ATTACHMENT E

Geotechnical Report

FREEBORN WIND PROJECT
FREEBORN COUNTY, MINNESOTA

Prepared By:

RRC

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May 12, 2017
RRC Project No. GE1704007

experience matters

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May 12, 2017

Freeborn Wind Energy Center, LLC
c/o Invenergy LLC
One South Wacker Drive, Suite 1800
Chicago, IL 60606

Attn: Mr. Daniel Birmingham

Re: Geotechnical Report
Freeborn Wind Project
Freeborn County, Minnesota
RRC Project No. GE1704007

Dear Mr. Birmingham:

RRC Power & Energy, LLC (RRC) has completed the authorized subsurface exploration and geotechnical engineering evaluation for the proposed Freeborn Wind Project. The purpose of the geotechnical engineering study was to explore and evaluate the subsurface conditions at various locations on the site, and develop geotechnical design and construction recommendations for the project. The attached report contains:

- A description of our findings from the field exploration and laboratory testing program;
- Our engineering interpretation of the results with respect to the project characteristics; and
- Our geotechnical subsurface exploration program, foundation design and construction recommendations for the planned project.

We appreciate the opportunity to be of service to Freeborn Wind Energy Center, LLC and are prepared to provide construction materials testing services during the construction phase of the project. Please call us if you have any questions concerning this report or any of our services.

Respectfully submitted,
RRC Power & Energy, LLC (RRC)

Eng-Chew Ang, Ph.D., P.E. (KS)
Senior Geotechnical Engineer

GEOTECHNICAL REPORT

FREEBORN WIND PROJECT
FREEBORN COUNTY, MINNESOTA

prepared for

FREEBORN WIND ENERGY CENTER, LLC
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May 12, 2017 ***Project No. GE1704007***

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GEOTECHNICAL REPORT

FREEBORN WIND PROJECT
FREEBORN COUNTY, MINNESOTA

1.0 INTRODUCTION

RRC has completed the authorized subsurface exploration and geotechnical engineering evaluation for the proposed Freeborn Wind Project. The site is located approximately between 8 and 13 miles east of and between 10 to 15 miles southeast of the City of Albert Lea, in Freeborn County, Minnesota. The approximate boundaries of the site are shown on Figure 1, Site Location Map.

The purpose of this investigation and report was to:

- Explore subsurface materials and groundwater conditions;
- Conduct field and laboratory testing to characterize the subsurface material properties at selected locations across the site; and
- Provide geotechnical engineering parameters for the design of foundation systems and private access roadways.

The recommendations contained in this report are based upon results of field and laboratory testing, engineering analyses, experience with similar soil conditions, and our understanding of the proposed project.

As part of the Scope of Work provided by the Client for this project, RRC performed 1-D Multi-Channel Analysis of Surface Waves (MASW) surveys, seismic refraction surveys, Electrical Resistivity (ER) testing and Thermal Resistivity testing at selected locations across the site. Shallow bulk soil samples were also collected from designated locations and transported to RRC's laboratory facility for laboratory thermal resistivity testing and laboratory CBR testing. The results for Electrical Resistivity (ER) testing and Thermal Resistivity testing are provided separate letter reports, and therefore, they are not included in this report.

Our recommendations contained herein are also based on the results of in-situ geophysical survey results, interpretation of published geological maps, and groundwater level data collected from published well logs and temporary piezometers installed at the project site.

2.0 PROPOSED CONSTRUCTION

We understand this project will consist of the construction of a 200 MW wind project powered by 100 Vestas V116-2.0 MW wind turbine generators (WTG's), as well as associated facilities within the project site. Structural loadings for the WTG's are summarized in Table 2.0.1.

Table 2.0.1 Summary of Structural Load Demand

WTG Type	Load Case	Axial Load (kips)	Shear at Base of Tower (kips)	Maximum Over-Turning Moment at Base of Tower (kips-ft)
Vestas V116 2.0MW IEC S 94m HH	Operational	615.3	90.9	27,348.4
	Normal Extreme	602.9	116.8	35,970.9
	Abnormal Extreme	599.1	143.0	46,385.3

The WTG's are anticipated to be supported on gravity foundation systems with an anticipated embedment depth of about 8.5 feet below finished grade. We have assumed finished turbine pad grade is at or slightly above the existing ground surface. Private access roadways will most likely be surfaced with imported road base materials from nearby quarry pits to support construction and vehicular traffic loads during and after construction.

3.0 SITE EXPLORATION

A subsurface exploration program for the first phase was conducted at the project site from April 29 to May 8, 2017 for the proposed 48 out of a total of 100 turbine sites. A second phase subsurface exploration program for the remaining turbine sites and auxiliary structures will be performed in a later date. The subsurface exploration consisted of performing a total of 48 Cone Penetrometer Test (CPT) soundings, one at each of the proposed turbine sites with 5 confirmation borings drilled at selected turbine locations. Figure 2 within Appendix A shows the 48 CPT sounding locations plotted on a topographic map. Figure 3 within Appendix A shows the 5 selected WTG confirmation boring locations plotted on a topographic map.

Geophysical MASW and seismic refraction surveys were performed at selected turbine sites. Figure 4 within Appendix A shows the selected turbine sites for MASW and seismic refraction surveys. The results for the MASW and seismic refraction surveys are discussed in Section 4.6 of this report.

In addition, temporary standpipe piezometers (PZ) were installed at 48 turbine sites to facilitate groundwater level measurements at desired time intervals after completion of piezometer installation. Bulk samples were collected from 2 selected WTG locations for California Bearing Ratio (CBR) testing. In addition, bulk samples were collected from 5 selected turbine locations for laboratory Standard Proctor testing.

Engineering properties of the subsurface materials were assessed through laboratory testing on selected soil samples. The following section describes our site exploration program in details.

3.1 Field Exploration and Testing

3.1.1 CPT Sounding

A total of 48 CPT soundings were performed by Fugro Consultants, Inc. (Fugro) during the period of April 29 through May 8, 2017. A summary of geographic latitude and longitude coordinates and depth of each CPT sounding performed as part of this subsurface exploration program is presented in Table 3.1.1. The CPT sounding locations were staked in the field by a surveyor working under the direction of Freeborn Wind Energy Center, LLC.

Table 3.1.1 Summary of CPT Sounding Locations and Depths

CPT No.	Latitude (North)	Longitude (West)	Total CPT Sounding Depth (feet)	Remarks
T-02	43.641726	-93.184437	50.6	
T-03	43.648312	-93.158133	50.5	
T-04	43.653958	-93.136697	50.7	
T-05	43.653501	-93.127180	50.6	
T-06	43.628371	-93.198284	50.6	
T-07	43.627243	-93.184531	50.8	
T-08	43.634839	-93.164673	48.9	
T-09	43.634734	-93.158174	50.6	
T-10	43.640159	-93.146022	50.7	
T-11	43.639481	-93.126055	50.6	
T-12	43.639482	-93.118168	50.6	
T-13	43.619491	-93.180644	50.6	
T-14	43.620101	-93.176149	47.9	
T-15	43.627040	-93.146901	50.7	
T-16	43.633627	-93.121939	50.8	
T-17a	43.628074	-93.117483	26.8	CPT refusal at 26.8 feet. Performed another sounding at T-17b.
T-17b	NA	NA	45.4	Offset within 15 feet from T-17a
T-18	43.602620	-93.191922	50.6	
T-19	43.596763	-93.194951	50.6	
T-20	43.566719	-93.203322	50.6	
T-21	43.568137	-93.198628	50.6	
T-22	43.547362	-93.254686	50.6	
T-23	43.546382	-93.246295	50.6	
T-24a	43.549936	-93.212292	24.9	CPT refusal at 24.9 feet. Performed another sounding at T-24b.
T-24b	NA	NA	50.6	Offset within 15 feet from T-24a
T-25	43.534378	-93.241412	46.8	
T-26	43.530820	-93.224506	50.6	
T-27	43.530754	-93.216227	50.6	
T-28	43.537887	-93.155554	50.6	
T-29	43.532474	-93.144029	44.7	
T-30	43.530211	-93.123969	45.0	
T-31	43.534093	-93.115413	50.3	
T-32	43.540694	-93.077166	44.1	
T-33a	43.542489	-93.073357	35.6	CPT refusal at 30.6 feet.

CPT No.	Latitude (North)	Longitude (West)	Total CPT Sounding Depth (feet)	Remarks
				Performed another sounding at T-33b.
T-33b	NA	NA	35.6	Offset within 15 feet from T-33a
T-34	43.544723	-93.066252	50.3	
T-35	43.527042	-93.220816	50.6	
T-36	43.523509	-93.203257	50.6	
T-37	43.518825	-93.186778	50.3	
T-38	43.518544	-93.162651	50.6	
T-39	43.519517	-93.156595	50.6	
T-40	43.518667	-93.141405	50.6	
T-41	43.520004	-93.136220	50.6	
T-42	43.517770	-93.124628	50.5	
T-43	43.520209	-93.120684	50.6	
T-44	43.522788	-93.116612	50.5	
T-45	43.501164	-93.186900	50.6	
T-46	43.505312	-93.183346	50.6	
T-47	43.504825	-93.166974	50.6	
T-48	43.507629	-93.163435	50.6	
T-49	43.501183	-93.145097	50.6	

The CPT soundings were carried out using an integrated electronic cone system, in accordance with ASTM D5778: Standard Test Method for Electronic Friction Cone and Piezocone Penetration Testing of Soils. The soundings were conducted using a 20-ton capacity track-mounted CPT equipment with a cone tip area of 15 cm^2, friction sleeve area of 200 cm^2, and a 60-degree apex angle. The cone is designed with an equal end area friction sleeve and a tip end area ratio of 0.59.

During a CPT sounding, the cylindrical cone was pneumatically pushed vertically into the ground at a constant rate of penetration of 20 mm/sec; and measurements were made of the cone tip resistance (q_c), the friction sleeve resistance (f_s), and penetration pore-water pressure (u) at 5-cm intervals during penetration, to provide a near-continuous hydro-geologic log.

RRC performed CPT data reduction and interpretation using the Computer Program “CPeT-IT” developed by GeoLogismiki and Gregg Drilling Inc., and presented various geotechnical parameters on the CPT logs based on published correlations (References 1 and 2). The CPT logs included interpreted Soil Behavior Type (SBT) plots. It should be noted that it is not always possible to clearly identify a soil type based solely on CPT tip resistance, sleeve friction and pore water pressure measurements, in which situations experience, judgment and an assessment of CPT tip resistance, sleeve friction and pore water pressure data were used to estimate the soil behavior type. A summary of CPT correlation equations and formulas used for the estimation of various soil properties are presented in Appendix A.

Temporary standpipe piezometers, 1-inch diameter schedule 40 PVC pipe consisting of 5 feet perforated and 10 feet solid riser pipe sections, were installed at 48 turbine locations to depths of about 13.5 to 15 feet below the existing ground surface. The temporary standpipe piezometers were installed by drilling shallow auxiliary borings at an offset distance of about 5 to 10 feet from the staked turbine locations. The screened portion of the temporary piezometer was placed at depths of about 8.5 to 10 feet below existing site grade and backfilled with sand extending about 1 foot above the screened portion. Hydrated bentonite was used to backfill the remaining portion of the piezometer borehole to the top of existing ground surface. Groundwater levels measured to date within the temporary piezometers are discussed in subsequent sections of this report.

3.1.2 Confirmation Borings

A total of 5 confirmation borings were drilled during the period of May 6 through May 8, 2017, at selected WTG locations after reviewing the CPT sounding results. The WTG borings were drilled near the centerline of the selected turbine structure. A summary of approximate geographic latitude and longitude coordinates and depth of each boring drilled as part of the subsurface exploration program is presented in Table 3.1.2.

Table 3.1.2 Summary of CPT Sounding Locations and Depths

Boring No.	Latitude (North)	Longitude (West)	Total Boring Depth (feet)	Remarks
T-06	43.628371	-93.198284	50.5	Drilled within 5 to 10 feet from the centerline of the turbine.
T-16	43.633627	-93.121939	50.5	Drilled within 5 to 10 feet from the centerline of the turbine.
T-23	43.546382	-93.246295	50.5	Drilled within 5 to 10 feet from the centerline of the turbine.
T-36	43.523509	-93.203257	50.5	Drilled within 5 to 10 feet from the centerline of the turbine.
T-47	43.504825	-93.166974	50.5	Drilled within 5 to 10 feet from the centerline of the turbine.

The borings were advanced with a CME-50 ATV-mounted drill rig utilizing hollow stem augers and wash rotary drilling techniques to the full depth of exploration. Relatively disturbed samples were obtained using Standard Penetration Test (SPT) samplers.

Penetration resistance values were recorded using methods based on the standard penetration test (SPT), in accordance with ASTM D1586: Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils. This test consists of driving the sampler into the ground with a 140-pound hammer free-falling a distance of 30 inches. The number of blows required to advance the sampler 18 inches is counted and recorded, with the sum of the blows to drive the last 12 inches referred to as the standard penetration resistance value (N-value) for SPT samplers. Results of the field tests are shown on the logs of boring under the “Field Data” column and are preceded by the letter “N”. Subsurface materials were collected from the SPT samplers in the field, visually classified, placed in plastic bags, and labeled as to location and depth. All SPT samples were arranged in core boxes and transported to our laboratory facility for further analysis.

Relatively undisturbed samples were obtained at specified intervals in cohesive and cohesionless soils, as directed by RRC's field geologist and/or field engineer, utilizing hydraulically advanced 3-inch (OD) diameter stainless steel, thin-walled tube (Shelby) samplers in accordance with ASTM D1587: Standard Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes. Soil samples obtained using Shelby tubes were tested for consistency utilizing a pocket-sized penetrometer. The penetrometer readings are included on the logs of boring preceded by the letter "P." Readings in excess of 4.5 tons per square feet (tsf), if any, indicate that the capacity of the device has been exceeded. Sufficient material from the lower end of the Shelby tube was removed for visual classification purposes. Both ends of the Shelby tube were sealed using plastic caps and secured with duct tape to prevent moisture loss in the sample. Sample location and depth were labeled on the outside surface of the tube. All Shelby tube samples were arranged vertically in Shelby tube holders with the same orientation as the sampling direction and transported to our laboratory facility for further analysis.

Soils were classified in general accordance with the Unified Soil Classification System (USCS); ASTM D2488: Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). The soil classification symbols appear on the logs of boring and are briefly described in Appendix A. Local and regional geologic characteristics were used to estimate seismic design criteria.

Field logs were prepared for each boring at the time of drilling by RRC's field geologist and/or field engineer. The project engineer/geologist reviewed all of the field logs of boring, soil samples, and made appropriate modifications to the logs of boring as necessary.

The field logs of boring contain visual classification of the materials encountered during drilling as well as interpolation of the subsurface conditions between samples. Final logs of boring, included in Appendix A, represent our interpretation of the field logs of boring and may include modifications based on laboratory testing performed on the selected samples. The final logs of boring describe the materials encountered, their approximate thickness, and the various depths at which the samples were obtained.

The field tests were conducted in general accordance with the basic requirements of the following:

- ASTM D1586: Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils;
- ASTM D1587: Standard Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes; and
- Locally accepted practices in this area.

During the field operations, the borings were observed for groundwater levels that are noted at the top of the logs of boring within Appendix A. Following the completion of the drilling operations, the borings were backfilled in accordance with state regulations.

3.2 Laboratory Analysis

The soil samples were returned to the laboratory, examined by the project engineer and geologist, and applicable laboratory testing was assigned on selected soil samples. Laboratory testing was performed in general accordance with ASTM and locally accepted practices. The following laboratory methods of analyses were generally utilized, where sample quality is allowed:

- Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System): ASTM D2487;
- Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass: ASTM D2216;
- Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils: ASTM D4318;
- Standard Test Methods for Amount of Material in Soils Finer than No. 200 (75-μm) Sieve: ASTM D1140;
- Standard Test Method for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis: ASTM D6913;
- Standard Test Method for Unconfined Compressive Strength of Cohesive Soils: ASTM D2166;
- Standard Test Method for Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils: ASTM D2850;
- Standard Test Methods for One-Dimensional Consolidation Properties of Saturated Cohesive Soils Using Controlled-Strain Loading: ASTM D4186;
- Standard Test Methods for One-Dimensional Consolidation Properties of Soils Using Incremental Loading: ASTM D2435;
- Standard Test Methods for One-Dimensional Swell or Collapse of Soils: ASTM D4546;
- Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort: ASTM D698;
- Standard Test Methods for CBR (California Bearing Ratio) of Laboratory-Compacted Soils: ASTM D1883;
- Standard Test Method for pH of Soils: ASTM D4972;
- Standard Test Methods for Measurement of Soil Resistivity Using the Two-Electrode Soil Box Method: ASTM G187; and,
- Sulfate and Chlorides Content: EPA 300/300.1.

4.0 SUBSURFACE CONDITIONS

4.1 Geology

Regional Geology

The project site is situated within the Owatonna Moraine Area physiographic province of Minnesota, a region modified and formed out of glacial landforms, primarily moraines along the eastern edge of the Des Moines lobe. The Des Moines lobe was part of the Laurentide Ice Sheet, a continental glacier, which extended down into Iowa. The glacial ice occupied the region up to around 12,000 years ago, at which point it began its retreat, leaving behind reworked sediments and the aforementioned moraine landforms. A variety of glacial deposits constitute the surficial geologic materials. Bedrock is found at nearly 100 feet, or more, below local ground surfaces.

Site-Specific Geology

The geologic interpretations contained herein are based on available geological maps and literature, and review of the logs of boring as part of this study. Till, found in ground and end moraine landform deposits along with outwash sand compromise the surficial geologic deposits at the project site. All are associated with last glacial period of North America, dating to Late Wisconsin Glacial Episode for which the maximum extent of the ice sheet was around 25,000 to 21,000 years ago. Since the deposition of the glacial sediments, local drainage systems have reworked some sediment, but much remains as it was left by the glacial ice. The Quaternary geologic map of the Des Moines 4° x 6° quadrangle, United States (Reference 3), indicates that the subsurface materials on the site consist of the following geologic units of the listed geologic time periods.

Quaternary Period

- **Outwash Sand** (gs)**:** Deposits of sand, either fine- to coarse-grained or silty sand, with occasional pebbles and small cobbles; and localized thin beds or lenses of silt. Sand is poorly to well sorted and well stratified at times. Color of the deposits varies, including pale- to dark-brown, reddish brown, yellowish- to grayish-brown and gray. Gravel is predominantly smaller than 32 millimeters in size, with some cobbles as large as 20 centimeters in diameter. Rock clasts within the deposits are rounded to subangular, primarily limestone or dolomite, large quantities of granitic rocks or gabbro and minor amounts of shale. The deposits are leached between 2 and 3 feet, with secondary carbonate concretions that form at depth and cement deposits. Iron oxide and manganese oxide are found along bedding planes and coating gravel, occasionally cementing material. Small deposits of alluvium or colluvium are present within mapped sections of the sand deposits. Thickness is commonly between 13 and 25 feet, but deposits can reach as much as 65 feet in thickness.
- **Loamy Till** (tlg)**:** Deposits of till consist of highly calcareous silt loam and loam, light brown, gray or grayish brown in color. Till is no more than poorly sorted. Eight percent of sand-sized particles within the deposits are carbonate particles, predominantly calcite. Clay minerals are noted as being dominantly expandable, including smectite with minor illite, kaolinite and chlorite presence. Rock clasts are primarily shale, limestone and dolomite, with some sandstone, chert and igneous rock-types occasionally. Thin, discontinuous cover of loess in isolated areas. Thickness ranges from 12 to 80 feet.

- **Loamy Till** (tlh)**:** Deposits of till consist of calcareous silt loam and loam, yellowish brown in color. Till is no more than poorly sorted. Sand-sized particles are primarily of a crystalline rock source. Pebble- and cobble-sized rock clasts vary in frequency, common to rare, with rock types including shale, limestone and minor amounts of igneous rock or chert. The unit is solely mapped in Minnesota. Some areas may be covered by up to 6 feet of loess. Thickness of deposits ranges between 15 and 50 feet.

Figure 5 within Appendix A shows approximate project boundaries plotted on a geologic map.

Based upon our review of Karst in the United States (Reference 4), the proposed wind turbine sites are located on carbonate bedrock overlain by more than 50 feet of glacially derived insoluble sediments in the humid climate. Rocks, or mineral deposits, such as limestone, dolomite, gypsum/anhydrite and salt are all susceptible to dissolution under the influence of groundwater.

A digitized version of the Karst in the United States: A Digital Map Compilation and Database, was created by the USGS for large-scale purposes (Reference 4). Due to the digitalization process, small errors may have been introduced, and this data set is not intended for site-specific purposes. Field exploration performed as a part of this study did not encounter bedrock formation to the maximum explored depth of approximately 50.8 feet below the existing ground surface. Therefore, the potential for land subsidence is low. Figure 6 within Appendix A depicts the wind turbine boring locations plotted on mapped karst zones in the vicinity of the project site.

4.2 Subsurface Stratigraphy

As indicated on the logs of boring for sites drilled as part of this study, native soils were encountered beneath about 12 to 24 inches of topsoil and extended to a depth of approximately 50.5 feet. The native soils generally consisted of the following:

- Very soft to very stiff lean clay with varying amounts of sand and gravel;
- Soft to very stiff silt with varying amounts of sand; and
- Very loose to medium dense sand with varying amounts of clay, silt and gravel.

Bedrock was not encountered in any of the borings completed as part of this study.

The above descriptions are general and depth ranges are approximate because boundaries between different strata are seldom clear and abrupt in the field. In addition, the lines separating major strata types on the logs of boring do not necessarily represent distinct lines of demarcation of the various strata. Detailed logs of boring for locations drilled as part of this study, which present the stratum descriptions, types of sampling used, laboratory test data, and additional field data, are presented in Appendix A. The Boring Log Key, defining the terms and descriptive symbols used on each log of boring, is also presented in Appendix A.

4.3 Field SPT Results

Figure 7 within Appendix A represent harmonic means for measured Standard Penetration Test (SPT) N-values for soils encountered at depths greater than 8.5 feet below existing site grade for WTG boring locations drilled at the project site. The measured SPT N-values above 8.5 feet are not included for these borings in the calculation since the foundation bearing elevation is assumed to be about 8.5 feet below existing site grade for this project.

The equation for the harmonic mean is shown below:

$$\frac{1}{H_y} = \frac{1}{n}\sum\frac{1}{Y_i}$$

Where:

H_y = Harmonic mean;

n = Total number of data points; and

Y = Measured SPT N-value.

As shown in Figure 7 within Appendix A, the lowest harmonic means of the measured SPT N-values is about 6 blows/ft at WTG No. T-06 and T-16. For other drilled WTG sites, harmonic means of N-values are between 7 and 10 blows/ft.

In addition to the analysis of harmonic mean SPT N-values for each boring, the results from geotechnical borings and CPT soundings were carefully reviewed for the presence of soft to medium stiff clay or very loose to loose sand layer(s) below foundation bearing elevation. Section 5.1 and Table A1 within Appendix A provide the recommended over-excavation depths, where required.

4.4 Laboratory Test Results

Laboratory testing is in progress. This section will be updated in the final report.

4.5 Groundwater Conditions

Groundwater was encountered in all 5 confirmation borings completed as part of this study during and after drilling. The groundwater was encountered at depths of about 13 to 35.5 feet below existing site grade at the time of drilling, and measured at depths of about 16 to 40 feet immediately after drilling. Groundwater conditions are summarized in Table 4.5.1. Upon completion of the drilling operations and/or subsequent groundwater measurements, the borings were backfilled in accordance with state and local regulations.

Table 4.5.1 Summary of Groundwater Conditions

WTG Location	Groundwater Depth during Drilling (feet)	Groundwater Depth Immediately after Drilling (feet)
T-06	34	8
T-16	N/A	19
T-23	N/A	10
T-36	N/A	6
T-47	19	N/A

Based upon review of published well logs in the vicinity of the project site available from Reference 5 (Minnesota Department of Health), within the project site, static groundwater levels were reported to be between 16 and 77 feet below the ground surface at well locations summarized in Table A2 within Appendix A. The shallowest groundwater level was recorded at approximately 16 feet below the ground surface at Well Nos. 413089, located approximately 0.35 miles from WTG No. T-29. The well locations shown on Table A2 are plotted on Figure 8 within Appendix A.

It should be noted that majority of the water wells were installed to deep aquifers below typical turbine foundation depth and indicate piezometric or static groundwater level within those deep aquifers only. The static water levels from the deep wells do not always provide useful groundwater information for shallow aquifers or perched water tables near turbine foundation depths that should be considered in turbine foundation design.

Temporary piezometers were installed at 48 WTG sites, to obtain additional groundwater levels after completion of drilling. Groundwater readings at the temporary piezometers were measured immediately after installation and 24 hours after installation, and prior to our demobilization from the site.

Relatively shallow groundwater appears to be somewhat prevalent within the majority of the temporary piezometers installed. Shallow groundwater conditions could be attributed to the proximity to existing bodies of water, natural drainages, irrigation practices, surrounding topography, seasonal variations, pumping and/or recharging characteristics on this site, and rain and snowfall in the area.

Based upon the information obtained from the borings drilled as part of this study, limited piezometer data and review of well log records, it is our opinion that groundwater may have an impact on shallow gravity foundation system design and construction at all locations drilled as part of this study. Table A1, within Appendix A, presents our recommended design groundwater depth below existing site grade for WTG foundation design at each of the proposed WTG sites.

In areas where groundwater levels are encountered at depths shallower than about 8.5 feet below existing site grade (assume WTG foundation bearing at 8.5 feet below existing site grade), the WTG foundations should be designed for buoyancy effects. Alternatively, foundation bearing elevation may be raised to a depth of the design groundwater level, if feasible. Relatively shallow groundwater levels encountered in the project area may also impact access roadways and crane pad construction. Further discussions related to groundwater conditions are presented in Section 5.1 of this report.

It is imperative to note that the short-term groundwater level observations performed as part of this study are not an accurate evaluation of groundwater levels at the project site, and should not be interpreted as a comprehensive groundwater study. The observations made during this investigation may also not represent conditions at the time of construction and it should be understood the presence of groundwater may have an effect on certain construction activities and long-term performance of foundations and pavements. Groundwater levels are highly dependent on climatic and hydrologic conditions before and after construction, and site development including irrigation demands, drainage and other factors. If a detailed groundwater study is desired, a groundwater hydrologist should be retained to perform these services.

4.6 Geophysical Properties

RRC performed 1-D MASW and seismic refraction surveys at selected turbine locations at WTG's T-06, T-16, T-23, T-36 and T-47, as shown on Figure 4 within Appendix A. The purpose of these geophysical surveys was to obtain shear wave velocity (V_s) and compressional wave velocity profiles at the center of the foundation at selected WTG locations. The MASW and seismic refraction survey methodologies and results are discussed in Section 4.6.1 and Section 4.6.2, respectively.

4.6.1 1-D MASW Survey

The Multi-Channel-Analysis-of-Surface-Waves (MASW) method is a non-intrusive/non-destructive technique which uses the nature of the Rayleigh waves to evaluate engineering and geotechnical properties (stiffness) of subsurface materials. Rayleigh waves of different wavelengths (or frequencies) travel at different velocities when they propagate along the surface of a layered system (material properties vary with depth). This property is called dispersion. In other words, the velocity of Rayleigh wave is dependent on the wavelength in the non-homogeneous system. Also, Rayleigh waves of different wavelengths travel/sample within different depth ranges (usually, waves of shorter wavelengths travel within shallower depth ranges).

Typically, for 1-D MASW survey, a linear array composed of twenty-four 4.5 Hz geophones with 5-foot equal spacing between each pair is laid out in the selected locations. Total length of the array is approximately 115 feet. A 16-pound sledge hammer is employed as the seismic source to generate a desired frequency (wavelength) range of the seismic waves by striking on a plate (placed 10 to 35 feet away from the first geophone) aligned within the geophone array. Seismic data are collected using the data recording device and processed using SurfSeis 4.0.4 computer software developed by Kansas Geological Survey (KGS).

The processed shear wave velocities are used to determine certain soil/bedrock characteristics based on simple equations. For example, the soil/bedrock shear modulus can be calculated using the following equation:

$$G = \rho V_S^2$$

where:

G = Shear Modulus (psf);
ρ = Mass density (pcf/(ft/sec.^{2})); and
V_s = Shear wave velocity (ft/sec.)

Young's Modulus, E, can also be calculated from the shear wave velocity data using the following equation:

$$E = 2G(1 + v)$$

where:

E = Young's Modulus (psf); and
v = Poisson's Ratio.

The weighted average is calculated based on the following formula based on the 2012 International Building Code (IBC) (Reference 6):

$$\overline{V_S} = \frac{\sum_i^n d_i}{\sum_i^n \frac{d_i}{V_{si}}}$$

Where:

d_i = Thickness of any layer between 0 and 100 feet; and
V_{si} = Shear wave velocity of a layer.

Note that the measured shear wave velocity using MASW may not be available up to 100 feet as shown in survey results in Appendix C (included in final submittal). In the case where measured shear wave velocity is available for less than 100 feet, the weighted shear wave velocity is calculated based on available depths.

To determine the rotational stiffness of the underlying soil, the parameters outlined in Table 4.6.1 can be used in the computation of the elastic and shear moduli when shear wave velocities are determined by geophysical methods.

Table 4.6.1 Recommended Soil Parameters

Soil/ Material Type	Poisson's Ratio	Average Total Unit Weight (pcf)
Soft to Medium Stiff Clay Soils	0.45(1)	110(1)
Stiff to Hard Clay Soils	0.35(1)	115(1)
Loose to Medium Dense Sand and Silt Soils	0.35(1)	115(1)
Dense to Very Dense Sand and Silt Soils	0.35(1)	120(1)
Structural Fill Materials (minimum 5 feet thick)	0.35	125

Note: (1) Based on Reference 7. (see page 123 for Poisson's ratio and page 163 for unit weight).

Computed parameters from the MASW surveys represent soil behavior at small strain; appropriate reduction factors should be used by the foundation designer to determine the rotational stiffness of the foundation system. The results of the 1-D MASW surveys at the project site will be presented in Appendix C in the final report.

4.6.2 Seismic Refraction Survey

Unlike the Rayleigh wavers, when seismic waves are generated at the ground surface, the body waves (Vp and Vs) not only travel along the surface but also into the subsurface. When the body waves, which propagate into the subsurface, reach an interface of 2 different soil (or rock) layers at a specific (critical) angle, some energy of the waves will travel along the boundary and be continuously refracted partial of their energy back to surface if the lower layer has higher velocity than the upper layer. If these refracted waves, which travel faster than the direct waves along the surface, and the reflection waves from the interface are detected by partial of a geophone array on the ground, engineers can use the arrival time gathered by these geophones to estimate the depth/thickness of each layer. Usually, compression waves (P-waves) are preferred for the seismic refraction because they are easier to be generated and observed.

Similar setup as of the MASW survey was used to perform the seismic refraction survey. The linear array employed is the same to the MASW survey, twenty-four 4.5 Hz geophones with equal spacing (5-foot) between each geophone pair. The total length of the array is 115 feet as well. Unlike the 1-D MASW surveys, there are 7 source locations instead of just one. The post-test process is performed using the software package, SeisImager/2D developed by Geometrics to reduce the data and provide a tomographic velocity image of each test site.

The results of the seismic refraction surveys performed at the project site will be presented in Appendix C in the final report.

5.0 GEOTECHNICAL RECOMMENDATIONS

5.1 General

The turbine sites drilled as part of this study appear suitable for the proposed construction. A summary of anticipated conditions that will require particular attention in the design and construction is presented below:

- Each log of boring was carefully reviewed for the presence of soft to medium stiff clays, loose sand layer(s) and/or non-competent materials below and near anticipated foundation bearing elevation. In order to improve foundation bearing capacity and to limit excessive settlement of these foundation soils, we recommend these materials be partially removed to the depth outlined in Table A1, Summary of Foundation Design Net Allowable Bearing Pressure and Design Groundwater Recommendations within Appendix A or to a competent soil layer. The removed materials may be re-compacted or replaced with on-site suitable materials or imported structural fill meeting the requirements outlined in subsequent sections of this report. The over-excavation of unsuitable soils could be terminated prior to reaching the recommended depths provided suitable bearing conditions are uniformly exposed throughout the excavation. Excavations should be observed by a qualified representative of the geotechnical engineer prior to backfilling to assess the suitability of the foundation soils and to verify the over-excavation depths. In some cases, additional over-excavation may be necessary.

  Replacement materials should be compacted to a minimum of 97% of the maximum dry density as determined by ASTM D698 and moisture conditioned within 2% of optimum moisture content. The over-excavated area should extend a minimum lateral distance of 1 foot beyond the edges of the foundation and then extend downward at a slope of 1:1 (H:V). The over-excavated areas should be sloped and/or shored in accordance with OHSA regulations as required.

- Cohesionless materials encountered near foundation bearing elevation could potentially be disturbed during excavation. It is recommended that for sites where foundation subgrade consist of cohesionless material, the upper 12 inches of soils shall be scarified and moisture conditioned within 2% of optimum moisture content and compacted to 97% of the maximum dry density as outlined by ASTM D698.

- Relatively shallow groundwater conditions encountered in a majority of piezometers installed at 48 turbine sites will require particular attention in the design and construction of foundations, access roadways, and crane pads. Table A1, Summary of Foundation Design Net Allowable Bearing Pressure and Design Groundwater Recommendations presented in Appendix A provides the recommended design groundwater levels for these sites based on measurements recorded as part of this study.

- The stability of the subgrade at foundation bearing elevation may be affected by the proximity to shallow groundwater levels and/or “Perched” Groundwater conditions. In order to improve stability and to establish a stable platform for construction, consideration should be given to dewatering the site during construction and/or the use of granular or crushed rock materials with or without geogrid/geotextile at the base of unstable foundation excavations. Dewatering means and methods are the responsibility of the contractor.

Over-excavation of loose, soft and wet soils and replacement with granular materials may be required at some locations. Unstable subgrade conditions may also develop if excavations are left exposed for surface run-off after periods of rainfall for an extended period of time, or where perched groundwater is present and where drying of wet soils is not practical. As a guide, larger sized crushed rock materials less than 6 inches in maximum overall nominal diameter may be used at the base of over-excavated areas and capped off with well-graded fill materials to establish a stable platform prior to mud slab placement. We anticipate about 18 to 24 inches of rock and well-graded materials with sufficient amount of fines may be needed in areas where stabilization measures are required. The use of chemical stabilizers such as lime (dry or hydrated) or fly ash or cement could also be considered to improve the stability of the subgrade; however, these alternatives must be evaluated and their feasibility assessed prior to use. Provisions to keep the excavations dry during construction and prior to backfill operations should also be implemented for all foundation sites.

- It is crucial to maintain a uniform foundation subgrade support below the turbine foundation to reduce the potential of excessive differential foundation settlement. If compacted structural fill is used below turbine foundation, the thickness of structural fill below turbine foundation shall be minimum 6-inches; the structural fill thickness shall be kept as uniform as possible with no abrupt thickness change, with an overall thickness difference of 2 feet or less across the turbine foundation footprint.

- Should cobble or larger sized gravel materials be exposed at foundation bearing elevation during excavation activities, consideration should be given to removal of these larger-sized particles and replacement with engineered fill, or on-site granular materials meeting the requirements outlined in subsequent sections of this report. Foundations bearing on exposed cobbles and larger-sized particles have the potential for the creation of point loads at the bottom of the foundations and increased risk of differential foundation stress.

- It is anticipated that excavations may be advanced with conventional earth moving equipment. Excavation contractors and/or underground utility installers should consider performing test pits or probing tests to evaluate proper means and methods for advancing excavations. Potential caving/sloughing of loose/soft and dry soils within narrow and shallow utility trenches may require sidewalls of trenches to be sloped in order to properly install underground utilities. Excavated trench bottoms should be thoroughly cleaned prior to bedding materials and cable placement and backfilling.

- The extent and location of the site grading is unknown at this time. We should review the civil drawings and cross-sections for each of the turbine pads and critical areas along the proposed roadways once they become available if significant grading is planned. This will allow us to evaluate the need for additional studies such as slope stability analyses. However, for this current study, we anticipate the majority of turbine foundations will bear on native soils with minimal slope stability impacts provided measures outlined in this report are implemented.

- WTG foundations located adjacent to natural or man-made slopes should be setback laterally from the top of the slope. The minimum setback distance should be 25 feet from the edge of foundation to the crest of any natural or man-made slopes. Proper drainage measures should be taken to reduce impacts to man-made cut and fill slopes as well as all undisturbed natural slopes.

It is imperative that a qualified representative of RRC observe each foundation excavation at the time of excavation to verify exposed foundation soil bearing conditions and to assess the need and limits of removal and replacement. Detailed foundation design and construction recommendations are outlined in subsequent sections of this report.

5.2 Turbine Gravity Foundation System

The use of gravity foundation systems for support of the WTG's is considered acceptable. Bearing capacity and settlement calculations were performed in general accordance with methodologies outlined in the 2nd Edition of "Guidelines for Design of Wind Turbines" (Reference 8) and generally accepted standard of care and practice along with experience with similar soil conditions in this type of geological setting. Detailed discussions of bearing capacity and settlement for WTG bearing on native soils are outlined in the following subsections.

5.2.1 Bearing Capacity and Settlement of Gravity Foundation System

Net allowable bearing pressures of 1,250 to 3,000 psf can be used in the structural design for foundation bearing directly on native soils provided the remedial measures outlined in Section 5.1 and in the summary of foundation design recommendations included in Table A1 within Appendix A are followed. The allowable values are based on a safety factor of 3. These net allowable bearing pressure values may be increased by 25% when considering short duration loading conditions such as extreme wind and seismic forces.

The estimated total turbine foundation settlement is expected on the order of 1.0 to 2.0 inches under normal operating loading condition at center of the foundation. The estimated differential settlement or tilt across the foundation diameter is less than 0.3% under both dead load and normal operating loading conditions.

Table 5.2.1.1 presents a summary of design parameters for on-site soils and structural fill materials required for the foundation design.

Table 5.2.1.1 Recommended Soil and Structural Fill Design Parameters

Soil/ Material Type	Friction Coefficient[1]	Modulus of Subgrade Reaction, k_s[2] (pci)
Soft to Medium Stiff Clay Soils	0.35	35
Stiff to Hard Clay Soils	0.35	75
Loose to Medium Dense Sand and Silt Soils	0.35	75
Dense to Very Dense Sand and Silt Soils	0.45	100
Structural Fill Materials (minimum 5 feet thick)	0.45	150

Note: [1] If necessary, lateral passive earth pressures can be considered to develop additional resistance. The coefficient of base friction should be reduced to 0.30 when used in conjunction with passive pressure.
[2] For 1-ft. X 1-ft. Plate.

To determine the rotational stiffness of the underlying soils, the foundation designer should refer the results of the MASW surveys performed as part of this study. The results of these surveys will be presented in Appendix C in the final submittal.

Potential Vertical Rise (PVR) is an estimate of the potential of an expansive soil to swell from its current state, if the clay is allowed to absorb additional moisture. Shrink/swell movement for the proposed turbine foundations at the project site is calculated to be on the order of 0.5 inch or less using the Texas Department of Transportation (TxDOT) method Tex-124-E. The estimated PVR value is dependent on the foundation embedment depth and the bearing pressure anticipated at the foundation grade. Additional shrink/swell movements can occur in areas if water is allowed to pond during or after construction on soils with high plasticity, or if highly plastic soils are allowed to dry out prior to fill or concrete placement. High plasticity clay may also experience shrinkage during periods of dry weather as moisture evaporation occurs at the ground surface and the groundwater table drops. Therefore, uniformity and preservation of the moisture contents of the near surface clays during construction and during the life of the structure is critical to reducing potential shrink-swell movement. It is imperative that proper drainage be maintained during construction and throughout the life of these structures.

The use of on-site clays or sands as backfill against foundations is considered acceptable provided the materials are properly processed and placed. Recommendations for use of on-site materials, borrow material or structural fill materials are discussed further in subsequent sections within this report.

Based on our experience with these types of materials and results of maximum dry density-optimum moisture content relationships performed as part of this study (ASTM D698), anticipated overburden backfill densities are outlined in Table 5.2.1.2 below.

Table 5.2.1.2 Overburden Backfill Density Range Requirement

Soil/ Material Type	Dry Backfill Unit Weight Range, γ_d (pcf)	Moist Backfill Unit Weight Range, γ_{total} (pcf)
On-site soils	To be determined	To be determined

Note: pcf= pounds per cubic foot

Overburden backfill over foundations should be compacted to a minimum of 90% of the maximum dry density as determined by ASTM D698 to reduce the potential of erosion and/or scour events. Overburden backfill soils should be moisture conditioned within 3% of optimum moisture content prior to compaction.

5.3 Lateral Earth Pressures

Lateral earth pressures will apply in strata where soils are the main constituent. The turbine will be designed to resist all lateral movements; therefore, the "at rest" lateral earth pressure will develop.

Where the design includes restrained elements, the following "at rest" equivalent fluid pressures are recommended as shown in Table 5.3.1.

Table 5.3.1 Recommended Equivalent Fluid Pressures for "At Rest" Lateral Earth Pressures

Material Type	"At Rest" Coefficient of Lateral Earth Pressure, *Ko*	Equivalent Fluid Pressure for "At Rest" Lateral Earth Pressure (psf/ft)
Clay Soils	0.65	75.0
Sand Soils	0.55	65.0

Passive and active earth pressure resistance will only mobilize after significant movement of the foundation. The passive case occurs where a structural element tends to move into the soil mass. The active case occurs when the element tends to move away from the soil mass. Both cases are applicable for unrestrained foundation elements.

For soils above any free water surface, recommended equivalent fluid pressures for unrestrained foundation elements when using on-site soils as backfill are shown on Table 5.3.2 and Table 5.3.3 for active and passive lateral earth pressures, respectively.

Table 5.3.2 Recommended Equivalent Fluid Pressures for Active Lateral Earth Pressures

Material Type	Active Coefficient of Lateral Earth Pressure, *Ka*	Equivalent Fluid Pressure for Active Lateral Earth Pressure (psf/ft)
Clay Soils	0.50	60.0
Sand Soils	0.35	40.0

Table 5.3.3 Recommended Equivalent Fluid Pressures for Passive Lateral Earth Pressures

Material Type	Passive Coefficient of Lateral Earth Pressure, *Kp*	Equivalent Fluid Pressure for Passive Lateral Earth Pressure (psf/ft)
Clay Soils	2.05	245.0
Sand Soils	2.75	330.0

The equivalent pressures listed above are based on an average unit weight of 120 pcf for on-site clays. For soils below the free water surface, hydrostatic water pressure should be added to the lateral earth pressure acting on below grade foundation walls under active and at-rest condition, and the equivalent fluid pressures should be calculated using the effective unit weights (the above total unit weight minus 62.4 pcf) multiplied by the appropriate earth pressure coefficient (Ko and Ka). For soils below the free water surface, equivalent fluid pressures for the passive earth pressure resistance should be calculated using the effective unit weights (the above total unit weight minus 62.4 pcf) multiplied by the appropriate earth pressure coefficient (Kp). Hydrostatic water pressure should not be considered for calculation of the passive earth pressure resistance. The above earth pressure values do not include safety factors. We recommend a minimum safety factor of 2.0 be applied when using passive earth pressure for lateral load resistance. Surcharge loads should also be considered where appropriate. The values apply only to cases where the ground surface is level. We should be contacted to provide suitable values for cases where the ground surface is sloped.

5.4 Seismic Considerations

For structural designs based upon the 2012 International Building Code (IBC) (Reference 6), a Site Class D should be used for the project site. The Mapped Spectral Response Acceleration for the 1 second (S_1) and short periods (S_S) were computed using the U.S. Seismic Design Maps web-based application program developed by the United States Geological Survey (USGS) (Reference 9). Table 5.4.1 summarizes recommended seismic parameters to be used in the design:

Table 5.4.1 Recommended Seismic Parameters

Parameter	Recommended Calculated Value
S_S – Mapped Spectral Response Acceleration at Short Period (0.2-Second)	0.051 g
S_1 – Mapped Spectral Response Acceleration at 1-Second Period	0.035 g
F_a (Site Coefficient) – Site Class D	1.6
F_v (Site Coefficient) – Site Class D	2.4

6.0 FOUNDATION CONSTRUCTION CRITERIA

6.1 Site Preparation

Prior to construction, we recommend adequate positive drainage be provided to maintain a relatively dry condition in the area of proposed construction. This will be very important if any work is attempted during periods of prolonged rainfall. Ponding of water in the areas of construction should be avoided.

Winter conditions can also impact the construction process. Newly placed fill should not be placed on frozen subgrade and frozen material should not be used for fill.

Site preparation should begin by removing surface vegetation, organic topsoil, and major root systems within the foundation areas. Deleterious materials should be placed in non-structural areas or removed from the site. During excavation of the turbine foundations, every effort should be made to avoid disturbing the subgrade materials at the planned foundation bearing elevation. When the subgrade is disturbed, the resulting surface should be re-compacted to achieve a minimum compaction of 97% of the maximum dry density as determined by ASTM D698 and moisture conditioned within 2% of optimum moisture content. In areas where densification of the subgrade materials is required, proper slopes meeting federal, and state OSHA requirements should be maintained. The base of each foundation excavation should be observed by the geotechnical engineer or a qualified representative prior to foundation installation.

6.2 On-Site Excavated Materials as Overburden Backfill

The use of on-site clay and sand soils is considered acceptable as backfill materials against foundations provided the materials are properly processed and placed. On-site soils containing significant amount of organics should not be used for backfill. Excavated material may be stockpiled for later use as overburden backfill or structural backfill. These materials should be free of organics, roots, and deleterious materials before the stockpile is allowed for reuse. The backfill materials should be placed in thin, loose lifts not exceeding 12 inches prior to compacting. Each overburden material lift should be compacted and moisture conditioned properly in order to provide the minimum and maximum dry and wet unit weight values used in the structural design.

Overburden backfill over turbine foundations should be compacted to a minimum of 90% of the maximum dry density as determined by ASTM D698 to reduce the potential of erosion and to reduce flood water infiltration within the backfill zone. Clay and sand soils should be moisture conditioned within 3% of optimum moisture content prior to compaction. Consideration should be given to the use of a minimum 12-inch clay cap when the backfill zone is comprised of granular materials and where the foundation bearing soils consist of clays. The clay cap should be extended a minimum of 5 feet beyond the turbine foundation edge.

In areas where structural elements such as transformer pads are located within the backfill zone, these subgrade soils should be compacted to a minimum of 97% of the maximum dry density as outlined by ASTM D698 and moisture conditioned within 2% of optimum moisture content and the compaction should be extended a minimum of 1.0 foot beyond the pad edge.

6.3 Structural Fill Specifications

Structural fill material beneath foundations and in areas where over-excavation is performed should consist of a non-expansive, well-graded material with sufficient binder for compaction purposes. Locally available materials meeting the Minnesota Department of Transportation Standard Specifications for Construction (Reference 10), Class 2 or better may be used. If other materials are to be considered, they should conform to the following general specification:

	Percent Finer by Weight
1 "	100
¾ "	100
3/8 "	65-90
No. 4 Sieve	35-70
No. 10 Sieve	25-45
No. 40 Sieve	12-30
No. 200 Sieve	5-13
• Maximum Plastic Index	10

Structural fill should be placed in lifts having a maximum loose lift thickness of 12 inches and should be compacted to a minimum of 95% of ASTM D 1557 or a minimum of 98% of ASTM D 698. The structural fill should be moisture conditioned with 2% of optimum moisture content.

6.4 Reuse of On-site Materials as Structural Fill below Foundation

Modification of unsuitable foundation soils shall consist of over-excavation and replacement with any of the following materials:

1. On-site clay and sand soils may be reused beneath the foundation with approval of the proposed material by the geotechnical engineer.

   i. On-site material used beneath the foundation shall have a maximum plasticity index of 12 and a maximum liquid limit of 40.

   ii. These reused materials shall be compacted to a minimum of 97% of the maximum dry density as determined by ASTM D698 or 95% as determined by ASTM D1557 and shall be moisture conditioned within 2% of optimum moisture content.

2. Borrow lean clay and sand soils may be used beneath the foundation with approval of the proposed material by the geotechnical engineer. Borrow material shall meet the requirements outlined in the items (i) and (ii) above.

3. Structural fill meeting the criteria shown in Section 6.3 of this report.

6.5 Shallow Foundation Construction

The following construction criteria and general guidance should be observed during foundation construction:

- All foundation excavations should be observed by a Geotechnical Engineer or a qualified representative to assess proper bearing materials are present at foundation bearing elevation in accordance with the recommendations given herein, and to assess the need for densification of the subgrade materials.

- Special care should be taken to protect the exposed soils from being disturbed, freezing or drying out prior to placement of the structural fill pad.

- The foundation contactor should determine proper excavation means and methods. The foundation excavation should be sloped sufficiently to create internal sumps for runoff collection and removal. Foundation excavations subject to rainfall and possible deterioration from accumulated water should be protected using a protective "mud-slab" (concrete) not less than 2 inches in thickness. If surface runoff water or groundwater seepage accumulates at the bottom of the foundation excavation, it should be collected and removed and not allowed to adversely affect the quality of the bearing surface.

- The foundation excavations should be checked for size and cleaned of loose material and debris prior to the placement of reinforcing steel. Precautions should be taken during the placement of reinforcement and concrete to prevent the loose excavated material from falling into the excavation. A proof-roll of the excavation subgrade should be performed with a fully-loaded front-end loader or a similar equipment to assess the need for any shallow remedial measures. If excessive deflection or soft areas are observed while performing the proof-roll operations, the remedial measures outlined in previous sections of this report should be followed, if applicable. The proof-roll operations should be observed by a qualified representative of the geotechnical engineer. In addition, Static or Dynamic Cone Penetrometer (depending on the subgrade materials exposed at foundation bearing elevation) should be conducted to verify foundation design bearing pressures are met.

- Prior to the placement of concrete, water or frozen ground if present must be removed from the foundation excavation.

- Prompt placement of concrete in the excavation as it is completed, cleaned, and observed is strongly recommended.

6.6 Open Excavations

Temporary construction slopes and/or permanent embankment slopes should be protected from surface runoff water. Site grading should be designed to allow drainage at planned areas where erosion protection is provided, instead of allowing surface water to flow down unprotected slopes.

Surcharge loads, either static or dynamic, should not be applied to an excavation slope. Construction equipment should be prevented from traveling along or near the top of the excavation slope. Monitoring of temporary slopes, trenches, and dewatering during construction should be undertaken by the contractor to detect early warnings of movement within slopes, structures, pavements, etc.

In all cases of excavations, sloped excavations and trench shields are recommended for excavations greater than 4 feet in depth. OSHA and applicable state and local standards should be observed and followed. Site safety is the responsibility of the contractor.

6.7 Corrosivity

Water-soluble sulfate, chloride, minimum resistivity and pH testing are currently in progress. The results will be provided in the final report.

Table 6.7.1 Effect of Resistivity on Corrosion (Reference 11)

Aggressiveness	Resistivity in ohm-cm
Very Corrosive	< 700
Corrosive	700 – 2,000
Moderately Corrosive	2,000 – 5,000
Mildly Corrosive	5,000 – 10,000
Non-Corrosive	> 10,000

6.8 Drainage and Construction Dewatering

Proper drainage should be provided away from the foundation elements during all phases of construction and post-construction grading. Proper drainage is essential to the long-term stability of the structures. Ponding of water near the foundation elements from improper drainage should not be permitted.

Based on the available groundwater information, shallow groundwater may be a concern for WTG foundation excavation dewatering at some turbine locations. If shallow perched water is present at WTG sites where clay soils are exposed within the turbine foundation excavation depths, we anticipate the groundwater re-charge rate may be slow enough to conduct excavation dewatering with conventional sumps and "trash" pumps.

However, at WTG locations where foundation excavation bottom extends into water-bearing sand soils, the groundwater re-charge rate may be too high to manage with conventional sumps and pumps. For those sites, a dewatering system with well points or eductors may be needed to draw down the groundwater table. Without effective dewatering, the sand soils at excavation bottom may become unstable, and could possibly result in a "quick sand" condition when the effective stress of sand soils is at or close to zero due to upward seepage force.

A dewatering contractor should be consulted to evaluate the need for dewatering with well points, and to determine the layout and depth of the dewatering well points or eductors, based on the available geotechnical information. In general, we recommend the groundwater table be lowered to a minimum of 1 to 2 feet below the bottom of the foundation excavation. For turbine sites that requires over-excavation, after the water table is lowered by dewatering, consideration can be given to using a 12-inch thick layer of large crushed rock materials (less than 6 inches in maximum overall nominal diameter) at the excavation bottom which can then be capped off with compacted granular structural fill to establish a stable platform for construction.

6.9 Private Access Roadways and Crane Pads Design and Construction Recommendations

Private Access Roadways: It is our understanding that private access roadways will be built for construction and maintenance purposes. Traffic volumes during construction are anticipated to be frequent with heavy equipment utilizing the access roadways. Following the construction period, the traffic volumes will be light and vehicles accessing the roadways will generally consist of pickup trucks and occasional single and multi- unit truck traffic. The section thickness design should be based upon the methodology outlined by the American Association of State Highways and Transportation Officials (AASHTO) for design of aggregate-surfaced roadways (Reference 12).

The surficial materials encountered within a majority of the confirmation borings indicated native soils consisting of clay soils with varying amounts of sand and sand soils with varying amounts of clay and silt. These materials are generally considered to be poor to fair in terms of supporting vehicular and construction traffic as defined by AASHTO when used for support of pavement structures. The actual pavement thickness should be determined by the design/build contractor, keeping in mind the frequency, duration and requirements of the turbine manufacturer.

CBR testing is currently in progress and the results will be provided in the final report.

Prior to the placement of the aggregate base materials along access roadway alignments, stripping and removal of existing vegetation and other deleterious materials from the proposed roadway alignment should be performed. Topsoil and organics could be up to about 12 inches or more in thickness in some areas and should not be allowed for use in structural areas or along roadway alignments. The exposed subgrade should then be proof-rolled prior to the placement of the aggregate base course materials to assess the presence of soft areas and the need for remedial measures, if any. In areas where excessive "pumping" of the subgrade is observed, partial removal of unsuitable soils in these areas and re-compaction and/or replacement with granular materials will be required. As an alternative, consideration should be given to placing geogrid (Tensar Biaxial Type 2 or equivalent) on top of geotextile (Mirafi HP 570 or equivalent) in areas where excessive "pumping" is observed. Aggregate base materials should be compacted to a minimum of 95% of ASTM D1557 or a minimum of 98% of ASTM D698 and within 2% of the optimum moisture content.

Consideration could be also be given to performing a cement or lime mix design to stabilize the subgrade soils supporting pavement structures as an alternative. Stabilized subgrade materials treated to a depth of 8 to 12 inches with about 4% to 6% cement or about 5% to 7% hydrated lime by dry weight can achieve higher CBR values when compacted to 95% of the maximum dry density as determined by ASTM D698 at or near optimum moisture content. Aggregate base thickness for stabilized access roadway subgrade sections could be reduced with a minimum of 4 inches. A formal cement or lime mix design should be performed prior to construction to determine design CBR values and aggregate base thicknesses.

Crane Pads: Based upon the information obtained from the turbine confirmation boring logs and CPT sounding logs, very soft to medium stiff clay with varying amounts of sand below the topsoil are capable of supporting a net allowable bearing pressure of 1,000 to 2,000 psf, which includes a safety factor of 2. To improve the performance of the subgrade native soils supporting crane pads, we recommend the exposed subgrade (after stripping and removal of organic soils, vegetation and other deleterious materials) be scarified and reworked to a depth of 48 to 60 inches below existing site grade. The reworked area should extend a minimum horizontal distance of 3 feet beyond the edges of the crane pads. Reworked on-site subgrade soils should be compacted to a minimum of 95% of the maximum dry density per ASTM D698.

We recommend the compacted subgrade be tested by proof-rolling. A fully loaded 40,000 lbs, double-axle water-truck or equivalent should be used for proof-roll tests. The subgrade soil should not deflect more than 1.0 inch under the imposed loads. If higher deflections are observed, the subgrade soil should be over-excavated to suitable material and replaced with a properly compacted material in accordance with Section 6.3 or Section 6.4 of this report. In addition, consideration should be given to the use of either Static or Dynamic Cone Penetrometer (depending on the subgrade materials exposed at foundation bearing elevation) as an added measure to verify design bearing pressures and the need for any remedial measures.

Once a suitable subgrade condition has been achieved, a structural gravel pad should be placed to a thickness of approximately 18 inches. The crushed stone or aggregate base should conform to the requirements of the Section 6.3 of this report or better. The base material should be compacted to a minimum of 98% of the maximum dry density and within 2% of optimum moisture content as determined in accordance with ASTM D698. Crane pads constructed as recommended above are anticipated to have an allowable bearing capacity of about 3,000 to 4,500 psf. For bearing loads in excess of this amount, load distribution mats should be utilized so that the bearing capacity is not exceeded. Composite mats are capable of widely distributing the crane loads to the underlying soils for crane pads. The type and number of layers of these composite mats should be determined by the contractor and/or manufacturer to assure proper performance of the crane pads.

General Consideration: It is imperative that proper drainage of the subgrade be provided in the construction of the roadways and crane pads to enhance their performance. Post-construction proof rolling of the subgrade materials should be performed prior to re-opening the roadways for traffic after periods of heavy rainfall or snowmelt to assess stability of the roadway and the need for remedial measures. The proof-roll should be accomplished with a fully loaded water truck or similar heavy equipment. Areas where remedial measures are required should be re-worked and corrected prior to acceptance. It is also imperative that periodic inspection of the access roadways be performed following periods of rainfall or snowmelt to assess the condition of the roadways and the need for remedial measures.

7.0 LIMITATIONS

Recommendations contained in this report are based on our field observations and subsurface explorations, limited laboratory tests, and our present knowledge of the proposed construction. It is likely soil conditions will vary between or beyond the points explored. If soil conditions are encountered during construction that differ from those described herein, we should be notified immediately in order to provide supplemental recommendations (if needed). If the scope of the proposed construction, including the proposed loads or structural locations, changes from those described in this report, our recommendations should also be reviewed.

We have prepared this report in substantial accordance with the generally accepted geotechnical engineering practice as it exists in the site area at the time of our study. No warranty is expressed or implied. The recommendations provided in this report are based on the assumption RRC will conduct an adequate program of tests and observations during the construction phase in order to evaluate compliance with our recommendations.

This report may be used only by the client and only for the purposes stated, within three years from its issuance. Land use, site conditions (both on site and off site) or other factors may change over time, and additional work may be required with the passage of time. Any party other than the client, or the client's design team members for this particular project, who wishes to use this report shall notify RRC of such intended use. Based on the intended use of the report, RRC may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the client or anyone else will release RRC from any liability resulting from the use of this report by any unauthorized party.

Other standards or documents referred in any given standard cited in this report, or otherwise relied upon by the authors of this report, are only mentioned in the given standard; they are not incorporated into it or "included by reference," as that latter term is used relative to contracts or other matters of law.

8.0 REFERENCES

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APPENDIX A

Table A1 -- Summary of Foundation Design Net Allowable Bearing Pressure and Design Groundwater Rommendations

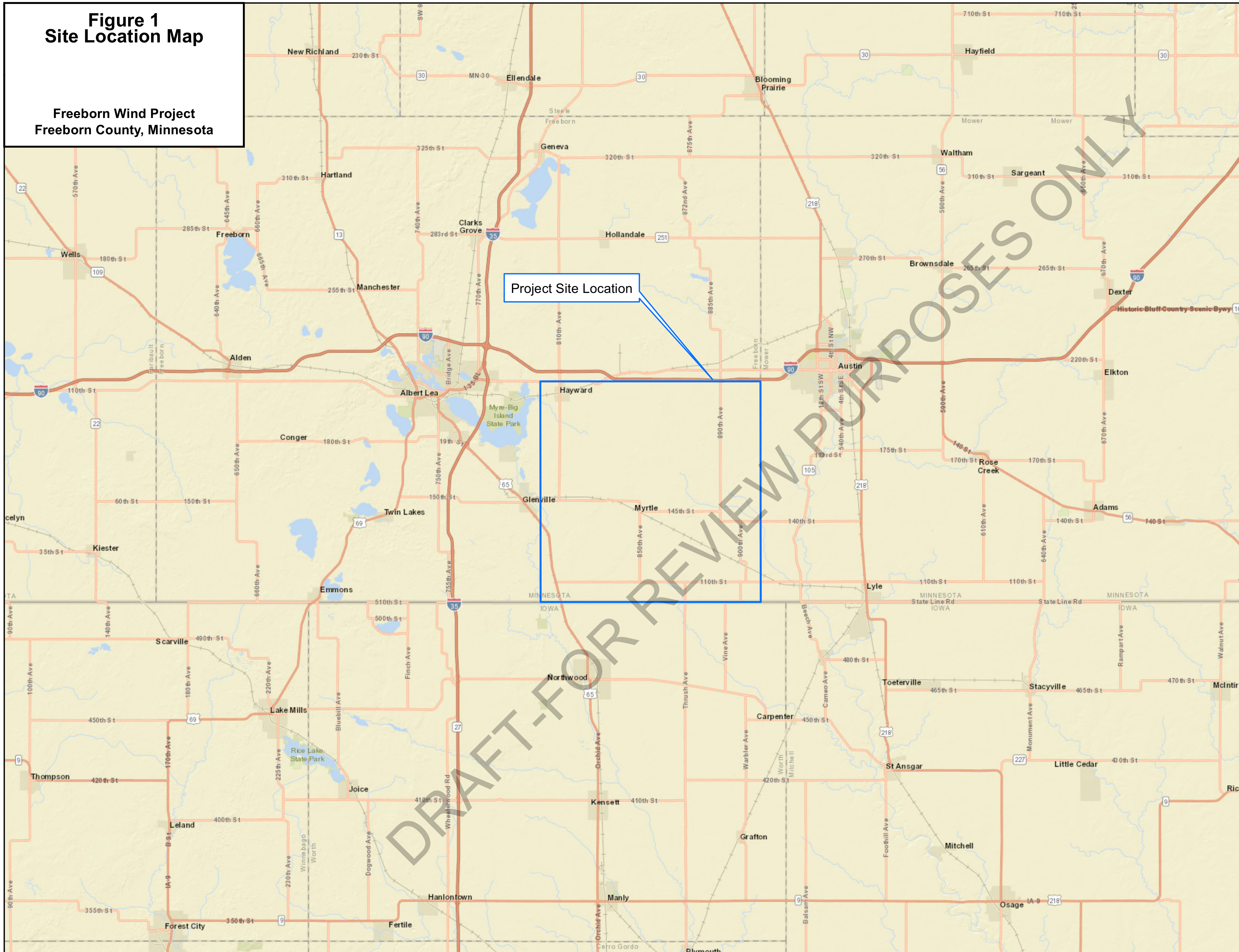
WTG No.	Latitude	Longitude	Groundwater During Drilling (feet)	Groundwater Immediately After Drilling (feet)	Estimated Groundwater from CPT Pore Presssure Dissipation Test (feet)	Groundwater Immediately After Piezometer Installation (feet)	Groundwater 24-Hour After Piezometer Installation (feet)	Groundwater in Piezometer Between 5/8/17 and 5/10/17 (feet)	Design Groundwater Level Recommendation (feet)	Preliminary Design Net Allowable Bearing Pressure (psf) [1]	Minimum Over-excavation and Recompaction Depth Below the Foundation Bearing Elevation of 8.5 feet (feet)
T-02	43.641726	-93.184437	NA	NA	NA	4.4	3.7	4.0	To be Determined	1,500	
T-03	43.648312	-93.158133	NA	NA	NA	11.7	4.0	4.5	To be Determined	1,500	
T-04	43.653958	-93.136697	NA	NA	NA	2.9	1.5	2.8	To be Determined	1,500	1.5
T-05	43.653501	-93.127180	NA	NA	NA	3.9	3.1	3.4	To be Determined	1,250	
T-06	43.628371	-93.198284	34.0	8.0	1.6	4.2	3.4	2.5	To be Determined	1,250	
T-07	43.627243	-93.184531	NA	NA	NA	3.4	3.3	3.8	To be Determined	1,500	
T-08	43.634839	-93.164673	NA	NA	NA	6.7	2.8	3.0	To be Determined	1,500	
T-09	43.634734	-93.158174	NA	NA	2.9	3.2	3.6	3.9	To be Determined	1,500	
T-10	43.640159	-93.146022	NA	NA	NA	NE	5.5	5.6	To be Determined	2,000	
T-11	43.639481	-93.126055	NA	NA	NA	7.5	2.1	2.3	To be Determined	1,250	
T-12	43.639482	-93.118168	NA	NA	NA	9.9	3.7	3.7	To be Determined	1,500	
T-13	43.619491	-93.180644	NA	NA	NA	2.7	3.5	4.2	To be Determined	1,250	
T-14	43.620101	-93.176149	NA	NA	NA	10.6	2.8	3.3	To be Determined	1,500	
T-15	43.627040	-93.146901	NA	NA	NA	12.5	2.9	3.8	To be Determined	1,500	
T-16	43.633627	-93.121939	NA	19.0	NA	4.1	3.4	3.9	To be Determined	1,250	0.5
T-17	43.628074	-93.117483	NA	NA	NA	9.5	5.3	4.4	To be Determined	1,250	
T-18	43.602620	-93.191922	NA	NA	7.4	10.8	7.9	4.2	To be Determined	1,500	
T-19	43.596763	-93.194951	NA	NA	7.7	NE	3.4	3.8	To be Determined	1,500	0.5
T-20	43.566719	-93.203322	NA	NA	8.0	5.3	5.1	5.3	To be Determined	2,000	0.5
T-21	43.568137	-93.198628	NA	NA	8.8	2.2	2.1	3.0	To be Determined	1,500	0.5
T-22	43.547362	-93.254686	NA	NA	2.4	2.9	2.6	2.7	To be Determined	3,000	
T-23	43.546382	-93.246295	NA	10.0	NA	5.9	5.6	6.2	To be Determined	1,750	
T-24	43.549936	-93.212292	NA	NA	2.0	3.4	3.2	3.8	To be Determined	1,250	
T-25	43.534378	-93.241412	NA	NA	7.9	2.1	2.2	2.5	To be Determined	1,500	
T-26	43.530820	-93.224506	NA	NA	4.2	2.7	3.0	3.5	To be Determined	1,750	2.5
T-27	43.530754	-93.216227	NA	NA	10.2	1.0	0.8	2.1	To be Determined	1,250	
T-28	43.537887	-93.155554	NA	NA	4.1	6.3	4.3	4.5	To be Determined	1,500	
T-29	43.532474	-93.144029	NA	NA	0.0	0.0	0.1	0.3	To be Determined	1,500	
T-30	43.530211	-93.123969	NA	NA	0.0	NE	4.2	4.3	To be Determined	1,750	
T-31	43.534093	-93.115413	NA	NA	3.3	10.1	2.1	2.0	To be Determined	1,750	
T-32	43.540694	-93.077166	NA	NA	8.5	8.2	8.1	8.2	To be Determined	3,000	
T-33	43.542489	-93.073357	NA	NA	4.0	4.6	4.6	4.7	To be Determined	2,000	2.0
T-34	43.544723	-93.066252	NA	NA	7.4	3.9	5.7	6.2	To be Determined	2,000	
T-35	43.527042	-93.220816	NA	NA	7.4	10.2	3.9	4.0	To be Determined	1,500	0.5
T-36	43.523509	-93.203257	19.0	6.0	10.8	7.7	3.3	3.3	To be Determined	1,250	
T-37	43.518825	-93.186778	NA	NA	6.0	6.2	3.9	4.3	To be Determined	1,500	
T-38	43.518544	-93.162651	NA	NA	NA	4.0	3.4	3.6	To be Determined	1,250	2.5
T-39	43.519517	-93.156595	NA	NA	3.9	6.5	4.0	5.1	To be Determined	1,500	
T-40	43.518667	-93.141405	NA	NA	10.8	11.1	7.9	8.1	To be Determined	2,000	
T-41	43.520004	-93.136220	NA	NA	NA	4.1	3.2	3.2	To be Determined	1,500	
T-42	43.517770	-93.124628	NA	NA	12.7	5.9	5.7	6.0	To be Determined	2,000	
T-43	43.520209	-93.120684	NA	NA	13.0	NE	3.1	2.9	To be Determined	1,250	3.0
T-44	43.522788	-93.116612	NA	NA	4.0	7.2	2.8	2.8	To be Determined	1,250	
T-45	43.501164	-93.186900	NA	NA	NA	NE	3.9	3.9	To be Determined	1,250	
T-46	43.505312	-93.183346	NA	NA	4.7	2.0	4.1	4.3	To be Determined	1,500	
T-47	43.504825	-93.166974	NA	NA	4.8	2.1	3.7	4.0	To be Determined	2,000	9.5
T-48	43.507629	-93.163435	NA	NA	NA	7.2	2.1	2.6	To be Determined	1,250	0.5
T-49	43.501183	-93.145097	NA	NA	7.3	4.1	3.8	3.7	To be Determined	1,500	

Notes: NA = Not Available

1) Preliminary Design Net Allowable Bearing Pressure based on in-situ data.

Figure 1
Site Location Map

Freeborn Wind Project
Freeborn County, Minnesota



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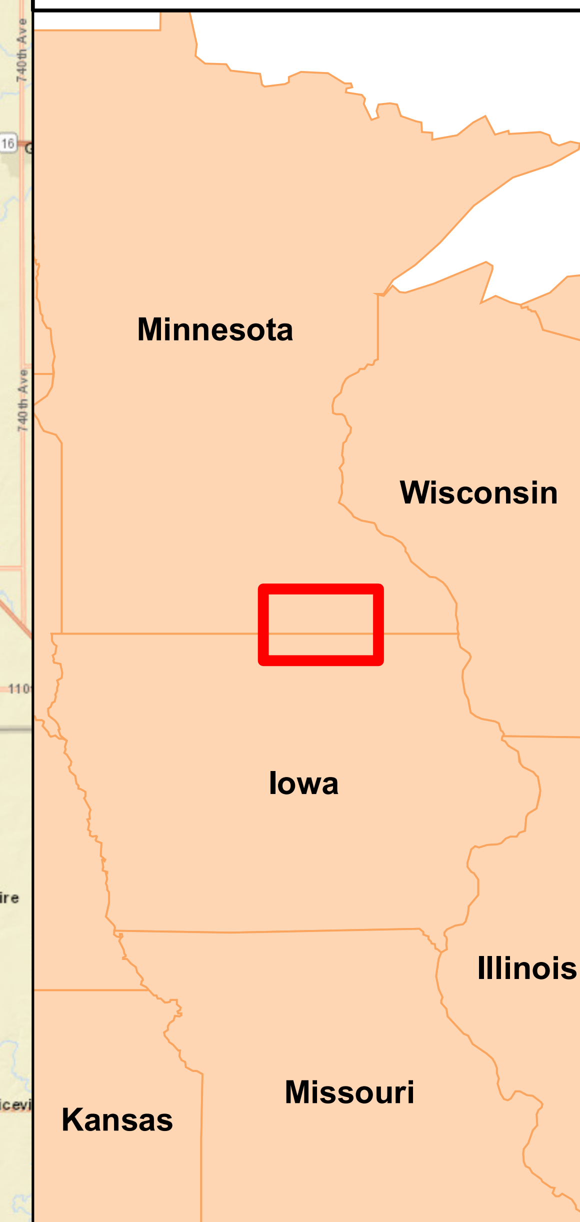
Legend

Approximate Project Boundary



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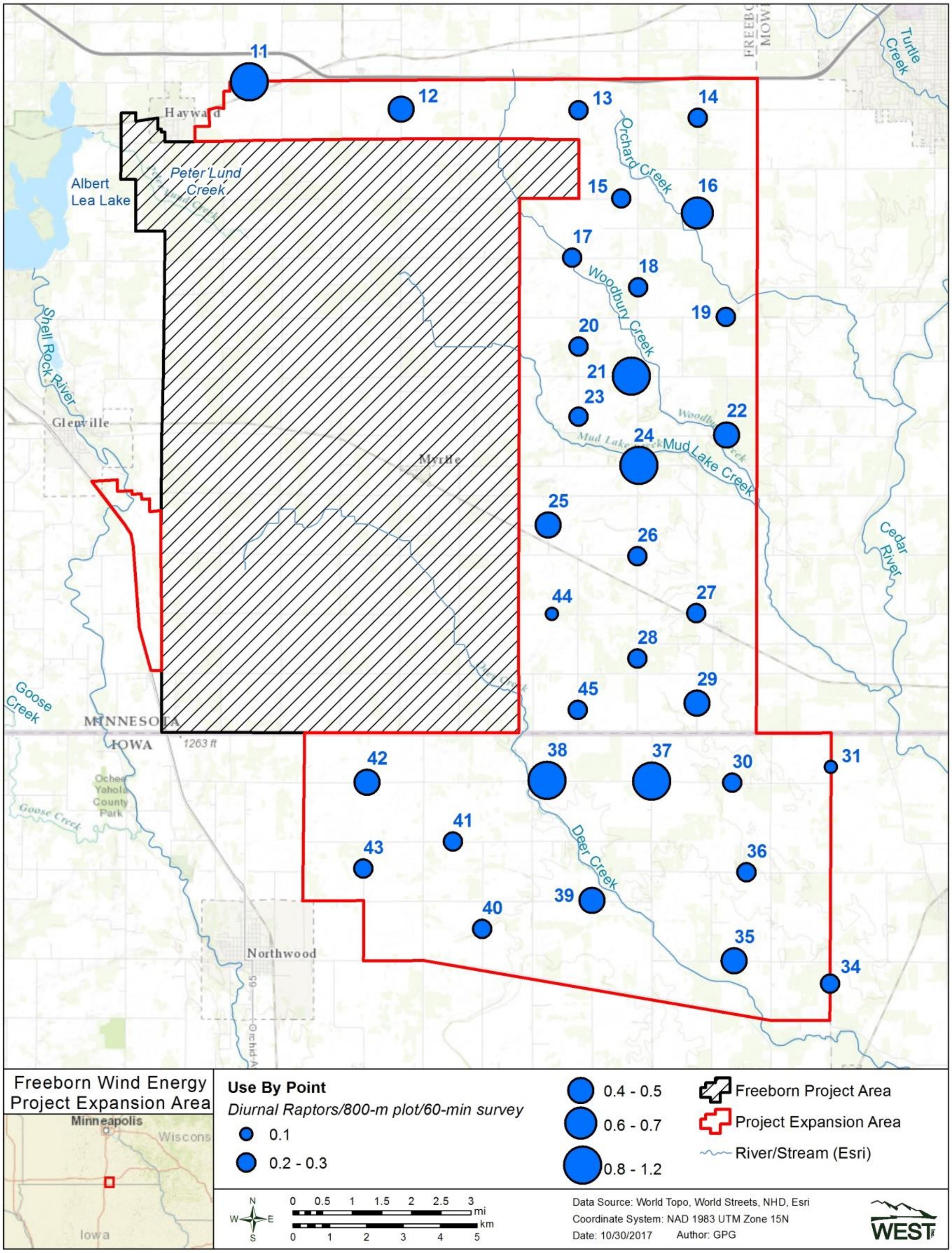
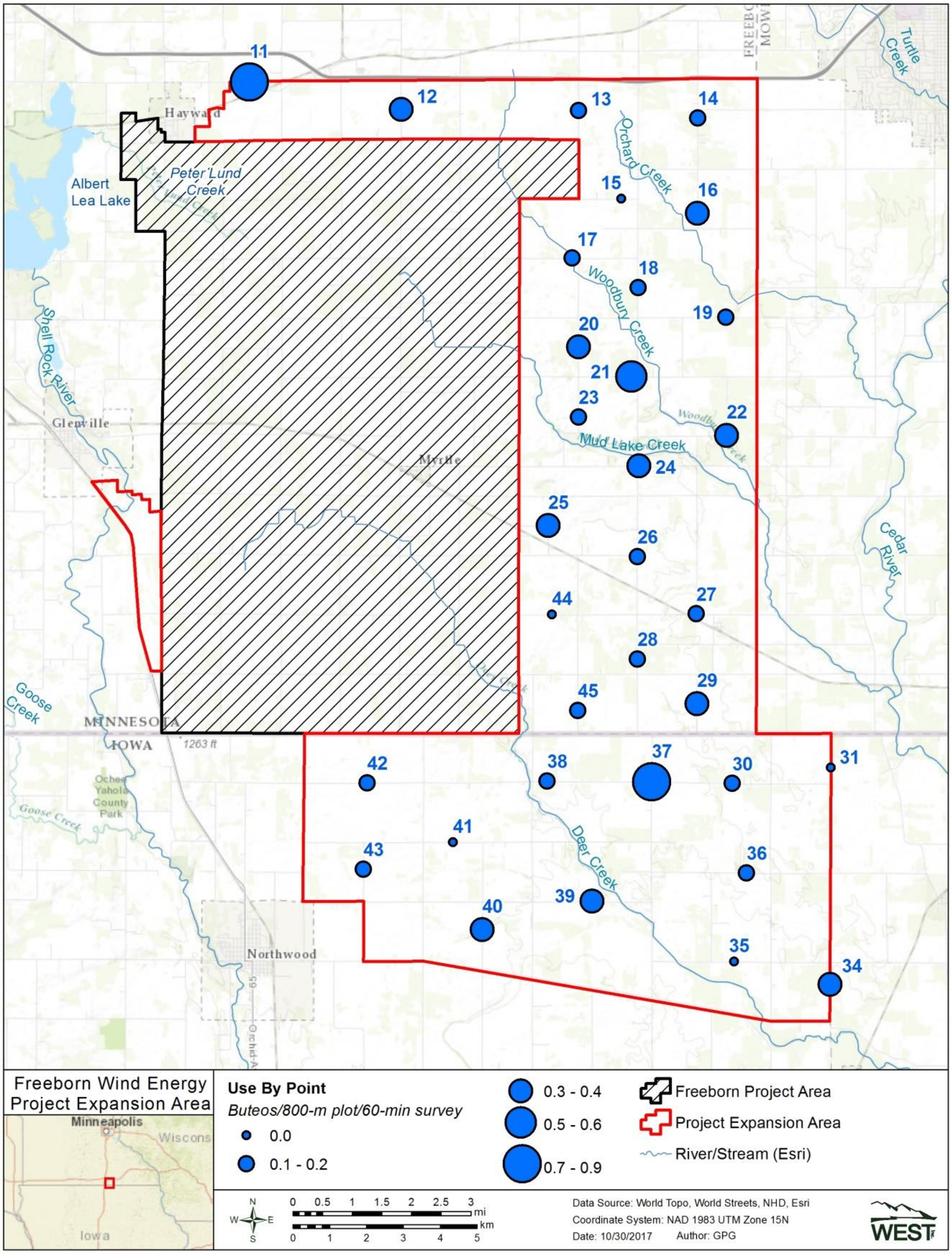
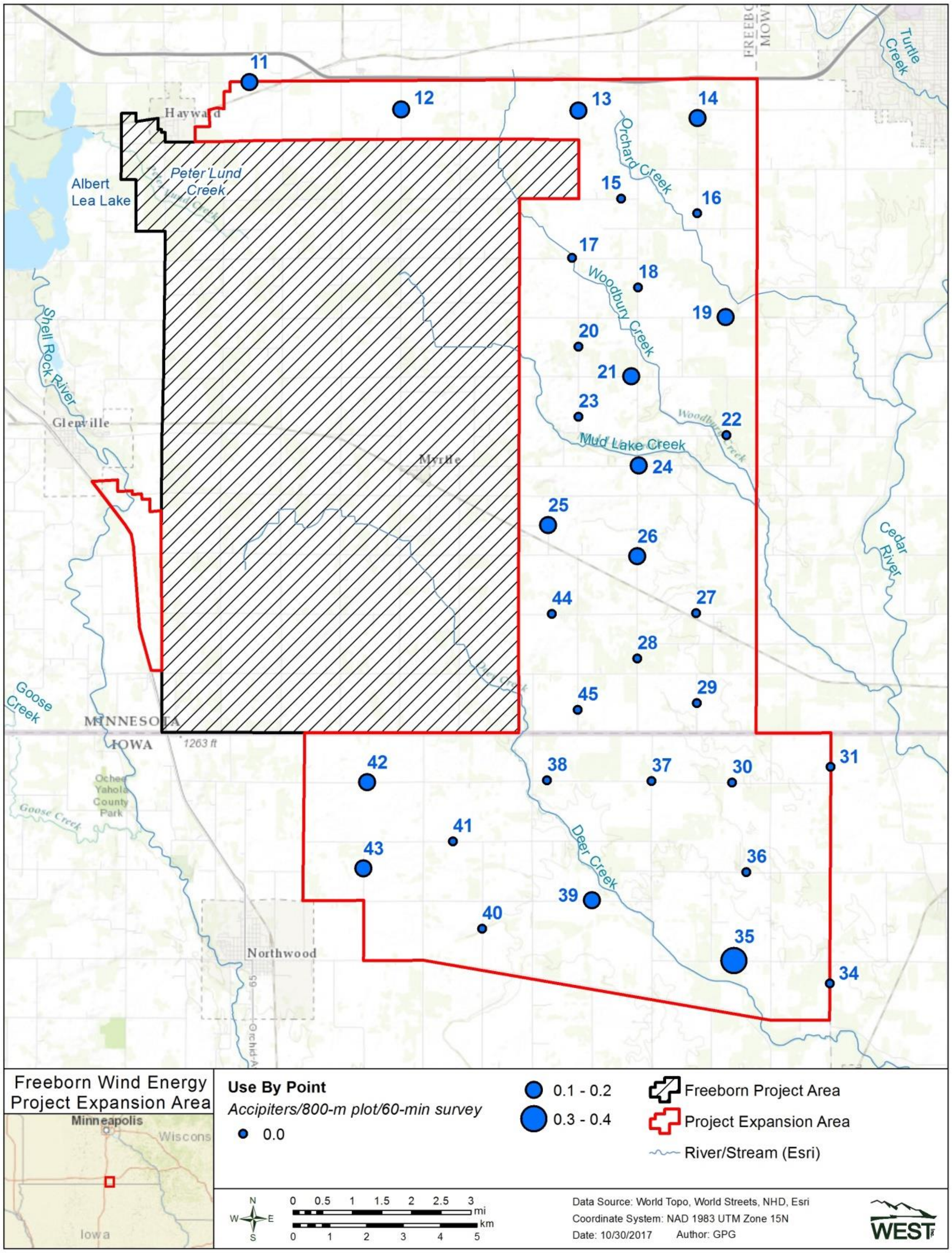


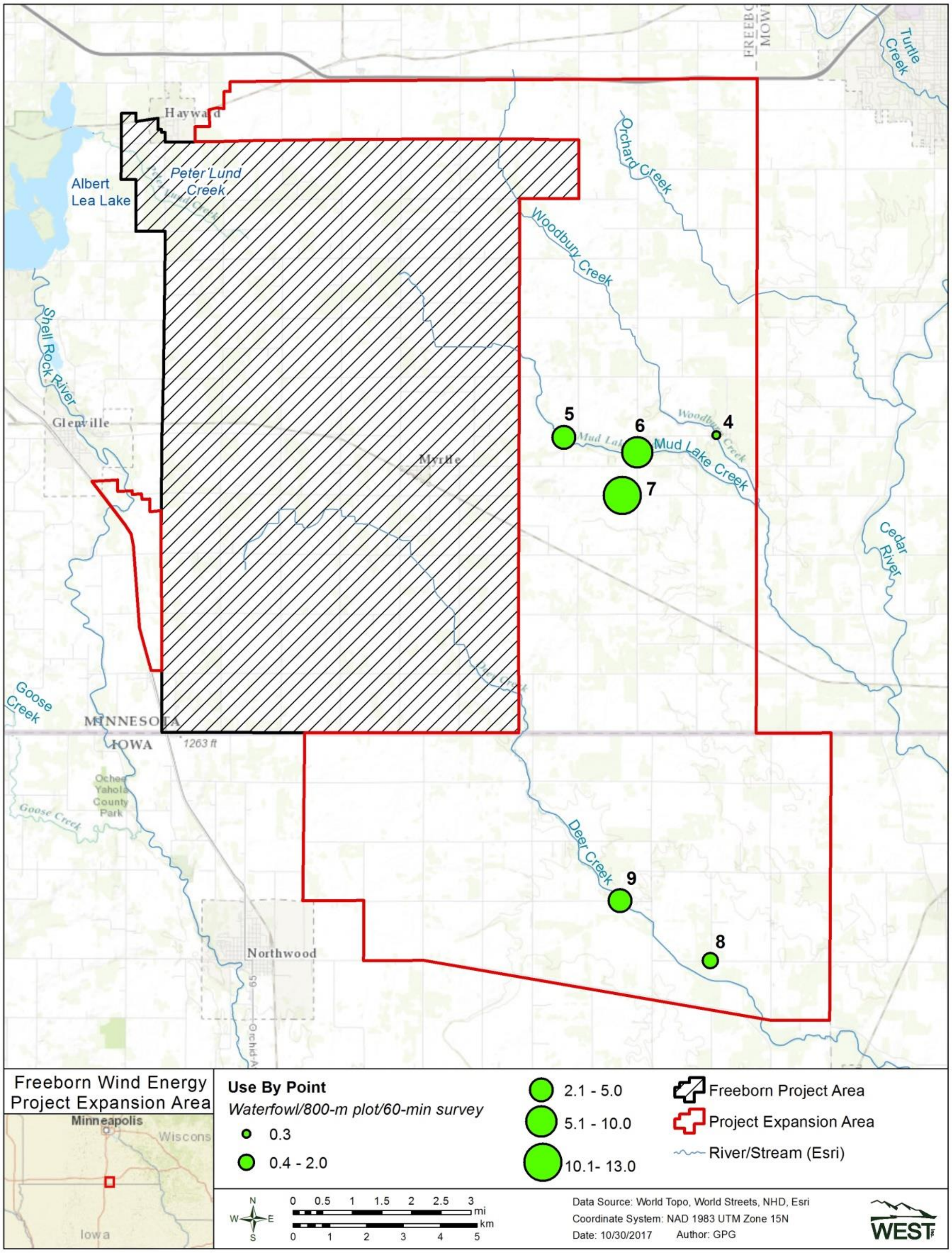
Appendix C2 (continued). Raptor use by observation point during large bird use surveys conducted in the Freeborn Wind Energy Project Expansion Area from October 25, 2016 – September 26, 2017.



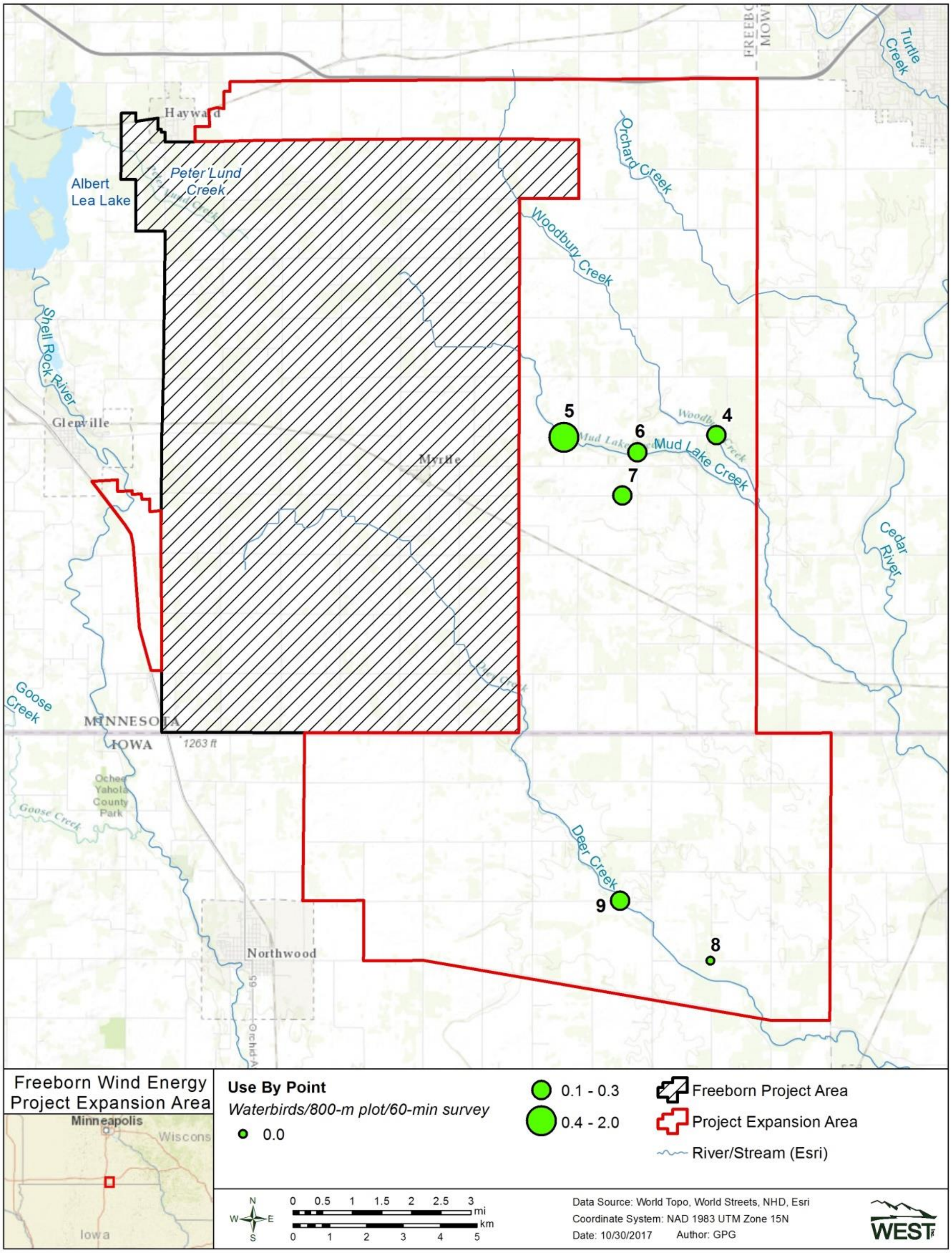
Appendix C2 (continued). Buteo use by observation point during large bird use surveys conducted in the Freeborn Wind Energy Project Expansion Area from October 25, 2016 – September 26, 2017.



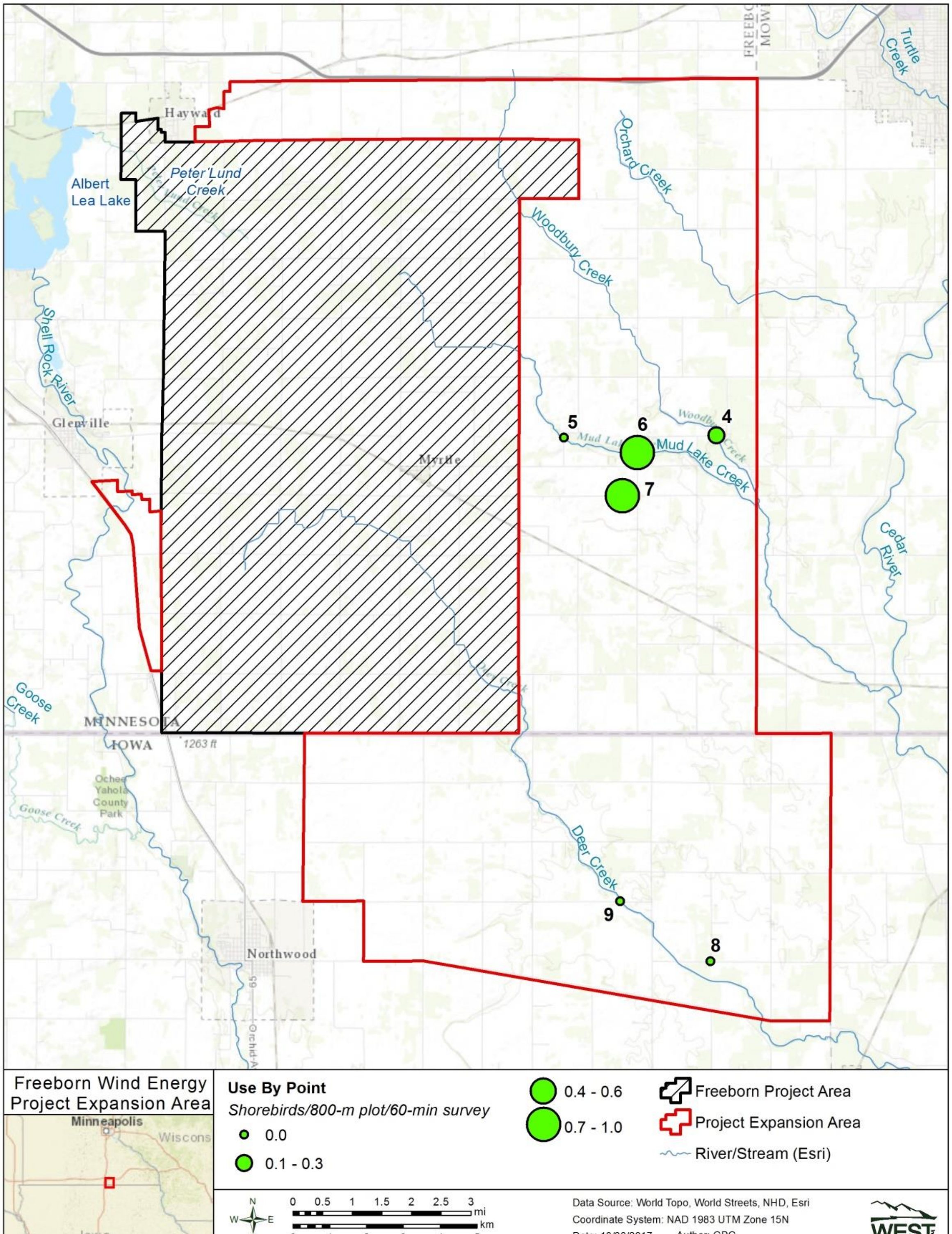
Appendix C2 (continued). Accipiter use by observation point during large bird use surveys conducted in the Freeborn Wind Energy Project Expansion Area from October 25, 2016 – September 26, 2017.



Appendix C3. Waterfowl use by observation point during wetland bird use surveys conducted in the Freeborn Wind Energy Project Expansion Area from March 29 – May 30, 2017.

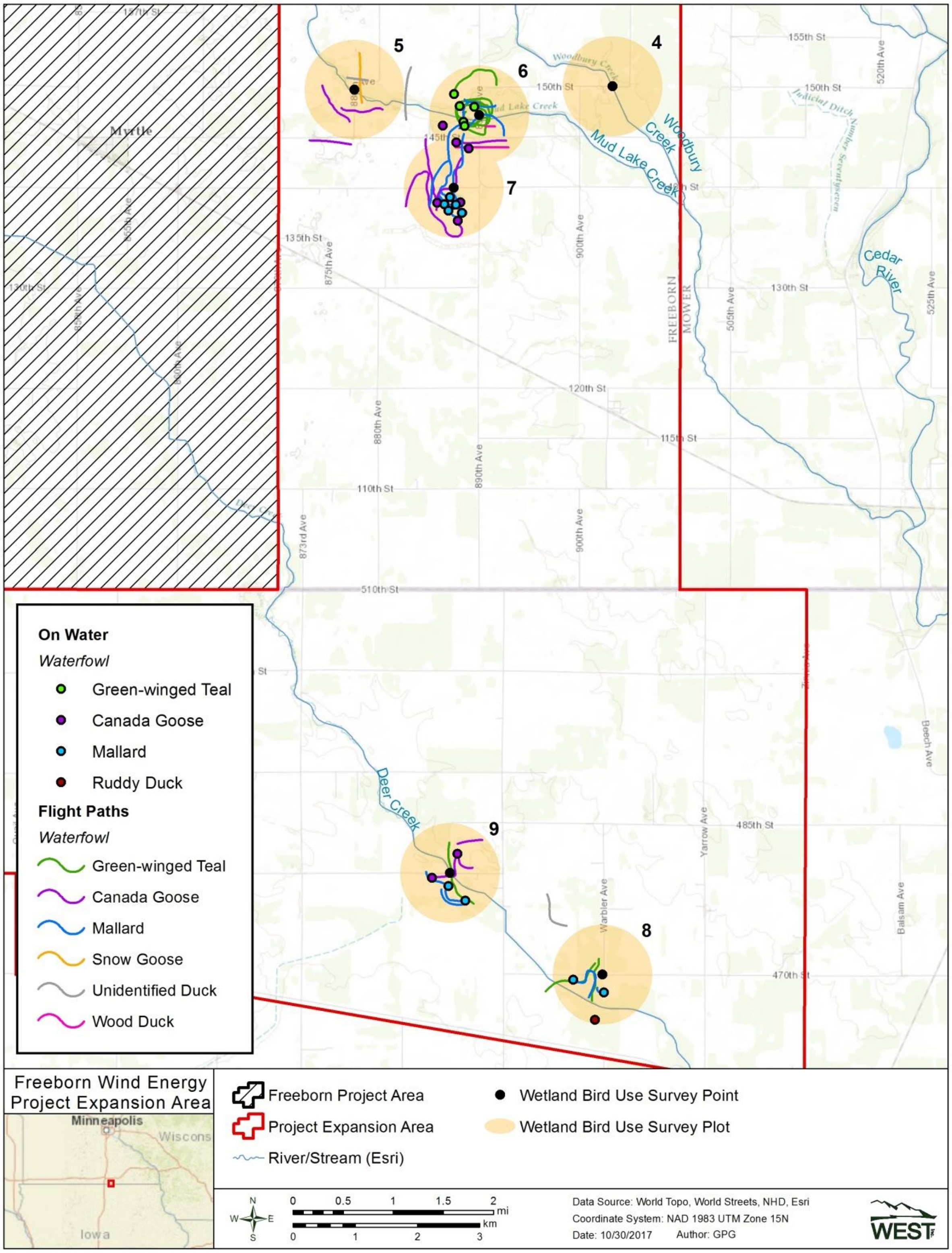


Appendix C3 (continued). Waterbird use by observation point during wetland bird use surveys conducted in the Freeborn Wind Energy Project Expansion Area from March 29 – May 30, 2017.

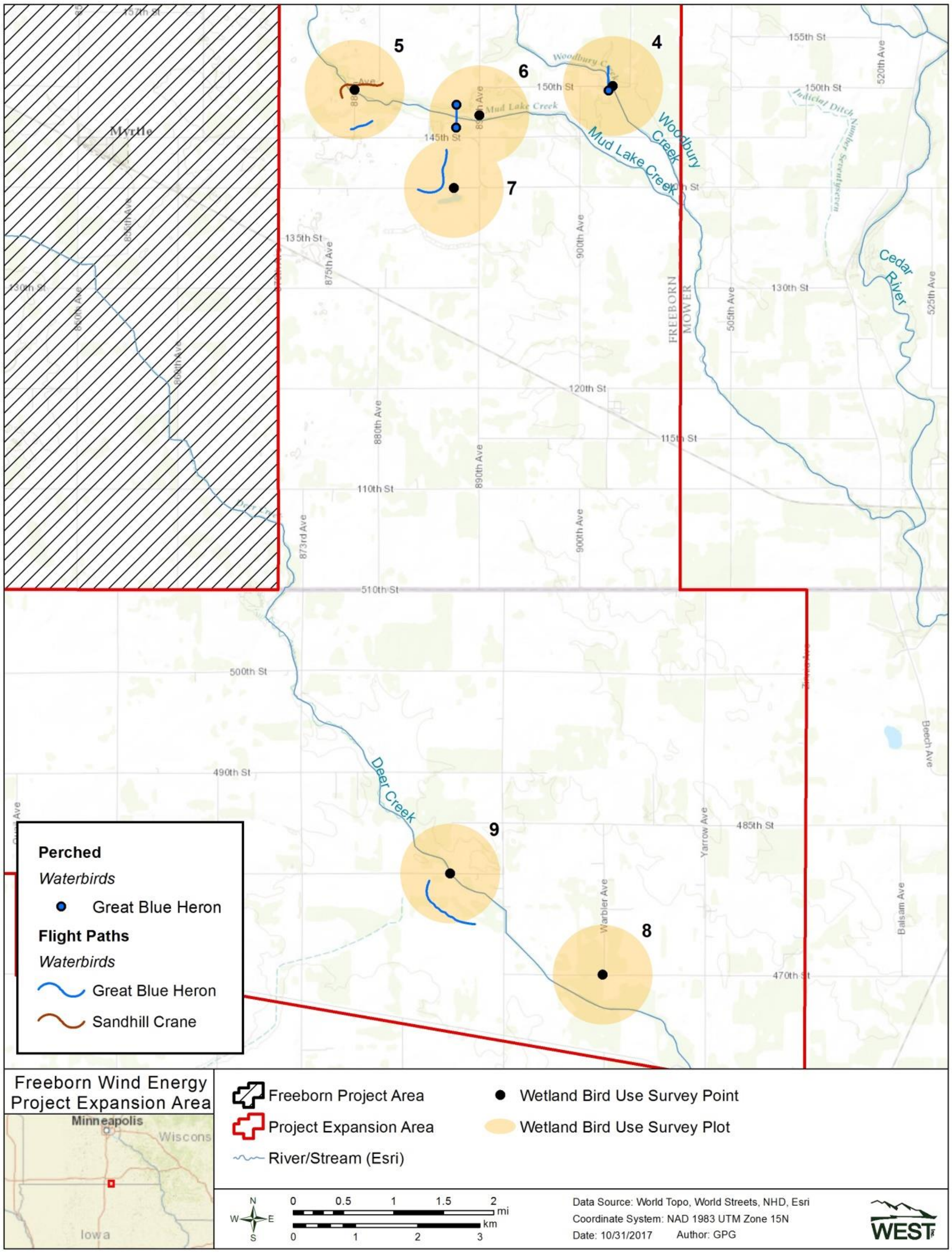


Appendix C3 (continued). Shorebird use by observation point during wetland bird use surveys conducted in the Freeborn Wind Energy Project Expansion Area from March 29 – May 30, 2017.

