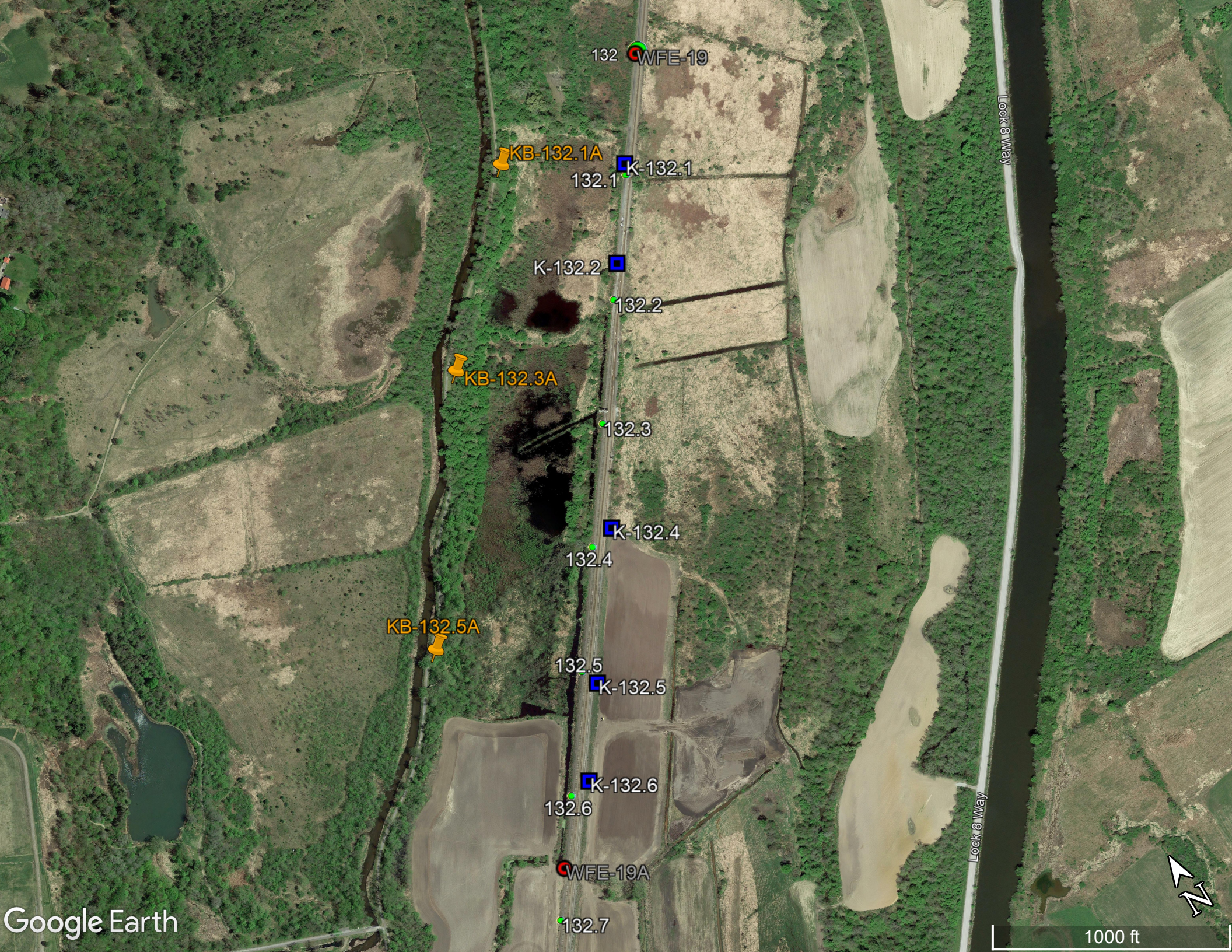

132
WFE-19
KB-132.1A
K-132.1
132.1
K-132.2
132.2
KB-132.3A
132.3
K-132.4
132.4
KB-132.5A
132.5
K-132.5
K-132.6
132.6
WFE-19A
132.7
Lock 8 Way
Lock 8 Way
N
1000 ft
Google Earth

BORING LOG NO. KB-132.1A

PROJECT: CHPE - Additional HDD Borings - Phase 3

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

SITE: Fort Ann to Coxsackie
Fort Ann, NY

LOCATION See Exploration Plan
Approximate
Latitude: 43.2994° Longitude: -73.5521°

DEPTH	ELEVATION (Ft.)
0.2	148.4
2.5	

TOPSOIL

FILL - SILTY SAND (SM), gravel noted, orange and brown

LEAN CLAY (CL), varved silt and clay, brown, very soft to stiff

grades gray

DEPTH (Ft.)	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	8	5-5-4-4 N=9			
	14	3-4-5-6 N=9			
5	10	4-4-4-5 N=8			
	20	2-3-4-5 N=7			
	24	5-5-7-7 N=12			
10	24	3-4-5-6 N=9			
	24	4-4-4-5 N=8			
15					
	24	2-2-3-4 N=5			
20					
	24	WH-WH-3-3 N=3			
25					

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud Rotary

Abandonment Method:
Boring backfilled with bentonite grout upon completion

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

Logged by AB
Hammer Efficiency Summary:
Energy Transfer Ratio: 78.6% +/-2.9%
Hammer Efficiency Correction (CE): 1.31

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
30 Corporate Cir Ste 201
Albany, NY

Boring Started: 08-23-2022 | Boring Completed: 08-24-2022
Drill Rig: Diedrich D-50 | Driller: C. Johnston
Project No.: JB215256G

BORING LOG NO. KB-132.1A

PROJECT: CHPE - Additional HDD Borings - Phase 3

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

SITE: Fort Ann to Coxsackie
Fort Ann, NY

LOCATION See Exploration Plan

Latitude: 43.2994° Longitude: -73.5521°

DEPTH ELEVATION (Ft.)

GRAPHIC LOG	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
LEAN CLAY (CL), varved silt and clay, brown, very soft to stiff *(continued)*	30				WH-WH-WH-WH			
	35				WH-WH-WH-WH			
37.0 **WEATHERED SHALE**, black								
40.0 **SHALE**, slightly weathered, very close to moderate fractured, good RQD, black	40				REC = 91% RQD = 83%			
45.0 **SHALE**, slightly weathered, close to moderate fractured, good RQD, black	45				REC = 91% RQD = 84%			
50.0 **SHALE**, slightly weathered, very close to moderate fractured, good RQD, black	50				REC = 100% RQD = 85%			
55.0	55							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud Rotary

Abandonment Method:
Boring backfilled with bentonite grout upon completion

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

Logged by AB
Hammer Efficiency Summary:
Energy Transfer Ratio: 78.6% +/-2.9%
Hammer Efficiency Correction (CE): 1.31

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
30 Corporate Cir Ste 201
Albany, NY

Boring Started: 08-23-2022 | Boring Completed: 08-24-2022

Drill Rig: Diedrich D-50 | Driller: C. Johnston

Project No.: JB215256G

BORING LOG NO. KB-132.1A

PROJECT: CHPE - Additional HDD Borings - Phase 3

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

SITE: Fort Ann to Coxsackie
Fort Ann, NY

LOCATION See Exploration Plan

Latitude: 43.2994° Longitude: -73.5521°

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS		WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SHALE, slightly weathered, very close to moderate fractured, good RQD, black *(continued)*						REC = 100% RQD = 89%				
	60.0		60								
	***Boring** Terminated at 60 Feet*										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud Rotary

Abandonment Method:
Boring backfilled with bentonite grout upon completion

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

Logged by AB
Hammer Efficiency Summary:
Energy Transfer Ratio: 78.6% +/-2.9%
Hammer Efficiency Correction (CE): 1.31

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
30 Corporate Cir Ste 201
Albany, NY

Boring Started: 08-23-2022 | Boring Completed: 08-24-2022

Drill Rig: Diedrich D-50 | Driller: C. Johnston

Project No.: JB215256G

BORING LOG NO. KB-132.3A

PROJECT: CHPE - Additional HDD Borings - Phase 3

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

SITE: Fort Ann to Coxsackie
Fort Ann, NY

LOCATION See Exploration Plan
Approximate
Latitude: 43.2976° Longitude: -73.5544°

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.3 **TOPSOIL**	147.8						
FILL - SILT, gravel and sand noted, dark brown			18	12-31-14-7 N=45			
			14	5-8-10-7 N=18			
		5	8	5-7-7-7 N=14			
6.0 **LEAN CLAY (CL)**, varved silt and clay, brown with gray mottling, very soft to very stiff			20	2-4-4-6 N=8			
			24	5-7-9-9 N=16			
		10	24	4-5-6-8 N=11			
		15	18	4-3-4-4 N=7			
		20	24	3-4-4-5 N=8			
grades gray		25		WH-4-3-5 N=7			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud Rotary

Abandonment Method:
Boring backfilled with bentonite grout upon completion

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

Logged by AB
Hammer Efficiency Summary:
Energy Transfer Ratio: 78.6% +/-2.9%
Hammer Efficiency Correction (CE): 1.31

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
30 Corporate Cir Ste 201
Albany, NY

Boring Started: 08-24-2022 | Boring Completed: 08-25-2022
Drill Rig: Diedrich D-50 | Driller: C. Johnston
Project No.: JB215256G

BORING LOG NO. KB-132.3A

PROJECT: CHPE - Additional HDD Borings - Phase 3

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

SITE: Fort Ann to Coxsackie
Fort Ann, NY

LOCATION See Exploration Plan

Latitude: 43.2976° Longitude: -73.5544°

DEPTH ELEVATION (Ft.)

