EXHIBIT

tabbies

6

Geotechnical Evaluation Report

Global Stampede Pipeline
2100 McKinney Avenue
Dallas, TX 75201

Prepared for

Summit Midstream Partners

Professional Certification:
I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Registered Professional Engineer under the laws of the State of North Dakota.

REGISTERED PROFESSIONAL ENGINEER
CHARLES W. DICKHUT
PE-9213
DATE 10/30/14
NORTH DAKOTA

Charles W. Dickhut, PE
Senior Engineer
Registration Number: PE-9213
October 30, 2014

27 PU-14-823 Filed: 3/30/2015 Pages: 25
Exhibit 6

Meadowlark Midstream Company, LLC

Project B14-06721

Braun Intertec Corporation

BRAUN INTERTEC
The Science You Build On.

Braun Intertec Corporation
403 40th Ave NE, Unit 3
Minot, ND 58702

Phone: 701.420.2738
Fax: 701.255.7208
Web: braunintertec.com

October 30, 2014 Project B14-06721

Mr. Jason Panek
Summit Midstream Partners
2100 McKinney Avenue
Dallas, TX 75201

Re: Geotechnical Evaluation
Global Stampede Pipeline Mined Land Evaluation
NENE, Sec 16, T162N, R94W
Burke County, North Dakota

Dear Mr. Panek:

We are pleased to present this Geotechnical Evaluation Report for the pipeline mined land evaluation. A summary of our results, and a summary of our recommendations in light of the geotechnical issues influencing design and construction, is presented below. More detailed information and recommendations follow.

Summary of Results

We drilled 5 borings at the site to depths ranging from 20 to 35 feet. At the surface, the borings encountered about 1 foot of topsoil consisting of lean clay and silty sand.

Below the topsoil, the borings encountered fill material to depths of up to 11 ½ feet. Below the fill, the borings encountered glacial till to depths of up to 20 ½ feet over weathered bedrock associated with the Sentinel Butte Formation.

The fill materials consisted of lean clay and silty sand. The glacial till consisted of lean clay and clayey sand. The bedrock layers consisted of claystone (texturally classified as fat clay and lean clay) and sandstone (texturally classified as silty sand).

Groundwater was observed in 3 of the borings at depths ranging from 14 to 18 ½ feet. Seasonal and annual fluctuations of groundwater should be anticipated.

Summary of Recommendations

This project was performed at the request of the Public Service Commission to evaluate if mine spoils would impact the proposed alignment of the pipeline. We reviewed historical air photographs of the site, and interviewed local residents that were familiar with the site. The photographs and conversations confirmed that the area to the south of 100th Street Northwest was mined and reclaimed, but they did not indicate the depth or extent of the mining.

Our explorations were intended to encounter suspected mine spoils along the alignment. We encountered existing fill soils that were probably related to mine reclamation to a depth of about 11 1/2 feet below grade. We concluded that the geologic materials present at anticipated structure subgrade elevations generally appear suitable for the support of the pipeline, and will not be detrimental to the long term performance of the pipeline. Therefore, it is our opinion that special design measures will not be necessary for this section of the pipeline.

The fill material is likely suitable for the support of the pipeline and the soils will be suitable for re-use as backfill.

Remarks

Thank you for making Braun Intertec your geotechnical consultant for this project. If you have questions about this report, or if there are other services that we can provide in support of our work to date, please call Greg Voigt at 701.420.2692.

Sincerely,

BRAUN INTERTEC CORPORATION

For
Greg Voigt, EI
Staff Engineer

Charles W. Dickhut, PE
Senior Engineer

BRAUN INTERTEC
The Science You Build On.

Braun Intertec Corporation
403 40th Ave NE, Unit 3
Minot, ND 58702

Phone: 701.420.2738
Fax: 701.255.7208
Web: braunintertec.com

Table of Contents

Table of Contents (continued)

Description **Page**

Appendix

BRAUN INTERTEC

A. Introduction

A.1. Project Description

From the letter dated August 26, 2014, from the Public Service Commission (PSC), we understand that a segment of the proposed Global Stampede Pipeline cross formerly mined land near the referenced locations. According to their information, BNI Coal mined the area including the highway right of way in the late 1970s. The area was reclaimed, but may be subject to future settling. The PSC recommended that Global Stampede have soil borings and geotechnical testing performed to determine the depth and extent of disturbance.

We reviewed recent air photos of the site and observed a hummocky area in the field that we suspect may have been formerly mined. Since a pipeline that crosses from reclaimed areas to undisturbed soil may experience differential settlement, it would be important to identify the transition areas and quantify the length of pipeline that may require special design measures.

A.2. Purpose

The purpose of our geotechnical evaluation is to characterize subsurface geologic conditions at selected exploration locations and evaluate their impact on the design and construction of the proposed improvements.

A.3. Background Information and Reference Documents

To facilitate our evaluation, we were provided with or reviewed the following information or documents:

- Air photos obtained from Google Earth™
- Geologic Map of North Dakota, North Dakota Geological Survey, 1980.
- Aerial photos from the NRCS office in Bowbells, ND, dated July 29, 1969 and July 6, 1984.

A.4. Site Conditions

The site appears to be an existing hay field. Perched surface water created wet conditions in some areas of the site. Based on the surface elevations of the borings, the existing grade of the pipeline alignment in this area slopes downward by about 6 to 10 feet in elevation from east to west.

