained at 2½ foot intervals to a depth of 10 feet, and at 5 foot intervals to the end of the borings. The SPT provides a means of estimating the relative density of granular soils and comparative consistency of cohesive soils, thereby providing a method of evaluating the subsoils' relative strength and compressibility characteristics.

The SPT soil samples were transferred into clean glass jars immediately after retrieval, and returned to the laboratory upon completion of the field operations. Samples will be stored for a period of 30 days at which time they will be discarded unless other instructions are received. All soil samples were visually classified by a soils engineer in general accordance with the Unified Soil Classification System (ASTM D-2488-75).

A copy of the Soil Boring Logs and Boring Location Diagram (Figure 1) is enclosed in the Appendix. The soil stratification shown on the logs represents the soil conditions in the actual boring locations at the time of the exploration. The terms and symbols used on the logs are described in the General Notes found on the last page of the Appendix. After completion of the borings, the auger holes were backfilled with bentonite chips and surface patched with asphaltic concrete.

Laboratory Testing

Soil samples obtained from the exploration were visually classified by a soils engineer in the laboratory, and subjected to moisture content determinations. Selected cohesive soil samples were tested with a calibrated hand penetrometer to aid in evaluating the soil strength characteristics. The values of strength tests performed on soil samples obtained by the Standard Penetration Test Method (SPT) are considered approximate, recognizing that the SPT method provides a representative but somewhat disturbed soil sample. The laboratory testing was performed in general accordance with the respective ASTM methods, as applicable, and the results are shown on the boring logs and data sheets in the Appendix.

DESCRIPTION OF SUBSURFACE CONDITIONS

General

A description of the subsurface conditions encountered at the test boring locations is shown on the Soil Boring Logs. The lines of demarcation shown on the logs represent an approximate boundary between the various soil classifications. It must be recognized that the soil descriptions are considered representative for the specific test hole location, but that variations may occur between and beyond the sampling intervals, and between boring locations. Soil depths, topsoil and layer thicknesses, and demarcation lines can be utilized for preliminary construction calculations, but should not be expected to yield exact and final quantities. A summary of the major soil profile components is described in the following paragraphs.

Soil Conditions

The surface of the site at the borings is covered with about 5 inches of asphalt. Gray silty sand fill was then present to a depth of about 2 ½ feet (EL. 858.0 to EL. 858.1±), and may have been used as a base course layer. The silty sand fill was underlain by brown and black silty clay, classified as fill because of its varied visual characteristics. The underlying natural soils consisted of a six inch layer if black silty clay (classified as possible buried topsoil), followed by brown silty sand to a depth of about 5 feet (EL. 855.5 to EL. 855.6±) below the existing ground surface.

The underlying soils typically consisted of gray silty clay, with varying amounts of gravel to the maximum depth explored. The gray silty clay soils exhibited very stiff to hard comparative consistency with hand penetrometer and unconfined compressive strengths ranging from 2.5 to 4.1 tsf, and N-values between 10 to 36 blows per foot of penetration.

The foregoing discussion of soil conditions on this site represents a generalized soil profile as determined at the test boring locations. A more detailed description and supporting data for each test location can be found on the individual Soil Boring Logs, enclosed in the Appendix.

Groundwater Observations

Groundwater observations were made during the drilling operations and upon completion. Water was encountered during auger advancement in soil boring B-2 at a depth of approximately 10 feet (EL. 850.6±) below the existing ground surface, and was at a depth of 12 feet (EL. 648.6±) upon completion. Free water was not encountered upon completion of boring B-1, to the termination depth of 20 feet (EL. 840.5±).

On the basis of the soil coloration and the field measurements, the water level at the test boring locations is judged to be at de depth of about 10 feet (EL. 850.6±) below the existing ground surface at the time of the exploration. No water was apparent in Parsons Creek at the time of drilling. The measured water levels reported herein are considered approximate. It must be recognized that groundwater levels fluctuate with time due to variations in seasonal precipitation, lateral drainage conditions, and soil permeability characteristics.