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
30				WH-WH-WH-WH			
35				WH-WH-WH-WH 3" Split Spoon With Ring Samplers			
40				WH-WH-WH-WH			
45				WH-50/1"			
50				REC = 100% RQD = 93%			
55				REC = 100% RQD = 97%			

45.5 **WEATHERED SHALE**, black, very dense

46.5 **SHALE**, slightly weathered, close to moderate fractured, excellent RQD, black

51.5 **SHALE**, slightly weathered, close to wide fractured, excellent RQD, black

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud Rotary

Abandonment Method:
Boring backfilled with bentonite grout upon completion

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

Logged by AB
Hammer Efficiency Summary:
Energy Transfer Ratio: 78.6% +/-2.9%
Hammer Efficiency Correction (CE): 1.31

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
30 Corporate Cir Ste 201
Albany, NY

Boring Started: 08-24-2022 | Boring Completed: 08-25-2022

Drill Rig: Diedrich D-50 | Driller: C. Johnston

Project No.: JB215256G

BORING LOG NO. KB-132.3A

PROJECT: CHPE - Additional HDD Borings - Phase 3

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

SITE: Fort Ann to Coxsackie
Fort Ann, NY

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 43.2976° Longitude: -73.5544° DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS		WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	56.5 ***Boring** Terminated at 56.5 Feet*									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud Rotary

Abandonment Method:
Boring backfilled with bentonite grout upon completion

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

Logged by AB
Hammer Efficiency Summary:
Energy Transfer Ratio: 78.6% +/-2.9%
Hammer Efficiency Correction (CE): 1.31

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
30 Corporate Cir Ste 201
Albany, NY

Boring Started: 08-24-2022 | Boring Completed: 08-25-2022

Drill Rig: Diedrich D-50 | Driller: C. Johnston

Project No.: JB215256G

BORING LOG NO. KB-132.5A

PROJECT: CHPE - Additional HDD Borings - Phase 3

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

SITE: Fort Ann to Coxsackie
Fort Ann, NY

LOCATION See Exploration Plan
Approximate
Latitude: 43.2950° Longitude: -73.5570°

DEPTH	ELEVATION (Ft.)	DESCRIPTION	DEPTH (Ft.)	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS
0.0	148.7	**FILL - SILTY SAND WITH GRAVEL**, brown and gray			20	9-17-15-18 N=32
					20	17-9-7-5 N=16
			5		15	6-6-8-10 N=14
6.0		**LEAN CLAY (CL)**, varved silt and clay, rootlets noted, brown and gray, stiff			18	4-4-7-6 N=11
					24	8-6-8-8 N=14
10.0		**POORLY GRADED SAND (SP)**, fine grained, gray, loose to medium dense	10		18	2-2-1-1 N=3
			15		0	6-5-7-4 N=12
20.0		**LEAN CLAY (CL)**, varved silt and clay, gray, very soft to medium stiff	20		24	3-4-5-5 N=9
			25		24	WH-4-4-5 N=9

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud Rotary

Abandonment Method:
Boring backfilled with bentonite grout upon completion

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

Logged by AB
Hammer Efficiency Summary:
Energy Transfer Ratio: 78.6% +/-2.9%
Hammer Efficiency Correction (CE): 1.31
WH = Weight of hammer
WR = Weight of rod

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
30 Corporate Cir Ste 201
Albany, NY

Boring Started: 02-25-2022 | Boring Completed: 08-26-2022
Drill Rig: Diedrich D-50 | Driller: C. Johnston
Project No.: JB215256G

BORING LOG NO. KB-132.5A

PROJECT: CHPE - Additional HDD Borings - Phase 3

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

SITE: Fort Ann to Coxsackie
Fort Ann, NY

LOCATION See Exploration Plan

Latitude: 43.2950° Longitude: -73.5570°

DEPTH ELEVATION (Ft.)

DEPTH (Ft.)	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS
30			
		24	WH-WH-WH-4
35			
		24	WH-WH-WH-WH
40			
		24	WH-WH-WH-WH
45			
		24	WH-WH-WH-WH
50			
		24	WR-WR-WR-WR
55		2	

LEAN CLAY (CL), varved silt and clay, gray, very soft to medium stiff *(continued)*

55.0
55.2 **WEATHERED ROCK**, gray, very dense

Boring Terminated at 55.2 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud Rotary

Abandonment Method:
Boring backfilled with bentonite grout upon completion

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

Logged by AB
Hammer Efficiency Summary:
Energy Transfer Ratio: 78.6% +/-2.9%
Hammer Efficiency Correction (CE): 1.31
WH = Weight of hammer
WR = Weight of rod

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
30 Corporate Cir Ste 201
Albany, NY

Boring Started: 02-25-2022 | Boring Completed: 08-26-2022

Drill Rig: Diedrich D-50 | Driller: C. Johnston

Project No.: JB215256G

GEOPHYSICAL SERVICES REPORT

Champlain Hudson Power Express Upland Cable Installation Project
Wetland Crossing, Near Hudson Falls (HDD21)
Whitehall, Washington County, New York

Schnabel Reference # 21C25020.040
June 14, 2022

Schnabel ENGINEERING

T 518.348.8575
28 Corporate Drive, Suite 204 / Clifton Park, NY 12065 schnabel-eng.com

June 14, 2022

Mr. Jaren Knighton, PE
Kiewit Engineering Group, Inc.
(Kiewit Engineering (NY) Corp.)
8880 Penrose Ln.
Lenexa, KS 66219

Subject: **Geophysical Services Report – Champlain Hudson Power Express Upland Cable Installation Project (HDD21); Wetland Crossing, near Hudson Falls, Whitehall, Washington County, New York (Schnabel Reference 21C25020.040)**

Dear Mr. Knighton:

SCHNABEL ENGINEERING OF NEW YORK is pleased to submit our geophysical report for this project. This study was performed in accordance with our proposal dated April 29, 2022, and revised May 5, 2022; and by Kiewit Task Assignment Order No. 04 (effective date May 6, 2022) of our Master Service Agreement KEG_MSA_Schnabel_2017 (December 11, 2017, Amended May 21, 2020).

EXECUTIVE SUMMARY

This report presents the results of our geophysical survey performed along the Canadian Pacific Railway south of Whitehall, New York, for Kiewit Engineering (NY) Corp. as part of the Champlain Hudson Power Express project.

Schnabel collected 1,800 linear feet of seismic data between about 200 ft southwest of Borehole K-132.4 and about 100 ft northeast of Borehole K-132.1; refer to Figure A-1 of this report. The data was processed using both multi-channel analysis of surface waves (MASW) and seismic refraction tomography (SRT) methods. The MASW method was unable to produce reliable results, most likely due to the subsurface conditions and geologic setting. The SRT method proved more effective and provided results that show the depth to rock varies between about 25 to 45 ft below the ground surface along the alignment.

We are providing this Executive Summary solely for purposes of overview. Any party that relies on this report must read the full report. This Executive Summary omits several details, any one of which could be important to the proper application of the report.

PROJECT DESCRIPTION

Site Description

The site of this geophysical survey is located along the Canadian Pacific (CP) Railway, about 2 miles east of Hudson Falls, Washington County, New York. A Site Vicinity Map is included as Figure 1.

