PREPARED FOR:

Grant County, WI

GEOTECHNICAL REPORT

FENNIMORE GF2

EDGE PROJECT NUMBER: 31987

April 5, 2022

Edge
Consulting Engineers, Inc.

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Prairie du Sac, Wisconsin 53578
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Reliable
Comprehensive
Exceeding Expectations

GEOTECHNICAL REPORT

Project Name:	Fennimore GF2
Site Address:	Preston Road Fennimore, WI 53809
Site Coordinates:	42° 59' 42.43" (42.995119) N Latitude 90° 32' 16.53" (-90.537925) W Longitude
Client:	Grant County 111 S. Jefferson St. Lancaster, WI 53813-0529 Contact: Sheriff Nate Dreckman Phone: (608) 723-2157
Consultant:	Edge Consulting Engineers, Inc. 624 Water Street Prairie du Sac, Wisconsin 53578 Contact: Arlen Ostreng, P.E. Phone: (608) 644-1449
Edge Project Number:	31987
Date:	April 5, 2022

Benjamin McBroom
Geotechnical Specialist

4/5/2022
Date

Arlen Ostreng, P.E.
Geotechnical Manager

4-5-2022
Date

WISCONSIN
ARLEN J. OSTRENG
32437
PRAIRIE DU SAC, WISCONSIN
PROFESSIONAL ENGINEER

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SECTION 1
INTRODUCTION

1.1 PROJECT INFORMATION

This report summarizes the results of a geotechnical exploration conducted by Edge Consulting Engineers, Inc. (Edge Consulting) for Grant County, who is proposing to construct a new 285-foot self-support telecommunications tower on a parcel of land located north of State Hwy. 18 on Preston Road in the Wingville Township in Grant County, Wisconsin. Proposed equipment will be located near the base of the proposed tower within a fenced compound. A street map showing the location of the proposed tower site is available in Figure 1. The location of the proposed project site on the Wingville, Wisconsin United States Geological Survey (USGS) 7.5 Minute Quadrangle is shown in Figure 2. Based on an inspection of the quadrangle map and detailed site survey, the site is located at an approximate elevation of 1117 feet above mean sea level. A site plan depicting the proposed project has been included as Figure 3. Site photos have also been included in Figure 4.

1.2 PURPOSE OF REPORT

The investigative activities of this report were conducted for the purposes of providing geotechnical engineering design parameters, soil characteristics, tower and equipment structure foundation recommendations, and site development recommendations with respect to the proposed improvements. This assessment was completed in conformance with client directed protocols, and utilizing the judgment of the geotechnical engineer.

1.3 SCOPE OF SERVICES

The scope of services for this project included research of reference materials and field exploration. Section 5 contains a list of references consulted in the preparation of this report. The scope of services for this report was determined predominantly by client supplied standards.

Field exploration consisted of advancing one boring in the vicinity of the proposed tower base to a depth of 40 feet, or until auger refusal. Edge Consulting reviewed the boring logs, the recovered soil samples, and laboratory testing results (if any) to determine the engineering characteristics of the soils at or near the proposed tower location. This report summarizes the field exploration results and provides recommendations related to suitable foundation types and depths, allowable bearing pressure, and estimates of foundation settlement.

SECTION 2
EXPLORATION RESULTS

2.1 REFERENCE RESEARCH & BACKGROUND

Review of United States Department of Agriculture NRCS (Natural Resource Conservation Service) Web Soil Survey for Grant County indicates natural site soils are classified as “DuD2” (Newglarus complex). These soil types are typically well drained soils that are moderate sloping to very steep and consist of Loess over clayey predisediment derived from dolomite. The soils are typically classified as CL-CH on the Unified Soil Classification System. The risk of corrosion to uncoated steel is high and for concrete is low. Edge Consulting reviewed the “Thickness of Unconsolidated Material in Wisconsin” map prepared by the Geologic and Natural History Survey. This map indicates that the anticipated depth to bedrock is between 0-50 feet, with underlying bedrock of the Prairie du Chien Group of the Ordovician System consisting of dolomite with some sandstone and shale.

2.2 TOPOGRAPHY

The existing topography of the subject site is moderately to steeply sloping, with surface water generally flowing to the southwest. Existing slopes are approximately 12-20% slope. Site drainage is adequate, and no standing water was observed during drilling operations.

2.3 FIELD EXPLORATION

One standard penetration test (SPT) soil boring was advanced to a depth of 15 feet below grade surface (bgs) due to auger refusal. Drilling was completed on 3/25/2022. The boring was advanced using a rotary drill rig. Representative soil samples were obtained using a standard 2-inch diameter split spoon sampler in general accordance with ASTM D1586 / D1586M-18, “Standard Test Method for Penetration Tests and Split-Barrel Sampling of Soils”. A description of this procedure is available in Appendix C of this report. Split spoon sampling was performed by collecting 18 inch samples at 2.5-foot intervals to a depth of 15 feet and 5 foot intervals thereafter.

The drill crew chief visually and manually classified samples in the field in accordance with ASTM D2487-17. The field personnel then collected representative soil samples from each split spoon and placed these samples in glass jars for further examination and verification of the field classification by a geotechnical engineer. The soil boring logs located in Appendix A contain pocket penetrometer readings, standard penetration measurements, soil classification information and other pertinent information.

Upon completion of drilling, the soil borings were abandoned in accordance with Chapter NR 141, Wisconsin Administrative Code.

2.4 SUBSURFACE CONDITIONS

One soil boring was completed at the site. Boring B-1 was drilled as close to the proposed tower center location as was possible. Subsurface soils were noted to consist of 10 inches of topsoil followed by stiff silty clay to 6 feet bgs, medium dense sand to 9 feet bgs, and weathered dolomite to the end of boring and auger refusal at 15 feet bgs. The approximate location of the boring is depicted in Figure 3. The boring log is available in Appendix A.

2.5 BEDROCK

Weathered dolomite was encountered at 9 feet bgs at the proposed tower center. This material was drillable until auger refusal was met at 15 feet. A confirmation boring was drilled 10 feet west of Boring 1 and auger refusal was met at 14 feet bgs.

2.6 FROST DEPTH AND COVER

According to the ANSI/TIA -222-G standards, frost depth for the area is expected to be 60 inches. It is recommended that all tower foundation elements, not bearing directly on solid rock or otherwise protected from frost, be founded at or below this depth to adequately protect against frost heave. Similarly, foundations for equipment buildings larger than 400 sq.ft. shall also extend below the frost line of the locality, be constructed on solid rock or be otherwise protected from frost in accordance with Section 1809.5 of the International Building Code (IBC).

