Certified Testing Services, Inc.

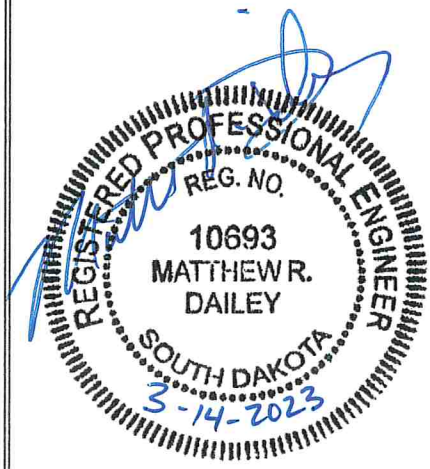
GEOTECHNICAL ENGINEERING REPORT

Garden Estates Development
Yankton County, South Dakota

Prepared For:
Yankton Thrive
803 East 4th Street
Yankton, South Dakota

CTS Project No. G6933

Geotechnical Engineering • Construction Materials Testing
www.certifiedtestingservices.com



I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly Licensed Professional Engineer under the laws of the State of South Dakota.

Name: Matthew R. Dailey, P.E.

License Number 10693

My license renewal date is March 31, 2024.

Pages or sheets covered by this seal:

This report contains 31 pages, including this page.

CTS File Number G6933

Certified Testing Services, Inc.
419 W. 6th Street • P.O. Box 1193 • Sioux City, Iowa 51102 • Phone (712) 252-5132

March 14, 2023

Attn: Ms. Nancy Wenande
Yankton Thrive
803 East 4th Street
Yankton, SD 57078

RE: Geotechnical Exploration Services
Garden Estates Development
Yankton County, South Dakota
CTS Job No. G6933

Dear Ms. Wenande:

Certified Testing Services, Inc. is pleased to transmit our Geotechnical Engineering Report for the referenced project. This report includes the results of field and laboratory testing, pavement subgrade and thickness recommendations and groundwater information.

We appreciate the opportunity to perform this Geotechnical Study and look forward to continued participation during the design and construction phases of this project. If you have any questions pertaining to this report or if we may be of further service, please contact our office.

Respectfully submitted,
CERTIFIED TESTING SERVICES, INC.

James A. Bertsch, P.E. SD 4410
Senior Geotechnical Engineer

Matthew R. Dailey, P.E. SD 10693
Geotechnical Department Manager

JAB/MRD/jb

cc: Stockwell Engineers, Inc.

GEOTECHNICAL ENGINEERING REPORT

GARDEN ESTATES DEVELOPMENT
YANKTON COUNTY, SOUTH DAKOTA

CTS PROJECT NO. G6933

PREPARED FOR

ATTN: MS. NANCY WENANDE
YANKTON THRIVE
803 EAST 4TH STREET
YANKTON, SD 57078

MARCH 14, 2023

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PROJECT INFORMATION

Project Authorization

Certified Testing Services, Inc. has completed a subsurface exploration for the Garden Estates Development project. Ms. Nancy Wenande, CEO for Yankton Thrive authorized our work by signing our proposal on December 9, 2022. This work was performed in accordance with CTS Proposal Number 6215 dated December 6, 2022.

Project Description

Mr. Eric Derickson of Stockwell Engineers, Inc. presented project information in emails on December 2 and 6, 2022, January 13, 2023, and March 1, 2023. The email on December 2, 2022, included a drawing titled, "Concept Layout 6" that showed the proposed project street layout. The email on December 6, 2022, was a modified copy of the drawing that showed suggested borings locations determined by Stockwell Engineers, Inc. and CTS personnel; however, the email on January 13, 2023, included a revised boring plan that reduced the number of borings from thirteen to seven. The email on March 1, 2023, included a drawing titled, "Grading Option 1" and an untitled and undated drawing showing the street cross-sections. It is understood that the project will consist of the construction of a subdivision on the west side of Westbrook Estates on the northwest side of Yankton, South Dakota. It is also understood that the project will consist of the installation of water, storm sewer and sanitary sewer with the deepest utility being approximately 19 feet deep. Based on the cross-sections the site will have up to 7 feet of fill and 13 feet of cut in some areas.

The geotechnical recommendations presented in this report are based on the available project information, project location, and the subsurface materials described in this report. If the noted information is incorrect, please inform CTS in writing so that we may amend the recommendations presented in this report, if appropriate. CTS will not be responsible for the implementation of its recommendations when it is not notified of changes in the project.

Purpose and Scope of Services

The purpose of this study was to explore the subsurface conditions at the site to prepare recommendations for pavement subgrade preparation, evaluation of the existing soils for suitability as pipe bedding and trench backfill, and groundwater information. Our scope of services included performing seven borings to depths of 30 feet below the existing grade in the project area. The scope of work also included select laboratory testing, and preparation of this geotechnical report. This report briefly outlines the testing procedures, presents available project information, describes the site and subsurface conditions, and provides recommendations for pavement subgrade preparation, suitability of existing material for pipe bedding and trench backfill, and groundwater information. The scope of services did not include an environmental assessment of the site.

SITE AND SUBSURFACE CONDITIONS

Site Location and Description

The project is located on the west side of Westbrook Estates on the northwest side of Yankton in Yankton County, South Dakota. At the time of drilling, the surface at the borings consisted of tall vegetation and a harvested field with a 12-inch root zone. The site was soft at the time of our site visit and the drill rig did experience some difficulty moving between the boring locations.

Subsurface Conditions

The site subsurface conditions were explored with a total of seven soil test borings sampled to depths of 30 feet below the existing ground surface in the project area. The boring locations and depths were determined by Stockwell Engineers, Inc personnel. Stockwell Engineers, Inc personnel located the borings in the field and provided elevations for the boring locations in an email on March 1, 2023. The approximate locations of the borings are also presented on the "Boring Location Plan" included in the Appendix, which is a modified copy of the drawing titled, "Grading Option 1".

The borings were advanced utilizing hollow stem auger drilling methods and soil samples were routinely obtained during the drilling process. Select soil samples were later tested in the laboratory to determine materials properties for our evaluation. CTS performed a standard Proctor test and CBR test on the lean clay material encountered between the depths of 1 feet and 5 feet below the existing grade in Boring B2 and the results are presented in the "Laboratory Test Data" section of the Appendix. Soil sampling and laboratory testing were accomplished generally in accordance with ASTM procedures. The borings were backfilled with on-site material after performing our work; however, it should be noted that some settlement of the backfill material may occur and it is the client's responsibility to backfill the borings once we have left the site.

The subsurface conditions below the surface material consisted of lean clay topsoil, lean clay altered loess, lean to fat clay with calcium deposits altered loess, lean to fat clay altered loess, lean clay Peorian loess, lean clay with calcium deposits Peorian loess, lean clay with sand leached till, sandy lean clay glacial outwash, lean clay with sand glacial outwash, clayey silt glacial outwash, clayey sand glacial sand, lean clay with sand weathered glacial till, lean clay with sand glacial till, and lean clay weathered claystone shale.