EVALUATION AND RECOMMENDATIONS

General Development Considerations

In view of the subsurface conditions encountered in the test borings, together with the structural loading criteria and development grades anticipated, the proposed bridge can be supported by conventional spread footings bearing upon suitable natural soil. The upper fill and possible buried topsoil are not suitable for foundation support. Some undercutting will therefore be required to reach suitable bearing soils. Discussions of the bridge foundation design parameters, as well as the support conditions for the pavements are included in a later section.

Spread Footing Foundation

On the basis of the soil conditions encountered, conventional spread footings can be used to support the proposed bridge. However, the upper fill and underlying possible buried topsoil present to a depth of about 6 feet (EL. 854.5 to EL. 854.6±) are not suitable for support. All foundations must therefore be extended through these materials to bear within the underlying natural brown silty sand, or the underlying gray silty clay. Where a suitable natural soil subgrade is present, the bridge foundation can be designed to exert a net allowable soil pressure of 3,000 psf. If isolated zones of soft or otherwise unsuitable soils not disclosed by the borings are present at the planned bearing grade, they must be undercut and replaced with compacted structural fill, or the footings must be extended into underlying suitable soils.

Proper placement and compaction of the backfill soils alongside the footings will be essential for the development of lateral resistance. It is therefore recommended that a well-graded granular material, which is much more readily compacted in confined areas, be used for this purpose. In general, the following values can be used in design, based upon the use of non-sloping granular soil (properly placed and compacted), such as that meeting the ¾ inch or 1 ¼ inch Crushed Stone Gradation of Section 305.2.2.1 of the WDOT specification.

Coefficient of Active Earth Pressure (Ka) - 0.30
Coefficient of At Rest Earth Pressure (Ko) - 0.46
Coefficient of Passive Earth Pressure (Kp) - 3.40
Angle of Internal Friction - 33°

For the recommended well graded granular backfill, a moist unit weight of 130 pcf can typically be applied; however, this should be approved by the geotechnical engineer, based upon gradation tests.

Excavations extending into the cohesive soils may encounter isolated soft or unstable areas. If so, it may be necessary to extend the footings to bear on underlying, higher strength soils, or to remove the areas and replace them with compacted structural fill. It is recommended that the footing excavations be observed by a representative of the soils engineer at the time of construction to evaluate the bearing subgrade.

The bridge footings must be placed at a depth of at least 4 feet below the finished grade for frost protection. All footings must be protected from the effects of frost if construction is carried out during winter months. In addition, the footings must be protected from the potential effects of scour, to prevent undermining.

It is recommended that the footings supporting individual columns have a minimum dimension of 30 inches, even if the maximum allowable bearing pressure is not fully utilized. In order to minimize the effects of any slight differential movement that may occur due to variations in seasonal moisture contents, it is recommended that all continuous footings be suitably reinforced to make them as rigid as necessary.

In general, the performance of the foundation system on this site is dependent on the various factors discussed herein. The excavation, preparation, and concreting of foundations should be monitored and tested by a representative of the soils engineer.

Lateral Earth Pressures

The below grade walls of the structure will experience lateral soil and water pressure. If well-graded granular soil is utilized as backfill for the below grade walls of the structures, equivalent fluid pressures of 65 psf per foot and 95 psf per foot may be used as the horizontal component of earth pressure at rest, above and below the water table, respectively. Silty clay soils are not recommended for use as backfill alongside below grade walls. It is recommended that a suitable drainage system be incorporated, where appropriate.

The backfill for the walls should be placed in 9-inch loose lifts, at moisture contents at or near optimum, and be compacted to at least 95 percent of the maximum Standard Proctor dry density.

Approach Slab Subgrade and Design Parameters

On the basis of the data obtained in this exploration, the subgrade soils encountered immediately below the existing pavement section within the planned approach areas at the soil borings consists predominantly of silty sand fill extending to a depth of about 2 ½ feet (EL. 858.0 to El. 858.1±), underlain by silty clay fill. The USDA Soil Survey categorizes silty sand soils to be fair in applications for pavement subgrade with low to moderate shrink-swell potential, moderate frost susceptibility, and fair drainage.

