Project Summary

General:	CHPE HDD 42 Conduit 2
	P3
	Start Date: 12-10-2021
	End Date: 12-10-2021
Project Owner:	TDI
Project Contractor:	Kiewit
Project Consultant:	CHA/BCE
Designer:	AJB
	CHA
Description:	HDD 42 10-inch DR 9 Conduit 2

Input Summary

Start Coordinate	(0.00, 0.00, 325.57) ft
End Coordinate	(560.00, 0.00, 322.60) ft
Project Length	560.00 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

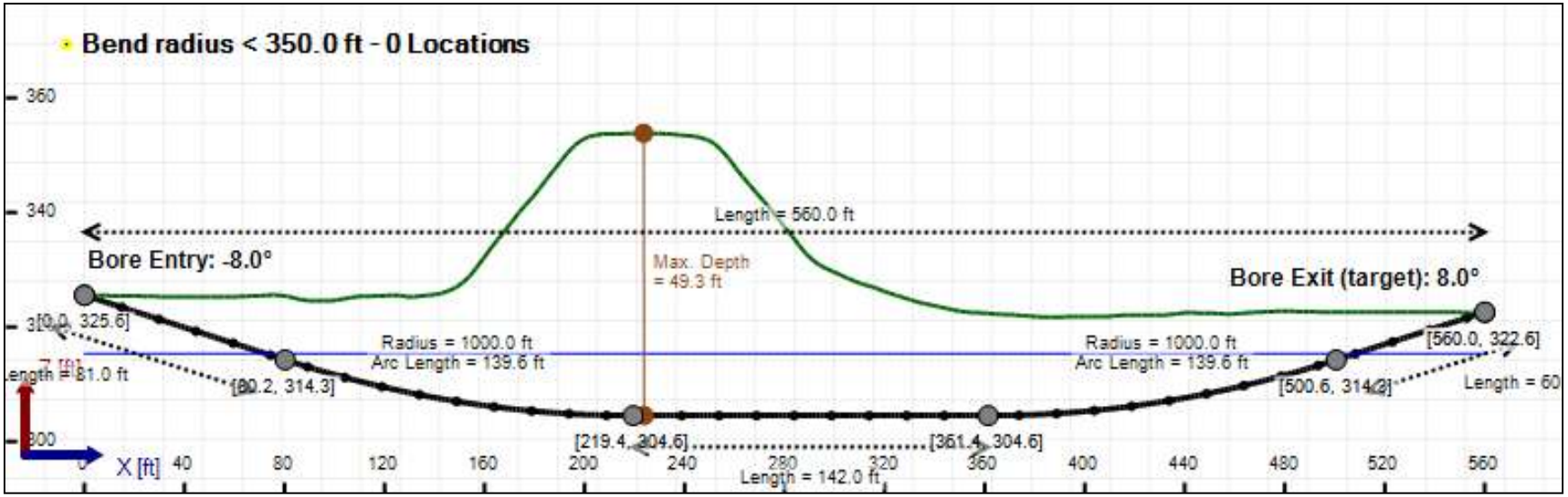
Number of Layers: 3

Soil Layer #1 USCS, Sand (S), SM
Depth: 10.10 ft
Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3]
Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

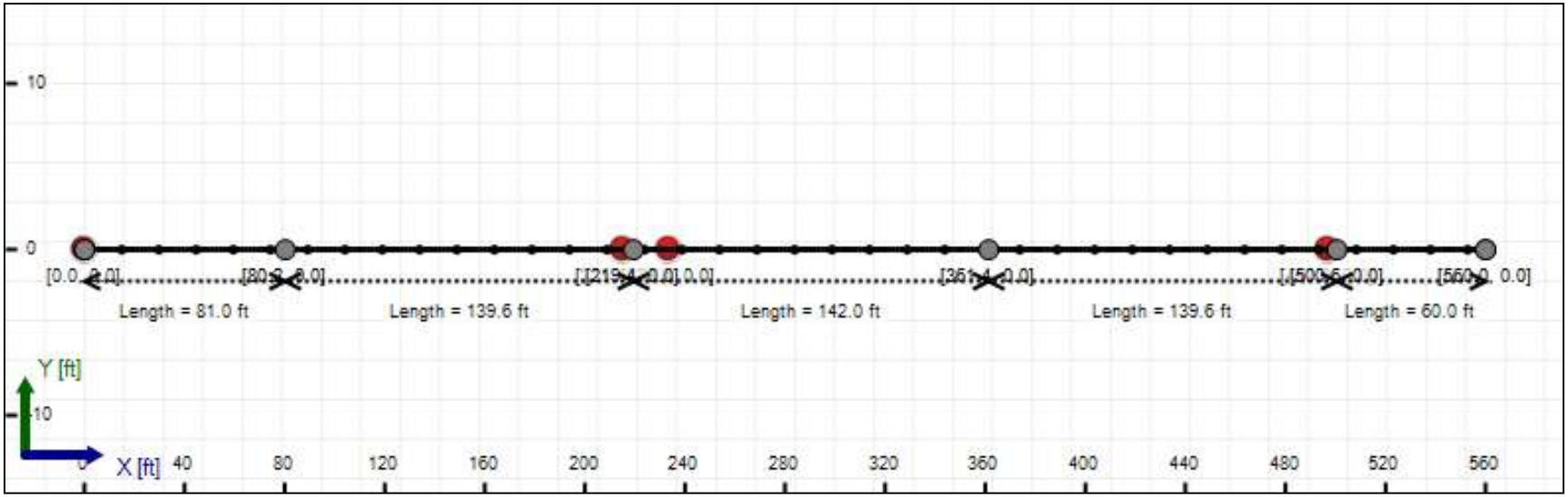
Soil Layer #2 USCS, Sand (S), SP
Depth: 10.00 ft
Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3]
Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #3 USCS, Sand (S), SM
Depth: 6.50 ft
Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft3]
Phi: 34.00, S.M.: 145.00, Coh: 0.00 [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: 570.00 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	4.9	32.1
Water Pressure	4.7	4.7
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	9.6	36.8
Deflection		
Earth Load Deflection	1.331	8.731
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.463	8.863
Compressive Stress [psi]		
Compressive Wall Stress	43.1	165.4

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	9144.2	9144.2
Pullback Stress [psi]	255.0	255.0
Pullback Strain	4.435E-3	4.435E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	255.0	279.4
Tensile Strain	4.435E-3	5.307E-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 [%]	1.463	7.5	5.1	OK
Unconstrained Collapse [psi]	13.7	121.1	8.9	OK
Compressive Wall Stress [psi]	43.1	1150.0	26.7	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	23.6	240.2	10.2	OK
Tensile Stress [psi]	279.4	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	104.976 psi	110.459 psi
1	8.00 in	12.00 in	104.937 psi	110.420 psi
2	12.00 in	16.13 in	104.881 psi	110.363 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