The boring logs included in the Appendix should be reviewed for specific information at individual boring locations. The boring logs include soil/rock descriptions, stratifications, penetration resistances, and locations of the samples and laboratory test data. The stratifications shown on the boring logs represent the conditions only at the actual boring locations. Variations may occur and should be expected between boring locations. The stratifications represent the approximate boundary between subsurface materials and the actual transition may be gradual. Water level information obtained during field operations is

also shown on these boring logs. Samples that were not altered by laboratory testing will be retained for 30 days from the date of this report and then will be discarded.

Water Level Measurements

Free water was encountered in Borings B1, B2, B4, B5, and B6 at depths of between 6.6 feet and 28.5 feet below the existing grade at the time of drilling and was encountered in Borings B2, B3, B4, B5, and B7 at depths ranging from 1.3 feet to 9.8 feet below the existing grade 7 days after drilling. It should be noted that a water table is normally encountered at the surface of the glacial till material. Water levels should be expected to fluctuate with changes in climatic conditions. The water level measurements presented in this report are the levels that were measured at the time of our field activities.

EVALUATIONS AND RECOMMENDATIONS

Geotechnical Discussion

CTS has several concerns from a geotechnical standpoint. The first concern is for utility installation based on free water being encountered in Borings B1, B2, B4, B5, and B6 at depths of between 6.6 feet and 28.5 feet below the existing grade at the time of drilling and in Borings B2, B3, B4, B5, and B7 at depths ranging from 1.3 feet to 9.8 feet below the existing grade 7 days after drilling. Based on this information, it is CTS's opinion that utility trenches will need to be dewatered. It should also be noted that water bearing clayey sand was encountered in Boring B5 between the depths of 8.5 feet and 13 feet and is anticipated to be encountered at other locations and depths. Water bearing sand will slough causing the sides of the utility excavations to collapse causing an unsafe condition if the water bearing sand is not dewatered prior to excavating into the water bearing sand materials. Based on the relatively impervious material encountered in the borings, it is CTSs opinion that the dewatering can be performed using pumps. It is also CTS's opinion that drawdown wells will not work on this site based on the relatively impervious materials encountered in the borings.

The second concern is the topsoil material encountered in the top foot to 2 feet in the borings. CTS recommends that the topsoil material be removed in the pavement areas.

The third concern is for expansive lean to fat clay material to be encountered at bottom of pavement grade, based on the lean to fat clay altered loess encountered between the depths of 3.5 feet and 6 feet in Borings B1 and B4 and cut depths of up to 7 feet in some areas. CTS recommends that expansive lean to fat clay material encountered within 18 inches of the bottom of the pavement be removed and replaced with lean clay material.

The soils encountered below the topsoil material in the borings are suitable for pavement subgrade, with the exception of lean to fat clay within 18 inches of the bottom of the pavement and is also suitable for bedding the utilities and for backfill in trenches. However, the lean to fat clay material should not be used for trench backfill within 18 inches

of the bottom of the pavement. It should also be noted that some of the site soils are very moist to wet and will need to be dried back prior to being used for pavement support and trench backfill. CTS also recommends that the pipe manufacturer's recommendations be followed.

Final pavement subgrade preparation, after the utilities have been installed, lean to fat clay has been addressed as previously discussed, and the site has been proofrolled as discussed in the "Site Preparation" section of this report, consist of scarifying, moisture conditioning and compacting the top 12 inches of the subgrade to meet the requirements of the "Site Preparation" section of this report, the day before the pavement is placed. **If there is a delay between subgrade preparation and paving, the moisture content of the pavement subgrade would need to be checked the day before or the day of the pavement placement to determine if the moisture content of the prepared subgrade meets the requirements of the "Site Preparation" section of this report. Material that does not meet the moisture requirement will need to be scarified, moisture conditioned and compacted to meet the requirements of the "Site Preparation" section of this report prior to pavement and granular base placement. If a granular base is used, the granular base should be placed just prior to the pavement placement and after the moisture content of the subgrade has been checked. Subdrains should be installed, where practical, if a granular base is placed below the pavement to minimize the potential for frost heave occurring due trapped water in the granular material.** The subdrains should consist of a 4-inch or 6-inch heavy walled perforated pipe wrapped in a filter sock and located a minimum of 42 inches below the top of pavement grade. The granular material around the drains should be a well-graded granular material or coarse sand with less than 5 percent passing the #200 sieve and the material passing the #200 sieve should not contain clay. The granular material in the subdrain should extend up to the granular base material and drain should outlet to a suitable means of disposal. The chance for frost heave issues to occur goes up greatly if the subgrade soils undergo an increase in moisture content prior to paving. Frost heave can result in the pavement heaving and cracking. If curbs and gutters are installed, they should be backfilled as soon as the curb and gutter concrete has achieved adequate strength, usually in 3 days to 7 days. If curbs and gutters are not installed, the edge of the pavement should be backfilled within 3 days to 7 days of the pavement being placed. The purpose of backfilling behind the curbs, gutters and edge of pavement as soon as possible is to eliminate areas where water can pond and cause frost heave issues under the pavement due to water migrating under the pavement. The owner should be aware that this procedure will help to minimize frost heave; however, some frost heave may occur from the soils below the prepared subgrade.

Site Preparation

CTS recommends that topsoil, vegetation, roots, soft, organic, material containing frost, and unsuitable soils in the areas to be stripped from the site and either wasted or stockpiled for later use in landscaping. The lean clay site materials are suitable for structural fill material; however, the materials are very moist to wet in some areas and will need to be moisture conditioned, dried, prior to being used as structural fill in trench and pavement areas. A representative of the geotechnical engineer should determine the depth of removal at the time of construction.

After stripping and excavating to the proposed subgrade level, as required, and after the utilities have been installed, the street subgrade should be proofrolled with a loaded tandem axle dump truck or similar piece of heavy rubber-tired vehicle (typically with an axle load greater than 9-tons). Soils that are observed to rut or deflect excessively (typically greater than 1-inch) under the moving load should be undercut and replaced with properly compacted fill. The proofrolling and undercutting activities should be witnessed by a representative of the geotechnical engineer and should be performed during a period of dry weather. If excessive movement is observed during the proofrolling, the proofrolling should be stopped and the site evaluated by the geotechnical engineer or his representative.

After subgrade preparation and observation have been completed, fill placement may begin. Fill should be a lean clay material free of organic or other deleterious materials, have a maximum particle size of less than 3-inches, and have a liquid limit less than 45 and plasticity index less than 22. Fill materials should not contain frost and new fill should not be placed on frozen ground.

Structural fill should be placed in maximum loose lifts of 4 inches for hand compaction equipment and 8 inches for riding compaction equipment and compacted to at least 95 percent of the material's standard Proctor maximum dry density. Lean clay should be compacted to within a minus 3 percent to a plus 3 percent of the optimum moisture content as determined in general accordance with ASTM D 698 procedures. The moisture content of the material should be maintained between the recommended moisture contents until the pavement is placed on the material. Materials that undergo increases or decreases in moisture content beyond the recommended moisture content ranges should be scarified, moisture conditioned and compacted to meet these moisture ranges just prior to pavement being placed. Every other lift of compacted-engineered fill should be tested by a representative of the geotechnical engineer prior to placement of subsequent lifts.