Analysis of the visual classification and laboratory testing has been made in determining pertinent engineering properties of the subgrade soils, as described in the Wisconsin Soils Manual for Pavement Section Design. Based upon the soils encountered in the borings, the new approach pavement will rest predominantly upon silty sand fill soils, with an estimated AASHTO classification of A-2-4. Any new fill brought to the site to raise the existing grade and/or replace unsuitable materials must be of comparable or better quality. The following estimated design parameters can be utilized in the designs, based upon the presence of suitable and stable silty sand fill soils at the pavement subgrade.

SOIL PARAMETER	APPROACH FILL SOIL VALUES
AASHTO Soil Classification	A-2-6
Drainage	Fair
Shrink/Swell Potential	Moderate
Design Frost Index	F-3
Design Group Index	9
Soil Support Value	4.6
Estimated Subgrade Modulus	225

<u>Site Preparation</u>

After the removal of the existing pavements, abutments, foundations, and existing base course; and the topsoil and vegetation in any widened areas, the subgrade must be thoroughly proofrolled with a 10-ton roller or other equipment of similar size and weight. If soft, wet, or unstable areas are encountered, they should be removed and replaced with suitable compacted fill. It must be recognized that the silty sand fill soils are somewhat moisture sensitive. In addition, underlying silty clay soils are highly moisture sensitive. They are therefore subject to significant softening and yielding when they become wet. Substantial difficulty with site preparation could therefore be encountered, especially if perched water is encountered. However, this will also be dependent on weather conditions at the time of construction.

If extensive areas of unstable soils are encountered after removing the topsoil or pavements, such as in the new widened areas and where excavations extend into the clayey silt, it may be possible to leave the less stable soils in place prior to filling. A combination of limited over-excavation, placement of a separation and stabilization (SAS) geotextile fabric (such as Mirafi 600x) and crushed stone (such as WisDOT Section 305.2.2.1, ¾ inch or 1 ¼ inch crushed stone) can be used to improve the subgrade stability in such areas, depending on the quality of the soils left in place. The effects of potential settlements of the proposed roadway, utilities, and other possible structures must be considered in decisions pertaining to the amount and method of subgrade preparation.

Any fill used in regrading, or to increase the elevation of the subgrade, should be a clean granular material with limited fines. It must be recognized that borrow soils will likely vary, and that actual shrinkage will be dependent on the type of material, original in-place density and moisture and final compacted density.

Fill should be placed in layers of not more than 9 inches in loose thickness before compaction, except that when the fill consists of well graded granular material and the compaction equipment is adequate for such purpose, the loose layer thickness may be increased to a maximum of 12 inches. Proper moisture control is essential to reduce the amount of compactive effort necessary to achieve the desired densities. This is especially true of clayey soils, where scarification and aeration may be required to achieve near - optimum moisture levels prior to compaction. It is recommended the fill soils be placed at moisture contents near optimum.

Each lift of new fill and/or existing subgrade should be compacted to a density of at least 95 percent of the maximum dry density as determined by ASTM Designation D-698 (AASHTO-T-99) as specified in the special compactive procedure of the WisDOT Road and Bridge Construction Manual, Section 207.3.6.3. Special compaction is recommended to ensure that the pavement subgrade materials develop the subgrade design coefficients previously specified, for pavement section thickness design. Compaction should be performed with equipment suitable for such purpose, such as a sheepsfoot roller for compaction of clayey soils, and a vibratory smooth drum roller for granular material. Small hand-operated compactors should be used in confined areas, such as utility trenches; granular fills are generally more readily compacted to the required densities in such applications.

The selection of fill materials for various applications should be done in consultation with the soils engineer. Similarly, the evaluation of the subgrade preparation, and placement and compaction of fill for structural applications should be monitored and tested by a qualified representative of the soils engineer.

Groundwater and Site Drainage

Groundwater is estimated to have been at a depth of about 10 feet (EL. 850.6±) below the existing pavement at the time of the exploration. In addition, no water was observed within Parsons Creek beneath the existing bridge. On this basis, no major difficulty with groundwater is expected. However, if excavations encroach upon or extend slightly into the groundwater or encounter perched groundwater conditions, it will likely be necessary to utilize a conventional sump pump for control. If groundwater levels rise due to seasonal fluctuations, or if water is present within Parsons Creek at the time of construction, more comprehensive dewatering with a series of high capacity pumps with sufficient lifting capacity may be required.