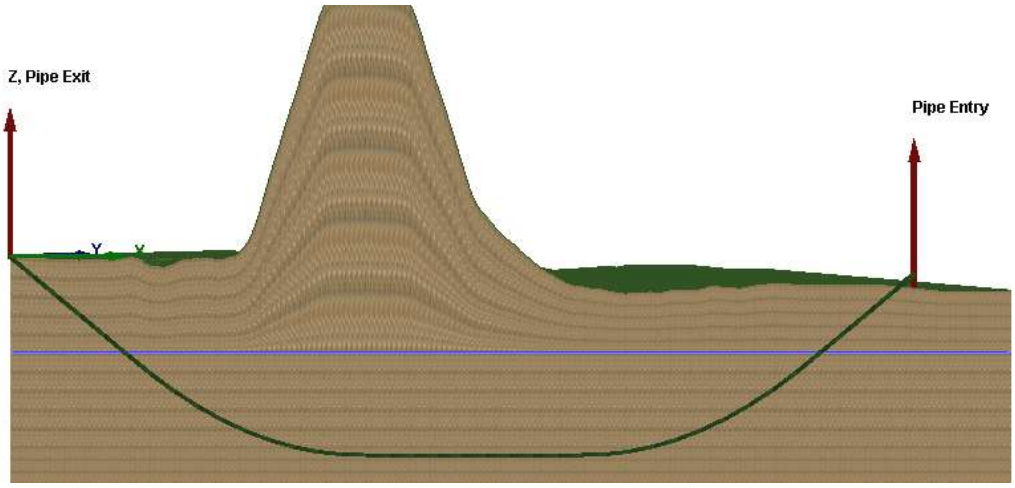
Rheological model: Bingham-Plastic

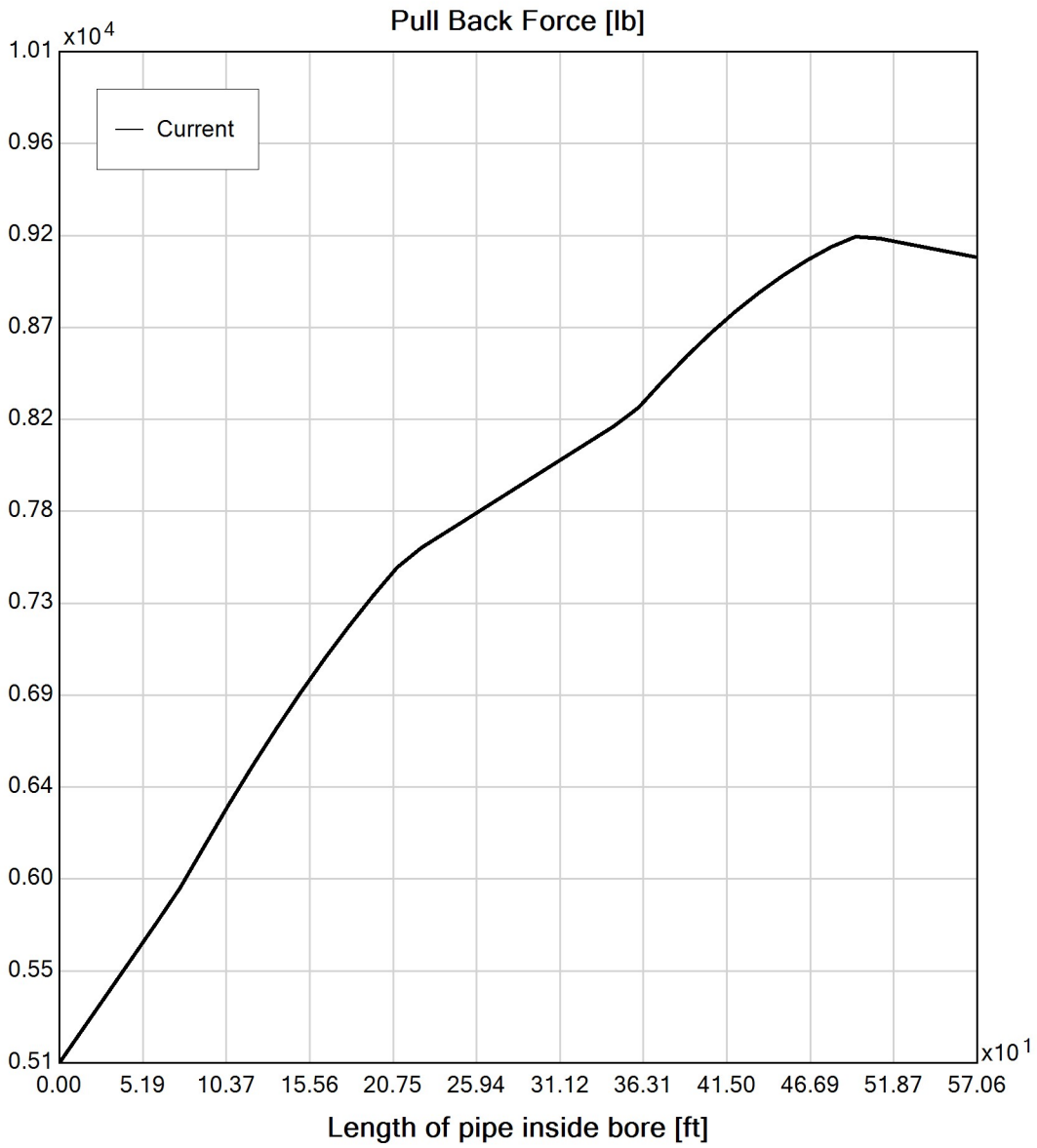
Plastic Viscosity (PV): 25.53

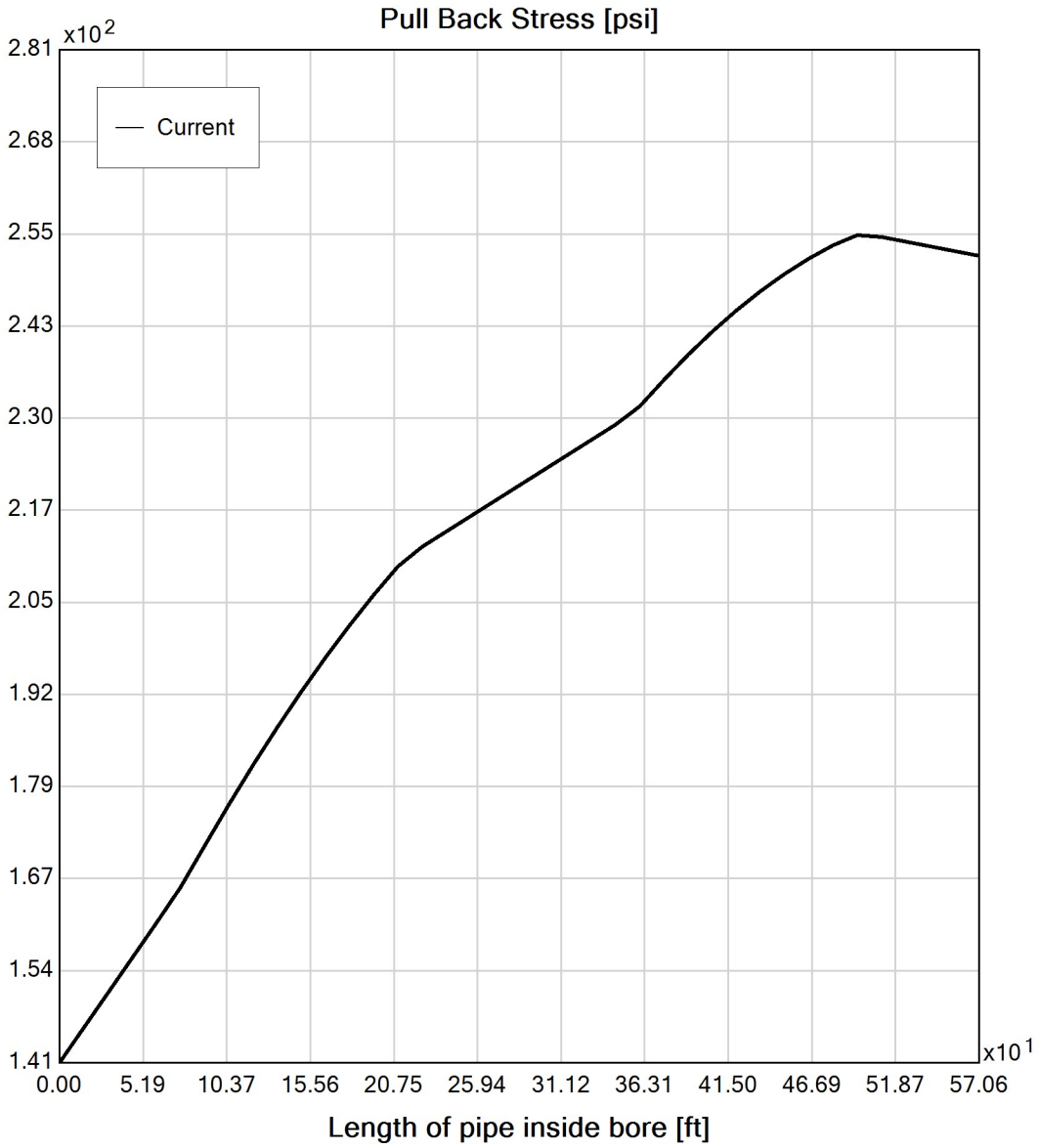
Yield Point (YP): 16.49

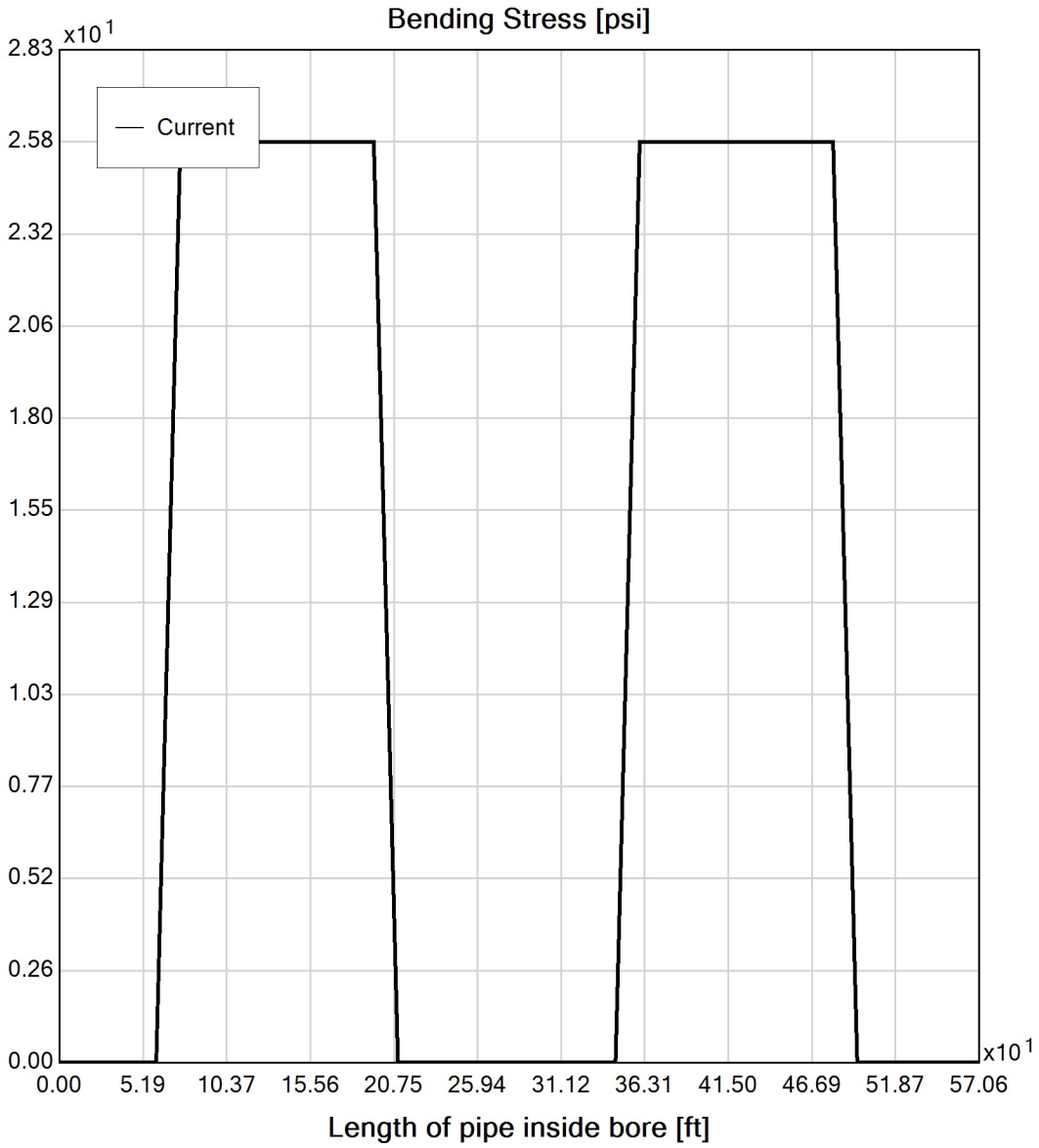
Effective Viscosity (cP): 1202.0

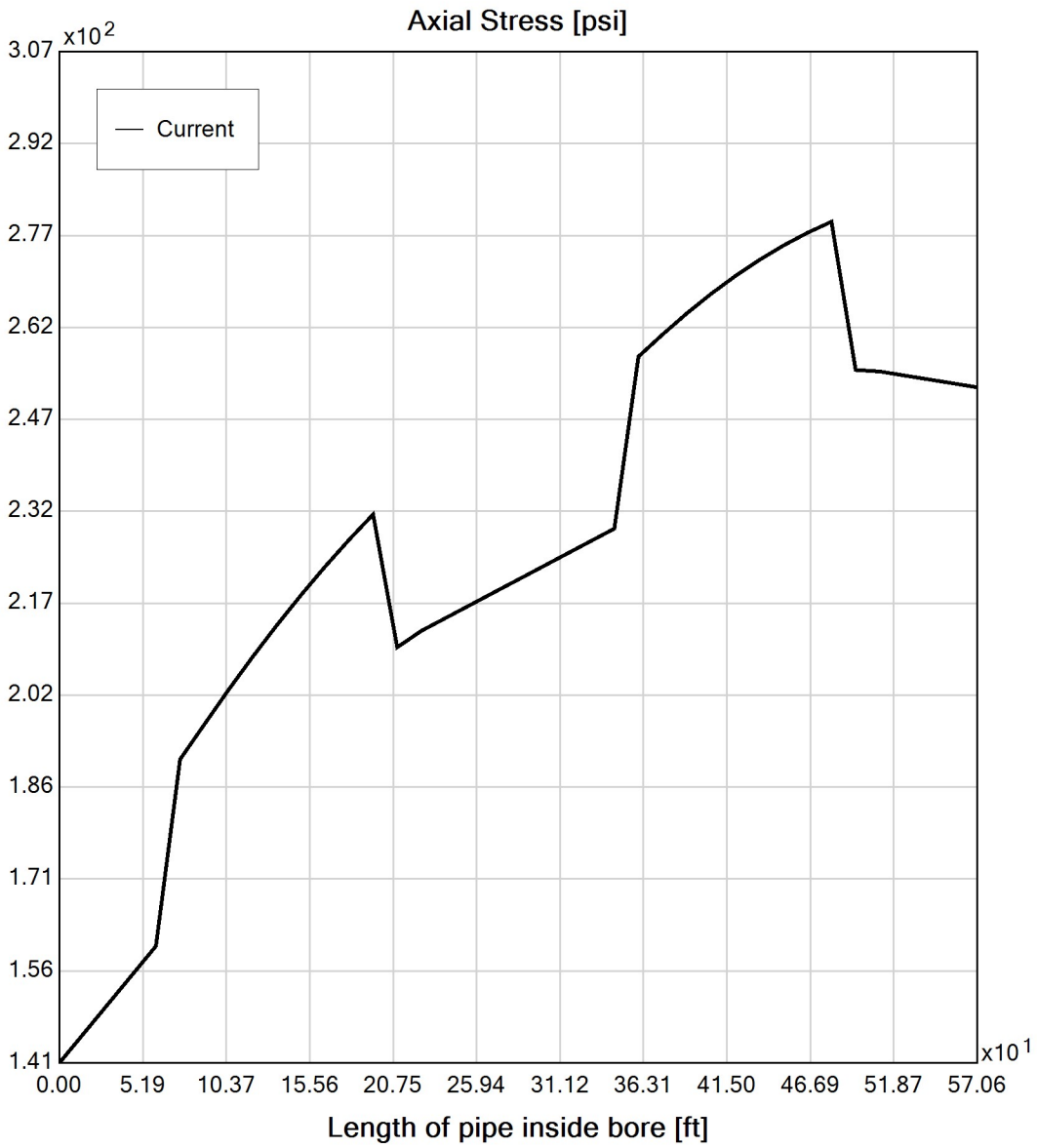
Virtual Site

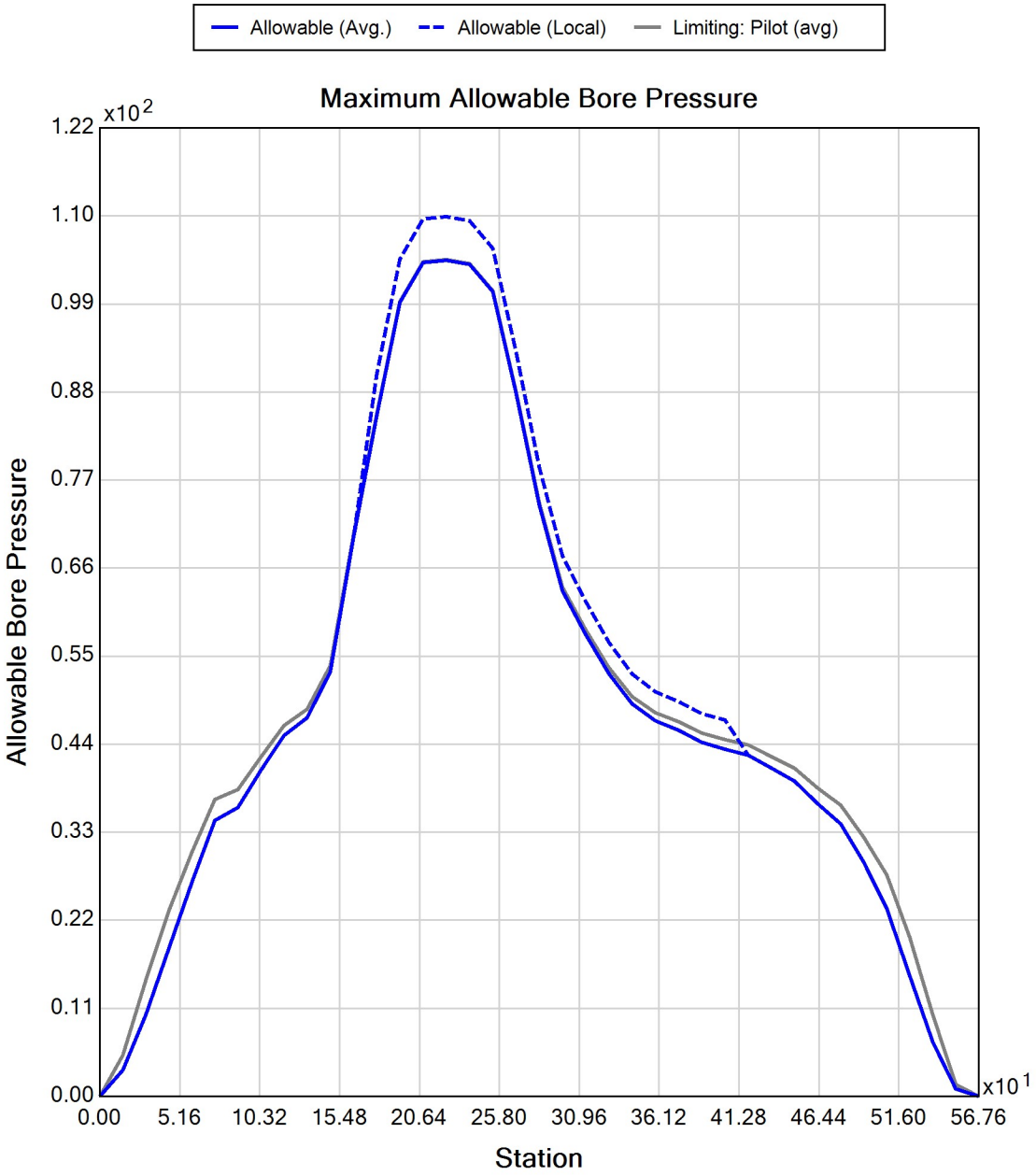


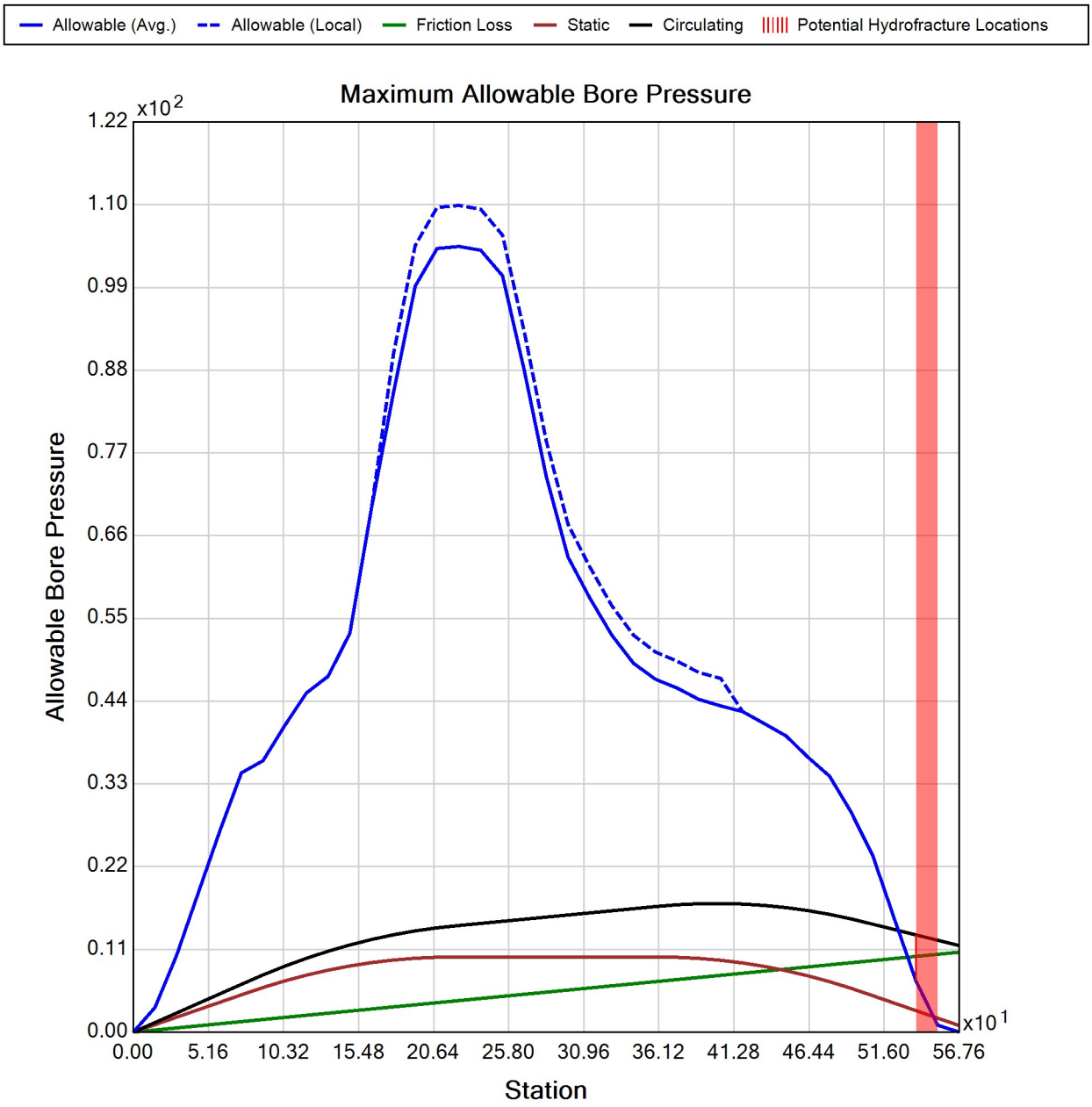












Generated Output

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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.

Input Summary

Start Coordinate	(0.00, 0.00, 325.57) ft
End Coordinate	(560.00, 0.00, 322.60) ft
Project Length	560.00 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: 570.00 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	1.9	32.1
Water Pressure	4.7	4.7
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	6.6	36.8
Deflection		
Earth Load Deflection	0.566	8.731
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	0.595	8.761
Compressive Stress [psi]		
Compressive Wall Stress	29.8	165.4

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	555.9	555.9
Pullback Stress [psi]	317.6	317.6
Pullback Strain	5.524E-3	5.524E-3
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	317.6	321.9
Tensile Strain	5.524E-3	5.698E-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 [%]	0.595	7.5	12.6	OK
Unconstrained Collapse [psi]	13.7	131.4	9.6	OK
Compressive Wall Stress [psi]	29.8	1150.0	38.5	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	23.6	238.6	10.1	OK
Tensile Stress [psi]	321.9	1200.0	3.7	OK

Generated Output

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Project Summary

General:	CHPE HDD 43
	P3
	Start Date: 12-10-2021
	End Date: 12-10-2021
Project Owner:	TDI
Project Contractor:	Kiewit
Project Consultant:	CHA/BCE
Designer:	AJB
	CHA
Description:	HDD 43 10-inch DR 9

Input Summary

Start Coordinate	(0.00, 0.00, 320.64) ft
End Coordinate	(1050.00, 0.00, 320.62) ft
Project Length	1050.00 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

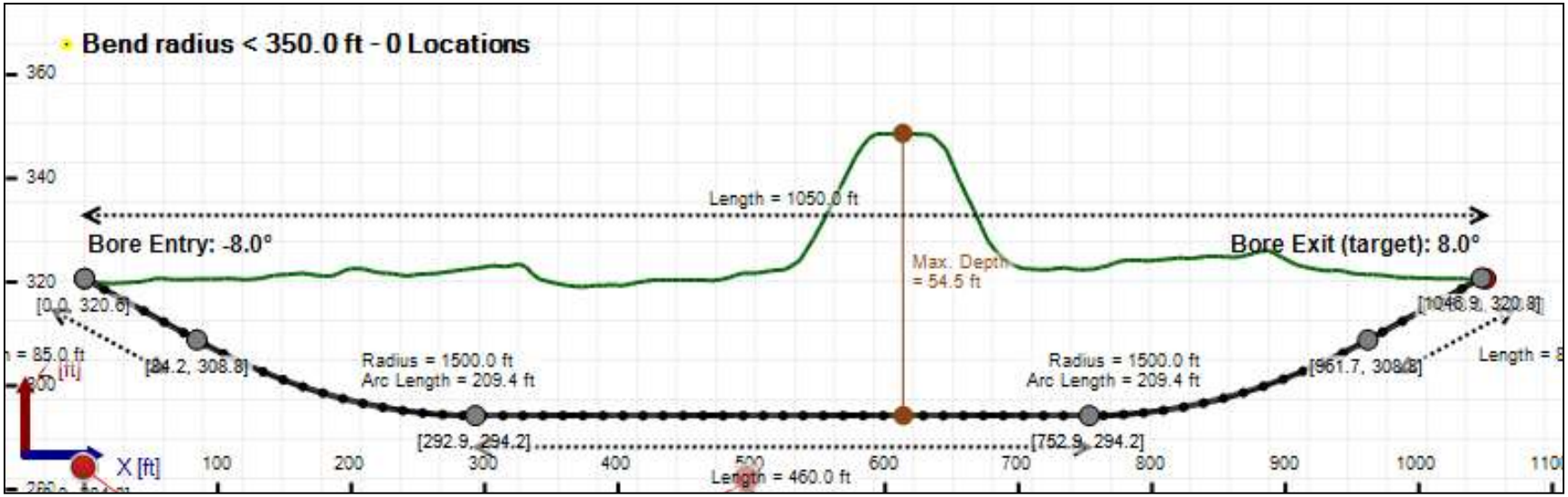
Number of Layers: 3

Soil Layer #1 USCS, Sand (S), SP
Depth: 23.10 ft
Unit Weight: 109.5552 (dry), 125.0000 (sat) [lb/ft3]
Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

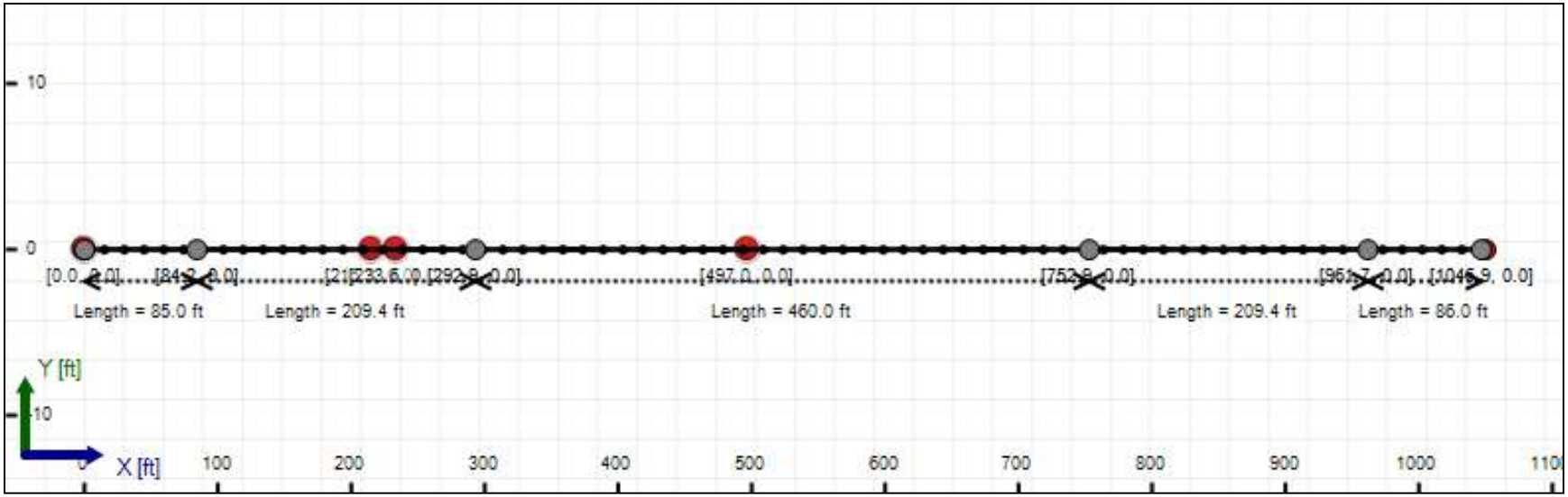
Soil Layer #2 USCS, Silt (M), MH
Depth: 5.00 ft
Unit Weight: 80.0000 (dry), 110.0000 (sat) [lb/ft3]
Phi: 0.00, S.M.: 145.00, Coh: 5.56 [psi]

Soil Layer #3 USCS, Sand (S), SP
Depth: 11.50 ft
Unit Weight: 110.0000 (dry), 124.0000 (sat) [lb/ft3]
Phi: 34.00, S.M.: 145.00, Coh: 0.00 [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: 1050.00 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	5.7	40.8
Water Pressure	0.0	0.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	5.7	40.8
Deflection		
Earth Load Deflection	1.563	11.099
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.695	11.231
Compressive Stress [psi]		
Compressive Wall Stress	25.8	183.4

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	16406.8	16406.8
Pullback Stress [psi]	457.6	457.6
Pullback Strain	7.958E-3	7.958E-3
Bending Stress [psi]	0.0	17.2
Bending Strain	0	2.986E-4
Tensile Stress [psi]	457.6	473.3
Tensile Strain	7.958E-3	8.530E-3

Net External Pressure = 16.9 [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]	17.3	118.7	6.9	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]	27.3	228.9	8.4	OK
Tensile Stress [psi]	473.3	1200.0	2.5	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	120.952 psi	79.928 psi
1	8.00 in	12.00 in	120.923 psi	79.779 psi
2	12.00 in	16.13 in	120.880 psi	79.564 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): 40.00 US (liquid) gallon/min

