

- Legend Key
- Kiewit Borings (2022)
 - Borings by Others





Kiewit

EXPLORATORY BORING LOG

Champlain Hudson Power Express
New York

BORING NO: K-226.2A

PROJECT NUMBER 20001480
START DATE 03/10/2022
FINISH DATE 03/10/2022

LOGGED BY Rafael Salas Jr
DRILLER/RIG Corey B. / Diedrich D-90
DRILL CONTRACTOR Parratt Wolf

COORDINATES N 1214427.62
E 650320.80
GROUND ELEV. 108.9 ft
HAMMER TYPE/EFF. Manual - Safety

Depth (ft)	Elevation (ft)	Graphic Log	Material Description	Sample Type	Core Run No.	Recovery % RQD	Pocket Pen. (tsf)	Blow Counts (N Value)	Notes	Legend			
										▲ SPT N Value	● MC (%)	— PL & LL (%)	☒ Fines Content (%)
108.4			6 inches gravel railroad FILL, subangular to angular, gray, dry CLAY (CL), brown with gray seams, stiff, dry			34%		5-7-9-6 (16)	Boring advanced with 3.5" ID HSA	▲			
5			With coarse subangular gravel, moist			46%		4-6-6-10 (12)		▲			
			Dark grayish brown			25%		4-7-8-7 (15)		▲			
						66%		5-10-12-13 (22)		▲	●		
10	98.9		CLAY (CH), olive brown to light brown with gray seams, stiff, moist			66%		3-2-6-6 (8)		▲			
			Rock stuck in shoe										
15						100%		4-6-8-10 (14)		▲	●	—	☒
20						100%		4-6-7-10 (13)		▲			
25						100%		3-5-8-9 (13)		▲			
30						100%	1.5	6-7-10-12	3-inch ring sampler		●	—	☒



PROJECT NUMBER 20001480

LOGGED BY Rafael Salas Jr

COORDINATES N 1214427.62
E 650320.80

START DATE 03/10/2022



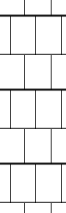

DRILLER/RIG Corey B. / Diedrich D-90

GROUND ELEV. 108.9 ft

FINISH DATE 03/10/2022

DRILL CONTRACTOR Parratt Wolf

HAMMER TYPE/EFF. Manual - Safety

Depth (ft)	Elevation (ft)	Graphic Log	Material Description	Sample Type	Core Run No.	Recovery % RQD	Pocket Pen. (tsf)	Blow Counts (N Value)	Notes	Legend													
										▲ SPT N Value	● MC (%)	— PL & LL (%)	☒ Fines Content (%)										
			Gray with light brown seams, firm																				
35	73.9		LIMESTONE, with healed calcite filled fractures, limited fracturing with little to no weathering on joints			100%		1-4-4-6 (8)	Refusal at 35 ft., switched to NX rock coring tools Unconfined Compressive Strength = 10,300 psi	▲													
40	68.9		Boring terminated at 40 ft			93%																	



Kiewit

EXPLORATORY BORING LOG

Champlain Hudson Power Express
New York

BORING NO: K-226.2B

PROJECT NUMBER 20001480
START DATE 03/09/2022
FINISH DATE 03/09/2022

LOGGED BY Rafael Salas Jr
DRILLER/RIG Corey B. / Diedrich D-90
DRILL CONTRACTOR Parratt Wolf

COORDINATES N 1214187.35
E 650265.97
GROUND ELEV. 105.8 ft
HAMMER TYPE/EFF. Manual - Safety

Depth (ft)	Elevation (ft)	Graphic Log	Material Description	Sample Type	Core Run No.	Recovery %	RQD	Pocket Pen. (tsf)	Blow Counts (N Value)	Notes	Legend			
											SPT N Value	MC (%)	PL & LL (%)	Fines Content (%)
	103.8		FILL: SAND (SM) with gravel, light grayish brown, medium to coarse grain, with clay, dense, dry			79%			4-15-18-17 (33)	Boring advanced with 3.5" ID HSA				
			FILL: Gravel (GM) with Clay, silty, angular to subangular, light brownish gray, coarse, dense to medium dense, dry			0%			17-27-21-17 (48)					
5			Some Siltstone, hard, some stratification			42%			18-11-15-13 (26)					
						42%			7-6-7-12 (13)					
						42%			12-13-10-9 (23)					
10	95.8		CLAY (CH) with gravel, gray, very stiff to firm, moist											
15			Olive and light brown			25%			2-3-6-4 (9)					
20			Gray clay seams below 25 ft			75%			3-8-10-11 (18)	3-inch ring sampler				
						100%			5-8-9-10					
						100%			2-4-6-7 (10)					
25														
30									3-4-8-8 (12)					



Kiewit

EXPLORATORY BORING LOG Champlain Hudson Power Express New York

BORING NO: K-226.2B

PROJECT NUMBER 20001480
 START DATE 03/09/2022
 FINISH DATE 03/09/2022

LOGGED BY Rafael Salas Jr
 DRILLER/RIG Corey B. / Diedrich D-90
 DRILL CONTRACTOR Parratt Wolf

COORDINATES N 1214187.35
E 650265.97
 GROUND ELEV. 105.8 ft
 HAMMER TYPE/EFF. Manual - Safety

Depth (ft)	Elevation (ft)	Graphic Log	Material Description	Sample Type	Core Run No.	Recovery % RQD	Pocket Pen. (tsf)	Blow Counts (N Value)	Notes	Legend			
										▲ SPT N Value	● MC (%)	— PL & LL (%)	☒ Fines Content (%)
35	70.8		CLAY (CH), gray, soft, moist			100%		3-3-5-7 (8)		▲	●	—	☒
40	65.8		Boring terminated at 40 ft			100%		0-0-2-2 (2)		▲			



ATLANTIC TESTING LABORATORIES

WBE certified company

LABORATORY DETERMINATION OF MOISTURE CONTENT OF SOILS

ASTM D 2216

Page 1 of 1

PROJECT INFORMATION

Client: Kiewit Infrastructure Co.
Project: Champlain Hudson Power Express
United Cable Installation
Various Locations, New York

ATL Report No.: CD10279E-08-03-22
Report Date: March 28, 2022
Date Received: March 18, 2022

TEST DATA

Boring No.	Sample No.	Depth (ft)	Moisture Content (%)
K-225.9	S-6	13-15	43.0
	S-9/10	28-30	48.0
K-226.2A	S-4	6-8	36.0
	S-6	13-15	33.8
	S-9/10	28-30	38.1
K-226.2B	S-5 ¹	8-10	7.7
	S-8/9	21-23	37.6
	S-12	33-35	37.8
K-226.7	S-5/6	4-6	34.5
	S-9/10	8-10	39.7
	S-15/16	23-25	55.6
K-226.8	S-7/8	8-10	36.2
	S-13/14	23-25	54.7
K-227.0	S-5/6 ¹	4-6	23.5
	S-9/10	8-10	33.3
	S-15/16	23-25	40.6

Remarks

1. Sample mass was less than the minimum mass outlined in the referenced test method.

Reviewed By:

Date: 03/28/22



ATLANTIC TESTING LABORATORIES

WBE certified company

AMOUNT OF MATERIAL IN SOILS FINER THAN THE NO. 200 SIEVE ASTM D 1140

PROJECT INFORMATION

Client: Kiewit Infrastructure Co.
Project: Champlain Hudson Power Express
United Cable Installation
Various Locations, New York

ATL Report No.: CD10279E-08-03-22
Report Date: March 28, 2022
Test Date: March 18, 2022
Performed By: M. White

TEST DATA

Boring No.	Sample No.	Depth (ft)	Method (A or B)	Soak Time (min)	Initial Dry Weight (g)	% Finer than #200
K-225.9	S-6	13-15	A	10	48.43	97.9
K-225.9	S-9/10	28-30	A	10	100.48	99.9
K-226.2A	S-6	13-15	A	10	62.57	98.3
K-226.2A	S-9/10	28-30	A	10	74.20	96.7
K-226.2B	S-8/9	21-23	A	10	95.42	99.9
K-226.2B	S-12	33-35	A	10	144.57	98.3
K-226.7	S-9/10	8-10	A	10	87.63	99.6
K-226.7	S-15/16	23-25	A	10	52.32	99.9
K-226.8	S-7/8	8-10	A	10	92.92	100.0
K-226.8	S-13/14	23-25	A	10	59.61	100.0
K-227.0	S-9/10	8-10	A	10	180.64	54.8
K-227.0	S-15/16	23-25	A	10	87.65	99.8

Reviewed By:

Date: 03/28/22



ATLANTIC TESTING LABORATORIES

WBE certified company

LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOIL ASTM D 4318

PROJECT INFORMATION

Client: Kiewit Infrastructure Co.
Project: Champlain Hudson Power Express
United Cable Installation
Various Locations, New York

ATL Report No.: CD10279E-08-03-22
Report Date: March 28, 2022
Date Received: March 18, 2022

TEST DATA

Boring No.	Sample No.	LL	PL	PI
K-225.9	S-6	58	24	34
K-225.9	S-9/10	37	21	16
K-226.2A	S-6	61	25	36
K-226.2A	S-9/10	61	26	35
K-226.2B	S-8/9	62	26	36
K-226.2B	S-12	50	24	26
K-226.7	S-9/10	65	27	38
K-226.7	S-15/16	59	26	33
K-226.8	S-7/8	63	26	37
K-226.8	S-13/14	52	23	29
K-227.0	S-9/10	54	26	28
K-227.0	S-15/16	57	24	33

SAMPLE INFORMATION

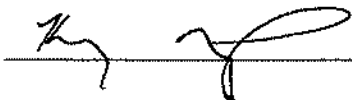
Boring No.	Sample No.	Maximum Grain Size (mm)	Estimated Amount of Sample Retained on No. 40 Sieve (%)	As Received Moisture Content (%)
K-225.9	S-6	0.074	0	43.0
K-225.9	S-9/10	0.050	0	48.0
K-226.2A	S-6	0.074	0	33.8
K-226.2A	S-9/10	0.074	0	38.1
K-226.2B	S-8/9	0.050	0	37.6
K-226.2B	S-12	0.074	0	37.8
K-226.7	S-9/10	0.050	0	39.7
K-226.7	S-15/16	0.050	0	55.6
K-226.8	S-7/8	0.050	0	36.2
K-226.8	S-13/14	0.050	0	54.7
K-227.0	S-9/10	4.76	6	33.3
K-227.0	S-15/16	0.050	0	40.6

PREPARATION INFORMATION

Boring No.	Sample No.	Preparation	Method of Removing Oversized Material
K-225.9	S-6	Air Dry	Not Necessary
K-225.9	S-9/10	Air Dry	Not Necessary
K-226.2A	S-6	Air Dry	Not Necessary
K-226.2A	S-9/10	Air Dry	Not Necessary
K-226.2B	S-8/9	Air Dry	Not Necessary
K-226.2B	S-12	Air Dry	Not Necessary
K-226.7	S-9/10	Air Dry	Not Necessary
K-226.7	S-15/16	Air Dry	Not Necessary
K-226.8	S-7/8	Air Dry	Not Necessary
K-226.8	S-13/14	Air Dry	Not Necessary
K-227.0	S-9/10	Air Dry	Pulverizing and Screening
K-227.0	S-15/16	Air Dry	Not Necessary

EQUIPMENT INFORMATION

Liquid Limit Procedure:	Multipoint - Method A	<input checked="" type="checkbox"/>	Single Point - Method B	<input type="checkbox"/>
Liquid Limit Apparatus:	Manual	<input checked="" type="checkbox"/>	Motor Driven	<input type="checkbox"/>
Liquid Limit Grooving Tool Material:	Plastic	<input checked="" type="checkbox"/>	Metal	<input type="checkbox"/>
Liquid Limit Grooving Tool Shape:	Flat	<input checked="" type="checkbox"/>	Curved (AASHTO Only)	<input type="checkbox"/>
Plastic Limit:	Hand Rolled	<input checked="" type="checkbox"/>	Mechanical Rolling Device	<input type="checkbox"/>

Reviewed By:  _____

Date: 03/28/22



ATLANTIC TESTING LABORATORIES

WBE certified company

Page 1 of 1

PROJECT INFORMATION

Client: Kiewit Infrastructure Co.
Project: Champlain Hudson Power Express
United Cable Installation
Various Locations, New York

ATL Report No.: CD10279E-08-03-22
Report Date: March 28, 2022
Date Received: March 18, 2022

UNCONFINED COMPRESSIVE STRENGTH OF INTACT ROCK CORE SPECIMENS ASTM D 7012, Method C

Boring No.	Sample No.	Depth (ft)	Diameter (in)	Length (in)	Load Rate (lbs/sec)	Total Load (lbs)	Area (in ²)	Compressive Strength (psi)
K-226.2A	RC-1	36.4-36.7	1.96	4.00	370	31,160	3.02	10,300

Failure Pictures

K-226.2A, RC-1, 36.4-36.7'



Reviewed By:

Date: March 28, 2022



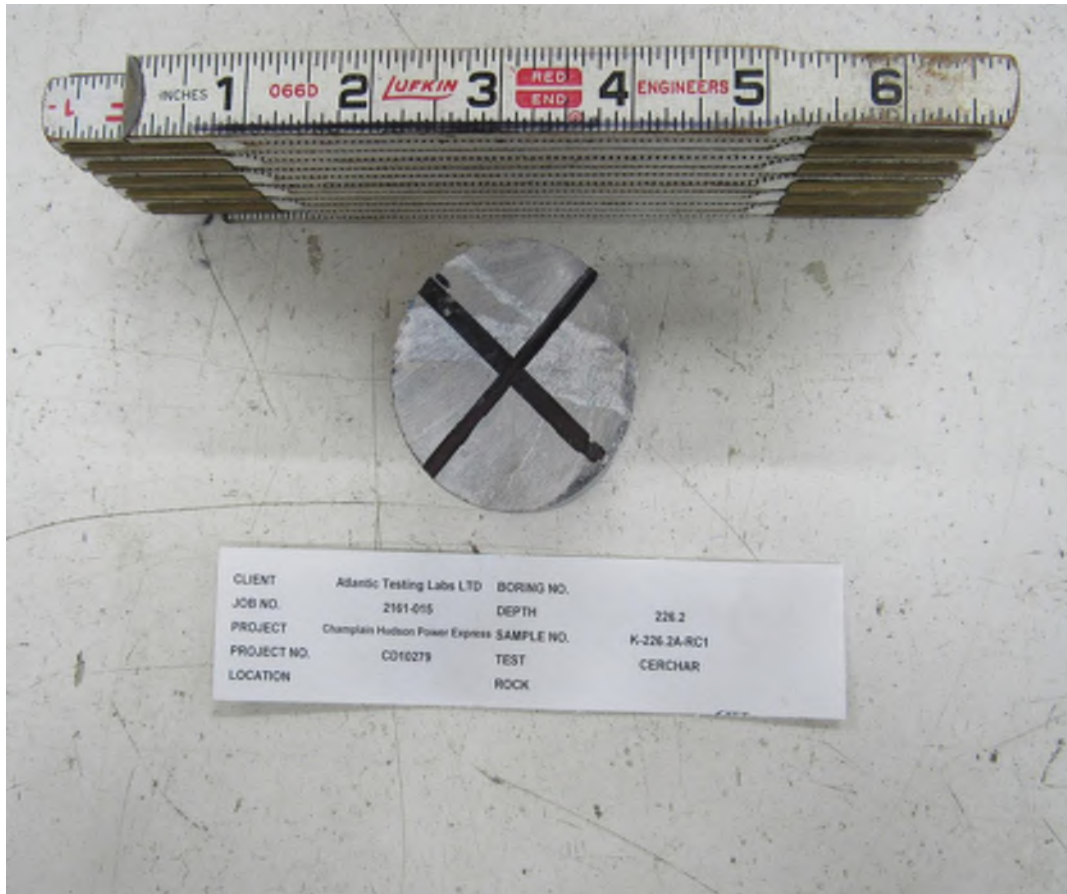
**CERCHAR Abrasiveness
ASTM D7625**

CLIENT	Atlantic Testing Labs LTD	JOB NO.	2161-015
PROJECT	Champlain Hudson Power Express	LOCATION	--
PROJECT NO.	CD10279		
BORING NO.			
DEPTH		226.2	
SAMPLE NO.		K-226.2A-RC1	
DATE SAMPLED			
DATE TESTED		04/25/22	
TECHNICIAN		HN	
ROCK TYPE			
Surface Type:		Saw Cut	
Moisture Condition		As Received	
Reading A.1 (in):		0.00874	
Reading A.2 (in):		0.00535	
Reading A.3 (in):		0.00835	
Reading A.4 (in):		0.00803	
Reading A.5 (in):		0.00843	
Reading B.1 (in):		0.00827	
Reading B.2 (in):		0.00921	
Reading B.3 (in):		0.00662	
Reading B.4 (in):		0.00945	
Reading B.5 (in):		0.00598	
Average Reading (in):		0.00784	
Average Reading (mm):		0.1992	
Uncorrected CAI or CAI _s :		1.99	
Corrected CAI:		2.45	
NOTES		<p>CAI_s is the CAI calculated on saw cut specimens. Corrected CAI for saw cut specimens based on R. Plinger and H. Kasling Suggested formula CAI = 0.99*CAI_s + 0.48. Applied pins had a Rockwell Hardness of 54-56. * Sample was broken during the test.</p>	
Data entry by:	HN	Date:	04/26/22
Checked by:	DL	Date:	04/27/22
File name:	2161015_CERCHAR ASTM D7625_0.xlsm		

**CHERCHAR Abrasiveness
ASTM D7625**

CLIENT	Atlantic Testing Labs LTD	BORING NO.	--
JOB NO.	2161-015	DEPTH	226.2
PROJECT	Champlain Hudson Power Express	SAMPLE NO.	K-226.2A-RC1
PROJECT NO.	CD10279	DATE SAMPLED	--
LOCATION	--	DATE TESTED	04/25/22
		TECHNICIAN	HN
		ROCK TYPE	--

Before Picture



NOTES

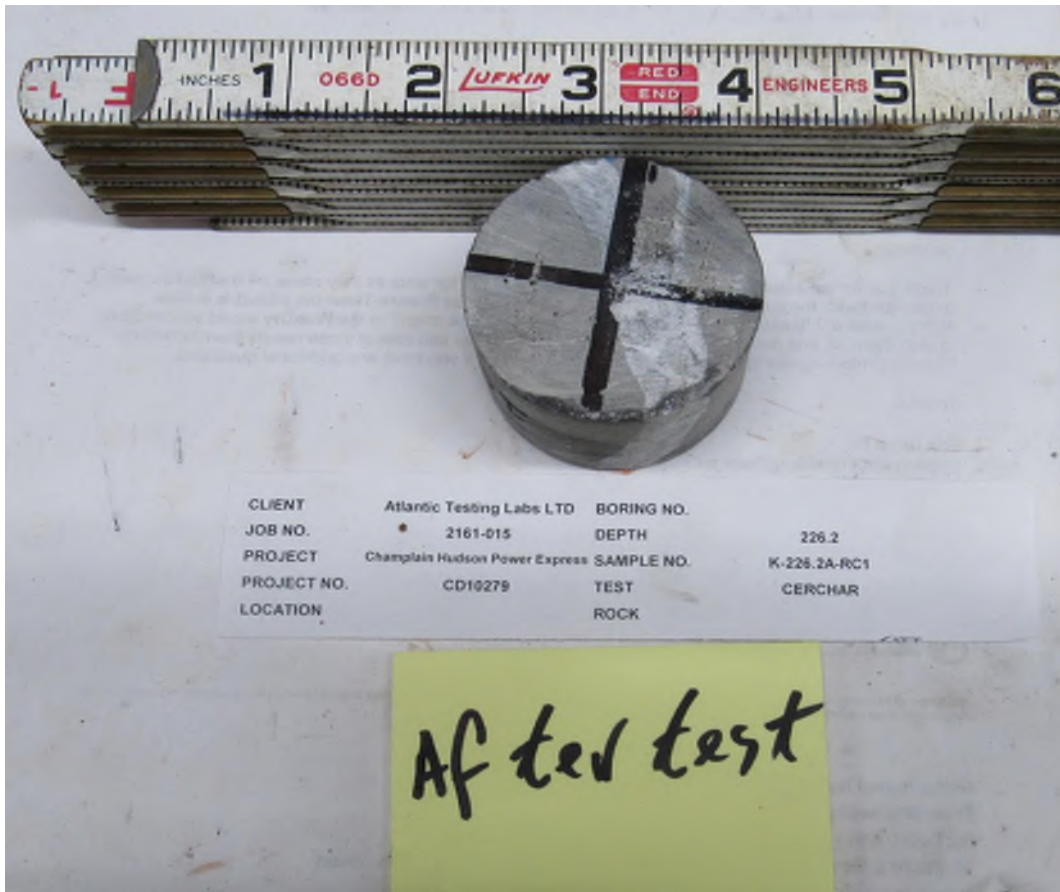
* Sample was broken during the test.

Picture File: 1.JPG
File name: 2161015__CHERCHAR ASTM D7625_0.xlsm

**CHERCHAR Abrasiveness
ASTM D7625**

CLIENT	Atlantic Testing Labs LTD	BORING NO.	--
JOB NO.	2161-015	DEPTH	226.2
PROJECT	Champlain Hudson Power Express	SAMPLE NO.	K-226.2A-RC1
PROJECT NO.	CD10279	DATE SAMPLED	--
LOCATION	--	DATE TESTED	04/25/22
		TECHNICIAN	HN
		ROCK TYPE	--

After Picture



NOTES

* Sample was broken during the test.

Picture File: 1a.JPG
File name: 2161015__CHERCHAR ASTM D7625_0.xlsm



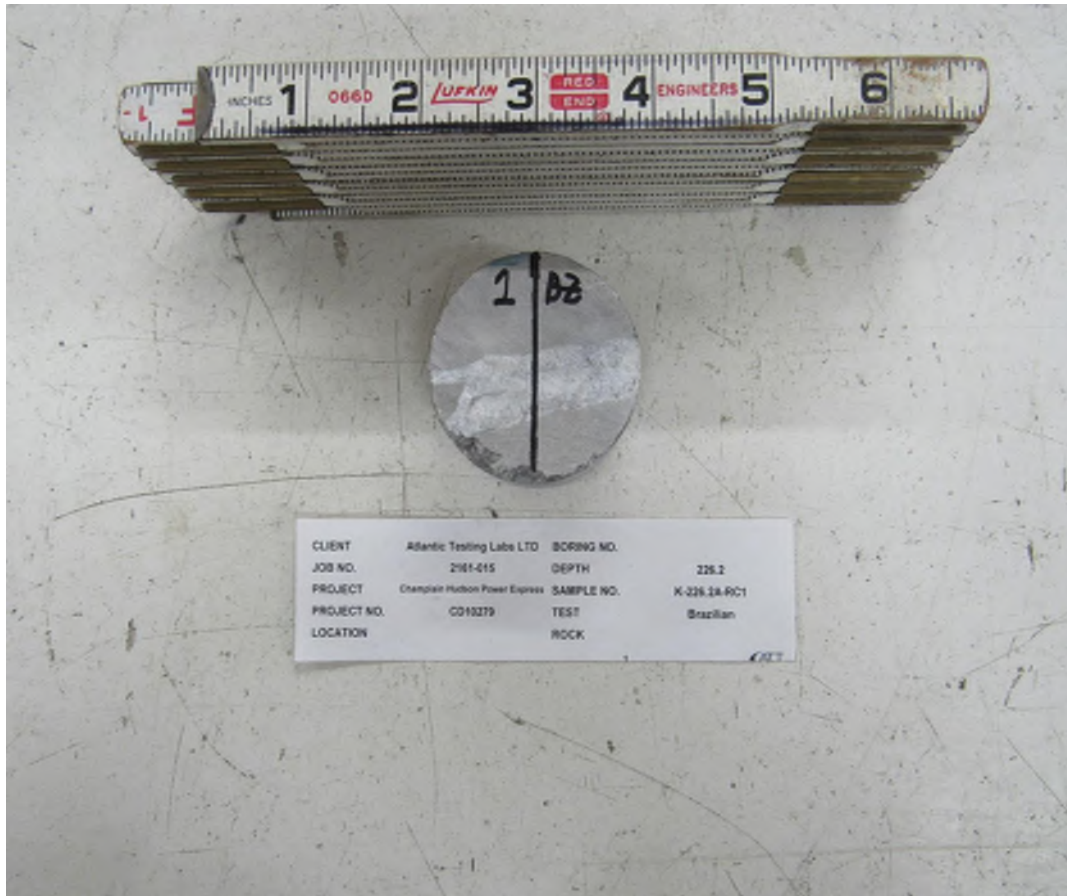
**Splitting Tensile Strength
ASTM D3967**

CLIENT	Atlantic Testing Labs LTD	JOB NO.	2161-015
PROJECT	Champlain Hudson Power Express	LOCATION	--
PROJECT NO.	CD10279		
BORING NO.			
DEPTH		226.2	
SAMPLE NO.		K-226.2A-RC1	
DATE SAMPLED			
DATE TESTED		04/19/22	
TECHNICIAN		DL	
ROCK TYPE			
Diameter (in):		1.975	
Height (in):		1.038	
Mass of Wet Rock (g):		135.60	
Wet Density (lbs/ft³):		162.4	
Wet Density (g/cm³):		2.602	
Peak Load (lbs):		2749	
Splitting Tensile Strength (psi):		854	
Splitting Tensile Strength (kPa):		5885	
Failure Type:		Single Plane	
BORING NO.			
DEPTH			
SAMPLE NO.			
DATE SAMPLED			
DATE TESTED			
TECHNICIAN			
ROCK TYPE			
Diameter (in):			
Height (in):			
Mass of Wet Rock (g):			
Wet Density (lbs/ft³):			
Wet Density (g/cm³):			
Peak Load (lbs):			
Splitting Tensile Strength (psi):			
Splitting Tensile Strength (kPa):			
Failure Type:			
NOTES			
Data entry by:	DL	Date:	04/20/22
Checked by:	HN	Date:	04/20/22
File name:	2161015_Brazilian ASTM D3967_0.xlsm		

**Splitting Tensile
ASTM D3967**

CLIENT	Atlantic Testing Labs LTD	BORING NO.	
JOB NO.	2161-015	DEPTH	226.2
PROJECT	Champlain Hudson Power Express	SAMPLE NO.	K-226.2A-RC1
PROJECT NO.	CD10279	DATE SAMPLED	
LOCATION	--	DATE TESTED	04/19/22
		TECHNICIAN	DL
		ROCK TYPE	

Before Picture



NOTES

Picture File: 1.JPG
File name: 2161015__Brazilian ASTM D3967_0.xlsm

Splitting Tensile ASTM D3967

CLIENT	Atlantic Testing Labs LTD	BORING NO.	
JOB NO.	2161-015	DEPTH	226.2
PROJECT	Champlain Hudson Power Express	SAMPLE NO.	K-226.2A-RC1
PROJECT NO.	CD10279	DATE SAMPLED	
LOCATION	--	DATE TESTED	04/19/22
		TECHNICIAN	DL
		ROCK TYPE	

After Picture



NOTES

Picture File: 1a.JPG
File name: 2161015__Brazilian ASTM D3967_0.xlsm



Package 7A Phase 3 Borings

Champlain Hudson Power Express
New York

PROJECT NUMBER 20001480

CREATED BY Kiewit
DATE 12/08/2022

Legend Key

- Kiewit Borings (Phase 3)





Kiewit

EXPLORATORY BORING LOG

Champlain Hudson Power Express
New York

BORING NO: KB-226.1

PROJECT NUMBER 20001480
START DATE 09/01/2022
FINISH DATE 09/01/2022

LOGGED BY Rafael Salas
DRILLER/RIG C. Brown / CME-850
DRILL CONTRACTOR Parratt Wolf

COORDINATES N 1214648.99
E 650356.50
GROUND ELEV. 107.8 ft
HAMMER TYPE/EFF. Automatic

Depth (ft)	Elevation (ft)	Graphic Log	Material Description	Sample Type	Core Run No.	Recovery % RQD	Pocket Pen. (tsf)	Blow Counts (N Value)	Notes	Legend			
										▲ SPT N Value	● MC (%)	— PL & LL (%)	☒ Fines Content (%)
	106.8		Railroad ballast						Boring advanced with 3.25" ID HSA	20	40	60	80
			SILT (MH), light brown with light gray, very stiff to stiff, high plasticity, moist			50%		9-9-8-4 (17)		▲			
5			Olive brown			50%		6-6-7-9 (13)		▲			
			Grayish brown with orange at 6 - 8 ft			54%		2-4-5-6 (9)		▲			
			Very stiff below 10 ft			84%		7-6-7-13 (13)		▲ ● ☒			
10						100%		4-5-6-8 (11)		▲			
						100%		10-12-13-11 (25)		▲			
15	92.8		FAT CLAY (CH), gray, stiff, moist			100%		5-4-6-8 (10)		▲			
20						71%		4-4-6-8 (10)		▲ ● ☒			
25			Dark gray below 25 ft			100%		4-5-6-6 (11)		▲			
30						92%		2-3-2-4 (5)		▲			
35													



Kiewit

EXPLORATORY BORING LOG

Champlain Hudson Power Express
New York

BORING NO: KB-226.1

PROJECT NUMBER 20001480
START DATE 09/01/2022
FINISH DATE 09/01/2022

LOGGED BY Rafael Salas
DRILLER/RIG C. Brown / CME-850
DRILL CONTRACTOR Parratt Wolf

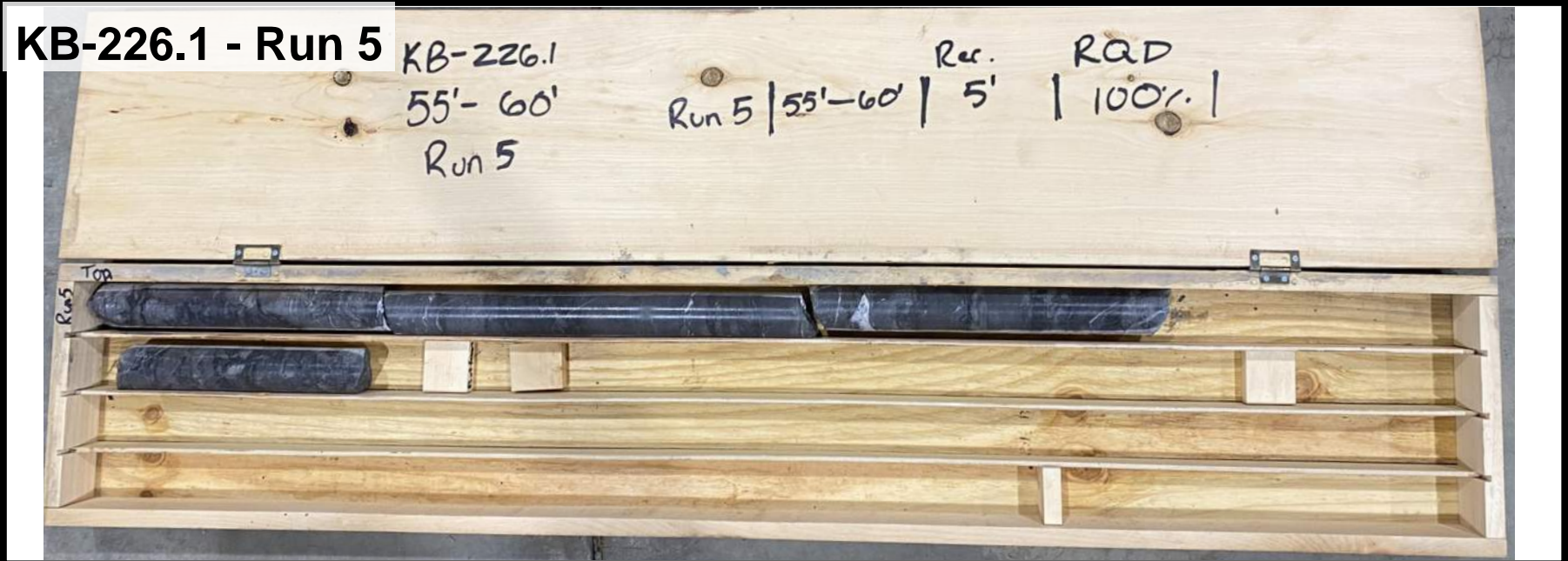
COORDINATES N 1214648.99
E 650356.50
GROUND ELEV. 107.8 ft
HAMMER TYPE/EFF. Automatic

Depth (ft)	Elevation (ft)	Graphic Log	Material Description	Sample Type	Core Run No.	Recovery % RQD	Pocket Pen. (tsf)	Blow Counts (N Value)	Notes	Legend					
										▲ SPT N Value	● MC (%)	— PL & LL (%)	☒ Fines Content (%)		
	70.4					92%		0-0-0-2 (0)		▲					
			Graywacke, dark gray, fine grained, calcite veins throughout, moderately spaced discontinuities, fresh to slightly weathered		1	88% 88			UCS = 7384 psi						
	40		Very closely to moderately spaced discontinuities		2	89% 84									
	45		Interbedded with shale at 45 - 48.3 ft		3	100% 90									
			Quartz vein at 46.9 ft		4	99% 95									
	50		Interbedded with shale below 50 ft		5	100% 100									
	60		Boring Terminated at 60 ft												
	47.8														
	65														
	70														

KB-226.1 - Runs 1 through 4



KB-226.1 - Run 5



Summary of Laboratory Results

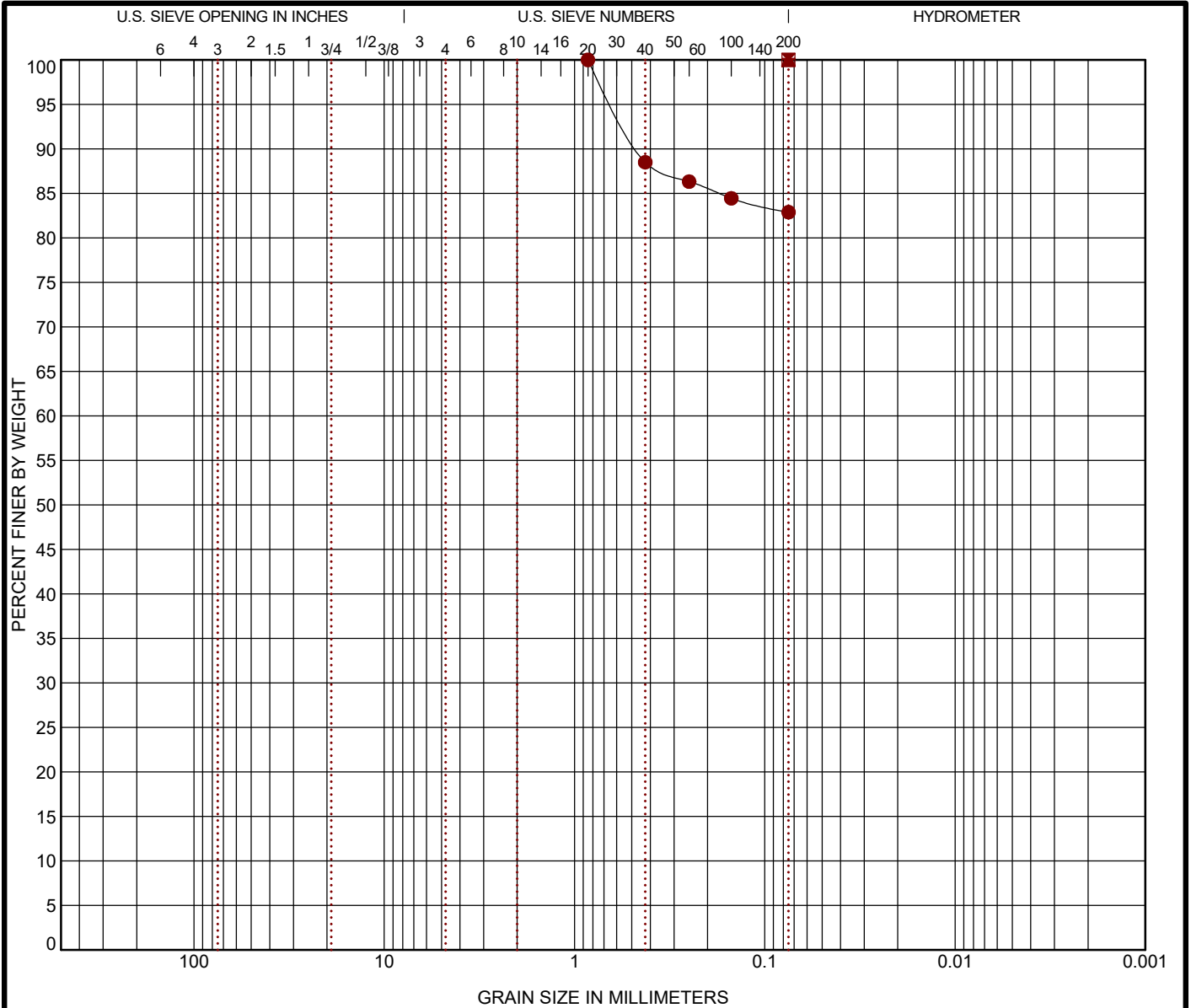
BORING ID	Depth (Ft.)	Water Content (%)
KB-222.6A	15-17	1.2
KB-222.6A	35-37	35.8
KB-222.6A	50-52	41.7
KB-222.6A	65-67	38.4
KB-223.1A	6-8	31.3
KB-223.1A	25-27	39.6
KB-223.1A	45-47	22.0
KB-226.1	6-8	33.3
KB-226.1	20-22	37.7
KB-226.8A	4-6	35.5
KB-226.8A	20-22	37.4
KB-226.8A	38-40	46.7

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. SMART LAB SUMMARY-PORTRAIT_JB215256H LAB TESTING.GPJ TERRACON_DATATEMPLATE.GDT 11/16/22

PROJECT: LAB Testing	 <p>30 Corporate Cir Ste 201 Albany, NY</p>	PROJECT NUMBER: JB215256H
SITE: Champlain- Hudson Power Express		CLIENT: Kiewit Engineering (NY) Corp Lone Tree, CO
		EXHIBIT: B-2

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Boring ID	Depth (Ft)	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
● KB-226.1	20 - 22	FAT CLAY with SAND (CH)	37.7	66	31	35		
☒ KB-226.8A	4 - 6	ELASTIC SILT (MH)	35.5	62	33	29		
▲ KB-226.8A	20 - 22	FAT CLAY (CH)	37.4	50	27	23		
★ KB-226.8A	38 - 40	ELASTIC SILT (MH)	46.7	50	32	18		

Boring ID	Depth (Ft)	D ₁₀₀	D ₆₀	D ₃₀	D ₁₀	%Cobbles	%Gravel	%Sand	%Silt	%Fines	%Clay
● KB-226.1	20 - 22	0.85				0.0	0.0	17.1		82.9	
☒ KB-226.8A	4 - 6	0.075				0.0	0.0	0.0		100.0	
▲ KB-226.8A	20 - 22	0.075				0.0	0.0	0.0		100.0	
★ KB-226.8A	38 - 40	0.075				0.0	0.0	0.0		100.0	

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 JB215256H LAB TESTING.GPJ TERRACON_DATATEMPLATE.GDT 11/16/22

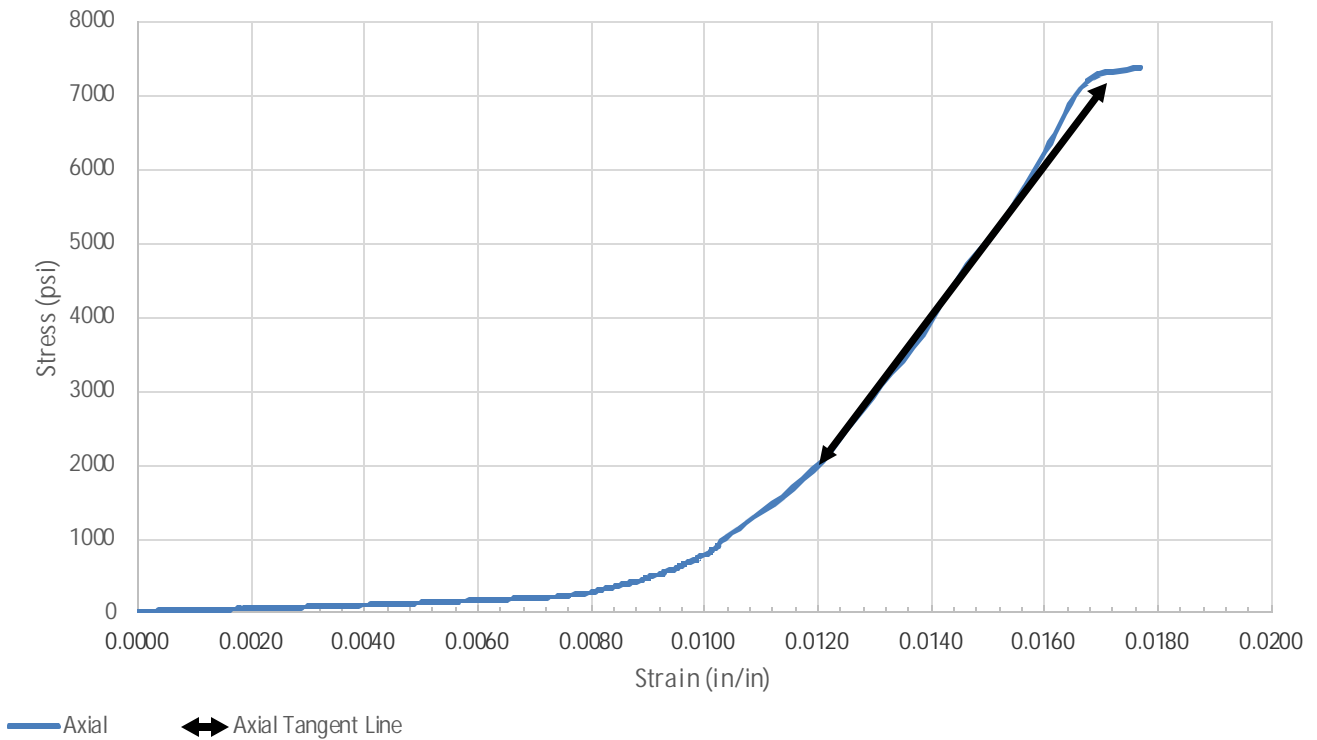
PROJECT: LAB Testing	 30 Corporate Cir Ste 201 Albany, NY	PROJECT NUMBER: JB215256H
SITE: Champlain- Hudson Power Express		CLIENT: Kiewit Engineering (NY) Corp Lone Tree, CO
		EXHIBIT: B-11

Client
Kiewit Engineering (NY) Corp

Project
LAB Testing

Project No. JB215256H

ASTM D7012 Stress/ Strain Curve



SAMPLE LOCATION

Site:	LAB Testing		
Description:	Greywacke interbedded with Shale		
Boring:	KB-226.1	Depth (feet):	40.0-45.0

SPECIMEN INFORMATION

Sample No.:	RC2	Mass (g):	573.16
Length (in.):	4.18	Diameter (in.):	1.98
L/D Ratio:	2.11	Density (pcf):	169.65

TEST RESULTS

Failure Load (lbs):	22736
Failure Strain (in/in):	0.020
Unconfined Compressive Strength (psi):	7,384
Elastic Modulus, E, (ksi):	1016
Time of Failure (min):	02:32
Rate of Loading (in/sec):	0.04
Moisture Content Post-break:	0.09%

Rock Core D7012 Method C



Client

Kiewit Engineering (NY) Corp

Project

LAB Testing

Project No. JB215256H

Equipment:

	TICCS ID:
Calipers	W-44049
Scale	B-71466
Dial Indicator	C-70608
Compression (spherically seated)	C-48999

Samples were prepared and tested in accordance with ASTM D4543 and D7012. Deviations, if any, are noted below:
Notes:

Per ASTM D4543, this specimen has not met the requirements for perpendicularity, by exceeding 0.250°.
Per ASTM D4543, this specimen has not met the requirements for flatness, by exceeding 0.001 inches.
Per ASTM D4543, this specimen has not met the requirements for parallelism, by exceeding 0.25°.
Per ASTM D4543, this specimen has not met the requirements for flatness, by exceeding 0.001 inches.
Per ASTM D4543 and ASTM D7012, the desired specimen length to diameter are between 2.0:1 and 2.5:1.

According to ASTM D7012 Section 8.2.1, this specimen, although not meeting all requirements of ASTM D4543 is acceptable for testing. However, the results reported may differ from results obtained from a test specimen that meets the requirements of D4543.

Client
Kiewit Engineering (NY) Corp

Project
LAB Testing

Project No. JB215256H

Splitting Tensile Strength of Intact Rock Core Specimens, ASTM D3967

Boring	KB-226.1	Material Description		Greywacke	
Sample No	RC2	Equipment Used		Tinius Olsen (120,000lbs)	
Depth (ft)	40.0-45.0	TICCS ID/Serial No.		C-48999, 118285	
Lab No	8752	Calibration Date		11/2/2021	
TENSILE STRENGTH					
Lab No.	1	2	3	4	5
Diameter (in)	1.97	1.98	1.97	1.97	1.98
Length (in)	0.6	0.64	0.58	0.69	0.58
Length Diameter Ratio	0.30	0.32	0.29	0.35	0.29
Rate of Loading	0.06	0.064	0.058	0.069	0.058
Moisture Condition	0.09%	0.09%	0.09%	0.09%	0.09%
Maximum Applied Load (lbf)	270	1372	1046	701	626
Splitting Tensile Strength (psi)	145.5	689.6	583.1	328.5	347.2
TENSILE STRENGTH					
Lab No.	6	7	8	9	10
Diameter (in)	1.97	1.97	1.97	1.97	
Length (in)	0.62	0.58	0.58	0.51	
Length Diameter Ratio	0.31	0.29	0.29	0.26	
Rate of Loading	0.062	0.58	0.58	0.51	
Moisture Condition	0.09%	0.09%	0.09%	0.09%	
Maximum Applied Load (lbf)	2095	689	1804	534	
Splitting Tensile Strength (psi)	1092.5	384.1	1005.6	338.5	



ADVANCED TERRA TESTING

**CERCHAR Abrasiveness
ASTM D7625**

CLIENT	Terracon		JOB NO.	2261-249
PROJECT	Champlain-Hudson Power Express		LOCATION	--
PROJECT NO.	JB215256			
BORING NO.	KB-192.8A	KB-226.1		
DEPTH	54.5	40.0-45.0		
SAMPLE NO.				
DATE SAMPLED				
DATE TESTED	10/18/22	10/18/22		
TECHNICIAN	HN	HN		
ROCK TYPE				
Surface Type:	Natural	Saw Cut		
Moisture Condition	As Received	As Received		
Reading A.1 (in):	0.00920	0.00480		
Reading A.2 (in):	0.01350	0.00750		
Reading A.3 (in):	0.00380	0.00600		
Reading A.4 (in):	0.00890	0.00640		
Reading A.5 (in):	0.00830	0.00650		
Reading B.1 (in):	0.00790	0.00770		
Reading B.2 (in):	0.01620	0.00760		
Reading B.3 (in):	0.00540	0.00670		
Reading B.4 (in):	0.00790	0.00500		
Reading B.5 (in):	0.00850	0.00700		
Average Reading (in):	0.00896	0.00652		
Average Reading (mm):	0.2276	0.1656		
Uncorrected CAI or CAI _s :	2.28	1.66		
Corrected CAI:	--	2.12		
NOTES	<p>CAI_s is the CAI calculated on saw cut specimens. Corrected CAI for saw cut specimens based on R. Plinger and H. Kasling Suggested formula CAI = 0.99*CAI_s + 0.48. Applied pins had a Rockwell Hardness of 54-56.</p>			
Data entry by:	DL		Date:	10/19/22
Checked by:	HN		Date:	10/19/22
File name:	2261249_CHERCHAR ASTM D7625_0.xlsm			



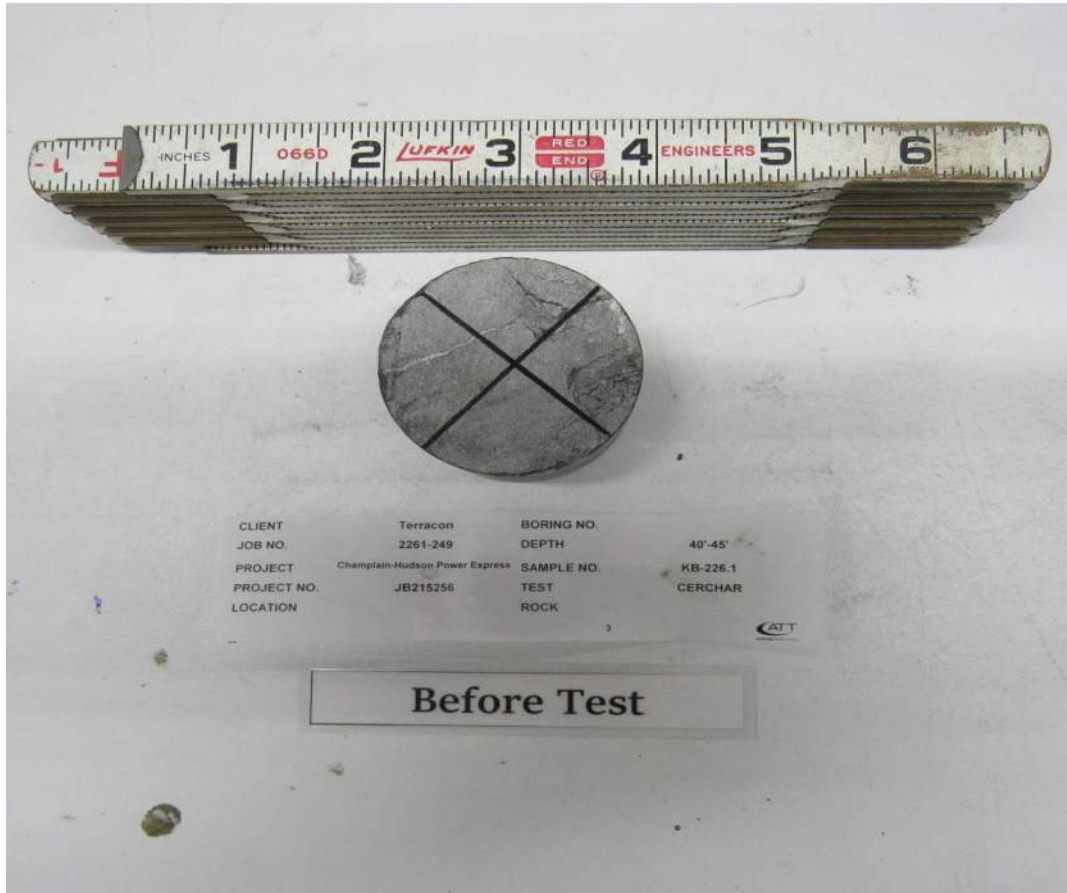
ADVANCED TERRA TESTING

CHERCHAR Abrasiveness ASTM D7625

CLIENT Terracon
 JOB NO. 2261-249
 PROJECT Champlain-Hudson Power Express
 PROJECT NO. JB215256
 LOCATION --

BORING NO. KB-226.1
 DEPTH 40.0-45.0
 SAMPLE NO. --
 DATE SAMPLED --
 DATE TESTED 10/18/22
 TECHNICIAN HN
 ROCK TYPE --

Before Picture



NOTES

Picture File: 3.JPG
 File name: 2261249__CHERCHAR ASTM D7625_0.xlsm



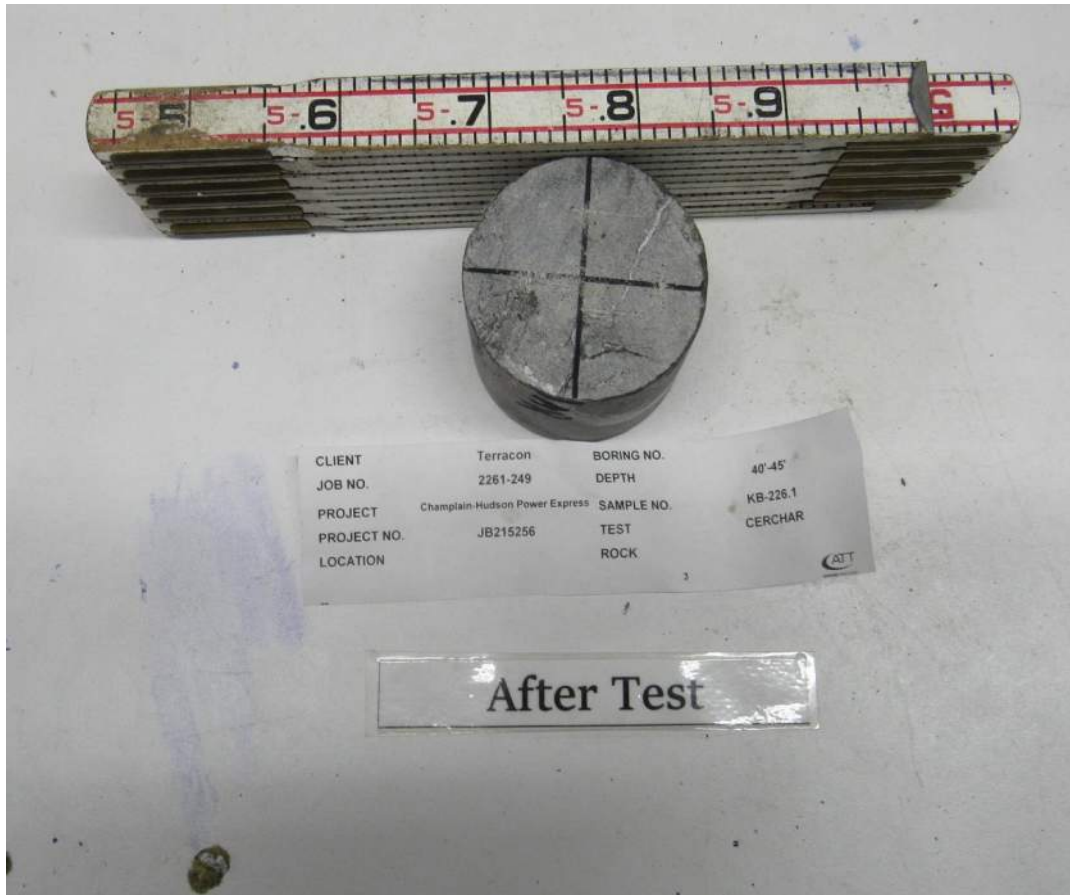
ADVANCED TERRA TESTING

CHERCHAR Abrasiveness ASTM D7625

CLIENT Terracon
 JOB NO. 2261-249
 PROJECT Champlain-Hudson Power Express
 PROJECT NO. JB215256
 LOCATION --

BORING NO. KB-226.1
 DEPTH 40.0-45.0
 SAMPLE NO. --
 DATE SAMPLED --
 DATE TESTED 10/18/22
 TECHNICIAN HN
 ROCK TYPE --

After Picture



NOTES

Picture File: 3a.JPG
 File name: 2261249__CHERCHAR ASTM D7625_0.xlsm

DATE: December 16, 2022

TO: Zachary Bauer; Tetra Tech Rooney

FROM: Matthew Hawley, P.E.; Kiewit Engineering (NY) Corp. 
Jaren Knighton; Kiewit Engineering (NY) Corp.

SUBJECT: Geotechnical Data: Segment 11 – Package 7A – HDD Crossing 123 – Revision 1
Champlain Hudson Power Express Project
Catskill, New York

Kiewit Engineering is providing the attached geotechnical data for use in the horizontal direction drill (HDD) design for the Champlain Hudson Power Express project in Upstate New York. This HDD crossing is located south of Catskill, New York. The approximate station for the start of HDD crossing number 123 is STA 70374+00 (42.1589° N, 73.9187° W).

The geotechnical data at this HDD crossing is attached. The available data is taken from the previous investigations by AECOM and TRC and the recent investigations by Kiewit, referenced below.

- AECOM, Geotechnical Data Report, Upland Segments: Putnam Station, Washington County, to Cementon, Green County, NY, Champlain Hudson Power Express, dated May 28, 2021.
- TRC, Geotechnical Data Report, Champlain Hudson Power Express, Canadian Pacific Railway Borings MP 177.6-228.2, dated March 15, 2013.
- Kiewit Engineering (NY) Corp., Segment 11 Package 7A HDD Borings - Catskill, Champlain-Hudson Power Express, dated May 9, 2022.
- Kiewit Engineering (NY) Corp., Package 7A Phase 3 Borings, Champlain Hudson Power Express, New York, dated December 8, 2022.

Contact us if you have questions or require additional information.