Pavement Recommendations

Our scope of services did include CBR testing of existing lean clay subgrade materials. **If conditions other than those found in our borings are encountered, CTS should be notified to determine if the recommendations presented below are valid.**

It is recommended that the pavement areas be prepared as discussed in the "Geotechnical Discussion" and "Site Preparation" sections of this report. Subdrains are recommended if a granular base is placed under the pavement. Subdrains should be designed as discussed in the "Geotechnical Discussion" section of this report.

The following CTS recommendation is based on the subgrade soils being prepared to achieve a minimum CBR of 8. Based on our analysis, using the Concrete Pavement Analyst software provided by the National Ready Mixed Concrete Association, the following equivalent pavement sections were calculated:

PAVEMENT MATERIALS*	LOCAL ROAD	COLLECTOR ROAD
Portland Cement Concrete	6 Inches	7 Inches

* Pavement materials should conform to local and state guidelines, if applicable.

The work should be performed in accordance with State Department of Transportation guidelines, if applicable.

CONSTRUCTION CONSIDERATIONS

CTS should be retained to provide observation and testing of construction activities involved in the street and utility activities of this project. CTS cannot accept responsibility for conditions that deviate from those described in this report, nor for the performance of the subgrade if not engaged to also provide construction observation and testing for this project.

Moisture Sensitive Soils and Weather Related Concerns

The fine-grained soils encountered at this site will be sensitive to disturbances caused by construction activities and to changes in moisture content. During wet weather periods, increases in the moisture content of the soil can cause significant reduction in the soil strength and support capabilities. In addition, soils that become wet may be slow to dry and thus significantly retard the progress of grading and compaction activities. It will, therefore, be advantageous to perform earthwork activities during dry weather.

Drainage and Groundwater Considerations

Water should not be allowed to collect in trench excavations or on prepared subgrade of the construction area during construction. Undercut or excavated areas should be sloped to facilitate removal of collected rainwater, groundwater, or surface runoff. Positive site drainage should be provided to reduce infiltration of surface water into trenches.

Free groundwater was encountered in Borings B1, B2, B4, B5, and B6 at depths of between 6.6 feet and 28.5 feet below the existing grade at the time of drilling and was encountered in Borings B2, B3, B4, B5, and B7 at depths ranging from 1.3 feet to 9.8 feet below the existing grade 7 days after drilling. As previously discussed in the “Geotechnical Discussion” section of this report, dewatering can be performed using pumps. The soils have very moist to wet moisture contents that may cause construction problems. It is possible that seasonal variations will cause fluctuations or a water table to be present in the upper soils. The contractor should determine the depth of groundwater at the time of the work and be prepared to handle the removal of the groundwater.

Excavations

In Federal Register, Volume 54, Number 209 (October 1989), the United States Department of Labor, Occupational Safety and Health Administration (OSHA) amended its

"Construction Standards for Excavations, 29 CFR, part 1926, Subpart P". This document was issued to better enhance the safety of workers entering trenches or excavations. It is mandated by this federal regulation that excavations, whether they be utility trenches, basement excavation or footing excavations, be constructed in accordance with the new OSHA guidelines. It is our understanding that these regulations are being strictly enforced and if they are not closely followed, the owner and the contractor could be liable for substantial penalties.

The contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, slope, or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. The contractor's "responsible person", as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the contractor's safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, state, and federal safety regulations. The lean clay and silt material is a Class B material and the clayey sand material is a Class C material in accordance with OSHA criteria.

We are providing this information solely as a service to our client. CTS does not assume responsibility for construction site safety or the contractor's or other party's compliance with local, state, and federal safety or other regulations.

REPORT LIMITATIONS

The recommendations submitted are based on the available subsurface information obtained by CTS and design details furnished by Mr. Eric Derickson of Stockwell Engineers, Inc. If deviations from the subsurface conditions noted in this report are encountered during construction, CTS should be notified immediately to determine if changes in the recommendations are required. If CTS is not retained to perform these functions, CTS will not be responsible for the impact of those conditions on the project.

The geotechnical engineer warrants that the findings, recommendations, specifications, or professional advice contained herein have been made in accordance with generally accepted professional geotechnical engineering practices in the local area. No other warranties are implied or expressed.

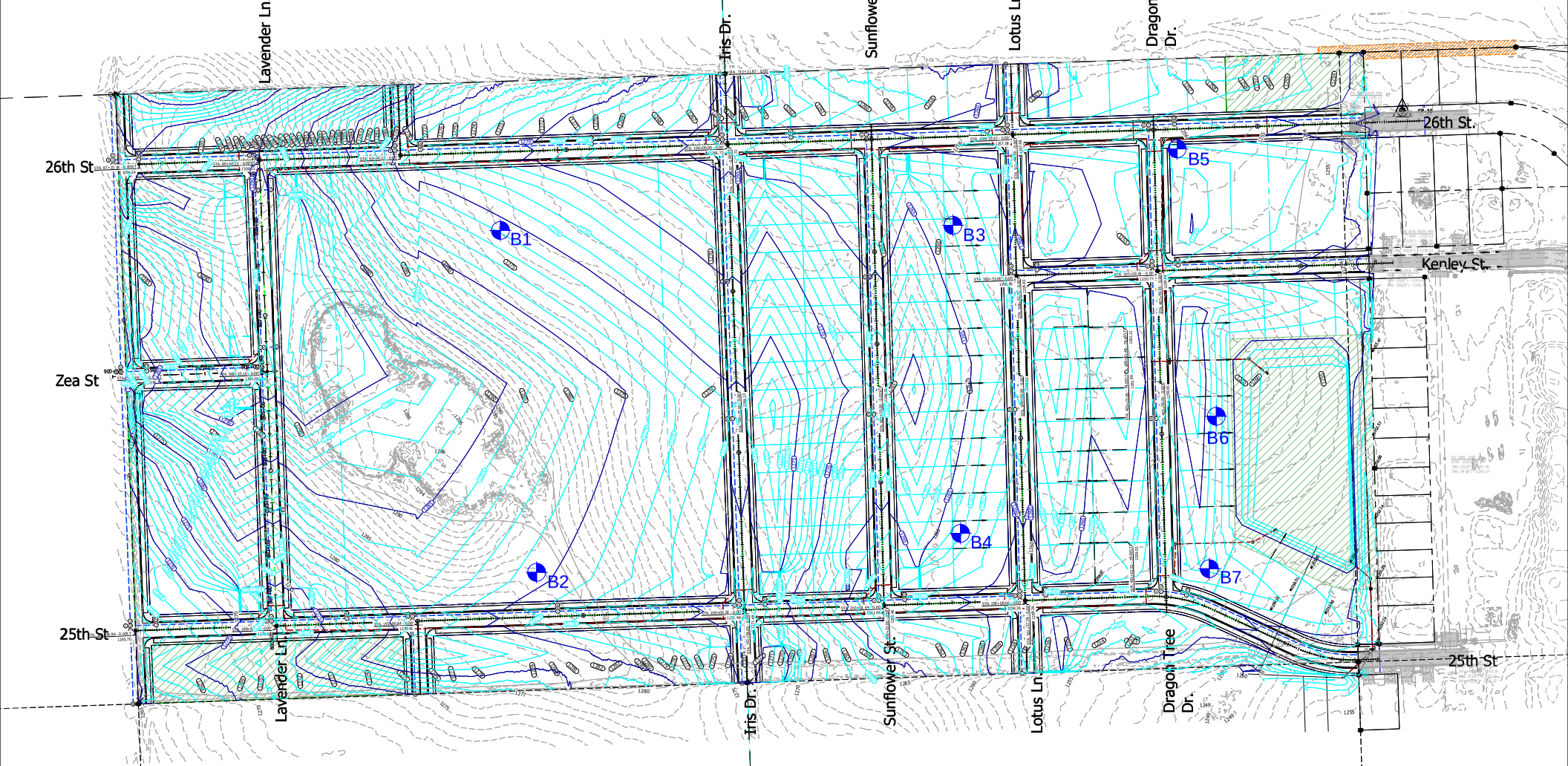
After the plans and specifications are more complete, the geotechnical engineer should be retained and provided the opportunity to review the final design plans and specifications to check that our engineering recommendations have been properly incorporated into the design documents. At that time, it may be necessary to submit supplementary recommendations. This report has been prepared for the exclusive use of Yankton Thrive and their consultants for the specific application to the Proposed Garden Estates Development Project in Yankton, South Dakota.