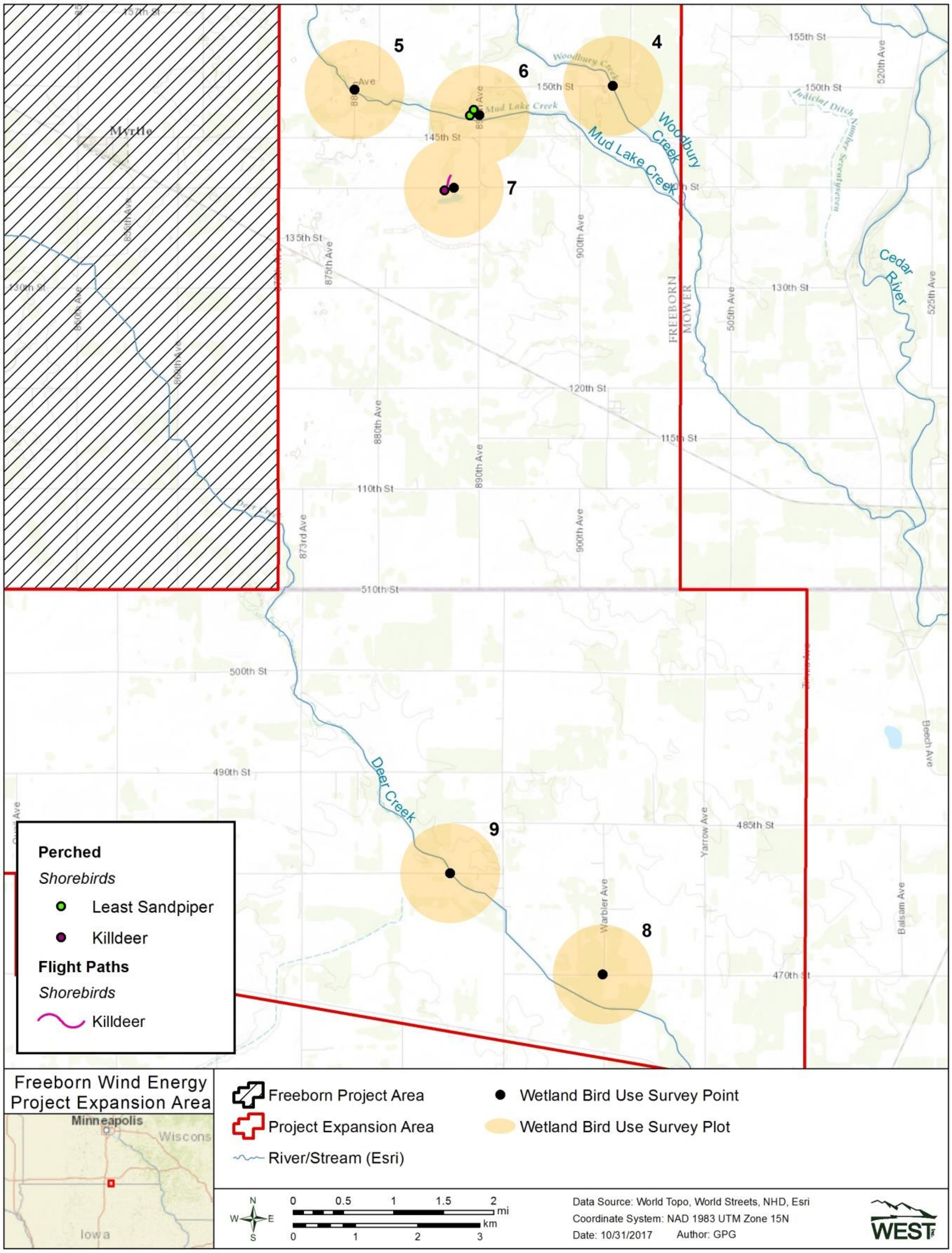
Appendix D. Flight Paths Recorded for All Waterfowl, Waterbirds, and Diurnal Raptors during Wetland Bird Use Surveys Conducted in the Freeborn Wind Energy Project Expansion Area from March 29 – May 30, 2017



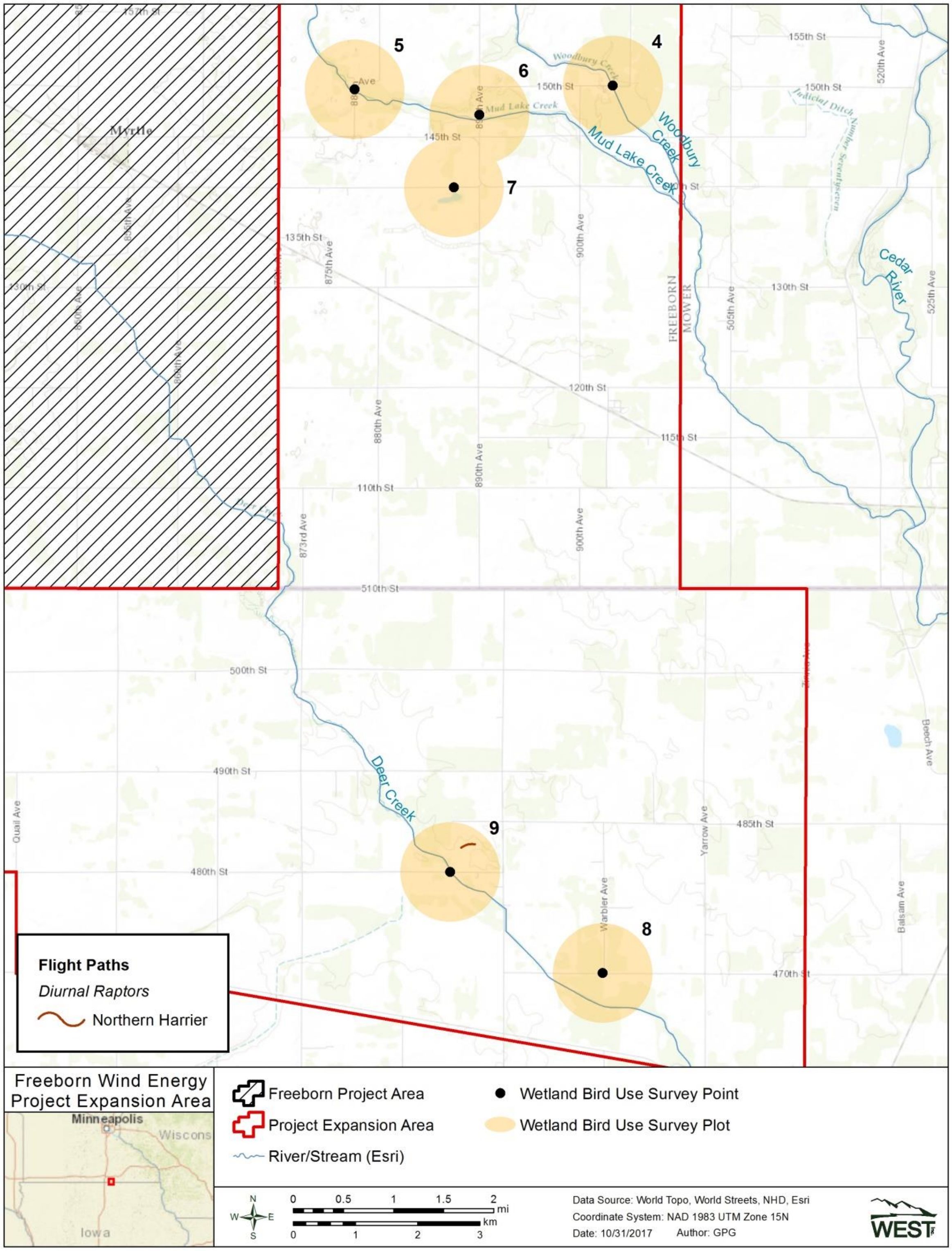
Appendix D. Waterfowl flight paths recorded during wetland bird use surveys conducted in the Freeborn Wind Energy Project Expansion Area from March 29 – May 30, 2017.



Appendix D (continued). Waterbird flight paths recorded during wetland bird use surveys conducted in the Freeborn Wind Energy Project Expansion Area from March 29 – May 30, 2017.



Appendix D (continued). Shorebird flight paths recorded during wetland bird use surveys conducted in the Freeborn Wind Energy Project Expansion Area from March 29 – May 30, 2017.



Appendix D (continued). Diurnal raptor flight paths recorded during wetland bird use surveys conducted in the Freeborn Wind Energy Project Expansion Area from March 29 – May 30, 2017.

Avian Use Study
Freeborn Wind Energy Project
Freeborn County, Minnesota

Final Report Addendum

May 26 – September 22, 2017

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Confidential Business Information

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1 INTRODUCTION

Freeborn Wind Energy LLC (Freeborn) is considering the development of the Freeborn Wind Energy Project (Project) in Freeborn County, Minnesota (Figure 1). To support development of the Project, Freeborn contracted Western Ecosystems Technology, Inc. (WEST) to conduct pre-construction baseline surveys to estimate temporal and spatial avian use of the Project area. The methods for this study were consistent with the U.S. Fish and Wildlife Service's (USFWS) *Eagle Conservation Plan Guidance, Module 1 – Land-based Wind Energy Guidance* (ECPG; USFWS 2013), the USFWS' *Final Land-Based Wind Energy Guidelines* (USFWS 2012), as well as the Minnesota Department of Natural Resources' (MNDNR) and the Minnesota Department of Commerce's (MNDOC) *Avian and Bat Survey Protocols for Large Wind Energy Conversion Systems in Minnesota* (MNDNR 2012).

Study objectives were to assess the following for large birds: 1) species composition, relative abundance, and diversity; 2) overall use, percent of use, and frequency of occurrence; 3) flight height; 4) and spatial use. Additional objectives were to document use of the Project area by threatened, endangered, and sensitive avian species and eagles. The following report describes the results of the avian use study conducted in the Project area from May 26 – September 22, 2017.

A 15 month avian study was conducted for the Project area in Freeborn County, Minnesota, and was summarized in a previous report (Simon and Mattson 2016); this 2017 report is an addendum to the original 15 month avian study. Freeborn expanded the Project area for potential siting of wind energy facilities to include additional areas in Minnesota and Iowa (Project Expansion Area). A similar 12 month avian use study was conducted in the Project Expansion Area in Freeborn County, Minnesota and Worth County, Iowa from October 2016 – September 2017; the results of this study are presented under a separate cover.

2 STUDY AREA

The proposed Project area encompasses 16,120 hectares (39,834 acres) in Freeborn County, Minnesota (Figure 1). The Project occurs in the Western Corn Belt Plains Ecoregion (U.S. Environmental Protection Agency [USEPA] 2013), characterized by glaciated till plains and undulating loess plains. Much of the region was originally dominated by tallgrass prairie, riparian forest, oak-prairie savannas, and woody and herbaceous wetlands. Today, most of the area has been cleared for farms producing corn, soybeans, and livestock (USEPA 2013).

Many smaller streams in this ecoregion have been tilled, ditched, and tied into existing drainage systems, resulting in a reduction in wetland and aquatic habitats (USEPA 2013). A few streams are present in and adjacent to the Project area, including Woodbury Creek in the northeast, Mud Lake Creek in the east, Deer Creek and tributaries in the south, Peter Lund Creek in the northwest, and the Shell Rock River and its tributaries in the west (Figure 1).

According to the 2011 U.S. Geological Survey National Land Cover Database (NLCD; USGS NLCD 2011 Homer et al. 2015), the majority (96.9%) of the Project area consists of cultivated croplands (i.e., agriculture) and developed areas (Table 1 and Figure 2). Corn (*Zea mays*) and soybean (*Glycine max*) are the most common crops. Herbaceous land cover comprises 1.0% of the Project area. Hay/pasture and deciduous forest land cover types each comprise less than 1.0% of the Project area. The remaining land cover types all comprise less than 0.1% of the Project area.

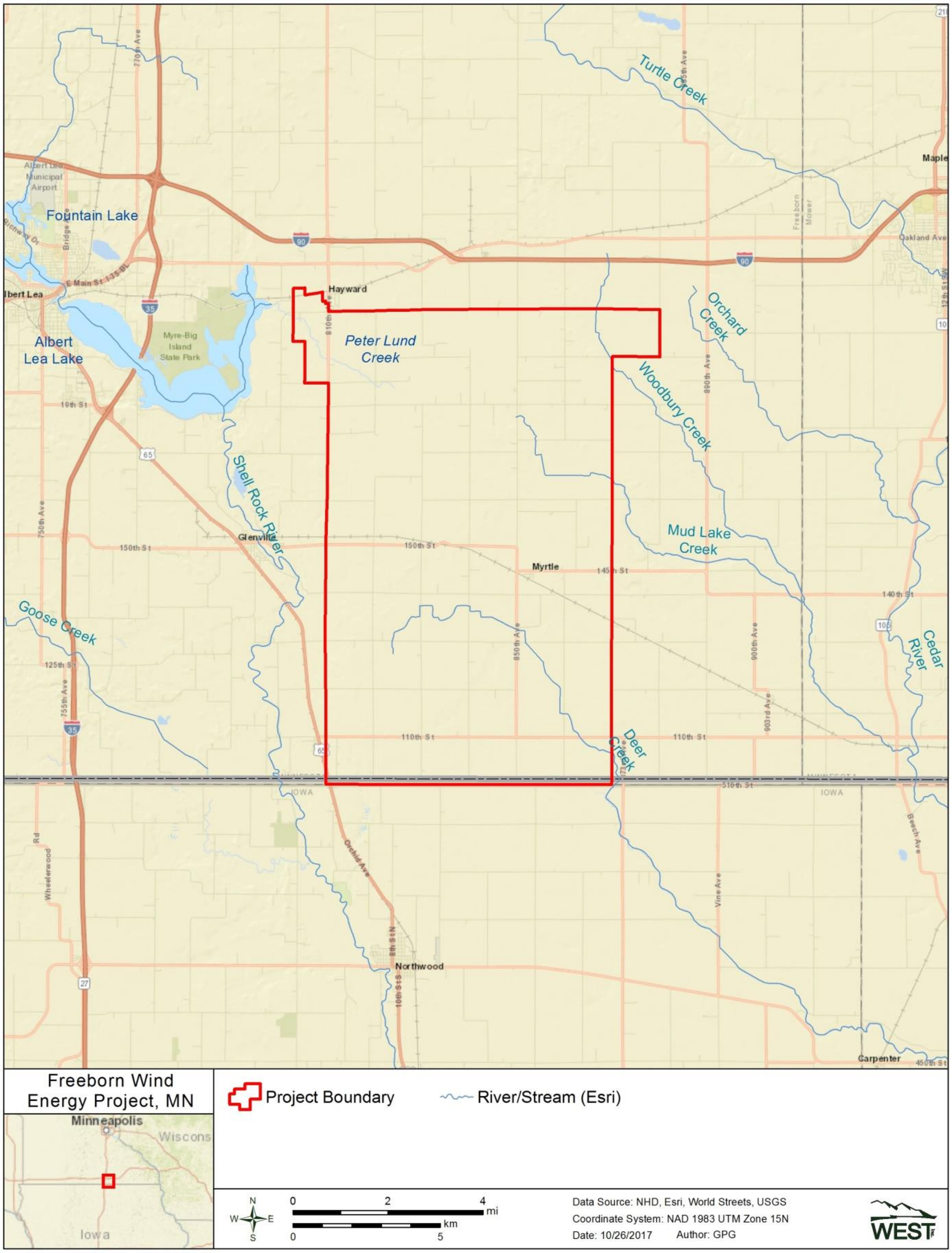

Figure 1. Location of the Freeborn Wind Energy Project in Freeborn County, Minnesota.

Table 1. 2011 National Land Cover Database land cover types within the Freeborn Wind Energy Project area.

Cover Type	Hectares	Acres	Percent (%)
Cultivated Crops	14,701.6	36,328.5	91.0
Developed, Open Space	849.8	2,100.0	5.3
Herbaceous	162.0	400.4	1.0
Hay/Pasture	133.2	329.1	0.8
Deciduous Forest	131.1	324.0	0.8
Developed, Low Intensity	56.3	139.1	0.4
Emergent Herbaceous Wetlands	40.0	98.9	0.3
Developed, Medium Intensity	21.5	53.1	0.1
Open Water	6.5	16.0	<0.1
Woody Wetlands	7.9	19.6	<0.1
Barren Land	5.3	13.1	<0.1
Evergreen Forest	2.9	7.1	<0.1
Developed, High Intensity	2.0	4.9	<0.1
Mixed Forest	0.0	0.0	0.0
Shrub/Scrub	0.0	0.0	0.0
Total	**16,120.2**	**39,833.8**	**100.0**

Source: U.S. Geological Society National Land Cover Database 2011, Homer et al. 2015

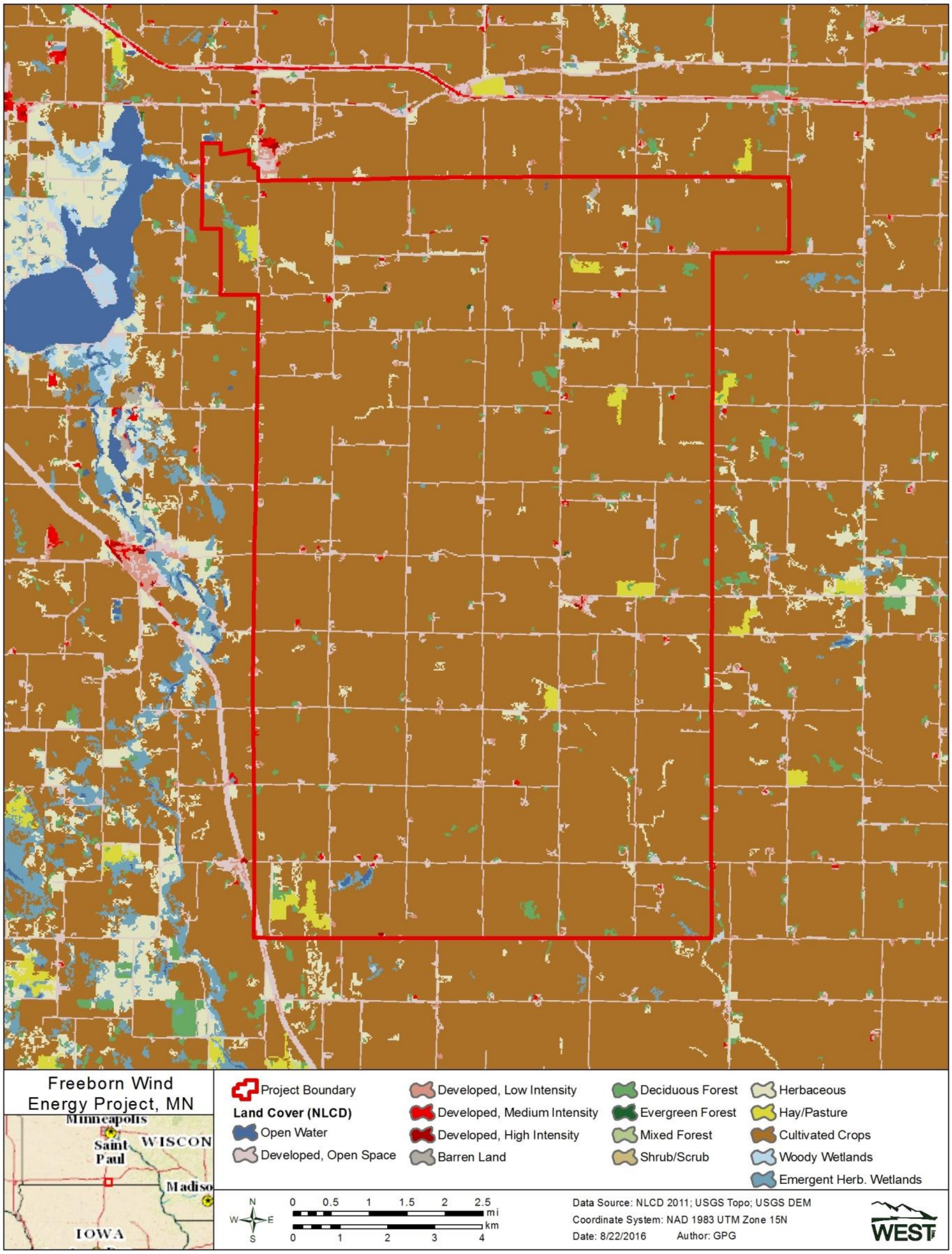

Figure 2. National Land Cover Database land cover types within and adjacent to the Freeborn Wind Energy Project area in Freeborn County, Minnesota.

3 METHODS

3.1 Large Bird Use Surveys

Large bird use surveys were conducted using methods described by Reynolds et al. (1980). Eighteen observation points consisting of 800-meter (m; 2,625-foot [ft]) radius circular plots were established within the Project area[1]. Circular plots covered approximately 31% of the Project area (Figure 3). Observation points (the center of the 800-m [2,625-ft] plot) were separated by at least 1,600 m (5,249 ft) to avoid overlap and were located along public roads using a systematic sampling scheme with a random start generated by ArcGIS (a Geographic Information System software program).

Large bird use surveys were conducted once per month during the following seasons: summer (May 27 – September 2) and fall (September 3 – September 22). Surveys were conducted during daylight hours; survey periods were varied to approximately cover all daylight hours during a season. Observation points were planned to be surveyed the same number of times.

Point count surveys were conducted for 60 minutes. All large birds seen were recorded during each survey using a unique observation number, regardless of distance. In some cases, observations represented repeated sightings of the same individual. Observations of large birds outside the 800-m (2,625-ft) plot were recorded. These data were included in the development of species composition, relative abundance, and species diversity metrics, but were not included in analyses of avian use and flight heights. Large birds included the subtypes waterbirds, waterfowl, rails and coots, grebes and loons, gulls and terns, shorebirds, diurnal raptors, owls, vultures, upland game birds, doves/pigeons, large corvids (e.g., ravens, magpies, and crows), and goatsuckers.

[1] The majority of Point 1 was originally located in the Project area in the northwest corner; however, the Project area was moved to the east in March 2015, following feedback from the MNDOC, MNDNR, and USFWS, which placed a large portion of Point 1 out of the Project boundary (see Figure 3).

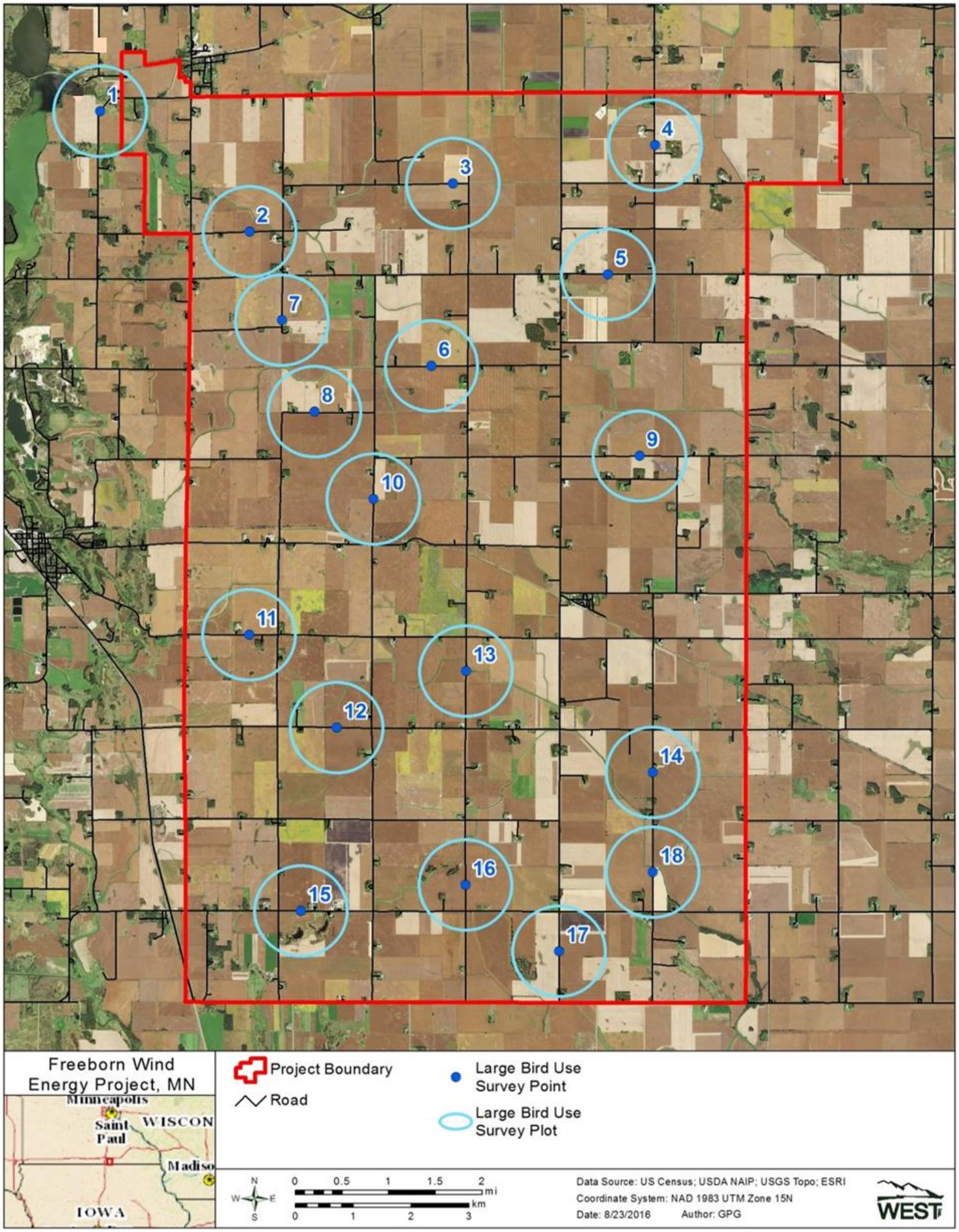

Figure 3. Location of large bird use survey plots in the Freeborn Wind Energy Project area where surveys were conducted from May 26 – September 22, 2017.

The following information was recorded during each large bird use survey: date, start and end time, and weather information (i.e., temperature, wind speed, wind direction, precipitation, and cloud cover). Additionally, the following data were recorded for each observation:

- Species (or best possible identification)
- Number of individuals
- Distance from plot center when first observed
- Closest distance observed
- Flight height above ground
- Flight direction
- Activity (flying or perched)

Approximate flight height, flight direction, and distance from plot center at first observation were recorded to the nearest 5-m (16-ft) interval; the approximate lowest and highest heights were also recorded.

For bald eagle (*Haliaeetus leucocephalus*) or golden eagle (*Aquila chrysaetos*) observations, flight height, distance, and activity (i.e., flying or perched) were recorded during each 1-minute interval the eagle was within the 800-m (2625-ft) plot and at or below 200 m (656 ft) above ground level, per the ECPG (USFWS 2013). In addition, the time eagles were observed outside of plots or flying at higher altitudes was recorded, but not included in statistical analyses. The perch locations and flight paths of eagles were mapped to qualitatively assess areas of eagle use within the Project area.

Wildlife incidental observations were recorded to provide information on wildlife seen outside of standardized surveys. All sensitive species were recorded along with unusual species or behavior observations, and birds observed outside of standardized survey plots. Incidental observations were recorded in a similar fashion to standardized surveys; the observation number, date, time, species, number of individuals, sex/age class, distance from observer, activity, and flight height above ground (for bird species) were recorded. The location of sensitive species was recorded by Universal Transverse Mercator coordinates using a hand-held Global Positioning System unit.

3.2 Quality Assurance and Quality Control

Quality assurance and quality control (QA/QC) measures were implemented at all stages of the study, including in the field, during data entry and analysis, and report writing. Following field surveys, observers were responsible for inspecting data forms for completeness, accuracy, and legibility. A data technician then compared a sample of records from an electronic database to the raw data forms and corrected any errors. Irregular codes or data suspected as questionable were discussed with the observer and/or project manager. Errors, omissions, or problems identified in later stages of analysis were traced back to the raw data forms, and appropriate changes in all steps were made.

A Microsoft® SQL database was developed to store, organize, and retrieve survey data. Data were keyed into the electronic database using a pre-defined format to facilitate subsequent QA/QC and data analysis. All data forms and electronic data files were retained for reference. QA/QC measurements implemented for report writing included review of the final document by a technical editor, statistician, peer (research biologist), project manager, independent reviewer, and senior manager.

4 DATA ANALYSIS

4.1 Species Composition, Relative Abundance, and Diversity

Species composition (i.e., species and bird types observed during the standardized surveys) and relative abundance (i.e., number of observations and groups of each species and bird type by season), and diversity (i.e., total number of species observed within each season) were compiled for all birds observed during point count surveys, irrespective of distance from observer (i.e., includes incidental observations). In addition, percent composition for each bird type was calculated by total percent of bird observations and total percent of bird observations by season to assess percent composition of bird types based on all bird observations, regardless of distance from observer.

4.2 Bird Use, Percent of Use, and Frequency of Occurrence

Bird use was calculated as the number of large birds per 800-m (2,625-ft) per 60-minute survey. Bird use by season was estimated using a 2-step calculation: (1) for each survey event, the sum of number of bird observations was divided by the number of plots surveyed (average number observations/plot) and 2) for all survey events within the season; the sum of number of observations/plot was divided by the number of survey events. Overall bird use was calculated as the weighted average of seasonal values by the number of calendar days in each season (as defined by the season dates). Percent of use was calculated as the proportion of large bird use attributable to a particular bird type or species, and frequency of occurrence was calculated as the percent of surveys in which a particular bird type or species was observed.

4.3 Flight Height

Flight height data were used to estimate bird use within the approximate turbine rotor-swept height (RSH) of 25 – 150 m (82 – 492 ft) above ground level. The flight height of each single bird or group when first observed was used to calculate the percentage of birds or groups flying below the 0-25 m (0-82 ft), within 25-150 m (82-492 ft), and above (≥ 150 m [492 ft]) the RSH.

4.4 Spatial Use

Bird use at each plot was used to document spatial use within the Project area. Use was calculated as the total number of bird observations made at a given plot divided by the number of survey events at that plot over the entire study period (number observations/800-m [2,625-ft] plot per 60-minutes survey). Large bird type groups are divided among waterbirds (e.g., herons, egrets, cormorants, and pelicans), waterfowl (e.g., ducks and geese), rails and coots, grebes and loons, gulls and terns, shorebirds, diurnal raptors, owls, vultures, upland game birds, doves/pigeons, large corvids (e.g., ravens, magpies, and crows), and goatsuckers. Waterfowl are separated from other waterbirds due to differences in foraging and flight behaviors.

Eagle flight paths were mapped during large bird use surveys and digitized to qualitatively show flight locations and flight direction (north/south, east/west) within survey plots. Aerial imagery was used to aid in recording locations of observations as accurately as possible.

4.5 Eagle Minutes

Following survey protocols described in the ECPG (USFWS 2013), eagle minutes were recorded within three-dimensional plots (i.e., cylinders) including the area within 800 m (2,625 ft) of the survey points and up to 200 m (656 ft) above ground level. Eagle minutes were defined as the number of minutes an eagle was observed in flight within these three-dimensional cylinders during the 60-minutes survey periods. Observations of perched eagles did not apply to eagle minutes. These observations were then summed and mapped to document eagle minutes per plot. Eagle minutes were summed by season and divided by the number of survey minutes per season to standardize the sum by level of effort. Temporal variation was evaluated by calculating eagle minutes per month over the 5-month study period. Spatial variation was evaluated by calculating eagle minutes per plot, averaged across the 5-month study period, and mapped, accordingly.

5 RESULTS

5.1 Large Bird Use Surveys

A total of 90 60-minute large bird use surveys were conducted in the Project area during 5 visits.

5.1.1 Large Bird Species Composition, Relative Abundance, and Diversity

A total of 1,352 large bird observations were recorded within 226 separate groups (Appendix A). The most commonly recorded large bird type was waterfowl, which comprised 34.0% of large bird observations during the 5-month study period, and 39.2% of observations during summer (Appendix A). The majority of waterfowl observations were comprised of snow geese (*Chen caerulescens;* 290 observations in five groups), with all observations recorded during summer (Appendix A).

Gulls/terns were the second most abundant bird type observed, accounting for 28.8% of large bird observations during both seasons (Appendix A). Four raptor species were observed during large bird use surveys, which accounted for 3.0% of large bird observations (41 observations). Bald eagles accounted for 7.3% of raptor observations (three observations) and 0.2% of large bird observations (Appendix A). Eagles were observed more often during fall (two observations; 66.7%) compared to summer (one observation; 33.3%; Appendix A).

Eighteen species were observed during large bird use surveys; species diversity was highest during summer (18 species) compared to fall (10 species).

5.1.2 Large Bird Seasonal Use, Percent of Use, and Frequency of Occurrence

Large bird use over the study period was 5.4 observations/800-m plot/60-minute survey and was higher during fall compared to summer (9.8 and 4.5 observations/800-m/60-minute survey, respectively; Table 2; Appendix B).

Table 2. Bird use[1], percent of total use (%), and frequency of occurrence (%) for each bird type by season observed during the large bird use surveys conducted in the Freeborn Wind Energy Project area from May 26 – September 22, 2017.

Type/Species	Bird Use		% of Use		% Frequency	
	Summer	Fall	Summer	Fall	Summer	Fall
Waterbirds	0.5	6.8	10.5	68.9	8.3	16.7
Waterfowl	1.2	0.0	27.2	0.0	11.1	0.0
Shorebirds	0.4	<0.1	8.6	0.6	29.2	5.6
Diurnal Raptors	0.3	0.3	7.1	2.8	25.0	16.7
Accipiters	*<0.1*	*0.1*	*0.9*	*1.1*	*4.2*	*11.1*
Buteos	*0.3*	*0.1*	*5.6*	*0.6*	*18.1*	*5.6*
Northern Harrier	*<0.1*	*0.0*	*0.3*	*0.0*	*1.4*	*0.0*
Eagles	*<0.1*	*0.1*	*0.3*	*1.1*	*1.4*	*5.6*
Vultures	0.8	1.2	17.3	11.9	33.3	44.4
Upland Game Birds	0.1	0.0	3.1	0.0	8.3	0.0
Large Corvids	1.2	1.6	26.2	15.8	36.1	50.0
Large Bird Overall	**4.5**	**9.8**	**100.0**	**100.0**		

[1] Number of observations/800-meter plots/observation period

Waterbirds

Waterbird use over the study period was 1.5 observations/800-m plot/60-minute survey and use was higher during fall (6.8 observations/800-m plot/60-minute survey) compared to summer (0.5 observation/800-m plot/60-minute survey; Table 2; Appendix B). Waterbirds accounted for 68.9% of all large bird use in fall and 10.5% in summer. Waterbirds were observed during 16.7% of fall surveys and 8.3% of summer surveys (Table 2; Appendix B). American white pelican (*Pelecanus erythrorhynchos*) accounted for the most waterbird use, composing 67.8% of all waterbird use in fall (Appendix B).

Waterfowl

Waterfowl use over the study period was 1.0 observations/800-m plot/60-minute survey, with all waterfowl use documented in summer (1.2 observations/800-m plot/60-minute survey; Table 2; Appendix B). Waterfowl accounted for 27.2%% of all large bird use in summer and were observed during 11.1% of summer surveys (Table 2; Appendix B). Snow geese made up the most waterfowl use during summer survey (0.8 observation/800-m plot/60-minute survey; Appendix B).

Shorebirds

Shorebird use over the study period was 0.3 observation/800-plot/60-minute survey, with higher use in summer (0.4 observation/800-m plot/60-minute survey) compared to fall (<0.1 observation/800-m plot/60-minute survey; Table 2; Appendix B). Shorebirds comprised 8.6% of large bird use in summer and 0.6% in fall. Shorebirds were observed more frequently during summer surveys (29.2%) compared to fall (5.6%; Table 2; Appendix B).

Diurnal Raptors

Diurnal raptor use over the study period was 0.3 observation/800-m plot/60-minute survey, and was the same during summer and fall (0.3 observation/800-m plot/60-minute survey; Table 2; Appendix B). Diurnal raptors comprised 7.1% of all large bird use in summer compared to 2.8% in fall. Diurnal raptors were observed most frequently during summer surveys (25.0%) compared to fall surveys (16.7%; Table 2; Appendix B).

Buteo use was highest during summer (0.2 observation/800-m plot/60-minute survey); buteos were observed during 18.1% of summer surveys, comprised only of red-tailed hawk (*Buteo jamaicensis*; Table 2; Appendix B). Accipiter use was slightly higher during fall (0.1 observation/800-m plot/60-minute survey) compared to summer (<0.1 observation/800-m plot/60-minute survey); accipiters were observed during 11.1% of fall surveys, comprised only of Cooper's hawk (*Accipiter cooperii;* Table 2; Appendix B).

Eagle use over the study period was <0.1 observation/800-m plot/60-minute survey, comprised only of bald eagle, and was slightly higher in fall (0.1 observation/800-m plot/60-minute survey) compared to summer (<0.1; Table 2; Appendix B). Eagles accounted for 1.1% of large bird use in fall and 0.3% of use in summer. Eagles were observed during 5.6% of fall surveys and 1.4% of summer surveys (Table 2; Appendix B).

Northern harrier (*Circus cyaneus*) use was only documented during summer (<0.1 observation/800-m plot/60-minute survey; northern harriers were observed during 1.4% of summer surveys (Table 2; Appendix B).

Vultures

Vulture use over the study period was 0.8 observation/800-m plot/60-minute survey, with use higher in fall (1.2 observation/800-m plot/60-minute survey) compared to 0.8 in summer (Table 2; Appendix B). Vultures accounted for 17.3% of all large bird use in summer and 11.9% in fall. Vultures were observed during 44.4% of fall surveys and 33.3% of summer surveys (Table 2; Appendix B).

Upland Game Birds

Upland game bird use was only documented in summer (0.1 observation/800-m plot/60-minute survey; Table 2; Appendix B). Upland game birds comprised 3.1% of all large bird use in summer and were observed during 8.3% of summer surveys (Table 2; Appendix B).

Large Corvids

Large Corvid bird use over the study period was 1.2 observations/800-m plot/60-minute survey, with use higher in fall (1.6 observations/800-m plot/60-minute survey) compared to 1.2 in summer (Table 2; Appendix B). Large corvids comprised 26.2% of all large bird use in summer and 15.8% in fall. Large corvids were observed during 50.0% of fall surveys and 36.1% of summer surveys (Table 2; Appendix B).

5.1.3 Flight Height Characteristics

Of the 117 groups (419 observations) of large birds observed flying within 800-m (2,625-ft) plots, 76.4% of groups were recorded in the estimated RSH (Table 3). Of these groups, 22 groups of 22 observations (i.e., one observation per group) of diurnal raptors were recorded, with 50.0% of the raptor flights recorded within the estimated RSH (Table 3). Considering only eagle observations in flight, 66.7% were observed flying within the RSH within 800-m (2,625-ft) radius plots (Table 3). Of all other raptor observations, buteos had the highest number of groups recorded in flight (14 groups); 50.0% were flying within the RSH based on initial observation (Table 3). Flying waterbirds were observed in eight groups of 152 observations, and 99.3% of the groups were flying within the RSH (Table 3).

Table 3. Flight height characteristics by bird type[1] and raptor subtype during large bird use surveys conducted in the Freeborn Wind Energy Project area from May 26 – September 22, 2017.

Bird Type	# Groups Flying	# Obs Flying	Mean Flight Height of Groups		% of Total Obs Flying	% of Groups within Flight Height Categories		
			Height (meters [m])	Height (feet [ft])		0-25 m (0-82 ft)	25-150 m (82–492 ft)[2]	> 150 m (> 492 ft)
Waterbirds	8	152	40.6	133.3	97.4	0.7	99.3	0.0
Waterfowl	9	78	37.4	122.8	88.6	2.6	97.4	0.0
Shorebirds	8	10	15.8	51.7	34.5	90.0	10.0	0.0
Diurnal Raptors	22	22	36.2	118.9	78.6	45.5	50.0	4.5
Accipiters	*4*	*4*	*22.5*	*73.8*	*80.0*	*50.0*	*50.0*	*0.0*
Buteos	*14*	*14*	*41.4*	*135.9*	*73.7*	*42.9*	*50.0*	*7.1*
Northern Harrier	*1*	*1*	*7.0*	*23.0*	*100.0*	*100.0*	*0.0*	*0.0*
Eagles	*3*	*3*	*40.0*	*137.5*	*100.0*	*33.3*	*66.7*	*0.0*
Vultures	39	76	41.9	137.5	98.7	28.9	71.1	0.0
Upland Game Birds	0	0	0.0	0.0	0.0	0.0	0.0	0.0
Large Corvids	31	81	19.1	62.7	71.7	66.7	33.3	0.0
Large Bird Overall	**117**	**419**	**32.6**	**106.9**	**83.6**	**23.4**	**76.4**	**0.2**

[1] For observations (Obs) within 800-m plots
[2] The likely rotor-swept height is 25–150 m (82–492 ft) above ground level

5.1.4 Large Bird Spatial Use

For all large bird species combined, bird use was highest at Point 1 (20.2 observations/800-m plot/60-minute survey; adjacent to Albert Lea Lake and the confluence of Peter Lund Creek), largely due to high waterbird use at that location (16.2 observations/800-m plot/60-minute survey). Large bird use ranged from 1.4 to 16.0 observations/800-m plot/60-minute survey at all other points (Appendix C).

Waterbird use was observed at six observation points, with Point 1 having the highest use (16.2 observations/800-m plot/60-minute survey; Appendix C). Waterbird use ranged from 0.2 to 14.0 observations/800-m plot/60-minute survey at the remaining five points with waterbird data (Appendix C).

Waterfowl were observed at seven observation points, with use was highest at Point 11 (12.0 observations/800-m plot/60-minute survey) just over 1.6 km (1.0 mi) east of the Shell Rock River. Remaining waterfowl use ranged from 0.2 to 2.0 observations/800-m plot/60-minute survey at the other six survey points with waterfowl use (Appendix C).

Shorebird use was observed at 14 observation points, with Point 13 having the highest use (1.0 observations/800-m plot/60-minute survey; Appendix C). Shorebird use ranged from 0.2 to 0.8 observations/800-m plot/60-minute survey at the remaining 13 points with shorebird data (Appendix C).

Diurnal raptor use was observed at 13 observation points. Diurnal raptor use was highest at Point 1 (1.0 observations/800-m plot/60-minute survey, adjacent to Albert Lea Lake and the confluence of Peter Lund Creek) and ranged from 0.2 to 0.6 observation/800-m plot/60-minute survey at the other survey points (Appendix C). Of the diurnal raptors, buteos were observed at 10 points, with highest use at Points 1 and 4 (0.6 observation/800-m plot/60-minute survey; Appendix C). Accipiters were observed at five points, with use at all five points being (0.2 observation/800-m plot/60-minute surveys; Appendix C). Eagle use was observed at two observation points, Points 1 and 2 (0.4 and 0.2 observation/800-m plot/60-minute survey, respectively; Figure 4; Appendix C).

Vulture use was observed at 17 observation points, with Point 3 having the highest use (4.8 observations/800-m plot/60-minute survey; Appendix C). Vulture use ranged from 0.2 to 2.2 observations/800-m plot/60-minute survey at the remaining 16 points with vulture data (Appendix C).

Large corvid use was observed at 17 observation points, with Point 12 having the highest use (4.6 observations/800-m plot/60-minute survey; Appendix C). Large corvid use ranged from 0.4 to 2.0 observations/800-m plot/60-minute survey at the remaining 16 points (Appendix C).

Figure 5[2] presents mapped bald eagle flight paths recorded from each survey point, with the highest number of flight paths documented at Point 1, located largely outside of the Project area near Albert Lea Lake (see Footnote 1; Figure 5). Point 2 was the only other point that documented eagle flight paths. Overall, flight patterns were concentrated to the northwest corner of the Project area (Figure 5).

[2] Flight paths on Figure 5 may represent more than one eagle using the same flight path.

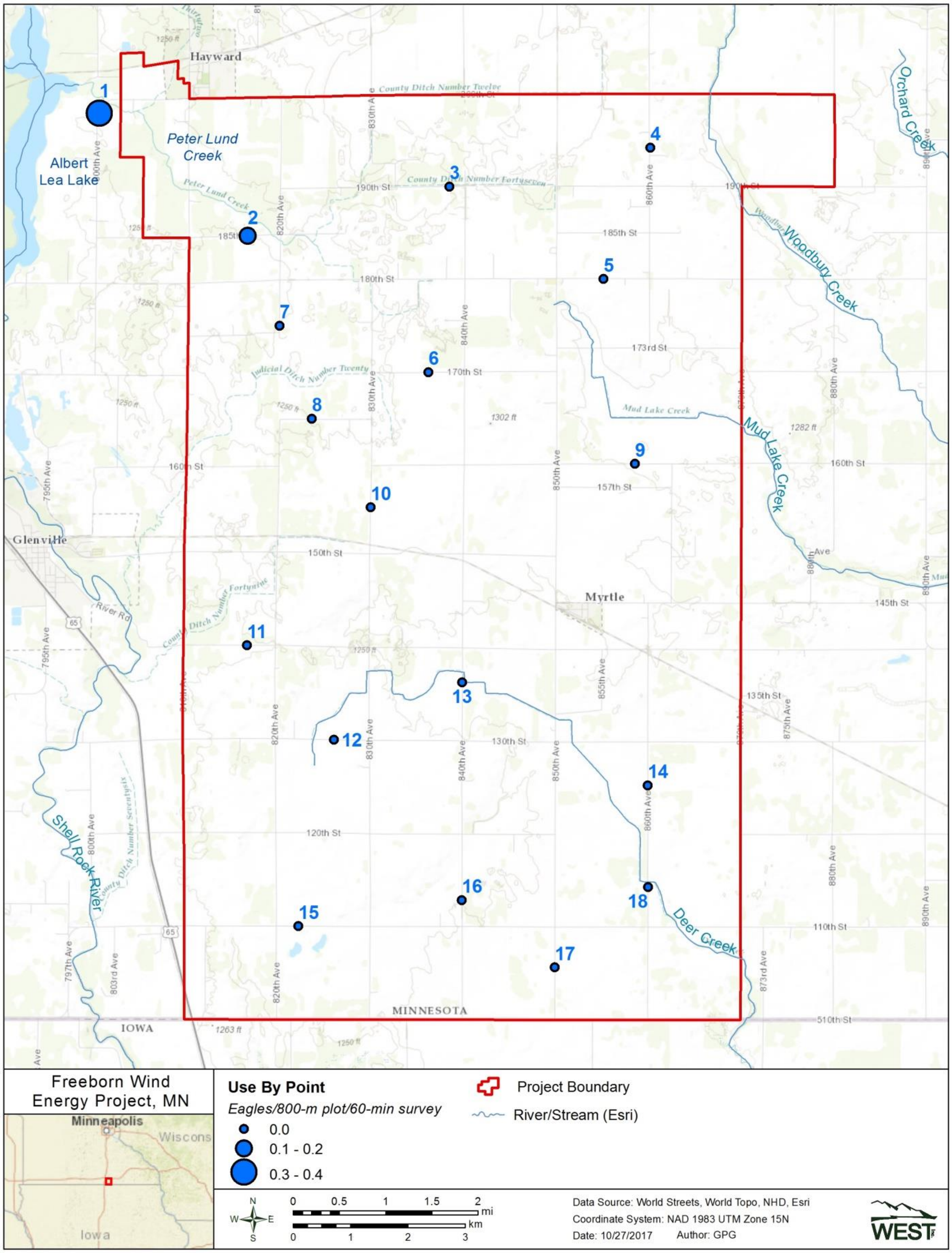

Figure 4. Eagle use by observation point during large bird use surveys conducted in the Freeborn Wind Energy Project area from May 26 – September 22, 2017.

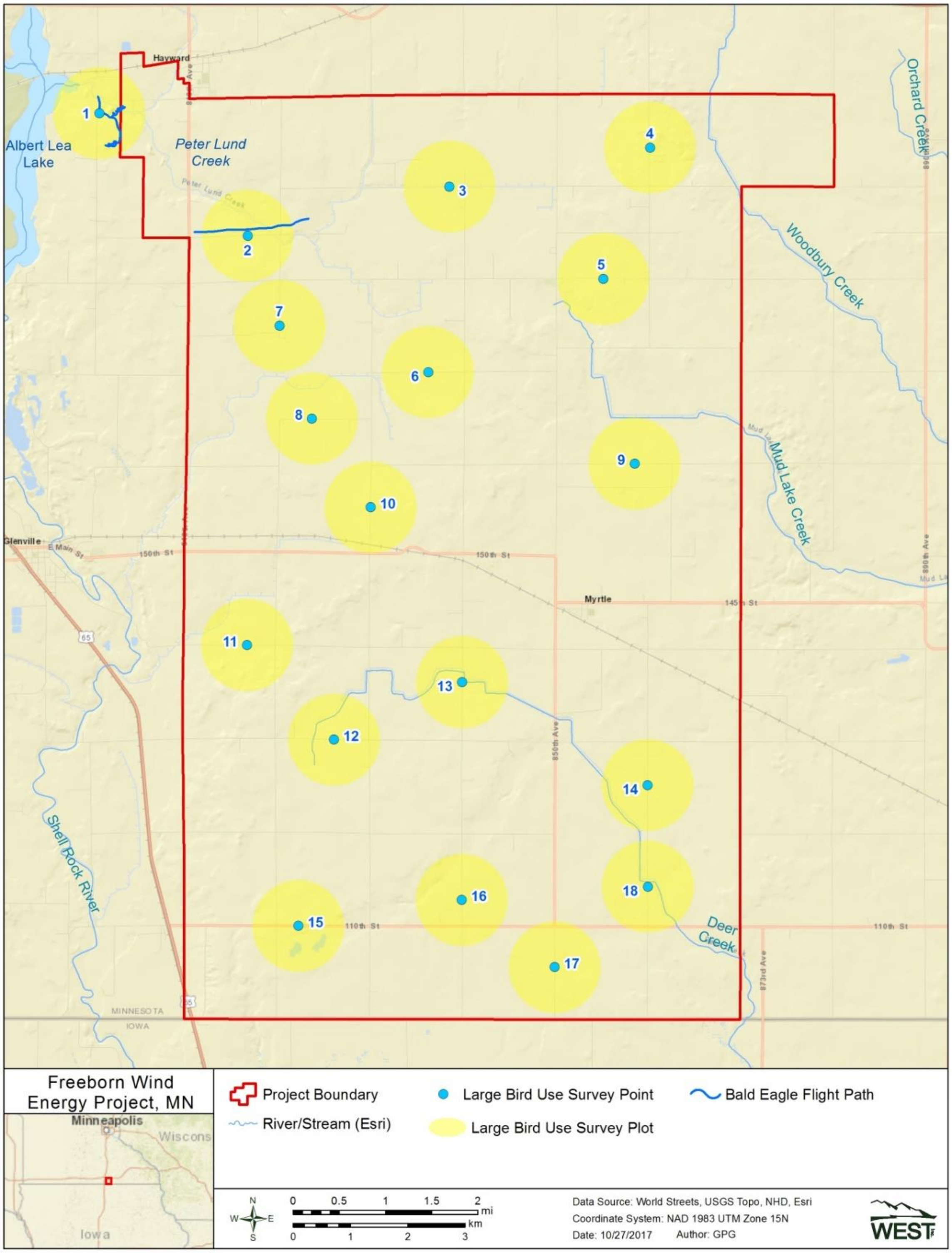

Figure 5. Bald eagle flight paths recorded during large bird use surveys conducted in the Freeborn Wind Energy Project area from May 26 – September 22, 2017.

5.1.5 Eagle Minutes

A total of 21 eagle minutes were documented during 90 large bird use survey observation hours. Eagle minutes per minute of survey were higher during fall (0.0176) compared to summer (0.0005; Table 4). The majority of eagle minutes were recorded during September (19 eagle minutes) followed by June (2 eagle minutes), and no eagle minutes were recorded during the other 3 months of the study (Table 5; Figure 6). Eagle minutes were documented at two of the observation points, Points 1 and 2 (Figure 7). Point 1, which largely falls outside of the Project area in the northwest corner, had the highest eagle minutes (19 minutes) followed by Point 2 (2 minutes; Figure 7).

Table 4. Eagle minutes documented during large bird surveys conducted in the Freeborn Wind Energy Project area from May 26 – September 22, 2017.

Season	Eagle Minutes	Survey Effort (hours)	Survey Effort (minutes)	Eagle minutes per minute survey
Summer (05/27/17 – 09/02/17)	2	72	4,320	0.0005
Fall (09/03/17 – 09/22/17)	19	18	1,080	0.0176
Total	**21**	**90**	**5,400**	**0.0039**

Table 5. Number of flying eagle observations[1] with a duration of 1 minute or more and eagle minutes by month during large bird use surveys conducted in the Freeborn Wind Energy Project area from May 26 – September 22, 2017.

Month/Year	Eagle Observations	Eagle Minutes
May, 2017	0	0
June, 2017	1	2
July, 2017	0	0
August, 2017	0	0
September, 2017	2	19
Total	**3**	**21**

[1] Observations of eagles flying with an 800-m (2,625-ft x 200-m (656-ft) cylinder

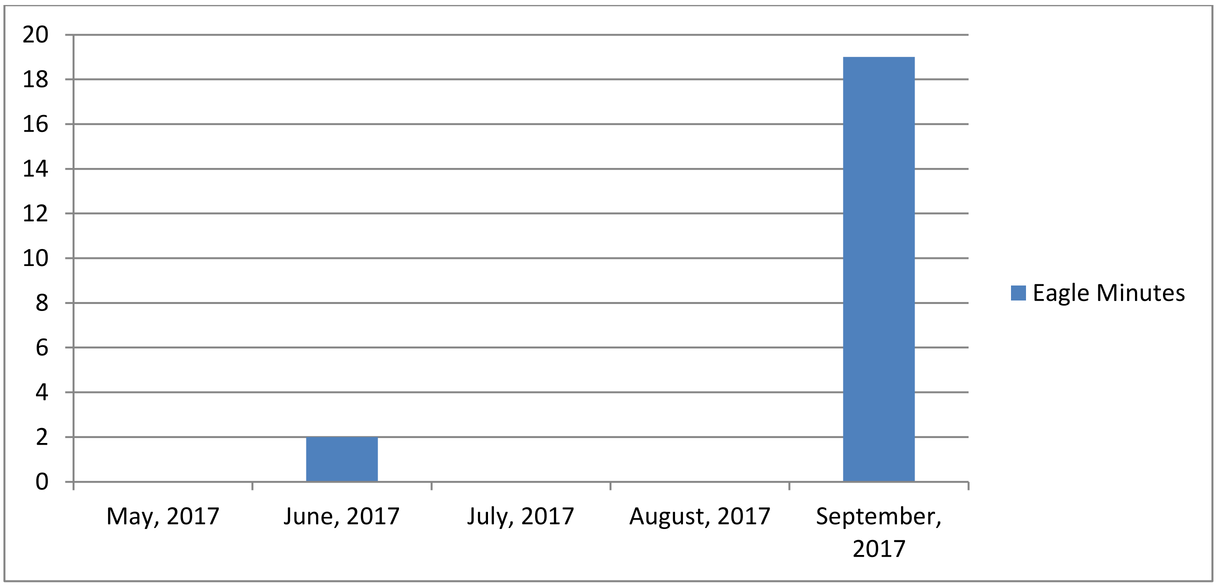

Figure 6. Number of eagle minutes recorded by month during large bird use surveys in the Freeborn Wind Energy Project area from May 26 – September 22, 2017.

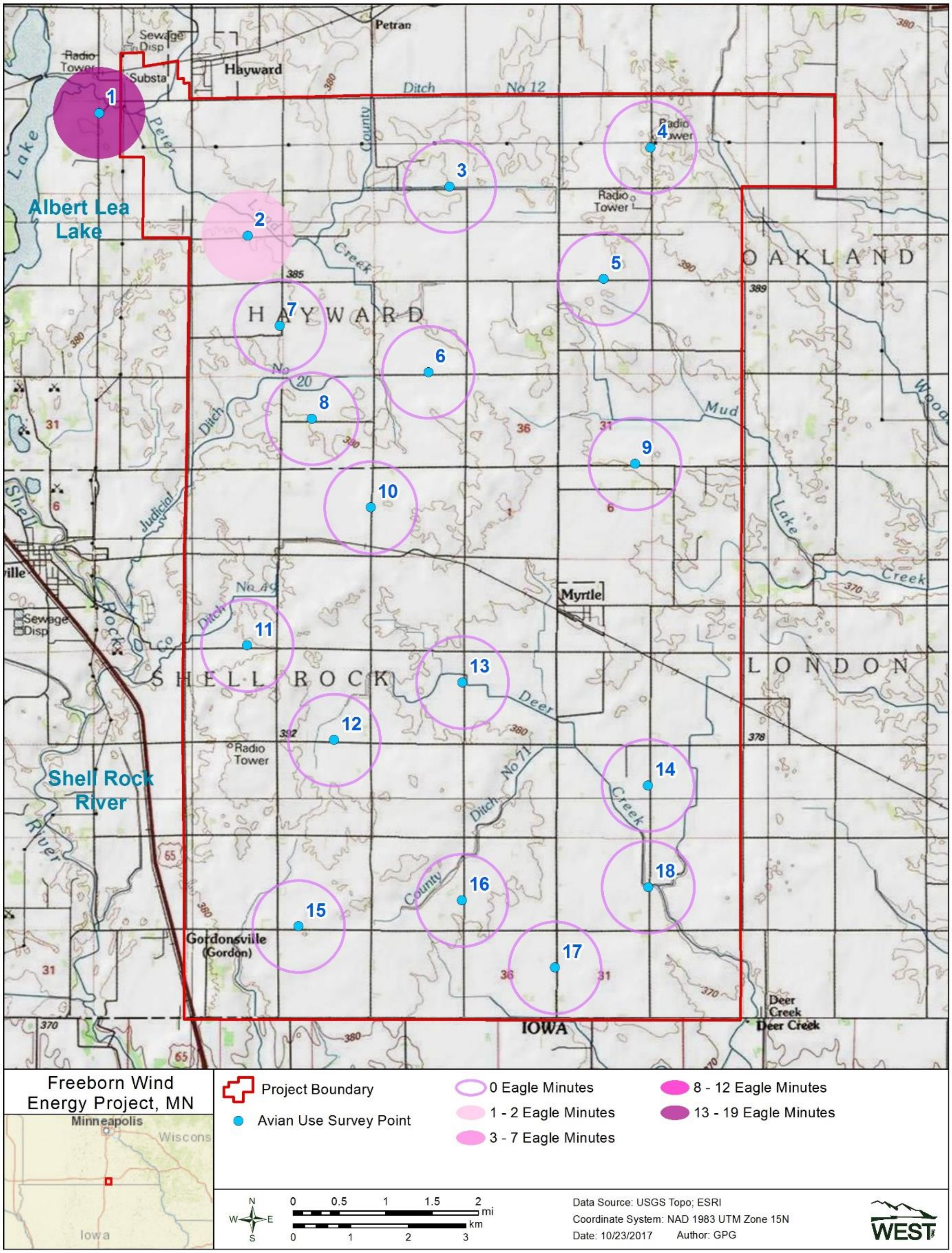

Figure 7. Number of eagle minutes recorded during large bird use surveys conducted in the Freeborn Wind Energy Project area from May 26 – September 22, 2017.

5.2 Threatened, Endangered, and Sensitive Species Observations

No federal- or state-threatened or endangered species were observed during large bird use surveys. Three sensitive species were observed during large bird use surveys (Table 6). American white pelican, a state-listed special concern species, comprised the majority of sensitive species observations, with 147 observations (Table 6).

For bald eagle, which is a USFWS Bird of Conservation Concern and is protected under the Bald and Golden Eagle Protection Act (BGEPA 1940), there were three observations (Table 6). One hundred-twenty observations of Franklin's gull (*Leucophaeus pipixcan*), a state-listed special concern, were recorded during large bird use surveys (Table 6).

Table 6. Summary of sensitive species observed in the Freeborn Wind Energy Project area during large bird use surveys (LB) from May 26 – September 22, 2017.

Species	Scientific Name	Status	LB		Total	
			# of grps	# of obs	# of grps	# of obs
American white pelican	*Pelecanus erythrorhynchos*	SCS	4	147	4	147
Bald eagle	*Haliaeetus leucocephalus*	BGEPA, BCC	3	3	3	3
Franklin's gull	*Leucophaeus pipixcan*	SCS	1	120	1	120
Overall	**3 Species**		**8**	**270**	**8**	**270**

SCS = state-listed special concern species (Minnesota Department of Natural Resources 2013); BCC=U.S. Fish and Wildlife Service (USFWS) Birds of Conservation Concern (USFWS 2008); BGEPA=Bald and Golden Eagle Protection Act (BGEPA 1940)

5.3 Incidental Observations

No incidental bird observations were observed or recorded while in transit between survey points during the 5-month study period.

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Appendix A. All Bird Types and Species Observed at the Freeborn Wind Energy Project Area During Large Bird Use Surveys from May 26 – September 22, 2017

Appendix A. Summary of observations by bird type and species for the large bird use surveys conducted in the Freeborn Wind Energy Project[1] area May 26 – September 22, 2017.

Type/Species	Scientific Name	Summer			Fall			Total		
		# grp	# obs	% obs	# grp	# obs	% obs	# grp	# obs	% obs
Waterbirds		**9**	**35**	**3.0**	**5**	**123**	**60.6**	**14**	**158**	**11.7**
American white pelican	*Pelecanus erythrorhynchos*	2	27		2	120		4	147	
Double-crested cormorant	*Phalacrocorax auritus*	1	1		0	0		1	1	
Great blue heron	*Ardea herodias*	2	3		2	2		4	5	
Great egret	*Ardea alba*	1	1		0	0		1	1	
Sandhill crane	*Grus canadensis*	3	3		1	1		4	4	
Waterfowl		**19**	**450**	**39.2**	**1**	**10**	**4.9**	**20**	**460**	**34.0**
Canada goose	*Branta canadensis*	5	140		1	10		6	150	
Mallard	*Anas platyrhynchos*	4	13		0	0		4	13	
Snow goose	*Chen caerulescens*	5	290		0	0		5	290	
Unidentified duck	*NA*	5	7		0	0		5	7	
Shorebirds		**21**	**28**	**2.4**	**1**	**1**	**0.5**	**22**	**29**	**2.1**
Killdeer	*Charadrius vociferus*	21	28		1	1		22	29	
Gulls/Terns		**3**	**390**	**33.9**	**0**	**0**	**0**	**3**	**390**	**28.8**
Franklin's gull	*Leucophaeus pipixcan*	1	120		0	0		1	120	
Unidentified gull	*NA*	2	270		0	0		2	270	
Diurnal Raptors		**33**	**36**	**3.1**	**5**	**5**	**2.5**	**38**	**41**	**3.0**
Accipiters		*3*	*3*		*2*	*2*		*5*	*5*	
Cooper's hawk	*Accipiter cooperii*	3	3		2	2		5	5	
Buteos		*28*	*31*		*1*	*1*		*29*	*32*	
Red-tailed hawk	*Buteo jamaicensis*	28	31		1	1		29	32	
Northern Harrier		*1*	*1*		*0*	*0*		*1*	*1*	
Northern harrier	*Circus cyaneus*	1	1		0	0		1	1	
Eagles		*1*	*1*		*2*	*2*		*3*	*3*	
Bald eagle	*Haliaeetus leucocephalus*	1	1		2	2		3	3	
Vultures		**56**	**101**	**8.8**	**17**	**36**	**17.7**	**73**	**137**	**10.1**
Turkey vulture	*Cathartes aura*	56	101		17	36		73	137	
Upland Game Birds		**6**	**10**	**0.9**	**0**	**0**	**0**	**6**	**10**	**0.7**
Ring-necked pheasant	*Phasianus colchicus*	5	5		0	0		5	5	
Wild turkey	*Meleagris gallopavo*	1	5		0	0		1	5	
Large Corvids		**39**	**99**	**8.6**	**11**	**28**	**13.8**	**50**	**127**	**9.4**
American crow	*Corvus brachyrhynchos*	39	99		11	28		50	127	
Overall Large Birds		**186**	**1,149**		**40**	**203**		**226**	**1,352**	

[1] Regardless of distance from observer

Appendix B. Large Bird Use, Percent of Use, and Frequency of Occurrence during Large Bird Use Surveys at the Freeborn Wind Energy Project Area from May 26 – September 22, 2017

Appendix B. Large bird use (number of large bird observations/800-meter plot/60-minute survey), percent of total use (%), and frequency of occurrence (%) for each large bird type and species by season during large bird use surveys conducted in the Freeborn Wind Energy Project area from May 26 – September 22, 2017.

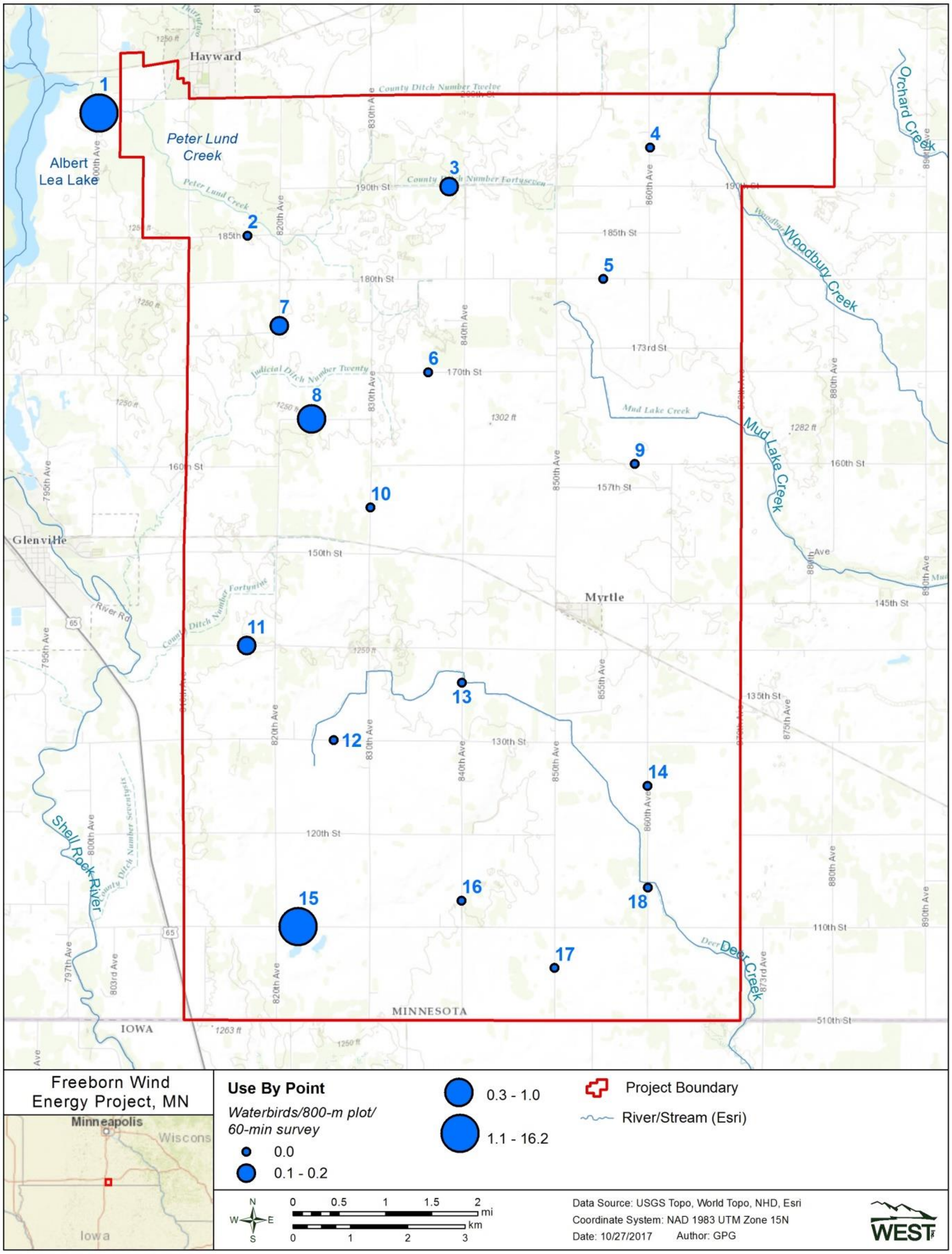
Type/Species	Bird Use			% of Use		% Frequency	
	Summer	Fall	Study Period	Summer	Fall	Summer	Fall
Waterbirds	**0.5**	**6.8**	**1.5**	**10.5**	**68.9**	**8.3**	**16.7**
American white pelican	0.4	6.7	1.4	8.3	67.8	2.8	11.1
Double-crested cormorant	<0.1	0.0	<0.1	0.3	0.0	1.4	0.0
Great blue heron	<0.1	<0.1	<0.1	0.9	0.6	2.8	5.6
Great egret	<0.1	0.0	<0.1	0.3	0.0	1.4	0.0
Sandhill crane	<0.1	<0.1	<0.1	0.6	0.6	2.8	5.6
Waterfowl	**1.2**	**0.0**	**1.0**	**27.2**	**0.0**	**11.1**	**0.0**
Canada goose	0.2	0.0	0.1	3.4	0.0	2.8	0.0
Mallard	0.2	0.0	0.2	4.0	0.0	5.6	0.0
Snow goose	0.8	0.0	0.7	18.5	0.0	1.4	0.0
Unidentified duck	<0.1	0.0	<0.1	1.2	0.0	2.8	0.0
Shorebirds	**0.4**	**<0.1**	**0.3**	**8.6**	**0.6**	**29.2**	**5.6**
Killdeer	0.4	<0.1	0.3	8.6	0.6	29.2	5.6
Diurnal Raptors	**0.3**	**0.3**	**0.3**	**7.1**	**2.8**	**25**	**16.7**
Accipiters	*<0.1*	*0.1*	*0.1*	*0.9*	*1.1*	*4.2*	*11.1*
Cooper's hawk	<0.1	0.1	0.1	0.9	1.1	4.2	11.1
Buteos	*0.2*	*<0.1*	*0.2*	*5.6*	*0.6*	*18.1*	*5.6*
Red-tailed hawk	0.2	<0.1	0.2	5.6	0.6	18.1	5.6
Northern Harrier	*<0.1*	*0.0*	*<0.1*	*0.3*	*0.0*	*1.4*	*0.0*
Northern harrier	<0.1	0.0	<0.1	0.3	0.0	1.4	0.0
Eagles	*<0.1*	*0.1*	*<0.1*	*0.3*	*1.1*	*1.4*	*5.6*
Bald eagle	<0.1	0.1	<0.1	0.3	1.1	1.4	5.6
Vultures	**0.8**	**1.2**	**0.8**	**17.3**	**11.9**	**33.3**	**44.4**
Turkey vulture	0.8	1.2	0.8	17.3	11.9	33.3	44.4
Upland Game Birds	**0.1**	**0.0**	**0.1**	**3.1**	**0.0**	**8.3**	**0.0**
Ring-necked pheasant	<0.1	0.0	0.1	1.5	0.0	6.9	0.0
Wild turkey	<0.1	0.0	0.1	1.5	0.0	1.4	0.0
Large Corvids	**1.2**	**1.6**	**1.2**	**26.2**	**15.8**	**36.1**	**50.0**
American crow	1.2	1.6	1.2	26.2	15.8	36.1	50.0
Overall	**4.5**	**9.8**	**5.4**	**100.0**	**100.0**		

Appendix C. Large Bird Use by Point for All Birds, Major Bird Types, and Diurnal Raptor Subtypes during Large Bird Use Surveys Conducted in the Freeborn Wind Energy Project Area from May 26 – September 22, 2017

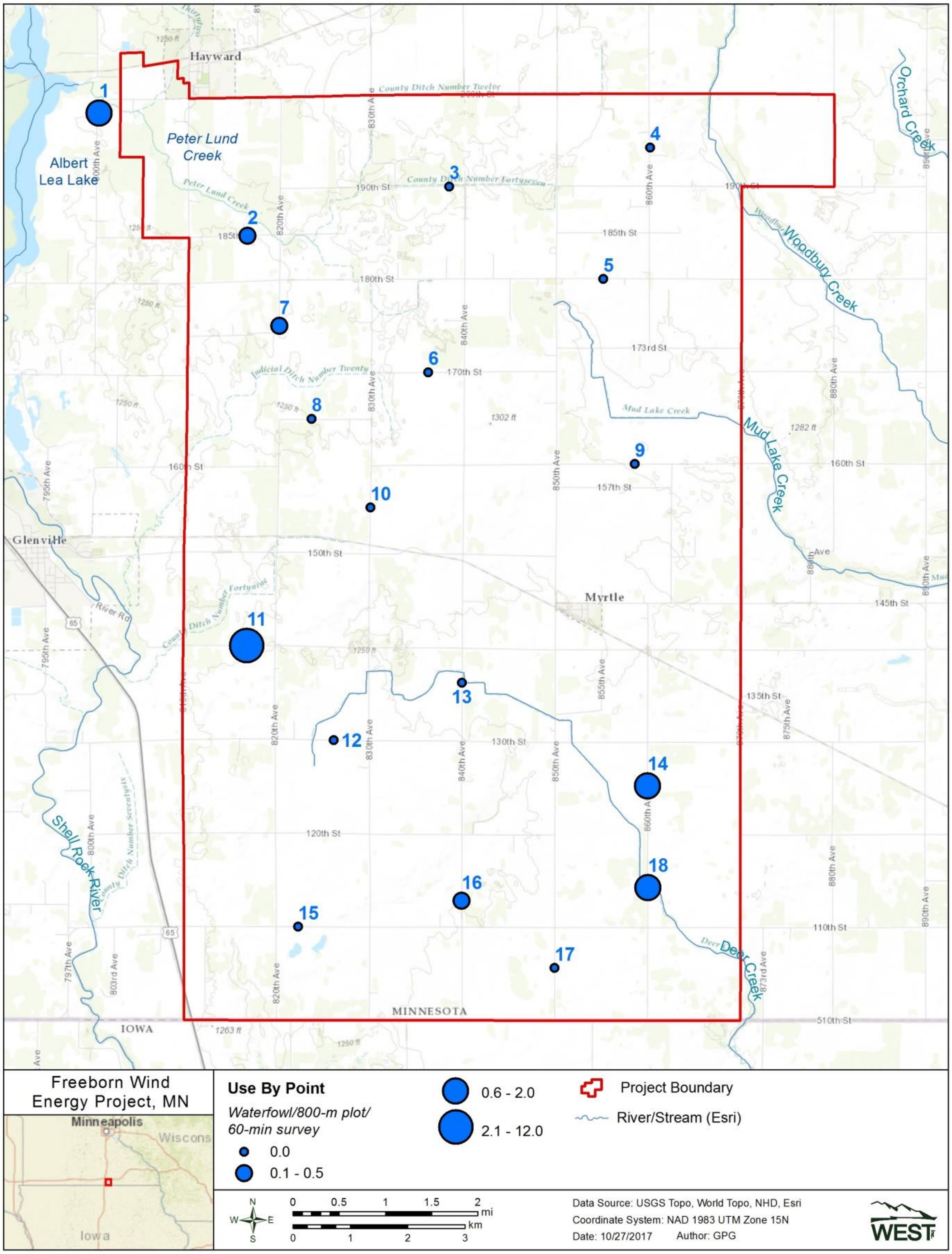
Appendix C1. Large bird use (number of observations/800-m plot/60-minute survey) by point for all birds[1], major bird types, and diurnal raptor subtypes observed at the Freeborn Wind Energy Project during the large bird use surveys from May 26 – September 22, 2017.

Bird Type	Survey Point																	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
Waterbirds	16.2	0.0	0.2	0.0	0.0	0.0	0.2	0.4	0.0	0.0	0.2	0.0	0.0	0.0	14.0	0.0	0.0	0.0
Waterfowl	1.4	0.4	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	12.0	0.0	0.0	1.2	0.0	0.2	0.0	2.0
Shorebirds	0.8	0.0	0.4	0.0	0.4	0.2	0.2	0.4	0.8	0.2	0.2	0.4	1.0	0.0	0.4	0.0	0.2	0.2
Diurnal Raptors	1.0	0.6	0.2	0.6	0.6	0.0	0.0	0.2	0.0	0.4	0.2	0.4	0.4	0.0	0.0	0.4	0.4	0.2
Accipiters	*0.0*	*0.0*	*0.2*	*0.0*	*0.2*	*0.0*	*0.0*	*0.2*	*0.0*	*0.0*	*0.0*	*0.2*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.2*
Buteos	*0.6*	*0.4*	*0.0*	*0.6*	*0.4*	*0.0*	*0.0*	*0.0*	*0.0*	*0.4*	*0.2*	*0.2*	*0.4*	*0.0*	*0.0*	*0.4*	*0.2*	*0.0*
Northern Harrier	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.2*	*0.0*
Eagles	*0.4*	*0.2*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Vultures	0.4	0.2	4.8	2.2	1.2	0.6	0.4	0.2	0.0	0.4	0.8	0.2	0.2	0.6	1.0	0.6	0.4	1.2
Upland Game Birds	0.0	0.6	0.0	0.0	0.0	1.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0
Large Corvids	0.4	0.6	1.2	1.0	0.0	0.8	1.0	0.8	1.8	0.4	1.4	4.6	2.0	3.0	0.4	0.6	0.8	1.8
All Large Birds	**20.2**	**2.4**	**6.8**	**3.8**	**2.2**	**2.6**	**2.2**	**2.0**	**2.8**	**1.4**	**14.8**	**5.6**	**3.6**	**4.8**	**16.0**	**1.8**	**1.8**	**5.4**

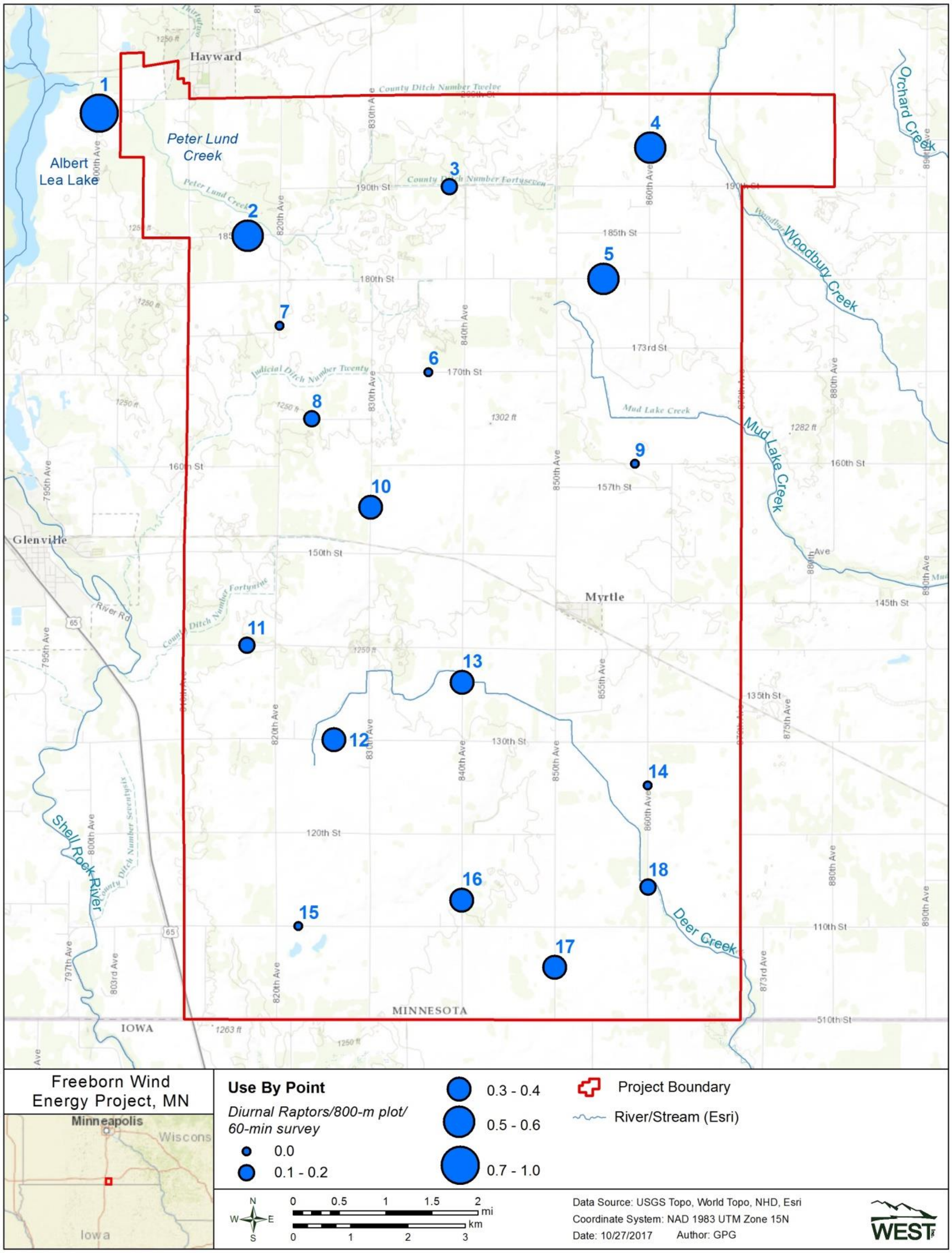
[1] 800-meter; 2,625-foot plot for large birds



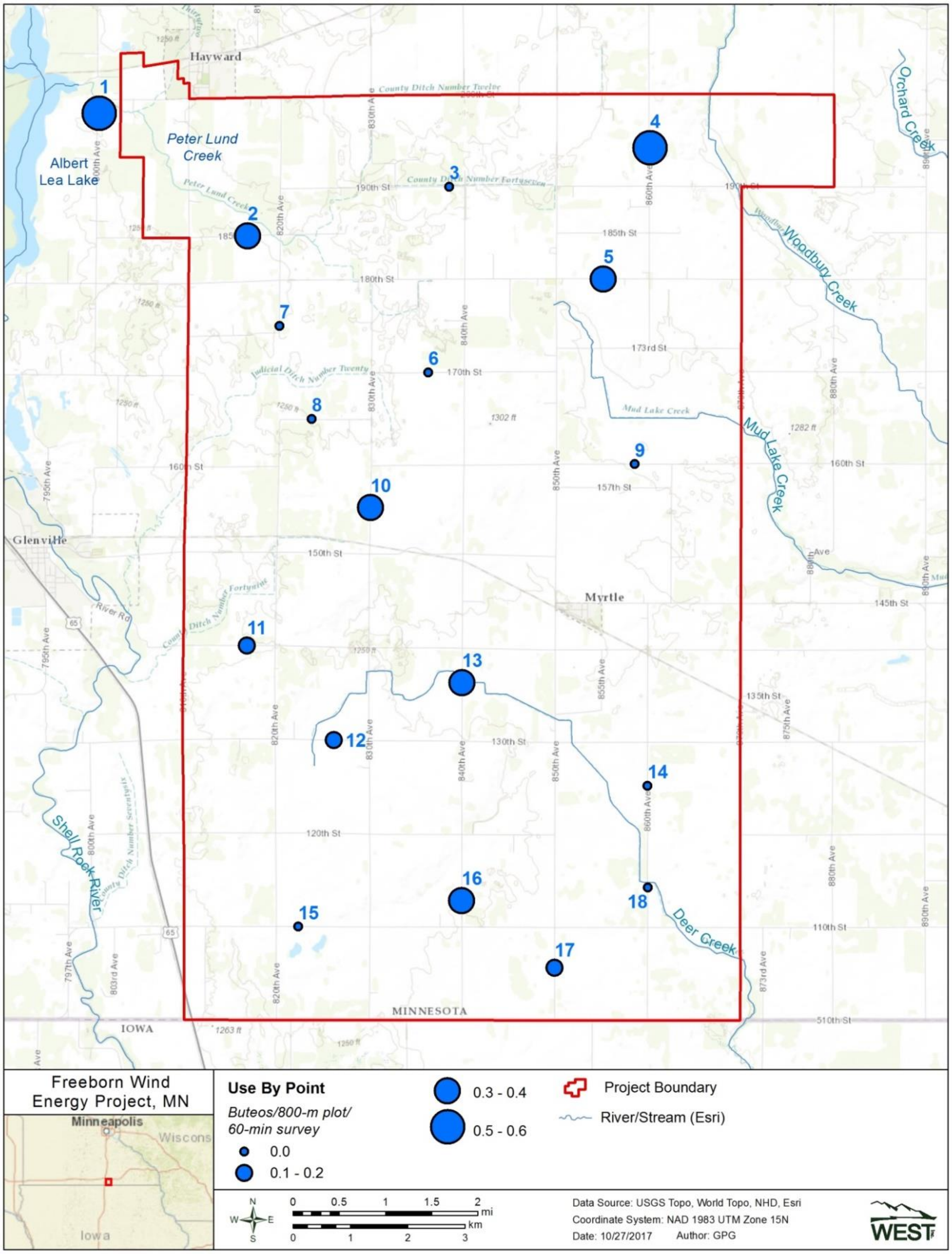
Appendix C2. Waterbird use by observation point during large bird use surveys conducted in the Freeborn Wind Energy Project area from May 26 – September 22, 2017.



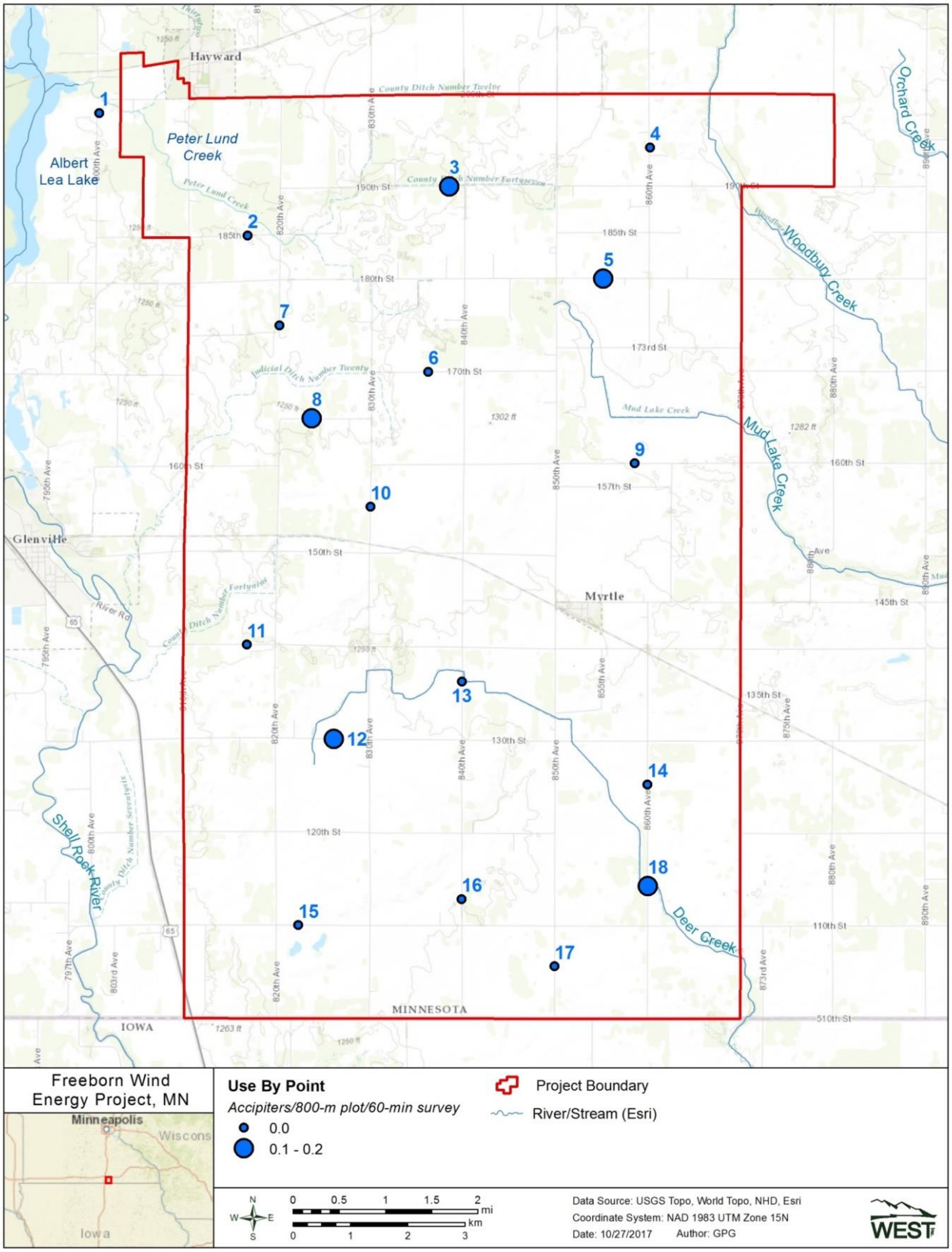
Appendix C2 (continued). Waterfowl use by observation point during large bird use surveys conducted in the Freeborn Wind Energy Project area from May 26 – September 22, 2017.



Appendix C2 (continued). Raptor use by observation point during large bird use surveys conducted in the Freeborn Wind Energy Project area from May 26 – September 22, 2017.



Appendix C2 (continued). Buteo use by observation point during large bird use surveys conducted in the Freeborn Wind Energy Project area from May 26 – September 22, 2017.



Appendix C2 (continued). Accipiter use by observation point during large bird use surveys conducted in the Freeborn Wind Energy Project area from May 26 – September 22, 2017.

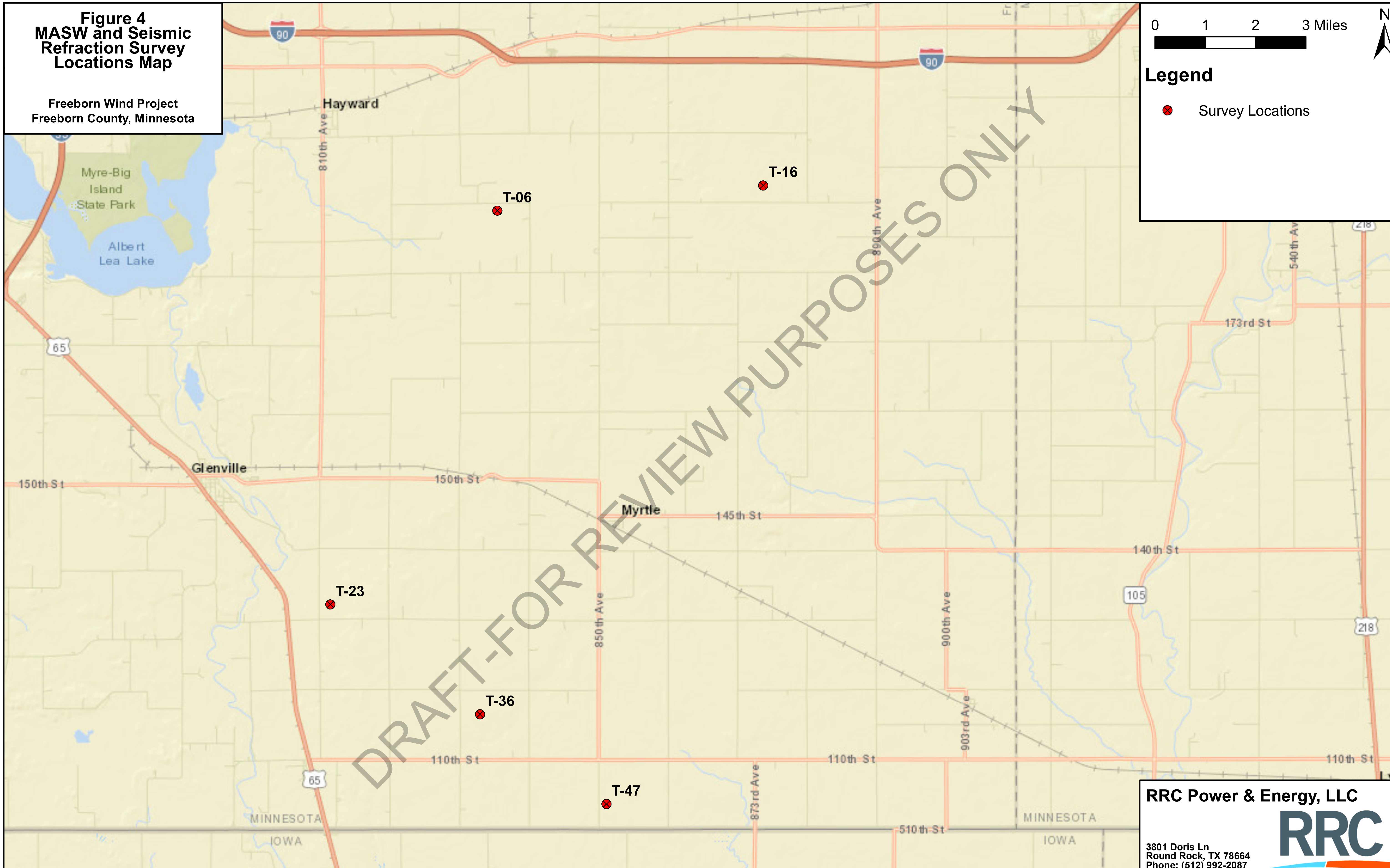


Figure 4
MASW and Seismic Refraction Survey Locations Map
Freeborn Wind Project
Freeborn County, Minnesota
0 1 2 3 Miles
N
Legend
Survey Locations
T-06
T-16
T-23
T-36
T-47
Hayward
Glenville
Myrtle
Myre-Big Island State Park
Albert Lea Lake
810th Ave
850th Ave
890th Ave
900th Ave
903rd Ave
873rd Ave
540th Ave
150th St
145th St
140th St
173rd St
110th St
510th St
90
65
105
218
MINNESOTA
IOWA
DRAFT-FOR REVIEW PURPOSES ONLY
RRC Power & Energy, LLC
3801 Doris Ln
Round Rock, TX 78664
Phone: (512) 992-2087

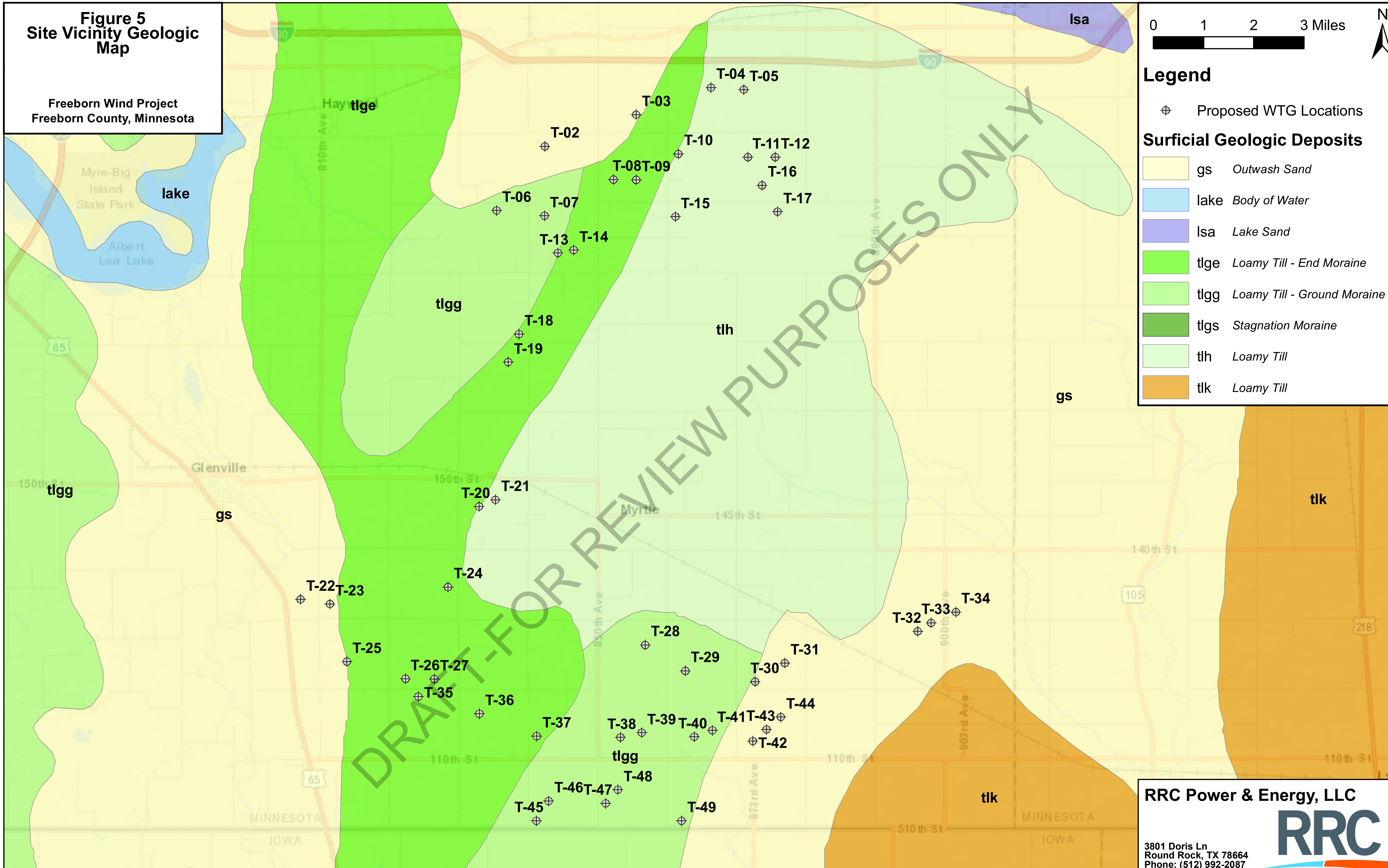


Figure 5
Site Vicinity Geologic Map
Freeborn Wind Project
Freeborn County, Minnesota
0 1 2 3 Miles
N
Legend
Proposed WTG Locations
Surficial Geologic Deposits
gs Outwash Sand
lake Body of Water
lsa Lake Sand
tlge Loamy Till - End Moraine
tlgg Loamy Till - Ground Moraine
tlgs Stagnation Moraine
tlh Loamy Till
tlk Loamy Till
DRAFT - FOR REVIEW PURPOSES ONLY
lsa
tlge
tlgg
tlh
gs
tlk
lake
Myre-Big Island State Park
Albert Lea Lake
Glenville
Myrtle
Hayward
150th St
145th St
140th St
110th St
510th St
MINNESOTA
IOWA
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Round Rock, TX 78664
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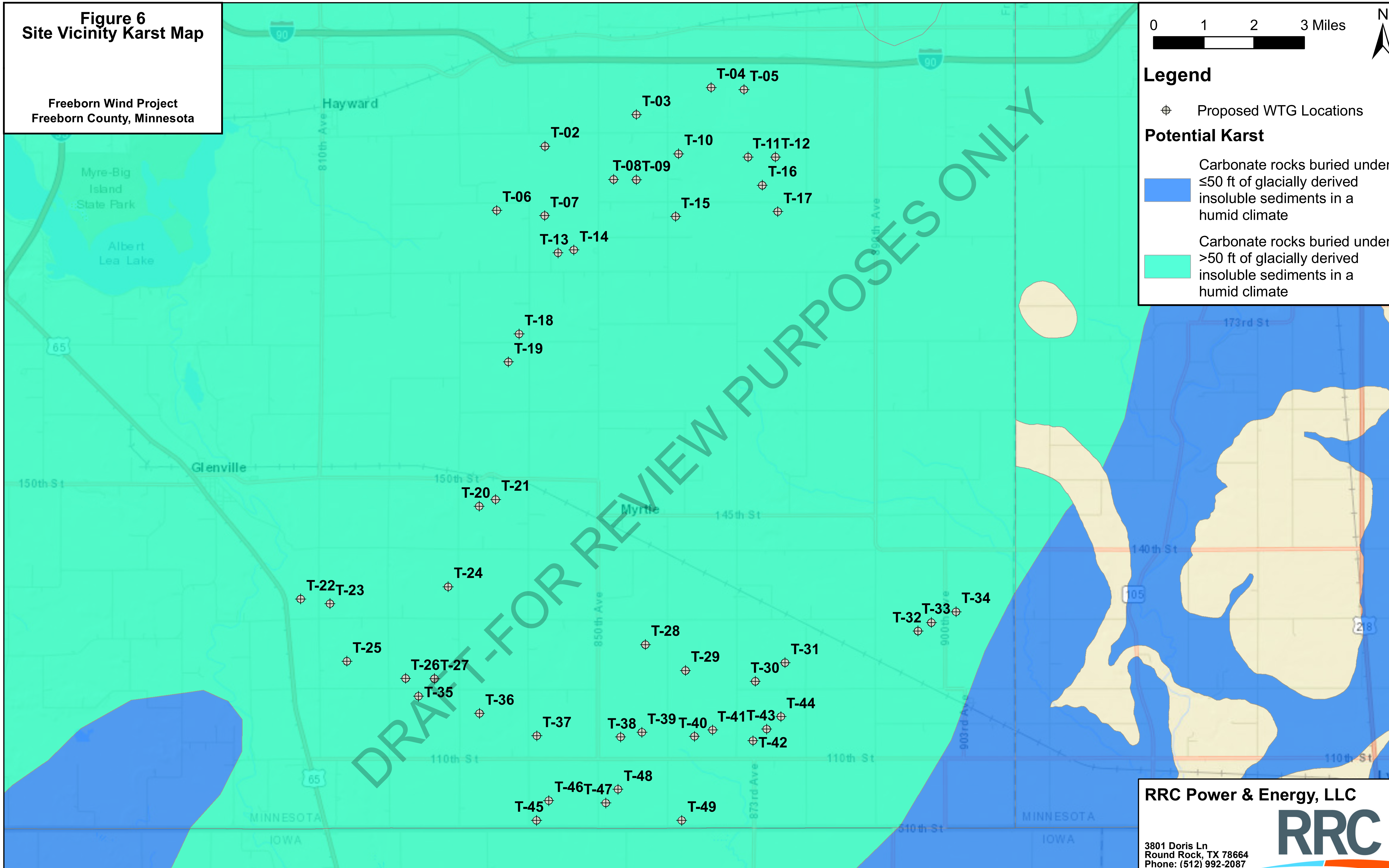

Figure 6
Site Vicinity Karst Map
Freeborn Wind Project
Freeborn County, Minnesota
0 1 2 3 Miles
N
Legend
Proposed WTG Locations
Potential Karst
Carbonate rocks buried under ≤50 ft of glacially derived insoluble sediments in a humid climate
Carbonate rocks buried under >50 ft of glacially derived insoluble sediments in a humid climate
DRAFT -FOR REVIEW PURPOSES ONLY
Hayward
Myre-Big Island State Park
Albert Lea Lake
Glenville
Myrtle
150th St
145th St
140th St
173rd St
110th St
810th Ave
850th Ave
873rd Ave
890th Ave
900th Ave
903rd Ave
MINNESOTA
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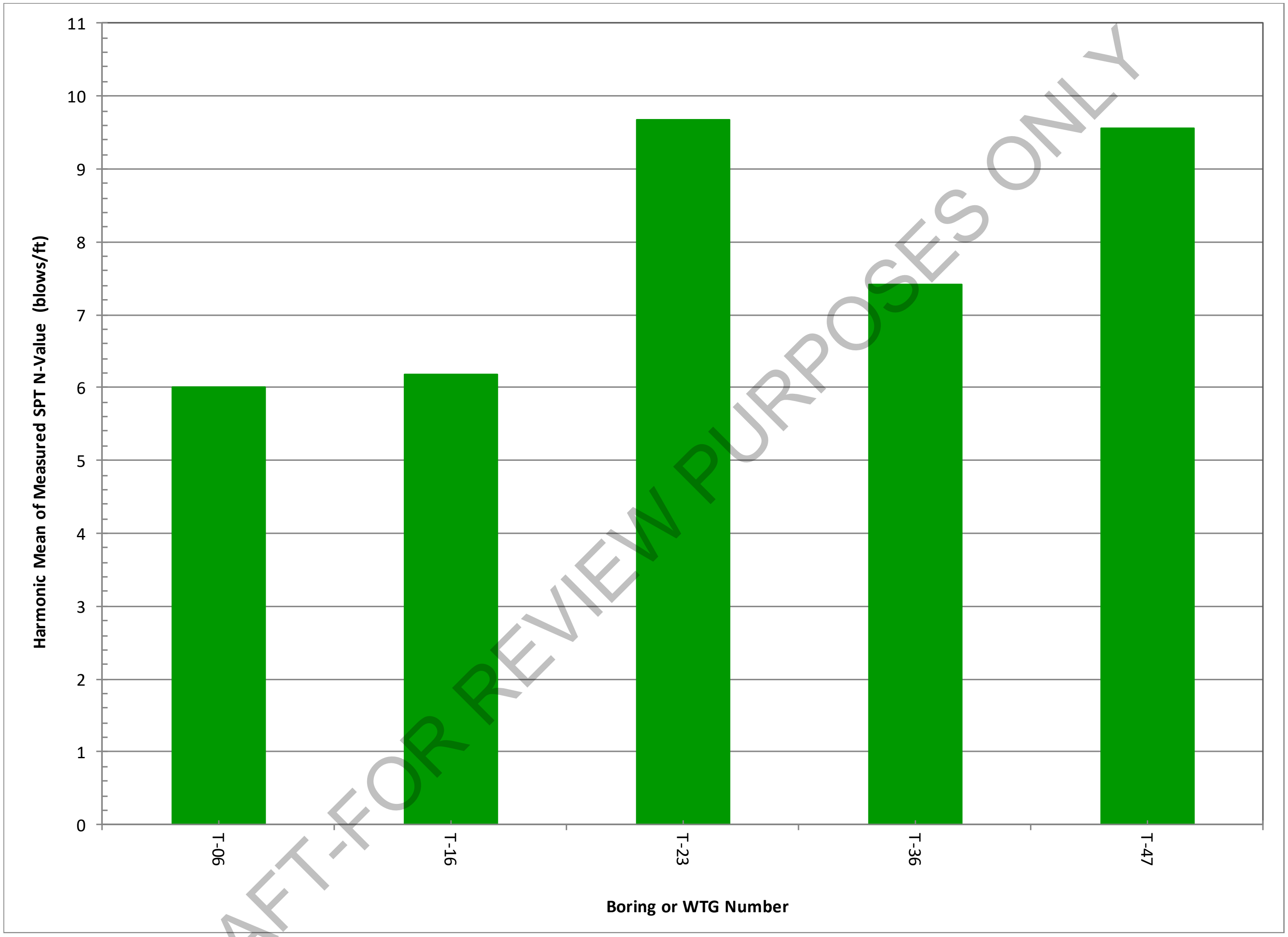

Figure 7 – Harmonic Mean of the Measured SPT N-values Below Foundation Bearing Elevation at Selected WTG Sites

Figure 8
Well Locations Obtained from the Minnesota Department of Health (Reference 5)

Freeborn Wind Project
Freeborn County, Minnesota

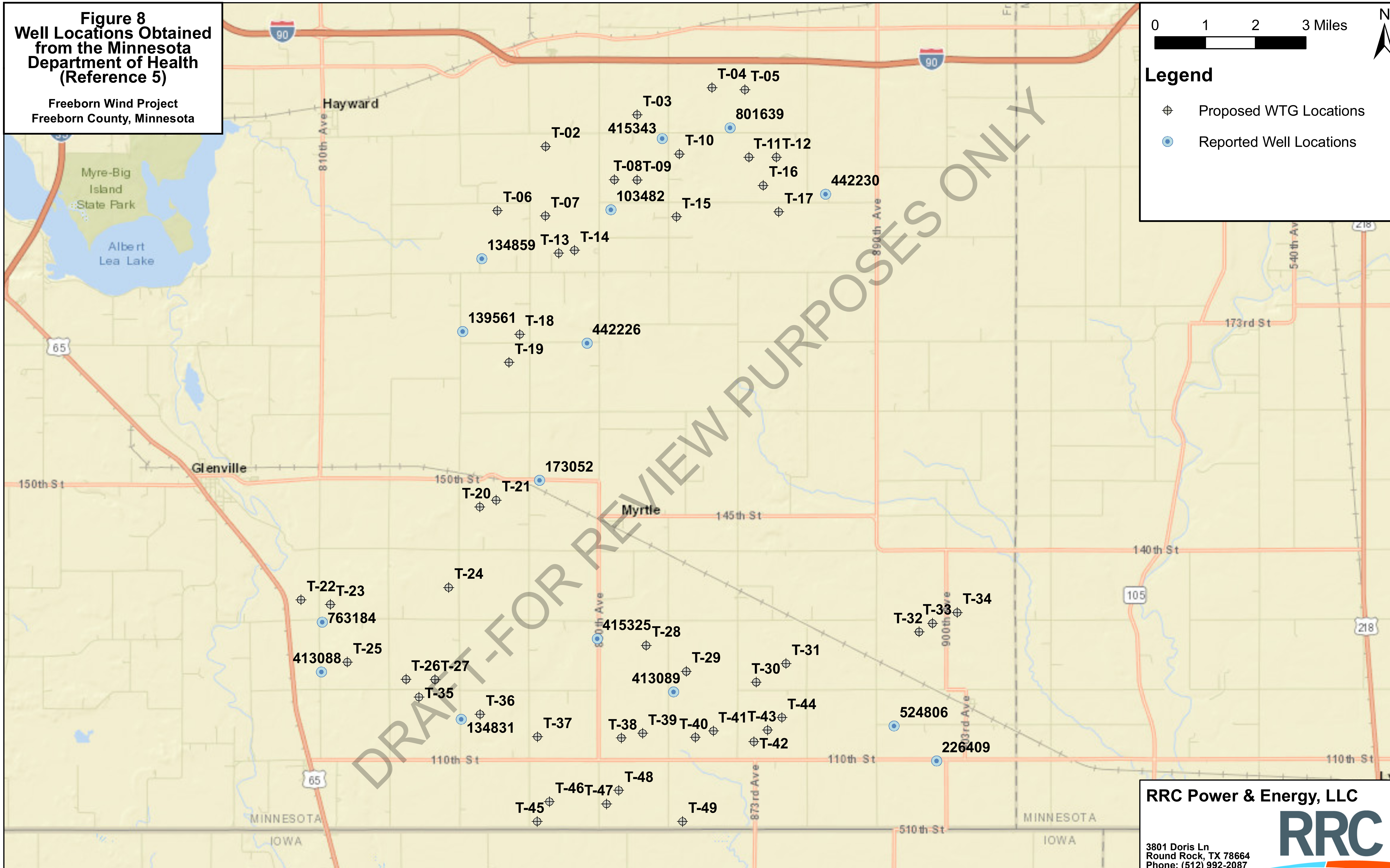

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Table A2 - Well Log Information Obtained from the Minnesota Department of Health (Reference 5)

Well Log No.	**Latitude**	**Longitude**	**Elevation** (feet above sea level)	**Total Well Depth** (feet below ground surface)	**Static Water Level** (feet below ground surface)	**Date of Measurement** (MM/DD/YYYY)	**Distance to Nearest Borehole** (miles)
103482	43.62850	-93.16573	1262	155	56	08/07/1975	0.44 mi. N of T-08
134831	43.52248	-93.20873	1277	191	70	03/31/1978	0.28 WSW of T-36
134859	43.61837	-93.20280	1260	156	52	05/23/1977	0.72 mi. SSW of T-06
139561	43.60320	-93.20830	1250	181	30	05/13/1983	0.82 mi. W of T-18
173052	43.57224	-93.18624	1275	146	46	08/09/1980	0.68 mi. NE of T-21
226409	43.51376	-93.07217	1221	105	27	08/17/1973	1.89 mi. S of T-32
413088	43.53237	-93.24890	1252	134	48	08/30/1988	0.33 mi. SW of T-25
413089	43.52814	-93.14770	1225	103	16	09/01/1988	0.35 mi. SW of T-29
415325	43.53928	93.16967	1240	130	50	03/20/1985	0.71 mi. W of T-28
415343	43.64334	-93.15096	1280	190	74	07/22/1985	0.33 mi. NW of T-10
442226	43.60078	-93.17259	1285	200	77	05/20/1988	0.98 mi. E of T-18
442230	43.63179	-93.10401	1260	156	60	10/20/1988	0.72 mi. NE of T-17
524806	43.52104	-93.08436	1215	400	37	06/15/1993	1.41 mi. SSW of T-32
763184	43.54270	-93.24864	1240	110	23	04/29/2009	0.28 mi. SW of T-23
801639	43.64558	-93.13148	1279.5	230	45	09/15/2014	0.50 mi. NW of T-11

Summary of CPT Correlation Equations and Formulas

Presented below is a list of formulas used for the estimation of various soil properties. The formulas are presented in SI unit system and assume that all components are expressed in the same units.