HDD 123
Borings B226.6-1, CU-5A,
K-226.7, K-226.8, K-227.0,
KB-226.8A
Segment 11 - Design Package 7A

CHPE Segment 11 - Package 7A
HDD Soil Boring Coordinates and Elevations

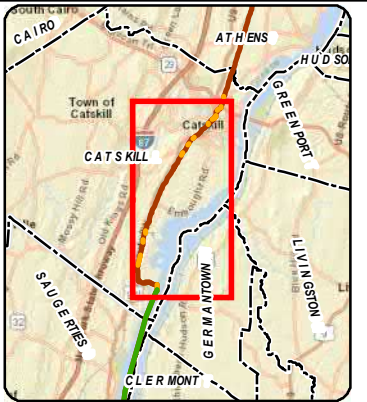
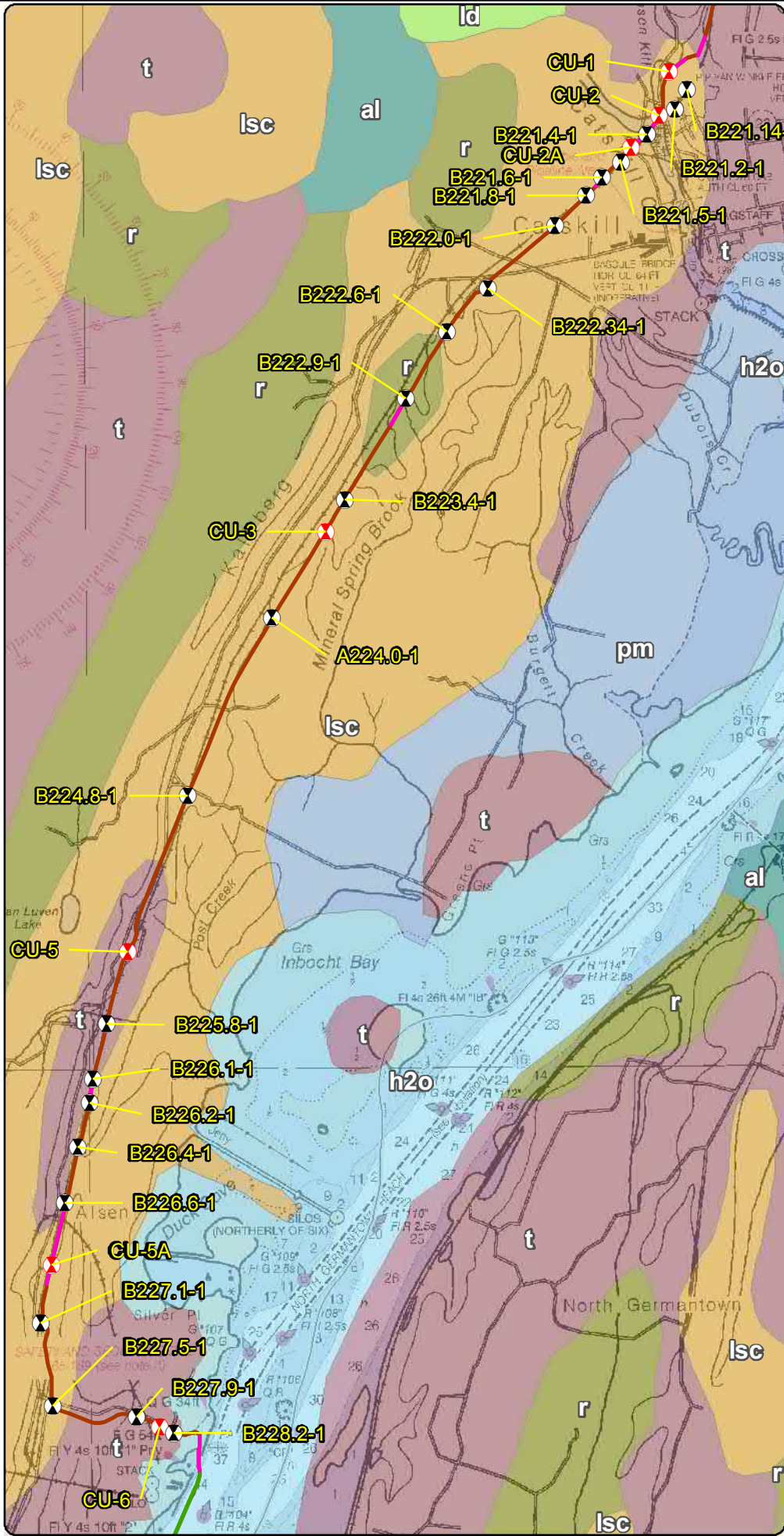
Firm	Boring	Northing (feet)	Easting (feet)	Ground Surface Elevation (feet)
TRC*	B221.0-1	1237452.6	663787.2	99.6
	B221.2-1	1236173.4	663261.8	115.0
	B221.4-1	1235622.5	662622.3	22.4
	B221.5-1	1235006.9	662058.8	95.5
	B221.6-1	1234675.8	661633.8	98.3
	B221.8-1	1234265.3	661277.2	99.4
	B222.34-1	1232191.5	659098.9	133.5
	B222.6-1	1231252.6	658182.3	113.7
	B222.9-1	1229751.0	657274.3	121.4
	B225.8-1	1215861.0	650622.7	91.0
	B226.1-1	1214654.4	650328.3	105.9
	B226.2-1	1214120.5	650254.4	108.5
	B226.6-1	1211894.7	649689.7	112.1
AECOM**	CU-1	1237028.6	663123.9	19.7
	CU-2	1236042.7	662897.0	24.8
	CU-2A	1235325.9	662268.9	38.1
	CU-5A	1210523.7	649411.8	118.4
	SC-5	1239310.3	664321.6	110.2
	SC-6	1237781.0	663919.8	101.6

Notes:

- Northings and Eastings are provided in NAD83 New York State Plane East Zone.
- Elevations are referenced to the NAVD88 datum.
- * TRC boring coordinates as shown in Table 1-6 in AECOM report (reference below). Boring elevations estimated from November 2021 topographic survey by Williams Aerial.
- ** AECOM boring coordinates and elevations as shown in Table 1-6 in AECOM report.
- *** Kiewit boring coordinates and elevations are noted on the boring logs.

Reference:

AECOM, Geotechnical Data Report, Upland Segments: Putnam Station, Washington County, to Cementon, Green County, NY, Champlain Hudson Power Express, dated May 28, 2021.



LEGEND

- 2021 Boring Location
- Previous (2013) Boring Location
- Terrestrial Route HVDC
- Submarine Route HVDC
- Terrestrial Route HVAC
- Preliminary HDD Locations
- Preliminary Pipe Bridge Location
- Town Boundary
- County Boundary

Surfacial Geology

- al - Recent alluvium
- h2o - Water
- ld - Lacustrine delta
- lsc - Lacustrine silt and clay
- pm - Swamp deposits
- r - Bedrock
- t - Till

0.3 0.15 0 0.3 Miles

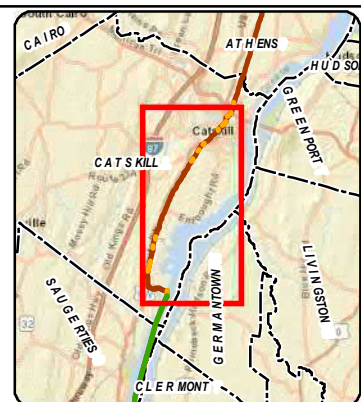
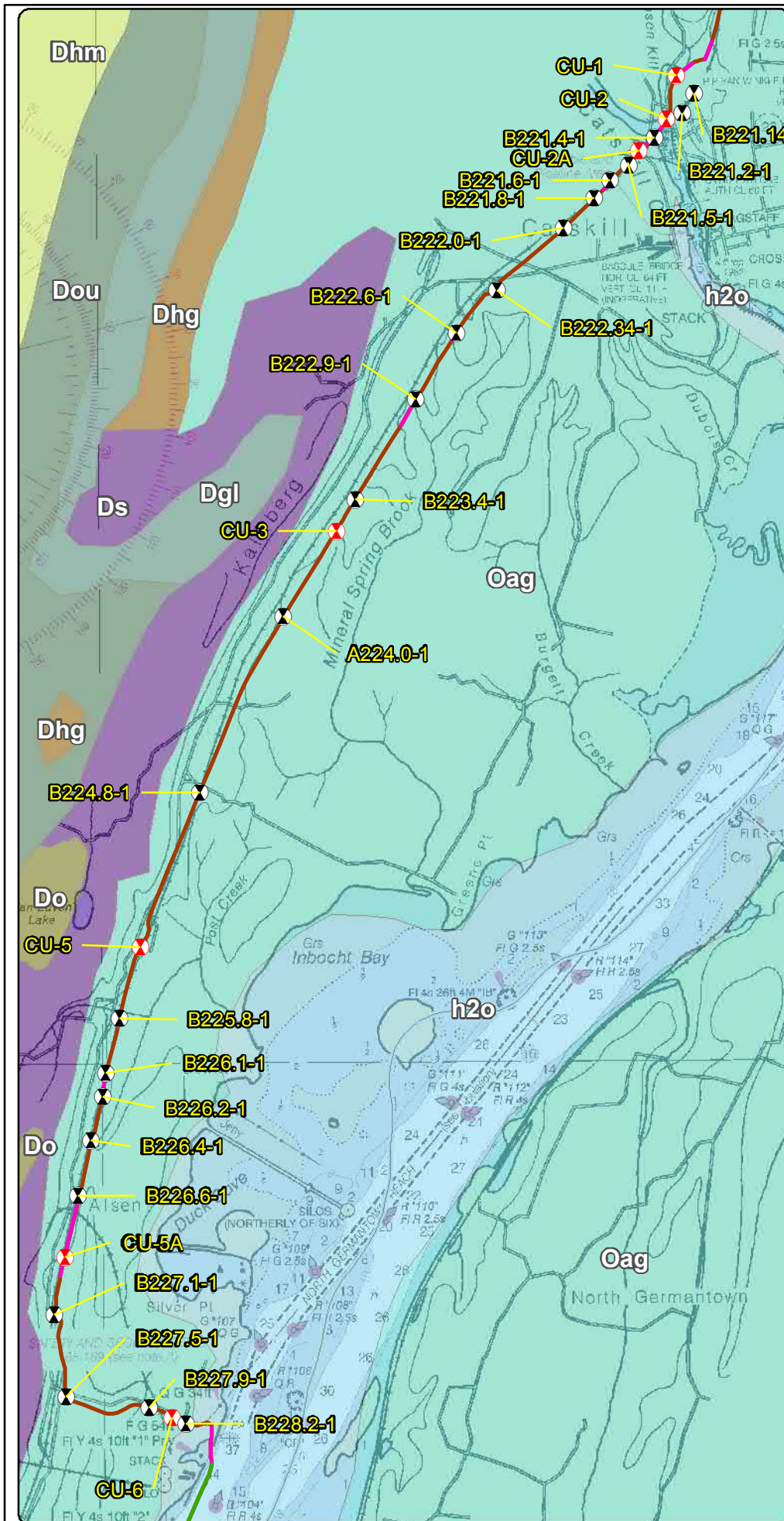
Champlain Hudson Power Express Project
Champlain Hudson Power Express Inc.

**Surfacial Geology and Geotechnical Borings
Catskill to Upland
Figure 3-11**

Prepared on 5/3/2021
by: **AECOM**

DATA SOURCES: ESRI, NYSDOT, NOAA, USACE, NYDOS, TDI, TRC

Y:\Projects\CHPE\Route\Consensus_Alternative_Routes\MD\Alt 5_Routes_DZ_201903\Boring_Locations\Maps_for_May_2021_Report\Catskill_to_Upland_Boring_Locations_Surfacial_May_2021_Report.mxd



LEGEND

- 2021 Boring Location
- Previous (2013) Boring Location
- Terrestrial Route HVDC
- Submarine Route HVDC
- Terrestrial Route HVAC
- Preliminary HDD Locations
- Preliminary Pipe Bridge Location
- Town Boundary
- County Boundary

Bedrock Geology

- Dgl - Glenerie Formation
- Dhg - Port Ewen Formation
- Dhm - Undiff Lower Hamilton Group
- Do - Oriskany Sandstone
- Dou - Onondaga Limestone
- Ds - Cashaqua Shale
- Oag - Austin Glen Form (graywacke, shale)
- h2o - Water

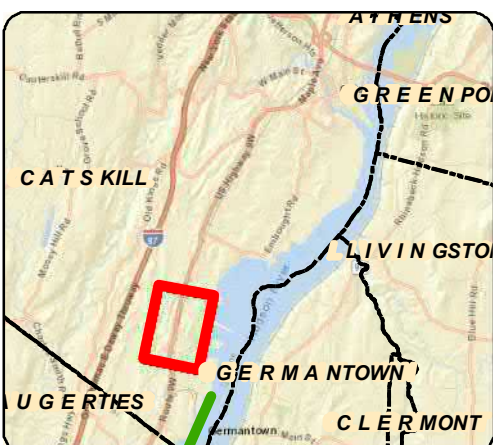
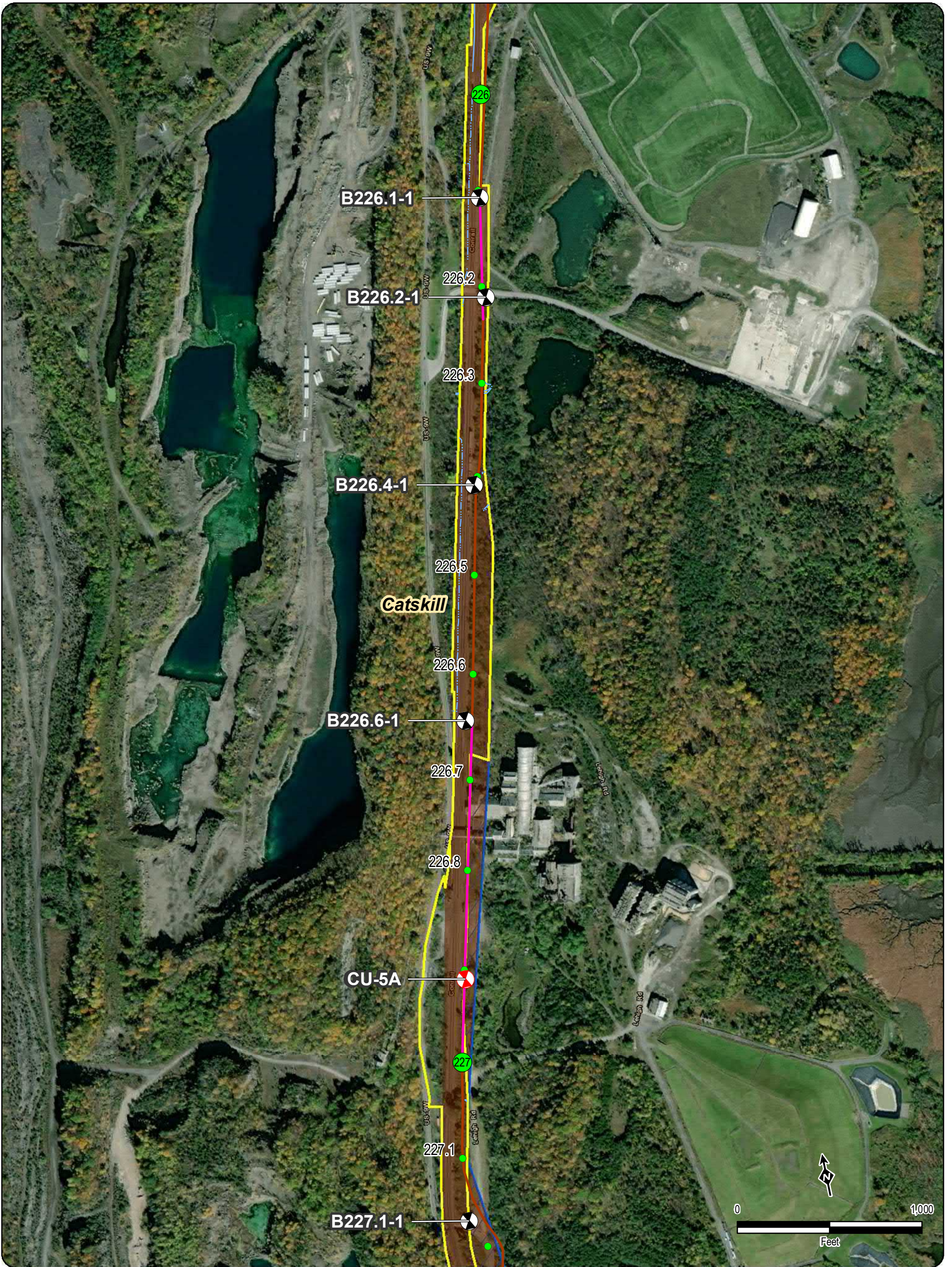
Champlain Hudson Power Express Project
 Champlain Hudson Power Express Inc.

**Bedrock Geology and Geotechnical Borings
 Catskill to Upland
 Figure 4-11**


Prepared on 5/18/2021
 by: **AECOM**

DATA SOURCES: ESRI, NYSDOT, NOAA, USACE, NYDOS, TDI, TRC

Y:\Projects\CHPE\Route\Consensus_Alternative_Routes\MD\Alt 5_Routes_DZ_201909\Boring_Locations\Maps_for_May_2021_Report\Catskill_to_Upland_Boring_Locations_Bedrock_May_2021_Report.mxd



LEGEND	
● 111.8 Certified Milepost - Tenths	— Streams/Ditches
● Certified Milepost	— Railroad ROW
○ Preferred Alternative Milepost - Tenths	— Deviation Zone
○ Preferred Alternative Milepost	— Deviation Zone Outside ROW
— Terrestrial Route HVDC	— Preferred Alternative Deviation Zone
— Submarine Route HVDC	— Preferred Alternative Deviation Zone Outside ROW
— Terrestrial Route HVAC	— Town Boundary
— Preliminary HDD Locations	— Village Boundary
— Preliminary Pipe Bridge Location	— State Park (OPRHP)
⊗ 2021 Boring Location	Parcel Ownership
⊗ Previous (2013) Boring Location	Road Name
	Village Name


Champlain Hudson Power Express Project
 Champlain Hudson Power Express Inc.

BORING LOCATION PLAN
Catskill to Upland
Figure A-11
 Sheet 5 of 6

Prepared by: **AECOM** 5/20/2021



TEST BORING LOG

BORING **B226.6-1**

G.S. ELEV. N/A

FILE 195651

SHEET 1 OF 1




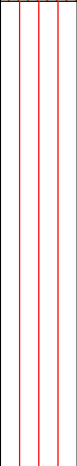
PROJECT: TDI CHAMPLAIN HUDSON POWER EXPRESS

LOCATION: CSX RAILROAD ROW, NY

GROUNDWATER DATA			
FIRST ENCOUNTERED NR			
DEPTH	HOUR	DATE	ELAPSED TIME
18.7'	NR	12/1	0 HR

METHOD OF ADVANCING BOREHOLE			
a	FROM	TO	
	0.0'	10.0'	
d	FROM	TO	
	10.0'	25.0'	

DRILLER	R. CARUSO
HELPER	C. SMART
INSPECTOR	N/A
DATE STARTED	11/30/2012
DATE COMPLETED	12/01/2012

DEPTH	A	B	C	DESCRIPTION	Wn	REMARKS
2.0	S-1	7 10 8 5		BLACK F/C GRAVEL-SIZED ROCK FRAGMENTS, SM M/C SAND, TR TO SM SILT (FILL)	29.5	
4.0	S-2	4 8 11 12		LIGHT BROWN SILT, TR CLAY (POSSIBLE FILL)	38.8	
5.0	S-3	4 8 9 9		GRAY/BROWN CLAY, SM SILT	40.7	
	S-4	4 4 5 5				
10.0	S-5	7 9 9 9				
13.5				GRAY SILT, TR CLAY	53.7	
15.0	S-6	2 2 3				
20.0	S-7	WOH 2				
25.0	S-8	WOR		END OF BORING AT 25'		
30.0						
35.0						

NEW PROJECTS TEST BORING LOG 195651_TDI_CSX.GPJ SITE BLAUVELT.GDT 3/12/13

DRN.	TBT
CKD.	PWK

BORING CONTRACTOR: ADT		<h1>AECOM</h1>								SHEET 1 OF 2				
DRILLER: Chris Chaillou										PROJECT NAME: CHPE -				
SOILS ENGINEER/GEOLOGIST: Chris French										PROJECT NO.: 60323056				
		BORING LOG								HOLE NO.: CU-5A				
LOCATION: MP - 226.91 (CSX rail line)										START DATE: 2/4/21				
										FINISH DATE: 2/4/21				
										OFFSET: N/A				
GROUND WATER OBSERVATIONS				CASING		SAMPLER		DRILL BIT		CORE BARREL				
Water at 25' (inferred)		TYPE		Flush Joint Steel		California Modified		Tricone Roller Bit		DRILL RIG: CME LC-55				
		SIZE I.D.		4"		2.5"		--		BORING TYPE: SPT				
		SIZE O.D.		4.5"		3"		3 7/8"		BORING O.D.: 4.5"				
		HAMMER WT.		140 lbs		140 lbs				SURFACE ELEV.:				
		HAMMER FALL		30"		30"				LONGITUDE:				
										LATITUDE:				
DEPTH	CORING RATE MIN/FT	S A M P L E		HAMMER FALL		BLOWS PER 6 in ON SAMPLER (ROCK QUALITY DESIGNATION)				N Corr. ⁽²⁾	USCS CLASS.	STRAT. CHNG. DEPTH	FIELD IDENTIFICATION OF SOILS	
		DEPTHS FROM - TO (FEET)	TYPE AND NO.	PEN. in	REC. in									
1.0		0'-5'				Hand Cleared						SAND & GRAVEL	Black fine-coarse SAND, little subrounded gravel, trace silt; loose, moist	
2.0														
3.0														
4.0		3'-5'		S-1								SILT and CLAY	3.9'; Dark gray SILT and clay; medium stiff, moist TR-1; (3.0'-5.0')	
5.0														
6.0		5'-7'		S-2	24"	15"	3	8	11	15	12	ML	Brown SILT and clay; stiff, moist	
7.0												SILT and CLAY	Brown SILT and clay, trace fine-medium sand; very stiff, moist TR-2; (8.0'-8.5')	
8.0		7'-9'		S-3	24"	24"	11	15	21	22	23			ML
9.0												CL	Brown and gray CLAY and silt, trace fine sand; very stiff, moist	
10.0		9'-11'		S-4	24"	17"	6	10	12	16	14			
11.0												CL	Gray and brown CLAY and silt; stiff, moist TR-3; (12.0'-12.5')	
12.0		11'-13'		S-5	24"	18"	9	13	14	15	18			
13.0												CL	Gray silty CLAY; stiff, moist	
14.0		13'-15'		S-6	24"	21"	4	7	10	11	11			
15.0												CL	Gray silty CLAY; medium stiff, moist	
16.0		15'-17'		S-7	24"	24"	13	15	15	16	20			
17.0														
18.0														
19.0														
20.0														
NOTES: (1) Thick-wall ring lined drive sampler (California sampler) used for SPT samples. Rings dimensions = 2-1/2" O.D. by 2-7/16" I.D. by 6" length. (2) Correction factor: $N_{corr} = N \cdot \sqrt{(2.0^2 - 1.375^2) \ln. / (3.0^2 - 2.4^2) \ln.} = N \cdot 0.65$.											The information contained on this log is not warranted to show the actual subsurface condition. The contractor agrees that he will make no claims against AECOM if he finds that the actual conditions do not conform to those indicated by this log.			
Soil description represents a field identification after D.M. Burmister unless otherwise noted.														
SAMPLE TYPE:		S= SPLIT SPOON		U=SHELBY TUBE		R=ROCK CORE								
PROPORTIONS:		TRACE=1-10%		LITTLE=10-20%		SOME=20-35%		AND=35-50%						

BORING CONTRACTOR: ADT	<h1 style="margin: 0;">AECOM</h1>	SHEET 2 OF 2
DRILLER: Chris Chaillou		PROJECT NAME: CHPE -
SOILS ENGINEER: Chris French		PROJECT NO.: 60323056 HOLE NO.: CU-5A
BORING LOG		START DATE: 2/4/21 FINISH DATE: 2/4/21 OFFSET: N/A
LOCATION: MP - 226.91 (CSX rail line)		

DEPTH	CORING RATE MIN/FT	DEPTHS FROM - TO (FEET)	TYPE AND NO.	PEN. in	REC. in	BLOWS PER 6 in ON SAMPLER (ROCK QUALITY DESIGNATION)				N Corr.	USCS CLASS.	STRAT. CHNG. DEPTH	FIELD IDENTIFICATION OF SOILS
						3	6	9	12				
21.0		20'-22'	S-8	24"	24"	3	6	9	12	15	CL	Silty CLAY	Gray silty CLAY; medium stiff, moist
22.0													
23.0													
24.0													
25.0													
26.0		25'-27'	S-9	24"	24"	5	8	10	11	12	CL		SAA TR-4; (26.0'-26.5')
27.0													
28.0													
29.0													
30.0													
31.0		30'-32'	S-10	24"	24"	2	5	5	5	7	CH		Gray silty CLAY; soft, wet
32.0													
33.0													
34.0													
35.0													
36.0		35'-37'	S-11	24"	24"	WOH	WOH	2	5	1	CH		SAA
37.0													
38.0													
39.0		38'-40'	S-12	24"	24"	WOH	WOH	WOH	5		CH		Gray silty CLAY; very soft, wet TR-5; (39.0'-39.5')
40.0													
41.0													
42.0													
43.0													
44.0													
45.0													

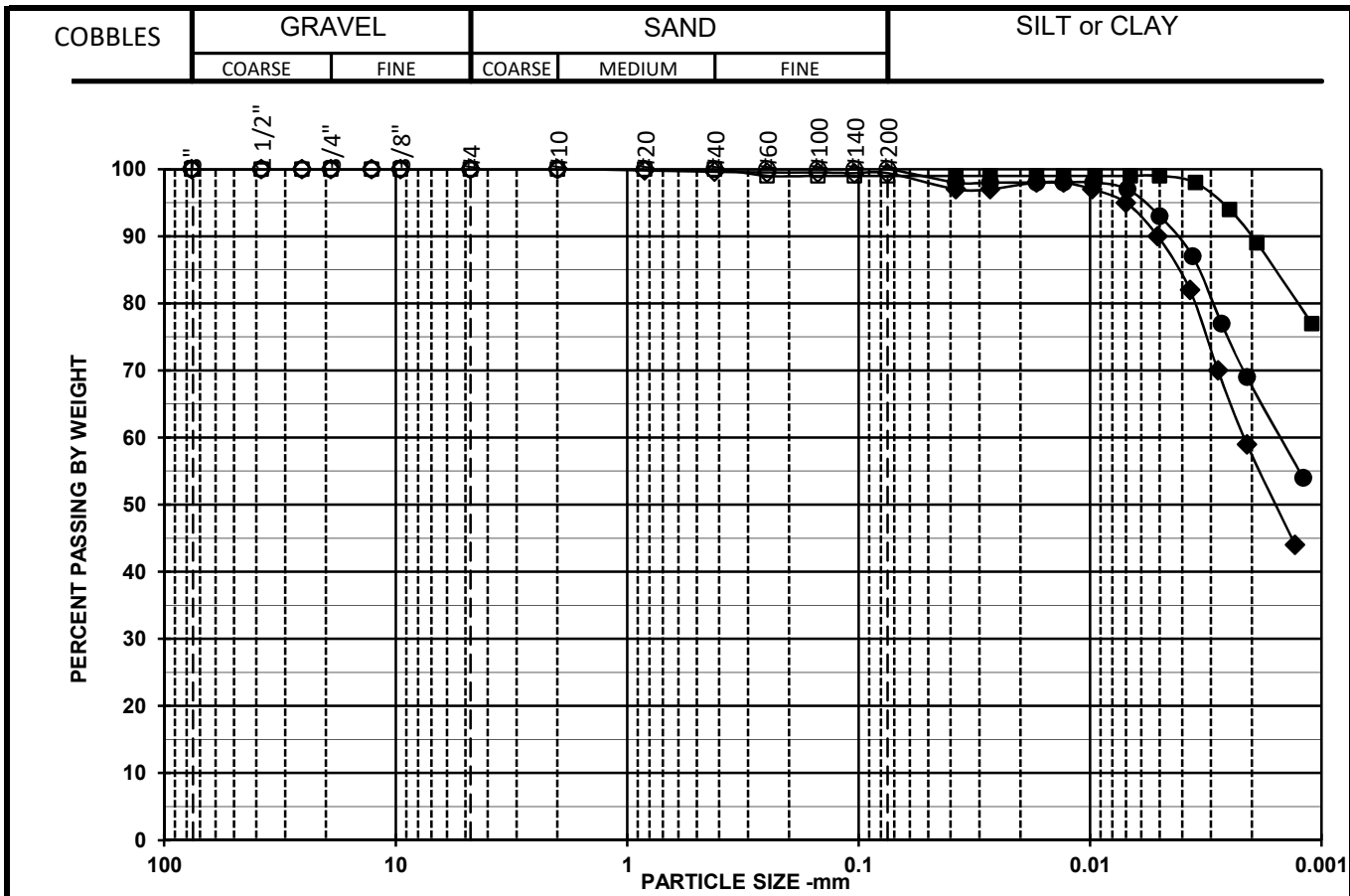
NOTES: Soil description represents a field identification after D.M. Burmister unless otherwise noted.	The information contained on this log is not warranted to show the actual subsurface condition. The contractor agrees that he will make no claims against AECOM if he finds that the actual conditions do not conform to those indicated by this log.
---	---

SAMPLE TYPE:	S= SPLIT SPOON	U=SHELBY TUBE	R=ROCK CORE
PROPORTIONS:	TRACE=1-10%	LITTLE=10-20%	SOME=20-35% AND=35-50%

Aquifer
CHPE - Catskill Upland Borings
LABORATORY SOIL TESTING DATA SUMMARY

BORING NO.	SAMPLE NO.	DEPTH (ft)	IDENTIFICATION TESTS							REMARKS
			WATER CONTENT (%)	LIQUID LIMIT (-)	PLASTIC LIMIT (-)	PLAS. INDEX (-)	USCS SYMB. (1)	SIEVE MINUS NO. 200 (%)	HYDROMETER % MINUS 2 μm (%)	
CU-1	S-3	7-9	7.5				SM	33	9	
CU-1	S-6	13-15	9.0				SM	16	4	
CU-2	S-2	5-7	22.1				SM	14	3	
CU-2	S-6	13-15	20.6	34	20	14	SC	45	14	
CU-2	S-11	35-37	7.0				SM	23	5	
CU-2A	S-6	15-17	59.4	53	23	30	CH	99	87	
CU-2A	S-9	30-32	35.4	37	20	17	CL	99.6	46	
CU-2A	S-14	55-57	25.1	28	17	11	CL	85	28	
CU-4	S-2	5-7	28.9	60	26	34	CH	95.7	77	
CU-4	S-4	9-11	33.0				GC	31	22	
CU-5A	S-4	9-11	33.7	64	25	39	CH	99	90	
CU-5A	S-8	20-22	29.8	59	25	34	CH	99.4	58	
CU-5A	S-11	35-37	37.8	48	23	25	CL	100	68	
CU-6	S-2	5-5.5	9.4				SM	20	7	
CU-6	S-5	11-13	9.8				SM	15	4	

Note: (1) USCS symbol based on visual observation and Sieve and Atterberg limits reported.



Open Symbols: Sieve analysis by ASTM D6913
 Filled symbols: Hydrometer analysis by ASTM D7928 corrected for complete sample

Symbol	□	◇	○
Boring	CU-5A	CU-5A	CU-5A
Sample	S-4	S-8	S-11
Depth	9-11	20-22	35-37
% +3"	0	0	0
% Gravel	0	0	0
% SAND	1	0.6	0
%C SAND	0	0	0
%M SAND	0	0.4	0
%F SAND	1	0.2	0
% FINES	99	99.4	100
D ₁₀₀ (mm)	4.75	2	0.075
D ₆₀ (mm)		0.002	0.002
D ₃₀ (mm)			
D ₁₀ (mm)			
Cc			
Cu			

Sieve	Percent Finer Data		
Size/ID #	□	◇	○
6"	100	100.0	100
4"	100	100.0	100
3"	100	100.0	100
1 1/2"	100	100.0	100
1"	100	100.0	100
3/4"	100	100.0	100
1/2"	100	100.0	100
3/8"	100	100.0	100
#4	100	100.0	100
#10	100	100.0	100
#20	100	99.8	100
#40	100	99.6	100
#60	99	99.5	100
#100	99	99.5	100
#140	99	99.4	100
#200	99	99.4	100
5µ m	99	90	93
2µ m	90	58	68
1µ m	75	36	49

SYMBOL	w (%)	LL	PL	PI	USCS	AASHTO	USCS DESCRIPTION AND REMARKS	DATE
□	33.7	64	25	39	CH		Gray, Fat clay	04/30/21
◇	29.8	59	25	34	CH		Gray, Fat clay	04/30/21
○	37.8	48	23	25	CL		Gray, Lean clay	04/30/21

Aquifer					CHPE - Catskill Upland Borings			
TerraSense, LLC #7853-21007								

PARTICLE SIZE DISTRIBUTION
ASTM D6913 & ASTM D7928

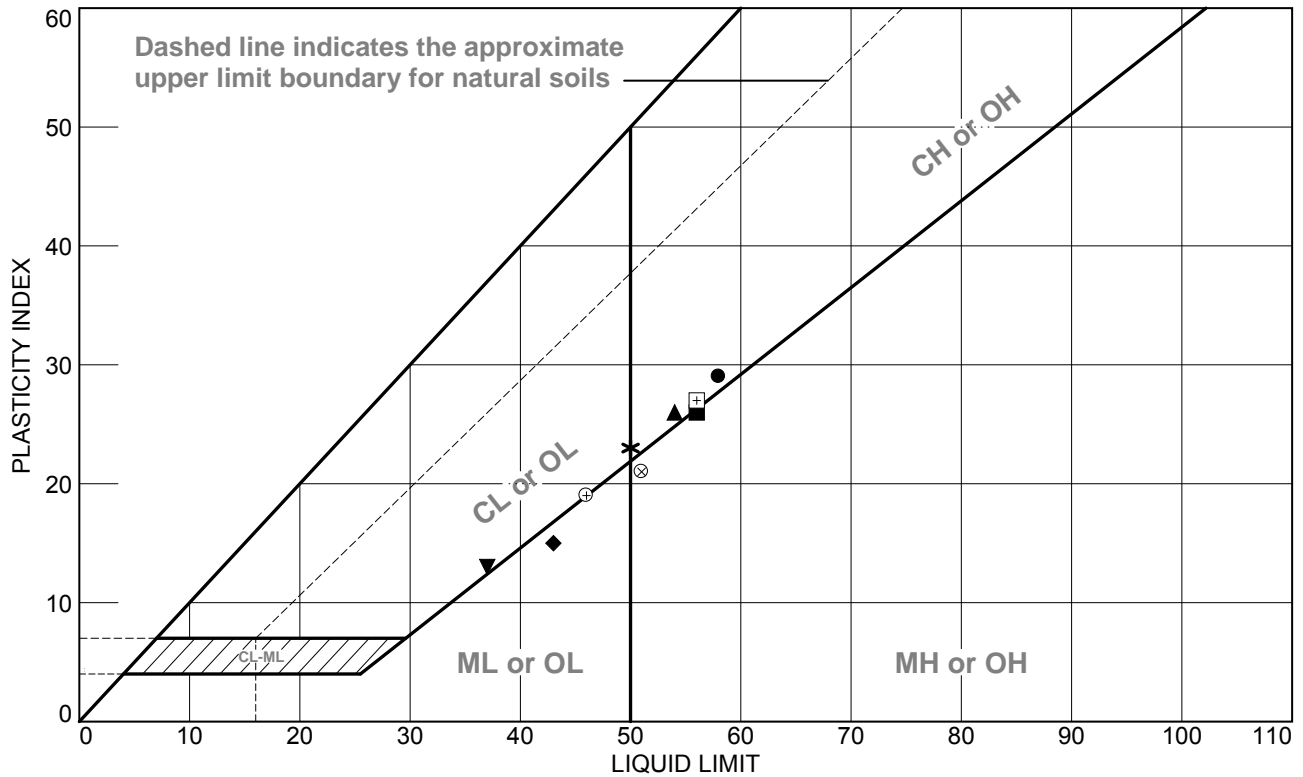


SUMMARY OF LABORATORY TEST DATA

Project Name: TDI Champlain Hudson Power Express – CSX
 Client Name: Transmission Developers, Inc.
 TRC Project #: 195651

SAMPLE IDENTIFICATION			Soil Group (USCS System)	GRAIN SIZE DISTRIBUTION				PLASTICITY				Specific Gravity	Moisture Content (%)	Unit Weight (pcf)	Compressive Strength (tsf)	Organic Content (%)
Boring #	Sample #	Depth (ft)		Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Liquidity Index					
	S-6	13.5-15.0	-	-	-	-	-	-	-	-	-	-	38.5	-	-	-
B226.6-1	S-2	2.0-4.0	-	-	-	-	-	-	-	-	-	-	29.5	-	-	-
	S-3	4.0-6.0	CH	-	-	-	-	56	29	27	0.3	-	38.8	-	-	-
	S-4	6.0-8.0		-	-	-	-	-	-	-	-	-	40.7	84.0	-	-
	S-5	8.0-10.0	-	-	-	-	-	-	-	-	-	-	53.7	-	-	-
	S-6	13.5-15.0	MH	-	-	-	-	51	30	21	1.1	-	53.7	-	-	-
	S-7	18.5-20.0		-	-	-	-	-	-	-	-	-	53.7	-	-	-
B227.1-1	S-2	2.0-4.0	-	-	-	-	-	-	-	-	-	-	36.0	-	-	-
	S-4	6.0-8.0	CH	0.0	2.7	1.0	96.3	57	30	27	0.3	2.81	38.2	-	-	-
	S-5	8.0-10.0		-	-	-	-	-	-	-	-	-	38.2	84.6	-	-
	S-7	18.5-20.0	-	-	-	-	-	-	-	-	-	-	35.3	-	-	-

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	B222.34-1	S-4	6.0-8.0 FT	35.2	29	58	29	CH
■	B222.34-1	S-6	13.5-15.0 FT	34.8	30	56	26	CH/MH
▲	B222.9-1	S-5	8.0-10.0 FT	33.4	28	54	26	CH
◆	B223.4-1	S-7	18.5-20.0 FT	31.6	28	43	15	ML
▼	B224.8-1	S-8 & S-9	23.5-30.0 FT	33.3	24	37	13	CL
*	B226.1-1	S-6	13.5-15.0 FT	36.9	27	50	23	CH
⊕	B226.1-1	S-8	23.5-25.0 FT	39.0	27	46	19	CL
⊞	B226.6-1	S-3 & S-4	4.0-8.0 FT	38.8	29	56	27	CH
⊗	B226.6-1	S-6 & S-7	13.5-20.0 FT	53.7	30	51	21	MH

**TRC
Engineers, Inc.
Mt. Laurel, NJ**

Client: TRANSMISSION DEVELOPERS INC.
Project: TDI CHAMPLAIN HUDSON POWER EXPRESS - CSX

Project No.: 195651

Figure 9

Legend Key

- Kiewit Borings (2022)
- Borings by Others





Kiewit

EXPLORATORY BORING LOG

Champlain Hudson Power Express
New York

BORING NO: K-226.7

PROJECT NUMBER 20001480
START DATE 03/09/2022
FINISH DATE 03/09/2022

LOGGED BY Rafael Salas Jr
DRILLER/RIG Corey B. / Diedrich D-90
DRILL CONTRACTOR Parratt Wolf

COORDINATES N 1211665.80
E 649663.36
GROUND ELEV. 110.9 ft
HAMMER TYPE/EFF. Manual - Safety

Depth (ft)	Elevation (ft)	Graphic Log	Material Description	Sample Type	Core Run No.	Recovery % RQD	Pocket Pen. (tsf)	Blow Counts (N Value)	Notes	Legend			
										▲ SPT N Value	● MC (%)	— PL & LL (%)	☒ Fines Content (%)
	108.9		FILL: CLAY (CL) with organics and gravel, medium to coarse, light to dark brown, angular to subangular, medium dense, moist			50%		2-4-4-8 (8)	Boring advanced with 3.5" ID HSA Water at around 1 ft from ground surface, likely from surface runoff. pH = 8.33, Resistivity = 1,071 ohm/cm, Chloride Content = 35 mg/kg, Sulfate = 700 mg/kg	▲			
	106.9		FILL: Silty GRAVEL (GM), some clay, dark brown to black, subangular to angular, medium to coarse, loose, wet			50%		8-5-4-4 (9)		▲			
5			CLAY (CH), light brown with gray seams, stiff, moist Very stiff			50%		6-5-6-9 (11)		▲ ●			
						92%		10-12-13-15 (25)		▲			
10			Rock stuck in shoe			92%		4-4-7-7 (11)		▲ ●	—	☒	
15	95.9		CLAY (CH), with Gravel, medium coarse, subangular, gray brown, firm, wet			0%		7-10-9-11 (19)	▲				
20						50%		4-5-7-7 (12)	▲				
25						100%	2.5	4-4-5-5		3-inch ring sampler	—	●	☒
30	80.9		Boring terminated at 30 ft					2-2-2-2 (4)	▲				



Kiewit

EXPLORATORY BORING LOG

Champlain Hudson Power Express
New York

BORING NO: K-226.8

PROJECT NUMBER 20001480
START DATE 03/08/2022
FINISH DATE 03/08/2022

LOGGED BY Rafael Salas Jr
DRILLER/RIG Corey B. / Diedrich D-90
DRILL CONTRACTOR Parratt Wolf

COORDINATES N 1210977.45
E 649510.63
GROUND ELEV. 108.5 ft
HAMMER TYPE/EFF. Manual - Safety

Depth (ft)	Elevation (ft)	Graphic Log	Material Description	Sample Type	Core Run No.	Recovery % RQD	Pocket Pen. (tsf)	Blow Counts (N Value)	Notes	Legend			
										▲ SPT N Value	● MC (%)	— PL & LL (%)	☒ Fines Content (%)
	106.5		FILL: SAND (SM) with Gravel, fine to medium coarse sand, coarse gravel, subangular to angular, dark brown to black, loose, wet			62%		5-4-3-3 (7)	Boring advanced with 3.5" ID HSA	▲			
	104.5		FILL: Silty GRAVEL (GM), black to dark brown, medium to coarse, angular to subangular, loose, moist			66%		2-4-4-6 (8)	Water present in upper 2 ft, no water beyond.	▲			
5			CLAY (CH) with Gravel, light gray brown, subangular to angular, coarse gravel, loose to medium dense, moist			71%		2-2-7-7 (9)		▲			
			with some gray sand, stiff, moist to dry			0%		6-8-13-14 (21)		▲			
10	98.5		CLAY (CH), light brown to gray, firm to soft, moist to wet			92%		2-5-9-8 (14)		▲	●	—	☒
15						71%		6-4-4-10 (8)		▲			
20						100%		3-2-2-3 (4)		▲			
25						100%	0.0	4-3-5-8	3-inch ring sampler		●	—	☒
30	78.5		Boring terminated at 30 ft			100%		1-2-3-4 (5)		▲			



Kiewit

EXPLORATORY BORING LOG

Champlain Hudson Power Express
New York

BORING NO: K-227.0

PROJECT NUMBER 20001480
START DATE 03/08/2022
FINISH DATE 03/08/2022

LOGGED BY Rafael Salas Jr
DRILLER/RIG Corey B. / Diedrich D-90
DRILL CONTRACTOR Parratt Wolf

COORDINATES N 1210143.14
E 649327.25
GROUND ELEV. 95.5 ft
HAMMER TYPE/EFF. Manual - Safety

Depth (ft)	Elevation (ft)	Graphic Log	Material Description	Sample Type	Core Run No.	Recovery % RQD	Pocket Pen. (tsf)	Blow Counts (N Value)	Notes	Legend			
										▲ SPT N Value	● MC (%)	— PL & LL (%)	☒ Fines Content (%)
93.5			FILL: Sandy CLAY (CL), with silt, dark brown to brown, firm, moist			58%		5-5-1-2 (6)	Boring advanced with 3.5" ID HSA	▲			
91.5			FILL: SILT (ML), with gravel and brick fragments, light brown and gray with red, 6 inches of brick, medium dense, dry			50%		11-6-6-6 (12)		▲			
89.5			FILL: Sandy CLAY (CL), brown, 4 inches of red brick, very stiff, dry			46%		8-11-15-7 (26)		●			
85.5			CLAY (CH), light brown with gray seams, organics, some gravel, coarse, subangular, stiff, dry Some silt and gravel, dark brown			50%		6-11-7-7 (18)		▲			
85.5			CLAY (CH), olive brown to light brown, stiff, dry			62%		2-3-7-3 (10)		▲	●	☒	
15			Blueish gray to light brown, firm			75%		2-5-8-9 (13)		▲			
20			Very stiff			84%		2-3-4-5 (7)		▲			
25			CLAY (CH), gray, firm, moist			100%		8-9-10-10	3-inch ring sampler		●	☒	
30			Boring terminated at 30 ft					2-3-3-2 (6)		▲			



ATLANTIC TESTING LABORATORIES

WBE certified company

LABORATORY DETERMINATION OF MOISTURE CONTENT OF SOILS

ASTM D 2216

Page 1 of 1

PROJECT INFORMATION

Client: Kiewit Infrastructure Co.
Project: Champlain Hudson Power Express
United Cable Installation
Various Locations, New York

ATL Report No.: CD10279E-08-03-22
Report Date: March 28, 2022
Date Received: March 18, 2022

TEST DATA

Boring No.	Sample No.	Depth (ft)	Moisture Content (%)
K-225.9	S-6	13-15	43.0
	S-9/10	28-30	48.0
K-226.2A	S-4	6-8	36.0
	S-6	13-15	33.8
	S-9/10	28-30	38.1
K-226.2B	S-5 ¹	8-10	7.7
	S-8/9	21-23	37.6
	S-12	33-35	37.8
K-226.7	S-5/6	4-6	34.5
	S-9/10	8-10	39.7
	S-15/16	23-25	55.6
K-226.8	S-7/8	8-10	36.2
	S-13/14	23-25	54.7
K-227.0	S-5/6 ¹	4-6	23.5
	S-9/10	8-10	33.3
	S-15/16	23-25	40.6

Remarks

1. Sample mass was less than the minimum mass outlined in the referenced test method.

Reviewed By:

Date: 03/28/22



ATLANTIC TESTING LABORATORIES

WBE certified company

AMOUNT OF MATERIAL IN SOILS FINER THAN THE NO. 200 SIEVE ASTM D 1140

PROJECT INFORMATION

Client: Kiewit Infrastructure Co.
Project: Champlain Hudson Power Express
United Cable Installation
Various Locations, New York

ATL Report No.: CD10279E-08-03-22
Report Date: March 28, 2022
Test Date: March 18, 2022
Performed By: M. White

TEST DATA

Boring No.	Sample No.	Depth (ft)	Method (A or B)	Soak Time (min)	Initial Dry Weight (g)	% Finer than #200
K-225.9	S-6	13-15	A	10	48.43	97.9
K-225.9	S-9/10	28-30	A	10	100.48	99.9
K-226.2A	S-6	13-15	A	10	62.57	98.3
K-226.2A	S-9/10	28-30	A	10	74.20	96.7
K-226.2B	S-8/9	21-23	A	10	95.42	99.9
K-226.2B	S-12	33-35	A	10	144.57	98.3
K-226.7	S-9/10	8-10	A	10	87.63	99.6
K-226.7	S-15/16	23-25	A	10	52.32	99.9
K-226.8	S-7/8	8-10	A	10	92.92	100.0
K-226.8	S-13/14	23-25	A	10	59.61	100.0
K-227.0	S-9/10	8-10	A	10	180.64	54.8
K-227.0	S-15/16	23-25	A	10	87.65	99.8

Reviewed By: _____

Date: 03/28/22



ATLANTIC TESTING LABORATORIES

WBE certified company

LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOIL ASTM D 4318

PROJECT INFORMATION

Client: Kiewit Infrastructure Co.
Project: Champlain Hudson Power Express
United Cable Installation
Various Locations, New York

ATL Report No.: CD10279E-08-03-22
Report Date: March 28, 2022
Date Received: March 18, 2022

TEST DATA

Boring No.	Sample No.	LL	PL	PI
K-225.9	S-6	58	24	34
K-225.9	S-9/10	37	21	16
K-226.2A	S-6	61	25	36
K-226.2A	S-9/10	61	26	35
K-226.2B	S-8/9	62	26	36
K-226.2B	S-12	50	24	26
K-226.7	S-9/10	65	27	38
K-226.7	S-15/16	59	26	33
K-226.8	S-7/8	63	26	37
K-226.8	S-13/14	52	23	29
K-227.0	S-9/10	54	26	28
K-227.0	S-15/16	57	24	33

SAMPLE INFORMATION

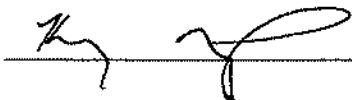
Boring No.	Sample No.	Maximum Grain Size (mm)	Estimated Amount of Sample Retained on No. 40 Sieve (%)	As Received Moisture Content (%)
K-225.9	S-6	0.074	0	43.0
K-225.9	S-9/10	0.050	0	48.0
K-226.2A	S-6	0.074	0	33.8
K-226.2A	S-9/10	0.074	0	38.1
K-226.2B	S-8/9	0.050	0	37.6
K-226.2B	S-12	0.074	0	37.8
K-226.7	S-9/10	0.050	0	39.7
K-226.7	S-15/16	0.050	0	55.6
K-226.8	S-7/8	0.050	0	36.2
K-226.8	S-13/14	0.050	0	54.7
K-227.0	S-9/10	4.76	6	33.3
K-227.0	S-15/16	0.050	0	40.6

PREPARATION INFORMATION

Boring No.	Sample No.	Preparation	Method of Removing Oversized Material
K-225.9	S-6	Air Dry	Not Necessary
K-225.9	S-9/10	Air Dry	Not Necessary
K-226.2A	S-6	Air Dry	Not Necessary
K-226.2A	S-9/10	Air Dry	Not Necessary
K-226.2B	S-8/9	Air Dry	Not Necessary
K-226.2B	S-12	Air Dry	Not Necessary
K-226.7	S-9/10	Air Dry	Not Necessary
K-226.7	S-15/16	Air Dry	Not Necessary
K-226.8	S-7/8	Air Dry	Not Necessary
K-226.8	S-13/14	Air Dry	Not Necessary
K-227.0	S-9/10	Air Dry	Pulverizing and Screening
K-227.0	S-15/16	Air Dry	Not Necessary

EQUIPMENT INFORMATION

Liquid Limit Procedure:	Multipoint - Method A	<input checked="" type="checkbox"/>	Single Point - Method B	<input type="checkbox"/>
Liquid Limit Apparatus:	Manual	<input checked="" type="checkbox"/>	Motor Driven	<input type="checkbox"/>
Liquid Limit Grooving Tool Material:	Plastic	<input checked="" type="checkbox"/>	Metal	<input type="checkbox"/>
Liquid Limit Grooving Tool Shape:	Flat	<input checked="" type="checkbox"/>	Curved (AASHTO Only)	<input type="checkbox"/>
Plastic Limit:	Hand Rolled	<input checked="" type="checkbox"/>	Mechanical Rolling Device	<input type="checkbox"/>

Reviewed By:  _____

Date: 03/28/22



ATLANTIC TESTING LABORATORIES

CORROSION ANALYSIS SUITE

Client: Kiewit Infrastructure Co.
Project: Champlain Hudson Power Express
 United Cable Installation
Location: Various Locations, New York

ATL Report No. CD10279E-08-03-22
Report Date: March 28, 2022
Date Received: March 18, 2022

Sample: K-226.7, S-5/6

Depth (ft): 4-6

**MEASURING pH OF SOIL FOR USE IN CORROSION TESTING
 ASTM G 51**

Type of Test	Soil Temperature (°C)	pH Readings			Average
Laboratory	20.0	8.37	8.32	8.31	8.33

pH of calibration standards used: 7.00

**MEASUREMENT OF SOIL RESISTIVITY USING THE TWO-ELECTRODE SOIL BOX METHOD
 ASTM G 187 (LABORATORY)**

Test Date: 03/22/22
Meter Used: Miller 400A

Performed by: E. Hannon
Soil Box Factor: 1.29

Date Collected	Temperature at Collection (°C)	Measured Resistance (Ω)	Calculated Resistivity (Ω/cm)
10/19/2021	Not Provided	830	1,071


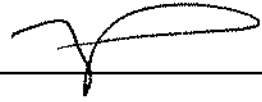
**WATER-SOLUBLE CHLORIDE ION CONTENT IN SOIL
 AASHTO T 291, Method A**

Chloride by Mass of Soil (mg/kg)
35

**WATER-SOLUBLE SULFATE IN SOIL
 ASTM C 1580**

Sulfate by Mass of Sample (%)	Sulfate by Mass of Sample (mg/kg)
0.07	700

Reviewed By:

Date:

03/28/22

Legend Key

- Kiewit Borings (Phase 3)





Kiewit

EXPLORATORY BORING LOG

Champlain Hudson Power Express
New York

BORING NO: KB-226.8A

PROJECT NUMBER 20001480
START DATE 08/31/2022
FINISH DATE 08/31/2022

LOGGED BY Rafael Salas
DRILLER/RIG C. Brown / CME-850
DRILL CONTRACTOR Parratt Wolf

COORDINATES N 1211213.00
E 649563.70
GROUND ELEV. 108.9 ft
HAMMER TYPE/EFF. Automatic

Depth (ft)	Elevation (ft)	Graphic Log	Material Description	Sample Type	Core Run No.	Recovery % RQD	Pocket Pen. (tsf)	Blow Counts (N Value)	Notes	Legend			
										SPT N Value	MC (%)	PL & LL (%)	Fines Content (%)
			FILL: Silty GRAVEL with railroad ballast (GM), dark gray, loose, fine to coarse, moist, subangular to subrounded			46%		1-2-3-4 (5)	Boring advanced with 3.25" ID HSA	▲			
	105.9		Silty CLAY (CL-ML), light gray, firm, moist			50%		5-3-3-3 (6)		▲			
	104.9		SILT (MH), olive brown and gray, very stiff to firm, high plasticity, moist			50%		2-4-7-6 (11)		▲	●		☒
5						100%		7-9-7-10 (16)		▲			
			2" gravel seam, fine to medium grained, subangular to subrounded, at 11.0- 11.2 ft			100%		3-5-6-9 (11)		▲			
						100%		2-3-4-4 (7)		▲			
15	93.9		CLAY (CH), medium to high plasticity, dark gray, stiff, moist			100%		4-4-5-6 (9)		▲			
20			Firm below 20 ft			100%		3-2-3-3 (5)		▲	●		☒
25	83.9		SILT (MH), dark gray, very soft, moist			100%		0-0-1-2 (1)		▲			
30						100%		0-0-0-1 (0)		▲			



Kiewit

EXPLORATORY BORING LOG

Champlain Hudson Power Express
New York

BORING NO: KB-226.8A

PROJECT NUMBER 20001480
START DATE 08/31/2022
FINISH DATE 08/31/2022

LOGGED BY Rafael Salas
DRILLER/RIG C. Brown / CME-850
DRILL CONTRACTOR Parratt Wolf

COORDINATES N 1211213.00
E 649563.70
GROUND ELEV. 108.9 ft
HAMMER TYPE/EFF. Automatic

Depth (ft)	Elevation (ft)	Graphic Log	Material Description	Sample Type	Core Run No.	Recovery % RQD	Pocket Pen. (tsf)	Blow Counts (N Value)	Notes	Legend				
										SPT N Value	MC (%)	PL & LL (%)	Fines Content (%)	
			SILT (MH), dark gray, very soft, moist								20	40	60	80
				X		100%		0-0-0-2 (0)						
40				X		100%		0-0-0-1 (0)						
45				X		100%		4-4-4-5	3-inch ring sampler					
50				X		100%		0-0-0-0 (0)	WOH					
55				X		100%		0-0-0-0 (0)	WOH					
60	48.9		Boring Terminated at 60 ft	X		100%		0-0-0-3 (0)						
65														
70														

Summary of Laboratory Results

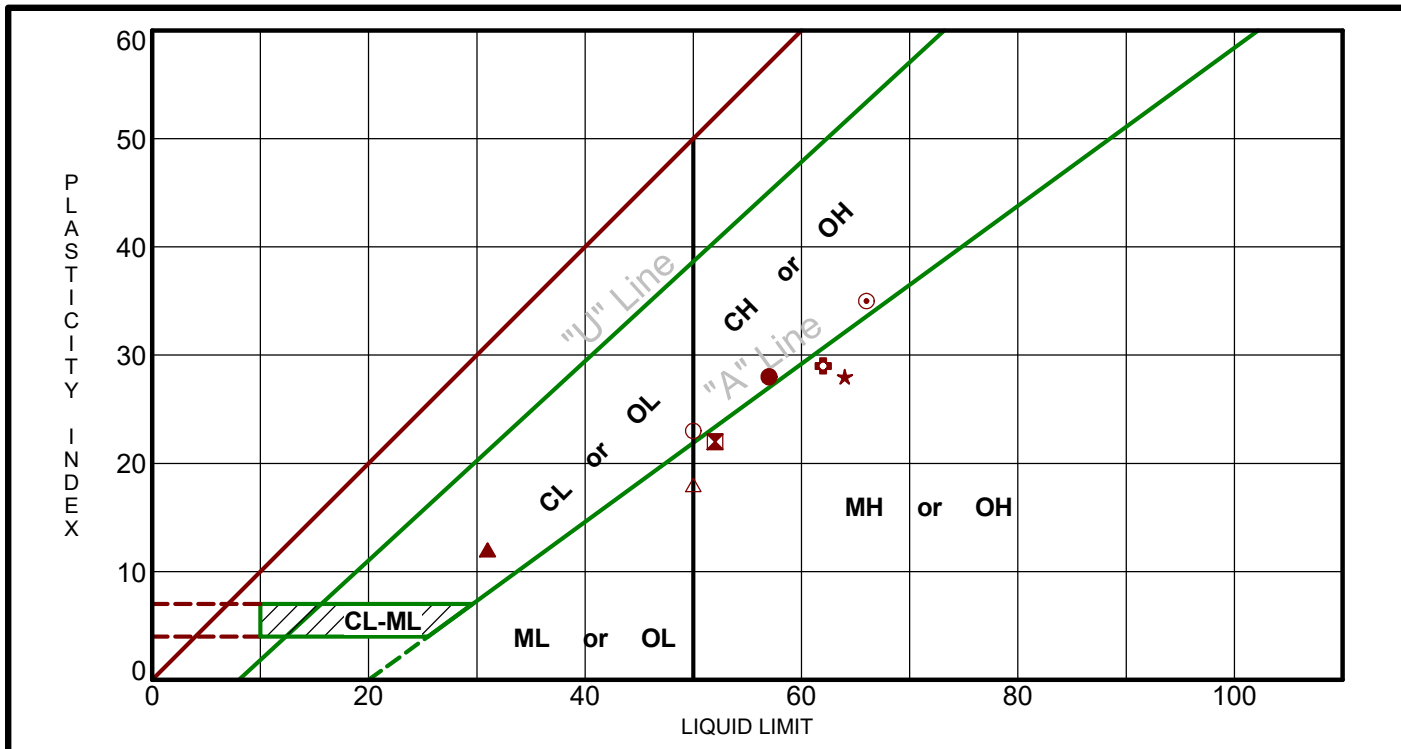
BORING ID	Depth (Ft.)	Water Content (%)
KB-222.6A	15-17	1.2
KB-222.6A	35-37	35.8
KB-222.6A	50-52	41.7
KB-222.6A	65-67	38.4
KB-223.1A	6-8	31.3
KB-223.1A	25-27	39.6
KB-223.1A	45-47	22.0
KB-226.1	6-8	33.3
KB-226.1	20-22	37.7
KB-226.8A	4-6	35.5
KB-226.8A	20-22	37.4
KB-226.8A	38-40	46.7

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. SMART LAB SUMMARY-PORTRAIT_JB215256H LAB TESTING.GPJ TERRACON_DATATEMPLATE.GDT 11/16/22

PROJECT: LAB Testing	 <p>30 Corporate Cir Ste 201 Albany, NY</p>	PROJECT NUMBER: JB215256H
SITE: Champlain- Hudson Power Express		CLIENT: Kiewit Engineering (NY) Corp Lone Tree, CO
		EXHIBIT: B-2