Drill Fluid Density: 68.700 lb/ft3

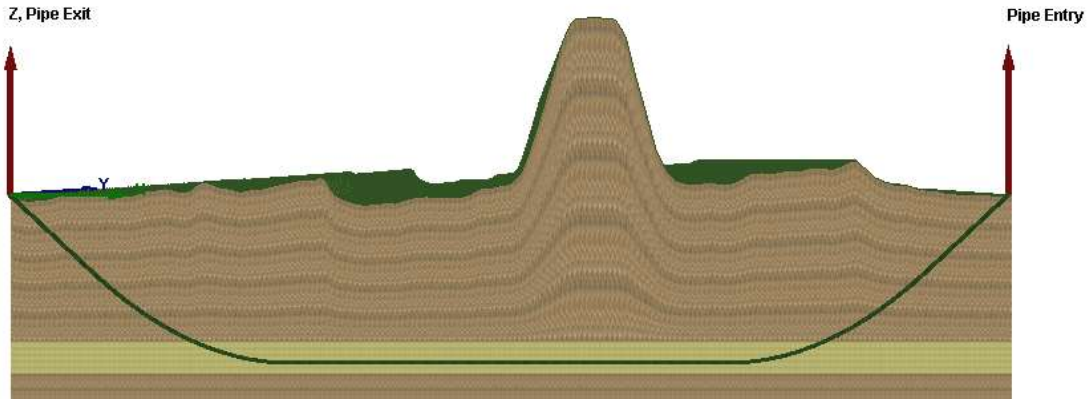
Rheological model: Bingham-Plastic

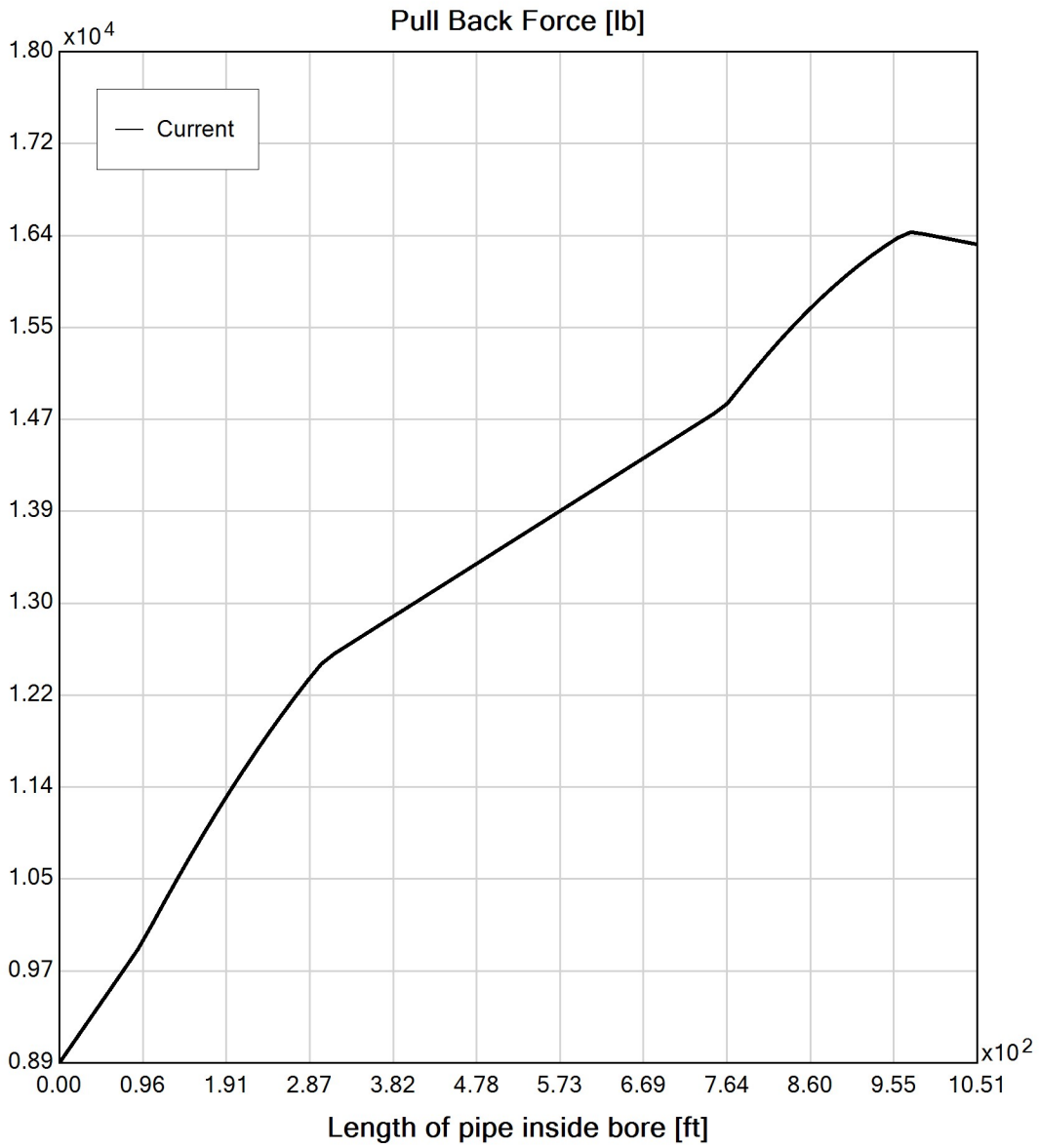
Plastic Viscosity (PV): 25.53

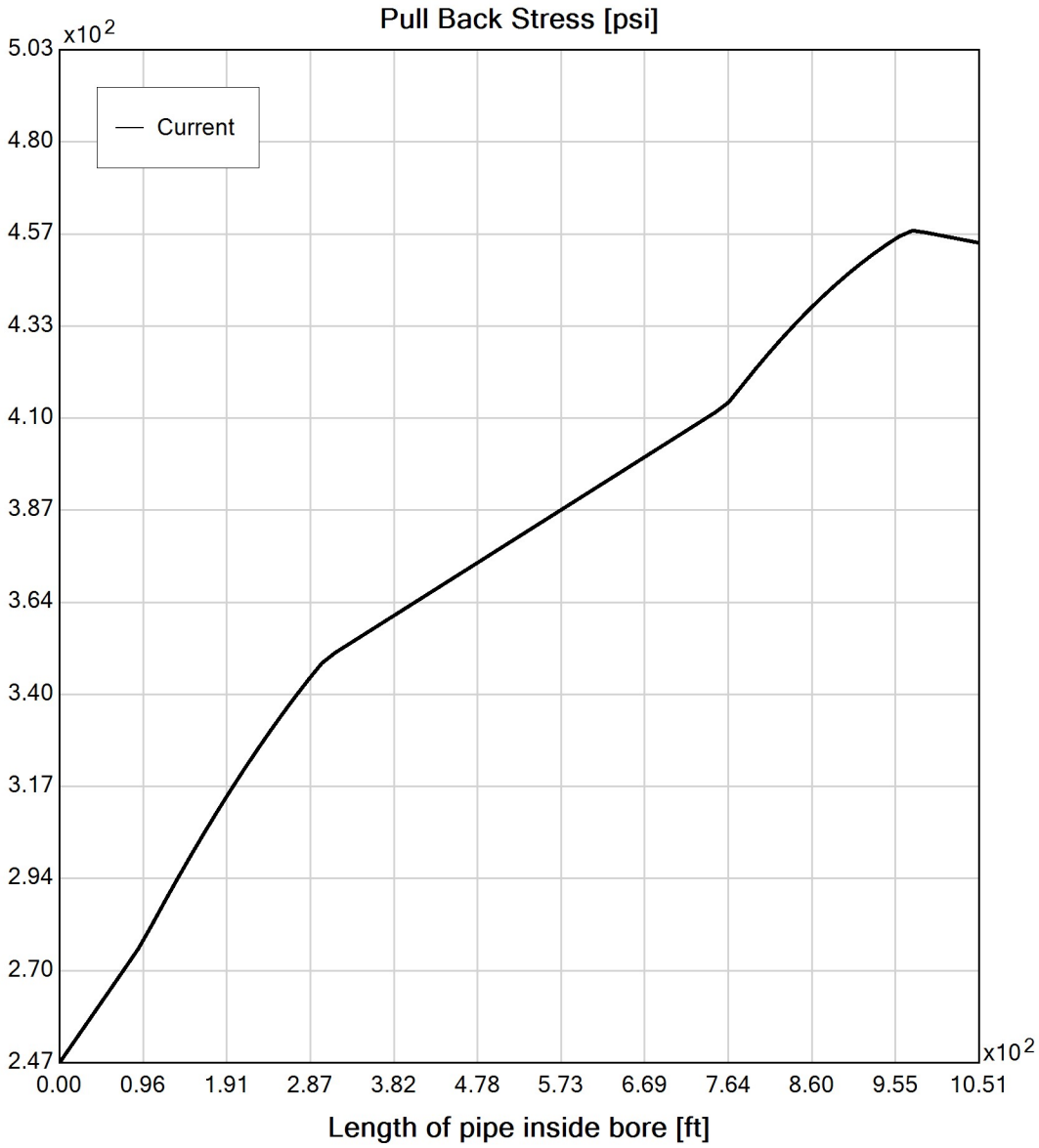
Yield Point (YP): 16.49

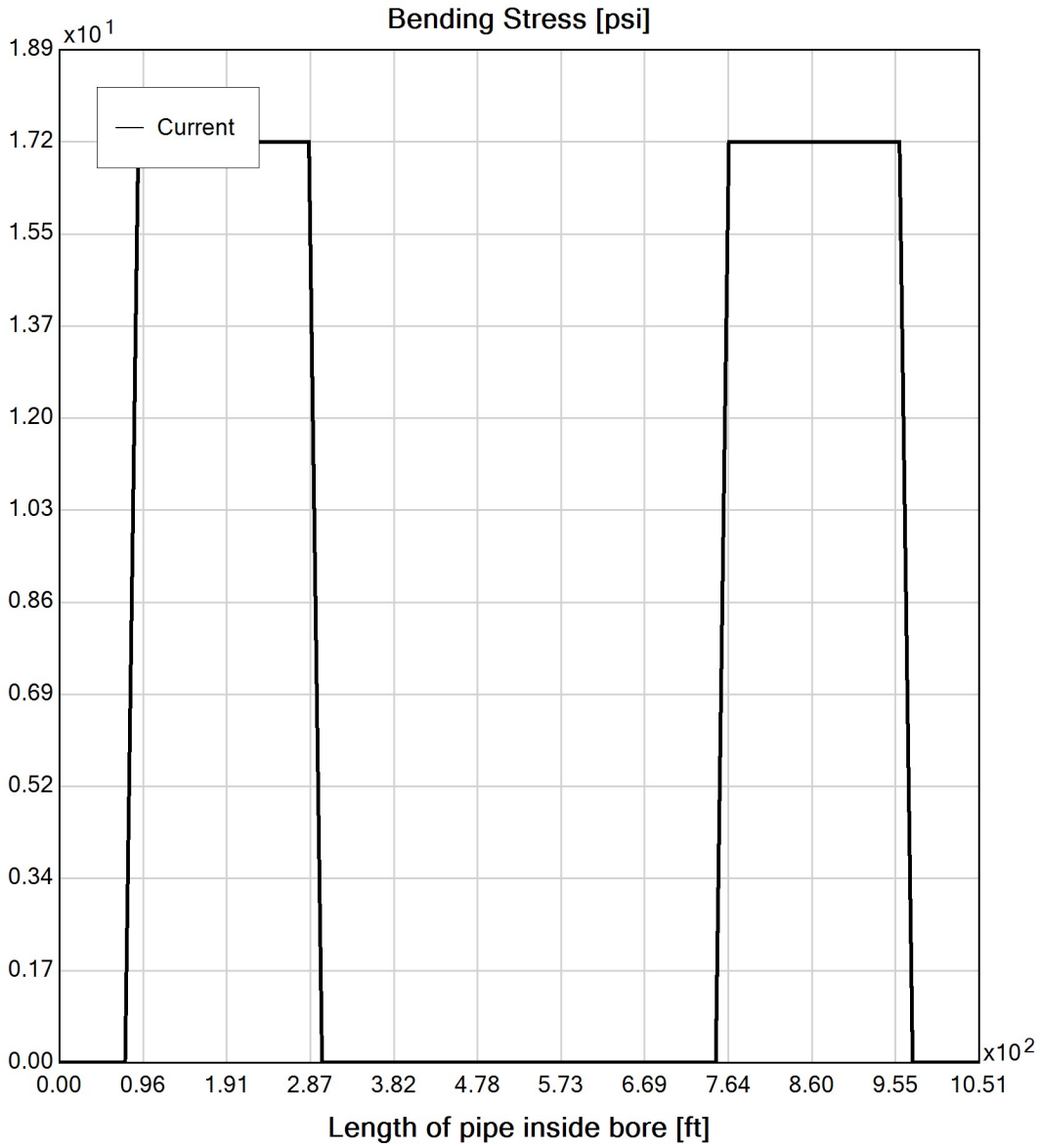
Effective Viscosity (cP): 1202.0

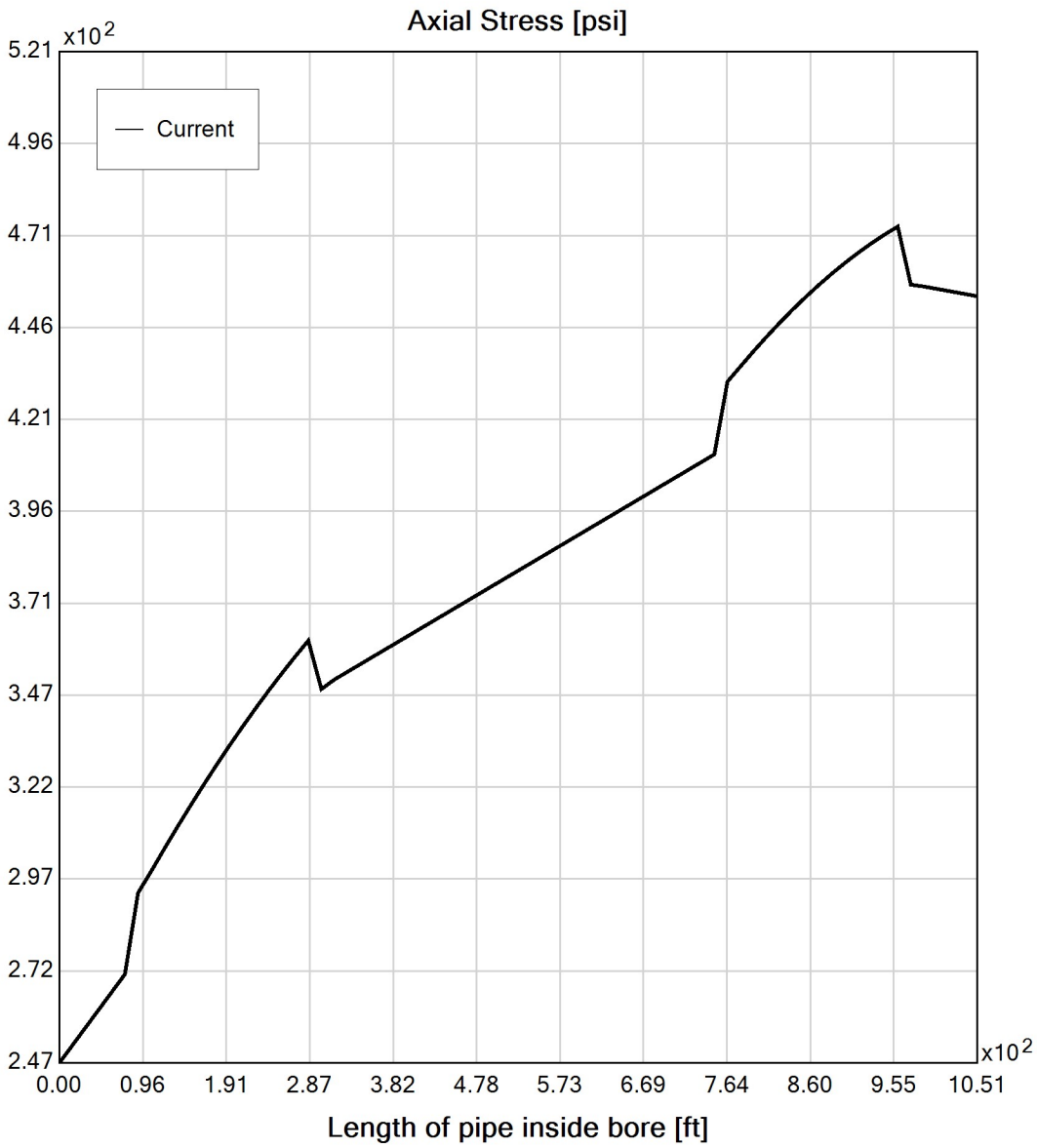
Virtual Site

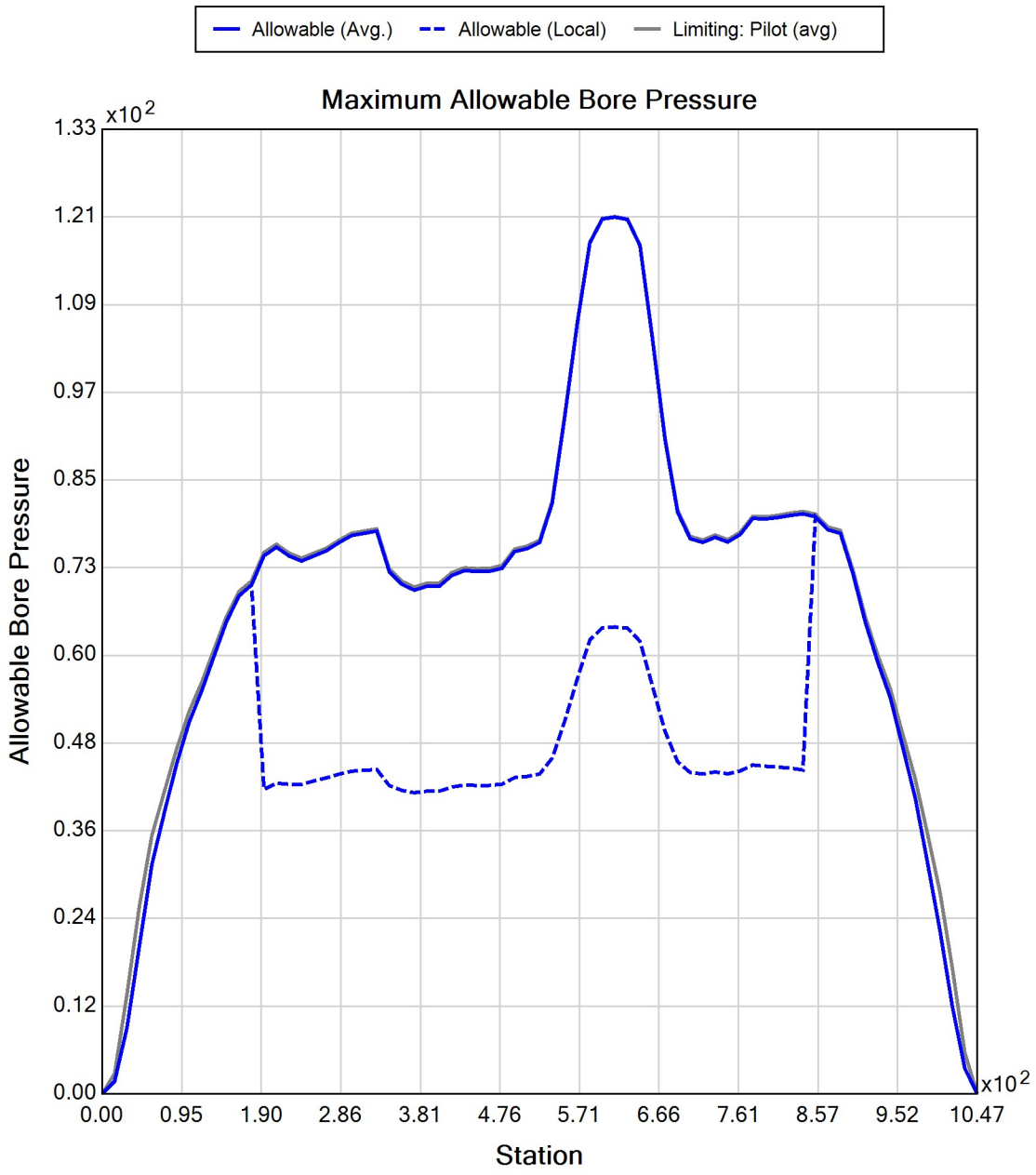


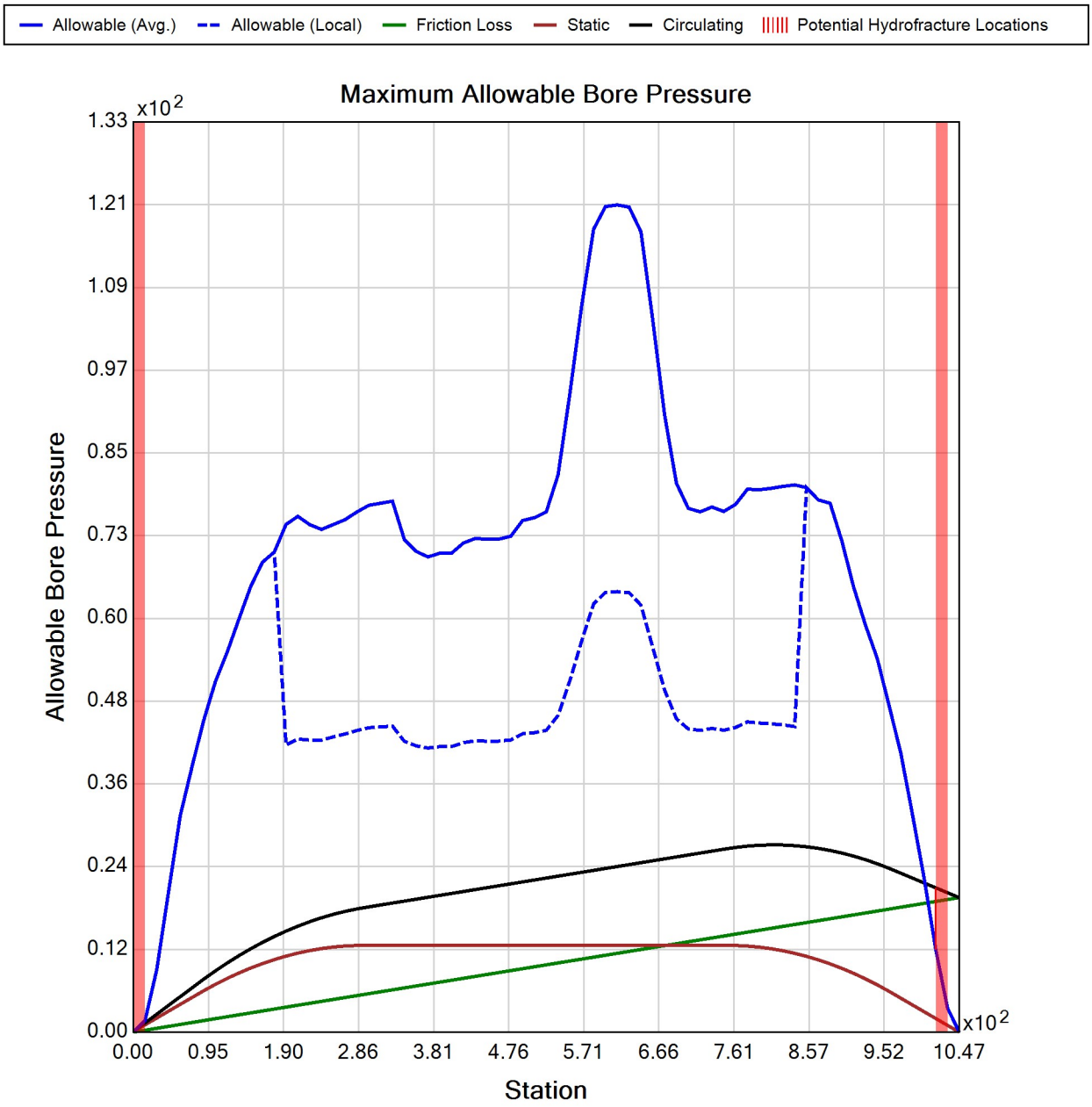












Generated Output

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Input Summary

Start Coordinate	(0.00, 0.00, 320.64) ft
End Coordinate	(1050.00, 0.00, 320.62) ft
Project Length	1050.00 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: 1050.00 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	2.3	40.8
Water Pressure	0.0	0.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	2.3	40.8
Deflection		
Earth Load Deflection	0.636	11.099
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	0.666	11.128
Compressive Stress [psi]		
Compressive Wall Stress	10.5	183.4

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	910.4	910.4
Pullback Stress [psi]	520.2	520.2
Pullback Strain	9.047E-3	9.047E-3
Bending Stress [psi]	0.0	3.8
Bending Strain	0	6.597E-5
Tensile Stress [psi]	520.2	522.5
Tensile Strain	9.047E-3	9.154E-3

Net External Pressure = 16.9 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.666	7.5	11.3	OK
Unconstrained Collapse [psi]	17.3	130.4	7.5	OK
Compressive Wall Stress [psi]	10.5	1150.0	109.4	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	27.3	226.5	8.3	OK
Tensile Stress [psi]	522.5	1200.0	2.3	OK

Generated Output

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Project Summary

General:	CHPE HDD 44
	P3
	Start Date: 12-10-2021
	End Date: 12-10-2021
Project Owner:	TDI
Project Contractor:	Kiewit
Project Consultant:	CHA/BCE
Designer:	AB
	CHA
Description:	HDD 44 10-inch DR 9

Input Summary

Start Coordinate	(0.00, 0.00, 315.00) ft
End Coordinate	(540.00, 0.00, 314.00) ft
Project Length	540.00 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, Sand (S), SP
Depth: 0.90 ft
Unit Weight: 109.5552 (dry), 125.0000 (sat) [lb/ft3]
Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

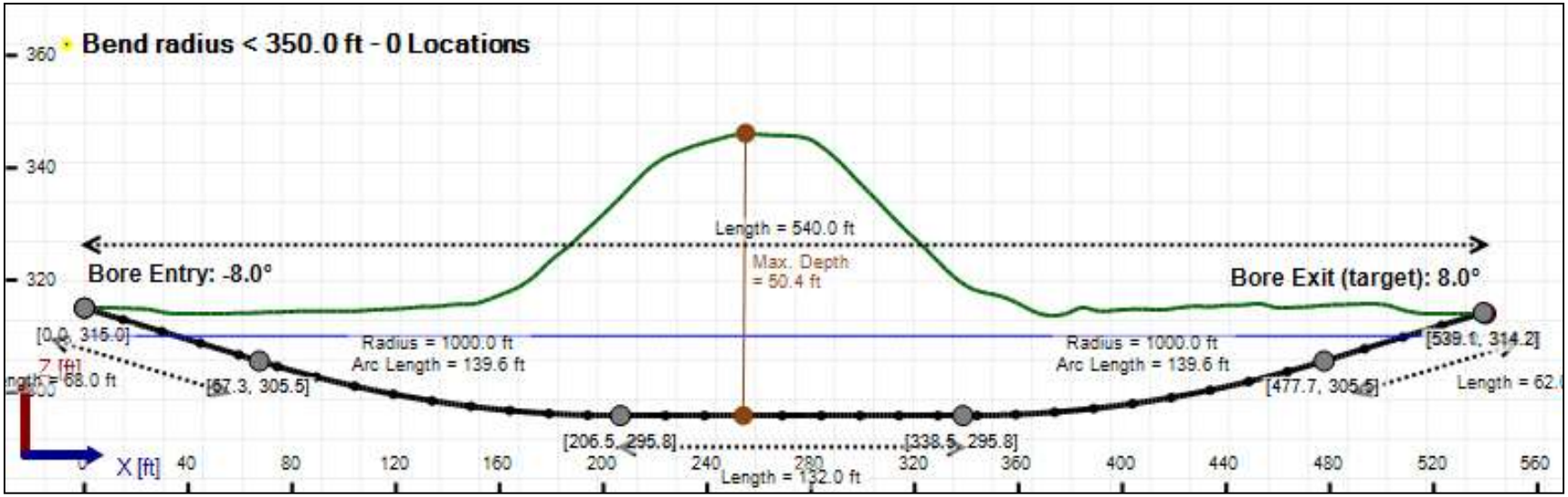
Soil Layer #2 USCS, Sand (S), SP
Depth: 10.80 ft
Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3]
Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #3 USCS, Sand (S), SW
Depth: 1.20 ft
Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3]
Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

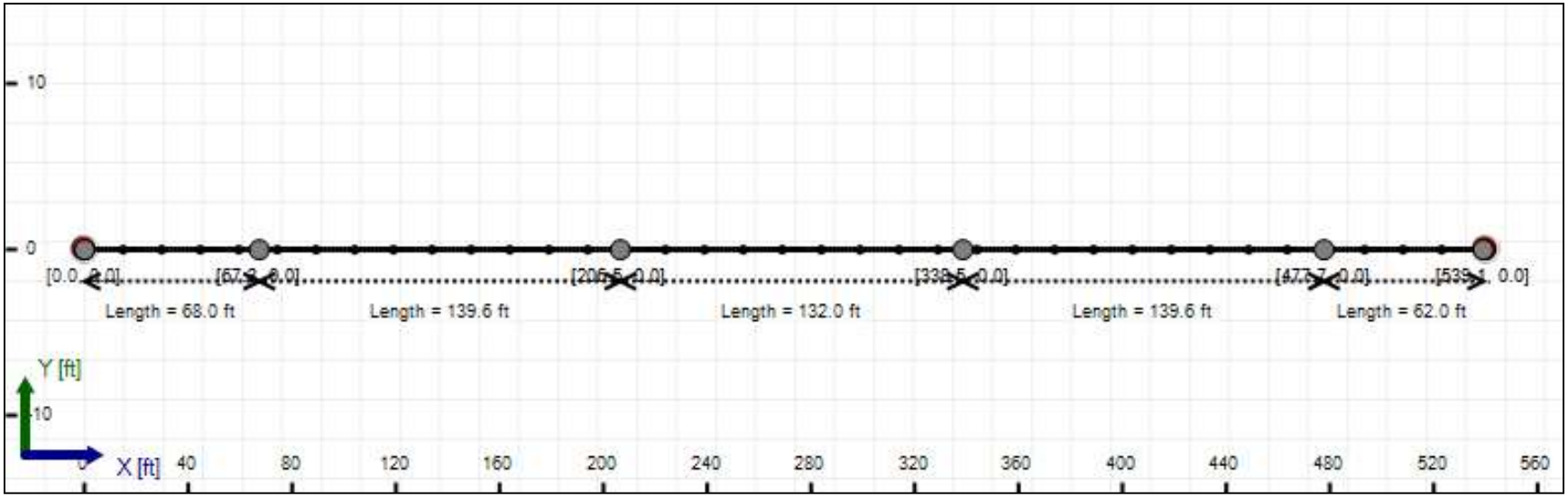
Soil Layer #4 USCS, Silt (M), ML
Depth: 6.00 ft
Unit Weight: 80.0000 (dry), 100.0000 (sat) [lb/ft3]
Phi: 0.00, S.M.: 145.00, Coh: 3.13 [psi]

Soil Layer #5 USCS, Sand (S), SP
Depth: 13.00 ft
Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft3]
Phi: 34.00, S.M.: 145.00, Coh: 0.00 [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	4.7	32.0
Water Pressure	6.2	6.2
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	10.9	38.1
Deflection		
Earth Load Deflection	1.293	8.708
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.425	8.840
Compressive Stress [psi]		
Compressive Wall Stress	49.1	171.6

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	9060.6	9060.6
Pullback Stress [psi]	252.7	252.7
Pullback Strain	4.395E-3	4.395E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	252.7	277.2
Tensile Strain	4.395E-3	5.269E-3

Net External Pressure = 16.1 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.425	7.5	5.3	OK
Unconstrained Collapse [psi]	13.2	121.5	9.2	OK
Compressive Wall Stress [psi]	49.1	1150.0	23.4	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	23.1	240.3	10.4	OK
Tensile Stress [psi]	277.2	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	105.358 psi	111.737 psi
1	8.00 in	12.00 in	105.321 psi	111.699 psi
2	12.00 in	16.13 in	105.268 psi	111.644 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