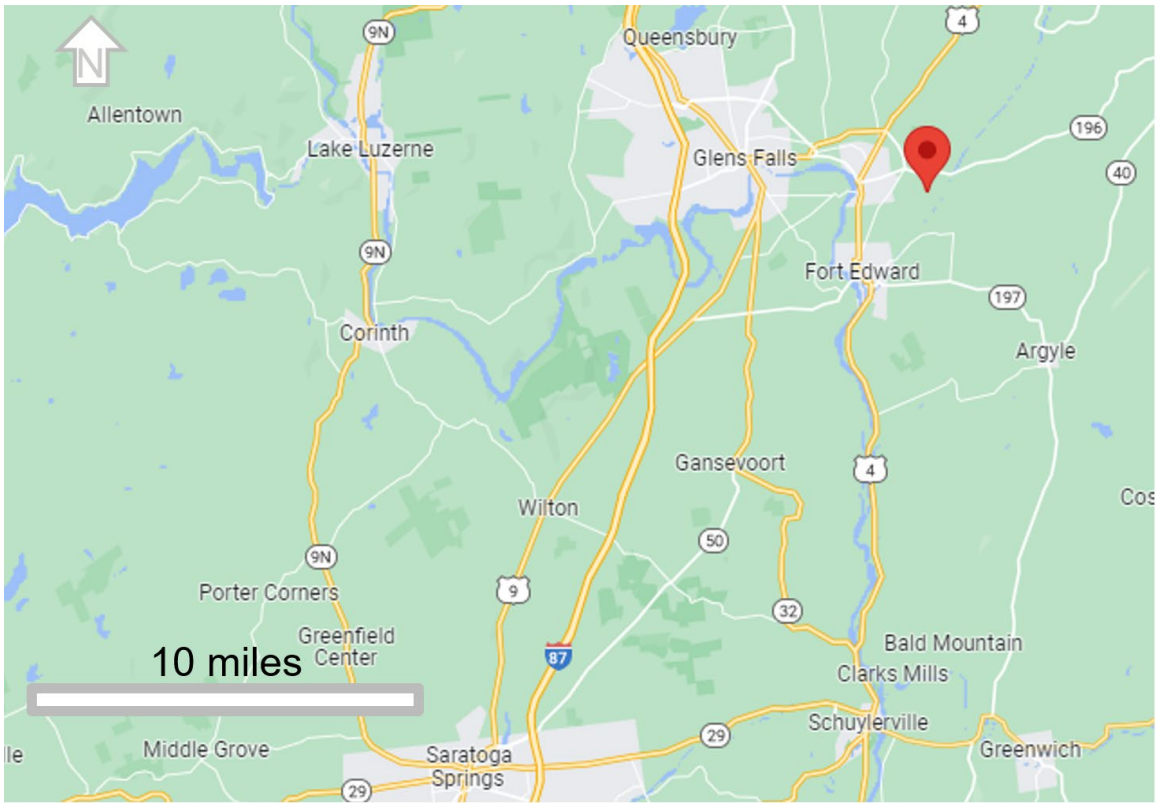


Figure 1: Site Vicinity Map (Site Represented by Red Symbol)

The seismic survey was conducted generally about 10 ft northwest of and parallel to the railroad line, starting about 200 ft southwest of Borehole K-132.4 and extending about 100 ft northeast of Borehole K-132.1. Three existing test borings were located along the seismic line. From the boring logs and data provided by Kiewit, two of the three boreholes were located directly along the line, while one (K-132.4) was about 65 ft to the southeast of the seismic data line. Figure 2 shows the site layout. Photographs 1, 2, and 3 show the site conditions at the time of data collection. Topography was generally flat with little variation. The ground surface was generally comprised of gravel (ballast) and provided effective ground coupling using geophones with 3-inch spikes.

Figure 2: Site Layout (Background Image from Azure Imagery)



Photographs 1,2, and 3: Site Conditions During Data Collection

SURVEY OBJECTIVE AND SCOPE

The objective of this study was to estimate the depth to bedrock between the test borings that were drilled along the proposed HDD21 alignment, and in particular to identify zones where bedrock is shallower than about 40 to 50 ft deep.

Given the available data and expected subsurface conditions, we recommended an MASW survey that would be collected in a manner that P-wave seismic refraction data could also be analyzed from the same data set. MASW measures how surface waves propagate and disperse through the soil, thereby inferring shear-wave velocities in those areas. Shear-wave velocities directly correlate to the stiffness of soil and will, therefore, be used to locate soft soil areas in contrast with stiff materials such as bedrock. Seismic refraction measures the time it takes for a P-wave, or compressional wave, to travel from the source at the ground surface to the soil/bedrock interface and back to geophones placed along the surface. With analysis, the travel times can be calculated to provide estimates of depths to the interface.

We collected 1,800 linear feet of seismic data between about 200 ft southwest of Borehole K-132.4 and about 100 ft northeast of Borehole K-132.1. The data was processed using both MASW and SRT methods. The MASW method was unable to produce reliable results, most likely due to the subsurface conditions and geologic setting; however, the SRT method proved more effective and will be the focus of this report.

Geophysical Methods

Schnabel personnel collected seismic data using two Geometrics, Inc., Geode, 24-channel seismographs and 48 geophones along a linear array on May 17, 2022. The geophones were spaced 10 ft along the array. We collected shot records starting 30 ft off the end of the line and every 30 ft down the line. The energy source was a 16-pound sledgehammer striking a polypropylene plate on the ground surface. Once shot points were collected along the first half of the initial 48-channel (470 ft) spread, the first 24 geophones were picked up and moved to the end of the line, and shot points continued to move up the line. This roll-along method was continued until data was collected for the full 1,800-ft line, at which time the shot points continued through the final spread. The seismic data were recorded digitally directly onto a laptop computer that controlled the seismograph. Sub-meter GPS data was collected along the full

seismic line using a Trimble Geo 7x. The GPS data were used to both located the horizontal location of the geophysical data collected and to generate a topographic surface for data processing and displaying the results.

Multi-Channel Analysis of Surface Waves (MASW)

Schnabel performed analysis on the seismic data using a surface wave recognition and modeling program (SurfSeis Version 6, Kansas Geological Survey). The data for each array location were processed and then modeled using an inversion method to estimate the subsurface shear wave velocities. The inversion models from each source/receiver array location were combined to form a two-dimensional cross-section model of the subsurface shear wave velocity for each MASW traverse; however, the dispersive energy for this dataset was inconsistent and not conducive to reliable modeling. This variability in data quality can be caused by subsurface geologic conditions or high levels of vibrational noise at the site. In this case, the noise levels were not abnormally high, so the geological conditions are expected to be the cause of the ineffectiveness of the MASW method.

Seismic Refraction Tomography (SRT)

Seismic data processing was conducted using Rayfract Version 4, from Intelligent Resources. The processing involved Schnabel personnel manually picking first-arrival times of seismic energy, incorporating elevations into the data, and generating a model that matches the first arrivals. Gradational velocity changes are common in geologic environments with thicker zones of weathered and fractured bedrock, such as at this site; therefore, we performed a tomographic inversion to estimate these gradational changes in the P-wave velocities.

Results and Interpretations

As discussed above, the MASW method did not produce reliable results; therefore, the results from the SRT method, which did produce reliable results that met the project objectives, are discussed below.

The SRT results are shown in Figure A-1, located in Appendix A. The figure shows the P-wave velocity model using a 10:1 vertical to horizontal scaling to enhance the variation on the velocity structure in the top 50 ft below ground surface (bgs). On the bottom left corner of the figure is a Location Plan that shows where the results are, with distances on the base map corresponding to the horizontal axis of the P-wave velocity model. The base map is also color coded to represent ranges of estimated depth to rock, as described below.

The three existing boreholes that were located along the seismic line are represented on the velocity model. Bedrock was not encountered in Boreholes K-132.4 and K-132.1, so we know that rock is deeper than the bottom of those boreholes at those locations. Borehole K-132.2 encountered apparent bedrock at a depth of 30 ft, and this depth is represented by a solid black line perpendicular to the boring stick.

Based on correlation with the limited borehole information and our experience in similar geologic settings, we chose the 7,500 ft/s contour line to represent the top of bedrock. This is shown as a dashed black line on the seismic refraction velocity model on Figure A-1. The black lines on either side represent the zone within 10% of the depth to the 7,500 ft/s contour line. A depth range of ±10% is the typical expected resolution for the seismic refraction method. Additionally, the Location Plan on Figure A-1 shows where

depth to top of bedrock, as indicated by the 7,500 ft/s contour line, is less than 30 ft, between 30 ft and 40 ft, or greater than 40 ft.

Based on these results, the depth to bedrock is shallower than 50 ft for a portion of the 1,800-ft alignment. For the southern 500 ft of the line, the depth to bedrock varies between elevations of 94 and 100 ft, or 35 and 45 ft bgs. From a distance of 420 ft to about 1,220 ft, the bedrock slopes upward from about an elevation of 94 ft (45 ft bgs) to an elevation of 115 ft (25 ft bgs). From 1,220 ft to a distance of about 1,600 ft, the bedrock drops back down to about an elevation of 100 ft (40 ft bgs).

LIMITATIONS

The seismic refraction method is based on subsurface interfaces (boundaries) that refract the seismic waves. The seismic wave energy refracts through interfaces where there is a lower velocity layer above a higher velocity layer. It is not capable of detecting a lower velocity layer beneath a higher velocity layer. Based on the observed soft clay material in the borehole logs and Boring K-132.2 indicating bedrock below the clay, we infer the transition from clay to bedrock is similar below Borings K-132.4 and K-132.1 in comparison to Boring K-132.2; however, this limitation (e.g., a lower velocity layer beneath a higher velocity layer) could affect the results for this project for conditions where lower velocity material underlies higher velocity material along the line of study.

Schnabel based the analyses and recommendations submitted in this report on the information provided by Kiewit and the information revealed by our geophysical exploration. We attempted to provide for normal contingencies, but the possibility remains that unexpected conditions may be encountered during construction.

Geophysical data depict a broad estimate of actual subsurface conditions. Correlation of this data with intrusive method data will indicate some variance due to the nature of measured geophysical properties. Also, the resolution of the geophysical methods may be such as to not detect potentially significant smaller features that may appear significant in HDD drilling results or excavations at a particular location. As such, some amount of variation in the actual field conditions should be expected, including possible natural wood/tree material, boulders, and a variable/jagged bedrock surface. Annotations on the results represent our interpretation of the data.

We have endeavored to complete the services identified herein in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality and under similar conditions as this project. No other representation, express or implied, is included or intended, and no warranty or guarantee is included or intended in this report or other instrument of service.

We appreciate the opportunity to be of service for this project. Please call us if you have any questions regarding this report.