ATTERBERG LIMITS RESULTS

ASTM D4318



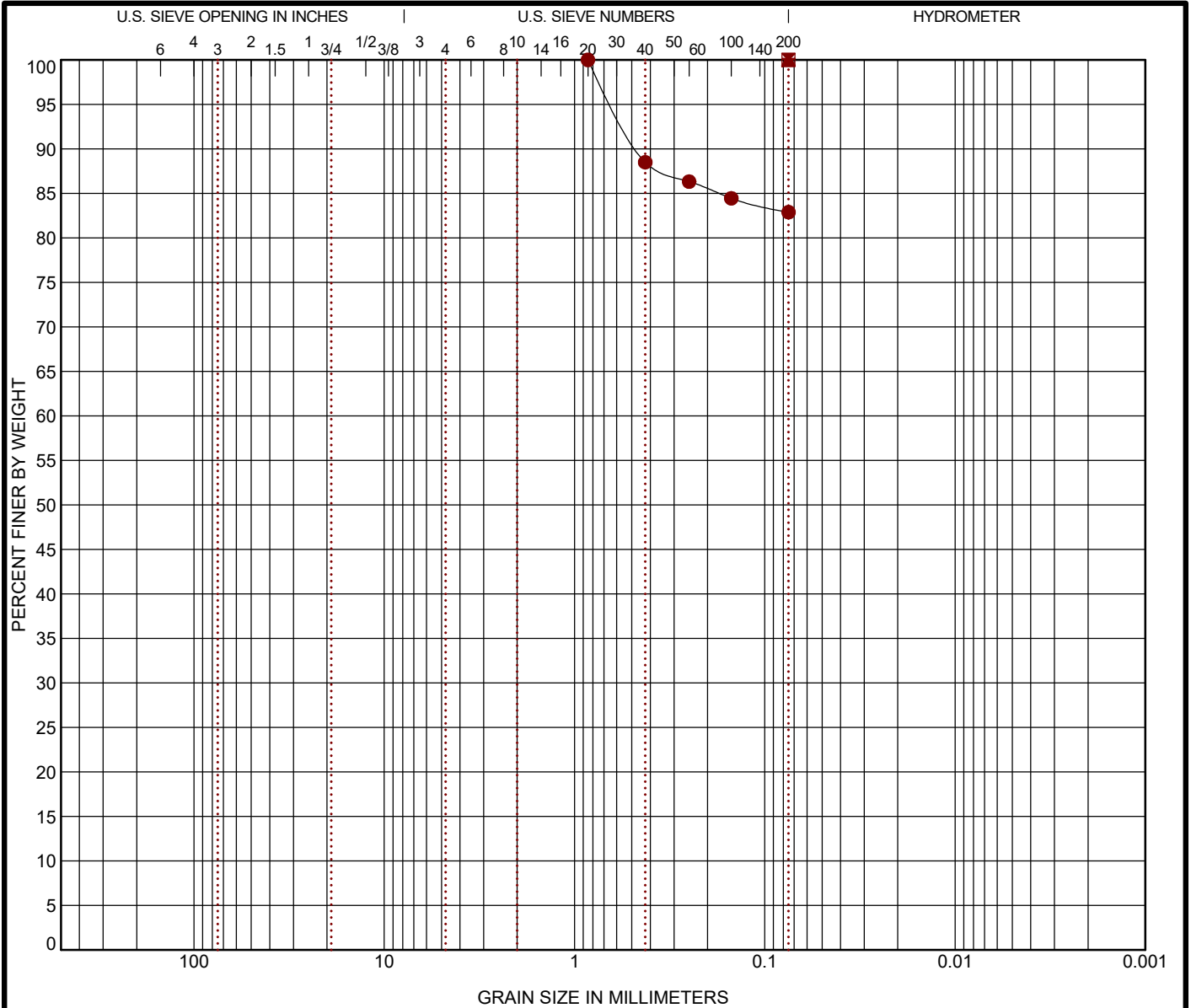
LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. ATTERBERG LIMITS JB215256H LAB TESTING.GPJ TERRACON_DATATEMPLATE.GDT 11/16/22

Boring ID	Depth (Ft)	LL	PL	PI	Fines	USCS	Description
● KB-223.1A	6 - 8	57	29	28	93.6	CH	FAT CLAY
⊠ KB-223.1A	25 - 27	52	30	22	96.6	MH	ELASTIC SILT
▲ KB-223.1A	45 - 47	31	19	12	56.8	CL	SANDY LEAN CLAY
★ KB-226.1	6 - 8	64	36	28	75.0	MH	ELASTIC SILT with SAND
⊙ KB-226.1	20 - 22	66	31	35	82.9	CH	FAT CLAY with SAND
⊕ KB-226.8A	4 - 6	62	33	29	100.0	MH	ELASTIC SILT
○ KB-226.8A	20 - 22	50	27	23	100.0	CH	FAT CLAY
△ KB-226.8A	38 - 40	50	32	18	100.0	MH	ELASTIC SILT

PROJECT: LAB Testing	<p style="font-size: small;">30 Corporate Cir Ste 201 Albany, NY</p>	PROJECT NUMBER: JB215256H
SITE: Champlain- Hudson Power Express		CLIENT: Kiewit Engineering (NY) Corp Lone Tree, CO
		EXHIBIT: B-3

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Boring ID	Depth (Ft)	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
● KB-226.1	20 - 22	FAT CLAY with SAND (CH)	37.7	66	31	35		
☒ KB-226.8A	4 - 6	ELASTIC SILT (MH)	35.5	62	33	29		
▲ KB-226.8A	20 - 22	FAT CLAY (CH)	37.4	50	27	23		
★ KB-226.8A	38 - 40	ELASTIC SILT (MH)	46.7	50	32	18		

Boring ID	Depth (Ft)	D ₁₀₀	D ₆₀	D ₃₀	D ₁₀	%Cobbles	%Gravel	%Sand	%Silt	%Fines	%Clay
● KB-226.1	20 - 22	0.85				0.0	0.0	17.1		82.9	
☒ KB-226.8A	4 - 6	0.075				0.0	0.0	0.0		100.0	
▲ KB-226.8A	20 - 22	0.075				0.0	0.0	0.0		100.0	
★ KB-226.8A	38 - 40	0.075				0.0	0.0	0.0		100.0	

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 JB215256H LAB TESTING.GPJ TERRACON_DATATEMPLATE.GDT 11/16/22

PROJECT: LAB Testing

SITE: Champlain- Hudson Power Express



PROJECT NUMBER: JB215256H

CLIENT: Kiewit Engineering (NY) Corp
Lone Tree, CO

EXHIBIT: B-11

Appendix C

BoreAid HDD Simulation Output



Generated Output



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Project Summary

General:

Kiewit - CHPE
Ref: New York
204-3701
Start Date: 04-29-2022
End Date: 03-17-2023

Designer:

Aaron Coady
Tetra Tech Rooney
115 Inverness Drive East, Suite 300
Englewood, Colorado
United States 80112
aaron.coady@tetrattech.com

Description:

Segment 11 (Package 7A)
Conduit 1
HDD 111.B
DWG C-311.B

Input Summary

Start Coordinate	(0.00, 0.00, 113.48) ft
End Coordinate	(765.00, 0.00, 120.84) ft
Project Length	765.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 8

Soil Layer #1 USCS, Sand (S), SP

Depth: 5.00 ft

Unit Weight: 14.6454 (dry), 16.9323 (sat) [lb/US (liquid) gallon]

Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Silt (M), ML

Depth: 4.00 ft

Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #3 USCS, Sand (S), SM

Depth: 4.00 ft

Unit Weight: 15.6618 (dry), 17.7639 (sat) [lb/US (liquid) gallon]

Phi: 30.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #4 USCS, Silt (M), ML

Depth: 3.00 ft

Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #5 Rock, Geological Classification, Sedimentary Rocks

Depth: 9.00 ft

Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]

Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Soil Layer #6 USCS, Gravel (G), GM

Depth: 7.00 ft

Unit Weight: 16.9785 (dry), 18.6879 (sat) [lb/US (liquid) gallon]

Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #7 Rock, Geological Classification, Sedimentary Rocks

Depth: 8.00 ft

Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]

Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

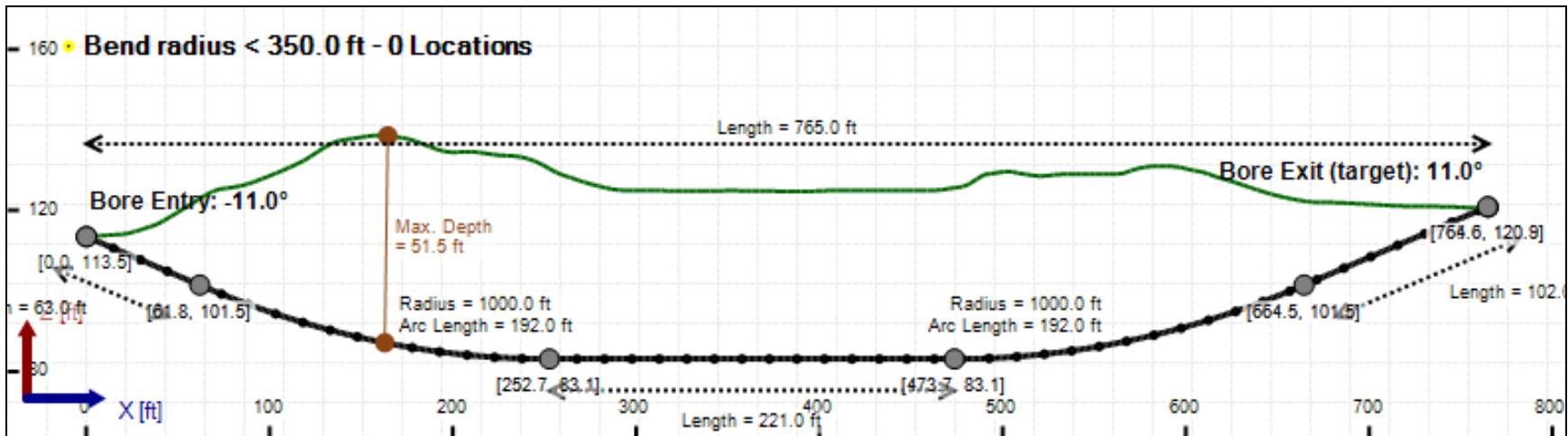
Soil Layer #8 Rock, Geological Classification, Sedimentary Rocks

Depth: 6.00 ft

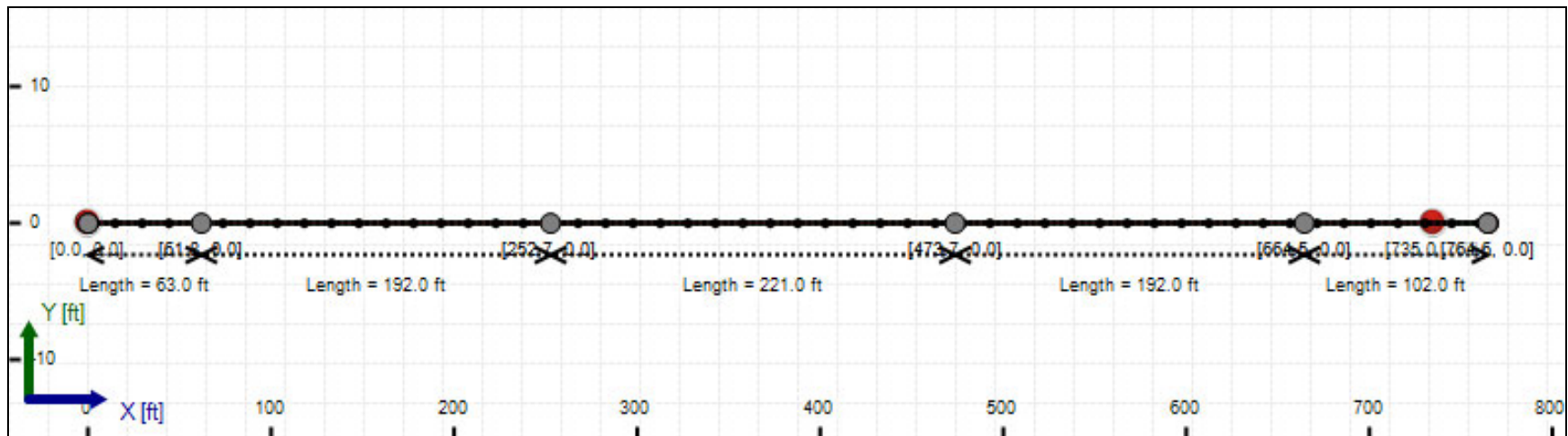
Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]

Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 10" (10.75")
Pipe DR: 9
Pipe Length: 780.00 ft
Internal Pressure: 0 psi
Borehole Diameter: 1.34400002161662 ft
Silo Width: 1.34400002161662 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 7.92790 lb/US (liquid) gallon
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 12.51801 lb/US (liquid) gallon
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	5.8	39.6
Water Pressure	0.0	0.0
Surface Surge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	5.8	39.6
Deflection		
Earth Load Deflection	1.569	10.781
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.701	10.913
Compressive Stress [psi]		
Compressive Wall Stress	25.9	178.1

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	13674.3	13674.3
Pullback Stress [psi]	381.4	381.4
Pullback Strain	6.632E-3	6.632E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	381.4	405.6
Tensile Strain	6.632E-3	7.502E-3

Net External Pressure = 23.5 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.701	7.5	4.4	OK
Unconstrained Collapse [psi]	25.8	118.6	4.6	OK
Compressive Wall Stress [psi]	25.9	1150.0	44.3	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	35.8	232.9	6.5	OK
Tensile Stress [psi]	405.6	1200.0	3.0	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	443.972 psi	1333.894 psi
1	8.00 in	12.00 in	443.901 psi	1333.740 psi
2	12.00 in	16.13 in	443.799 psi	1333.516 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 200.00 US (liquid) gallon/min

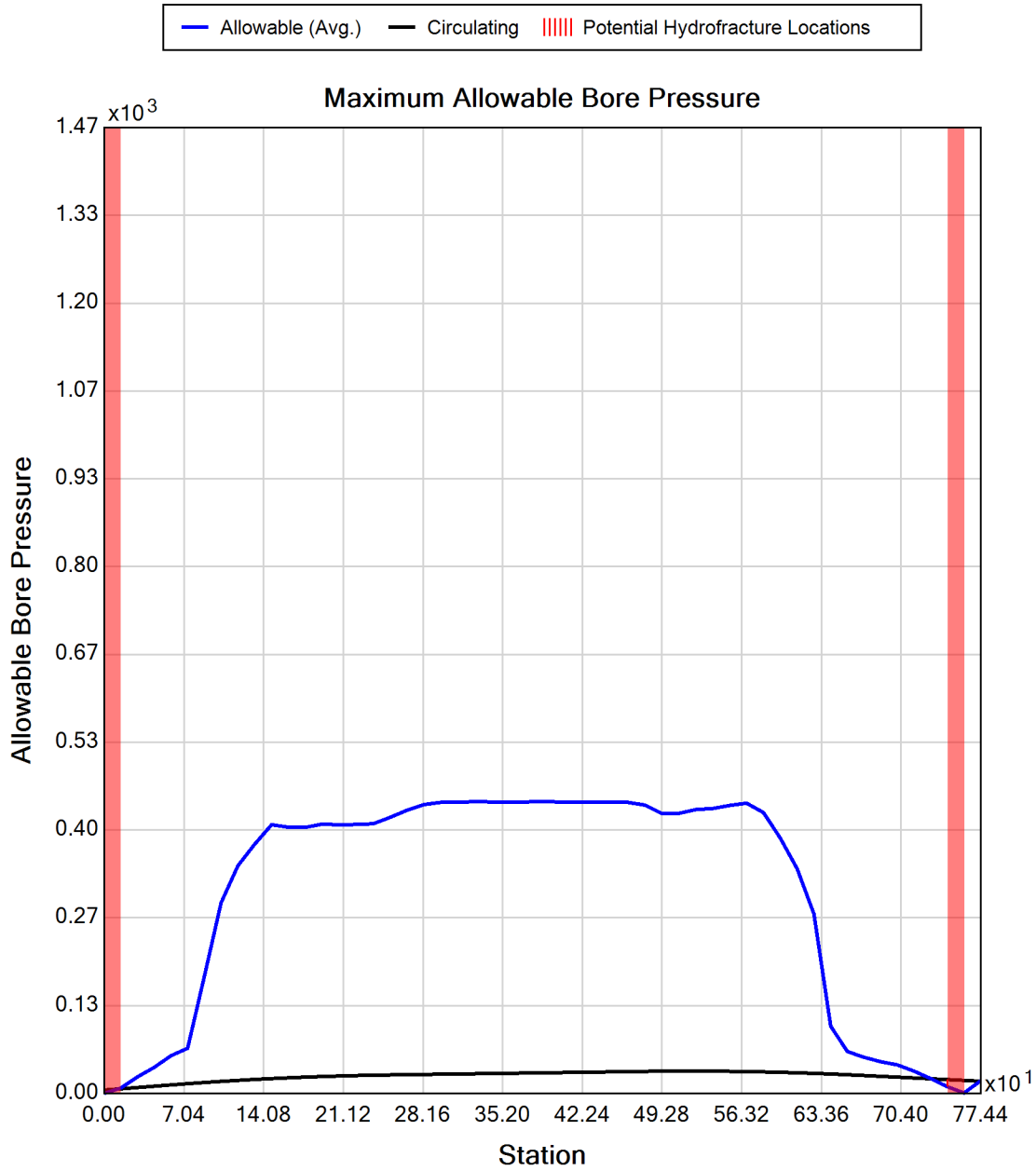
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 260.8





Generated Output



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Project Summary

General:

Kiewit - CHPE
Ref: New York
204-3701
Start Date: 04-29-2022
End Date: 03-17-2023

Designer:

Aaron Coady
Tetra Tech Rooney
115 Inverness Drive East, Suite 300
Englewood, Colorado
United States 80112
aaron.coady@tetrattech.com

Description:

Segment 11 (Package 7A)
Conduit 2
HDD 111.B
DWG C-311.B.2

Input Summary

Start Coordinate	(0.00, 0.00, 112.32) ft
End Coordinate	(765.00, 0.00, 120.00) ft
Project Length	765.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 8

Soil Layer #1 USCS, Sand (S), SP

Depth: 5.00 ft

Unit Weight: 14.6454 (dry), 16.9323 (sat) [lb/US (liquid) gallon]

Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Silt (M), ML

Depth: 4.00 ft

Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #3 USCS, Sand (S), SM

Depth: 4.00 ft

Unit Weight: 15.6618 (dry), 17.7639 (sat) [lb/US (liquid) gallon]

Phi: 30.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #4 USCS, Silt (M), ML

Depth: 3.00 ft

Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #5 Rock, Geological Classification, Sedimentary Rocks

Depth: 9.00 ft

Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]

Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Soil Layer #6 USCS, Gravel (G), GM

Depth: 7.00 ft

Unit Weight: 16.9785 (dry), 18.6879 (sat) [lb/US (liquid) gallon]

Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #7 Rock, Geological Classification, Sedimentary Rocks

Depth: 8.00 ft

Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]

Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

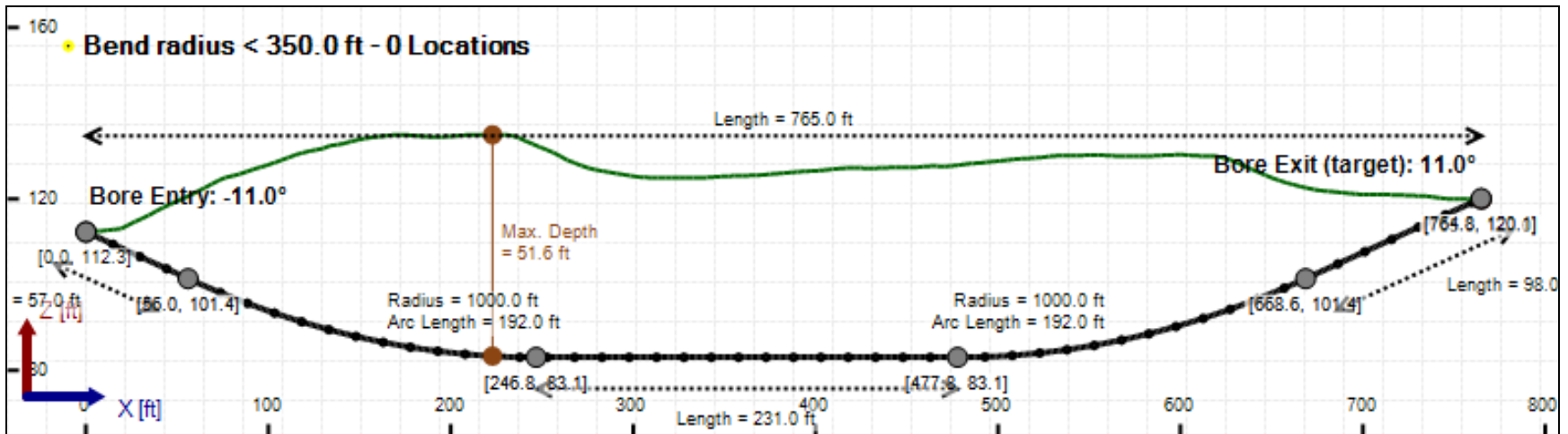
Soil Layer #8 Rock, Geological Classification, Sedimentary Rocks

Depth: 6.00 ft

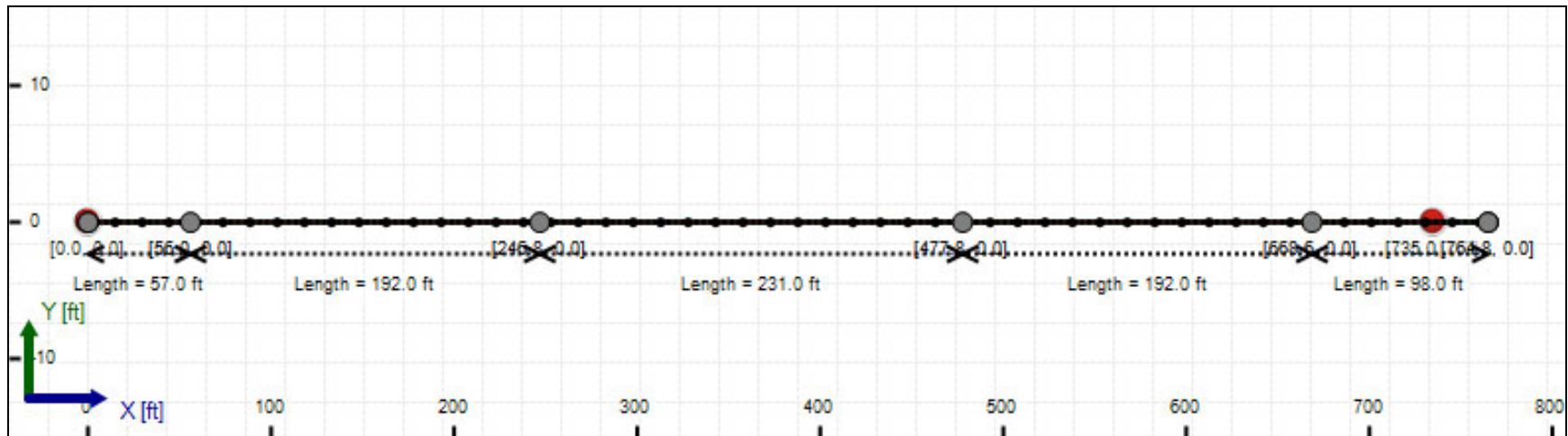
Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]

Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 10" (10.75")
Pipe DR: 9
Pipe Length: 780.00 ft
Internal Pressure: 0 psi
Borehole Diameter: 1.34400002161662 ft
Silo Width: 1.34400002161662 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 7.92790 lb/US (liquid) gallon
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 12.51801 lb/US (liquid) gallon
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	5.7	39.8
Water Pressure	0.0	0.0
Surface Surge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	5.7	39.8
Deflection		
Earth Load Deflection	1.563	10.827
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.695	10.959
Compressive Stress [psi]		
Compressive Wall Stress	25.8	178.9

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	13656.8	13656.8
Pullback Stress [psi]	380.9	380.9
Pullback Strain	6.624E-3	6.624E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	380.9	406.2
Tensile Strain	6.624E-3	7.512E-3

Net External Pressure = 21.9 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.695	7.5	4.4	OK
Unconstrained Collapse [psi]	25.4	118.6	4.7	OK
Compressive Wall Stress [psi]	25.8	1150.0	44.5	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	35.3	233.1	6.6	OK
Tensile Stress [psi]	406.2	1200.0	3.0	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	442.106 psi	1331.520 psi
1	8.00 in	12.00 in	442.037 psi	1331.339 psi
2	12.00 in	16.13 in	441.937 psi	1331.077 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 200.00 US (liquid) gallon/min

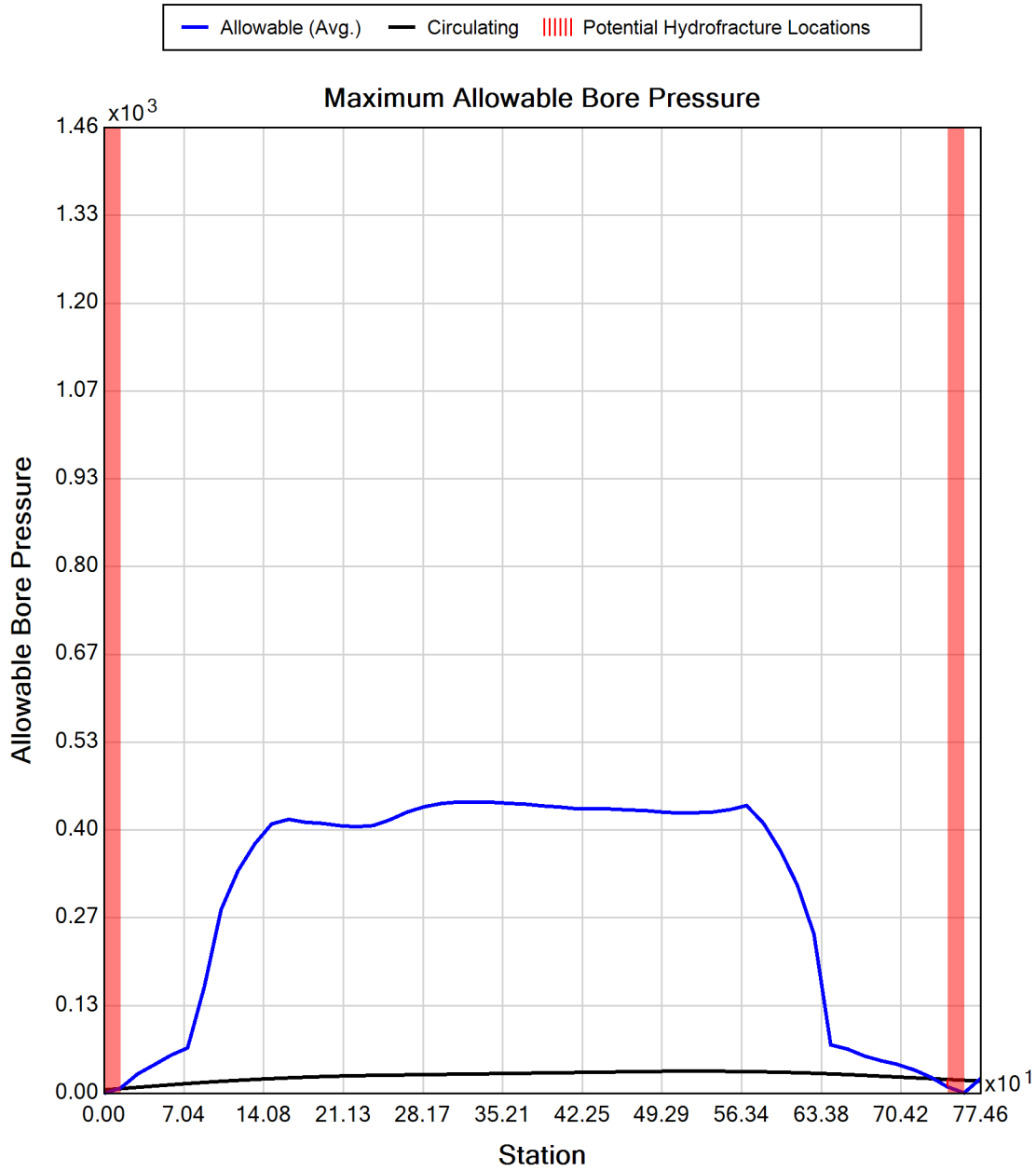
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 260.8





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Englewood, Colorado
United States 80112
aaron.coady@tetrattech.com

Description:

Segment 11 (Package 7A)
Conduit 3
HDD 111.B
DWG C-311.B.2

Input Summary

Start Coordinate	(0.00, 0.00, 112.32) ft
End Coordinate	(765.00, 0.00, 120.00) ft
Project Length	765.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	2.375 in
Pipe DR	7.0
Pipe Thickness	0.34 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 8

Soil Layer #1 USCS, Sand (S), SP

Depth: 5.00 ft

Unit Weight: 14.6454 (dry), 16.9323 (sat) [lb/US (liquid) gallon]

Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Silt (M), ML

Depth: 4.00 ft

Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #3 USCS, Sand (S), SM

Depth: 4.00 ft

Unit Weight: 15.6618 (dry), 17.7639 (sat) [lb/US (liquid) gallon]

Phi: 30.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #4 USCS, Silt (M), ML

Depth: 3.00 ft

Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #5 Rock, Geological Classification, Sedimentary Rocks

Depth: 9.00 ft

Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]

Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Soil Layer #6 USCS, Gravel (G), GM

Depth: 7.00 ft

Unit Weight: 16.9785 (dry), 18.6879 (sat) [lb/US (liquid) gallon]

Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #7 Rock, Geological Classification, Sedimentary Rocks

Depth: 8.00 ft

Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]

Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

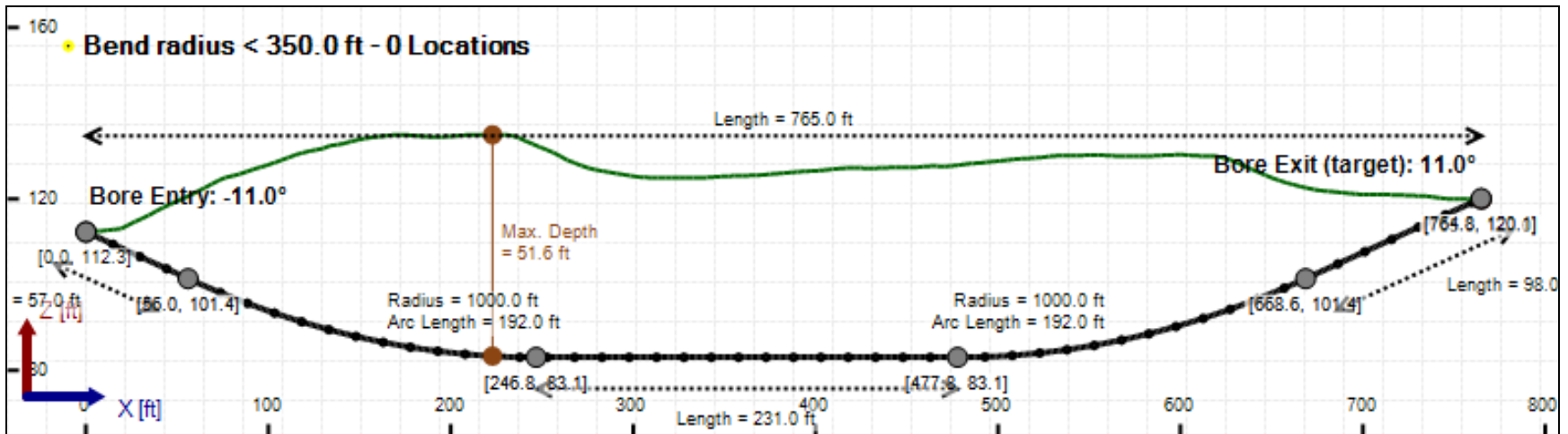
Soil Layer #8 Rock, Geological Classification, Sedimentary Rocks

Depth: 6.00 ft

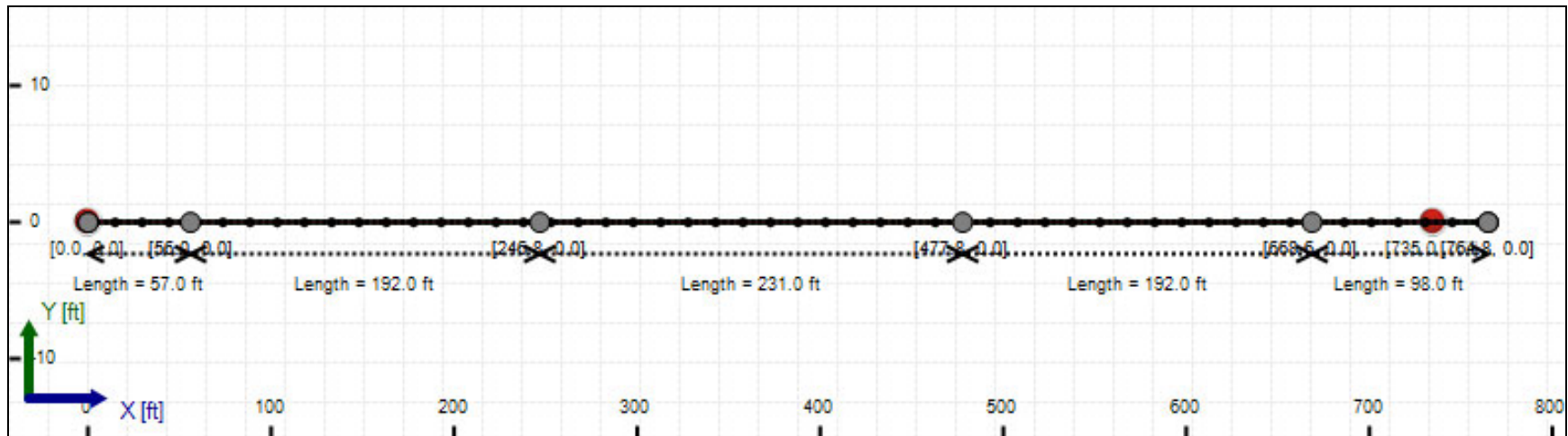
Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]

Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 2" (2.375")
Pipe DR: 7
Pipe Length: 780.00 ft
Internal Pressure: 0 psi
Borehole Diameter: 0.531000018119812 ft
Silo Width: 0.531000018119812 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 7.92790 lb/US (liquid) gallon
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 12.51801 lb/US (liquid) gallon
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	2.3	39.8
Water Pressure	0.0	0.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	2.3	39.8
Deflection		
Earth Load Deflection	0.261	4.568
Buoyant Deflection	0.014	0.014
Reissner Effect	0	0
Net Deflection	0.275	4.581
Compressive Stress [psi]		
Compressive Wall Stress	8.0	139.1

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	739.1	739.1
Pullback Stress [psi]	340.6	340.6
Pullback Strain	5.924E-3	5.924E-3
Bending Stress [psi]	5.7	5.7
Bending Strain	9.896E-5	9.896E-5
Tensile Stress [psi]	346.3	346.3
Tensile Strain	6.122E-3	6.122E-3

Net External Pressure = 23.8 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.275	7.5	27.3	OK
Unconstrained Collapse [psi]	25.4	319.4	12.6	OK
Compressive Wall Stress [psi]	8.0	1150.0	144.4	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.007	7.5	1114.2	OK
Unconstrained Collapse [psi]	35.3	561.6	15.9	OK
Tensile Stress [psi]	346.3	1200.0	3.5	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	442.106 psi	1331.520 psi
1	8.00 in	12.00 in	442.037 psi	1331.339 psi
2	12.00 in	16.13 in	441.937 psi	1331.077 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 200.00 US (liquid) gallon/min

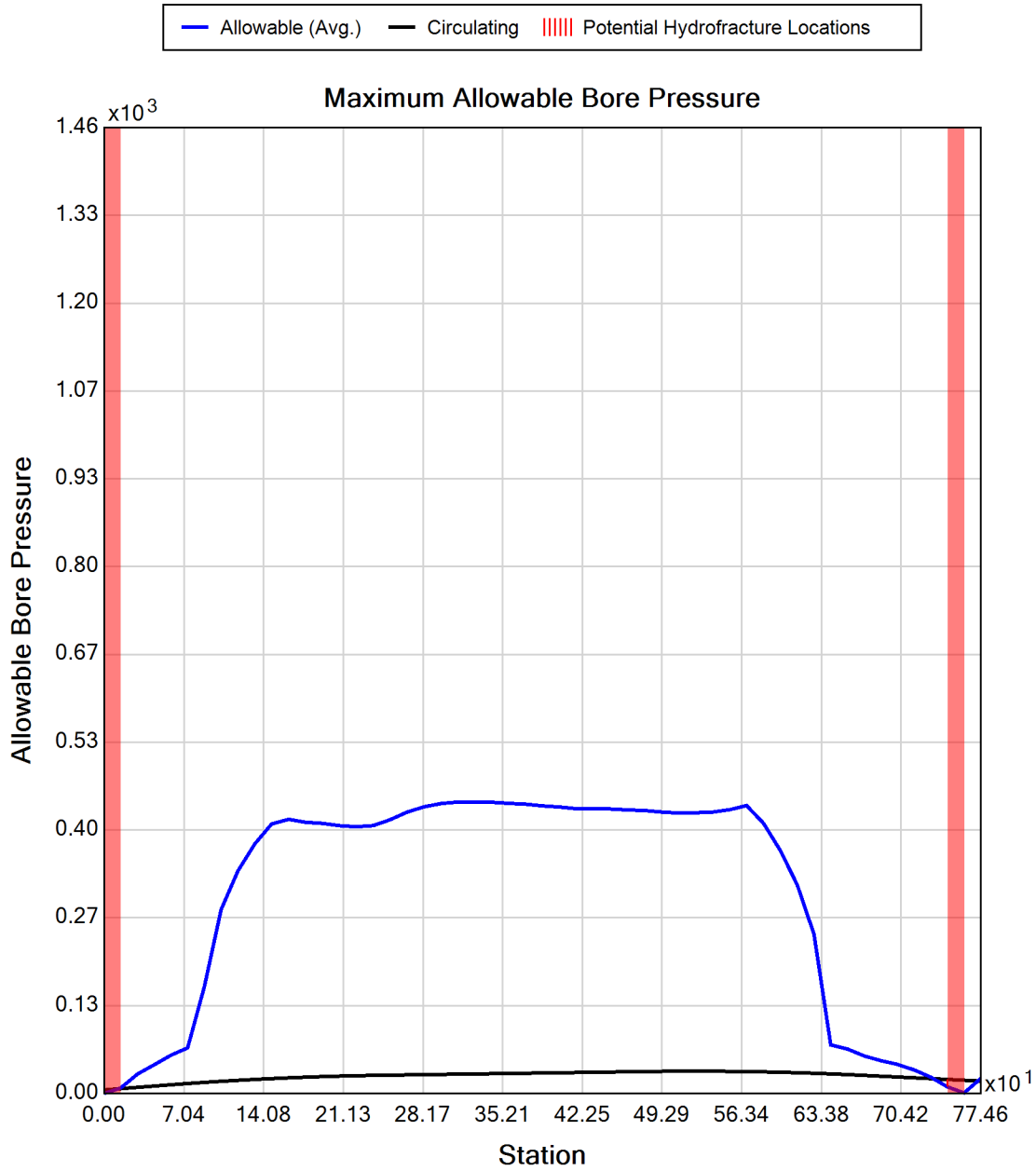
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 260.8





Generated Output



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OSHA CFR 29 1926.651 requires that the estimated location of underground utilities be determined before beginning the excavation or underground drilling operation. When the actual excavation or bore approaches an estimated utility location, the exact location of the underground installation must be determined by a safe, acceptable and dependable method. If the utility cannot be precisely located, it must be shut off by the utility company.

Project Summary

General: Kiewit - CHPE
Ref: New York
204-3701
Start Date: 04-29-2022
End Date: 03-17-2023

Designer: Aaron Coady
Tetra Tech Rooney
115 Inverness Drive East, Suite 300
Englewood, Colorado
United States 80112
aaron.coady@tetrattech.com

Description: Segment 11 (Package 7A)
Conduit 2 & 3 Equivalent Pipe Bundle
HDD 111.B
DWG C-311.B.2

Input Summary

Start Coordinate	(0.00, 0.00, 112.32) ft
End Coordinate	(765.00, 0.00, 120.00) ft
Project Length	765.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	14.000 in
Pipe DR	14.3
Pipe Thickness	0.98 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 14" (14")
Pipe DR: 14.3
Pipe Length: 780.00 ft
Internal Pressure: 0 psi
Borehole Diameter: 1.75 ft
Silo Width: 1.75 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 7.92790 lb/US (liquid) gallon
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 12.51801 lb/US (liquid) gallon
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	7.4	39.8
Water Pressure	0.0	0.0
Surface Surge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	7.4	39.8
Deflection		
Earth Load Deflection	9.310	49.749
Buoyant Deflection	0.690	0.690
Reissner Effect	0	0
Net Deflection	10.000	50.439
Compressive Stress [psi]		
Compressive Wall Stress	53.2	284.2

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	11399.7	11399.7
Pullback Stress [psi]	284.6	284.6
Pullback Strain	4.950E-3	4.950E-3
Bending Stress [psi]	33.5	33.5
Bending Strain	5.833E-4	5.833E-4
Tensile Stress [psi]	318.2	318.2
Tensile Strain	6.117E-3	6.117E-3

Net External Pressure = 14.6 [psi]

Buoyant Deflection = 0.3

Hydrokinetic Force = 962.1 lb

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.338	7.5	22.2	OK
Unconstrained Collapse [psi]	18.4	50.4	2.7	OK
Tensile Stress [psi]	318.2	1200.0	3.8	OK



Generated Output



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Project Summary

General:

Kiewit - CHPE
Ref: New York
204-3701
Start Date: 04-29-2022
End Date: 03-17-2023

Designer:

Aaron Coady
Tetra Tech Rooney
115 Inverness Drive East, Suite 300
Englewood, Colorado
United States 80112
aaron.coady@tetrattech.com

Description:

Segment 11 (Package 7A)
Conduit 1
HDD 112
DWG C-312

Input Summary

Start Coordinate	(0.00, 0.00, 110.55) ft
End Coordinate	(960.00, 0.00, 131.68) ft
Project Length	960.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 7

Soil Layer #1 USCS, Sand (S), SP

Depth: 5.00 ft

Unit Weight: 14.6454 (dry), 16.9323 (sat) [lb/US (liquid) gallon]

Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Silt (M), ML

Depth: 4.00 ft

Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #3 USCS, Sand (S), SM

Depth: 4.00 ft

Unit Weight: 15.6618 (dry), 17.7639 (sat) [lb/US (liquid) gallon]

Phi: 30.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #4 USCS, Silt (M), ML

Depth: 3.00 ft

Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #5 Rock, Geological Classification, Sedimentary Rocks

Depth: 9.00 ft

Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]

Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Soil Layer #6 USCS, Gravel (G), GM

Depth: 7.00 ft

Unit Weight: 16.9785 (dry), 18.6879 (sat) [lb/US (liquid) gallon]

Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

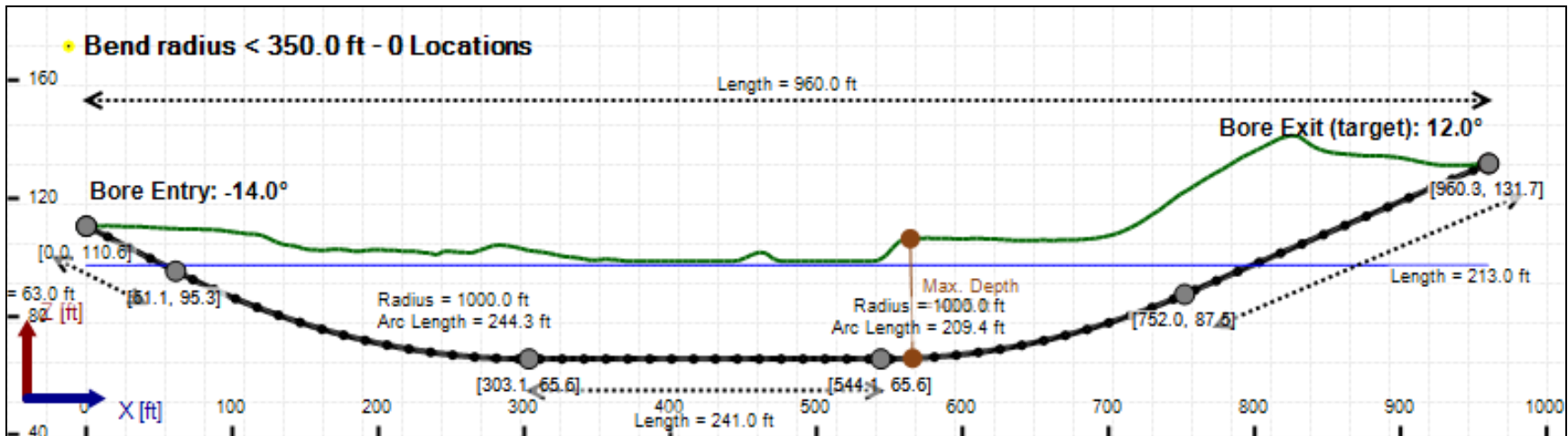
Soil Layer #7 Rock, Geological Classification, Sedimentary Rocks

Depth: 25.00 ft

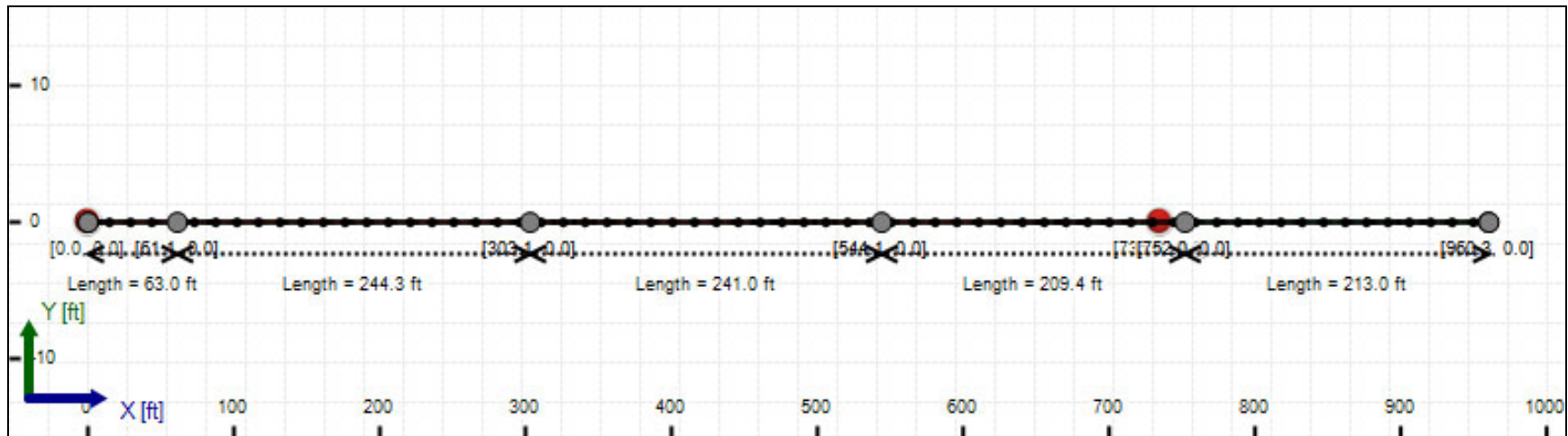
Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]

Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 10" (10.75")
Pipe DR: 9
Pipe Length: 975.00 ft
Internal Pressure: 0 psi
Borehole Diameter: 1.34400002161662 ft
Silo Width: 1.34400002161662 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 7.92790 lb/US (liquid) gallon
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 12.51801 lb/US (liquid) gallon
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	5.4	29.4
Water Pressure	13.7	13.6
Surface Surge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	19.2	43.0
Deflection		
Earth Load Deflection	1.541	8.025
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.673	8.157
Compressive Stress [psi]		
Compressive Wall Stress	86.2	193.5

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	18384.6	18384.6
Pullback Stress [psi]	512.7	512.7
Pullback Strain	8.917E-3	8.917E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	512.7	536.9
Tensile Strain	8.917E-3	9.785E-3

Net External Pressure = 33.8 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.673	7.5	4.5	OK
Unconstrained Collapse [psi]	43.6	119.5	2.7	OK
Compressive Wall Stress [psi]	86.2	1150.0	13.3	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	53.6	225.5	4.2	OK
Tensile Stress [psi]	536.9	1200.0	2.2	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	942.517 psi	1340.597 psi
1	8.00 in	12.00 in	942.273 psi	1340.367 psi
2	12.00 in	16.13 in	941.918 psi	1340.033 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 200.00 US (liquid) gallon/min

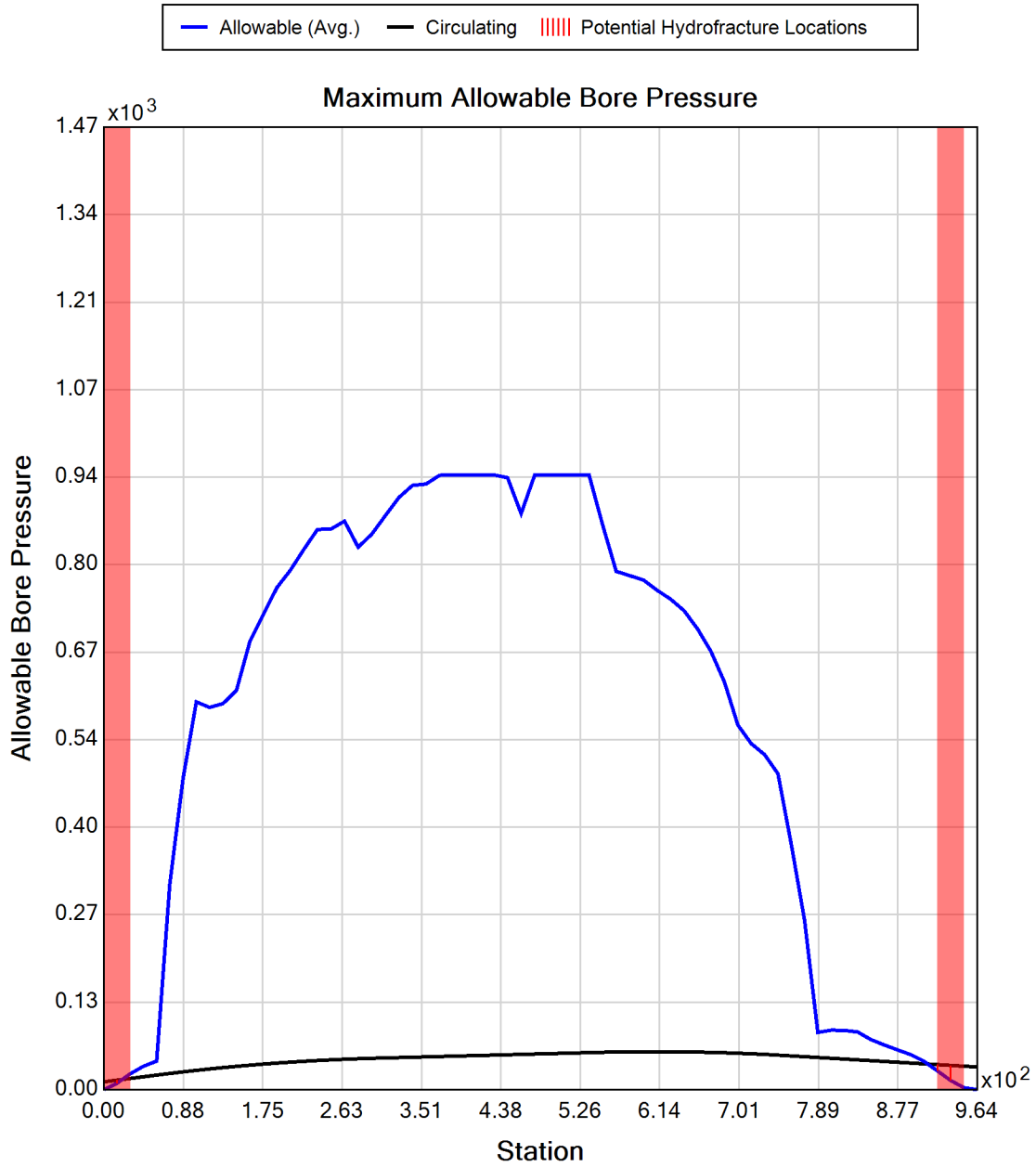
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 260.8





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Ref: New York
204-3701
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End Date: 03-17-2023

Designer:

Aaron Coady
Tetra Tech Rooney
115 Inverness Drive East, Suite 300
Englewood, Colorado
United States 80112
aaron.coady@tetrattech.com

Description:

Segment 11 (Package 7A)
Conduit 2
HDD 112
DWG C-312.2

Input Summary

Start Coordinate	(0.00, 0.00, 110.99) ft
End Coordinate	(960.00, 0.00, 129.86) ft
Project Length	960.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 7

Soil Layer #1 USCS, Sand (S), SP

Depth: 5.00 ft

Unit Weight: 14.6454 (dry), 16.9323 (sat) [lb/US (liquid) gallon]

Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Silt (M), ML

Depth: 4.00 ft

Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #3 USCS, Sand (S), SM

Depth: 4.00 ft

Unit Weight: 15.6618 (dry), 17.7639 (sat) [lb/US (liquid) gallon]

Phi: 30.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #4 USCS, Silt (M), ML

Depth: 3.00 ft

Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #5 Rock, Geological Classification, Sedimentary Rocks

Depth: 9.00 ft

Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]

Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Soil Layer #6 USCS, Gravel (G), GM

Depth: 7.00 ft

Unit Weight: 16.9785 (dry), 18.6879 (sat) [lb/US (liquid) gallon]

Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

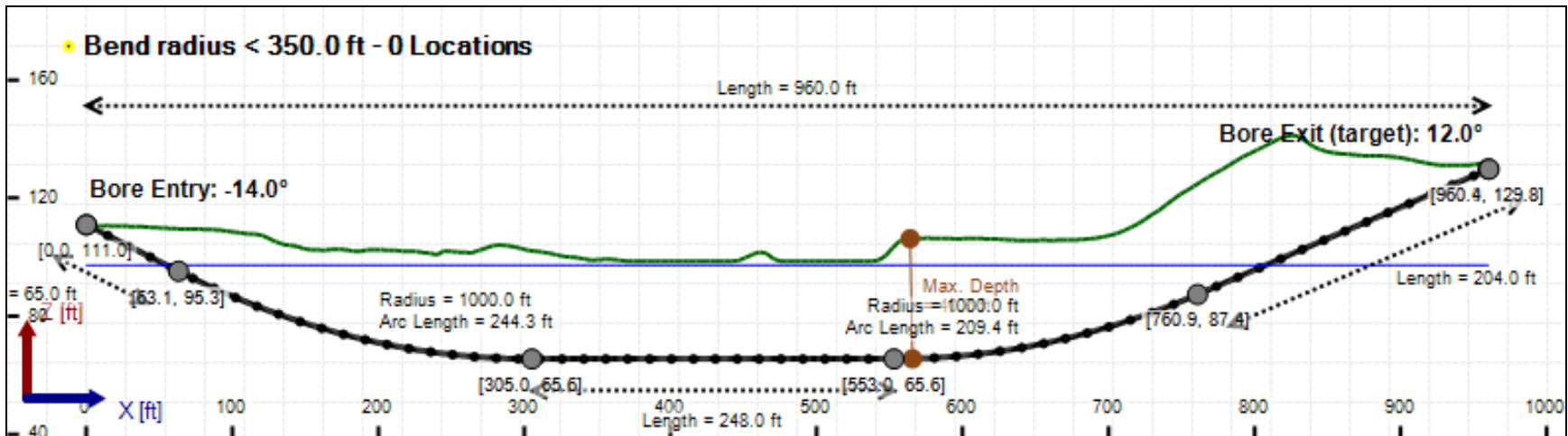
Soil Layer #7 Rock, Geological Classification, Sedimentary Rocks

Depth: 25.00 ft

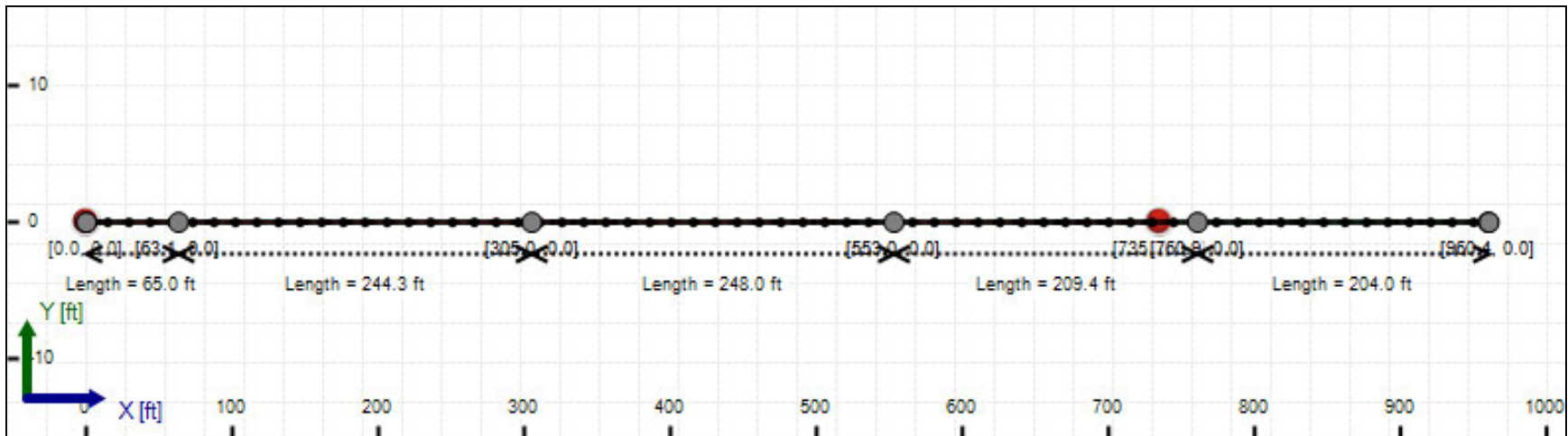
Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]

Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 10" (10.75")
Pipe DR: 9
Pipe Length: 975.00 ft
Internal Pressure: 0 psi
Borehole Diameter: 1.34400002161662 ft
Silo Width: 1.34400002161662 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 7.92790 lb/US (liquid) gallon
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 12.51801 lb/US (liquid) gallon
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	5.5	29.7
Water Pressure	13.7	13.7
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	19.2	43.4
Deflection		
Earth Load Deflection	1.541	8.460
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.673	8.592
Compressive Stress [psi]		
Compressive Wall Stress	86.5	195.3

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	18257.6	18257.6
Pullback Stress [psi]	509.2	509.2
Pullback Strain	8.855E-3	8.855E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	509.2	533.6
Tensile Strain	8.855E-3	9.727E-3

Net External Pressure = 32.3 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.673	7.5	4.5	OK
Unconstrained Collapse [psi]	42.4	119.4	2.8	OK
Compressive Wall Stress [psi]	86.5	1150.0	13.3	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	52.3	225.7	4.3	OK
Tensile Stress [psi]	533.6	1200.0	2.2	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	957.805 psi	1340.940 psi
1	8.00 in	12.00 in	957.558 psi	1340.712 psi
2	12.00 in	16.13 in	957.198 psi	1340.381 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 200.00 US (liquid) gallon/min