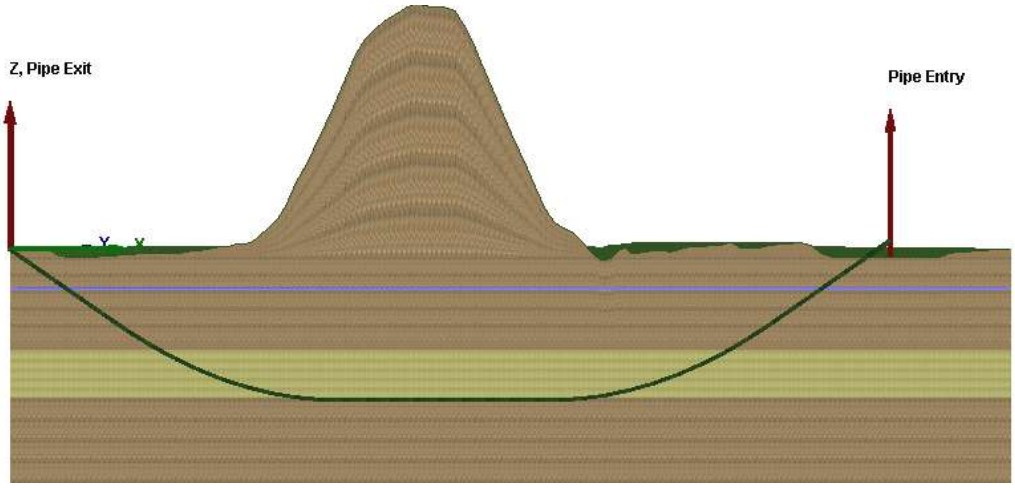
Rheological model: Bingham-Plastic

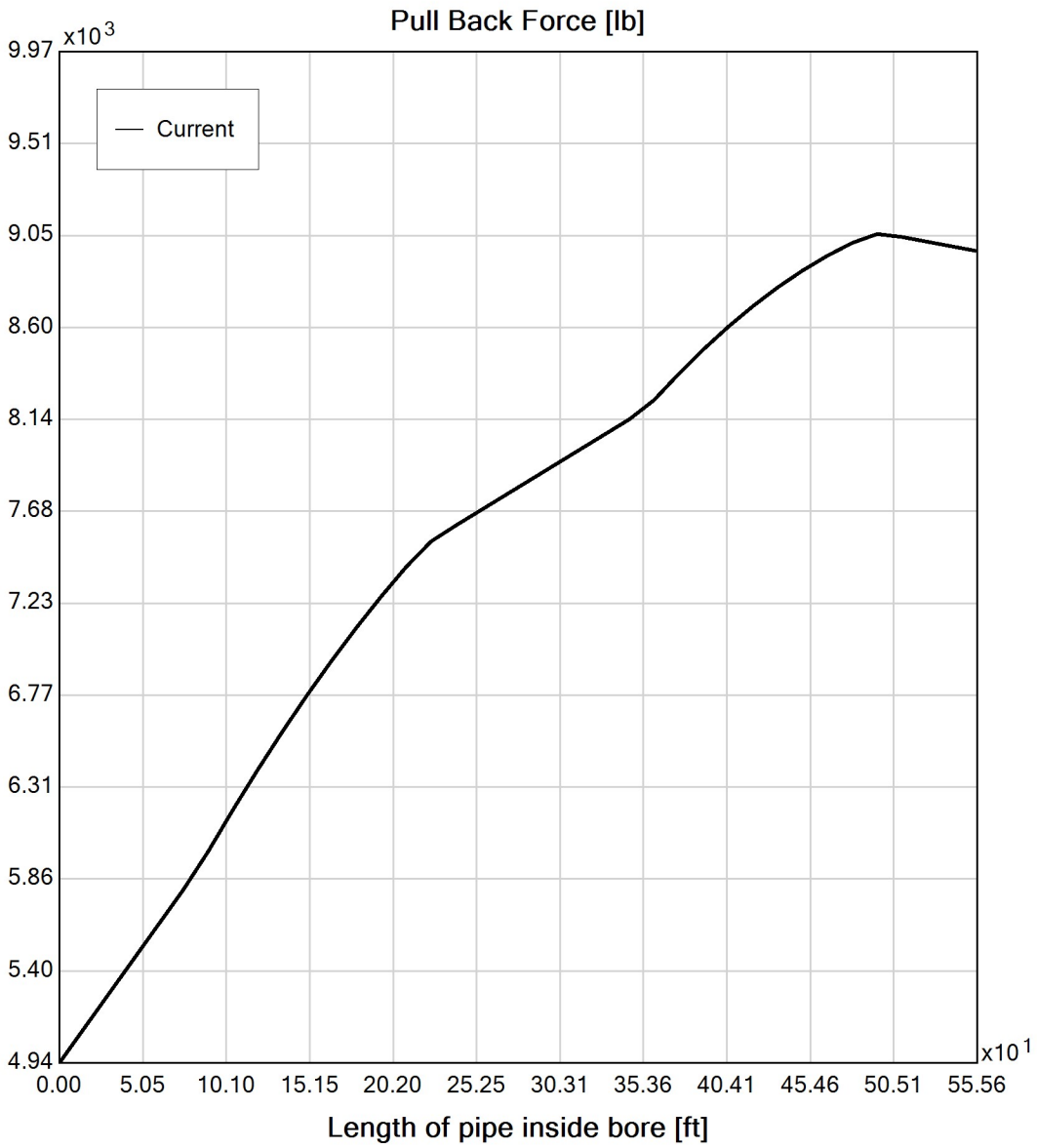
Plastic Viscosity (PV): 25.53

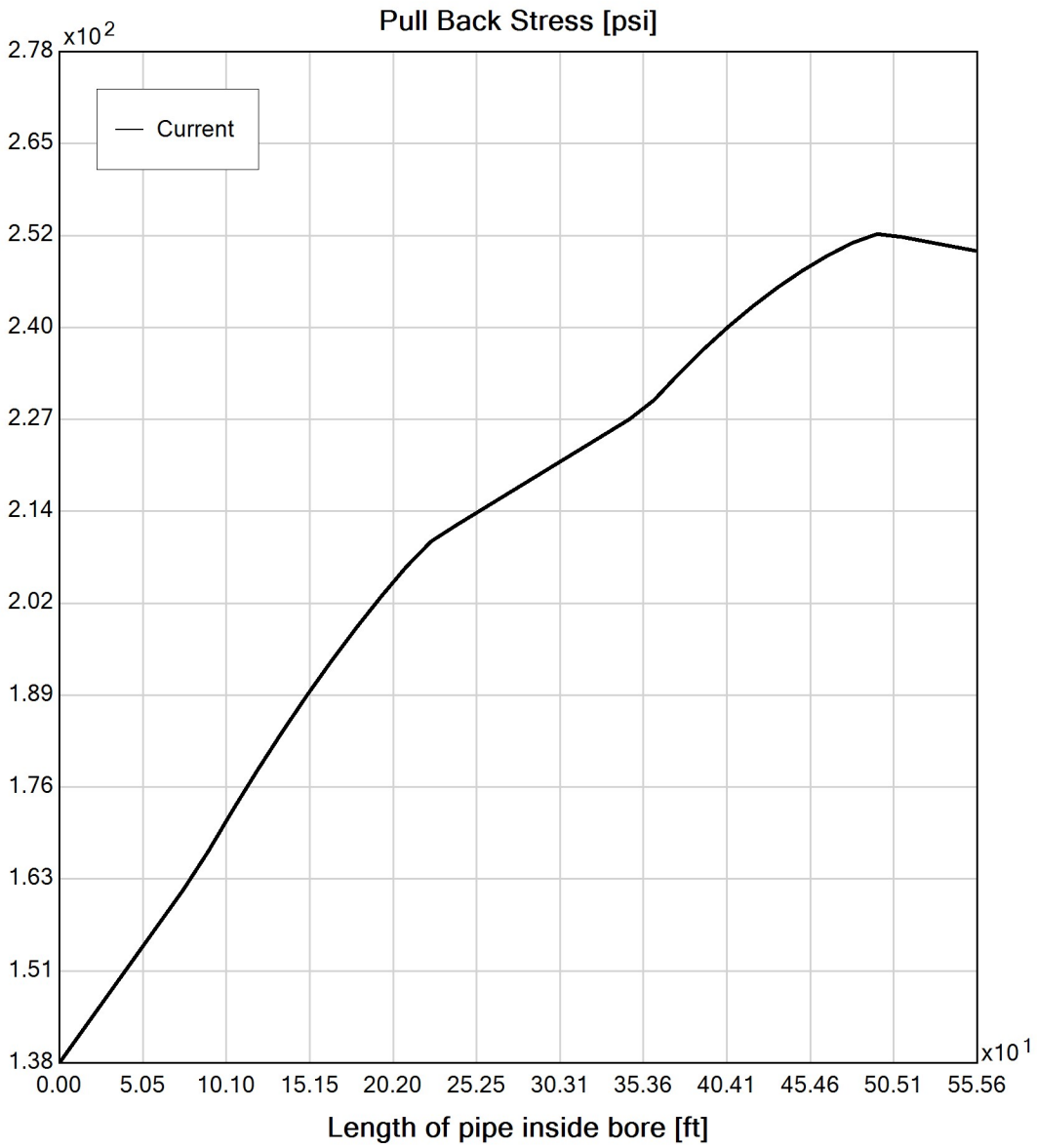
Yield Point (YP): 16.49

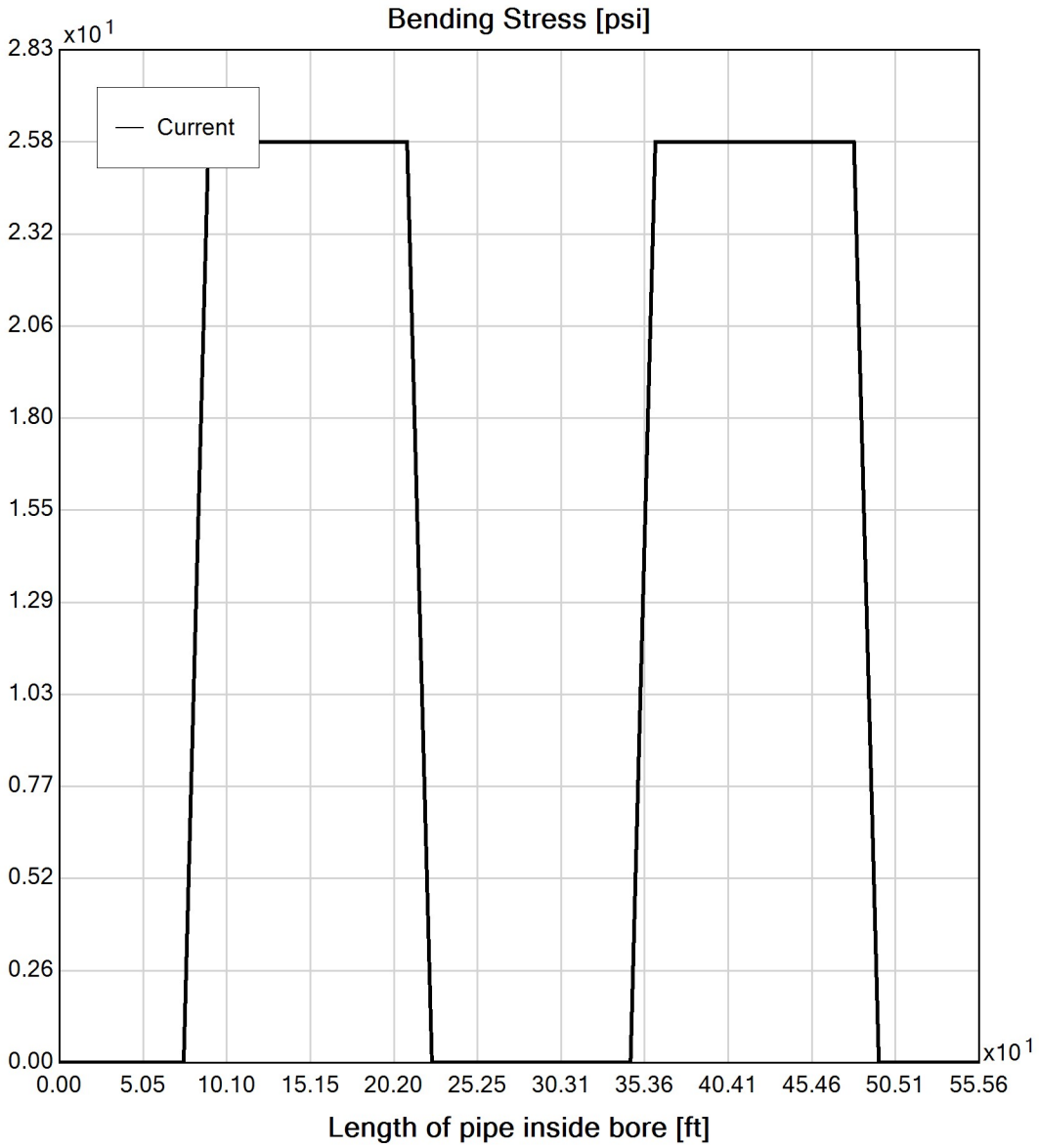
Effective Viscosity (cP): 1202.0

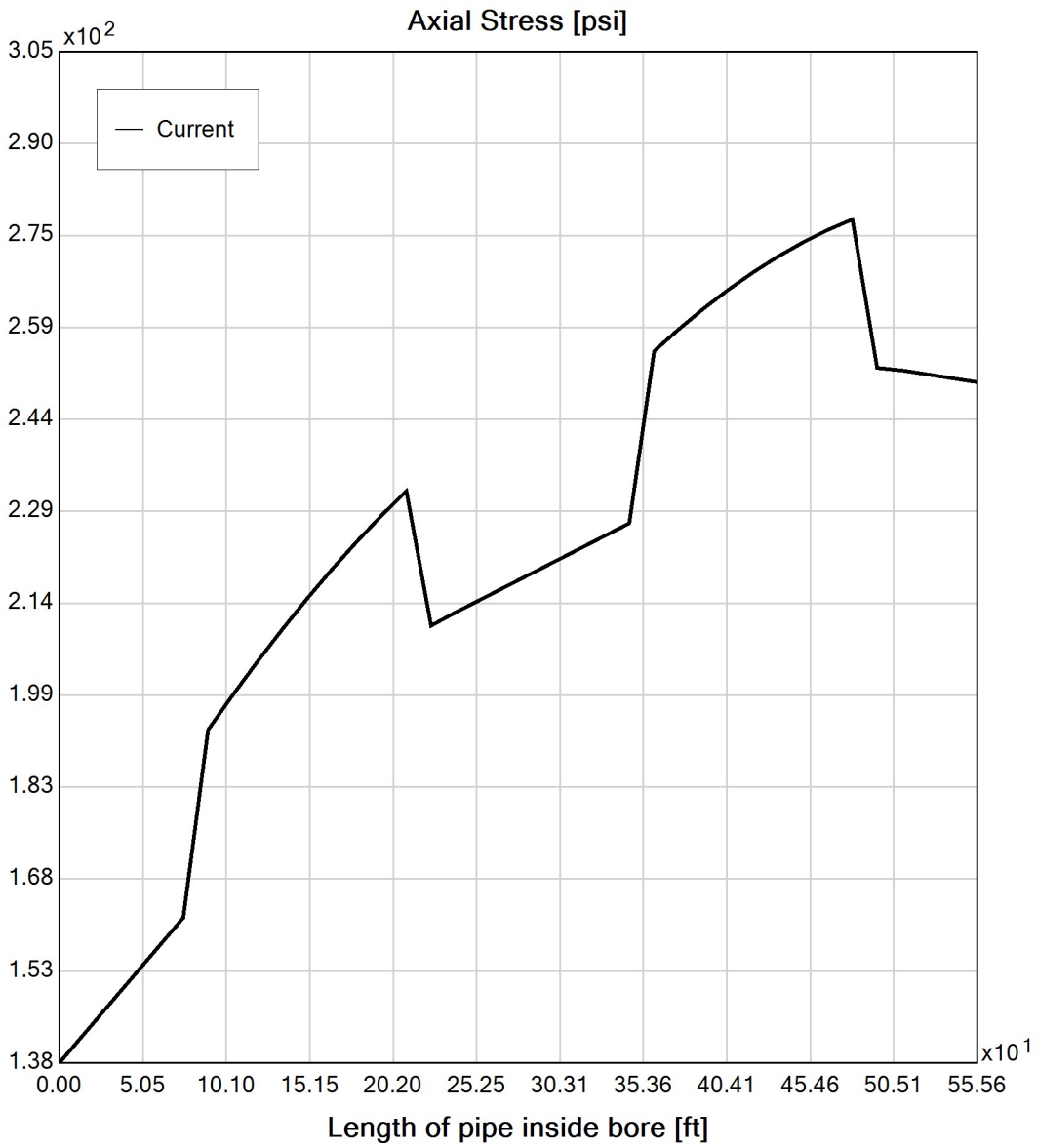
Virtual Site

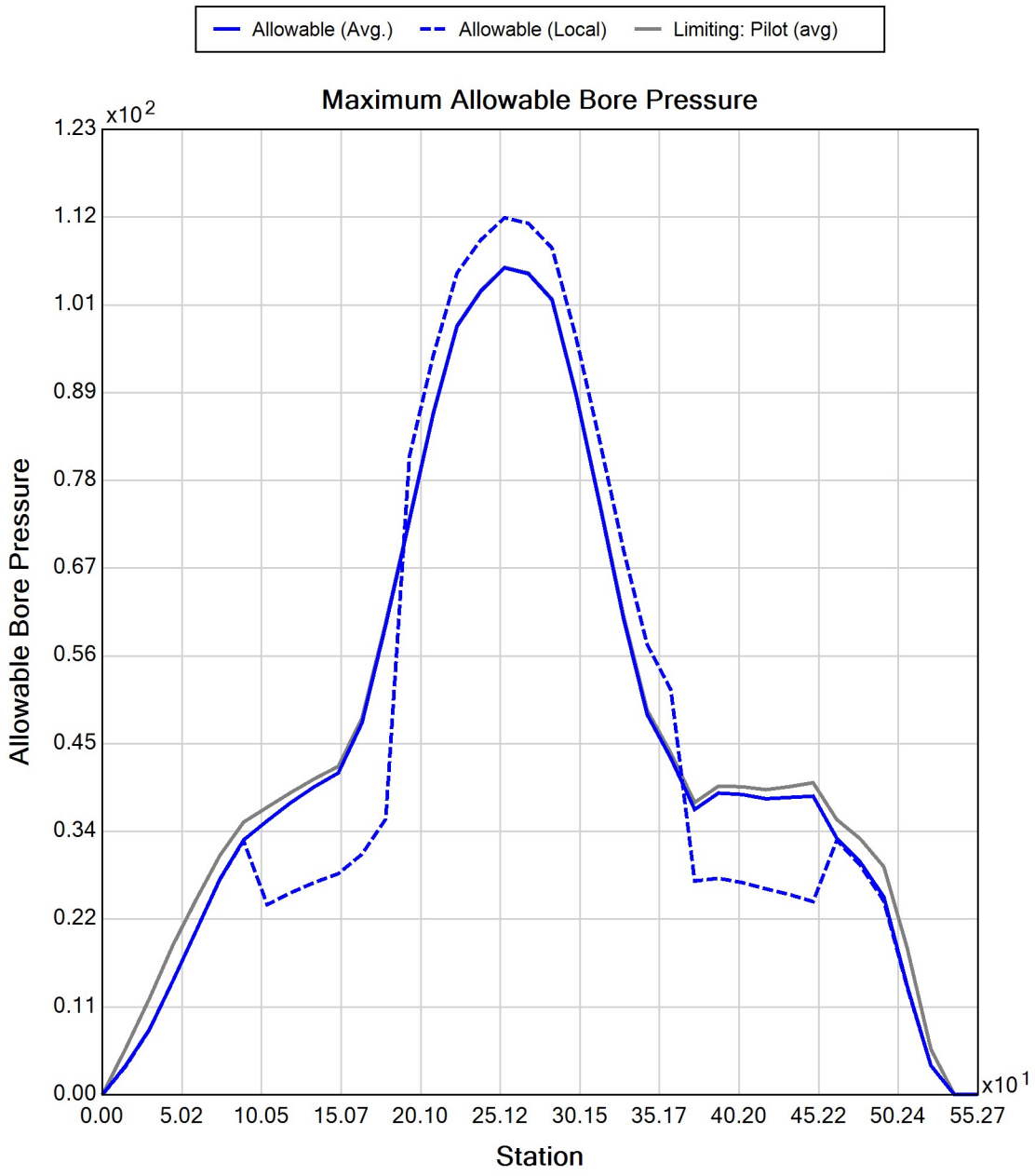


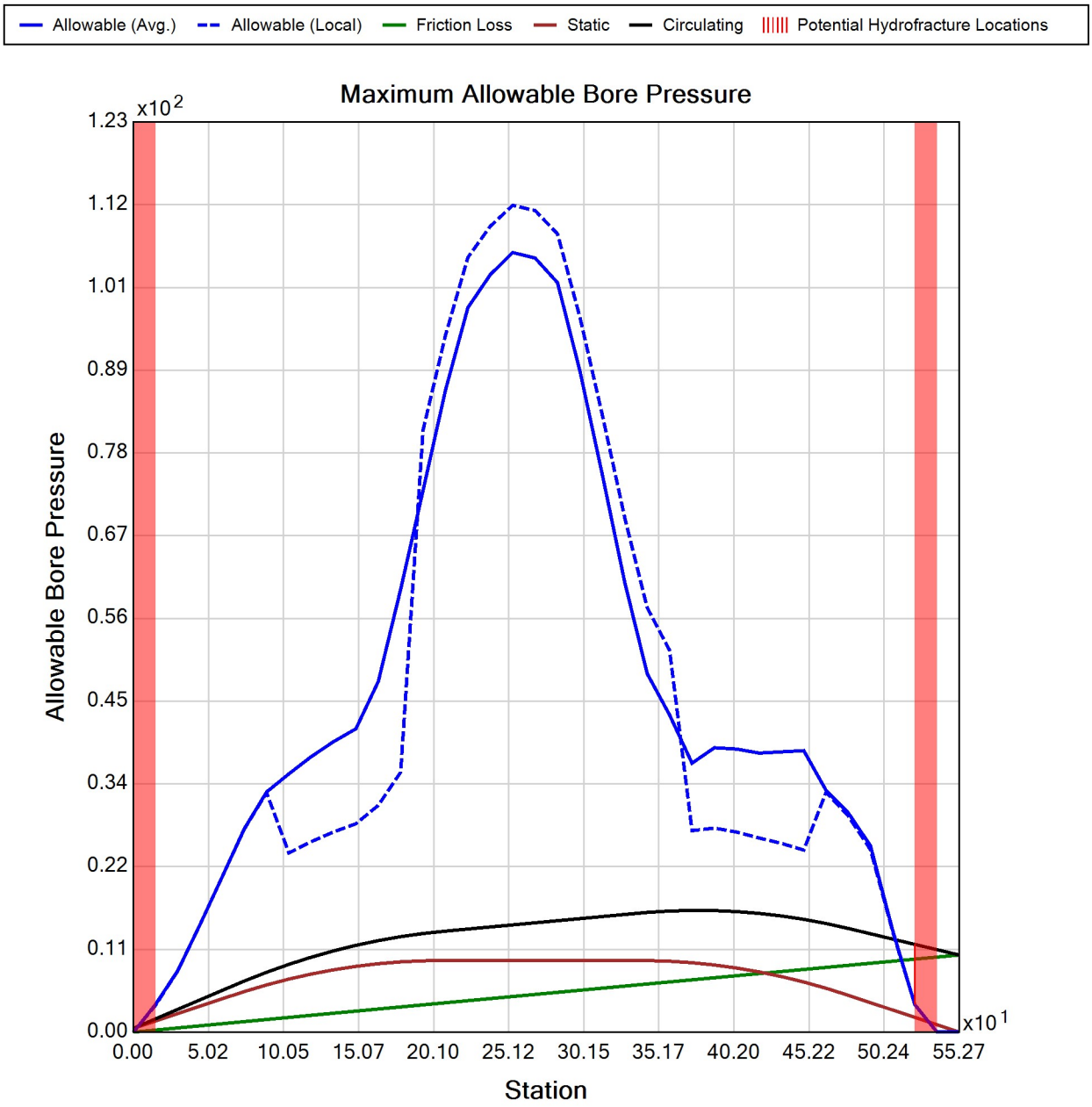












Generated Output

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Input Summary

Start Coordinate	(0.00, 0.00, 315.00) ft
End Coordinate	(540.00, 0.00, 314.00) ft
Project Length	540.00 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	1.9	32.0
Water Pressure	6.2	6.2
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	8.0	38.1
Deflection		
Earth Load Deflection	0.511	8.708
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	0.541	8.737
Compressive Stress [psi]		
Compressive Wall Stress	36.1	171.6

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	551.8	551.8
Pullback Stress [psi]	315.3	315.3
Pullback Strain	5.484E-3	5.484E-3
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	315.3	319.8
Tensile Strain	5.484E-3	5.660E-3

Net External Pressure = 16.1 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.541	7.5	13.9	OK
Unconstrained Collapse [psi]	13.2	131.6	10.0	OK
Compressive Wall Stress [psi]	36.1	1150.0	31.8	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	23.2	239.2	10.3	OK
Tensile Stress [psi]	319.8	1200.0	3.8	OK

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Project Summary

General:	CHPE HDD 45
	P3
	Start Date: 12-10-2021
	End Date: 12-10-2021
Project Owner:	TDI
Project Contractor:	Kiewit
Project Consultant:	CHA/BCE
Designer:	AB
	CHA
Description:	HDD 45 10-inch DR 9

Input Summary

Start Coordinate	(0.00, 0.00, 324.14) ft
End Coordinate	(620.00, 0.00, 318.50) ft
Project Length	620.00 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