APPENDIX

BORING LOCATION PLAN

STOCKWELL

STOCKWELLENGINEERS.COM | (605) 338-6668



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Garden Estates Development

Grading Option 1

2/21/2023 SEI#22048

THRIVE

BORING LOGS

LOG OF EXPLORATORY BORING

Job Number: **G6933**
Project: **Garden Estates Development**
Date Started: **2/20/23**
Date Completed: **2/20/23**

Boring No.: **B-1**
Boring Location: **Yankton, SD**
Drill Type: **Hollow Stem**
Ground Elev.: **1274.0**

Shelby Tube | Standard Split Spoon | Water Level ATD
Modified California | Grab Sample | Water Level After 7-DAYS

Depth in Feet	Graphic Log	Sample Type	SOIL DESCRIPTION	USCS	Blow Counts SPT (N) Blows/Foot	Moisture Content, %	Dry Density (PCF)	% Saturation	Hand Penetrometer (TSF)	Unconfined Comp. Strength (TSF)	Liquid Limit %	Plastic Limit %	Plasticity Index %	Cone Penetrometer (Blows/ 1-3/4")
			12-Inch Root and Disturbed Zone, 12-Inch Frost Zone											
			LEAN CLAY, Medium Brown, Moist, Stiff, Altered Loess	CL	3-3-5 N= 8	13								
5			LEAN TO FAT CLAY WITH CALCIUM DEPOSITS, Light Brown, Moist, Altered Loess	CL-CH		15	103	63	4.50					
			SANDY LEAN CLAY, Grayish Yellow Brown, Moist, Stiff, Glacial Outwash	CL	3-5-5 N= 10	16								
10						15	112	84	4.50					
			CLAYEY SILT, Medium Yellow Brown and Gray, Very Moist to Wet, Stiff, Glacial Outwash	ML	2-3-5 N= 8	26								
15														
20						29	93	100	2.75					
25					3-4-5 N= 9	23								
						30	92	100	1.50					
30			END OF BORING AT 30 FEET FREE WATER WAS ENCOUNTERED AT 20 FEET AT TIME OF DRILLING											

LOG OF EXPLORATORY BORING

Job Number: **G6933**
Project: **Garden Estates Development**
Date Started: **2/20/23**
Date Completed: **2/20/23**

Boring No.: **B-2**
Boring Location: **Yankton, SD**
Drill Type: **Hollow Stem**
Ground Elev.: **1284.6**

Shelby Tube | Standard Split Spoon | Water Level ATD
Modified California | Grab Sample | Water Level After 7-DAYS

Depth in Feet	Graphic Log	Sample Type	SOIL DESCRIPTION	USCS	Blow Counts SPT (N) Blows/Foot	Moisture Content, %	Dry Density (PCF)	% Saturation	Hand Penetrometer (TSF)	Unconfined Comp. Strength (TSF)	Liquid Limit %	Plastic Limit %	Plasticity Index %	Cone Penetrometer (Blows/ 1-3/4")
			12-Inch Root and Disturbed Zone, 12-Inch Frost Zone											
			LEAN CLAY WITH ROOTS, Medium Brown, Moist, Topsoil	CL	2-5-7 N= 12	13								
			LEAN CLAY, Medium Brown, Moist, Very Stiff, Altered Loess (Calcium Stringers, Medium Yellow Brown)		5-6-7 N= 13	14								
5			LEAN CLAY, Medium Yellow Brown and Gray, Moist, Stiff, Oxidized, Peorian Loess	CL		14	105	64	4.00					
			SILT, Yellow Brown and Gray, Moist to Wet, Stiff, Oxidized, Peorian Loess	ML	2-4-7 N= 11	17								
10														
			SANDY LEAN CLAY, Grayish Yellow Brown, Wet, Glacial Outwash	CL		19	110	100	3.00					
15														
			CLAYEY SILT, Medium Yellow Brown and Gray, Wet, Stiff to Soft, Glacial Outwash	ML	3-4-5 N= 9	19								
20														
						25	100	100	1.25					
25														
					2-2-1 N= 3	32								
30			END OF BORING AT 30 FEET FREE WATER WAS ENCOUNTERED AT 28.5 FEET AT TIME OF DRILLING AND AT 9.8 FEET 7 DAYS AFTER DRILLING											

LOG OF EXPLORATORY BORING

Job Number: **G6933**
Project: **Garden Estates Development**
Date Started: **2/16/23**
Date Completed: **2/16/23**

Boring No.: **B-3**
Boring Location: **Yankton, SD**
Drill Type: **Hollow Stem**
Ground Elev.: **1258.9**

Shelby Tube | Standard Split Spoon | Water Level ATD
Modified California | Grab Sample | Water Level After 7-DAYS