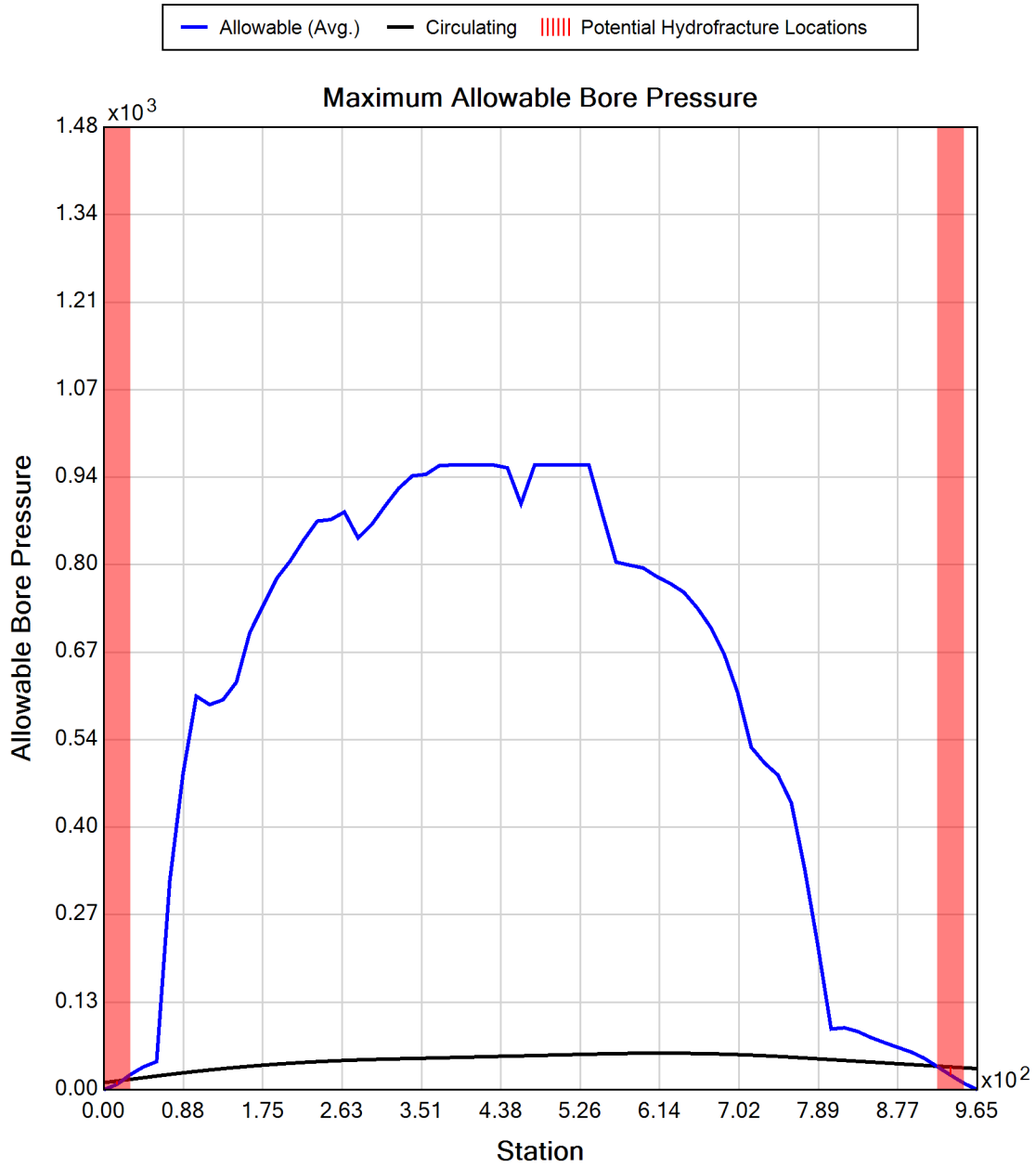
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 260.8





Generated Output



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Project Summary

General:

Kiewit - CHPE
Ref: New York
204-3701
Start Date: 04-29-2022
End Date: 03-17-2023

Designer:

Aaron Coady
Tetra Tech Rooney
115 Inverness Drive East, Suite 300
Englewood, Colorado
United States 80112
aaron.coady@tetrattech.com

Description:

Segment 11 (Package 7A)
Conduit 3
HDD 112
DWG C-312.2

Input Summary

Start Coordinate	(0.00, 0.00, 110.99) ft
End Coordinate	(960.00, 0.00, 129.86) ft
Project Length	960.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	2.375 in
Pipe DR	7.0
Pipe Thickness	0.34 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 7

Soil Layer #1 USCS, Sand (S), SP

Depth: 5.00 ft

Unit Weight: 14.6454 (dry), 16.9323 (sat) [lb/US (liquid) gallon]

Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Silt (M), ML

Depth: 4.00 ft

Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #3 USCS, Sand (S), SM

Depth: 4.00 ft

Unit Weight: 15.6618 (dry), 17.7639 (sat) [lb/US (liquid) gallon]

Phi: 30.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #4 USCS, Silt (M), ML

Depth: 3.00 ft

Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #5 Rock, Geological Classification, Sedimentary Rocks

Depth: 9.00 ft

Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]

Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Soil Layer #6 USCS, Gravel (G), GM

Depth: 7.00 ft

Unit Weight: 16.9785 (dry), 18.6879 (sat) [lb/US (liquid) gallon]

Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

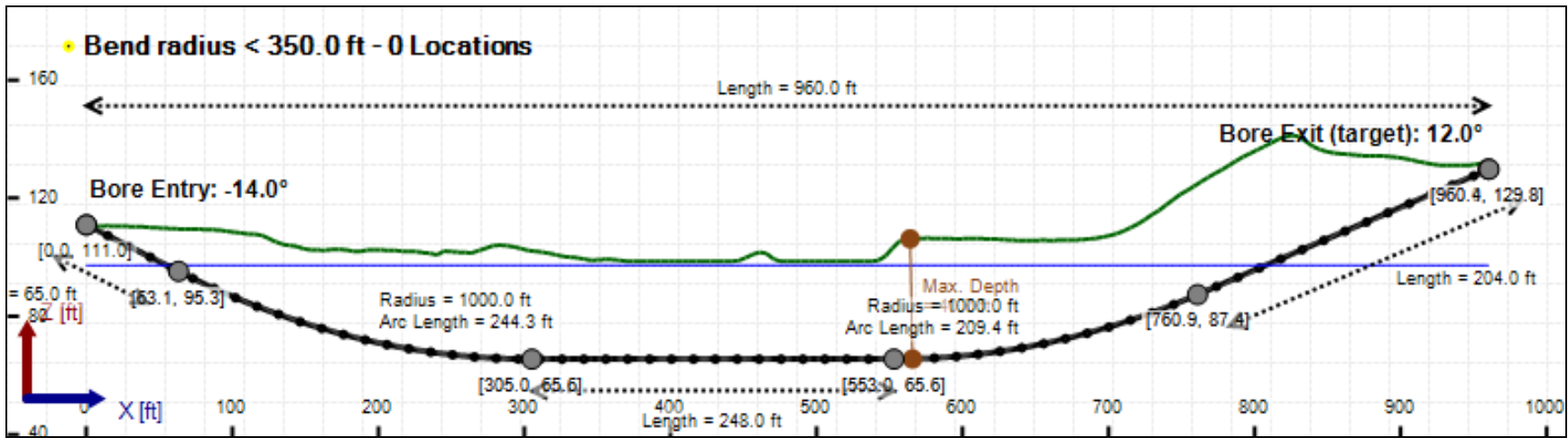
Soil Layer #7 Rock, Geological Classification, Sedimentary Rocks

Depth: 25.00 ft

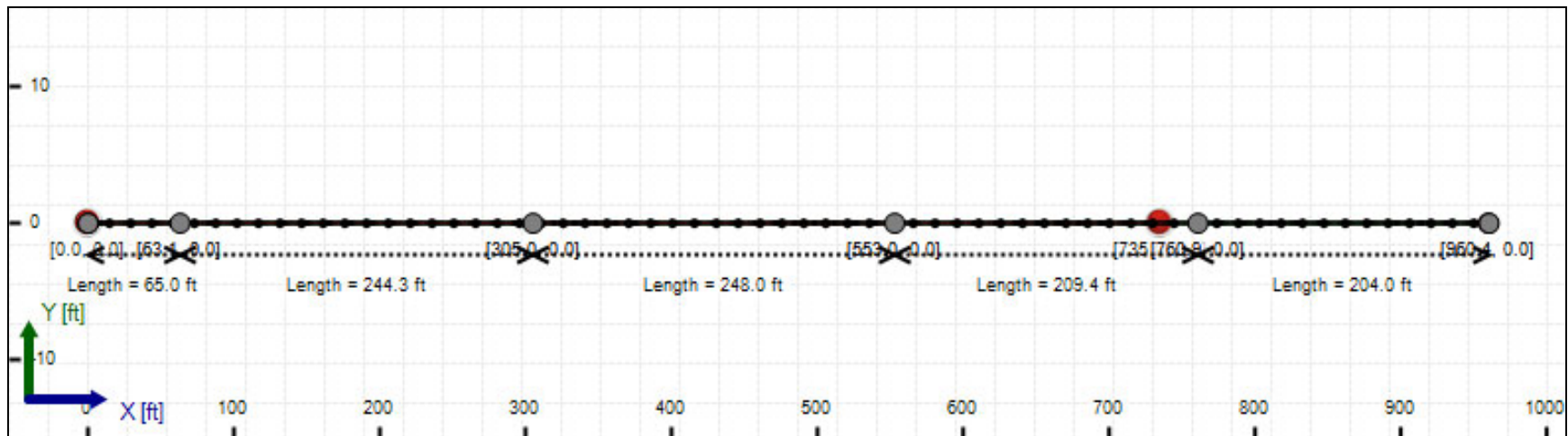
Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]

Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 2" (2.375")
Pipe DR: 7
Pipe Length: 975.00 ft
Internal Pressure: 0 psi
Borehole Diameter: 0.531000018119812 ft
Silo Width: 0.531000018119812 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 7.92790 lb/US (liquid) gallon
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 12.51801 lb/US (liquid) gallon
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	2.2	29.7
Water Pressure	13.7	13.7
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	15.9	43.4
Deflection		
Earth Load Deflection	0.273	3.569
Buoyant Deflection	0.014	0.014
Reissner Effect	0	0
Net Deflection	0.286	3.583
Compressive Stress [psi]		
Compressive Wall Stress	55.7	151.9

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	948.9	948.9
Pullback Stress [psi]	437.3	437.3
Pullback Strain	7.606E-3	7.606E-3
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	437.3	442.9
Tensile Strain	7.606E-3	7.802E-3

Net External Pressure = 32.3 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.286	7.5	26.2	OK
Unconstrained Collapse [psi]	42.4	319.7	7.5	OK
Compressive Wall Stress [psi]	55.7	1150.0	20.6	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.007	7.5	1114.2	OK
Unconstrained Collapse [psi]	52.3	548.2	10.5	OK
Tensile Stress [psi]	442.9	1200.0	2.7	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	957.805 psi	1340.940 psi
1	8.00 in	12.00 in	957.558 psi	1340.712 psi
2	12.00 in	16.13 in	957.198 psi	1340.381 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 200.00 US (liquid) gallon/min

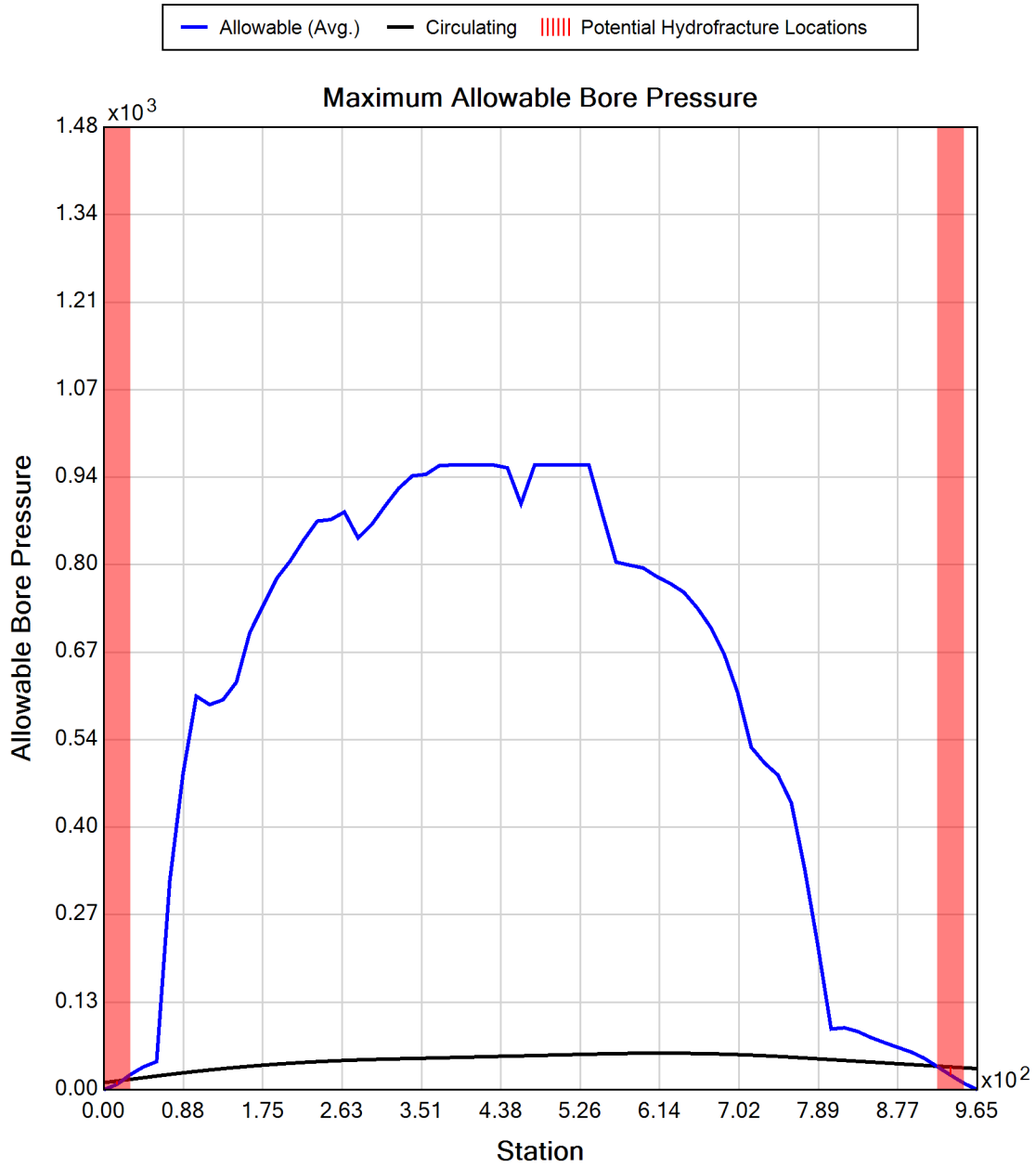
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 260.8





Generated Output



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Project Summary

General:

Kiewit - CHPE
Ref: New York
204-3701
Start Date: 04-29-2022
End Date: 03-17-2023

Designer:

Aaron Coady
Tetra Tech Rooney
115 Inverness Drive East, Suite 300
Englewood, Colorado
United States 80112
aaron.coady@tetrattech.com

Description:

Segment 11 (Package 7A)
Conduit 2 & 3 Equivalent Pipe Bundle
HDD 112
DWG C-312.2

Input Summary

Start Coordinate	(0.00, 0.00, 110.99) ft
End Coordinate	(960.00, 0.00, 129.86) ft
Project Length	960.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	14.000 in
Pipe DR	14.3
Pipe Thickness	0.98 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 14" (14")
Pipe DR: 14.3
Pipe Length: 975.00 ft
Internal Pressure: 0 psi
Borehole Diameter: 1.75 ft
Silo Width: 1.75 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 7.92790 lb/US (liquid) gallon
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 12.51801 lb/US (liquid) gallon
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	7.0	29.7
Water Pressure	13.7	13.7
Surface Surge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	20.7	43.4
Deflection		
Earth Load Deflection	9.120	38.875
Buoyant Deflection	0.690	0.690
Reissner Effect	0	0
Net Deflection	9.810	39.565
Compressive Stress [psi]		
Compressive Wall Stress	148.4	310.3

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	15033.1	15033.1
Pullback Stress [psi]	375.4	375.4
Pullback Strain	6.528E-3	6.528E-3
Bending Stress [psi]	33.5	33.5
Bending Strain	5.833E-4	5.833E-4
Tensile Stress [psi]	408.9	408.9
Tensile Strain	7.695E-3	7.695E-3

Net External Pressure = 18.2 [psi]

Buoyant Deflection = 0.3

Hydrokinetic Force = 962.1 lb

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.338	7.5	22.2	OK
Unconstrained Collapse [psi]	24.1	49.3	2.0	OK
Tensile Stress [psi]	408.9	1200.0	2.9	OK



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Kiewit - CHPE
Ref: New York
204-3701
Start Date: 04-29-2022
End Date: 03-17-2023

Designer:

Aaron Coady
Tetra Tech Rooney
115 Inverness Drive East, Suite 300
Englewood, Colorado
United States 80112
aaron.coady@tetrattech.com

Description:

Segment 11 (Package 7A)
Conduit 1
HDD 113
DWG C-313

Input Summary

Start Coordinate	(0.00, 0.00, 96.49) ft
End Coordinate	(610.00, 0.00, 110.20) ft
Project Length	610.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 4

Soil Layer #1 USCS, Sand (S), SM

Depth: 2.00 ft

Unit Weight: 15.6618 (dry), 17.7639 (sat) [lb/US (liquid) gallon]

Phi: 30.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #2 USCS, Clay (C), CH

Depth: 18.00 ft

Unit Weight: 11.9889 (dry), 15.2922 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 400.00, Coh: 8.30 [psi]

Soil Layer #3 USCS, Clay (C), CL

Depth: 25.00 ft

Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 200.00, Coh: 3.10 [psi]

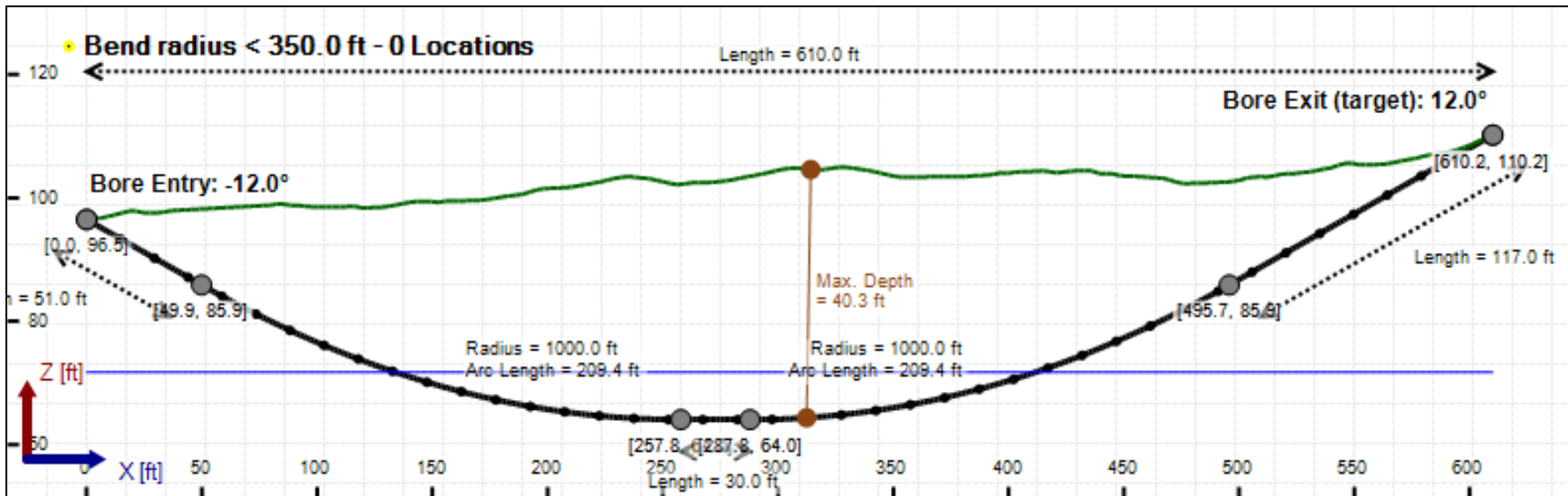
Soil Layer #4 USCS, Silt (M), ML

Depth: 12.00 ft

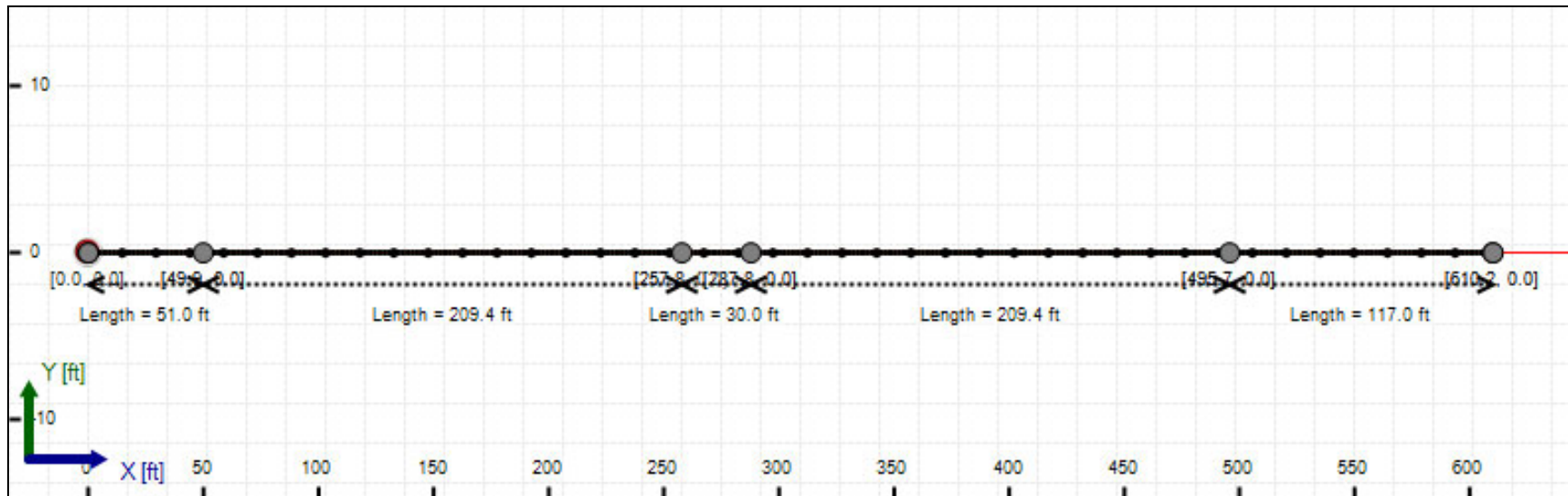
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 10" (10.75")
Pipe DR: 9
Pipe Length: 630.00 ft
Internal Pressure: 0 psi
Borehole Diameter: 1.34400002161662 ft
Silo Width: 1.34400002161662 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 7.92790 lb/US (liquid) gallon
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 12.51801 lb/US (liquid) gallon
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	9.1	26.3
Water Pressure	3.3	3.2
Surface Surge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	12.4	29.5
Deflection		
Earth Load Deflection	2.696	7.176
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	2.828	7.308
Compressive Stress [psi]		
Compressive Wall Stress	55.7	132.9

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	11975.3	11975.3
Pullback Stress [psi]	334.0	334.0
Pullback Strain	5.808E-3	5.808E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	334.0	359.3
Tensile Strain	5.808E-3	6.696E-3

Net External Pressure = 26.8 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	2.828	7.5	2.7	OK
Unconstrained Collapse [psi]	31.8	109.4	3.4	OK
Compressive Wall Stress [psi]	55.7	1150.0	20.6	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	41.8	235.9	5.6	OK
Tensile Stress [psi]	359.3	1200.0	3.3	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	77.463 psi	58.852 psi
1	8.00 in	12.00 in	77.384 psi	58.562 psi
2	12.00 in	16.13 in	77.269 psi	58.157 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 70.00 US (liquid) gallon/min

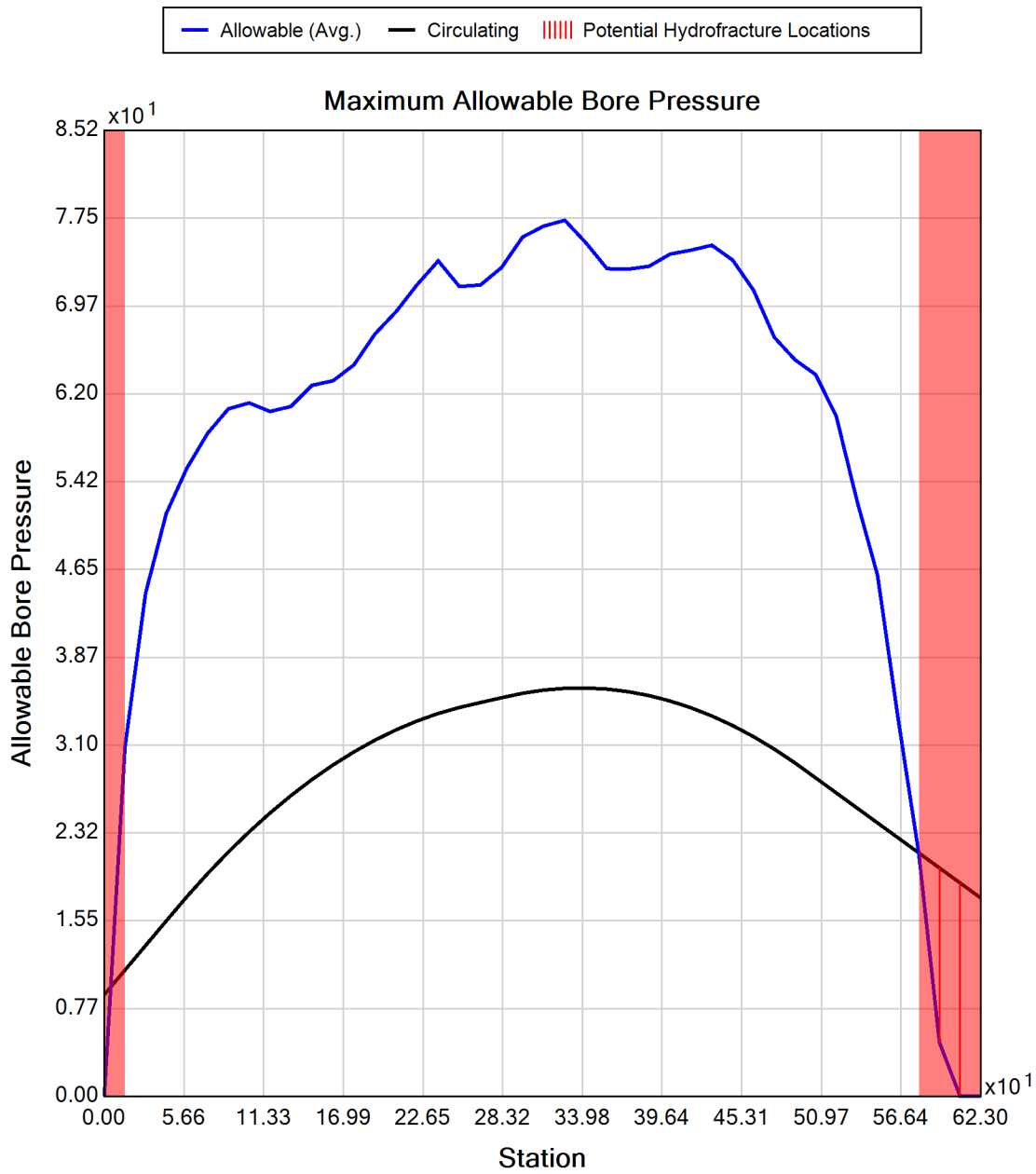
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 697.8





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General: Kiewit - CHPE
Ref: New York
204-3701
Start Date: 04-29-2022
End Date: 03-17-2023

Designer: Aaron Coady
Tetra Tech Rooney
115 Inverness Drive East, Suite 300
Englewood, Colorado
United States 80112
aaron.coady@tetrattech.com

Description: Segment 11 (Package 7A)
Conduit 2
HDD 113
DWG C-313.2

Input Summary

Start Coordinate	(0.00, 0.00, 96.49) ft
End Coordinate	(610.00, 0.00, 109.16) ft
Project Length	610.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 4

Soil Layer #1 USCS, Sand (S), SM

Depth: 2.00 ft

Unit Weight: 15.6618 (dry), 17.7639 (sat) [lb/US (liquid) gallon]

Phi: 30.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #2 USCS, Clay (C), CH

Depth: 18.00 ft

Unit Weight: 11.9889 (dry), 15.2922 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 400.00, Coh: 8.30 [psi]

Soil Layer #3 USCS, Clay (C), CL

Depth: 25.00 ft

Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 200.00, Coh: 3.10 [psi]

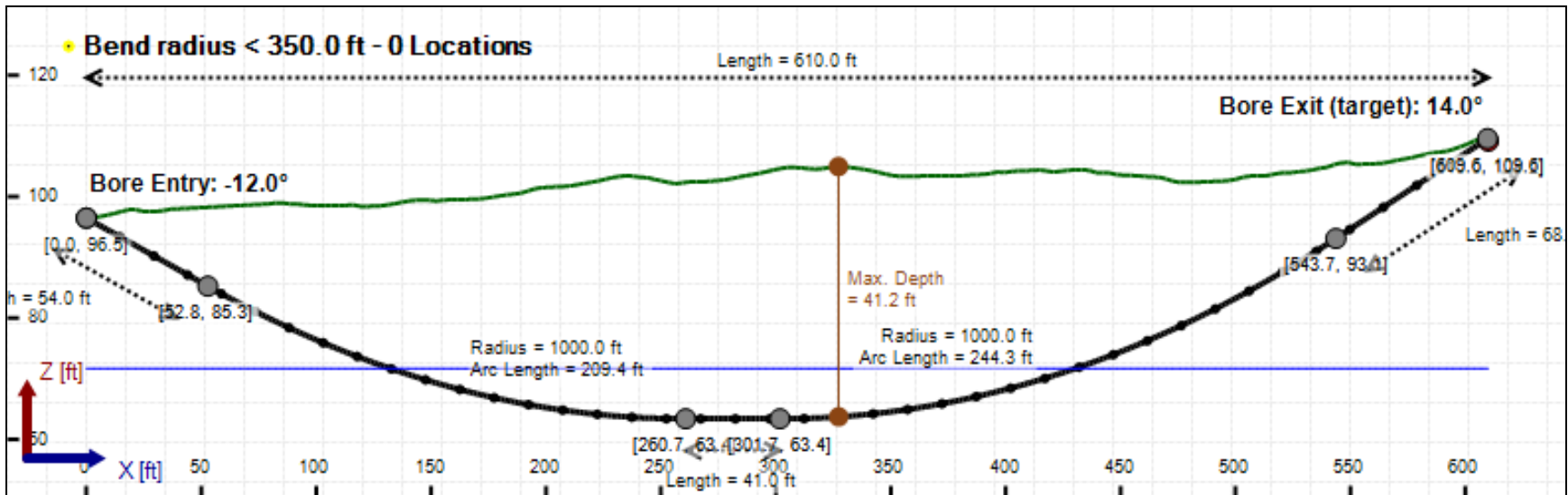
Soil Layer #4 USCS, Silt (M), ML

Depth: 12.00 ft

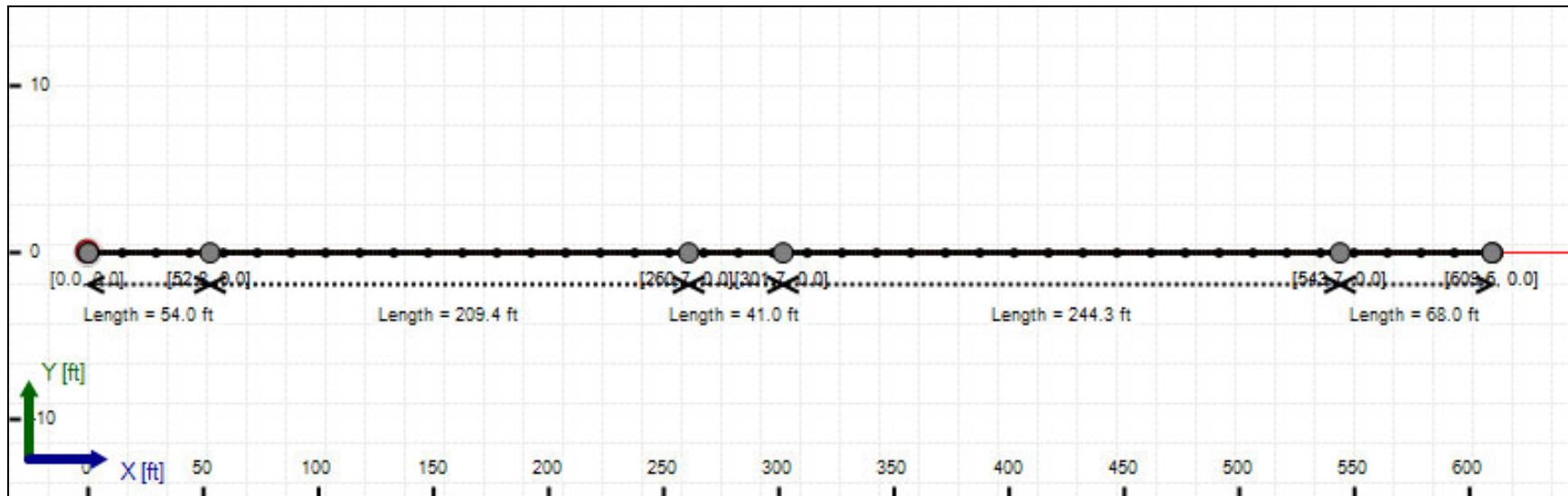
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 10" (10.75")
Pipe DR: 9
Pipe Length: 630.00 ft
Internal Pressure: 0 psi
Borehole Diameter: 1.34400002161662 ft
Silo Width: 1.34400002161662 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 7.92790 lb/US (liquid) gallon
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 12.51801 lb/US (liquid) gallon
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	9.1	26.7
Water Pressure	3.6	3.6
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	12.7	30.3
Deflection		
Earth Load Deflection	2.713	7.307
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	2.845	7.439
Compressive Stress [psi]		
Compressive Wall Stress	57.2	136.4

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	12100.8	12100.8
Pullback Stress [psi]	337.5	337.5
Pullback Strain	5.869E-3	5.869E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	337.5	363.2
Tensile Strain	5.869E-3	6.764E-3

Net External Pressure = 26.7 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	2.845	7.5	2.6	OK
Unconstrained Collapse [psi]	32.1	109.3	3.4	OK
Compressive Wall Stress [psi]	57.2	1150.0	20.1	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	42.1	235.5	5.6	OK
Tensile Stress [psi]	363.2	1200.0	3.3	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	77.768 psi	56.357 psi
1	8.00 in	12.00 in	77.694 psi	55.980 psi
2	12.00 in	16.13 in	77.587 psi	55.463 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 70.00 US (liquid) gallon/min

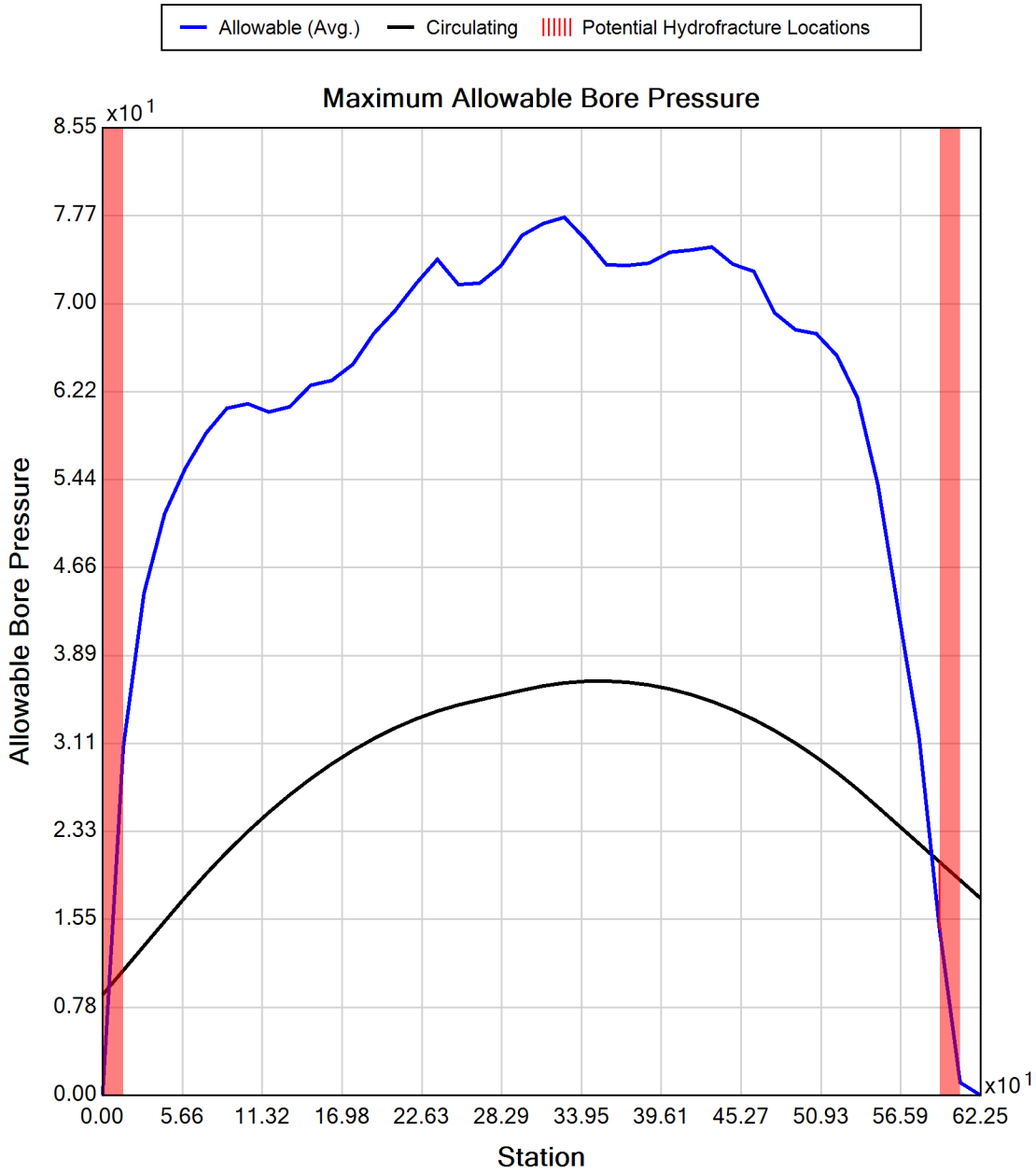
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 697.8





Generated Output



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Project Summary

General:

Kiewit - CHPE
Ref: New York
204-3701
Start Date: 04-29-2022
End Date: 03-17-2023

Designer:

Aaron Coady
Tetra Tech Rooney
115 Inverness Drive East, Suite 300
Englewood, Colorado
United States 80112
aaron.coady@tetrattech.com

Description:

Segment 11 (Package 7A)
Conduit 3
HDD 113
DWG C-313.2

Input Summary

Start Coordinate	(0.00, 0.00, 96.49) ft
End Coordinate	(610.00, 0.00, 109.16) ft
Project Length	610.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	2.375 in
Pipe DR	7.0
Pipe Thickness	0.34 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 4

Soil Layer #1 USCS, Sand (S), SM

Depth: 2.00 ft

Unit Weight: 15.6618 (dry), 17.7639 (sat) [lb/US (liquid) gallon]

Phi: 30.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #2 USCS, Clay (C), CH

Depth: 18.00 ft

Unit Weight: 11.9889 (dry), 15.2922 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 400.00, Coh: 8.30 [psi]

Soil Layer #3 USCS, Clay (C), CL

Depth: 25.00 ft

Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 200.00, Coh: 3.10 [psi]

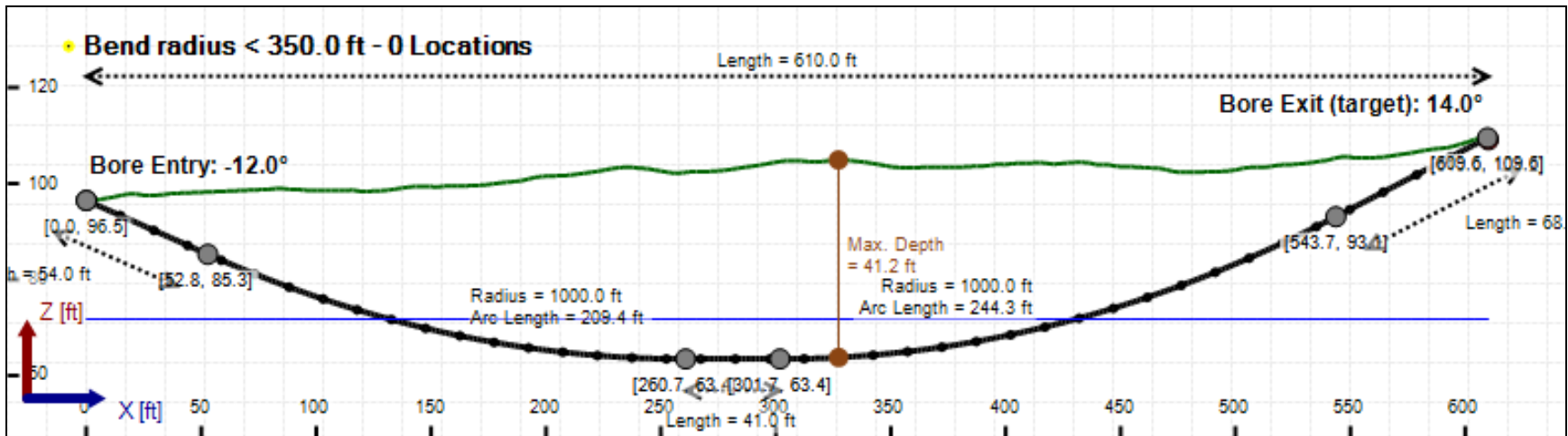
Soil Layer #4 USCS, Silt (M), ML

Depth: 12.00 ft

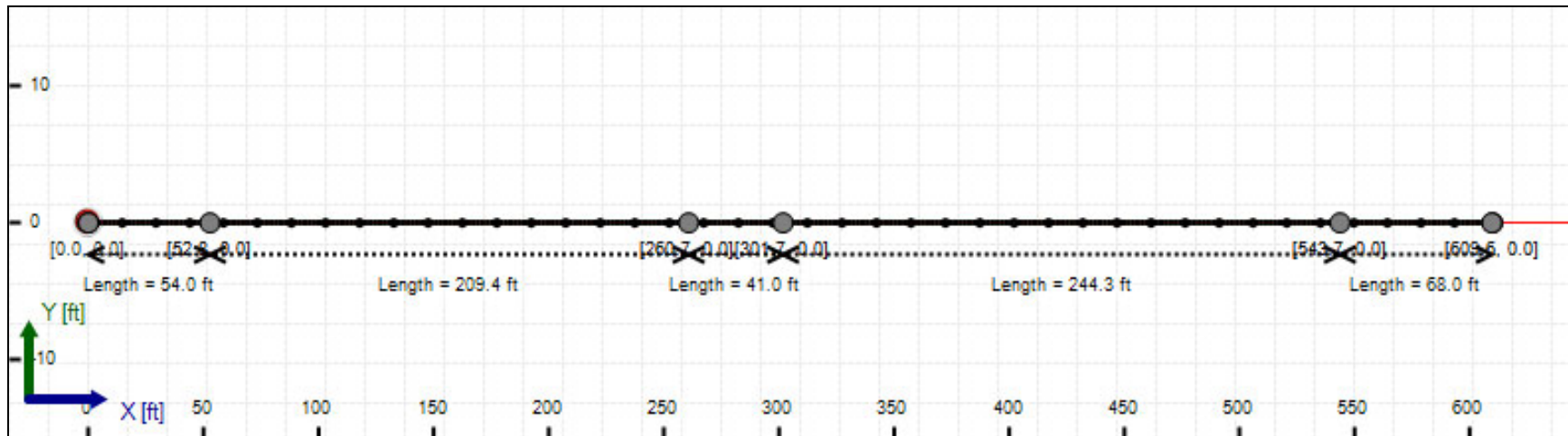
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 2" (2.375")
Pipe DR: 7
Pipe Length: 630.00 ft
Internal Pressure: 0 psi
Borehole Diameter: 0.531000018119812 ft
Silo Width: 0.531000018119812 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 7.92790 lb/US (liquid) gallon
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 12.51801 lb/US (liquid) gallon
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	3.9	26.7
Water Pressure	3.6	3.6
Surface Surge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	7.5	30.3
Deflection		
Earth Load Deflection	0.572	3.082
Buoyant Deflection	0.014	0.014
Reissner Effect	0	0
Net Deflection	0.586	3.096
Compressive Stress [psi]		
Compressive Wall Stress	26.3	106.1

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	671.2	671.2
Pullback Stress [psi]	309.3	309.3
Pullback Strain	5.380E-3	5.380E-3
Bending Stress [psi]	5.7	5.7
Bending Strain	9.896E-5	9.896E-5
Tensile Stress [psi]	315.0	315.0
Tensile Strain	5.578E-3	5.578E-3

Net External Pressure = 32.3 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.586	7.5	12.8	OK
Unconstrained Collapse [psi]	32.1	314.0	9.8	OK
Compressive Wall Stress [psi]	26.3	1150.0	43.7	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.007	7.5	1114.2	OK
Unconstrained Collapse [psi]	42.1	565.6	13.4	OK
Tensile Stress [psi]	315.0	1200.0	3.8	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	77.768 psi	56.357 psi
1	8.00 in	6.37 in	77.790 psi	56.470 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 70.00 US (liquid) gallon/min

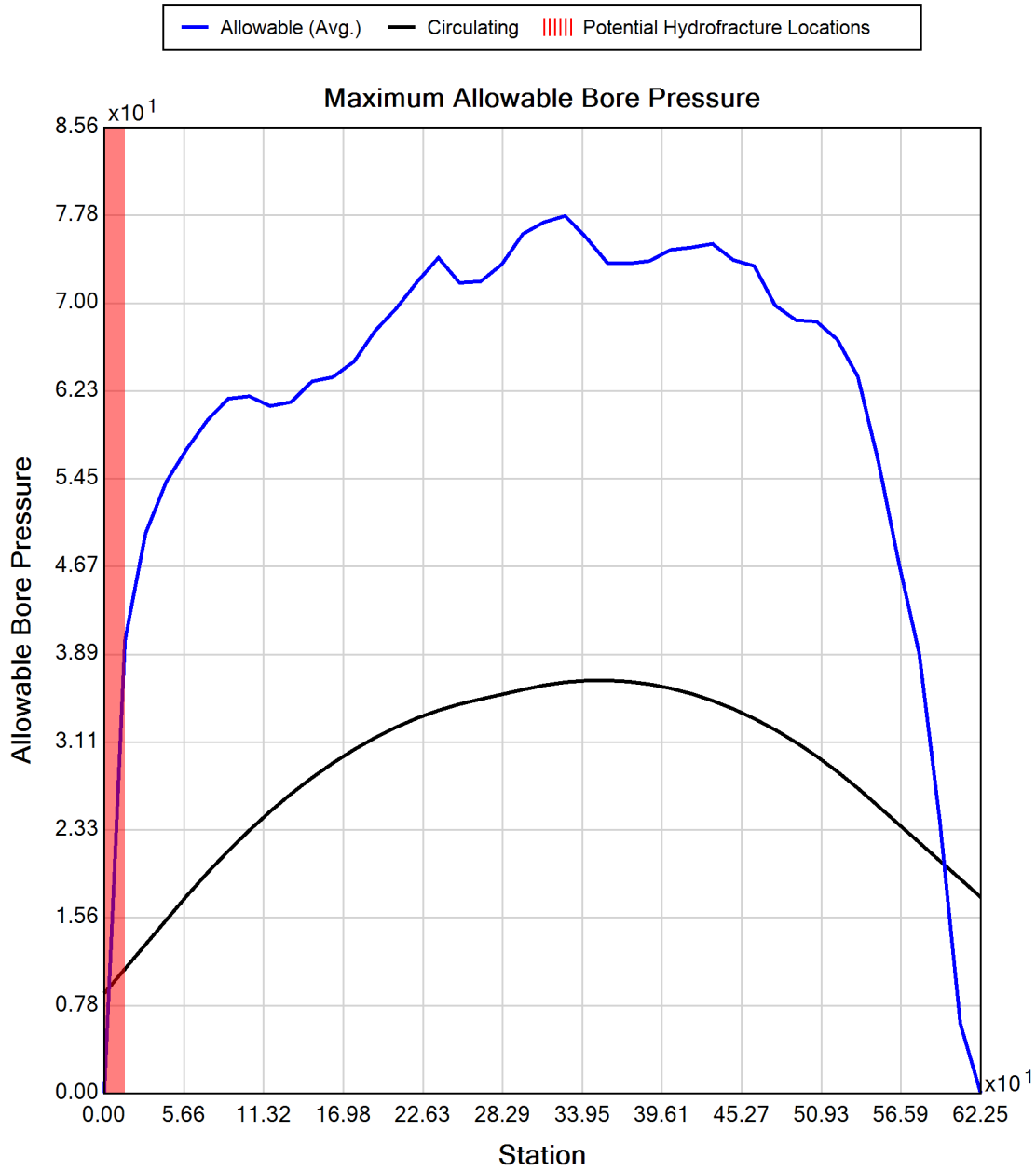
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 697.8





Generated Output



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Project Summary

General:

Kiewit - CHPE
Ref: New York
204-3701
Start Date: 04-29-2022
End Date: 03-17-2023

Designer:

Aaron Coady
Tetra Tech Rooney
115 Inverness Drive East, Suite 300
Englewood, Colorado
United States 80112
aaron.coady@tetrattech.com

Description:

Segment 11 (Package 7A)
Conduit 2 & 3 Equivalent Pipe Bundle
HDD 113
DWG C-313.2

Input Summary

Start Coordinate	(0.00, 0.00, 96.49) ft
End Coordinate	(610.00, 0.00, 109.16) ft
Project Length	610.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	14.000 in
Pipe DR	14.3
Pipe Thickness	0.98 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 14" (14")
Pipe DR: 14.3
Pipe Length: 630.00 ft
Internal Pressure: 0 psi
Borehole Diameter: 1.75 ft
Silo Width: 1.75 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 7.92790 lb/US (liquid) gallon
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 12.51801 lb/US (liquid) gallon
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	11.0	26.7
Water Pressure	3.6	3.6
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	14.6	30.3
Deflection		
Earth Load Deflection	14.503	33.574
Buoyant Deflection	0.690	0.690
Reissner Effect	0	0
Net Deflection	15.192	34.263
Compressive Stress [psi]		
Compressive Wall Stress	104.7	216.7

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	10257.0	10257.0
Pullback Stress [psi]	256.1	256.1
Pullback Strain	4.454E-3	4.454E-3
Bending Stress [psi]	33.5	33.5
Bending Strain	5.833E-4	5.833E-4
Tensile Stress [psi]	289.7	289.7
Tensile Strain	5.621E-3	5.621E-3

Net External Pressure = 18.0 [psi]

Buoyant Deflection = 0.3

Hydrokinetic Force = 962.1 lb

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.338	7.5	22.2	OK
Unconstrained Collapse [psi]	20.7	50.7	2.5	OK
Tensile Stress [psi]	289.7	1200.0	4.1	OK



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Project Summary

General: Kiewit CHPE
Ref: New York
204-3701
Start Date: 04-29-2022
End Date: 03-17-2023

Designer: Aaron Coady
TetraTech Rooney
115 Inverness Drive, Suite 300
Englewood, Colorado
United States 80112
aaron.coady@tetrattech.com

Description: Segment 11 (Package 7A)
Conduit 1
HDD 115
DWG C-315

Input Summary

Start Coordinate	(0.00, 0.00, 34.11) ft
End Coordinate	(1337.80, 0.00, 51.18) ft
Project Length	1337.80 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	12.750 in
Pipe DR	7.0
Pipe Thickness	1.82 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 5

Soil Layer #1 USCS, Gravel (G), GC

Depth: 2.00 ft

Unit Weight: 16.3086 (dry), 18.2028 (sat) [lb/US (liquid) gallon]

Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Clay (C), CL

Depth: 4.00 ft

Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 145.00, Coh: 7.30 [psi]

Soil Layer #3 USCS, Silt (M), ML

Depth: 2.00 ft

Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #4 USCS, Gravel (G), GC

Depth: 8.00 ft

Unit Weight: 16.3086 (dry), 18.2028 (sat) [lb/US (liquid) gallon]

Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

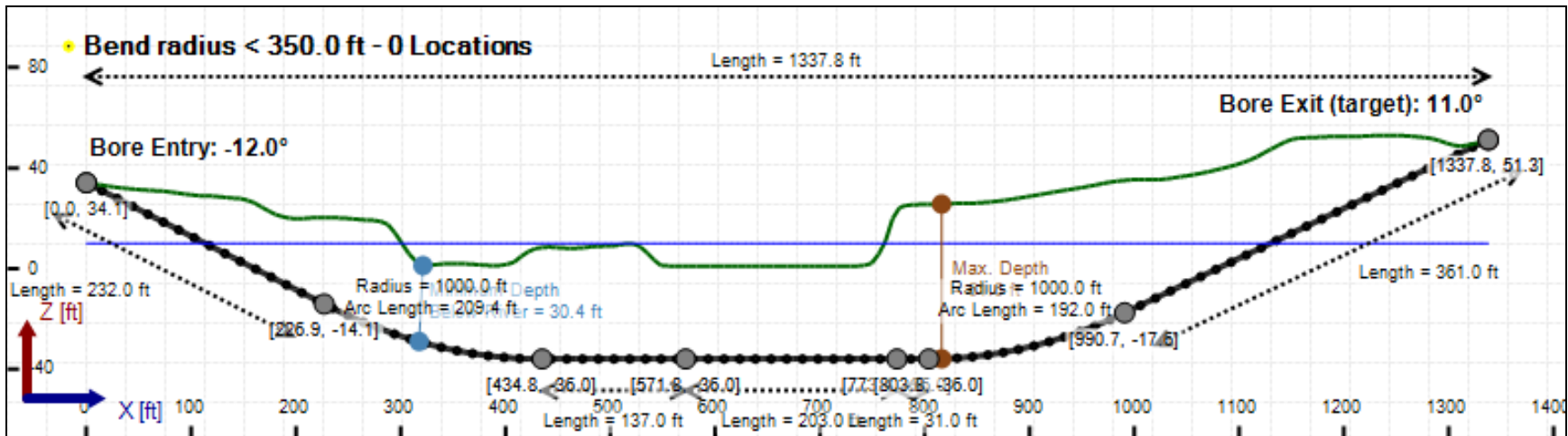
Soil Layer #5 Rock, Geological Classification, Sedimentary Rocks

Depth: 94.00 ft

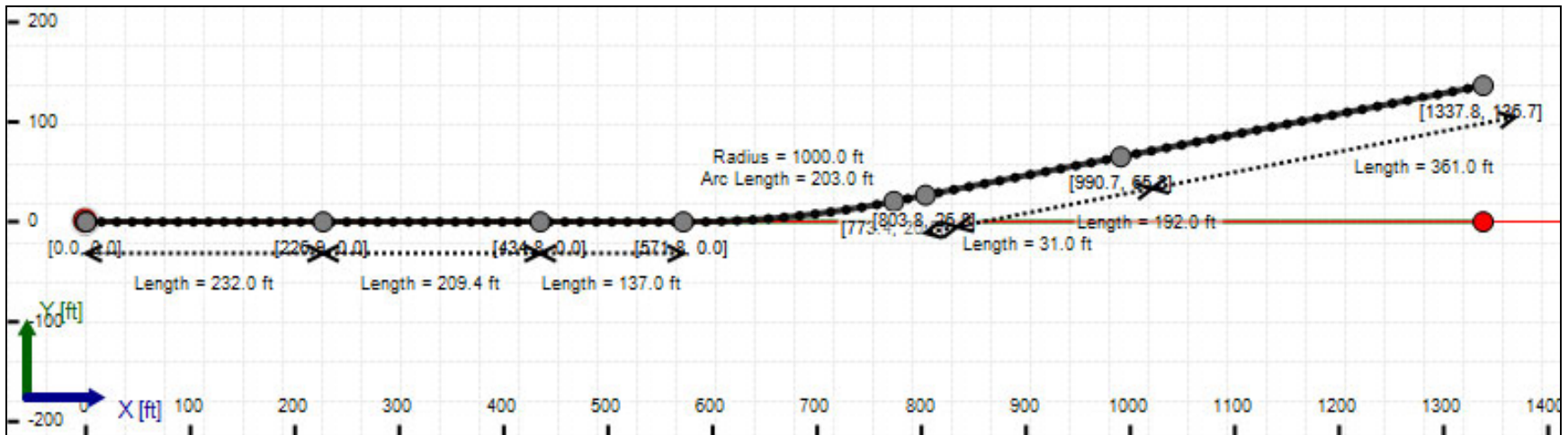
Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]

Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 12" (12.75")
Pipe DR: 7
Pipe Length: 1379.99 ft
Internal Pressure: 0 psi
Borehole Diameter: 1.59400002161662 ft
Silo Width: 1.59400002161662 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 7.92790 lb/US (liquid) gallon
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 12.51801 lb/US (liquid) gallon
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	7.4	49.2
Water Pressure	20.0	20.0
Surface Surge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	27.4	69.1
Deflection		
Earth Load Deflection	0.854	5.652
Buoyant Deflection	0.074	0.074
Reissner Effect	0	0
Net Deflection	0.928	5.725
Compressive Stress [psi]		
Compressive Wall Stress	95.8	241.9

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	35994.5	35994.5
Pullback Stress [psi]	575.6	575.6
Pullback Strain	1.001E-2	1.001E-2
Bending Stress [psi]	0.0	30.5
Bending Strain	0	5.313E-4
Tensile Stress [psi]	575.6	604.4
Tensile Strain	1.001E-2	1.104E-2

Net External Pressure = 53.4 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 798.4 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.928	7.5	8.1	OK
Unconstrained Collapse [psi]	58.5	301.2	5.1	OK
Compressive Wall Stress [psi]	95.8	1150.0	12.0	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.036	7.5	207.6	OK
Unconstrained Collapse [psi]	68.5	522.9	7.6	OK
Tensile Stress [psi]	604.4	1200.0	2.0	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	1353.034 psi	1363.505 psi
1	8.00 in	14.00 in	1352.738 psi	1363.340 psi
2	14.00 in	19.13 in	1352.357 psi	1363.129 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 200.00 US (liquid) gallon/min