2.7 WATER LEVEL OBSERVATIONS

Groundwater **was not** encountered during this investigation.

2.8 LABORATORY TESTING

Edge Consulting utilized a Bluelab® soil pH pen to obtain a pH reading of 6.9 from a collective soil sample obtained at the tower center from 3.5 to 5 feet bgs. The pH level was obtained in accordance with ASTM G51-95(2005) “Standard Test Method for Measuring pH of Soil for Use in Corrosion Testing”.

A soil resistivity test was also completed on the same collective soil sample using a MC Miller soil box in conjunction with a Nilsson Model 400 Soil Resistance Meter to obtain a resistance reading of 2,200 OHM-cm. The soil resistance test was collected in accordance with ASTM G57-95a (Reapproved 2001) “Standard Test Method for Field Measurement of Soil Resistivity Using the Wenner Four-Electrode Method”.

SECTION 3
ANALYSIS & RECOMMENDATIONS

3.1 FOUNDATIONS

3.1.1 Proposed Tower

Based upon the information obtained during this investigation, Edge Consulting recommends the use of a standard spread footing (mat) or individual pad and pier footings at each of the tower legs to support the proposed tower. It is recommended that either tower foundation should bear on existing stiff silty clay soils at a minimum depth of 5 feet below existing grade surface. A complete listing of soil properties for use in foundation design is contained in Appendix B.

3.1.2 Equipment Support Structure

Edge Consulting recommends the use of conventional strip footings or an engineered floating slab for an equipment building foundation. Strip footings should have a minimum width of 12 inches. Strip footings for structures larger than 400 sq.ft. should extend to below the frost line of the locality or 48 inches below finished grade, whichever is greater. Footings bearing directly on solid rock above this depth or insulated by other means are also acceptable forms of frost protection.

If a floating slab foundation system is utilized, the slab should be designed in accordance with ACI 302.1R80 practice. Concrete floor slabs may be constructed on exposed subgrade or new compacted fill. In all cases, the exposed subgrade beneath new fill or the proposed floor slab should be compacted to 90% - 95% of the Modified Proctor maximum dry density (ASTM D1557). A minimum of 8 inches of compacted granular fill, or free draining gravel (ASTM C33, Size 57 concrete aggregate), should be located immediately beneath any floor slabs.

If an elevated equipment platform or building is to be utilized, Edge Consulting recommends supporting these structures with the use of individual drilled piers. Drilled piers for elevated equipment platforms and buildings should extend below the frost line of the locality or 48 inches below finished grade, whichever is greater.

3.2 SITE AND FOUNDATION DRAINAGE

Positive site drainage should be provided to reduce infiltration of surface water into the backfills around the perimeters of tall proposed structures. All grades should slope away from these structures. Edge Consulting recommends that the top of tower foundation elements extend a minimum of 6 inches above the final site surface.

3.3 SITE PREPARATION & FILL RECOMMENDATIONS

The following general site preparation and fill recommendations are provided for the development of this site.

- All vegetation, root-mat, topsoil, and any other soft or unsuitable material should be stripped from the areas of all proposed improvements. The removed material should be placed outside of any proposed improvement areas. These materials should not be utilized for backfill purposes.
- Removal of unsuitable fill material should be conducted within the footprint of the proposed improvements. Any construction debris should be removed from the site. The remaining material may be used as fill in other “non load bearing” areas of the site outside of the equipment pad, tower compound and road bed footprints.
- All areas requiring engineered fill should be brought up to grade. Engineered fill material should consist of clean well graded granular material containing less than 15% by weight passing the No. 200 sieve. This material should be placed in thin lifts not exceeding 8 inches in a loose thickness and compacted to 90% to 95% of the maximum dry density, as determined by ASTM D 1557, Modified Proctor test. Fill areas under footings should be extended from each side of the outermost location of the footing at a rate of 2/3 foot width for every 1 foot of fill depth. Fill placement activities should be performed in the presence of a qualified geotechnical engineer.
- Once final grade for footing placement has been established, density tests and/or examination by a geotechnical engineer should be performed in the footing trenches prior to footing placement to confirm that the material has achieved an adequate degree of compaction.
- Foundation and wall construction should follow in accordance with the structural engineers requirements.
- Once the prescribed curing time has been achieved, installation of any required perimeter drainage system and backfill may be initiated. Backfill of foundation walls may consist of onsite or imported granular material. Backfill should be installed in a maximum of 12 inch lifts and compacted to a 92% of the maximum dry density (D1557).

3.4 EXCAVATION SLOPE RECOMMENDATIONS

It is expected that short term slopes of 1:1 can be maintained in the soils encountered at this site. However, construction practices should follow all federal, state and local regulations regarding safety standards for all excavation activities.

Construction site safety is the sole responsibility of the Contractor. Edge Consulting assumes no liability for Contractor’s construction activities, construction site safety, or interpretation of information provided within this report. Such responsibility shall neither be implied nor inferred.

3.5 SOIL BEARING CAPACITY

The recommended maximum presumptive net bearing capacity of stiff silty clay soils at depths between 0 and 6 feet bgs is 4,000 psf. Foundation systems designed for these capacities should experience a total settlement of less than 1 inch, with a differential settlement of less than half this amount. All bearing values should be considered allowable. A factor of safety of 2.0 has been assumed.

3.6 LATERAL EARTH PRESSURE

Edge Consulting utilized Rankine methodology to determine the foundation earth pressure parameters. Recommended values for passive lateral earth pressure based on soil depth are available in Appendix B. All calculated values are considered ultimate. It is assumed that a minimum factor of safety of 2.0 will be incorporated at the time of foundation design.

3.7 FRICTIONAL SKIN RESISTANCE

Included in Appendix B are recommended values for compressive frictional skin resistance for this site. These resistances are assumed to occur between concrete foundation elements and existing site soils. All calculated values are considered ultimate. It is assumed that a minimum factor of safety of 2.0 will be incorporated at the time of foundation design. For uplift and pull-out type calculations, it is further recommended that the uplift frictional skin resistance be considered as 2/3 of the listed compressive values.

3.8 SPECIAL DESIGN CONSIDERATIONS

Based upon the proposed site grading plans for this site, the dimension from top of concrete at the tower anchor bolt setting to the foundation base should be a minimum of 5.5 feet to account for existing site contour, proposed filling, drainage and frost protection.

Steep grades are present in the vicinity of the proposed tower site. The site survey and grading plan should be referenced for the foundation design to account for the existing and proposed surface grades.

Weathered dolomite bedrock was encountered at a depth of 9 feet bgs. The design of drilled pier foundations at this site is not recommended.