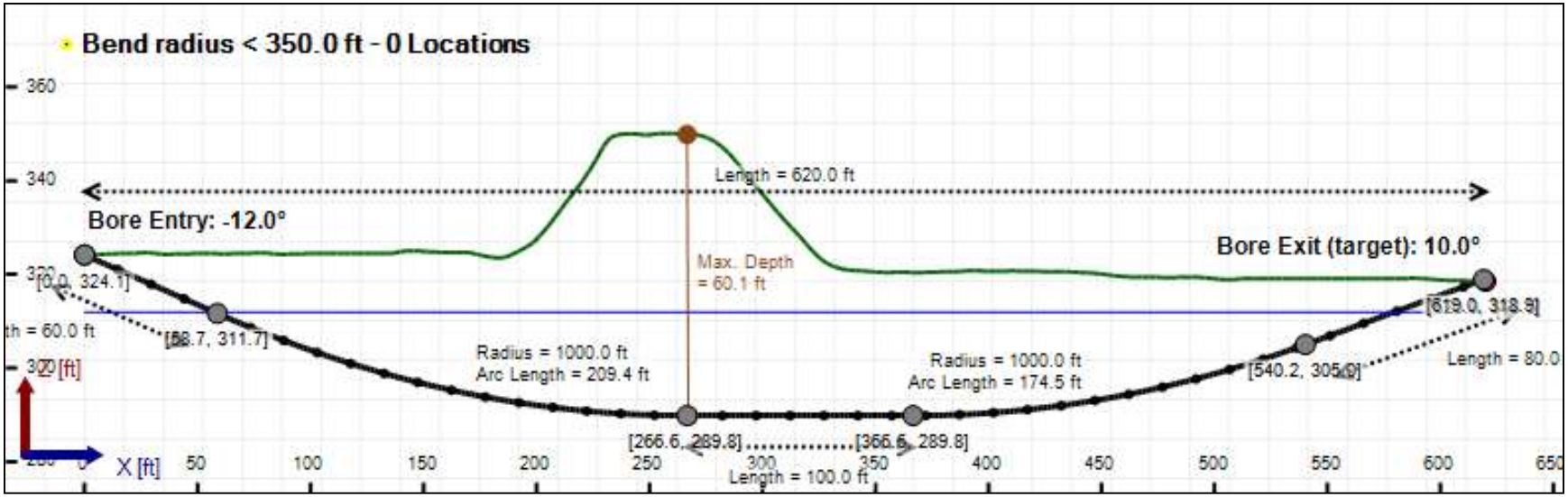
Number of Layers: 3

Soil Layer #1 USCS, Gravel (G), GP
Depth: 6.80 ft
Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3]
Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

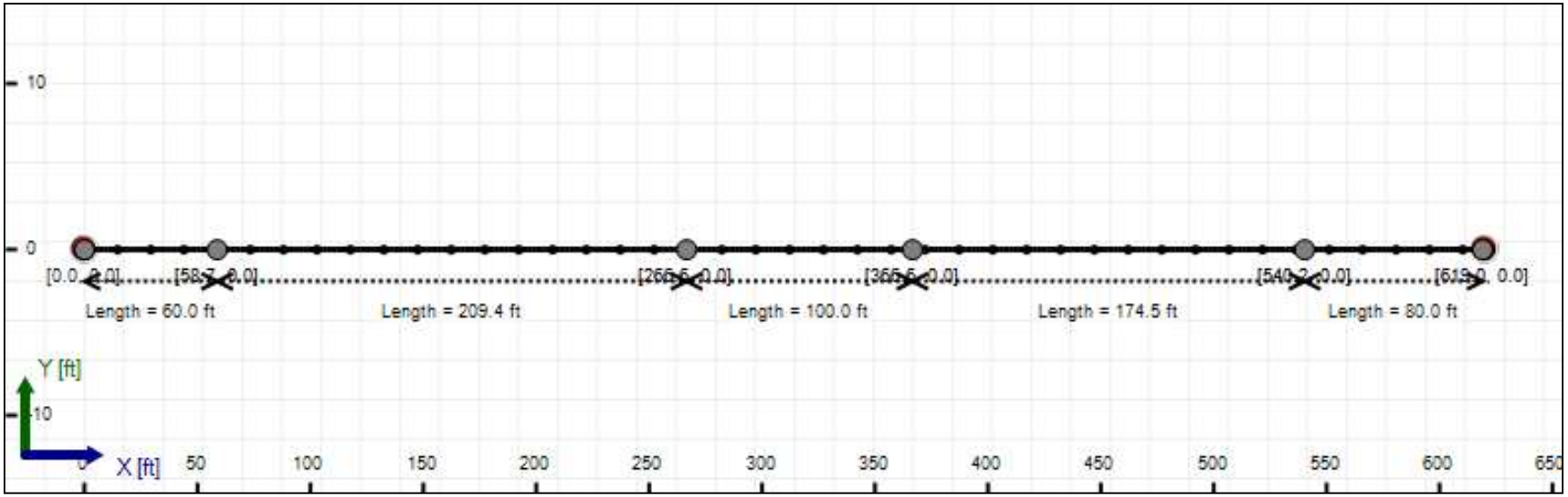
Soil Layer #2 USCS, Sand (S), SW
Depth: 18.00 ft
Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft3]
Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #3 USCS, Sand (S), SP
Depth: 17.00 ft
Unit Weight: 109.5552 (dry), 125.0000 (sat) [lb/ft3]
Phi: 34.00, S.M.: 145.00, Coh: 0.00 [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: 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	4.8	37.5
Water Pressure	9.6	9.6
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	14.3	47.0
Deflection		
Earth Load Deflection	1.297	10.206
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.429	10.338
Compressive Stress [psi]		
Compressive Wall Stress	64.5	211.7

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	10665.1	10665.1
Pullback Stress [psi]	297.4	297.4
Pullback Strain	5.173E-3	5.173E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	297.4	322.6
Tensile Strain	5.173E-3	6.059E-3

Net External Pressure = 18.1 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.429	7.5	5.2	OK
Unconstrained Collapse [psi]	22.3	121.5	5.4	OK
Compressive Wall Stress [psi]	64.5	1150.0	17.8	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	32.3	237.9	7.4	OK
Tensile Stress [psi]	322.6	1200.0	3.7	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	123.450 psi	126.470 psi
1	8.00 in	12.00 in	123.425 psi	126.444 psi
2	12.00 in	16.13 in	123.389 psi	126.408 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