Sincerely,

SCHNABEL ENGINEERING OF NEW YORK

Jacob Sheehan, PGp
Senior Scientist

Mia A. Painter, PG-NY
Associate

JRS:CMM:MAP:MPT:vm

Appendix A: Seismic Refraction Results

APPENDIX A

SEISMIC REFRACTION TOMOGRAPHY RESULTS

South

North

K-132.4

K-132.2

K-132.1

Ground Surface

Depth = 30 ft

Depth = 40 ft

Depth = 50 ft

5000

10000

15000

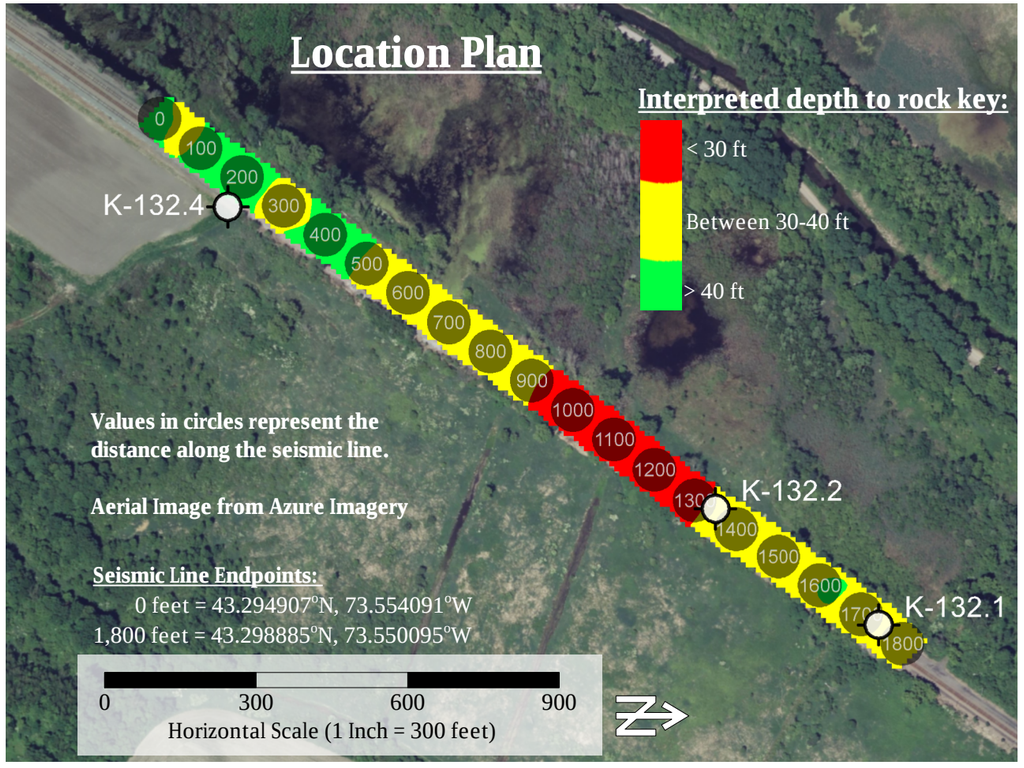
Elevation (feet)

140
130
120
110
100
90

0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800

Distance (feet)

Location Plan



Estimated
Top of Rock

1500 3500 5500 7500 9500 11500

P-wave Velocity (ft/s)

Vertical Scale (ft)
(1 in = 12.5 ft)

12.5
0

Velocity
Profile
Scale
(10x V:H)

0 125

Horizontal Scale (ft)
(1 in = 125 ft)

Legend

K-132.1

Represents borehole location and depth drilled

Represents the top of rock in borehole log

Dashed line represents top of rock as estimated from seismic results, based on 7,500 ft/s contour line and borehole information with solid lines representing +/- 10% of estimated depth

Note: Seismic and drilling results displayed with a 10 times vertical exaggeration.

Schnabel ENGINEERING

CHAMPLAIN HUDSON POWER EXPRESS UPLAND CABLE INSTALLATION HDD21
WETLAND CROSSING, NEAR HUDSON FALLS, WHITEHALL, NY

PROJECT NO. 21C25020.04

SEISMIC REFRACTION RESULTS

FIGURE A-1

Appendix D

BoreAid HDD Simulation Output

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:	HDD #9 - Conduit 1
	Start Date: 02-28-2022
	End Date: 02-28-2022
Project Owner:	TDI
Project Contractor:	KIEWIT
Project Consultant:	CHA
Designer:	MCS
	CHA

Description:

Input Summary

Start Coordinate	(0.00, 0.00, 127.18) ft
End Coordinate	(546.00, 0.00, 125.88) ft
Project Length	546.00 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: 2.00 ft
Unit Weight: 120.0000 (dry), 140.0000 (sat) [lb/ft3]
Phi: 37.00, S.M.: 1000.00, Coh: 0.00 [psi]

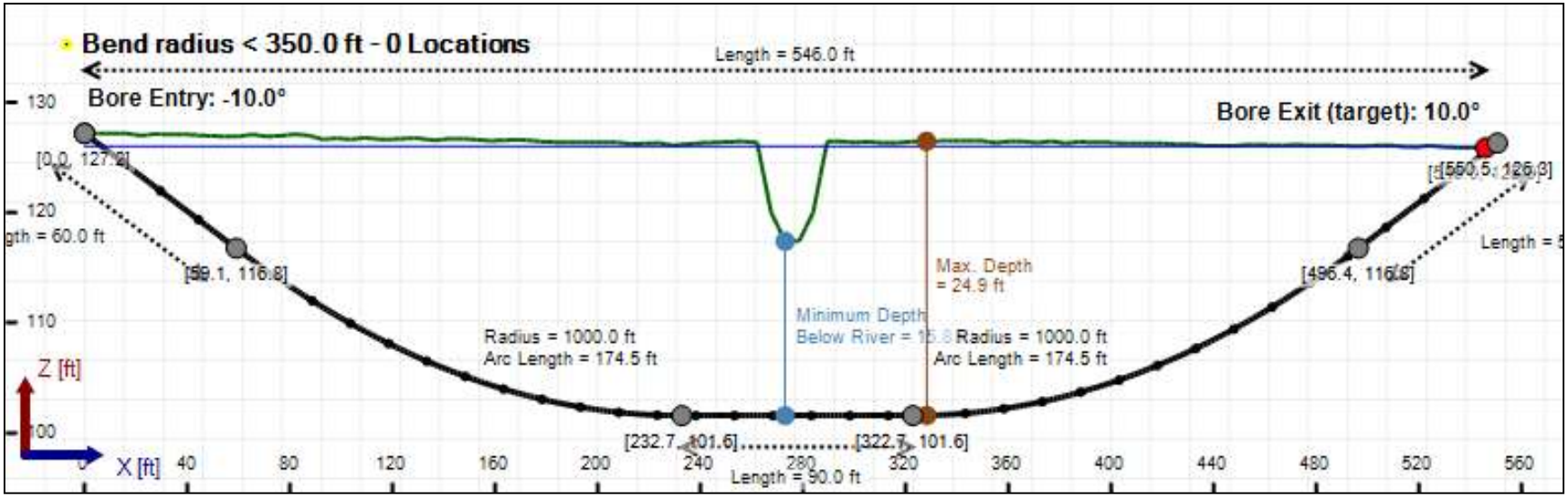
Soil Layer #2 USCS, Sand (S), SW
Depth: 6.00 ft
Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft3]
Phi: 34.00, S.M.: 200.00, Coh: 0.00 [psi]

Soil Layer #3 USCS, Clay (C), CH
Depth: 2.00 ft
Unit Weight: 80.0000 (dry), 110.0000 (sat) [lb/ft3]
Phi: 0.00, S.M.: 300.00, Coh: 5.60 [psi]

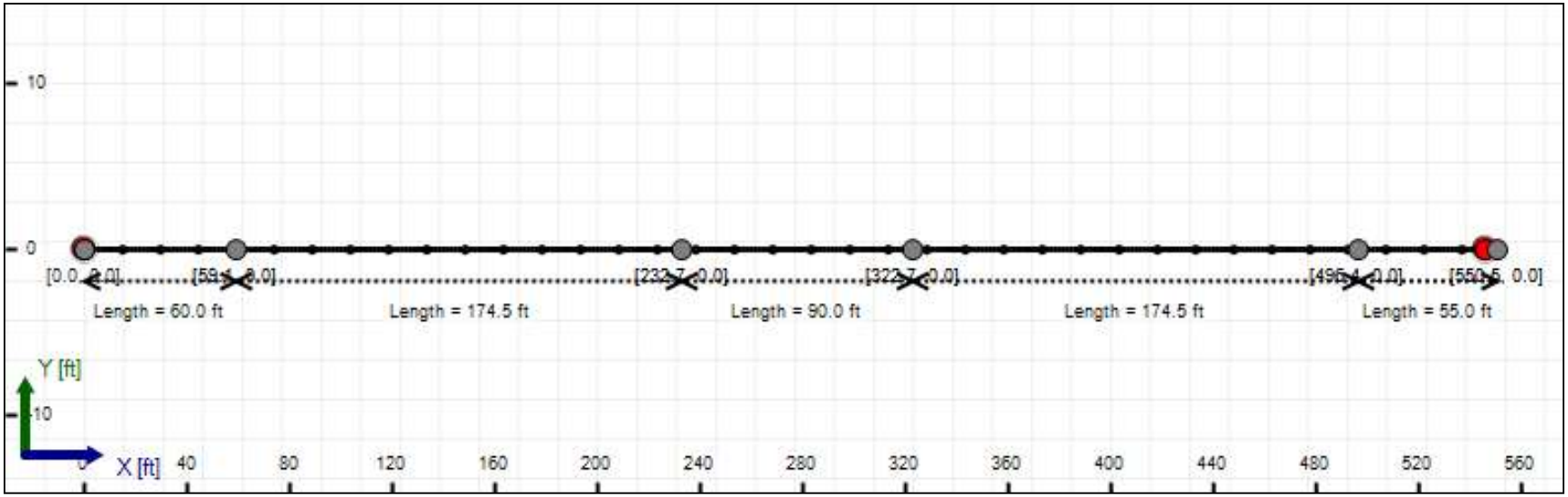
Soil Layer #4 USCS, Sand (S), SC
Depth: 11.00 ft
Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3]
Phi: 30.00, S.M.: 200.00, Coh: 0.00 [psi]