A.5. Scope of Services

Our scope of services for this project was originally submitted as a Proposal to Jason Panek of Summit Midstream Partners. We received authorization to proceed from Mr. Panek on September 11, 2014. Tasks performed in accordance with our authorized scope of services included:

- Applying for a geophysical testing permit with the state of North Dakota.
- Performing an initial investigation for possible evidence of formerly mined land.
- Performing a reconnaissance of the site to evaluate equipment access to exploration locations.
- Staking and clearing exploration locations of underground utilities.
- Performing 1 penetration test boring to 35 feet, 1 penetration test boring to 25 feet, and 3 penetration test borings to 20 feet.
- Performing 27 moisture content tests on selected penetration test samples.
- Preparing this report containing a CAD sketch, exploration logs, a summary of the geologic materials encountered, results of laboratory tests, and recommendations for structure subgrade preparation and the design of the pipeline.

We staked exploration locations by measuring dimensions from road intersections with a surveyor's wheel at approximate right angles from those roads. Surface elevations were measured using a surveyor's level. We referenced surface elevations to the base of the telephone pole located north of boring ST-03, whose assumed elevation is 150 feet.

Our scope of services was performed under the terms of our September 1, 2013, General Conditions.

B. Results

B.1. Exploration Logs

B.1.a. Log of Boring Sheets

Log of Boring sheets for our penetration test borings are included in the Appendix. The logs identify and describe the geologic materials that were penetrated, and present the results of penetration resistance and other in-situ tests performed within them, laboratory tests performed on penetration test samples retrieved from them, and groundwater measurements.

Strata boundaries were inferred from changes in the penetration test samples and the auger cuttings. Because sampling was not performed continuously, the strata boundary depths are only approximate. The boundary depths likely vary away from the boring locations, and the boundaries themselves may also occur as gradual rather than abrupt transitions.

B.1.b. Geologic Origins

Geologic origins assigned to the materials shown on the logs and referenced within this report were based on: (1) a review of the background information and reference documents cited above, (2) visual classification of the various geologic material samples retrieved during the course of our subsurface exploration, (3) penetration resistance and other in-situ testing performed for the project, (4) laboratory test results, and (5) available common knowledge of the geologic processes and environments that have impacted the site and surrounding area in the past. A fence Diagram depicting the subsurface conditions encountered is in the Appendix.

B.2. Geologic Profile

B.2.a. Geologic Materials

At the surface, the borings encountered about 1 foot of topsoil consisting of lean clay and silty sand.

Below the topsoil, the borings encountered fill materials to depths of up to 11 ½ feet. Below the fill, the borings encountered glacial till to depths of up to 20 ½ feet over weathered bedrock associated with the Sentinel Butte Formation.

The fill material consisted of lean clay and silty sand. The glacial till consisted of lean clay and clayey sand. The bedrock layers consisted of claystone (texturally classified as fat clay and lean clay) and sandstone (texturally classified as silty sand).

B.2.a. Penetration Resistances

The penetration resistance values recorded in the fill ranged from 7 to 16 blows per foot (BPF). The penetration resistance values recorded in the glacial till ranged from 9 to 12 BPF, indicating they were rather stiff in consistency. The penetration resistance values recorded in the weathered bedrock ranged from 13 to 37 BPF. Penetration resistance values are listed in the "BPF" column on the attached Log of Borings sheets.

B.2.b. Groundwater

Groundwater was observed in 3 of the borings to depths ranging from 14 to 18 ½ feet. Seasonal and annual fluctuations of groundwater should be anticipated. The water level is marked in the "WL" column of the Log of Boring Sheets attached in the Appendix.

B.3. Laboratory Test Results

B.3.a. Moisture Contents

Moisture content (MC) tests (per ASTM D2216) were performed on selected penetration tests to aid in our classifications and estimations of the materials' engineering properties. The results of the moisture content tests are listed in the "MC" column of the Log of Boring Sheets attached in the Appendix. Moisture content results in the fill material typically indicated that the samples were at to slightly above the estimated optimum moisture content.

C. Basis for Recommendations

C.1. Design Details

C.1.a. Pipeline Details

We were not provided with specific details of the proposed pipeline. We anticipate that the pipeline will have an invert about 5 feet below existing grade.

C.1.b. Anticipated Grade Changes

We have assumed that the existing grades will remain unchanged.

C.1.c. Precautions Regarding Changed Information

We have attempted to describe our understanding of the proposed construction to the extent it was reported to us by others. Depending on the extent of available information, assumptions may have been made based on our experience with similar projects. If we have not correctly recorded or interpreted the project details, we should be notified. New or changed information could require additional evaluation, analyses and/or recommendations.

C.2. Design and Construction Considerations

This project was performed at the request of the Public Service Commission to evaluate if mine spoils would impact the proposed alignment of the pipeline. We reviewed historical air photographs of the site, and interviewed local residents that were familiar with the site. The photographs and conversations confirmed that the area to the south of 100th Street Northwest was mined and reclaimed, but they did not indicate the depth or extent of the mining.

Our explorations were intended to encounter suspected mine spoils along the alignment. We encountered existing fill soils that were probably related to mine reclamation to a depth of about 11 1/2 feet below grade. We concluded that the geologic materials present at anticipated structure subgrade elevations generally appear suitable for the support of the pipeline, and will not be detrimental to the long term performance of the pipeline. Therefore, it is our opinion that special design measures will not be necessary for this section of the pipeline.

The fill material is likely suitable for the support of the pipeline and the soils will be suitable for re-use as backfill.