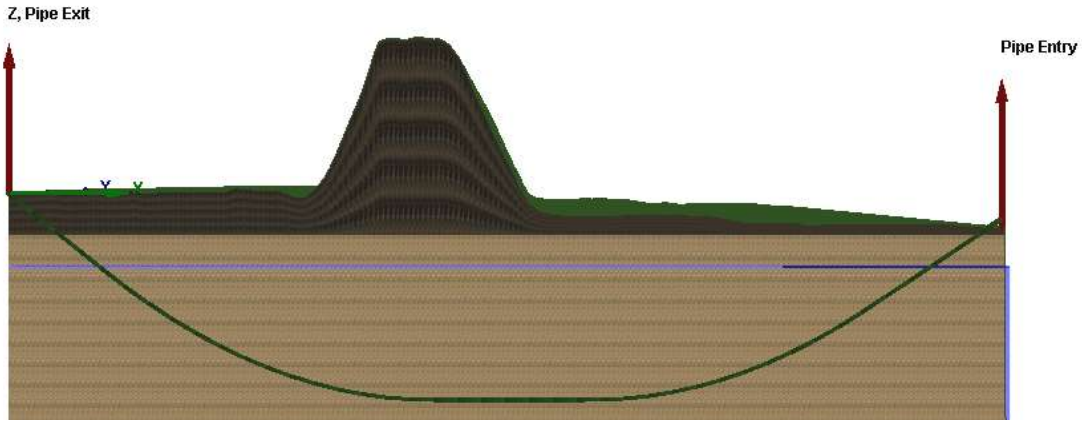
Rheological model: Bingham-Plastic

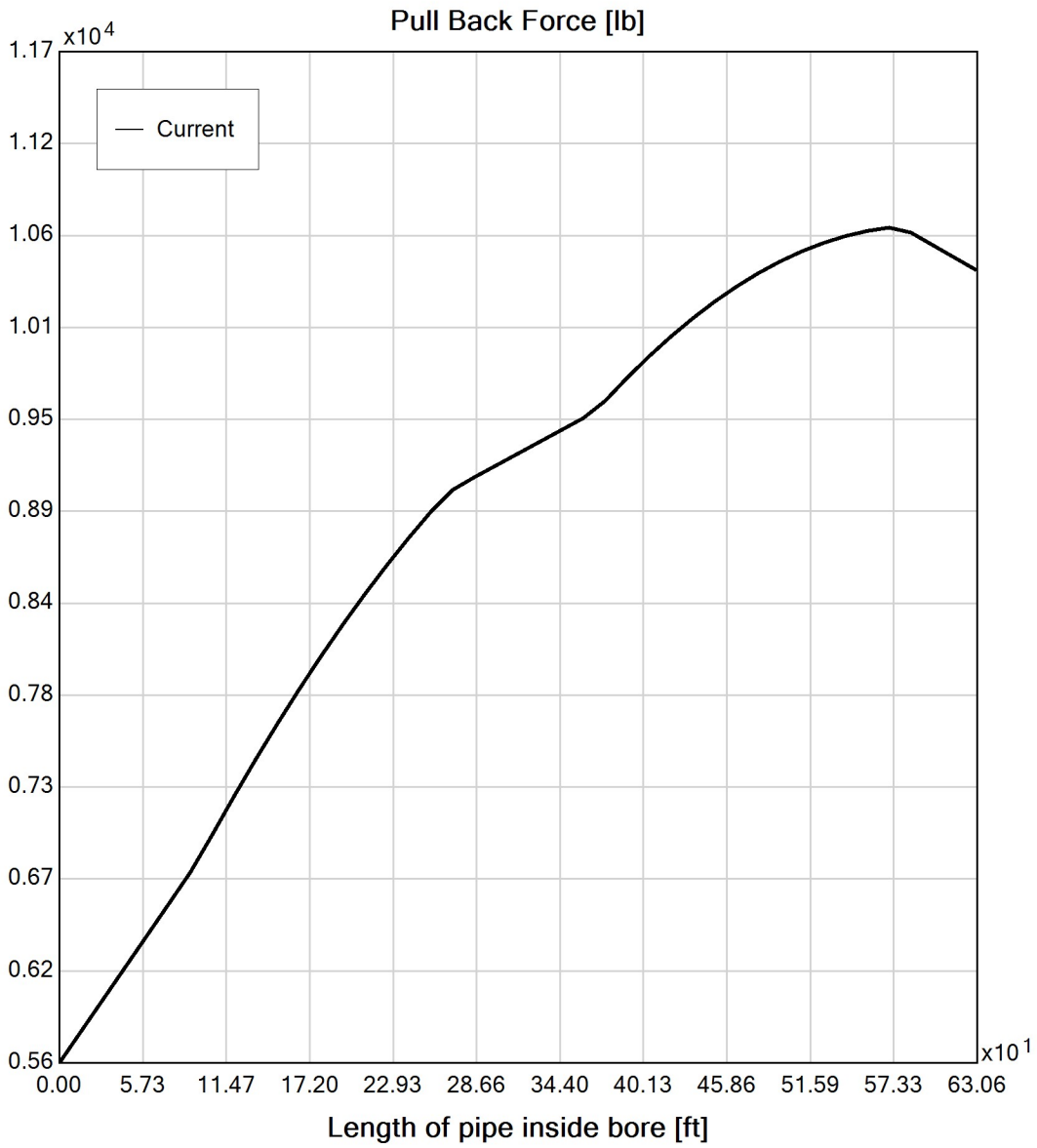
Plastic Viscosity (PV): 25.53

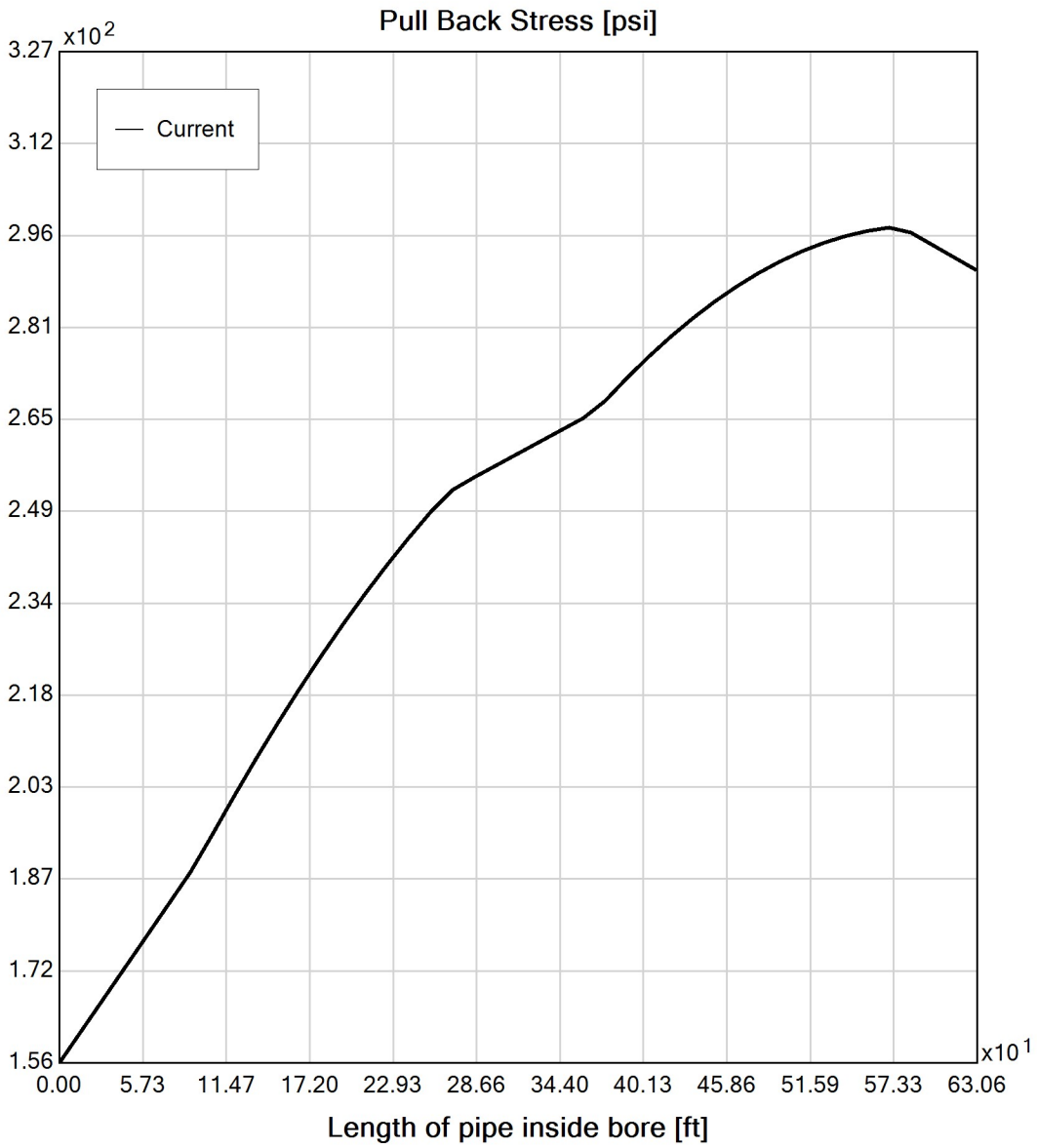
Yield Point (YP): 16.49

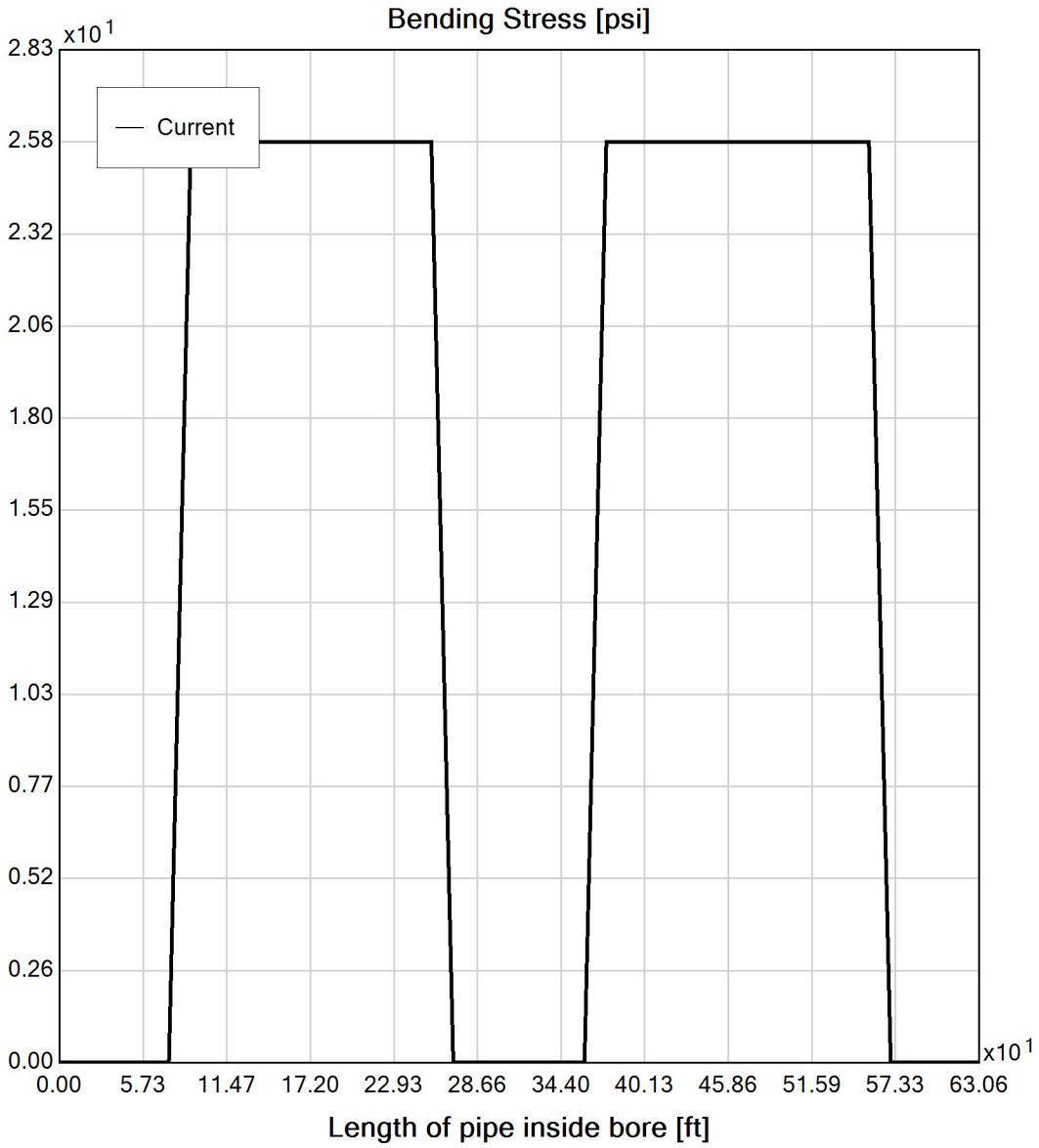
Effective Viscosity (cP): 1202.0

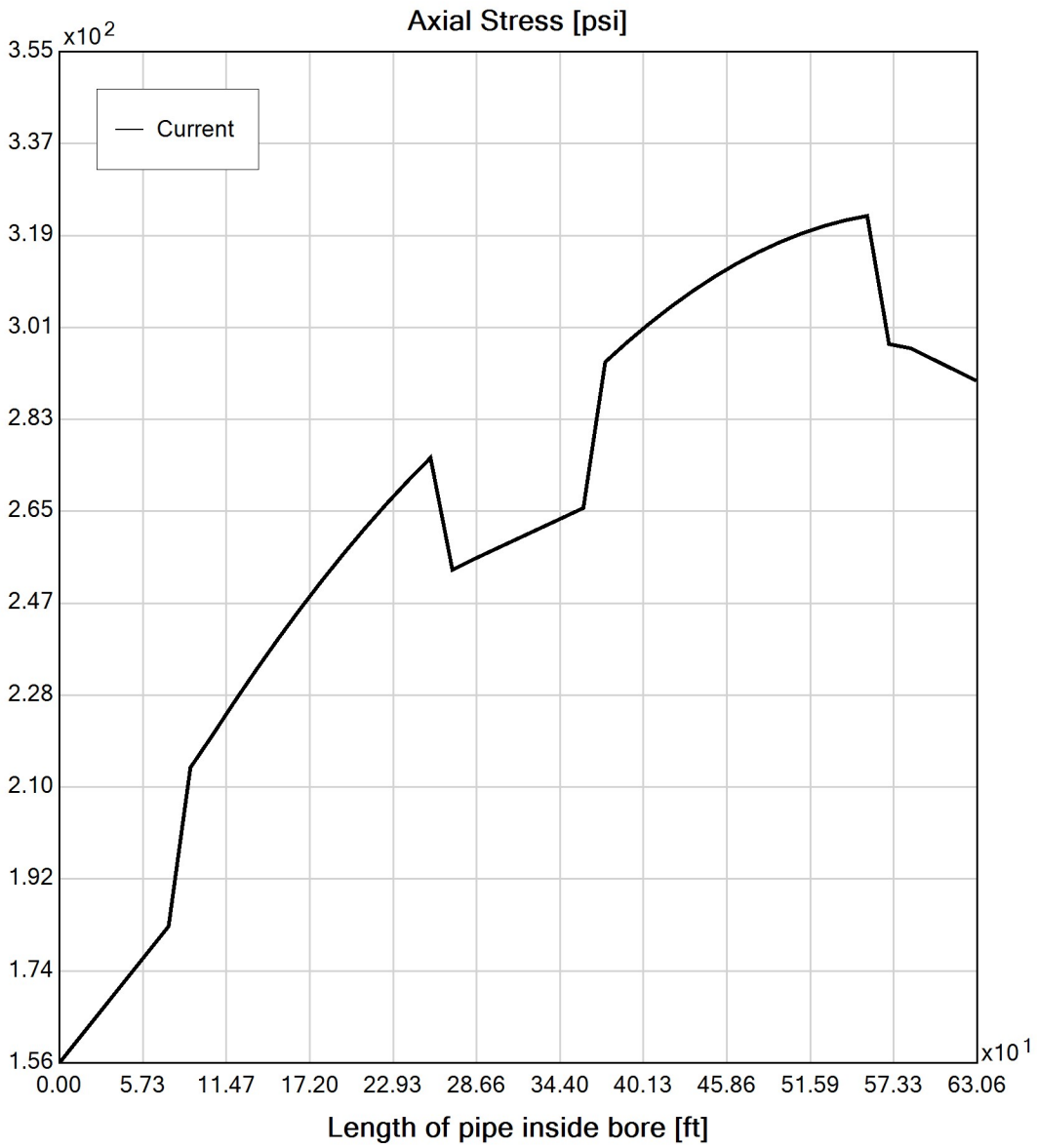
Virtual Site

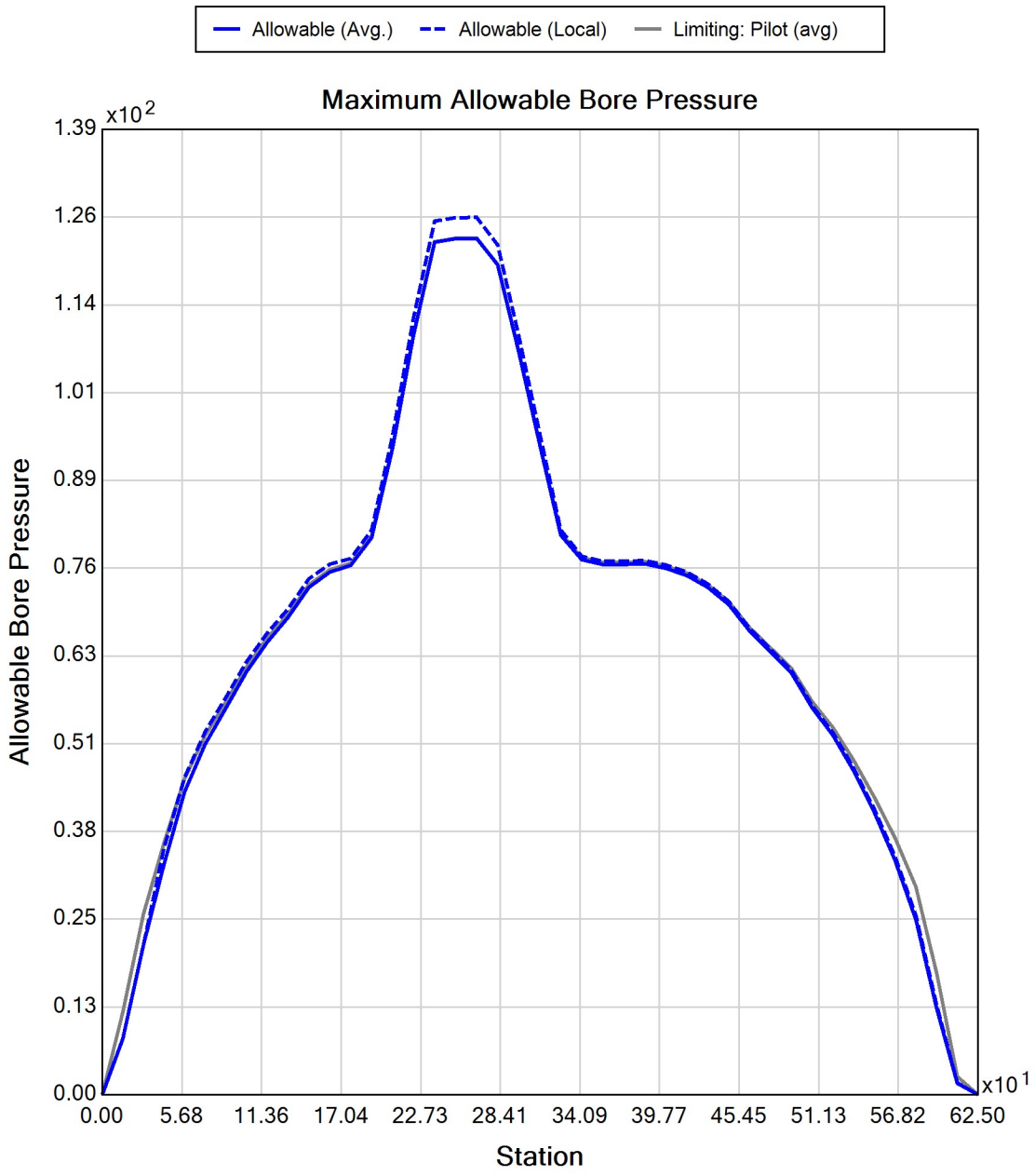


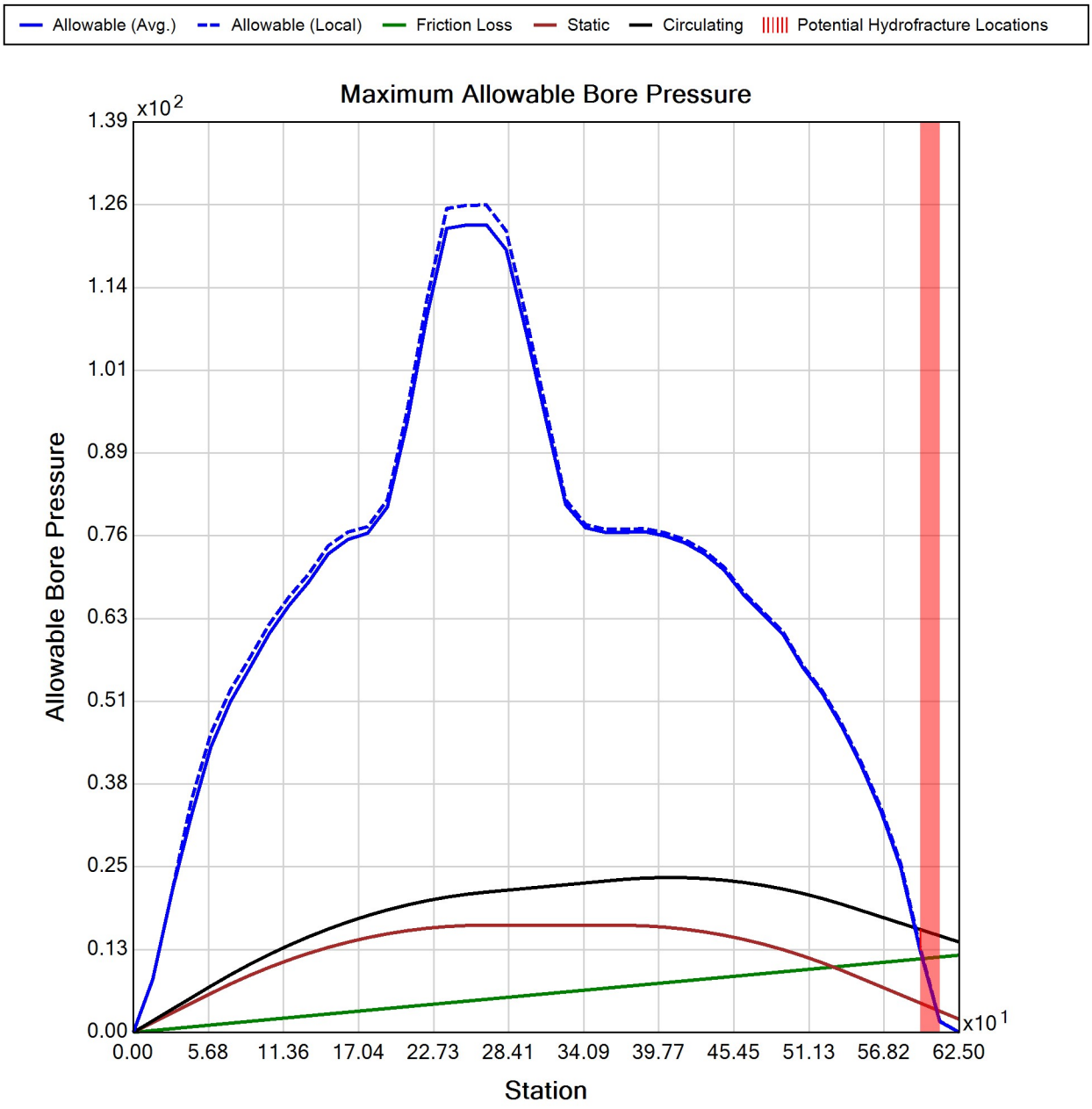












Generated Output

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Input Summary

Start Coordinate	(0.00, 0.00, 324.14) ft
End Coordinate	(620.00, 0.00, 318.50) ft
Project Length	620.00 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: 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: 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	1.9	37.5
Water Pressure	9.6	9.6
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	11.5	47.0
Deflection		
Earth Load Deflection	0.596	10.206
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	0.626	10.235
Compressive Stress [psi]		
Compressive Wall Stress	51.5	211.7

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	630.2	630.2
Pullback Stress [psi]	360.1	360.1
Pullback Strain	6.262E-3	6.262E-3
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	360.1	365.2
Tensile Strain	6.262E-3	6.450E-3

Net External Pressure = 18.1 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.626	7.5	12.0	OK
Unconstrained Collapse [psi]	22.3	131.6	5.9	OK
Compressive Wall Stress [psi]	51.5	1150.0	22.3	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	32.3	236.2	7.3	OK
Tensile Stress [psi]	365.2	1200.0	3.3	OK

Generated Output

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Project Summary

General:	CHPE HDD 46
	P3
	Start Date: 06-30-2022
	End Date: 06-30-2022
Project Owner:	TDI
Project Contractor:	Kiewit
Project Consultant:	CHA/BCE
Designer:	MB
	BCE
Description:	HDD 46 10-inch DR 9

Input Summary

Start Coordinate	(0.00, 0.00, 317.00) ft
End Coordinate	(3150.00, 0.00, 320.00) ft
Project Length	3150.00 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), SW
From Assistant
Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft3]
Phi: 34.00, S.M.: 500.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Clay (C), CH
From Assistant
Unit Weight: 80.0000 (dry), 110.0000 (sat) [lb/ft3]
Phi: 0.00, S.M.: 300.00, Coh: 5.50 [psi]

Soil Layer #3 USCS, Sand (S), SW
From Assistant
Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft3]
Phi: 34.00, S.M.: 500.00, Coh: 0.00 [psi]

Soil Layer #4 USCS, Clay (C), CH
From Assistant
Unit Weight: 80.0000 (dry), 110.0000 (sat) [lb/ft3]
Phi: 0.00, S.M.: 300.00, Coh: 5.50 [psi]

Soil Layer #5 USCS, Clay (C), CL
From Assistant
Unit Weight: 100.0000 (dry), 120.0000 (sat) [lb/ft3]
Phi: 0.00, S.M.: 400.00, Coh: 8.30 [psi]

Soil Layer #6 USCS, Gravel (G), GW
From Assistant
Unit Weight: 120.0000 (dry), 140.0000 (sat) [lb/ft3]
Phi: 37.00, S.M.: 500.00, Coh: 0.00 [psi]

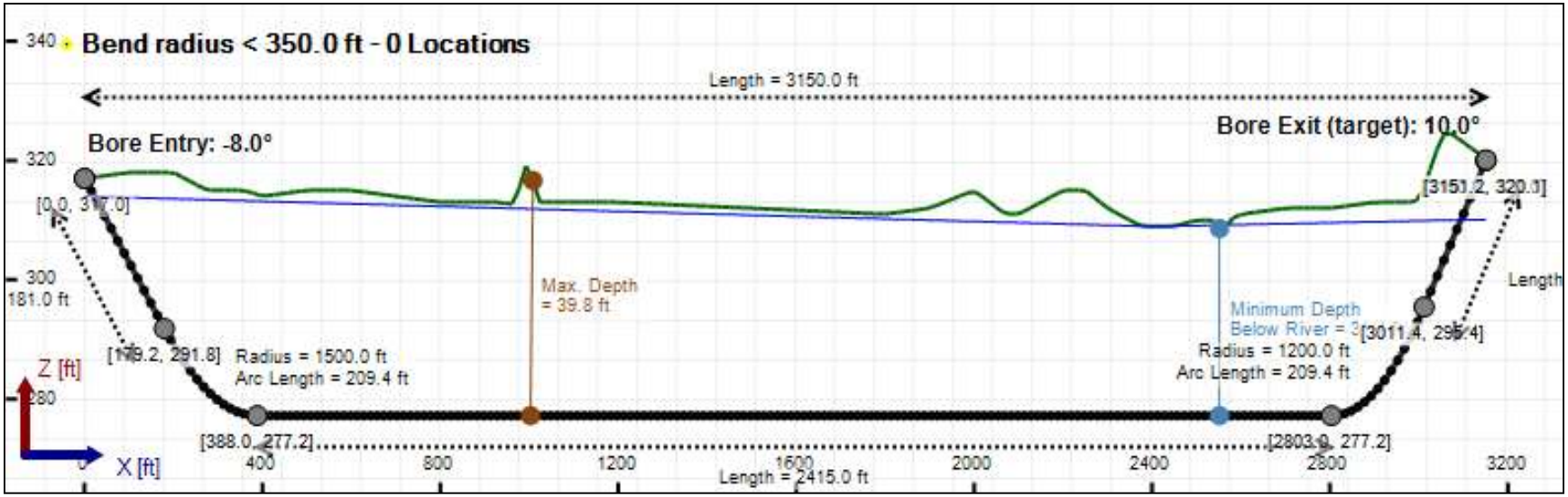
Soil Layer #7 Rock, Geological Classification, Sedimentary Rocks

From Assistant

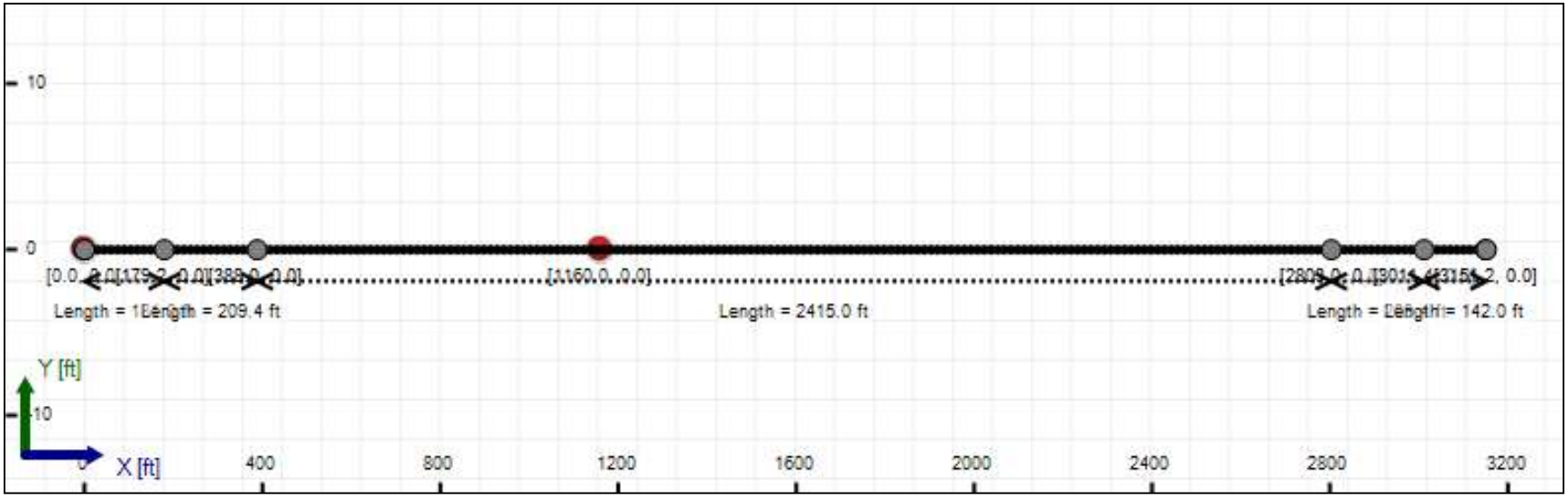
Unit Weight: 107.8272 (dry), 177.6384 (sat) [lb/ft3]

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: 3165.00 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	12.5	28.7
Water Pressure	11.5	15.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	24.0	43.8
Deflection		
Earth Load Deflection	3.395	7.828
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	3.527	7.960
Compressive Stress [psi]		
Compressive Wall Stress	108.0	197.1

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	29006.6	29006.6
Pullback Stress [psi]	809.0	809.0
Pullback Strain	1.407E-2	1.407E-2
Bending Stress [psi]	0.0	21.5
Bending Strain	0	3.733E-4
Tensile Stress [psi]	809.0	823.6
Tensile Strain	1.407E-2	1.470E-2

Net External Pressure = 19.6 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	3.527	7.5	2.1	OK
Unconstrained Collapse [psi]	24.9	100.7	4.0	OK
Compressive Wall Stress [psi]	108.0	1150.0	10.6	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	19.6	199.8	10.2	OK
Tensile Stress [psi]	823.6	1200.0	1.5	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	6.50 in	1231.507 psi	1341.558 psi
1	6.50 in	12.00 in	1231.119 psi	1341.283 psi
2	12.00 in	16.13 in	1230.677 psi	1340.969 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