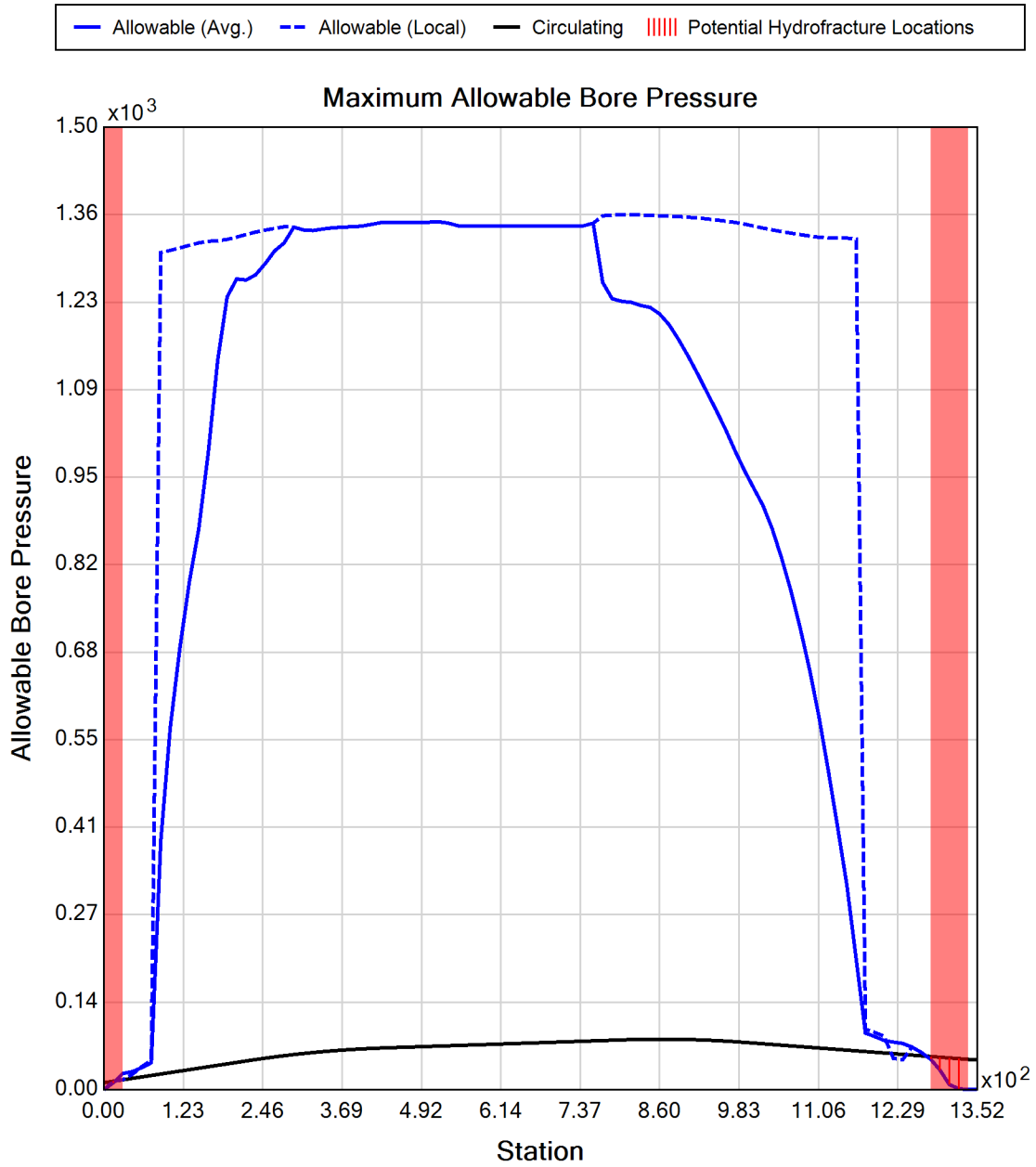
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 260.8





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Project Summary

General: Kiewit CHPE
Ref: New York
204-3701
Start Date: 04-29-2022
End Date: 03-17-2023

Designer: Aaron Coady
Tetra Tech Rooney
115 Inverness Drive, Suite 300
Englewood, Colorado
United States 80112
aaron.coady@tetrattech.com

Description: Segment 11 (Package 7A)
Conduit 2
HDD 115
DWG C-315.2

Input Summary

Start Coordinate	(0.00, 0.00, 33.87) ft
End Coordinate	(1349.00, 0.00, 54.01) ft
Project Length	1349.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	12.750 in
Pipe DR	7.0
Pipe Thickness	1.82 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 5

Soil Layer #1 USCS, Gravel (G), GC

Depth: 2.00 ft

Unit Weight: 16.3086 (dry), 18.2028 (sat) [lb/US (liquid) gallon]

Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Clay (C), CL

Depth: 4.00 ft

Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 145.00, Coh: 7.30 [psi]

Soil Layer #3 USCS, Silt (M), ML

Depth: 2.00 ft

Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #4 USCS, Gravel (G), GC

Depth: 8.00 ft

Unit Weight: 16.3086 (dry), 18.2028 (sat) [lb/US (liquid) gallon]

Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

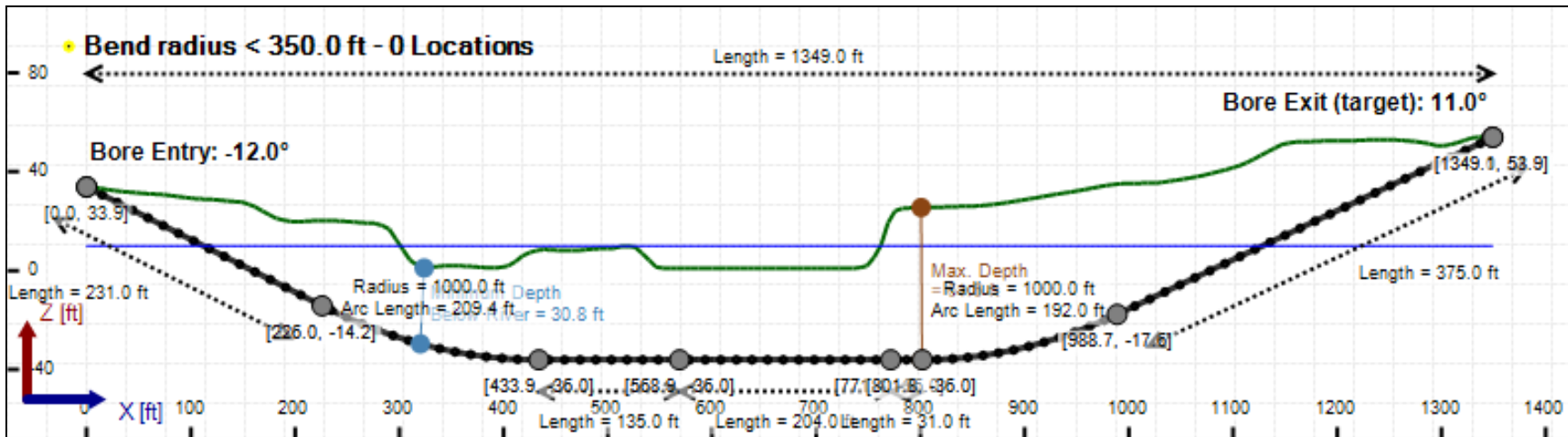
Soil Layer #5 Rock, Geological Classification, Sedimentary Rocks

Depth: 94.00 ft

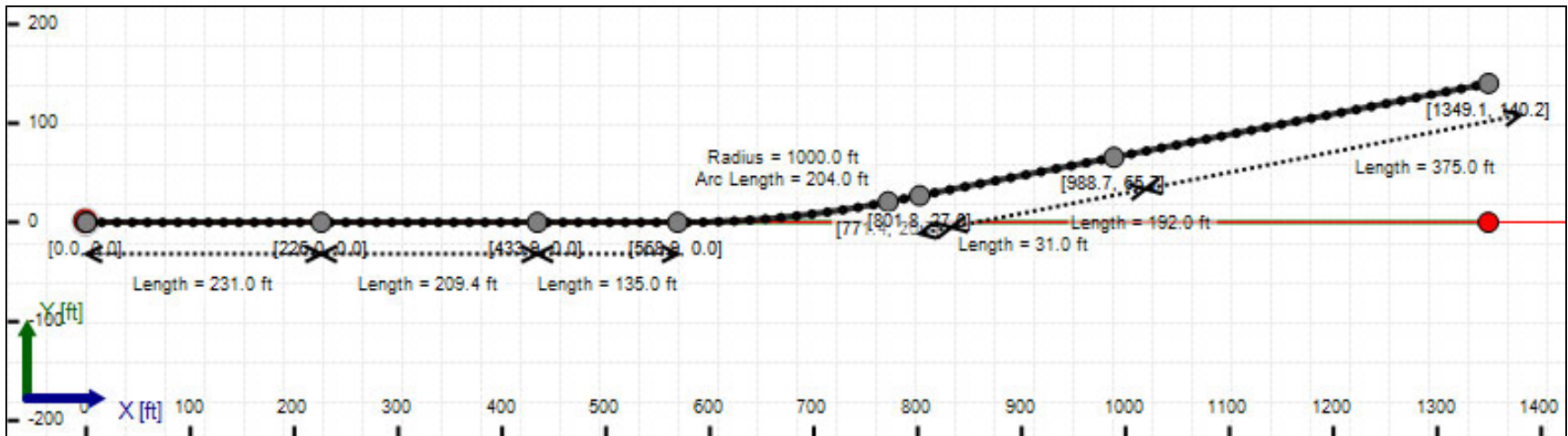
Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]

Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 12" (12.75")
Pipe DR: 7
Pipe Length: 1379.99 ft
Internal Pressure: 0 psi
Borehole Diameter: 1.59400002161662 ft
Silo Width: 1.59400002161662 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 7.92790 lb/US (liquid) gallon
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 12.51801 lb/US (liquid) gallon
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	7.4	49.2
Water Pressure	20.0	20.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	27.4	69.2
Deflection		
Earth Load Deflection	0.854	5.656
Buoyant Deflection	0.074	0.074
Reissner Effect	0	0
Net Deflection	0.928	5.730
Compressive Stress [psi]		
Compressive Wall Stress	95.9	242.2

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	36042.4	36042.4
Pullback Stress [psi]	576.4	576.4
Pullback Strain	1.002E-2	1.002E-2
Bending Stress [psi]	0.0	30.5
Bending Strain	0	5.313E-4
Tensile Stress [psi]	576.4	605.0
Tensile Strain	1.002E-2	1.105E-2

Net External Pressure = 53.8 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 798.4 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.928	7.5	8.1	OK
Unconstrained Collapse [psi]	58.8	301.2	5.1	OK
Compressive Wall Stress [psi]	95.9	1150.0	12.0	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.036	7.5	207.6	OK
Unconstrained Collapse [psi]	68.8	522.9	7.6	OK
Tensile Stress [psi]	605.0	1200.0	2.0	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	1353.070 psi	1363.561 psi
1	8.00 in	14.00 in	1352.774 psi	1363.397 psi
2	14.00 in	19.13 in	1352.393 psi	1363.185 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 200.00 US (liquid) gallon/min

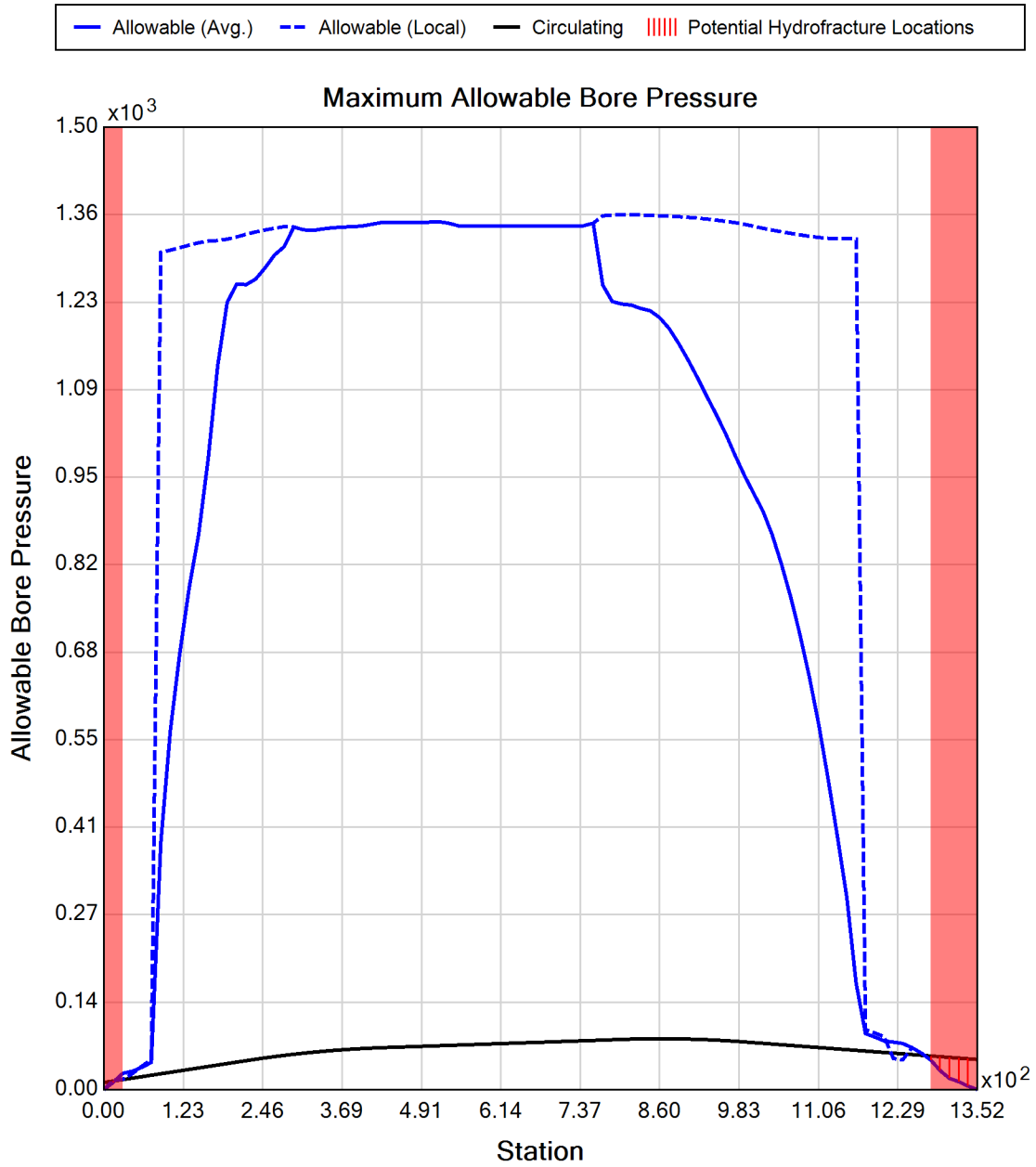
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 260.8





Generated Output



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Project Summary

General: Kiewit CHPE
Ref: New York
204-3701
Start Date: 04-29-2022
End Date: 03-17-2023

Designer: Aaron Coady
Tetra Tech Rooney
115 Inverness Drive, Suite 300
Englewood, Colorado
United States 80112
aaron.coady@tetrattech.com

Description: Segment 11 (Package 7A)
Conduit 3
HDD 115
DWG C-315.2

Input Summary

Start Coordinate	(0.00, 0.00, 33.87) ft
End Coordinate	(1349.00, 0.00, 54.01) ft
Project Length	1349.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	2.375 in
Pipe DR	7.0
Pipe Thickness	0.34 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 5

Soil Layer #1 USCS, Gravel (G), GC

Depth: 2.00 ft

Unit Weight: 16.3086 (dry), 18.2028 (sat) [lb/US (liquid) gallon]

Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Clay (C), CL

Depth: 4.00 ft

Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 145.00, Coh: 7.30 [psi]

Soil Layer #3 USCS, Silt (M), ML

Depth: 2.00 ft

Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #4 USCS, Gravel (G), GC

Depth: 8.00 ft

Unit Weight: 16.3086 (dry), 18.2028 (sat) [lb/US (liquid) gallon]

Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

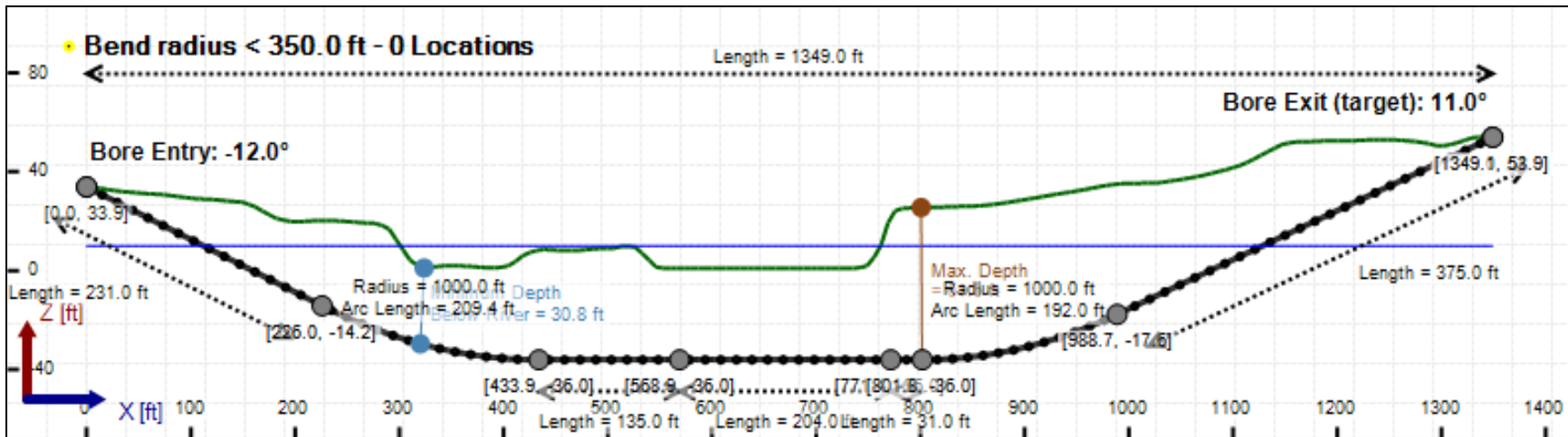
Soil Layer #5 Rock, Geological Classification, Sedimentary Rocks

Depth: 94.00 ft

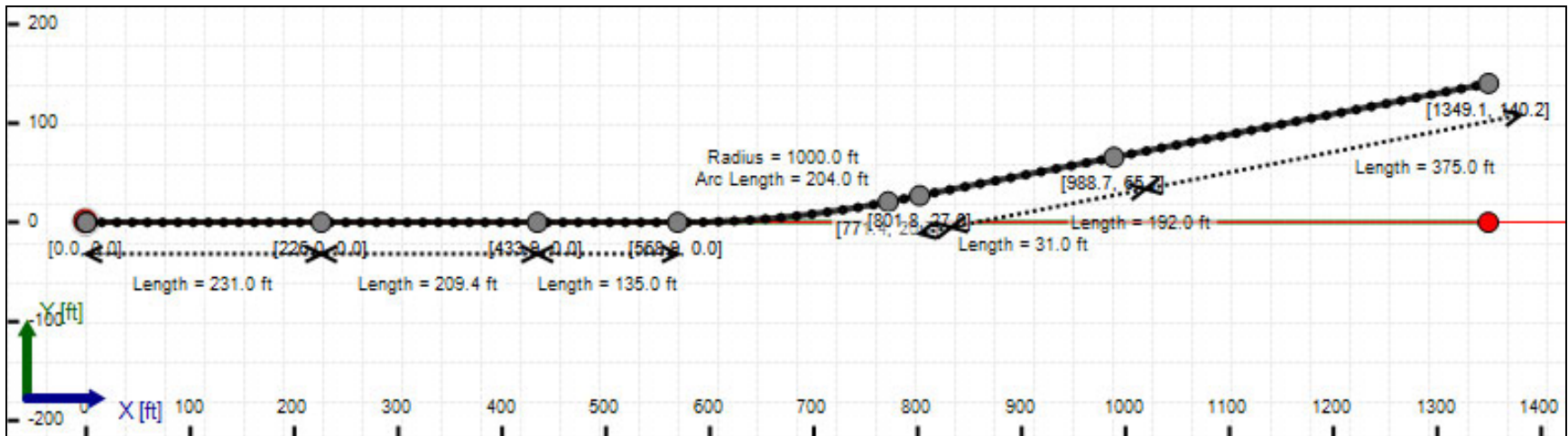
Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]

Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 2" (2.375")
Pipe DR: 7
Pipe Length: 1379.99 ft
Internal Pressure: 0 psi
Borehole Diameter: 0.531000018119812 ft
Silo Width: 0.531000018119812 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 7.92790 lb/US (liquid) gallon
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 12.51801 lb/US (liquid) gallon
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	2.5	49.2
Water Pressure	20.0	20.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	22.5	69.2
Deflection		
Earth Load Deflection	0.363	5.656
Buoyant Deflection	0.014	0.014
Reissner Effect	0	0
Net Deflection	0.376	5.670
Compressive Stress [psi]		
Compressive Wall Stress	78.6	242.2

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	1360.2	1360.2
Pullback Stress [psi]	626.9	626.9
Pullback Strain	1.090E-2	1.090E-2
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	626.9	630.7
Tensile Strain	1.090E-2	1.107E-2

Net External Pressure = 53.8 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.376	7.5	19.9	OK
Unconstrained Collapse [psi]	58.8	318.7	5.4	OK
Compressive Wall Stress [psi]	78.6	1150.0	14.6	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.007	7.5	1114.2	OK
Unconstrained Collapse [psi]	68.8	519.8	7.6	OK
Tensile Stress [psi]	630.7	1200.0	1.9	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	1353.070 psi	1363.561 psi
1	8.00 in	14.00 in	1352.774 psi	1363.397 psi
2	14.00 in	19.13 in	1352.393 psi	1363.185 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 200.00 US (liquid) gallon/min

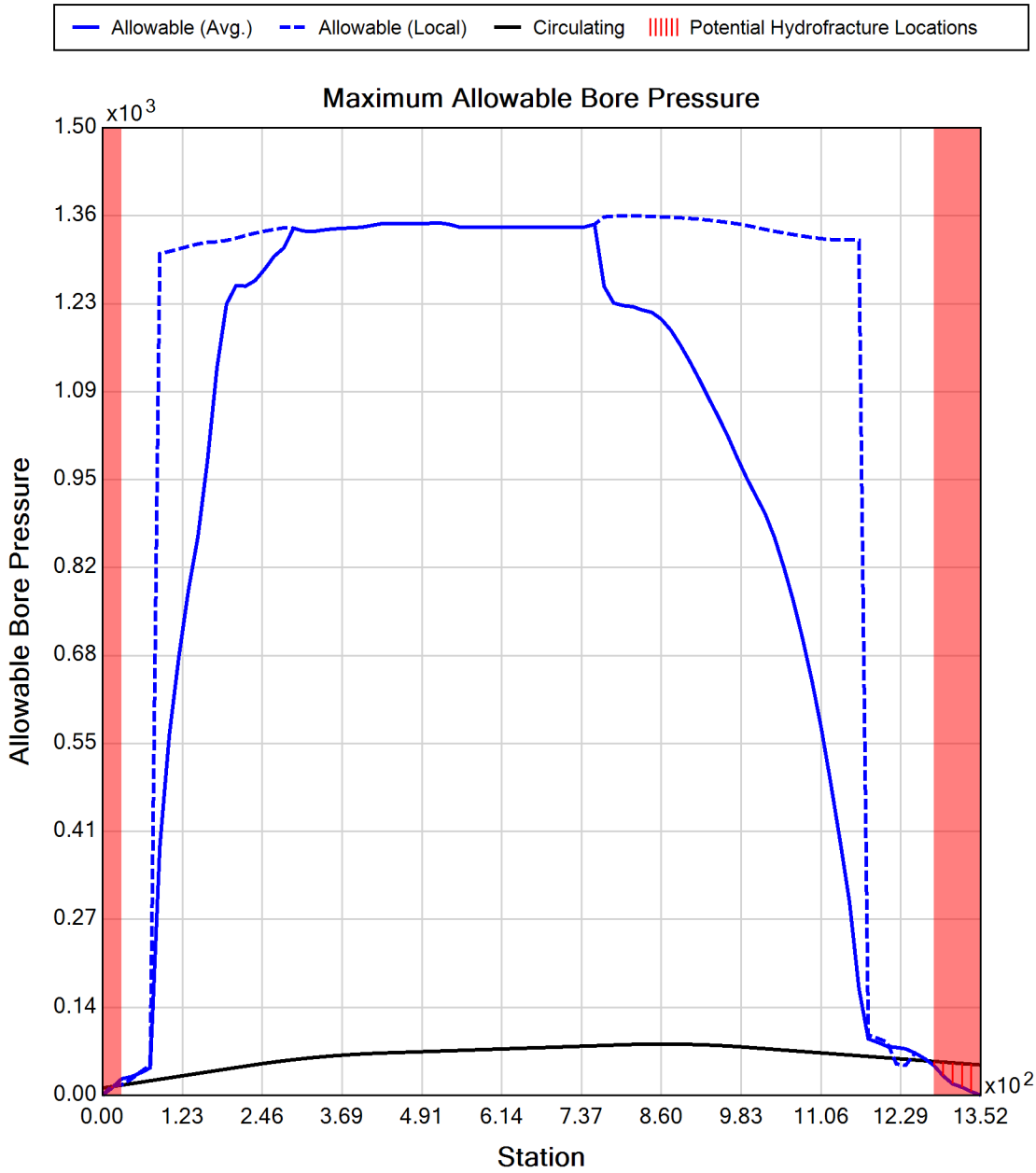
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 260.8





Generated Output



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Project Summary

General:

Kiewit CHPE
Ref: New York
204-3701
Start Date: 04-29-2022
End Date: 03-17-2023

Designer:

Aaron Coady
Tetra Tech Rooney
115 Inverness Drive, Suite 300
Englewood, Colorado
United States 80112
aaron.coady@tetrattech.com

Description:

Segment 11 (Package 7A)
Conduit 2 & 3 Equivalent Pipe Bundle
HDD 115
DWG C-315.2

Input Summary

Start Coordinate	(0.00, 0.00, 33.87) ft
End Coordinate	(1349.00, 0.00, 54.01) ft
Project Length	1349.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	16.000 in
Pipe DR	11.0
Pipe Thickness	1.45 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 16" (16")
Pipe DR: 11
Pipe Length: 1379.99 ft
Internal Pressure: 0 psi
Borehole Diameter: 2 ft
Silo Width: 2 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 7.92790 lb/US (liquid) gallon
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 12.51801 lb/US (liquid) gallon
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	9.3	49.2
Water Pressure	20.0	20.0
Surface Surge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	29.3	69.2
Deflection		
Earth Load Deflection	4.944	26.185
Buoyant Deflection	0.359	0.359
Reissner Effect	0	0
Net Deflection	5.303	26.544
Compressive Stress [psi]		
Compressive Wall Stress	160.9	380.6

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	30471.4	30471.4
Pullback Stress [psi]	458.4	458.4
Pullback Strain	7.973E-3	7.973E-3
Bending Stress [psi]	0.0	38.3
Bending Strain	0	6.667E-4
Tensile Stress [psi]	458.4	496.2
Tensile Strain	7.973E-3	9.297E-3

Net External Pressure = 24.6 [psi]

Buoyant Deflection = 0.2

Hydrokinetic Force = 1256.6 lb

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%] Unconstrained	0.176	7.5	42.6	OK
Collapse [psi] Tensile Stress	29.6	114.4	3.9	OK
[psi]	496.2	1200.0	2.4	OK



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Ref: New York
204-3701
Start Date: 04-29-2022
End Date: 03-17-2023

Designer:

Aaron Coady
Tetra Tech Rooney
115 Inverness Drive East, Suite 300
Englewood, Colorado
United States 80112
aaron.coady@tetrattech.com

Description:

Segment 11 Package 7A
Conduit 1
HDD# 117
DWG# C-317

Input Summary

Start Coordinate	(0.00, 0.00, 100.79) ft
End Coordinate	(735.00, 0.00, 101.29) ft
Project Length	735.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 6

Soil Layer #1 USCS, Sand (S), SP

Depth: 2.00 ft

Unit Weight: 14.6454 (dry), 16.9323 (sat) [lb/US (liquid) gallon]

Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Clay (C), CL

Depth: 2.00 ft

Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 400.00, Coh: 8.30 [psi]

Soil Layer #3 USCS, Silt (M), ML

Depth: 2.00 ft

Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #4 USCS, Silt (M), ML

Depth: 29.00 ft

Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #5 USCS, Silt (M), MH

Depth: 10.00 ft

Unit Weight: 10.9956 (dry), 14.5068 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

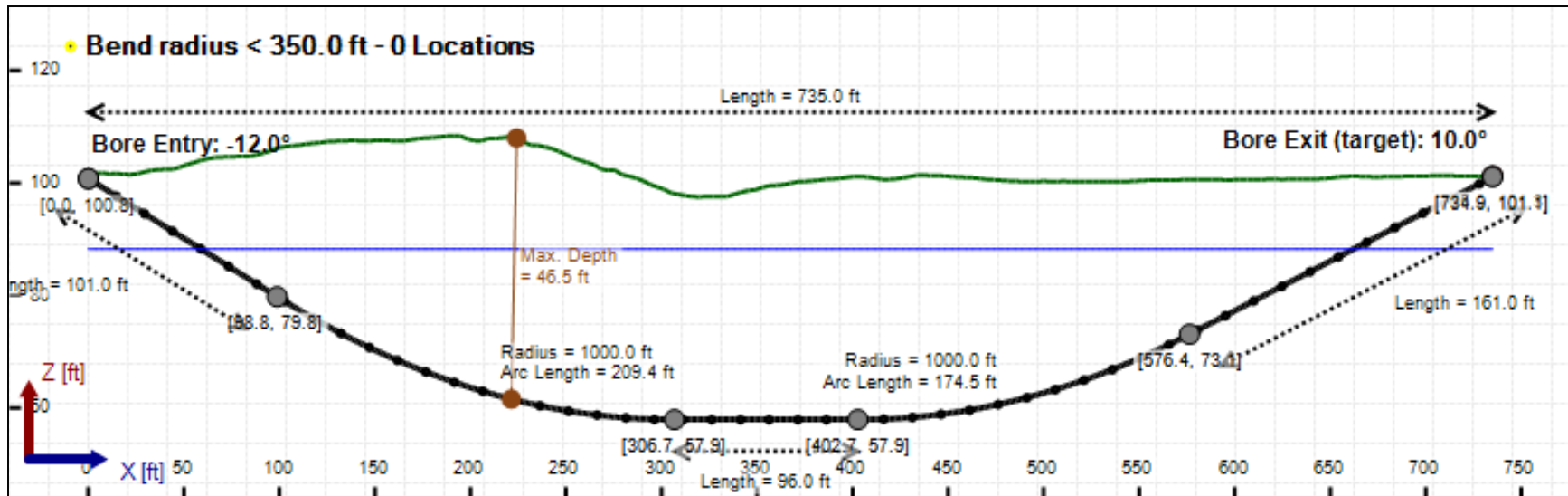
Soil Layer #6 USCS, Silt (M), ML

Depth: 37.00 ft

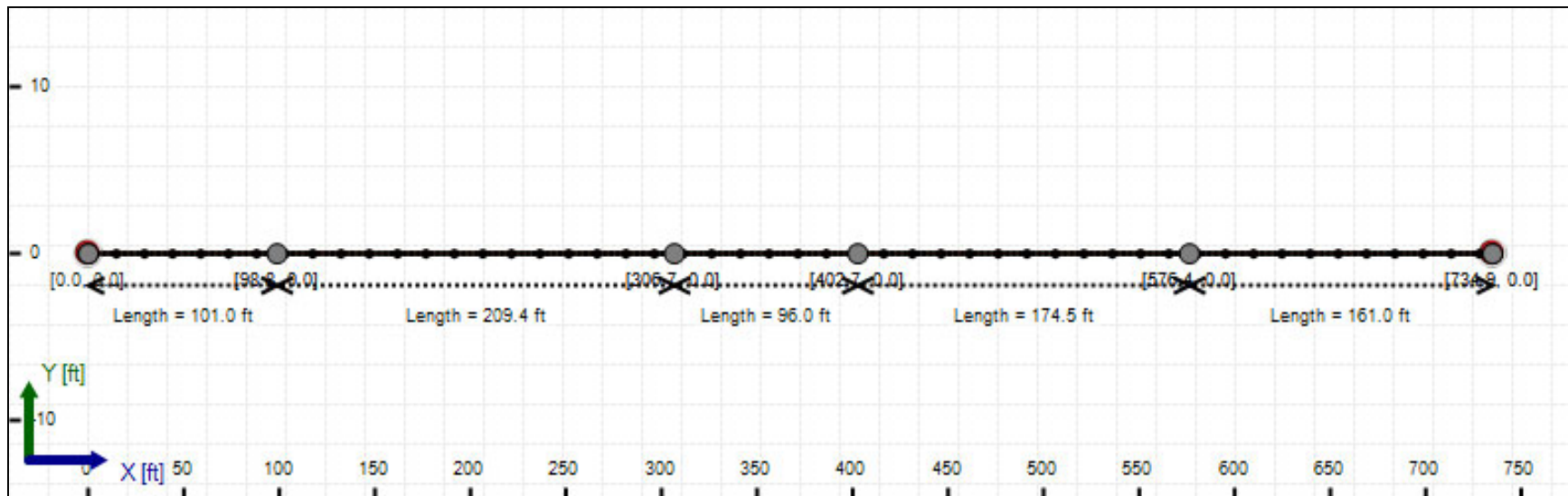
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 10" (10.75")
Pipe DR: 9
Pipe Length: 750.00 ft
Internal Pressure: 0 psi
Borehole Diameter: 1.34400002161662 ft
Silo Width: 1.34400002161662 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 7.92790 lb/US (liquid) gallon
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 12.51801 lb/US (liquid) gallon
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	20.0	26.3
Water Pressure	13.1	11.6
Surface Surge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	33.1	37.9
Deflection		
Earth Load Deflection	5.440	7.163
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	5.572	7.295
Compressive Stress [psi]		
Compressive Wall Stress	149.0	170.4

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	13164.4	13164.4
Pullback Stress [psi]	367.1	367.1
Pullback Strain	6.385E-3	6.385E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	367.1	392.7
Tensile Strain	6.385E-3	7.277E-3

Net External Pressure = 23.3 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	5.572	7.5	1.3	OK
Unconstrained Collapse [psi]	33.1	84.0	2.5	OK
Compressive Wall Stress [psi]	149.0	1150.0	7.7	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	38.9	234.0	6.0	OK
Tensile Stress [psi]	392.7	1200.0	3.1	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	68.231 psi	57.630 psi
1	8.00 in	12.00 in	68.201 psi	57.594 psi
2	12.00 in	16.13 in	68.157 psi	57.541 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 70.00 US (liquid) gallon/min

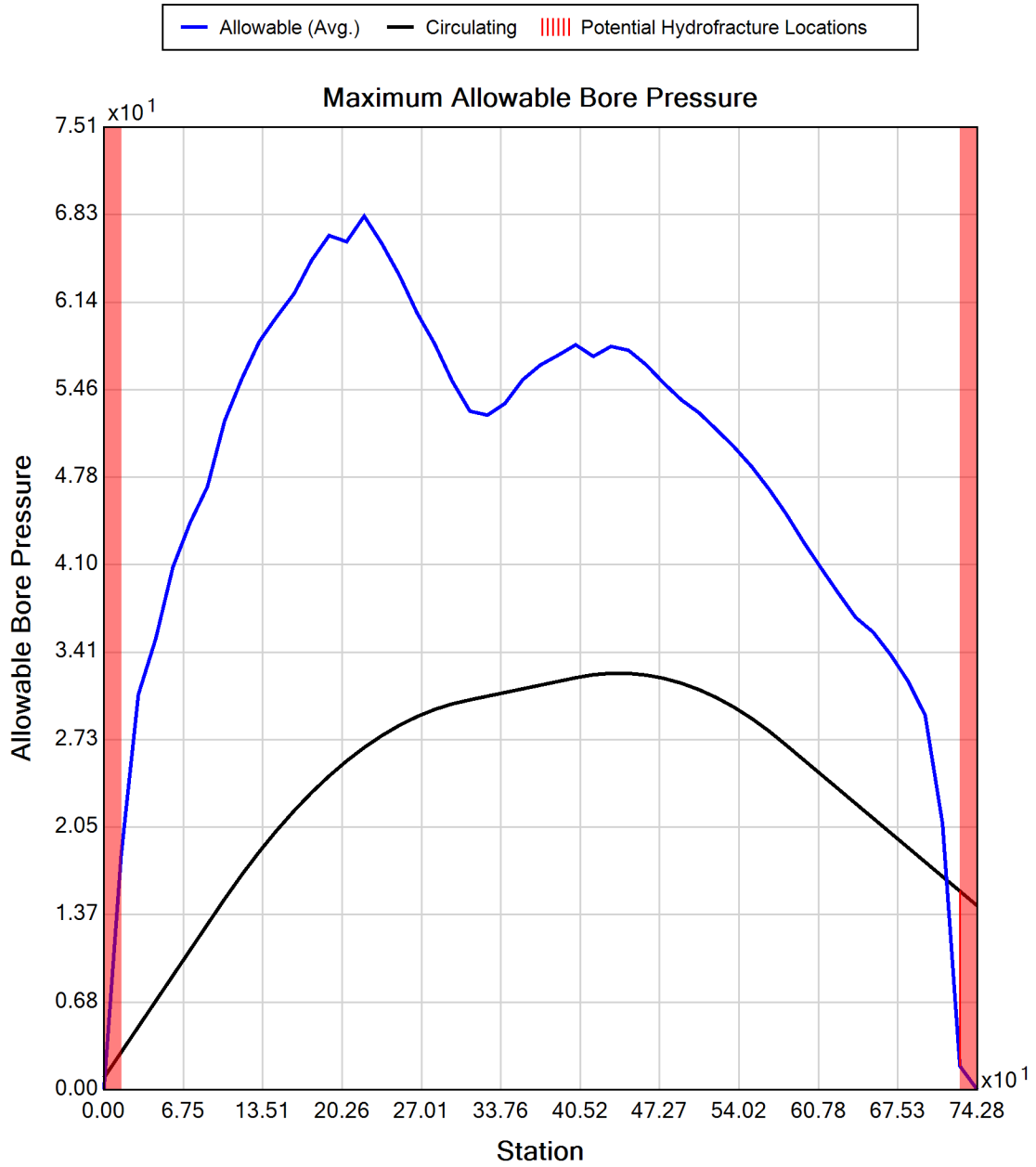
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 697.8





Generated Output



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Project Summary

General:

Kiewit - CHPE
Ref: New York
204-3701
Start Date: 04-29-2022
End Date: 03-17-2023

Designer:

Aaron Coady
Tetra Tech Rooney
115 Inverness Drive East, Suite 300
Englewood, Colorado
United States 80112
aaron.coady@tetrattech.com

Description:

Segment 11 (Package 7A)
Conduit 2
HDD# 117
DWG# C-317.2

Input Summary

Start Coordinate	(0.00, 0.00, 105.20) ft
End Coordinate	(790.00, 0.00, 101.50) ft
Project Length	790.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 6

Soil Layer #1 USCS, Sand (S), SP

Depth: 2.00 ft

Unit Weight: 14.6454 (dry), 16.9323 (sat) [lb/US (liquid) gallon]

Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Clay (C), CL

Depth: 2.00 ft

Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 400.00, Coh: 8.30 [psi]

Soil Layer #3 USCS, Silt (M), ML

Depth: 2.00 ft

Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #4 USCS, Silt (M), ML

Depth: 29.00 ft

Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #5 USCS, Silt (M), MH

Depth: 10.00 ft

Unit Weight: 10.9956 (dry), 14.5068 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

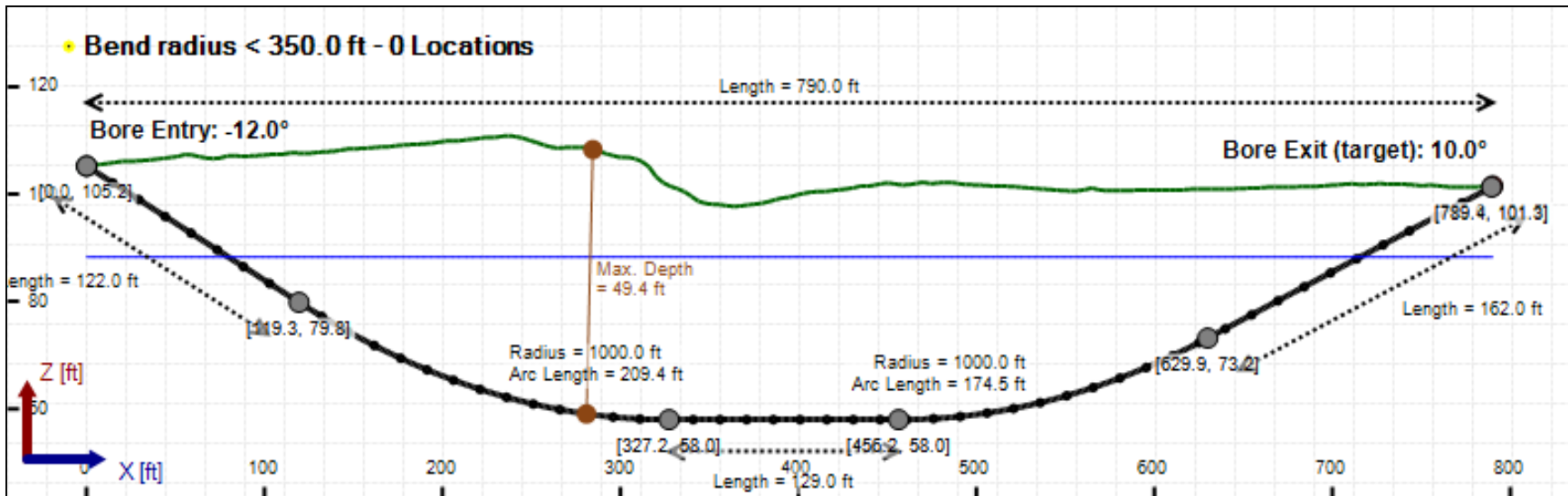
Soil Layer #6 USCS, Silt (M), ML

Depth: 37.00 ft

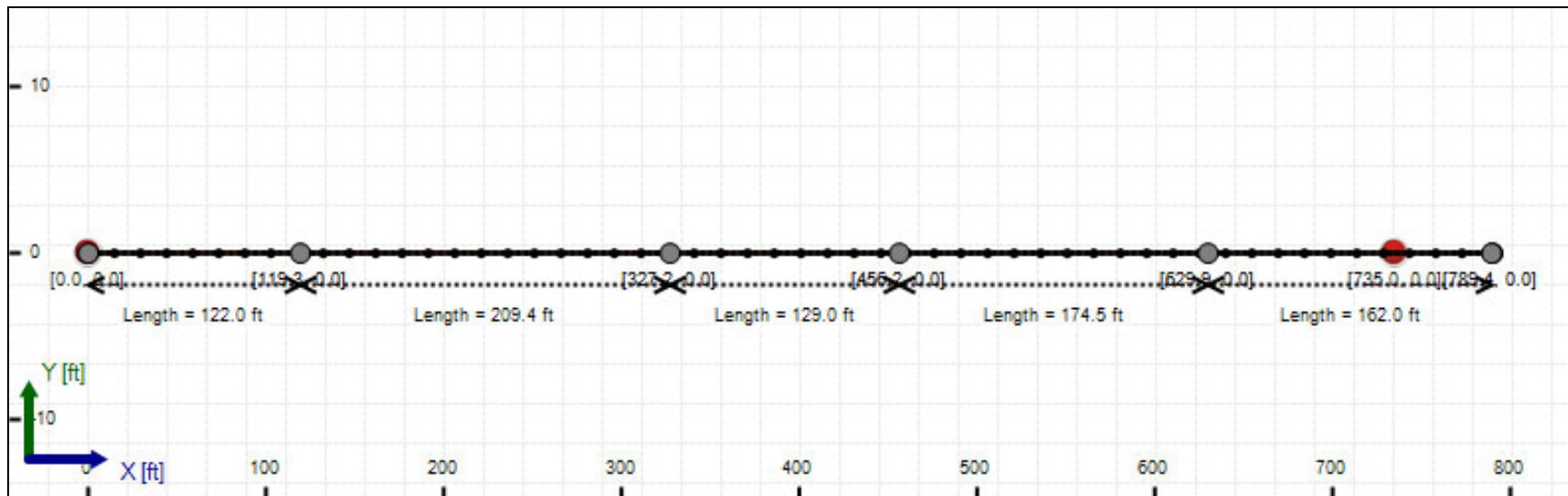
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 10" (10.75")
Pipe DR: 9
Pipe Length: 810.00 ft
Internal Pressure: 0 psi
Borehole Diameter: 1.34400002161662 ft
Silo Width: 1.34400002161662 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 7.92790 lb/US (liquid) gallon
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 12.51801 lb/US (liquid) gallon
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	22.3	27.0
Water Pressure	13.1	12.7
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	35.5	39.6
Deflection		
Earth Load Deflection	6.081	7.491
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	6.213	7.623
Compressive Stress [psi]		
Compressive Wall Stress	159.5	178.4

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	14047.1	14047.1
Pullback Stress [psi]	391.8	391.8
Pullback Strain	6.813E-3	6.813E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	391.8	416.2
Tensile Strain	6.813E-3	7.685E-3

Net External Pressure = 26.2 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	6.213	7.5	1.2	OK
Unconstrained Collapse [psi]	35.5	79.4	2.2	OK
Compressive Wall Stress [psi]	159.5	1150.0	7.2	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	40.7	232.7	5.7	OK
Tensile Stress [psi]	416.2	1200.0	2.9	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	67.320 psi	59.415 psi
1	8.00 in	12.00 in	67.294 psi	59.383 psi
2	12.00 in	16.13 in	67.256 psi	59.336 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 70.00 US (liquid) gallon/min

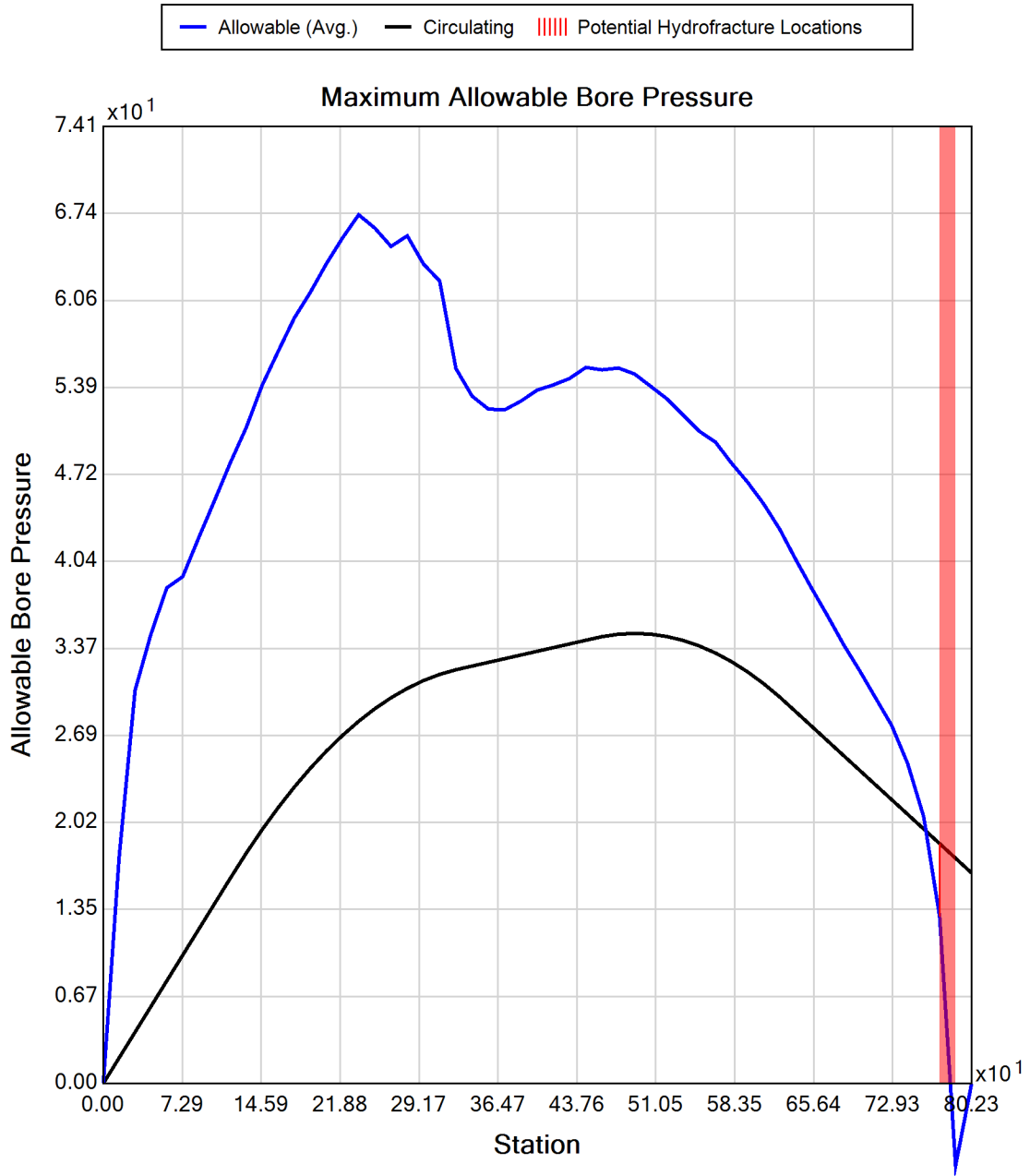
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 697.8





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Project Summary

General:

Kiewit - CHPE
Ref: New York
204-3701
Start Date: 04-29-2022
End Date: 03-17-2023

Designer:

Aaron Coady
Tetra Tech Rooney
115 Inverness Drive East, Suite 300
Englewood, Colorado
United States 80112
aaron.coady@tetrattech.com

Description:

Segment 11 (Package 7A)
Conduit 3
HDD# 117
DWG# C-317.2

Input Summary

Start Coordinate	(0.00, 0.00, 105.20) ft
End Coordinate	(790.00, 0.00, 101.50) ft
Project Length	790.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	2.375 in
Pipe DR	7.0
Pipe Thickness	0.34 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 6

Soil Layer #1 USCS, Sand (S), SP

Depth: 2.00 ft

Unit Weight: 14.6454 (dry), 16.9323 (sat) [lb/US (liquid) gallon]

Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Clay (C), CL

Depth: 2.00 ft

Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 400.00, Coh: 8.30 [psi]

Soil Layer #3 USCS, Silt (M), ML

Depth: 2.00 ft

Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #4 USCS, Silt (M), ML

Depth: 29.00 ft

Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #5 USCS, Silt (M), MH

Depth: 10.00 ft

Unit Weight: 10.9956 (dry), 14.5068 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

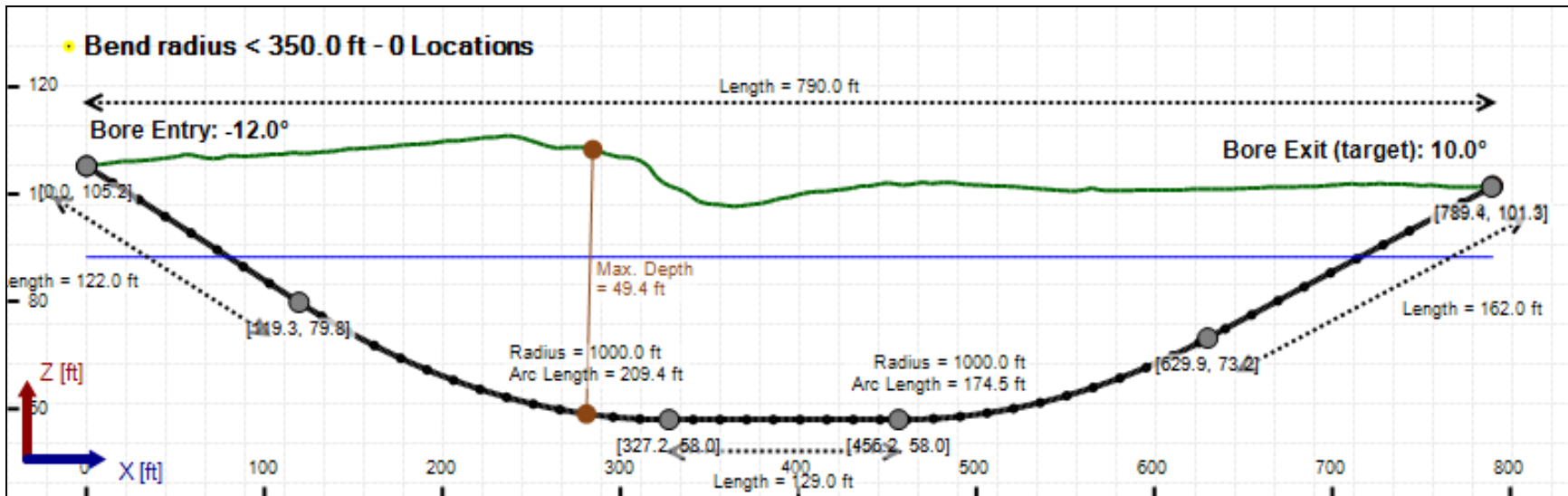
Soil Layer #6 USCS, Silt (M), ML

Depth: 37.00 ft

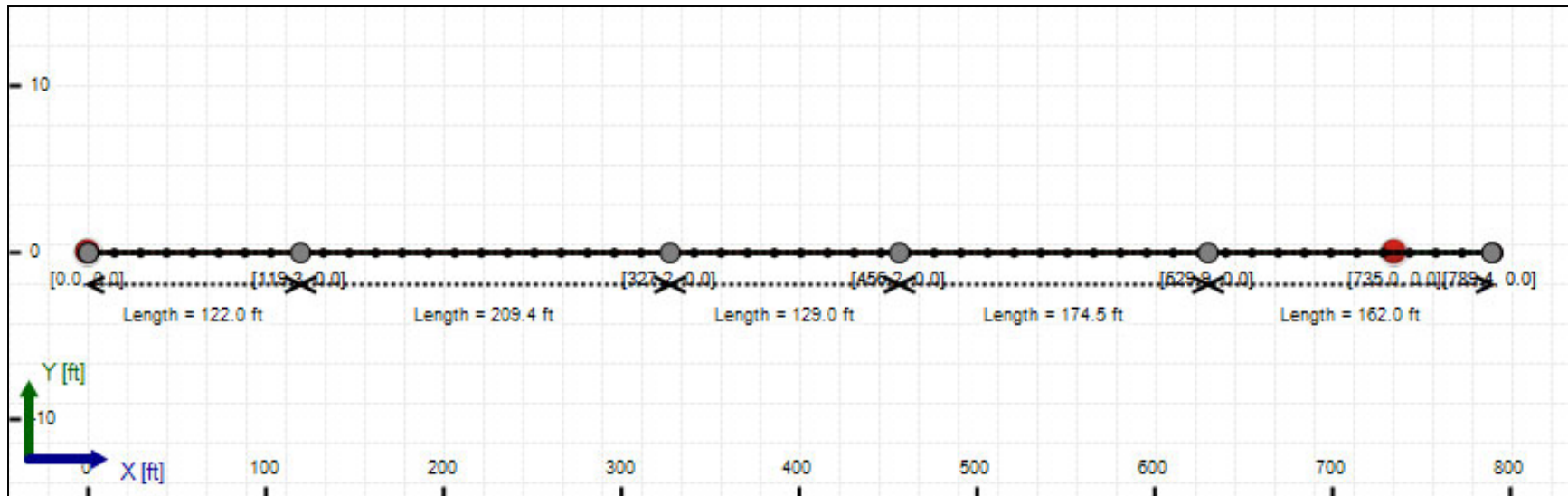
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 2" (2.375")
Pipe DR: 7
Pipe Length: 810.00 ft
Internal Pressure: 0 psi
Borehole Diameter: 0.531000018119812 ft
Silo Width: 0.531000018119812 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 7.92790 lb/US (liquid) gallon
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 12.51801 lb/US (liquid) gallon
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	22.3	27.0
Water Pressure	13.1	12.7
Surface Surge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	35.5	39.6
Deflection		
Earth Load Deflection	2.566	3.160
Buoyant Deflection	0.014	0.014
Reissner Effect	0	0
Net Deflection	2.579	3.174
Compressive Stress [psi]		
Compressive Wall Stress	124.1	138.7

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	765.5	765.5
Pullback Stress [psi]	352.8	352.8
Pullback Strain	6.135E-3	6.135E-3
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	352.8	358.3
Tensile Strain	6.135E-3	6.331E-3

Net External Pressure = 26.2 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	2.579	7.5	2.9	OK
Unconstrained Collapse [psi]	35.5	259.8	7.3	OK
Compressive Wall Stress [psi]	124.1	1150.0	9.3	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.007	7.5	1114.2	OK
Unconstrained Collapse [psi]	40.7	560.1	13.8	OK
Tensile Stress [psi]	358.3	1200.0	3.3	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	67.320 psi	59.415 psi
1	8.00 in	12.00 in	67.294 psi	59.383 psi
2	12.00 in	16.13 in	67.256 psi	59.336 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 70.00 US (liquid) gallon/min

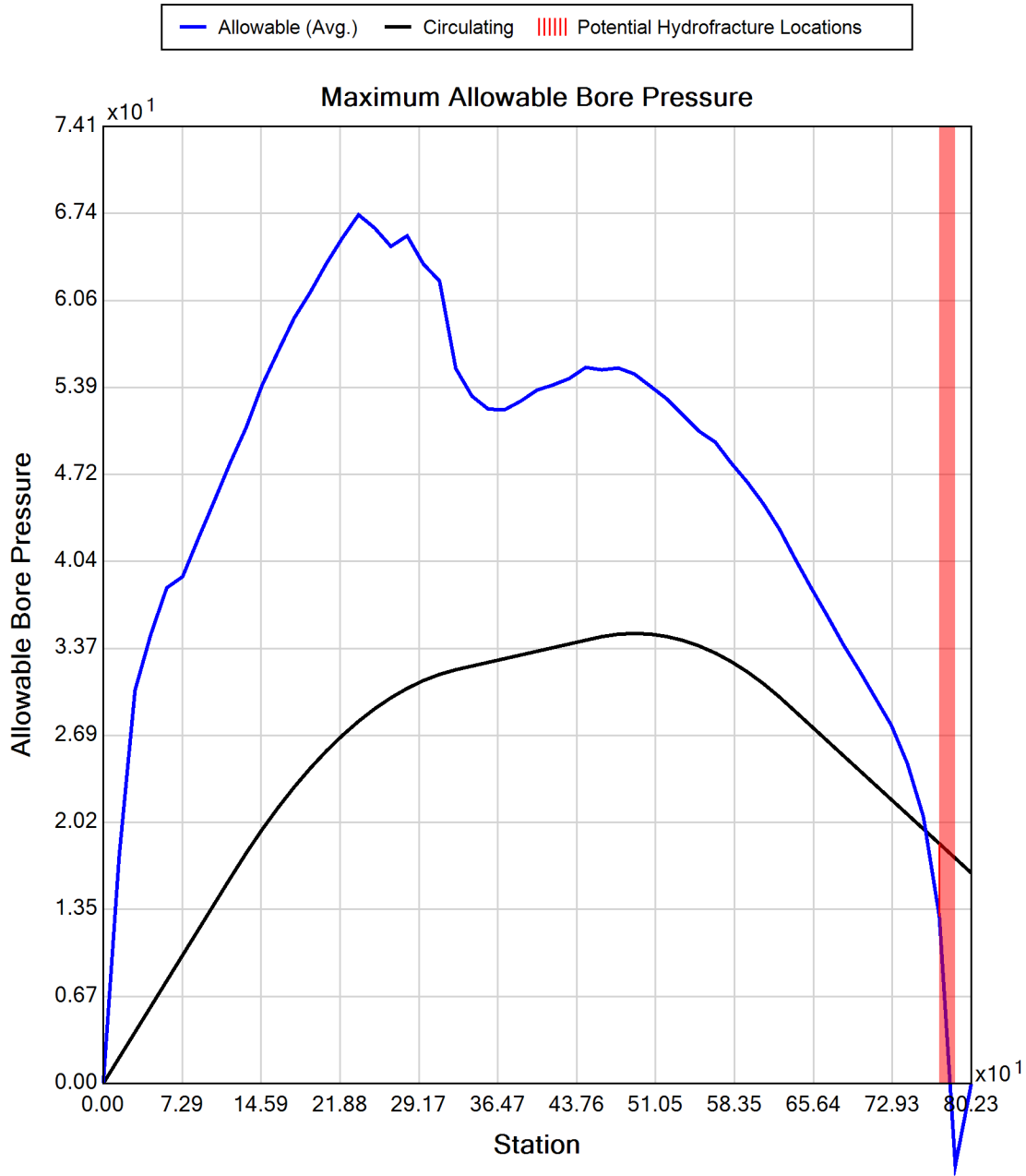
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General: Kiewit - CHPE
Ref: New York
204-3701
Start Date: 04-29-2022
End Date: 03-17-2023