The subsurface soils encountered on this site are generally considered to be poorly drained. These fine grained soils are highly susceptible to moisture, and compaction difficulties may arise should they become wet during construction. Additionally, the cohesive nature of the subgrade soils make them sensitive to moisture and construction activity, therefore every effort should be made to prevent ponding during earthwork/reconstruction operations. It may be necessary to use a crushed stone working mat and geotextile fabric to maintain a relative dry and stable working subgrade.

Subgrade Frost Action

The proposed roadway reconstruction project is located in an area that experiences annual freezing cycles, and the subgrade soils encountered have been classified as susceptible to frost action when free water is present. In order to reduce the potential for frost action, it will be necessary to control water seepage and/or remove and replace any frost susceptible (cohesive) subgrade soils that may be encountered. If it is not economical to remove and replace frost susceptible soils, a properly designed and installed under-drainage system should be incorporated to control surface water infiltration. It is recommended that low frost susceptible granular fill soils such as those specified in the previous section be used to help minimize frost actions.

Stability of Slopes and Embankments

Based upon the anticipated construction, stability problems are expected along the banks during construction of the planned bridge. The use of sloping, benching, or some form of lateral bracing will be required to protect life and property. All excavation work must be performed in accordance with OSHA requirements. It is recommended that any new slopes be "benched" into the existing slope to provide a positive bond between the existing and new embankment. Any new slopes developed in the reconstruction grading should be reviewed by WisDOT design personnel, to determine if a slope stability analysis is warranted.

Generally, the soils along this roadway project alignment are susceptible to erosion by wind and water. Therefore a vegetation cover or other suitable protection should be utilized to provide appropriate protection.

Utility Construction

In general, the on-site soils are considered to be adequate for bearing support of utility lines. However, removal of isolated unsuitable zones may be required, especially where existing foundation wall, utility or other fill soils are encountered. In addition, some difficulty with the stability of utility trenches should be expected. The use of shoring, bracing, or trench boxes will be required for deeper excavations. Utility construction should be performed in accordance with "The Standard Specifications for Sewer and Water Line Construction for the State of Wisconsin."

It is recommended that well graded granular soils such as those specified in Tables 37 and 39 of the Standard Specification for Sewer and Water Construction be utilized as backfill in utility trenches to reduce the potential for consolidation and settlement of the backfill. All fill soils should be placed and compacted in accordance with the site grading specifications under engineering controlled conditions, to provide suitable support for overlaying structures and roadways. Silty and clayey soils are not recommended for re-use as backfill within utility trenches due to the substantial difficulty of obtaining proper compaction in confined areas. Substantial importing of granular materials may be required.