3.9 SPECIAL CONSTRUCTION CONSIDERATIONS

The contractor should review the proposed tower foundation design with the site construction plans prior to ordering foundation reinforcing steel. The tower foundation should be designed such that the top of concrete extends 6-inches above the proposed compound finished grade. In addition, the foundation base should extend to a minimum of 5 feet below existing grade. If the plans do not reflect this condition, please contact the project manager and foundation designer.

Bedrock was encountered within 9 feet of ground surface. The depth to bedrock is based on the depth of auger refusal in a single boring at the tower center and confirmation boring 10' west of the tower center. Based on the size of the tower it is anticipated that there will be a relatively large spread footing at the site. The depth to bedrock can vary widely across the width of the foundation. In addition, it is likely that relatively solid bedrock may be encountered above the depth of auger refusal. This is difficult to quantify without completing test pits at various locations. The contractor should anticipate significant difficulties in completing the necessary excavation to install the tower foundation, including the use of hydraulic hammering and/or blasting. If this is a major factor in the bidding process, the contractor may wish to complete several test pits within the boundaries of the proposed foundation to better determine the exact conditions that will be encountered prior to ordering the foundation steel.

The contractor should be prepared to remove large boulders and cobbles as necessary to accommodate foundation installation. The use of heavy equipment including a large backhoe will likely be required to complete this work.

Special precautions should be taken for earthwork during winter months. Footings or fills should not be placed on frozen soils. Exposed subgrade soil should be adequately protected with insulating blankets.

SECTION 4
LIMITATIONS AND RESTRICTIONS

This report has been prepared to aid in the evaluation of this property for the intended use described herein, and to assist in the design or planning of this project. In the event any changes in the design as outlined herein, or changes in the vertical position or horizontal location of the facility are planned, the conclusions and recommendations contained in this report shall not be considered valid unless such changes are reviewed by Edge Consulting Engineers, Inc.

The analysis and recommendations submitted in this report are our opinions based on the data obtained and subsurface conditions noted from the field investigation described at the locations indicated on the accompanying site plan. This report does not reflect any variations that may occur between, beyond, or below the depths of these test pits or borings. If variations then appear evident, it will be necessary for a re-evaluation of the recommendations of this report to be made after performing on-site observations during the construction period and noting the characteristics of any variations.

The soil report is only for the purposes stated in the contract and may not be sufficient to prepare an accurate bid.

Certain assumptions have been made regarding the foundation design for this site. Edge Consulting Engineers, Inc. should be given the opportunity to review the final foundation design to determine whether the final design necessitates any changes of the recommendations contained in this document. If Edge Consulting is not provided the opportunity for this review, we can assume no responsibility for the misinterpretation or misapplication of these recommendations or for their validity in the event changes have been made to the initial understanding of the project or design content.

There is the possibility that variations in soil conditions will be encountered during construction. In order to permit correlation between soil data in this report and the actual soil conditions encountered during construction, it is required that the soil engineer be retained to perform a review of the excavation prior to foundation placement. Edge Consulting assumes no responsibility for construction compliance with design concepts, specifications, or recommendations unless we have been retained to perform on-site review during the course of construction. Edge Consulting should be contacted immediately if conditions encountered are not consistent with those described.

This report was prepared in accordance with generally accepted soil and foundation engineering practices and makes no other warranties, either expressed or implied, as to the professional advice provided under the terms of the agreement between the Engineer and his client. This report has not been prepared for uses or parties other than those specifically named, or for uses or applications other than those enumerated herein. The report may contain insufficient or inaccurate information for other purposes, applications, building sites, or other uses.

SECTION 5
REFERENCES

1. Das, Braja M., *Principles of Foundation Engineering*, 2nd. Edition, 1990.

2. Das, Braja M., *Principles of Geotechnical Engineering*, 2nd. Edition, 1990.

3. Das, Braja M., *Soil Mechanics Laboratory Manual*, 3rd. Edition, 1989.

4. Hadley, David W. and Pelham, James H., *Glacial Deposits of Wisconsin*, 1976.

5. Hole, F.D., etal., *Overlay Soil Map of Wisconsin*, 1:250,000, University of Wisconsin, Geological and Natural History Survey, 1968.

6. Mudrey, M.G., Brown, B.A., & Greenburg, J.K. Bedrock Geologic Map of Wisconsin [map]. 1982. 1:1,000,000. University of Wisconsin, Geological and Natural History Survey. Retrieved from http://www.uwex.edu/wgnhs/gis.htm.

7. Ostrom, Meredith E. Thickness of Unconsolidated Material in Wisconsin [map]. 1983. No scale. University of Wisconsin – Extension, Wisconsin Geologic and Natural History Survey. Retrieved from http://www.uwex.edu/wgnhs/gis.htm

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9. Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. Available online at http://websoilsurvey.gov/.