Soil Layer #5 USCS, Clay (C), CH
Depth: 12.00 ft
Unit Weight: 70.0000 (dry), 100.0000 (sat) [lb/ft3]
Phi: 0.00, S.M.: 200.00, Coh: 3.13 [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: 555.00 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: 59.30500 lb/ft3
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: 93.64118 lb/ft3
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 62.42746 lb/ft3

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	2.7	9.3
Water Pressure	10.6	10.6
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	13.3	19.9
Deflection		
Earth Load Deflection	0.768	2.536
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	0.900	2.668
Compressive Stress [psi]		
Compressive Wall Stress	59.9	89.5

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	9347.8	9347.8
Pullback Stress [psi]	260.7	260.7
Pullback Strain	4.534E-3	4.534E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	260.7	285.5
Tensile Strain	4.534E-3	5.414E-3

Net External Pressure = 16.8 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.900	7.5	8.3	OK
Unconstrained Collapse [psi]	16.7	127.7	7.7	OK
Compressive Wall Stress [psi]	59.9	1150.0	19.2	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	26.6	240.0	9.0	OK
Tensile Stress [psi]	285.5	1200.0	4.2	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	59.150 psi	52.714 psi
1	8.00 in	12.00 in	58.547 psi	52.184 psi
2	12.00 in	16.13 in	57.787 psi	51.457 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): 40.00 US (liquid) gallon/min