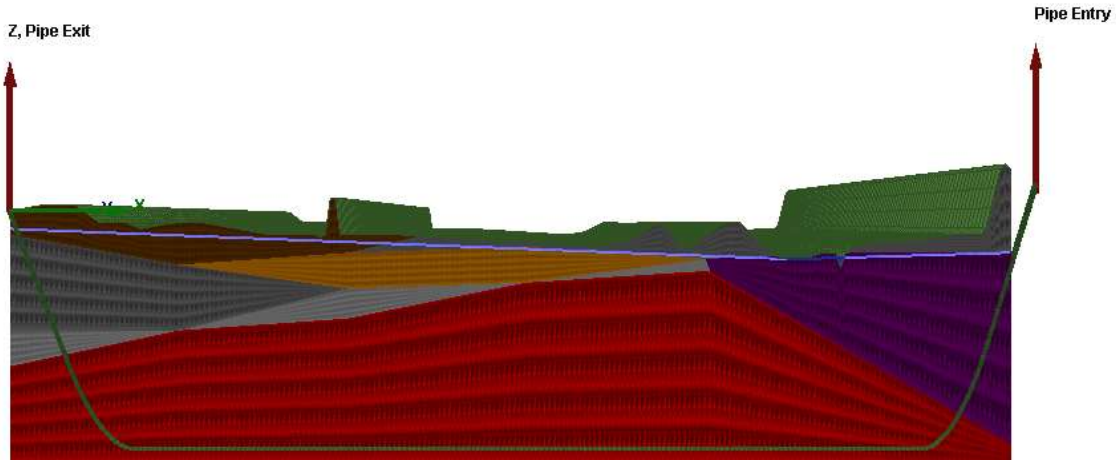
Rheological model: Power-Law

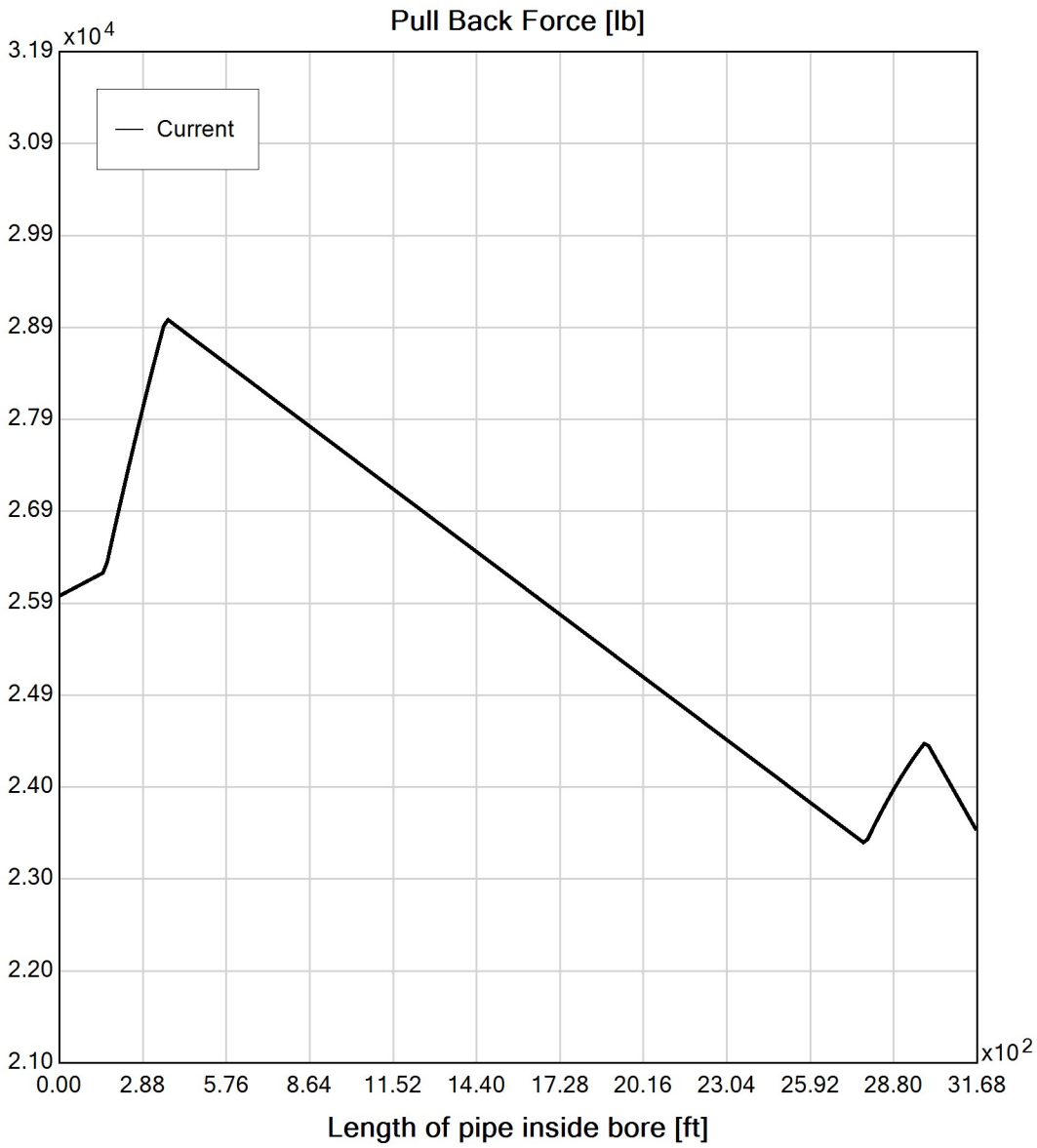
Fluid Consistency Index (K): 63.17

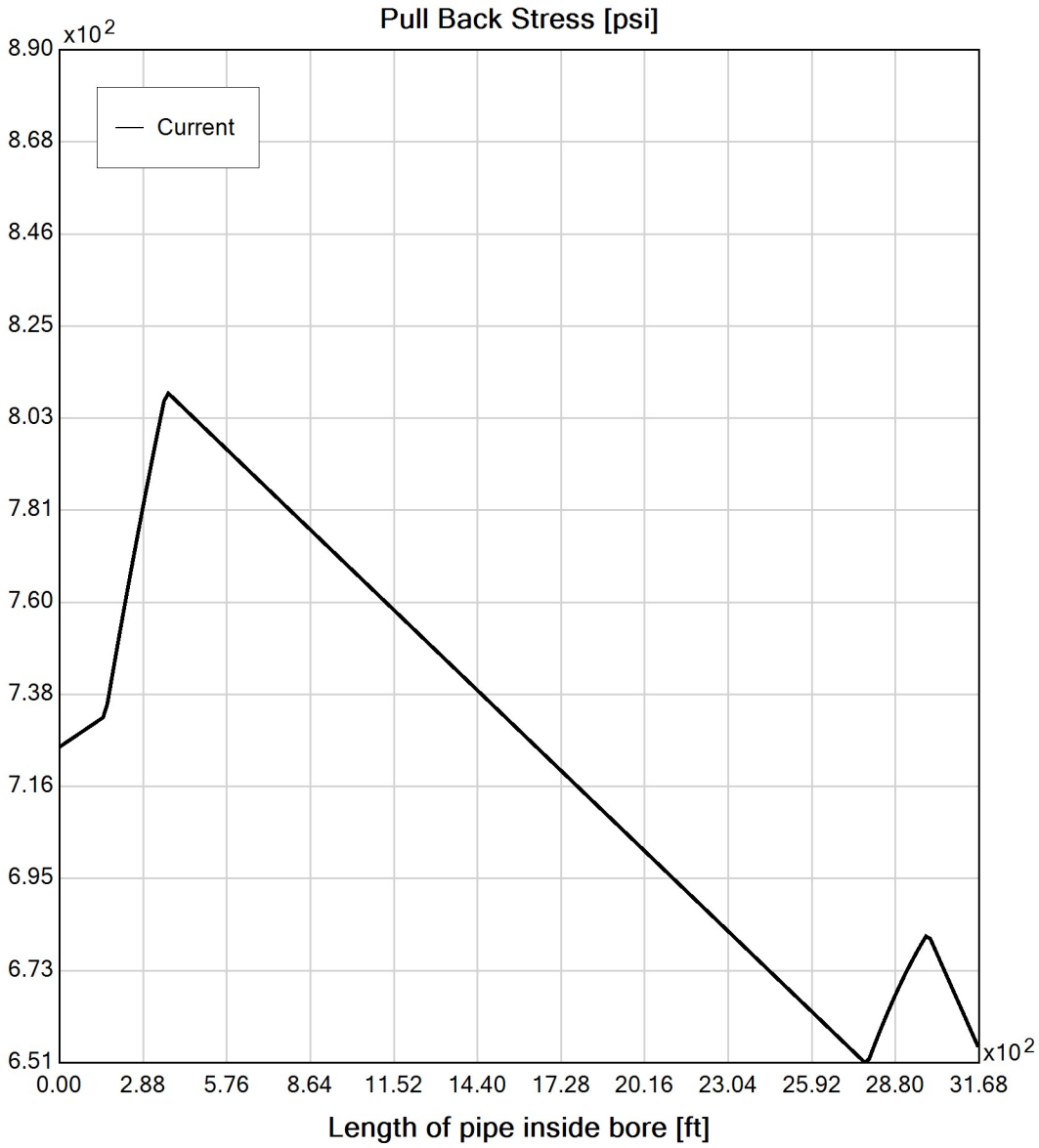
Power Law Exponent (n): 0.14

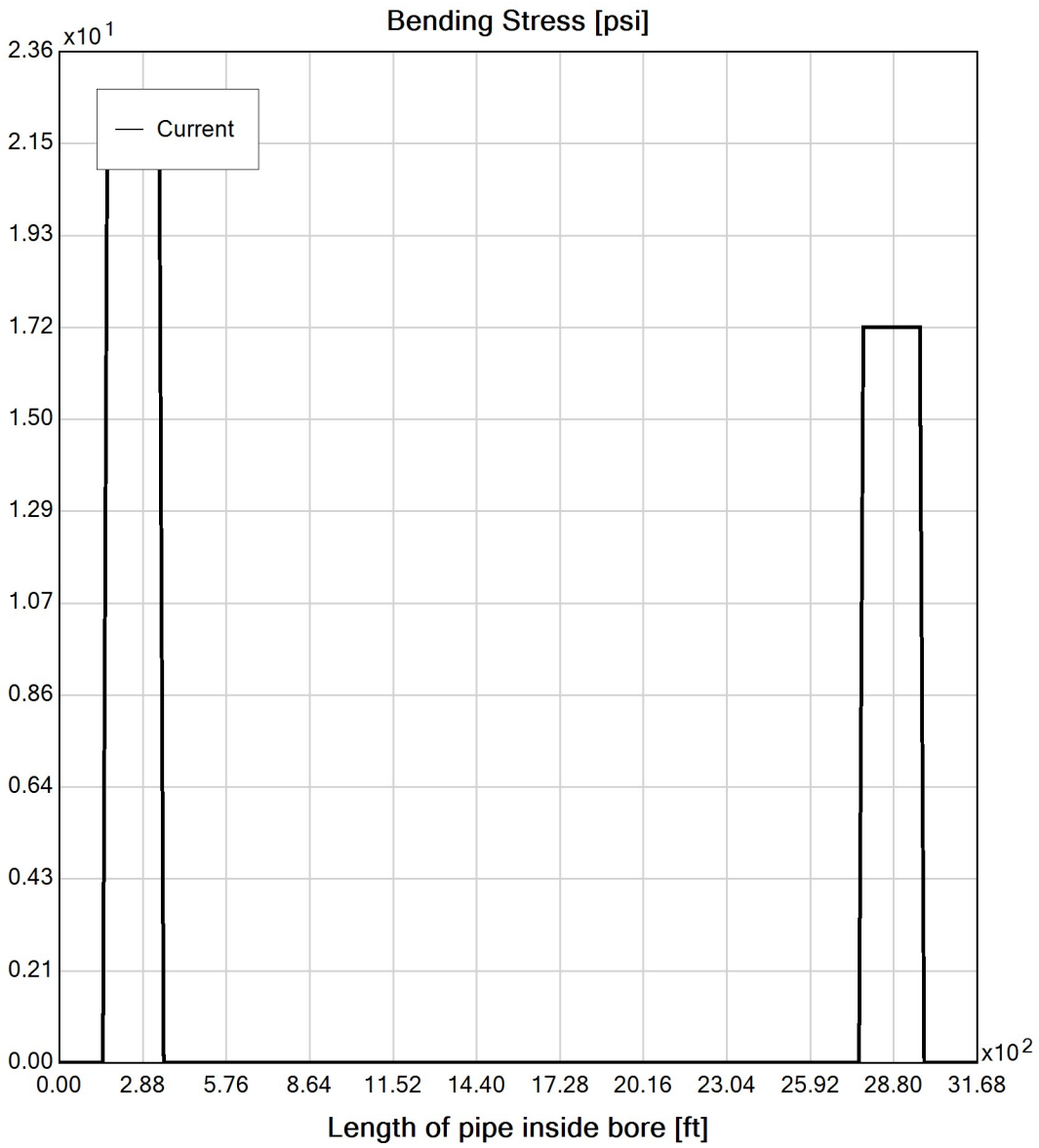
Effective Viscosity (cP): 378.3

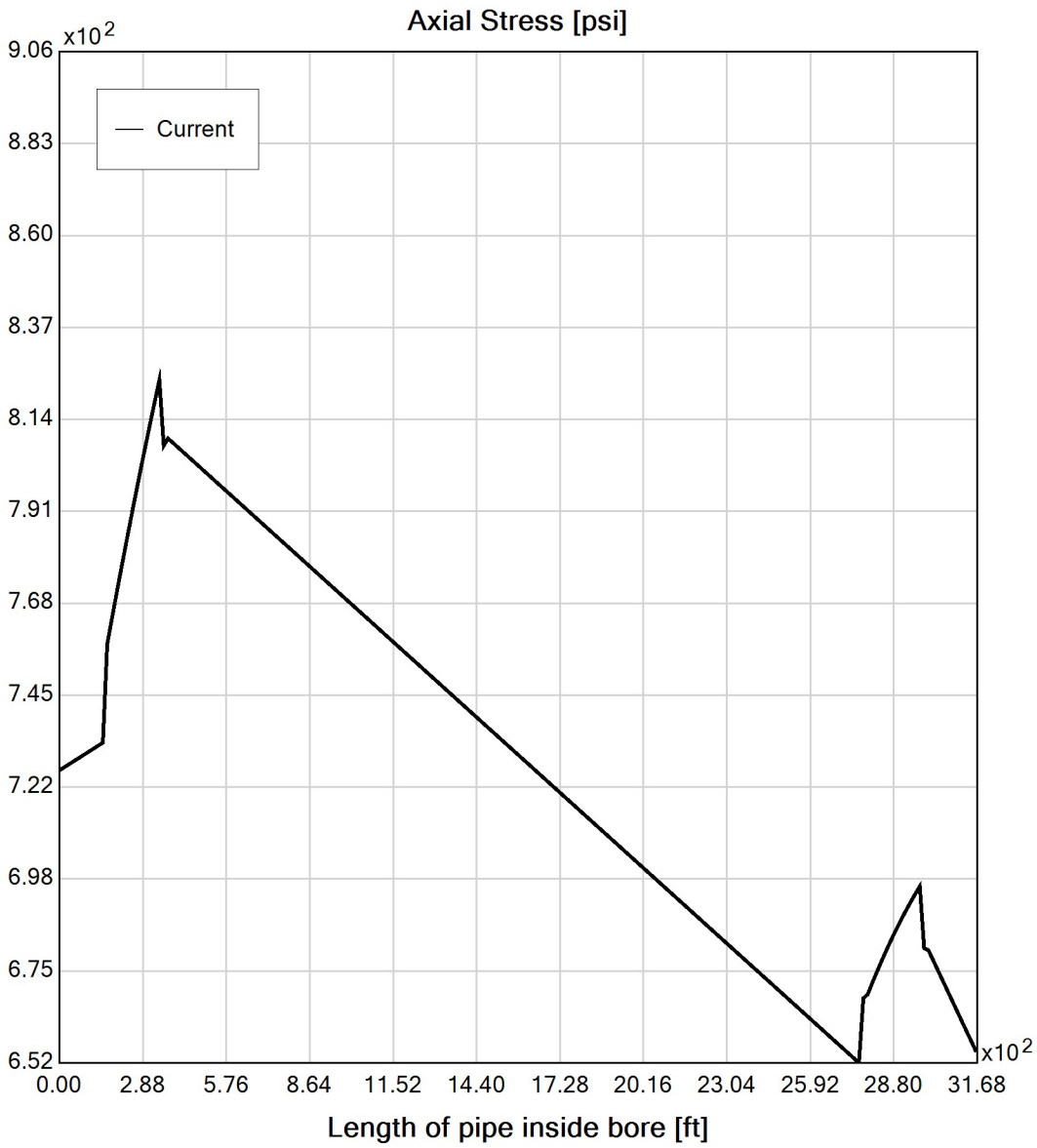
Virtual Site

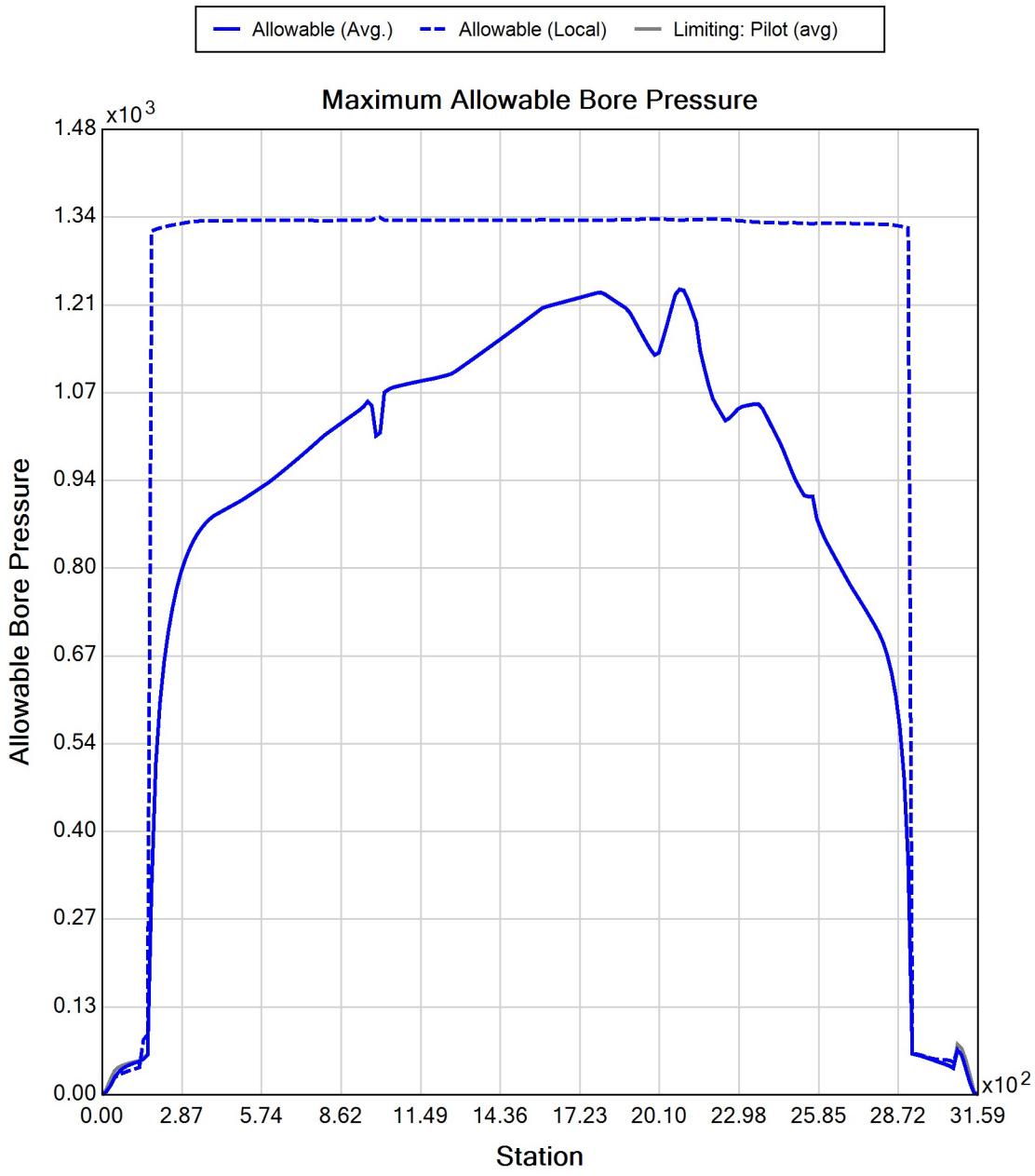


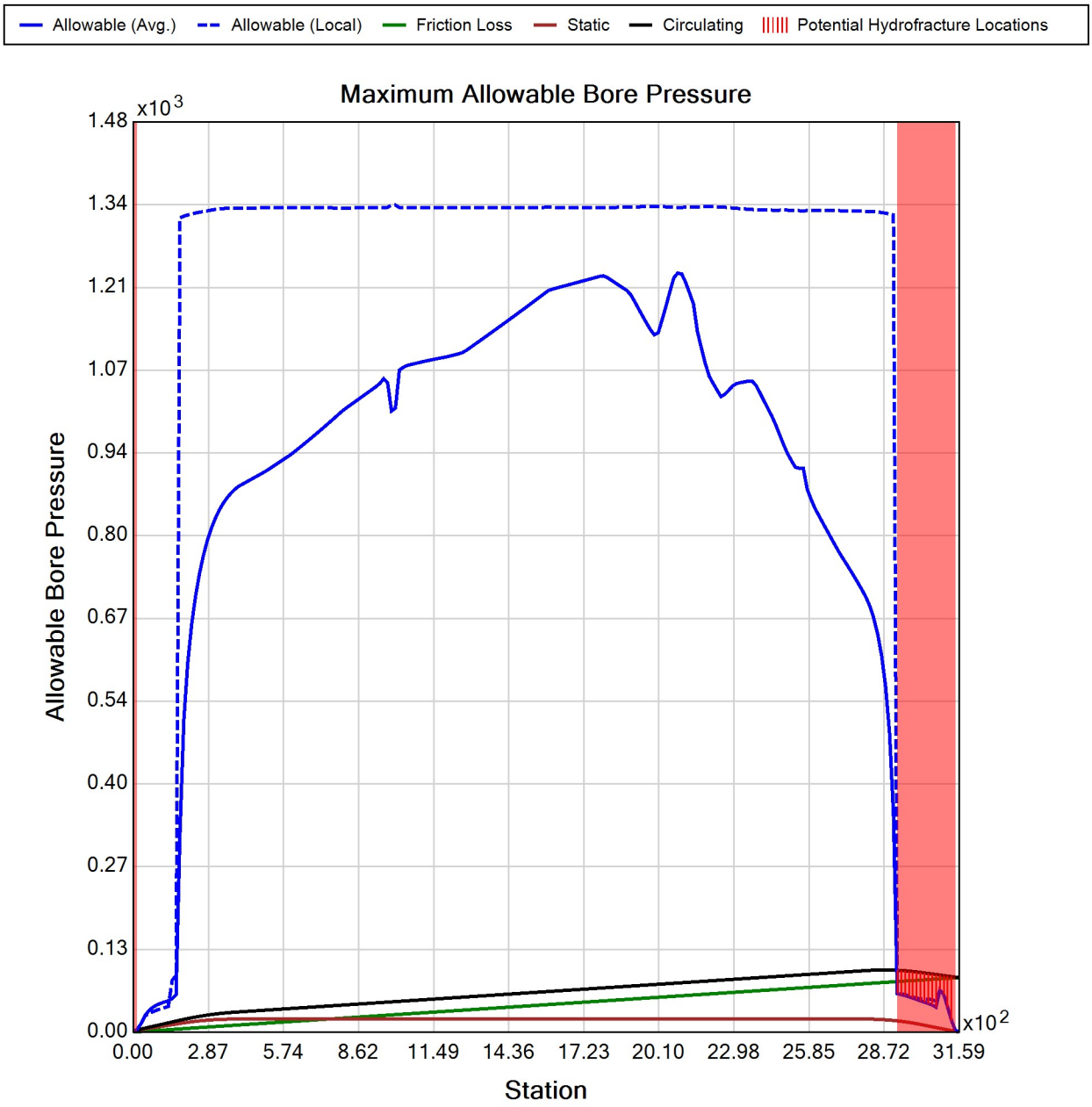












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Input Summary

Start Coordinate	(0.00, 0.00, 317.00) ft
End Coordinate	(3150.00, 0.00, 320.00) ft
Project Length	3150.00 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: 3165.00 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	12.5	28.7
Water Pressure	11.5	15.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	24.0	43.8
Deflection		
Earth Load Deflection	3.395	7.828
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	3.425	7.858
Compressive Stress [psi]		
Compressive Wall Stress	108.0	197.1

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	1525.4	1525.4
Pullback Stress [psi]	871.6	871.6
Pullback Strain	1.516E-2	1.516E-2
Bending Stress [psi]	0.0	4.7
Bending Strain	0	8.247E-5
Tensile Stress [psi]	871.6	871.6
Tensile Strain	1.516E-2	1.520E-2

Net External Pressure = 19.6 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	3.425	7.5	2.2	OK
Unconstrained Collapse [psi]	24.9	101.7	4.1	OK
Compressive Wall Stress [psi]	108.0	1150.0	10.6	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	19.6	196.8	10.0	OK
Tensile Stress [psi]	871.6	1200.0	1.4	OK

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Project Summary

General:	CHPE HDD 47
	P3
	Start Date: 12-10-2021
	End Date: 12-10-2021
Project Owner:	TDI
Project Contractor:	Kiewit
Project Consultant:	CHA/BCE
Designer:	AB
	CHA
Description:	HDD 47 10-inch DR 9

Input Summary

Start Coordinate	(0.00, 0.00, 330.00) ft
End Coordinate	(570.00, 0.00, 318.00) ft
Project Length	570.00 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), SW
From Assistant
Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3]
Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Sand (S), SP
From Assistant
Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3]
Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #3 USCS, Gravel (G), GP
From Assistant
Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3]
Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #4 USCS, Sand (S), SM
From Assistant
Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3]
Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #5 USCS, Sand (S), SP
From Assistant
Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft3]
Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #6 USCS, Sand (S), SW
From Assistant
Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft3]
Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

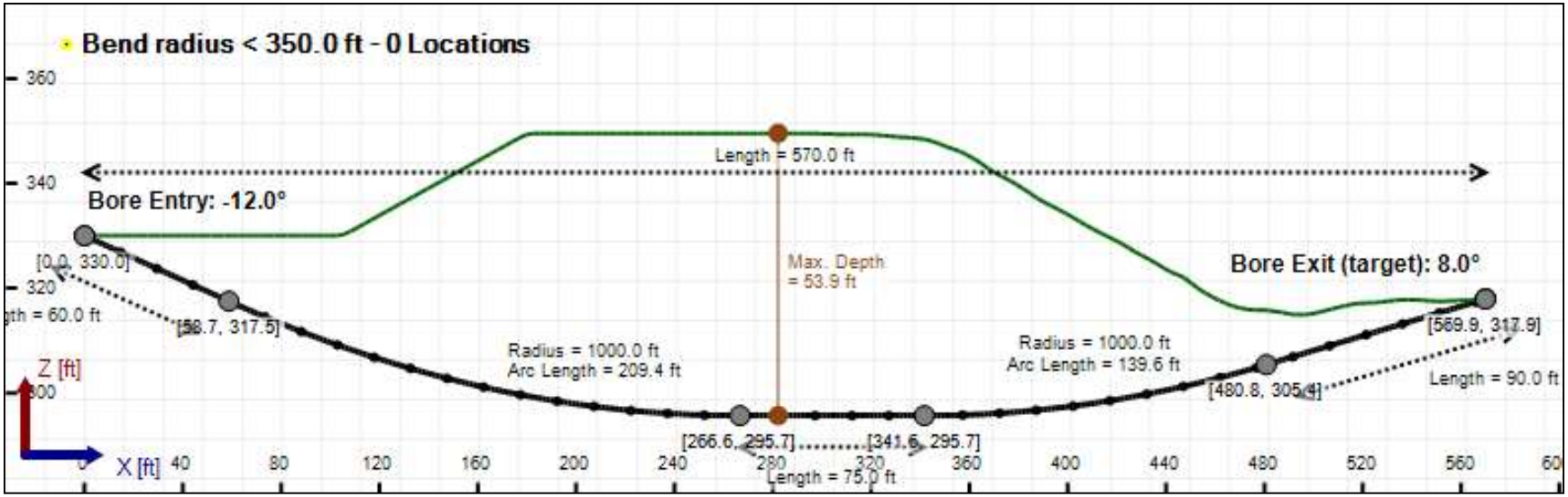
Soil Layer #7 USCS, Sand (S), SW

From Assistant

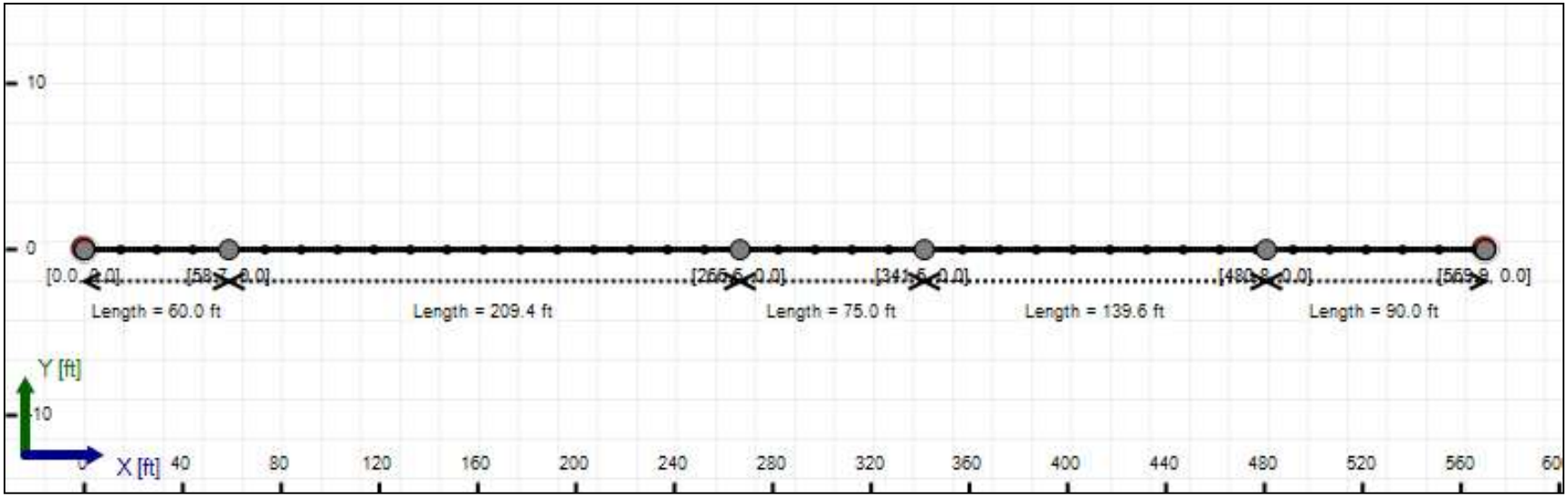
Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft3]

Phi: 34.00, S.M.: 145.00, Coh: 0.00 [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: 585.00 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	5.6	39.8
Water Pressure	0.0	0.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	5.6	39.8
Deflection		
Earth Load Deflection	1.527	10.851
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.659	10.983
Compressive Stress [psi]		
Compressive Wall Stress	25.2	179.3

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	9485.8	9485.8
Pullback Stress [psi]	264.5	264.5
Pullback Strain	4.601E-3	4.601E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	264.5	289.9
Tensile Strain	4.601E-3	5.490E-3

Net External Pressure = 18.1 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.659	7.5	4.5	OK
Unconstrained Collapse [psi]	22.3	119.0	5.3	OK
Compressive Wall Stress [psi]	25.2	1150.0	45.6	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	32.3	239.8	7.4	OK
Tensile Stress [psi]	289.9	1200.0	4.1	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	117.566 psi	121.590 psi
1	8.00 in	12.00 in	117.536 psi	121.560 psi
2	12.00 in	16.13 in	117.492 psi	121.516 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): 40.00 US (liquid) gallon/min