:: Unit Weight, g (kN/m³) ::

$$g = g_w \cdot \left(0.27 \cdot \log(R_f) + 0.36 \cdot \log\left(\frac{q_t}{p_a}\right) + 1.236\right)$$

where g_w = water unit weight

:: Permeability, k (m/s) ::

$I_c < 3.27$ and $I_c > 1.00$ then $k = 10^{0.952 - 3.04 \cdot I_c}$

$I_c \leq 4.00$ and $I_c > 3.27$ then $k = 10^{-4.52 - 1.37 \cdot I_c}$

:: N_{SPT} (blows per 30 cm) ::

$$N_{60} = \left(\frac{q_c}{P_a}\right) \cdot \frac{1}{10^{1.1268 - 0.2817 \cdot I_c}}$$

$$N_{1(60)} = Q_{tn} \cdot \frac{1}{10^{1.1268 - 0.2817 \cdot I_c}}$$

:: Young's Modulus, Es (MPa) ::

$$(q_t - \sigma_v) \cdot 0.015 \cdot 10^{0.55 \cdot I_c + 1.68}$$

(applicable only to $I_c < I_{c\_cutoff}$)

:: Relative Density, Dr (%) ::

$$100 \cdot \sqrt{\frac{Q_{tn}}{k_{DR}}}$$

(applicable only to SBT_n: 5, 6, 7 and 8 or $I_c < I_{c\_cutoff}$)

:: State Parameter, ψ ::

$$\psi = 0.56 - 0.33 \cdot \log(Q_{tn,cs})$$

:: Peak drained friction angle, φ (°) ::

$$\varphi = 17.60 + 11 \cdot \log(Q_{tn})$$

(applicable only to SBT_n: 5, 6, 7 and 8)

:: 1-D constrained modulus, M (MPa) ::

If $I_c > 2.20$

$\alpha = 14$ for $Q_{tn} > 14$

$\alpha = Q_{tn}$ for $Q_{tn} \leq 14$

$M_{CPT} = \alpha \cdot (q_t - \sigma_v)$

If $I_c \leq 2.20$

$M_{CPT} = (q_t - \sigma_v) \cdot 0.0188 \cdot 10^{0.55 \cdot I_c + 1.68}$

:: Small strain shear Modulus, Go (MPa) ::

$$G_0 = (q_t - \sigma_v) \cdot 0.0188 \cdot 10^{0.55 \cdot I_c + 1.68}$$

:: Shear Wave Velocity, Vs (m/s) ::

$$V_s = \left(\frac{G_0}{\rho}\right)^{0.50}$$

:: Undrained peak shear strength, Su (kPa) ::

$N_{kt} = 10.50 + 7 \cdot \log(F_r)$ or user defined

$$S_u = \frac{(q_t - \sigma_v)}{N_{kt}}$$

(applicable only to SBT_n: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: Remolded undrained shear strength, Su(rem) (kPa) ::

$S_{u(rem)} = f_s$ (applicable only to SBT_n: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: Overconsolidation Ratio, OCR ::

$$k_{OCR} = \left[\frac{Q_{tn}^{0.20}}{0.25 \cdot (10.50 + 7 \cdot \log(F_r))}\right]^{1.25}$$ or user defined

$$OCR = k_{OCR} \cdot Q_{tn}$$

(applicable only to SBT_n: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: In situ Stress Ratio, Ko ::

$$K_O = (1 - \sin\varphi') \cdot OCR^{\sin\varphi'}$$

(applicable only to SBT_n: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: Soil Sensitivity, S_t ::

$$S_t = \frac{N_S}{F_r}$$

(applicable only to SBT_n: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: Effective Stress Friction Angle, φ' (°) ::

$$\varphi' = 29.5° \cdot B_q^{0.121} \cdot (0.256 + 0.336 \cdot B_q + \log Q_t)$$

(applicable for $0.10 < B_q < 1.00$)

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

References

• Robertson, P.K., Cabal K.L., Guide to Cone Penetration Testing for Geotechnical Engineering, Gregg Drilling & Testing, Inc., 5th Edition, November 2012

• Robertson, P.K., Interpretation of Cone Penetration Tests - a unified approach., Can. Geotech. J. 46(11): 1337–1355 (2009)

RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

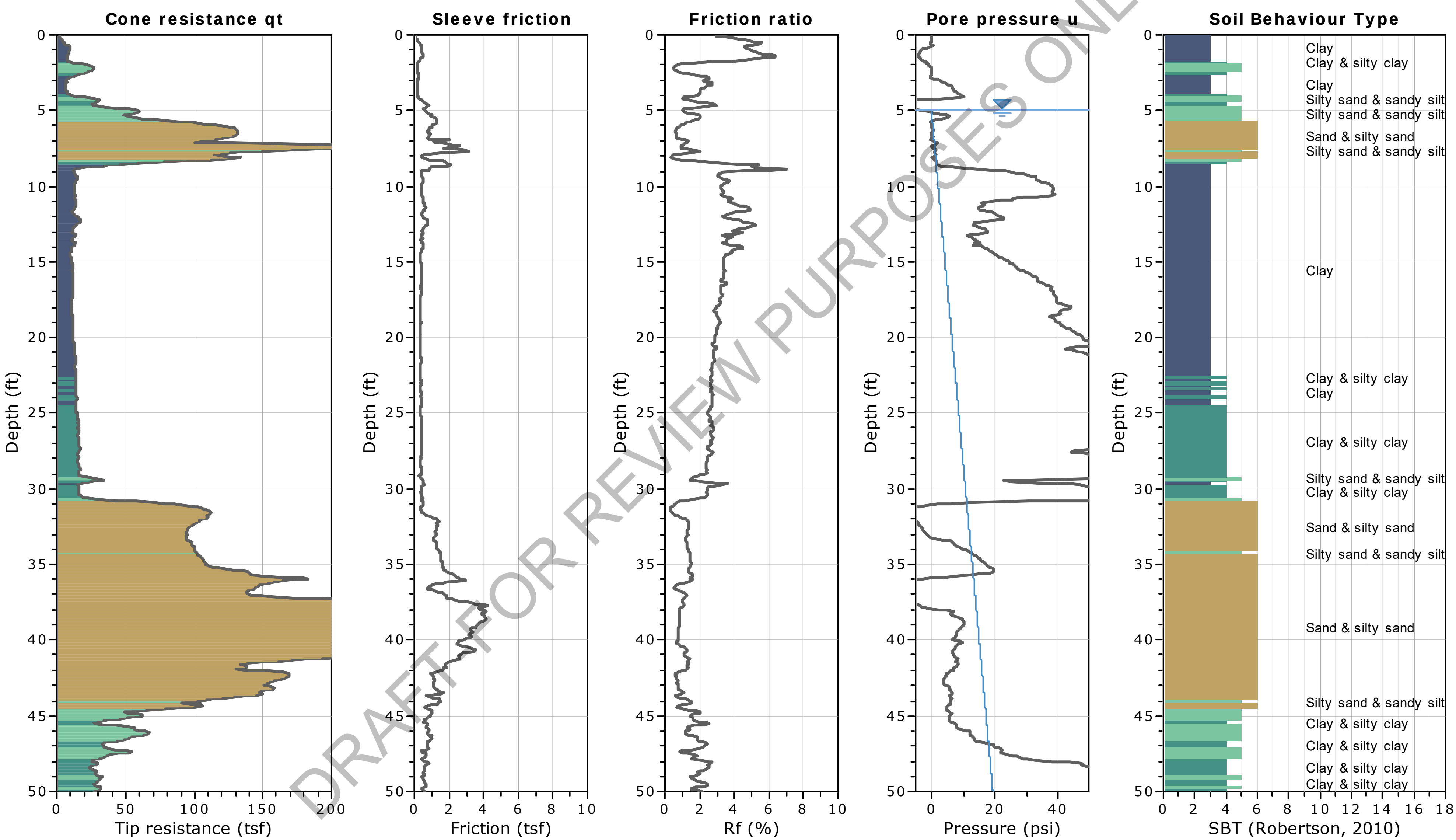
CPT: T-02

Total depth: 50.58 ft, Date: 5/5/2017

Coords: lat 43.6417° lon -93.1844°

Project: Freeborn Wind Project

Location: Freeborn County, Minnesota



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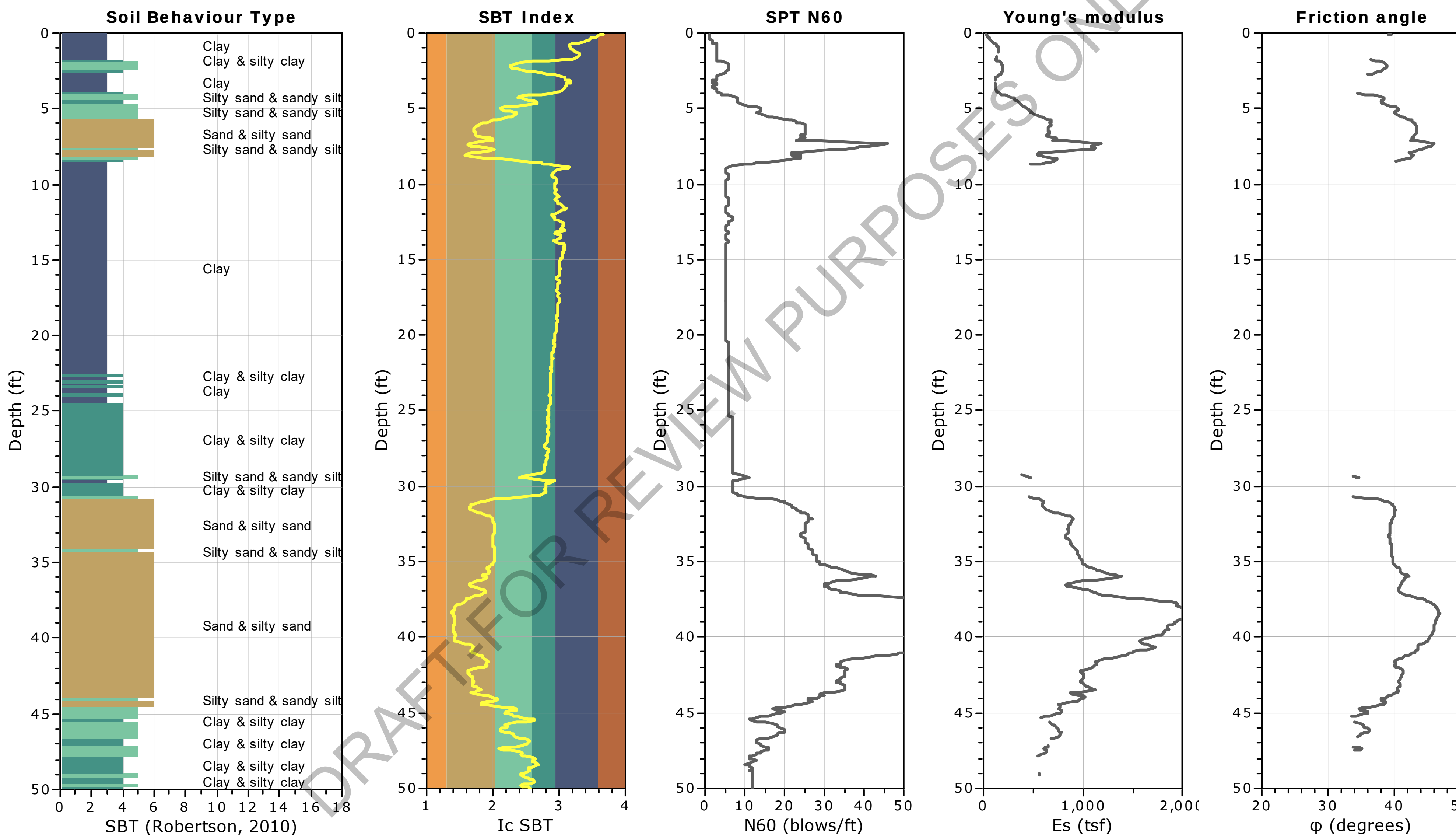
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-02
Total depth: 50.58 ft, Date: 5/5/2017
Coords: lat 43.6417° lon -93.1844°

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**



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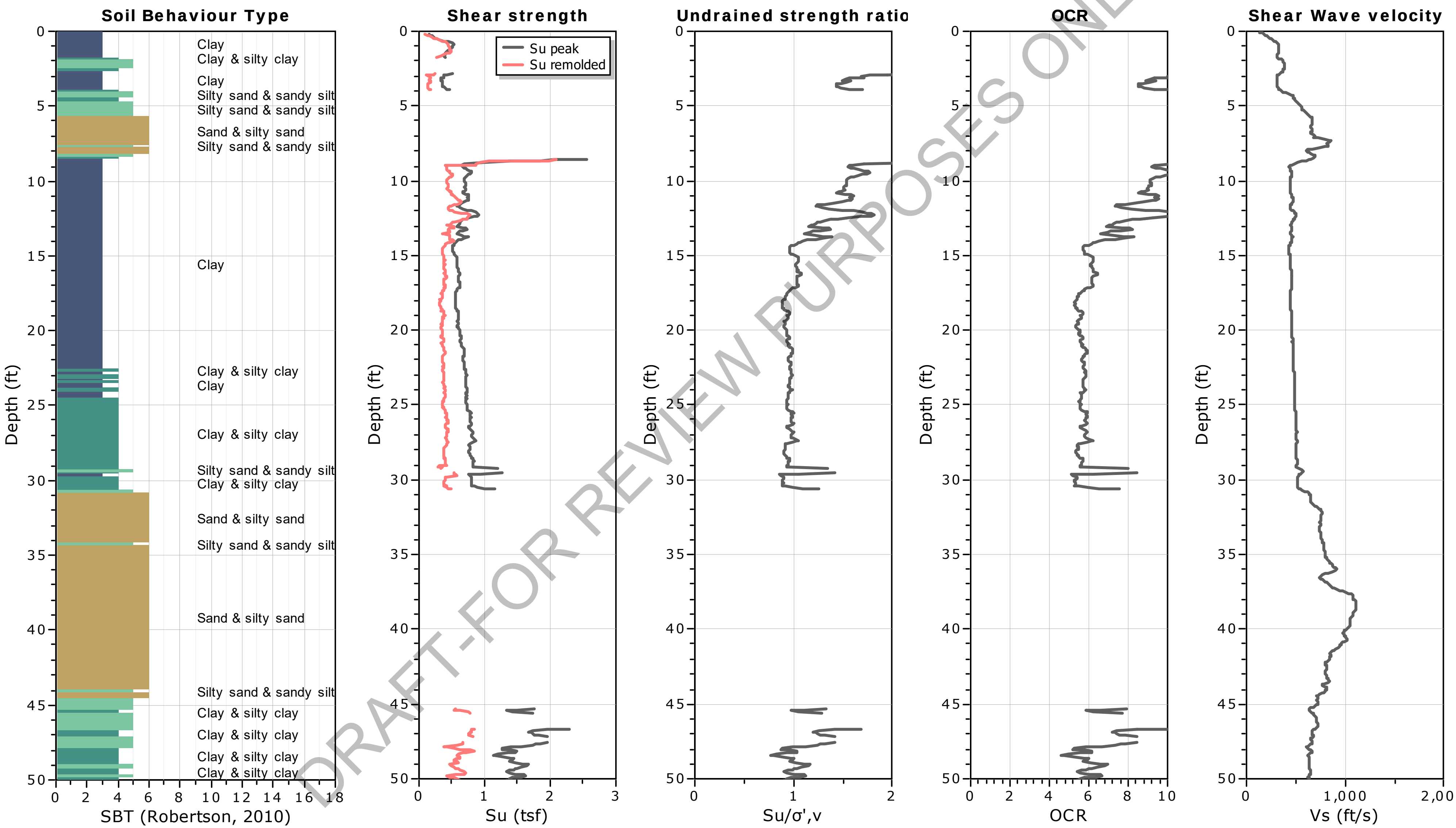
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-02

Project: Freeborn Wind Project
Total depth: 50.58 ft, Date: 5/5/2017

Location: Freeborn County, Minnesota
Coords: lat 43.6417° lon -93.1844°



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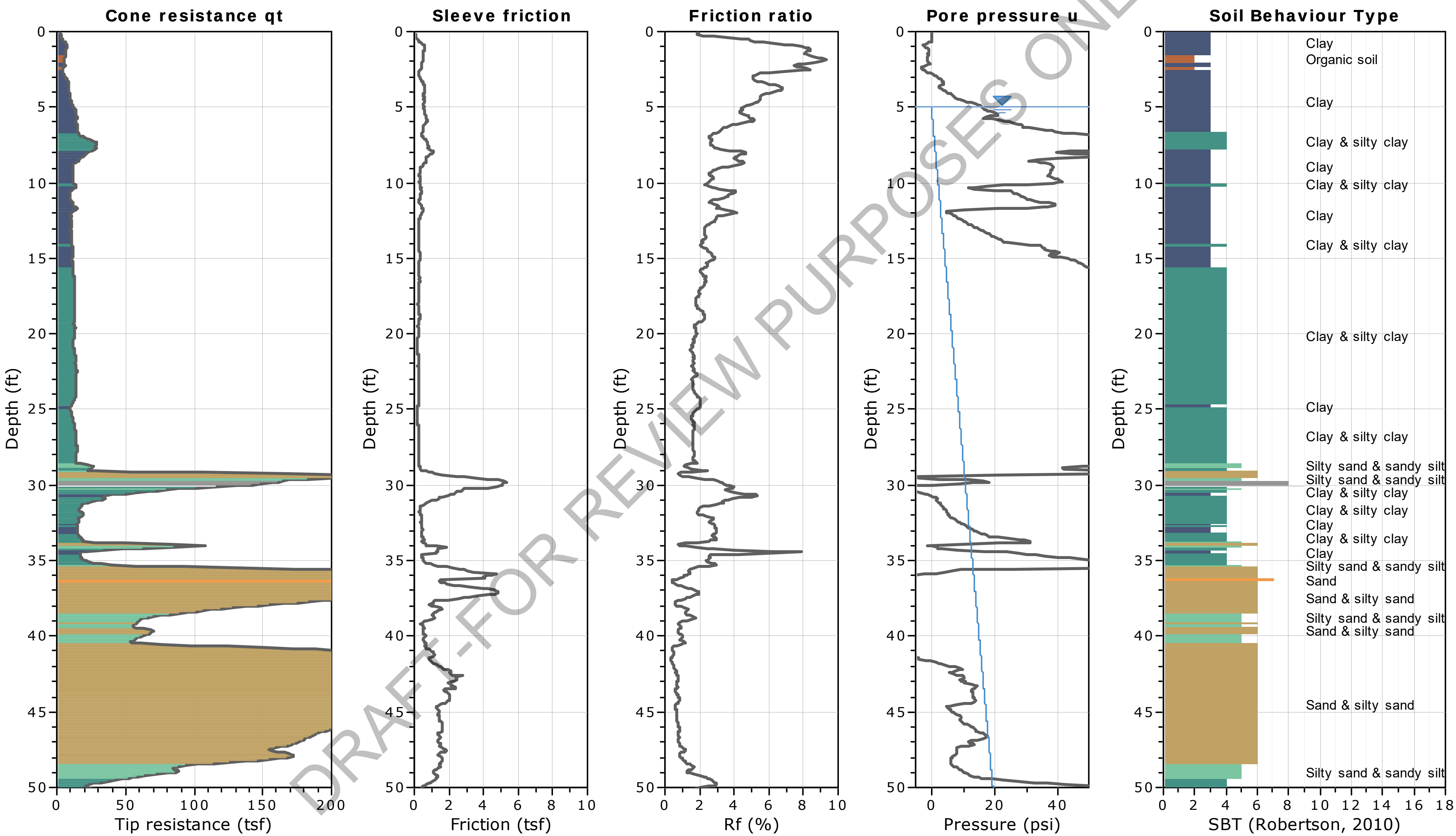
Telephone: (512) 992-2087

CPT: T-03

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

Total depth: 50.51 ft, Date: 5/5/2017
Coords: lat 43.6483° lon -93.1581°



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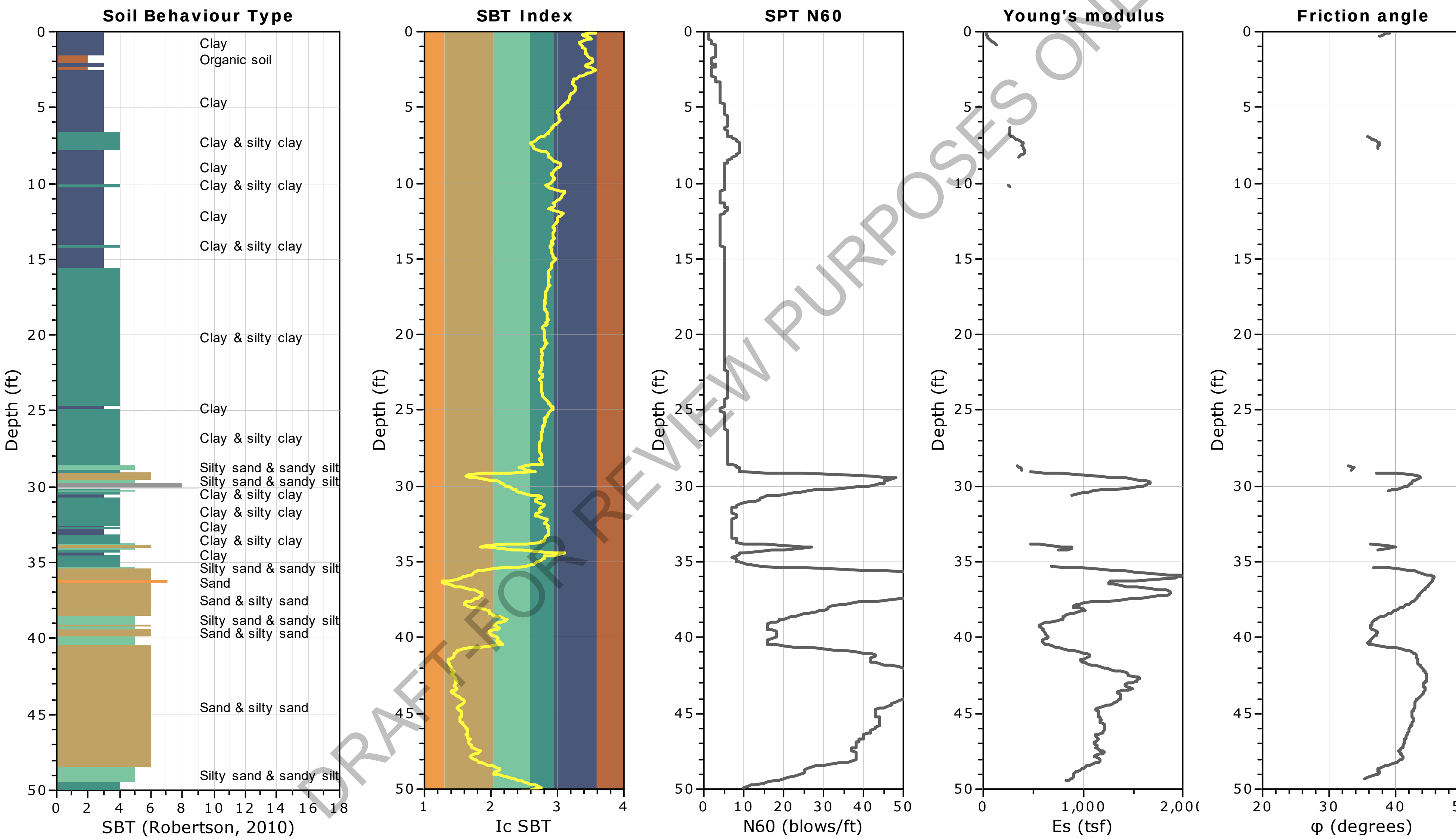
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-03

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

Total depth: 50.51 ft, Date: 5/5/2017
Coords: lat 43.6483° lon -93.1581°



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Round Rock, TX 78664
Telephone: (512) 992-2087

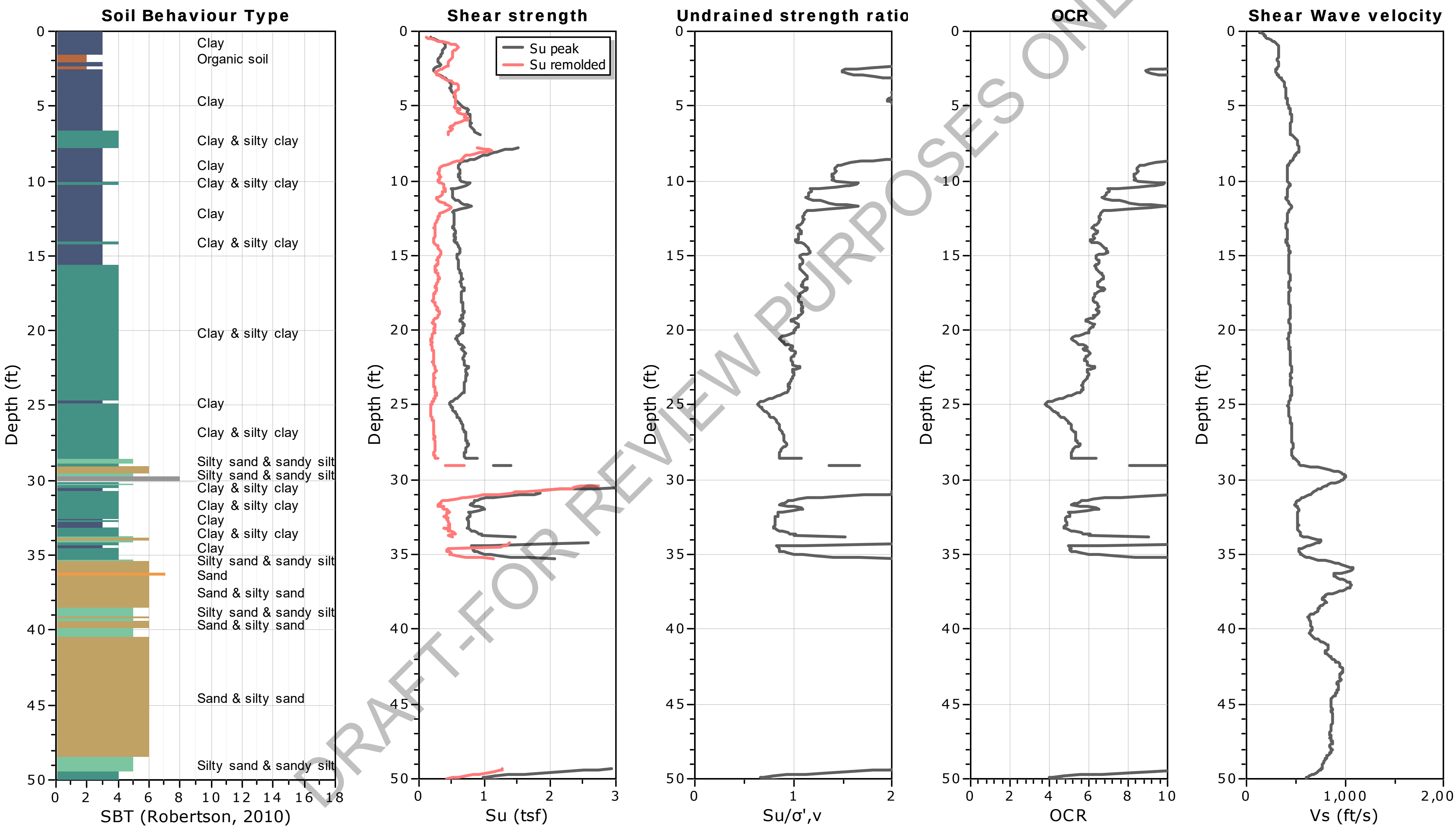
CPT: T-03

Project: **Freeborn Wind Project**

Location: **Freeborn County, Minnesota**

Total depth: 50.51 ft, Date: 5/5/2017

Coords: lat 43.6483° lon -93.1581°



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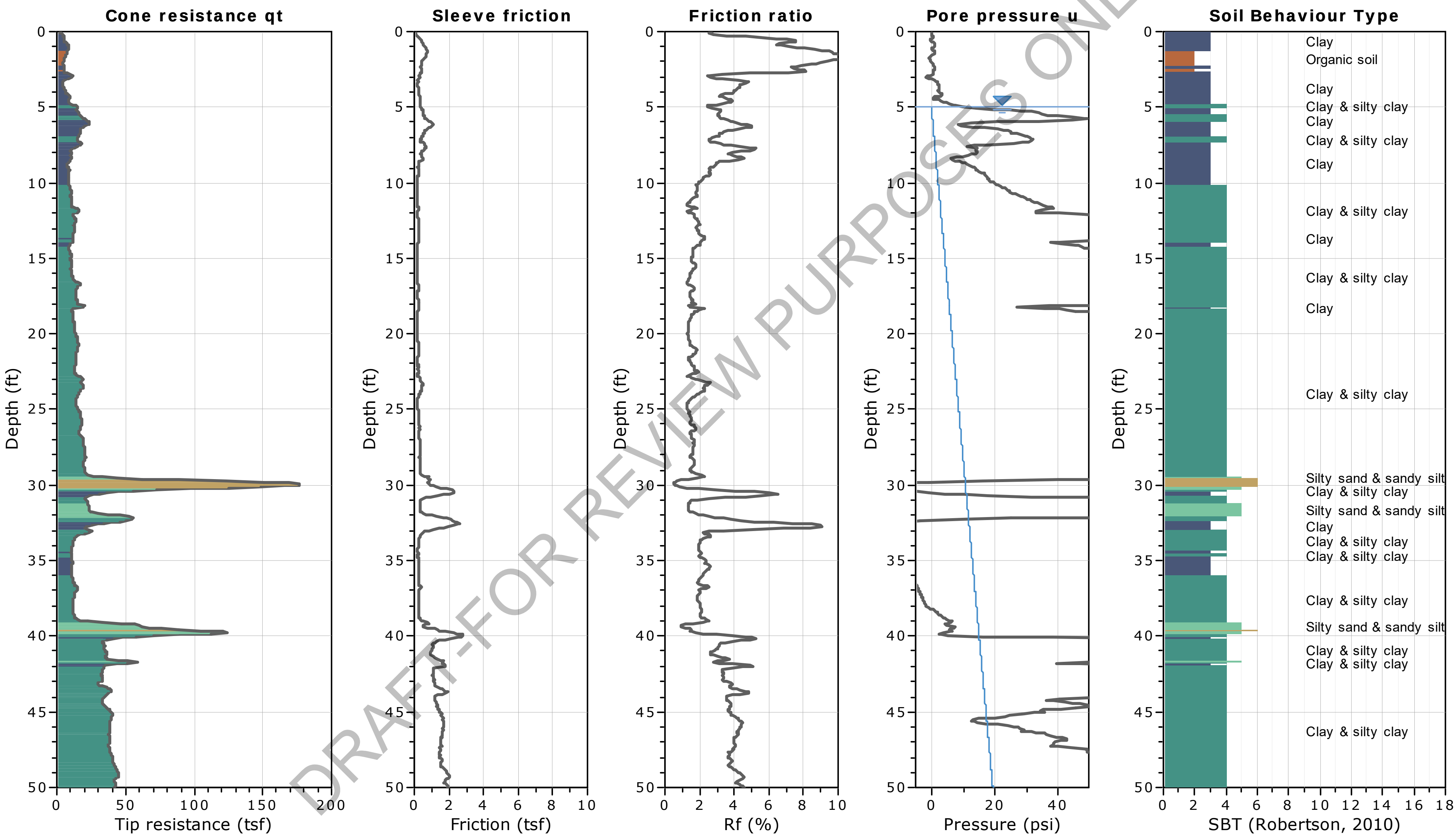
Telephone: (512) 992-2087

CPT: T-04

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

Total depth: 50.71 ft, Date: 5/5/2017
Coords: lat 43.654° lon -93.1367°



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3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

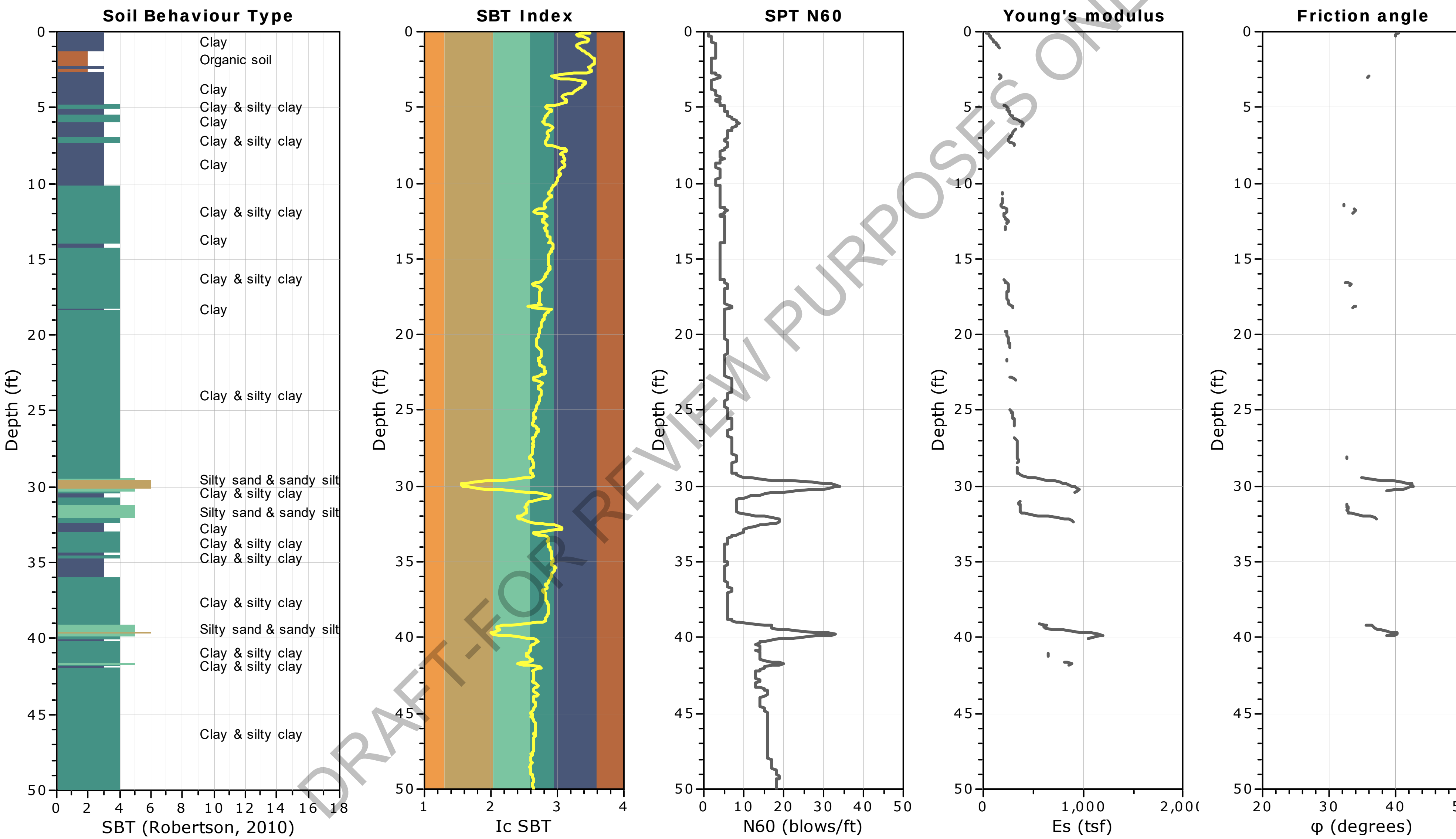
CPT: T-04

Project: **Freeborn Wind Project**

Location: **Freeborn County, Minnesota**

Total depth: 50.71 ft, Date: 5/5/2017

Coords: lat 43.654° lon -93.1367°

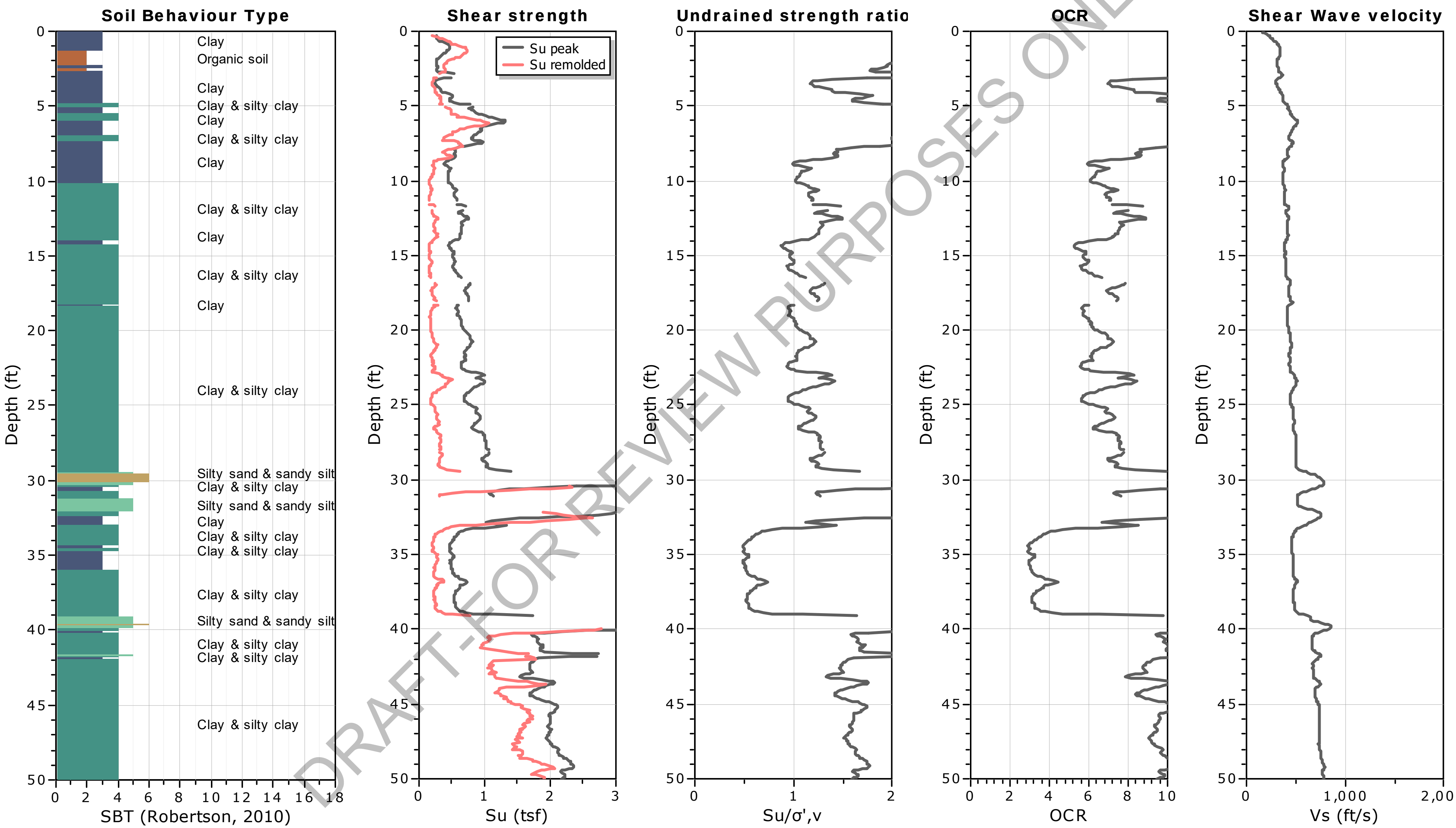


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-04

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

Total depth: 50.71 ft, Date: 5/5/2017
Coords: lat 43.654° lon -93.1367°



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3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

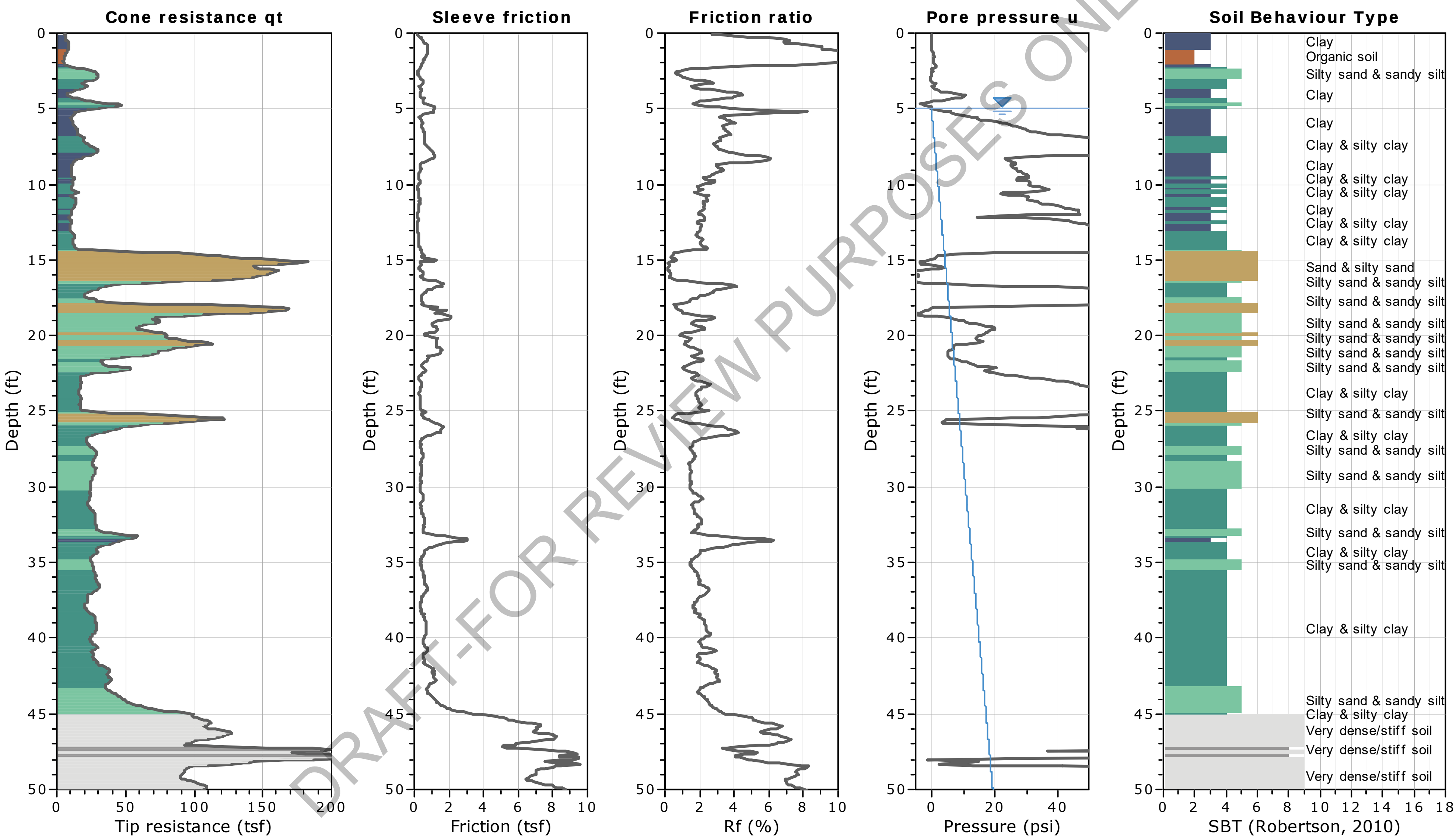
CPT: T-05

Total depth: 50.64 ft, Date: 5/5/2017

Coords: lat 43.6535° lon -93.1272°

Project: **Freeborn Wind Project**

Location: **Freeborn County, Minnesota**



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3801 Doris Lane
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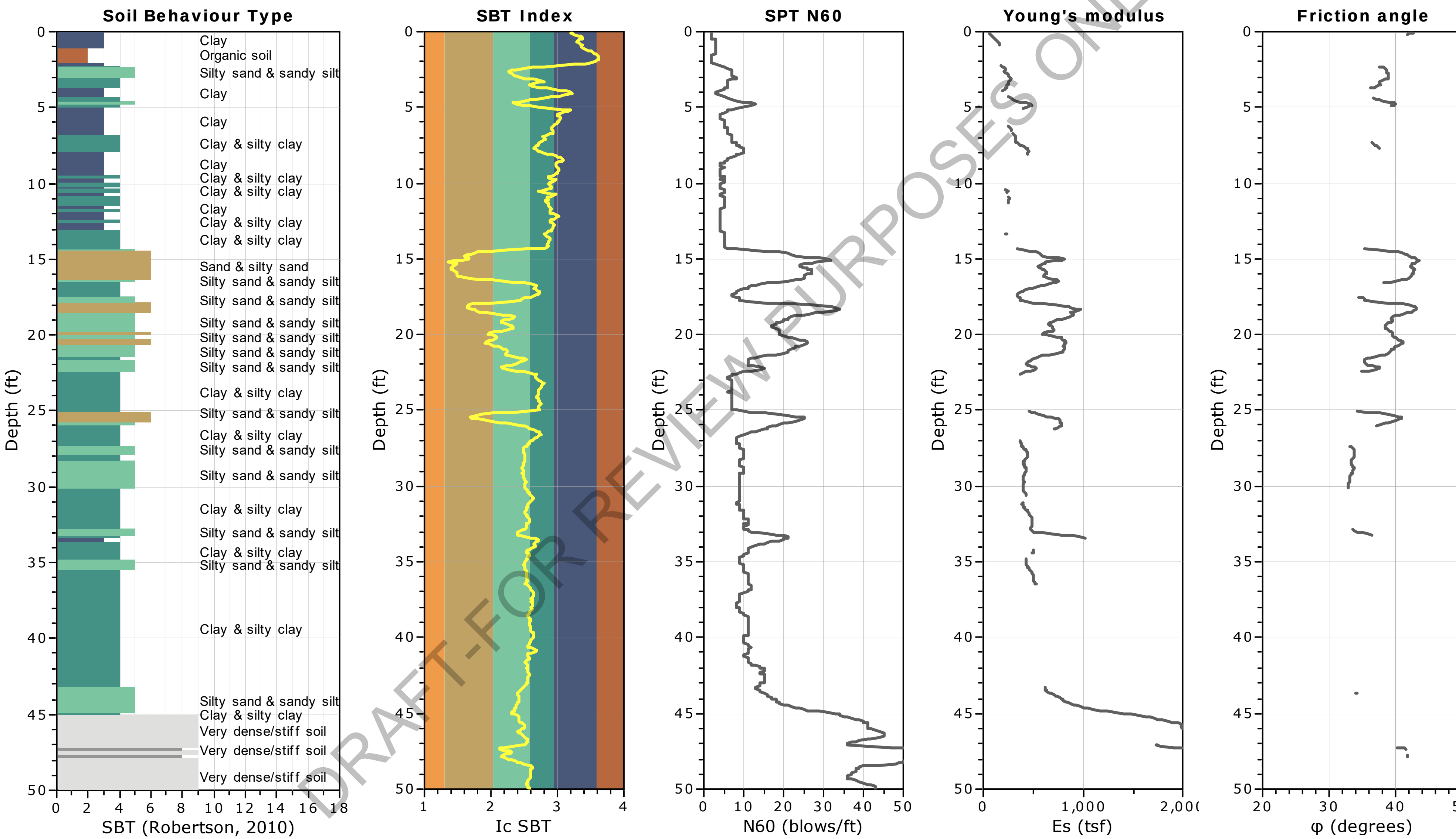
Telephone: (512) 992-2087

CPT: T-05

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

Total depth: 50.64 ft, Date: 5/5/2017
Coords: lat 43.6535° lon -93.1272°

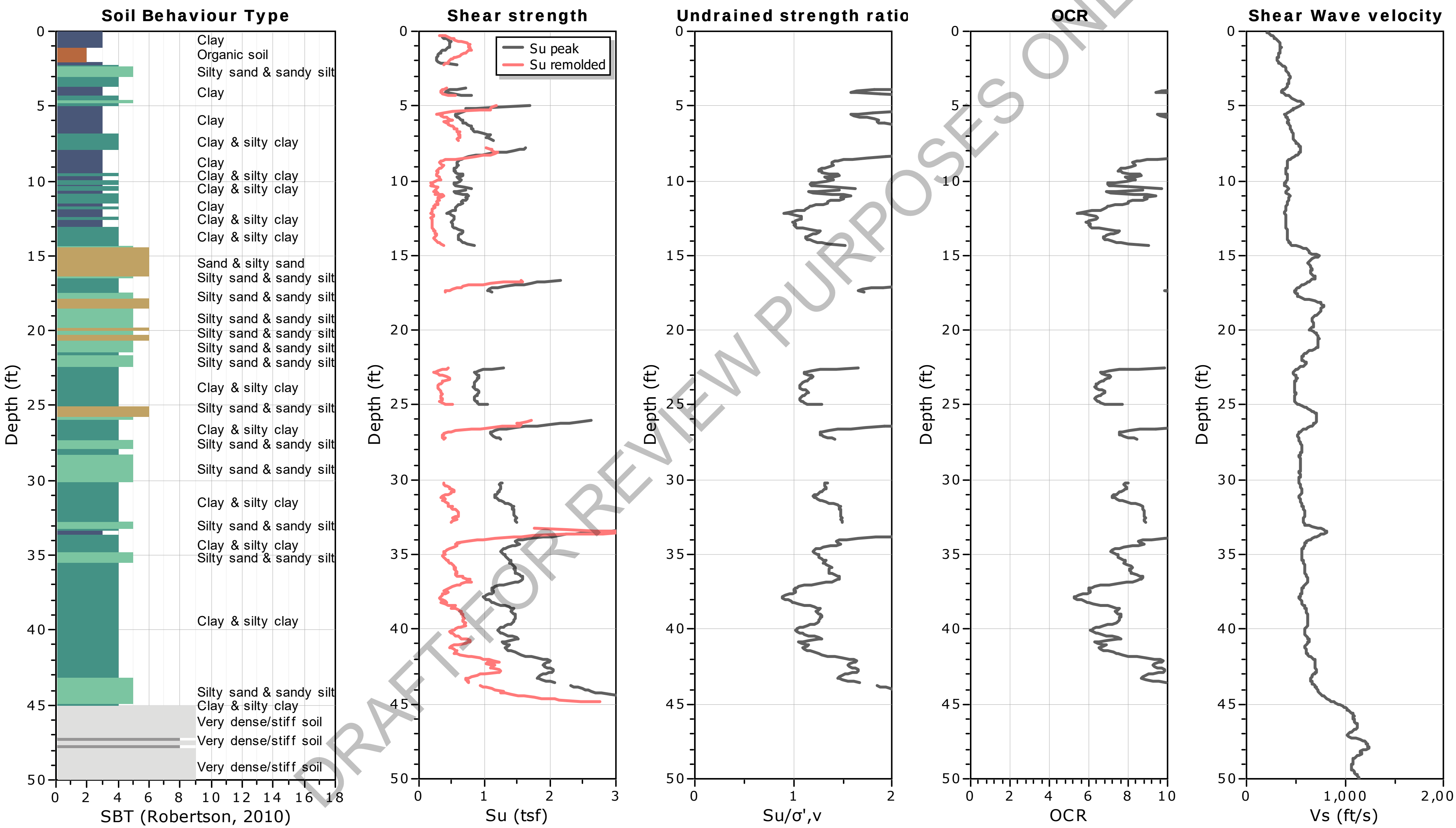


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-05

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

Total depth: 50.64 ft, Date: 5/5/2017
Coords: lat 43.6535° lon -93.1272°



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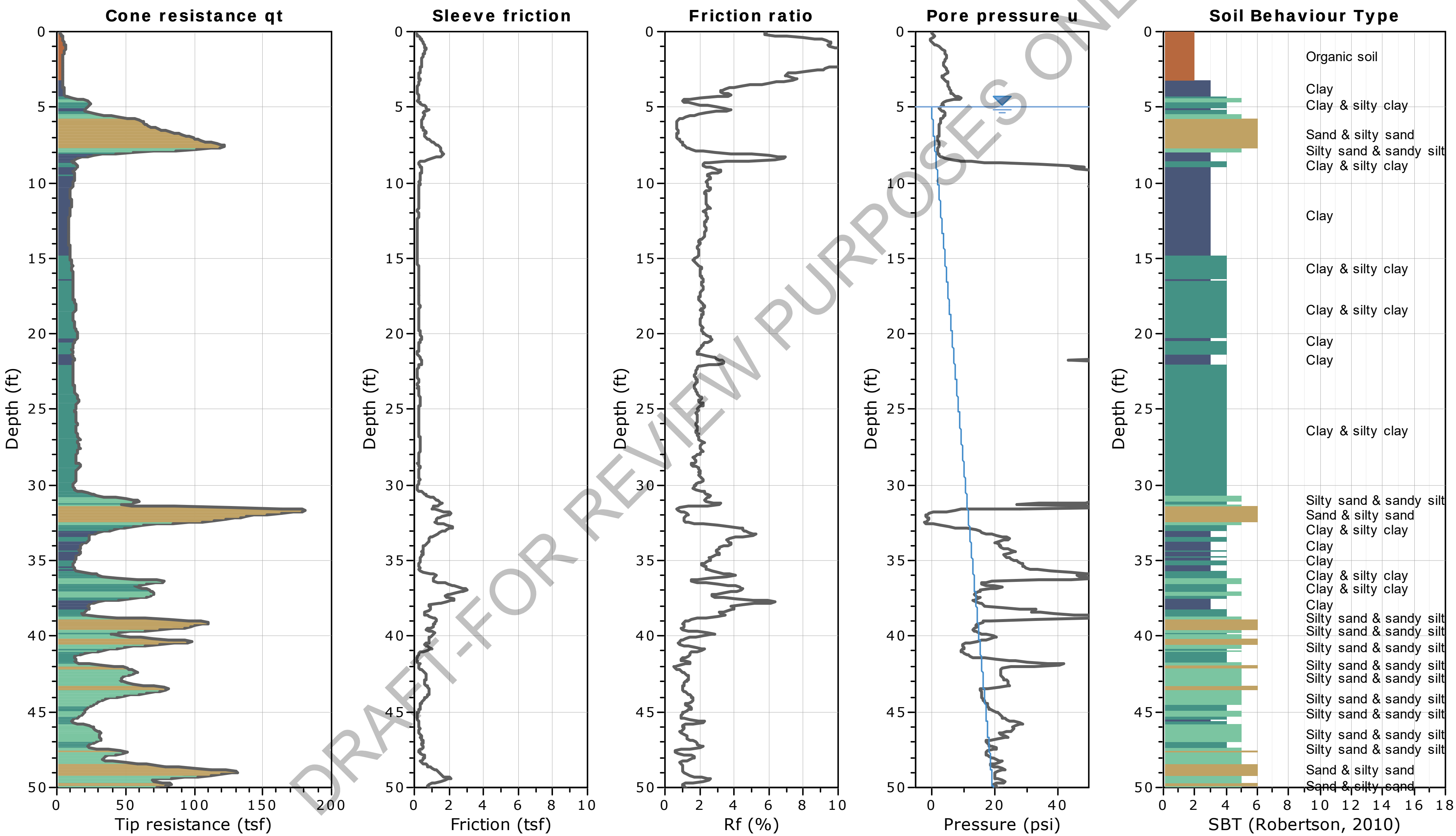
CPT: T-06

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

Total depth: 50.64 ft, Date: 5/5/2017
Coords: lat 43.6284° lon -93.1983°



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Round Rock, TX 78664
Telephone: (512) 992-2087

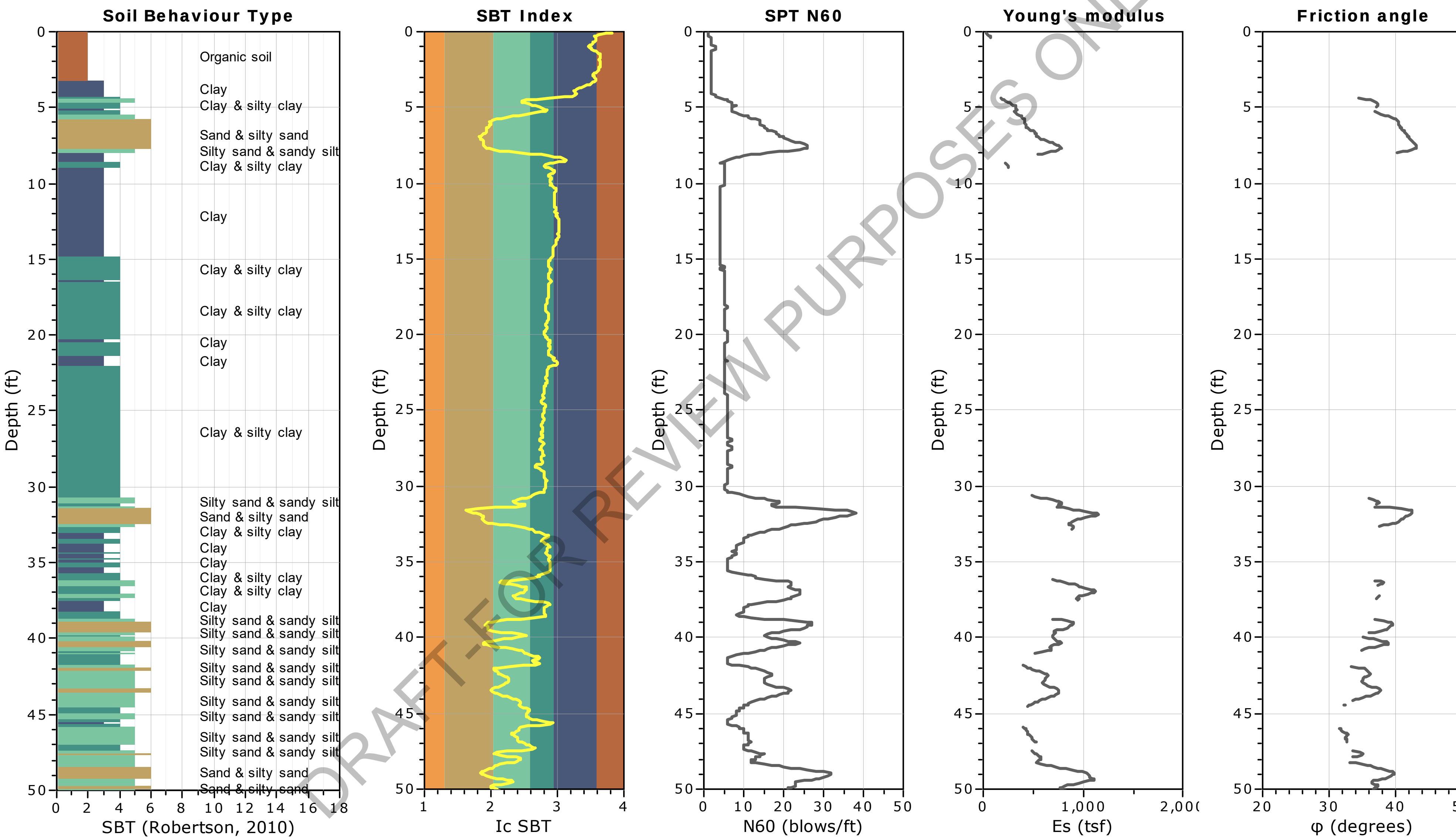
CPT: T-06

Project: **Freeborn Wind Project**

Location: **Freeborn County, Minnesota**

Total depth: 50.64 ft, Date: 5/5/2017

Coords: lat 43.6284° lon -93.1983°



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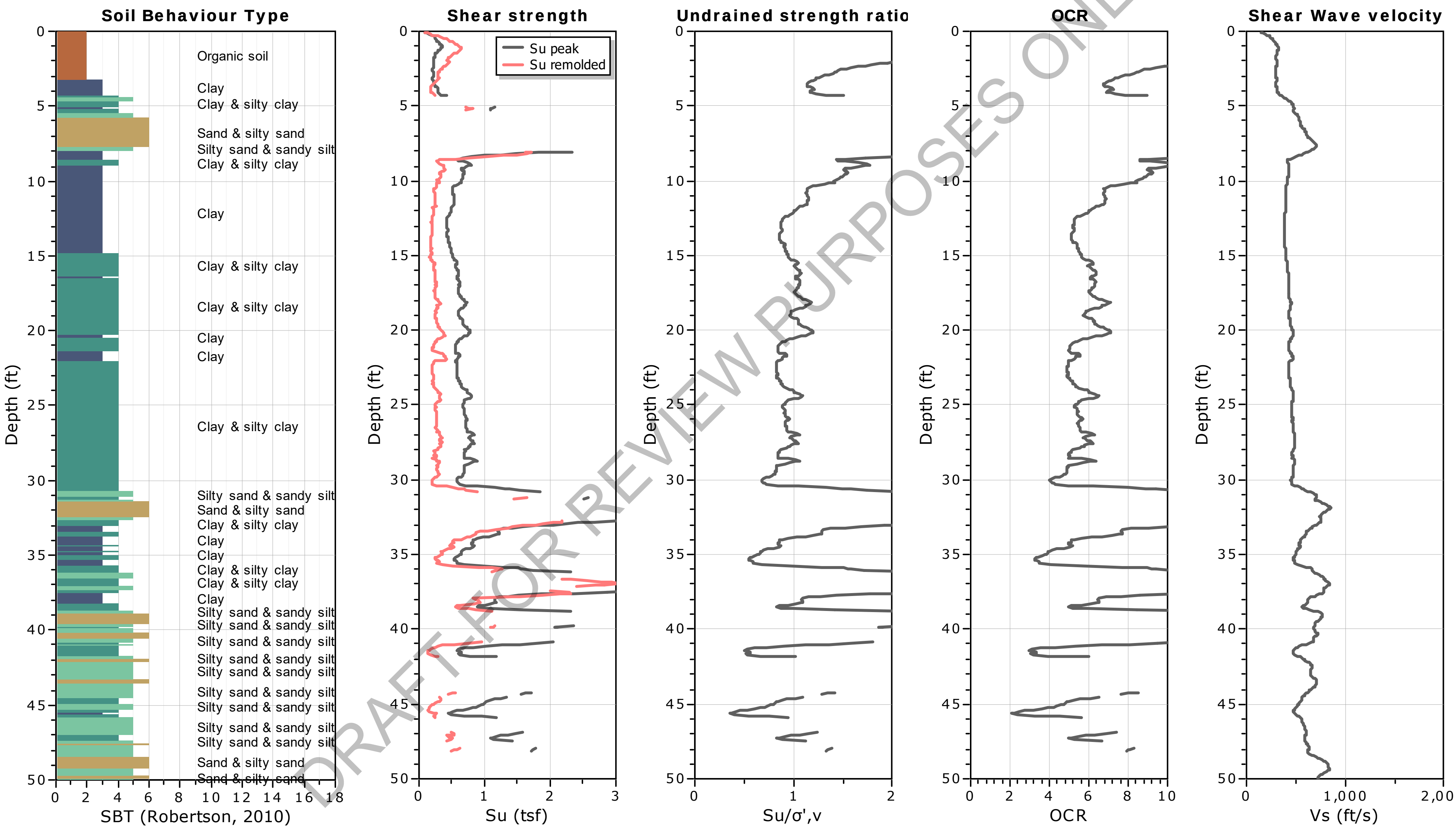
CPT: T-06

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

Total depth: 50.64 ft, Date: 5/5/2017
Coords: lat 43.6284° lon -93.1983°



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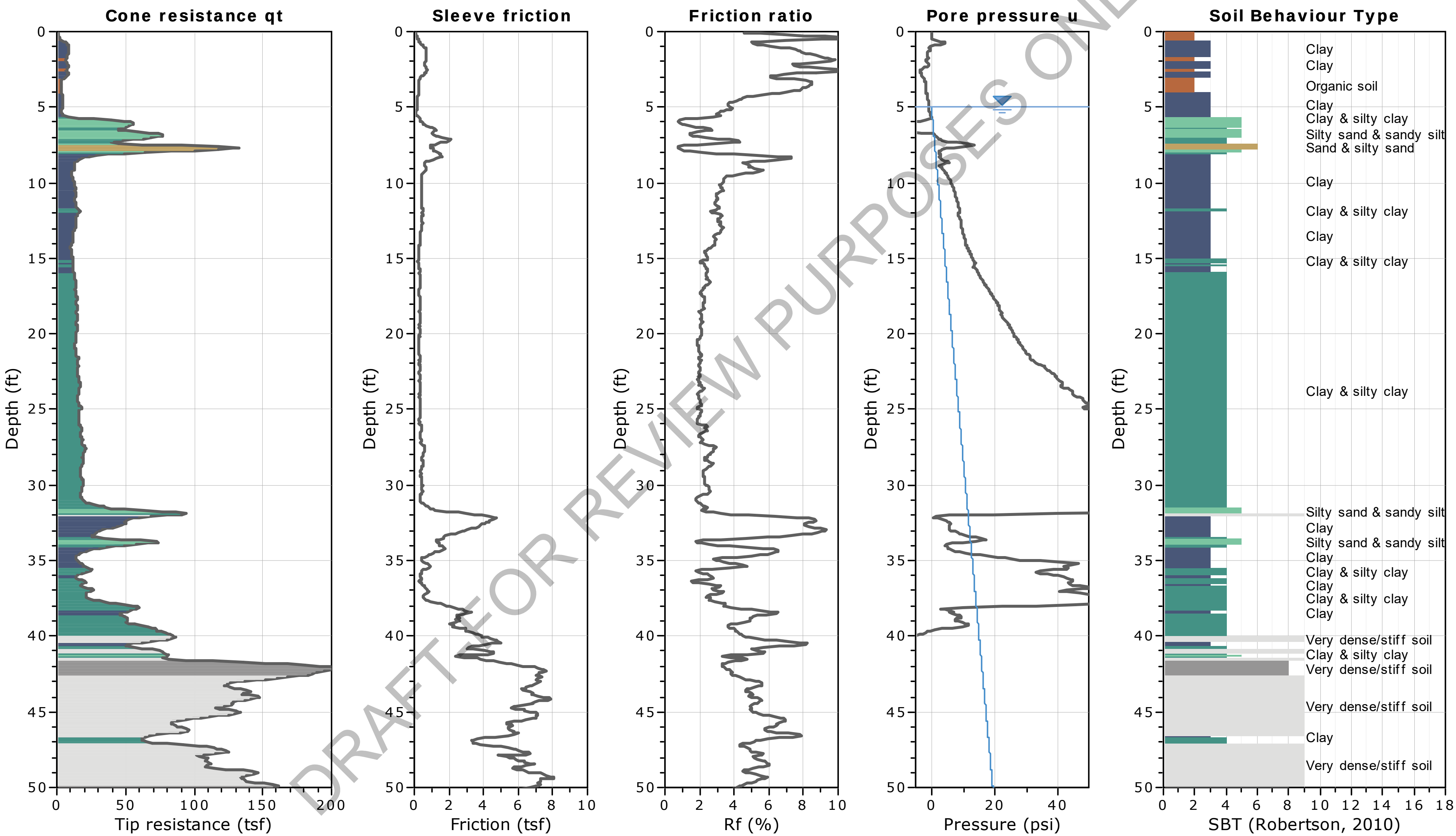
CPT: T-07

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

Total depth: 50.77 ft, Date: 5/5/2017
Coords: lat 43.6272° lon -93.1845°



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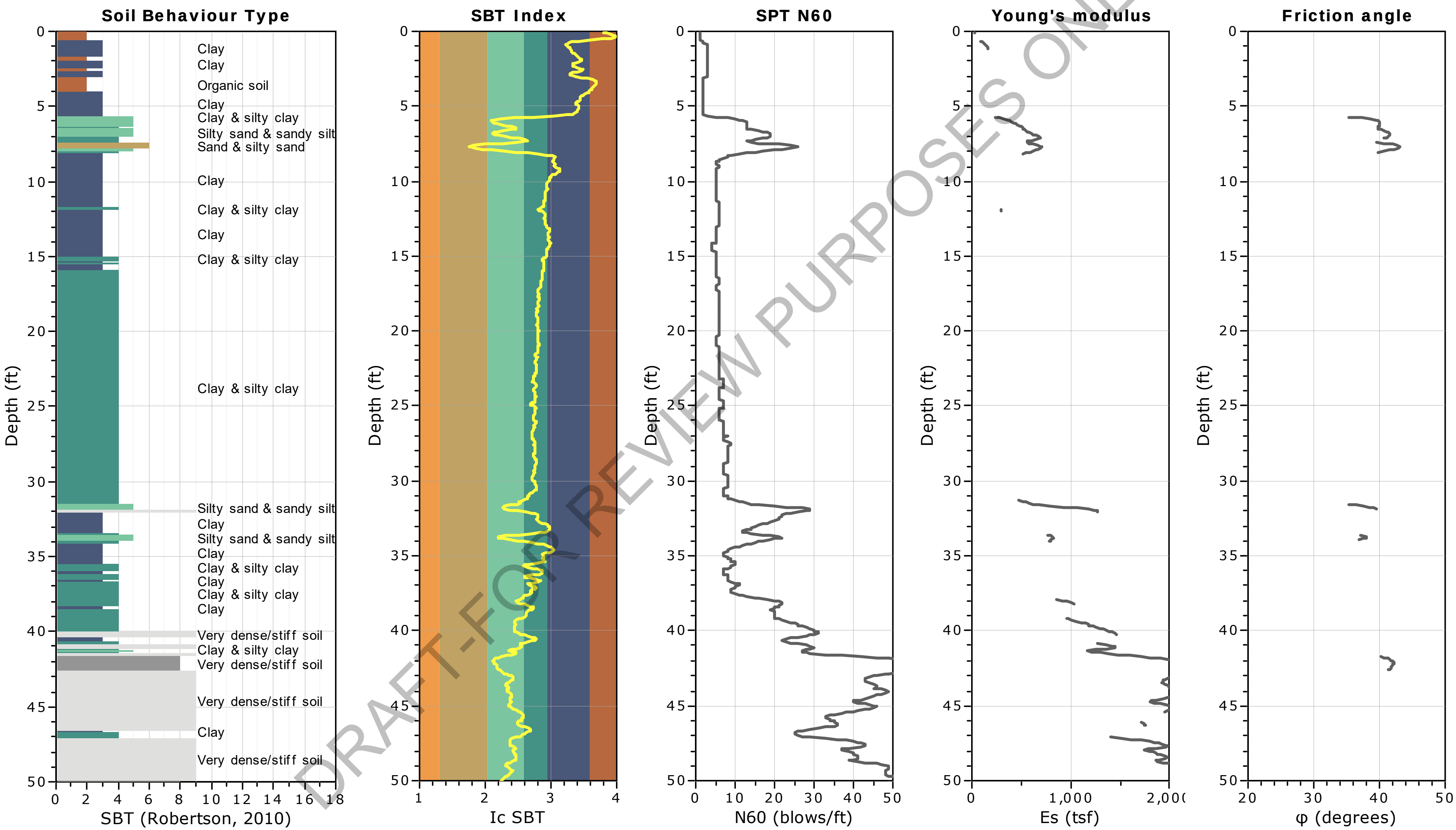
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-07

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

Total depth: 50.77 ft, Date: 5/5/2017
Coords: lat 43.6272° lon -93.1845°



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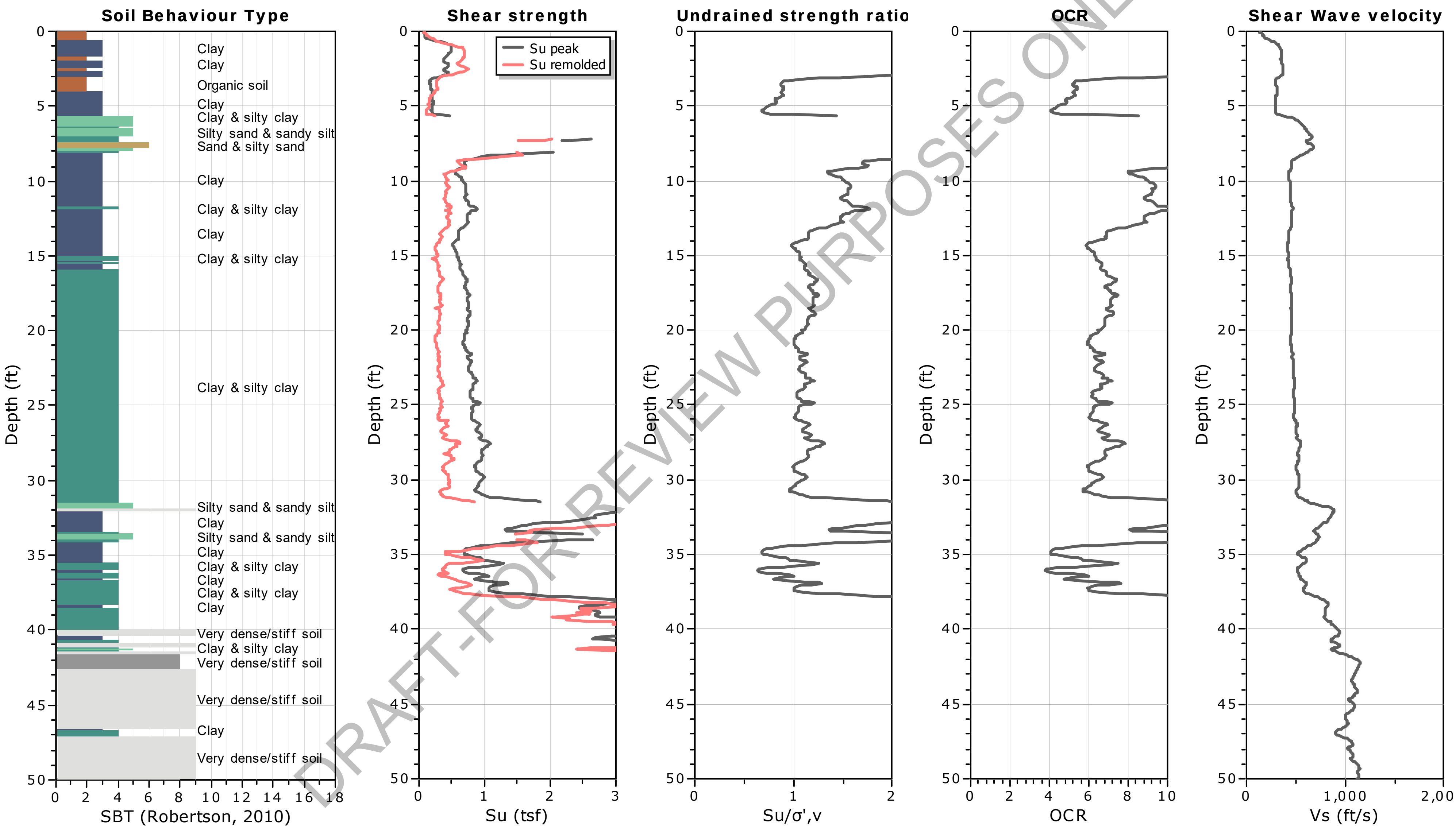
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-07

Total depth: 50.77 ft, Date: 5/5/2017
Coords: lat 43.6272° lon -93.1845°

Project: Freeborn Wind Project
Location: Freeborn County, Minnesota



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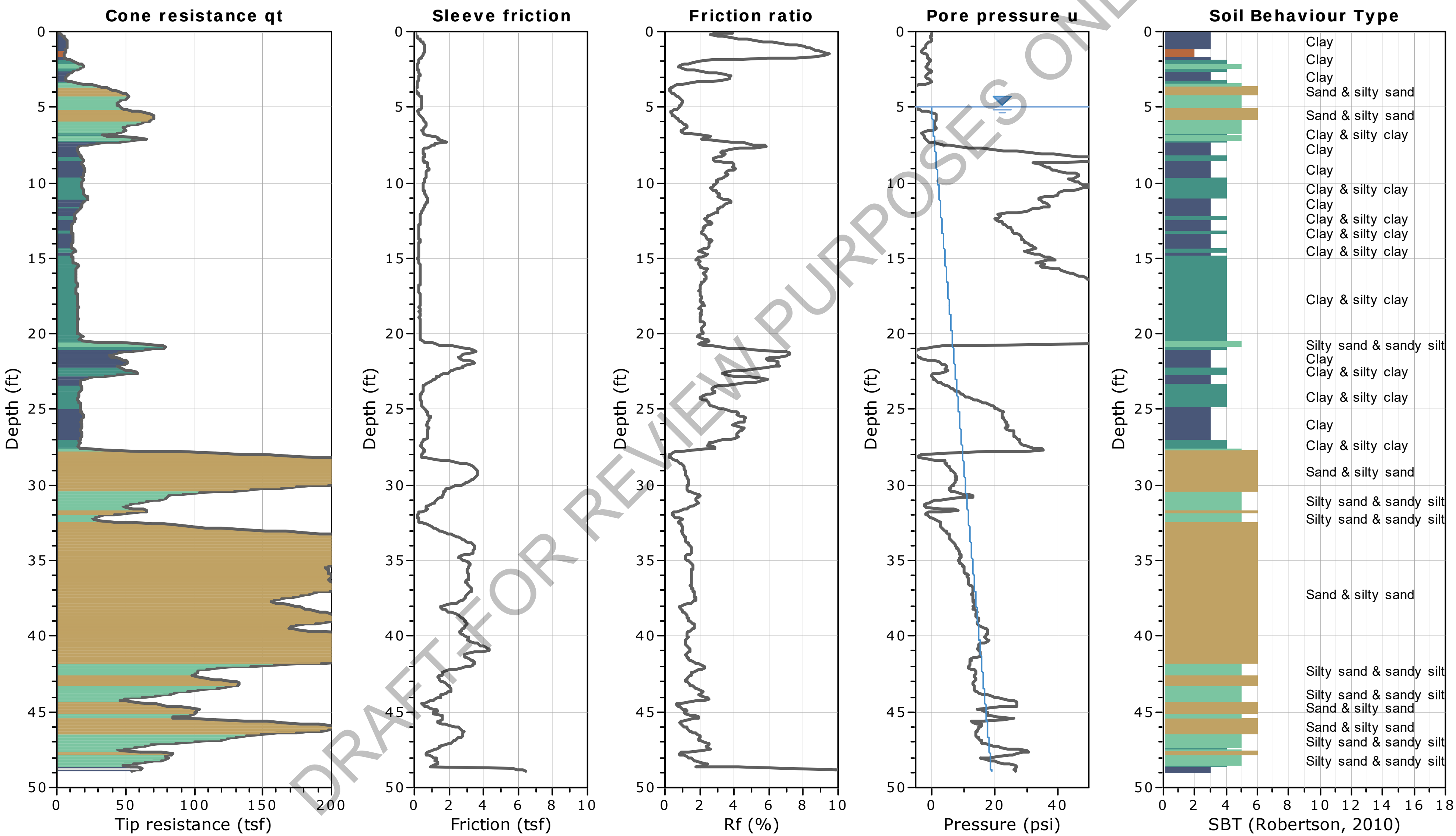
CPT: T-08

Project: Freeborn Wind Project
Location: Freeborn County, Minnesota

Total depth: 48.94 ft, Date: 5/5/2017
Coords: lat 43.6348° lon -93.1647°



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3801 Doris Lane
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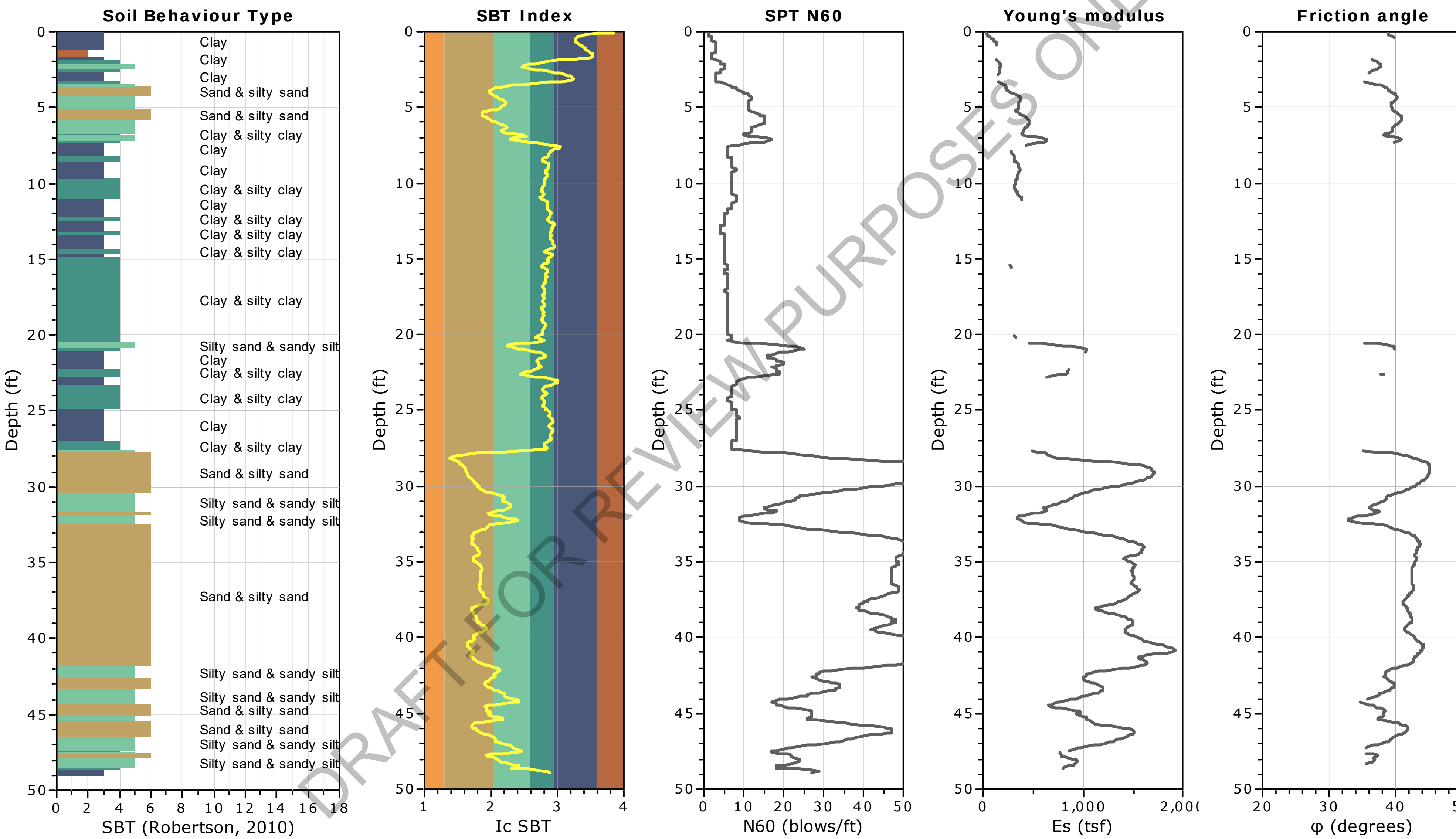
Telephone: (512) 992-2087

CPT: T-08

Project: **Freeborn Wind Project**

Location: **Freeborn County, Minnesota**

Total depth: 48.94 ft, Date: 5/5/2017
Coords: lat 43.6348° lon -93.1647°



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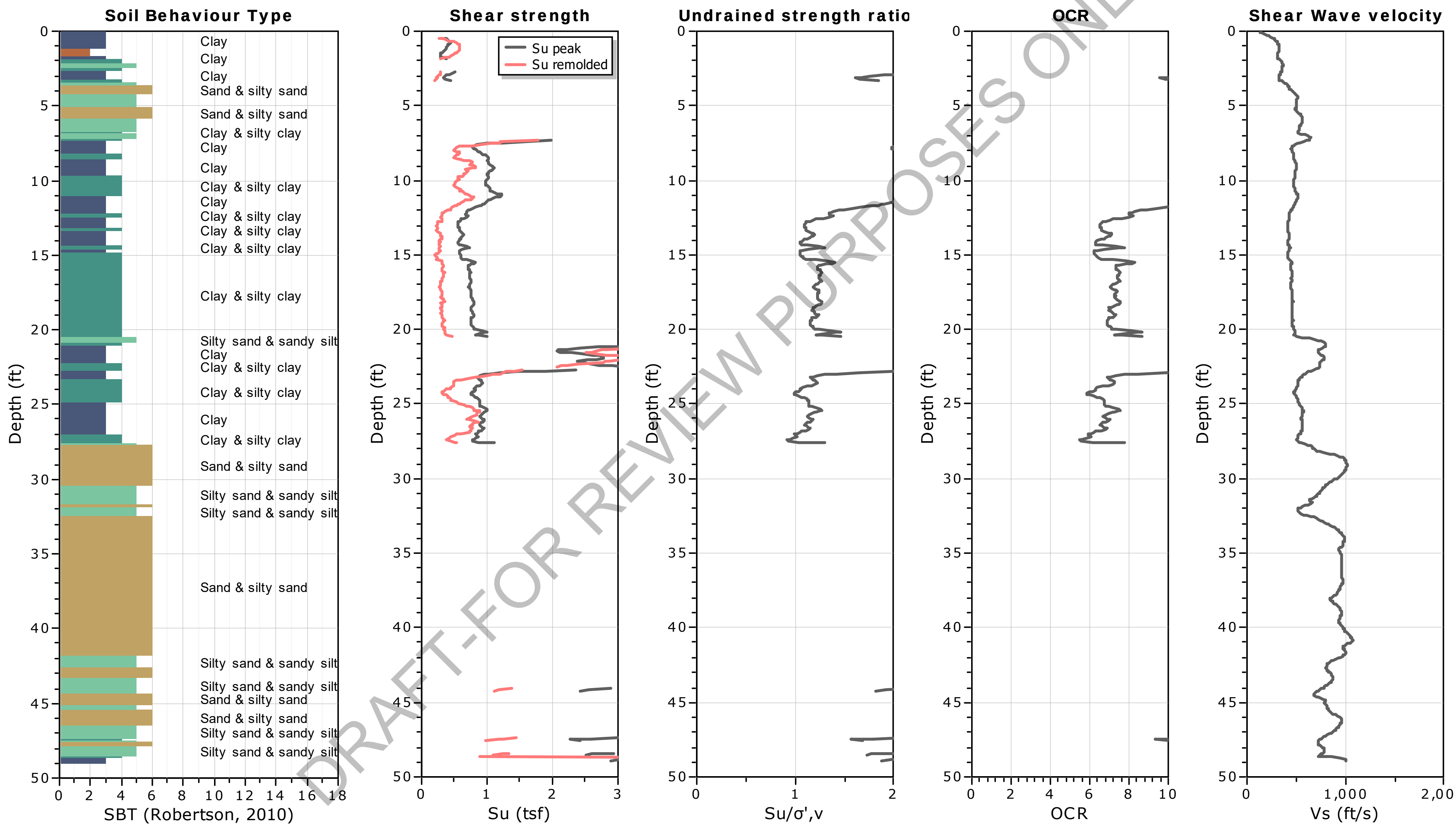
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-08

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

Total depth: 48.94 ft, Date: 5/5/2017
Coords: lat 43.6348° lon -93.1647°



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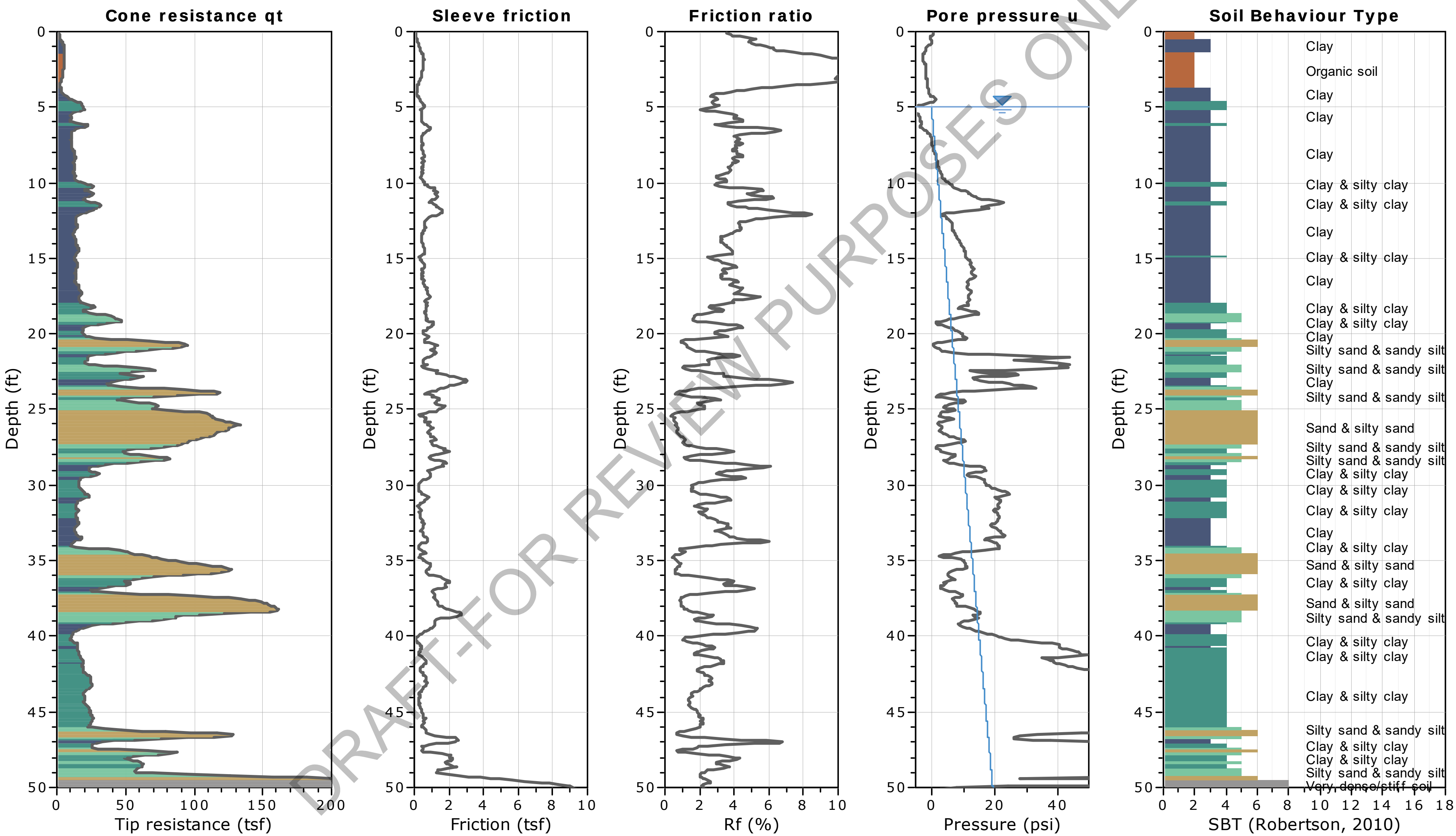
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-09

Project: **Freeborn Wind Project**
Total depth: 50.58 ft, Date: 5/5/2017

Location: **Freeborn County, Minnesota**
Coords: lat 43.6347° lon -93.1582°

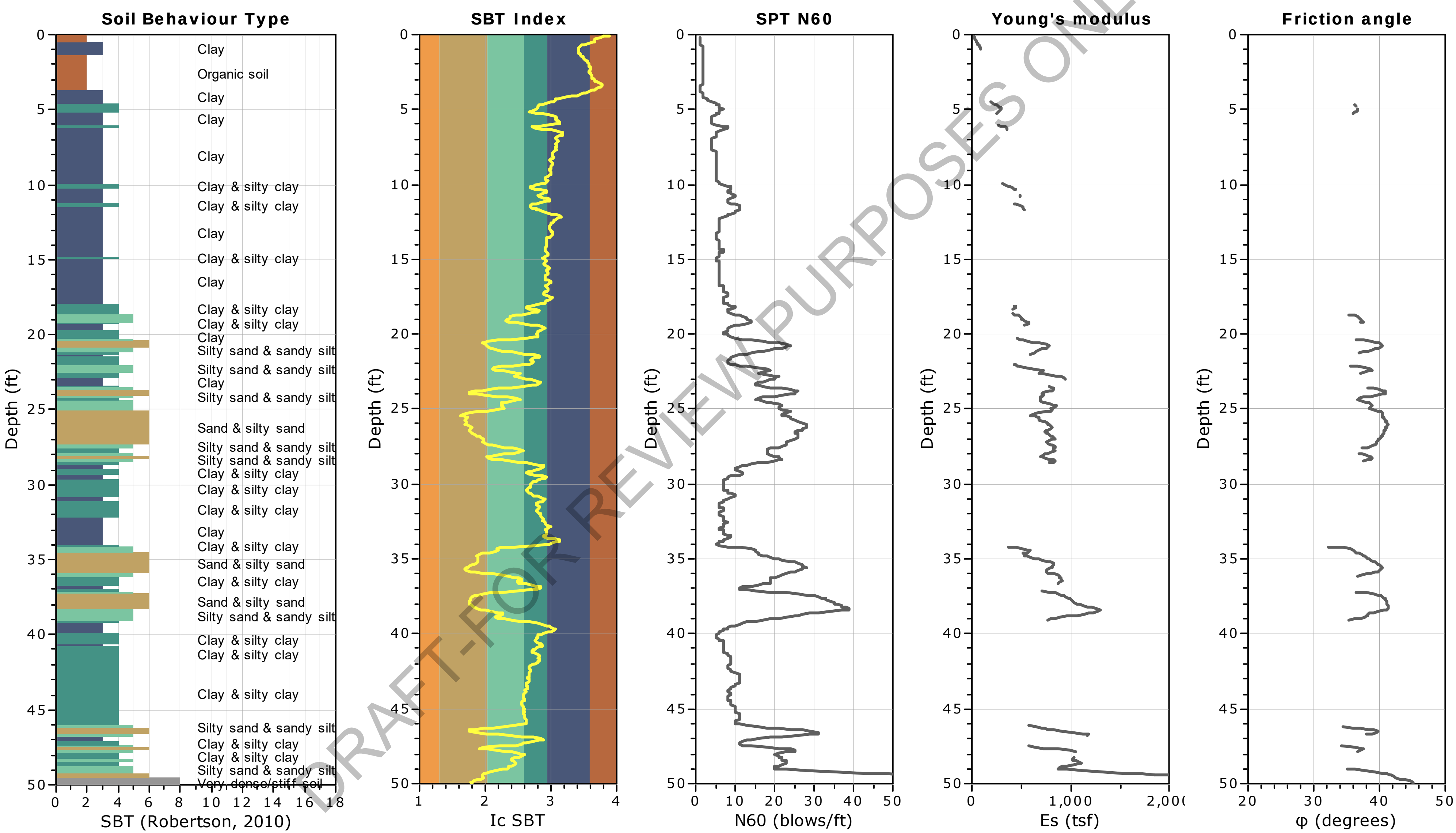


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-09

Project: **Freeborn Wind Project**
Total depth: 50.58 ft, Date: 5/5/2017

Location: **Freeborn County, Minnesota**
Coords: lat 43.6347° lon -93.1582°

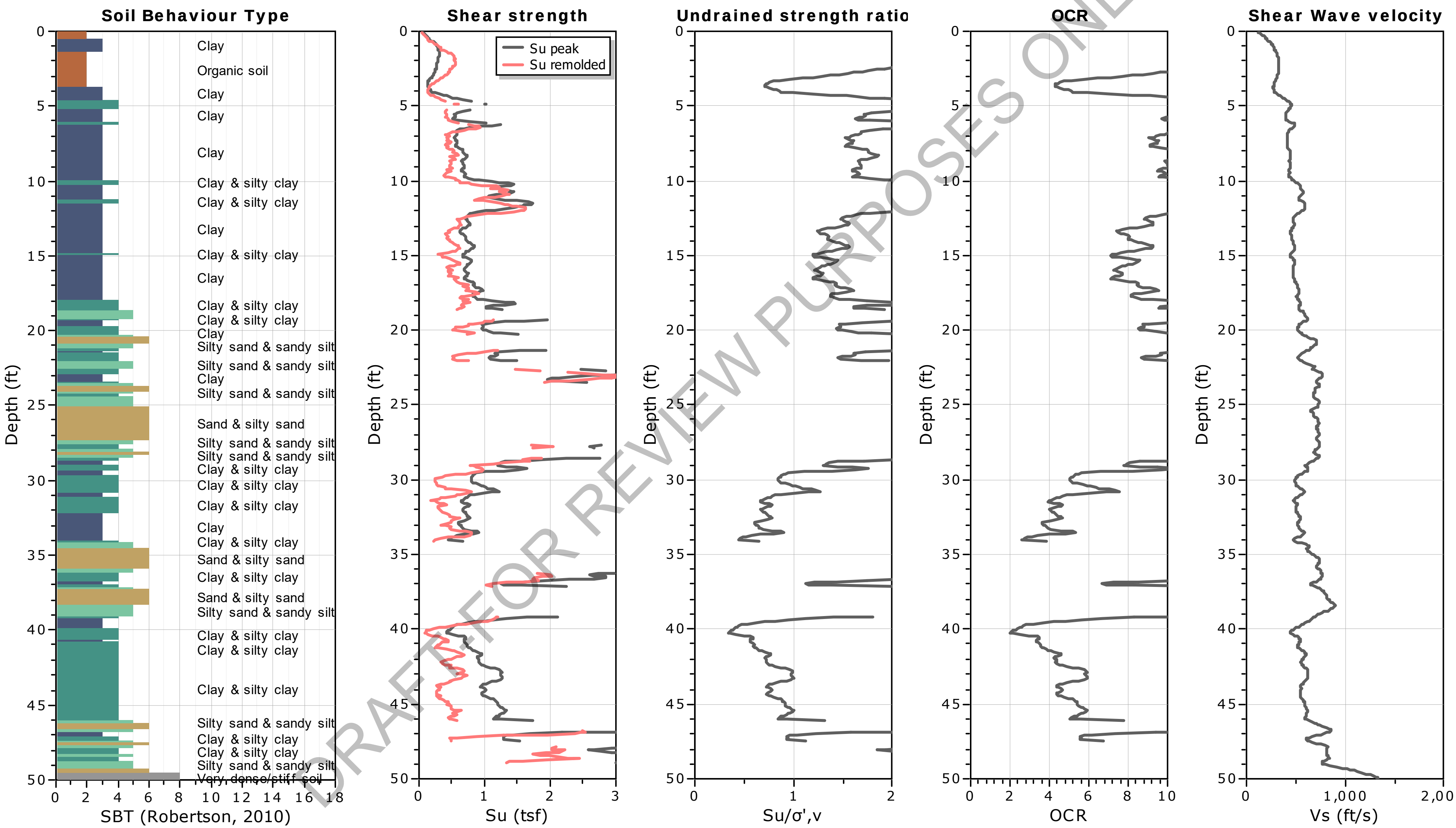


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-09

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

Total depth: 50.58 ft, Date: 5/5/2017
Coords: lat 43.6347° lon -93.1582°



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

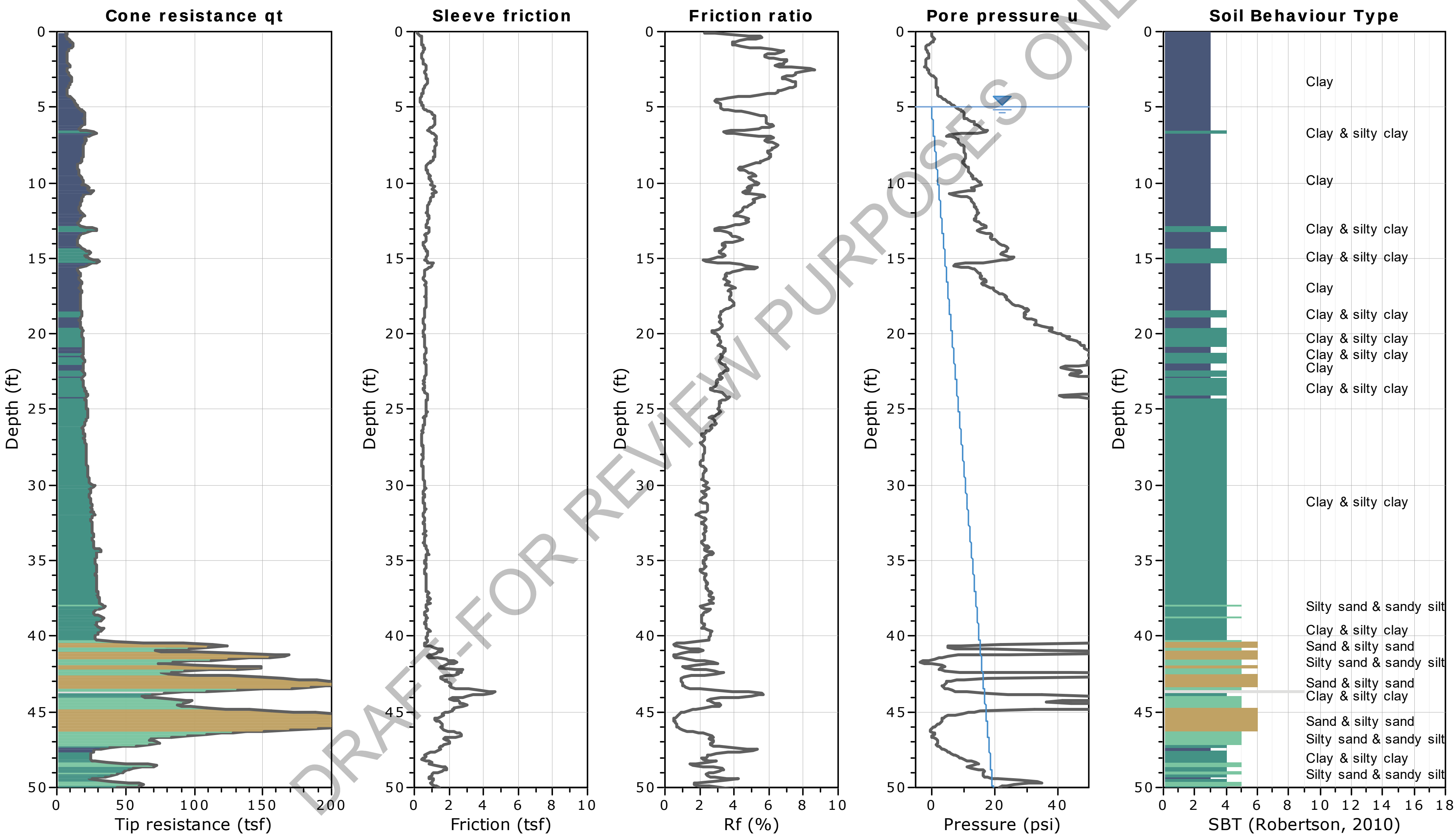
CPT: T-10

Total depth: 50.71 ft, Date: 5/5/2017

Coords: lat 43.6402° lon -93.146°

Project: **Freeborn Wind Project**

Location: **Freeborn County, Minnesota**



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3801 Doris Lane
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Telephone: (512) 992-2087