Figure 1

Street Maps

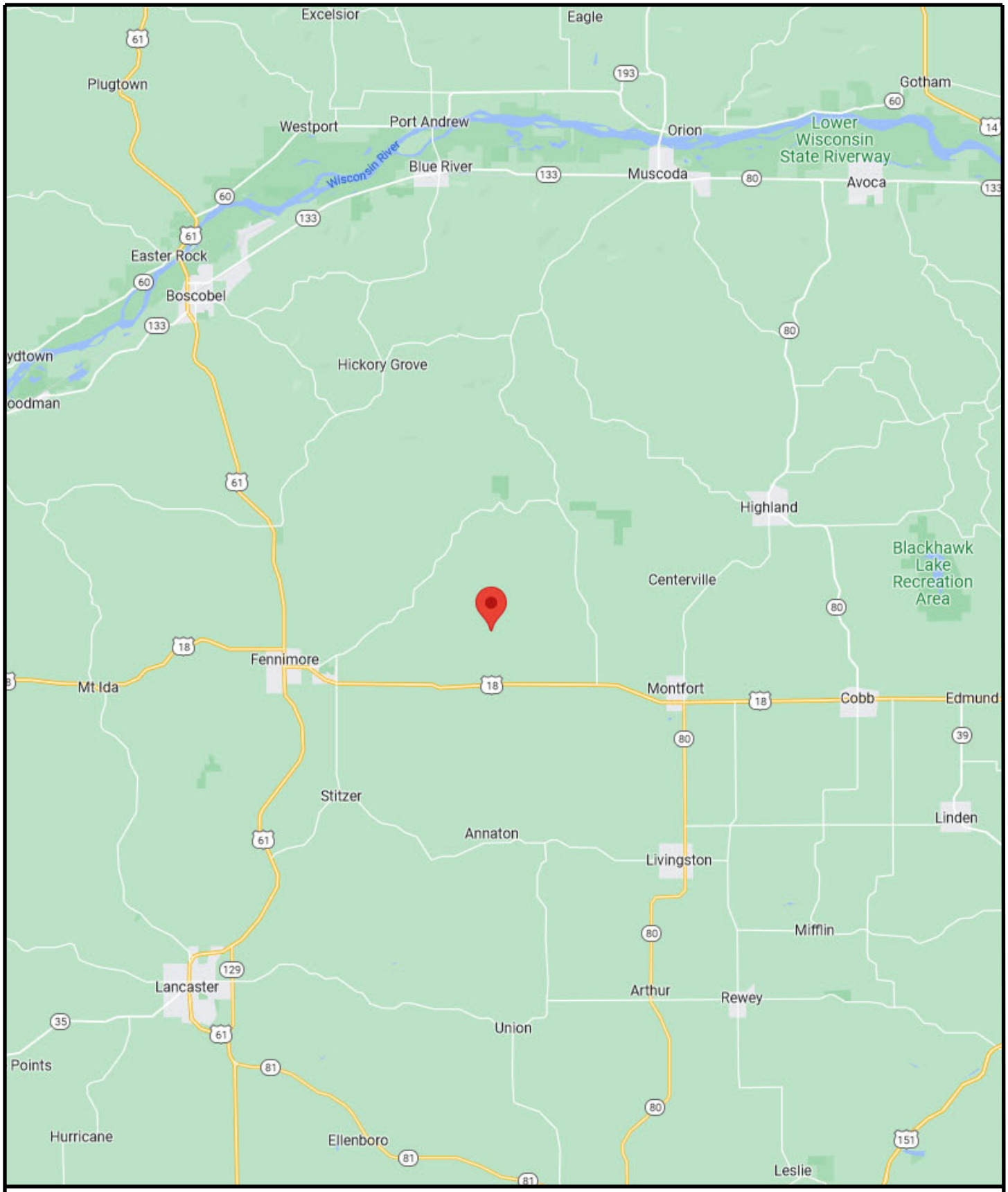


FIGURE #1: Regional Map

Edge
Consulting Engineers, Inc.

Project Number: #31987
Project Name: Grant County / Fennimore GF 2
Project Address: Preston Road, Wingville Twp, Grant County

N
Project Location

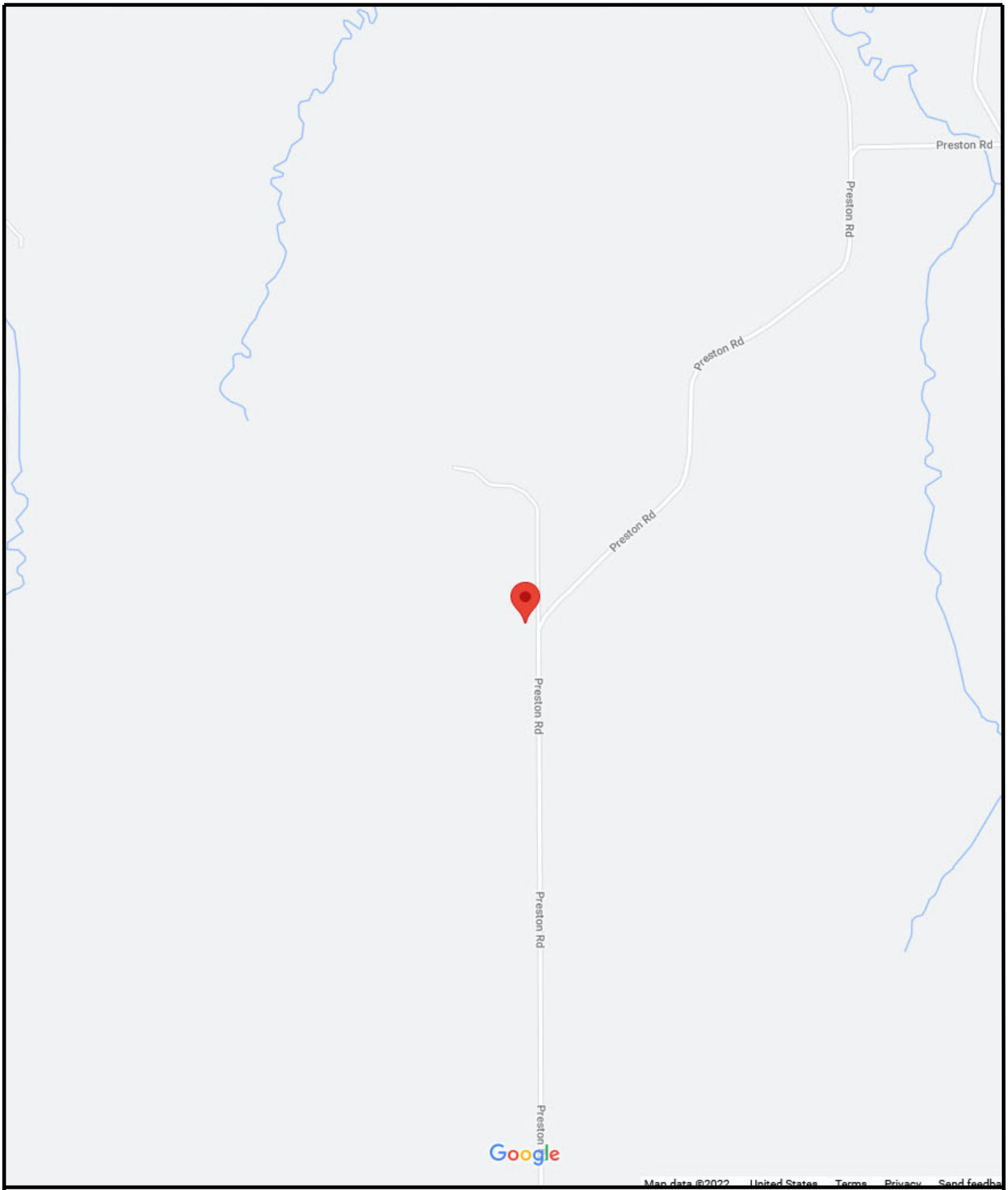


FIGURE #1: Street Map

Edge
Consulting Engineers, Inc.