D. Recommendations

In accordance with our findings, we prepared the following recommendations for the design and construction of the pipeline.

D.1. Pipeline

D.1.a. Existing Fill

Fill material was found in the borings to depths of up to 11 ½ feet. The fill consisted of what appears to be re-used glacial till. Based on the approximate age of the fill and also the relatively high blow counts, excessive future settlement should not be an issue. Therefore, it is our opinion that special design measures will not be needed for this section of the pipeline.

The fill material is likely suitable for the support of the pipeline. We recommend a Braun Intertec geotechnical engineer evaluate the existing fill materials at the proposed subgrade levels at the time of construction.

D.1.b. Subgrade Stabilization

Based on the borings, the pipeline subgrades may consist of a variety of natural and fill materials. If wet soils or groundwater is encountered while excavating, we recommend over-excavating 1 foot below the pipeline inverts and replacing with imported free-draining aggregate bedding to facilitate dewatering and providing a stable working surface for installation crews. The subgrade should be covered with a layer of separation geotextile fabric prior to placement of the aggregate to limit the migration of fines into the coarser material.

D.1.c. Excavation Support

The fill soils encountered in the borings and soil from which water is freely seeping should be considered Type C soils under OSHA guidelines. Unsupported excavations in Type C soils should be maintained at a gradient no steeper than 1.5H:1V.

An OSHA approved competent person should review this soil classification in the field. Excavations must comply with the requirements of OSHA 29 CFR, Part 2926, Subpart P, "Excavations and Trenches." This document states that excavation safety is the responsibility of the contractor. Reference to these OSHA requirements should be included in the project specifications.

D.1.d. Dewatering

Groundwater was observed in the 3 of the borings at a depth as shallow as 14 feet below existing ground. With the potential for perched groundwater levels in the spring months and following extended periods of precipitation, we recommend the contractor be prepared to dewater. We anticipate that pumping from sumps will be adequate to remove water that infiltrates into the excavation.

D.1.e. Selection, Placement and Compaction of Backfill

The excavated materials may be reused as backfill. Topsoil or other organic soils should not be reused as backfill.

We recommend spreading backfill in loose lifts of approximately 4 to 6 inches. We recommend trench backfills be compacted per the requirements listed in the following table. Trenches that cross roads should be backfilled in accordance with state, county, or township requirements.

Table D.1.e. Summary of Compaction and Moisture Recommendations

Reference	Relative Compaction, percent (ASTM D 698 – Standard Proctor)	Moisture Content Variance from Optimum, % points
Trench Backfill in Green Area	≥90	-1 to +3 for Clay Soils +/-3 for Granular Soils

D.2. Construction Quality Control

D.2.a. Excavation Observations

We recommend having a Braun Intertec geotechnical engineer observe all excavations related to subgrade preparation. The purpose of the observations is to evaluate the competence of the geologic materials exposed in the excavations.

D.2.b. Materials Testing

We recommend that density testing for the trench backfill be performed at a frequency of 1 test every 100 linear feet for each 2' lift

D.2.c. Cold Weather Precautions

If site grading and construction is anticipated during cold weather, all snow and ice should be removed from cut and fill areas prior to additional grading. No fill should be placed on frozen subgrades. No frozen soils should be used as fill.

E. Procedures

E.1. Penetration Test Borings

The penetration test borings were drilled with a truck-mounted core and auger drill equipped with hollow-stem auger. The borings were performed in accordance with ASTM D 1586. Penetration test samples were taken at 2 1/2- or 5-foot intervals. Actual sample intervals and corresponding depths are shown on the boring logs.

The penetration test borings were sealed with bentonite grout.

E.2. Material Classification and Testing

E.2.a. Visual and Manual Classification

The geologic materials encountered were visually and manually classified in accordance with ASTM Standard Practice D 2488. A chart explaining the classification system is attached. Samples were placed in jars and returned to our facility for review and storage.

E.2.b. Laboratory Testing

The results of the laboratory tests performed on geologic material samples are noted on or follow the appropriate attached exploration logs. The tests were performed in accordance with ASTM procedures.

E.3. Groundwater Measurements

The drillers checked for groundwater as the penetration test borings were advanced, and again after auger withdrawal. The boreholes were then backfilled or allowed to remain open for an extended period of observation as noted on the boring logs.

F. Qualifications

F.1. Variations in Subsurface Conditions

F.1.a. Material Strata

Our evaluation, analyses and recommendations were developed from a limited amount of site and subsurface information. It is not standard engineering practice to retrieve material samples from exploration locations continuously with depth, and therefore strata boundaries and thicknesses must be inferred to some extent. Strata boundaries may also be gradual transitions, and can be expected to vary in depth, elevation and thickness away from the exploration locations.

Variations in subsurface conditions present between exploration locations may not be revealed until additional exploration work is completed, or construction commences. If any such variations are revealed, our recommendations should be re-evaluated. Such variations could increase construction costs, and a contingency should be provided to accommodate them.

F.1.b. Groundwater Levels

Groundwater measurements were made under the conditions reported herein and shown on the exploration logs, and interpreted in the text of this report. It should be noted that the observation periods were relatively short, and groundwater can be expected to fluctuate in response to rainfall, flooding, irrigation, seasonal freezing and thawing, surface drainage modifications and other seasonal and annual factors.