Depth in Feet	Graphic Log	Sample Type	SOIL DESCRIPTION	USCS	Blow Counts SPT (N) Blows/Foot	Moisture Content, %	Dry Density (PCF)	% Saturation	Hand Penetrometer (TSF)	Unconfined Comp. Strength (TSF)	Liquid Limit %	Plastic Limit %	Plasticity Index %	Cone Penetrometer (Blows/ 1-3/4")
			12-Inch Root and Disturbed Zone, 14-Inch Frost Zone											
			LEAN CLAY WITH ROOTS, Dark Brown, Moist, Topsoil	CL	3-2-3 N= 5	18								
			LEAN CLAY, Medium Brown, Moist, Altered Loess	CL										
5			LEAN CLAY WITH SAND, Yellow Brown and Gray, Moist to Wet, Medium, Leached Till			23	98	87	1.75					
					3-2-3 N= 5	20								
10						20	108	100	4.00					
			LEAN CLAY WITH SAND, Yellow Brown and Gray, Very Moist, Stiff, Weathered Glacial Till	CL	3-5-6 N= 11	19								
15														
20			(Medium Gray)			16	116	96	3.00					
25					2-2-5 N= 7	15								
			LEAN CLAY WITH SAND, Medium Gray, Very Moist, Glacial Till	CL		17	115	98	3.00					
30			END OF BORING AT 30 FEET FREE WATER WAS NOT ENCOUNTERED AT TIME OF DRILLING AND WAS ENCOUNTERED AT 7.1 FEET 7 DAYS AFTER DRILLING											

LOG OF EXPLORATORY BORING

Job Number: **G6933**
Project: **Garden Estates Development**
Date Started: **2/13/23**
Date Completed: **2/13/23**

Boring No.: **B-4**
Boring Location: **Yankton, SD**
Drill Type: **Hollow Stem**
Ground Elev.: **1259.8**

Shelby Tube | Standard Split Spoon | Water Level ATD
Modified California | Grab Sample | Water Level After 7-DAYS

Depth in Feet	Graphic Log	Sample Type	SOIL DESCRIPTION	USCS	Blow Counts SPT (N) Blows/Foot	Moisture Content, %	Dry Density (PCF)	% Saturation	Hand Penetrometer (TSF)	Unconfined Comp. Strength (TSF)	Liquid Limit %	Plastic Limit %	Plasticity Index %	Cone Penetrometer (Blows/ 1-3/4")
			12-Inch Root and Disturbed Zone, 6-Inch Frost Zone											
			LEAN CLAY, Dark Brown, Moist to Wet, Stiff, Altered Loess	CL	3-4-5 N= 9	15								
5			LEAN TO FAT CLAY, Light Gray and Brownish Gray, Moist, Very Stiff, Altered Loess	CL-CH	7-7-9 N= 16	16					52	20	32	
			SANDY LEAN CLAY, Yellow Brown and Gray, Very Moist to Wet, Stiff, Glacial Outwash	CL		19	109	96	2.50					
10					3-4-7 N= 11	20								
15			(Medium Gray, Oxidized)			21	107	100	3.50	1.80				
20			CLAYEY SILT, Medium Yellow Brown and Gray, Wet, Stiff, Glacial Outwash	ML	3-4-5 N= 9	28								
25						31	90	100	2.50					
			SANDY LEAN CLAY, Grayish Yellow Brown, Wet, Stiff, Glacial Outwash	CL	3-5-6 N= 11	20								
30			END OF BORING AT 30 FEET FREE WATER WAS ENCOUNTERED AT 10.4 FEET AT TIME OF DRILLING AND AT 1.3 FEET 7 DAYS AFTER DRILLING											

LOG OF EXPLORATORY BORING

Job Number: **G6933**
Project: **Garden Estates Development**
Date Started: **2/13/23**
Date Completed: **2/13/23**

Boring No.: **B-5**
Boring Location: **Yankton, SD**
Drill Type: **Hollow Stem**
Ground Elev.: **1255.9**

Shelby Tube | Standard Split Spoon | Water Level ATD
Modified California | Grab Sample | Water Level After 7-DAYS

Depth in Feet	SOIL DESCRIPTION	USCS	Blow Counts SPT (N) Blows/Foot	Moisture Content, %	Dry Density (PCF)	% Saturation	Hand Penetrometer (TSF)	Unconfined Comp. Strength (TSF)	Liquid Limit %	Plastic Limit %	Plasticity Index %	Cone Penetrometer (Blows/ 1-3/4")
	12-Inch Root and Disturbed Zone, 6-Inch Frost Zone											
	LEAN CLAY WITH ROOTS, Dark Brown, Moist, Topsoil	CL	4-3-4 N= 7	20								
	LEAN CLAY, Medium Brown, Moist, Altered Loess	CL		20	104	88	2.25					
5	LEAN CLAY WITH CALCIUM DEPOSITS, Medium Yellow Brown and Gray, Moist, Oxidized, Peorian Loess											
	SANDY LEAN CLAY, Yellow Brown and Gray, Moist to Wet, Very Stiff, Glacial Outwash	CL	4-6-9 N= 15	20								
10	CLAYEY SAND, Grayish Yellow Brown, Wet, Medium Dense, Glacial Sand	SC	5-7-7 N= 14									
	LEAN CLAY WITH SAND, Yellow Brown and Gray, Very Moist, Stiff, Oxidized, Weathered Glacial Till	CL	3-4-4 N= 8	23								
15												
20			4-5-7 N= 12	20								
25	LEAN CLAY, Light Gray, Very Moist, Stiff to Very Hard, Weathered Claystone Shale	CL	4-5-5 N= 10	36								
			14-27-50 N= 77	45								
30	END OF BORING AT 30 FEET FREE WATER WAS ENCOUNTERED AT 6.6 FEET AT TIME OF DRILLING AND AT 8.8 FEET 7 DAYS AFTER DRILLING											

LOG OF EXPLORATORY BORING

Job Number: **G6933**
Project: **Garden Estates Development**
Date Started: **2/13/23**
Date Completed: **2/13/23**

Boring No.: **B-6**
Boring Location: **Yankton, SD**
Drill Type: **Hollow Stem**
Ground Elev.: **1256.9**

Shelby Tube | Standard Split Spoon | Water Level ATD
Modified California | Grab Sample | Water Level After 7-DAYS

Depth in Feet	Graphic Log	Sample Type	SOIL DESCRIPTION	USCS	Blow Counts SPT (N) Blows/Foot	Moisture Content, %	Dry Density (PCF)	% Saturation	Hand Penetrometer (TSF)	Unconfined Comp. Strength (TSF)	Liquid Limit %	Plastic Limit %	Plasticity Index %	Cone Penetrometer (Blows/ 1-3/4")
			12-Inch Root and Disturbed Zone, 6-Inch Frost Zone											
			LEAN CLAY, Medium Brown, Moist, Stiff, Altered Loess	CL	3-4-6 N= 10	16								
5			LEAN CLAY, Medium Yellow Brown and Gray, Moist, Medium, Oxidized, Peorian Loess	CL	1-2-2 N= 4	22								
			SANDY LEAN CLAY, Grayish Yellow Brown, Very Moist, Stiff, Glacial Outwash	CL		21	103	92	1.00					
10					3-3-5 N= 8	22								
			LEAN CLAY WITH SAND, Yellow Brown and Gray, Very Moist to Wet, Very Stiff to Stiff, Oxidized, Glacial Till	CL		20	107	96	3.50	1.10				
15														
20					8-11-12 N= 23	19								
25					2-5-4 N= 9	19								
			(Medium Gray)		2-5-5 N= 10	18								
30			END OF BORING AT 30 FEET FREE WATER WAS ENCOUNTERED AT 26.8 FEET AT TIME OF DRILLING											