Designer: Aaron Coady
Tetra Tech Rooney
115 Inverness Drive East, Suite 300
Englewood, Colorado
United States 80112
aaron.coady@tetrattech.com

Description: Segment 11 (Package 7A)
Conduit 2 & 3 Equivalent Pipe Bundle
HDD# 117
DWG# C-317.2

Input Summary

Start Coordinate	(0.00, 0.00, 105.20) ft
End Coordinate	(790.00, 0.00, 101.50) ft
Project Length	790.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	14.000 in
Pipe DR	14.3
Pipe Thickness	0.98 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 14" (14")
Pipe DR: 14.3
Pipe Length: 810.00 ft
Internal Pressure: 0 psi
Borehole Diameter: 1.75 ft
Silo Width: 1.75 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 7.92790 lb/US (liquid) gallon
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 12.51801 lb/US (liquid) gallon
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	22.3	27.0
Water Pressure	13.1	12.7
Surface Surge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	35.5	39.6
Deflection		
Earth Load Deflection	27.943	34.419
Buoyant Deflection	0.690	0.690
Reissner Effect	0	0
Net Deflection	28.633	35.109
Compressive Stress [psi]		
Compressive Wall Stress	253.5	283.4

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	11897.2	11897.2
Pullback Stress [psi]	297.1	297.1
Pullback Strain	5.166E-3	5.166E-3
Bending Stress [psi]	33.5	33.5
Bending Strain	5.833E-4	5.833E-4
Tensile Stress [psi]	330.6	330.6
Tensile Strain	6.333E-3	6.333E-3

Net External Pressure = 16.1 [psi]

Buoyant Deflection = 0.3

Hydrokinetic Force = 962.1 lb

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.338	7.5	22.2	OK
Unconstrained Collapse [psi]	20.2	50.2	2.5	OK
Tensile Stress [psi]	330.6	1200.0	3.6	OK



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204-3701
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End Date: 03-17-2023

Designer:

Aaron Coady
Tetra Tech Rooney
115 Inverness Drive East, Suite 300
Englewood, Colorado
United States 80112
aaron.coady@tetrattech.com

Description:

Segment 11 (Package 7A)
Conduit 1
HDD 118
DWG C-318

Input Summary

Start Coordinate	(0.00, 0.00, 134.19) ft
End Coordinate	(850.00, 0.00, 122.96) ft
Project Length	850.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 4

Soil Layer #1 USCS, Gravel (G), GW

From Assistant

Unit Weight: 17.3250 (dry), 18.9651 (sat) [lb/US (liquid) gallon]

Phi: 40.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Silt (M), MH

From Assistant

Unit Weight: 10.9956 (dry), 14.5068 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #3 USCS, Clay (C), CL

From Assistant

Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 200.00, Coh: 3.10 [psi]

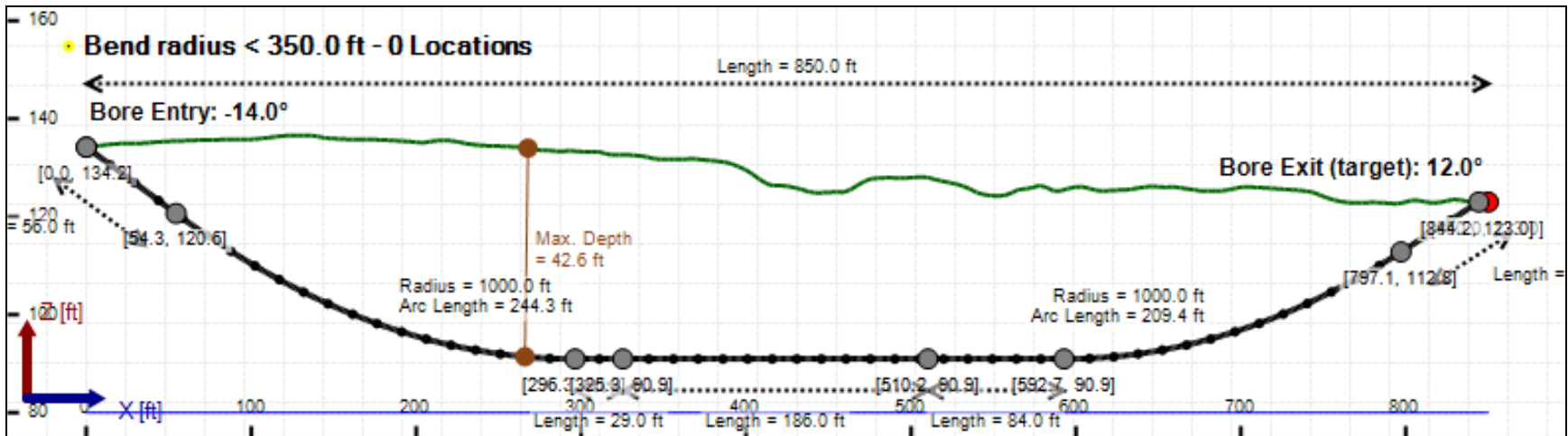
Soil Layer #4 Rock, Geological Classification, Sedimentary Rocks

From Assistant

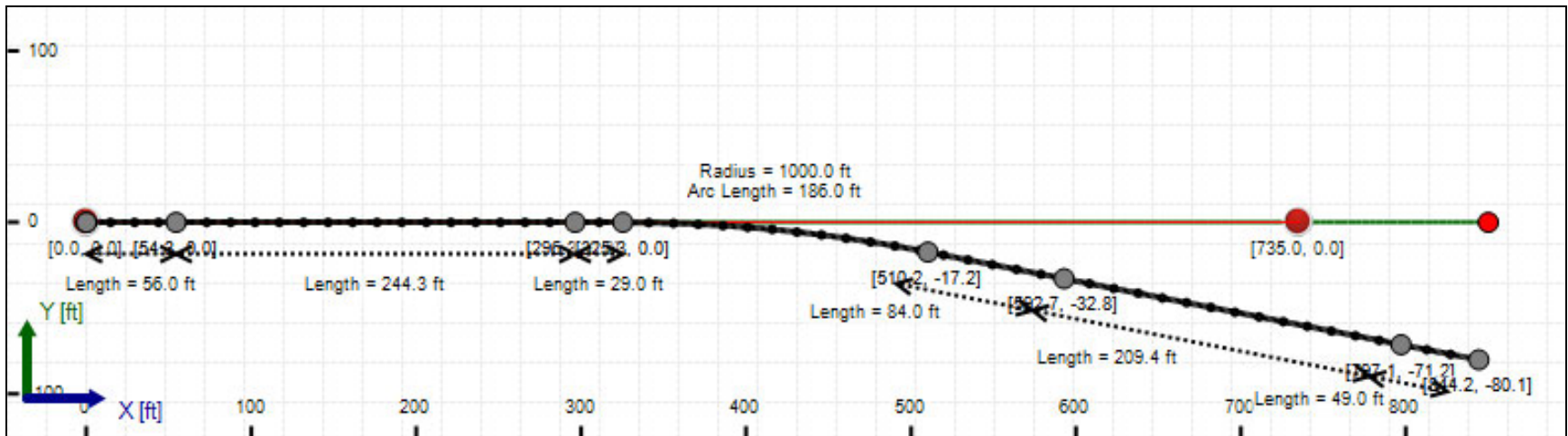
Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]

Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 10" (10.75")
Pipe DR: 9
Pipe Length: 869.99 ft
Internal Pressure: 0 psi
Borehole Diameter: 1.34400002161662 ft
Silo Width: 1.34400002161662 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 7.92790 lb/US (liquid) gallon
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 12.51801 lb/US (liquid) gallon
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	21.0	31.9
Water Pressure	0.0	0.0
Surface Surge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	21.0	31.9
Deflection		
Earth Load Deflection	5.731	8.693
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	5.863	8.825
Compressive Stress [psi]		
Compressive Wall Stress	94.7	143.6

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	15404.2	15404.2
Pullback Stress [psi]	429.6	429.6
Pullback Strain	7.471E-3	7.471E-3
Bending Stress [psi]	25.8	25.8
Bending Strain	4.479E-4	4.479E-4
Tensile Stress [psi]	455.4	455.4
Tensile Strain	8.367E-3	8.367E-3

Net External Pressure = 19.4 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	5.863	7.5	1.3	OK
Unconstrained Collapse [psi]	27.8	81.9	2.9	OK
Compressive Wall Stress [psi]	94.7	1150.0	12.1	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	38.1	230.3	6.0	OK
Tensile Stress [psi]	455.4	1200.0	2.6	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	897.113 psi	1329.103 psi
1	8.00 in	12.00 in	896.960 psi	1328.895 psi
2	12.00 in	16.13 in	896.737 psi	1328.594 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 70.00 US (liquid) gallon/min

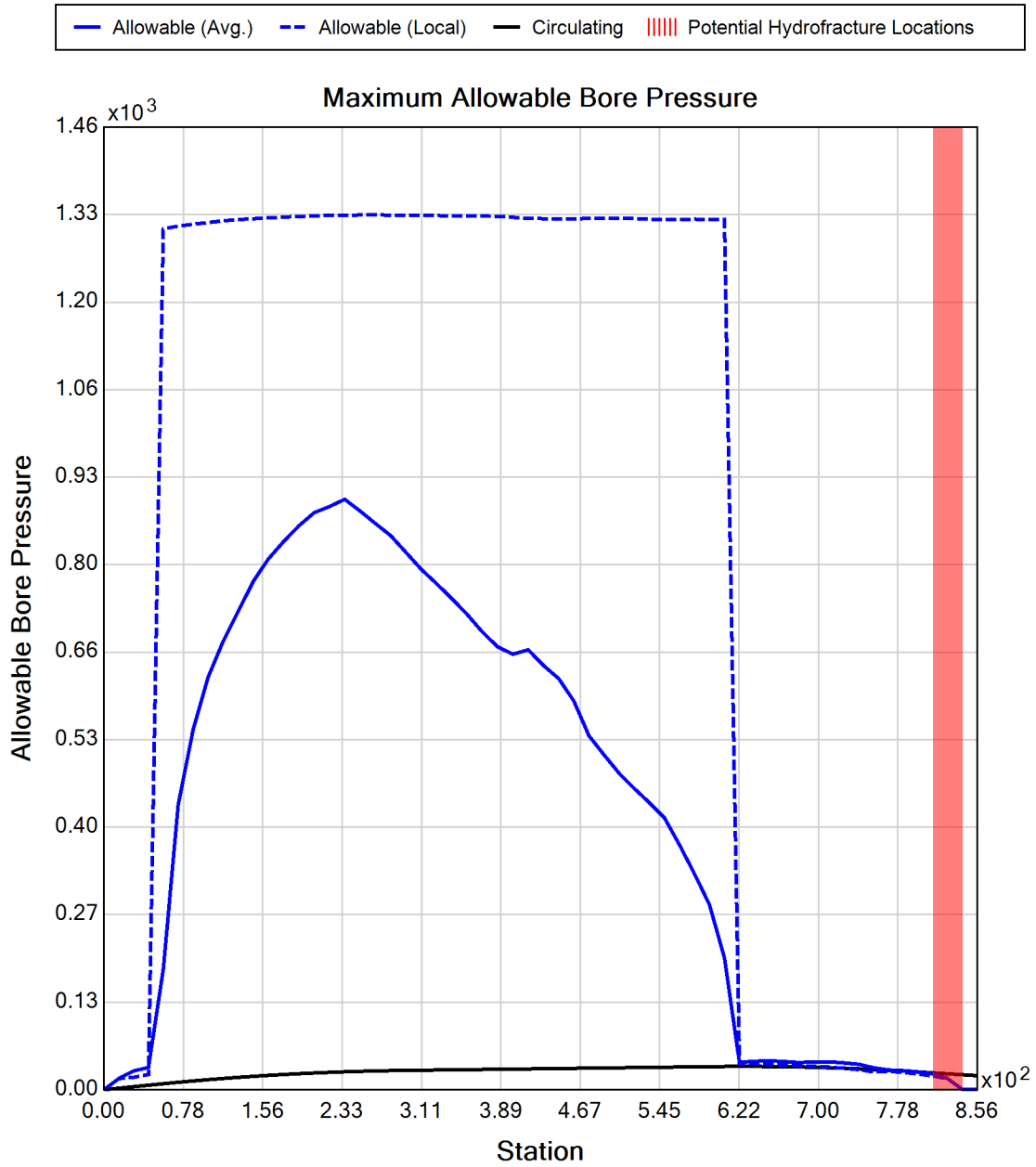
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 697.8





Generated Output



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Project Summary

General:

Kiewit - CHPE
Ref: New York
204-3701
Start Date: 04-29-2022
End Date: 03-17-2023

Designer:

Aaron Coady
Tetra Tech Rooney
115 Inverness Drive East, Suite 300
Englewood, Colorado
United States 80112
aaron.coady@tetrattech.com

Description:

Segment 11 (Package 7A)
Conduit 2
HDD 118
DWG C-318.2

Input Summary

Start Coordinate	(0.00, 0.00, 133.93) ft
End Coordinate	(854.50, 0.00, 121.52) ft
Project Length	854.50 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 4

Soil Layer #1 USCS, Gravel (G), GW

From Assistant

Unit Weight: 17.3250 (dry), 18.9651 (sat) [lb/US (liquid) gallon]

Phi: 40.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Silt (M), MH

From Assistant

Unit Weight: 10.9956 (dry), 14.5068 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #3 USCS, Clay (C), CL

From Assistant

Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 200.00, Coh: 3.10 [psi]

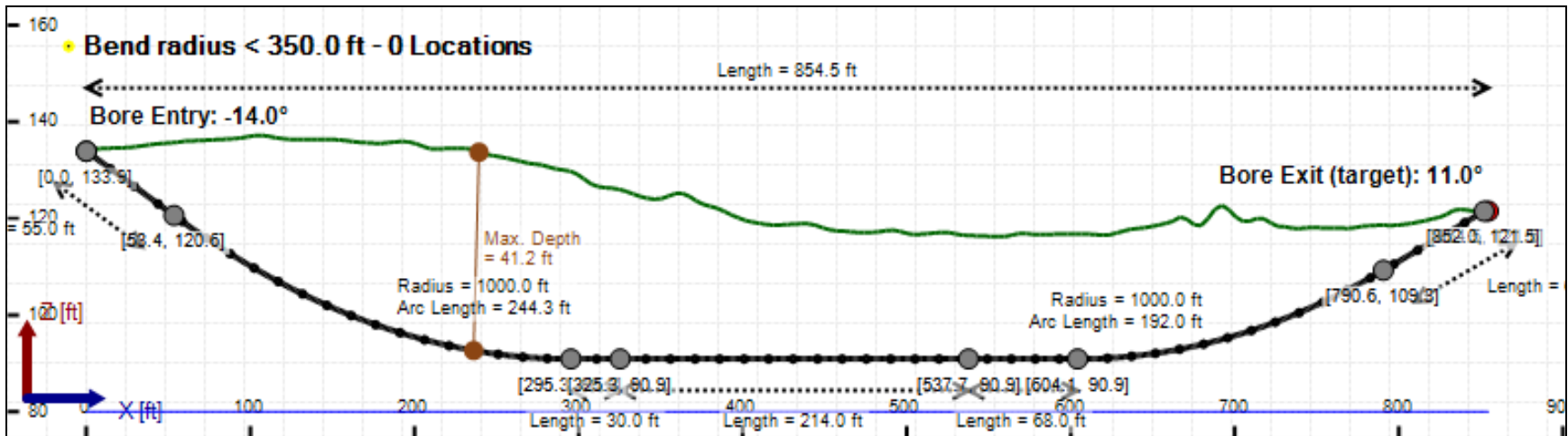
Soil Layer #4 Rock, Geological Classification, Sedimentary Rocks

From Assistant

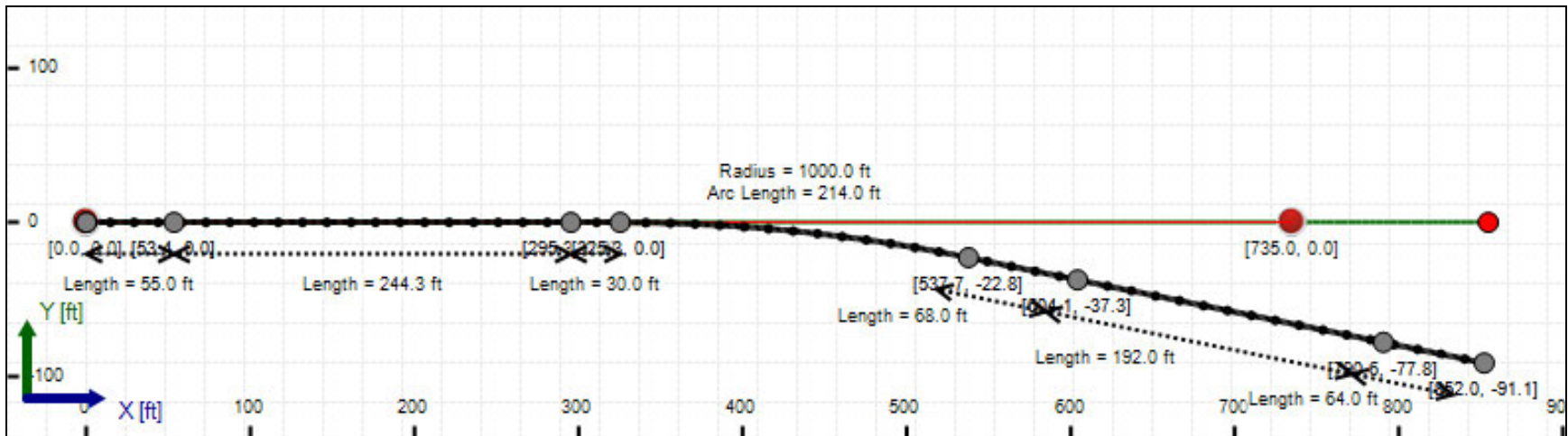
Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]

Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 10" (10.75")
Pipe DR: 9
Pipe Length: 869.99 ft
Internal Pressure: 0 psi
Borehole Diameter: 1.34400002161662 ft
Silo Width: 1.34400002161662 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 7.92790 lb/US (liquid) gallon
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 12.51801 lb/US (liquid) gallon
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	18.8	31.2
Water Pressure	0.0	0.0
Surface Surge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	18.8	31.2
Deflection		
Earth Load Deflection	5.112	8.492
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	5.244	8.624
Compressive Stress [psi]		
Compressive Wall Stress	84.5	140.3

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	15189.1	15189.1
Pullback Stress [psi]	423.6	423.6
Pullback Strain	7.367E-3	7.367E-3
Bending Stress [psi]	25.8	25.8
Bending Strain	4.479E-4	4.479E-4
Tensile Stress [psi]	449.4	449.4
Tensile Strain	8.263E-3	8.263E-3

Net External Pressure = 19.4 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	5.244	7.5	1.4	OK
Unconstrained Collapse [psi]	27.9	87.2	3.1	OK
Compressive Wall Stress [psi]	84.5	1150.0	13.6	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	37.9	230.5	6.1	OK
Tensile Stress [psi]	449.4	1200.0	2.7	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	903.267 psi	1328.479 psi
1	8.00 in	12.00 in	903.110 psi	1328.261 psi
2	12.00 in	16.13 in	902.881 psi	1327.943 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 70.00 US (liquid) gallon/min

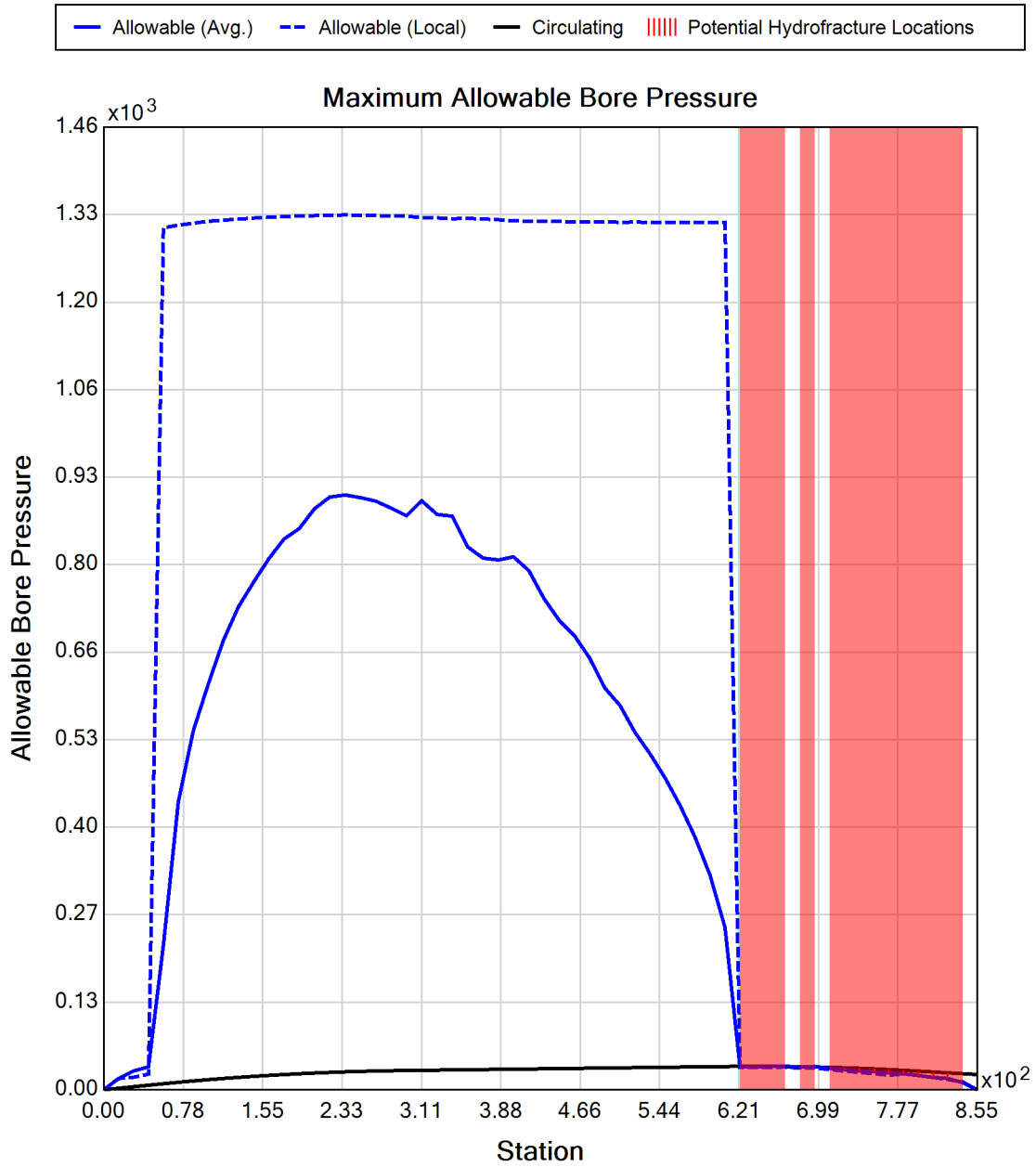
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 697.8





Generated Output



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Project Summary

General:

Kiewit - CHPE
Ref: New York
204-3701
Start Date: 04-29-2022
End Date: 03-17-2023

Designer:

Aaron Coady
Tetra Tech Rooney
115 Inverness Drive East, Suite 300
Englewood, Colorado
United States 80112
aaron.coady@tetrattech.com

Description:

Segment 11 (Package 7A)
Conduit 3
HDD 118
DWG C-318.2

Input Summary

Start Coordinate	(0.00, 0.00, 133.93) ft
End Coordinate	(854.50, 0.00, 121.52) ft
Project Length	854.50 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	2.375 in
Pipe DR	7.0
Pipe Thickness	0.34 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 4

Soil Layer #1 USCS, Gravel (G), GW

From Assistant

Unit Weight: 17.3250 (dry), 18.9651 (sat) [lb/US (liquid) gallon]

Phi: 40.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Silt (M), MH

From Assistant

Unit Weight: 10.9956 (dry), 14.5068 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #3 USCS, Clay (C), CL

From Assistant

Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 200.00, Coh: 3.10 [psi]

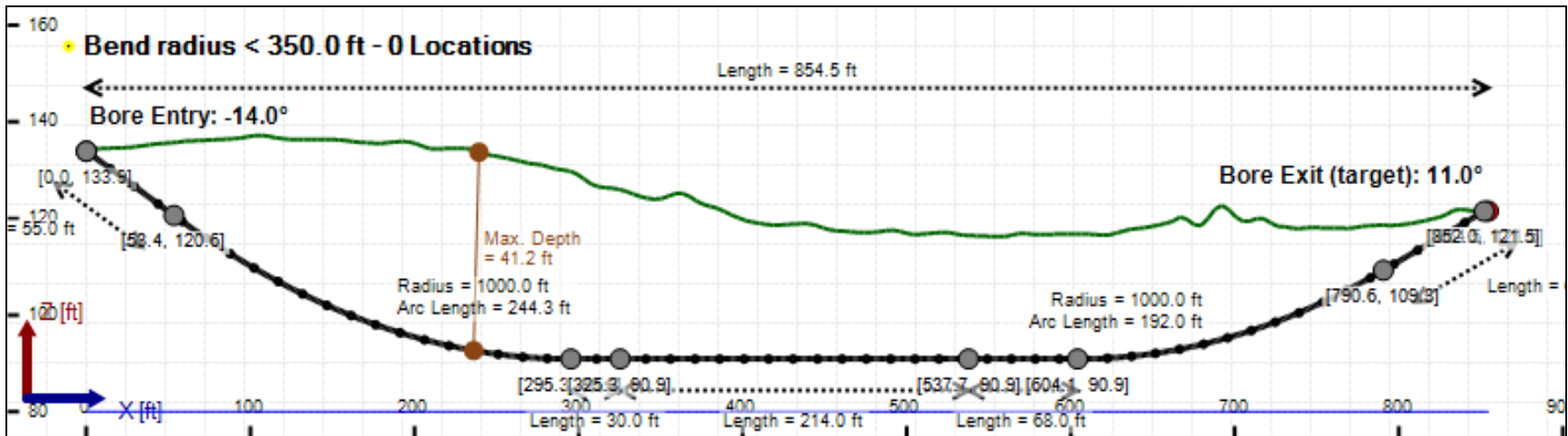
Soil Layer #4 Rock, Geological Classification, Sedimentary Rocks

From Assistant

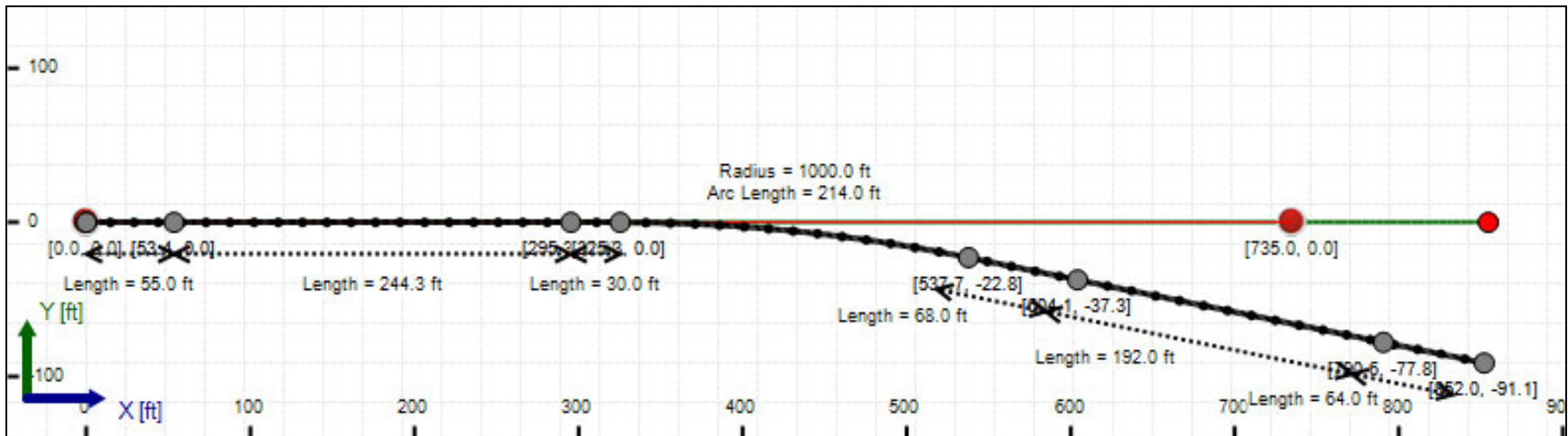
Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]

Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 2" (2.375")
Pipe DR: 7
Pipe Length: 869.99 ft
Internal Pressure: 0 psi
Borehole Diameter: 0.531000018119812 ft
Silo Width: 0.531000018119812 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 7.92790 lb/US (liquid) gallon
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 12.51801 lb/US (liquid) gallon
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	18.8	31.2
Water Pressure	0.0	0.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	18.8	31.2
Deflection		
Earth Load Deflection	2.157	3.583
Buoyant Deflection	0.014	0.014
Reissner Effect	0	0
Net Deflection	2.170	3.596
Compressive Stress [psi]		
Compressive Wall Stress	65.7	109.1

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	814.0	814.0
Pullback Stress [psi]	375.1	375.1
Pullback Strain	6.524E-3	6.524E-3
Bending Stress [psi]	5.7	5.7
Bending Strain	9.896E-5	9.896E-5
Tensile Stress [psi]	380.8	380.8
Tensile Strain	6.722E-3	6.722E-3

Net External Pressure = 23.8 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	2.170	7.5	3.5	OK
Unconstrained Collapse [psi]	27.9	270.4	9.7	OK
Compressive Wall Stress [psi]	65.7	1150.0	17.5	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.007	7.5	1114.2	OK
Unconstrained Collapse [psi]	38.0	556.7	14.7	OK
Tensile Stress [psi]	380.8	1200.0	3.2	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	903.267 psi	1328.479 psi
1	8.00 in	12.00 in	903.110 psi	1328.261 psi
2	12.00 in	16.13 in	902.881 psi	1327.943 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 70.00 US (liquid) gallon/min

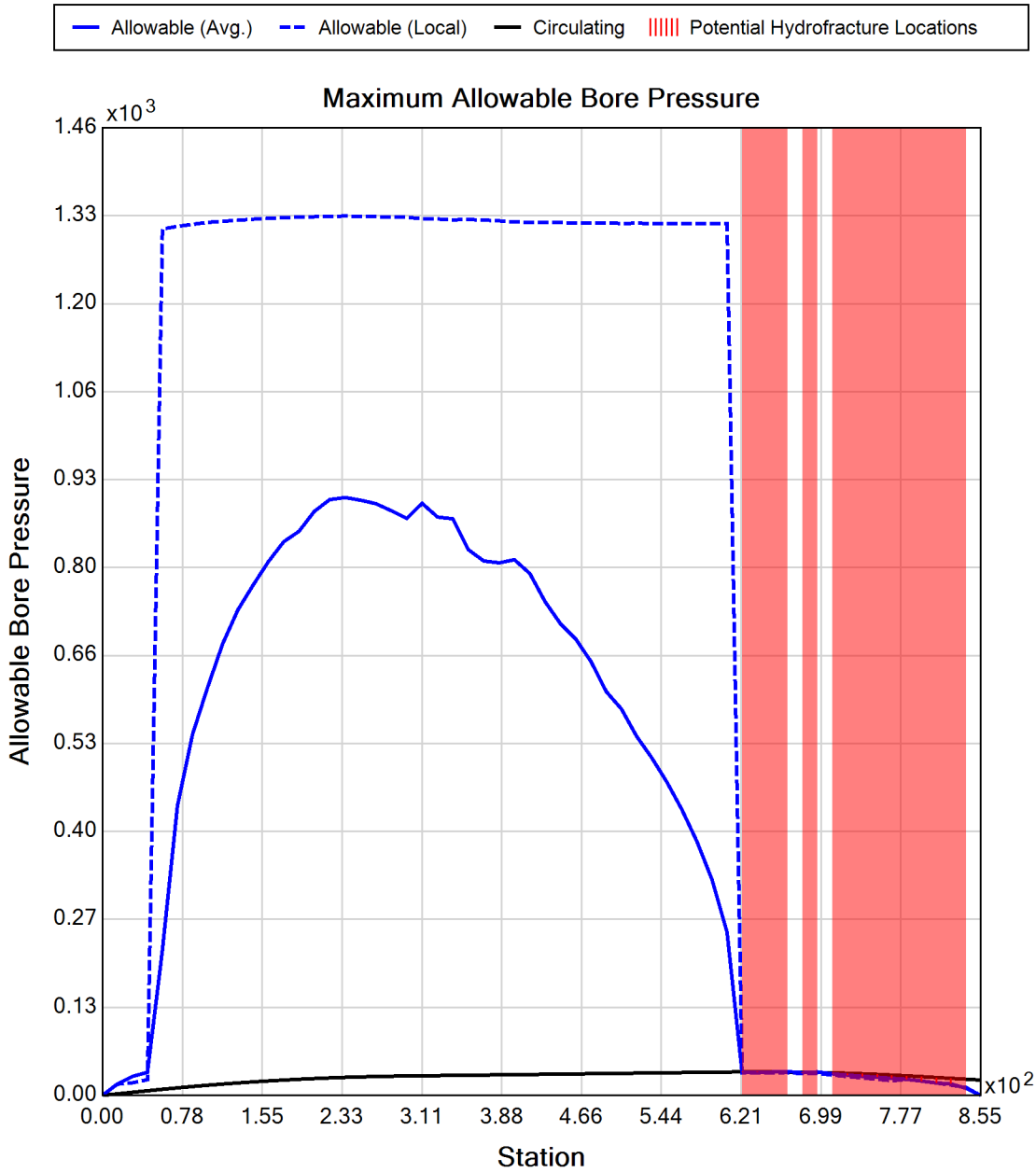
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 697.8





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General: Kiewit - CHPE
Ref: New York
204-3701
Start Date: 04-29-2022
End Date: 03-17-2023

Designer: Aaron Coady
Tetra Tech Rooney
115 Inverness Drive East, Suite 300
Englewood, Colorado
United States 80112
aaron.coady@tetrattech.com

Description: Segment 11 (Package 7A)
Conduit 2 & 3 Equivalent Pipe Bundle
HDD 118
DWG C-318.2

Input Summary

Start Coordinate	(0.00, 0.00, 133.93) ft
End Coordinate	(854.50, 0.00, 121.52) ft
Project Length	854.50 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	14.000 in
Pipe DR	14.3
Pipe Thickness	0.98 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 14" (14")
Pipe DR: 14.3
Pipe Length: 869.99 ft
Internal Pressure: 0 psi
Borehole Diameter: 1.75 ft
Silo Width: 1.75 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 7.92790 lb/US (liquid) gallon
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 12.51801 lb/US (liquid) gallon
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	18.8	31.2
Water Pressure	0.0	0.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	18.8	31.2
Deflection		
Earth Load Deflection	23.489	39.021
Buoyant Deflection	0.690	0.690
Reissner Effect	0	0
Net Deflection	24.179	39.711
Compressive Stress [psi]		
Compressive Wall Stress	134.2	222.9

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	12736.8	12736.8
Pullback Stress [psi]	318.0	318.0
Pullback Strain	5.531E-3	5.531E-3
Bending Stress [psi]	33.5	33.5
Bending Strain	5.833E-4	5.833E-4
Tensile Stress [psi]	351.6	351.6
Tensile Strain	6.698E-3	6.698E-3

Net External Pressure = 15.2 [psi]

Buoyant Deflection = 0.3

Hydrokinetic Force = 962.1 lb

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%] Unconstrained	0.338	7.5	22.2	OK
Collapse [psi] Tensile Stress	19.3	49.9	2.6	OK
[psi]	351.6	1200.0	3.4	OK



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Ref: New York
204-3701
Start Date: 04-29-2022
End Date: 03-17-2023

Designer:

Aaron Coady
Tetra Tech Rooney
115 Inverness Drive East, Suite 300
Englewood, Colorado
United States 80112
aaron.coady@tetrattech.com

Description:

Segment 11 (Package 7A)
Conduit 1
HDD 119
DWG C-319

Input Summary

Start Coordinate	(0.00, 0.00, 94.50) ft
End Coordinate	(840.00, 0.00, 116.17) ft
Project Length	840.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	12.750 in
Pipe DR	7.0
Pipe Thickness	1.82 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 6

Soil Layer #1 USCS, Clay (C), CL

From Assistant

Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 200.00, Coh: 3.10 [psi]

Soil Layer #2 USCS, Silt (M), MH

From Assistant

Unit Weight: 10.9956 (dry), 14.5068 (sat) [lb/US (liquid) gallon]

Phi: 32.00, S.M.: 100.00, Coh: 0.00 [psi]

Soil Layer #3 USCS, Clay (C), CH

From Assistant

Unit Weight: 11.9889 (dry), 15.2922 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 300.00, Coh: 5.60 [psi]

Soil Layer #4 USCS, Silt (M), ML

From Assistant

Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 28.00, S.M.: 50.00, Coh: 0.00 [psi]

Soil Layer #5 USCS, Silt (M), MH

From Assistant

Unit Weight: 10.9956 (dry), 14.5068 (sat) [lb/US (liquid) gallon]

Phi: 28.00, S.M.: 50.00, Coh: 0.00 [psi]

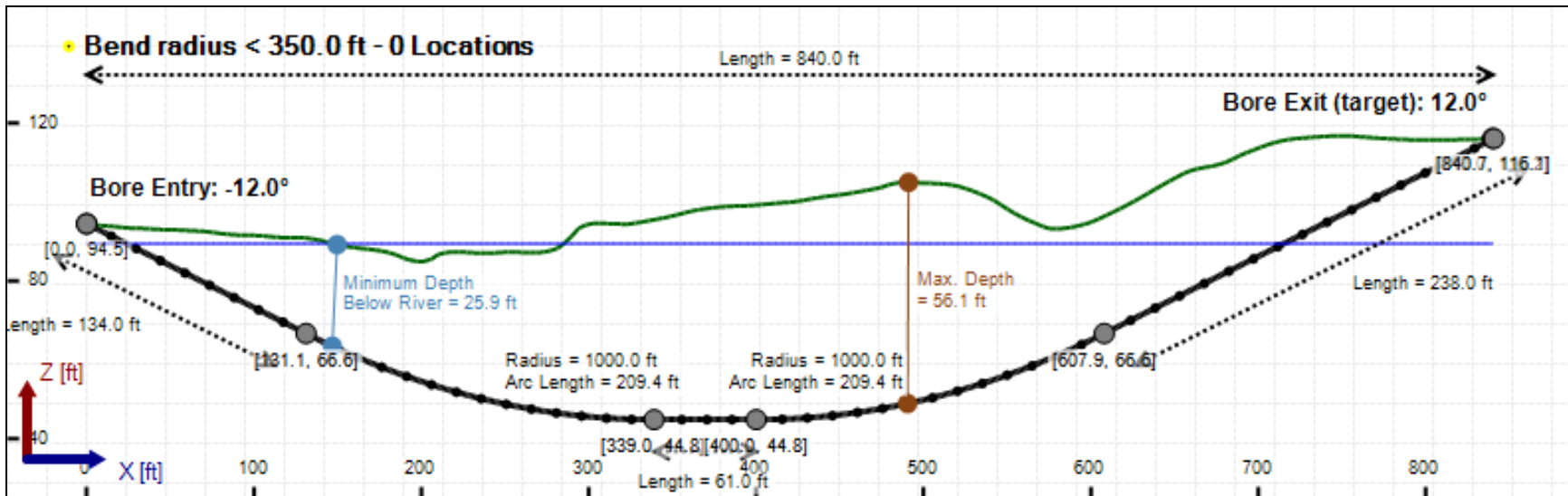
Soil Layer #6 USCS, Clay (C), CL

From Assistant

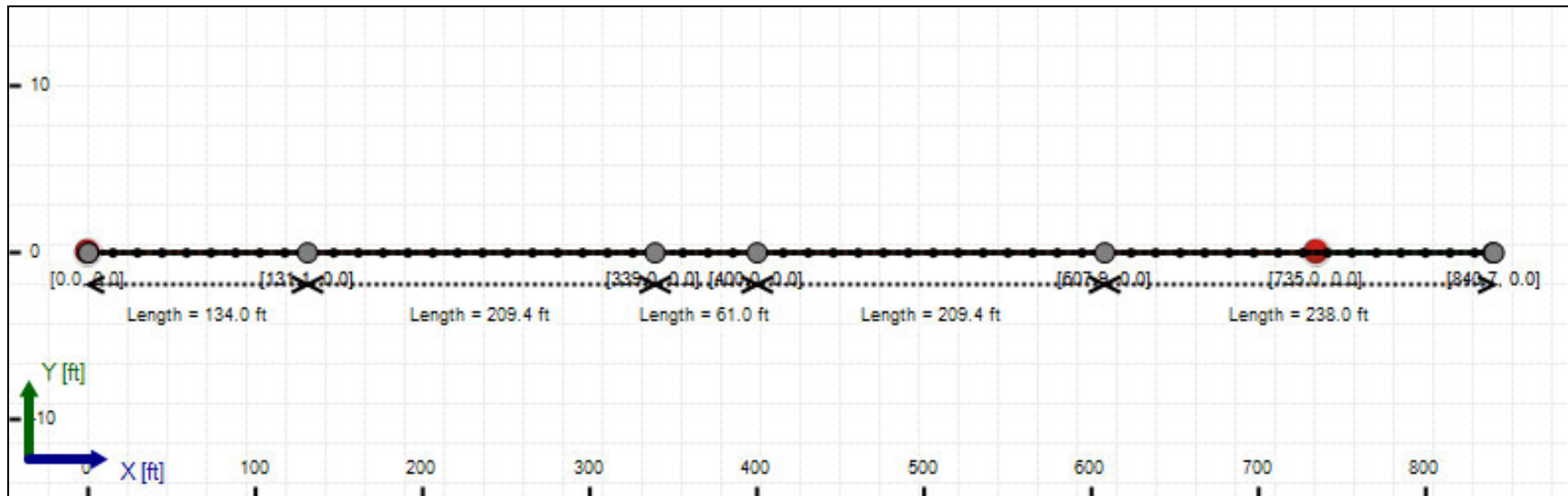
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 400.00, Coh: 8.30 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 12" (12.75")
Pipe DR: 7
Pipe Length: 855.00 ft
Internal Pressure: 0 psi
Borehole Diameter: 1.59400002161662 ft
Silo Width: 1.59400002161662 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 7.92790 lb/US (liquid) gallon
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 12.51801 lb/US (liquid) gallon
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	4.6	24.7
Water Pressure	19.4	18.9
Surface Surge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	23.9	43.6
Deflection		
Earth Load Deflection	1.394	2.952
Buoyant Deflection	0.074	0.074
Reissner Effect	0	0
Net Deflection	1.468	3.025
Compressive Stress [psi]		
Compressive Wall Stress	83.8	152.7

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	22119.8	22119.8
Pullback Stress [psi]	353.7	353.7
Pullback Strain	6.152E-3	6.152E-3
Bending Stress [psi]	30.5	30.5
Bending Strain	5.313E-4	5.313E-4
Tensile Stress [psi]	384.3	384.3
Tensile Strain	7.214E-3	7.214E-3

Net External Pressure = 42.7 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 798.4 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.468	7.5	5.1	OK
Unconstrained Collapse [psi]	46.8	310.3	6.6	OK
Compressive Wall Stress [psi]	83.8	1150.0	13.7	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.036	7.5	207.6	OK
Unconstrained Collapse [psi]	56.8	555.1	9.8	OK
Tensile Stress [psi]	384.3	1200.0	3.1	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	88.209 psi	77.161 psi
1	8.00 in	14.00 in	88.156 psi	77.149 psi
2	14.00 in	19.13 in	88.087 psi	77.132 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 70.00 US (liquid) gallon/min

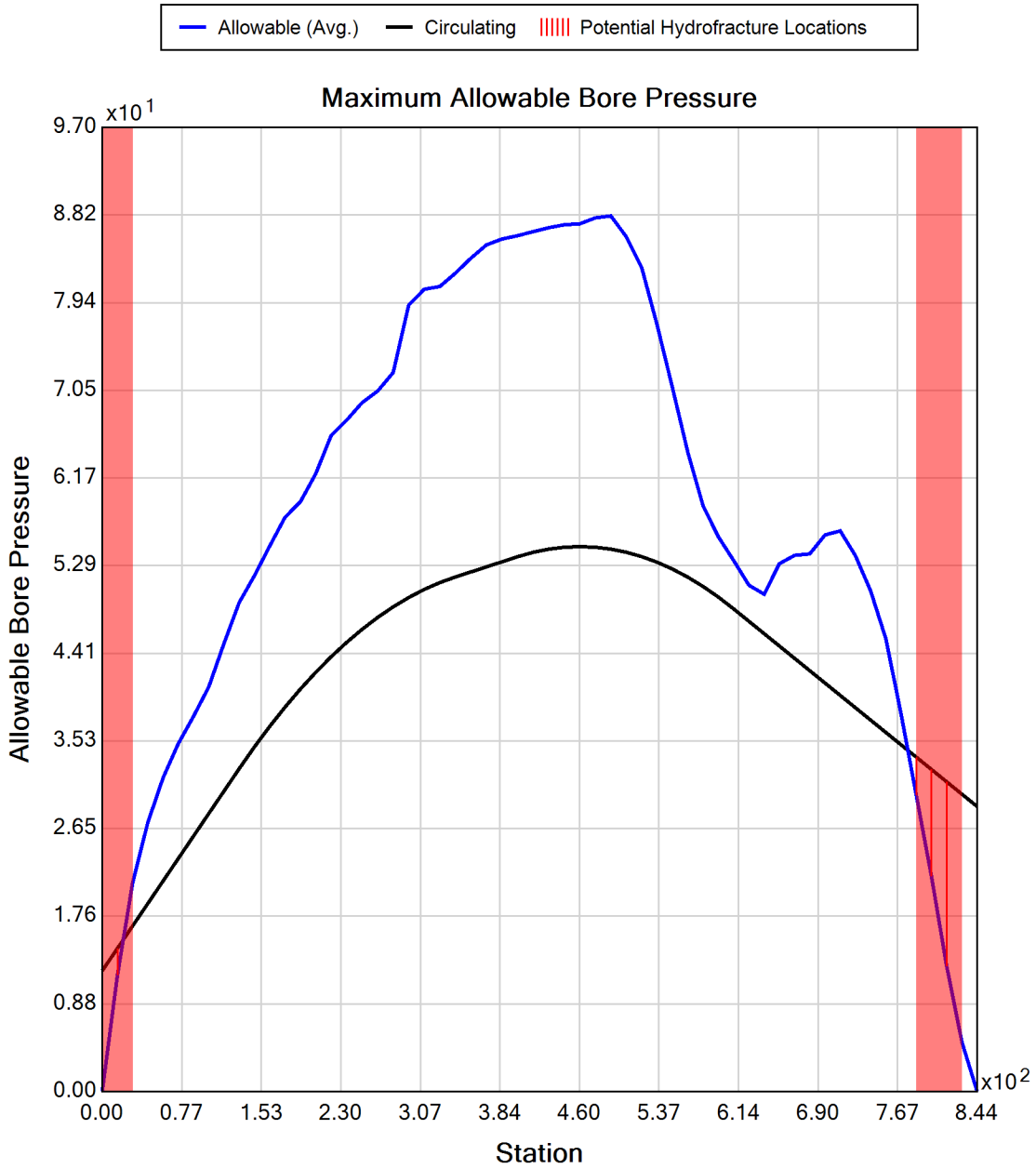
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 697.8





Generated Output



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OSHA CFR 29 1926.651 requires that the estimated location of underground utilities be determined before beginning the excavation or underground drilling operation. When the actual excavation or bore approaches an estimated utility location, the exact location of the underground installation must be determined by a safe, acceptable and dependable method. If the utility cannot be precisely located, it must be shut off by the utility company.

Project Summary

General:

Kiewit - CHPE
Ref: New York
204-3701
Start Date: 04-29-2022
End Date: 03-17-2023

Designer:

Aaron Coady
Tetra Tech Rooney
115 Inverness Drive East, Suite 300
Englewood, Colorado
United States 80112
aaron.coady@tetrattech.com

Description:

Segment 11 (Package 7A)
Conduit 2
HDD 119
DWG C-319.2

Input Summary

Start Coordinate	(0.00, 0.00, 95.00) ft
End Coordinate	(840.00, 0.00, 116.84) ft
Project Length	840.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	12.750 in
Pipe DR	7.0
Pipe Thickness	1.82 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 6

Soil Layer #1 USCS, Clay (C), CL

From Assistant

Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 200.00, Coh: 3.10 [psi]

Soil Layer #2 USCS, Silt (M), MH

From Assistant

Unit Weight: 10.9956 (dry), 14.5068 (sat) [lb/US (liquid) gallon]

Phi: 32.00, S.M.: 100.00, Coh: 0.00 [psi]

Soil Layer #3 USCS, Clay (C), CH

From Assistant

Unit Weight: 11.9889 (dry), 15.2922 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 300.00, Coh: 5.60 [psi]

Soil Layer #4 USCS, Silt (M), ML

From Assistant

Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 28.00, S.M.: 50.00, Coh: 0.00 [psi]

Soil Layer #5 USCS, Silt (M), MH

From Assistant

Unit Weight: 10.9956 (dry), 14.5068 (sat) [lb/US (liquid) gallon]

Phi: 28.00, S.M.: 50.00, Coh: 0.00 [psi]

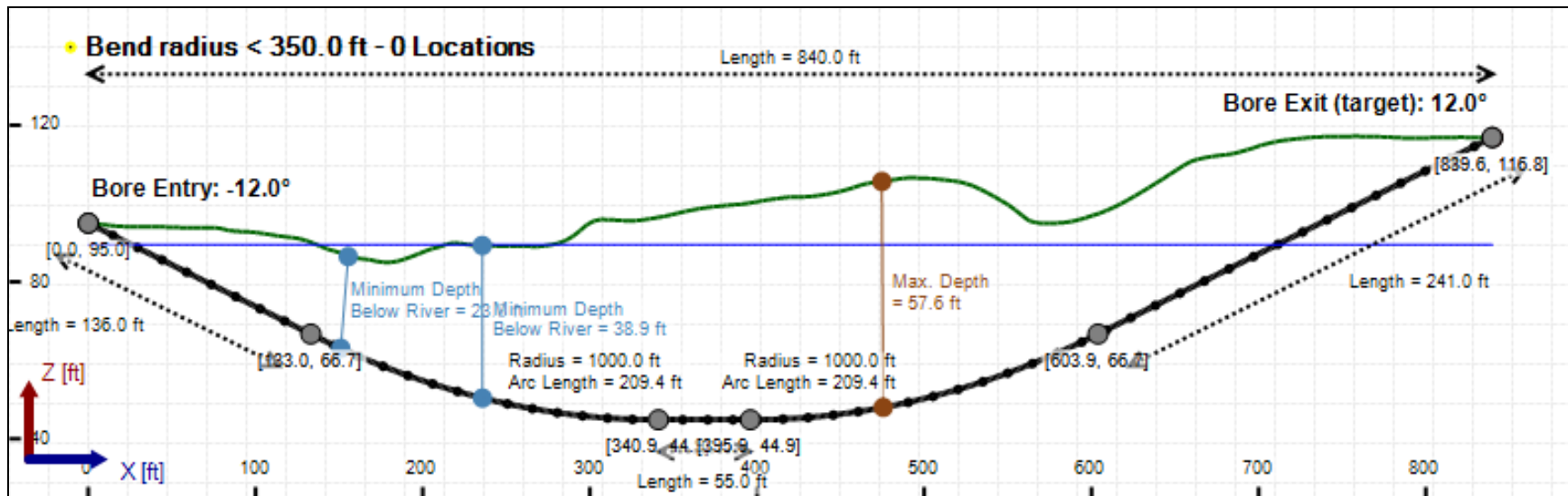
Soil Layer #6 USCS, Clay (C), CL

From Assistant

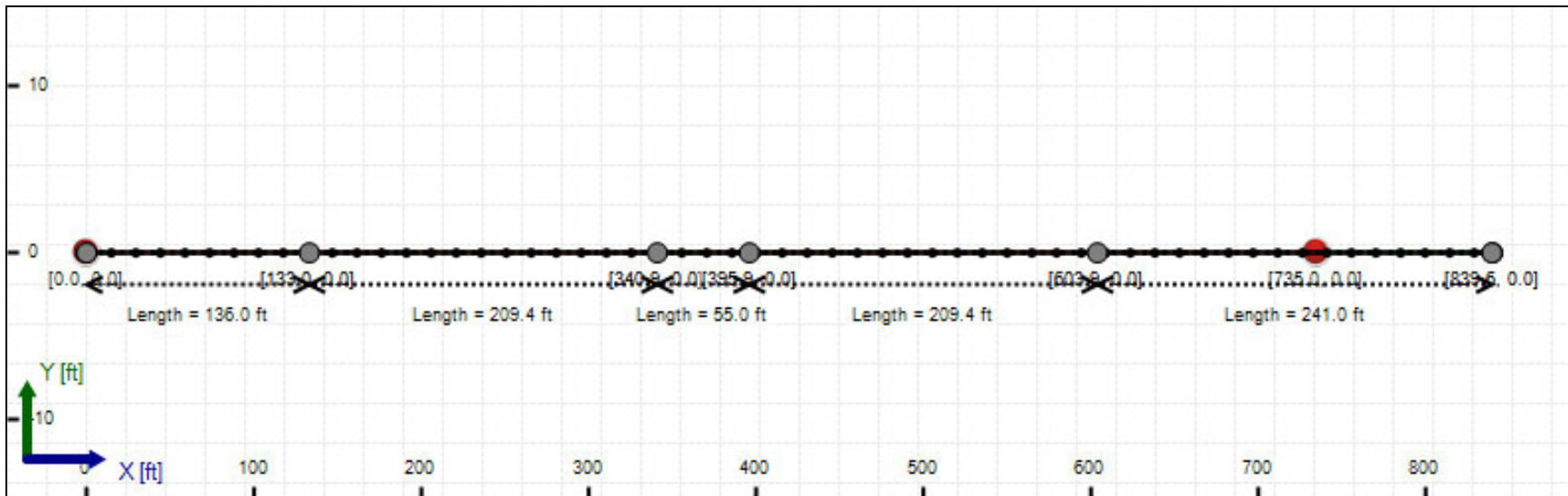
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 400.00, Coh: 8.30 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 12" (12.75")
Pipe DR: 7
Pipe Length: 855.00 ft
Internal Pressure: 0 psi
Borehole Diameter: 1.59400002161662 ft
Silo Width: 1.59400002161662 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 7.92790 lb/US (liquid) gallon
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 12.51801 lb/US (liquid) gallon
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	4.8	26.0
Water Pressure	19.3	18.4
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	24.0	44.4
Deflection		
Earth Load Deflection	1.357	3.036
Buoyant Deflection	0.074	0.074
Reissner Effect	0	0
Net Deflection	1.430	3.110
Compressive Stress [psi]		
Compressive Wall Stress	84.0	155.5

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	22182.9	22182.9
Pullback Stress [psi]	354.7	354.7
Pullback Strain	6.169E-3	6.169E-3
Bending Stress [psi]	0.0	30.5
Bending Strain	0	5.313E-4
Tensile Stress [psi]	354.7	384.7
Tensile Strain	6.169E-3	7.222E-3

Net External Pressure = 43.0 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 798.4 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.430	7.5	5.2	OK
Unconstrained Collapse [psi]	47.3	309.9	6.5	OK
Compressive Wall Stress [psi]	84.0	1150.0	13.7	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.036	7.5	207.6	OK
Unconstrained Collapse [psi]	57.4	555.2	9.7	OK
Tensile Stress [psi]	384.7	1200.0	3.1	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	90.155 psi	78.460 psi
1	8.00 in	14.00 in	90.104 psi	78.448 psi
2	14.00 in	19.13 in	90.040 psi	78.432 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 70.00 US (liquid) gallon/min

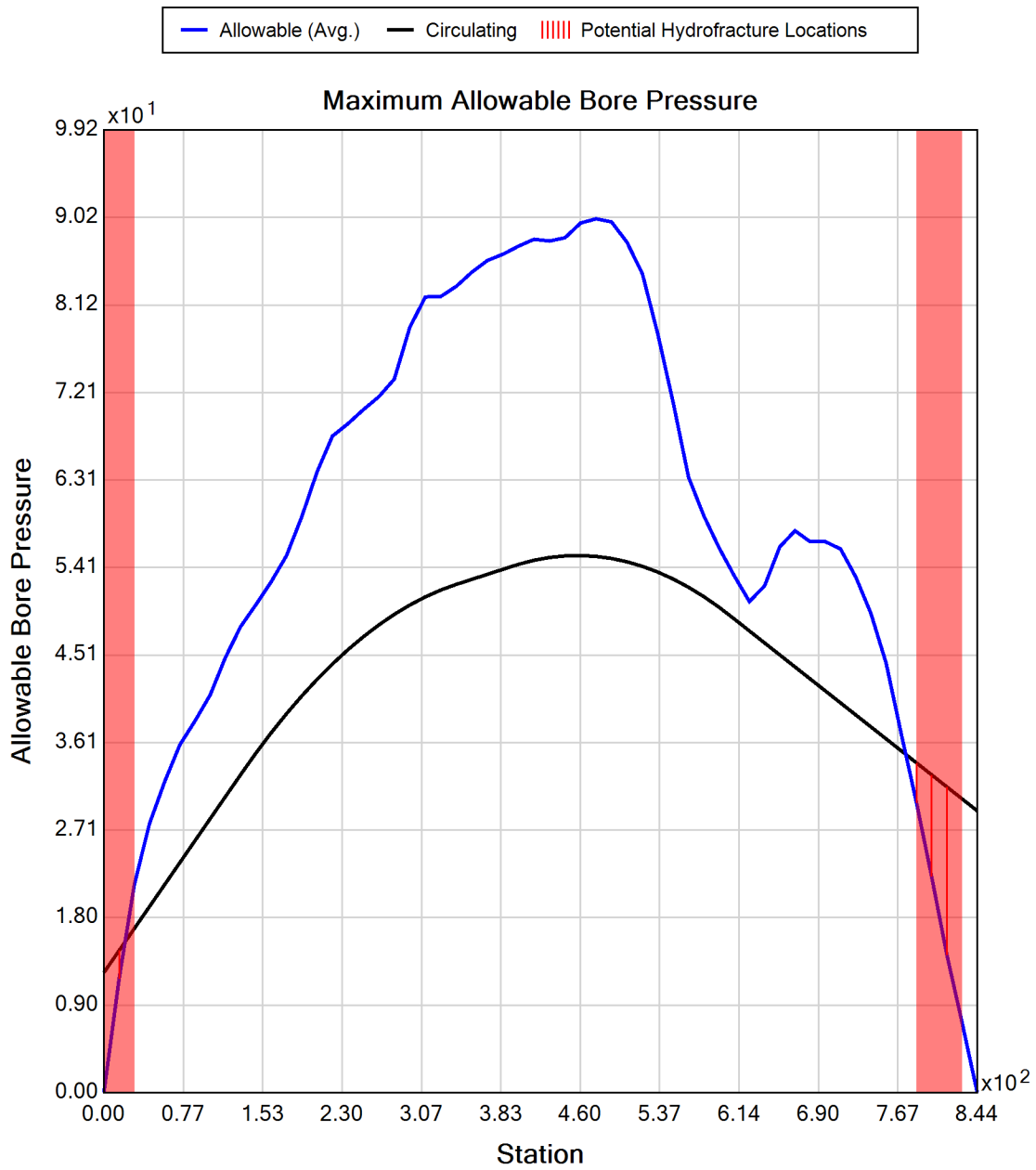
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 697.8