F.2. Continuity of Professional Responsibility

F.2.a. Plan Review

This report is based on a limited amount of information, and a number of assumptions were necessary to help us develop our recommendations. It is recommended that our firm review the geotechnical aspects of the designs and specifications, and evaluate whether the design is as expected, if any design changes have affected the validity of our recommendations, and if our recommendations have been correctly interpreted and implemented in the designs and specifications.

F.2.b. Construction Observations and Testing

It is recommended that we be retained to perform observations and tests during construction. This will allow correlation of the subsurface conditions encountered during construction with those encountered by the borings, and provide continuity of professional responsibility.

F.3. Use of Report

This report is for the exclusive use of the parties to which it has been addressed. Without written approval, we assume no responsibility to other parties regarding this report. Our evaluation, analyses and recommendations may not be appropriate for other parties or projects.

F.4. Standard of Care

In performing its services, Braun Intertec used that degree of care and skill ordinarily exercised under similar circumstances by reputable members of its profession currently practicing in the same locality. No warranty, express or implied, is made.

Appendix

BRAUN
INTERTEC

DENOTES APPROXIMATE LOCATION OF STANDARD PENETRATION TEST BORING

75' 0 150'

SCALE: 1"= 150'

BRAUN INTERTEC

11001 Hampshire Avenue So.
Minneapolis, MN 55438
PH. (952) 995-2000
FAX (952) 995-2020

Base Dwg Provided By:

SOIL BORING LOCATION SKETCH
GEOTECHNICAL EVALUATION
GLOBAL STAMPEDE PIPELINE
T162N, R94W, SEC. 16
LARSON, NORTH DAKOTA

Project No:	B1406721
Drawing No:	B1406721
Scale:	1"= 150'
Drawn By:	JAG
Date Drawn:	10/24/14
Checked By:	GV
Last Modified:	10/27/14

Sheet: of | Fig:

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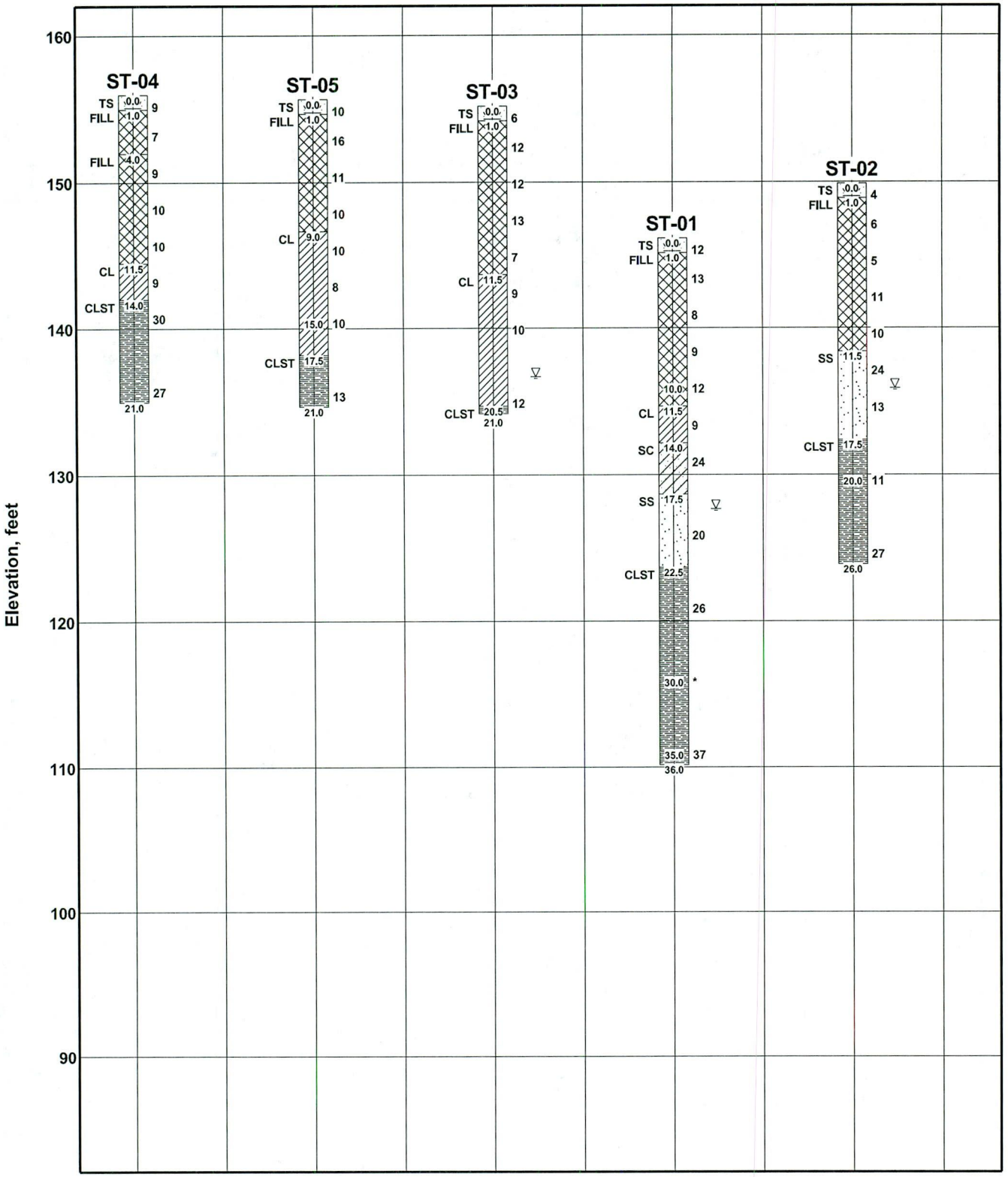