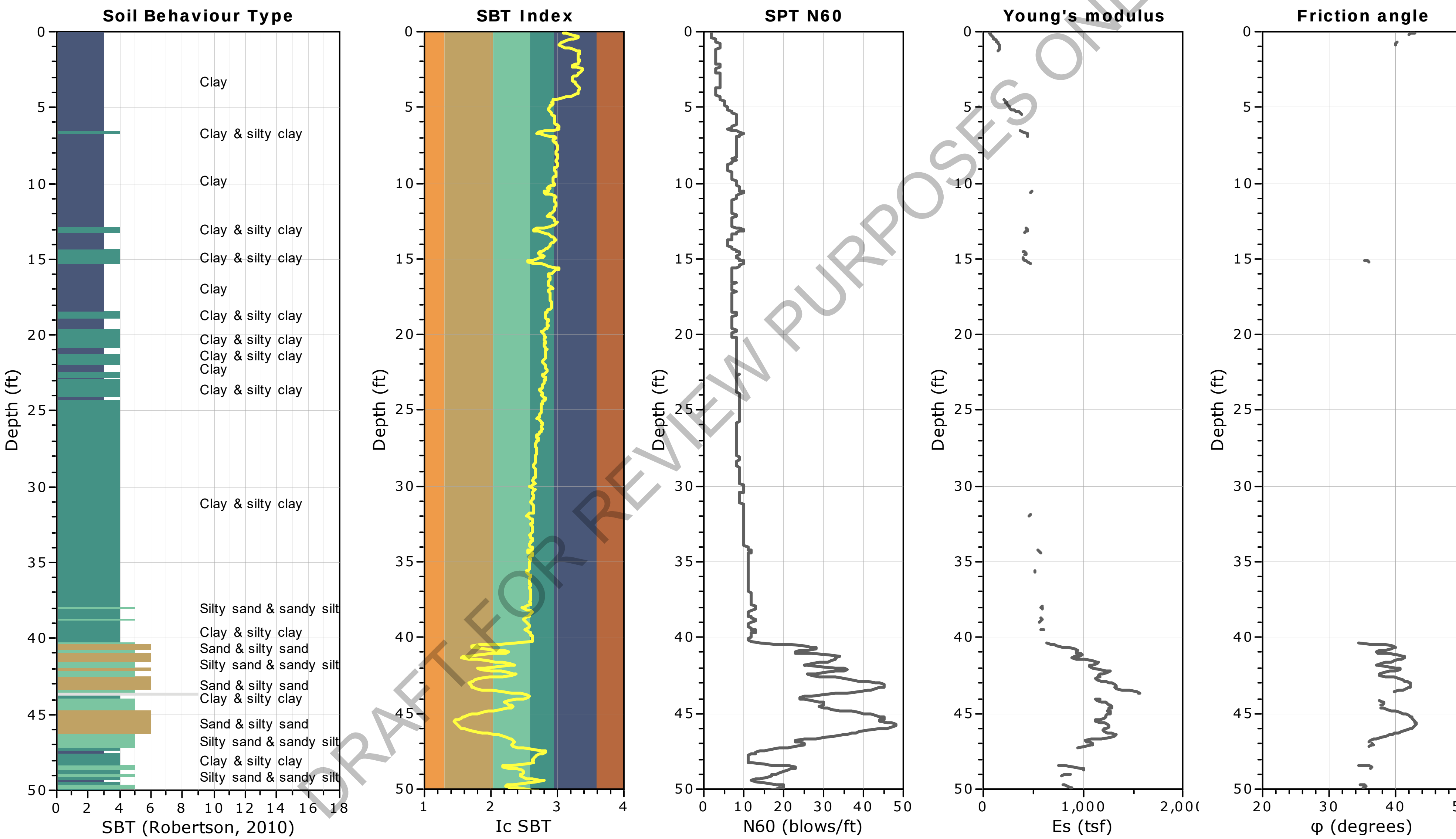
CPT: T-10

Project: **Freeborn Wind Project**

Location: **Freeborn County, Minnesota**

Total depth: 50.71 ft, Date: 5/5/2017

Coords: lat 43.6402° lon -93.146°



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3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

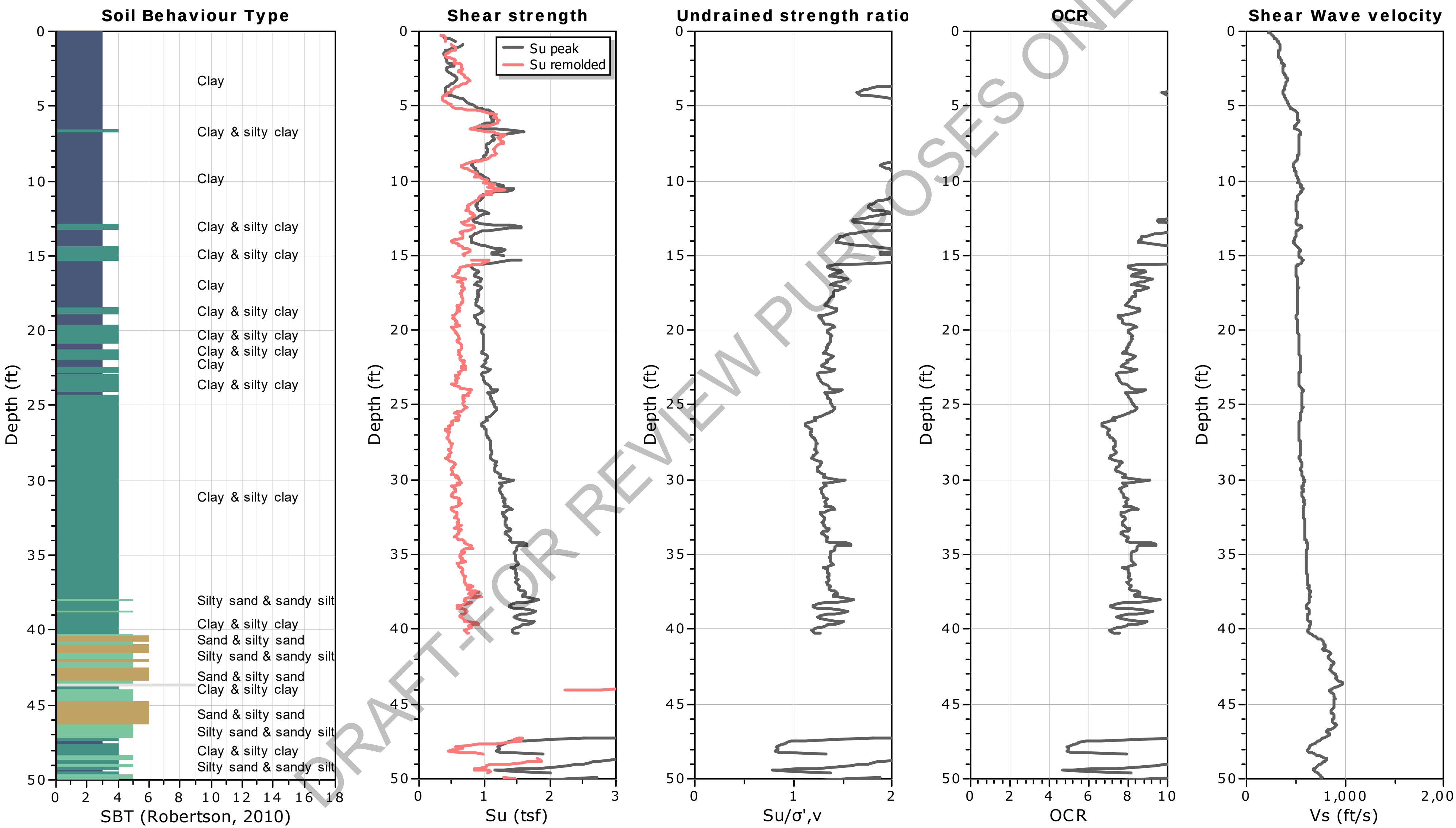
CPT: T-10

Total depth: 50.71 ft, Date: 5/5/2017

Coords: lat 43.6402° lon -93.146°

Project: **Freeborn Wind Project**

Location: **Freeborn County, Minnesota**



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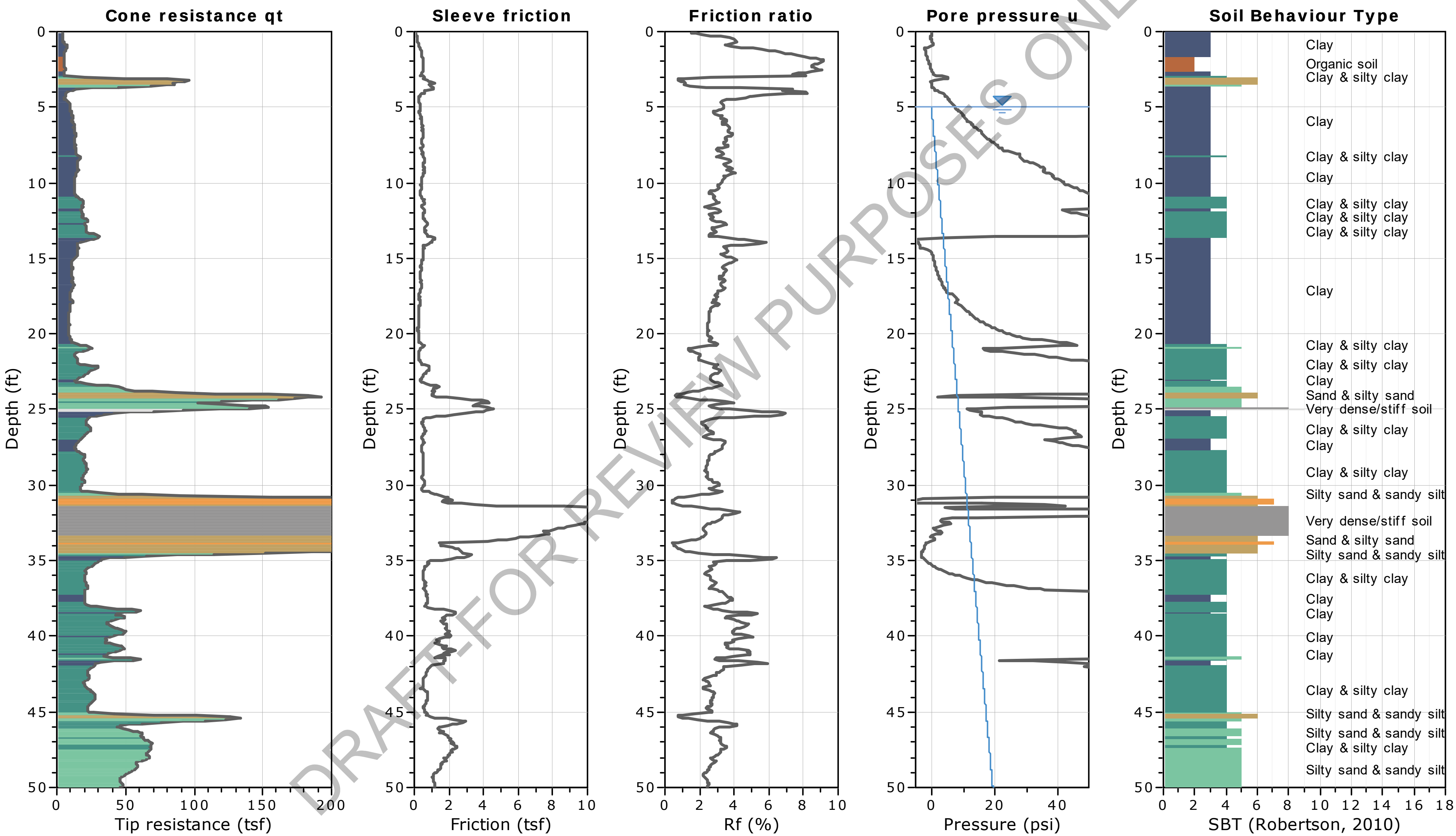
Telephone: (512) 992-2087

CPT: T-11

Total depth: 50.58 ft, Date: 5/5/2017
Coords: lat 43.6395° lon -93.1261°

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

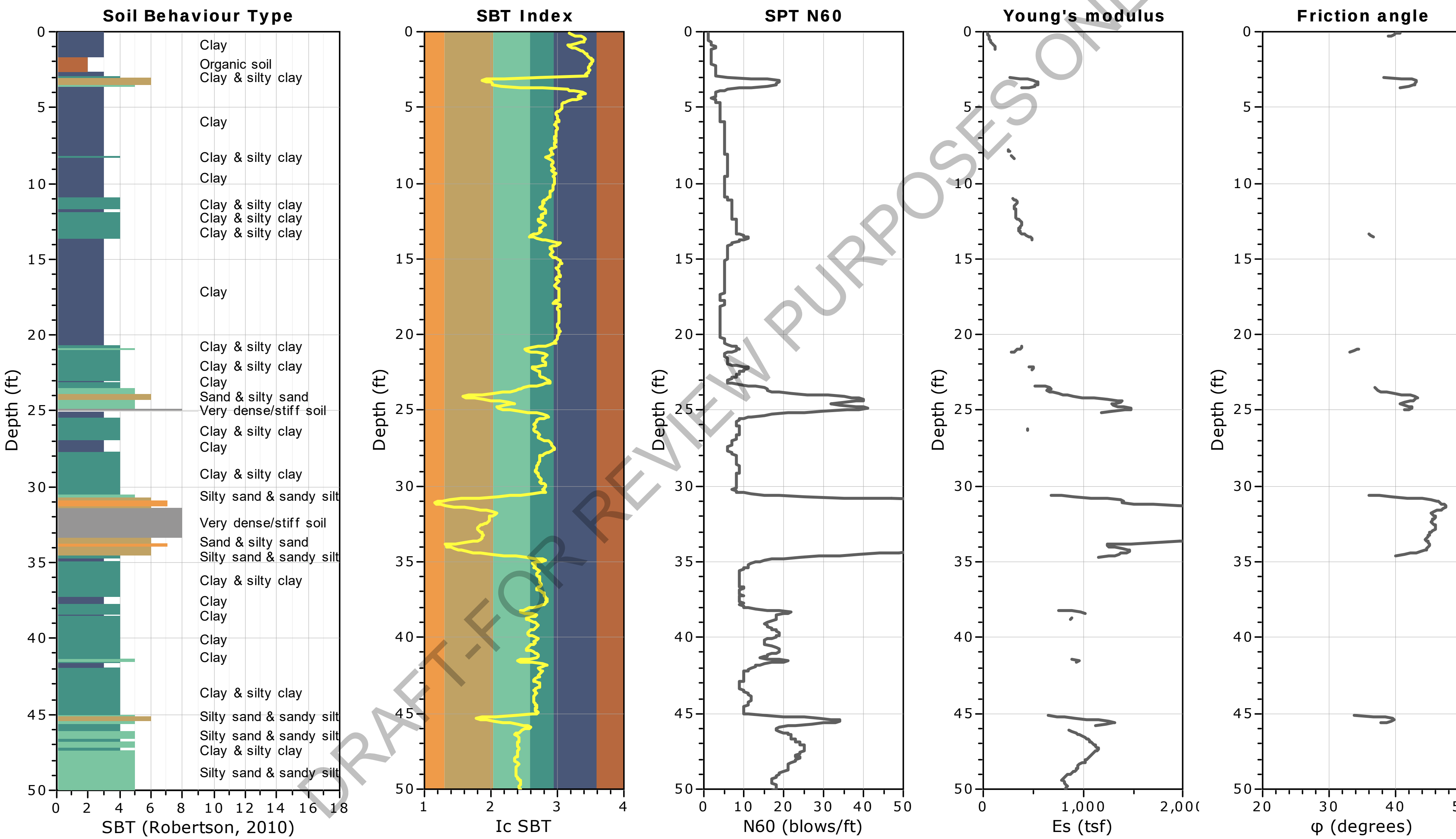
CPT: T-11

Project: **Freeborn Wind Project**

Location: **Freeborn County, Minnesota**

Total depth: 50.58 ft, Date: 5/5/2017

Coords: lat 43.6395° lon -93.1261°



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

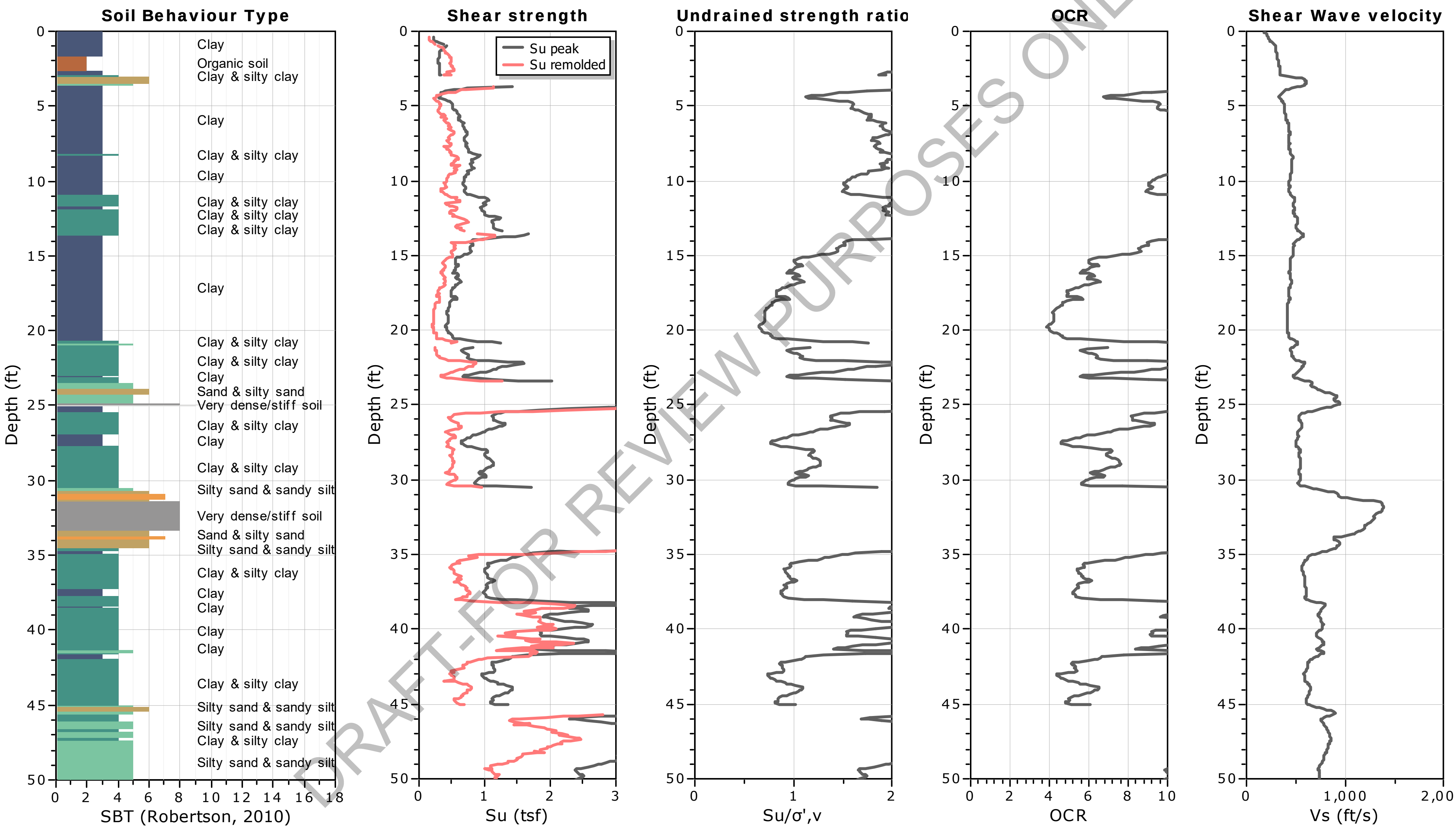
CPT: T-11

Total depth: 50.58 ft, Date: 5/5/2017

Coords: lat 43.6395° lon -93.1261°

Project: **Freeborn Wind Project**

Location: **Freeborn County, Minnesota**



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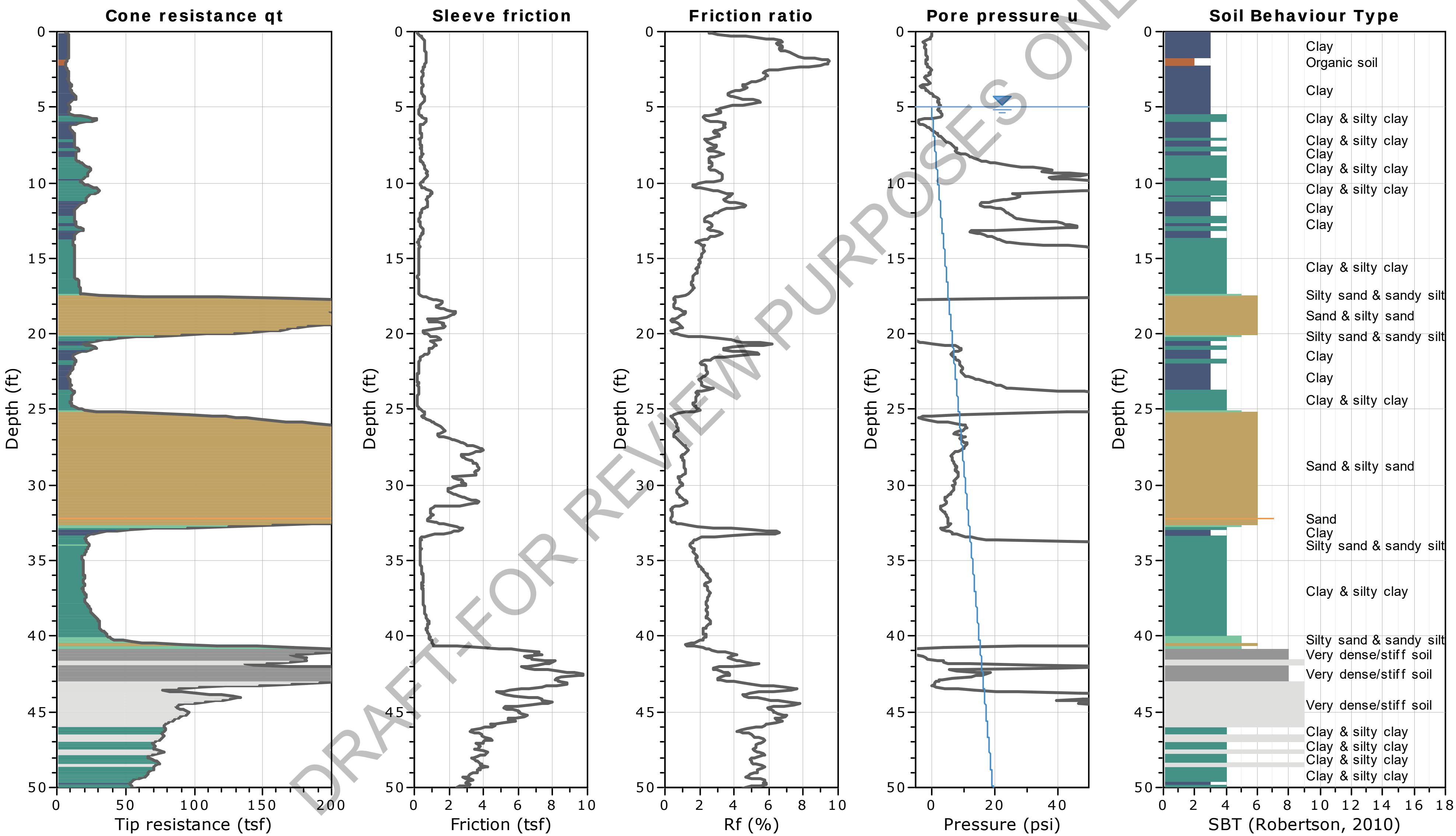
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-12

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

Total depth: 50.58 ft, Date: 5/5/2017
Coords: lat 43.6395° lon -93.1182°

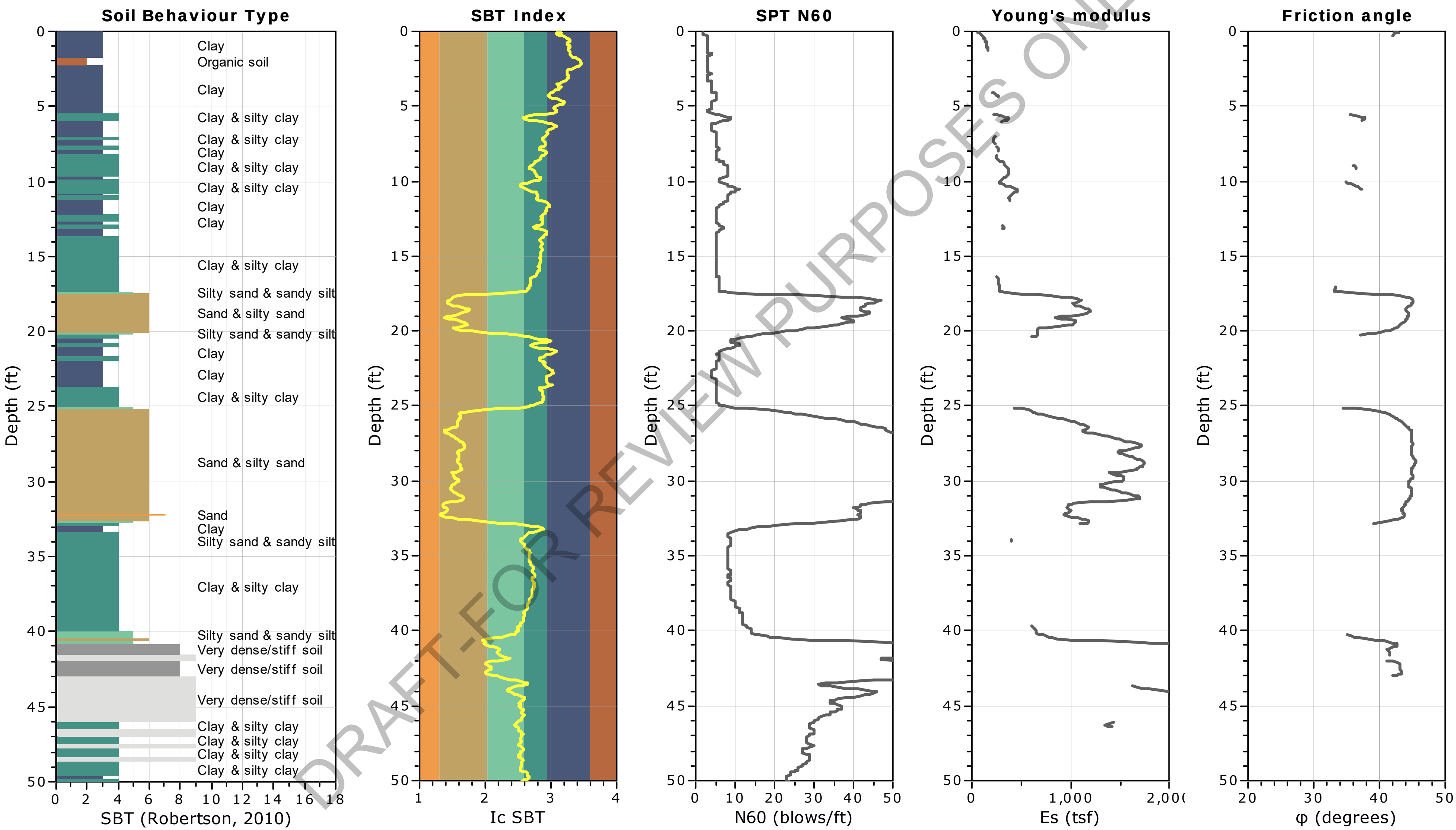


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-12

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

Total depth: 50.58 ft, Date: 5/5/2017
Coords: lat 43.6395° lon -93.1182°



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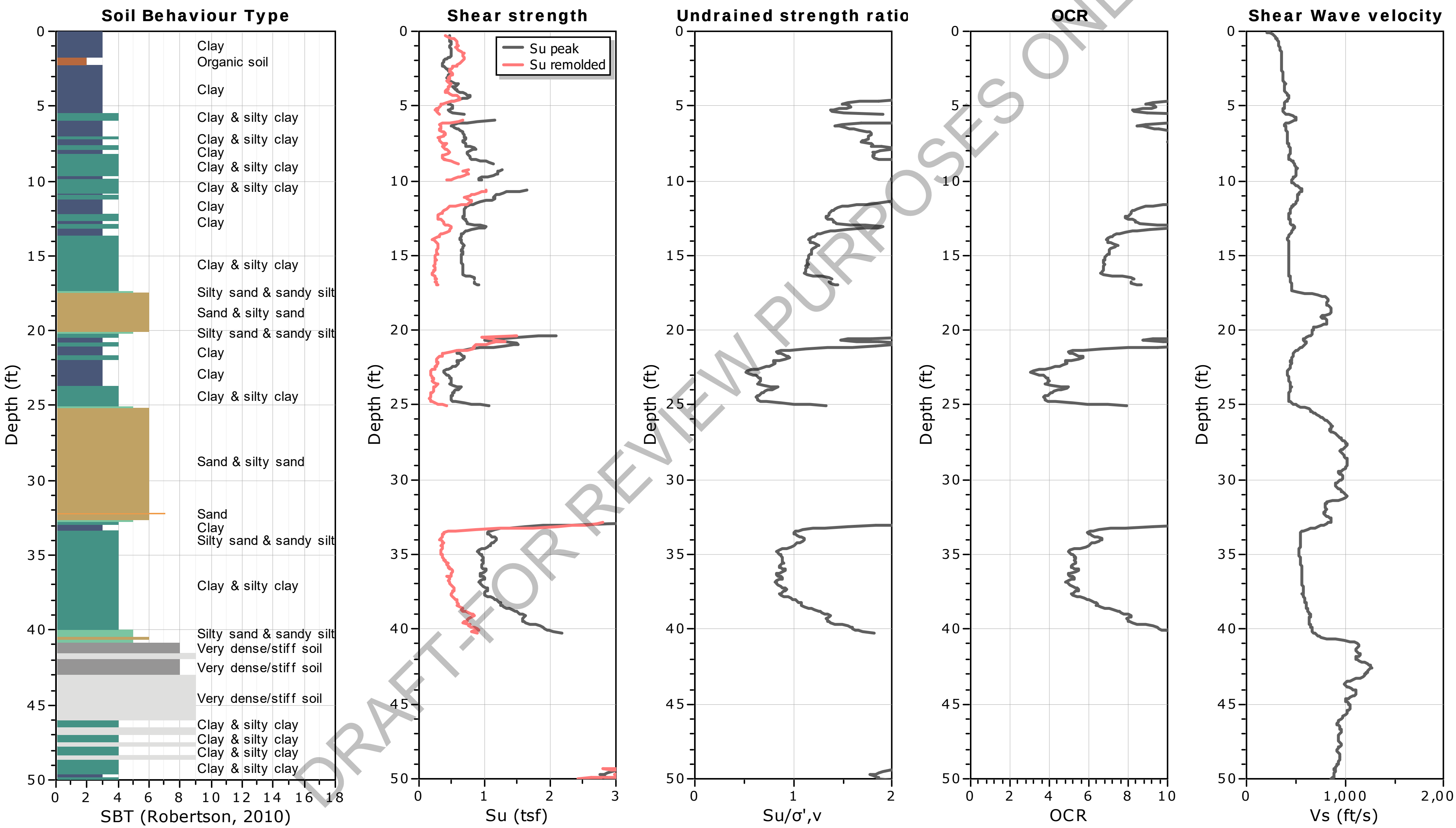
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-12

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

Total depth: 50.58 ft, Date: 5/5/2017
Coords: lat 43.6395° lon -93.1182°



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3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

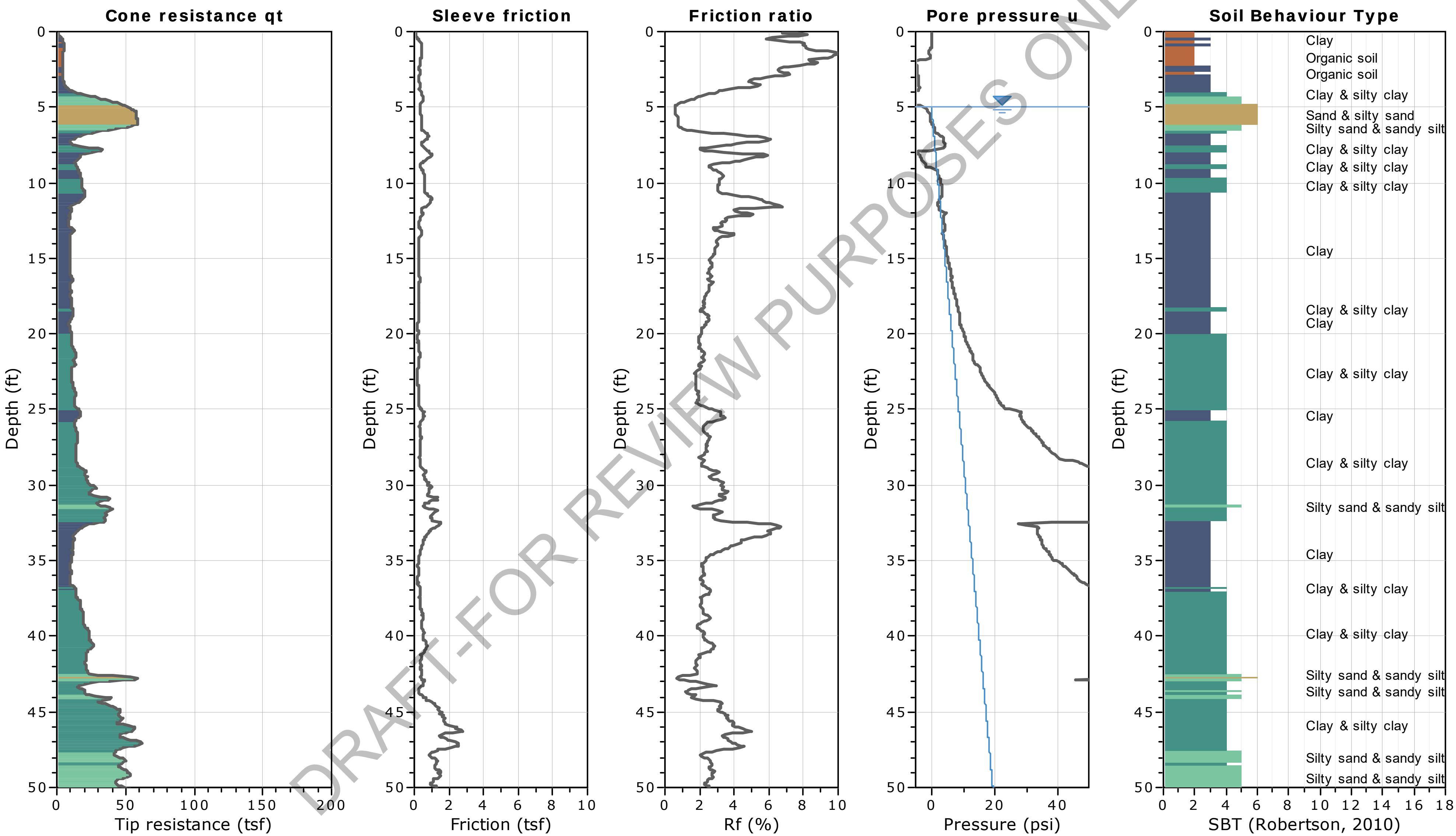
CPT: T-13

Project: **Freeborn Wind Project**

Location: **Freeborn County, Minnesota**

Total depth: 50.58 ft, Date: 5/5/2017

Coords: lat 43.6195° lon -93.1806°



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3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

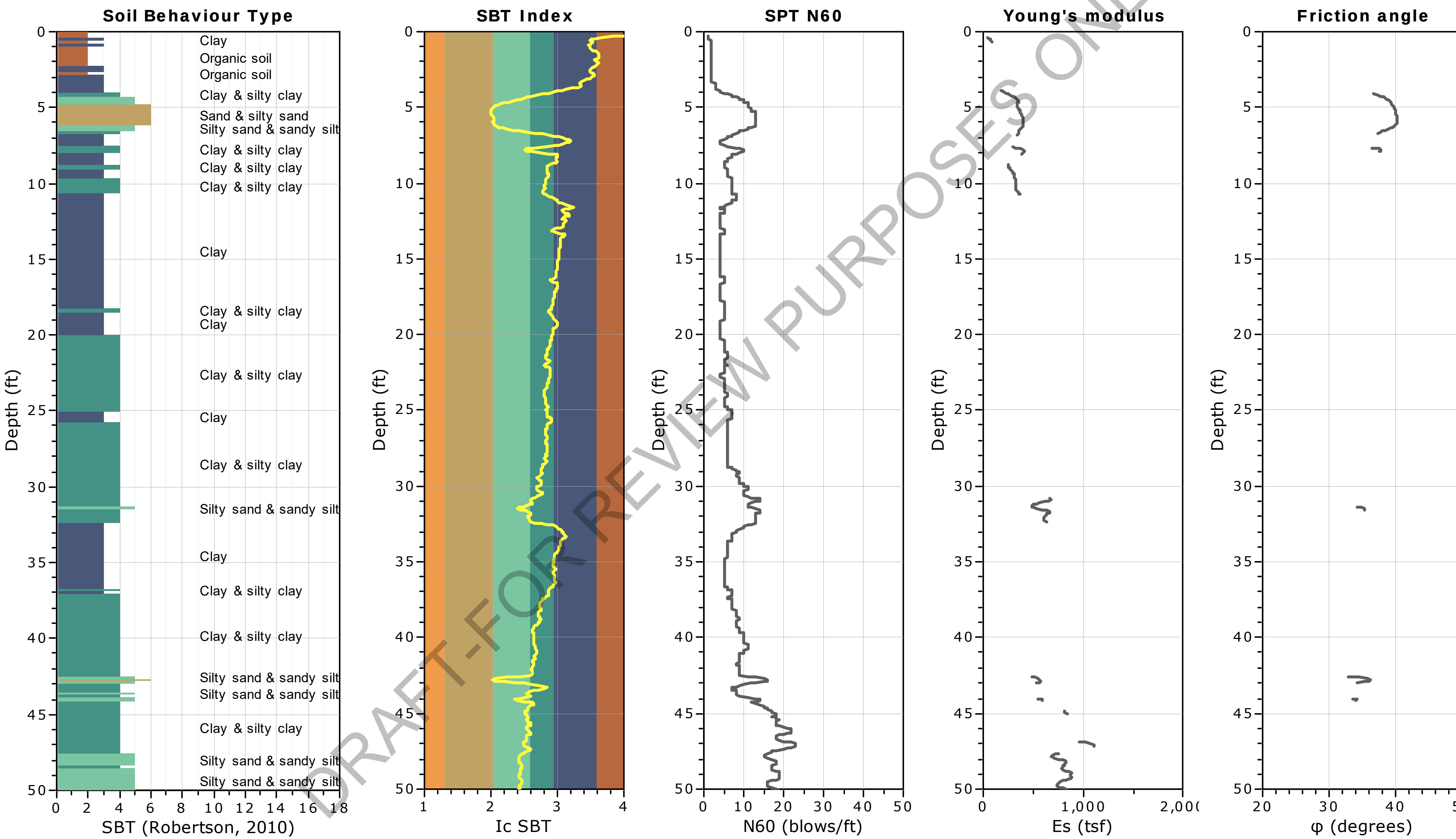
CPT: T-13

Total depth: 50.58 ft, Date: 5/5/2017

Coords: lat 43.6195° lon -93.1806°

Project: **Freeborn Wind Project**

Location: **Freeborn County, Minnesota**



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

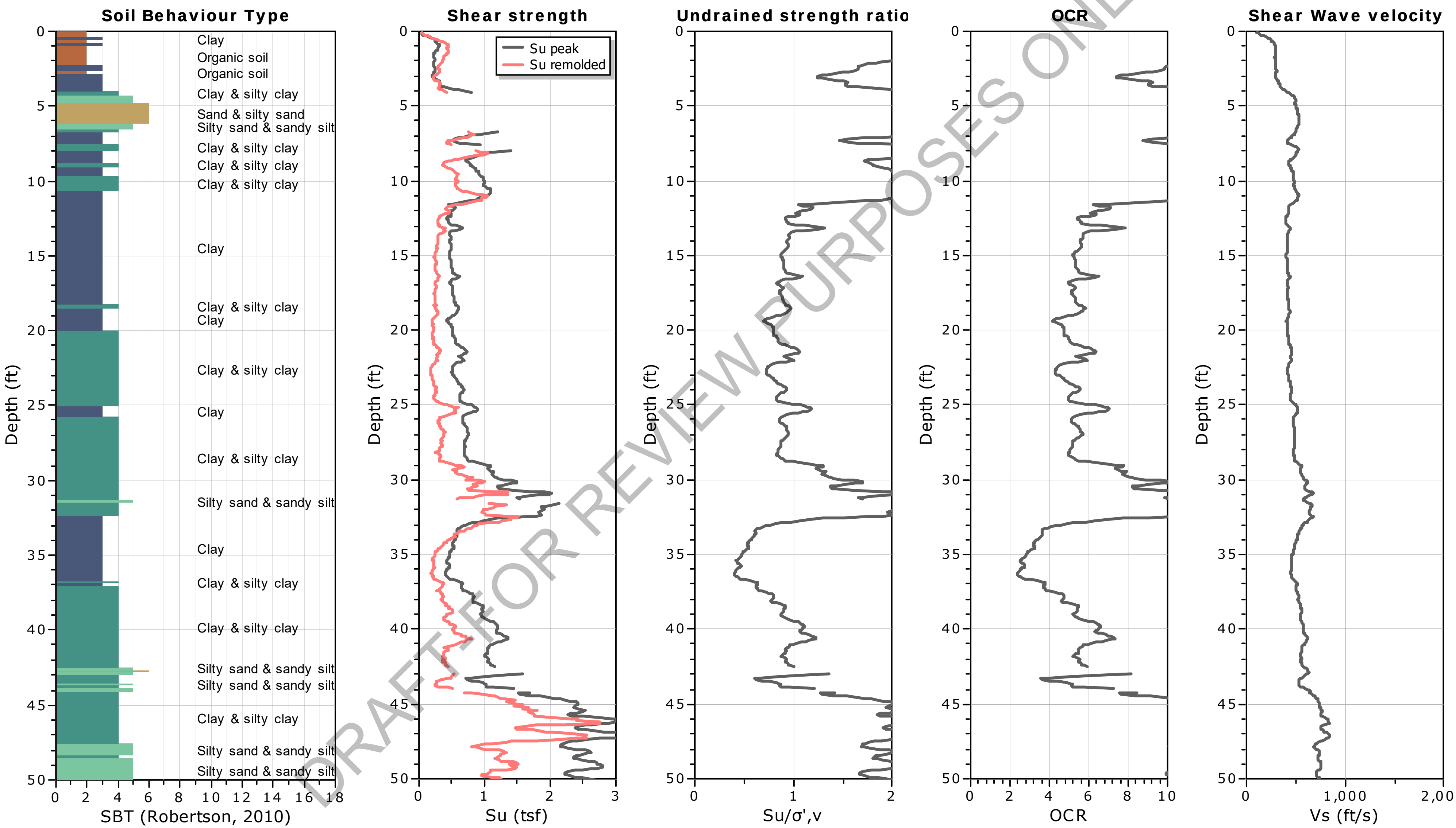
CPT: T-13

Total depth: 50.58 ft, Date: 5/5/2017

Coords: lat 43.6195° lon -93.1806°

Project: **Freeborn Wind Project**

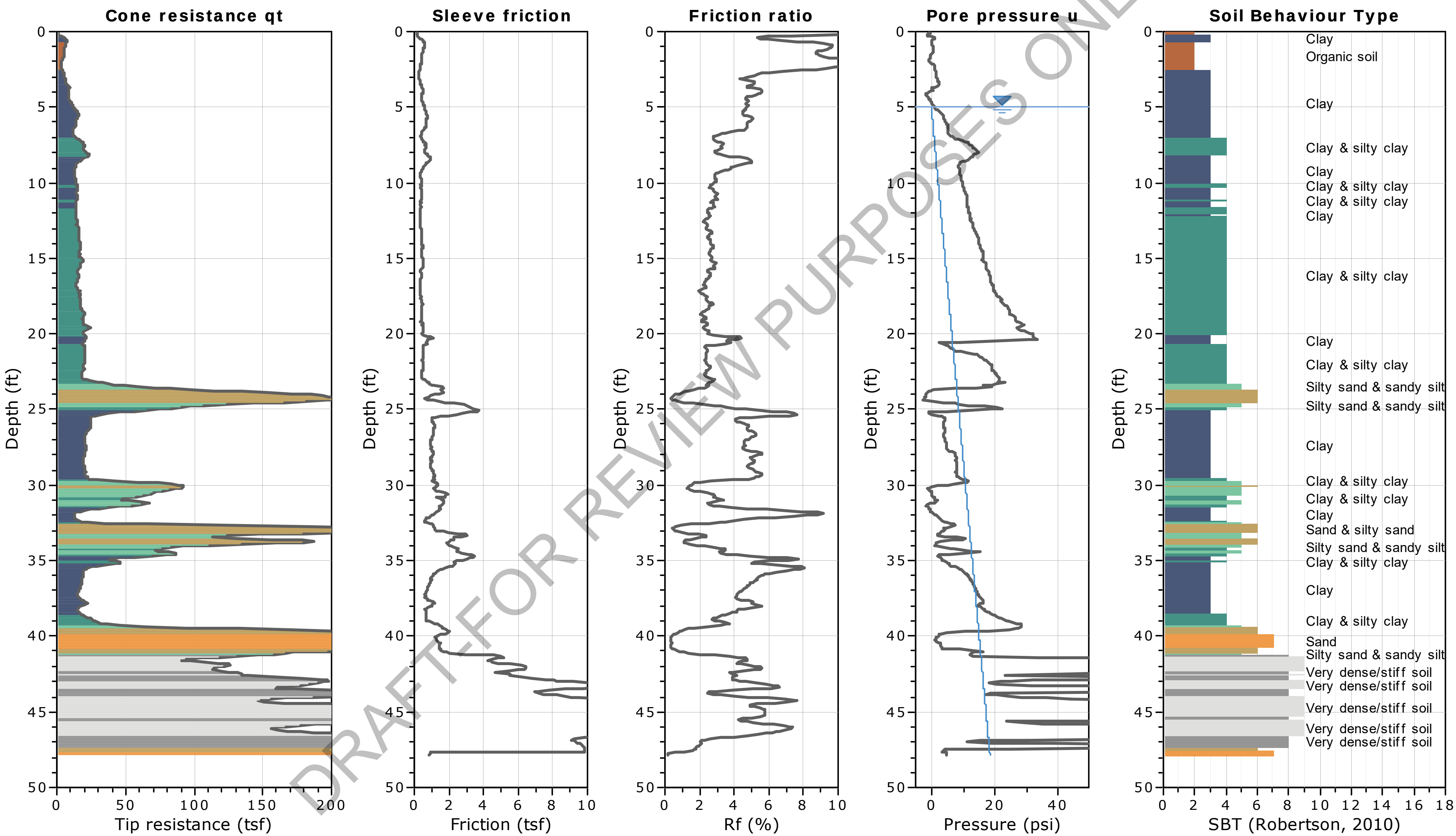
Location: **Freeborn County, Minnesota**



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-14
Total depth: 47.89 ft, Date: 5/5/2017
Coords: lat 43.6201° lon -93.1761°

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**



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Telephone: (512) 992-2087

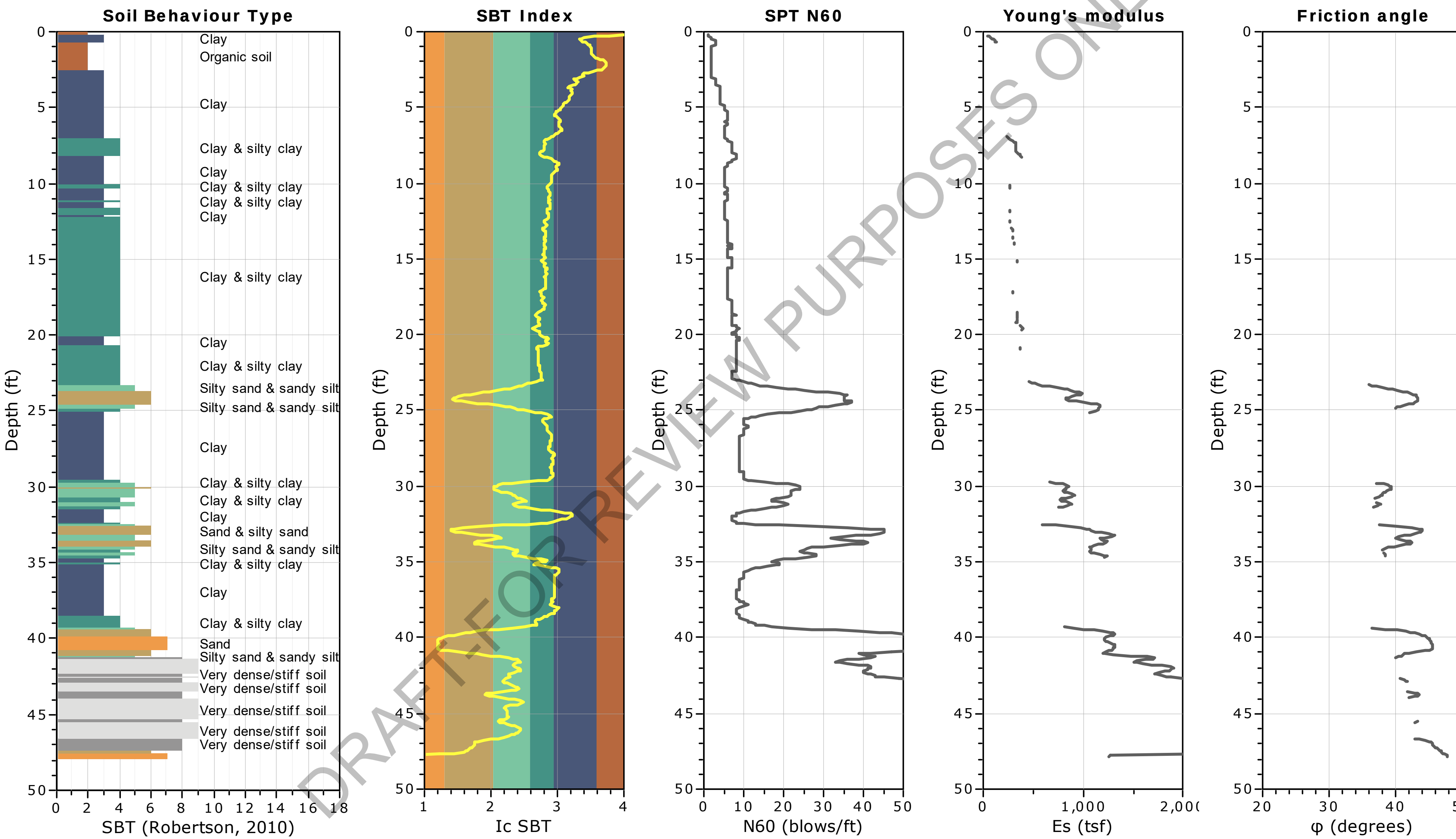
CPT: T-14

Total depth: 47.89 ft, Date: 5/5/2017

Coords: lat 43.6201° lon -93.1761°

Project: Freeborn Wind Project

Location: Freeborn County, Minnesota

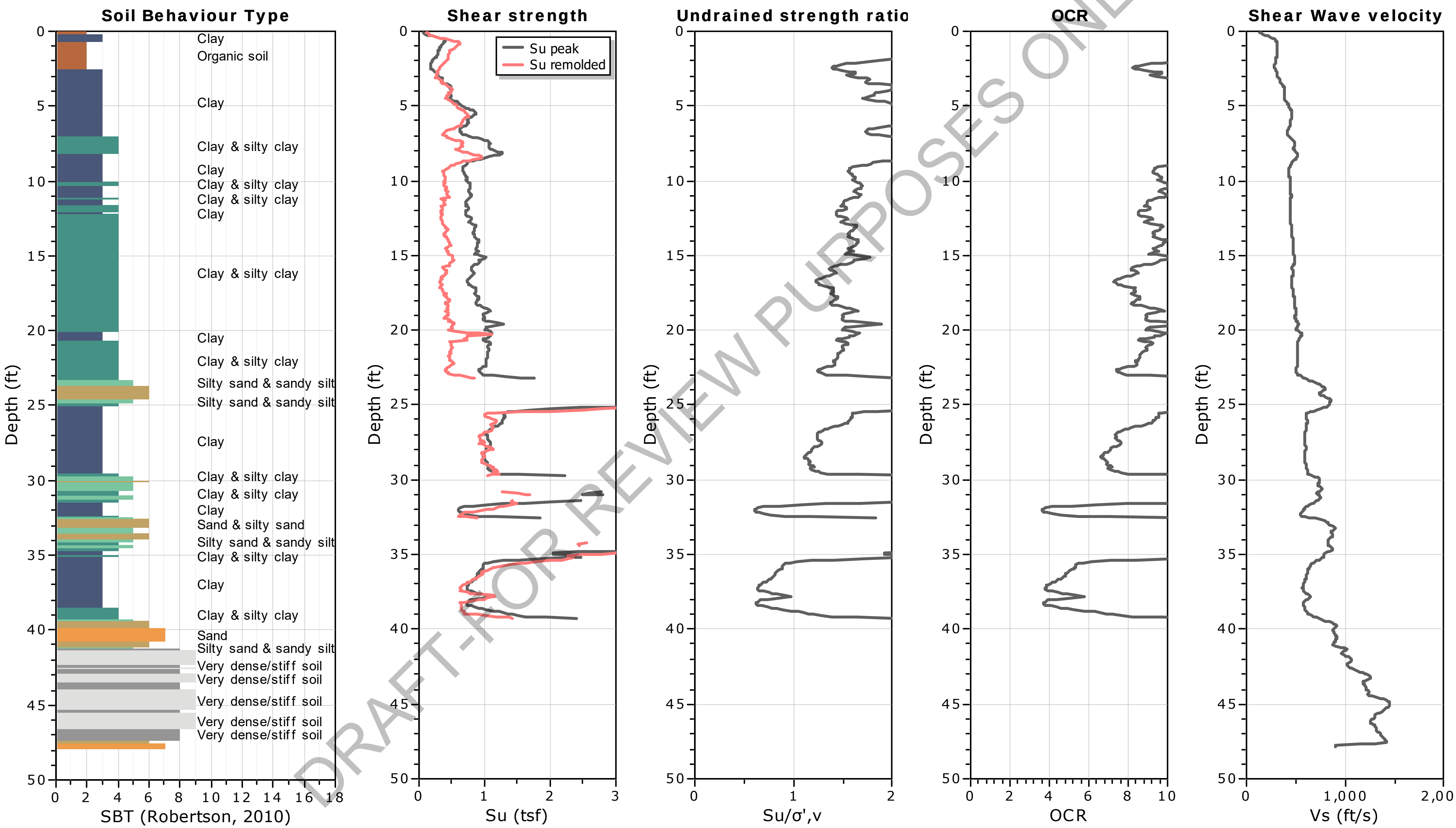


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-14

Project: **Freeborn Wind Project**
Total depth: 47.89 ft, Date: 5/5/2017

Location: **Freeborn County, Minnesota**
Coords: lat 43.6201° lon -93.1761°



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

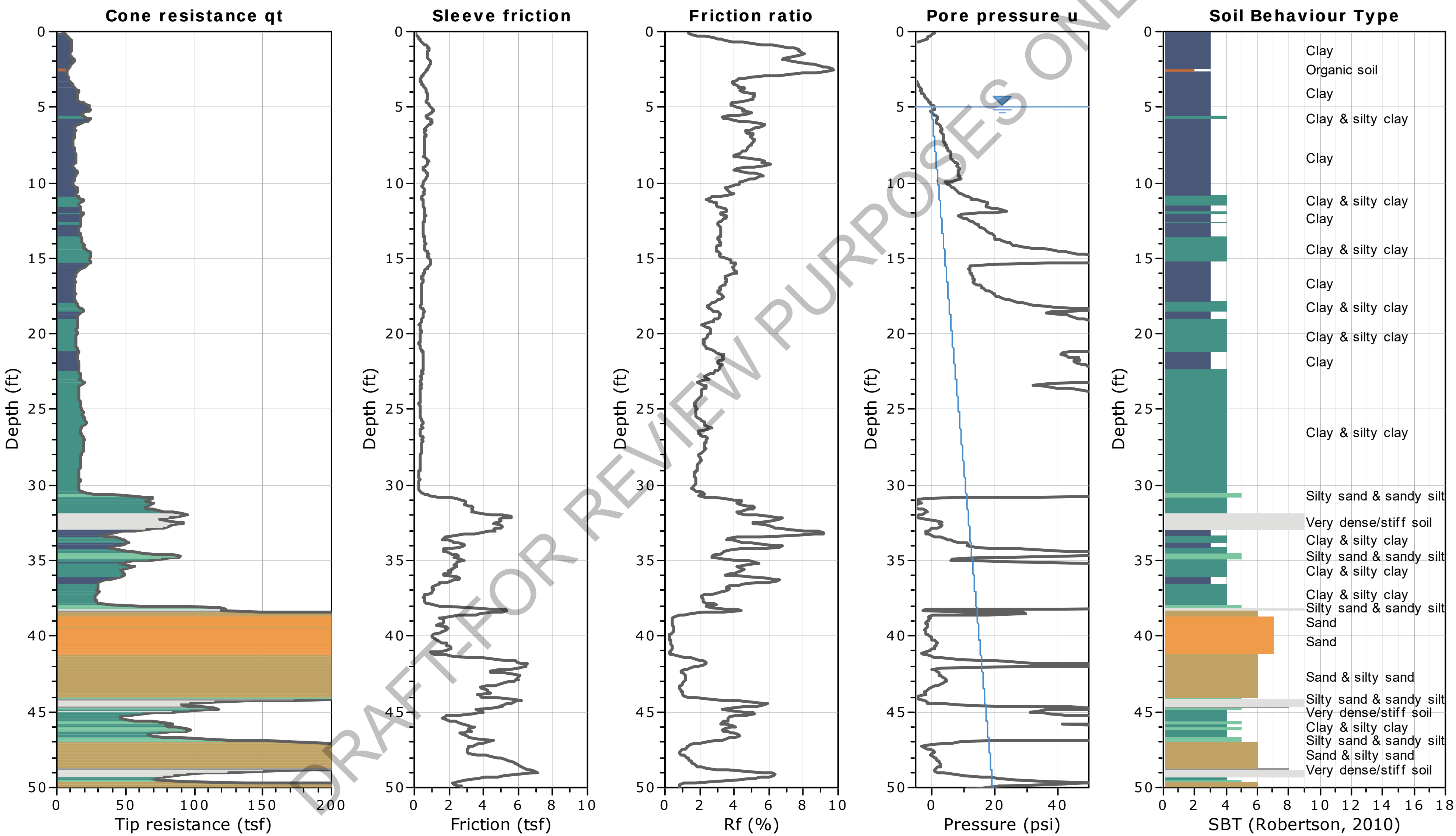
CPT: T-15

Total depth: 50.71 ft, Date: 5/5/2017

Coords: lat 43.627° lon -93.1469°

Project: **Freeborn Wind Project**

Location: **Freeborn County, Minnesota**

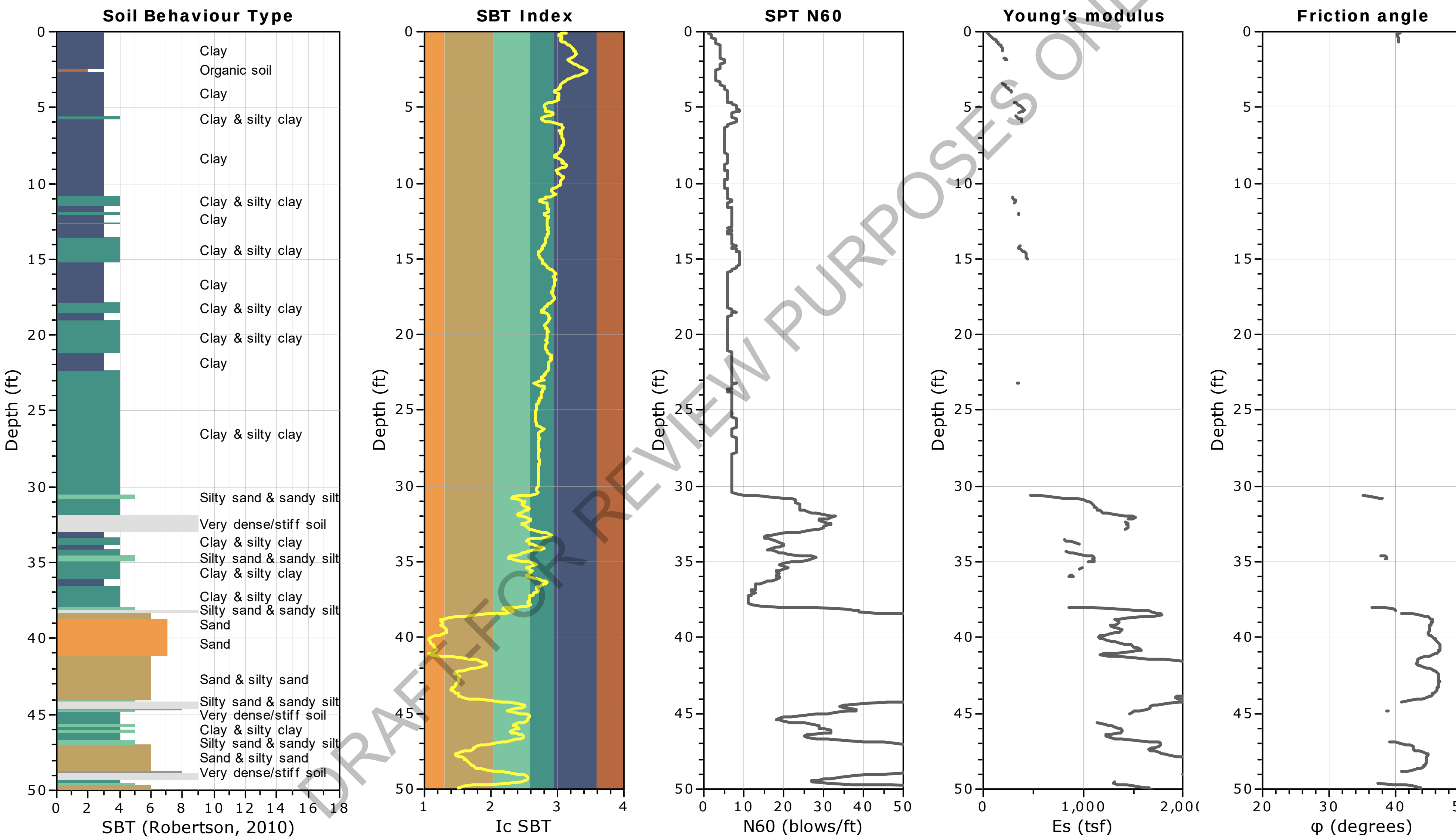


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-15

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

Total depth: 50.71 ft, Date: 5/5/2017
Coords: lat 43.627° lon -93.1469°



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

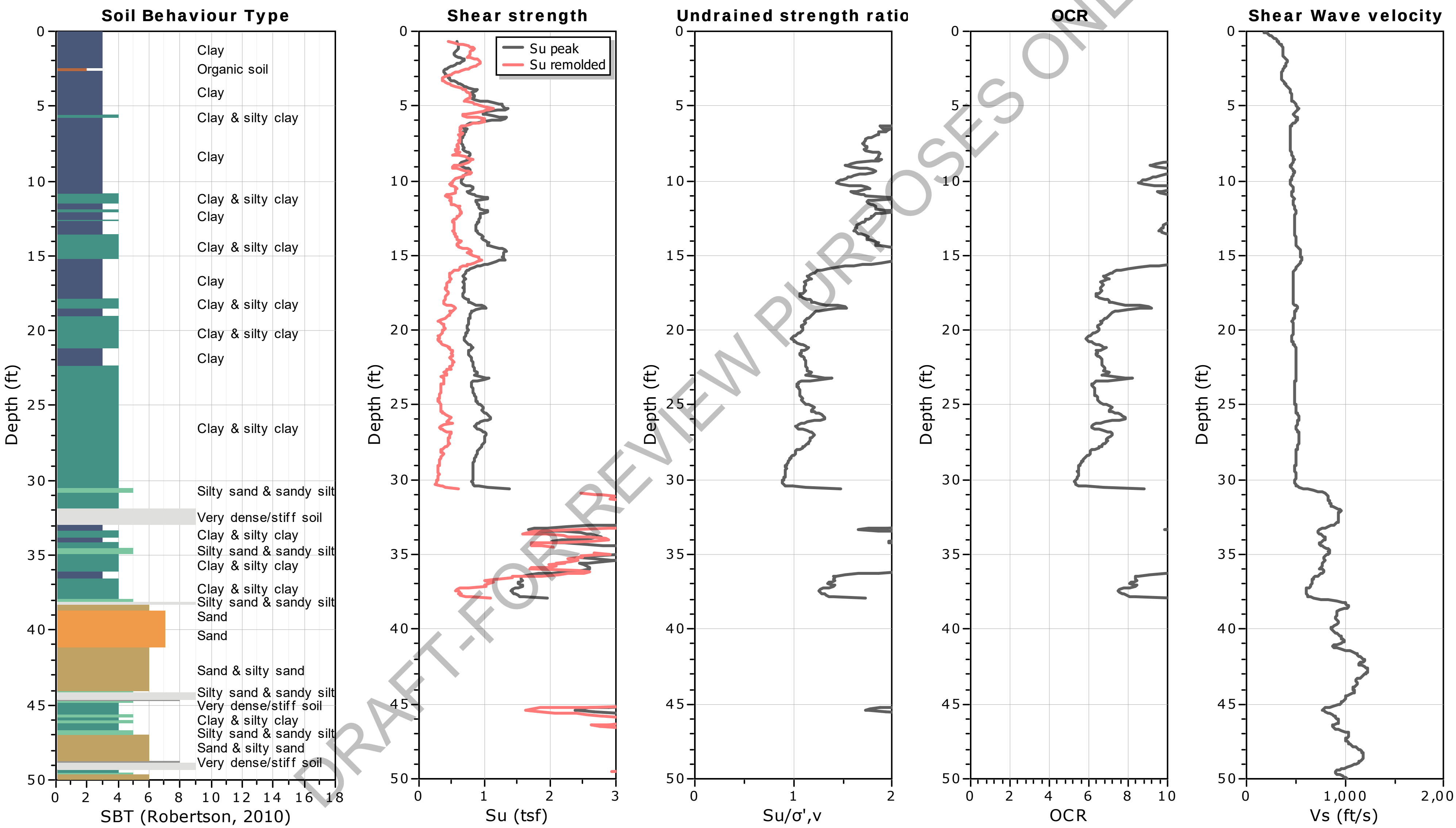
CPT: T-15

Total depth: 50.71 ft, Date: 5/5/2017

Coords: lat 43.627° lon -93.1469°

Project: **Freeborn Wind Project**

Location: **Freeborn County, Minnesota**

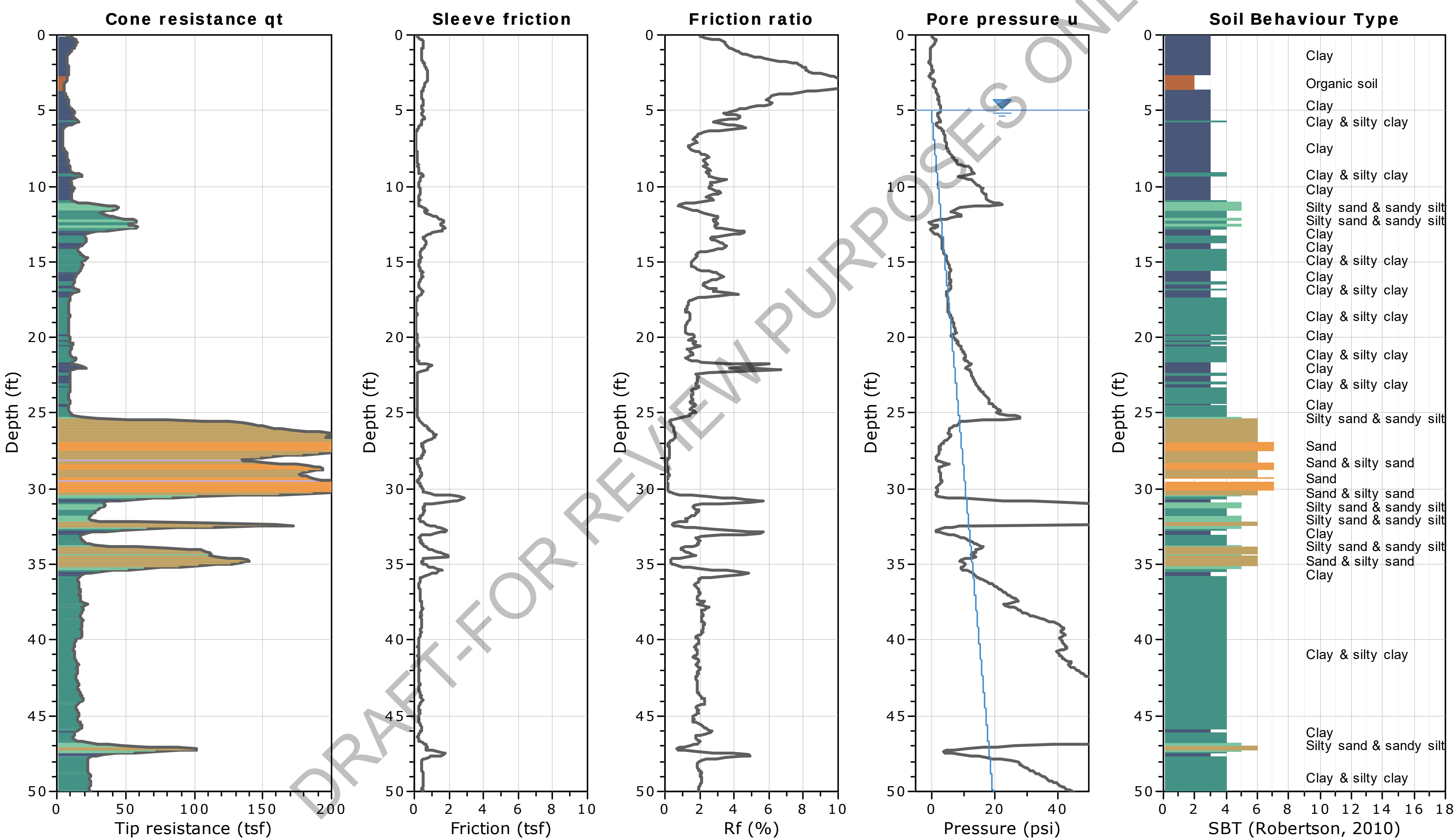


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-16

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

Total depth: 50.77 ft, Date: 5/5/2017
Coords: lat 43.6336° lon -93.1219°

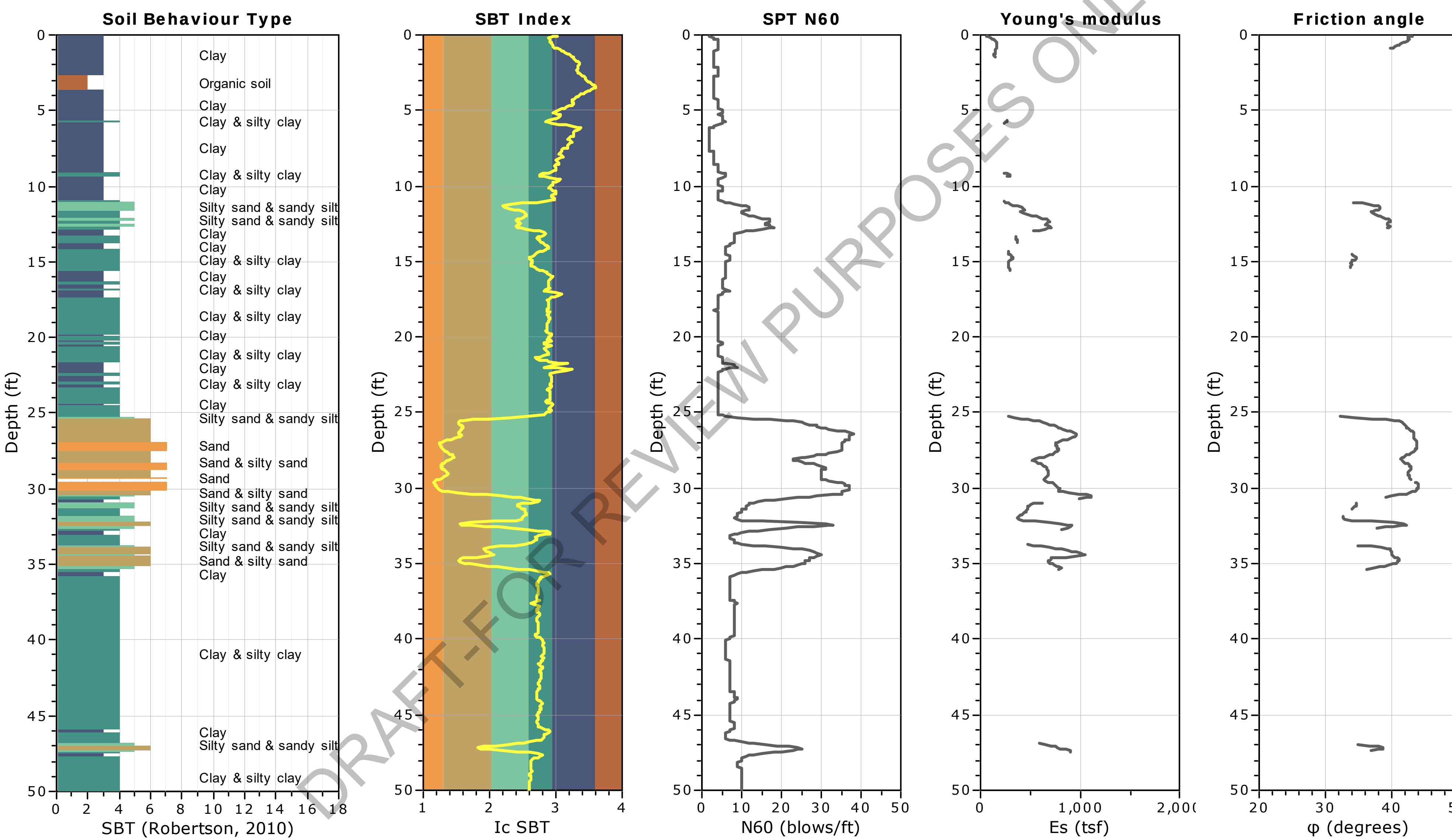


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-16

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

Total depth: 50.77 ft, Date: 5/5/2017
Coords: lat 43.6336° lon -93.1219°



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

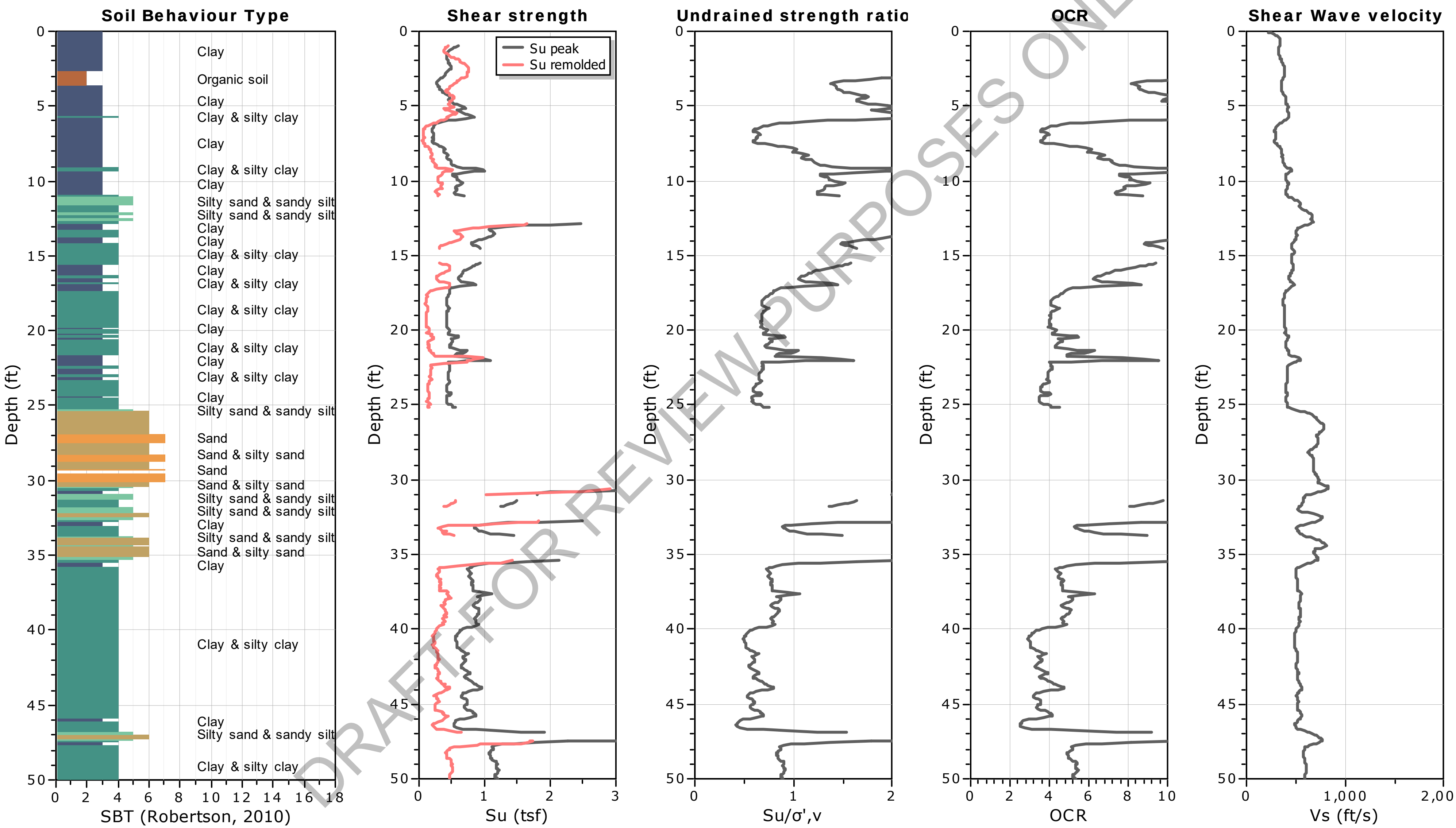
CPT: T-16

Project: **Freeborn Wind Project**

Location: **Freeborn County, Minnesota**

Total depth: 50.77 ft, Date: 5/5/2017

Coords: lat 43.6336° lon -93.1219°

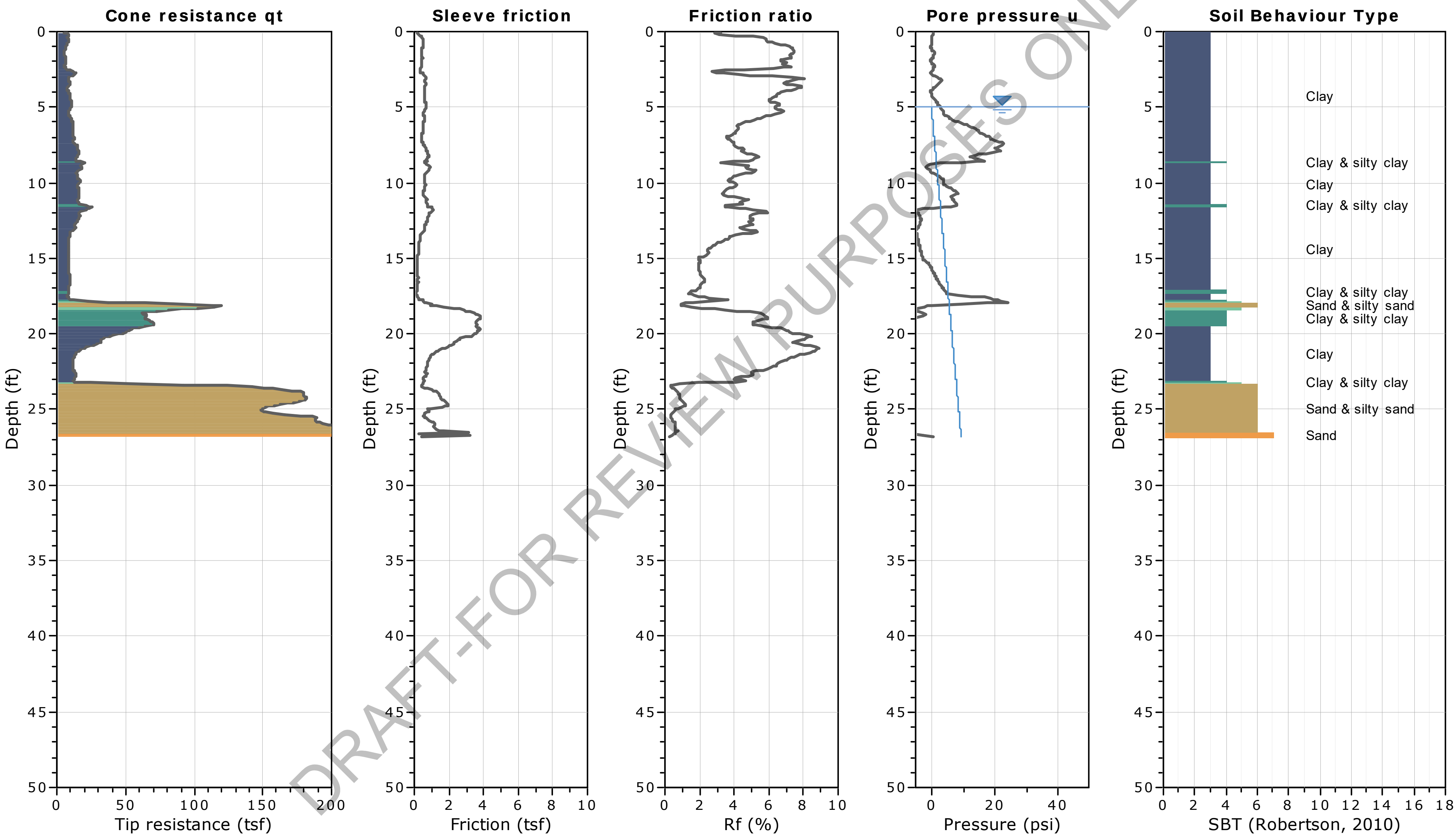


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-17a

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

Total depth: 26.76 ft, Date: 5/5/2017
Coords: lat 43.6281° lon -93.1175°

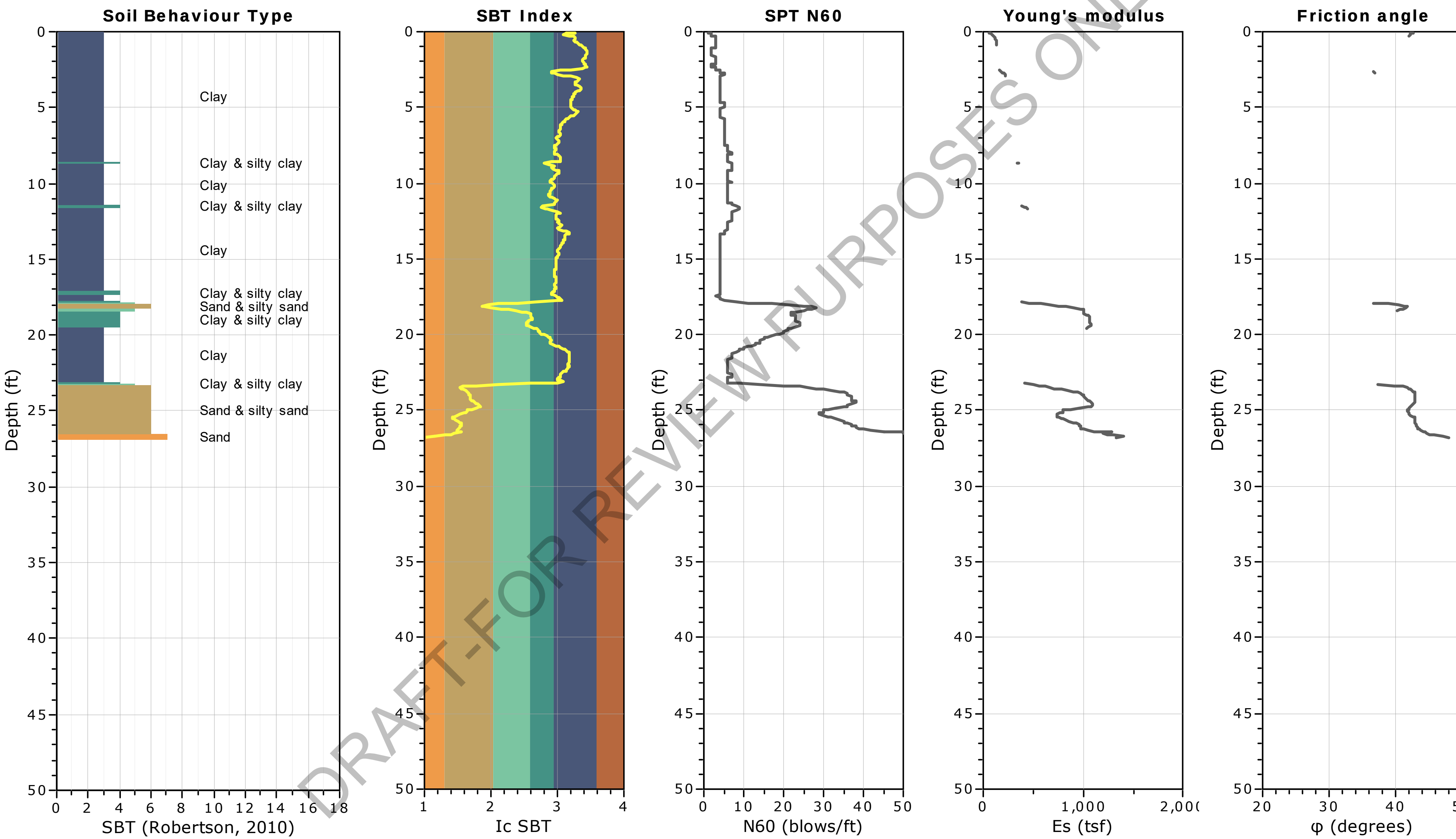


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-17a

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

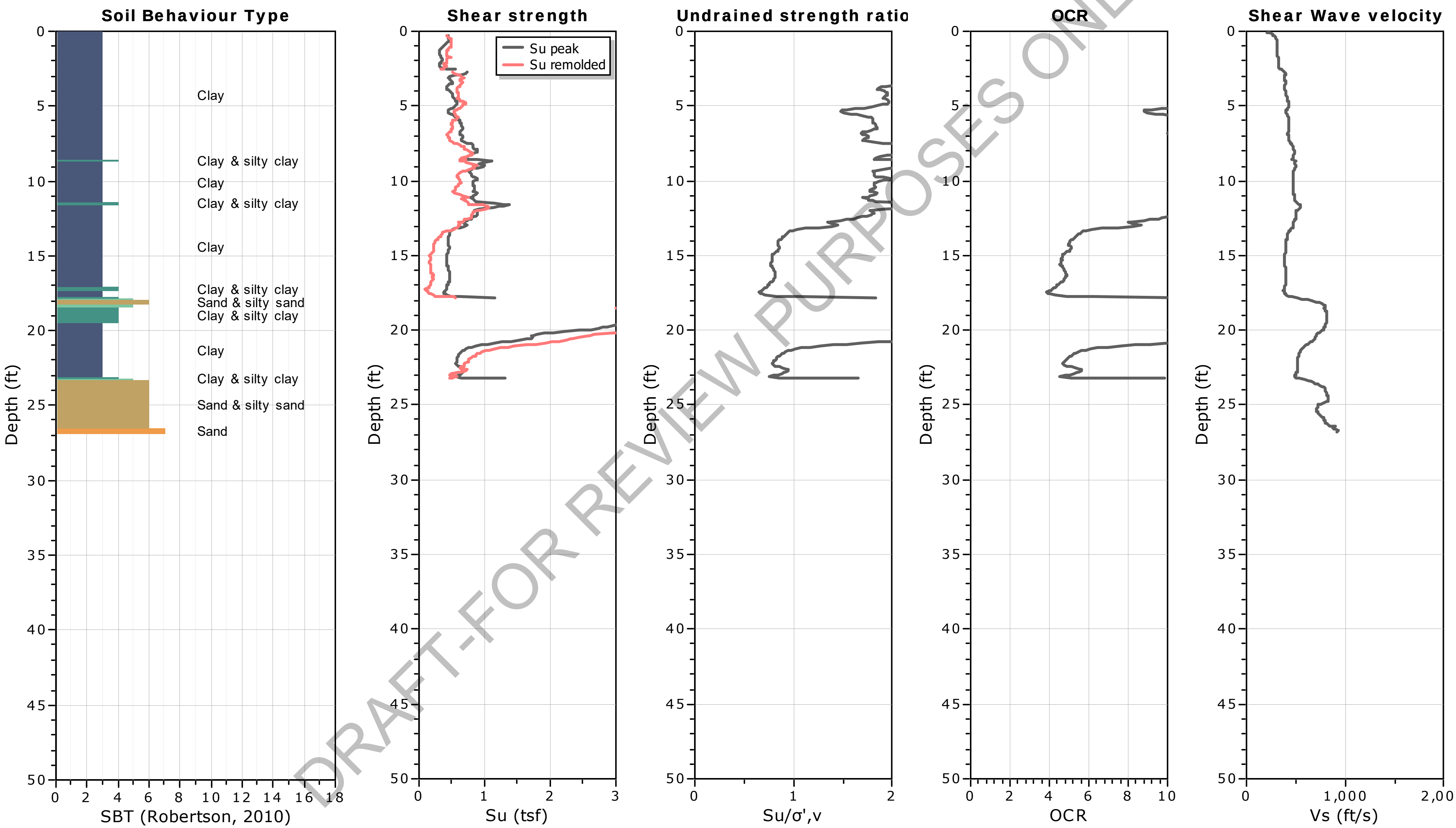
Total depth: 26.76 ft, Date: 5/5/2017
Coords: lat 43.6281° lon -93.1175°



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-17a
Total depth: 26.76 ft, Date: 5/5/2017
Coords: lat 43.6281° lon -93.1175°

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

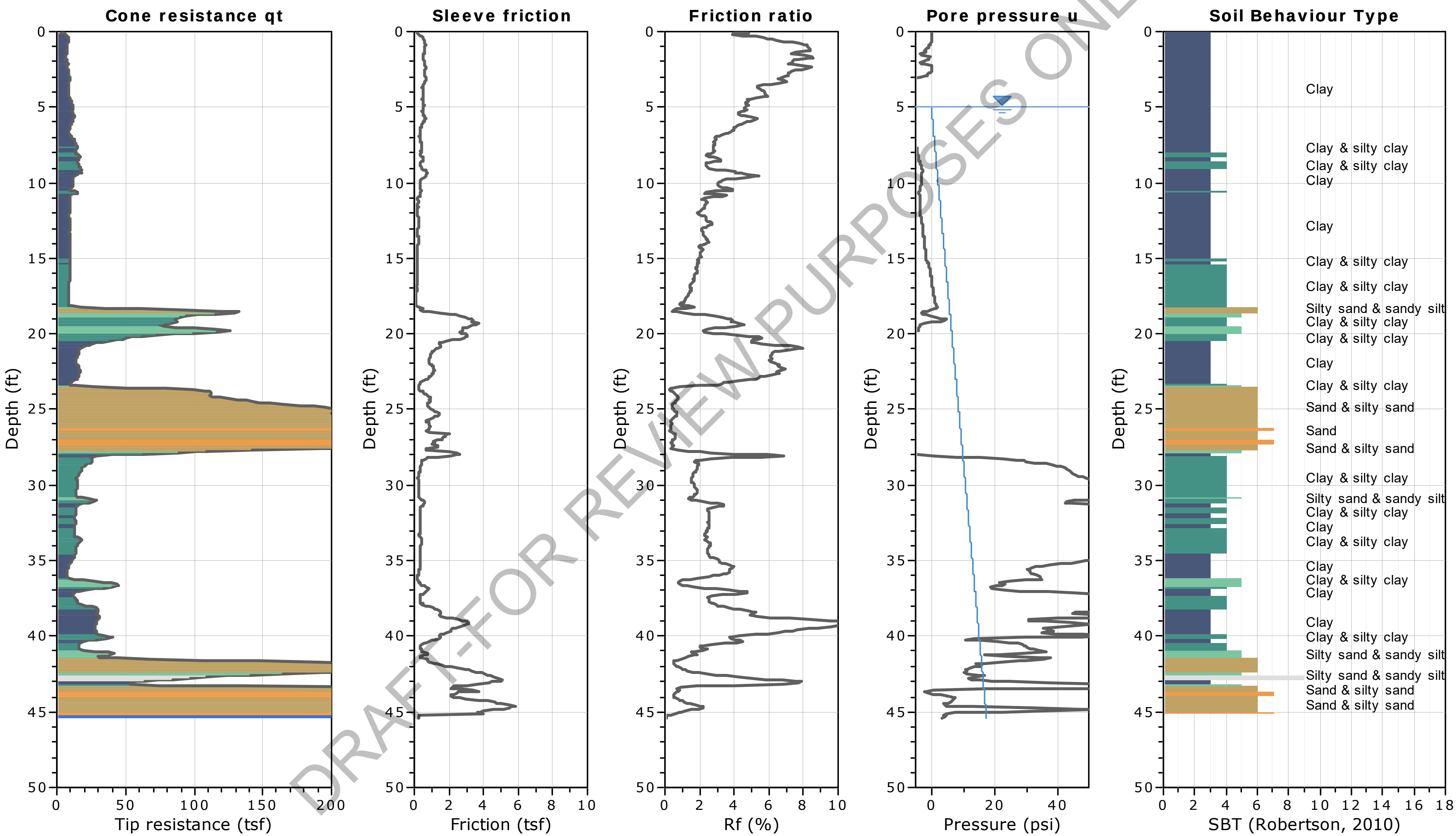
CPT: T-17b

Project: **Freeborn Wind Project**

Location: **Freeborn County, Minnesota**

Total depth: 45.40 ft, Date: 5/5/2017

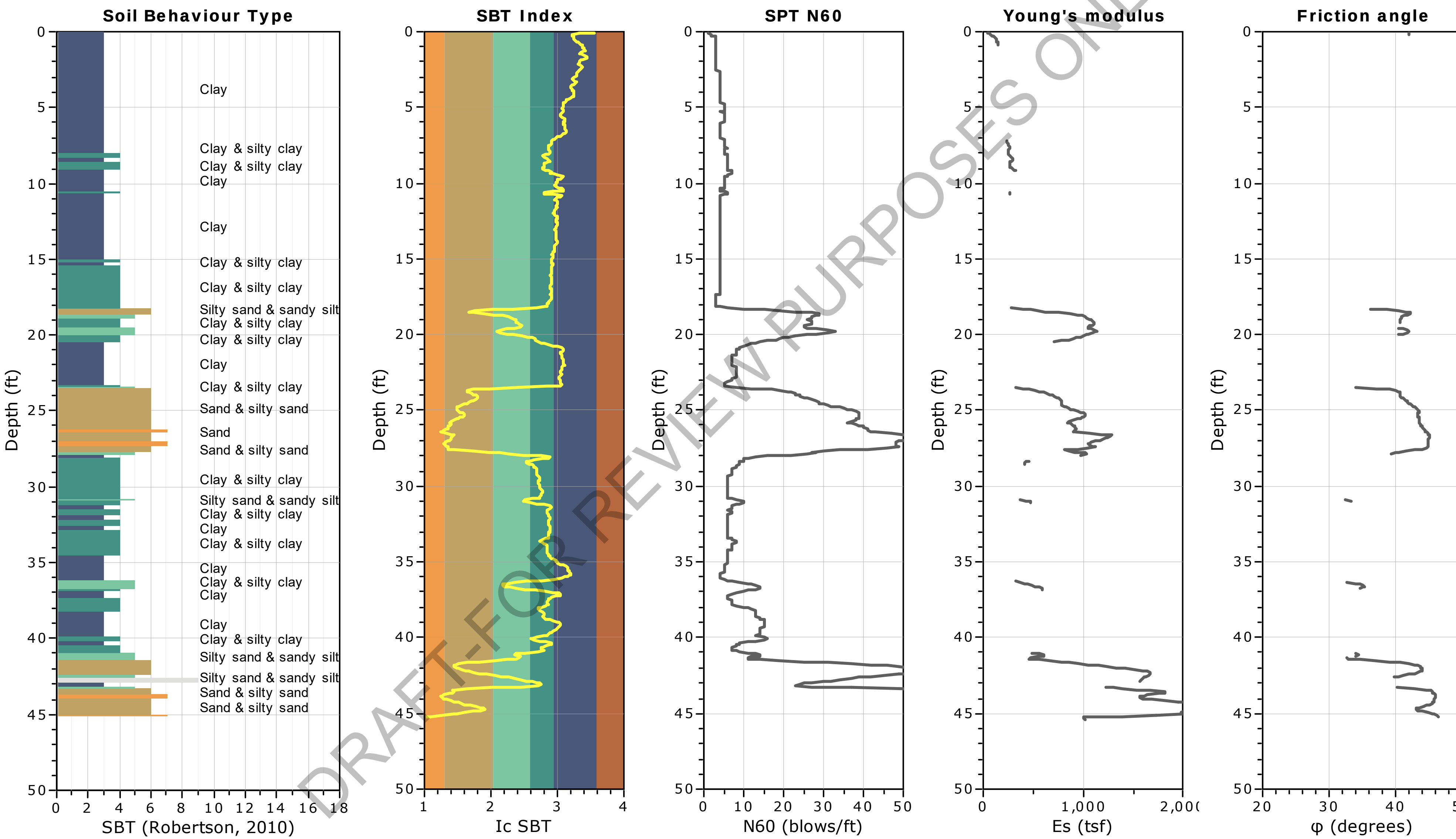
Coords: lat 43.6281° lon -93.1175°



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-17b
Total depth: 45.40 ft, Date: 5/5/2017
Coords: lat 43.6281° lon -93.1175°

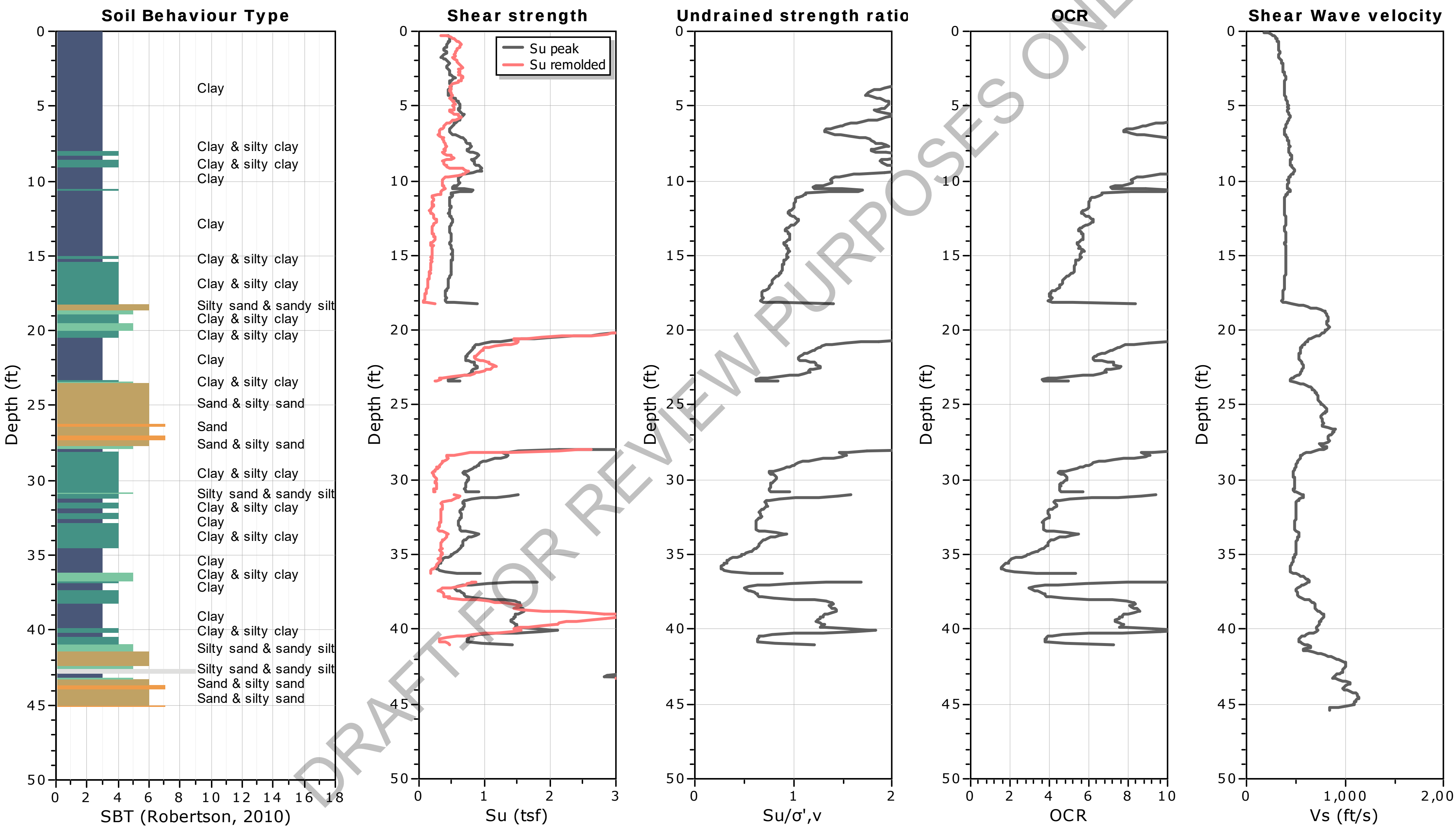
Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-17b
Total depth: 45.40 ft, Date: 5/5/2017
Coords: lat 43.6281° lon -93.1175°