Generated Output



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Project Summary

General:

Kiewit - CHPE
Ref: New York
204-3701
Start Date: 04-29-2022
End Date: 03-17-2023

Designer:

Aaron Coady
Tetra Tech Rooney
115 Inverness Drive East, Suite 300
Englewood, Colorado
United States 80112
aaron.coady@tetrattech.com

Description:

Segment 11 (Package 7A)
Conduit 3
HDD 119
DWG C-319.2

Input Summary

Start Coordinate	(0.00, 0.00, 95.00) ft
End Coordinate	(840.00, 0.00, 116.84) ft
Project Length	840.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	2.375 in
Pipe DR	7.0
Pipe Thickness	0.34 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 6

Soil Layer #1 USCS, Clay (C), CL

From Assistant

Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 200.00, Coh: 3.10 [psi]

Soil Layer #2 USCS, Silt (M), MH

From Assistant

Unit Weight: 10.9956 (dry), 14.5068 (sat) [lb/US (liquid) gallon]

Phi: 32.00, S.M.: 100.00, Coh: 0.00 [psi]

Soil Layer #3 USCS, Clay (C), CH

From Assistant

Unit Weight: 11.9889 (dry), 15.2922 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 300.00, Coh: 5.60 [psi]

Soil Layer #4 USCS, Silt (M), ML

From Assistant

Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 28.00, S.M.: 50.00, Coh: 0.00 [psi]

Soil Layer #5 USCS, Silt (M), MH

From Assistant

Unit Weight: 10.9956 (dry), 14.5068 (sat) [lb/US (liquid) gallon]

Phi: 28.00, S.M.: 50.00, Coh: 0.00 [psi]

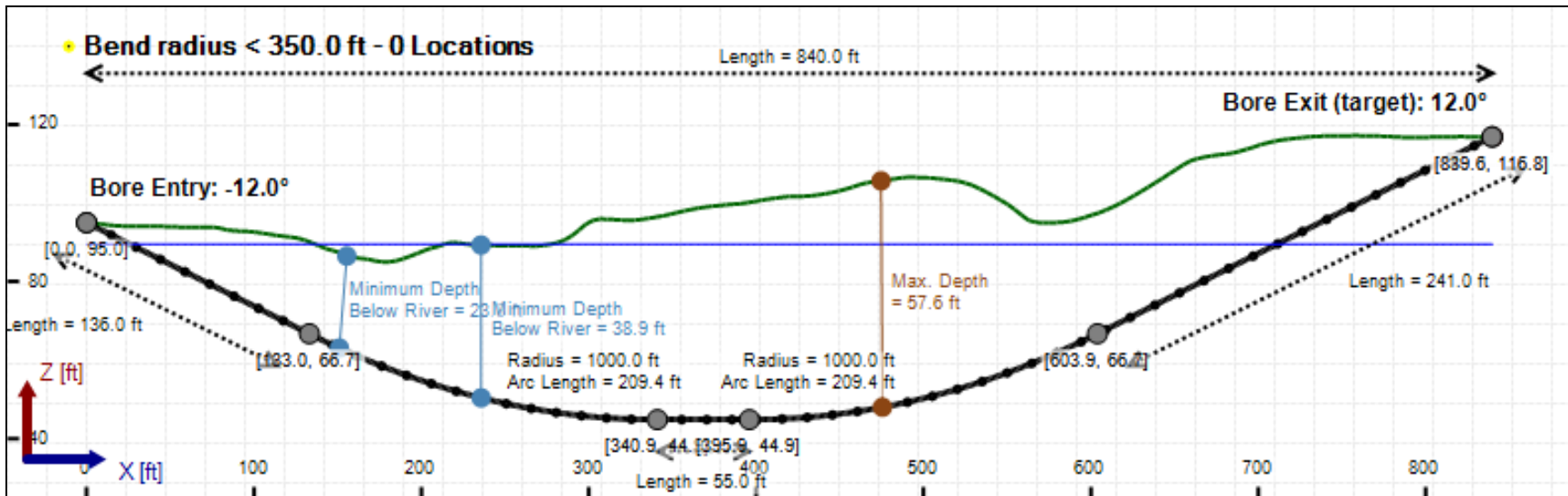
Soil Layer #6 USCS, Clay (C), CL

From Assistant

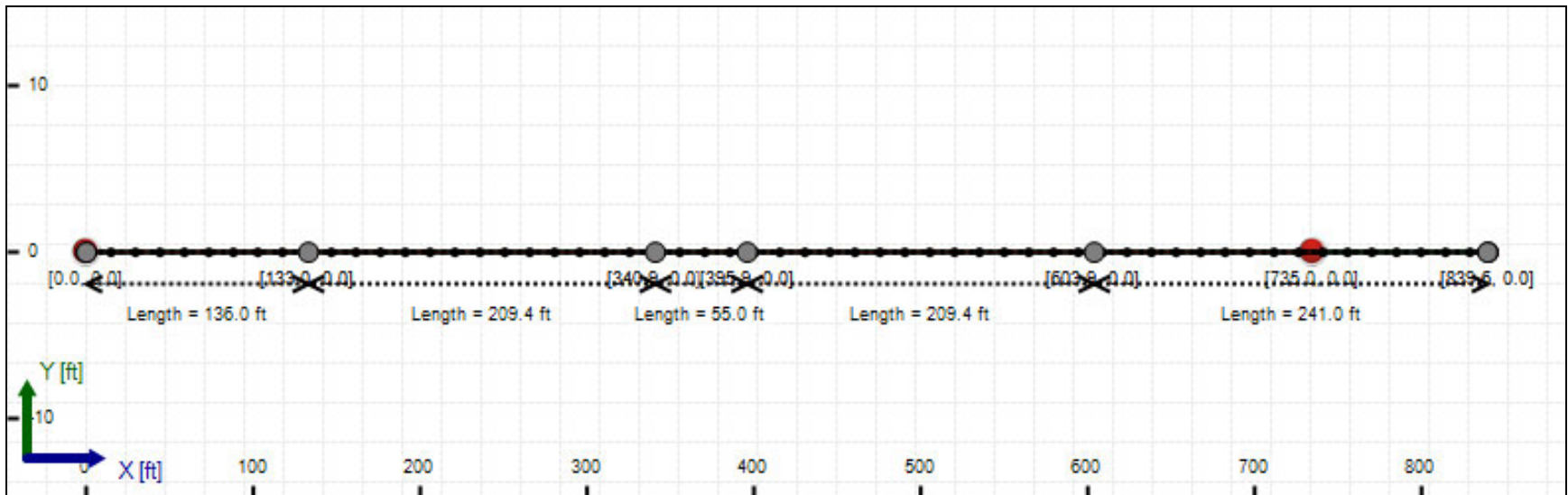
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 400.00, Coh: 8.30 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 2" (2.375")
Pipe DR: 7
Pipe Length: 855.00 ft
Internal Pressure: 0 psi
Borehole Diameter: 0.531000018119812 ft
Silo Width: 0.531000018119812 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 7.92790 lb/US (liquid) gallon
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 12.51801 lb/US (liquid) gallon
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	1.6	26.0
Water Pressure	19.3	18.4
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	20.9	44.4
Deflection		
Earth Load Deflection	0.972	3.036
Buoyant Deflection	0.014	0.014
Reissner Effect	0	0
Net Deflection	0.986	3.050
Compressive Stress [psi]		
Compressive Wall Stress	73.1	155.5

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	879.3	879.3
Pullback Stress [psi]	405.2	405.2
Pullback Strain	7.048E-3	7.048E-3
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	405.2	410.4
Tensile Strain	7.048E-3	7.236E-3

Net External Pressure = 43.0 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.986	7.5	7.6	OK
Unconstrained Collapse [psi]	47.3	321.8	6.8	OK
Compressive Wall Stress [psi]	73.1	1150.0	15.7	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.007	7.5	1114.2	OK
Unconstrained Collapse [psi]	57.4	552.7	9.6	OK
Tensile Stress [psi]	410.4	1200.0	2.9	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	90.155 psi	78.460 psi
1	8.00 in	6.37 in	90.164 psi	78.462 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 70.00 US (liquid) gallon/min

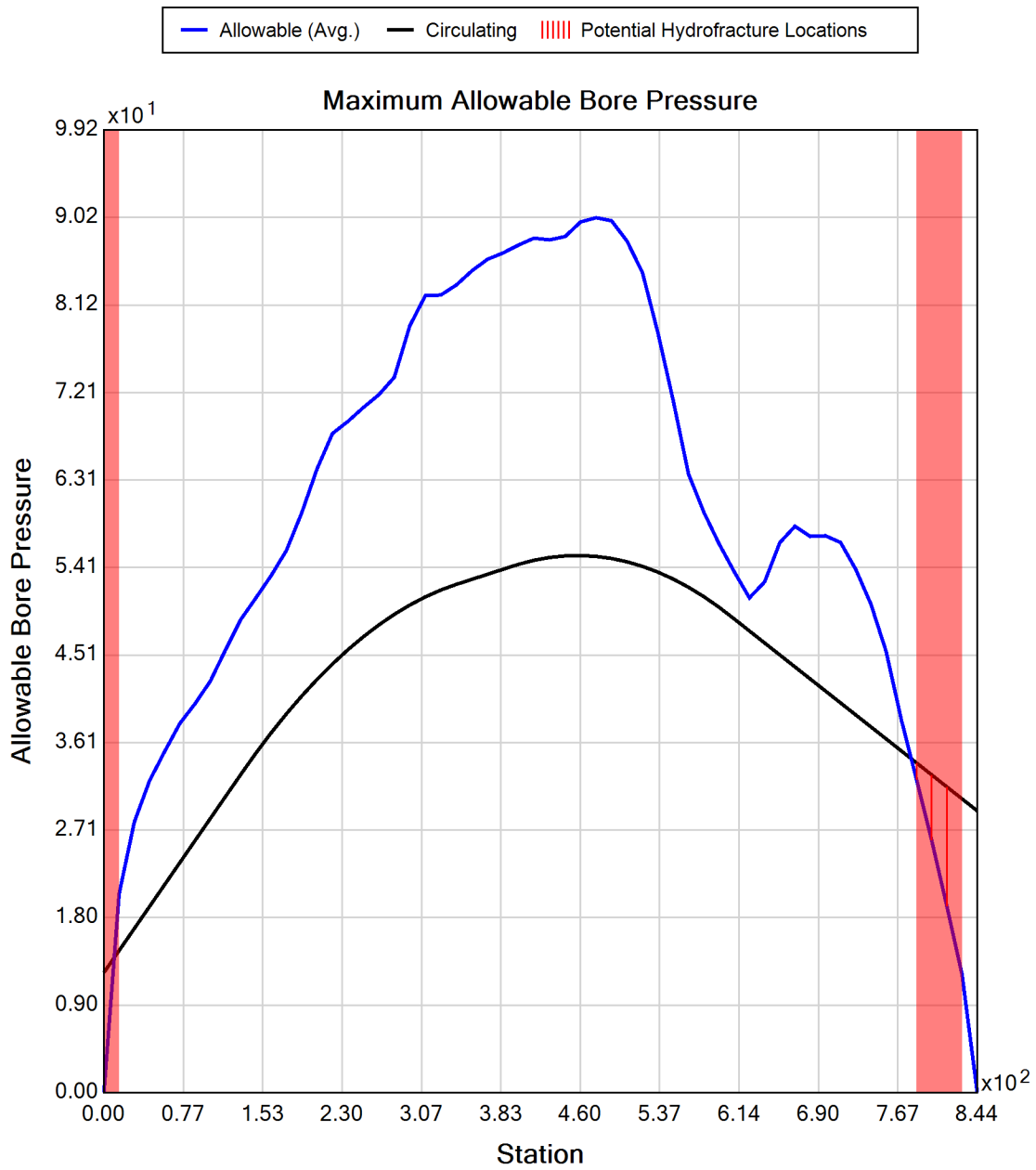
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 697.8





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End Date: 03-17-2023

Designer:

Aaron Coady
Tetra Tech Rooney
115 Inverness Drive East, Suite 300
Englewood, Colorado
United States 80112
aaron.coady@tetrattech.com

Description:

Segment 11 (Package 7A)
Conduit 2 & 3 Equivalent Pipe Bundle
HDD 119
DWG C-319.2

Input Summary

Start Coordinate	(0.00, 0.00, 95.00) ft
End Coordinate	(840.00, 0.00, 116.84) ft
Project Length	840.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	16.000 in
Pipe DR	11.0
Pipe Thickness	1.45 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 16" (16")
Pipe DR: 11
Pipe Length: 855.00 ft
Internal Pressure: 0 psi
Borehole Diameter: 2 ft
Silo Width: 2 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 7.92790 lb/US (liquid) gallon
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 12.51801 lb/US (liquid) gallon
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	5.9	26.0
Water Pressure	19.3	18.4
Surface Surge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	25.2	44.4
Deflection		
Earth Load Deflection	6.513	14.056
Buoyant Deflection	0.359	0.359
Reissner Effect	0	0
Net Deflection	6.872	14.415
Compressive Stress [psi]		
Compressive Wall Stress	138.4	244.4

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	37697.4	37697.4
Pullback Stress [psi]	567.2	567.2
Pullback Strain	9.864E-3	9.864E-3
Bending Stress [psi]	0.0	38.3
Bending Strain	0	6.667E-4
Tensile Stress [psi]	567.2	601.9
Tensile Strain	9.864E-3	1.113E-2

Net External Pressure = 41.0 [psi]

Buoyant Deflection = 0.2

Hydrokinetic Force = 1256.6 lb

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.176	7.5	42.6	OK
Unconstrained Collapse [psi]	57.3	112.3	2.0	OK
Tensile Stress [psi]	601.9	1200.0	2.0	OK



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OSHA CFR 29 1926.651 requires that the estimated location of underground utilities be determined before beginning the excavation or underground drilling operation. When the actual excavation or bore approaches an estimated utility location, the exact location of the underground installation must be determined by a safe, acceptable and dependable method. If the utility cannot be precisely located, it must be shut off by the utility company.

Project Summary

General:

Kiewit - CHPE
Ref: New York
204-3701
Start Date: 04-29-2022
End Date: 03-17-2023

Designer:

Aaron Coady
Tetra Tech Rooney
115 Inverness Drive East, Suite 300
Englewood, Colorado
United States 80112
aaron.coady@tetrattech.com

Description:

Segment 11 (Package 7A)
Conduit 1
HDD# 120
DWG# C-320

Input Summary

Start Coordinate	(0.00, 0.00, 119.72) ft
End Coordinate	(1470.00, 0.00, 122.35) ft
Project Length	1470.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	12.750 in
Pipe DR	7.0
Pipe Thickness	1.82 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 5

Soil Layer #1 USCS, Clay (C), CH

Depth: 25.00 ft

Unit Weight: 11.9889 (dry), 15.2922 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 400.00, Coh: 8.30 [psi]

Soil Layer #2 USCS, Silt (M), MH

Depth: 20.00 ft

Unit Weight: 10.9956 (dry), 14.5068 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #3 USCS, Clay (C), CL

Depth: 2.00 ft

Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 200.00, Coh: 3.10 [psi]

Soil Layer #4 Rock, Geological Classification, Sedimentary Rocks

Depth: 10.00 ft

Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]

Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

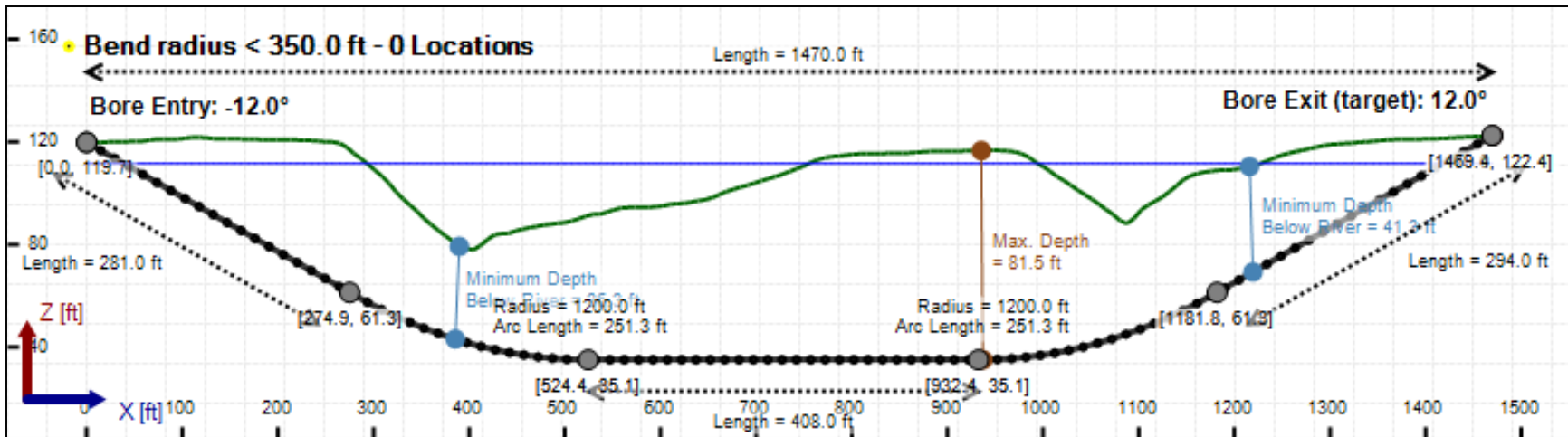
Soil Layer #5 Rock, Geological Classification, Sedimentary Rocks

Depth: 38.00 ft

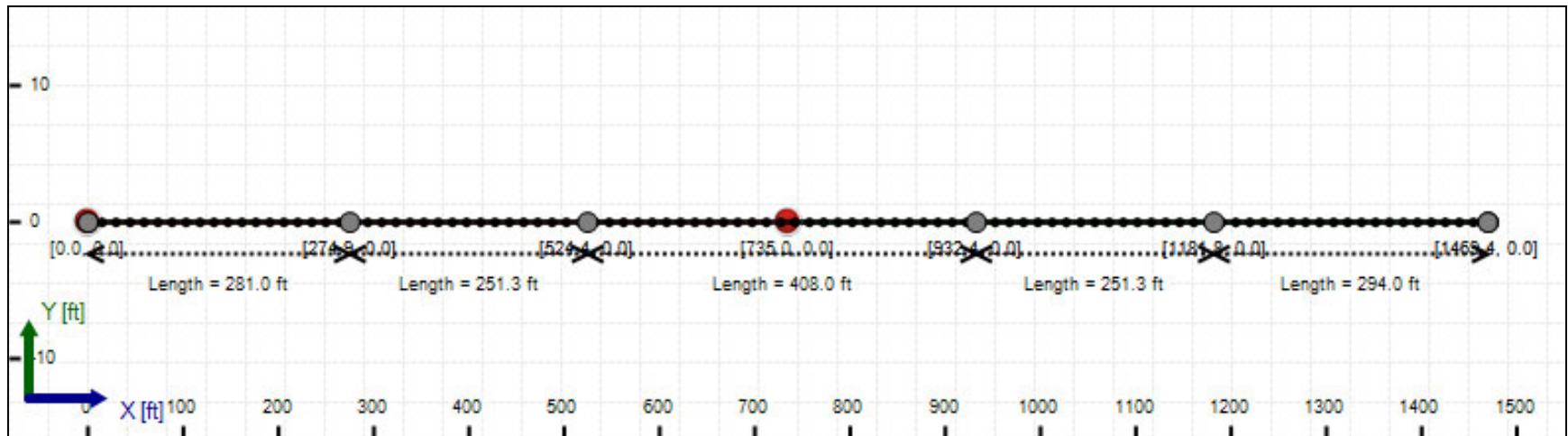
Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]

Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 12" (12.75")
Pipe DR: 7
Pipe Length: 1500.00 ft
Internal Pressure: 0 psi
Borehole Diameter: 1.59400002161662 ft
Silo Width: 1.59400002161662 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 7.92790 lb/US (liquid) gallon
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 12.51801 lb/US (liquid) gallon
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	5.8	46.6
Water Pressure	33.1	33.1
Surface Surge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	38.9	79.7
Deflection		
Earth Load Deflection	2.178	5.356
Buoyant Deflection	0.074	0.074
Reissner Effect	0	0
Net Deflection	2.252	5.430
Compressive Stress [psi]		
Compressive Wall Stress	136.1	279.0

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	36124.2	36124.2
Pullback Stress [psi]	577.7	577.7
Pullback Strain	1.005E-2	1.005E-2
Bending Stress [psi]	0.0	25.5
Bending Strain	0	4.427E-4
Tensile Stress [psi]	577.7	602.6
Tensile Strain	1.005E-2	1.092E-2

Net External Pressure = 50.2 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 798.4 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	2.252	7.5	3.3	OK
Unconstrained Collapse [psi]	58.7	306.4	5.2	OK
Compressive Wall Stress [psi]	136.1	1150.0	8.5	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.036	7.5	207.6	OK
Unconstrained Collapse [psi]	68.7	523.4	7.6	OK
Tensile Stress [psi]	602.6	1200.0	2.0	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	1141.163 psi	1374.564 psi
1	8.00 in	14.00 in	1140.761 psi	1374.470 psi
2	14.00 in	19.13 in	1140.243 psi	1374.350 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 200.00 US (liquid) gallon/min

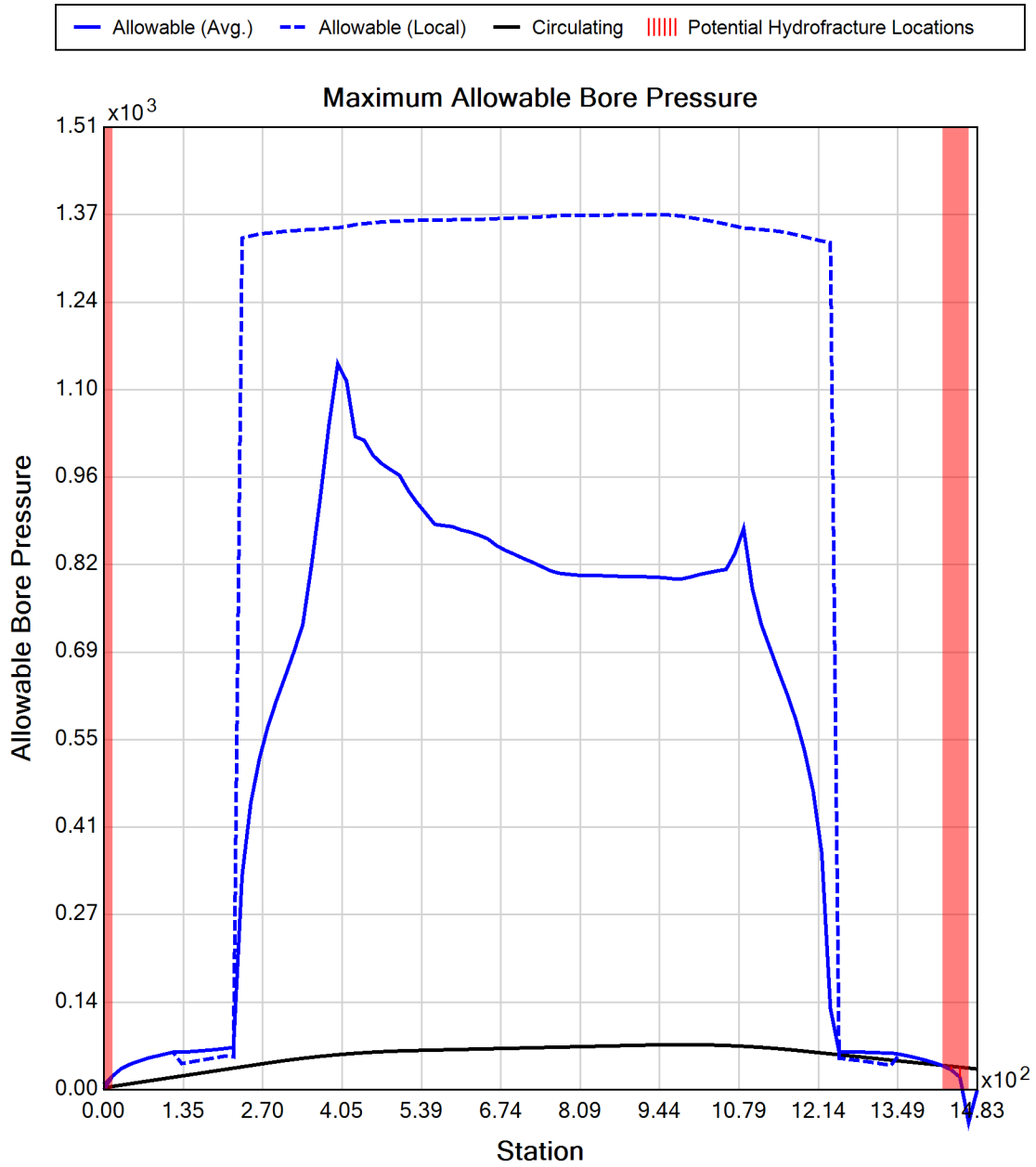
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 260.8





Generated Output



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Ref: New York
204-3701
Start Date: 04-29-2022
End Date: 03-17-2023

Designer:

Aaron Coady
Tetra Tech Rooney
115 Inverness Drive East, Suite 300
Englewood, Colorado
United States 80112
aaron.coady@tetrattech.com

Description:

Segment 11 (Package 7A)
Conduit 2
HDD# 120
DWG# C-320.2

Input Summary

Start Coordinate	(0.00, 0.00, 121.03) ft
End Coordinate	(1470.00, 0.00, 122.91) ft
Project Length	1470.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	12.750 in
Pipe DR	7.0
Pipe Thickness	1.82 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 5

Soil Layer #1 USCS, Clay (C), CH

Depth: 25.00 ft

Unit Weight: 11.9889 (dry), 15.2922 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 400.00, Coh: 8.30 [psi]

Soil Layer #2 USCS, Silt (M), MH

Depth: 20.00 ft

Unit Weight: 10.9956 (dry), 14.5068 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #3 USCS, Clay (C), CL

Depth: 2.00 ft

Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 200.00, Coh: 3.10 [psi]

Soil Layer #4 Rock, Geological Classification, Sedimentary Rocks

Depth: 10.00 ft

Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]

Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

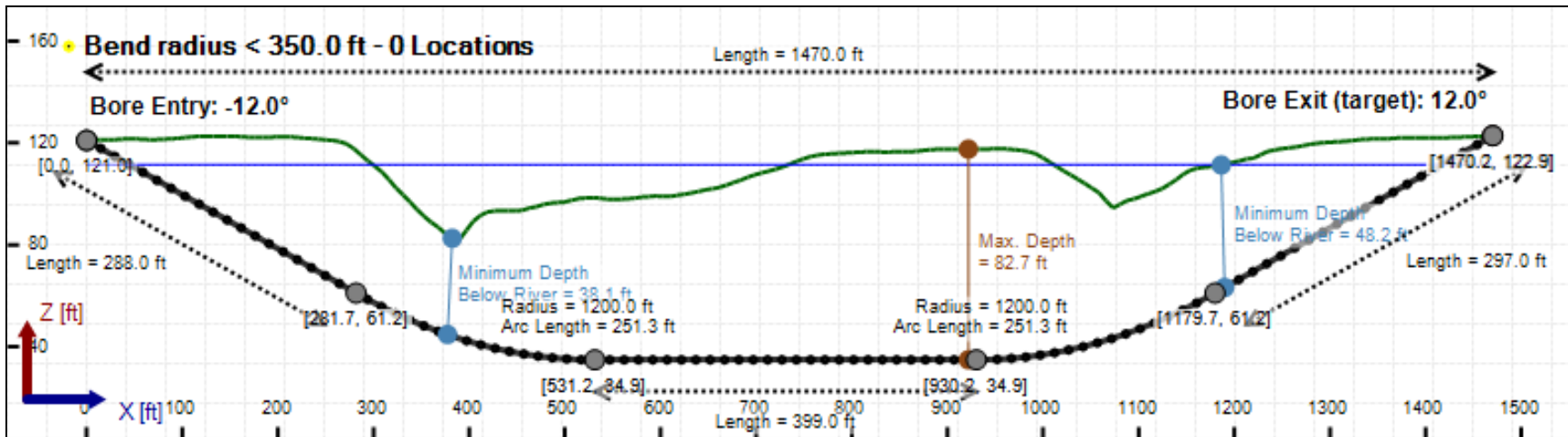
Soil Layer #5 Rock, Geological Classification, Sedimentary Rocks

Depth: 38.00 ft

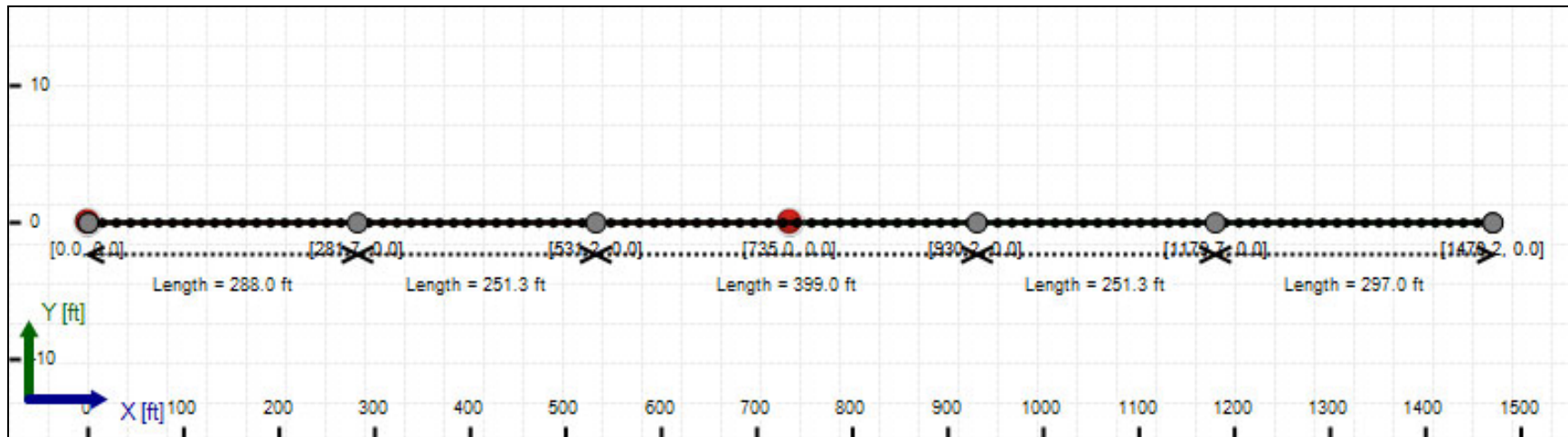
Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]

Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 12" (12.75")
Pipe DR: 7
Pipe Length: 1500.00 ft
Internal Pressure: 0 psi
Borehole Diameter: 1.59400002161662 ft
Silo Width: 1.59400002161662 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 7.92790 lb/US (liquid) gallon
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 12.51801 lb/US (liquid) gallon
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	5.7	48.0
Water Pressure	33.2	33.2
Surface Surge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	38.9	81.2
Deflection		
Earth Load Deflection	2.238	5.514
Buoyant Deflection	0.074	0.074
Reissner Effect	0	0
Net Deflection	2.311	5.587
Compressive Stress [psi]		
Compressive Wall Stress	136.1	284.1

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	36150.6	36150.6
Pullback Stress [psi]	578.1	578.1
Pullback Strain	1.005E-2	1.005E-2
Bending Stress [psi]	0.0	25.5
Bending Strain	0	4.427E-4
Tensile Stress [psi]	578.1	601.9
Tensile Strain	1.005E-2	1.091E-2

Net External Pressure = 51.6 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 798.4 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	2.311	7.5	3.2	OK
Unconstrained Collapse [psi]	59.0	306.6	5.2	OK
Compressive Wall Stress [psi]	136.1	1150.0	8.5	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.036	7.5	207.6	OK
Unconstrained Collapse [psi]	69.0	523.1	7.6	OK
Tensile Stress [psi]	601.9	1200.0	2.0	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	1050.092 psi	1375.772 psi
1	8.00 in	14.00 in	1049.751 psi	1375.681 psi
2	14.00 in	19.13 in	1049.312 psi	1375.564 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 200.00 US (liquid) gallon/min

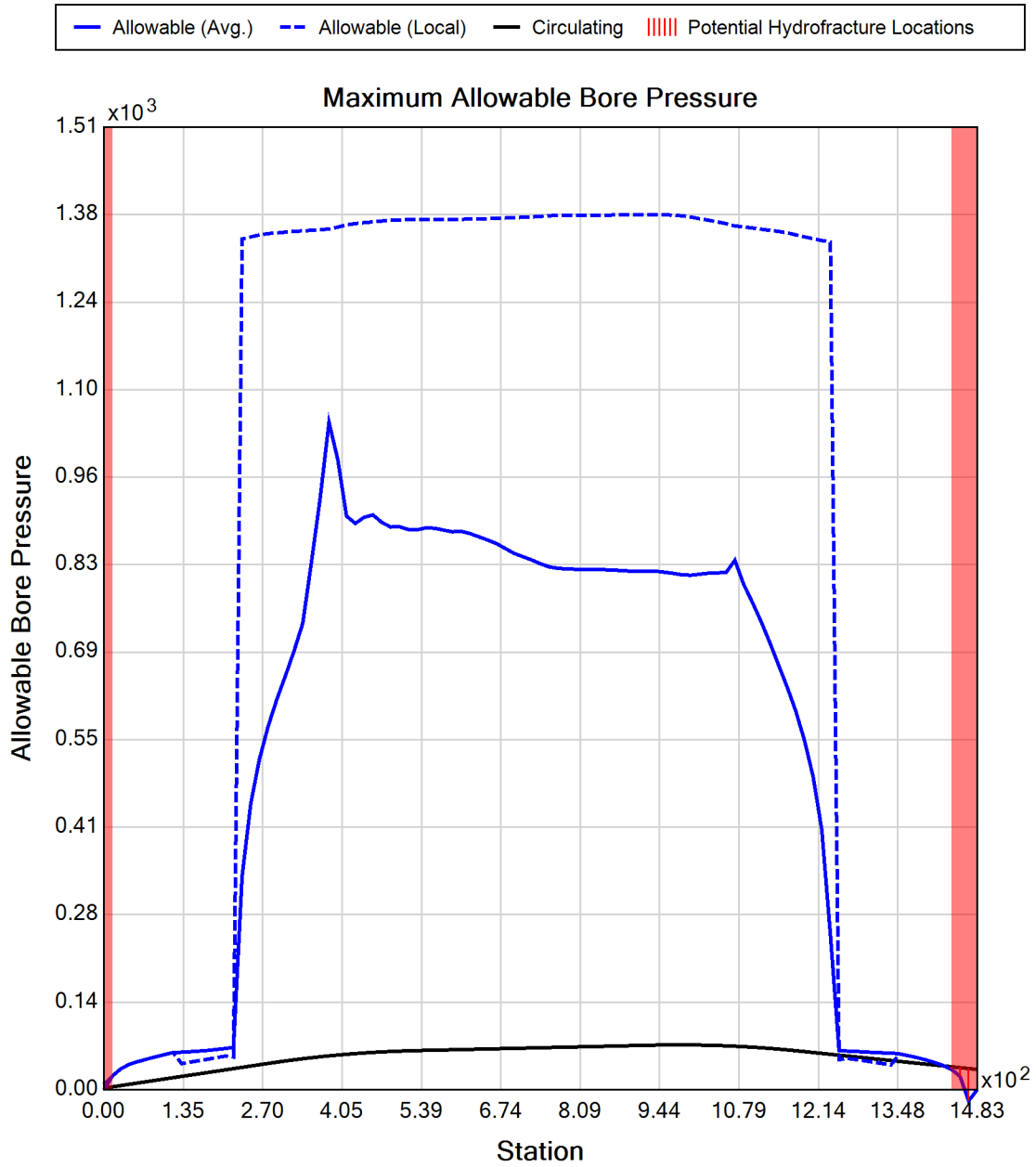
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 260.8





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Ref: New York
204-3701
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End Date: 03-17-2023

Designer:

Aaron Coady
Tetra Tech Rooney
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United States 80112
aaron.coady@tetrattech.com

Description:

Segment 11 (Package 7A)
Conduit 3
HDD# 120
DWG# C-320.2

Input Summary

Start Coordinate	(0.00, 0.00, 121.03) ft
End Coordinate	(1470.00, 0.00, 122.91) ft
Project Length	1470.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	2.375 in
Pipe DR	7.0
Pipe Thickness	0.34 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 5

Soil Layer #1 USCS, Clay (C), CH

Depth: 25.00 ft

Unit Weight: 11.9889 (dry), 15.2922 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 400.00, Coh: 8.30 [psi]

Soil Layer #2 USCS, Silt (M), MH

Depth: 20.00 ft

Unit Weight: 10.9956 (dry), 14.5068 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #3 USCS, Clay (C), CL

Depth: 2.00 ft

Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 200.00, Coh: 3.10 [psi]

Soil Layer #4 Rock, Geological Classification, Sedimentary Rocks

Depth: 10.00 ft

Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]

Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

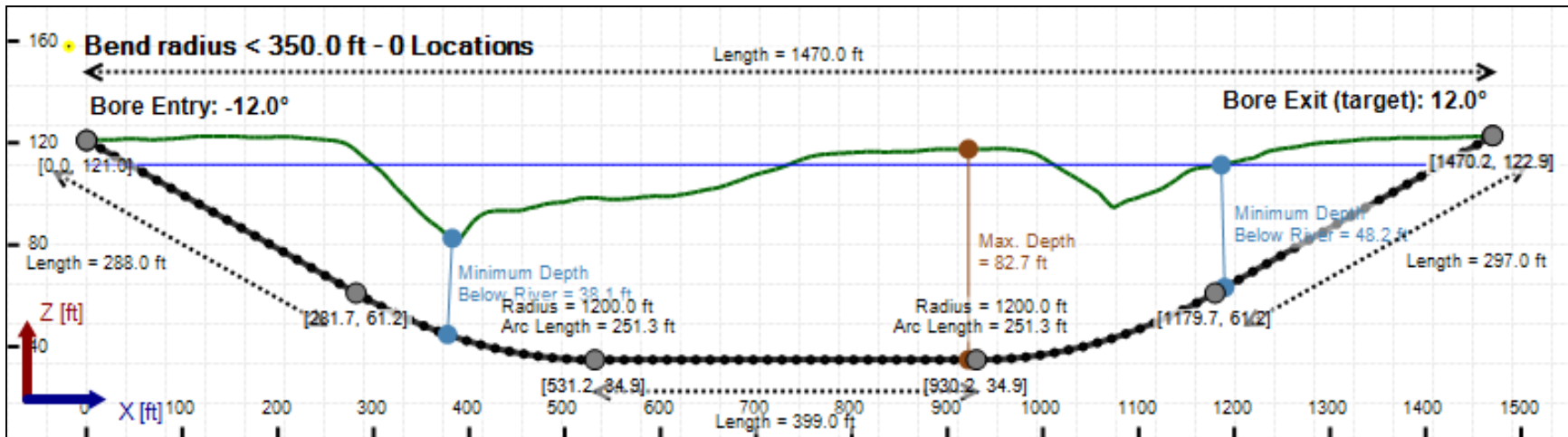
Soil Layer #5 Rock, Geological Classification, Sedimentary Rocks

Depth: 38.00 ft

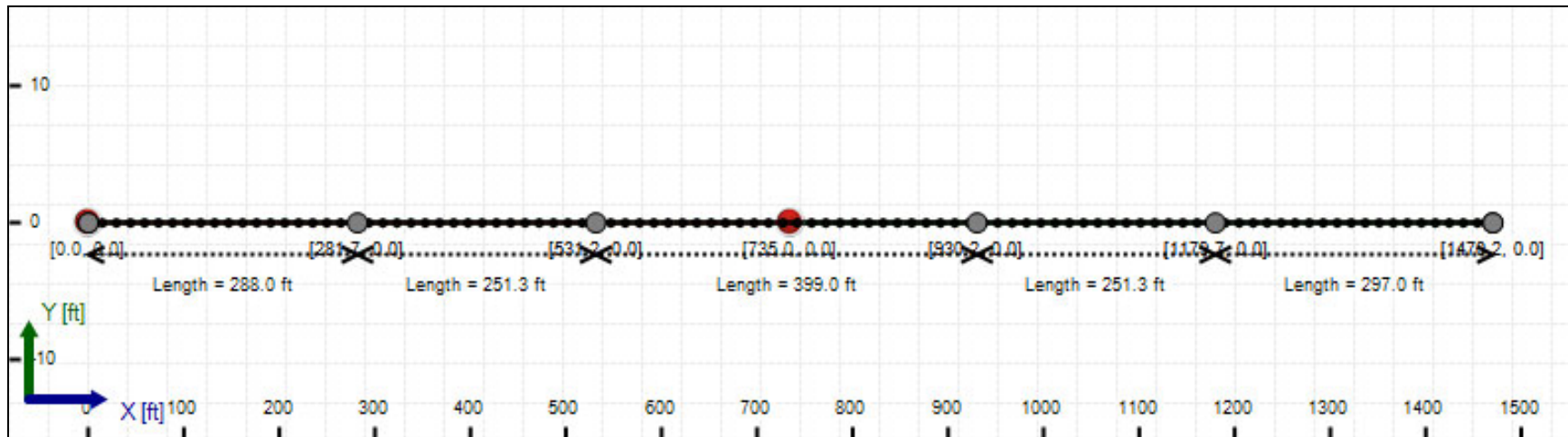
Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]

Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 2" (2.375")
Pipe DR: 7
Pipe Length: 1500.00 ft
Internal Pressure: 0 psi
Borehole Diameter: 0.531000018119812 ft
Silo Width: 0.531000018119812 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 7.92790 lb/US (liquid) gallon
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 12.51801 lb/US (liquid) gallon
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	19.5	48.0
Water Pressure	16.1	33.2
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	35.6	81.2
Deflection		
Earth Load Deflection	2.238	5.514
Buoyant Deflection	0.014	0.014
Reissner Effect	0	0
Net Deflection	2.251	5.528
Compressive Stress [psi]		
Compressive Wall Stress	124.6	284.1

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	1364.0	1364.0
Pullback Stress [psi]	628.6	628.6
Pullback Strain	1.093E-2	1.093E-2
Bending Stress [psi]	0.0	4.7
Bending Strain	0	8.247E-5
Tensile Stress [psi]	628.6	631.7
Tensile Strain	1.093E-2	1.107E-2

Net External Pressure = 51.6 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	2.251	7.5	3.3	OK
Unconstrained Collapse [psi]	59.0	320.6	5.4	OK
Compressive Wall Stress [psi]	124.6	1150.0	9.2	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.007	7.5	1114.2	OK
Unconstrained Collapse [psi]	69.0	519.4	7.5	OK
Tensile Stress [psi]	631.7	1200.0	1.9	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	1050.092 psi	1375.772 psi
1	8.00 in	6.37 in	1050.152 psi	1375.788 psi

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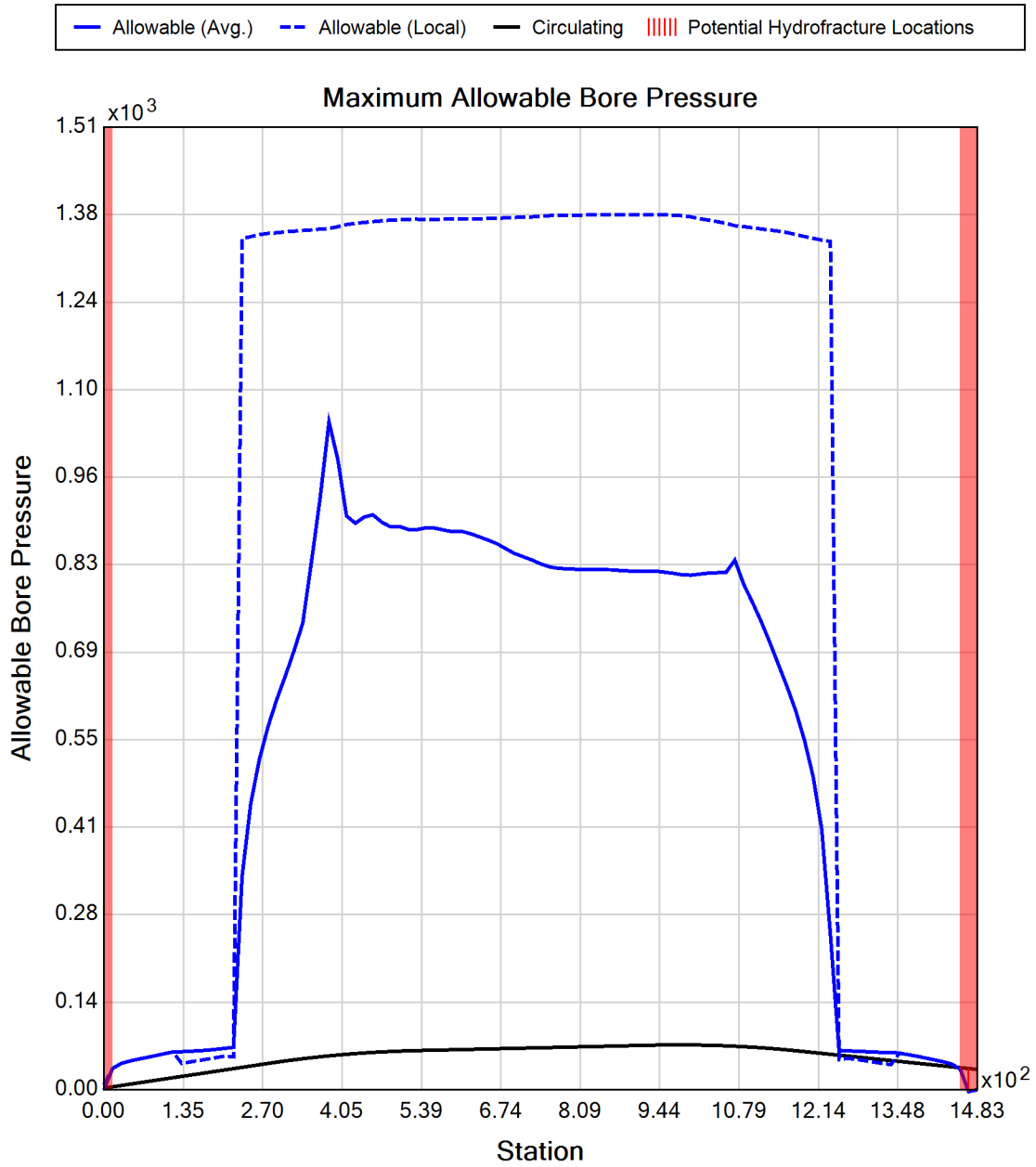
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aaron.coady@tetrattech.com

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HDD# 120
DWG# C-320.2

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Project Length	1470.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	16.000 in
Pipe DR	11.0
Pipe Thickness	1.45 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 16" (16")
Pipe DR: 11
Pipe Length: 1500.00 ft
Internal Pressure: 0 psi
Borehole Diameter: 2 ft
Silo Width: 2 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 7.92790 lb/US (liquid) gallon
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 12.51801 lb/US (liquid) gallon
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	7.2	48.0
Water Pressure	33.2	33.2
Surface Surge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	40.3	81.2
Deflection		
Earth Load Deflection	10.360	25.527
Buoyant Deflection	0.359	0.359
Reissner Effect	0	0
Net Deflection	10.718	25.886
Compressive Stress [psi]		
Compressive Wall Stress	221.8	446.4

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	30740.3	30740.3
Pullback Stress [psi]	462.5	462.5
Pullback Strain	8.043E-3	8.043E-3
Bending Stress [psi]	0.0	31.9
Bending Strain	0	5.556E-4
Tensile Stress [psi]	462.5	494.1
Tensile Strain	8.043E-3	9.148E-3

Net External Pressure = 23.9 [psi]

Buoyant Deflection = 0.2

Hydrokinetic Force = 1256.6 lb

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%] Unconstrained	0.176	7.5	42.6	OK
Collapse [psi] Tensile Stress	29.7	114.2	3.8	OK
[psi]	494.1	1200.0	2.4	OK



Generated Output



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Project Summary

General:

Kiewit - CHPE
Ref: New York
204-3701
Start Date: 04-29-2022
End Date: 03-17-2023

Designer:

Aaron Coady
Tetra Tech Rooney
115 Inverness Drive East, Suite 300
Englewood, Colorado
United States 80112
aaron.coady@tetrattech.com

Description:

Segment 11 (Package 7A)
Conduit 1
HDD 122
DWG C-322

Input Summary

Start Coordinate	(0.00, 0.00, 90.52) ft
End Coordinate	(1100.00, 0.00, 106.00) ft
Project Length	1100.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 3

Soil Layer #1 USCS, Silt (M), MH

From Assistant

Unit Weight: 10.9956 (dry), 14.5068 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #2 USCS, Clay (C), CH

From Assistant

Unit Weight: 11.9889 (dry), 15.2922 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 400.00, Coh: 8.30 [psi]

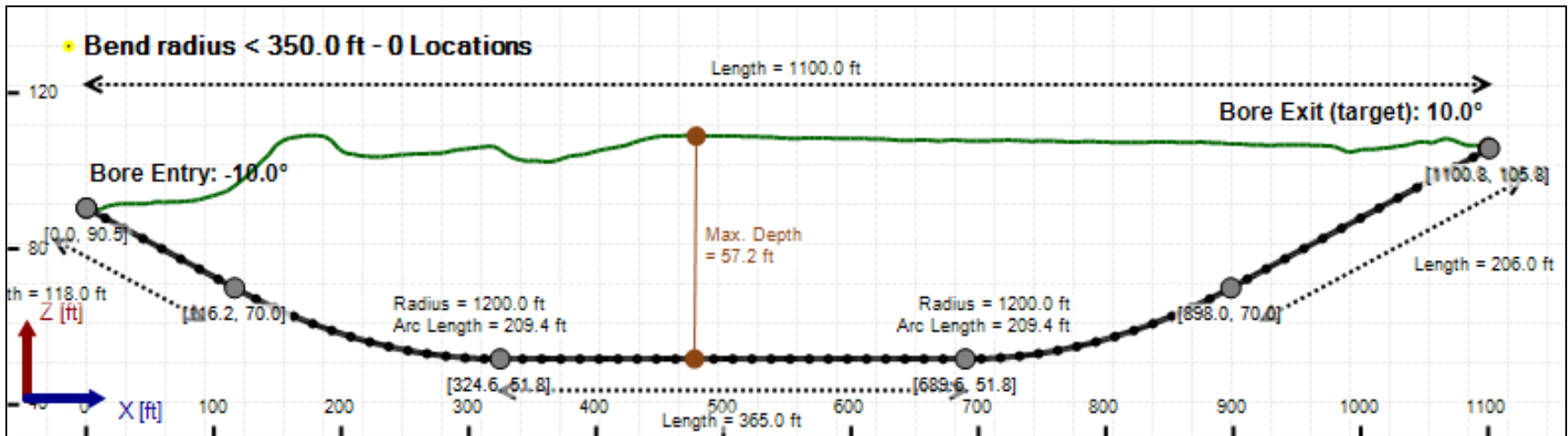
Soil Layer #3 Rock, Geological Classification, Sedimentary Rocks

From Assistant

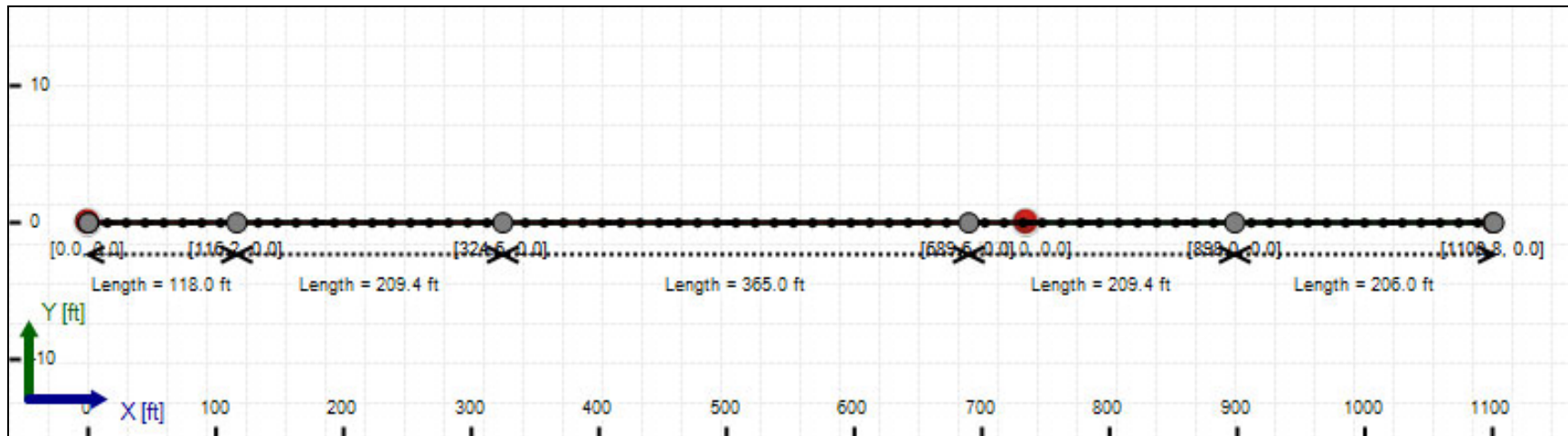
Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]

Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 10" (10.75")
Pipe DR: 9
Pipe Length: 1110.00 ft
Internal Pressure: 0 psi
Borehole Diameter: 1.34400002161662 ft
Silo Width: 1.34400002161662 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 7.92790 lb/US (liquid) gallon
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 12.51801 lb/US (liquid) gallon
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	20.7	37.1
Water Pressure	0.0	0.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	20.7	37.1
Deflection		
Earth Load Deflection	5.651	10.115
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	5.783	10.247
Compressive Stress [psi]		
Compressive Wall Stress	93.4	167.1

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	19078.4	19078.4
Pullback Stress [psi]	532.1	532.1
Pullback Strain	9.253E-3	9.253E-3
Bending Stress [psi]	0.0	21.5
Bending Strain	0	3.733E-4
Tensile Stress [psi]	532.1	552.5
Tensile Strain	9.253E-3	9.983E-3

Net External Pressure = 32.0 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	5.783	7.5	1.3	OK
Unconstrained Collapse [psi]	35.4	116.4	3.3	OK
Compressive Wall Stress [psi]	93.4	1150.0	12.3	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	45.3	224.0	4.9	OK
Tensile Stress [psi]	552.5	1200.0	2.2	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	722.705 psi	1333.527 psi
1	8.00 in	12.00 in	722.621 psi	1333.411 psi
2	12.00 in	16.13 in	722.500 psi	1333.244 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 200.00 US (liquid) gallon/min

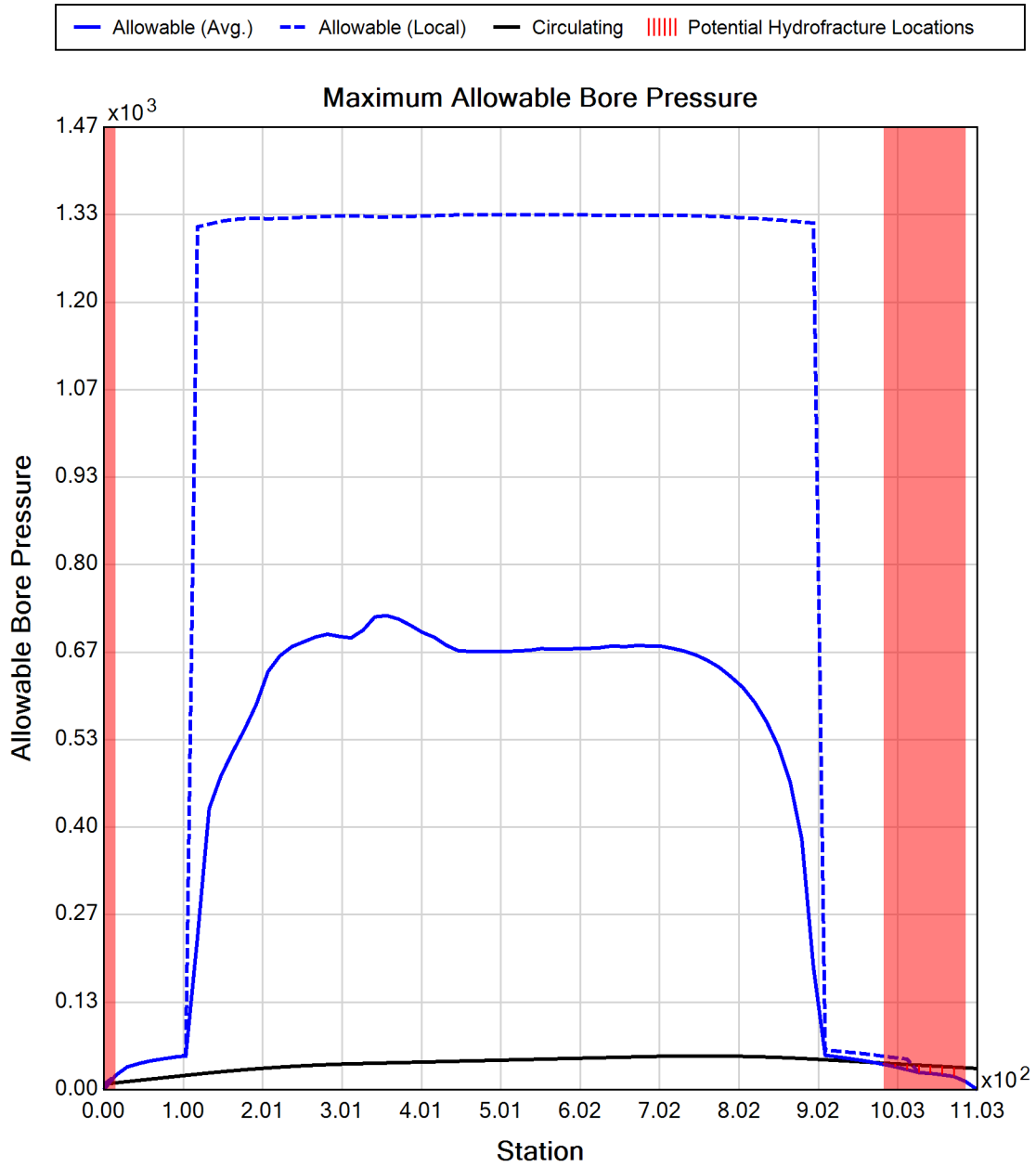
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 260.8