Project Number: #31987
Project Name: Grant County / Fennimore GF 2
Project Address: Preston Road, Wingville Twp, Grant County

N
Project Location

Figure 2

USGS Topographic Quadrangle Map

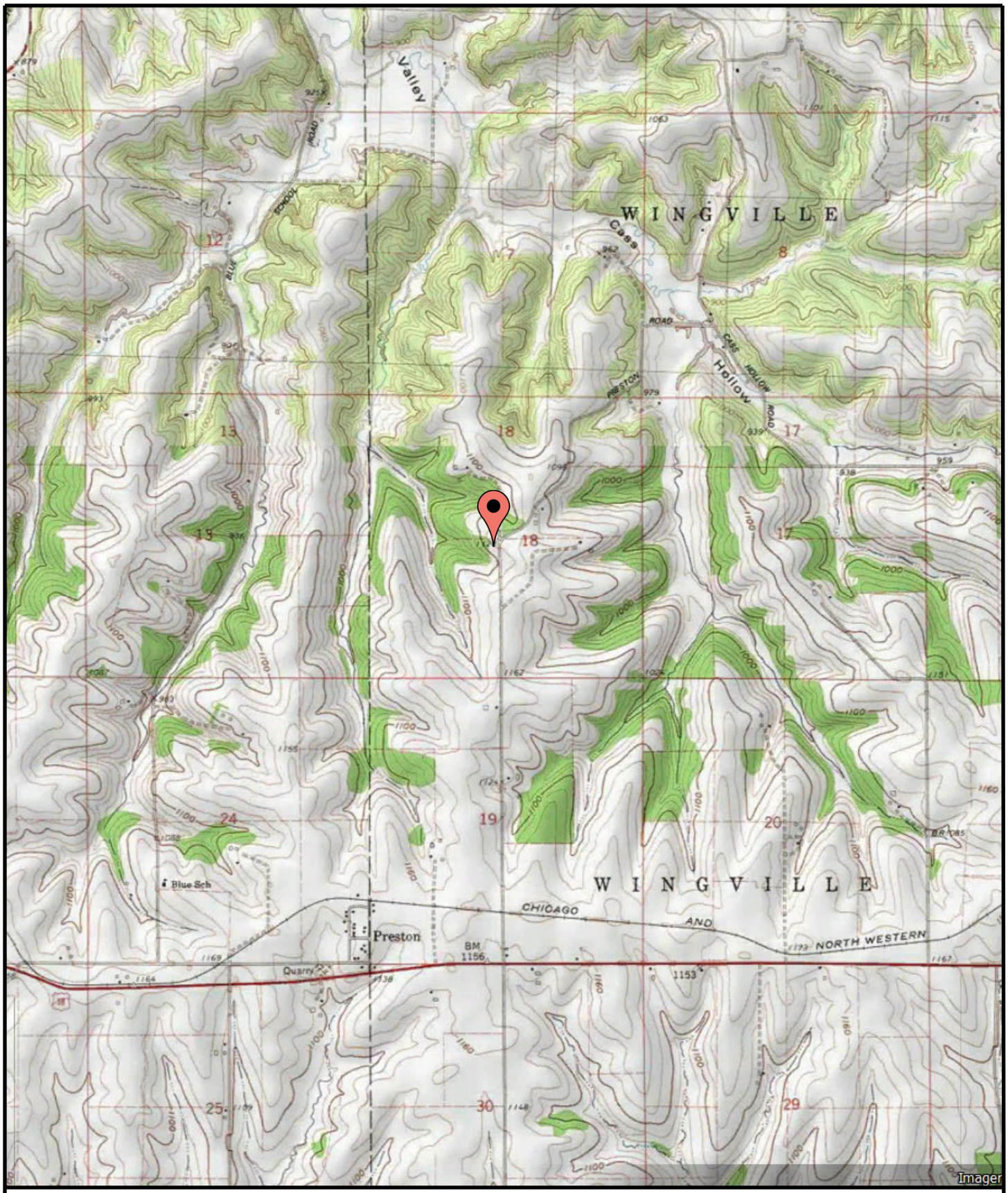


FIGURE #2: USGS 7.5-Minute Quadrangle

Edge
Consulting Engineers, Inc.

Project Number: #31987
Project Name: Grant County / Fennimore GF 2
Project Address: Preston Road, Wingville Twp, Grant County