Fence Diagram

(Horizontal distance not to scale)

Braun Project B14-06721
Geotechnical Evaluation
Global Stampede Pipeline
NENE, S16, T162N, R94W
Larson, North Dakota

BRAUN INTERTEC

ELEVATION SCALE N:\GINT\PROJECTS\AX PROJECTS\2014\06721.GPJ BRAUN_V8_CURRENT.GDT 10/29/14 15:49

B14-06721

BRAUN INTERTEC

LOG OF BORING

Braun Project B14-06721
Geotechnical Evaluation
Global Stampede Pipeline
NENE, S16, T162N, R94W
Larson, North Dakota

BORING: **ST-01**

LOCATION: See Sketch

DRILLER: J. Barrett | METHOD: 3 1/4" HSA, Autohammer | DATE: **10/15/14** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	q_p tsf	MC %	Tests or Notes
146.2	0.0							
145.2	1.0	TS	FILL: Lean Clay with Sand, trace Lignite, brown, moist. (Topsoil)	12			14	
		FILL	FILL: Lean Clay with Sand, brown and gray, moist.	13		1 1/2	16	
				8		3/4	17	
				9		1	14	
			- Sand seams at 10 feet.	12			17	
134.7	11.5							
		CL	SANDY LEAN CLAY, trace Gravel and Lignite, brown, moist, rather stiff. (Glacial Till)	9		1 1/4	19	
132.2	14.0							
		SC	CLAYEY SAND, fine-grained, gray, damp, medium dense. (Glacial Till)	24				
128.7	17.5							
		SS	SENTINEL BUTTE FORMATION, SANDSTONE, gray, moist, decomposed, very soft, sample retrieved as non-cemented "Silty Sand (SM)."		▽			
				20				An open triangle in the water level (WL) column indicates the depth at which groundwater was observed while drilling.
123.7	22.5							
		CLST	SENTINEL BUTTE FORMATION, CLAYSTONE, gray, damp, decomposed, very soft, hand deformed sample classified as "Lean Clay (CL)".	26				
			- Lignite seam at 30 feet.	*				*14, 50/4"

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2014\06721.GPJ BRAUN_V8_CURRENT.GDT 10/29/14 15:47

BRAUN INTERTEC

LOG OF BORING

Braun Project B14-06721
Geotechnical Evaluation
Global Stampede Pipeline
NENE, S16, T162N, R94W
Larson, North Dakota

BORING: **ST-01 (cont.)**
LOCATION: See Sketch

DRILLER: J. Barrett | METHOD: 3 1/4" HSA, Autohammer | DATE: **10/15/14** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	q_p tsf	MC %	Tests or Notes
114.2	32.0		SENTINEL BUTTE FORMATION, CLAYSTONE, gray, damp, decomposed, very soft, hand deformed sample classified as "Lean Clay (CL)". *(continued)*					
110.2	36.0		- moist at 35 feet.	37				Benchmark: Surface elevations at the boring locations were referenced to the base of the telephone pole to the north of ST-03.
			END OF BORING.					
			Water observed at a depth of 20 feet while drilling.					
			Water observed at a depth of 18 1/2 feet with a cave-in depth of 19 feet when rechecked 24 hours after withdrawal of auger.					
			Boring then backfilled.					

(See Descriptive Terminology sheet for explanation of abbreviations)

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LOG OF BORING

Braun Project B14-06721
Geotechnical Evaluation
Global Stampede Pipeline
NENE, S16, T162N, R94W
Larson, North Dakota

BORING: **ST-02**

LOCATION: See Sketch

DRILLER: J. Barrett | METHOD: 3 1/4" HSA, Autohammer | DATE: **10/15/14** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	q_p tsf	MC %	Tests or Notes
149.9	0.0							
148.9	1.0	TS	FILL: Lean Clay with Sand, trace roots, brown, moist. (Topsoil)	4			14	
		FILL	FILL: Lean Clay with Sand, with Sand lenses, trace Gravel, brown, moist.	6			17	
				5			14	
				11		3	14	
				10		1 3/4	17	
138.4	11.5	SS	SENTINEL BUTTE FORMATION, SANDSTONE, gray, moist, decomposed, very soft, sample retrieved as non-cemented "Clayey Sand (SC)".	24	▽			
				13				
132.4	17.5	CLST	SENTINEL BUTTE FORMATION, CLAYSTONE, gray, moist, decomposed, very soft, hand deformed sample classified as "Fat Clay (CH)".					
			- Lignite seam at 20 feet.	11		2 3/4		
123.9	26.0			27				
			END OF BORING.					
			Water observed at a depth of 20 feet while drilling.					
			Water observed at a depth of 14 feet with a cave-in depth of 19 feet when rechecked 24 hours after withdrawal of auger.					
			Boring then backfilled.					