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

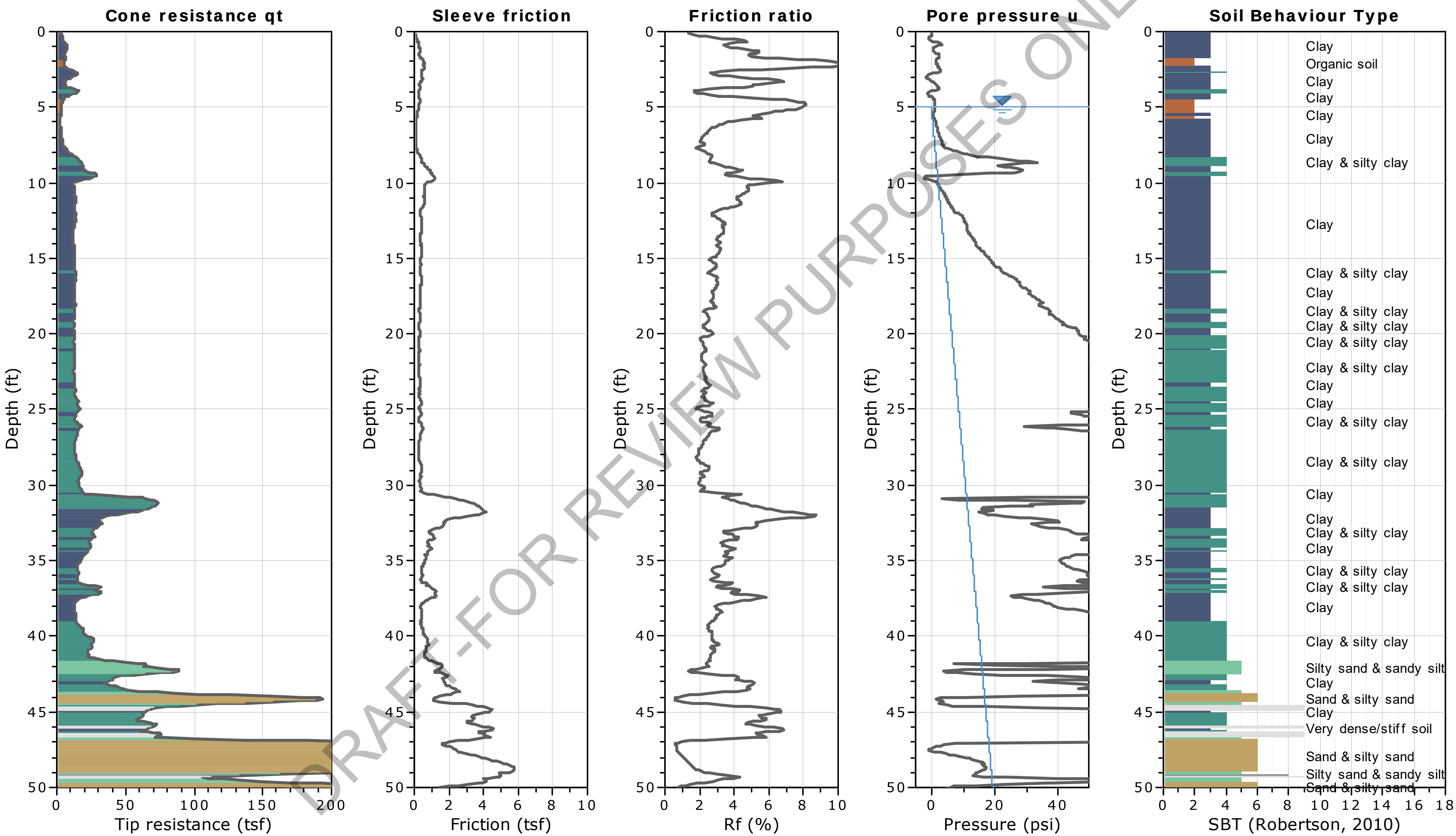
CPT: T-18

Project: **Freeborn Wind Project**

Location: **Freeborn County, Minnesota**

Total depth: 50.64 ft, Date: 5/5/2017

Coords: lat 43.6026° lon -93.1919°

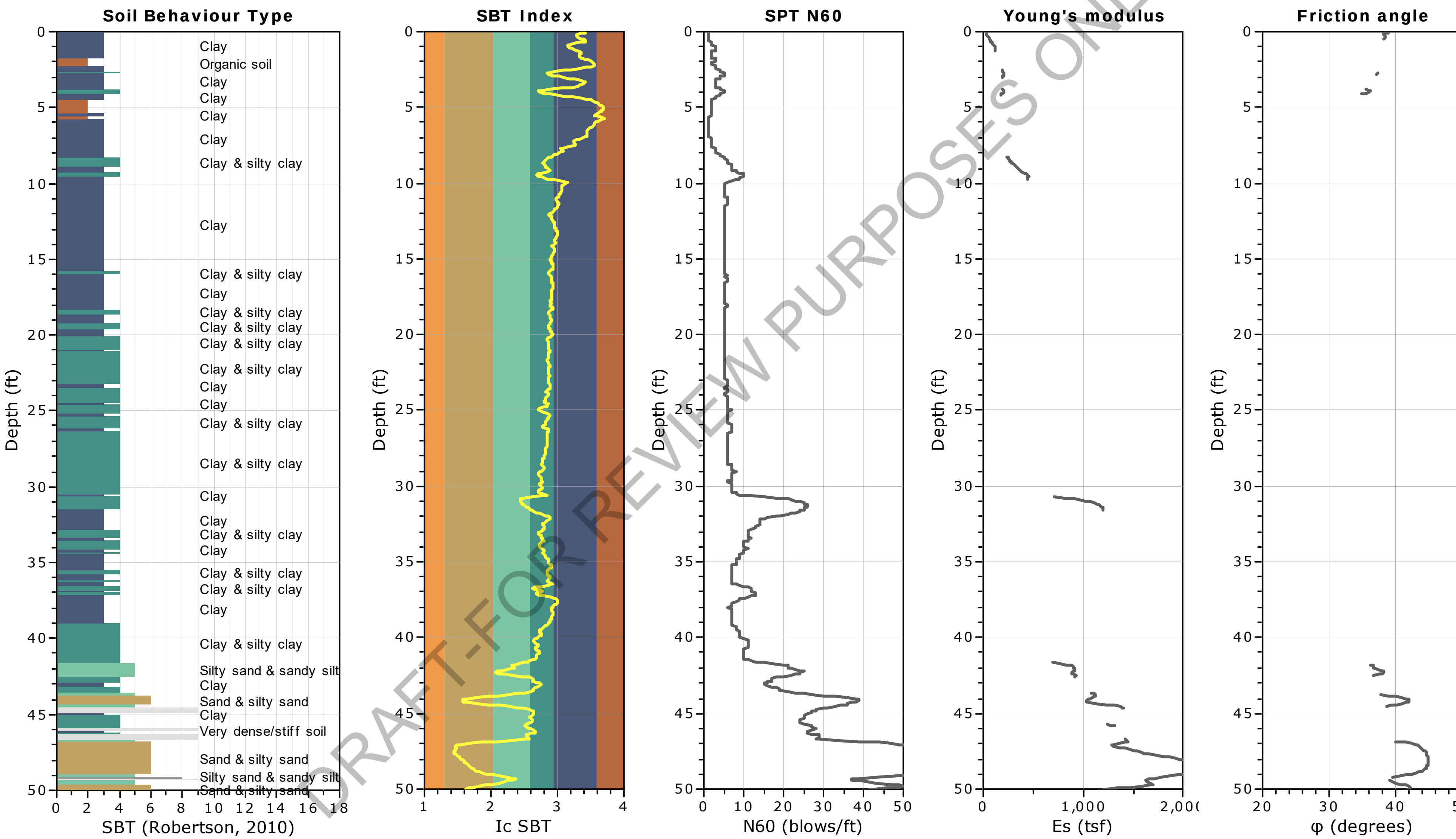


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-18

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

Total depth: 50.64 ft, Date: 5/5/2017
Coords: lat 43.6026° lon -93.1919°



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

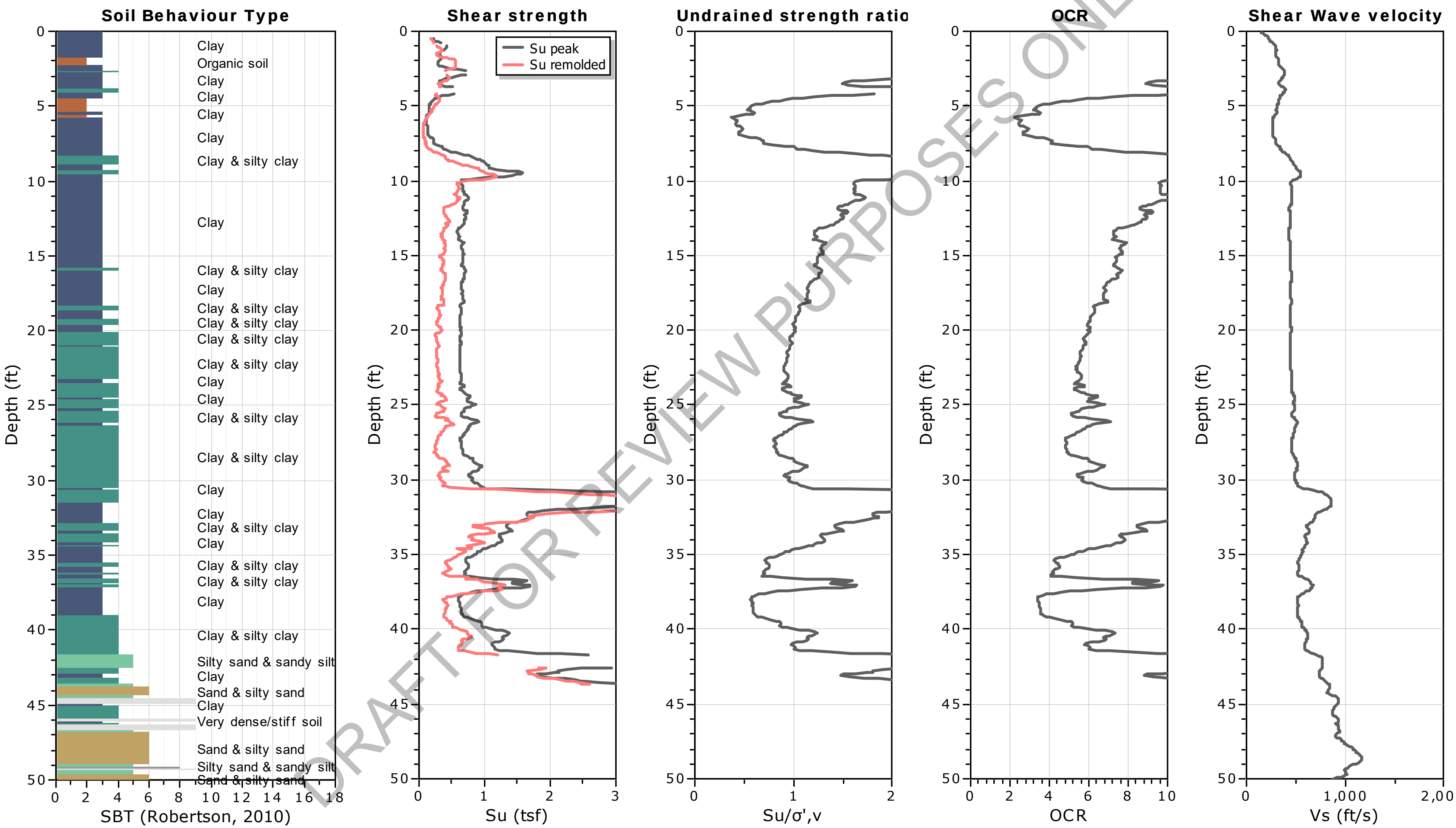
CPT: T-18

Total depth: 50.64 ft, Date: 5/5/2017

Coords: lat 43.6026° lon -93.1919°

Project: **Freeborn Wind Project**

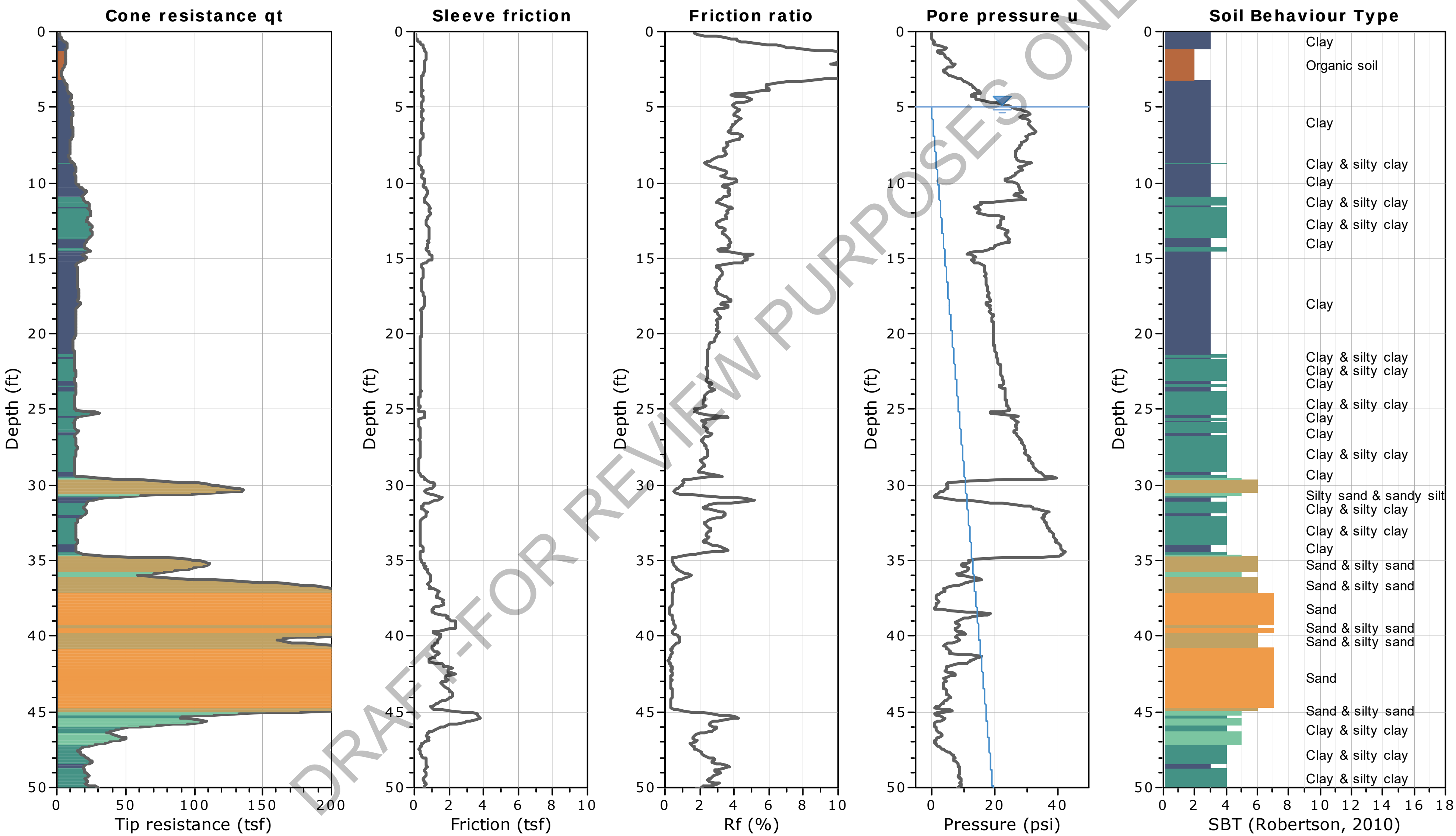
Location: **Freeborn County, Minnesota**



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-19
Total depth: 50.58 ft, Date: 5/5/2017
Coords: lat 43.5968° lon -93.195°

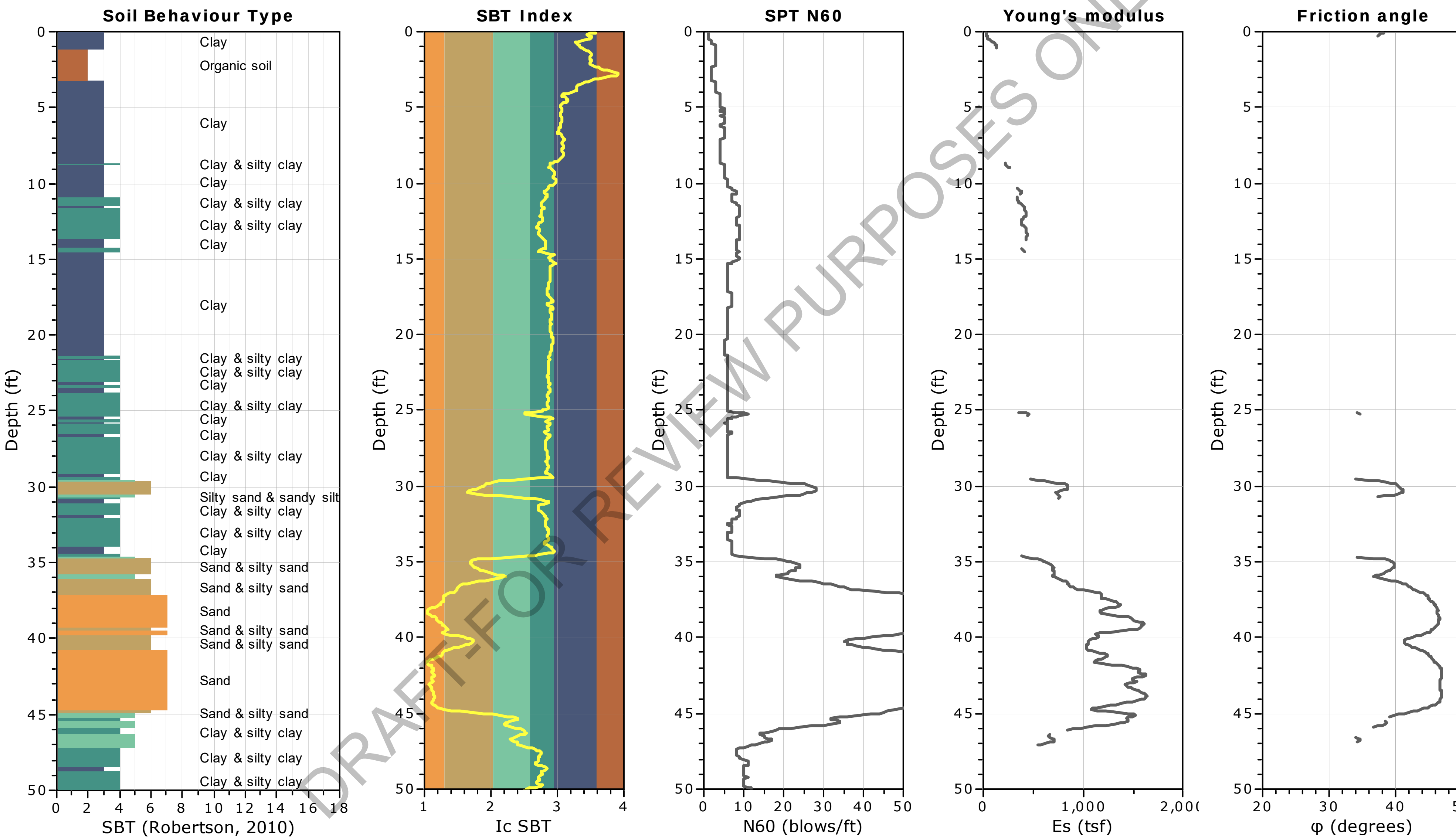
Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-19
Total depth: 50.58 ft, Date: 5/5/2017
Coords: lat 43.5968° lon -93.195°

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

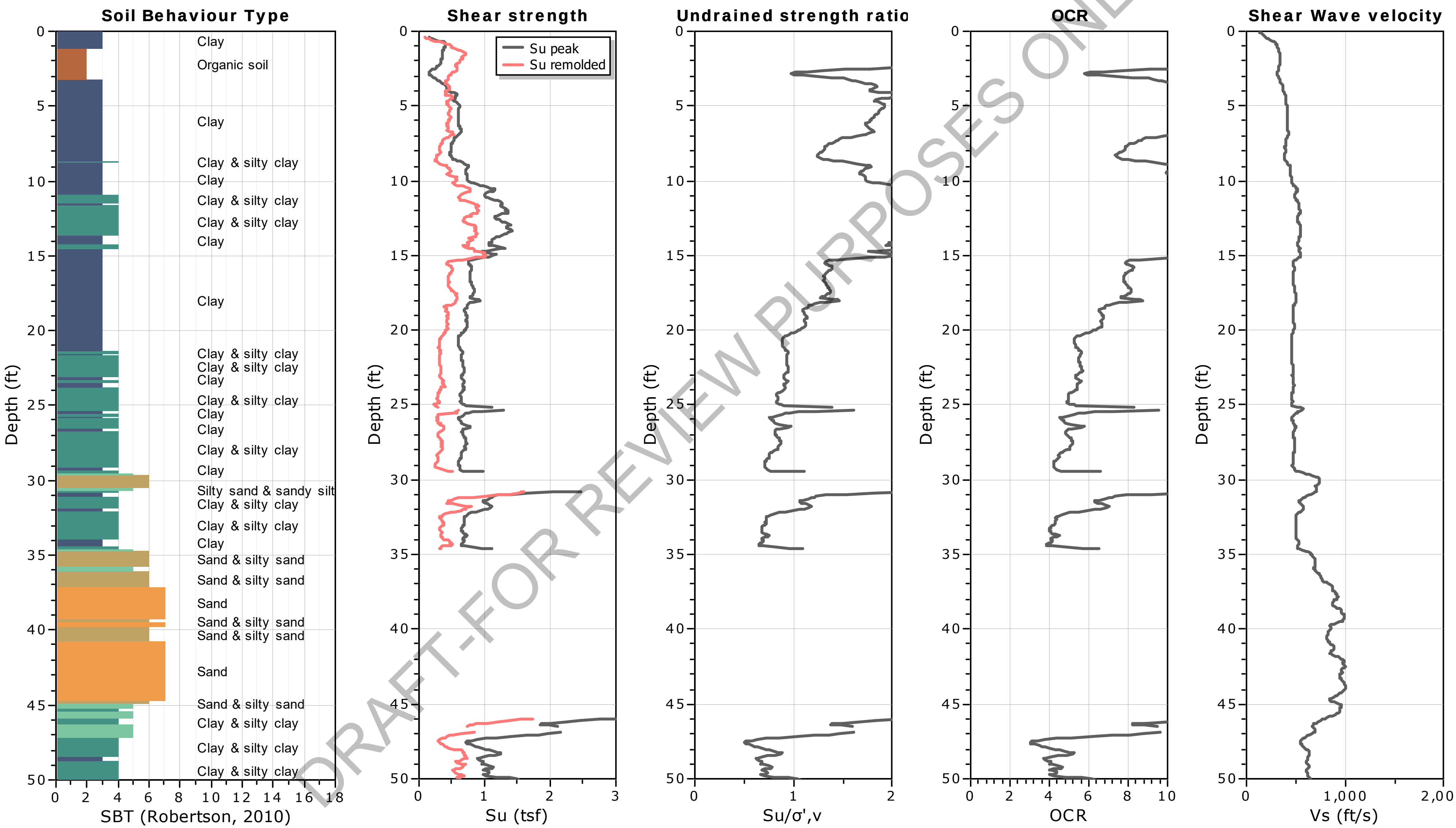
CPT: T-19

Project: **Freeborn Wind Project**

Location: **Freeborn County, Minnesota**

Total depth: 50.58 ft, Date: 5/5/2017

Coords: lat 43.5968° lon -93.195°



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

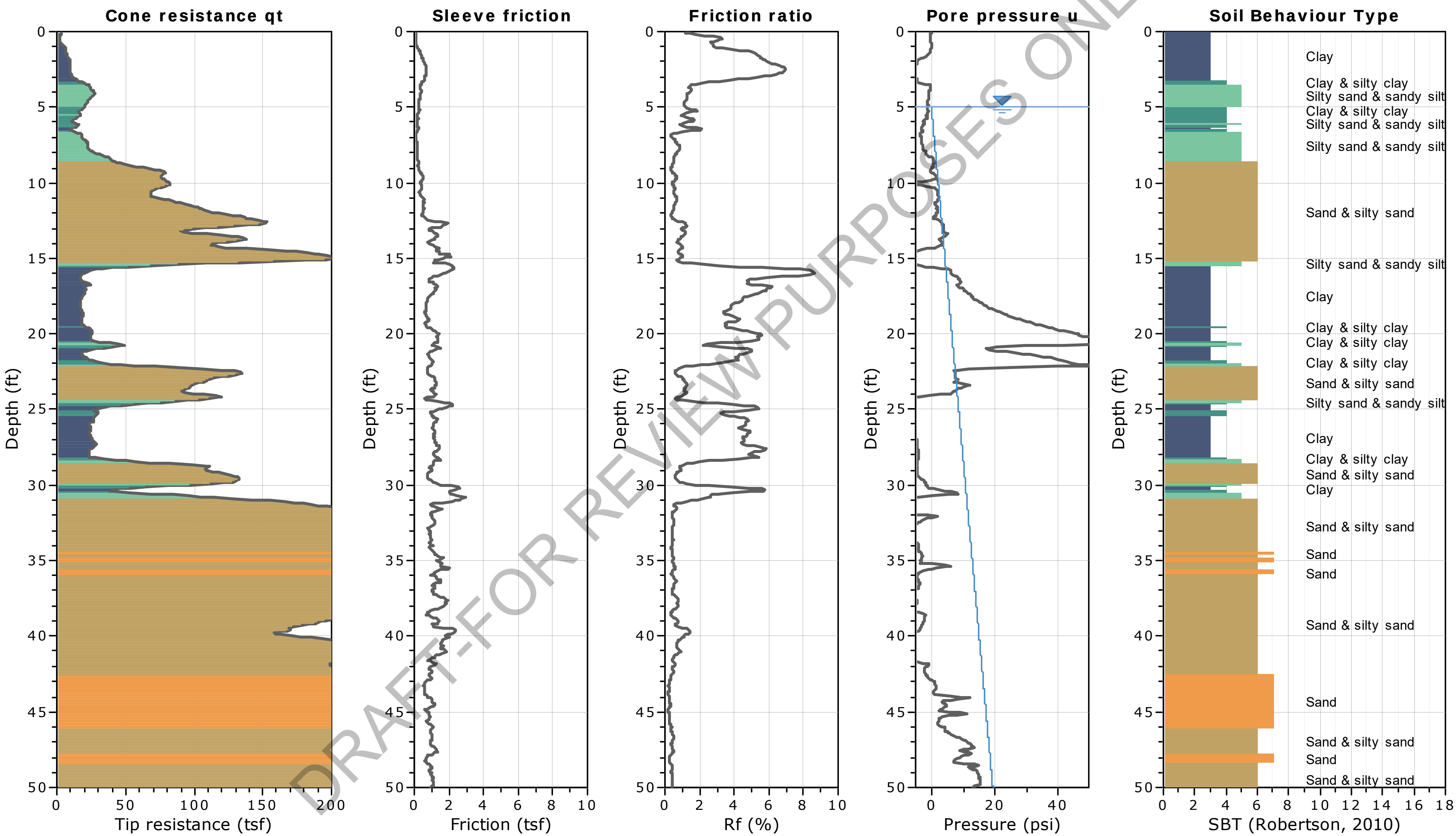
CPT: T-20

Project: **Freeborn Wind Project**

Location: **Freeborn County, Minnesota**

Total depth: 50.58 ft, Date: 5/5/2017

Coords: lat 43.5667° lon -93.2033°



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

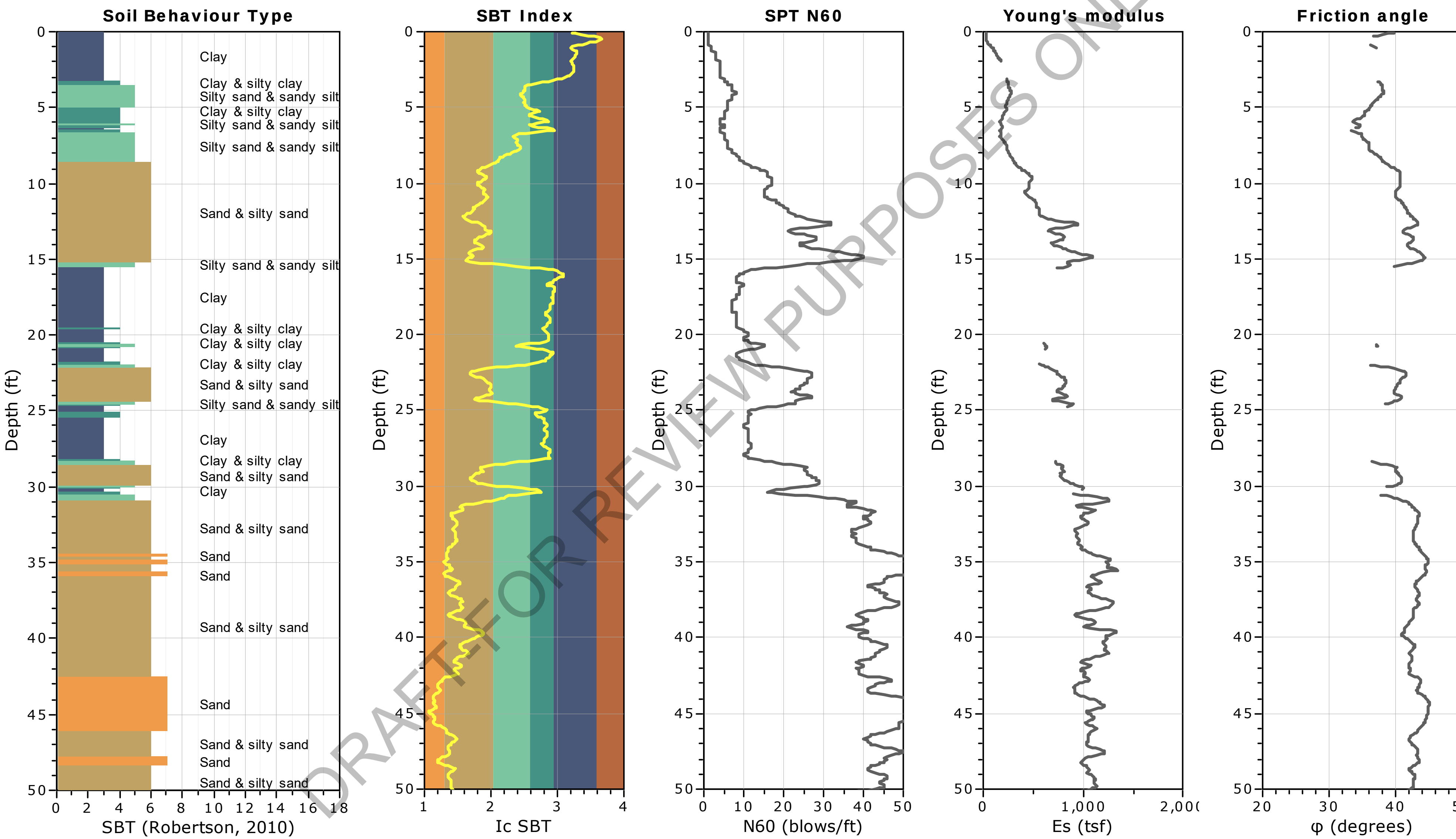
CPT: T-20

Project: **Freeborn Wind Project**

Location: **Freeborn County, Minnesota**

Total depth: 50.58 ft, Date: 5/5/2017

Coords: lat 43.5667° lon -93.2033°



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

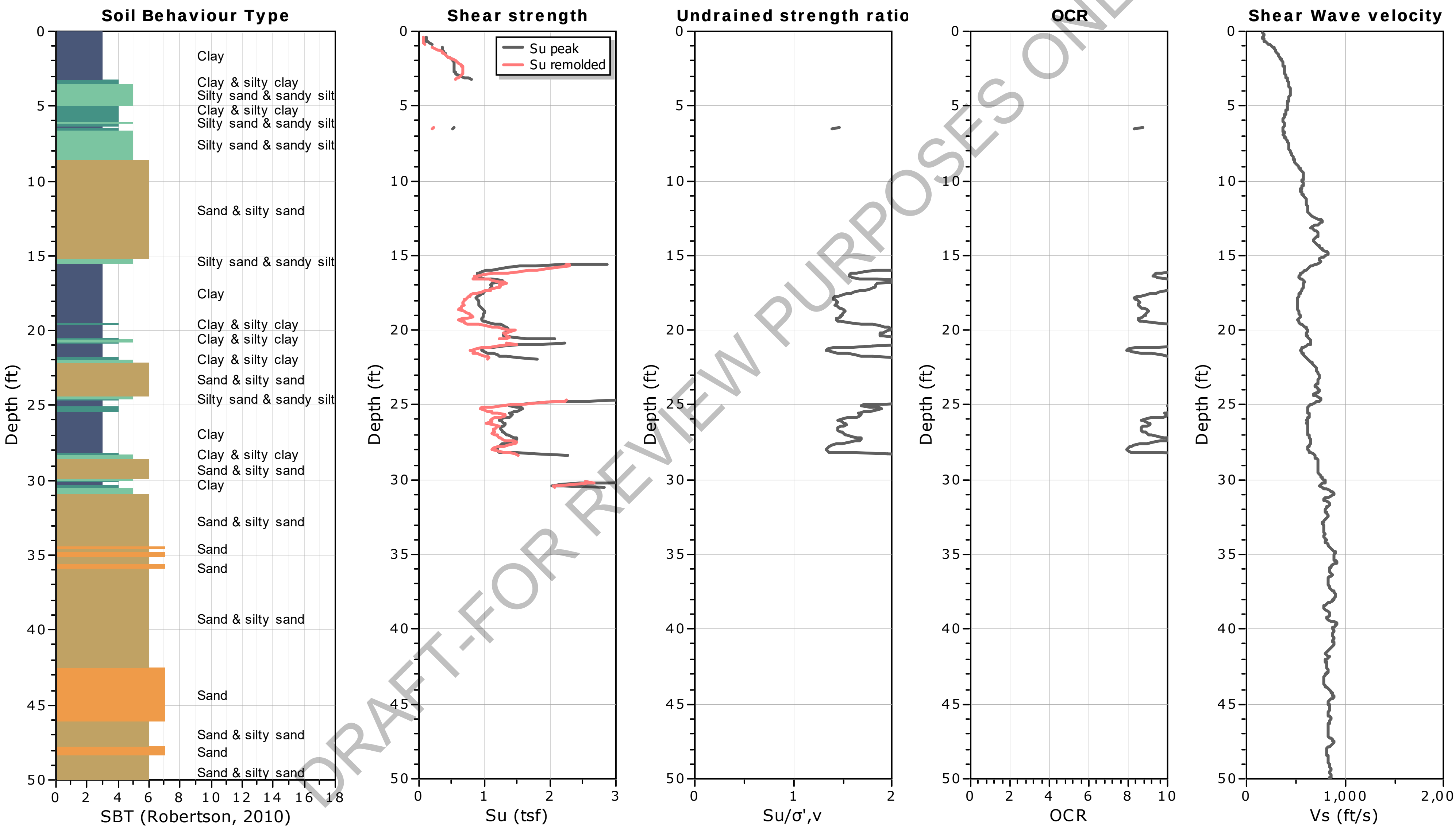
CPT: T-20

Project: **Freeborn Wind Project**

Location: **Freeborn County, Minnesota**

Total depth: 50.58 ft, Date: 5/5/2017

Coords: lat 43.5667° lon -93.2033°

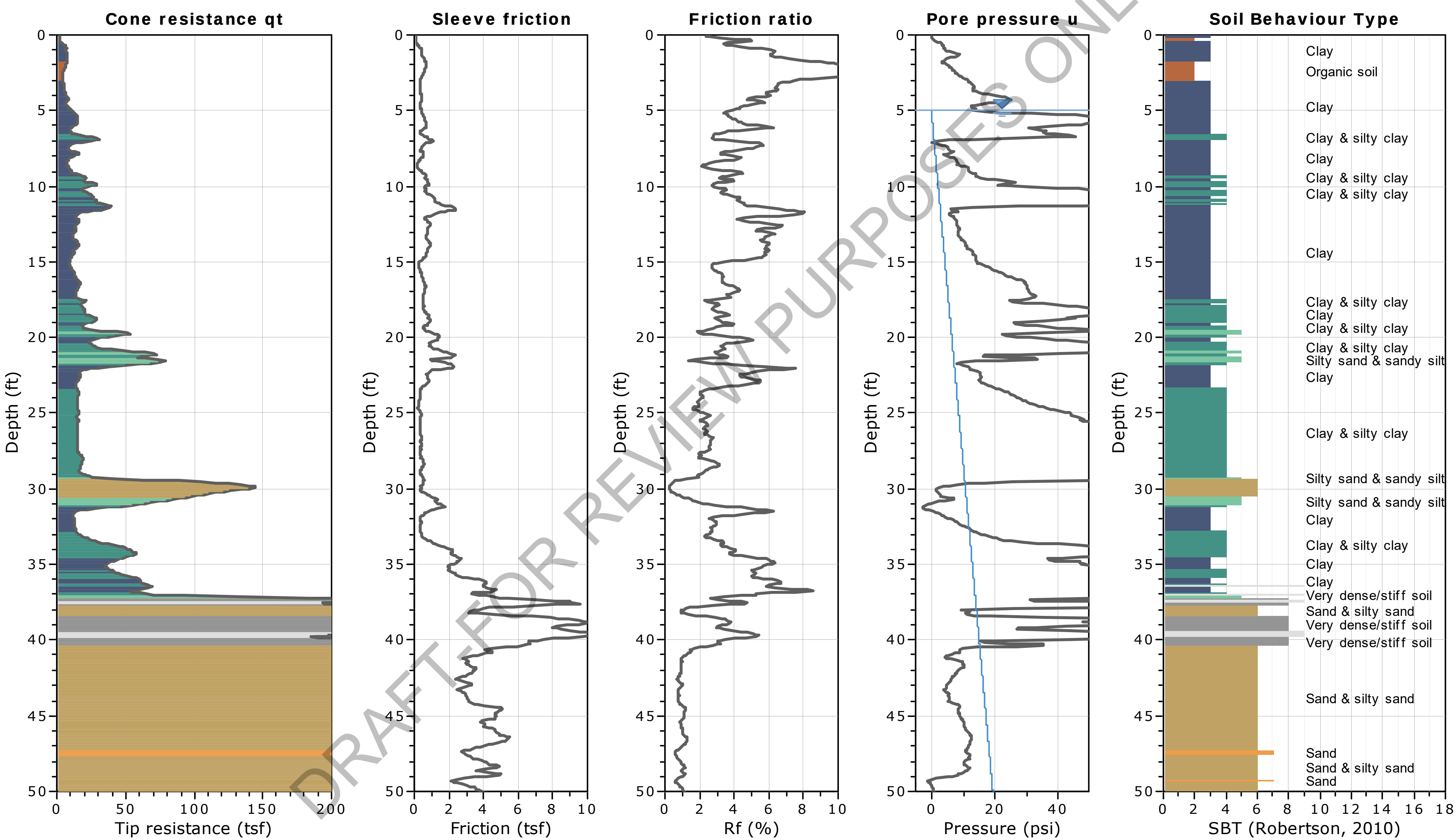


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-21

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

Total depth: 50.64 ft, Date: 5/5/2017
Coords: lat 43.5681° lon -93.1986°

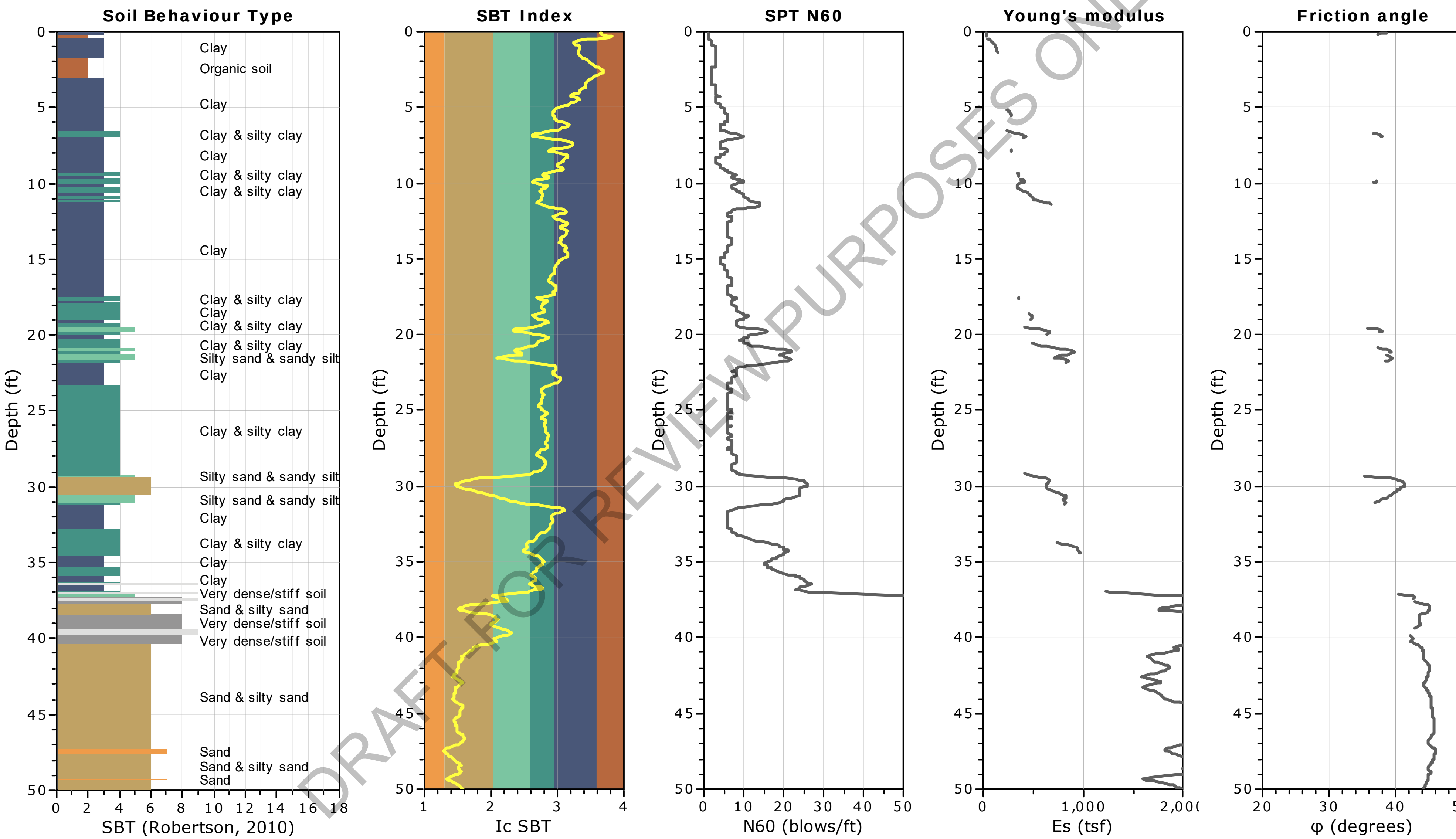


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-21

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

Total depth: 50.64 ft, Date: 5/5/2017
Coords: lat 43.5681° lon -93.1986°

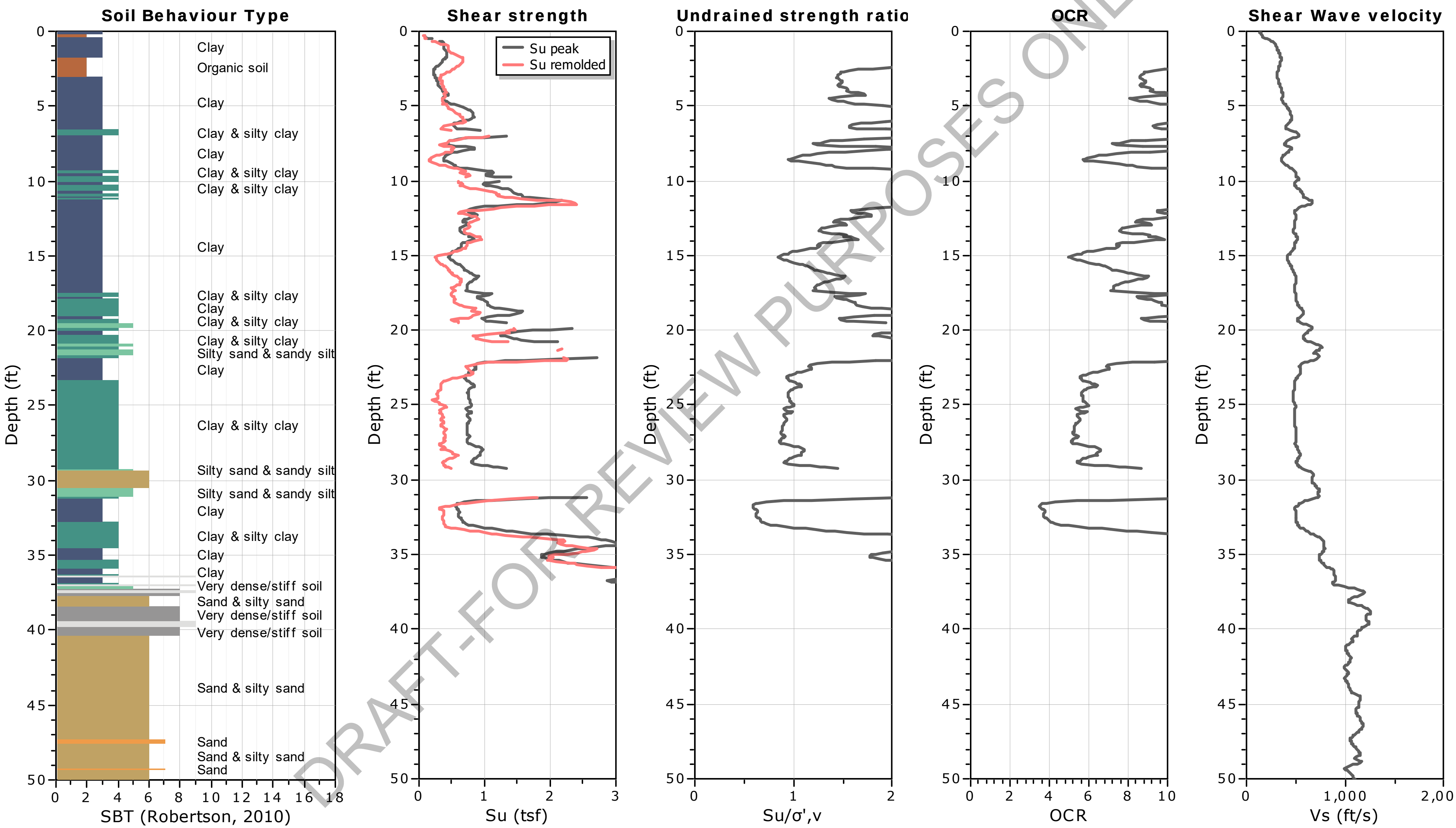


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-21

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

Total depth: 50.64 ft, Date: 5/5/2017
Coords: lat 43.5681° lon -93.1986°



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

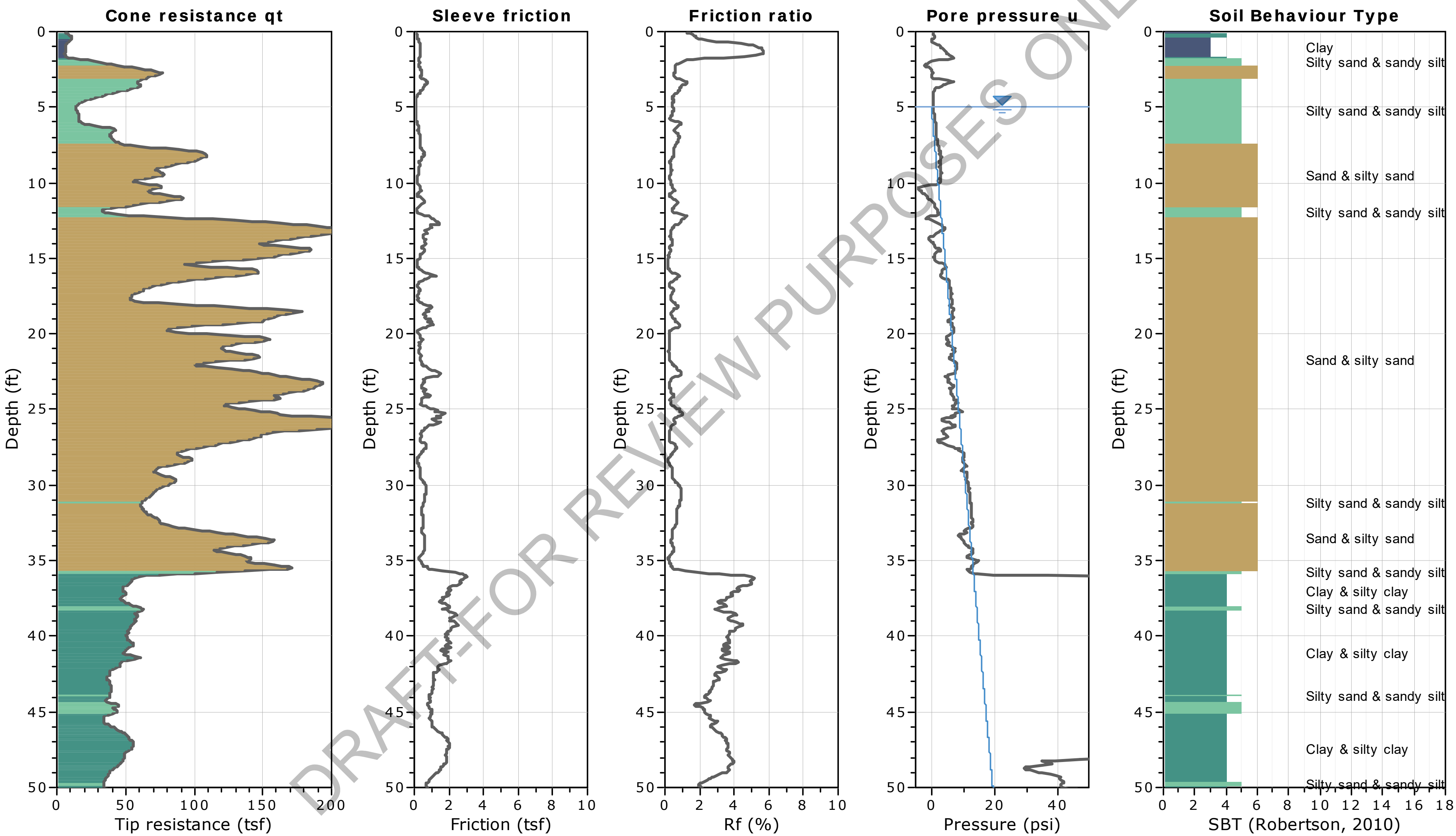
CPT: T-22

Project: **Freeborn Wind Project**

Location: **Freeborn County, Minnesota**

Total depth: 50.64 ft, Date: 5/5/2017

Coords: lat 43.5474° lon -93.2547°



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

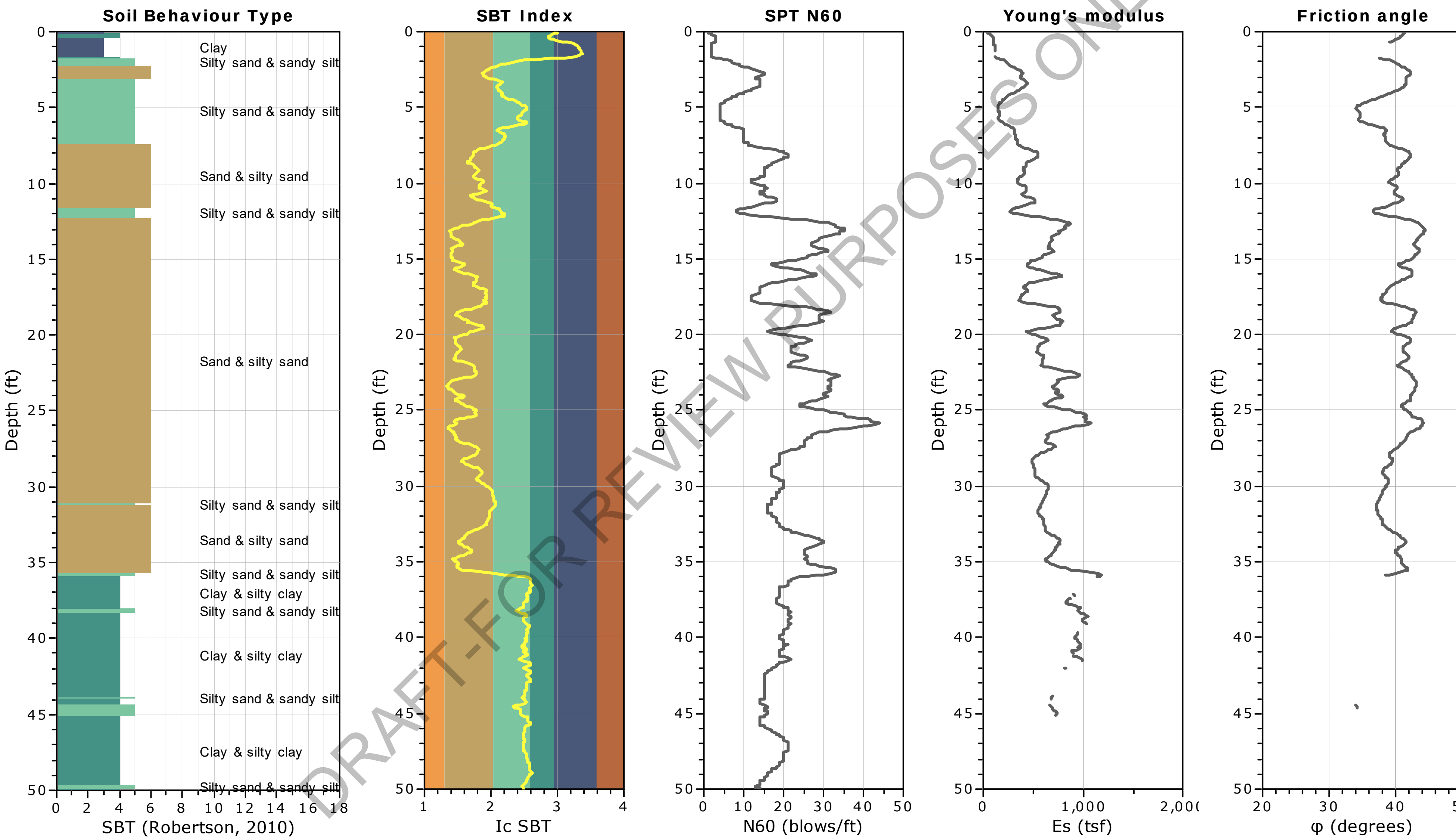
CPT: T-22

Total depth: 50.64 ft, Date: 5/5/2017

Coords: lat 43.5474° lon -93.2547°

Project: **Freeborn Wind Project**

Location: **Freeborn County, Minnesota**



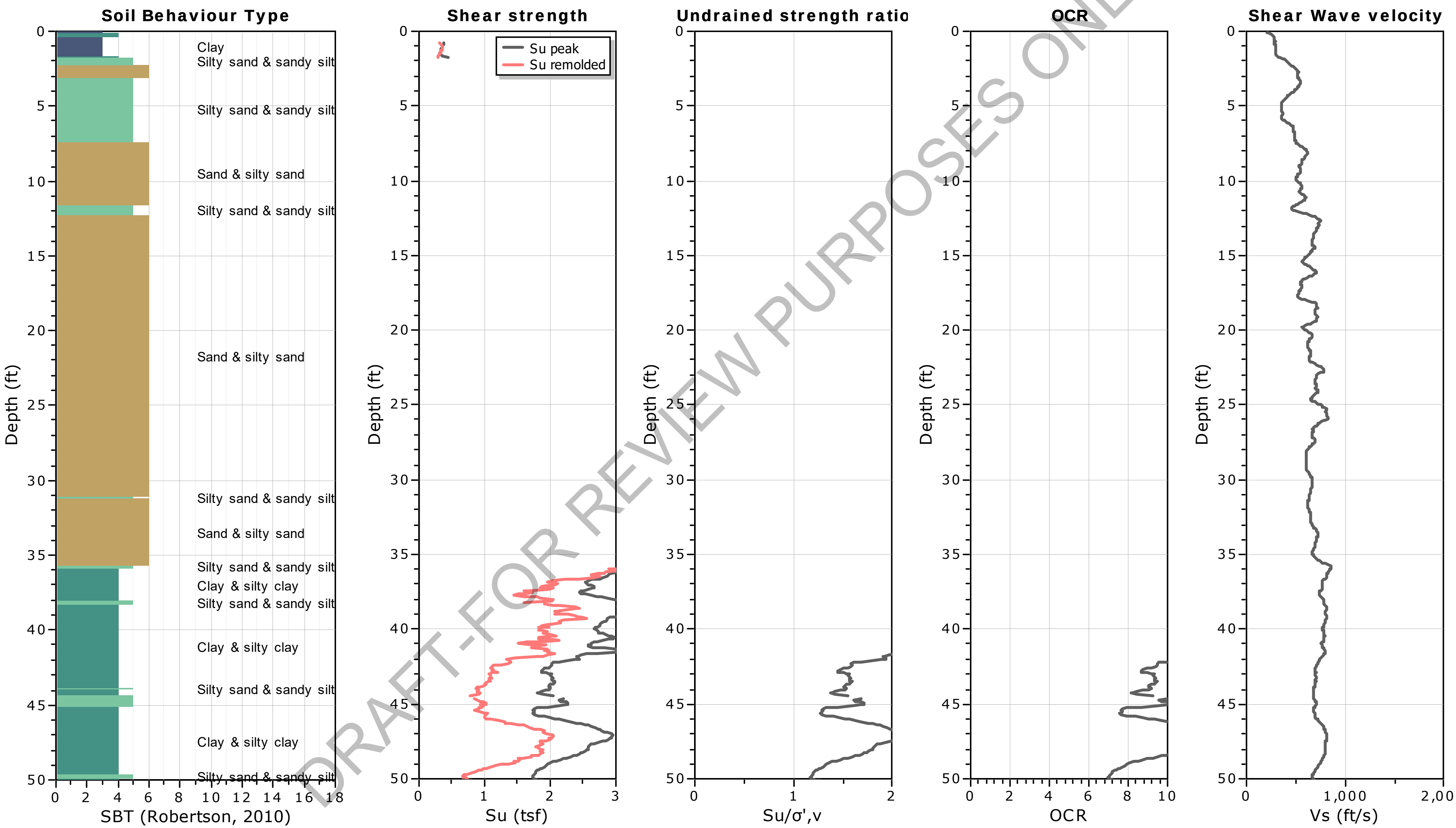
RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-22

Project: **Freeborn Wind Project**

Location: **Freeborn County, Minnesota**

Total depth: 50.64 ft, Date: 5/5/2017
Coords: lat 43.5474° lon -93.2547°



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

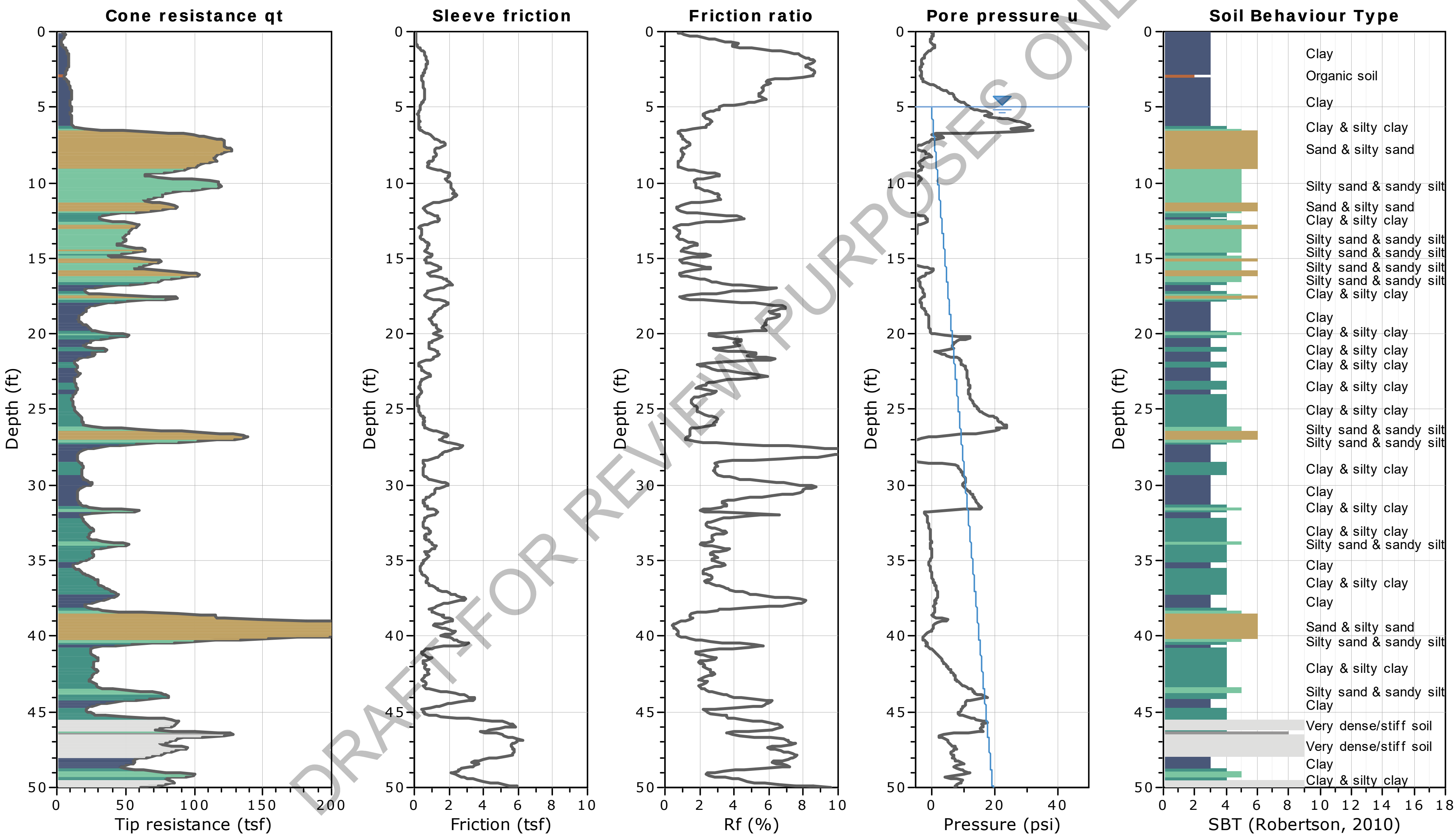
CPT: T-23

Project: **Freeborn Wind Project**

Location: **Freeborn County, Minnesota**

Total depth: 50.58 ft, Date: 5/5/2017

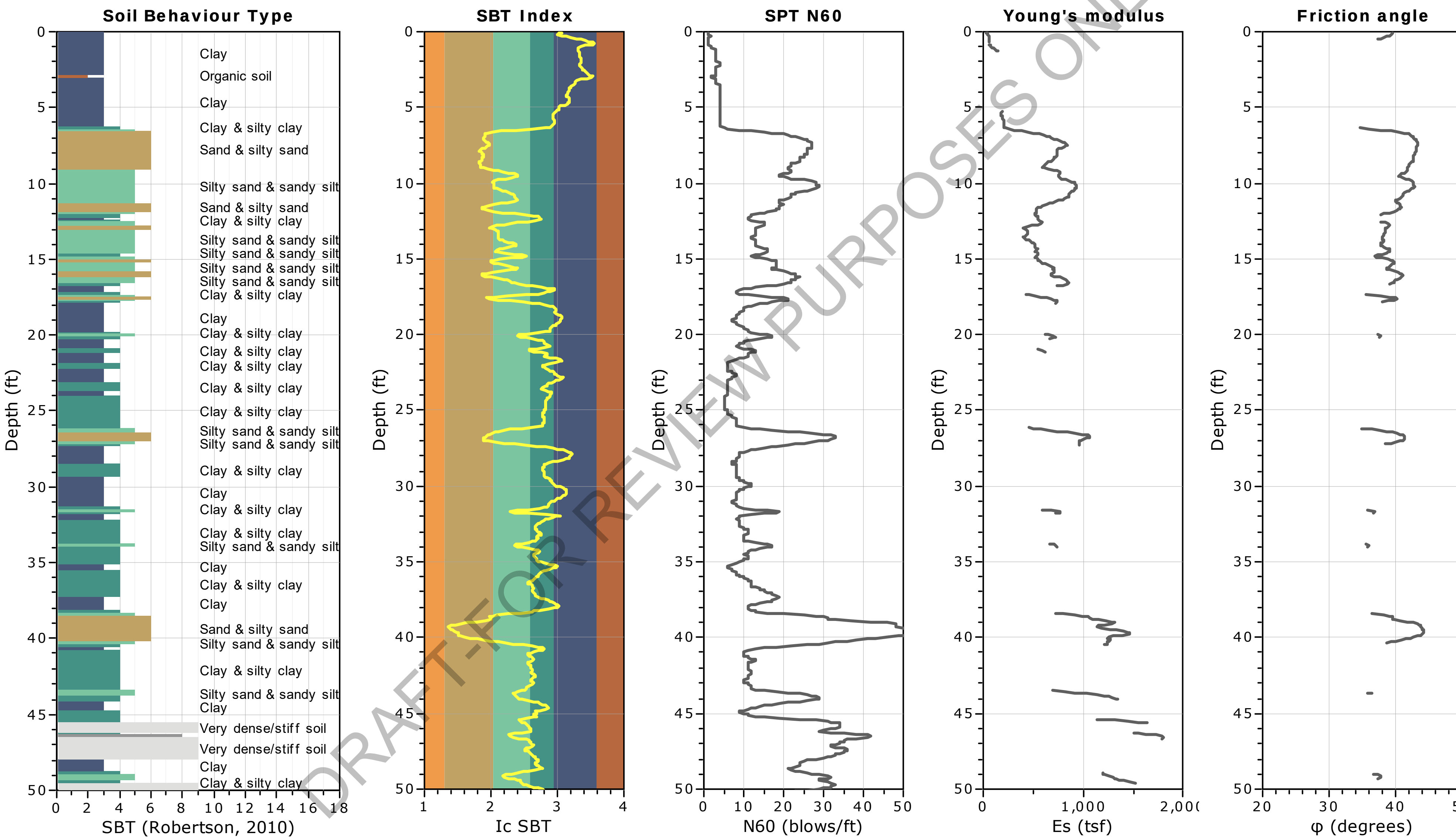
Coords: lat 43.5464° lon -93.2463°



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-23
Total depth: 50.58 ft, Date: 5/5/2017
Coords: lat 43.5464° lon -93.2463°

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

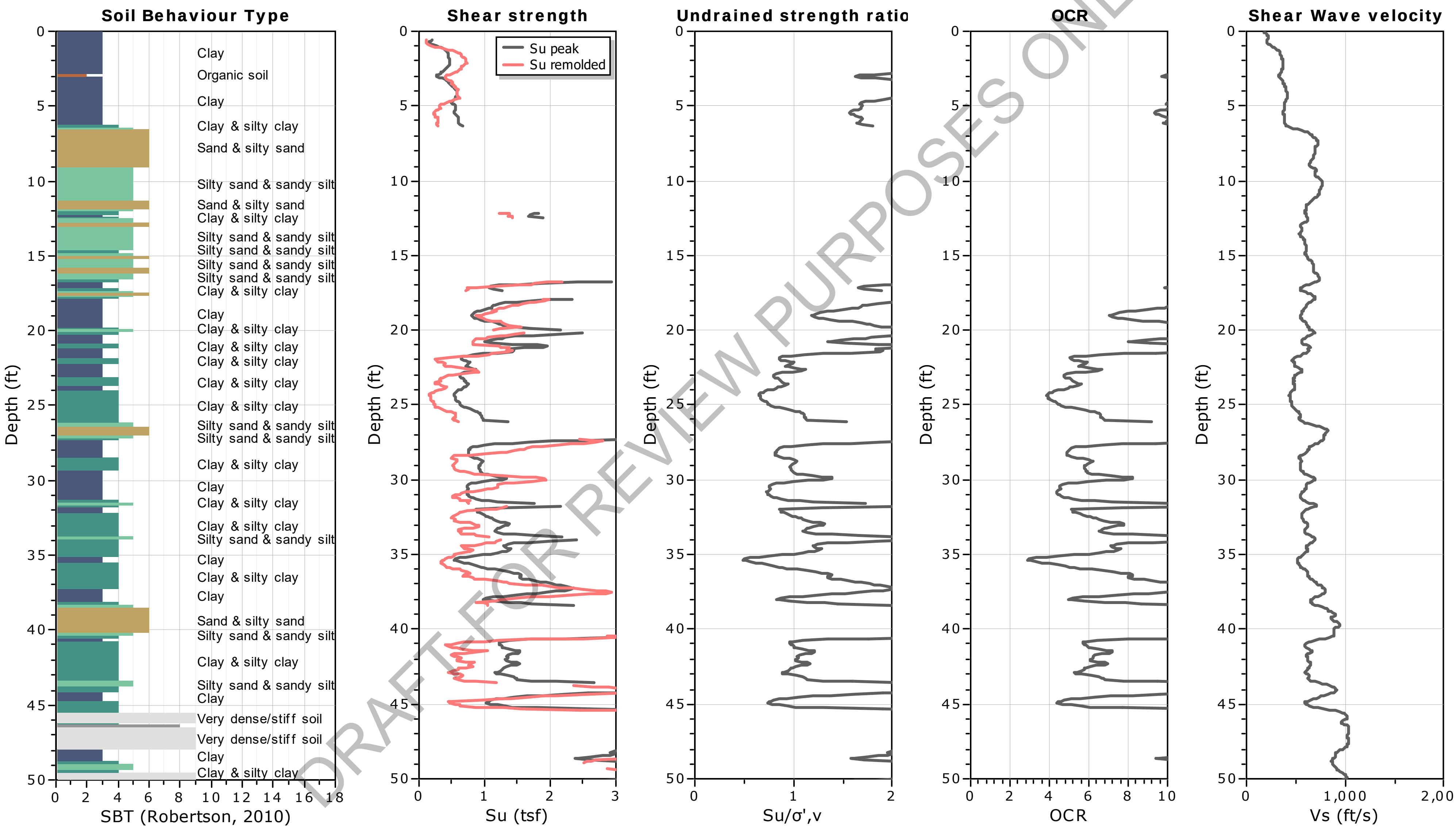


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-23

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

Total depth: 50.58 ft, Date: 5/5/2017
Coords: lat 43.5464° lon -93.2463°

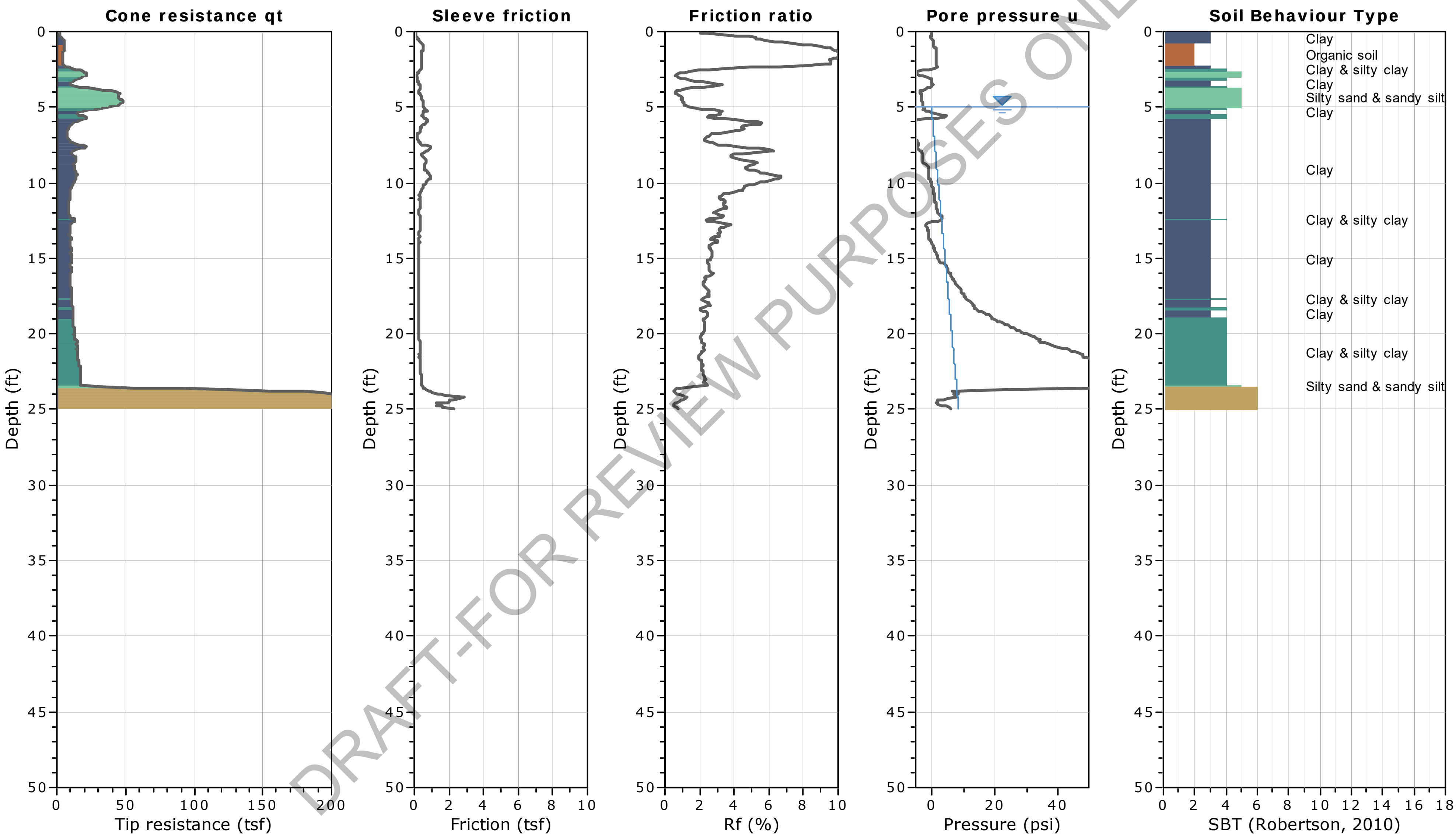


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-24a

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

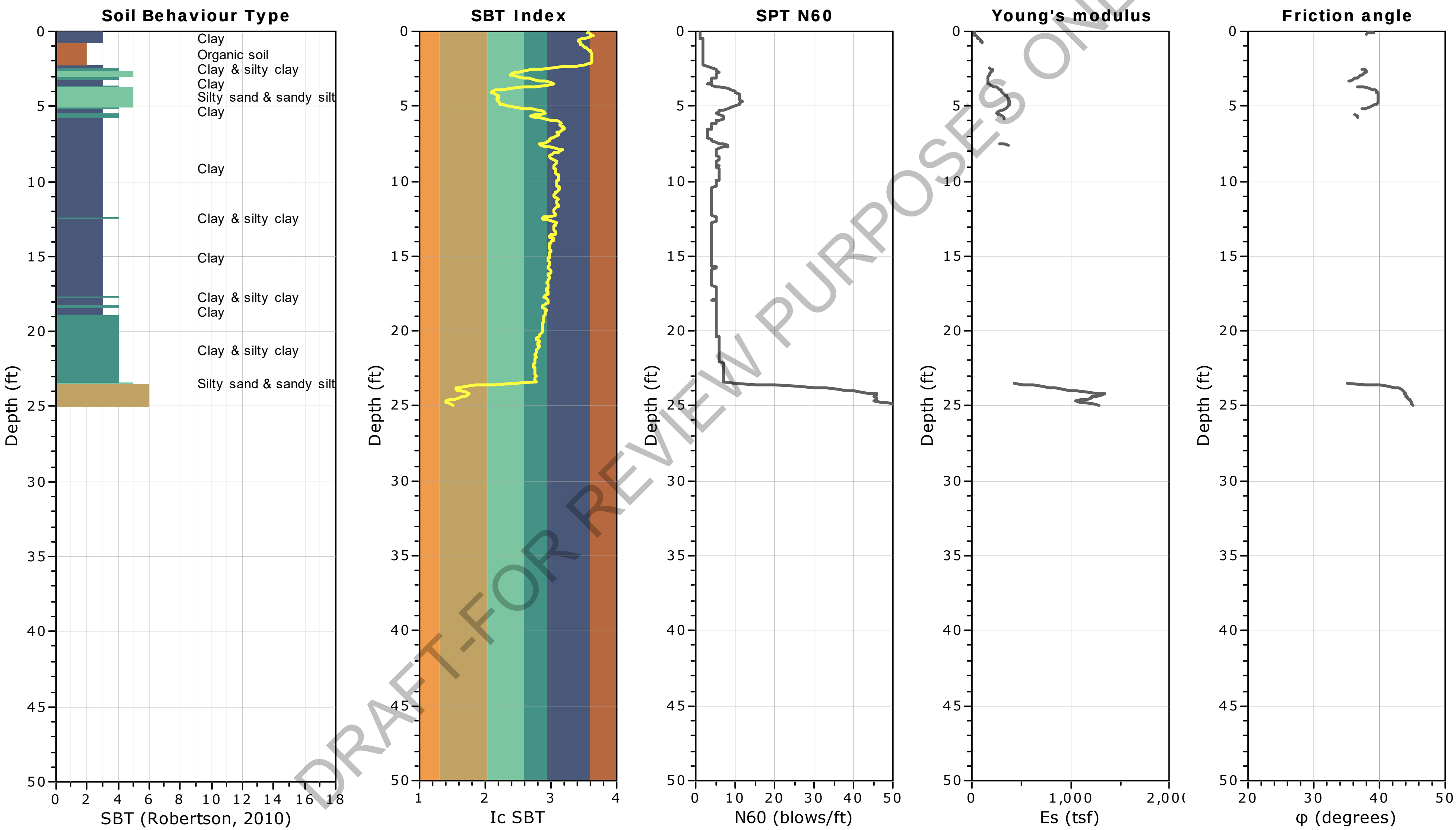
Total depth: 24.93 ft, Date: 5/5/2017
Coords: lat 43.5499° lon -93.2123°



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-24a
Total depth: 24.93 ft, Date: 5/5/2017
Coords: lat 43.5499° lon -93.2123°