N
Project Location

Figure 3

Site Plan

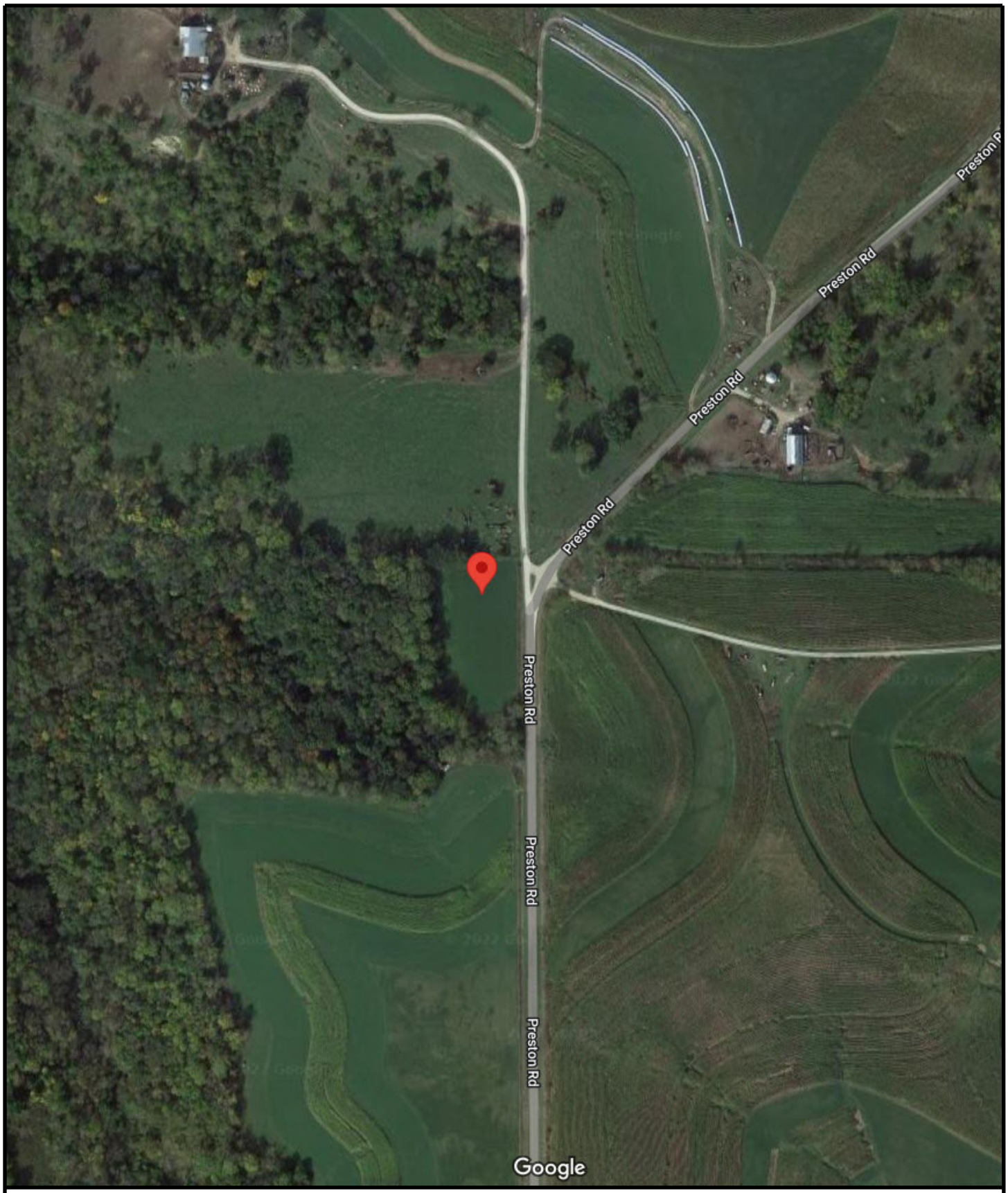


FIGURE #3: Aerial/Satellite Plan View

Edge
Consulting Engineers, Inc.

Project Number: #31987
Project Name: Grant County / Fennimore GF 2
Project Address: Preston Road, Wingville Twp, Grant County

N
Project Location

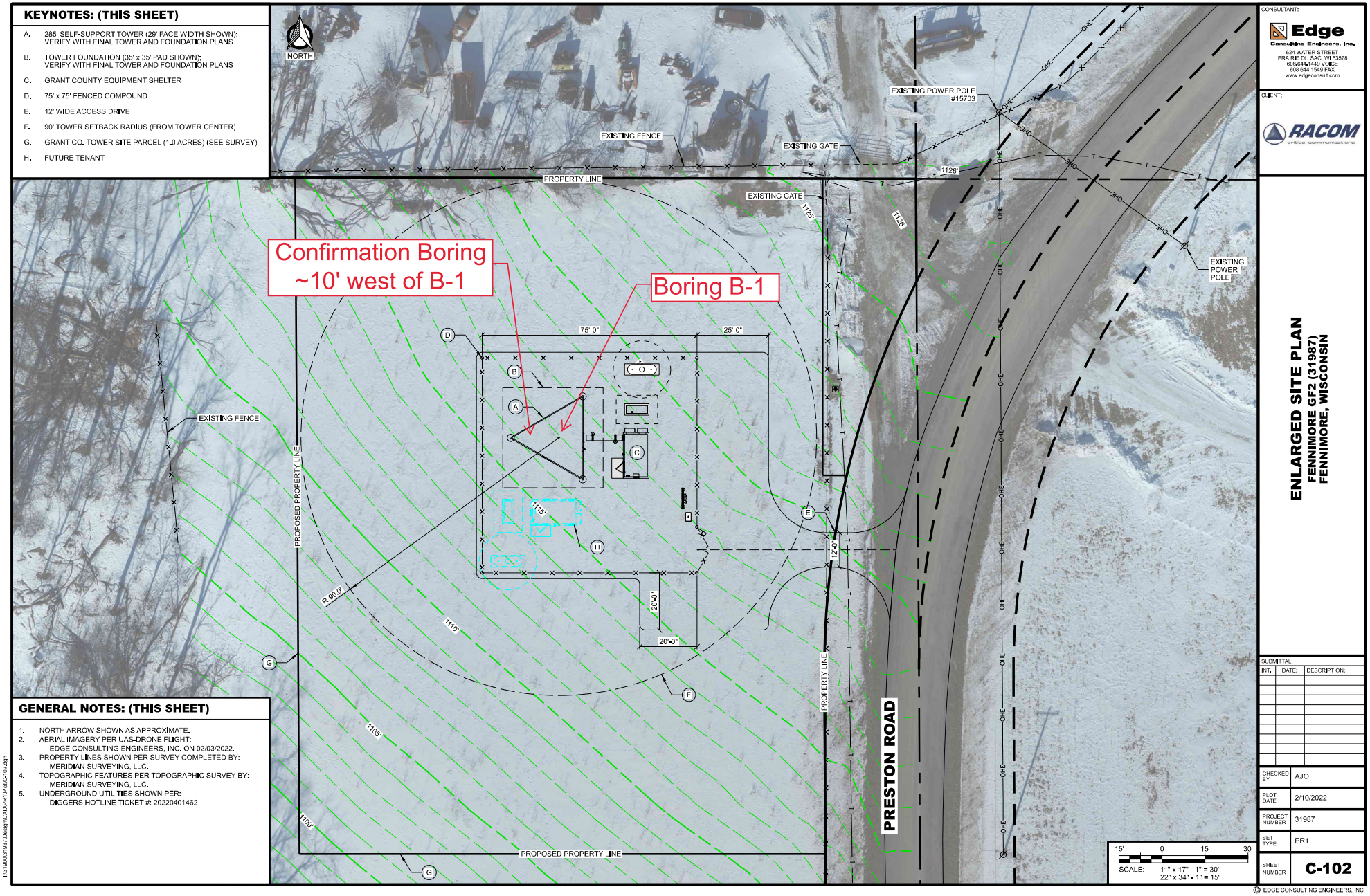


Figure 4

Site Photographs

VIEW NORTH TOWARD PROJECT LOCATION

VIEW SOUTH TOWARD PROJECT LOCATION

FIGURE #4: Project Location Photographs

Edge
Consulting Engineers, Inc.

Project Number: #31987
Project Name: Grant County / Fennimore GF 2
Project Address: Preston Road, Wingville Twp, Grant County
Photograph Date: February 3, 2022

VIEW EAST TOWARD PROJECT LOCATION

VIEW WEST TOWARD PROJECT LOCATION

FIGURE #4: Project Location Photographs

Edge
Consulting Engineers, Inc.

Project Number: #31987
Project Name: Grant County / Fennimore GF 2
Project Address: Preston Road, Wingville Twp, Grant County
Photograph Date: February 3, 2022

Appendix A

Soil Boring Logs

Edge
Consulting Engineers, Inc.