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BRAUN INTERTEC

LOG OF BORING

Braun Project B14-06721
Geotechnical Evaluation
Global Stampede Pipeline
NENE, S16, T162N, R94W
Larson, North Dakota

BORING: **ST-03**

LOCATION: See Sketch

DRILLER: J. Barrett | METHOD: 3 1/4" HSA, Autohammer | DATE: **10/15/14** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	q_p tsf	MC %	Tests or Notes
155.2	0.0							
154.2	1.0	TS	FILL: Lean Clay with Sand, brown, moist. (Topsoil)	6			23	
		FILL	FILL: Sandy Lean Clay, trace Gravel, brown and gray, moist.	12			13	
				12		2 1/4	16	
				13		1 1/4	17	
				7		3/4	24	
143.7	11.5	CL	SANDY LEAN CLAY, trace Gravel and Lignite, brown, moist, rather stiff. (Glacial Till)	9			16	
				10		1 1/4		
					▽			
134.7	20.5			12		4.5+		
134.2	21.0	CLST	SENTINEL BUTTE FORMATION, CLAYSTONE, gray, moist, decomposed, very soft, hand deformed sample classified as "Fat Clay (CH)."					
			END OF BORING.					
			Water observed at a depth of 18 1/2 feet with a cave-in depth of 19 feet when rechecked 24 hours after withdrawal of auger.					
			Boring then backfilled.					

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BRAUN INTERTEC

LOG OF BORING

Braun Project B14-06721
Geotechnical Evaluation
Global Stampede Pipeline
NENE, S16, T162N, R94W
Larson, North Dakota

BORING: **ST-04**

LOCATION: See Sketch

DRILLER: J. Barrett | METHOD: 3 1/4" HSA, Autohammer | DATE: **10/16/14** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	q_p tsf	MC %	Tests or Notes
156.0	0.0							
155.0	1.0	TS	FILL: Silty Sand, brown, damp. (Topsoil)	9			15	
		FILL	FILL: Silty Sand, brown, damp.	7			11	
152.0	4.0	FILL	FILL: Lean Clay with Sand, trace Gravel and Lignite, brown and gray, moist.	9		2 1/4	20	
				10		1 3/4	21	
				10		2 1/2	20	
144.5	11.5	CL	SANDY LEAN CLAY, trace Gravel and Lignite, brown, moist, rather stiff. (Glacial Till)	9		1 1/2	18	
142.0	14.0	CLST	SENTINEL BUTTE FORMATION, CLAYSTONE, with Lignite seams, gray, moist, decomposed, very soft, hand deformed sample classified as "Fat Clay (CH)".	30		4.5+		
				27		4.5+		
135.0	21.0		END OF BORING. Water not observed immediately after withdrawal of auger. Boring then backfilled.					

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2014\06721.GPJ BRAUN_V8_CURRENT.GDT 10/29/14 15:48

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LOG OF BORING

Braun Project B14-06721
Geotechnical Evaluation
Global Stampede Pipeline
NENE, S16, T162N, R94W
Larson, North Dakota

BORING: **ST-05**

LOCATION: See Sketch

DRILLER: J. Barrett | METHOD: 3 1/4" HSA, Autohammer | DATE: **10/16/14** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	q_p tsf	MC %	Tests or Notes
155.7	0.0							
154.7	1.0	TS	FILL: Silty Sand, trace roots, brown, damp. (Topsoil)	10			12	
		FILL	FILL: Lean Clay with Sand, trace Gravel, brown and gray, damp.	16			9	
				11		2 1/2	18	
				10		1 3/4	19	
146.7	9.0	CL	SANDY LEAN CLAY, trace Gravel and Lignite, brown, moist, medium to rather stiff. (Glacial Till)	10		1 1/4		
				8		1 3/4		
			- Sand seams at 15 feet.	10				
138.2	17.5	CLST	SENTINEL BUTTE FORMATION, CLAYSTONE, gray, moist, decomposed, very soft, hand deformed sample classified as "Fat Clay (CH)".					
134.7	21.0			13		4.5+		
			END OF BORING. Water not observed immediately after withdrawal of auger. Boring then backfilled.					

(See Descriptive Terminology sheet for explanation of abbreviations)

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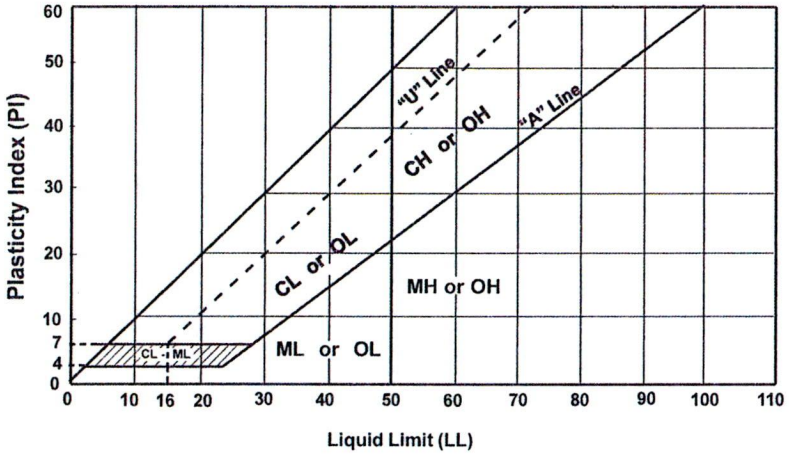
Descriptive Terminology of Soil

Standard D 2487 - 00
Classification of Soils for Engineering Purposes
(Unified Soil Classification System)