Drill Fluid Density: 68.700 lb/ft3

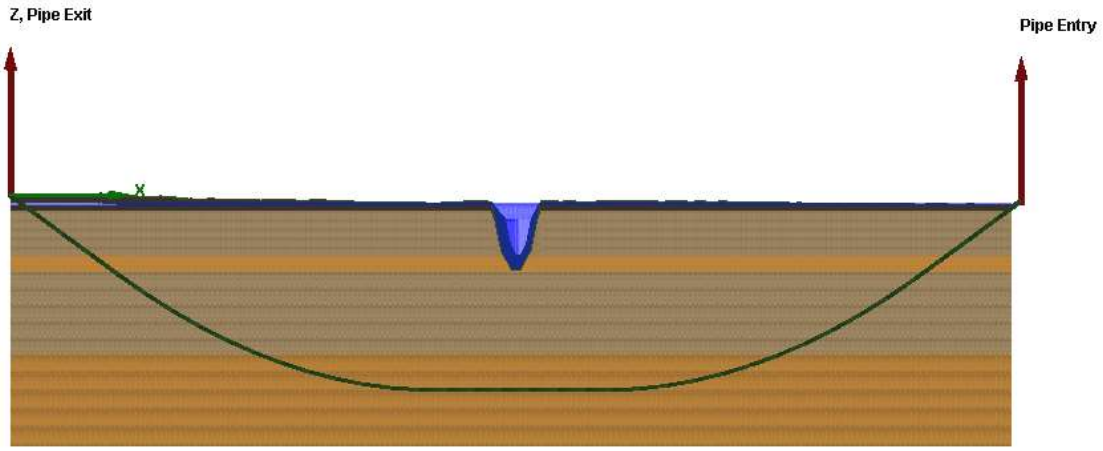
Rheological model: Bingham-Plastic

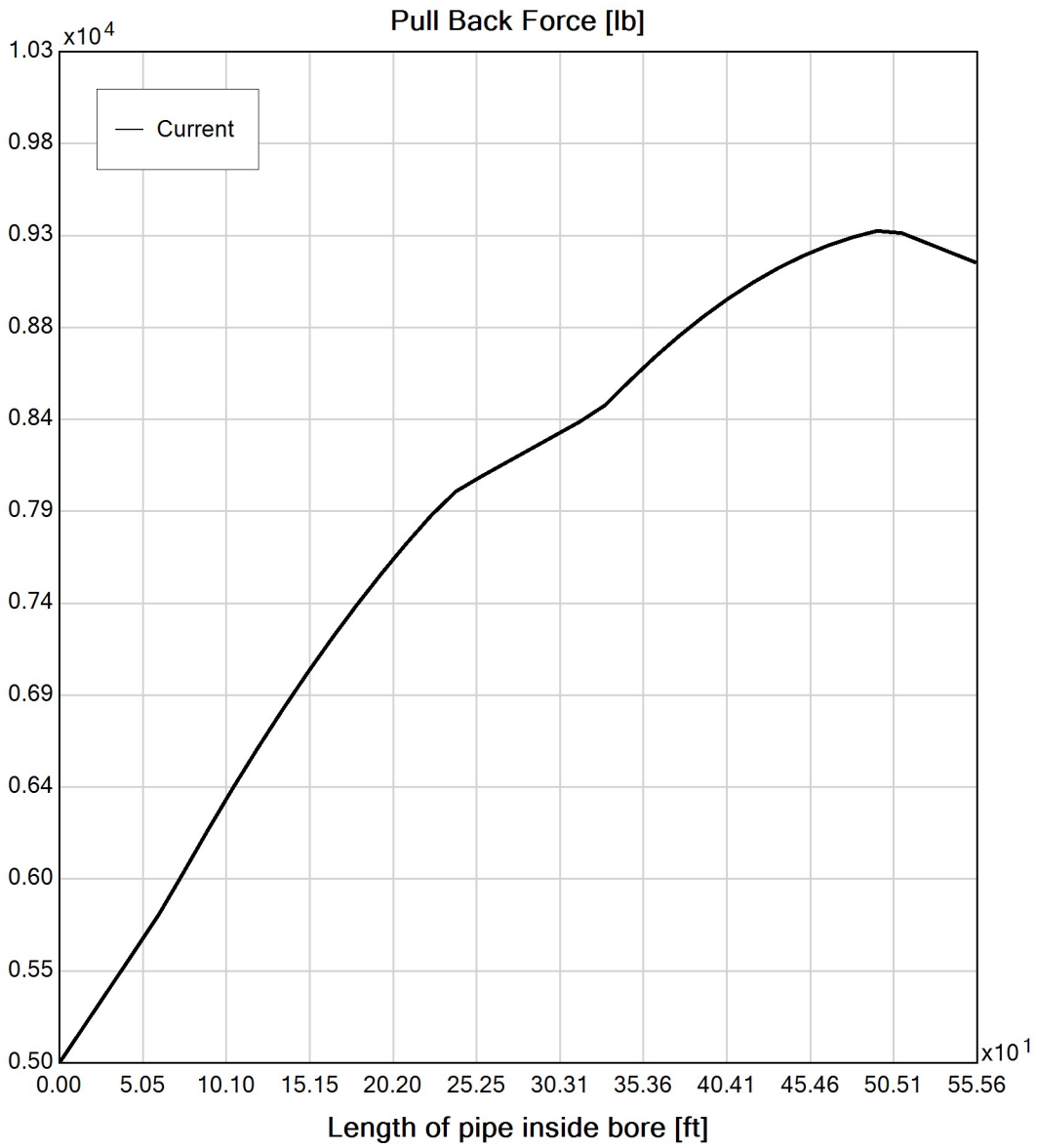
Plastic Viscosity (PV): 25.53

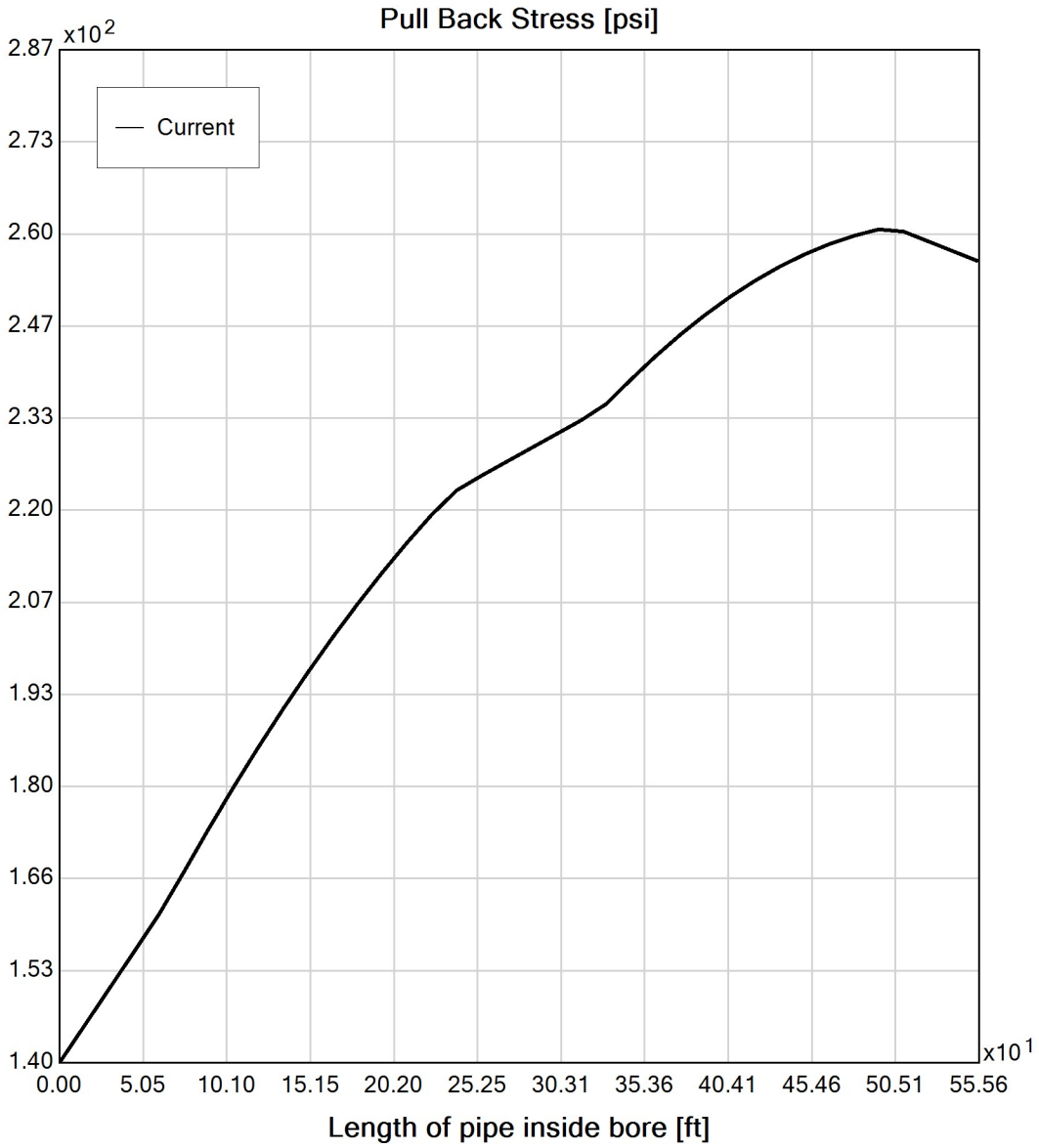
Yield Point (YP): 16.49

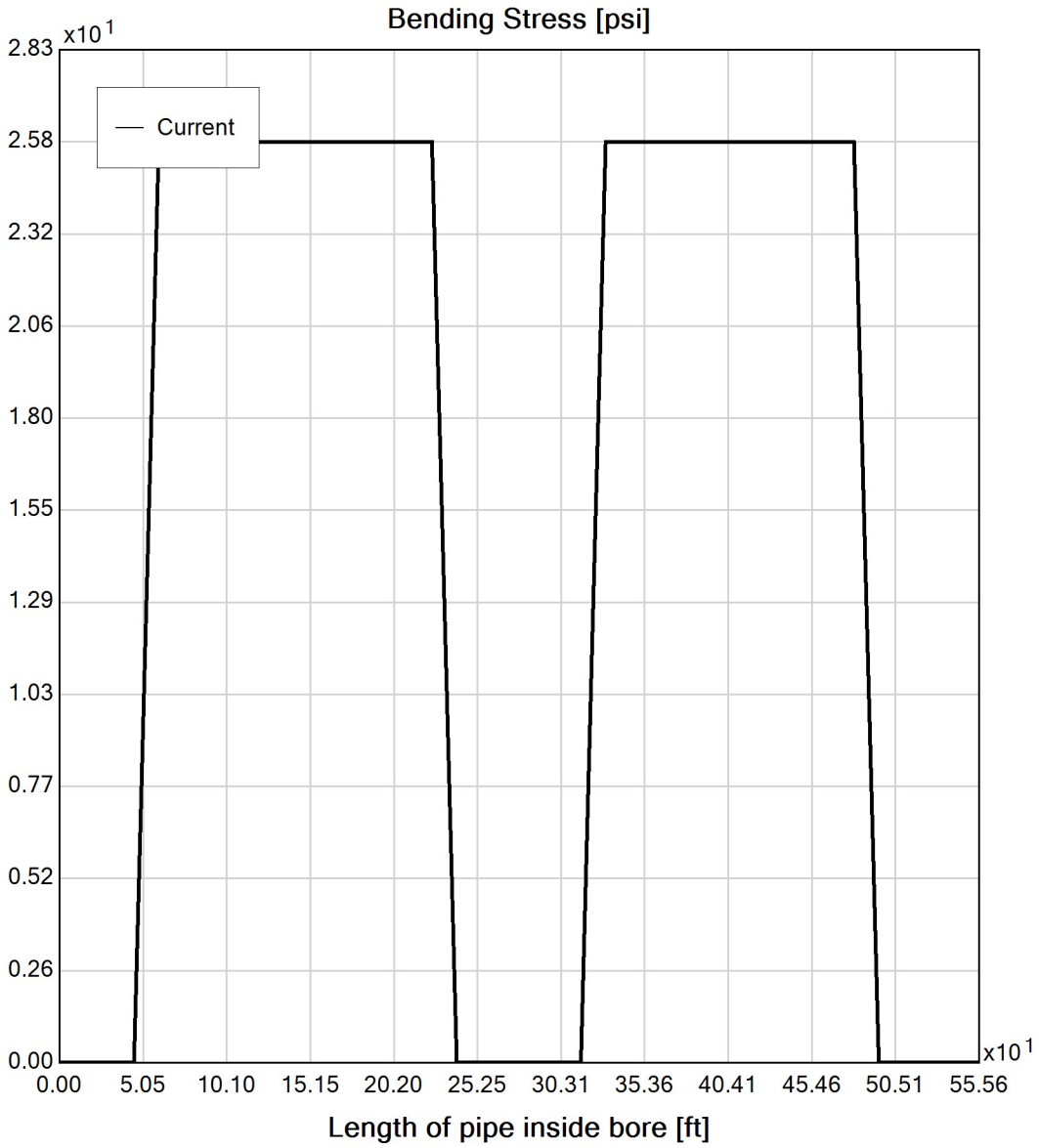
Effective Viscosity (cP): 1202.0

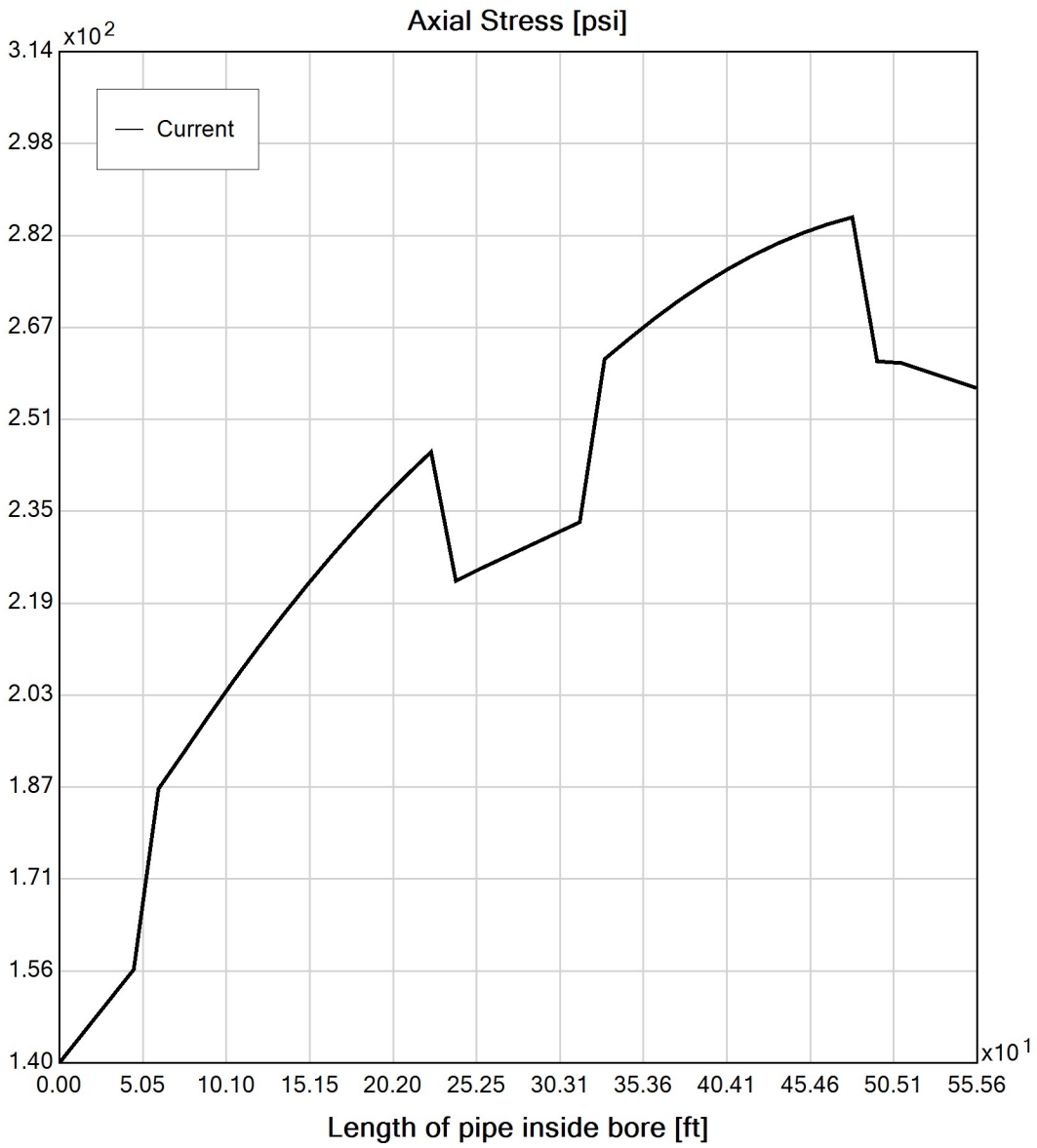
Virtual Site

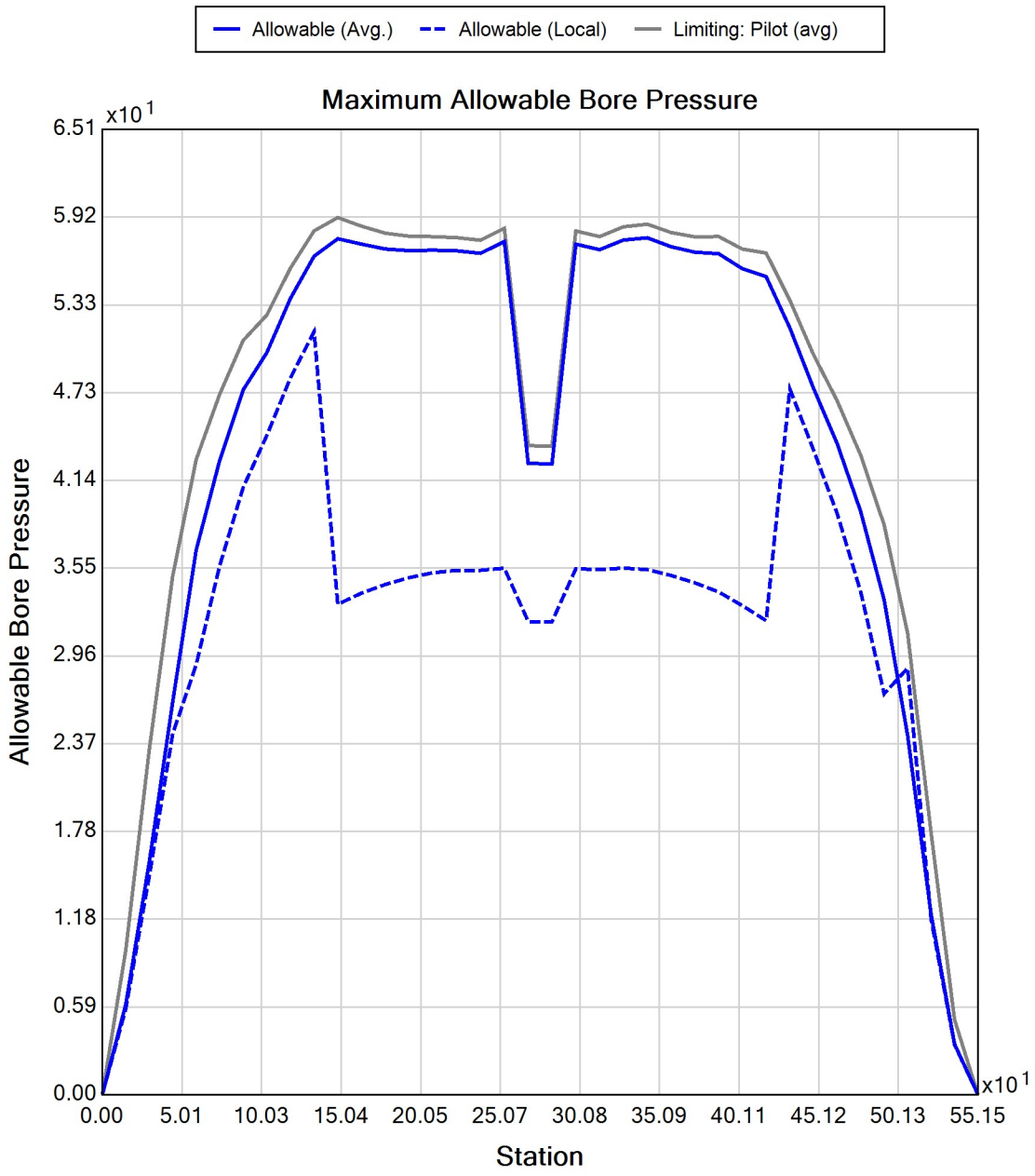


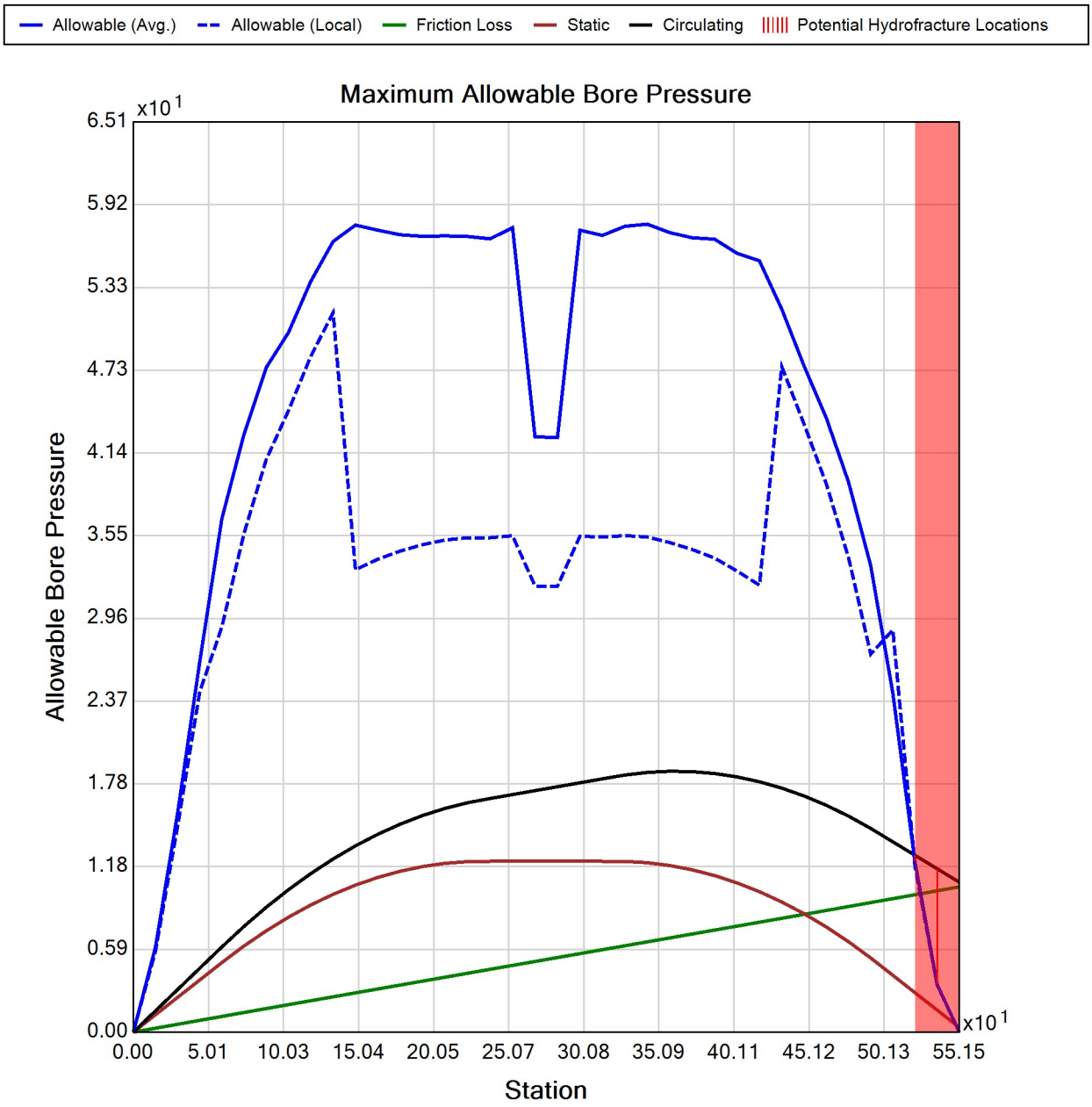












Generated Output

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Input Summary

Start Coordinate	(0.00, 0.00, 127.18) ft
End Coordinate	(546.00, 0.00, 125.88) ft
Project Length	546.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	2.375 in
Pipe DR	9.0
Pipe Thickness	0.26 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: 2" (2.375")
Pipe DR: 9
Pipe Length: 555.00 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: 59.30500 lb/ft3
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: 93.64118 lb/ft3
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 62.42746 lb/ft3