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

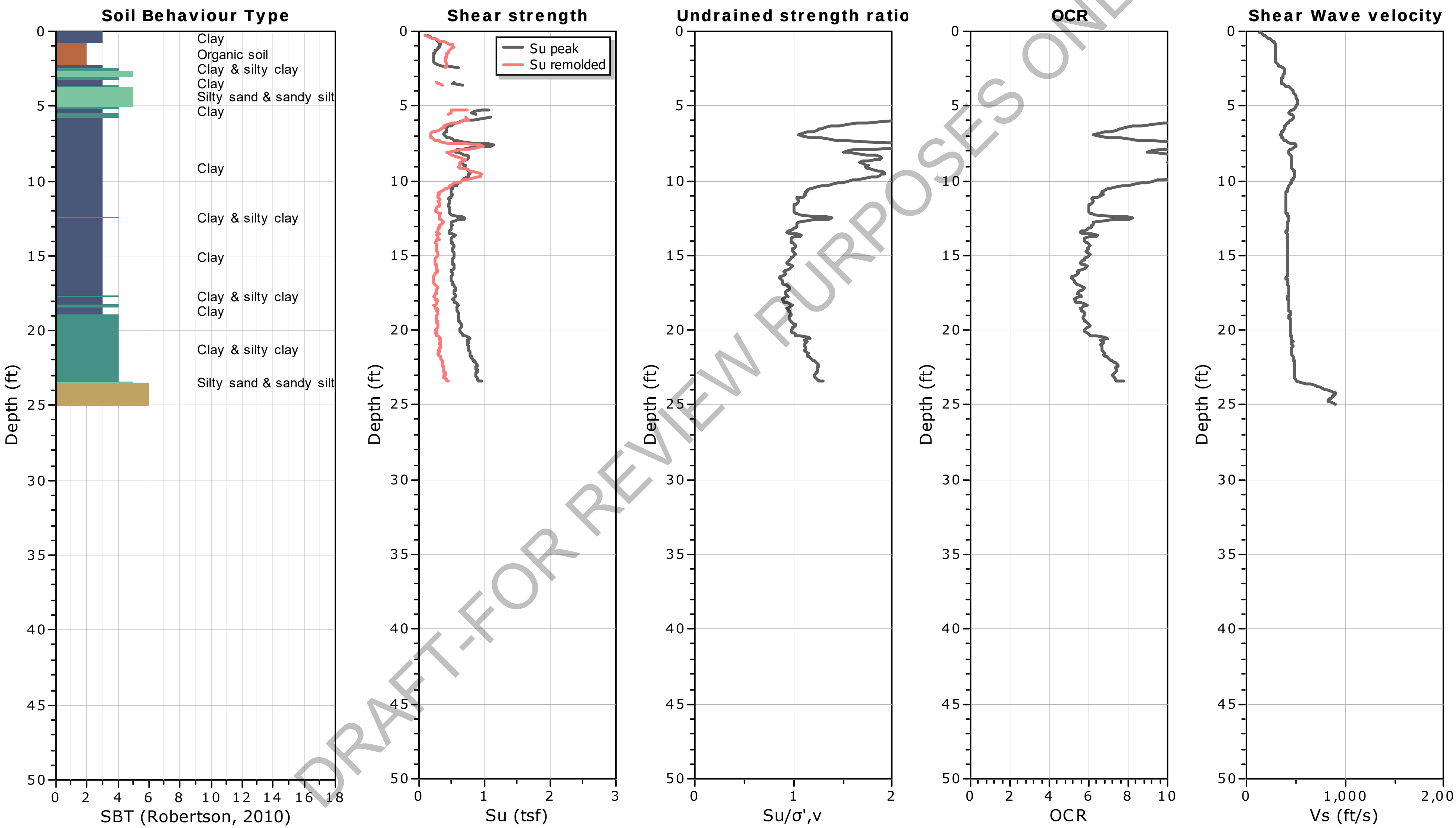
CPT: T-24a

Total depth: 24.93 ft, Date: 5/5/2017

Coords: lat 43.5499° lon -93.2123°

Project: **Freeborn Wind Project**

Location: **Freeborn County, Minnesota**



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

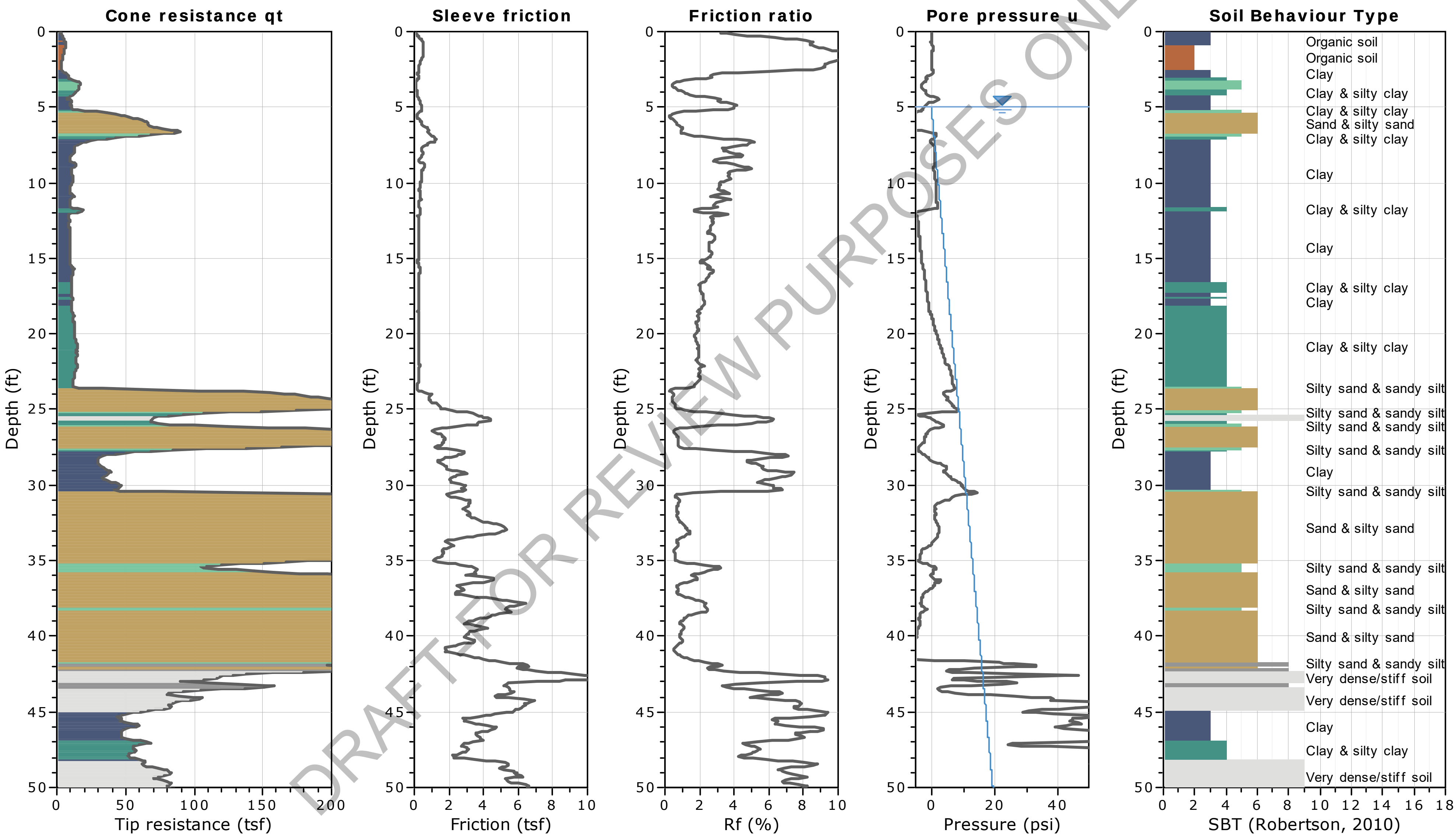
CPT: T-24b

Total depth: 50.64 ft, Date: 5/5/2017

Coords: lat 43.5499° lon -93.2123°

Project: **Freeborn Wind Project**

Location: **Freeborn County, Minnesota**



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

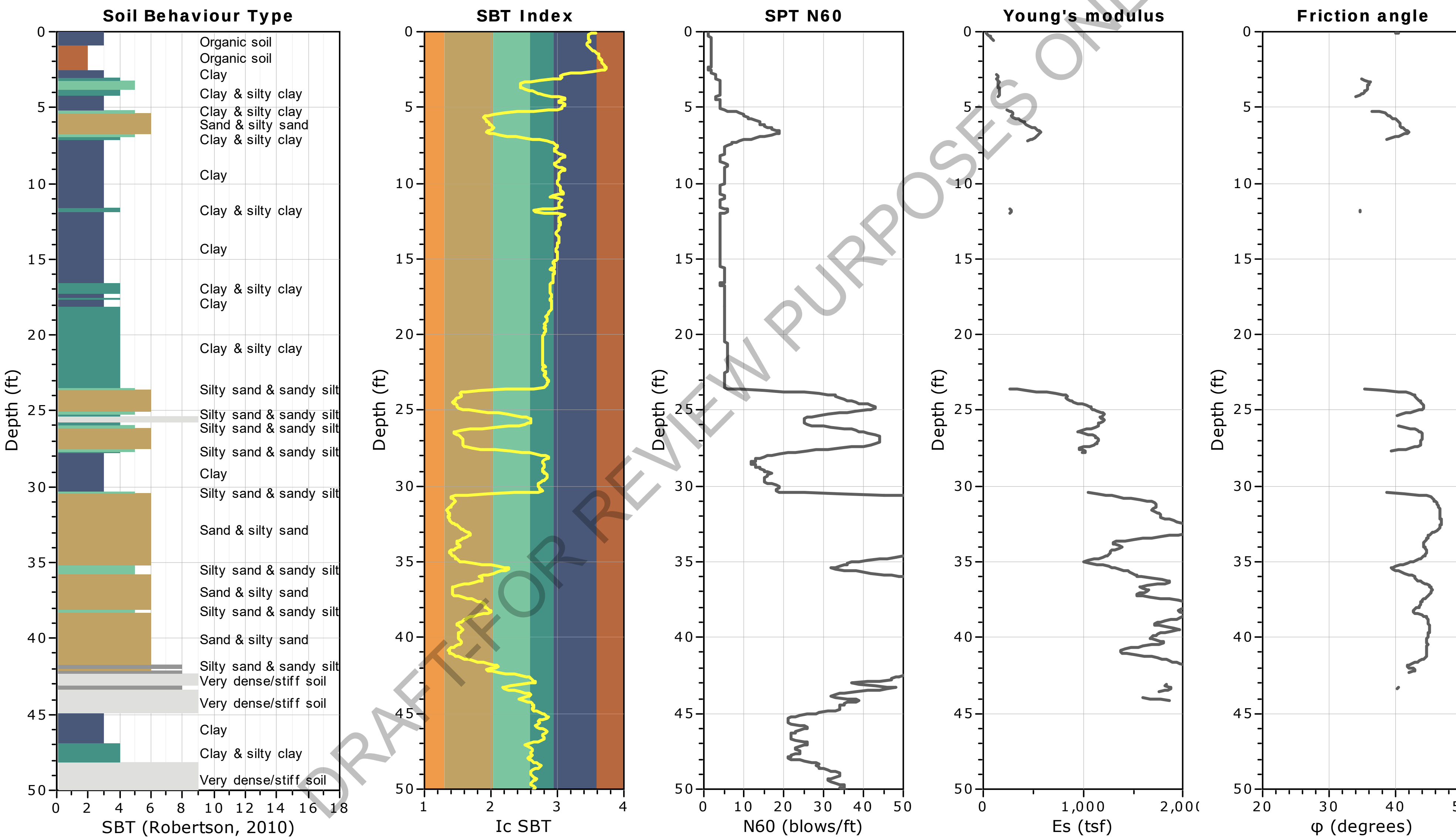
CPT: T-24b

Project: **Freeborn Wind Project**

Location: **Freeborn County, Minnesota**

Total depth: 50.64 ft, Date: 5/5/2017

Coords: lat 43.5499° lon -93.2123°

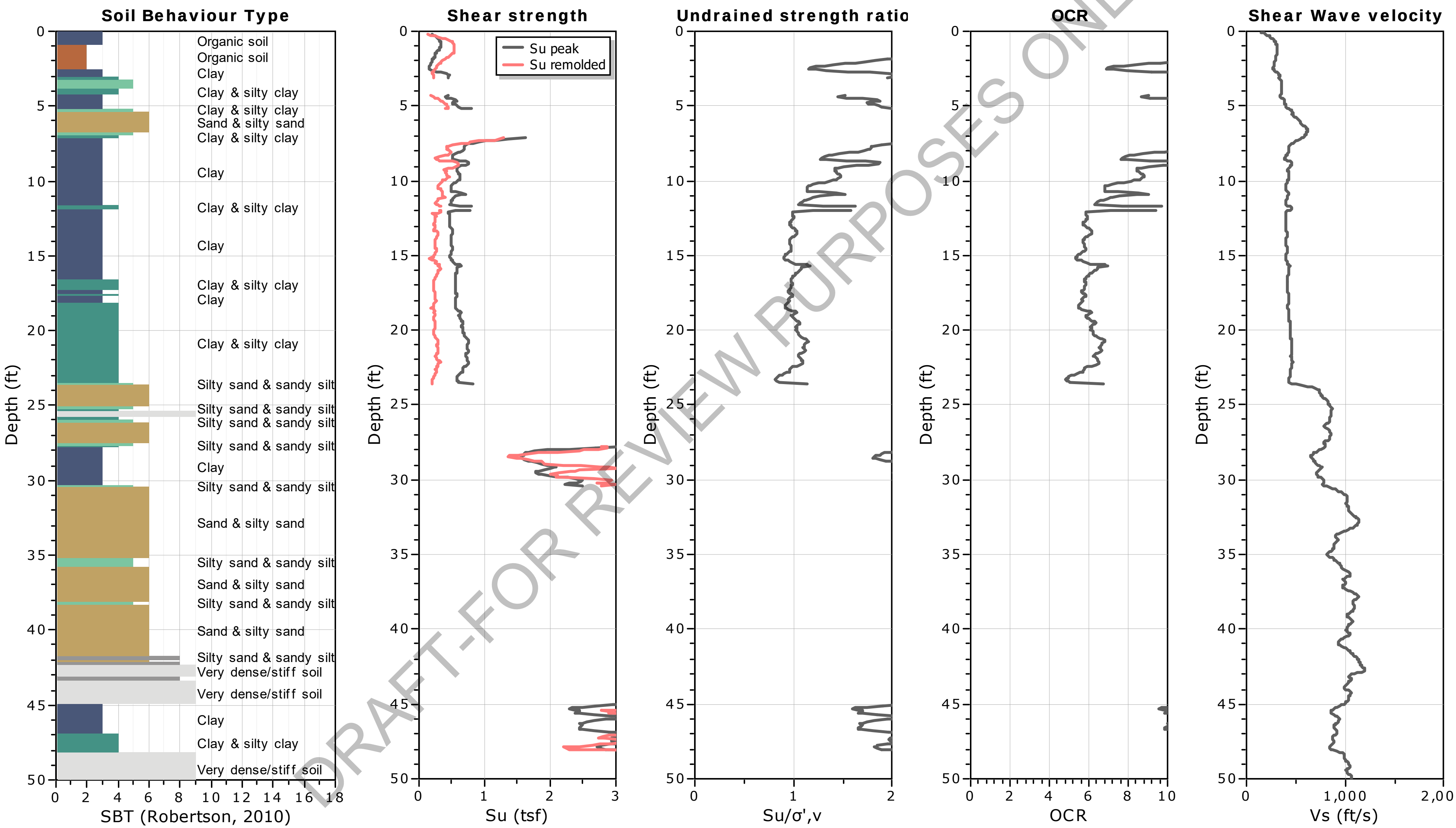


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-24b

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

Total depth: 50.64 ft, Date: 5/5/2017
Coords: lat 43.5499° lon -93.2123°



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

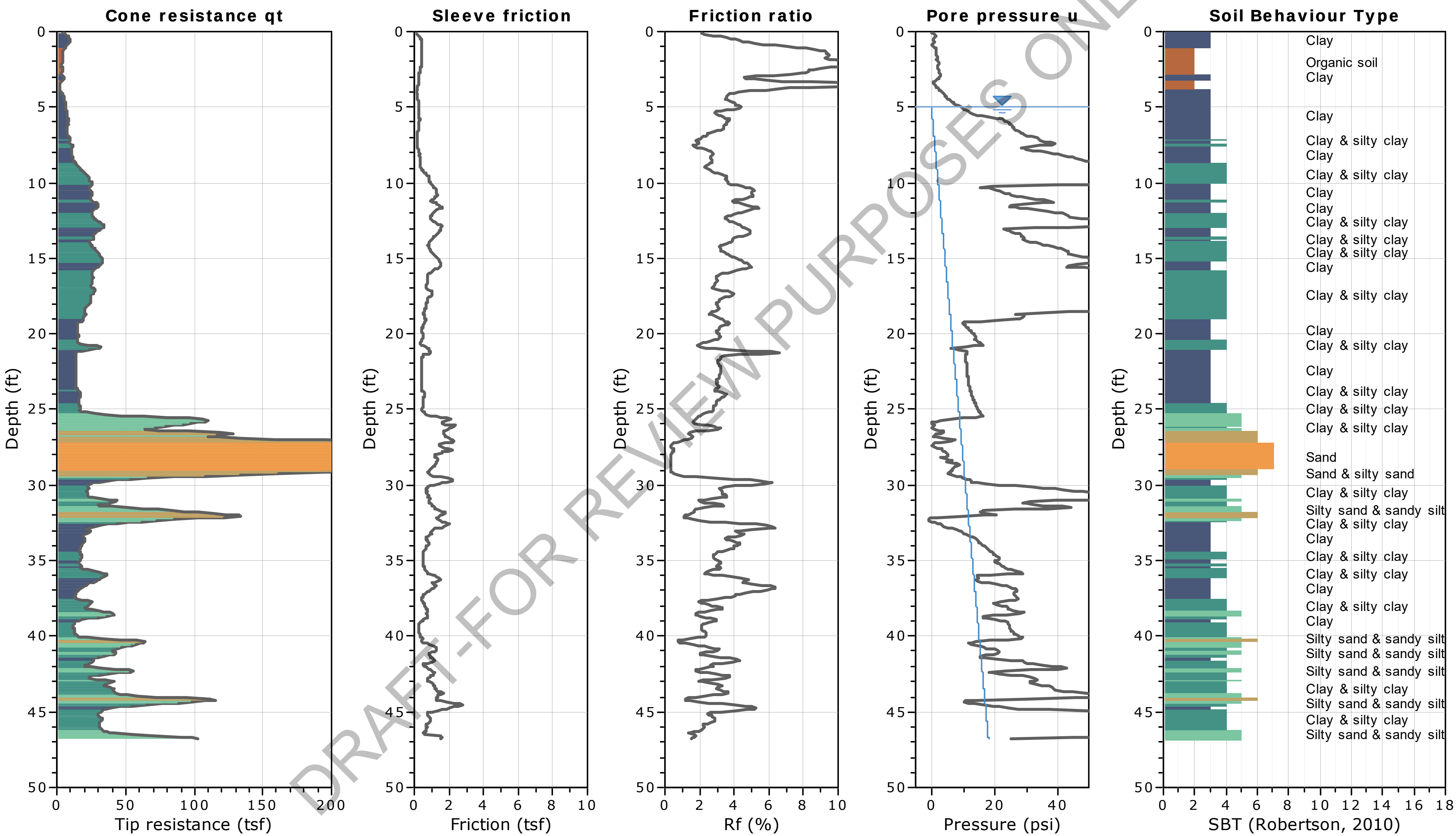
CPT: T-25

Total depth: 46.77 ft, Date: 5/5/2017

Coords: lat 43.5344° lon -93.2414°

Project: Freeborn Wind Project

Location: Freeborn County, Minnesota



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

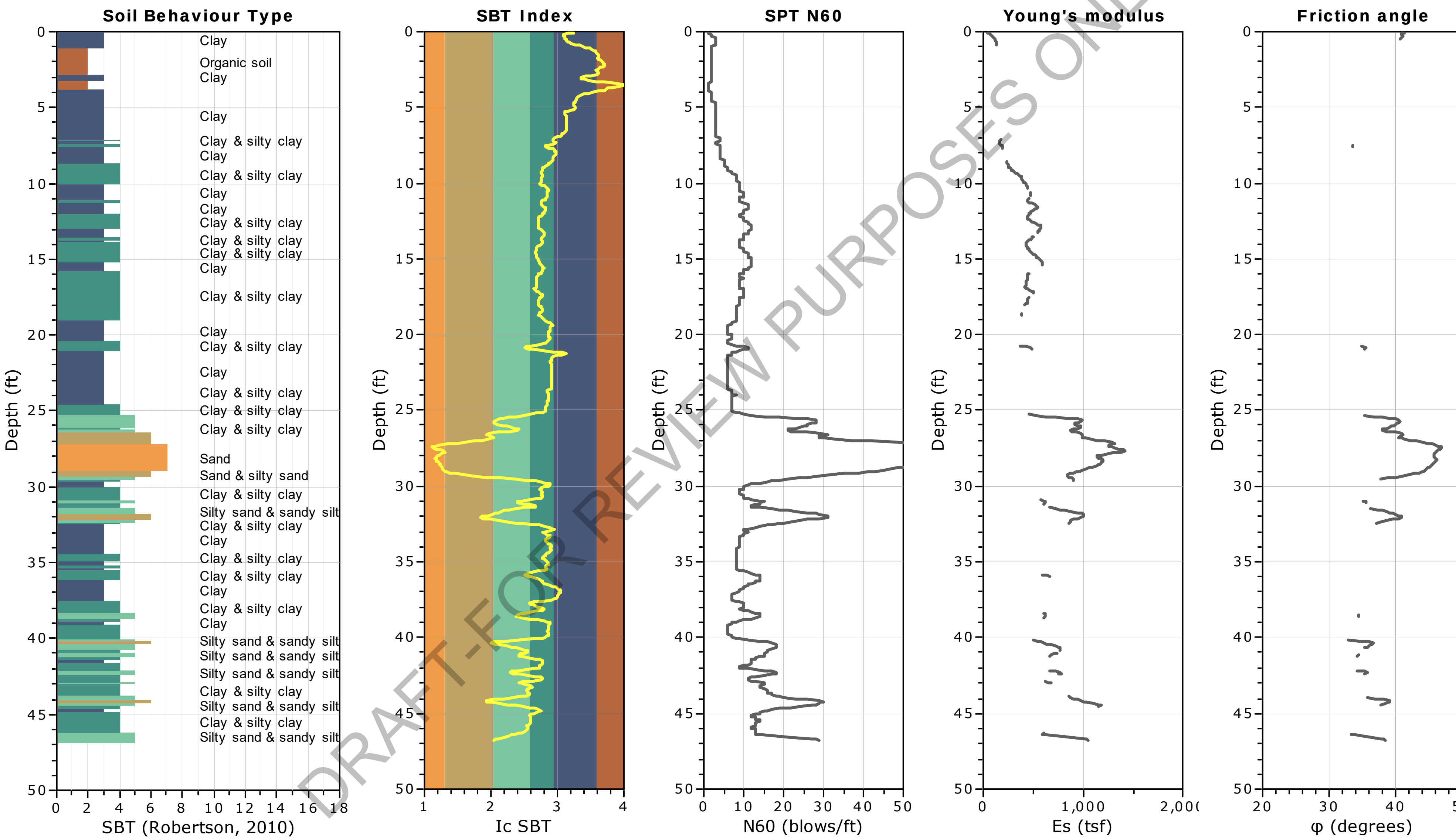
CPT: T-25

Total depth: 46.77 ft, Date: 5/5/2017

Coords: lat 43.5344° lon -93.2414°

Project: Freeborn Wind Project

Location: Freeborn County, Minnesota

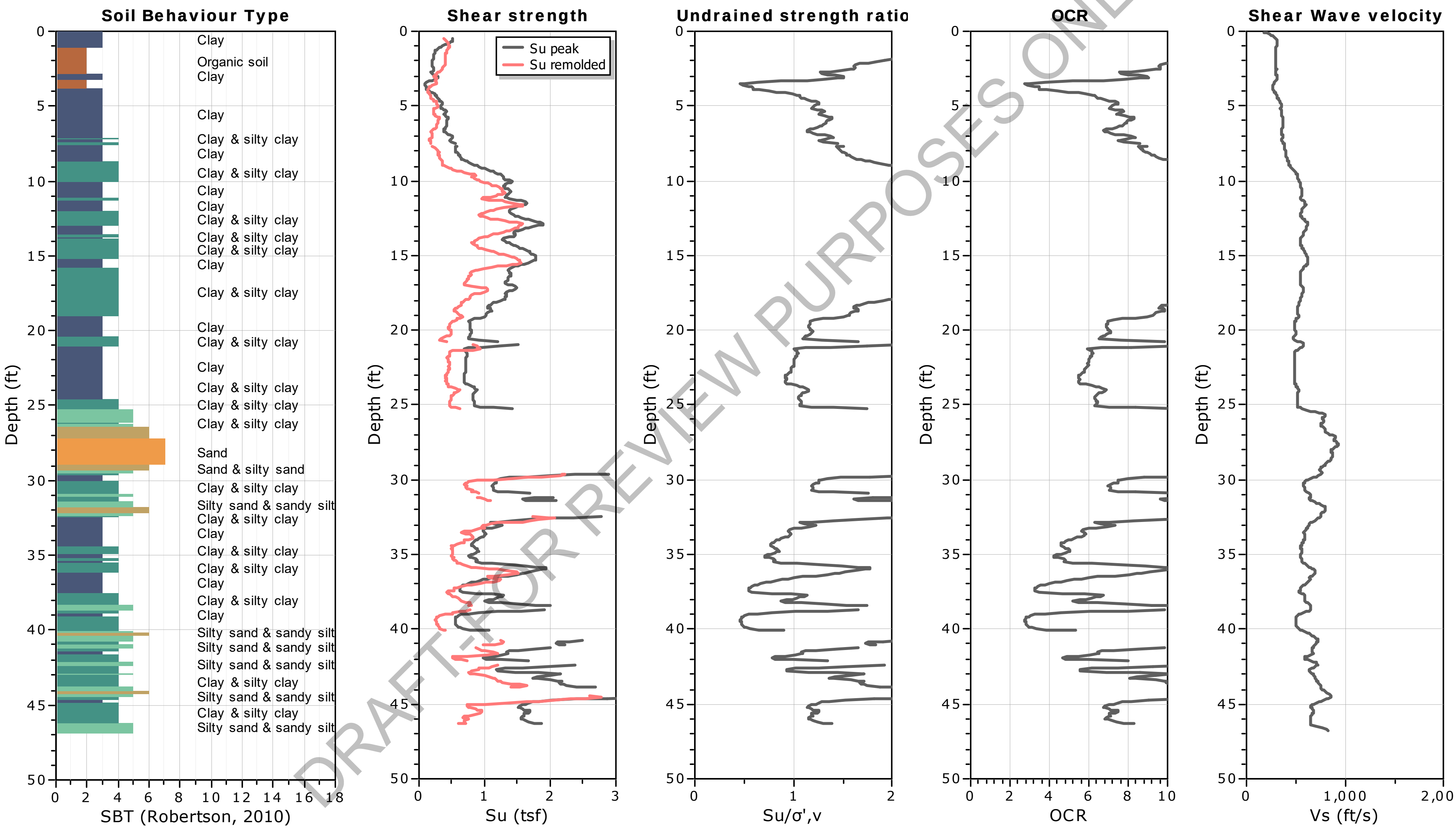


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-25

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

Total depth: 46.77 ft, Date: 5/5/2017
Coords: lat 43.5344° lon -93.2414°

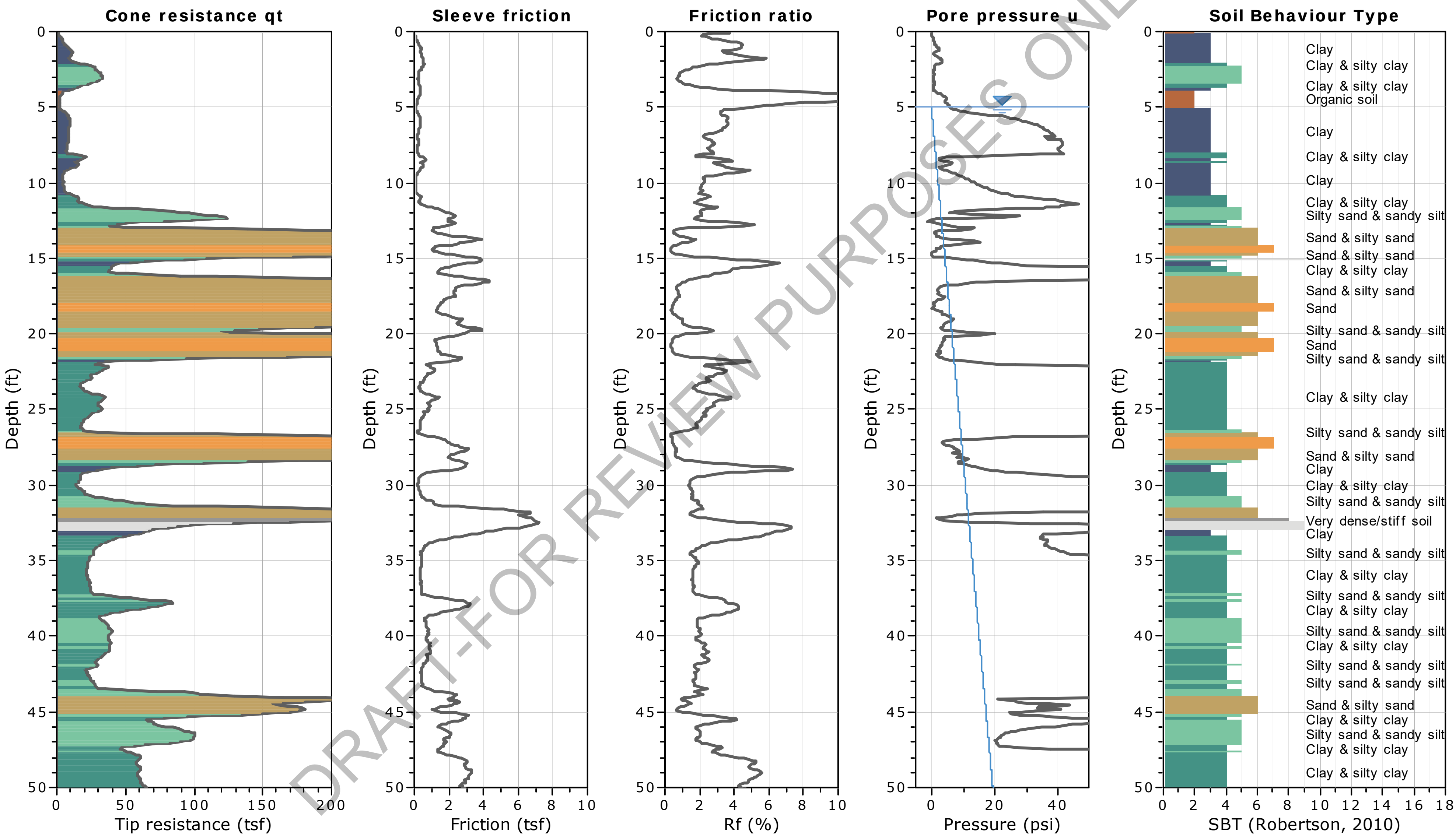


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-26

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

Total depth: 50.64 ft, Date: 5/5/2017
Coords: lat 43.5308° lon -93.2245°

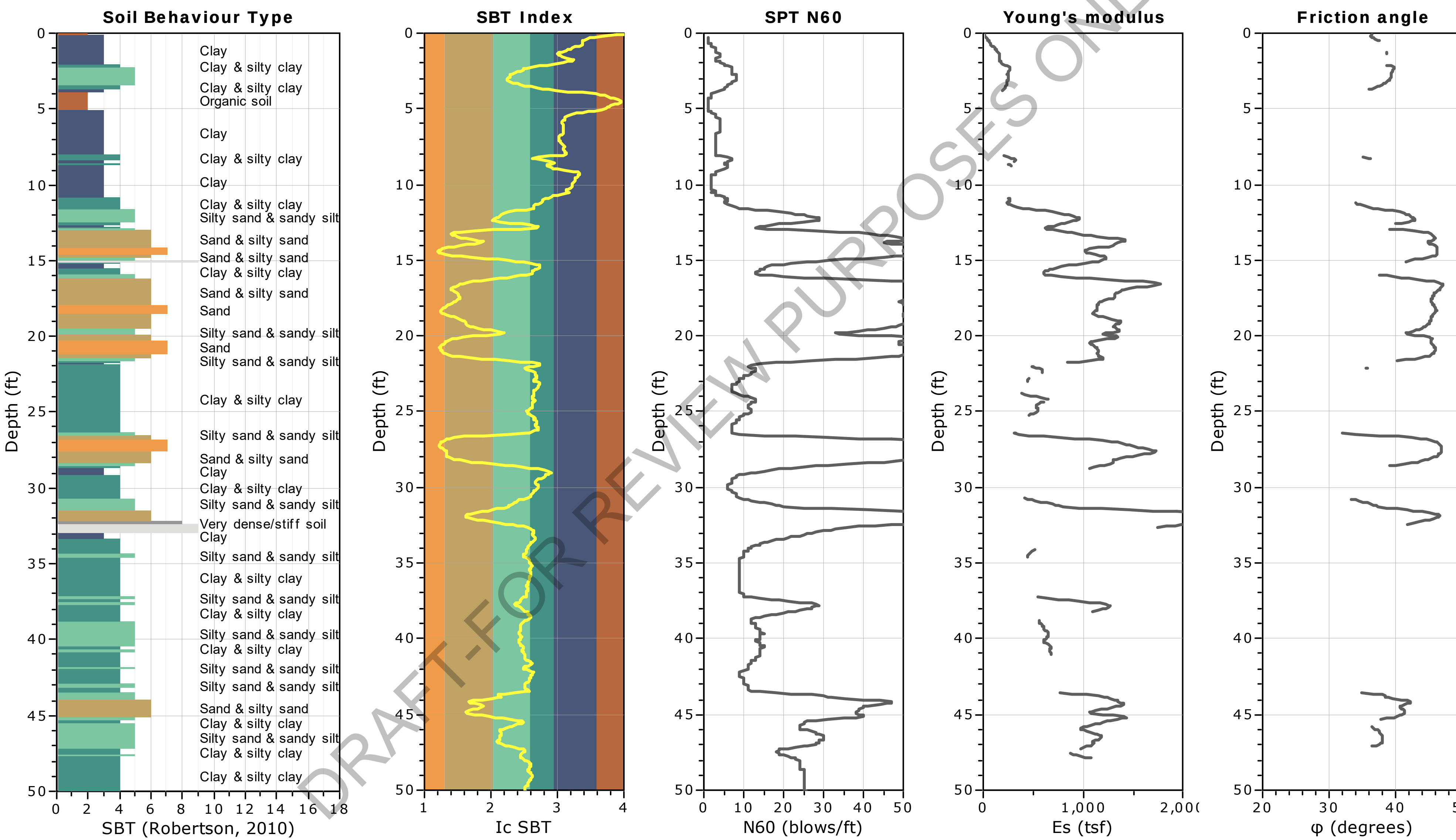


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-26

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

Total depth: 50.64 ft, Date: 5/5/2017
Coords: lat 43.5308° lon -93.2245°

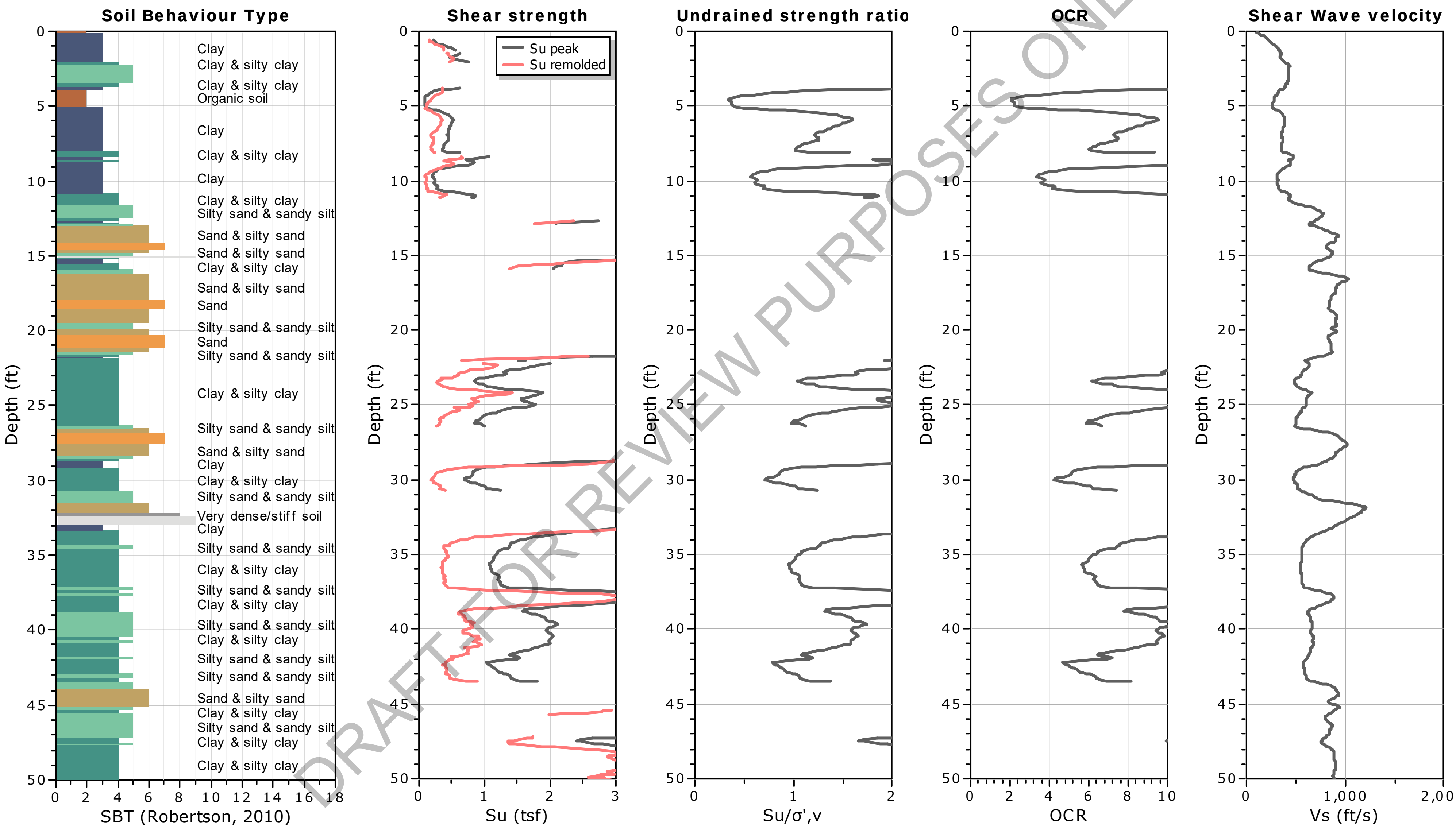


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-26

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

Total depth: 50.64 ft, Date: 5/5/2017
Coords: lat 43.5308° lon -93.2245°



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

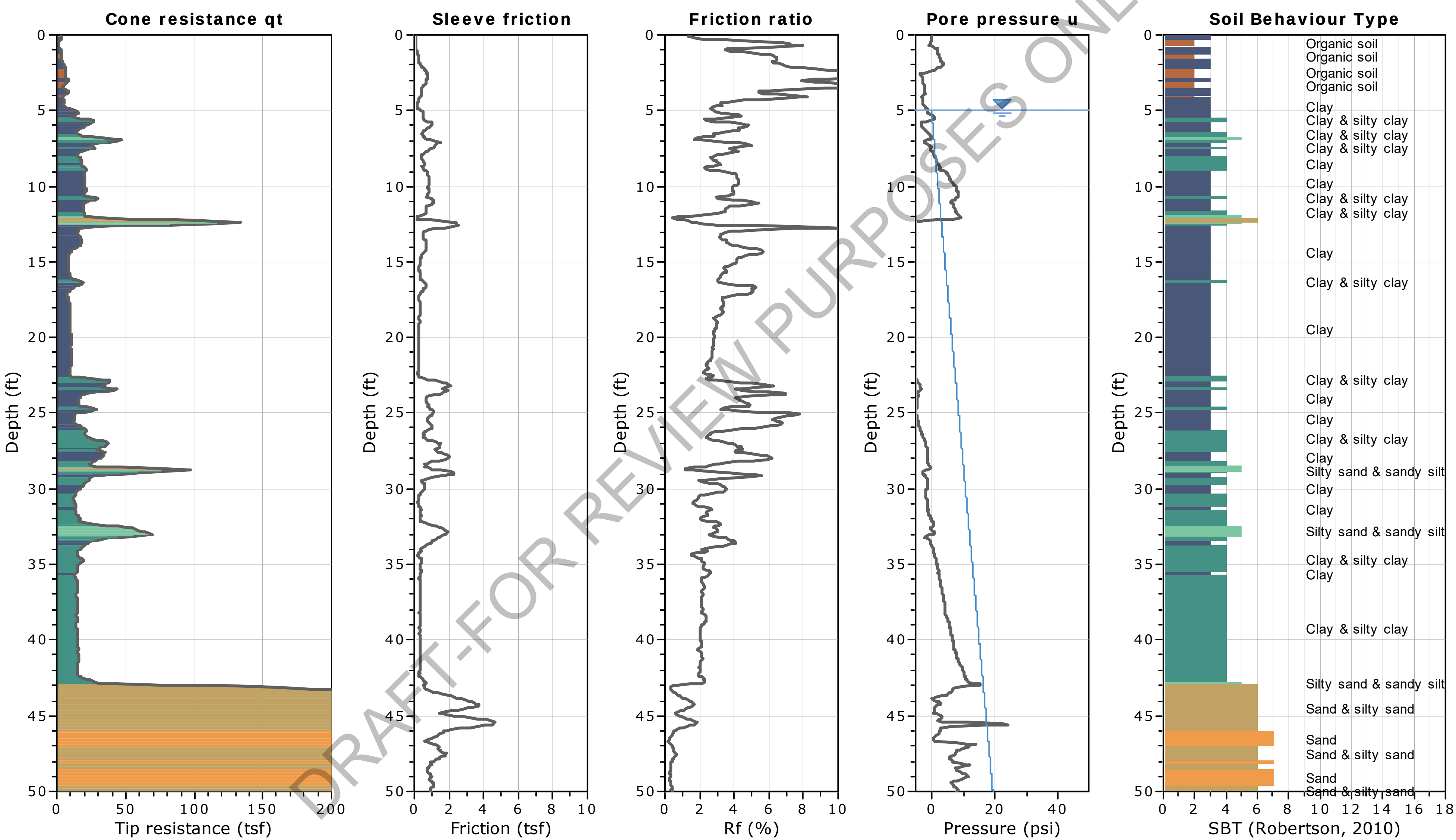
CPT: T-27

Project: **Freeborn Wind Project**

Location: **Freeborn County, Minnesota**

Total depth: 50.64 ft, Date: 5/5/2017

Coords: lat 43.5308° lon -93.2162°

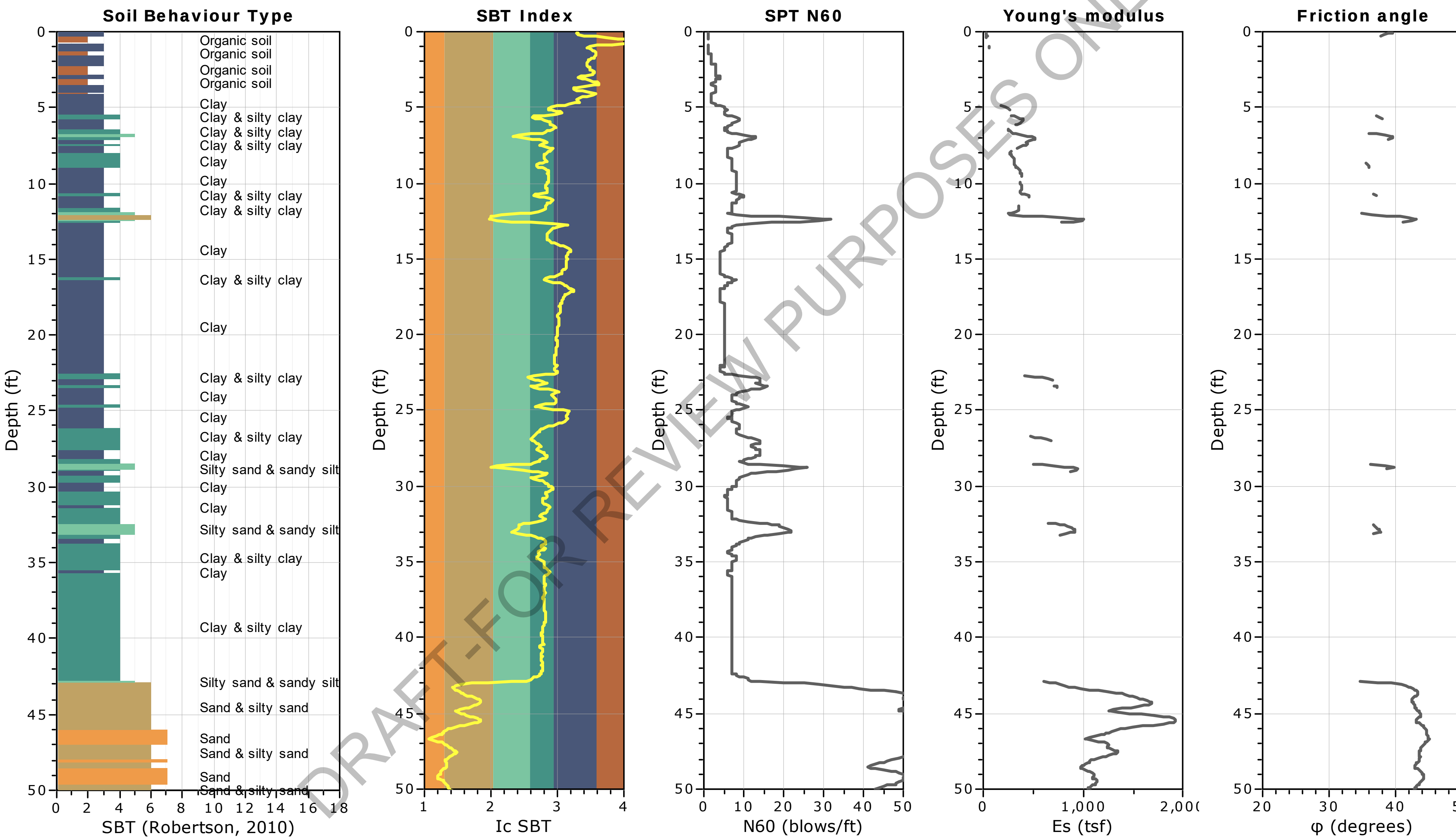


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-27

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

Total depth: 50.64 ft, Date: 5/5/2017
Coords: lat 43.5308° lon -93.2162°



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

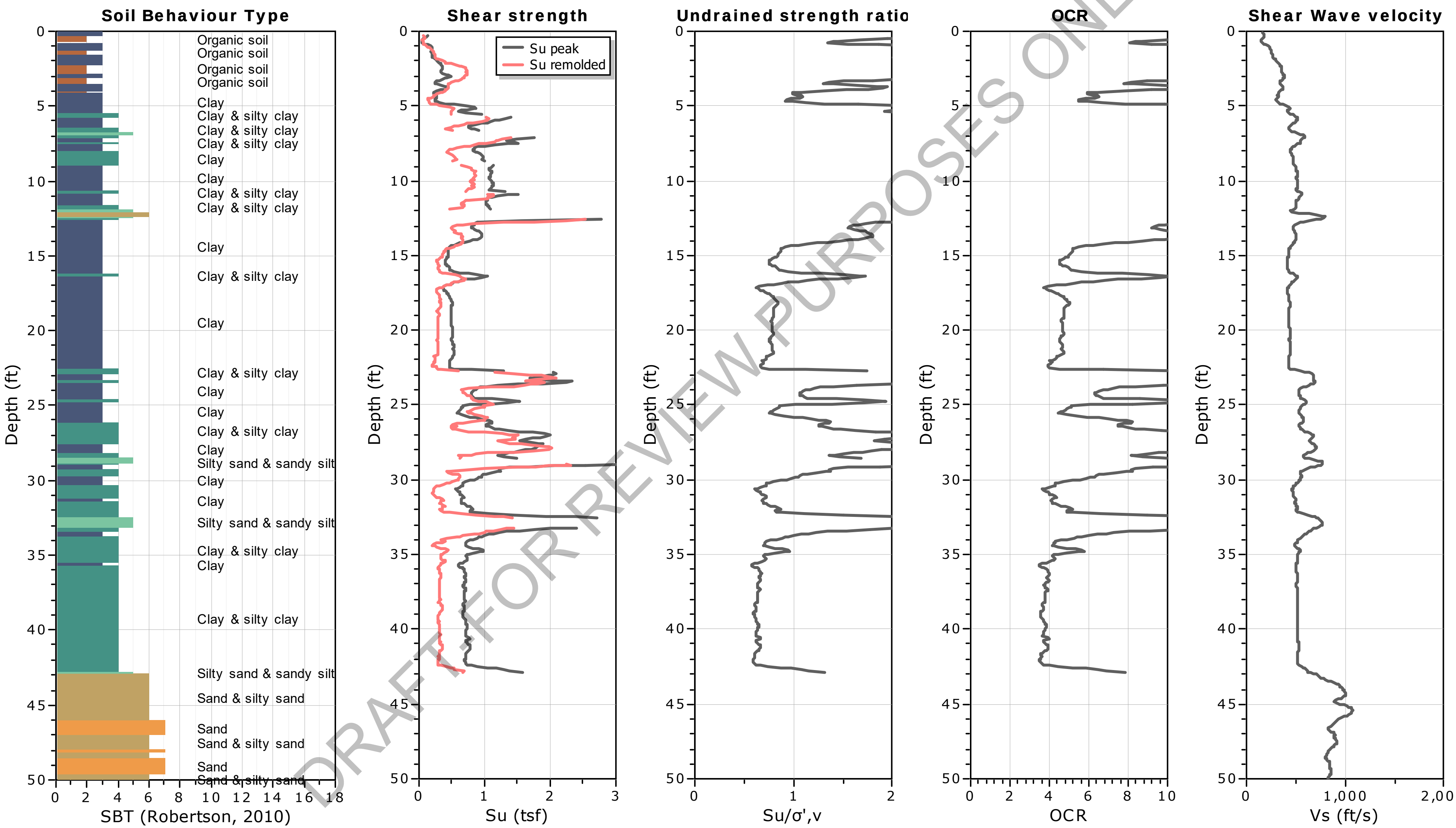
CPT: T-27

Project: **Freeborn Wind Project**

Location: **Freeborn County, Minnesota**

Total depth: 50.64 ft, Date: 5/5/2017

Coords: lat 43.5308° lon -93.2162°



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

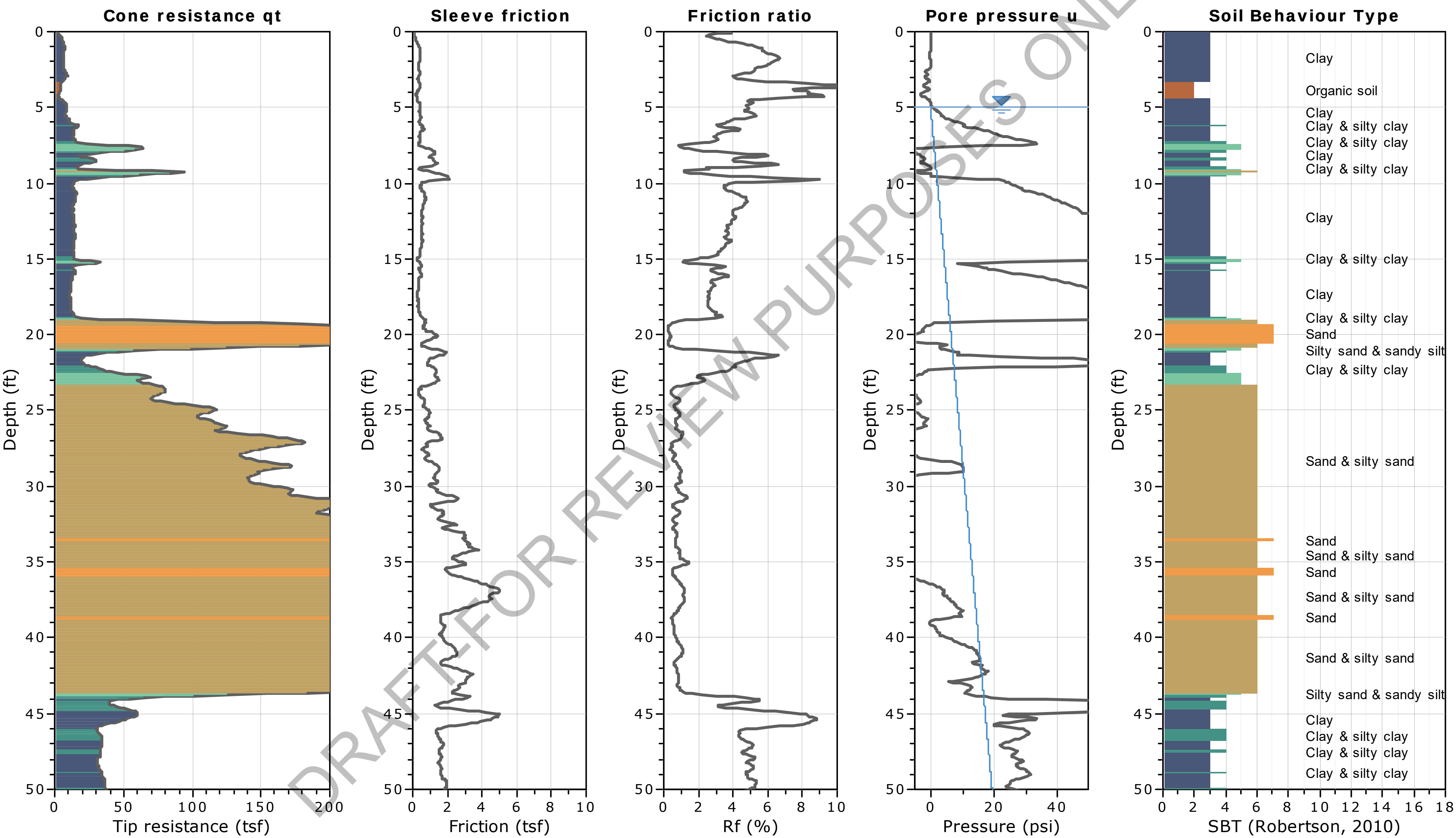
CPT: T-28

Total depth: 50.58 ft, Date: 5/5/2017

Coords: lat 43.5379° lon -93.1556°

Project: **Freeborn Wind Project**

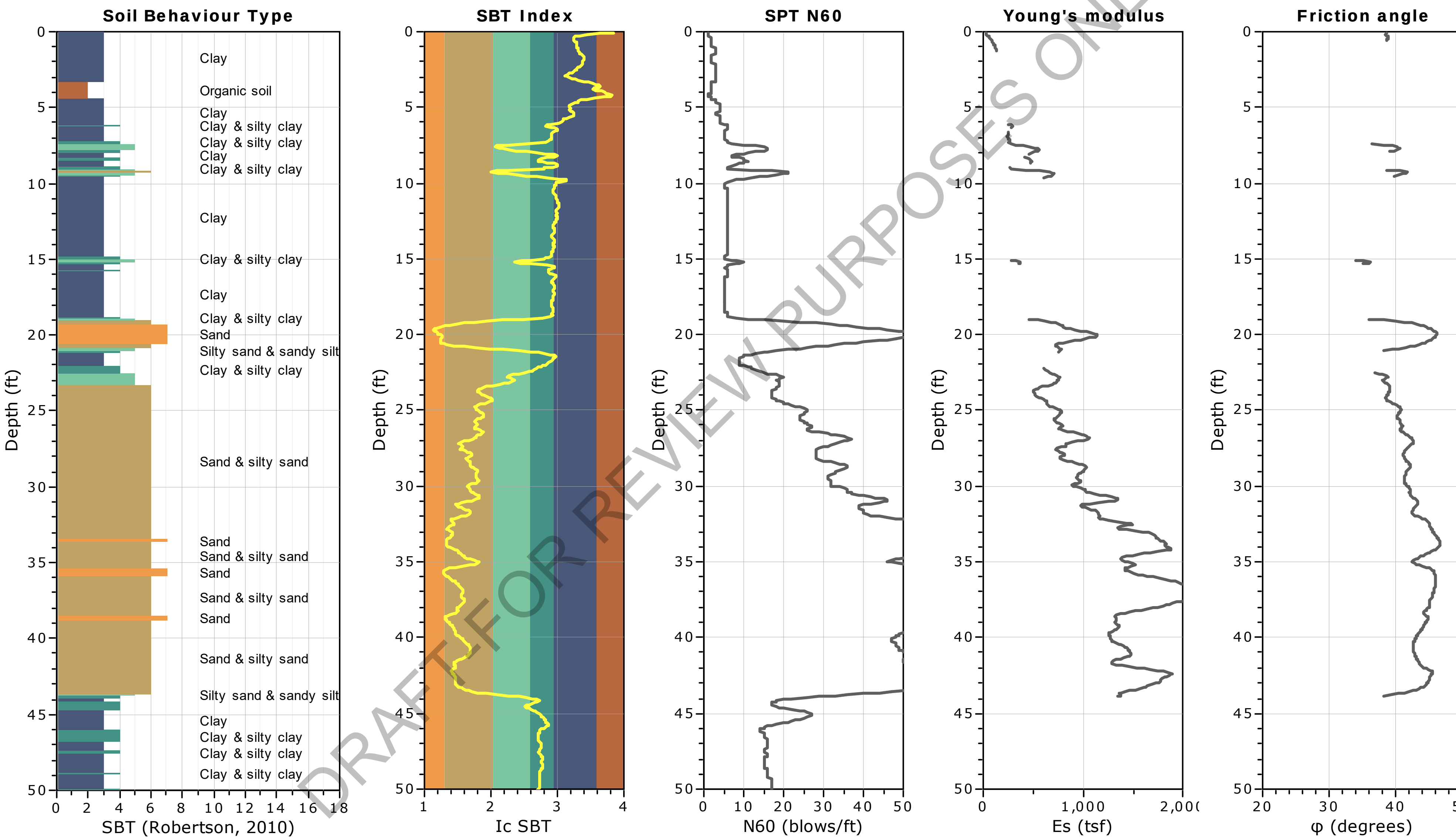
Location: **Freeborn County, Minnesota**



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-28
Total depth: 50.58 ft, Date: 5/5/2017
Coords: lat 43.5379° lon -93.1556°

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

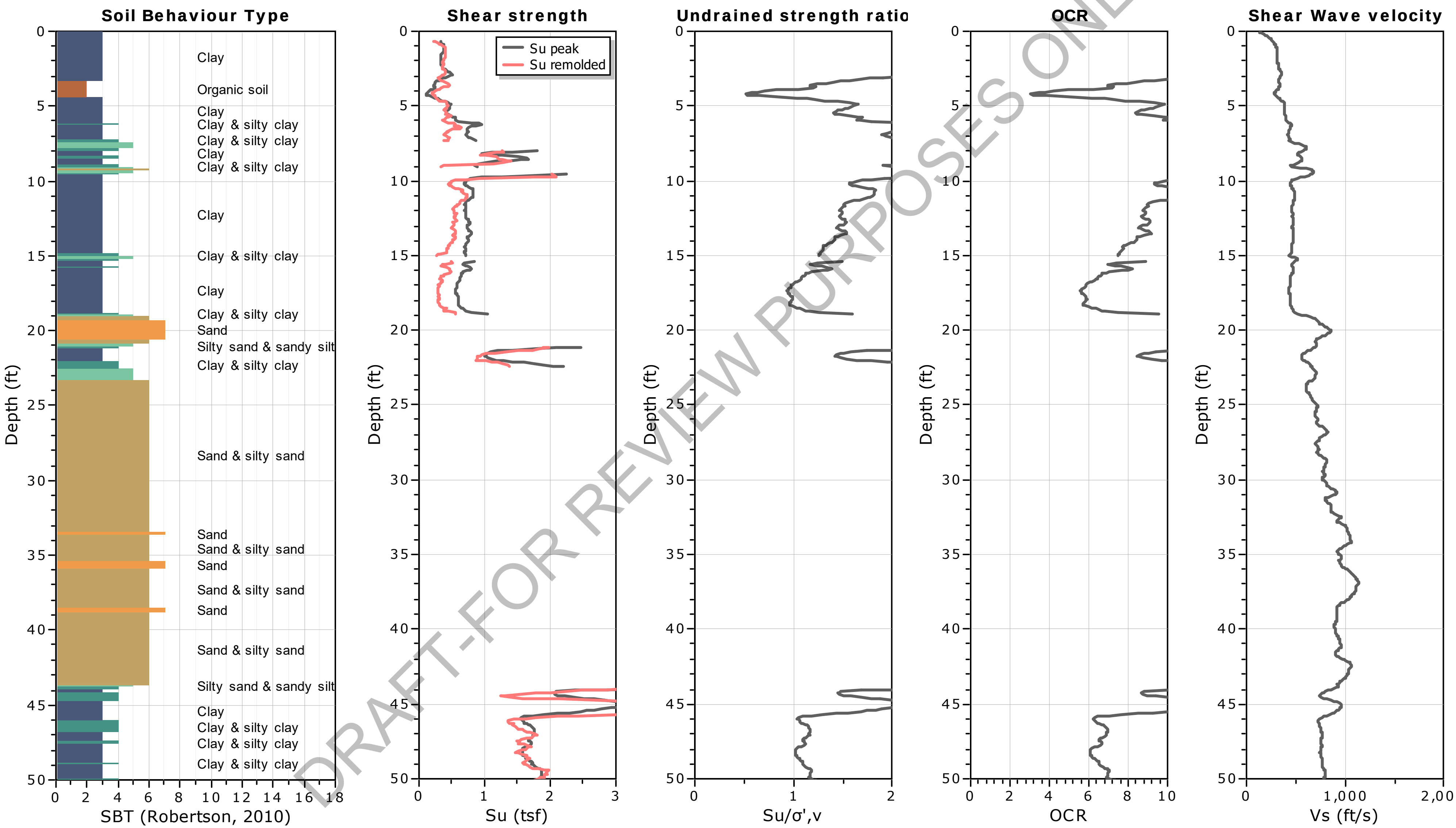
CPT: T-28

Total depth: 50.58 ft, Date: 5/5/2017

Coords: lat 43.5379° lon -93.1556°

Project: **Freeborn Wind Project**

Location: **Freeborn County, Minnesota**



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

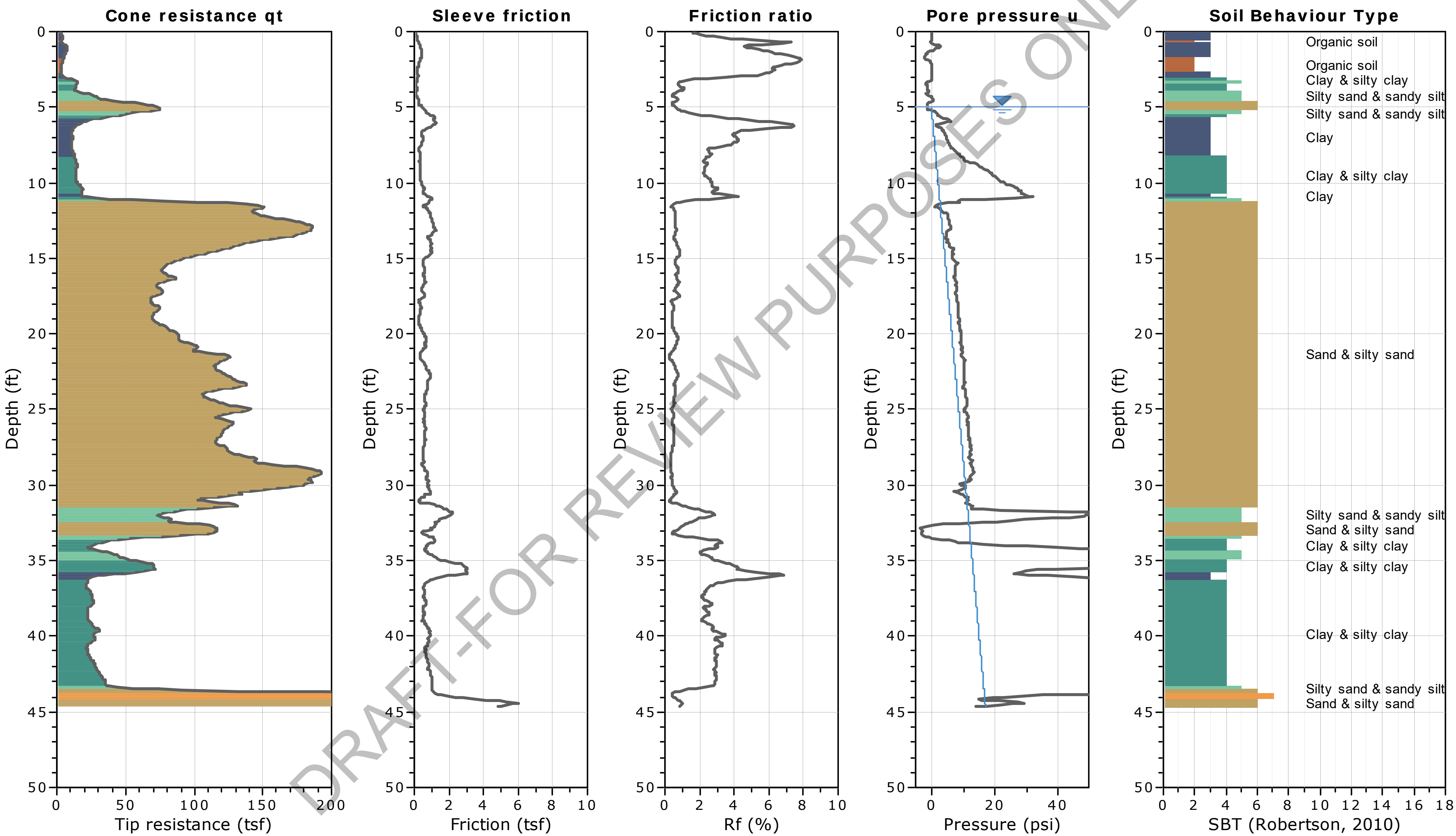
CPT: T-29

Project: Freeborn Wind Project

Location: Freeborn County, Minnesota

Total depth: 44.67 ft, Date: 5/5/2017

Coords: lat 43.5325° lon -93.144°

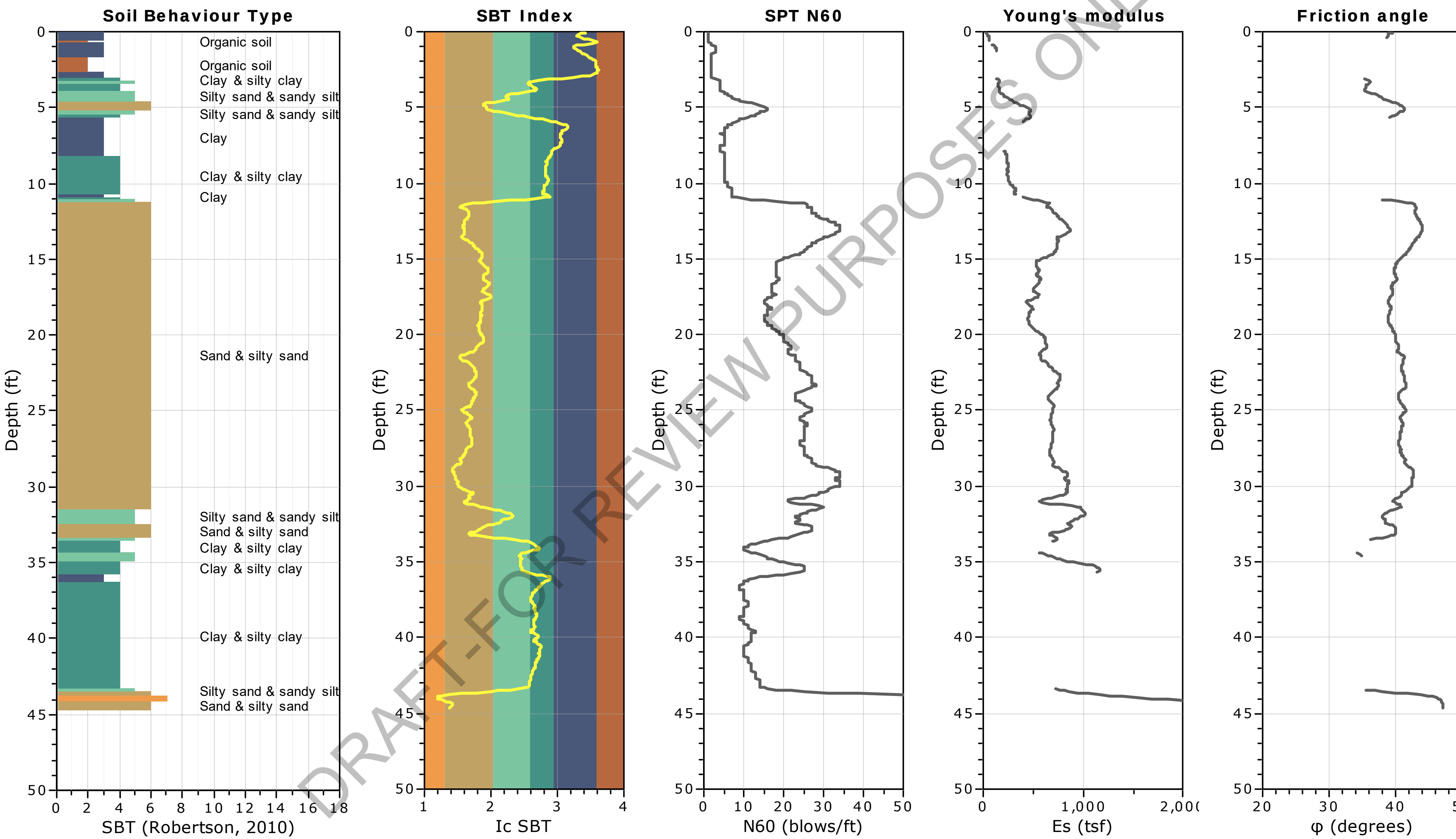


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-29

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

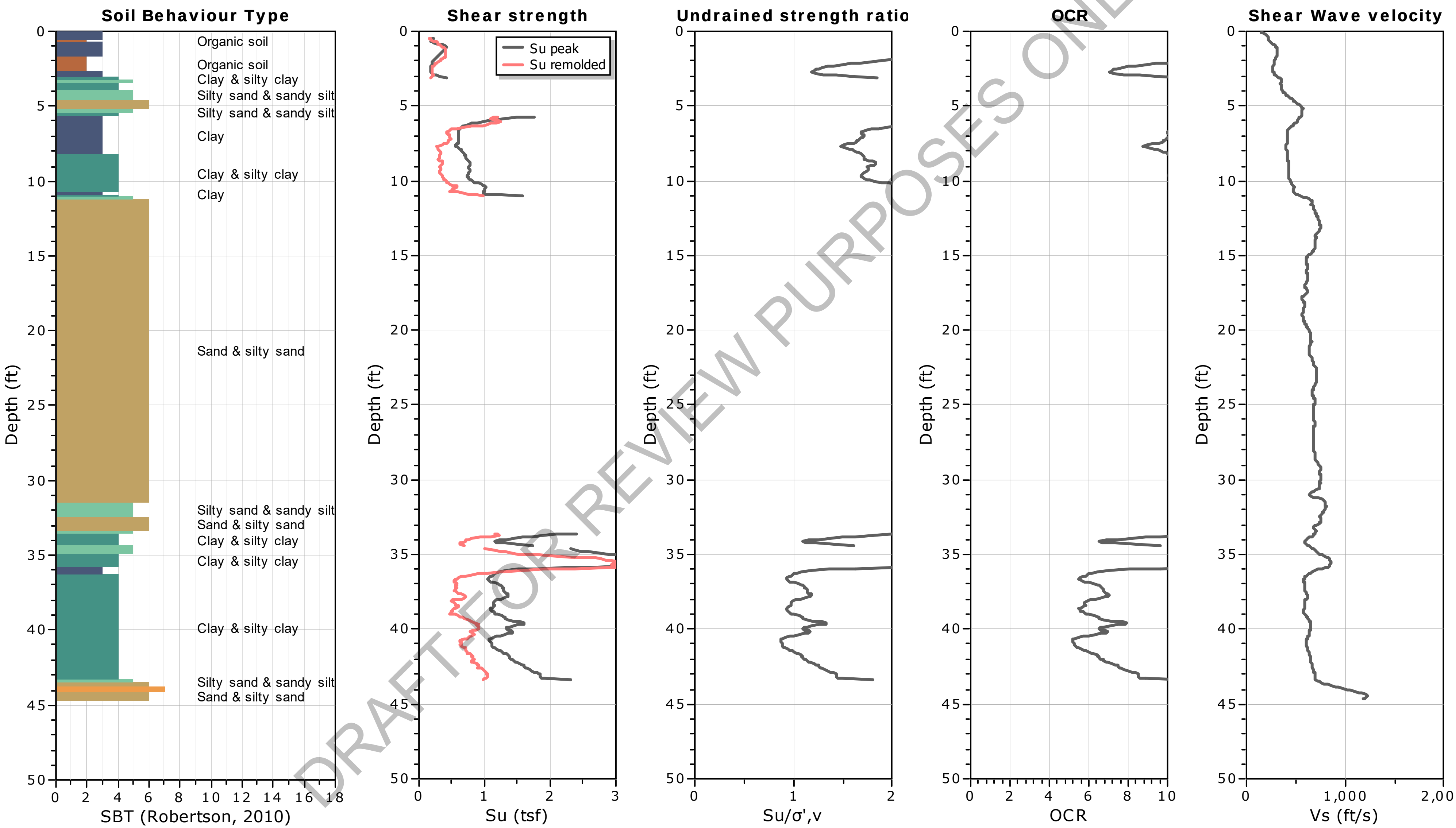
Total depth: 44.67 ft, Date: 5/5/2017
Coords: lat 43.5325° lon -93.144°



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-29
Total depth: 44.67 ft, Date: 5/5/2017
Coords: lat 43.5325° lon -93.144°

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

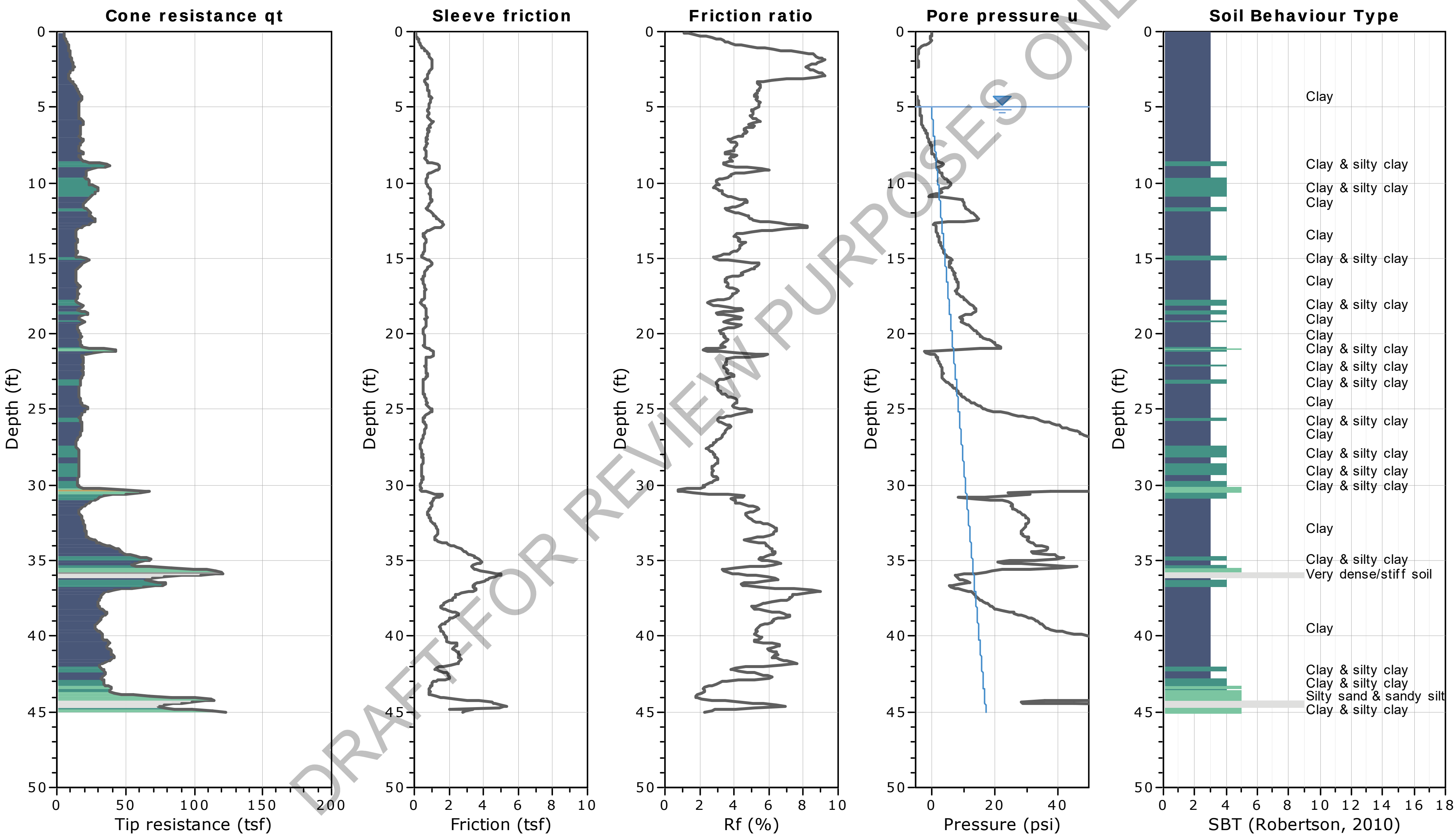
CPT: T-30

Project: **Freeborn Wind Project**

Location: **Freeborn County, Minnesota**

Total depth: 45.00 ft, Date: 5/5/2017

Coords: lat 43.5302° lon -93.124°

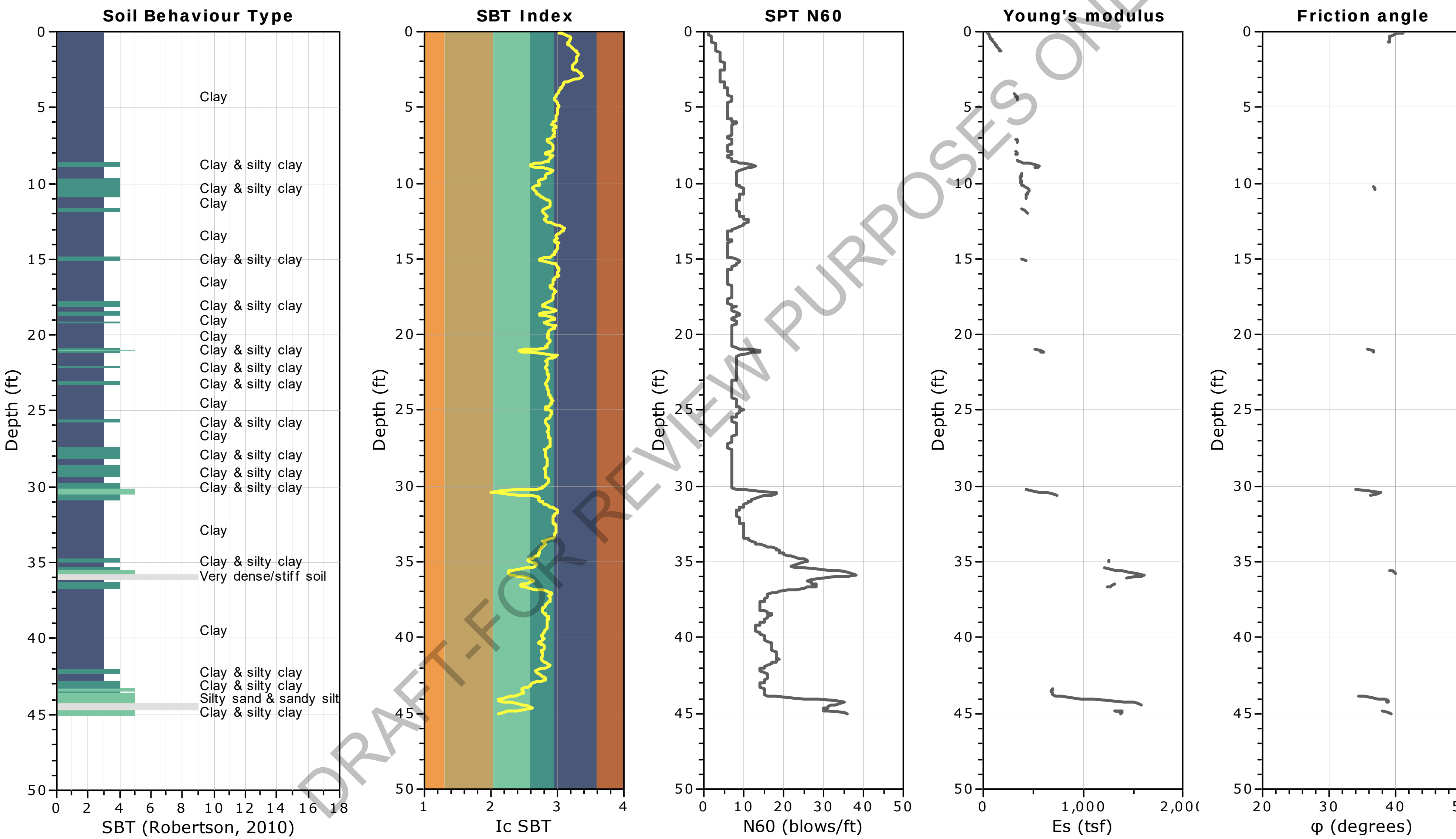


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-30

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

Total depth: 45.00 ft, Date: 5/5/2017
Coords: lat 43.5302° lon -93.124°

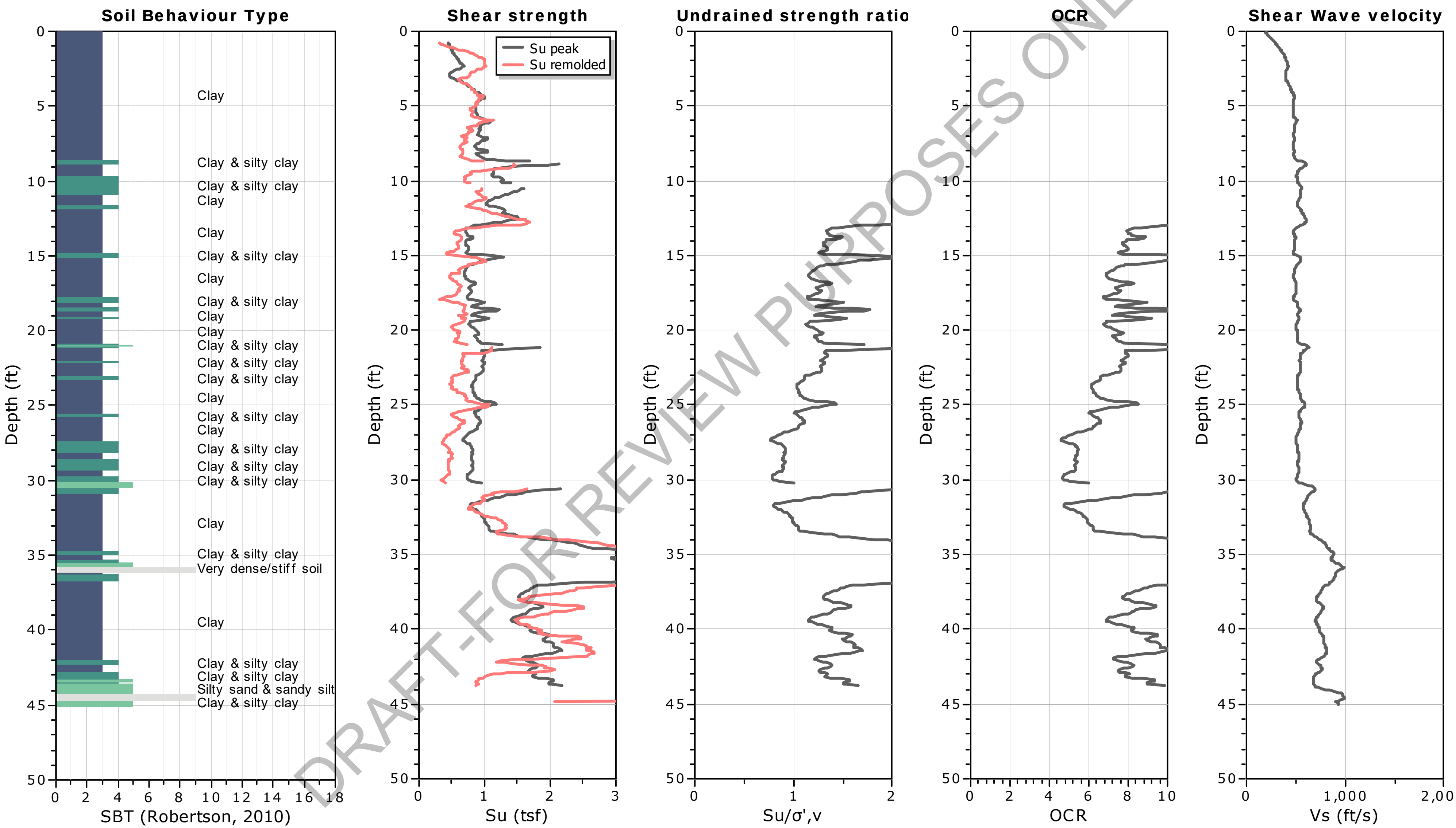


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-30

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

Total depth: 45.00 ft, Date: 5/5/2017
Coords: lat 43.5302° lon -93.124°

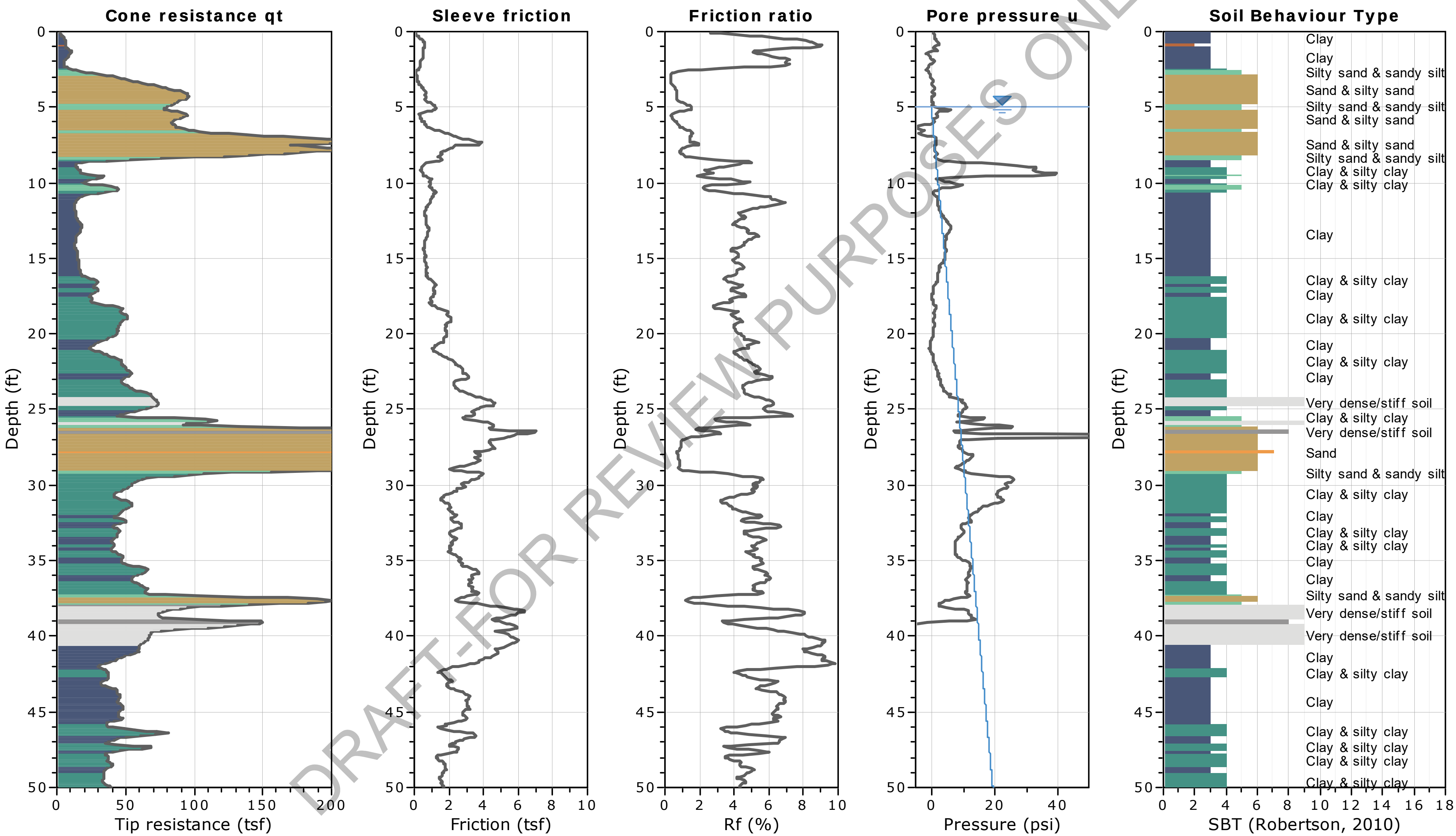


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-31

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

Total depth: 50.32 ft, Date: 5/5/2017
Coords: lat 43.5341° lon -93.1154°

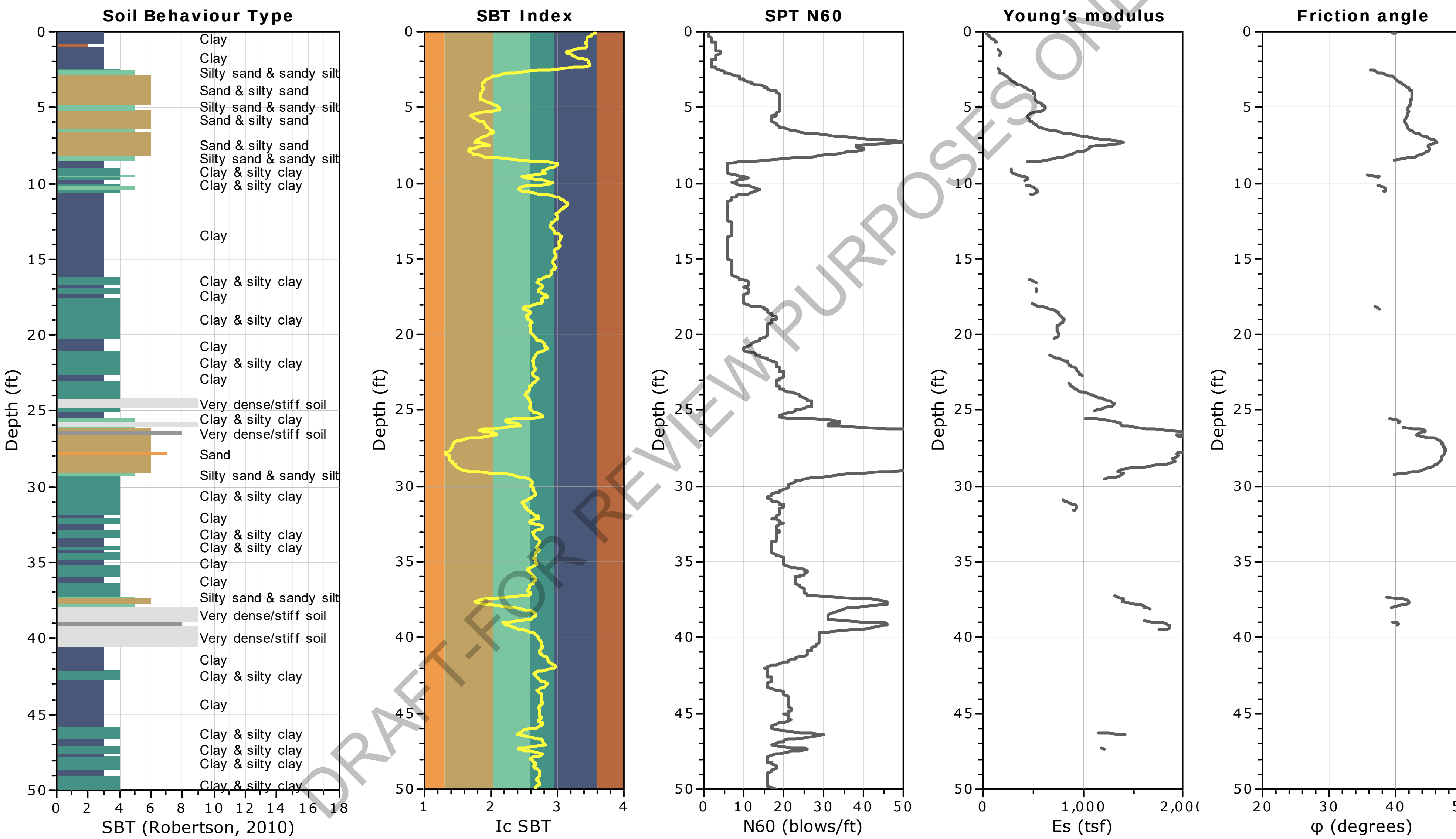


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-31

Total depth: 50.32 ft, Date: 5/5/2017
Coords: lat 43.5341° lon -93.1154°

Project: Freeborn Wind Project
Location: Freeborn County, Minnesota

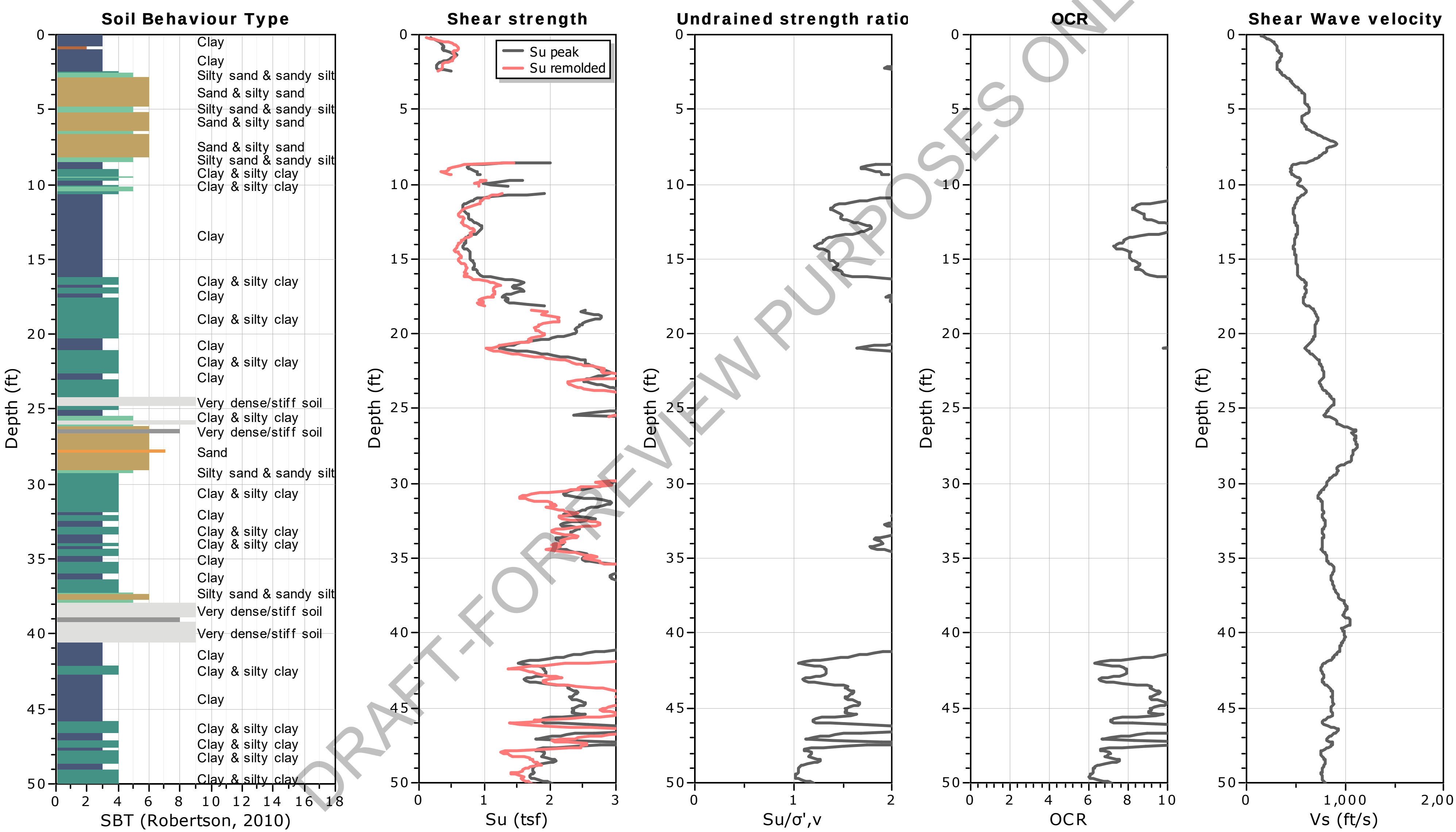


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-31

Project: Freeborn Wind Project
Location: Freeborn County, Minnesota

Total depth: 50.32 ft, Date: 5/5/2017
Coords: lat 43.5341° lon -93.1154°



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

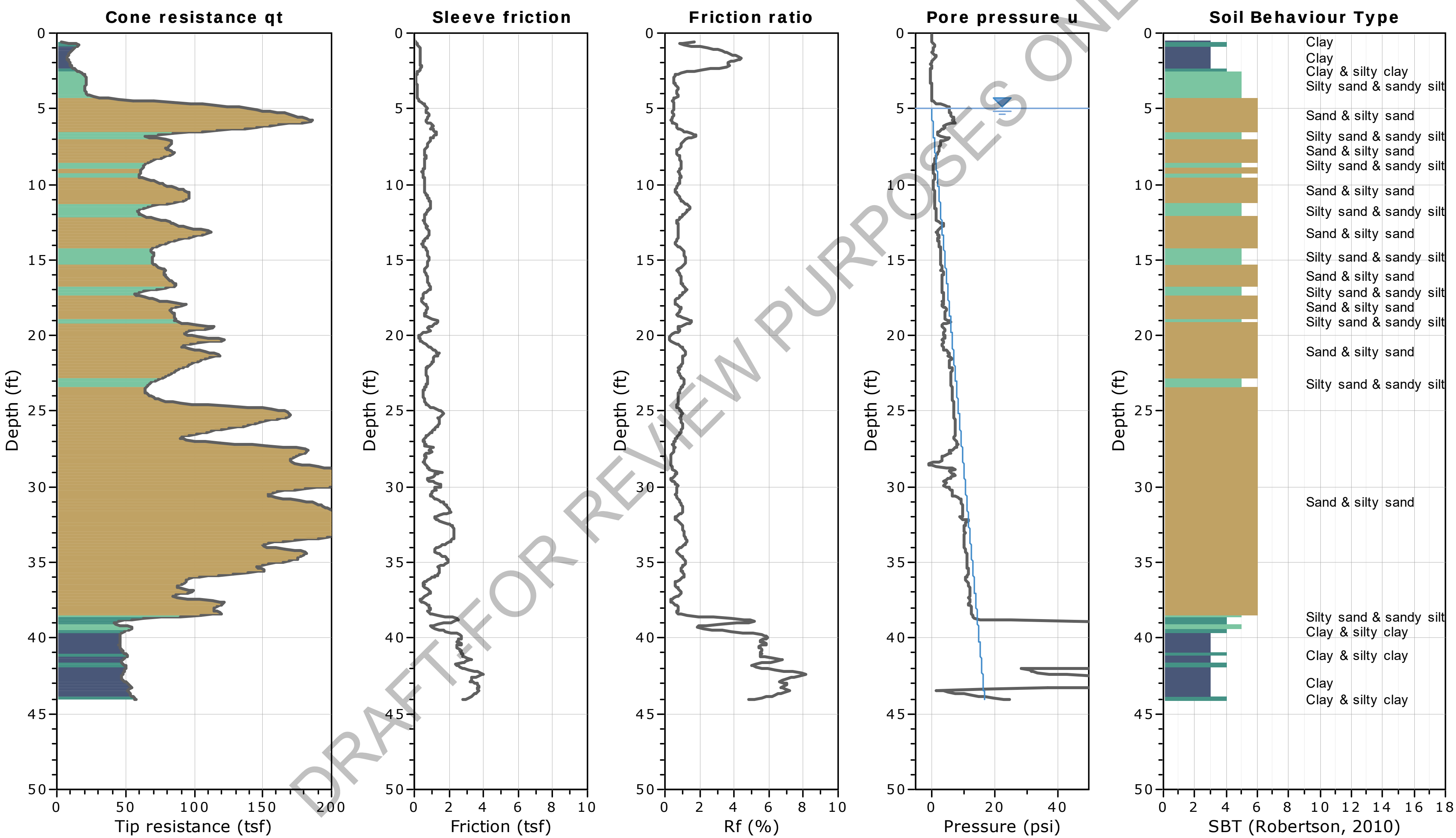
CPT: T-32

Project: **Freeborn Wind Project**

Location: **Freeborn County, Minnesota**

Total depth: 44.08 ft, Date: 5/5/2017

Coords: lat 43.5407° lon -93.0772°



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

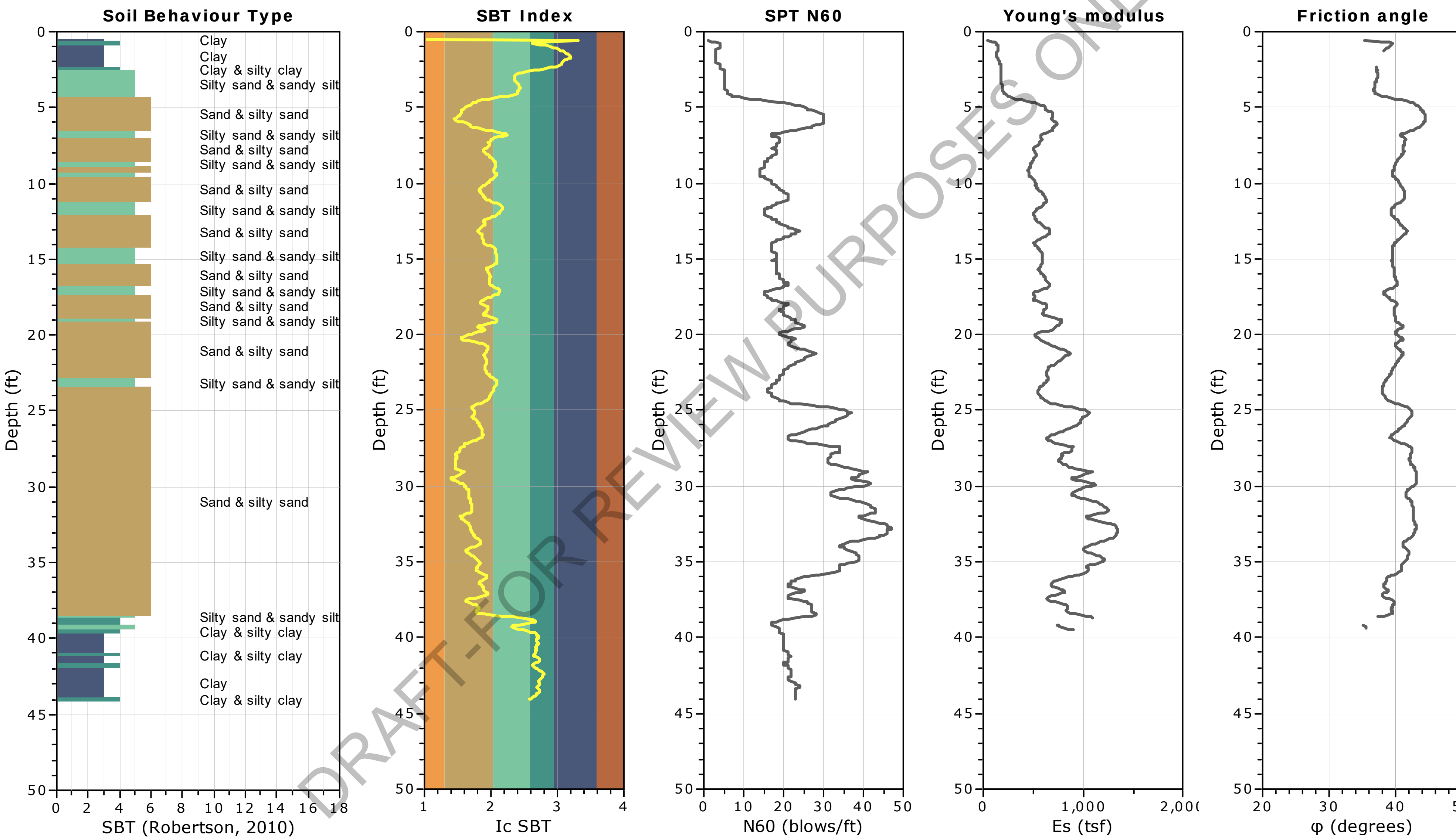
CPT: T-32

Total depth: 44.08 ft, Date: 5/5/2017

Coords: lat 43.5407° lon -93.0772°

Project: Freeborn Wind Project

Location: Freeborn County, Minnesota

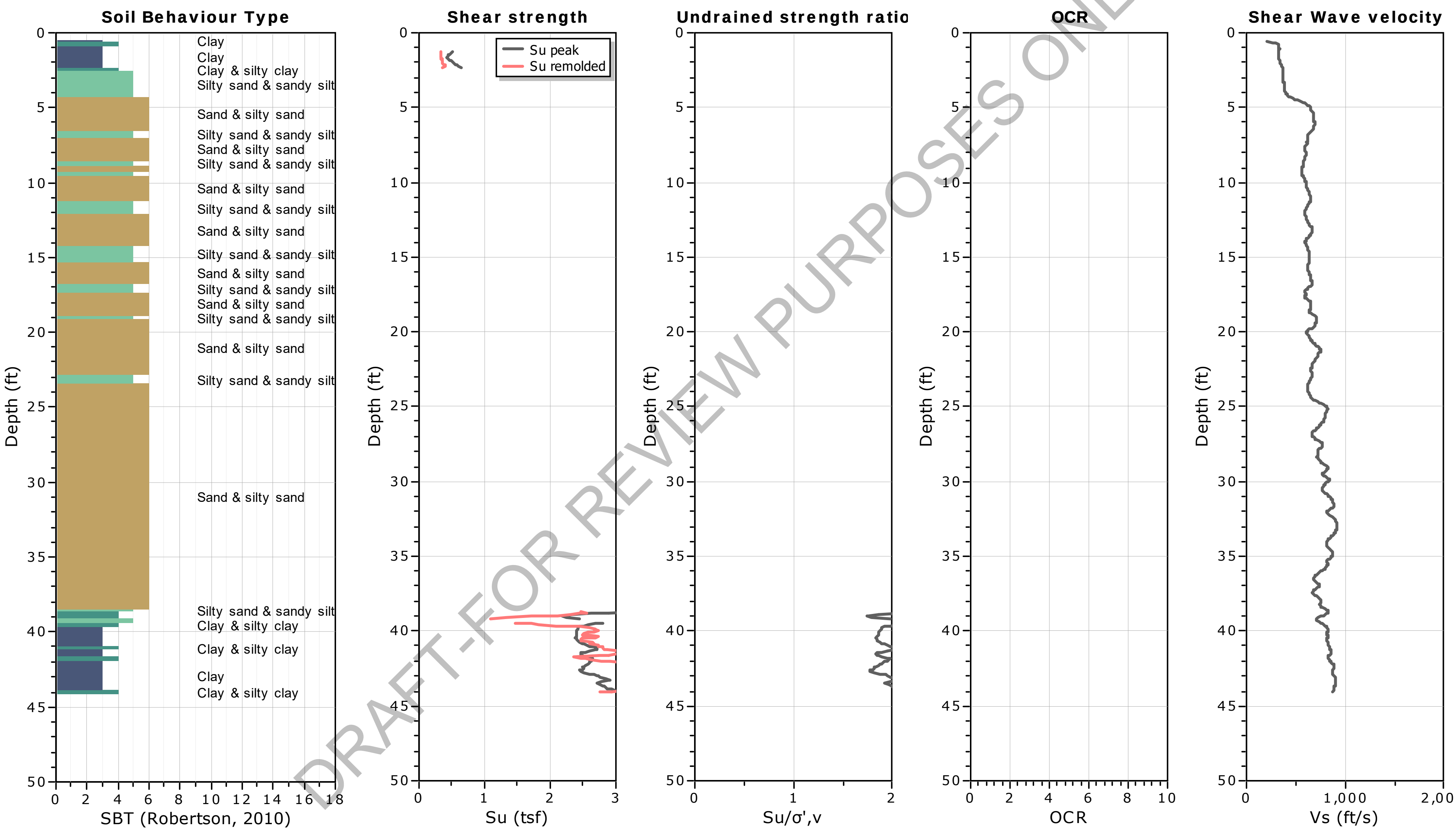


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-32

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

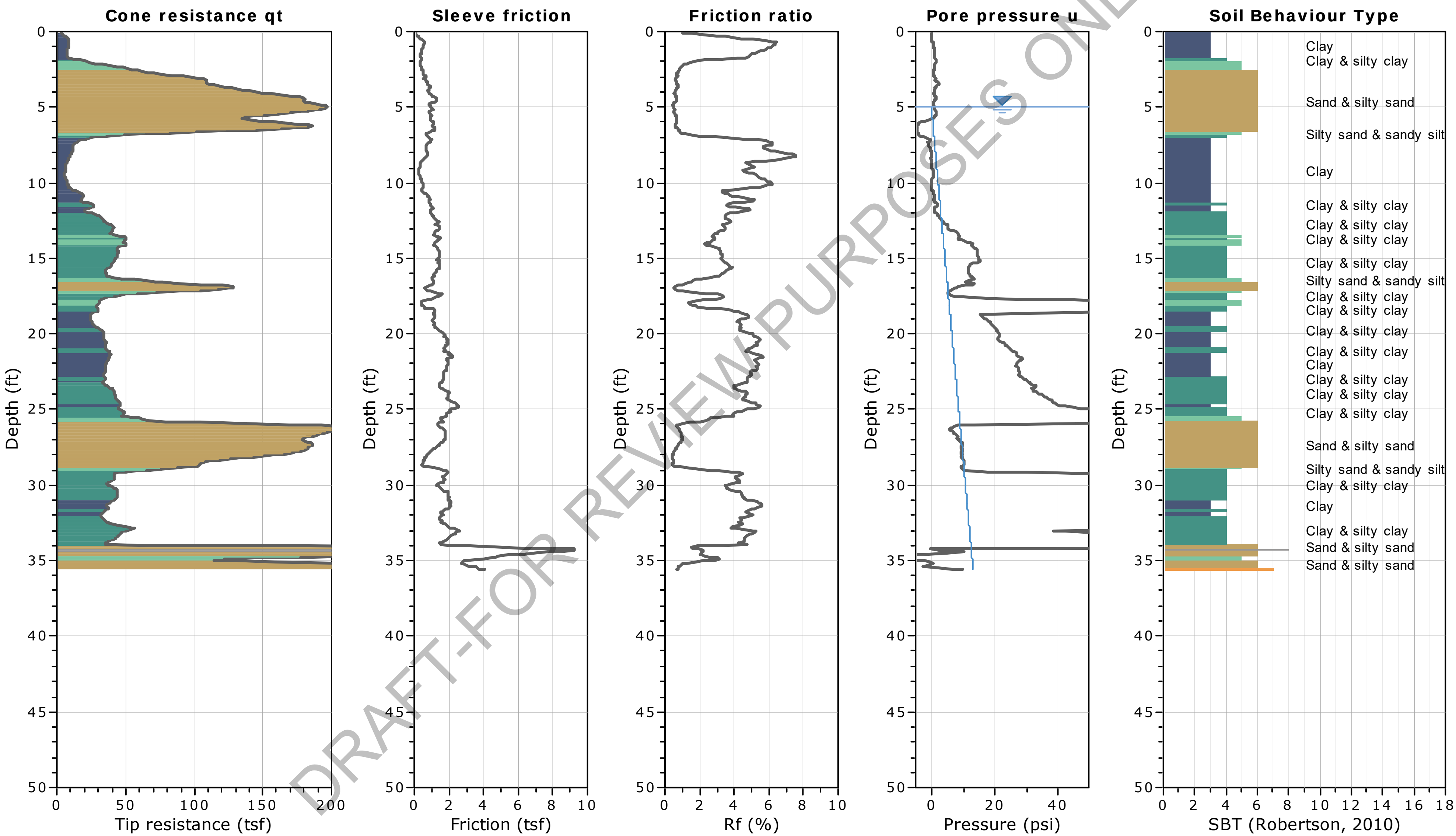
Total depth: 44.08 ft, Date: 5/5/2017
Coords: lat 43.5407° lon -93.0772°



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

CPT: T-33a
Total depth: 35.62 ft, Date: 5/5/2017
Coords: lat 43.5425° lon -93.0734°

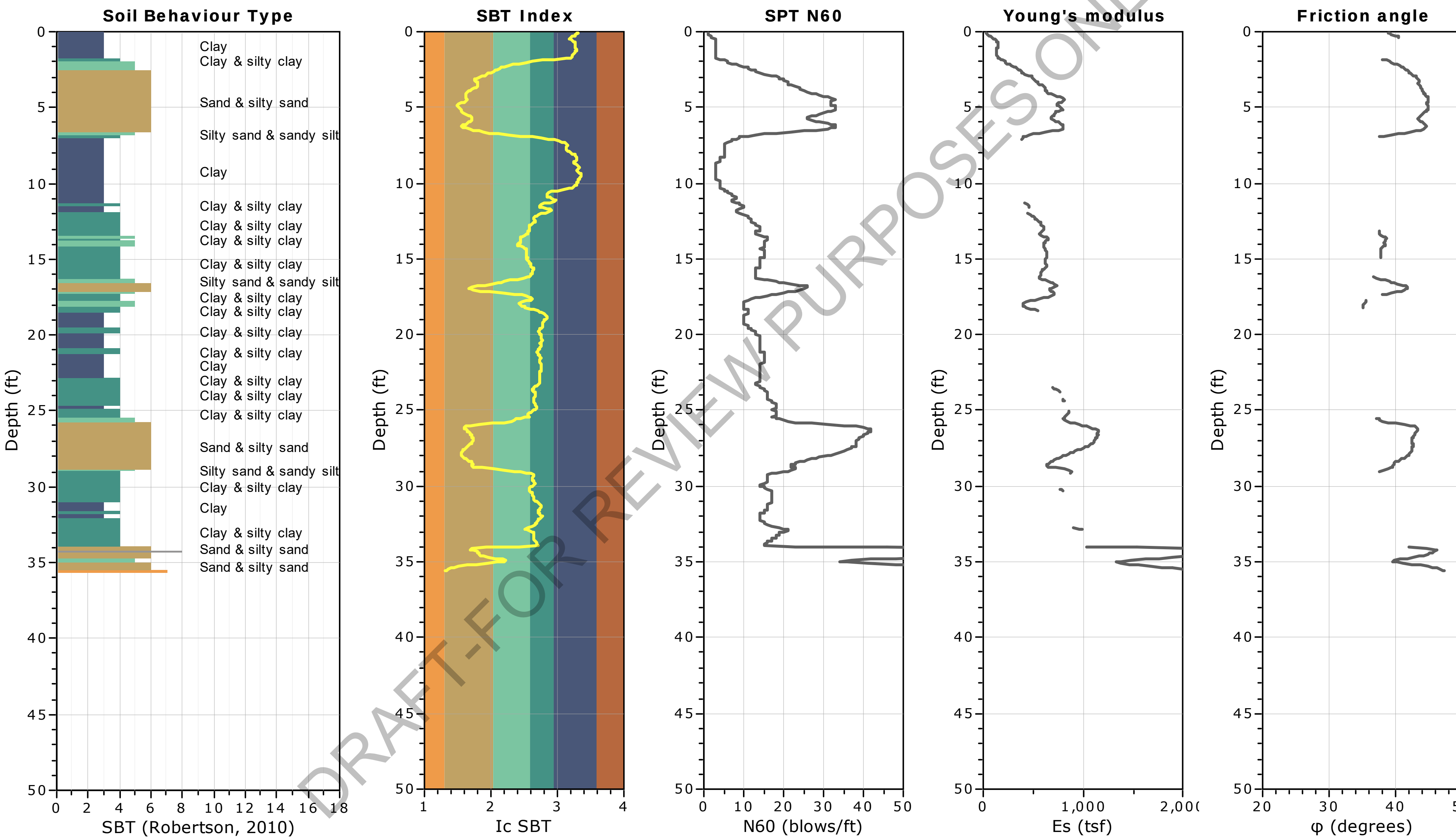


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-33a

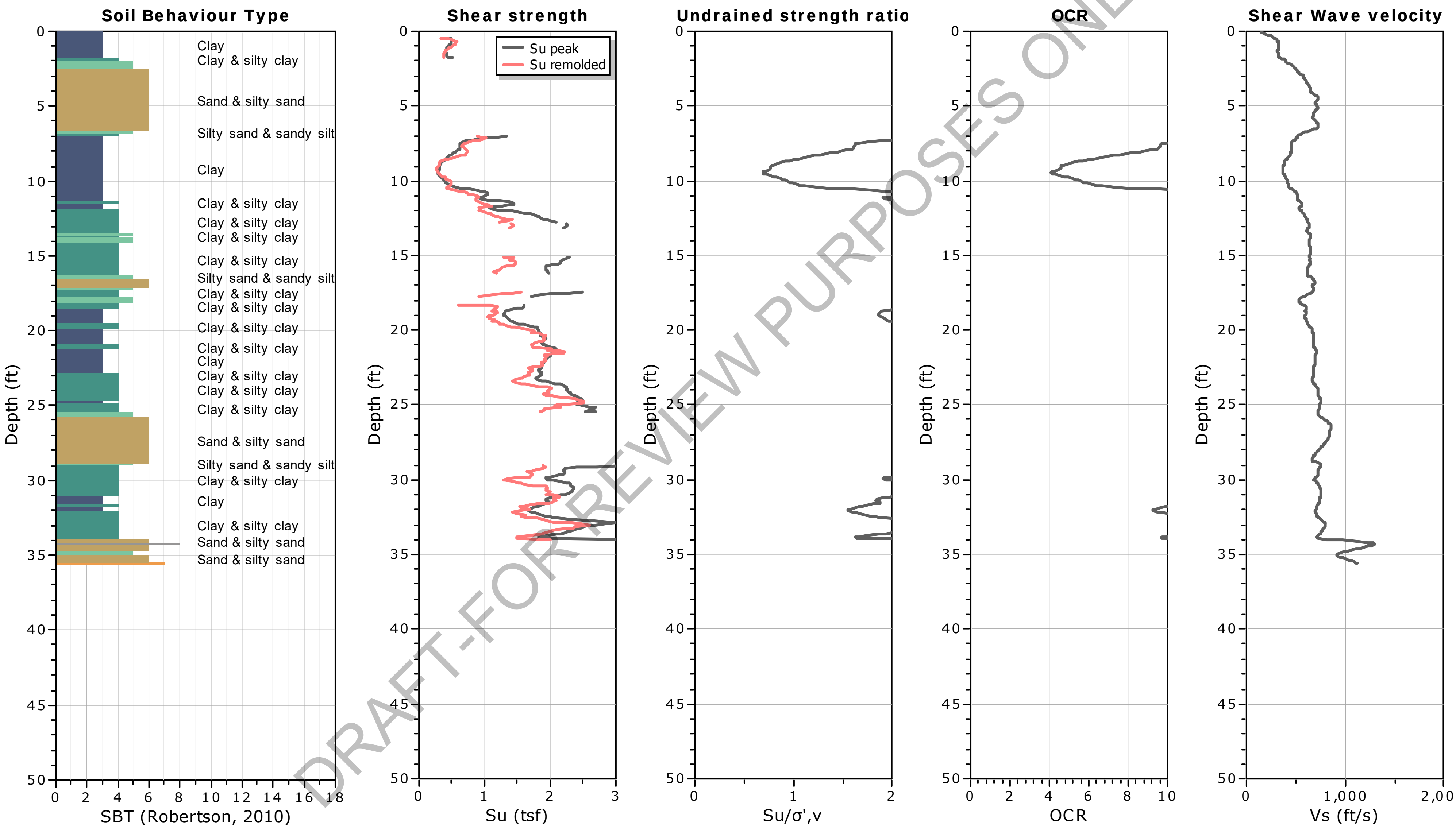
Total depth: 35.62 ft, Date: 5/5/2017
Coords: lat 43.5425° lon -93.0734°

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**



CPT: T-33a
Total depth: 35.62 ft, Date: 5/5/2017
Coords: lat 43.5425° lon -93.0734°

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

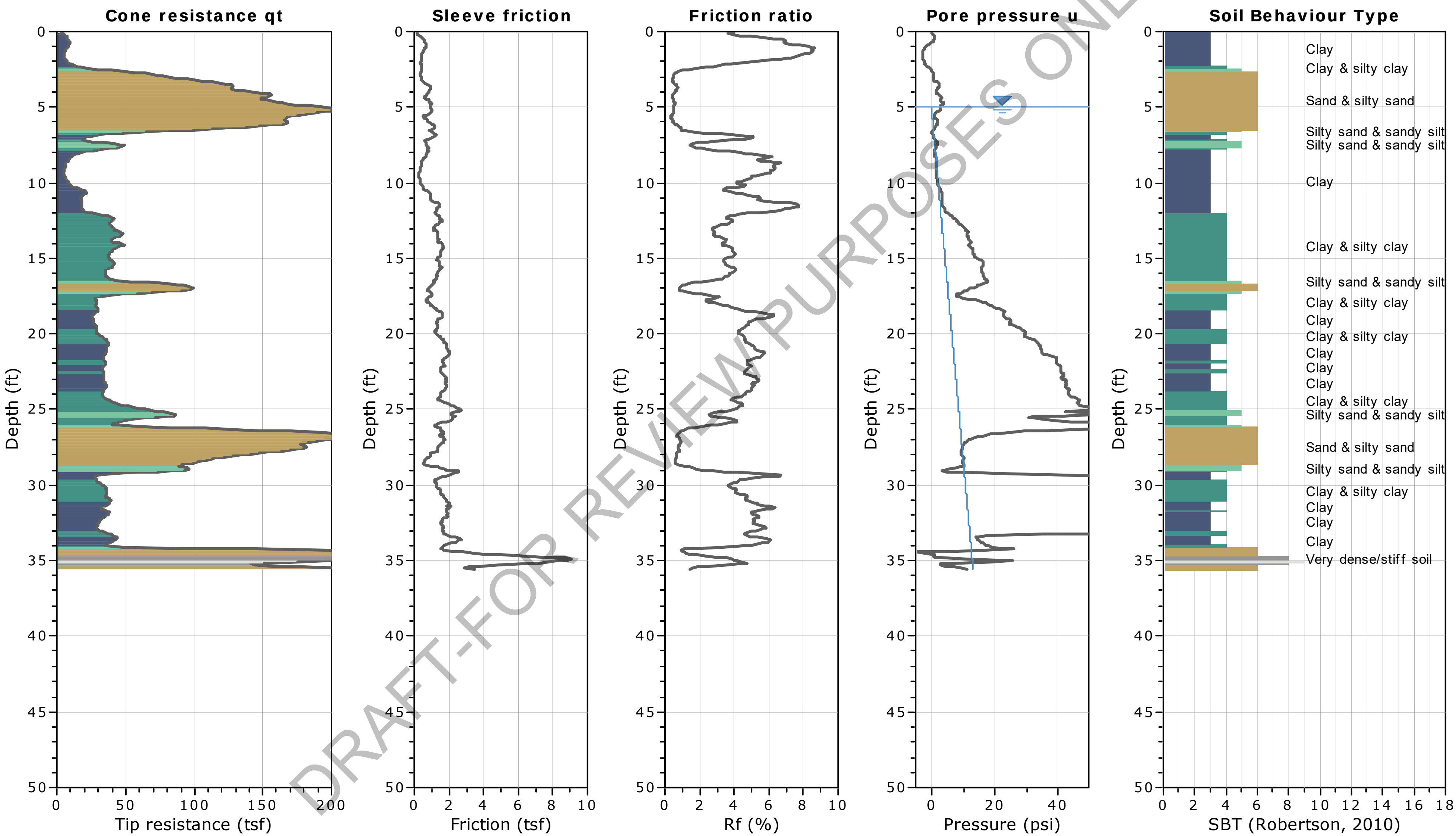


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-33b

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

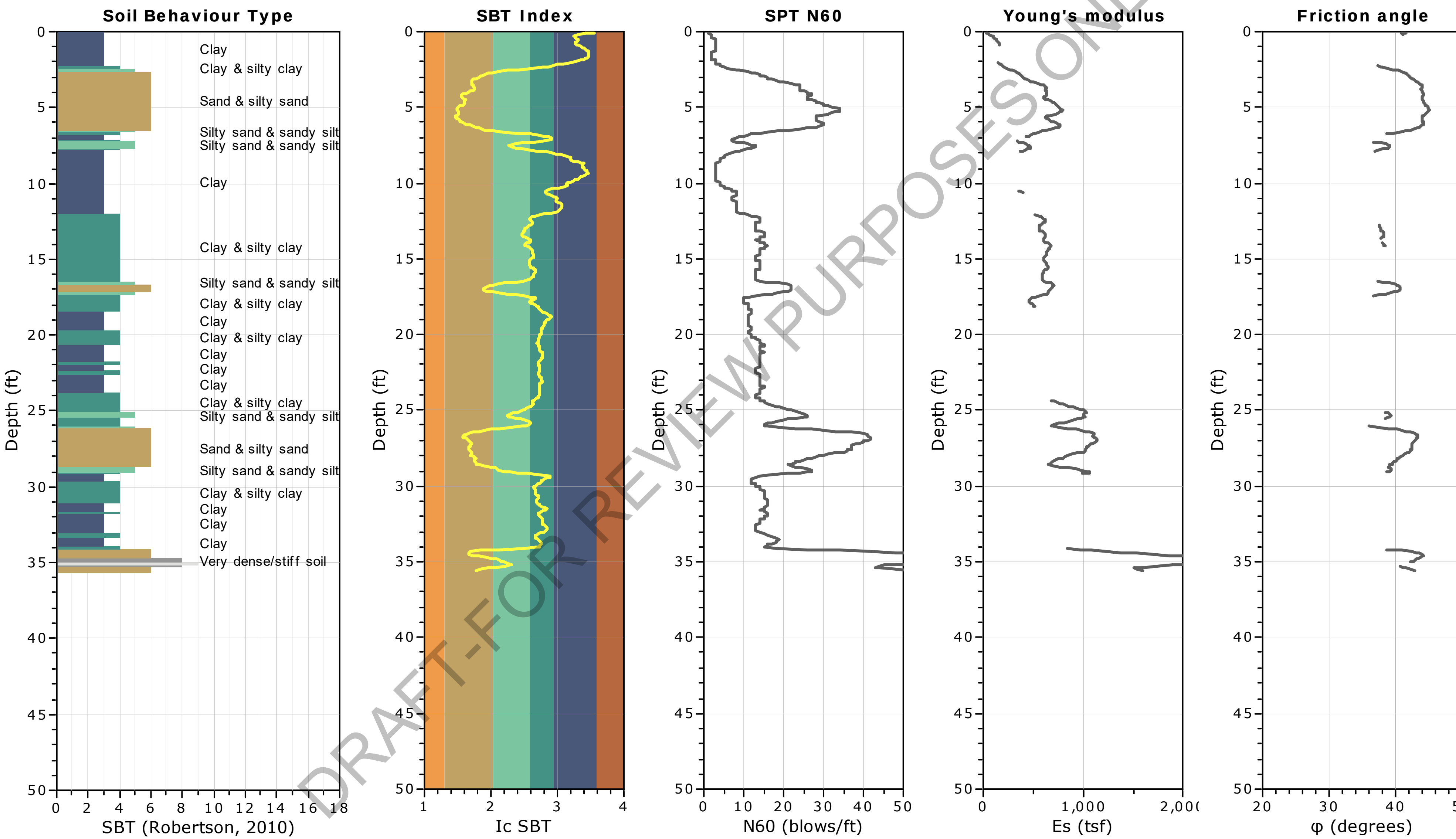
Total depth: 35.56 ft, Date: 5/5/2017
Coords: lat 43.5425° lon -93.0734°



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-33b
Total depth: 35.56 ft, Date: 5/5/2017
Coords: lat 43.5425° lon -93.0734°