Project: Grant County (Fennimore GF2)
Project Location: Fennimore, Wisconsin
Project Number: 31987

Log of Boring B-1

Sheet 1 of 1

Date(s) Drilled **March 25, 2022**	Logged By **Tim**	Checked By **Ben**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type **2 inch Split-Spoon**	Total Depth of Borehole **17.5 feet bgs**
Drill Rig Type **Geoprobe 7822DT**	Drilling Contractor **Soil Essentials**	Approximate Surface Elevation **1117 feet MSL**
Groundwater Level and Date Measured **Not Encountered ATD**	Sampling Method(s) **SPT, Grab**	Hammer Data **140 lb, 30 in drop, rope & cathead**
Borehole Backfill **Bentonite/Cuttings**	Location **Tower Center**	

Elevation, feet	Depth, feet	Sample Type	Sample Number	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	Moisture	Qu (tsf)	Recovery (in)	REMARKS AND OTHER TESTS
1117	0		0			OL-OH		10" of Brown Silty Clay Topsoil	M	-	-	
						CL-CH		Silty Clay, No Gravel, Brown				
			1	2,3,5	Stiff				D	-	16	
			2	6,8,7	Stiff				D	1.5	16	
1112	5											
			3	6,10,16	Medium Dense	SP		Sand, w/Some Gravel & Cobbles, Fine to Medium Grained, Light Brown	D	-	16	
			4	22,100/1"	-	DOLOMITE		Weathered Dolomite	D	-	7	
1107	10											
			5	100/2"	-				D	-	2	
			6	100/2"	-				D	-	2	
1102	15							Auger Refusal and Bottom of Boring at 15 feet bgs				
								Confirmation boring 10' west - Auger Refusal at 14 feet bgs				
1097	20											

Figure 1

Edge
Consulting Engineers, Inc.

Project: Grant County (Fennimore GF2)
Project Location: Fennimore, Wisconsin
Project Number: 31987

Key to Log of Boring

Sheet 1 of 1

Elevation, feet	Depth, feet	Sample Type	Sample Number	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	Moisture	Qu (tsf)	Recovery (in)	REMARKS AND OTHER TESTS
1	2	3	4	5	6	7	8	9	10	11	12	13

COLUMN DESCRIPTIONS

1 **Elevation, feet:** Elevation (MSL, feet)

2 **Depth, feet:** Depth in feet below the ground surface.

3 **Sample Type:** Type of soil sample collected at the depth interval shown.

4 **Sample Number:** Sample identification number.

5 **Sampling Resistance, blows/foot:** Number of blows to advance driven sampler foot (or distance shown) beyond seating interval using the hammer identified on the boring log.

6 **Relative Consistency:** Relative consistency of the subsurface material.

7 **USCS Symbol:** USCS symbol of the subsurface material.

8 **Graphic Log:** Graphic depiction of the subsurface material encountered.

9 **MATERIAL DESCRIPTION:** Description of material encountered. May include consistency, moisture, color, and other descriptive text.

10 **Moisture:** Water content of the soil sample, expressed as percentage of dry weight of sample.

11 **Qu (tsf):** Dry weight per unit volume of soil sample measured in laboratory, in pounds per cubic foot.

12 **Recovery (in):** The percent fines (soil passing the No. 200 Sieve) in the sample. WA indicates a Wash Sieve, SA indicates a Sieve Analysis.

13 **REMARKS AND OTHER TESTS:** Comments and observations regarding drilling or sampling made by driller or field personnel.

FIELD AND LABORATORY TEST ABBREVIATIONS

CHEM: Chemical tests to assess corrosivity
COMP: Compaction test
CONS: One-dimensional consolidation test
LL: Liquid Limit, percent
PI: Plasticity Index, percent
SA: Sieve analysis (percent passing No. 200 Sieve)
UC: Unconfined compressive strength test, Qu, in ksf
WA: Wash sieve (percent passing No. 200 Sieve)

TYPICAL MATERIAL GRAPHIC SYMBOLS

- Well graded GRAVEL (GW)
- Poorly graded GRAVEL (GP)
- Well graded GRAVEL with Silt (GW-GM)
- Well graded GRAVEL with Clay (GW-GC)
- Poorly graded GRAVEL with Silt (GP-GM)
- Poorly graded GRAVEL with Clay (GP-GC)
- Silty GRAVEL (GM)
- Clayey GRAVEL (GC)
- Well graded SAND (SW)
- Poorly graded SAND (SP)
- Well graded SAND with Silt (SW-SM)
- Well graded SAND with Clay (SW-SC)
- Poorly graded SAND with Silt (SP-SM)
- Poorly graded SAND with Clay (SP-SC)
- Silty SAND (SM)
- Clayey SAND (SC)
- SILT, SILT w/SAND, SANDY SILT (ML)
- Lean CLAY, CLAY w/SAND, SANDY CLAY (CL)
- SILT, SILT w/SAND, SANDY SILT (MH)
- Fat CLAY, CLAY w/SAND, SANDY CLAY (CH)
- SILT, SILT with SAND, SANDY SILT (ML-MH)
- Lean-Fat CLAY, CLAY w/SAND, SANDY CLAY (CL-CH)
- SILTY CLAY (CL-ML)
- Lean CLAY/PEAT (CL-OL)
- Fat CLAY/SILT (CH-MH)
- Fat CLAY/PEAT (CH-OH)
- Silty SAND to Sandy SILT (SM-ML)
- Silty SAND to Sandy SILT (SM-MH)
- Clayey SAND to Sandy CLAY (SC-CL)
- Clayey SAND to Sandy CLAY (SC-CH)
- SILT to CLAY (CL/ML)
- Silty to Clayey SAND (SC/SM)

TYPICAL SAMPLER GRAPHIC SYMBOLS

- 2-inch-OD unlined split spoon (SPT)
- 2.5-inch-OD Modified California w/ brass liners
- 3-inch-OD California w/ brass rings
- Shelby Tube (Thin-walled, fixed head)
- Grab Sample
- Bulk Sample
- Pitcher Sample
- Other sampler

OTHER GRAPHIC SYMBOLS

- Water level (at time of drilling, ATD)
- Water level (after waiting a given time)
- Minor change in material properties within a stratum
- Inferred or gradational contact between strata
- Queried contact between strata

GENERAL NOTES

1. Soil classifications are based on the Unified Soil Classification System. Descriptions and stratum lines are interpretive, and actual lithologic changes may be gradual. Field descriptions may have been modified to reflect results of lab tests.
2. Descriptions on these logs apply only at the specific boring locations and at the time the borings were advanced. They are not warranted to be representative of subsurface conditions at other locations or times.