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	1.1	9.3
Water Pressure	10.6	10.6
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	11.7	19.9
Deflection		
Earth Load Deflection	0.385	2.536
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	0.414	2.565
Compressive Stress [psi]		
Compressive Wall Stress	52.7	89.5

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	565.9	565.9
Pullback Stress [psi]	323.3	323.3
Pullback Strain	5.623E-3	5.623E-3
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	323.3	328.1
Tensile Strain	5.623E-3	5.805E-3

Net External Pressure = 16.8 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.414	7.5	18.1	OK
Unconstrained Collapse [psi]	16.7	134.1	8.0	OK
Compressive Wall Stress [psi]	52.7	1150.0	21.8	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	26.6	238.4	9.0	OK
Tensile Stress [psi]	328.1	1200.0	3.7	OK

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Project Summary

General:	HDD #9 - Conduit 2
	Start Date: 02-28-2022
	End Date: 02-28-2022
Project Owner:	TDI
Project Contractor:	KIEWIT
Project Consultant:	CHA
Designer:	MCS
	CHA

Description:

Input Summary

Start Coordinate	(0.00, 0.00, 127.18) ft
End Coordinate	(546.00, 0.00, 125.88) ft
Project Length	546.00 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: 2.00 ft
Unit Weight: 120.0000 (dry), 140.0000 (sat) [lb/ft3]
Phi: 37.00, S.M.: 1000.00, Coh: 0.00 [psi]

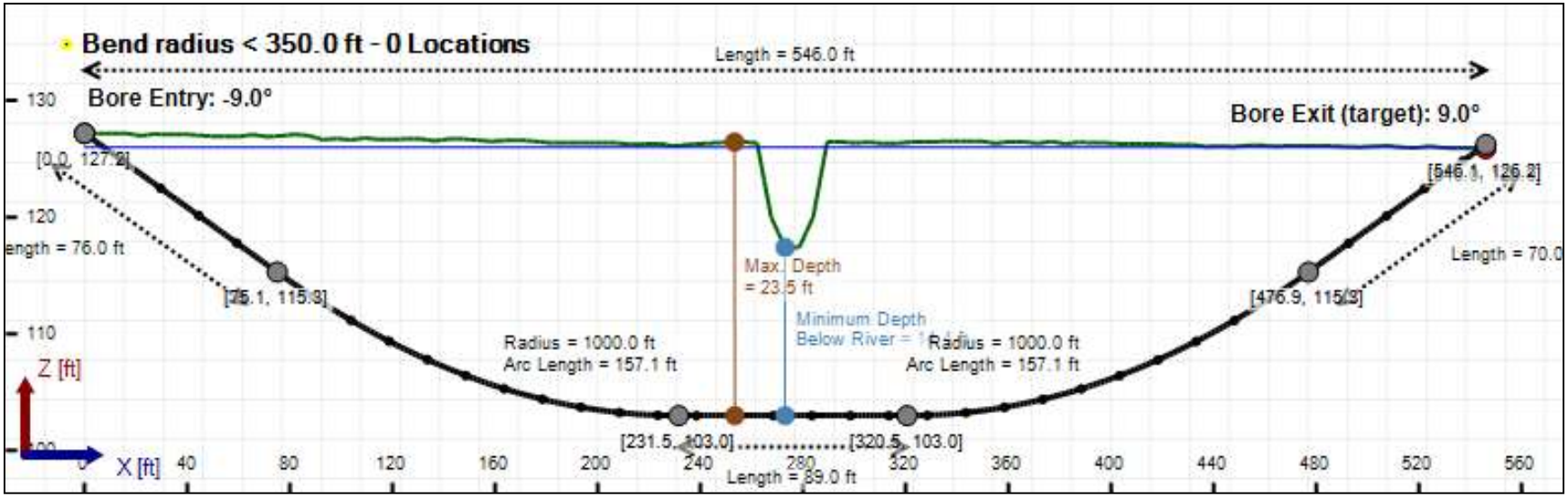
Soil Layer #2 USCS, Sand (S), SW
Depth: 6.00 ft
Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft3]
Phi: 34.00, S.M.: 200.00, Coh: 0.00 [psi]

Soil Layer #3 USCS, Clay (C), CH
Depth: 2.00 ft
Unit Weight: 80.0000 (dry), 110.0000 (sat) [lb/ft3]
Phi: 0.00, S.M.: 300.00, Coh: 5.60 [psi]

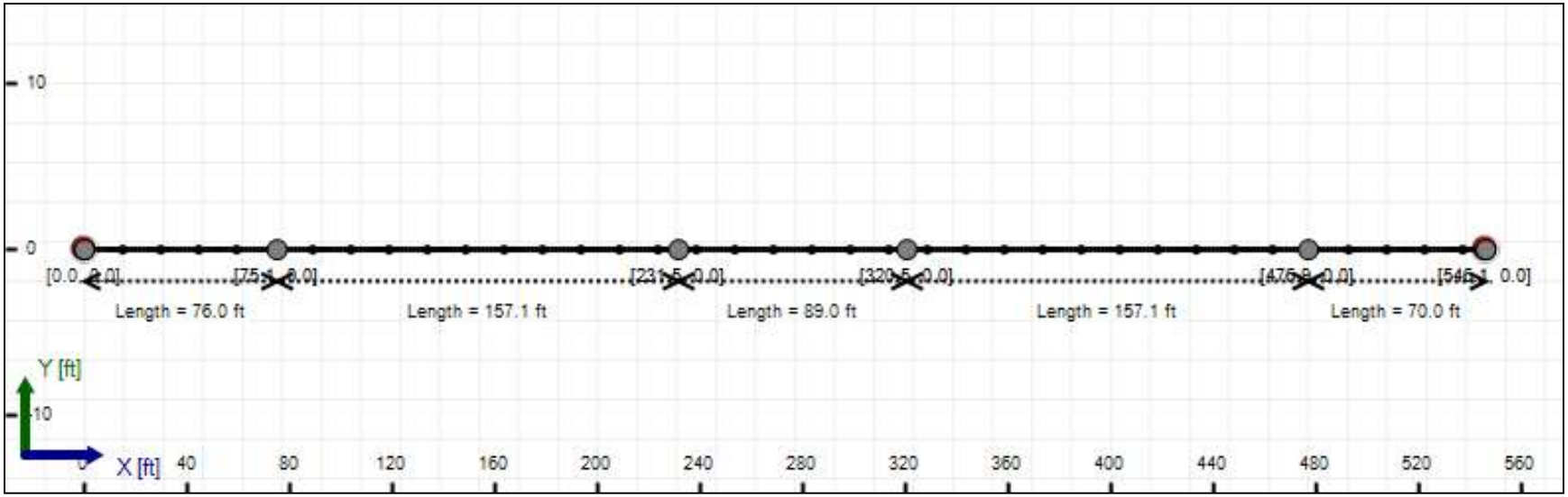
Soil Layer #4 USCS, Sand (S), SC
Depth: 11.00 ft
Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3]
Phi: 30.00, S.M.: 200.00, Coh: 0.00 [psi]

Soil Layer #5 USCS, Clay (C), CH
Depth: 12.00 ft
Unit Weight: 70.0000 (dry), 100.0000 (sat) [lb/ft3]
Phi: 0.00, S.M.: 200.00, Coh: 3.13 [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: 555.00 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: 59.30500 lb/ft3
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: 93.64118 lb/ft3
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 62.42746 lb/ft3

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	2.7	8.9
Water Pressure	10.0	10.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	12.7	18.9
Deflection		
Earth Load Deflection	0.771	2.435
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	0.903	2.567
Compressive Stress [psi]		
Compressive Wall Stress	57.2	85.1

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	9230.1	9230.1
Pullback Stress [psi]	257.4	257.4
Pullback Strain	4.477E-3	4.477E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	257.4	281.9
Tensile Strain	4.477E-3	5.351E-3

Net External Pressure = 17.6 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.903	7.5	8.3	OK
Unconstrained Collapse [psi]	15.7	127.7	8.1	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]	25.7	240.1	9.3	OK
Tensile Stress [psi]	281.9	1200.0	4.3	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	58.682 psi	53.027 psi
1	8.00 in	12.00 in	57.961 psi	52.504 psi
2	12.00 in	16.13 in	57.305 psi	51.788 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): 40.00 US (liquid) gallon/min

Drill Fluid Density: 68.700 lb/ft3

Rheological model: Power-Law

Fluid Consistency Index (K): 63.17

Power Law Exponent (n): 0.14

Effective Viscosity (cP): 859.3

Virtual Site