Generated Output



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Ref: New York
204-3701
Start Date: 04-29-2022
End Date: 03-17-2023

Designer:

Aaron Coady
Tetra Tech Rooney
115 Inverness Drive East, Suite 300
Englewood, Colorado
United States 80112
aaron.coady@tetrattech.com

Description:

Segment 11 (Package 7A)
Conduit 2
HDD 122
DWG C-322.2

Input Summary

Start Coordinate	(0.00, 0.00, 92.66) ft
End Coordinate	(1100.00, 0.00, 105.98) ft
Project Length	1100.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 3

Soil Layer #1 USCS, Silt (M), MH

From Assistant

Unit Weight: 10.9956 (dry), 14.5068 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #2 USCS, Clay (C), CH

From Assistant

Unit Weight: 11.9889 (dry), 15.2922 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 400.00, Coh: 8.30 [psi]

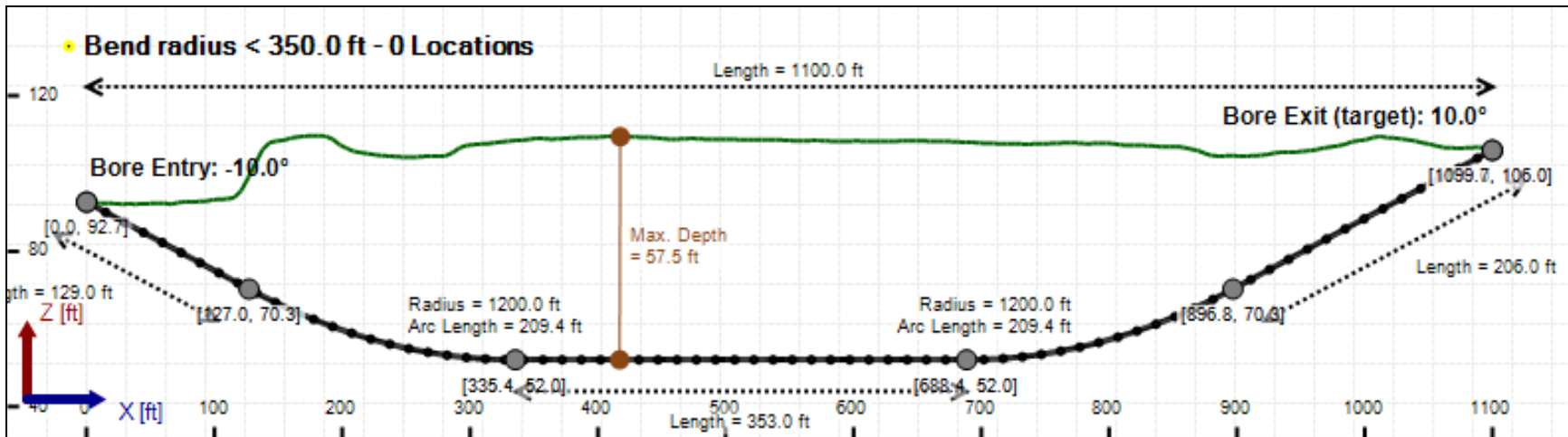
Soil Layer #3 Rock, Geological Classification, Sedimentary Rocks

From Assistant

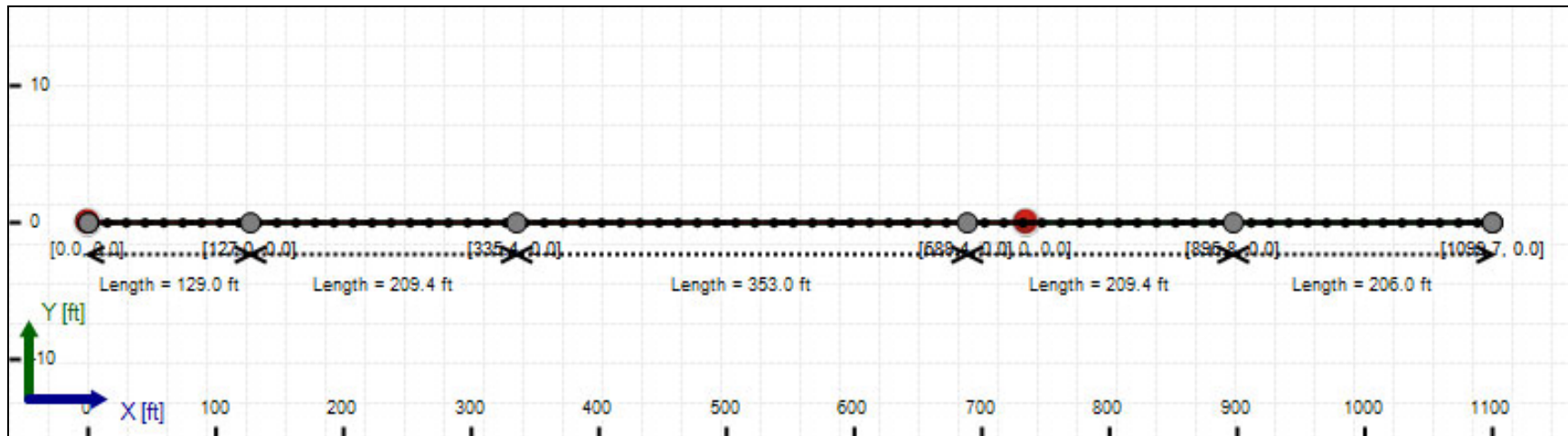
Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]

Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 10" (10.75")
Pipe DR: 9
Pipe Length: 1110.00 ft
Internal Pressure: 0 psi
Borehole Diameter: 1.34400002161662 ft
Silo Width: 1.34400002161662 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 7.92790 lb/US (liquid) gallon
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 12.51801 lb/US (liquid) gallon
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	19.6	37.3
Water Pressure	0.0	0.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	19.6	37.3
Deflection		
Earth Load Deflection	5.343	10.145
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	5.475	10.277
Compressive Stress [psi]		
Compressive Wall Stress	88.3	167.6

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	19032.4	19032.4
Pullback Stress [psi]	530.8	530.8
Pullback Strain	9.231E-3	9.231E-3
Bending Stress [psi]	0.0	21.5
Bending Strain	0	3.733E-4
Tensile Stress [psi]	530.8	550.5
Tensile Strain	9.231E-3	9.947E-3

Net External Pressure = 32.6 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	5.475	7.5	1.4	OK
Unconstrained Collapse [psi]	35.5	116.3	3.3	OK
Compressive Wall Stress [psi]	88.3	1150.0	13.0	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	45.4	224.2	4.9	OK
Tensile Stress [psi]	550.5	1200.0	2.2	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	688.359 psi	1333.618 psi
1	8.00 in	12.00 in	688.281 psi	1333.504 psi
2	12.00 in	16.13 in	688.169 psi	1333.339 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 200.00 US (liquid) gallon/min

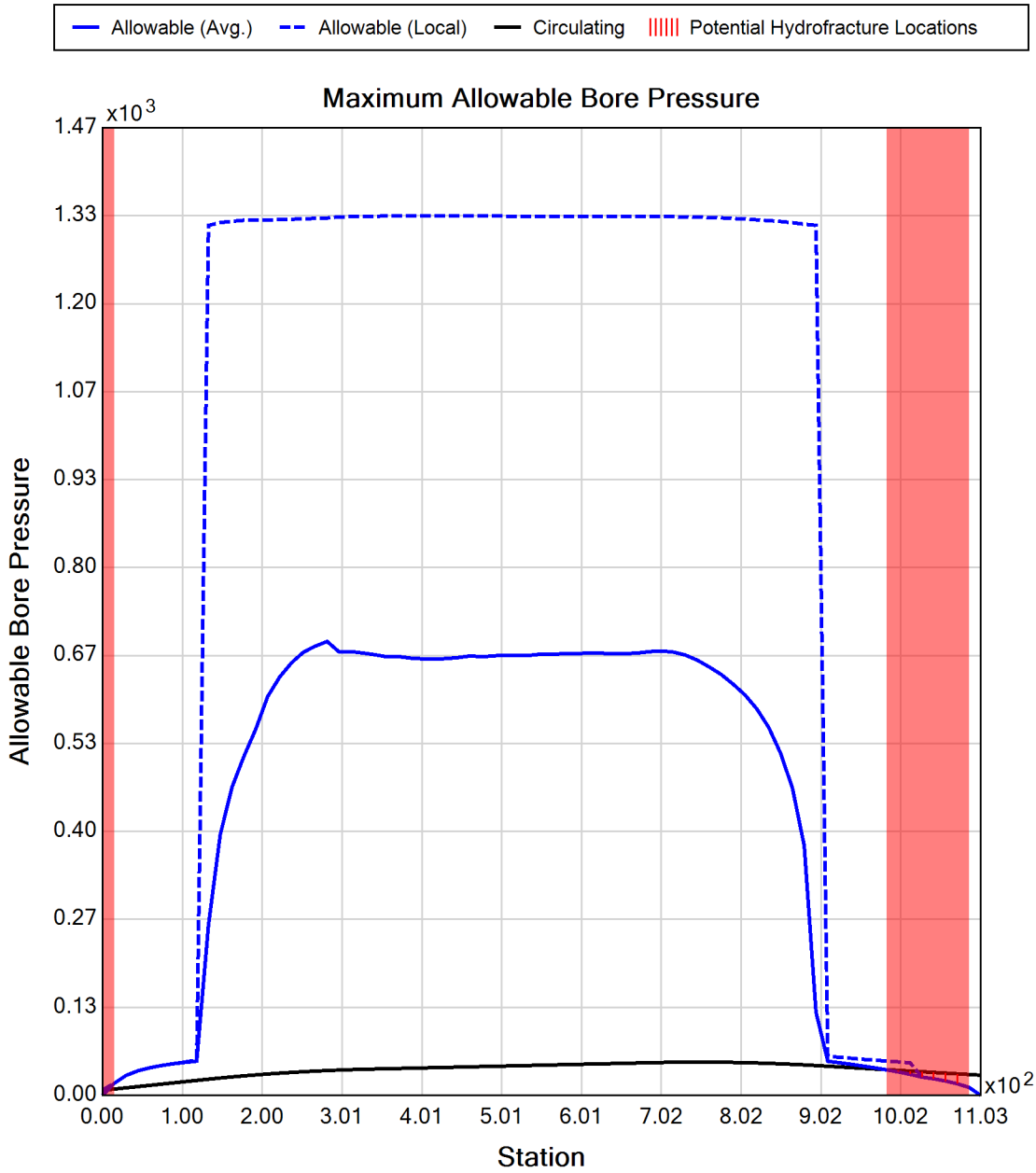
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 260.8





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Designer:

Aaron Coady
Tetra Tech Rooney
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United States 80112
aaron.coady@tetrattech.com

Description:

Segment 11 (Package 7A)
Conduit 3
HDD 122
DWG C-322.2

Input Summary

Start Coordinate	(0.00, 0.00, 92.66) ft
End Coordinate	(1100.00, 0.00, 105.98) ft
Project Length	1100.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	2.375 in
Pipe DR	7.0
Pipe Thickness	0.34 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 3

Soil Layer #1 USCS, Silt (M), MH

From Assistant

Unit Weight: 10.9956 (dry), 14.5068 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #2 USCS, Clay (C), CH

From Assistant

Unit Weight: 11.9889 (dry), 15.2922 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 400.00, Coh: 8.30 [psi]

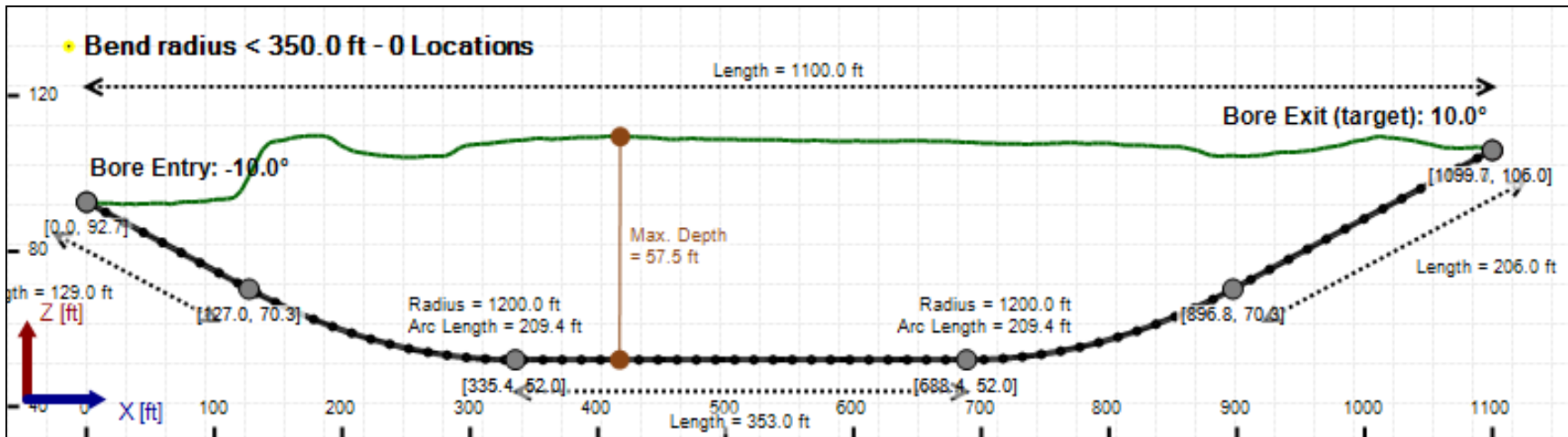
Soil Layer #3 Rock, Geological Classification, Sedimentary Rocks

From Assistant

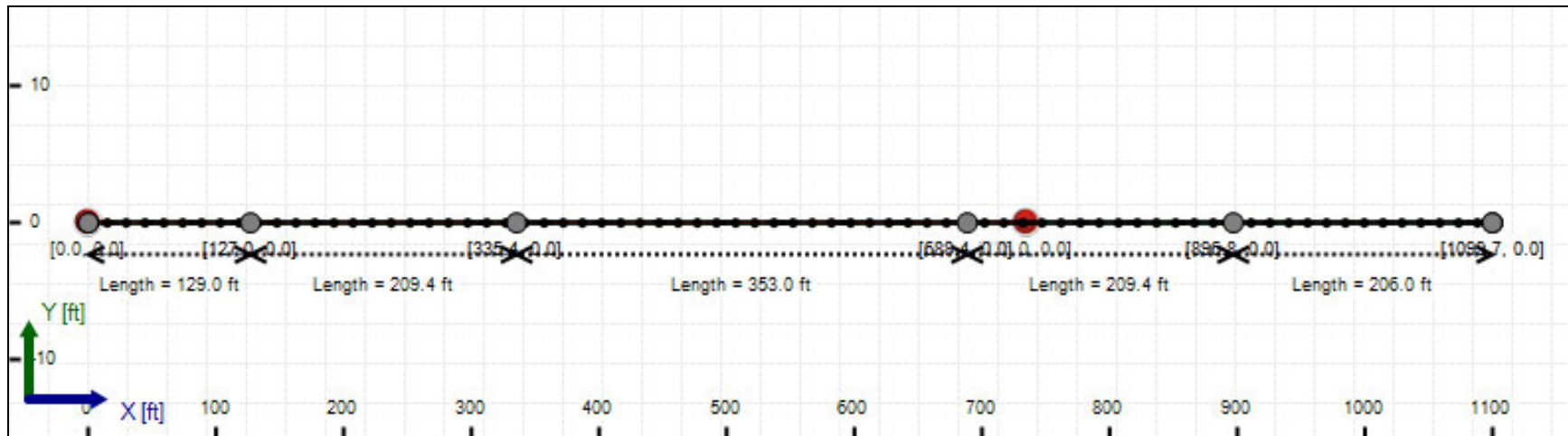
Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]

Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 2" (2.375")
Pipe DR: 7
Pipe Length: 1110.00 ft
Internal Pressure: 0 psi
Borehole Diameter: 0.531000018119812 ft
Silo Width: 0.531000018119812 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 7.92790 lb/US (liquid) gallon
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 12.51801 lb/US (liquid) gallon
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	19.2	37.3
Water Pressure	0.0	0.0
Surface Surge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	19.2	37.3
Deflection		
Earth Load Deflection	2.209	4.280
Buoyant Deflection	0.014	0.014
Reissner Effect	0	0
Net Deflection	2.223	4.294
Compressive Stress [psi]		
Compressive Wall Stress	67.3	130.4

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	990.9	990.9
Pullback Stress [psi]	456.7	456.7
Pullback Strain	7.942E-3	7.942E-3
Bending Stress [psi]	0.0	4.7
Bending Strain	0	8.247E-5
Tensile Stress [psi]	456.7	461.0
Tensile Strain	7.942E-3	8.100E-3

Net External Pressure = 32.6 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	2.223	7.5	3.4	OK
Unconstrained Collapse [psi]	35.5	318.3	9.0	OK
Compressive Wall Stress [psi]	67.3	1150.0	17.1	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.007	7.5	1114.2	OK
Unconstrained Collapse [psi]	45.4	545.0	12.0	OK
Tensile Stress [psi]	461.0	1200.0	2.6	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	688.359 psi	1333.618 psi
1	8.00 in	6.37 in	688.381 psi	1333.652 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 200.00 US (liquid) gallon/min

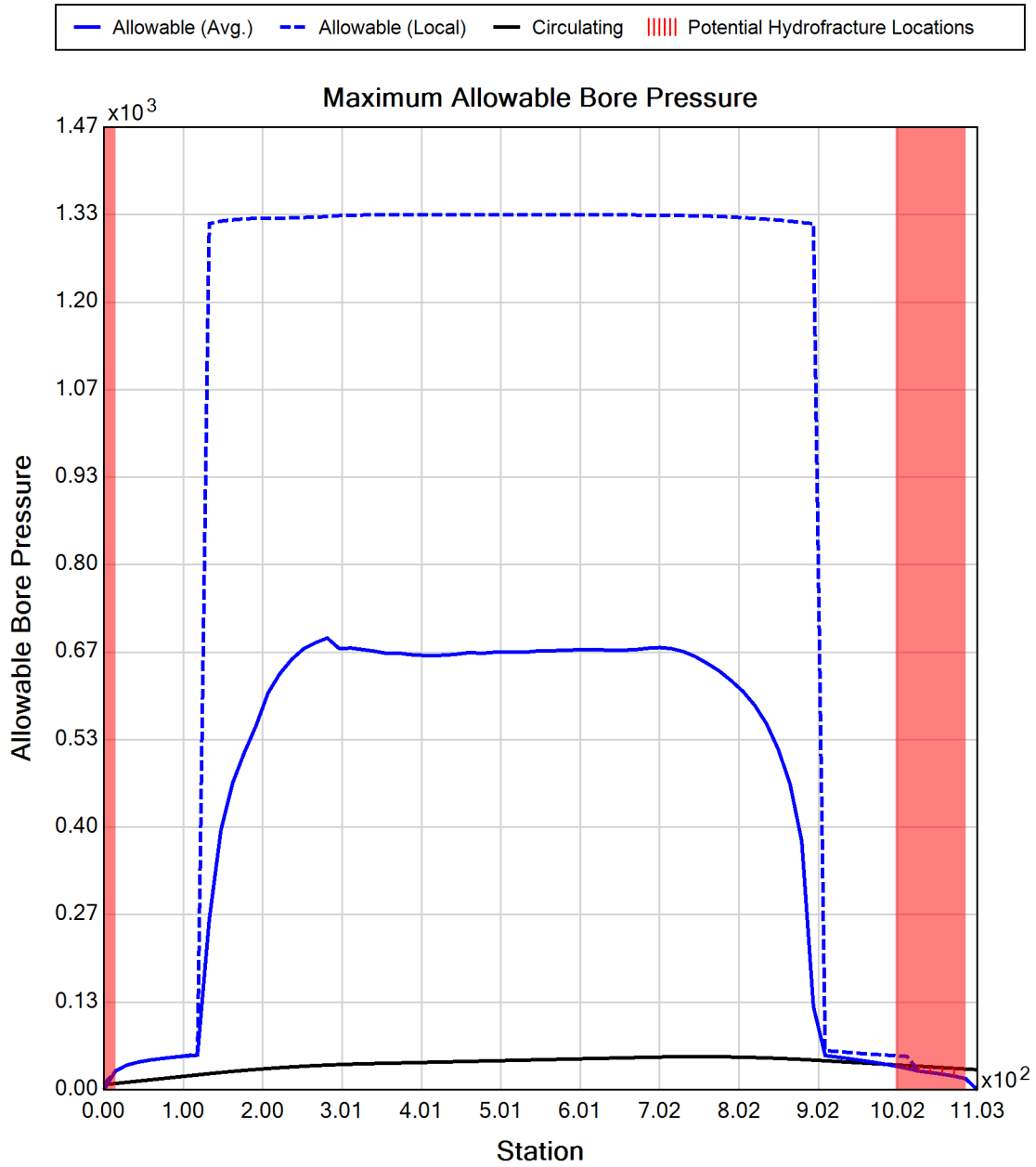
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 260.8





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Tetra Tech Rooney
115 Inverness Drive East, Suite 300
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United States 80112
aaron.coady@tetrattech.com

Description:

Segment 11 (Package 7A)
Conduit 2 & 3 Equivalent Pipe Bundle
HDD 122
DWG C-322.2

Input Summary

Start Coordinate	(0.00, 0.00, 92.66) ft
End Coordinate	(1100.00, 0.00, 105.98) ft
Project Length	1100.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	14.000 in
Pipe DR	14.3
Pipe Thickness	0.98 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 14" (14")
Pipe DR: 14.3
Pipe Length: 1110.00 ft
Internal Pressure: 0 psi
Borehole Diameter: 1.75 ft
Silo Width: 1.75 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 7.92790 lb/US (liquid) gallon
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 12.51801 lb/US (liquid) gallon
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	19.9	37.3
Water Pressure	0.0	0.0
Surface Surge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	19.9	37.3
Deflection		
Earth Load Deflection	24.921	46.617
Buoyant Deflection	0.690	0.690
Reissner Effect	0	0
Net Deflection	25.610	47.307
Compressive Stress [psi]		
Compressive Wall Stress	142.4	266.4

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	15785.6	15785.6
Pullback Stress [psi]	394.2	394.2
Pullback Strain	6.855E-3	6.855E-3
Bending Stress [psi]	0.0	28.0
Bending Strain	0	4.861E-4
Tensile Stress [psi]	394.2	421.9
Tensile Strain	6.855E-3	7.824E-3

Net External Pressure = 17.5 [psi]

Buoyant Deflection = 0.3

Hydrokinetic Force = 962.1 lb

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%] Unconstrained	0.338	7.5	22.2	OK
Collapse [psi] Tensile Stress	21.8	49.1	2.2	OK
[psi]	421.9	1200.0	2.8	OK



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Project Summary

General:

Kiewit - CHPE
Ref: New York
204-3701
Start Date: 04-29-2022
End Date: 03-17-2023

Designer:

Aaron Coady
Tetra Tech Rooney
115 Inverness Drive East, Suite 300
Englewood, Colorado
United States 80112
aaron.coady@tetrattech.com

Description:

Segment 11 (Package 7A)
Conduit 1
HDD# 123
DWG# C-323

Input Summary

Start Coordinate	(0.00, 0.00, 108.39) ft
End Coordinate	(850.00, 0.00, 113.09) ft
Project Length	850.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 5

Soil Layer #1 USCS, Gravel (G), GM

Depth: 3.00 ft

Unit Weight: 16.9785 (dry), 18.6879 (sat) [lb/US (liquid) gallon]

Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Clay (C), CL

Depth: 1.00 ft

Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 300.00, Coh: 5.60 [psi]

Soil Layer #3 USCS, Silt (M), MH

Depth: 11.00 ft

Unit Weight: 10.9956 (dry), 14.5068 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 145.00, Coh: 3.10 [psi]

Soil Layer #4 USCS, Clay (C), CH

Depth: 10.00 ft

Unit Weight: 11.9889 (dry), 15.2922 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 300.00, Coh: 5.60 [psi]

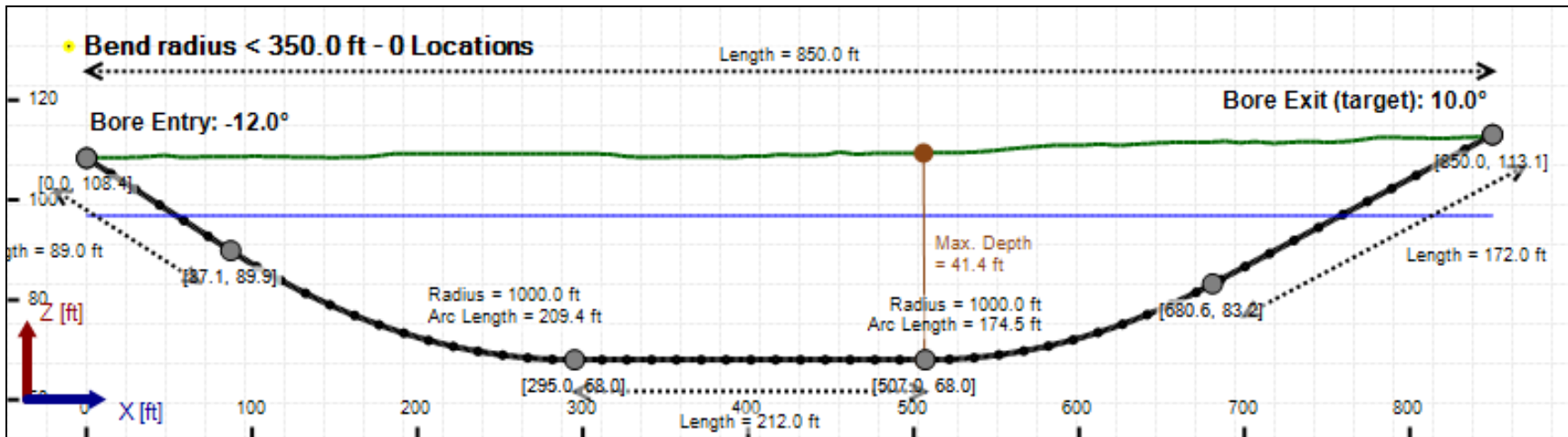
Soil Layer #5 USCS, Silt (M), MH

Depth: 35.00 ft

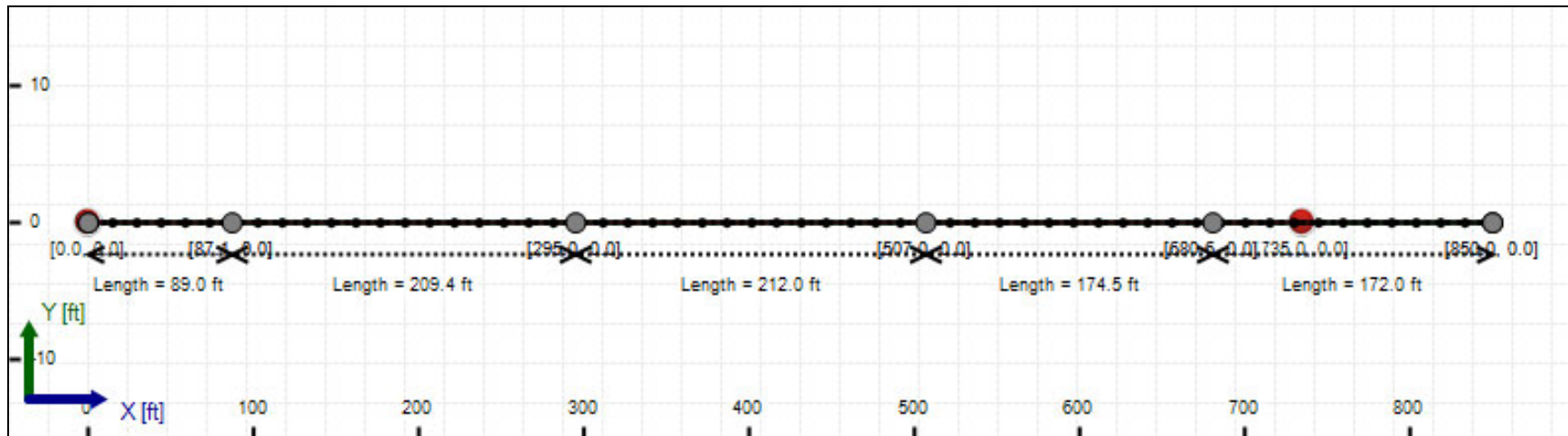
Unit Weight: 10.9956 (dry), 14.5068 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 145.00, Coh: 3.10 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 10" (10.75")
Pipe DR: 9
Pipe Length: 870.00 ft
Internal Pressure: 0 psi
Borehole Diameter: 1.34400002161662 ft
Silo Width: 1.34400002161662 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 7.92790 lb/US (liquid) gallon
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 12.51801 lb/US (liquid) gallon
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	9.8	18.2
Water Pressure	12.5	12.5
Surface Surge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	22.3	30.7
Deflection		
Earth Load Deflection	2.677	5.070
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	2.809	5.202
Compressive Stress [psi]		
Compressive Wall Stress	100.5	138.3

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	15258.9	15258.9
Pullback Stress [psi]	425.5	425.5
Pullback Strain	7.401E-3	7.401E-3
Bending Stress [psi]	25.8	25.8
Bending Strain	4.479E-4	4.479E-4
Tensile Stress [psi]	451.3	451.3
Tensile Strain	8.297E-3	8.297E-3

Net External Pressure = 26.7 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	2.809	7.5	2.7	OK
Unconstrained Collapse [psi]	30.8	107.4	3.5	OK
Compressive Wall Stress [psi]	100.5	1150.0	11.4	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	40.7	230.5	5.7	OK
Tensile Stress [psi]	451.3	1200.0	2.7	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	55.176 psi	48.369 psi
1	8.00 in	12.00 in	55.128 psi	48.160 psi
2	12.00 in	16.13 in	55.060 psi	47.872 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 70.00 US (liquid) gallon/min

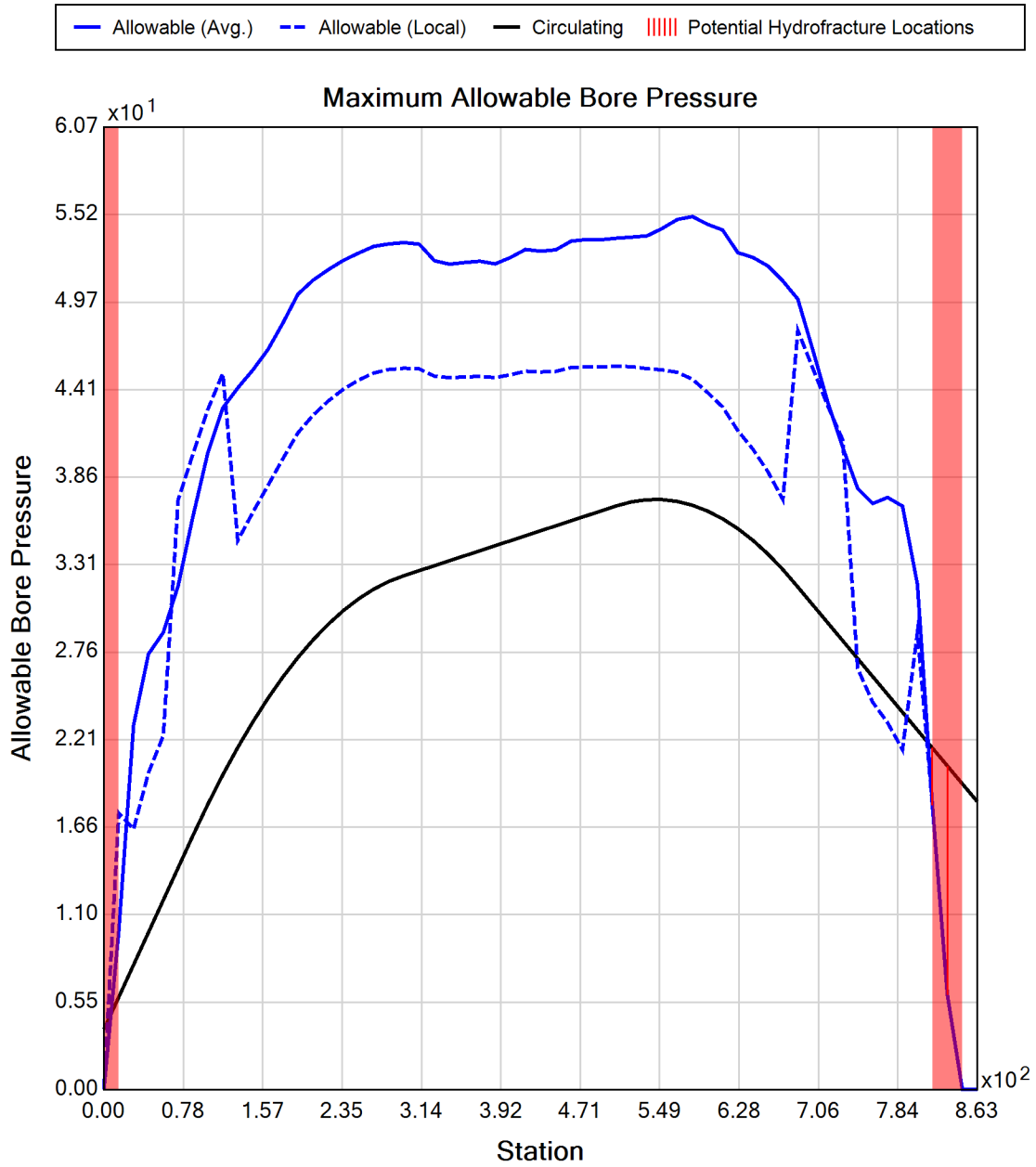
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 697.8





Generated Output



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Project Summary

General:

Kiewit - CHPE
Ref: New York
204-3701
Start Date: 04-29-2022
End Date: 03-17-2023

Designer:

Aaron Coady
Tetra Tech Rooney
115 Inverness Drive East, Suite 300
Englewood, Colorado
United States 80112
aaron.coady@tetrattech.com

Description:

Segment 11 (Package 7A)
Conduit 2
HDD# 123
DWG# C-323.2

Input Summary

Start Coordinate	(0.00, 0.00, 108.68) ft
End Coordinate	(850.00, 0.00, 112.75) ft
Project Length	850.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 5

Soil Layer #1 USCS, Gravel (G), GM

Depth: 3.00 ft

Unit Weight: 16.9785 (dry), 18.6879 (sat) [lb/US (liquid) gallon]

Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Clay (C), CL

Depth: 1.00 ft

Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 300.00, Coh: 5.60 [psi]

Soil Layer #3 USCS, Silt (M), MH

Depth: 11.00 ft

Unit Weight: 10.9956 (dry), 14.5068 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 145.00, Coh: 3.10 [psi]

Soil Layer #4 USCS, Clay (C), CH

Depth: 10.00 ft

Unit Weight: 11.9889 (dry), 15.2922 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 300.00, Coh: 5.60 [psi]

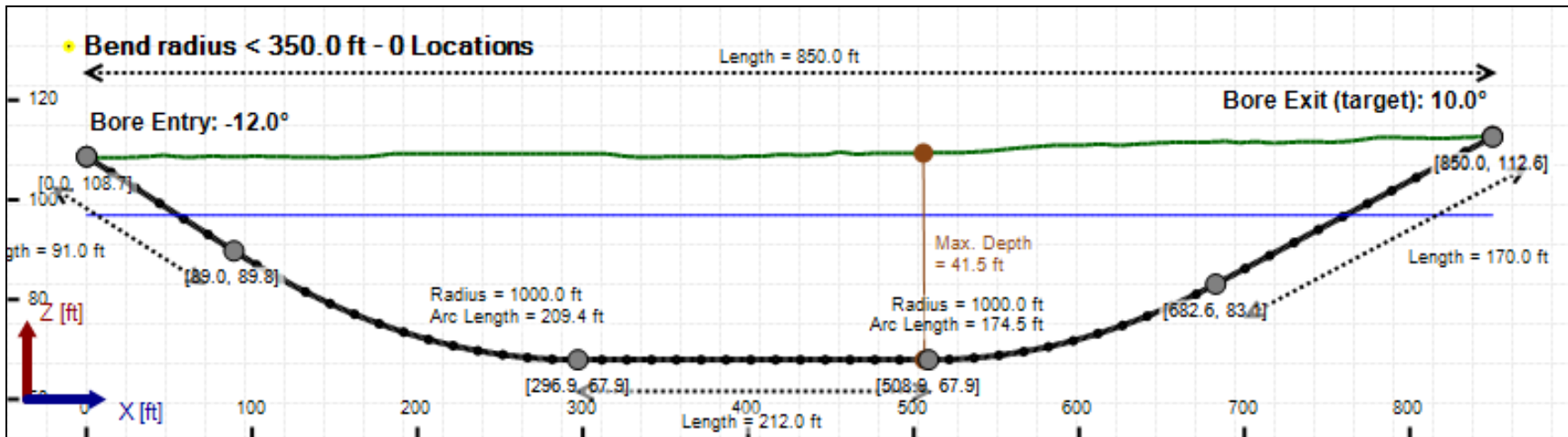
Soil Layer #5 USCS, Silt (M), MH

Depth: 35.00 ft

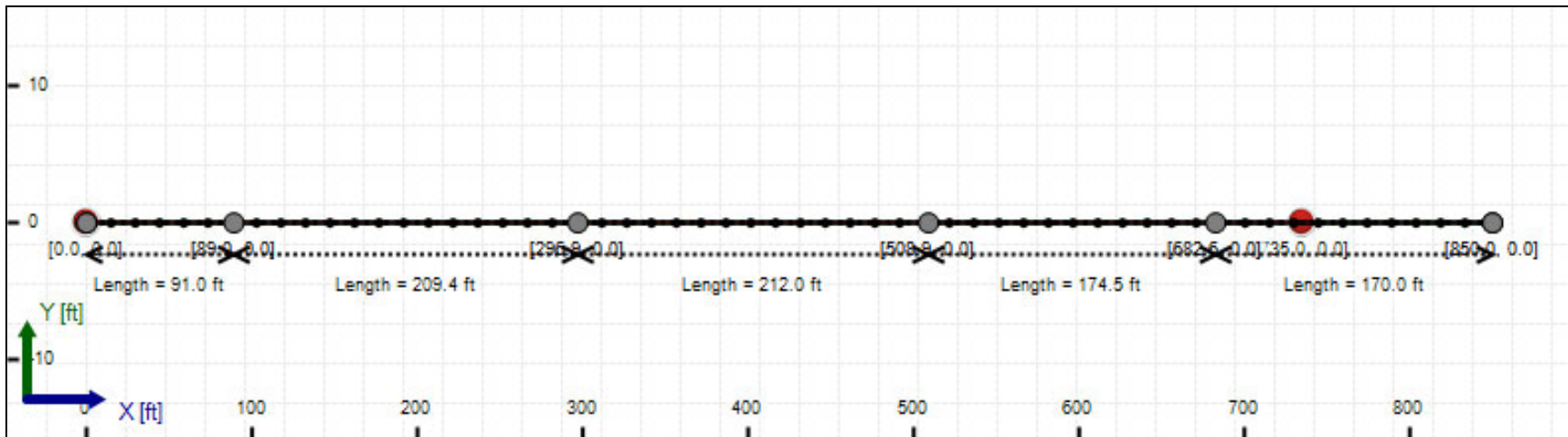
Unit Weight: 10.9956 (dry), 14.5068 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 145.00, Coh: 3.10 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 10" (10.75")
Pipe DR: 9
Pipe Length: 870.00 ft
Internal Pressure: 0 psi
Borehole Diameter: 1.34400002161662 ft
Silo Width: 1.34400002161662 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 7.92790 lb/US (liquid) gallon
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 12.51801 lb/US (liquid) gallon
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	10.2	18.2
Water Pressure	12.6	12.6
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	22.8	30.7
Deflection		
Earth Load Deflection	2.785	5.069
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	2.917	5.201
Compressive Stress [psi]		
Compressive Wall Stress	102.6	138.3

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	15233.9	15233.9
Pullback Stress [psi]	424.9	424.9
Pullback Strain	7.389E-3	7.389E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	424.9	448.9
Tensile Strain	7.389E-3	8.255E-3

Net External Pressure = 26.2 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	2.917	7.5	2.6	OK
Unconstrained Collapse [psi]	30.5	106.4	3.5	OK
Compressive Wall Stress [psi]	102.6	1150.0	11.2	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	40.5	230.7	5.7	OK
Tensile Stress [psi]	448.9	1200.0	2.7	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	54.857 psi	46.400 psi
1	8.00 in	12.00 in	54.810 psi	46.154 psi
2	12.00 in	16.13 in	54.744 psi	45.815 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 70.00 US (liquid) gallon/min

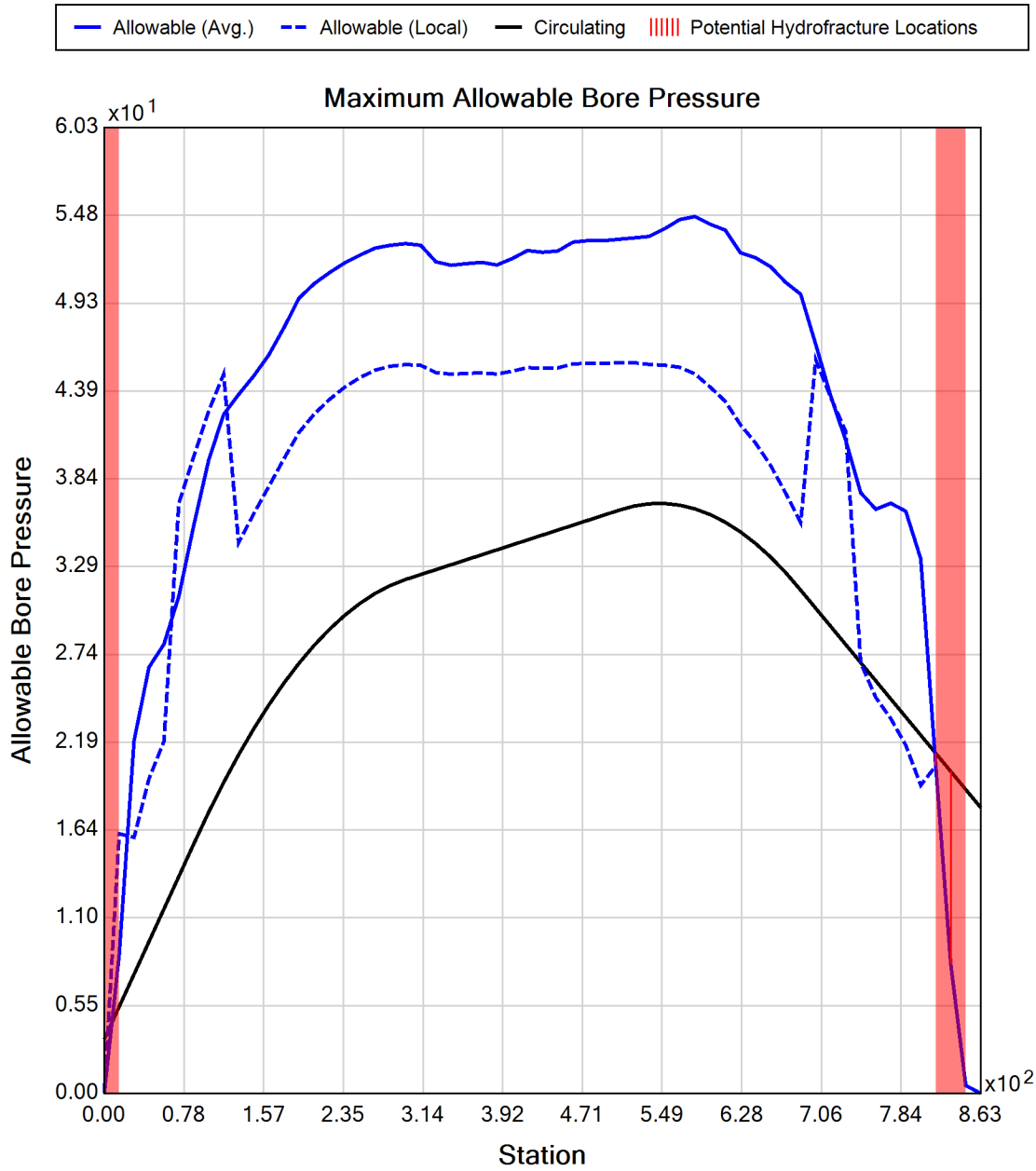
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 697.8





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aaron.coady@tetrattech.com

Description:

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Conduit 3
HDD# 123
DWG# C-323.2

Input Summary

Start Coordinate	(0.00, 0.00, 108.68) ft
End Coordinate	(850.00, 0.00, 112.75) ft
Project Length	850.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	2.375 in
Pipe DR	7.0
Pipe Thickness	0.34 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 5

Soil Layer #1 USCS, Gravel (G), GM

Depth: 3.00 ft

Unit Weight: 16.9785 (dry), 18.6879 (sat) [lb/US (liquid) gallon]

Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Clay (C), CL

Depth: 1.00 ft

Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 300.00, Coh: 5.60 [psi]

Soil Layer #3 USCS, Silt (M), MH

Depth: 11.00 ft

Unit Weight: 10.9956 (dry), 14.5068 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 145.00, Coh: 3.10 [psi]

Soil Layer #4 USCS, Clay (C), CH

Depth: 10.00 ft

Unit Weight: 11.9889 (dry), 15.2922 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 300.00, Coh: 5.60 [psi]

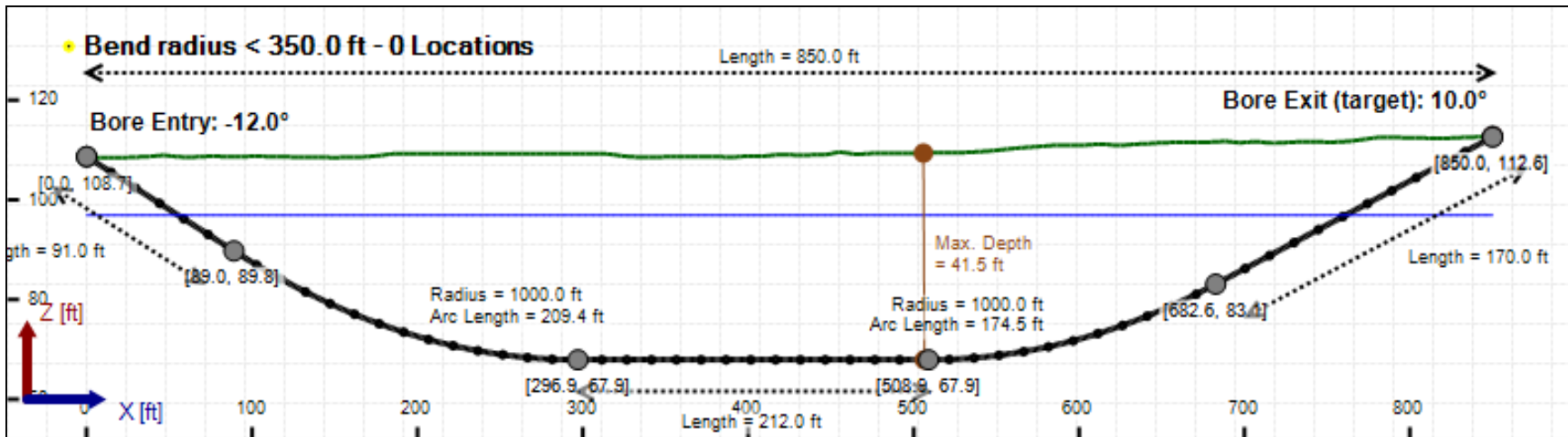
Soil Layer #5 USCS, Silt (M), MH

Depth: 35.00 ft

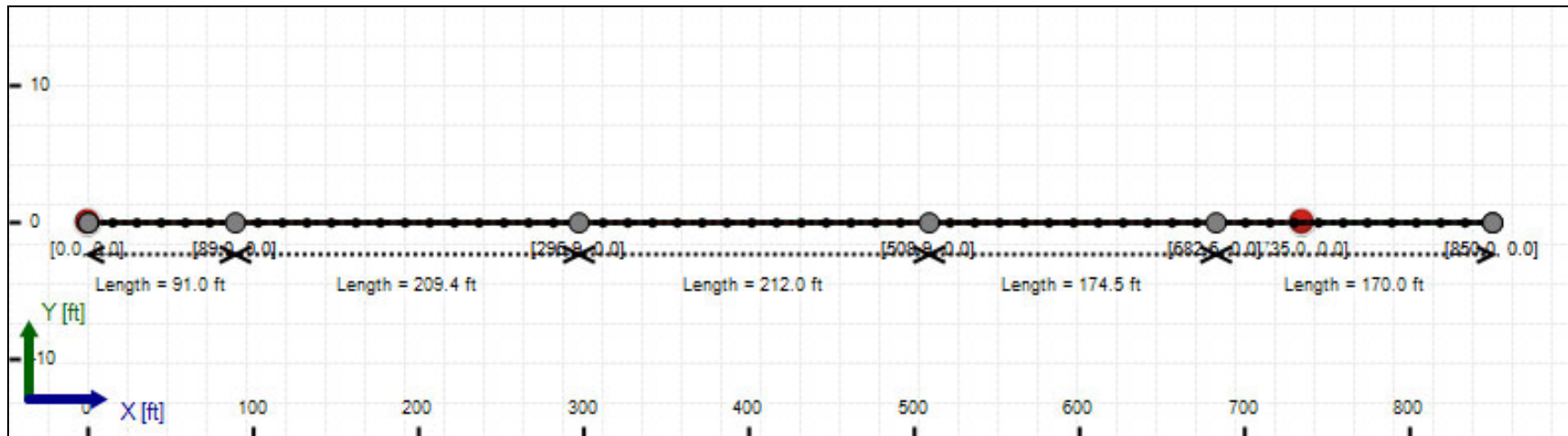
Unit Weight: 10.9956 (dry), 14.5068 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 145.00, Coh: 3.10 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 2" (2.375")
Pipe DR: 7
Pipe Length: 870.00 ft
Internal Pressure: 0 psi
Borehole Diameter: 0.531000018119812 ft
Silo Width: 0.531000018119812 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 7.92790 lb/US (liquid) gallon
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 12.51801 lb/US (liquid) gallon
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	5.5	18.2
Water Pressure	12.6	12.6
Surface Surge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	18.1	30.7
Deflection		
Earth Load Deflection	0.635	2.138
Buoyant Deflection	0.014	0.014
Reissner Effect	0	0
Net Deflection	0.649	2.152
Compressive Stress [psi]		
Compressive Wall Stress	63.3	107.6

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	814.8	814.8
Pullback Stress [psi]	375.5	375.5
Pullback Strain	6.531E-3	6.531E-3
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	375.5	380.8
Tensile Strain	6.531E-3	6.722E-3

Net External Pressure = 26.2 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.649	7.5	11.6	OK
Unconstrained Collapse [psi]	30.5	308.9	10.1	OK
Compressive Wall Stress [psi]	63.3	1150.0	18.2	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.007	7.5	1114.2	OK
Unconstrained Collapse [psi]	40.5	557.0	13.7	OK
Tensile Stress [psi]	380.8	1200.0	3.2	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	54.857 psi	46.400 psi
1	8.00 in	6.37 in	54.870 psi	46.474 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 70.00 US (liquid) gallon/min

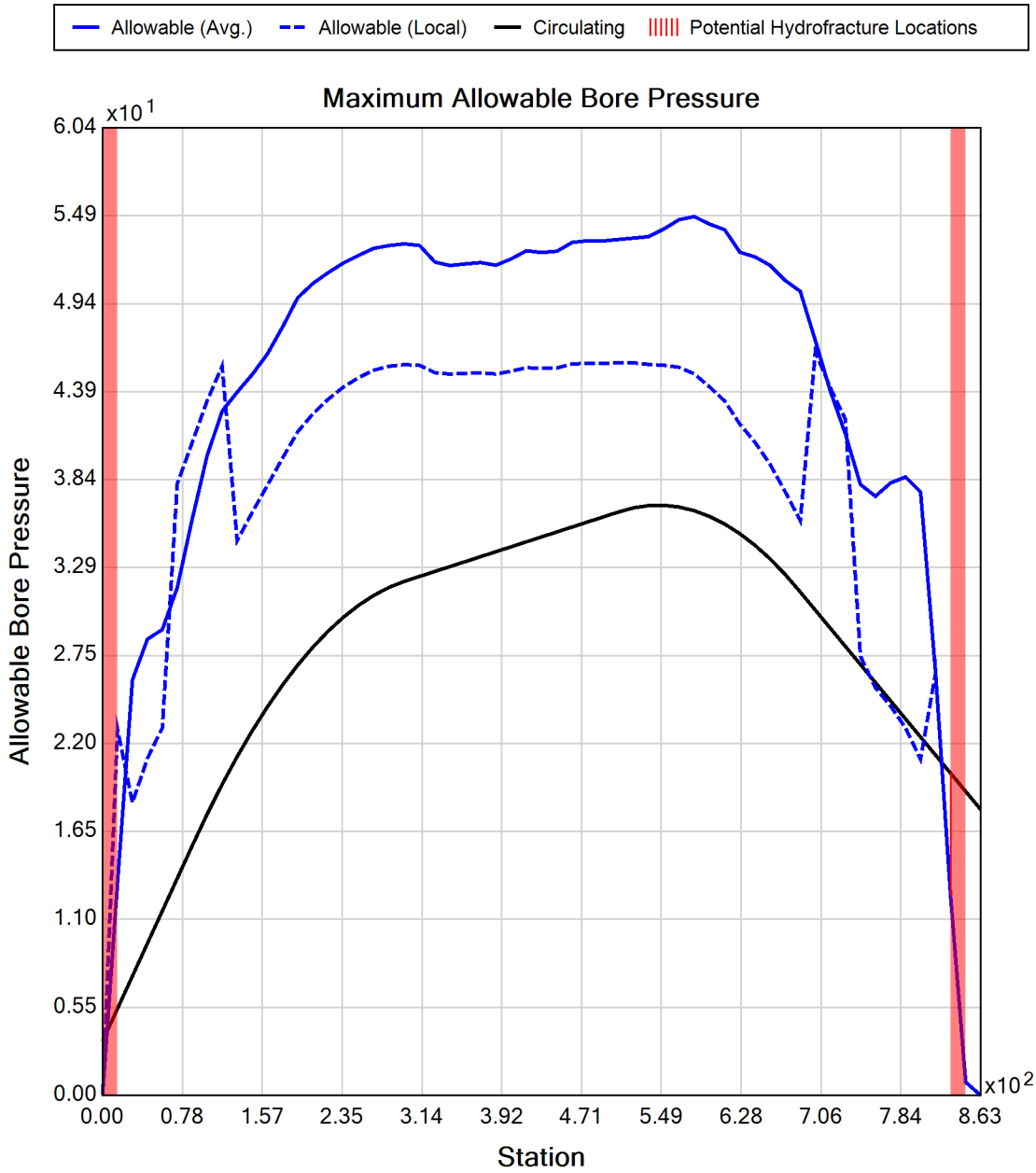
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 697.8





Generated Output



WARNING: The accuracy of the data obtained by the BoreAid® system is highly dependent upon accurate data gathering, data input and proper use of the software. Vermeer is not responsible for that information. BoreAid® data is not intended to replace the need for future on-site utility locating, measuring and verification procedures, which are essential for accurate placement of new underground installations and avoidance of existing utilities.

CALL YOUR ONE-CALL SYSTEM FIRST



WARNING: Always contact your local One-Call system before the start of your digging project. The BoreAid® system is intended to be used with other utility locating methods, such as the use of the One-Call system and the exposing of existing utilities by potholing.

Locate utilities before drilling. Call 811 (U.S. only) or 1-888-258-0808 (U.S. or Canada) or local utility companies or national regulating authority.

Before you start any digging project, do not forget to call the local One-Call system in your area and any utility company that does not subscribe to the One-Call system. For areas not represented by One-Call Systems International, contact the appropriate utility companies or national regulating authority to locate and mark the underground installations. If you do not call, you may have an accident or suffer injuries; cause interruption of services; damage the environment; or experience job delays.

OSHA CFR 29 1926.651 requires that the estimated location of underground utilities be determined before beginning the excavation or underground drilling operation. When the actual excavation or bore approaches an estimated utility location, the exact location of the underground installation must be determined by a safe, acceptable and dependable method. If the utility cannot be precisely located, it must be shut off by the utility company.

Project Summary

General: Kiewit - CHPE
Ref: New York
204-3701
Start Date: 04-29-2022
End Date: 03-17-2023

Designer: Aaron Coady
Tetra Tech Rooney
115 Inverness Drive East, Suite 300
Englewood, Colorado
United States 80112
aaron.coady@tetrattech.com

Description: Segment 11 (Package 7A)
Conduit 2 & 3 Equivalent Pipe Bundle
HDD# 123
DWG# C-323.2

Input Summary

Start Coordinate	(0.00, 0.00, 108.68) ft
End Coordinate	(850.00, 0.00, 112.75) ft
Project Length	850.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	14.000 in
Pipe DR	14.3
Pipe Thickness	0.98 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 14" (14")
Pipe DR: 14.3
Pipe Length: 870.00 ft
Internal Pressure: 0 psi
Borehole Diameter: 1.75 ft
Silo Width: 1.75 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 7.92790 lb/US (liquid) gallon
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 12.51801 lb/US (liquid) gallon
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	11.5	18.2
Water Pressure	12.6	12.6
Surface Surge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	24.0	30.7
Deflection		
Earth Load Deflection	14.339	23.290
Buoyant Deflection	0.690	0.690
Reissner Effect	0	0
Net Deflection	15.029	23.980
Compressive Stress [psi]		
Compressive Wall Stress	171.8	219.7

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	12724.5	12724.5
Pullback Stress [psi]	317.7	317.7
Pullback Strain	5.526E-3	5.526E-3
Bending Stress [psi]	0.0	33.5
Bending Strain	0	5.833E-4
Tensile Stress [psi]	317.7	351.1
Tensile Strain	5.526E-3	6.690E-3

Net External Pressure = 15.4 [psi]

Buoyant Deflection = 0.3

Hydrokinetic Force = 962.1 lb

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%] Unconstrained	0.338	7.5	22.2	OK
Collapse [psi] Tensile Stress	20.2	50.0	2.5	OK
[psi]	351.1	1200.0	3.4	OK

Appendix D

HDD Design Drawings