LOG OF EXPLORATORY BORING

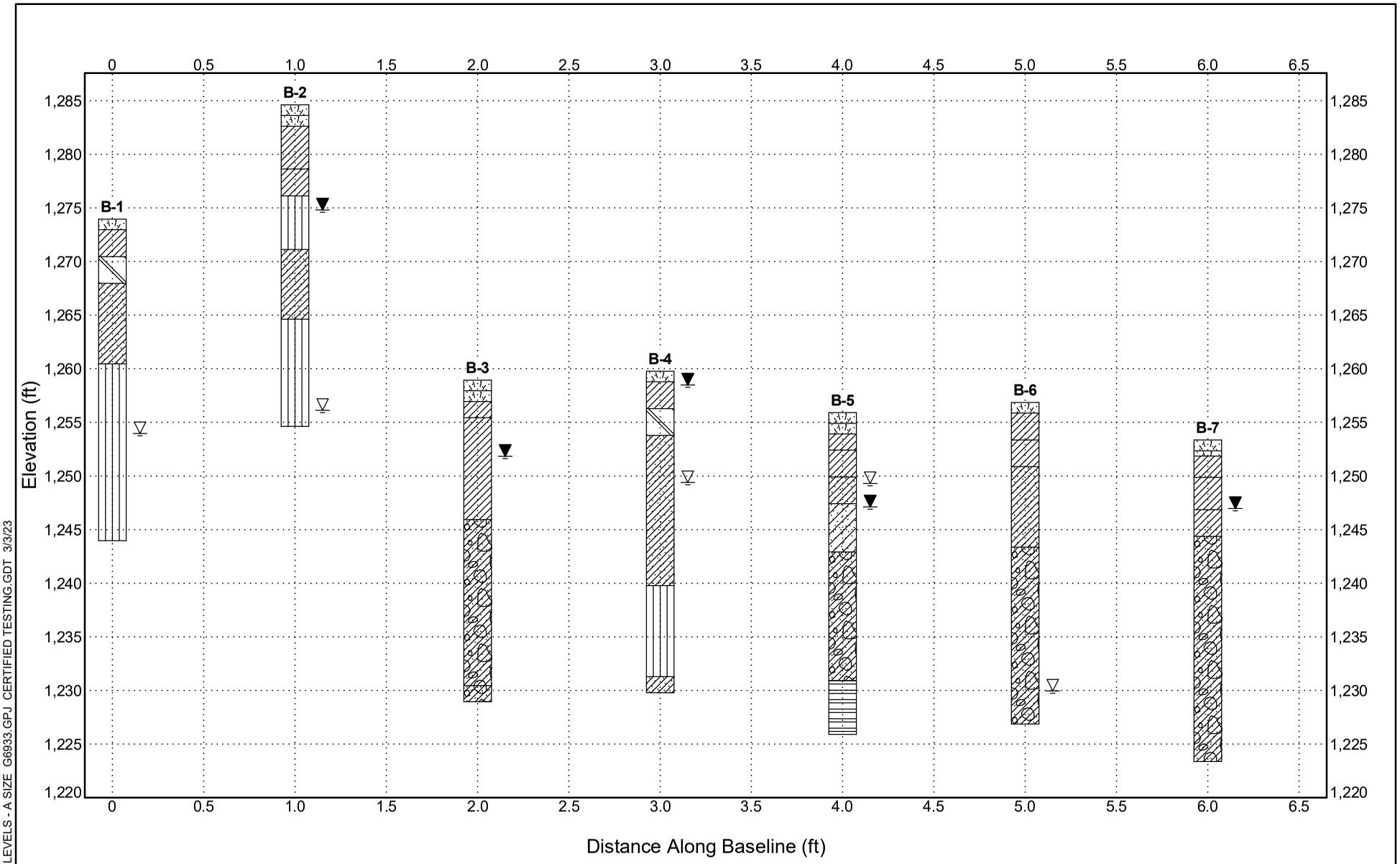
Job Number: **G6933**
Project: **Garden Estates Development**
Date Started: **2/13/23**
Date Completed: **2/13/23**

Boring No.: **B-7**
Boring Location: **Yankton, SD**
Drill Type: **Hollow Stem**
Ground Elev.: **1253.4**

Shelby Tube | Standard Split Spoon | Water Level ATD
Modified California | Grab Sample | Water Level After 7-DAYS

Depth in Feet	Graphic Log	Sample Type	SOIL DESCRIPTION	USCS	Blow Counts SPT (N) Blows/Foot	Moisture Content, %	Dry Density (PCF)	% Saturation	Hand Penetrometer (TSF)	Unconfined Comp. Strength (TSF)	Liquid Limit %	Plastic Limit %	Plasticity Index %	Cone Penetrometer (Blows/ 1-3/4")
			12-Inch Root and Disturbed Zone, 6-Inch Frost Zone											
			LEAN CLAY WITH ROOTS, Medium Brown, Moist, Topsoil	CL	2-4-4 N= 8	21								
			LEAN CLAY, Medium Brown, Moist, Altered Loess	CL	2-3-5 N= 8	20								
5			LEAN CLAY WITH CALCIUM DEPOSITS, Medium Yellow Brown and Gray, Moist to Wet, Stiff, Peorian Loess											
			LEAN CLAY WITH SAND, Yellow Brown and Gray, Wet, Medium, Glacial Outwash	CL	1-2-4 N= 6	24								
			LEAN CLAY WITH SAND, Yellow Brown and Gray, Very Moist, Very Stiff to Stiff, Oxidized, Weathered Glacial Till	CL		20	109	98	3.50					
10														
			(Calcium Deposits)		3-6-8 N= 14	18								
15														
20						18	109	94	4.50	2.00				
25			(Medium Gray)		1-4-4 N= 8	22								
						16	115	97	2.25					
30			END OF BORING AT 30 FEET FREE WATER WAS NOT ENCOUNTERED AT TIME OF DRILLING AND WAS ENCOUNTERED AT 6.4 FEET 7 DAYS AFTER DRILLING											