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

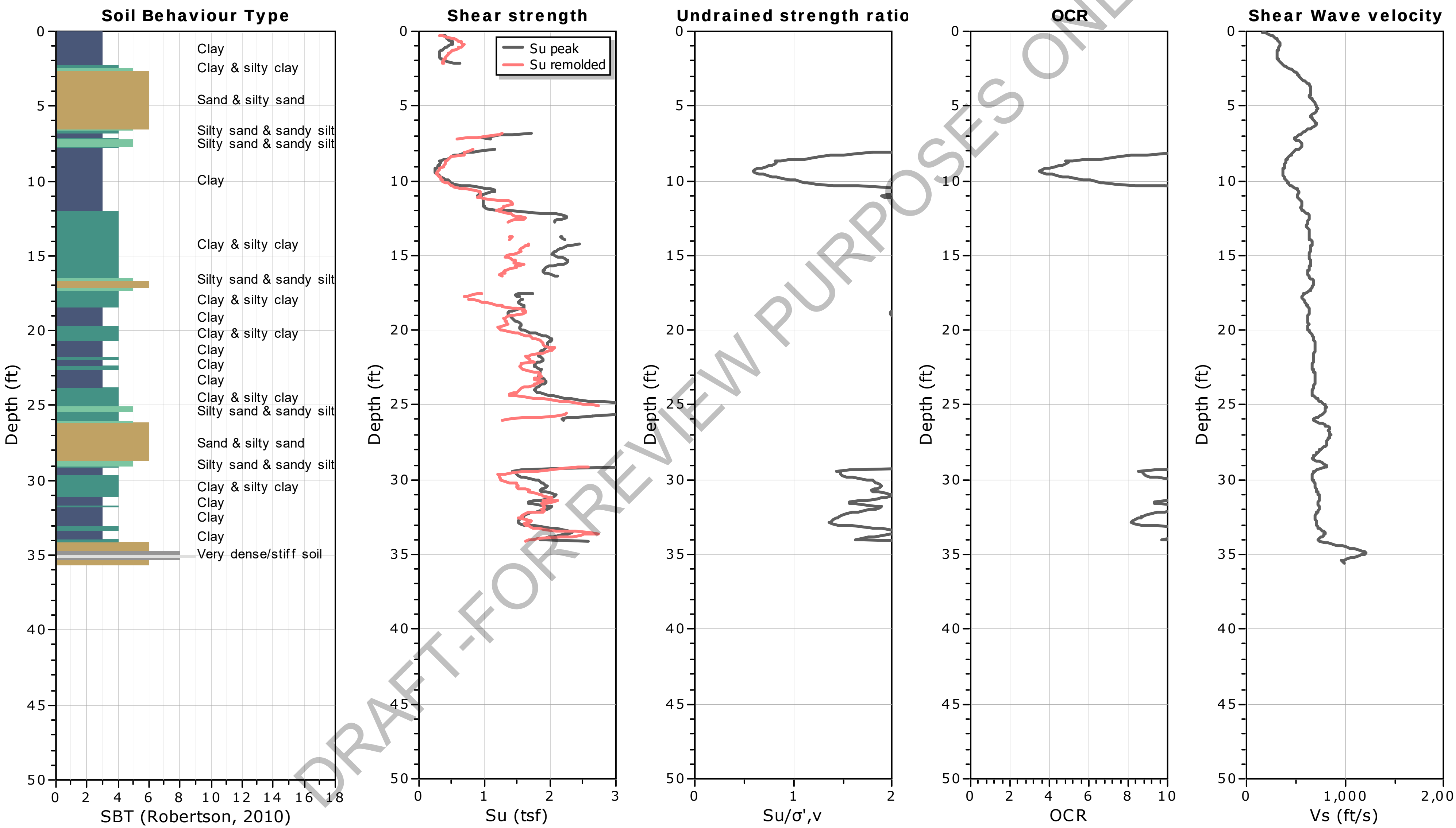
CPT: T-33b

Total depth: 35.56 ft, Date: 5/5/2017

Coords: lat 43.5425° lon -93.0734°

Project: **Freeborn Wind Project**

Location: **Freeborn County, Minnesota**

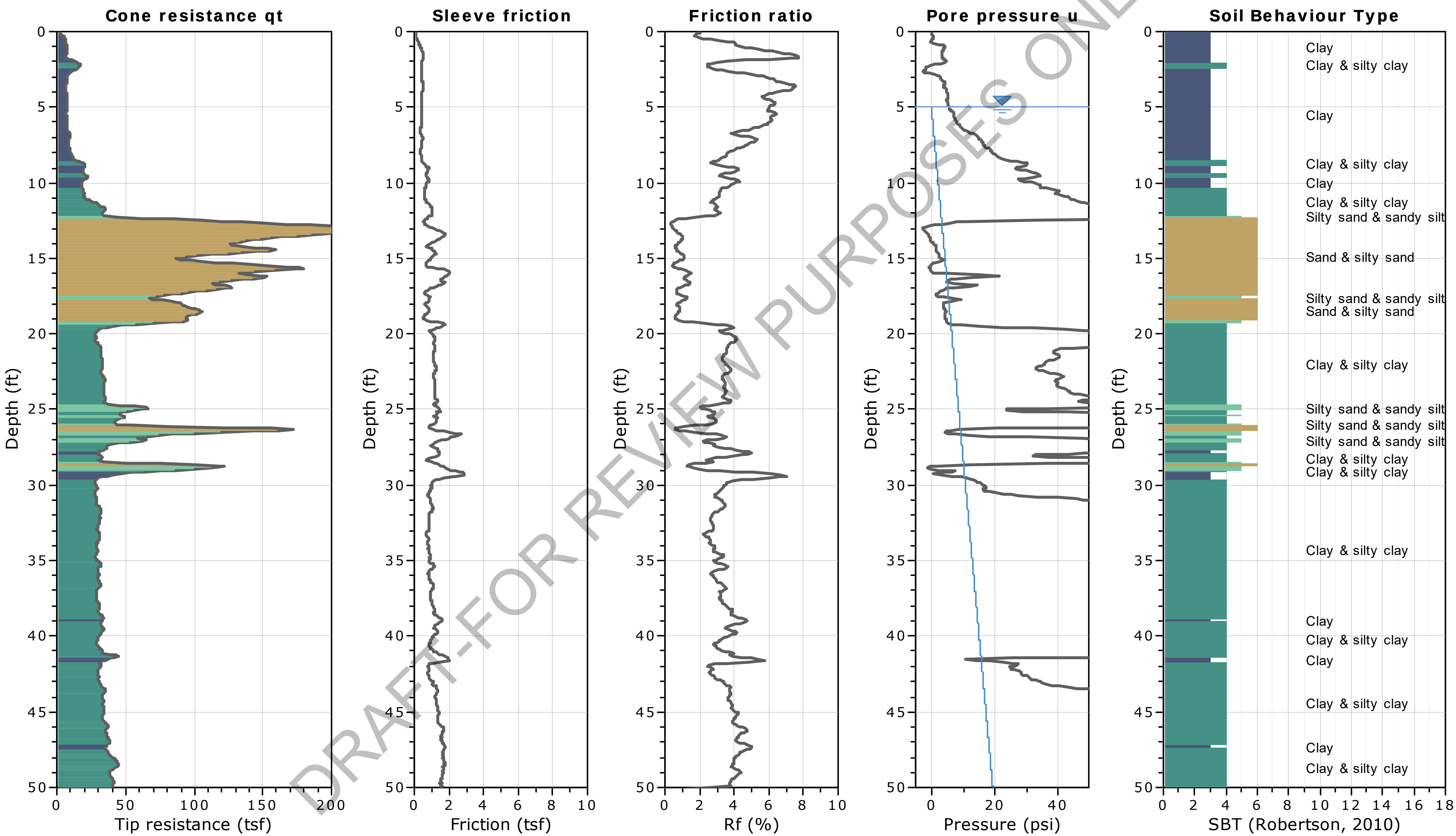


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-34

Total depth: 50.25 ft, Date: 5/5/2017
Coords: lat 43.5447° lon -93.0663°

Project: Freeborn Wind Project
Location: Freeborn County, Minnesota



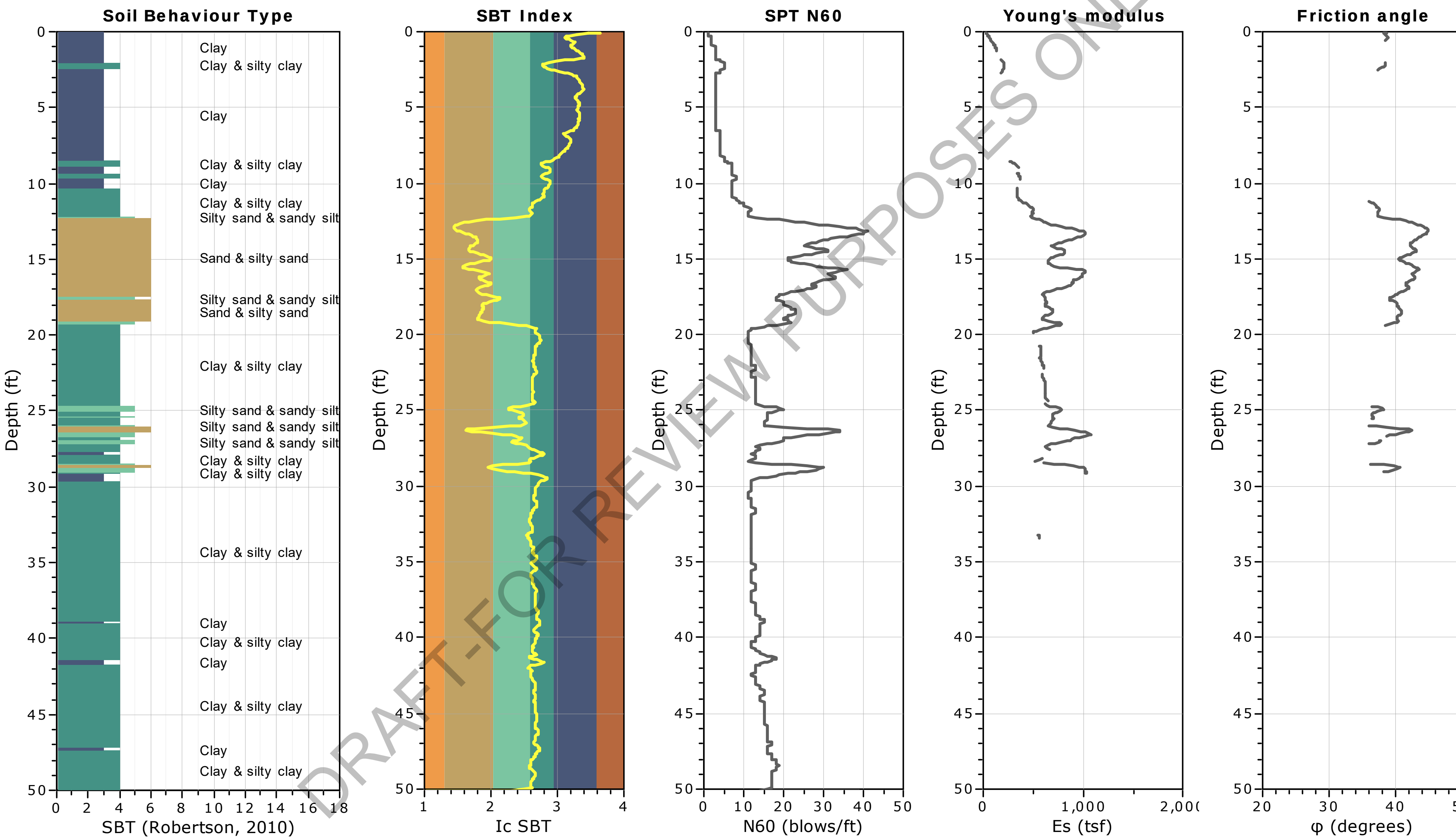
RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-34

Project: Freeborn Wind Project

Location: Freeborn County, Minnesota

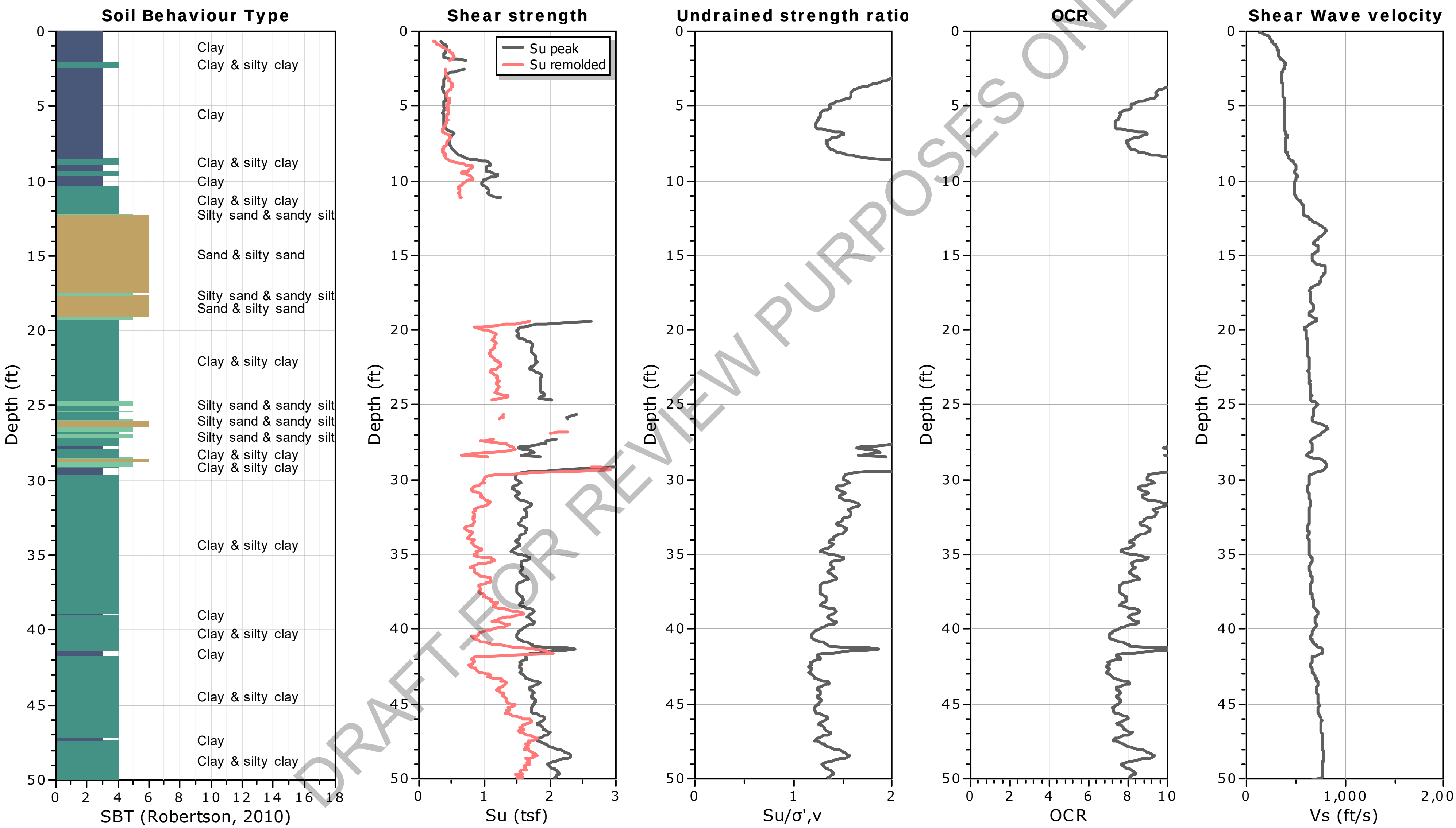
Total depth: 50.25 ft, Date: 5/5/2017
Coords: lat 43.5447° lon -93.0663°



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-34
Total depth: 50.25 ft, Date: 5/5/2017
Coords: lat 43.5447° lon -93.0663°

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

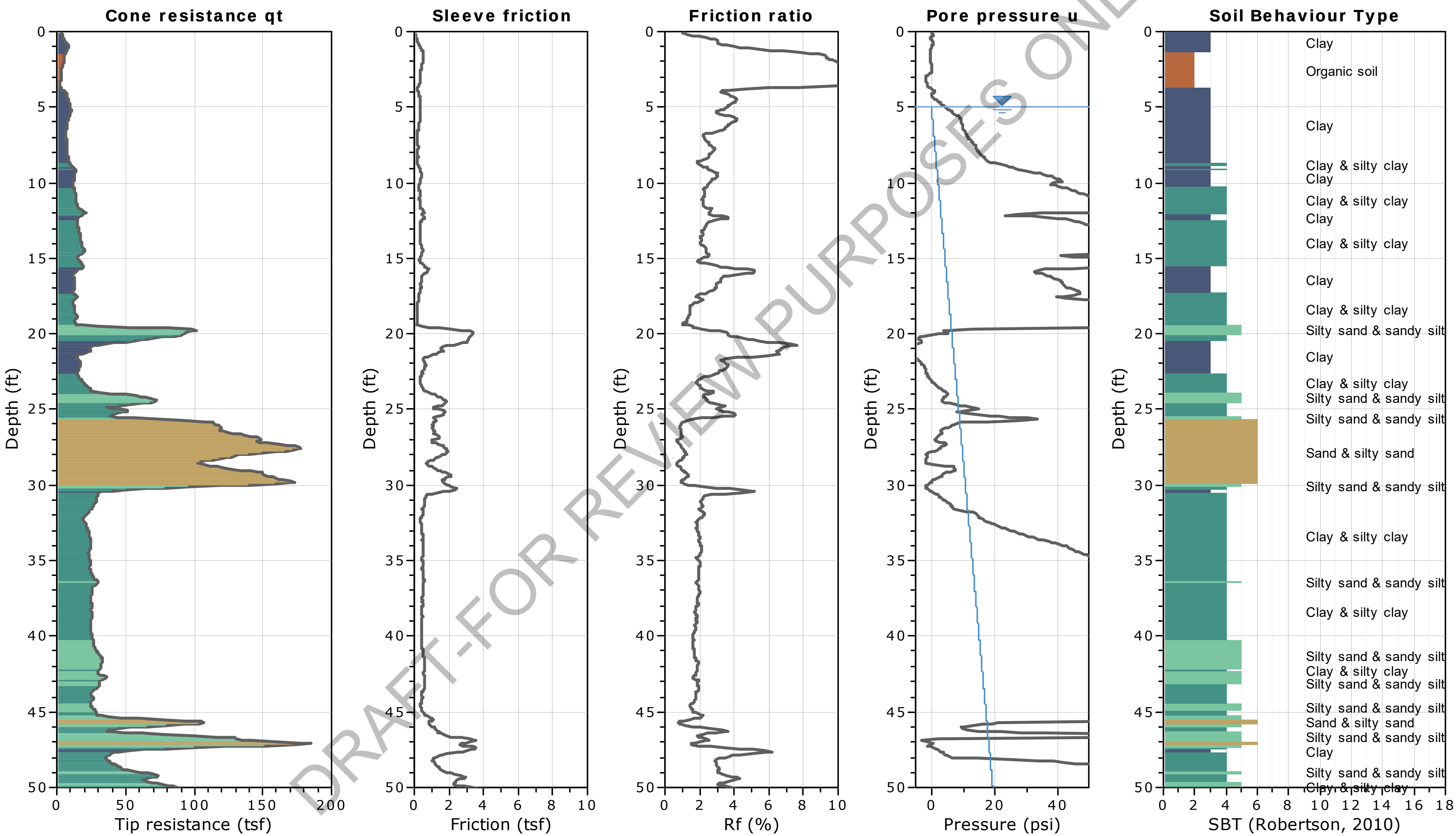
CPT: T-35

Total depth: 50.64 ft, Date: 5/5/2017

Coords: lat 43.527° lon -93.2208°

Project: **Freeborn Wind Project**

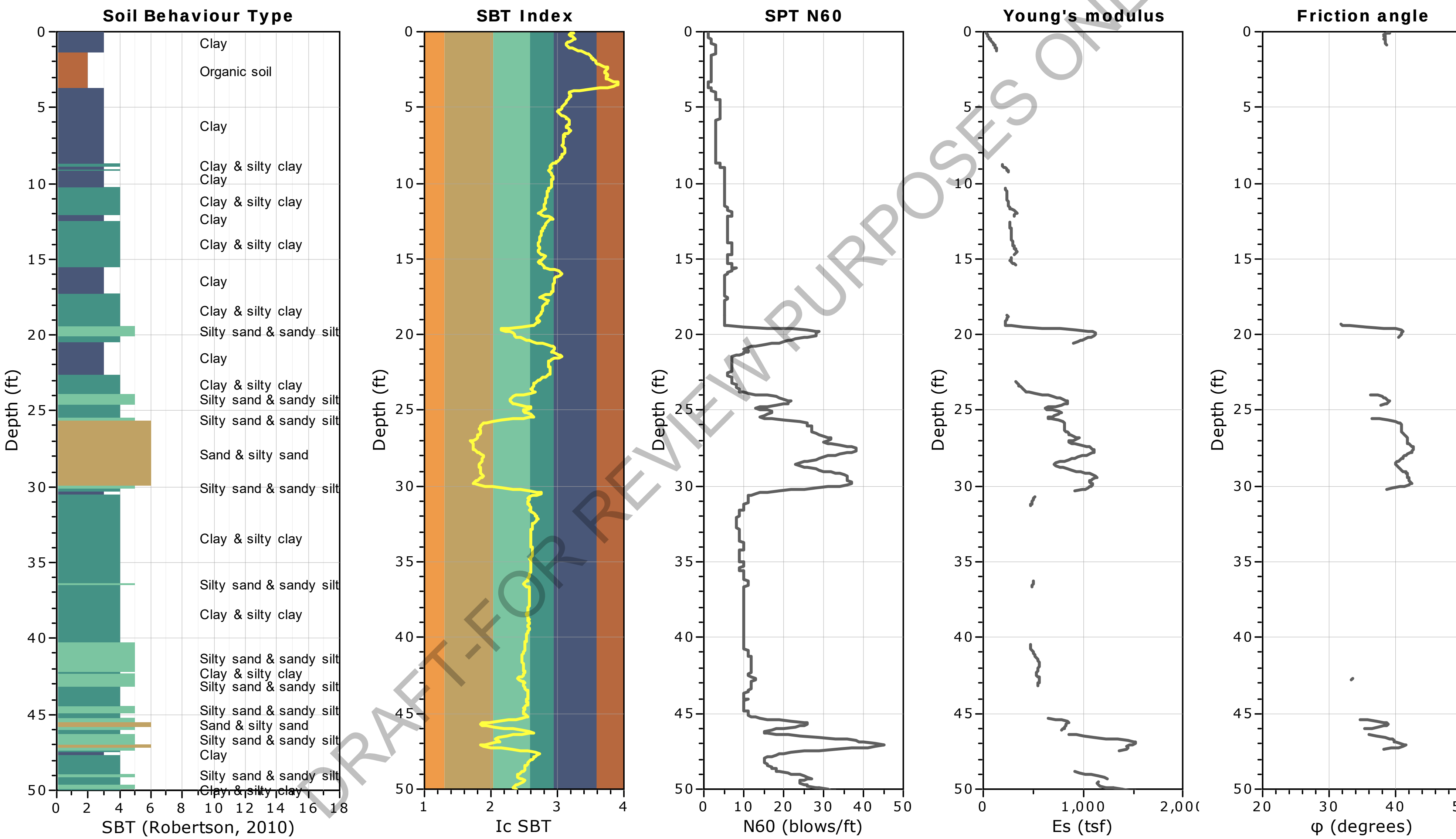
Location: **Freeborn County, Minnesota**



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-35
Total depth: 50.64 ft, Date: 5/5/2017
Coords: lat 43.527° lon -93.2208°

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**



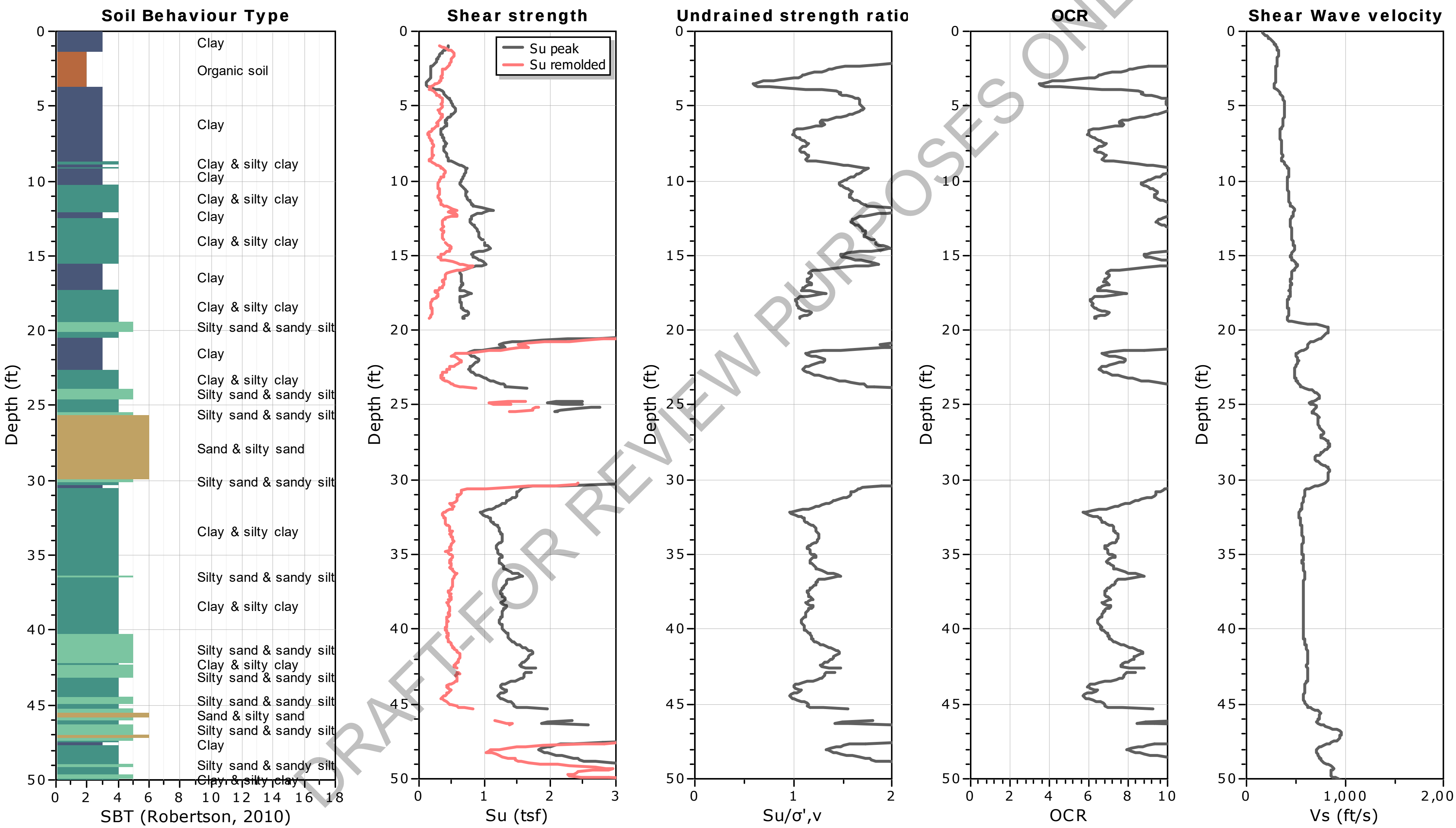
CPeT-IT v.2.0.1.55 - CPTU data presentation & interpretation software - Report created on: 5/12/2017, 4:30:47 PM
Project file:

RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-35

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

Total depth: 50.64 ft, Date: 5/5/2017
Coords: lat 43.527° lon -93.2208°



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

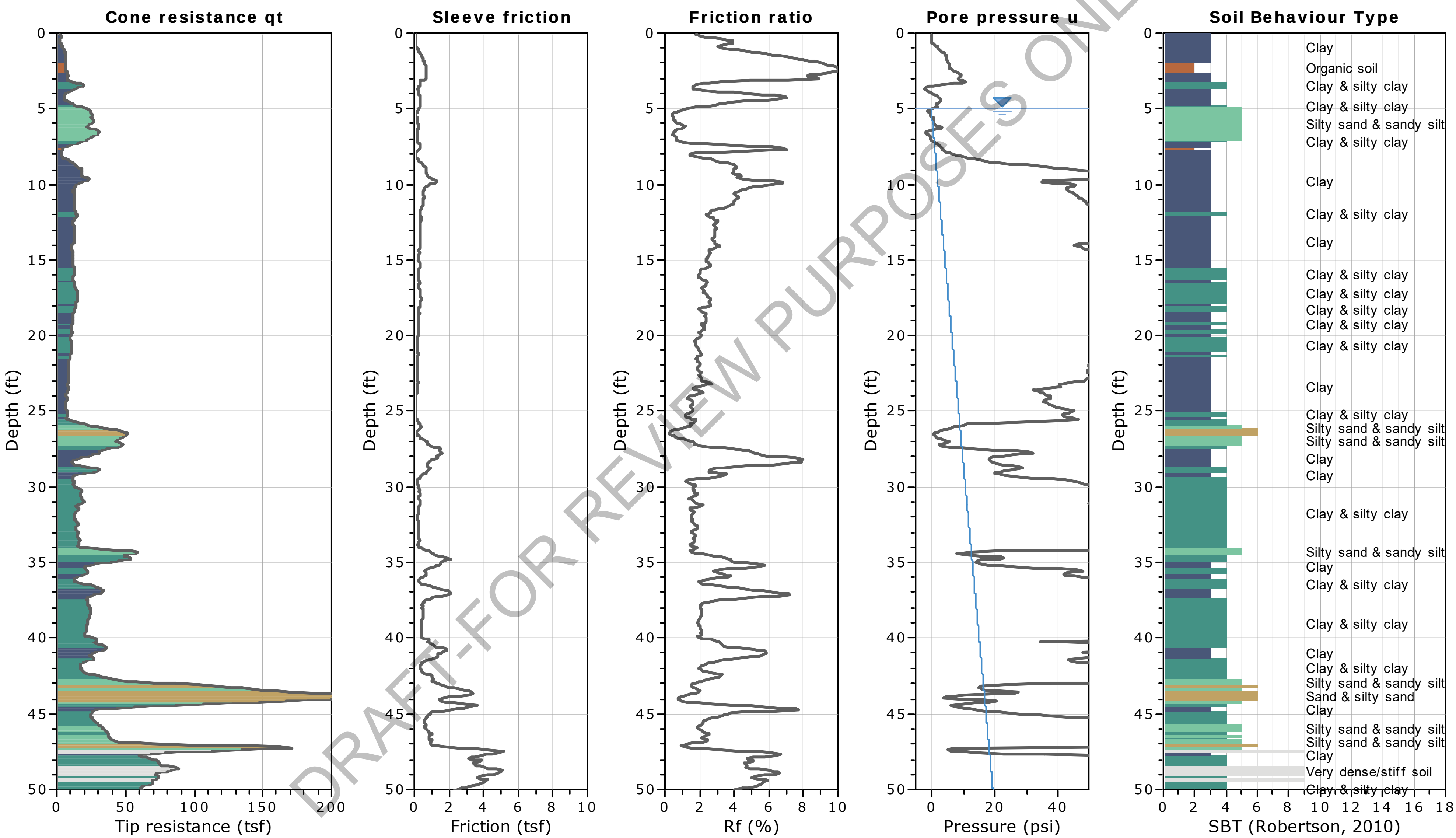
CPT: T-36

Total depth: 50.64 ft, Date: 5/5/2017

Coords: lat 43.5235° lon -93.2033°

Project: **Freeborn Wind Project**

Location: **Freeborn County, Minnesota**

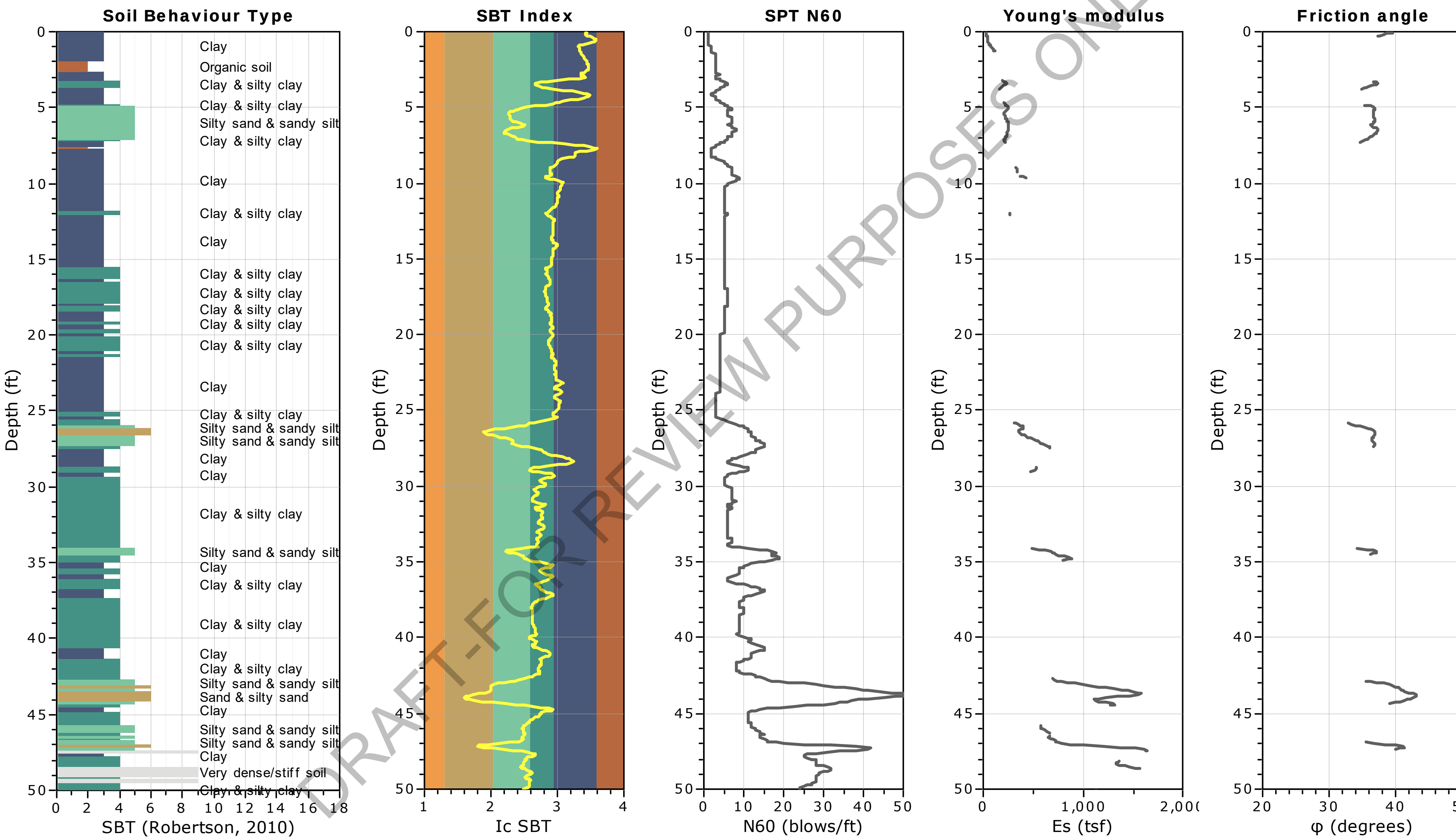


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-36

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

Total depth: 50.64 ft, Date: 5/5/2017
Coords: lat 43.5235° lon -93.2033°

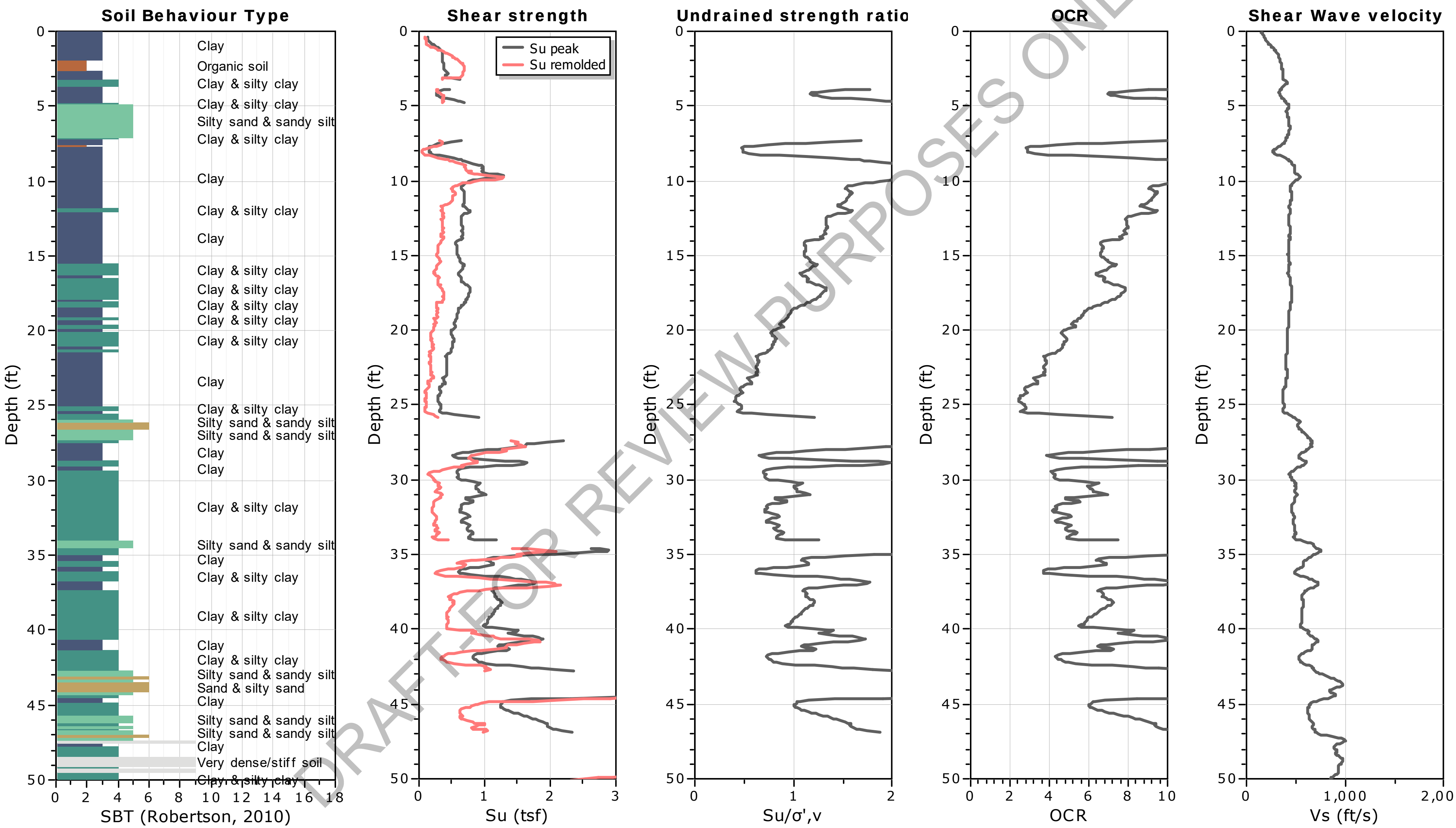


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-36

Project: Freeborn Wind Project
Location: Freeborn County, Minnesota

Total depth: 50.64 ft, Date: 5/5/2017
Coords: lat 43.5235° lon -93.2033°



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

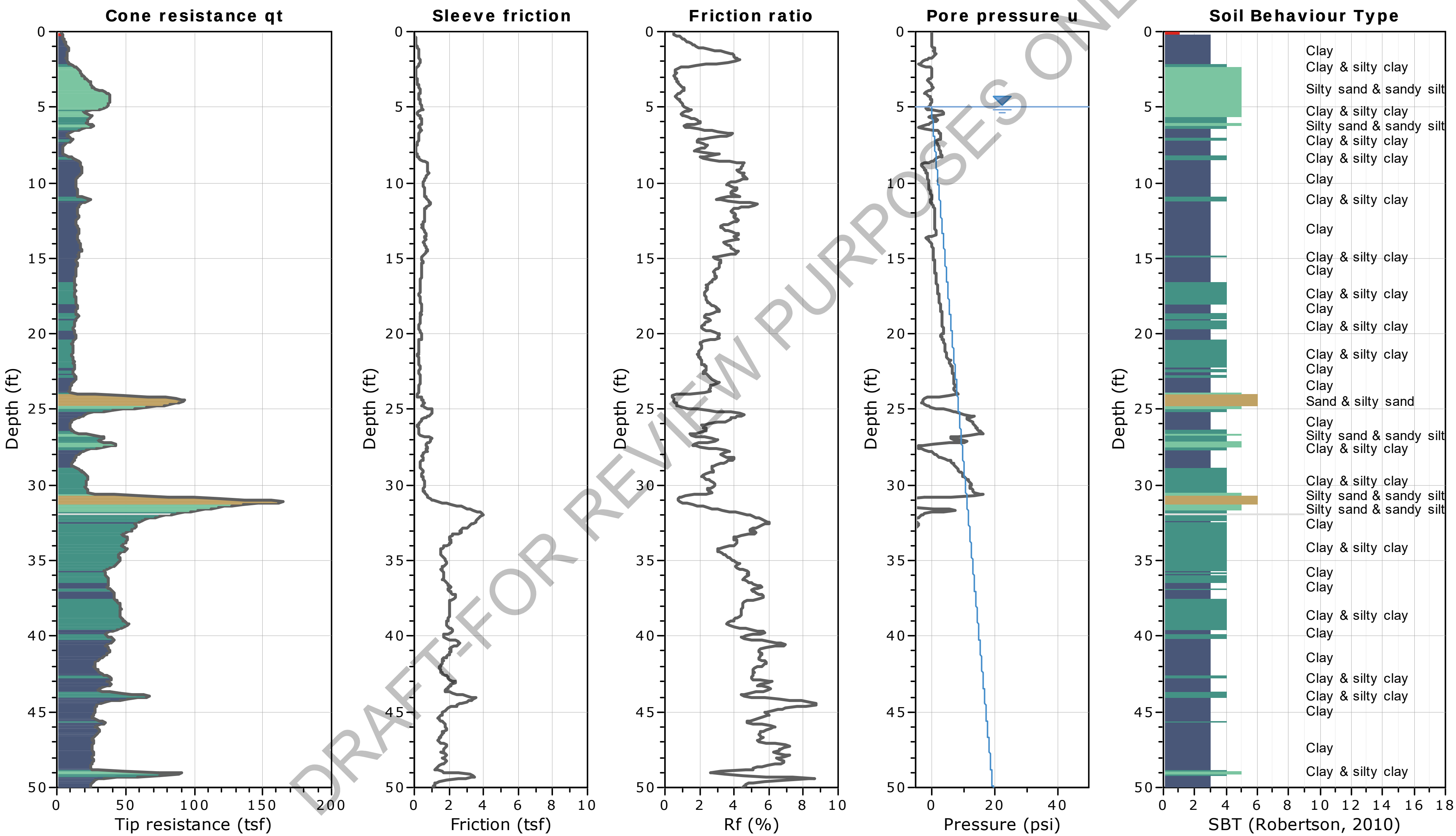
CPT: T-37

Project: **Freeborn Wind Project**

Location: **Freeborn County, Minnesota**

Total depth: 50.32 ft, Date: 5/5/2017

Coords: lat 43.5188° lon -93.1868°

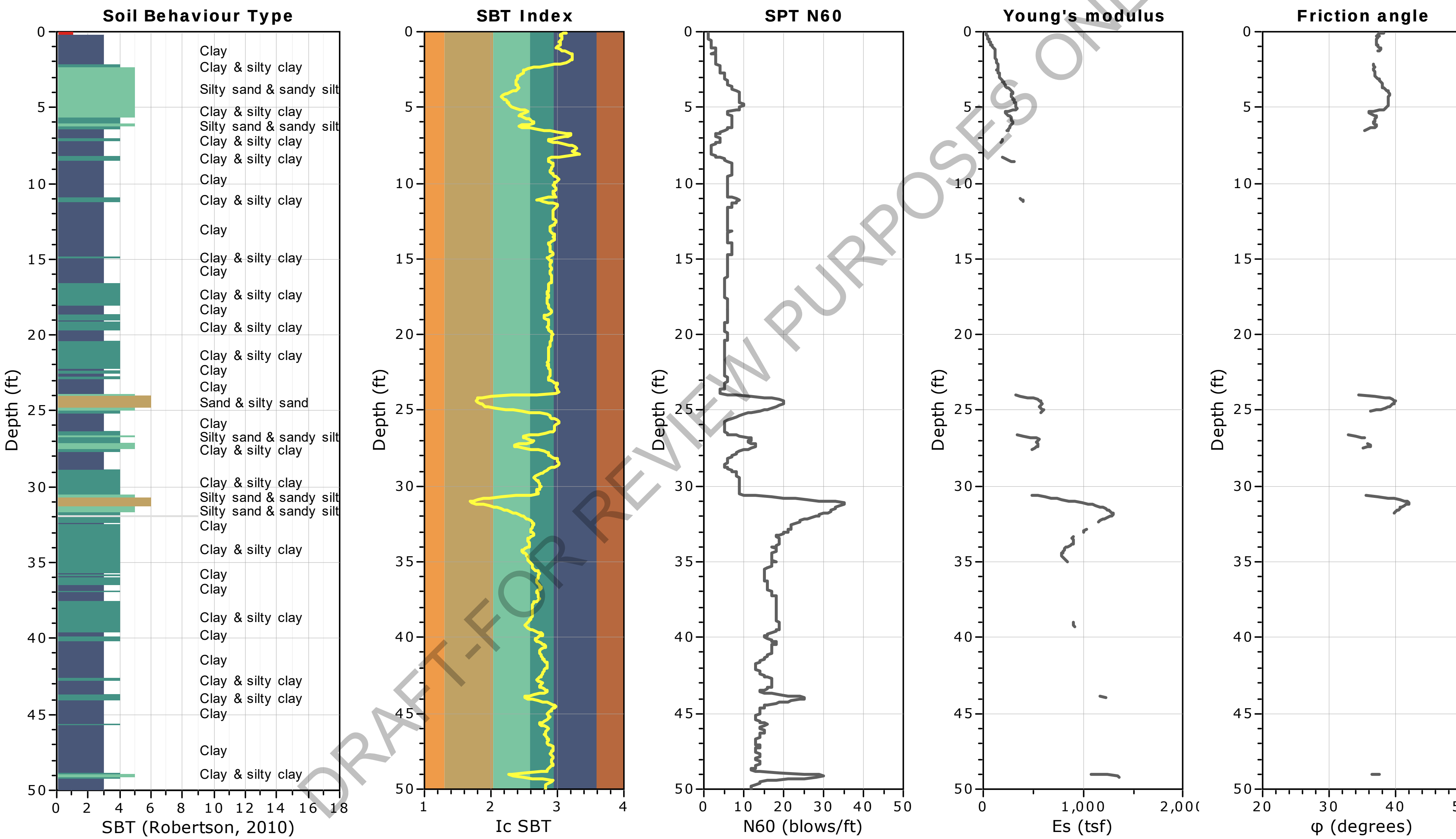


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-37

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

Total depth: 50.32 ft, Date: 5/5/2017
Coords: lat 43.5188° lon -93.1868°



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

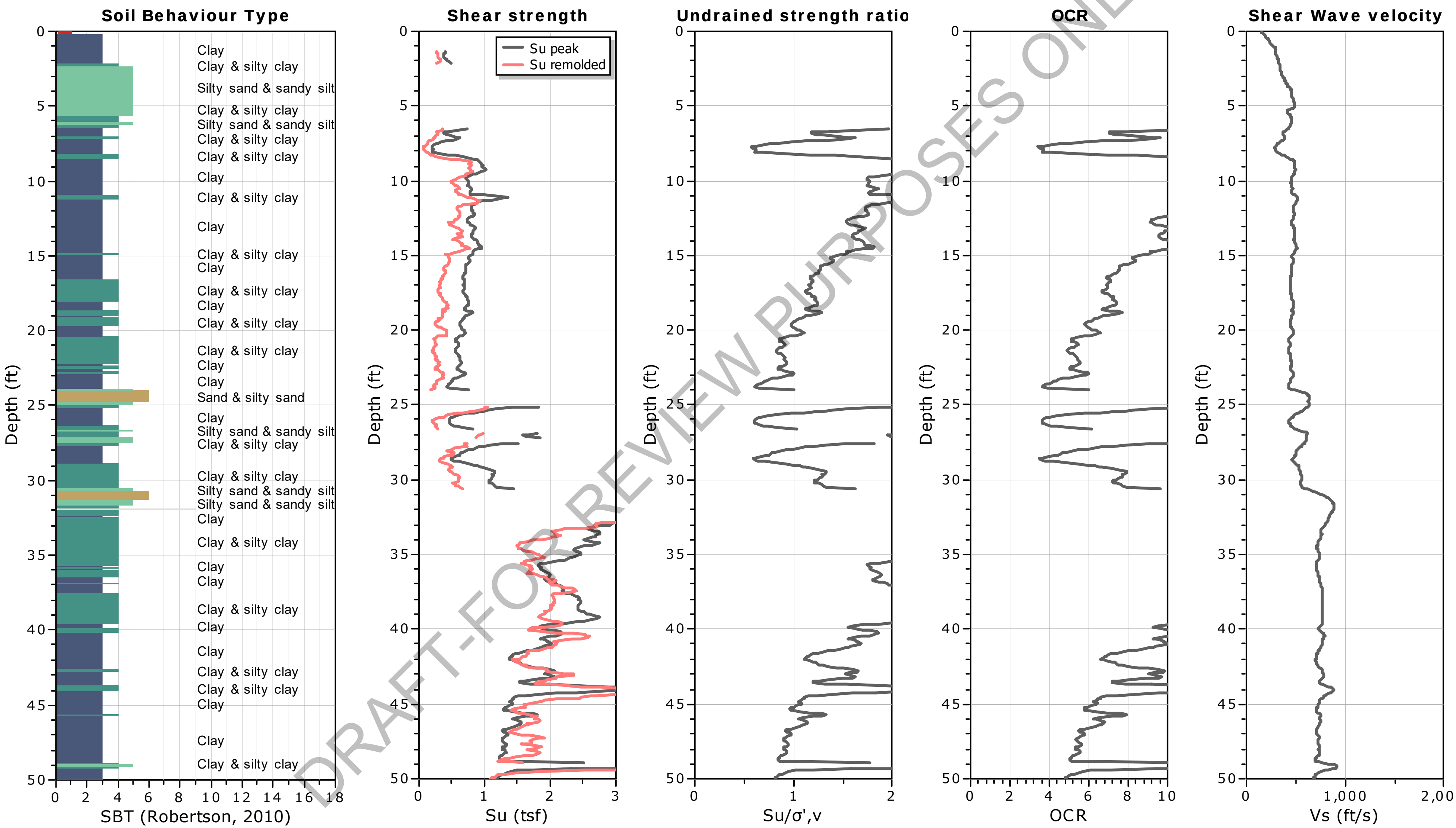
CPT: T-37

Total depth: 50.32 ft, Date: 5/5/2017

Coords: lat 43.5188° lon -93.1868°

Project: **Freeborn Wind Project**

Location: **Freeborn County, Minnesota**



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

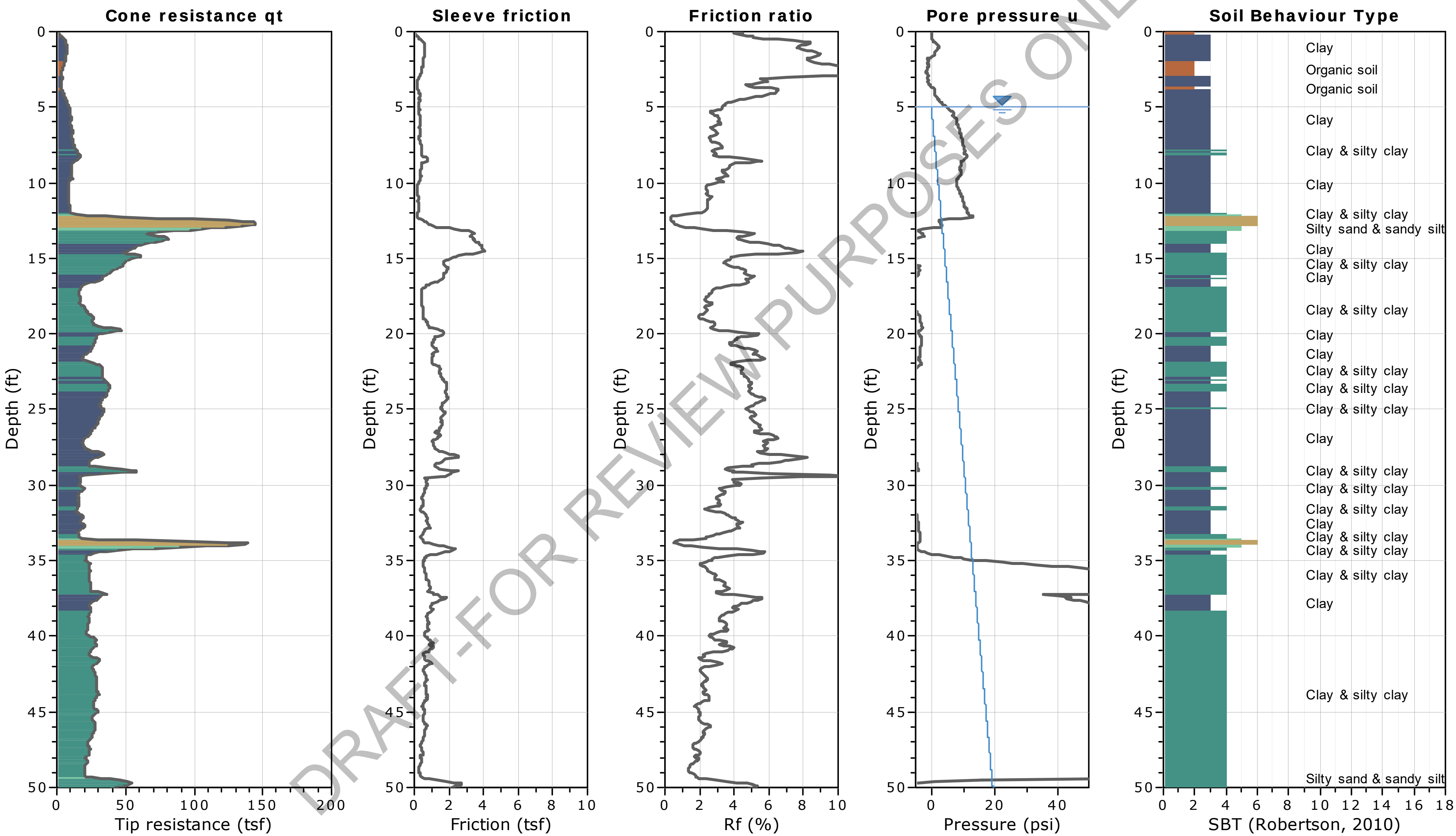
CPT: T-38

Total depth: 50.58 ft, Date: 5/5/2017

Coords: lat 43.5185° lon -93.1627°

Project: **Freeborn Wind Project**

Location: **Freeborn County, Minnesota**

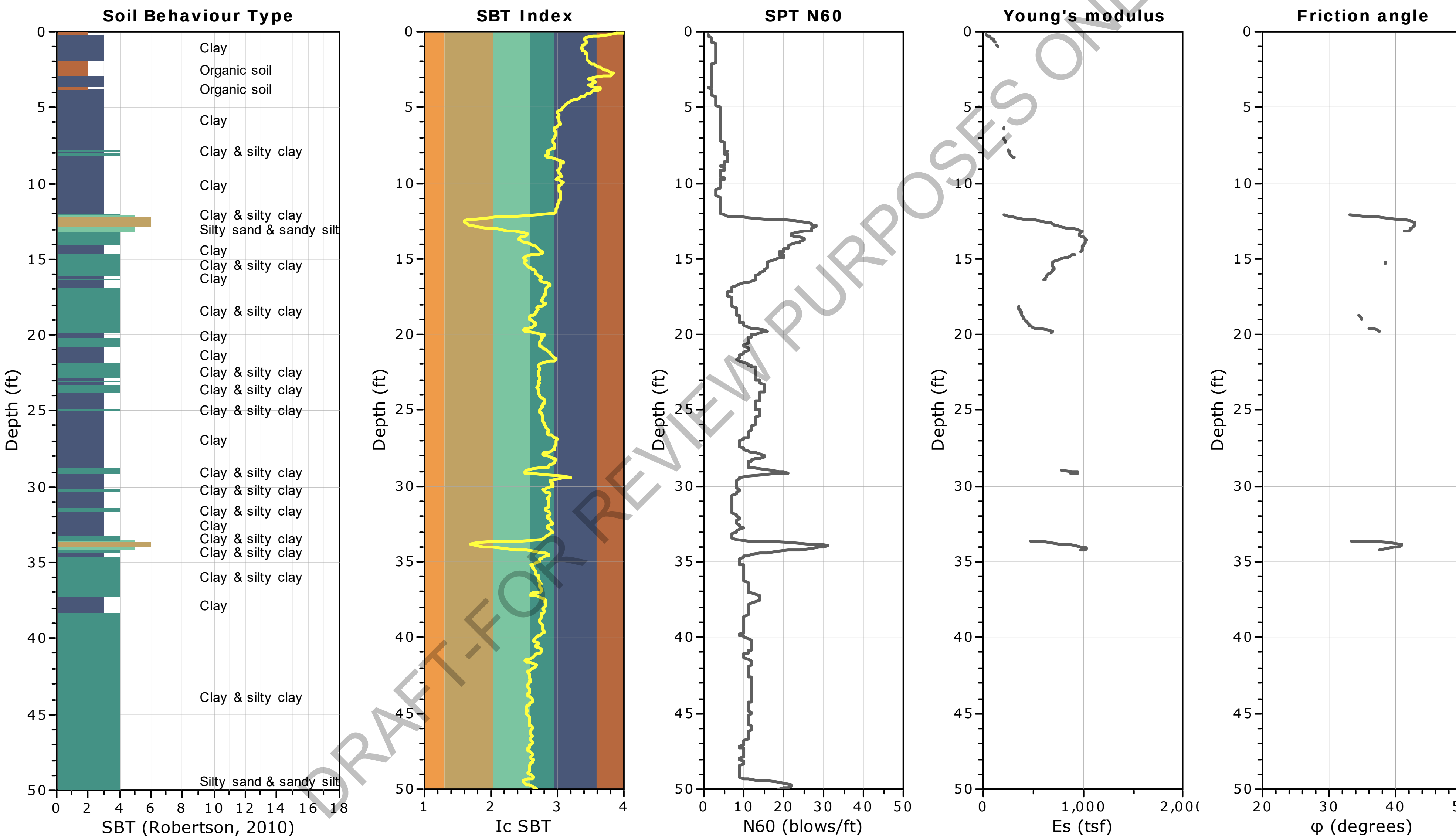


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-38

Project: Freeborn Wind Project
Location: Freeborn County, Minnesota

Total depth: 50.58 ft, Date: 5/5/2017
Coords: lat 43.5185° lon -93.1627°

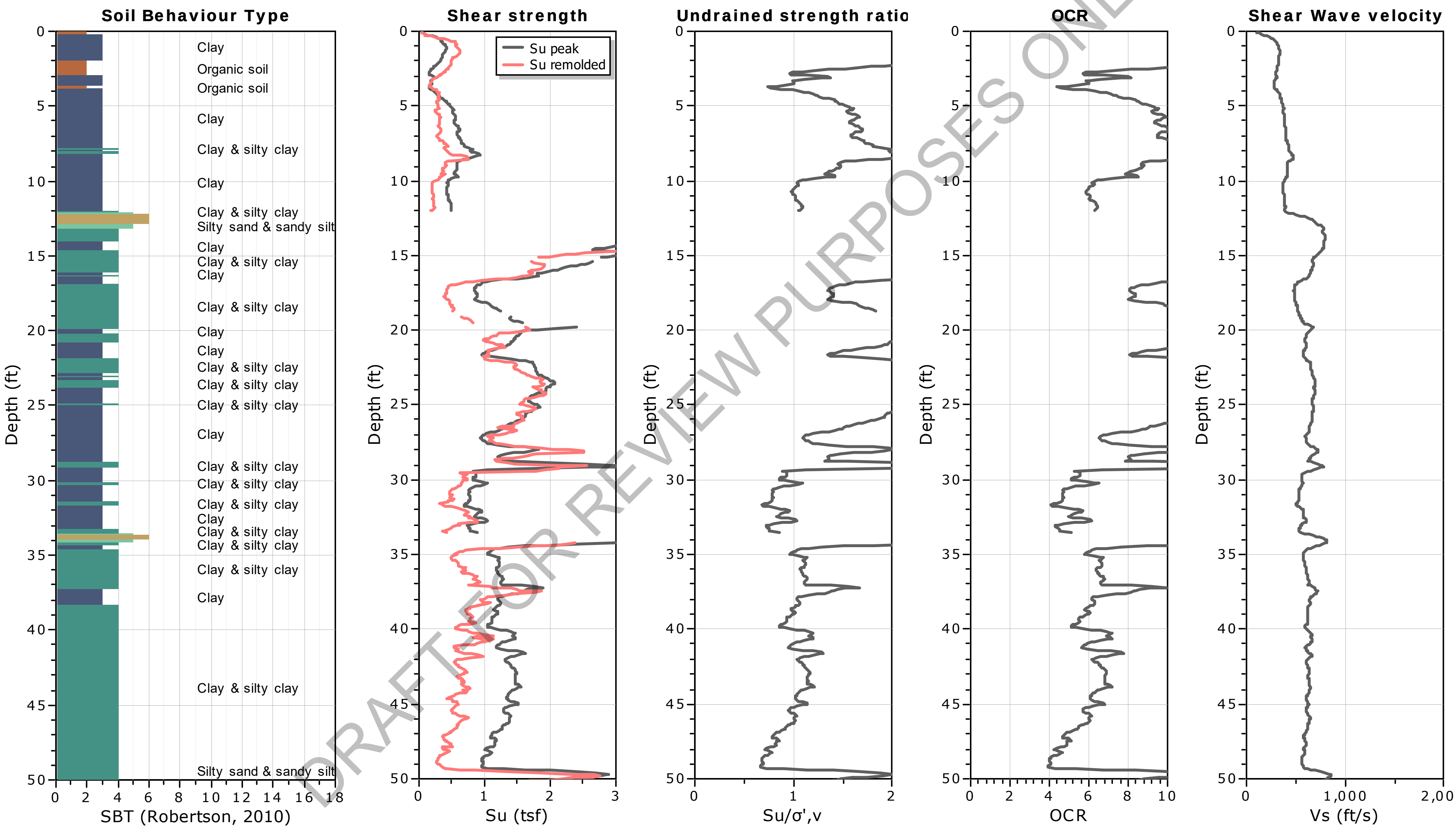


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-38

Project: Freeborn Wind Project
Location: Freeborn County, Minnesota

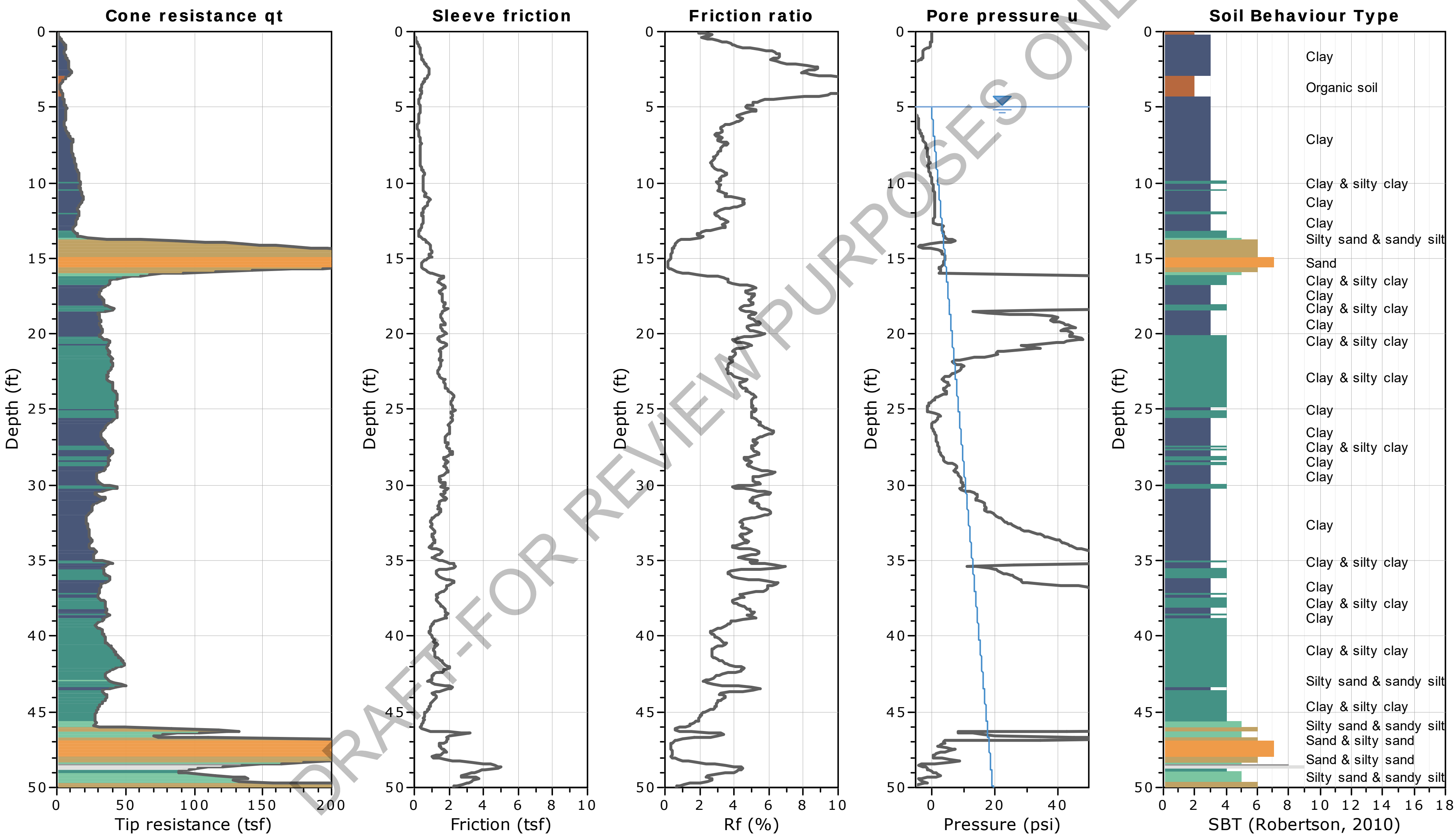
Total depth: 50.58 ft, Date: 5/5/2017
Coords: lat 43.5185° lon -93.1627°



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-39
Total depth: 50.58 ft, Date: 5/5/2017
Coords: lat 43.5195° lon -93.1566°

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

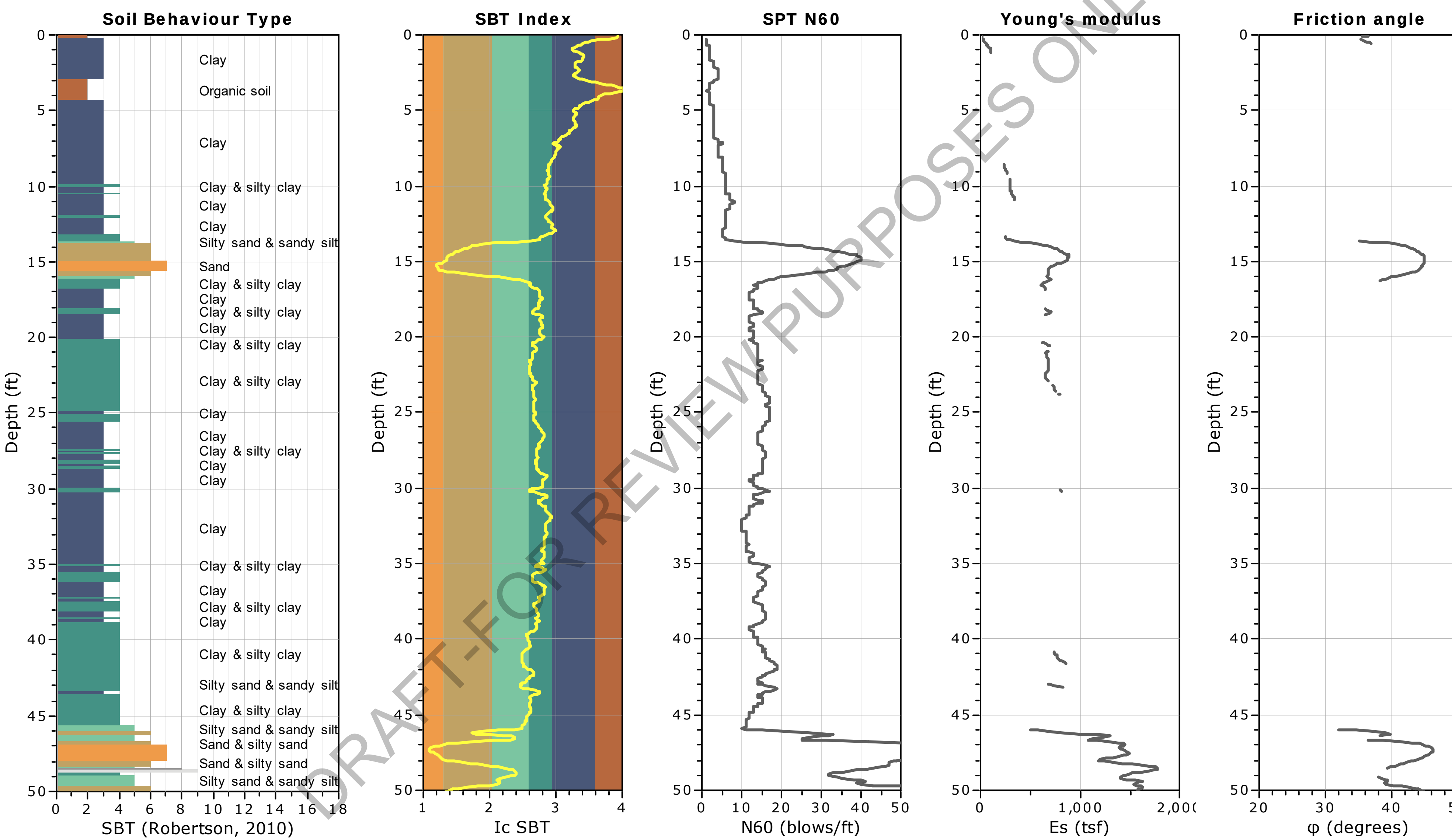
CPT: T-39

Project: **Freeborn Wind Project**

Location: **Freeborn County, Minnesota**

Total depth: 50.58 ft, Date: 5/5/2017

Coords: lat 43.5195° lon -93.1566°

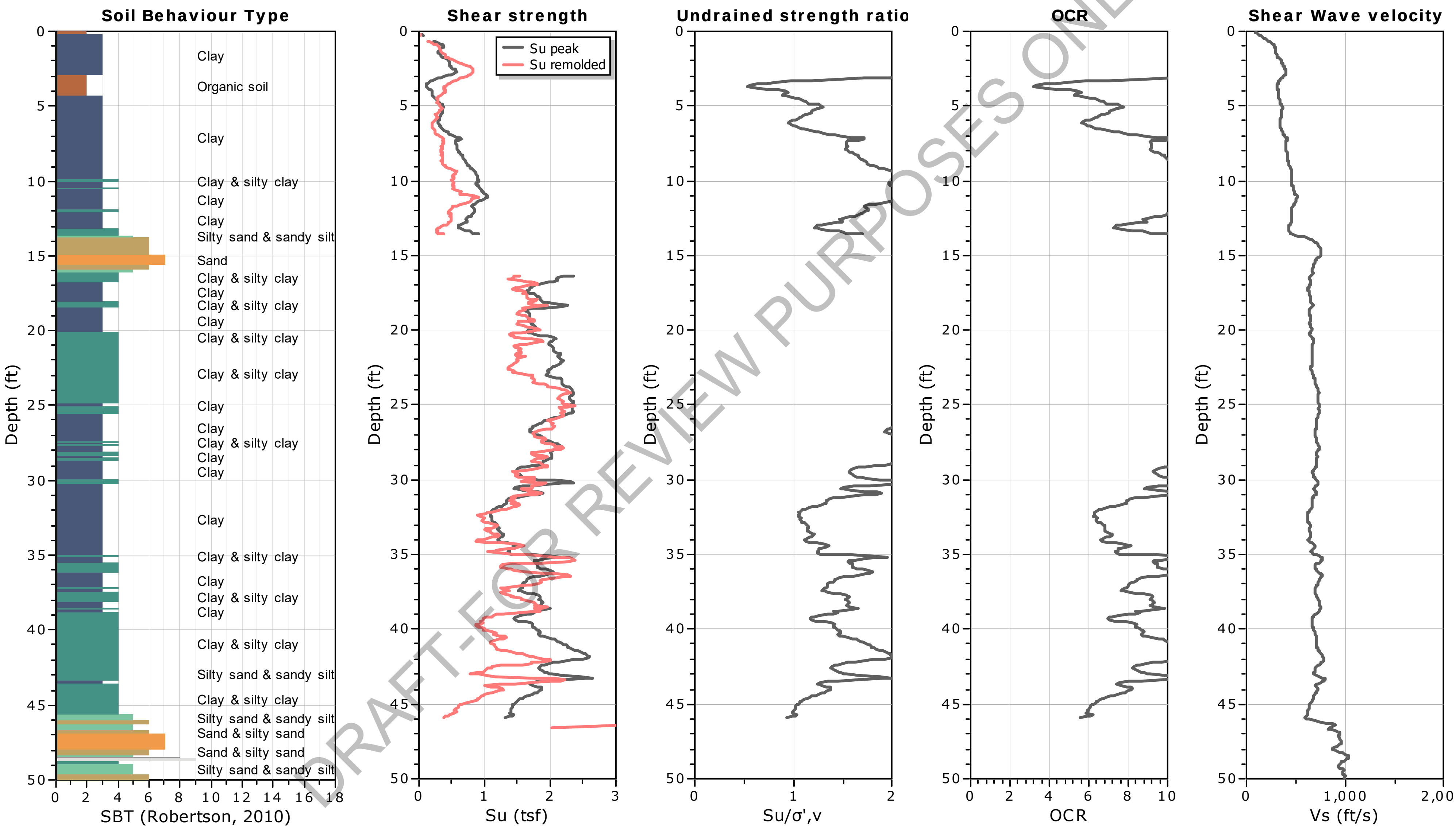


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-39

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

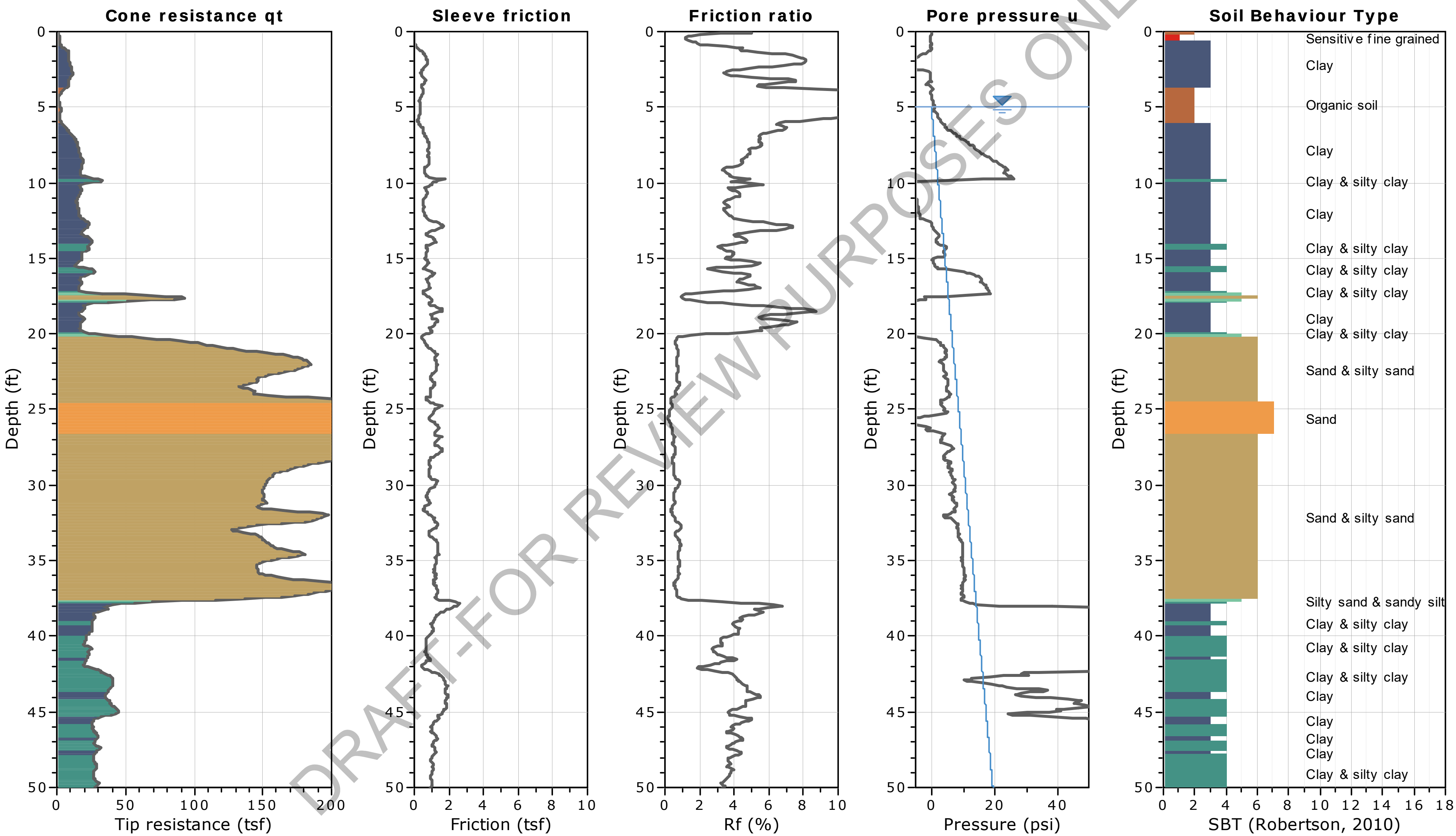
Total depth: 50.58 ft, Date: 5/5/2017
Coords: lat 43.5195° lon -93.1566°



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

Project: Freeborn Wind Project
Location: Freeborn County, Minnesota

CPT: T-40
Total depth: 50.58 ft, Date: 5/5/2017
Coords: lat 43.5187° lon -93.1414°



RRC

RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

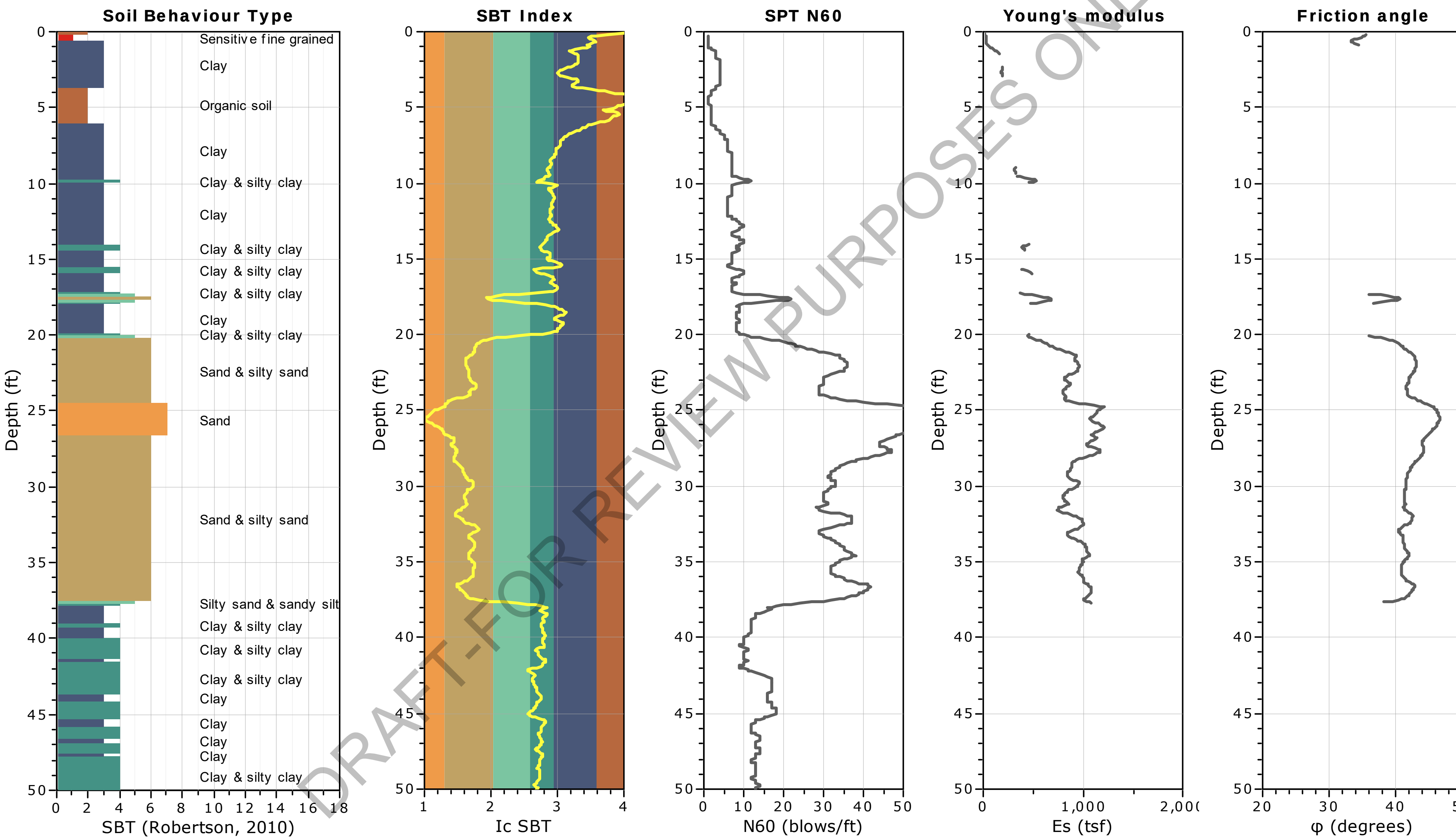
CPT: T-40

Total depth: 50.58 ft, Date: 5/5/2017

Coords: lat 43.5187° lon -93.1414°

Project: **Freeborn Wind Project**

Location: **Freeborn County, Minnesota**



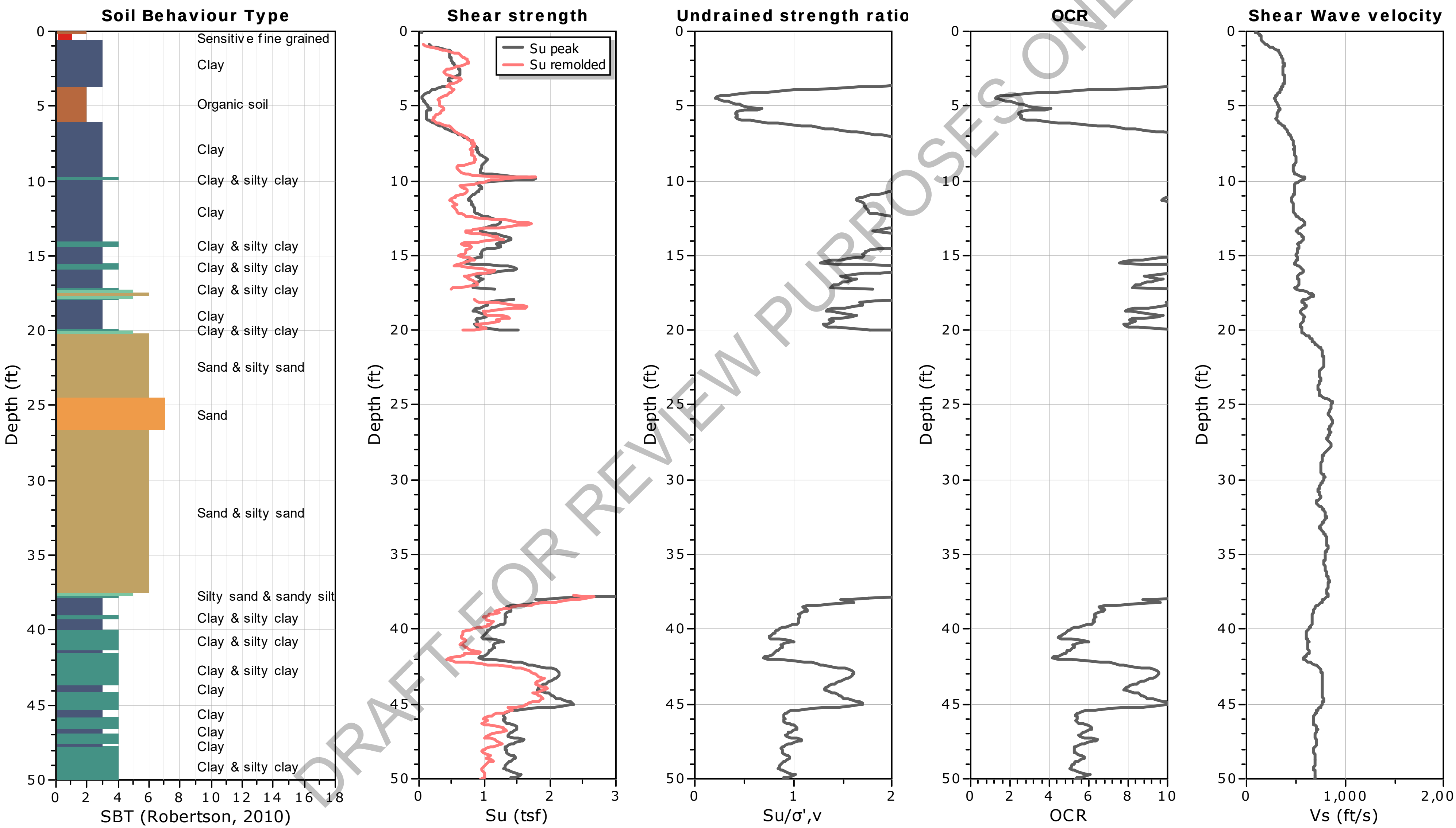
RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-40