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [a]				Soils Classification	
				Group Symbol	Group Name [b]
Coarse-grained Soils more than 50% retained on No. 200 sieve	Gravels More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels 5% or less fines [e]	$C_u \geq 4$ and $1 \leq C_c \leq 3$ [c]	GW	Well-graded gravel [d]
			$C_u < 4$ and/or $1 > C_c > 3$ [c]	GP	Poorly graded gravel [d]
		Gravels with Fines More than 12% fines [e]	Fines classify as ML or MH	GM	Silty gravel [d f g]
			Fines classify as CL or CH	GC	Clayey gravel [d f g]
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands 5% or less fines [i]	$C_u \geq 6$ and $1 \leq C_c \leq 3$ [c]	SW	Well-graded sand [h]
			$C_u < 6$ and/or $1 > C_c > 3$ [c]	SP	Poorly graded sand [h]
		Sands with Fines More than 12% [i]	Fines classify as ML or MH	SM	Silty sand [f g h]
			Fines classify as CL or CH	SC	Clayey sand [f g h]
Fine-grained Soils 50% or more passed the No. 200 sieve	Silts and Clays Liquid limit less than 50	Inorganic	PI > 7 and plots on or above "A" line [j]	CL	Lean clay [k l m]
			PI < 4 or plots below "A" line [j]	ML	Silt [k l m]
		Organic	Liquid limit - oven dried / Liquid limit - not dried < 0.75	OL	Organic clay [k l m n]
				OL	Organic silt [k l m o]
	Silts and clays Liquid limit 50 or more	Inorganic	PI plots on or above "A" line	CH	Fat clay [k l m]
			PI plots below "A" line	MH	Elastic silt [k l m]
		Organic	Liquid limit - oven dried / Liquid limit - not dried < 0.75	OH	Organic clay [k l m p]
				OH	Organic silt [k l m q]
Highly Organic Soils	Primarily organic matter, dark in color and organic odor			PT	Peat

a. Based on the material passing the 3-in (75mm) sieve.
b. If field sample contained cobbles or boulders, or both, add "with cobbles or boulders or both" to group name.
c. $C_u = D_{60} / D_{10}$ $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$
d. If soil contains ≥15% sand, add "with sand" to group name.
e. Gravels with 5 to 12% fines require dual symbols:
GW-GM well-graded gravel with silt
GW-GC well-graded gravel with clay
GP-GM poorly graded gravel with silt
GP-GC poorly graded gravel with clay
f. If fines classify as CL-ML, use dual symbol GC-GM or SC-SM.
g. If fines are organic, add "with organic fines" to group name.
h. If soil contains ≥ 15% gravel, add "with gravel" to group name.
i. Sands with 5 to 12% fines require dual symbols:
SW-SM well-graded sand with silt
SW-SC well-graded sand with clay
SP-SM poorly graded sand with silt
SP-SC poorly graded sand with clay
j. If Atterberg limits plot in hatched area, soil is a CL-ML, silty clay.
k. If soil contains 10 to 29% plus No. 200, add "with sand" or "with gravel" whichever is predominant.
l. If soil contains ≥ 30% plus No. 200, predominantly sand, add "sandy" to group name.
m. If soil contains ≥ 30% plus No. 200 predominantly gravel, add "gravelly" to group name.
n. PI ≥ 4 and plots on or above "A" line.
o. PI < 4 or plots below "A" line.
p. PI plots on or above "A" line.
q. PI plots below "A" line.



Laboratory Tests

DD	Dry density, pcf	OC	Organic content, %
WD	Wet density, pcf	S	Percent of saturation, %
MC	Natural moisture content, %	SG	Specific gravity
LL	Liqiuid limit, %	C	Cohesion, psf
PL	Plastic limit, %	∅	Angle of internal friction
PI	Plasticity index, %	qu	Unconfined compressive strength, psf
P200	% passing 200 sieve	qp	Pocket penetrometer strength, tsf

Particle Size Identification

Boulders	over 12"
Cobbles	3" to 12"
Gravel	
Coarse	3/4" to 3"
Fine	No. 4 to 3/4"
Sand	
Coarse	No. 4 to No. 10
Medium	No. 10 to No. 40
Fine	No. 40 to No. 200
Silt	< No. 200, PI < 4 or below "A" line
Clay	< No. 200, PI ≥ 4 and on or above "A" line

Relative Density of Cohesionless Soils

Very loose	0 to 4 BPF
Loose	5 to 10 BPF
Medium dense	11 to 30 BPF
Dense	31 to 50 BPF
Very dense	over 50 BPF

Consistency of Cohesive Soils

Very soft	0 to 1 BPF
Soft	2 to 3 BPF
Rather soft	4 to 5 BPF
Medium	6 to 8 BPF
Rather stiff	9 to 12 BPF
Stiff	13 to 16 BPF
Very stiff	17 to 30 BPF
Hard	over 30 BPF

Drilling Notes

Standard penetration test borings were advanced by 3 1/4" or 6 1/4" ID hollow-stem augers unless noted otherwise, Jetting water was used to clean out auger prior to sampling only where indicated on logs. Standard penetration test borings are designated by the prefix "ST" (Split Tube). All samples were taken with the standard 2" OD split-tube sampler, except where noted.

Power auger borings were advanced by 4" or 6" diameter continuous-flight, solid-stem augers. Soil classifications and strata depths were inferred from disturbed samples augered to the surface and are, therefore, somewhat approximate. Power auger borings are designated by the prefix "B."

Hand auger borings were advanced manually with a 1 1/2" or 3 1/4" diameter auger and were limited to the depth from which the auger could be manually withdrawn. Hand auger borings are indicated by the prefix "H."