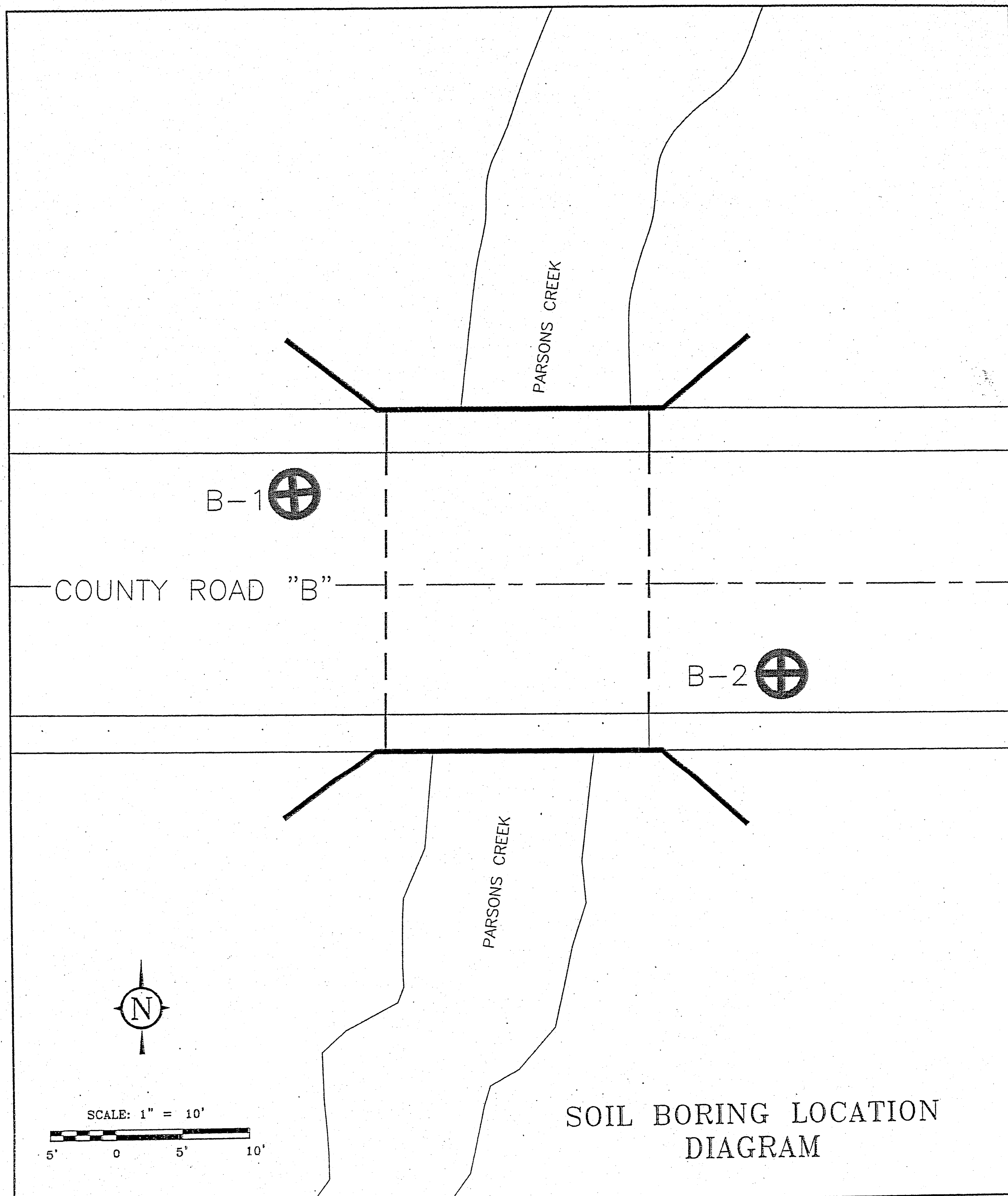
As with all excavation work, all open cut trenches must be properly shored and braced as required by applicable federal and state OSHA codes, and as necessary to protect life and property.

GENERAL COMMENTS

This geotechnical exploration and foundation analysis has been prepared to aid in the evaluation of the foundation conditions on this site. The recommendations presented herein are based on the available soil information and the design information provided. Any changes in the design information or structure locations should be brought to the attention of the soils engineer to determine if modifications in the recommendations are required. The final design plans and specifications should also be reviewed by the soils engineer to determine that the recommendations presented herein have been interpreted and implemented as intended.

This geotechnical study has been conducted in a manner consistent with that level of care ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions. The findings, recommendations and opinions contained herein have been promulgated in accordance with generally accepted practice in the fields of foundation engineering, soils mechanics, and engineering geology. No other representations, expressed or implied, and no warranty or guarantee is included or intended in this report.

It is recommended that the earthwork and foundation operations be monitored by the soils engineer, to test and evaluate the bearing capacities, and the selection, placement and compaction of controlled fills.



SOIL BORING LOCATION DIAGRAM

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608 N. Stanton St. Ripon, WI
Tel: (920) 745-2200
Fax: (920) 745-2222

12-63026

DRAWN BY: KP

DATE: 5/17/06

ID#: BRIDGE

C.T.H. "B" WATER CROSSING
TOWN OF BYRON, WISCONSIN
GEOTECHNICAL REPORT

midwest engineering services, inc.

