



# Department of Transportation

Division of Planning/Engineering  
Office of Materials and Surfacing  
Geotechnical Engineering Activity

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## REPORT OF FOUNDATION INVESTIGATION

October 29, 2018

**PROJECT:** BRF 6312(00)18-1 Brookings County, PCN 06VH

**LOCATION:** Structure No. 06-120-053 – 446 Ave, 1.7 miles north of Bruce over the Big Sioux River

### METHOD OF INVESTIGATION:

All soundings are made according to the Standard South Dakota Subsurface Investigation Techniques and AASHTO Specifications. Penetration Test holes are drilled with a 6-5/8 inch continuous hollow stem auger. Penetration tests are conducted by dropping a 140 pound hammer 30 inches to obtain 2 inch nominal diameter samples and to measure the resistance to penetration of the soil. Drive Test holes are performed with the SDDOT drive rig using 2-7/8 inch diameter PK rod drill stem. Drive tests are conducted by dropping a 490 pound hammer 30 inches to measure the resistance to penetration of the soil. All laboratory tests are performed in accordance with standard AASHTO or SDDOT laboratory procedures.

### RECOMMENDATIONS:

Steel Piling:

Pile Size	Location	Anticipated Tip Elevation	LRFD Maximum Factored Pile Bearing Resistance	Nominal Pile Bearing Resistance (Verified by SDDOT's Modified ENR Formula)
HP 12x53	Abutments	1545	98 tons	245 tons
	Bents	1538		

### DISCUSSION:

The proposed structure location is underlain by dark brown clay silt over sand and gravel resting on brown to gray sand clay (Glacial Till).

Due to the nature of the subsurface conditions, cofferdams may be required to construct the bents. Soil parameters that can be used for the design of the cofferdams are listed in the Site Plan and Subsurface Profile Sheet. Include in the plans current cofferdam notes provided by the Office of Bridge Design under the Ancillary Bridge Notes located on the SDDOT website.

Pertinent design information for Steel HP 12x53 piling, (as requested) is listed in the recommendations section for use in the bridge abutments and bents.

Steel piling was evaluated for driveability at the LRFD Strength Limit State. Settlement of the substructure units was evaluated at the LRFD Service Limit State.

AASHTO requires the minimum spacing of driven pile to be 2.5 times the pile diameter (B) or 30 inches, whichever is greater. When evaluating horizontal pile foundation movement, group effects can be ignored and a

group efficiency factor of 1.0 can be used with no reduction in lateral resistance required if the center to center spacing is greater than 5B.

The following soil parameters can be used for hydraulic design and calculations of horizontal movement at the substructure units:

	D50	D95	Phi Angle	Cohesion	Wet Unit Weight
Clay silt	0.01 mm	0.40 mm	16 degrees	200 psf	112 pcf
Sand and gravel	2.00 mm	25.0 mm	34 degrees	0 psf	128 pcf
Sand clay (Glacial Till)	0.02 mm	1.00 mm	23 degrees	950 psf	129 pcf

Pile tips will be founded within Glacial Till. Results of settlement analysis and past experience for deep foundations located in this material show a possibility of up to 1 inch of settlement of the piling. Therefore, 1 inch of total settlement is recommended for use in design of the substructure units.

As discussed with the designer, 3 ft. of granular bridge end backfill will be placed behind the abutment. A 4" drain system shall be incorporated at the base of the granular fill and daylighted. A layer of Type B drainage fabric should be placed between the top of the granular bridge end backfill and surfacing section.

Soils maps of the area indicate the soils in the location of the proposed structure have a low to moderate corrosivity to concrete. Concrete mix design will not require considerations for corrosivity.

Groundwater elevations, as of June and July 2018, along with the average skin friction values measured over the length of the drive tests are listed on the Site Plan and Subsurface Profile Sheet.

The designer shall make sure that the subsurface sheet submitted in the plans has retained the same text, line weight, line style and any other features present in the original subsurface sheet sent by the Geotechnical Engineering Activity.

**The following note shall be placed in the structure plans:**

A driveability analysis was performed using the wave equation analysis program (GRLWEAP). A list of acceptable hammers is provided below. The hammers listed were found to produce acceptable driving stresses. Pile hammers not listed will require evaluation and approval prior to use from the Geotechnical Engineering Activity. Requests for evaluation of hammers not listed shall be submitted a minimum of 5 working days prior to installation of piles.

Delmag D30-32

SPI D30

APE D30-32

APE D30-52

Any questions about the recommendations, other desired pile types or bearings, or the subsurface conditions can be directed to the Geotechnical Engineering Activity.



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