BPF: Numbers indicate blows per foot recorded in standard penetration test, also known as "N" value. The sampler was set 6" into undisturbed soil below the hollow-stem auger. Driving resistances were then counted for second and third 6" increments and added to get BPF. Where they differed significantly, they are reported in the following form: 2/12 for the second and third 6" increments, respectively.

WH: WH indicates the sampler penetrated soil under weight of hammer and rods alone; driving not required.

WR: WR indicates the sampler penetrated soil under weight of rods alone; hammer weight and driving not required.

TW indicates thin-walled (undisturbed) tube sample.

Note: All tests were run in general accordance with applicable ASTM standards.

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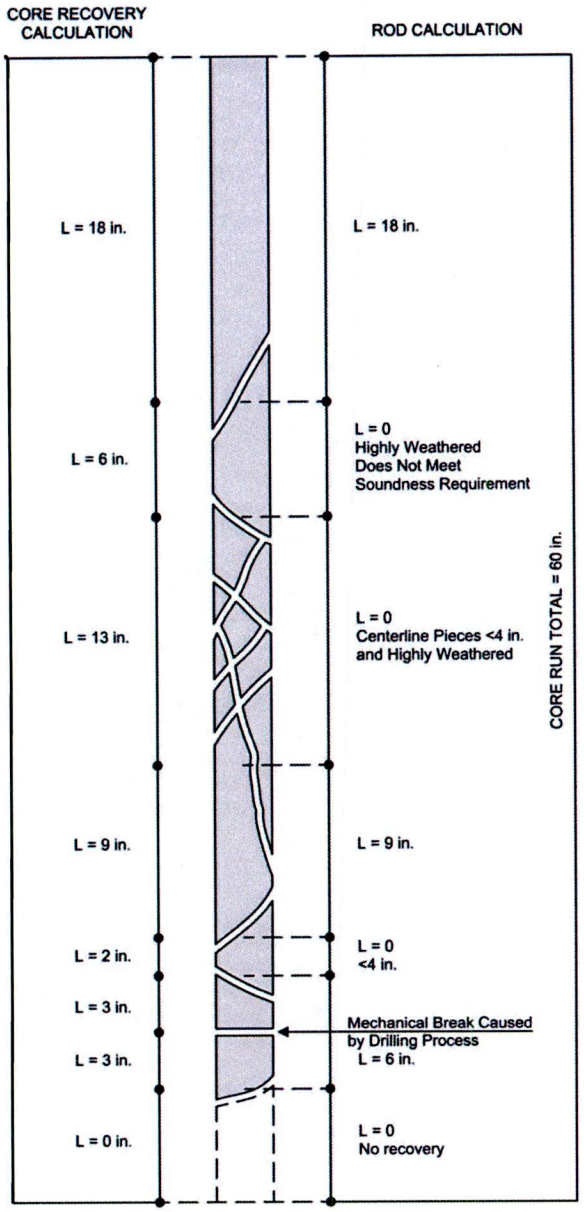
Descriptive Terminology of Rock

Based on U.S. Army Corps of Engineers EM 1110-1-2908



Example Calculations

Core Recovery, CR = $\frac{\text{Total length of rock recovered}}{\text{Total core run length}}$

Example: $CR = \frac{(18 + 6 + 13 + 9 + 2 + 3 + 3)}{(60)}$

CR = 90%

RQD = $\frac{\text{Sum of sound pieces longer than 4 inches}}{\text{Total core run length}}$

RQD Percent	Rock Quality
<25	very poor
25 < 50	poor
50 < 75	fair
75 < 90	good
90 < 100	excellent

Example: $RQD = \frac{(18 + 9 + 4 + 6)}{(60)}$

RQD = 62%

Weathering

Unweathered: No evidence of chemical or mechanical alteration.

Slightly weathered: Slight discoloration on surface, slight alteration along discontinuities, less than 10% of rock volume altered.

Moderately Weathered: Discoloration evident, surface pitted and altered with alteration penetrating well below rock surfaces, weathering halos evident, 10% to 50% of the rock altered.

Highly Weathered: Entire mass discolored, alteration pervading nearly all of the rock, with some pockets of slightly weathered rock noticeable, some mineral leached away.

Decomposed: Rock reduced to a soil consistency with relict rock texture, generally molded and crumbled by hand.

Hardness

Very soft:	Can be deformed by hand
Soft:	Can be scratched with a fingernail
Moderately hard:	Can be scratched easily with a knife
Hard:	Can be scratched with difficulty with a knife
Very hard:	Cannot be scratched with a knife

Texture

Sedimentary Rocks:	Grain Size
Coarse grained	2 – 5 mm
Medium grained	0.4 – 2 mm
Fine grained	0.1 – 0.4 mm
Very fine grained	< 0.1 mm

Igneous and Metamorphic Rocks:	
Coarse grained	5 mm
Medium grained	1 – 5 mm
Fine grained	0.1 – 1 mm
Aphanitic	< 0.1 mm

Thickness of Bedding

Massive:	3 ft. thick or greater
Thick bedded:	1 to 3 ft. thick
Medium bedded:	4 in. to 1 ft. thick
Thin bedded:	4 in. thick or less

Degree of Fracturing (Jointing)

Unfractured:	Fracture spacing 6 ft. or more
Slightly fractured:	Fracture spacing 2 to 6 ft.
Moderately fractured:	Fracture spacing 8 in. to 2 ft.
Highly fractured:	Fracture spacing 2 in. to 8 in.
Intensely fractured:	Fracture spacing 2 in. or less