SOIL BORING LOG: B - 1

Project: County Trunk Highway B Water Crossing
Location: County Road B
Town of Byron, Wisconsin

Project No.: 12-63026
Drill Date: May 9, 2006
Drilled by: Gary Wellner
Logged by: Clint Malinski

DEPTH (feet)	EL.	VISUAL SOIL CLASSIFICATION — GROUND SURFACE ELEVATION: 860.5	SAMPLE NO.	N (bpf)	Qp (tsf)	Qu (tsf)	MC (%)	PID (ppm)	REMARKS
0–0.4		5" Asphalt							
1	859.5	Gray Silty SAND with gravel, (FILL), damp	1-AS	--					
2	858.5								
3	857.5	Brown and Black Silty CLAY, trace sand, (FILL), moist	2-SS	10	1.5				
4	856.5								
5	855.5	Black Silty CLAY, trace sand, (Possible Old Topsoil), moist	3-SS	18					
6	854.5	Brown Silty SAND, trace clay and gravel, moist							
7	853.5								
8	852.5	Gray Silty CLAY, trace gravel, moist	4-SS	28	3.5	4.12			
9	851.5								
10	850.5		5-SS	36					
11	849.5								
12	848.5								
13	847.5								
14	846.5								
15	845.5		6-SS	17	2.5	3.22			
16	844.5								
17	843.5								
18	842.5								⊥
19	841.5		7-SS	14					
20	840.5								

END OF BORING @ 20 FEET

WATER LEVEL OBSERVATIONS:

Water Level during drilling	No Water Observed	(▼)
Water Level upon completion	No Water Observed	▼
Caved at upon completion	18 Feet (EL. 842.5±)	⊥
Delay Time		–
Water Level delayed		¥
Caved at delayed		⊥

ADDITIONAL COMMENTS:

Note: Lines of stratification represent an approximate boundary between soil types. Variations may occur between sampling intervals and/or boring locations. Transitions may also be gradual. Dashed lines are indicative of potentially erratic or unknown transitions, such as fill-to-natural soil zone transitions.

midwest engineering services, inc.

SOIL BORING LOG: B - 2

Project: County Trunk Highway B Water Crossing

Location: County Road B
Town of Byron, Wisconsin

Project No.: 12-63026
Drill Date: May 9, 2006
Drilled by: Gary Wellner
Logged by: Clint Malinski

DEPTH (feet)	EL. (feet)	VISUAL SOIL CLASSIFICATION GROUND SURFACE ELEVATION: 860.6	SAMPLE NO.	N (bpf)	Qp (tsf)	Qu (tsf)	MC (%)	PID (ppm)	REMARKS
0	860.6	5" Asphalt							
1	859.6	Gray Silty SAND with gravel, (FILL), damp	1-AS						
2	858.6								
3	857.6	Black and Brown Silty CLAY, trace sand and gravel, (FILL), moist	2-SS	8	1.5				
4	856.6								
5	855.6	Black Silty CLAY, trace sand, (Possible Old Topsoil), moist	3-SS	6					
6	854.6	Brown Silty SAND, trace gravel and clay, moist							
7	853.6								
8	852.6	Gray Silty CLAY, trace gravel, moist	4-SS	10	3.0				
9	851.6								
10	850.6		5-SS	13	3.5	2.60			(▼)
11	849.6								
12	848.6								▼
13	847.6								
14	846.6								
15	845.6		6-SS	21					
16	844.6								
17	843.6								⊥
18	842.6								
19	841.6		7-SS	19		2.43			
20	840.6								

END OF BORING @ 20 FEET

WATER LEVEL OBSERVATIONS:

Water Level during drilling	10 Feet (EL. 850.6±)	(▼)
Water Level upon completion	12 Feet (EL. 848.6±)	▼
Caved at upon completion	17 Feet (EL. 843.6±)	⊥
Delay Time		--
Water Level delayed		¥
Caved at delayed		⊥

ADDITIONAL COMMENTS:

Note: Lines of stratification represent an approximate boundary between soil types. Variations may occur between sampling intervals and/or boring locations. Transitions may also be gradual. Dashed lines are indicative of potentially erratic or unknown transitions, such as fill-to-natural soil zone transitions.