BORING PROFILES



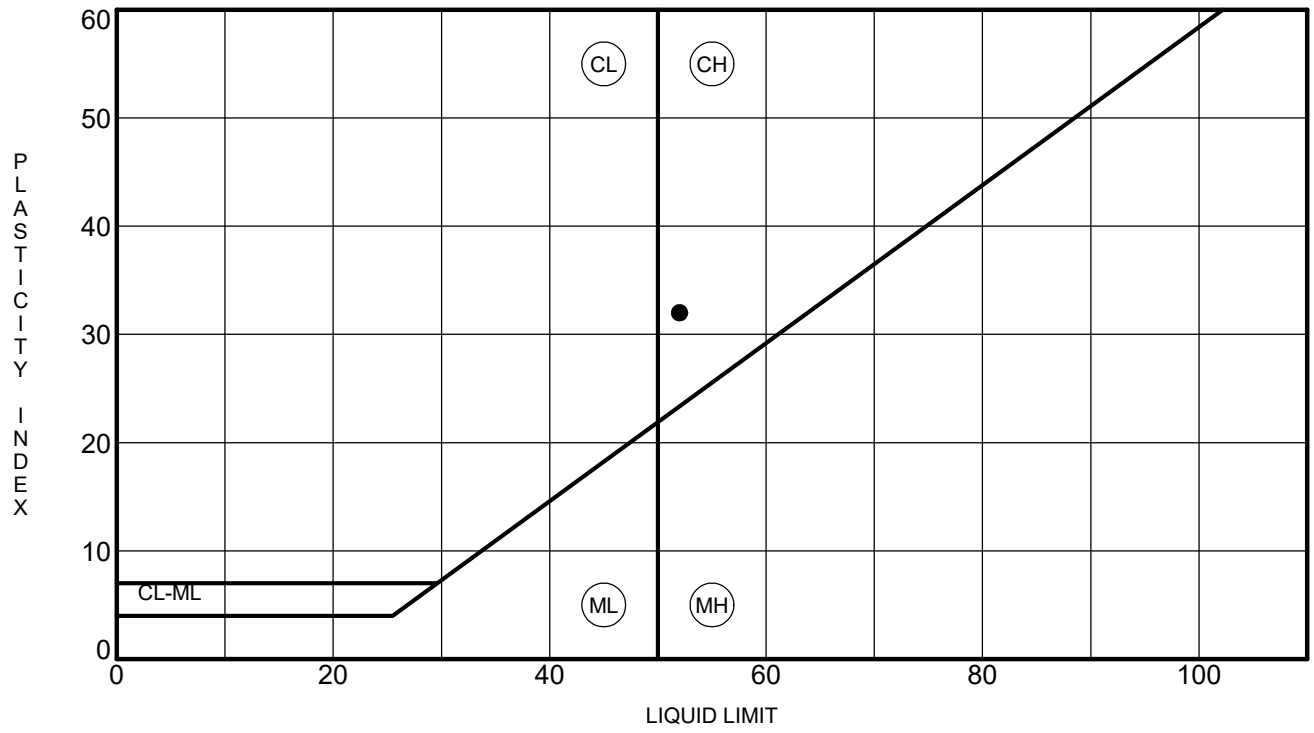
LITHOLOGY AND WATER LEVELS - A SIZE G6933.GPJ CERTIFIED TESTING.GDT 3/3/23

Certified Testing Services, Inc.
419 W. 6th Street, PO Box 1193
Sioux City, Iowa 51102
Telephone: 712-252-5132
Fax: 712-252-0110

Garden Estates Development
Yankton, SD

Project Number: G6933

LABORATORY TEST DATA



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**B-4**	**4.3**	**52**	**20**	**32**		**LEAN TO FAT CLAY (CL-CH)**

419 W. 6th Street, PO Box 1193
Sioux City, Iowa 51102
Telephone: 712-252-5132
Fax: 712-252-0110

ATTERBERG LIMITS' RESULTS

Project: Garden Estates Development

Location: Yankton, SD

Number: G6933

CERTIFIED TESTING SERVICES, INC.
419 W. 6th Street
P.O. Box 1193
Sioux City, Iowa 51102

Laboratory Compaction Characteristics of Soil

Client Name: Yankton Thrive
803 East 4th Street
Yankton, SD 57078

Project Name: Garden Estates Subdivision
Location: Yankton, SD
Source Material: On Site: B2 - 1' to 5'
Sample Description: Dark Brown CL
Soil ID. No. 1

Material Designation: --- Sample date: 02/20/23
Test Method: ASTM D698
Test Procedure: A
Sample Preparation: Dry Method
Rammer: ___ Mechanical X Manual

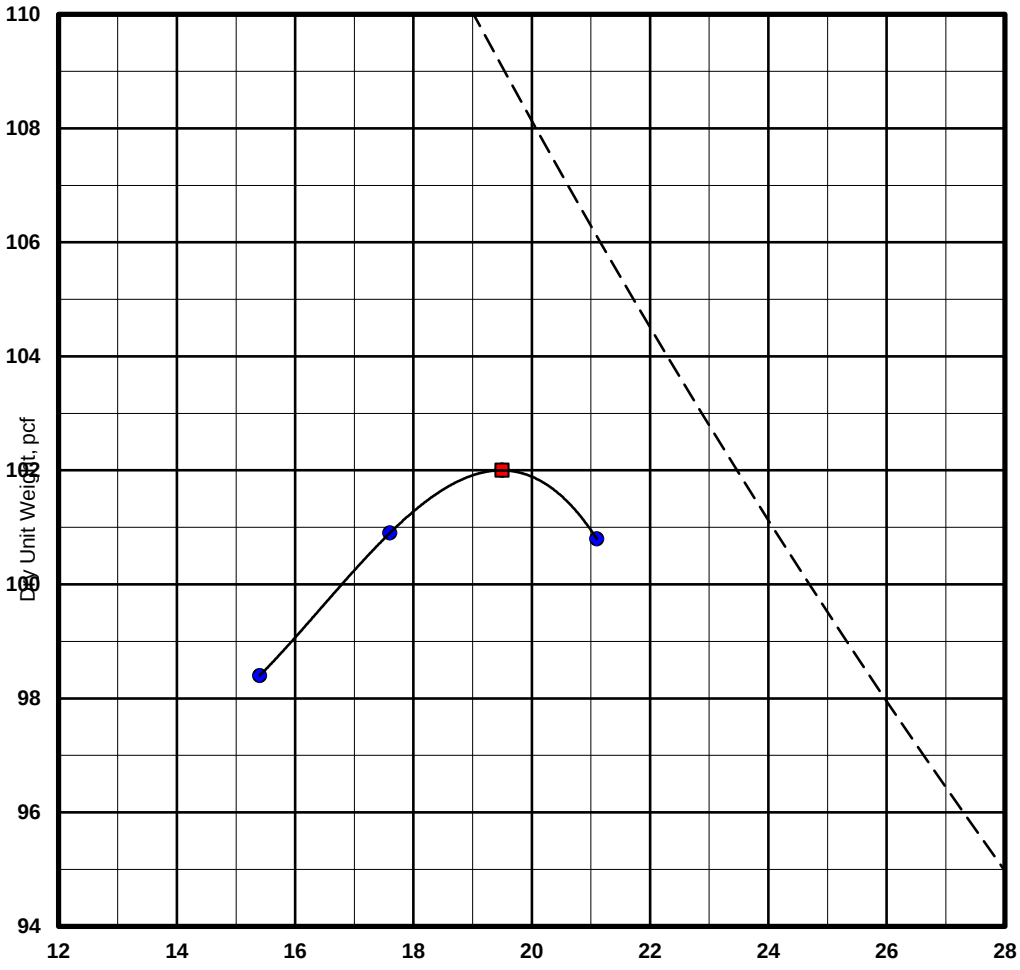
Project No.: G6933 Date: 02/27/23

TEST RESULTS
Maximum Dry Unit Wt.: 102.0 pcf
Optimum Water Content: 19.5 %

Test performed date: 02/24/23
Liquid Limit: --- Plastic Limit: ---
Plasticity Index: --- ASTM D4318
% passing # 200 sieve: --- ASTM D1140

Reviewed by: Matthew R. Dailey, P.E.