Appendix B

Soil Properties, Calculations

Edge
Consulting Engineers, Inc.
624 Water Street
Prairie du Sac, WI 53578
608.644.1449 phone

Project Name: Fennimore GF2
Project Number: 31987
Client: Grant County
Location: Fennimore, Wisconsin

SOIL PROFILE

Notes:
- Groundwater not encountered
- Frost depth is at 5' BGS
- k, E50 values are for Lpile use only

Stiff Silty Clay (CL-CH) (0 to 6 feet BGS)		
γ =	110	pcf
Φ =	0	°
Cu =	2,000	psf
E50 =	0.007	
k =	500	pci
Bc =	4,000	psf

Medium Dense Sand (SP) (6 to 9 feet BGS)		
γ =	120	pcf
Φ =	35	°
Cu =	0	psf
E50 =	N/A	
k =	90	pci
Bc =	6,000	psf

Weathered Dolomite (9 to 15 feet BGS)		
γ =	135	pcf
Φ =	40	°
Cu =	0	psf
E50 =	N/A	
k =	225	pci
Bc =	10,000	psf

SOIL PROPERTIES

Depth (feet)	Unit Weight (pcf)	Friction Angle (°)	Cohesion (psf)	Effective Stress (psf)	Passive Pressure (psf)	Skin Friction Resistance (psf)
0	110	0°	2,000	0	0	800
1	110	0°	2,000	110	4,110	800
2	110	0°	2,000	220	4,220	800
3	110	0°	2,000	330	4,330	800
4	110	0°	2,000	440	4,440	800
5	110	0°	2,000	550	4,550	800
6	110	0°	2,000	660	4,660	800
6	120	35°	0	660	2,436	772
7	120	35°	0	780	2,878	891
8	120	35°	0	900	3,321	1,006
9	120	35°	0	1,020	3,764	1,117
9	135	40°	0	1,020	4,691	1,117
10	135	40°	0	1,155	5,312	1,239
11	135	40°	0	1,290	5,933	1,357
12	135	40°	0	1,425	6,553	1,471
13	135	40°	0	1,560	7,174	1,581
14	135	40°	0	1,695	7,795	1,686
15	135	40°	0	1,830	8,416	1,788

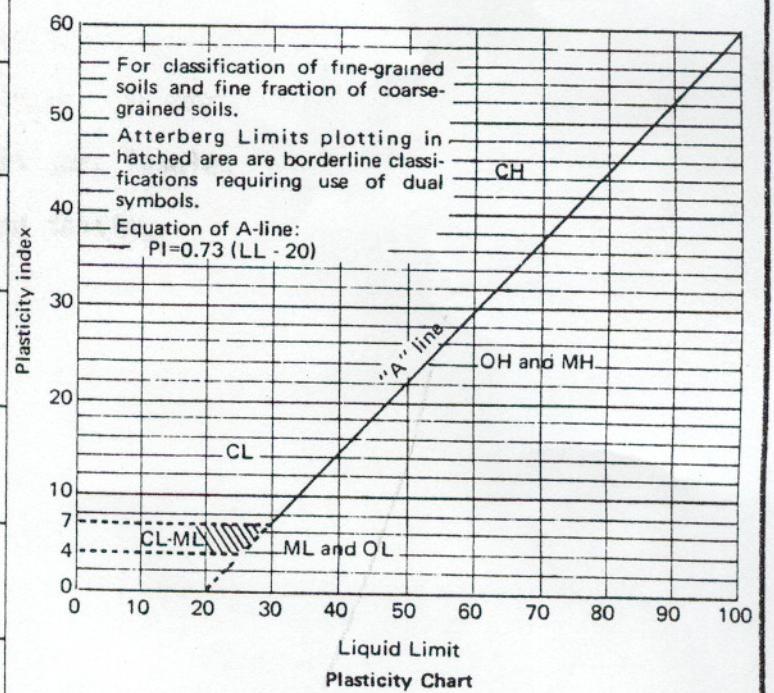
Appendix C

Classification of Soils for
Engineering Purposes

UNIFIED SOIL CLASSIFICATION SYSTEM

Major divisions			Group symbols	Typical names	Laboratory classification criteria
Coarse-grained soils (More than half of material is *larger* than No. 200 sieve size)	Gravels (More than half of coarse fraction larger than No. 4 sieve size	Clean gravels (Little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines	$C_u=\frac{D_{60}}{D_{10}}$ greater than 4; $C_c=\frac{(D_{30})^2}{D_{10}XD_{60}}$ between 1 and 3
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines	Not meeting all gradation requirements for GW
		Gravels with fines (Appreciable amount of fines)	GM d / u	Silty gravels, gravel-sand-silt mixtures	Atterberg limits below "A" line or P.I. less than 4 / Atterberg limits above "A" line with P.I. greater than 7 — Above "A" line with P.I. between 4 and 7 are *borderline* cases requiring use of dual symbols
			GC	Clayey gravels, gravel-sand-clay mixtures	
	Sands (More than half of coarse fraction is smaller than No. 4 sieve size)	Clean sands (Little or no fines)	SW	Well-graded sands, gravelly sands, little or no fines	$C_u=\frac{D_{60}}{D_{10}}$ greater than 6; $C_c=\frac{(D_{30})^2}{D_{10}XD_{60}}$ between 1 and 3
			SP	Poorly graded sands, gravelly sands, little or no fines	Not meeting all gradation requirements for SW
		Sands with fines (Appreciable amount of fines)	SM d / u	Silty sands, sand-silt mixtures	Atterberg limits below "A" line or P.I. less than 4 / Atterberg limits above "A" line with P.I. greater than 7 — Limits plotting in hatched zone with P.I. between 4 and 7 are *borderline* cases requiring use of dual symbols.
			SC	Clayey sands, sand-clay mixtures	
Fine-grained soils (More than half of material is *smaller* than No. 200 sieve)	Silts and clays (Liquid limit less than 50)		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity	
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	
			OL	Organic silts and organic silty clays of low plasticity	
	Silts and clays (Liquid limit greater than 50)		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	
			CH	Inorganic clays of high plasticity, fat clays	
			OH	Organic clays of medium to high plasticity, organic silts	
	Highly organic soils		Pt	Peat and other highly organic soils	

Determine percentages of sand and gravel from grain-size curve.
Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:
Less than 5 per cent . . . . . .GW, GP, SW, SP
More than 12 per cent . . . . . .GM, GC, SM, SC
5 to 12 per cent . . . . . .*Borderline* cases requiring dual symbols



Plasticity Chart

Penetration Testing Procedure - "N" Values

The penetration testing procedure used for this project followed the requirements of ASTM Specification D 1586-67, "Standard Method for Penetration Tests and Split-Barrel Sampling of Soils". This procedure involves driving a 2-inch OD standard split spoon sampler 18 inches with a 140-pound hammer free falling a distance of 30 inches. The number of blows required to drive the sampler the final foot was recorded as the Standard "N" Penetration. This N-value is used by Soils Engineers to estimate the strength and compressibility of the soil. After driving, the sampler was returned to the surface and opened. The length of sample (recovery) was measured and the soil was preliminarily classified according to type by a Soils Technician. A representative portion of each sample was then sealed in a glass jar, labeled, and returned to our office for further examination and testing.