Project: **Freeborn Wind Project**

Location: **Freeborn County, Minnesota**

Total depth: 50.58 ft, Date: 5/5/2017
Coords: lat 43.5187° lon -93.1414°

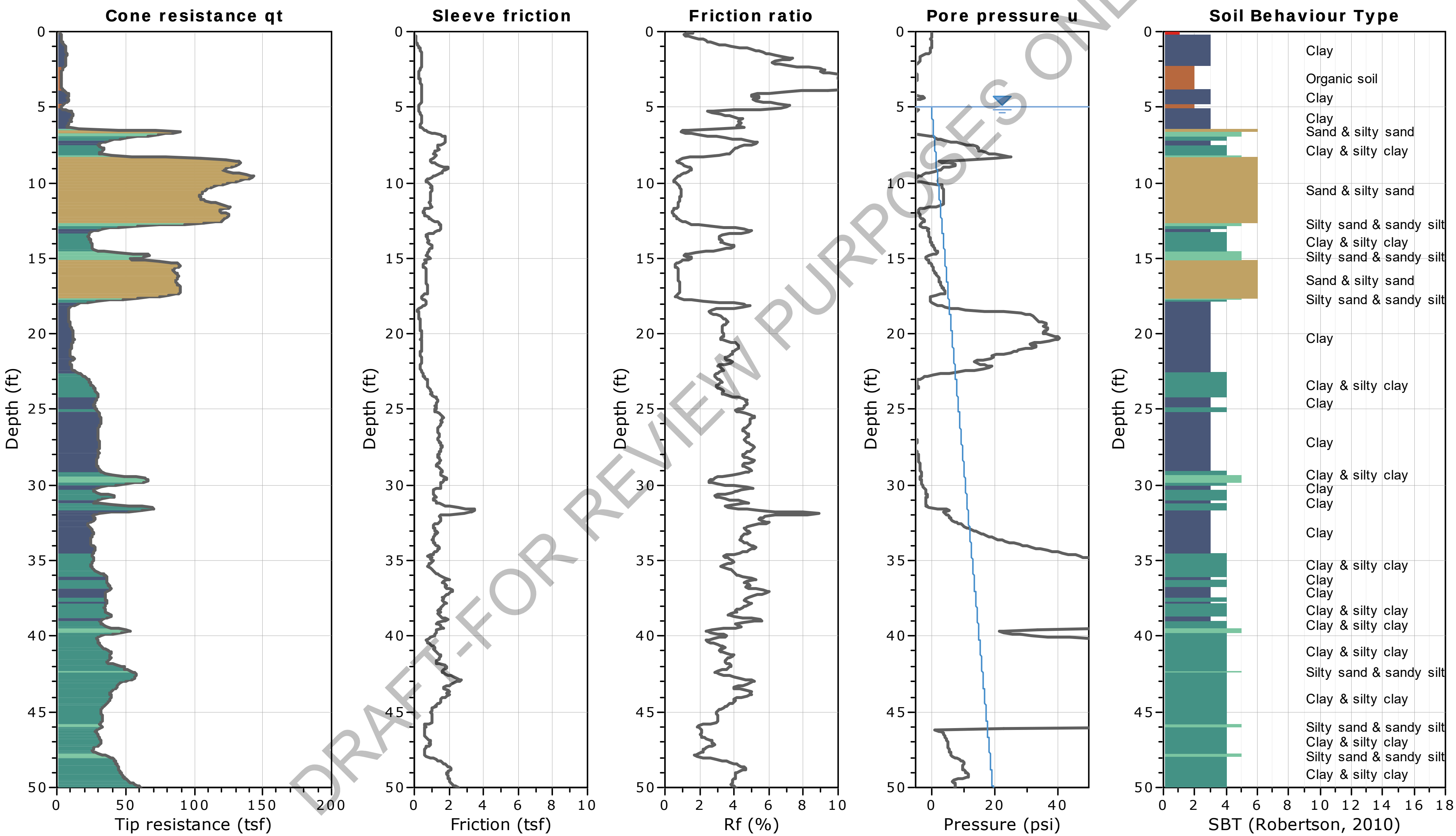


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-41

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

Total depth: 50.58 ft, Date: 5/5/2017
Coords: lat 43.52° lon -93.1362°



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

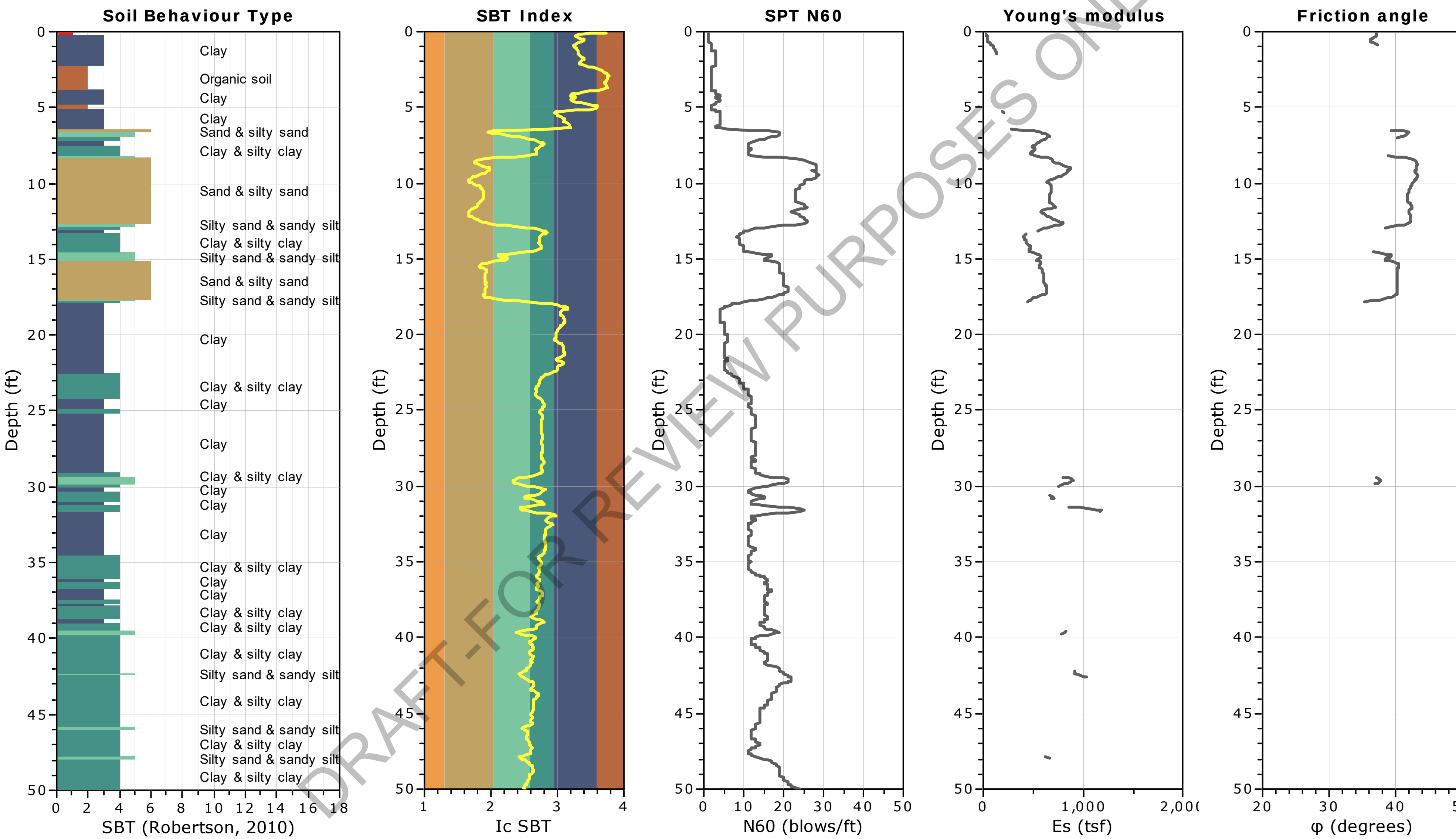
CPT: T-41

Project: **Freeborn Wind Project**

Location: **Freeborn County, Minnesota**

Total depth: 50.58 ft, Date: 5/5/2017

Coords: lat 43.52° lon -93.1362°



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

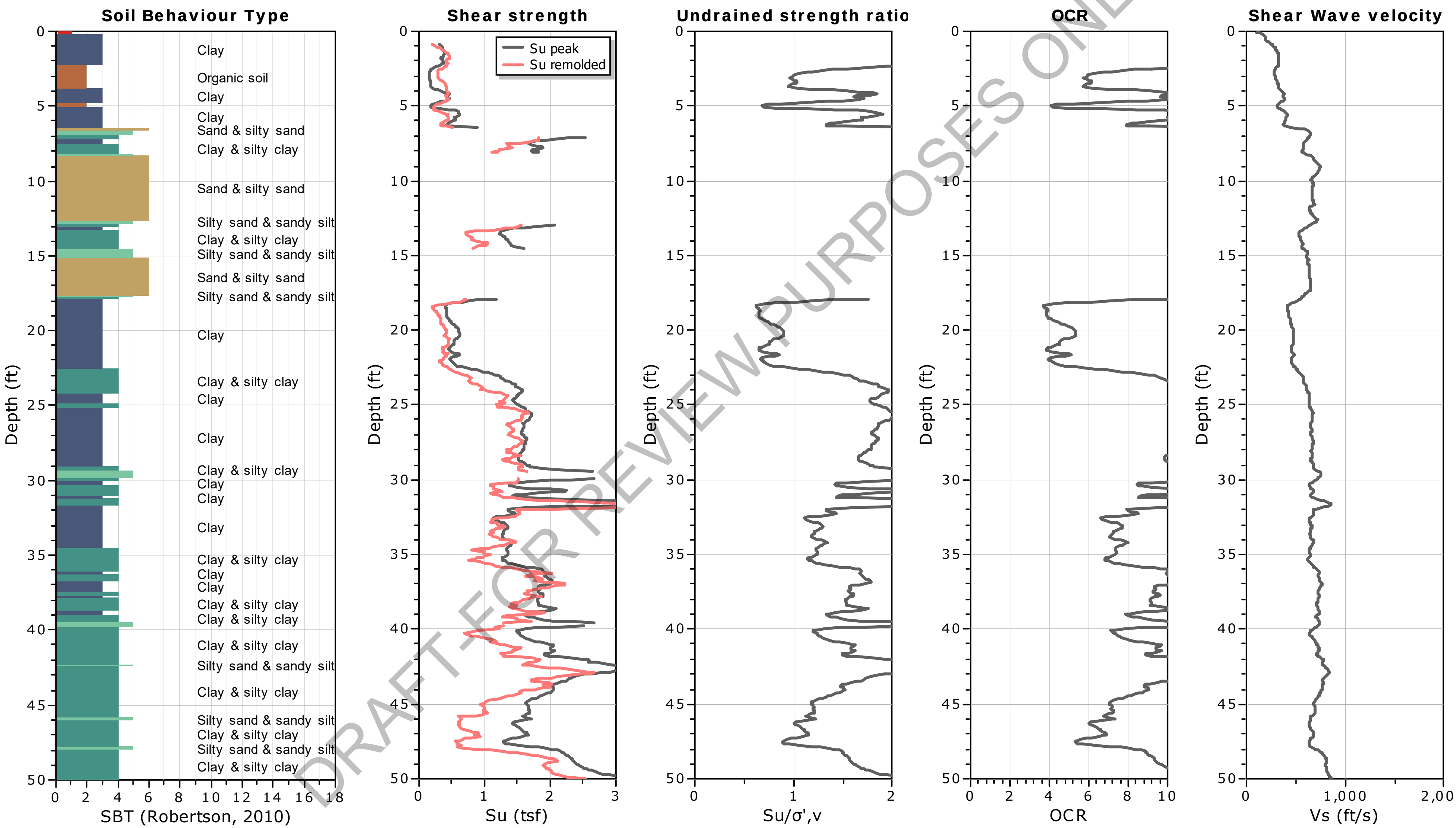
CPT: T-41

Project: **Freeborn Wind Project**

Location: **Freeborn County, Minnesota**

Total depth: 50.58 ft, Date: 5/5/2017

Coords: lat 43.52° lon -93.1362°

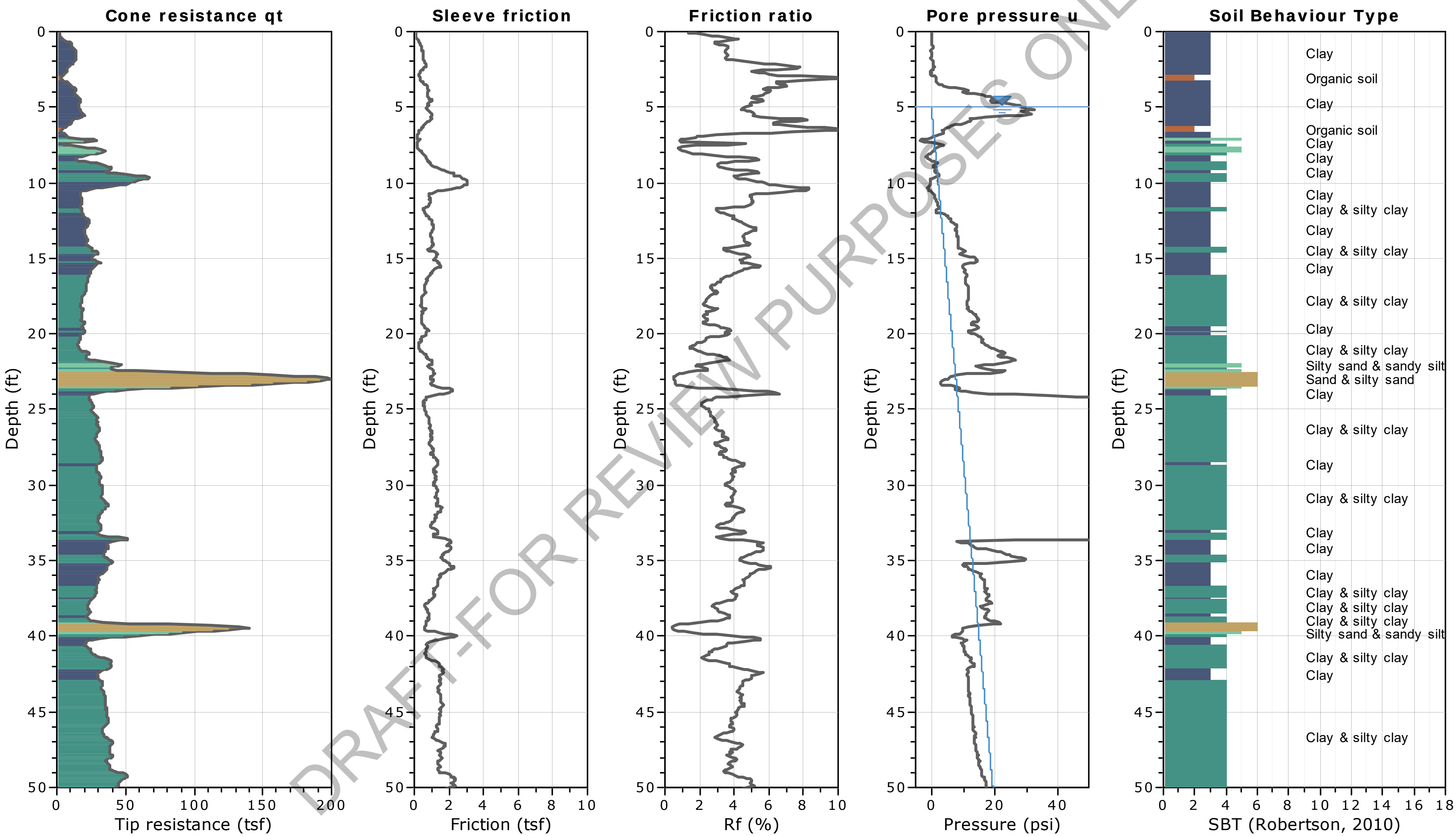


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-42

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

Total depth: 50.51 ft, Date: 5/5/2017
Coords: lat 43.5178° lon -93.1246°



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

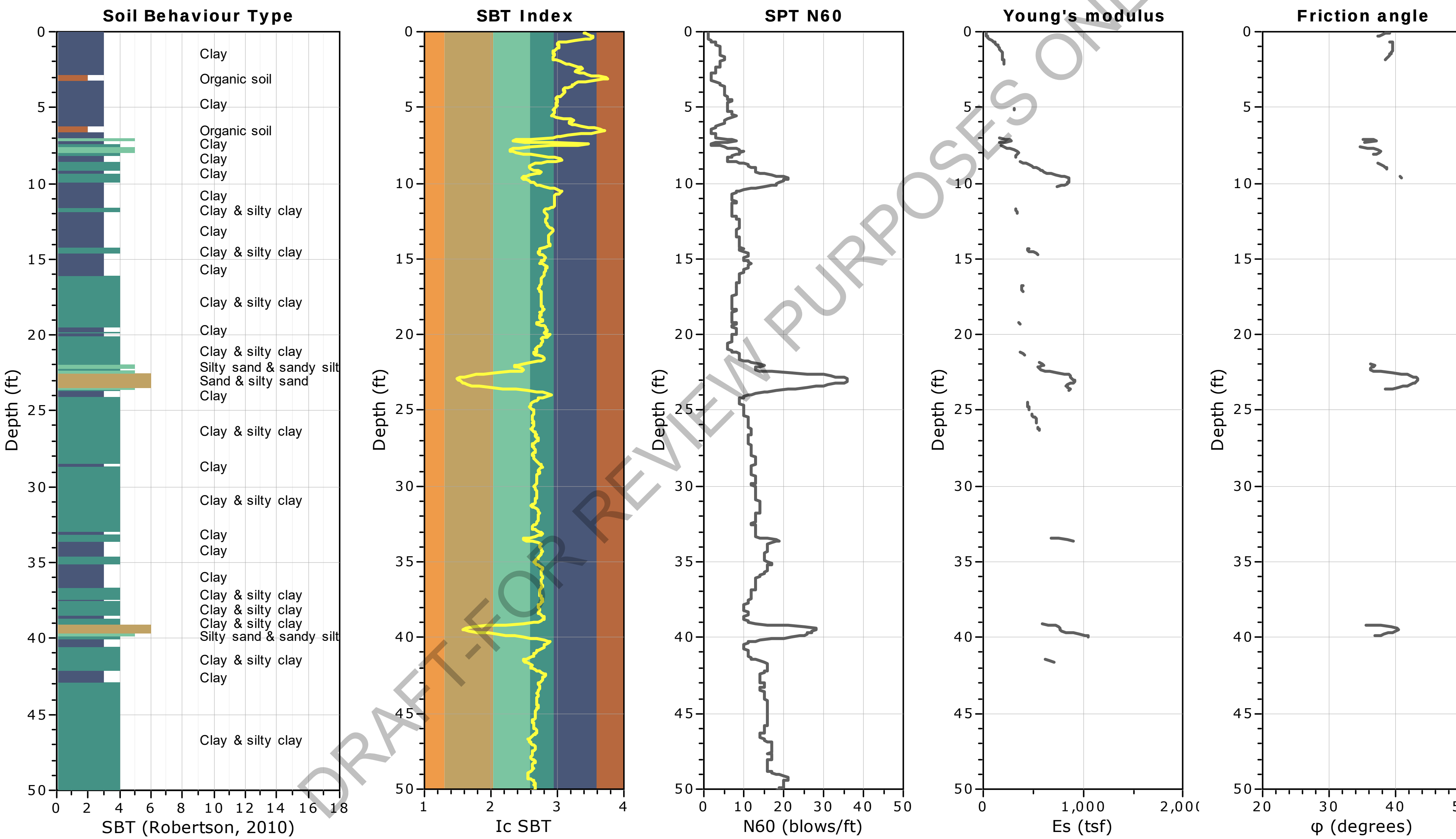
CPT: T-42

Total depth: 50.51 ft, Date: 5/5/2017

Coords: lat 43.5178° lon -93.1246°

Project: **Freeborn Wind Project**

Location: **Freeborn County, Minnesota**



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

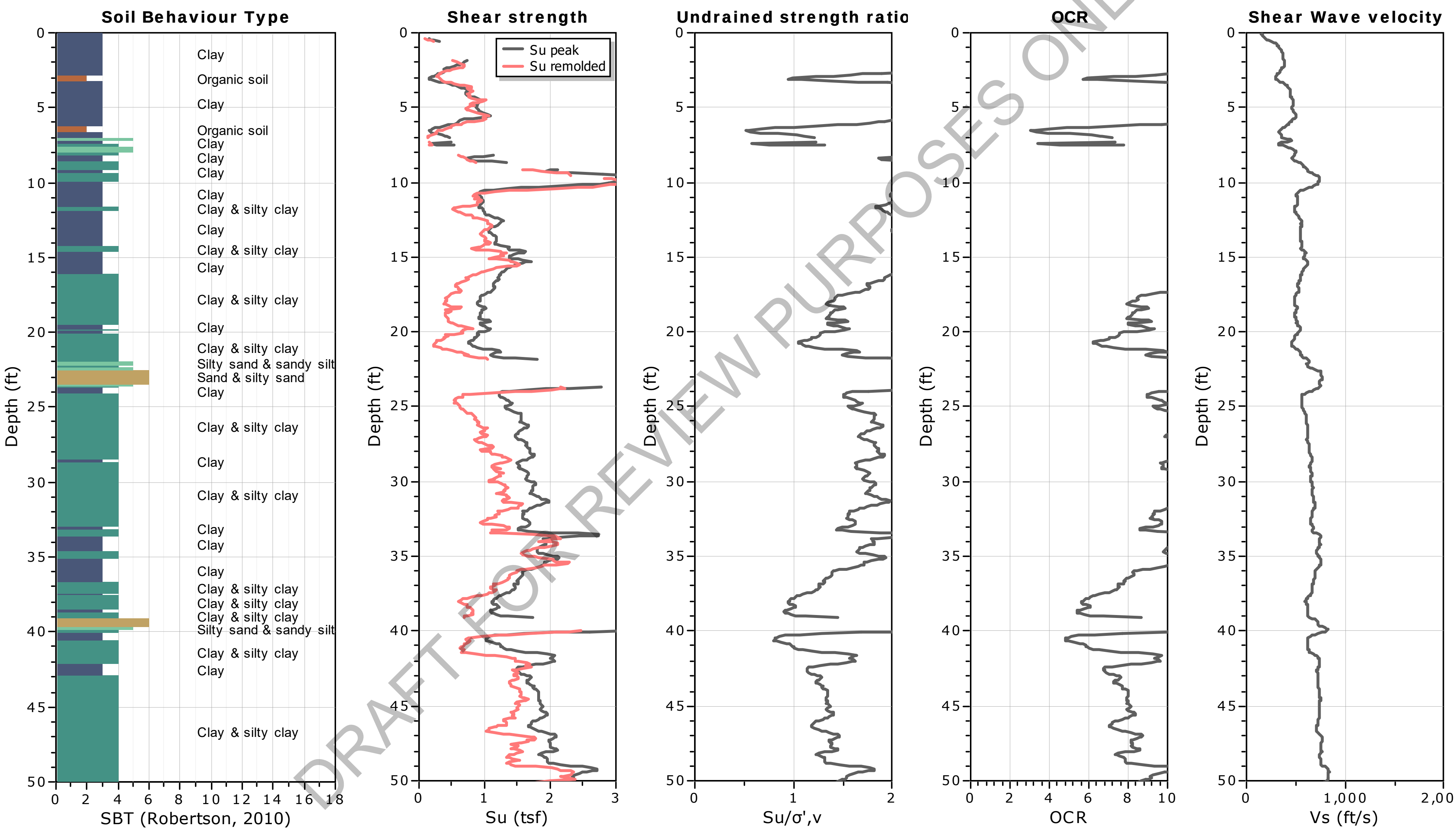
CPT: T-42

Total depth: 50.51 ft, Date: 5/5/2017

Coords: lat 43.5178° lon -93.1246°

Project: **Freeborn Wind Project**

Location: **Freeborn County, Minnesota**



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

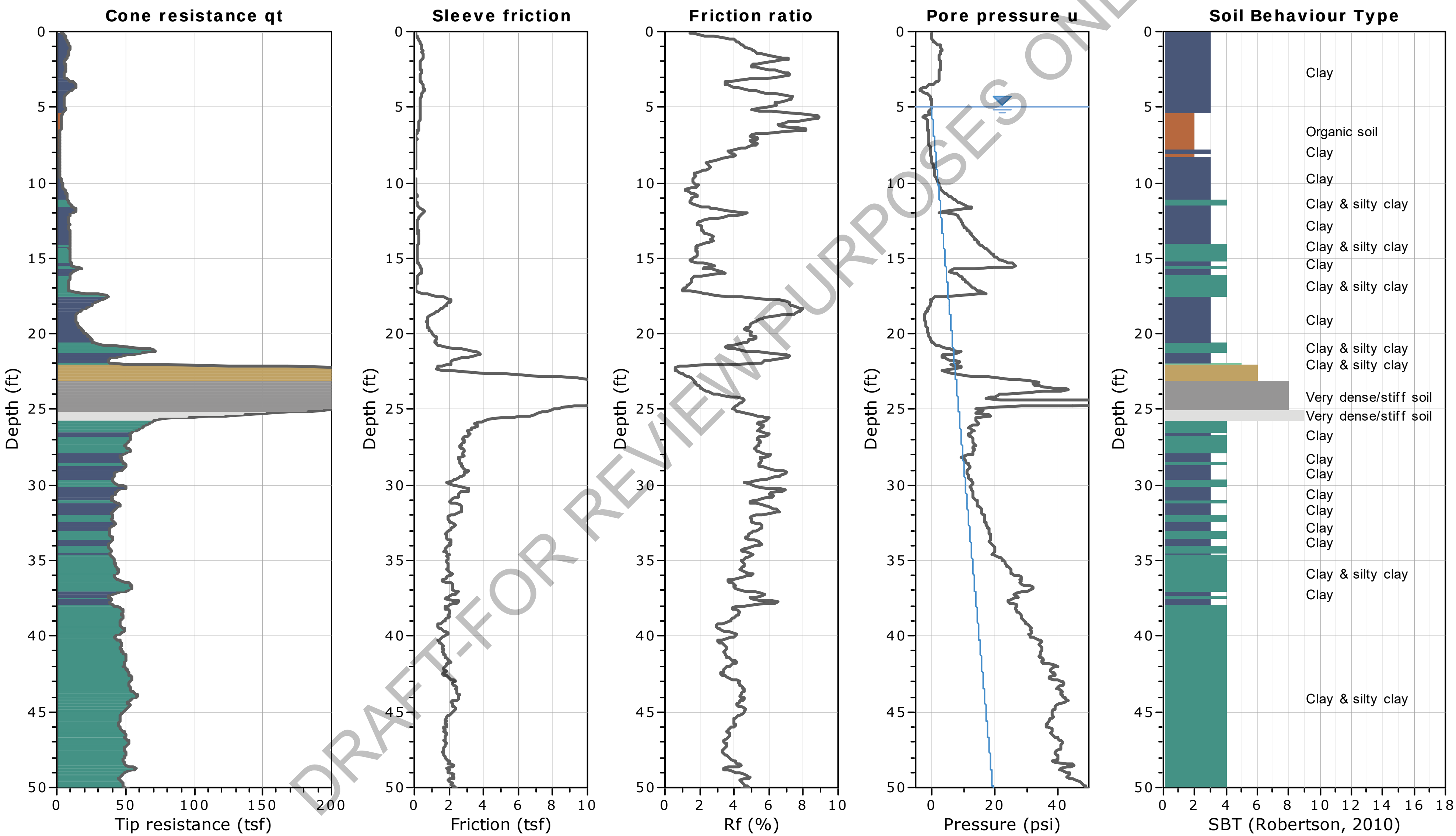
CPT: T-43

Total depth: 50.64 ft, Date: 5/5/2017

Coords: lat 43.5202° lon -93.1207°

Project: Freeborn Wind Project

Location: Freeborn County, Minnesota

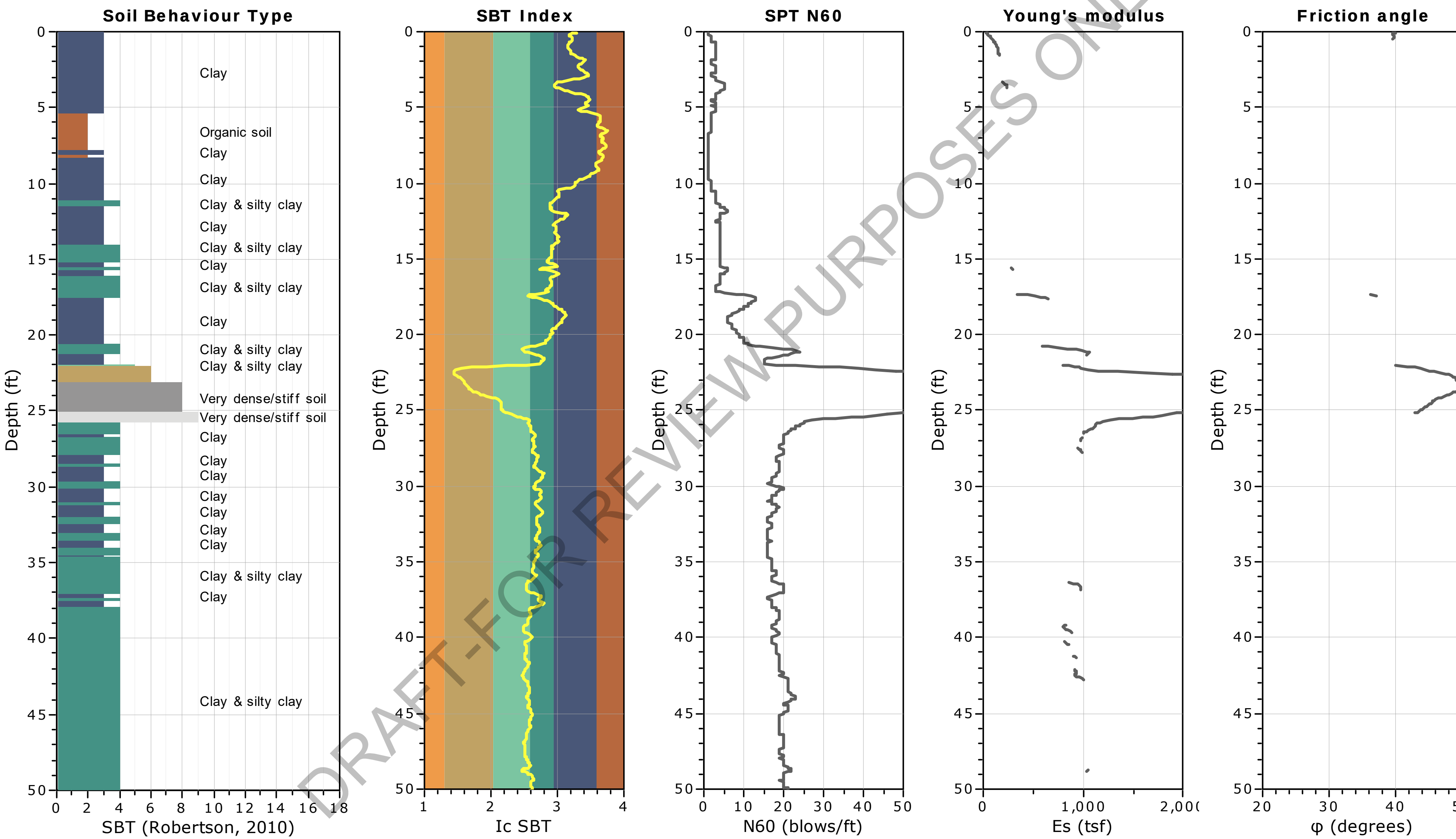


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-43

Project: Freeborn Wind Project
Location: Freeborn County, Minnesota

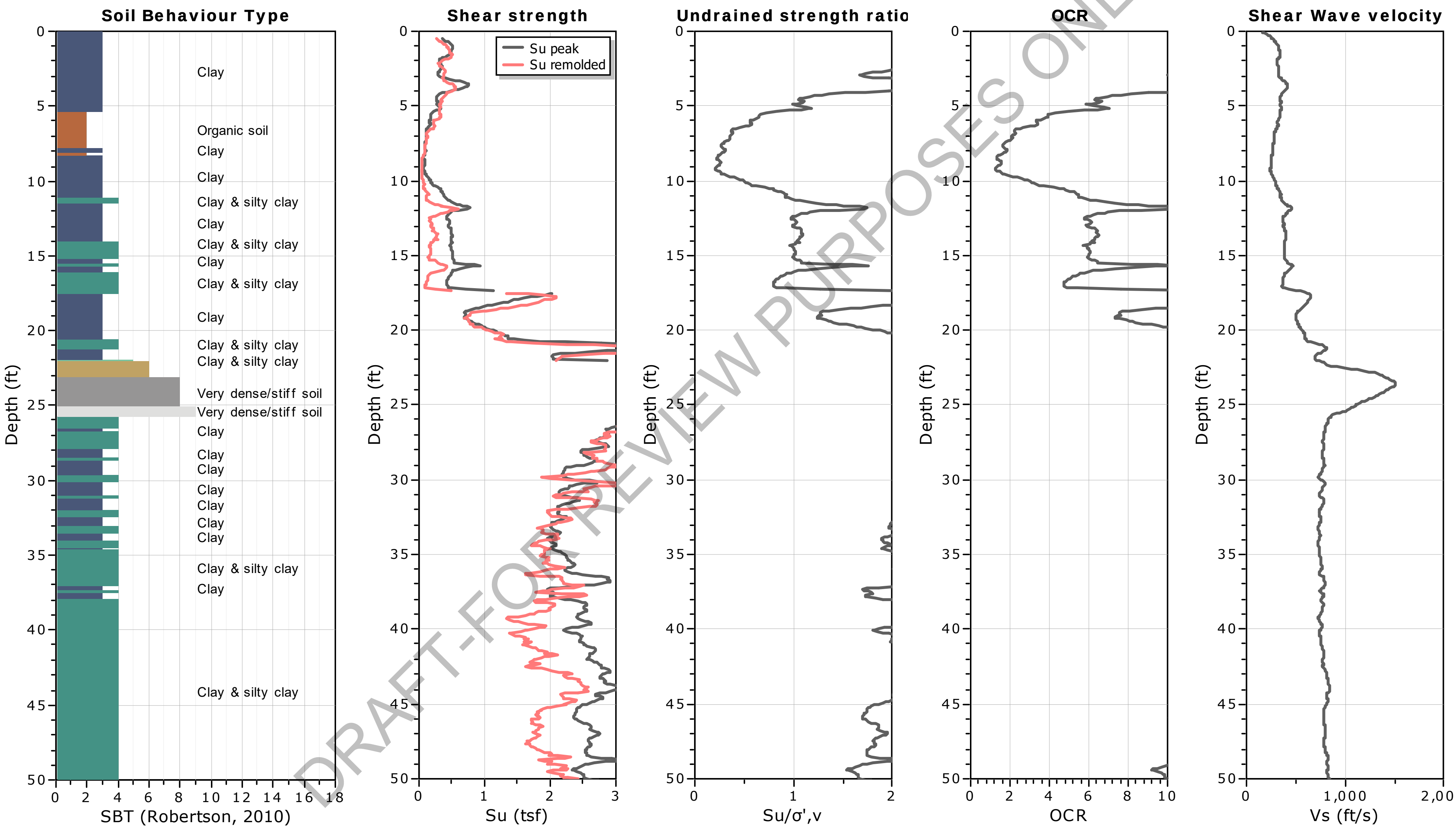
Total depth: 50.64 ft, Date: 5/5/2017
Coords: lat 43.5202° lon -93.1207°



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-43
Total depth: 50.64 ft, Date: 5/5/2017
Coords: lat 43.5202° lon -93.1207°

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**



CPeT-IT v.2.0.1.55 - CPTU data presentation & interpretation software - Report created on: 5/12/2017, 4:30:59 PM
Project file:

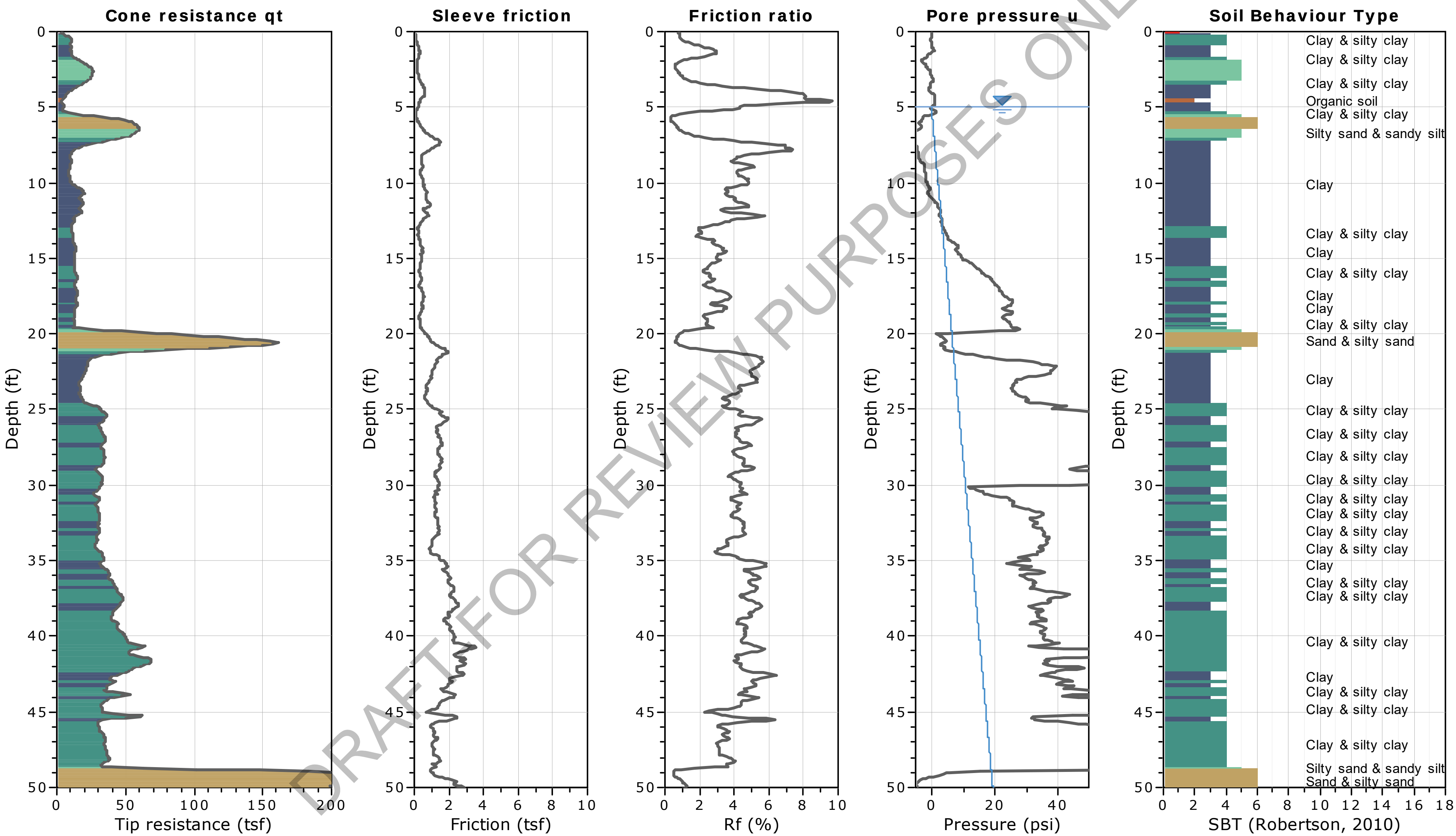
RRC

RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-44

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

Total depth: 50.45 ft, Date: 5/5/2017
Coords: lat 43.5228° lon -93.1166°

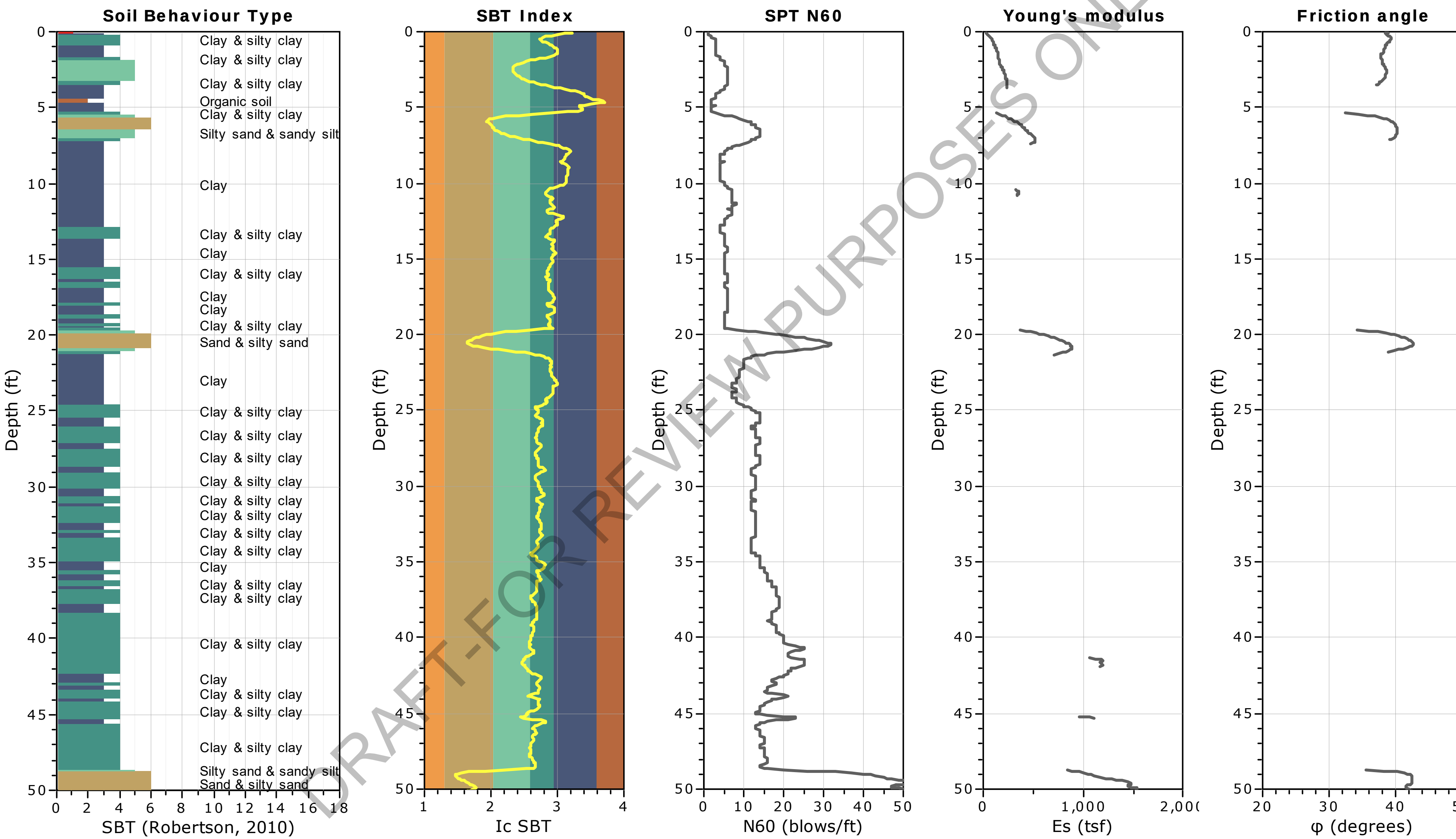


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-44

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

Total depth: 50.45 ft, Date: 5/5/2017
Coords: lat 43.5228° lon -93.1166°



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

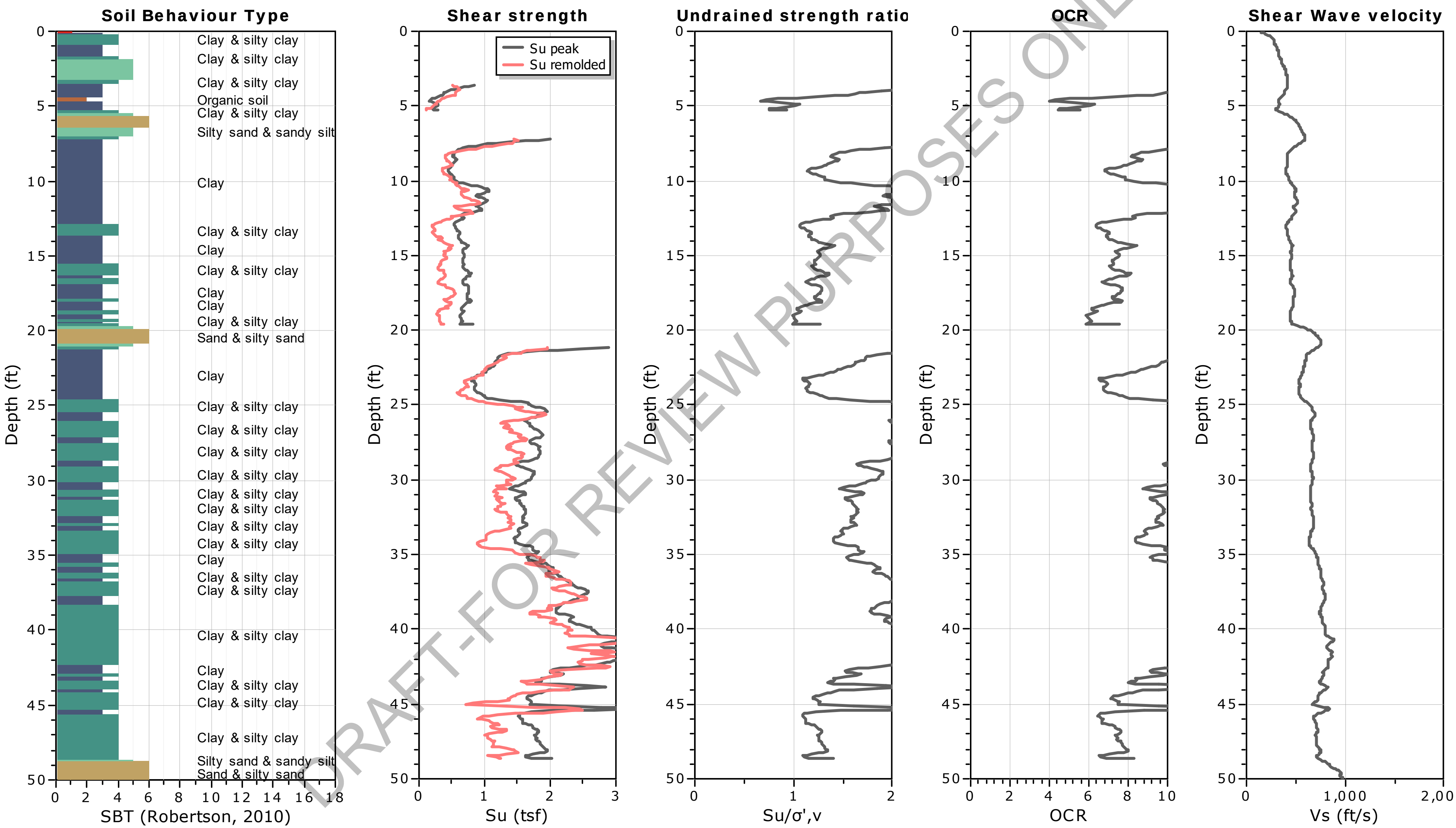
CPT: T-44

Total depth: 50.45 ft, Date: 5/5/2017

Coords: lat 43.5228° lon -93.1166°

Project: **Freeborn Wind Project**

Location: **Freeborn County, Minnesota**

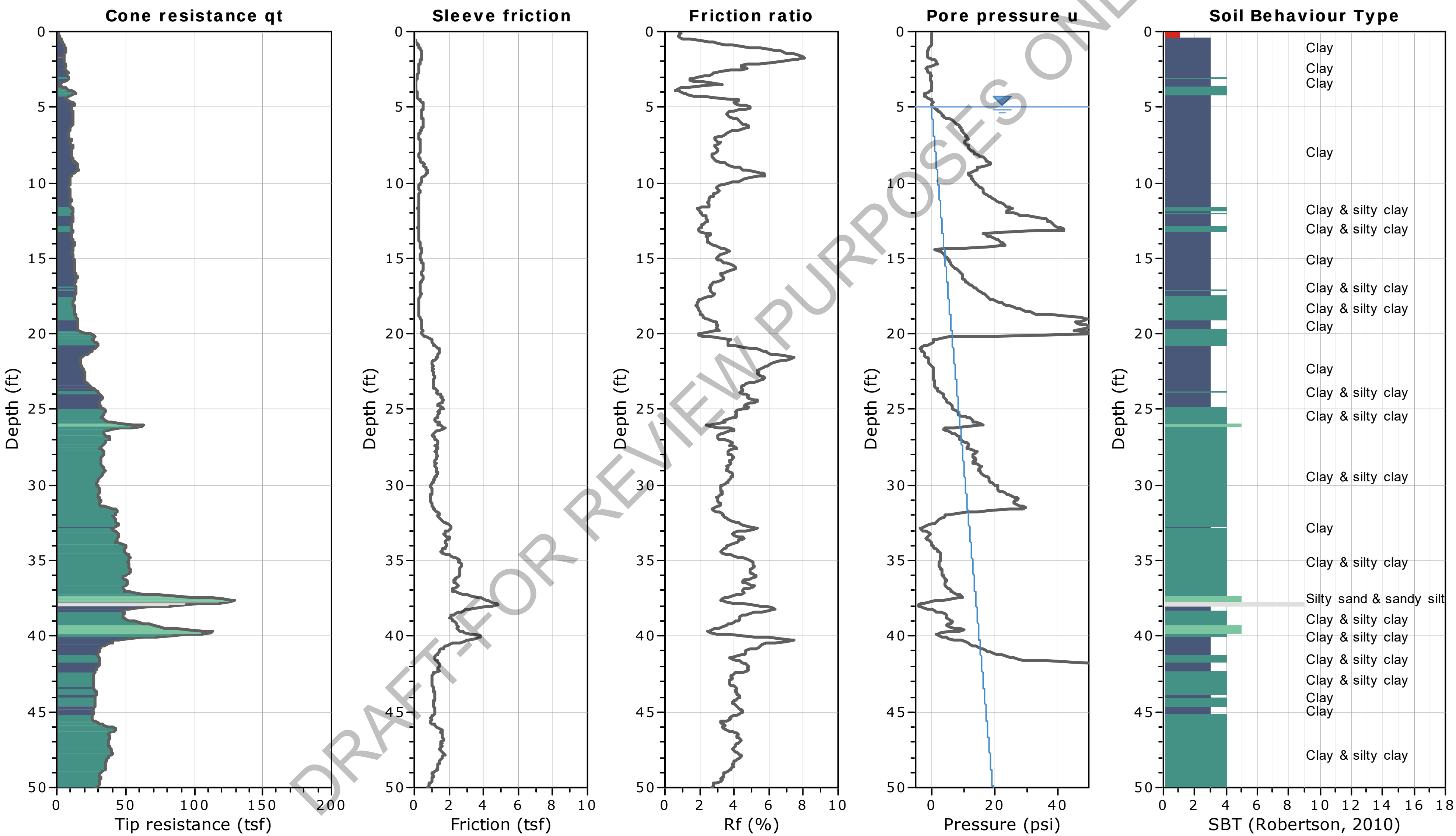


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-45

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

Total depth: 50.58 ft, Date: 5/5/2017
Coords: lat 43.5012° lon -93.1869°

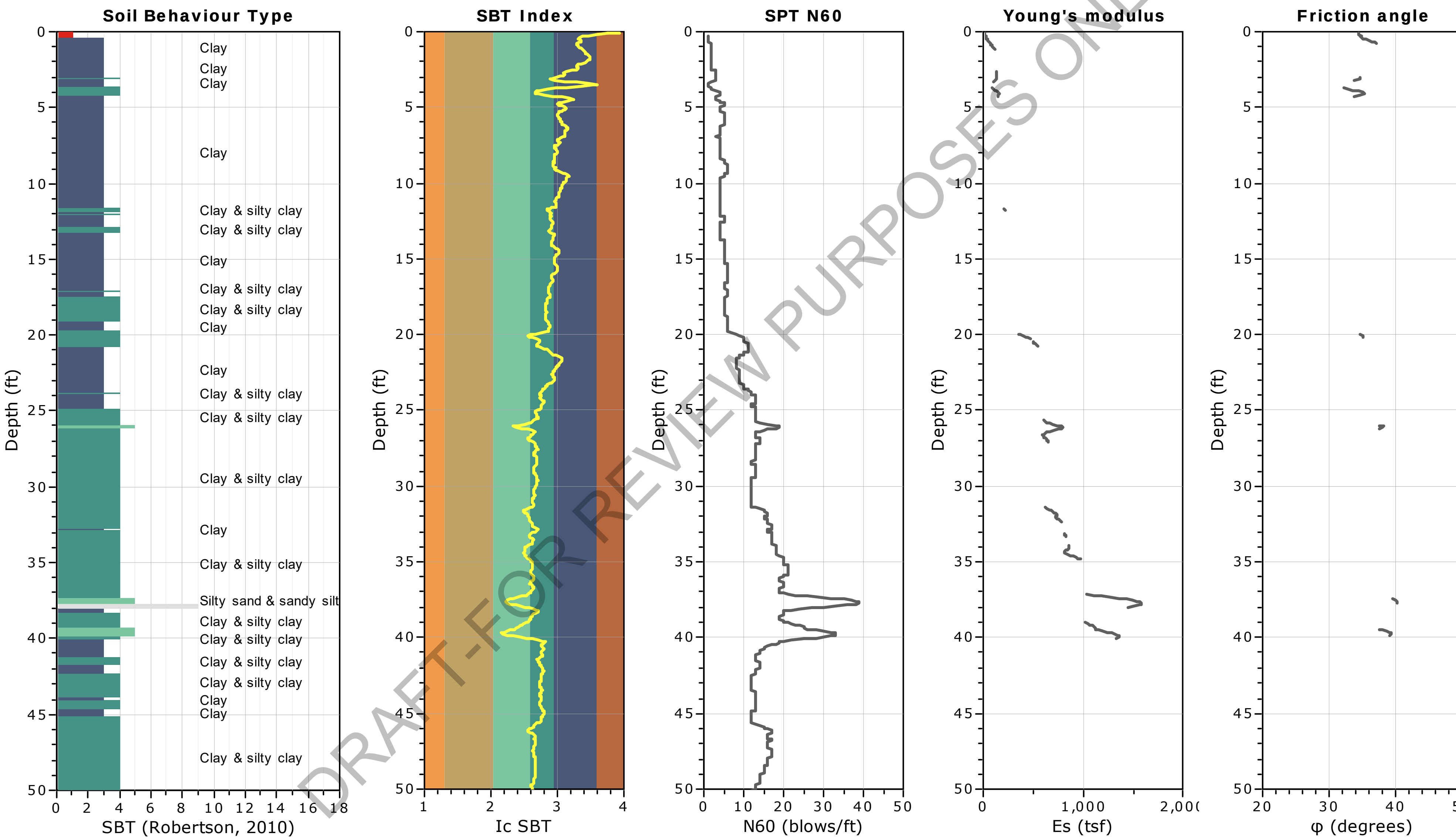


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-45

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

Total depth: 50.58 ft, Date: 5/5/2017
Coords: lat 43.5012° lon -93.1869°

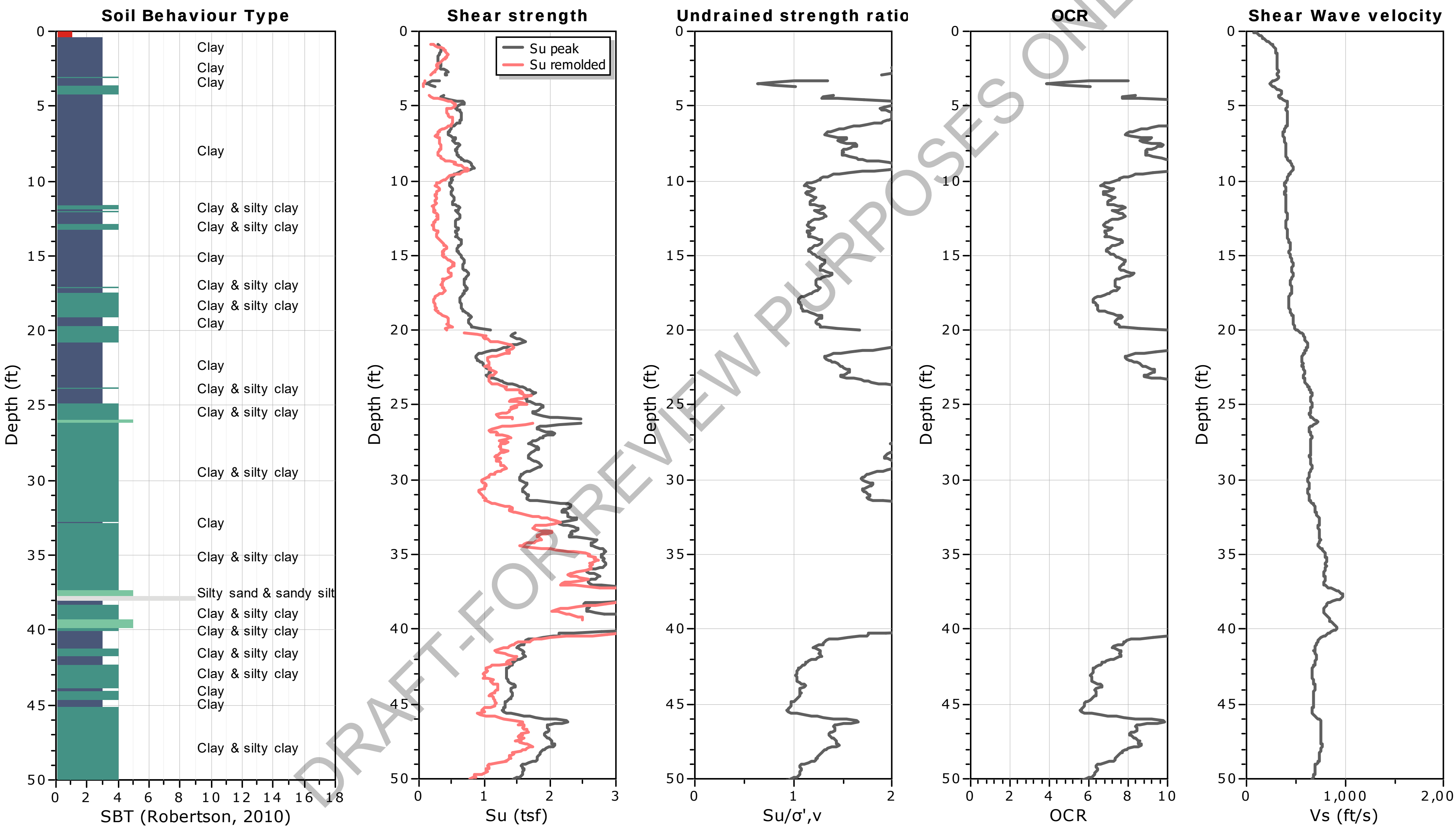


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-45

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

Total depth: 50.58 ft, Date: 5/5/2017
Coords: lat 43.5012° lon -93.1869°

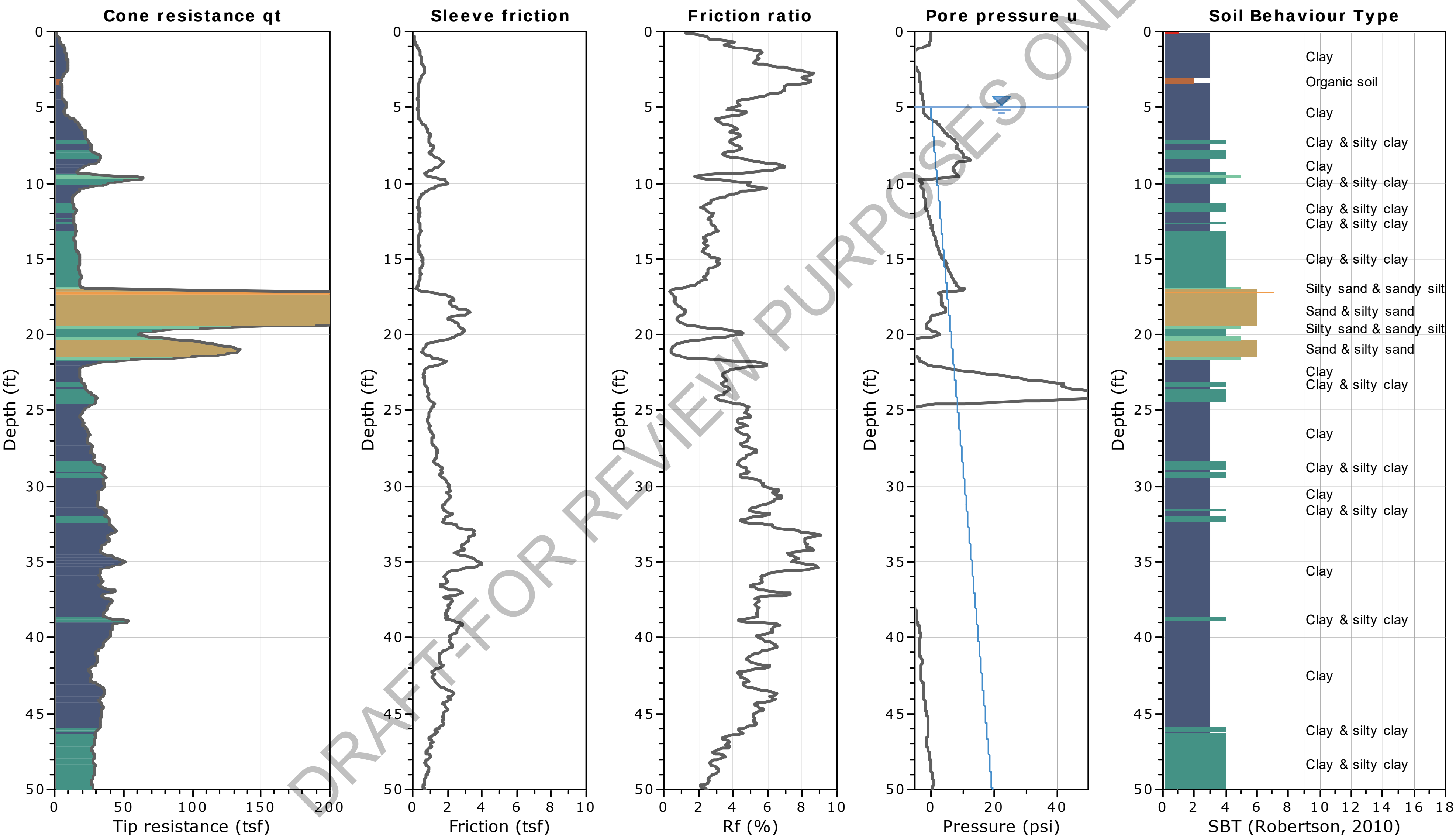


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-46

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

Total depth: 50.58 ft, Date: 5/5/2017
Coords: lat 43.5053° lon -93.1833°

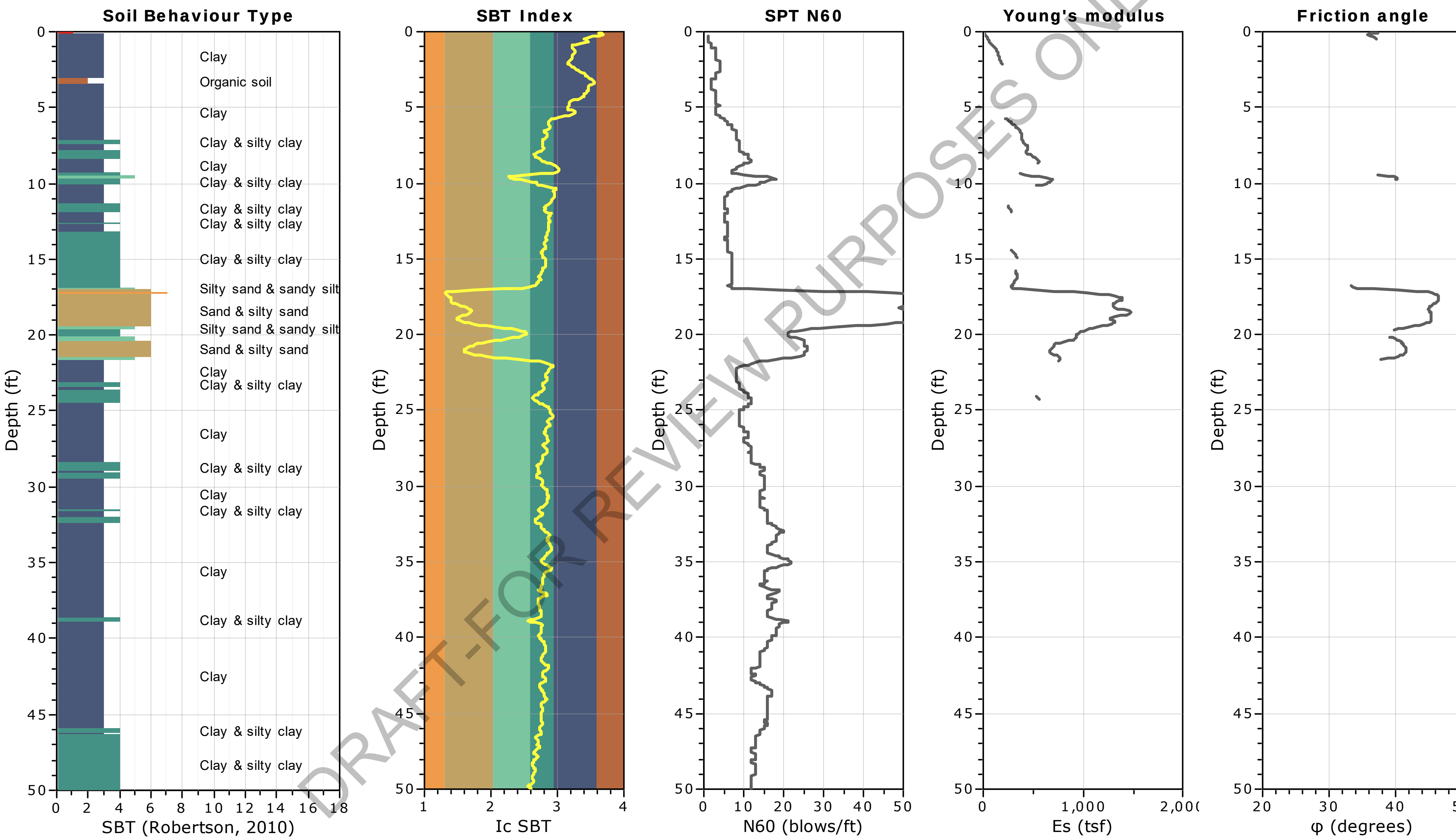


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-46

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

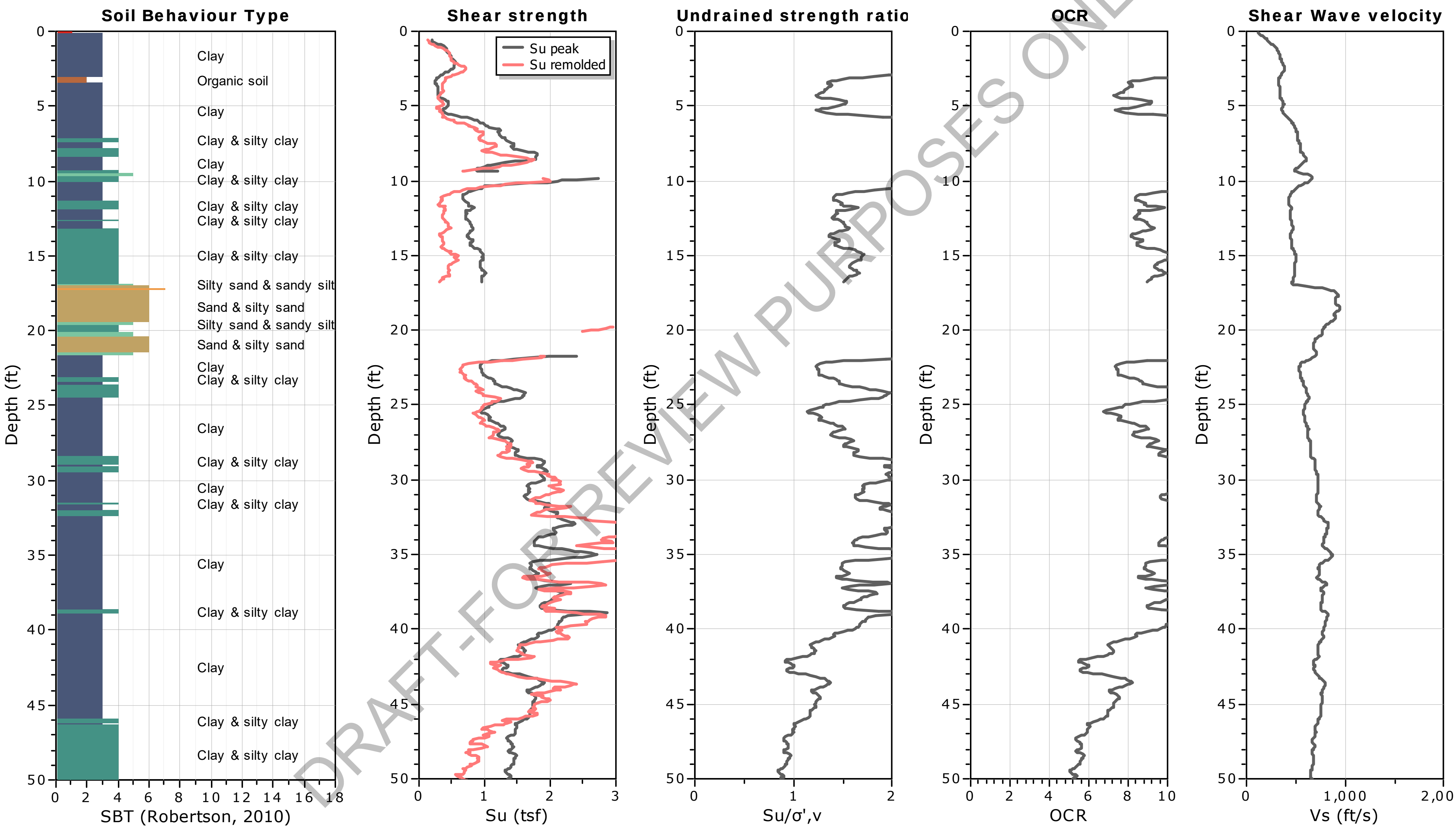
Total depth: 50.58 ft, Date: 5/5/2017
Coords: lat 43.5053° lon -93.1833°



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-46
Total depth: 50.58 ft, Date: 5/5/2017
Coords: lat 43.5053° lon -93.1833°

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

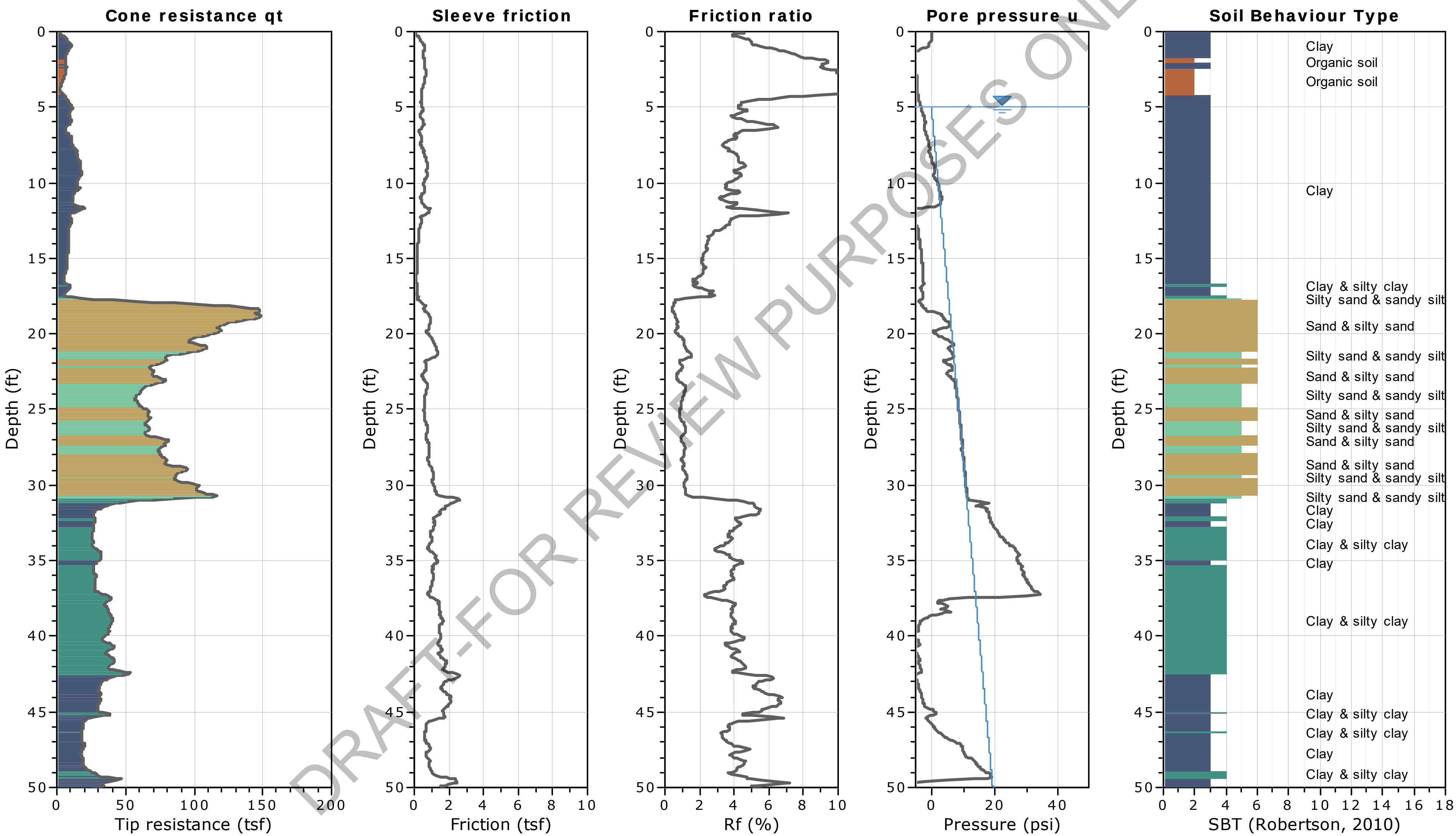
CPT: T-47

Project: **Freeborn Wind Project**

Location: **Freeborn County, Minnesota**

Total depth: 50.64 ft, Date: 5/5/2017

Coords: lat 43.5048° lon -93.167°

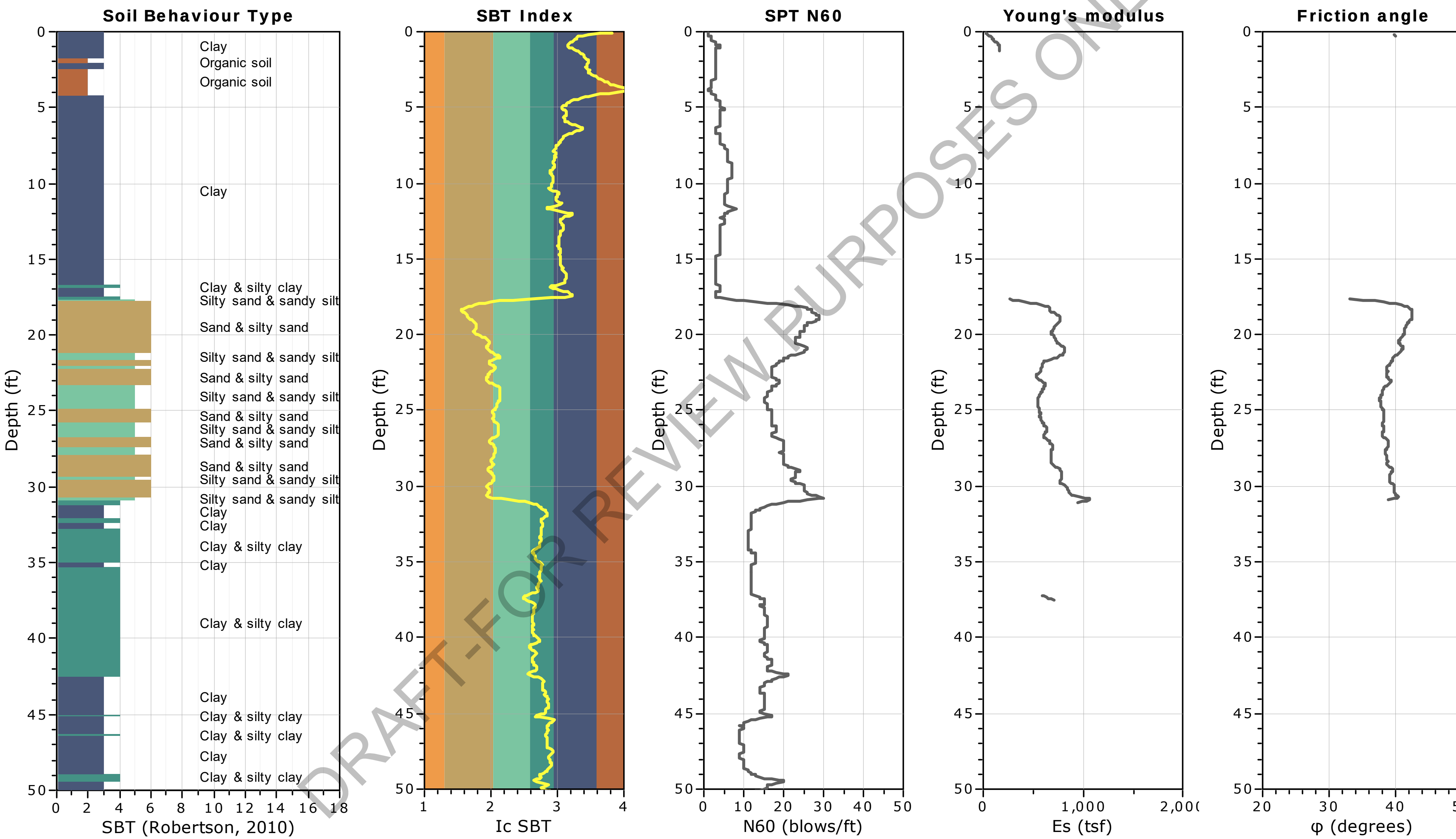


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-47

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

Total depth: 50.64 ft, Date: 5/5/2017
Coords: lat 43.5048° lon -93.167°



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

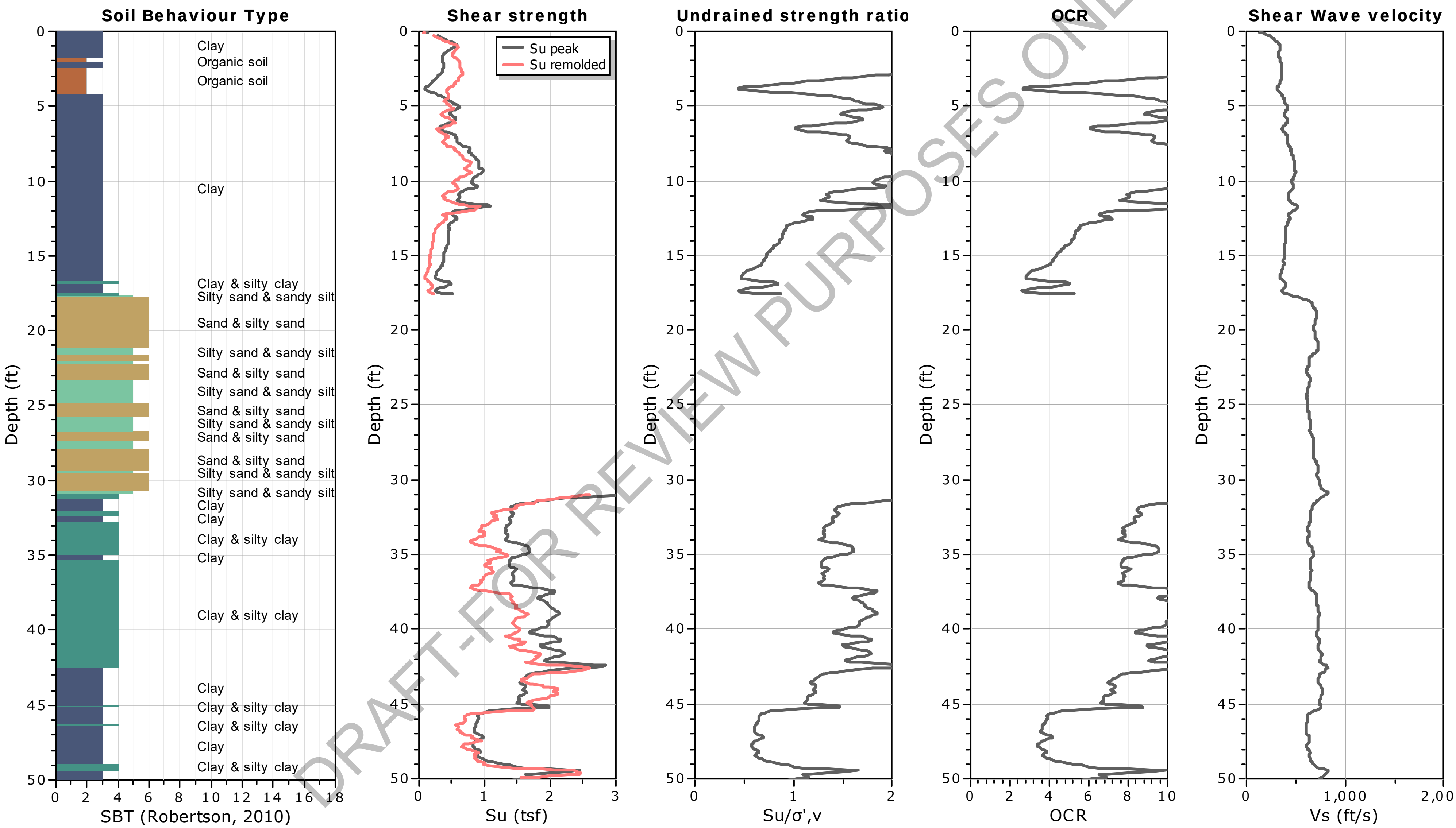
CPT: T-47

Total depth: 50.64 ft, Date: 5/5/2017

Coords: lat 43.5048° lon -93.167°

Project: Freeborn Wind Project

Location: Freeborn County, Minnesota

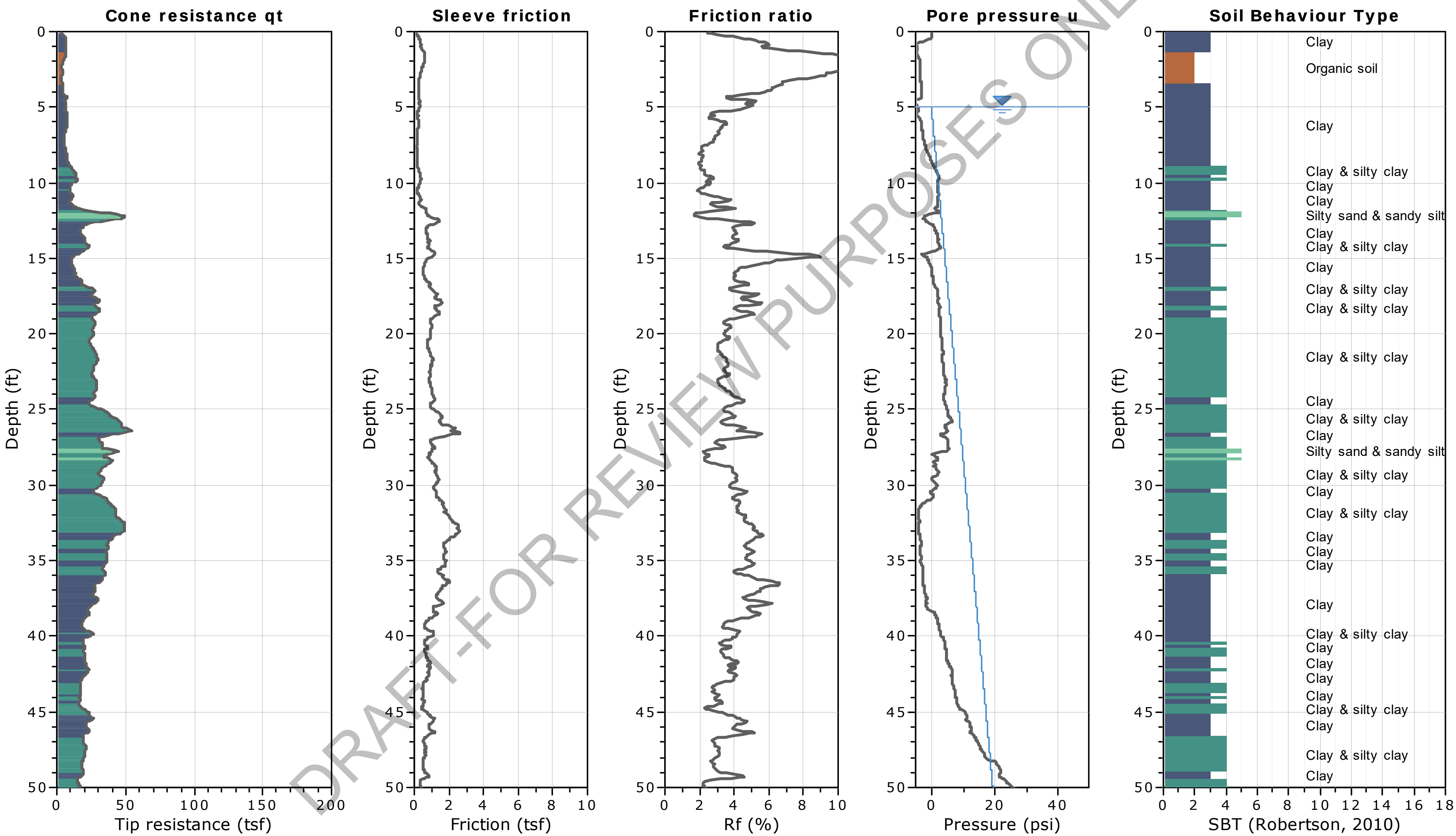


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-48

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

Total depth: 50.64 ft, Date: 5/5/2017
Coords: lat 43.5076° lon -93.1634°

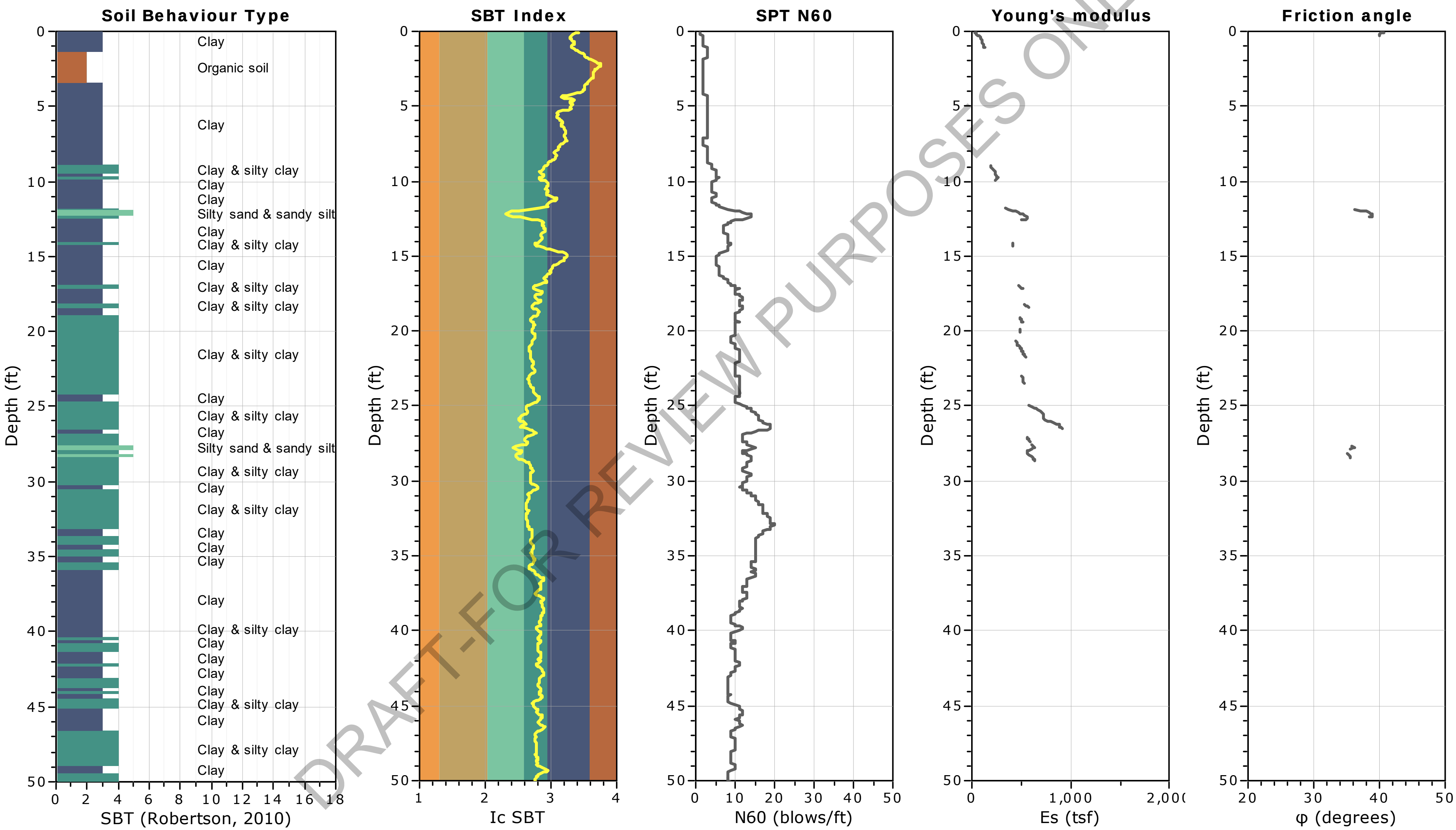


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-48

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

Total depth: 50.64 ft, Date: 5/5/2017
Coords: lat 43.5076° lon -93.1634°

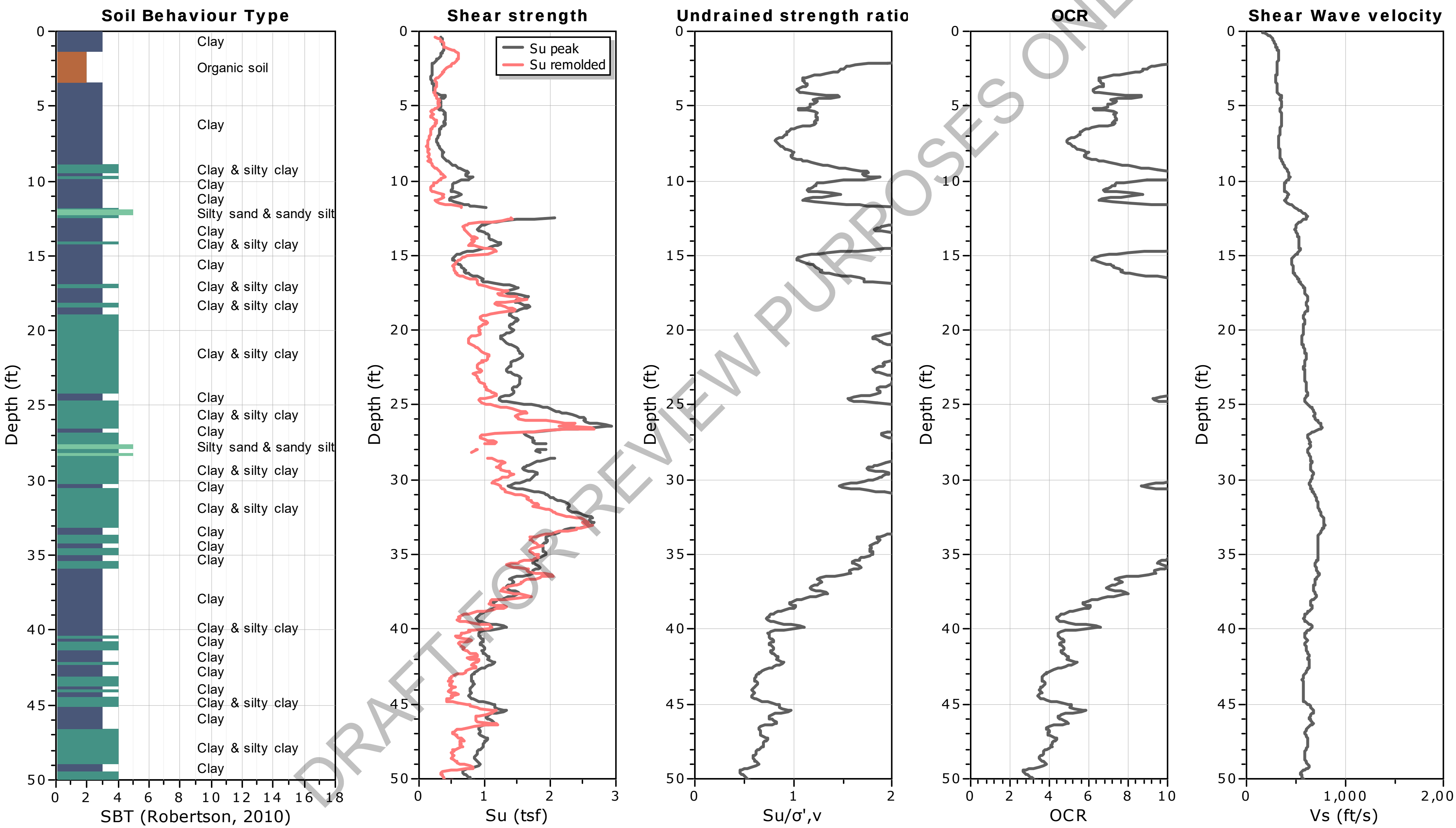


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-48

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

Total depth: 50.64 ft, Date: 5/5/2017
Coords: lat 43.5076° lon -93.1634°

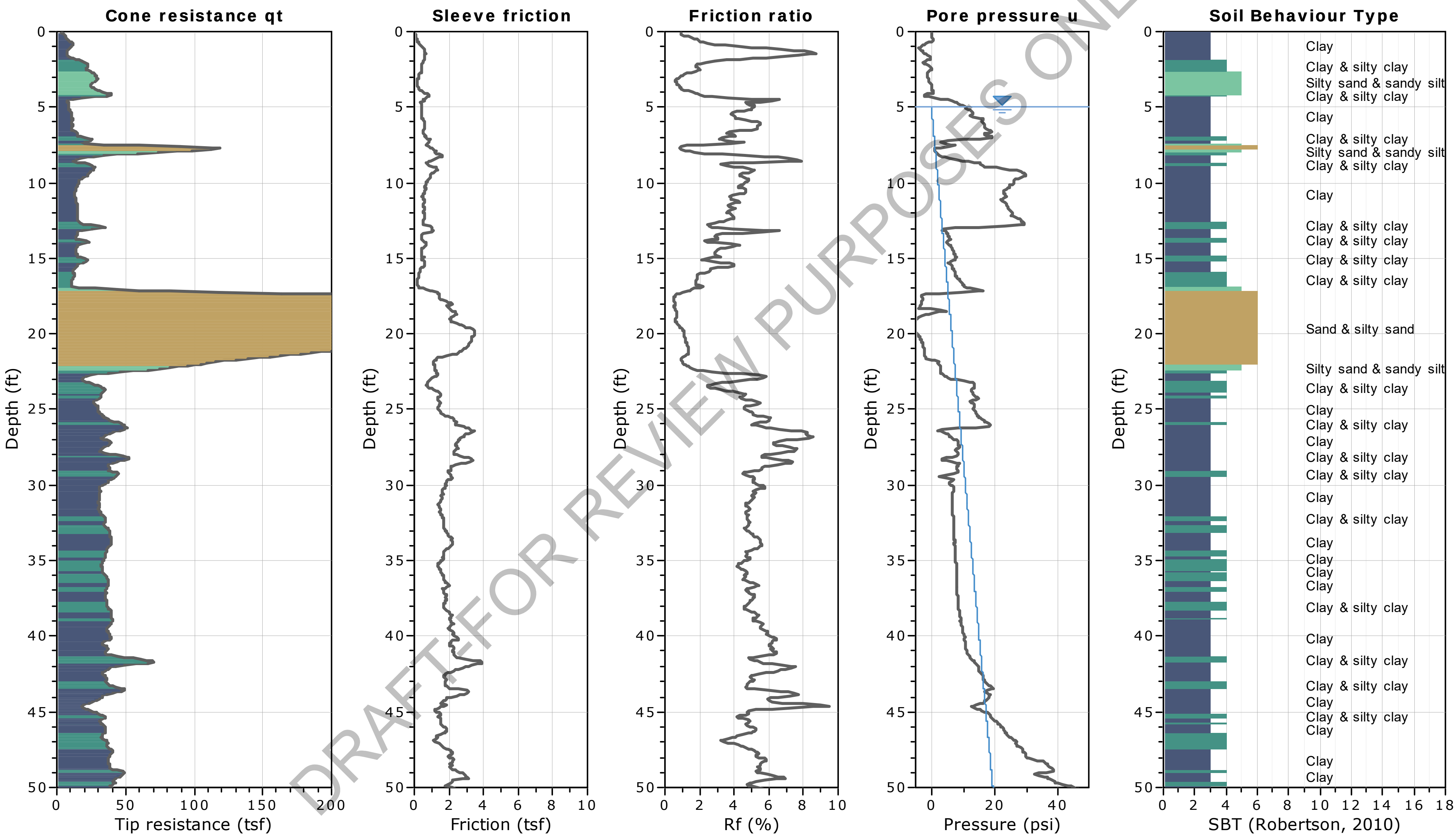


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-49

Total depth: 50.58 ft, Date: 5/5/2017
Coords: lat 43.5012° lon -93.1451°

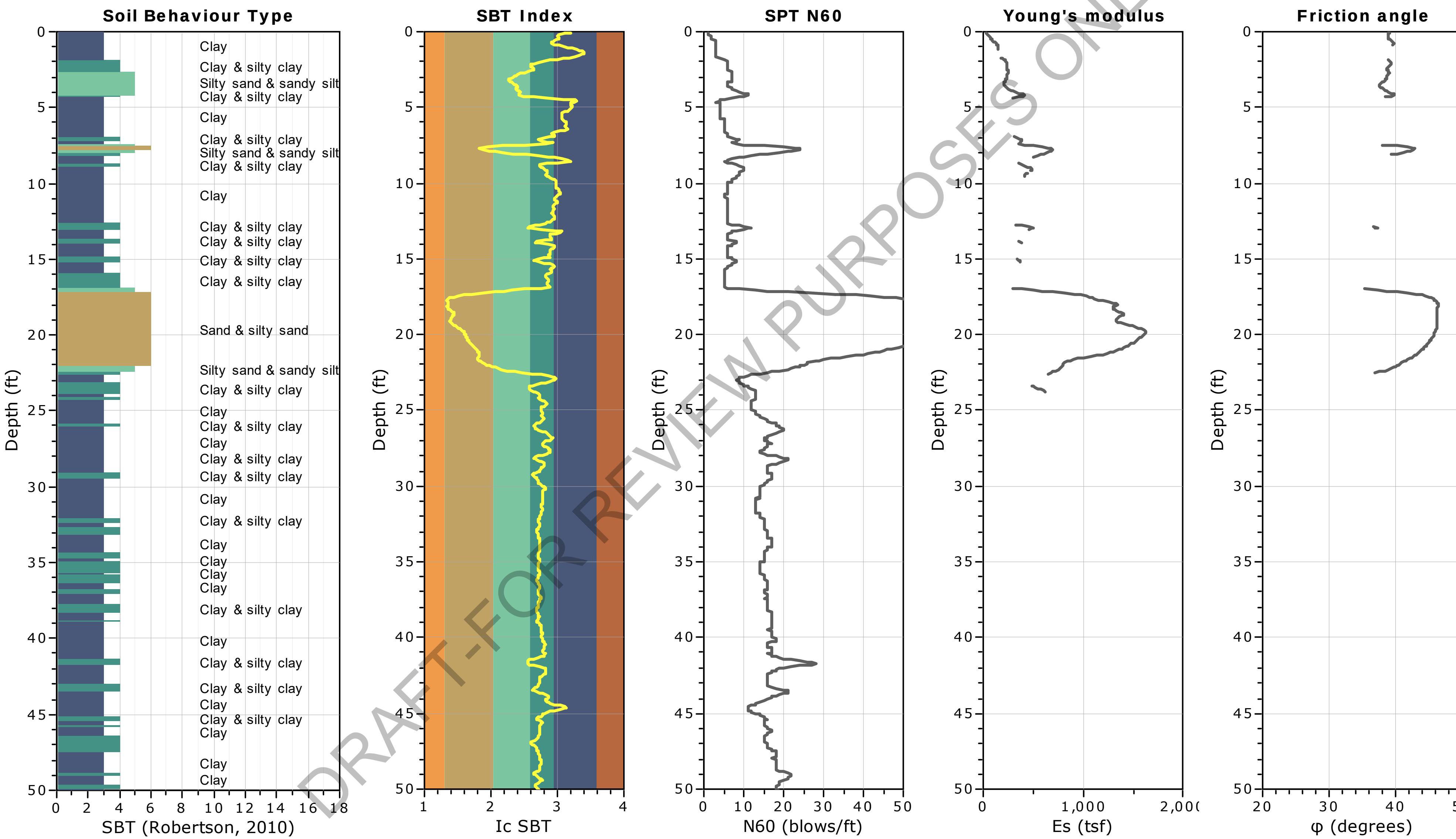
Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**



RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

CPT: T-49
Total depth: 50.58 ft, Date: 5/5/2017
Coords: lat 43.5012° lon -93.1451°

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

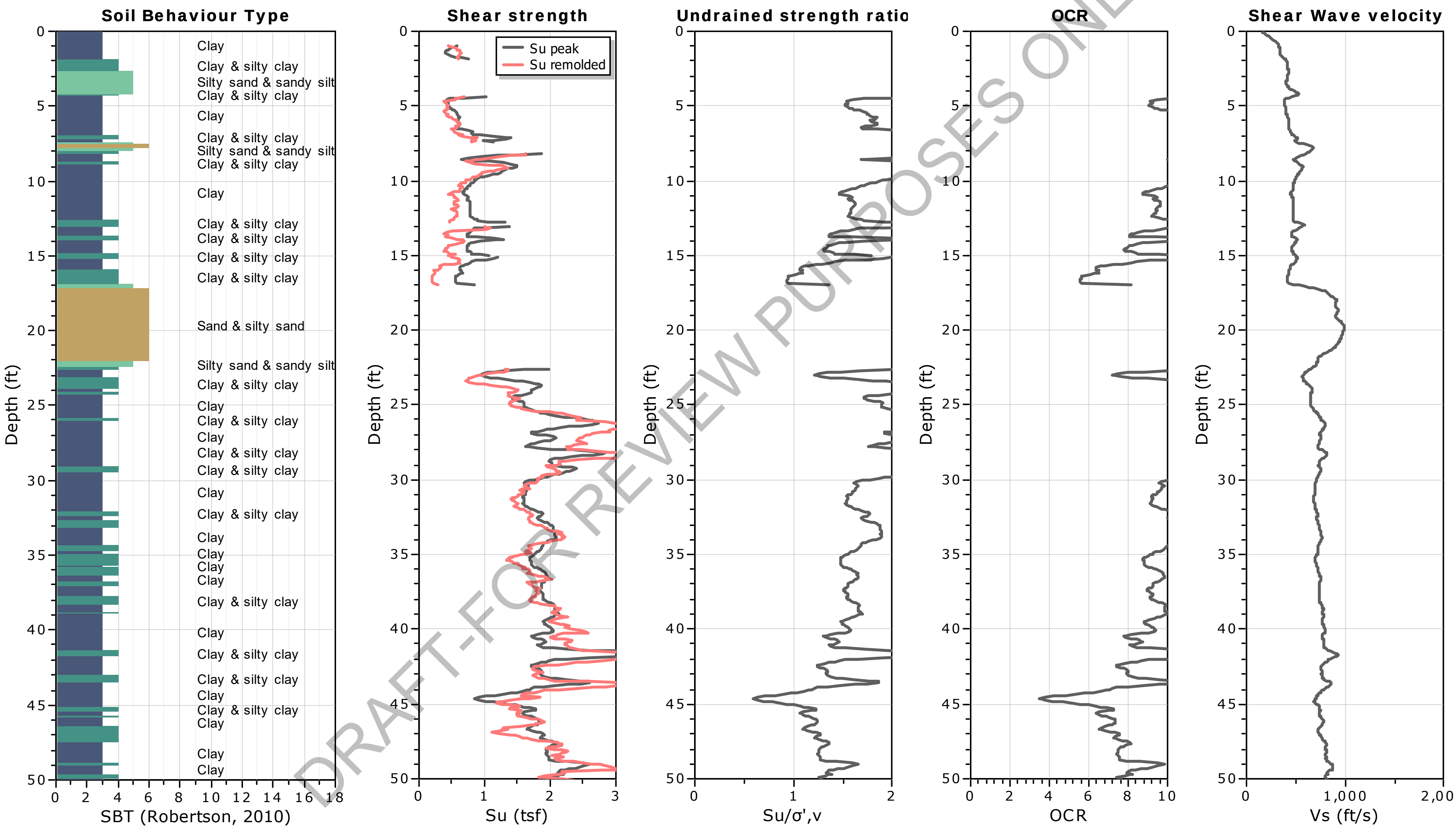


RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087

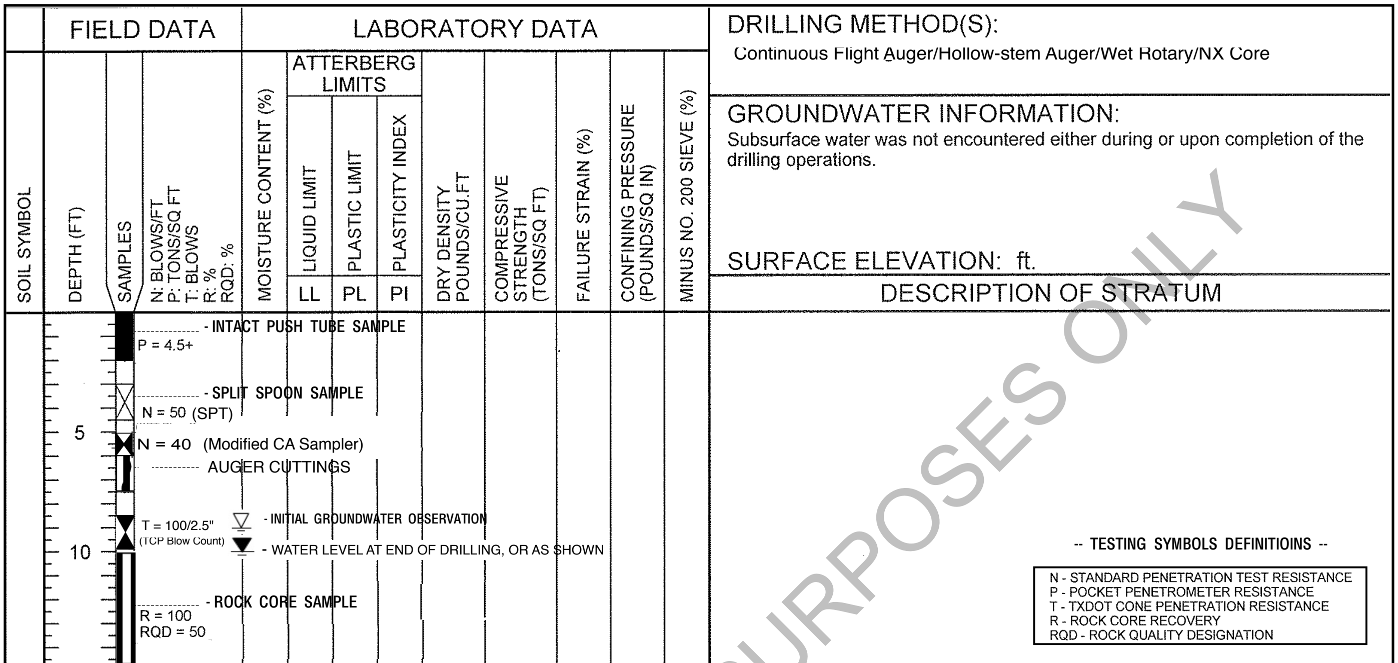
CPT: T-49

Project: **Freeborn Wind Project**
Location: **Freeborn County, Minnesota**

Total depth: 50.58 ft, Date: 5/5/2017
Coords: lat 43.5012° lon -93.1451°



BORING LOG KEY



TYPICAL SOIL AND ROCK SYMBOLS (USCS CLASSIFICATION)

Lean Clay (CL)	Poorly-Graded Sand (SP)	Claystone
Fat Clay (CH)	Well-Graded Sand (SW)	BASALT
Silt (ML)	Poorly-Graded Gravel (GP)	Limestone
Elastic Silt (MH)	Well-Graded Gravel (GW)	Sandstone
Silty Sand (SM)	Clayey Gravel (GC)	Siltstone
Clayey Sand (SC)	Silty Gravel (GM)	Fill Material
Silty, Clayey Sand (SC-SM)	Silty Clay (CL-ML)	Shale

DEGREE OF WEATHERING

1) Unweathered: No evidence of any chemical or mechanical alteration.
2) Slightly weathered: Slight discoloration on surface, slight alteration along discontinuities, less than 10% of the rock volume altered.
3) Moderately weathered: Discoloring evident, surface pitted and altered with alteration penetrating well below rock surfaces, weathering "halos" evident, 10% to 50% of the rock volume altered.
4) Highly weathered: Entire mass discolored, alteration pervading nearly all of the rock with some pockets of slightly weathered rock noticeable, some minerals leached away.
5) Decomposed: rock reduced to a soil with relicit rock texture, generally molded and crumbled by hand.

SOIL STRUCTURE

Calcareous.......... Containing calcium carbonate

Slickensided........ The presence of planes of weakness having a slick and glossy appearance

Interbedded......... Alternating layers of varying material

LOG OF BORING T-06

RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087
Fax: (512) 251-2518

CLIENT: Freeborn Wind Energy Center, LLC
PROJECT: Freeborn Wind Project
LOCATION: Freeborn County, Minnesota
NUMBER: GE1704007

DATE(S) DRILLED: 5/8/17

DRILLING METHOD(S):
Hollow Stem Auger, Drilling fluids introduced at 44 ft. to prevent soil heave.

GROUNDWATER INFORMATION:
Groundwater encountered at 34 ft. prior to the introduction of drilling fluids. Water level measured at 8 ft. immediately after drilling.

SURFACE ELEVATION (FT):

FIELD DATA / LABORATORY DATA

DEPTH (FT)	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
0–2	N = 3										Topsoil 24 in.
2											LEAN CLAY (CL), trace Sand, olive gray, soft to medium stiff, moist
5	N = 3										
8	N = 7										Grading with Sand
	P = 0.5										
10	N = 4										Trace Gravel at 10.5 ft.
	P = 0.75										
15	N = 5										
20	N = 6										
	P = 0.5										
25	N = 6										
30	N = 7										SANDY LEAN CLAY (CL), gray, medium stiff to stiff, moist
35	N = 10										
40	N = 8										SILTY CLAY (CL-ML), trace Sand, gray, medium stiff, moist to wet
45	N = 4										SILTY SAND (SM), gray, loose, wet, fine to medium grianed
	P = NA*										
50	N = 25										SILTY CLAY (CL-ML), trace Sand, gray, very stiff, wet
											Total Depth = 50.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 43.628371, Long. -93.198284
*No Recovery; Borehole Cave-In Depth: 35 ft.

LOG OF BORING T-16

RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087
Fax: (512) 251-2518

CLIENT: Freeborn Wind Energy Center, LLC
PROJECT: Freeborn Wind Project
LOCATION: Freeborn County, Minnesota
NUMBER: GE1704007

DATE(S) DRILLED: 5/8/17

DRILLING METHOD(S):
Hollow Stem Auger, Drilling fluids introduced at 25 ft. to prevent soil heave.

GROUNDWATER INFORMATION:
Groundwater not encountered prior to the introduction of drilling fluids. Water level measured at 19 ft. immediately after drilling.

SURFACE ELEVATION (FT):

FIELD DATA			LABORATORY DATA									
SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													Topsoil 18 in.
			N = 4										LEAN CLAY (CL), with Sand, brown, soft to medium stiff, moist to wet
	5		N = 6										
			N = 4										
	10		P = 0.75										
			N = 8										Grading with occasional Sand seams
	15		N = 8										SANDY LEAN CLAY (CL), gray, soft to medium stiff, moist
			P = 0.5	▼									
	20		N = 4										CLAYEY SAND (SC), gray to brown, loose, moist, fine grained
			P = 0.75										
	25		N = 7										
	30		N = 5										SILTY SAND (SM), trace Gravel, olive brown, loose, wet, fine to medium grained
	35		N = 5										LEAN CLAY (CL), trace Sand and Gravel, gray to brown, medium stiff to stiff, wet
	40		N = 7										Grading with Sand, gray
	45		N = 5										
	50		N = 14										
													Total Depth = 50.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 43.633627, Long. -93.121939
Borehole Cave-In Depth: 8 ft.

LOG OF BORING T-23

RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087
Fax: (512) 251-2518

CLIENT: Freeborn Wind Energy Center, LLC
PROJECT: Freeborn Wind Project
LOCATION: Freeborn County, Minnesota
NUMBER: GE1704007

DATE(S) DRILLED: 5/7/17

DRILLING METHOD(S):
Hollow Stem Auger, Drilling fluids introduced at 39 ft. to prevent soil heave.

GROUNDWATER INFORMATION:
Groundwater not encountered prior to the introduction of drilling fluids. Water level measured at 10 ft. immediately after drilling.

SURFACE ELEVATION (FT):

FIELD DATA / LABORATORY DATA

DEPTH (FT)	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
0											Topsoil 18 in.
1.5	N = 5										SANDY LEAN CLAY (CL), with Sand, trace Gravel, brown, medium stiff to stiff, moist
5	N = 5										
	N = 7										
10	P = NA*	▼									Sand layer at 10 ft.
	N = 9										
15	N = 8										Sand seam at 14 ft.
20	N = 11										
	P = 1.25										
25	N = 6										SANDY LEAN CLAY (CL), gray, medium stiff, moist
30	P = NA*										
	N = 8										
35	N = 9										SILTY CLAY (CL-ML), trace Sand, brown, stiff, moist
40	N = 9										SILTY, CLAYEY SAND (SC-SM), gray, loose, wet, fine grained
45	N = 19										SANDY SILTY CLAY (CL-ML), gray, very stiff, moist to wet
50	N = 27										LEAN CLAY (CL), with Sand, brown, very stiff, moist
											Total Depth = 50.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 43.546382, Long. -93.246295
*Not Available; Borehole Cave-In Depth: 23 ft.

LOG OF BORING T-36

RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087
Fax: (512) 251-2518

CLIENT: Freeborn Wind Energy Center, LLC
PROJECT: Freeborn Wind Project
LOCATION: Freeborn County, Minnesota
NUMBER: GE1704007

DATE(S) DRILLED: 5/7/17

DRILLING METHOD(S):
Hollow Stem Auger, Drilling fluids introduced at 10 ft. to prevent soil heave.

GROUNDWATER INFORMATION:
Groundwater not encountered prior to the introduction of drilling fluids. Water level measured at 6 ft. immediately after drilling.

SURFACE ELEVATION (FT):

FIELD DATA / LABORATORY DATA

DEPTH (FT)	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
											Topsoil 24 in.
	N = 8										
											FAT CLAY (CH), trace Sand, brown, medium stiff, dry to moist
5	N = 5										SILTY, CLAYEY SAND (SC-SM), brown, loose, moist, fine grained
	N = 2										SILTY CLAY (CL-ML), trace Sand, olive brown, soft, moist
10	P = 1.25										SANDY LEAN CLAY (CL), olive gray, soft to stiff, moist to wet
	N = 4										
15	P = 0.5										
	N = 9										
20	N = 6										
25	P = 1.0										Grading trace Gravel, brown
	N = 12										Grading gray
30	N = 4										
35	N = 7										LEAN CLAY (CL), trace Sand, brown, medium stiff to stiff, wet; intermixed with Silty Sand at 34 ft.
	P = 1.5										
40	N = 10										
45	N = 13										SANDY LEAN CLAY (CL), olive gray, stiff to hard, moist
50	N = 31										Grading gray
											Total Depth = 50.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 43.523509, Long. -93.203257
Borehole Cave-In Depth: 6 ft.

LOG OF BORING T-47

RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087
Fax: (512) 251-2518

CLIENT: Freeborn Wind Energy Center, LLC
PROJECT: Freeborn Wind Project
LOCATION: Freeborn County, Minnesota
NUMBER: GE1704007

DATE(S) DRILLED: 5/6/17

DRILLING METHOD(S):
Hollow Stem Auger: 0 to 19 ft.; Wash Rotary: 19 to 50.5 ft.

GROUNDWATER INFORMATION:
Groundwater encountered at 19 ft. prior to the introduction of drilling fluids

SURFACE ELEVATION (FT):

FIELD DATA / LABORATORY DATA

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)
			N = 6									
	5		N = 7									
			N = 5									
	10		N = 7									
			N = 8									
	15											
			P = NA*									
	20		N = 11									
	25		N = 4									
	30		N = 11									
	35		N = 16									
	40		N = 27									
	45		N = 17									
	50		N = 12									

DESCRIPTION OF STRATUM

- Topsoil 12 in.
- LEAN CLAY (CL), trace to with Sand, trace Gravel, light brown, medium stiff, moist
- POORLY GRADED SAND (SP-SM), with Silt, medium dense, moist to wet, fine to medium grained
- SILTY SAND (SM), brown, loose, moist, fine to medium grained
- LEAN CLAY (CL), trace Sand, brown, stiff, moist
- FAT CLAY (CH), trace Sand, dark brown, very stiff, moist
- SANDY LEAN CLAY (CL), olive gray, very stiff, moist
- LEAN CLAY (CL), with Sand, olive gray, stiff, wet

Total Depth = 50.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 43.504825, Long. -93.166974
*Poor Recovery

LOG OF BORING T-47a

RRC Power & Energy, LLC
3801 Doris Lane
Round Rock, TX 78664
Telephone: (512) 992-2087
Fax: (512) 251-2518

CLIENT: Freeborn Wind Energy Center, LLC
PROJECT: Freeborn Wind Project
LOCATION: Freeborn County, Minnesota
NUMBER: GE1704007

DATE(S) DRILLED: 5/6/17

DRILLING METHOD(S):
Hollow Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during drilling or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
	0–12												Undifferentiated Overburden, refer to Log of Boring T-47 for additional information.
	12–18		P = 0.5										LEAN CLAY (CL), with Sand, trace Gravel, light brown, very soft to medium stiff, moist
			P = 0.0										
													Total Depth = 18 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 43.504825, Long. -93.166974
Offset 1st Boring Location 3 ft.

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3801 Doris Lane
Round Rock, TX 78664
512.992.2087

APPENDIX B

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(Laboratory Testing is in Progress)

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3801 Doris Lane
Round Rock, TX 78664
512.992.2087

APPENDIX C

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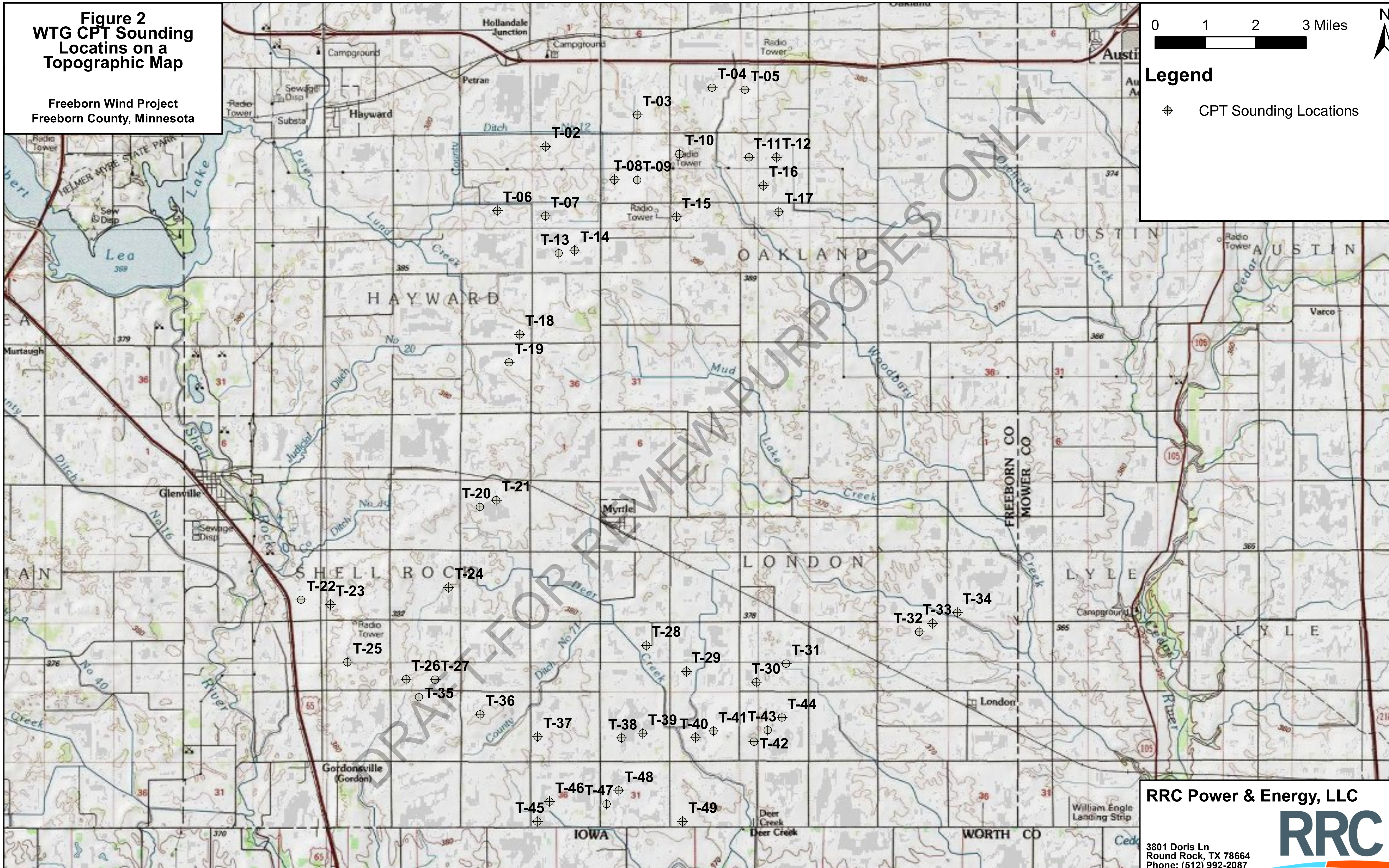
(MASW and Seismic Refraction Data Reduction in Progress)

Figure 2
WTG CPT Sounding Locatins on a Topographic Map

Freeborn Wind Project
Freeborn County, Minnesota



0 1 2 3 Miles

N

Legend

⊕ CPT Sounding Locations

RRC Power & Energy, LLC
3801 Doris Ln
Round Rock, TX 78664
Phone: (512) 992-2087

Figure 3
WTG Confirmation Boring Locations on a Topographic Map

Freeborn Wind Project
Freeborn County, Minnesota

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3801 Doris Ln
Round Rock, TX 78664
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