Zero air voids for specific gravity of 2.65 Assumed



Certified Testing Services, Inc.
419 W. 6th Street • P.O. Box 1193 • Sioux City, Iowa 51102 • Phone (712) 252-5132

CALIFORNIA BEARING RATIO TEST RESULTS

ASTM D 1883-16

CTS Project No.:	G6933 Date: 03/06/23	Sample Number:	Sample 1
		Sample Description:	Medium Brown Lean Clay
Client Name:	Yankton Thrive	USCS Classification:	CL
	803 East 4th St	Proctor Number:	Soil ID-1
	Yankton, SD	Source Material:	Boring B2 (1' to 5')
Project Name:	Garden Estates Subdivision	Test performed date:	03/03/23
		Liquid Limit:	Plastic Limit:
Location:	Yankton, SD	Plasticity Index:	ASTM D4318
Reviewed by:	Matthew R. Dailey, P.E.	% passing # 200 sieve: N/A	ASTM D1140

Sample Data:

Test Description:	ASTM D 698
Maximum Dry Density:	102 PCF
Optimum Moisture Content:	19.5 %
Surcharge Weight:	10.0 lbs
Soaked or Unsoaked:	Soaked

CBR Test Data:

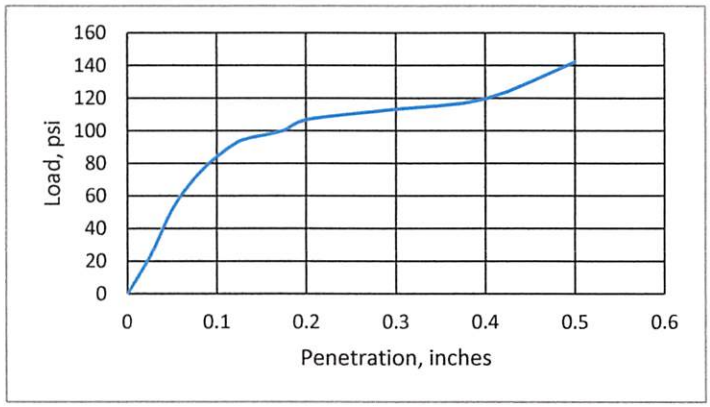
	Dry Density	Moisture Content
Initial:	100.2 PCF	16.7 %
Final:	99.4 PCF	21.9 %
Percent Compaction:	98.2 %	

Swell Data:

Elapsed Time (hours)	Dial Reading (in. x 1,000)	Swell, %
0	0	0.0
96	0.042	**0.9**

Penetration Test Data:

Penetration (inches)	Unit Load (psi)
0	0.0
0.025	22.6
0.05	51.7
0.075	71.1
0.1	84.0
0.125	93.7
0.15	97.0
0.175	100.2
0.2	106.7
0.3	113.1
0.4	119.6
0.5	142.2

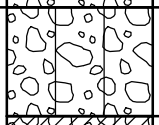
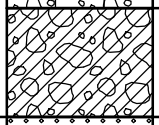
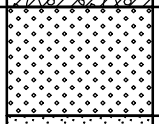
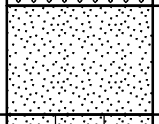
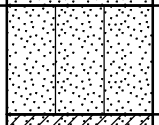
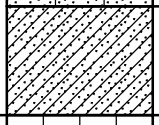
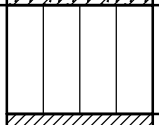
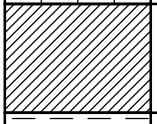
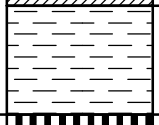
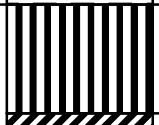
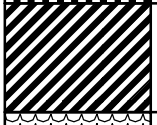
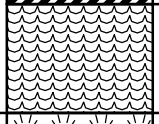
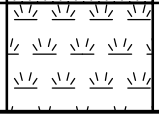


Bearing Ratio:

at 0.1 inches penetration	8.40 percent
at 0.2 inches penetration	7.11 percent

SOIL CLASSIFICATION CHART AND GENERAL NOTES

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

GENERAL NOTES

SAMPLING SYMBOLS:

	STANDARD PENETRATION TEST – 1 3/8: I.D., 2" O.D.
	SHELBY THIN-WALLED TUBE – 3" O.D. UNDISTURBED SAMPLE
	GRAB SAMPLE
	ROCK CORE
	AUGER SAMPLE
	NO RECOVERY

WATER LEVEL MEASUREMENT SYMBOLS:

▽	WATER LEVEL AT TIME OF DRILLING
▼	WATER LEVEL AFTER 7 DAYS

CONSISTENCY OF FINE-GRAINED SOILS	
UNCONFINED COMPRESSIVE STRENGTH, QU, PSF	CONSISTENCY
< 500	VERY SOFT
500 - 1,000	SOFT
1,001 - 2,000	MEDIUM
2,001 - 4,000	STIFF
4,001 - 8,000	VERY STIFF
8,001 - 16,000	HARD
> 16,000	VERY HARD

RELATIVE DENSITY OF COARSE GRAINED SOILS	
N-BLOWS/FT.	RELATIVE DENSITY
0 - 3	VERY LOOSE
4 - 9	LOOSE
10 - 29	MEDIUM DENSE
30 - 49	DENSE
50 - 80	VERY DENSE
80 +	EXTREMELY DENSE

RELATIVE PROPORTIONS OF SAND AND GRAVEL	
DESCRIPTIVE TERM(S) (OF COMPONENTS ALSO PRESENT IN SAMPLE)	PERCENT OF DRY WEIGHT
WITH	15 - 29
MODIFIER	> 30

GRAIN SIZE TERMINOLOGY	
MAJOR COMPONENT OF SAMPLE	SIZE RANGE
BOULDERS	OVER 12 IN. (300MM)
COBBLES	12 IN. TO 3 IN. (300 MM TO 75 MM)
GRAVEL	3 IN. TO #4 SIEVE (75MM TO 4.75MM)
SAND	#4 TO #200 SIEVE (4.75MM TO 0.075 MM)
SILT OR CLAY	PASSING #200 SIEVE (0.075MM)

RELATIVE PROPORTIONS OF FINES	
DESCRIPTIVE TERM(S) (OF COMPONENTS ALSO PRESENT IN SAMPLE)	PERCENT OF DRY WEIGHT
WITH	15 - 29
MODIFIER	> 30