Drill Fluid Density: 68.700 lb/ft3

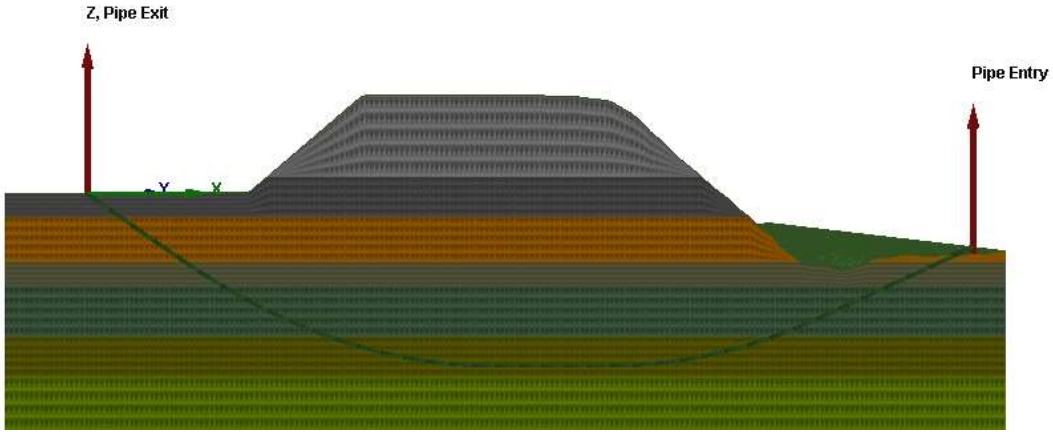
Rheological model: Bingham-Plastic

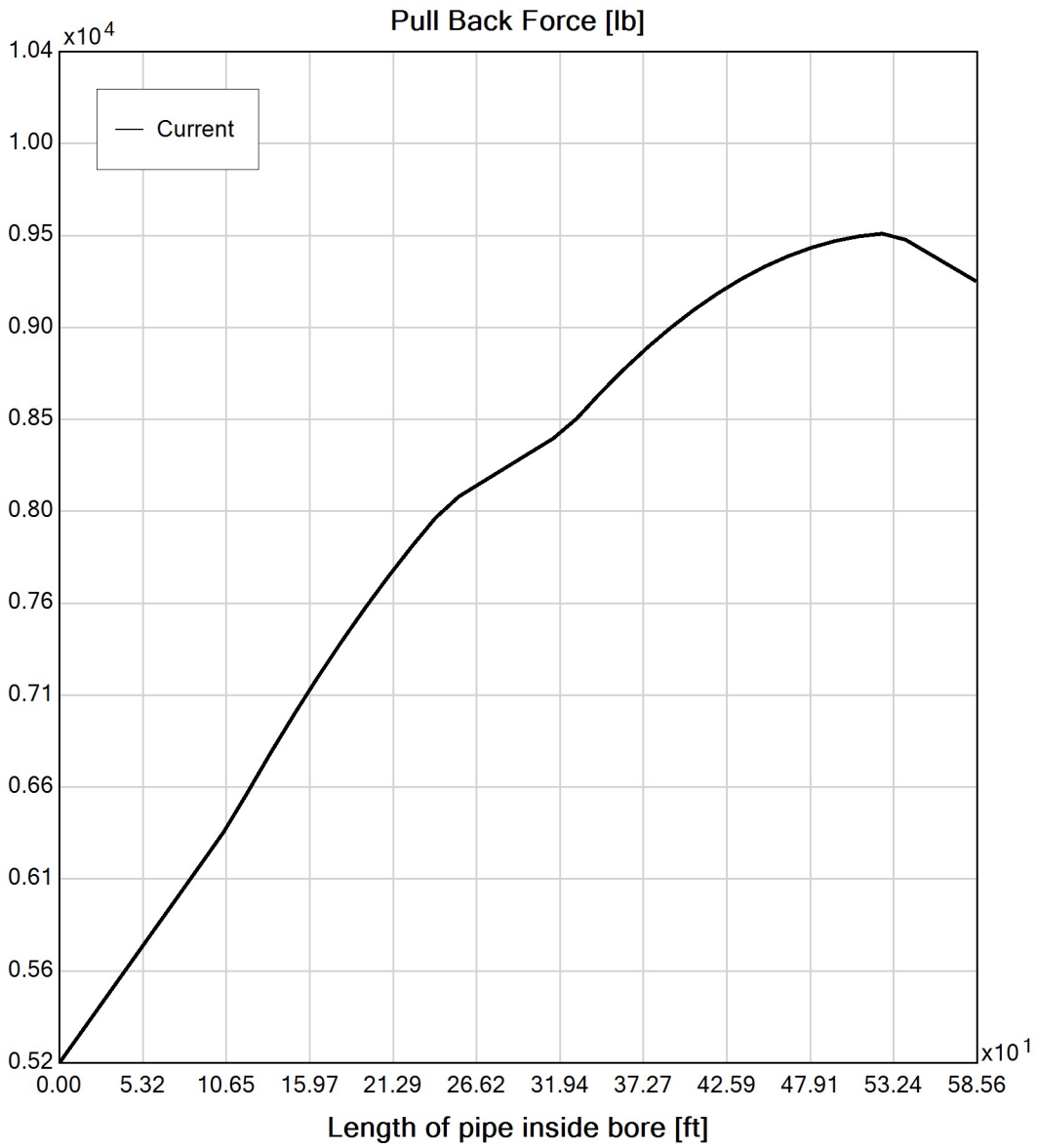
Plastic Viscosity (PV): 25.53

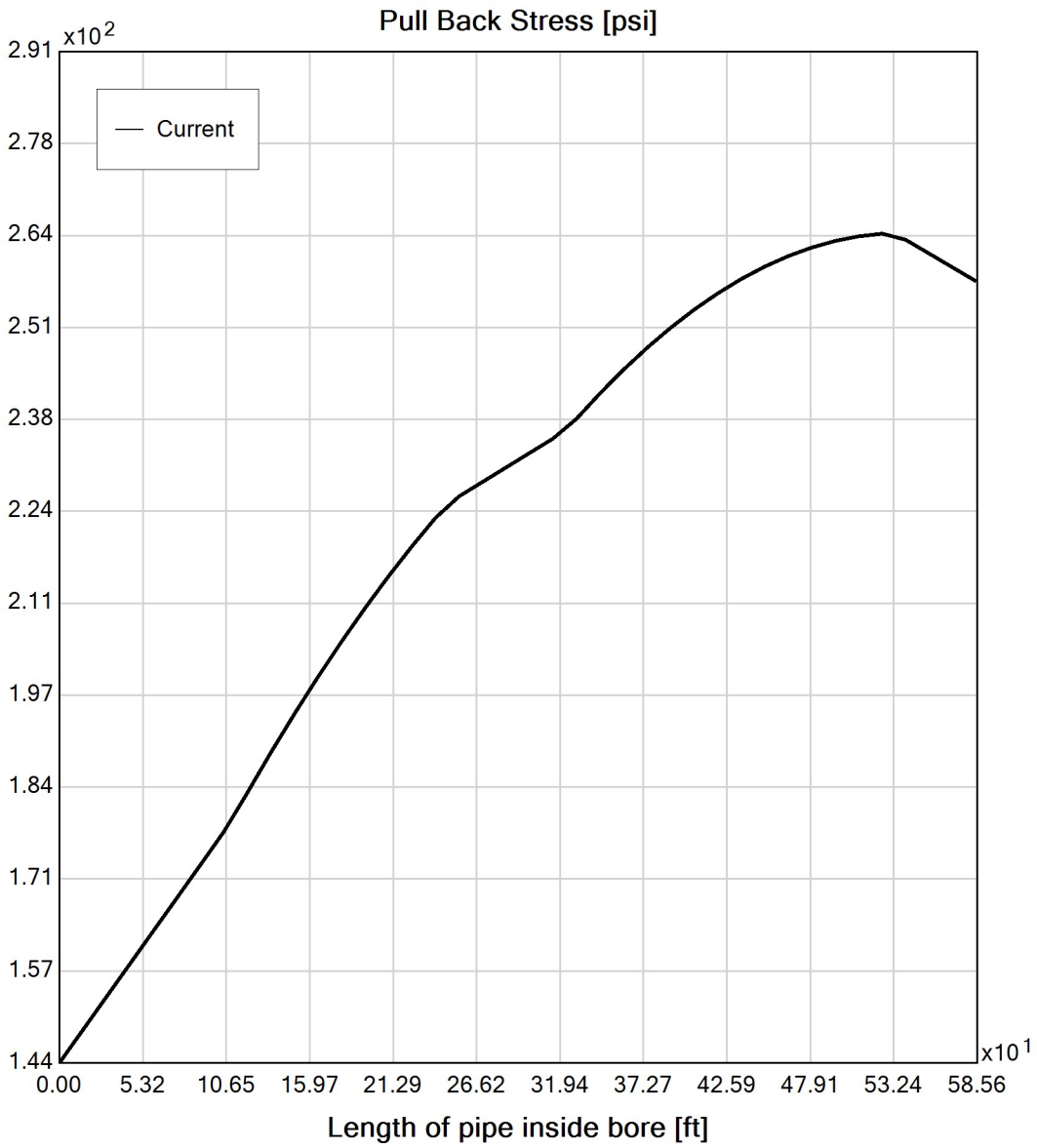
Yield Point (YP): 16.49

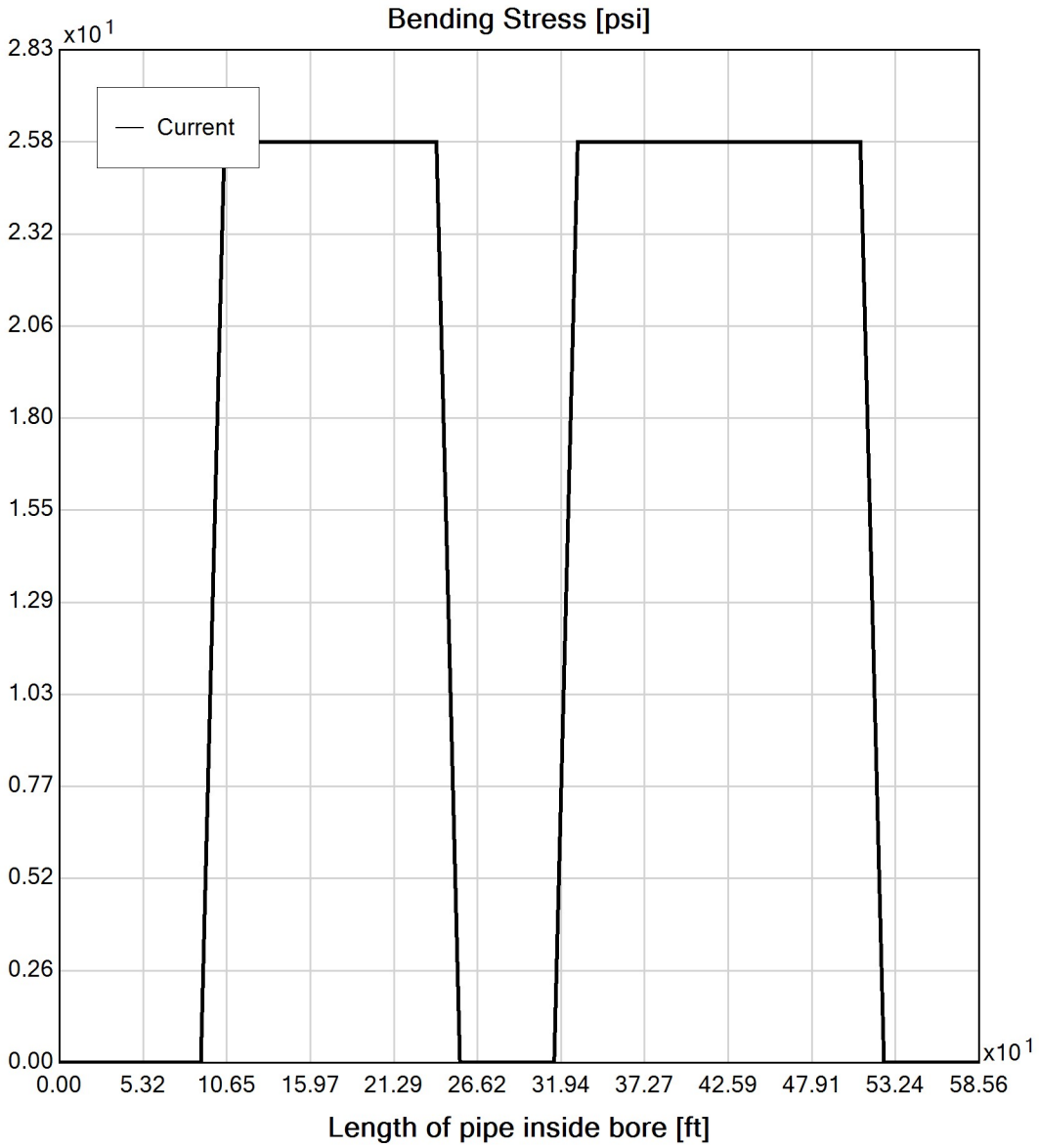
Effective Viscosity (cP): 1202.0

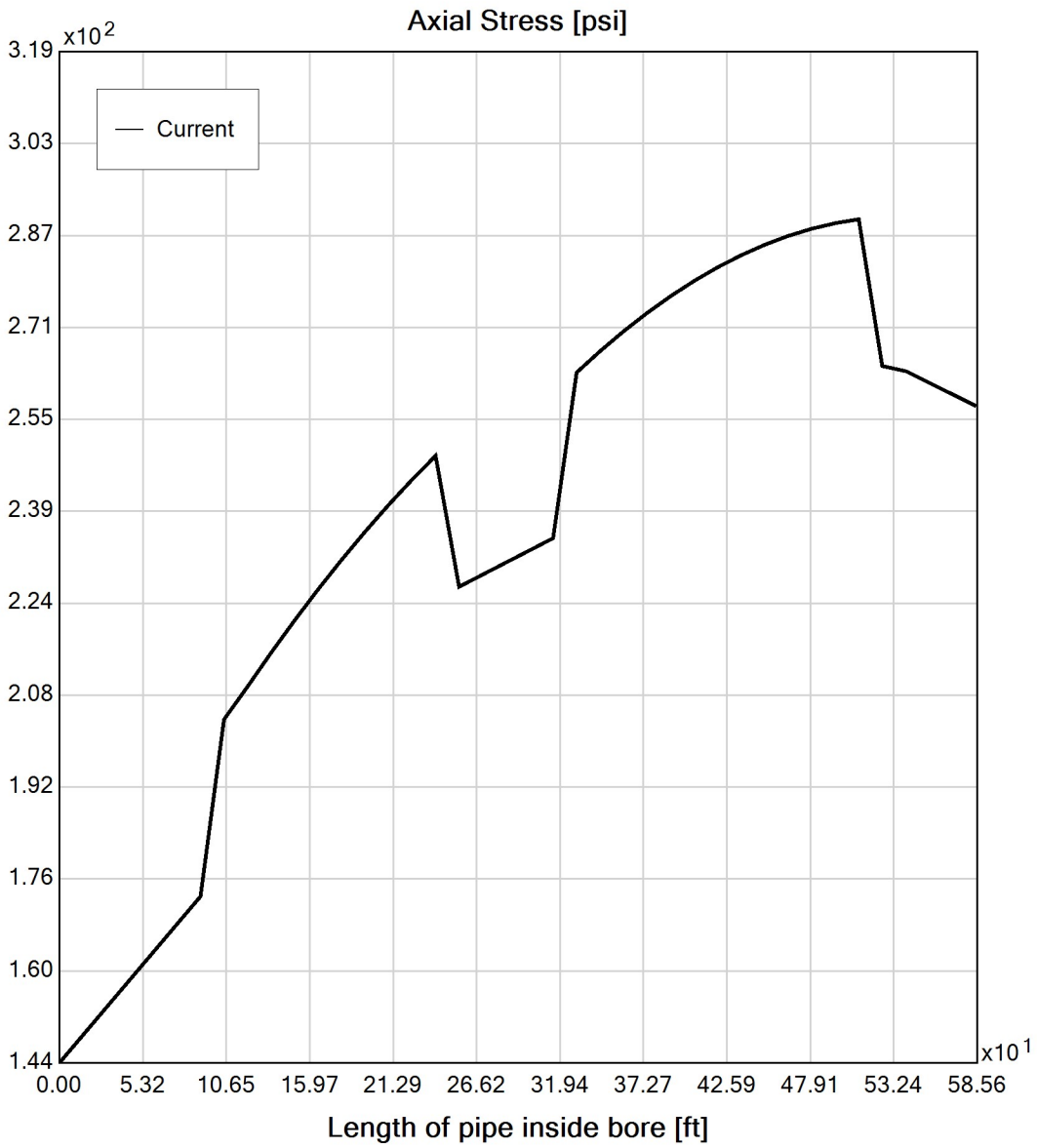
Virtual Site

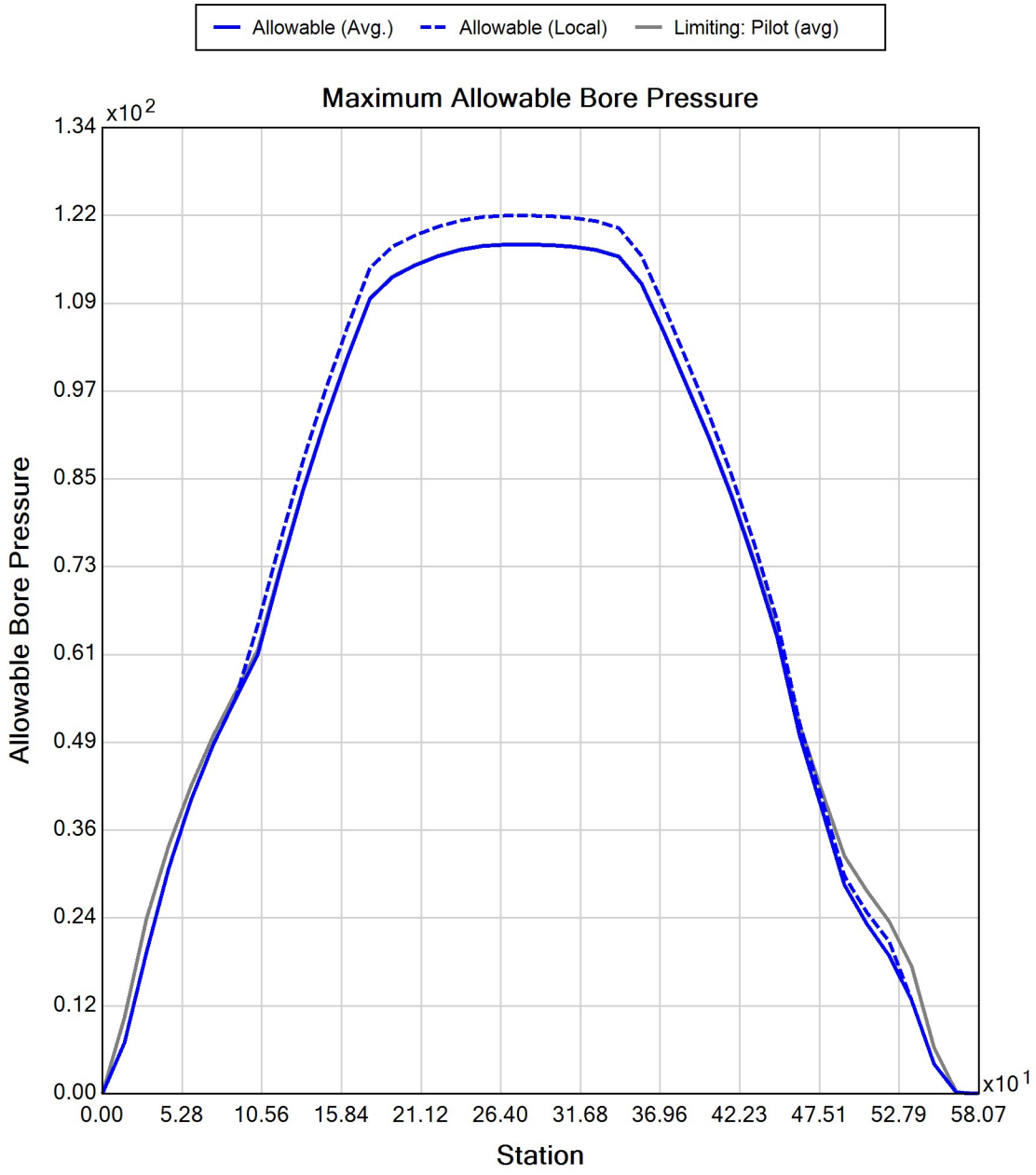


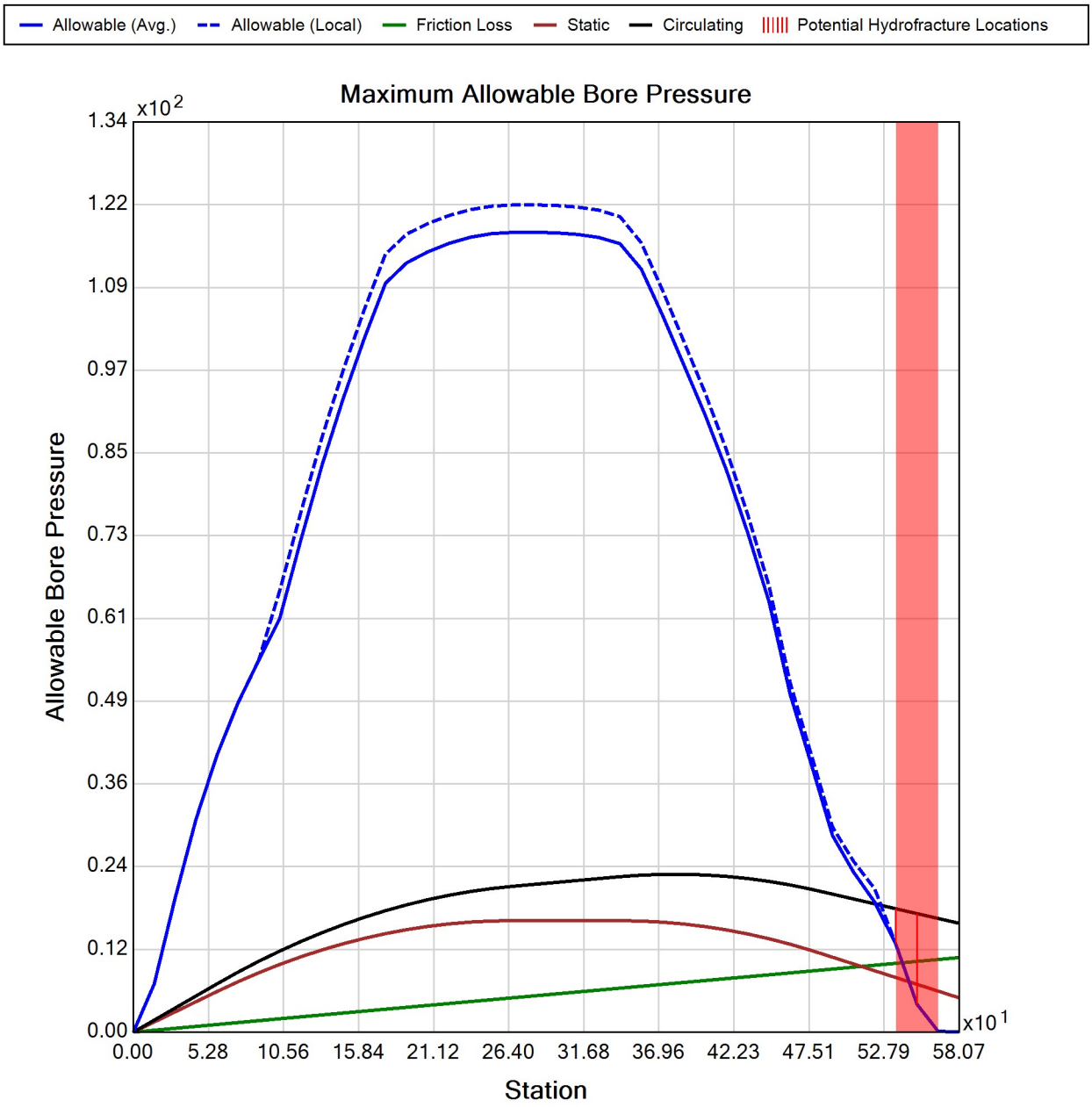












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Input Summary

Start Coordinate	(0.00, 0.00, 330.00) ft
End Coordinate	(570.00, 0.00, 318.00) ft
Project Length	570.00 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: 585.00 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	2.2	39.8
Water Pressure	0.0	0.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	2.2	39.8
Deflection		
Earth Load Deflection	0.612	10.851
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	0.641	10.880
Compressive Stress [psi]		
Compressive Wall Stress	10.1	179.3

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	572.6	572.6
Pullback Stress [psi]	327.2	327.2
Pullback Strain	5.690E-3	5.690E-3
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	327.2	332.5
Tensile Strain	5.690E-3	5.881E-3

Net External Pressure = 18.1 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.641	7.5	11.7	OK
Unconstrained Collapse [psi]	22.3	130.5	5.8	OK
Compressive Wall Stress [psi]	10.1	1150.0	113.7	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	32.3	238.2	7.4	OK
Tensile Stress [psi]	332.5	1200.0	3.6	OK

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Project Summary

General:	CHPE HDD 49 J2105 P3 Start Date: 09-20-2022 End Date: 09-20-2022
Project Owner:	TDI
Project Contractor:	Kiewit
Project Consultant:	CHA/BCE
Designer:	MDB BCE
Description:	HDD 49 12 inch DR 7 new GS Conduit #1

Input Summary

Start Coordinate	(0.00, 0.00, 229.00) ft
End Coordinate	(1900.00, 0.00, 289.00) ft
Project Length	1900.00 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: 4

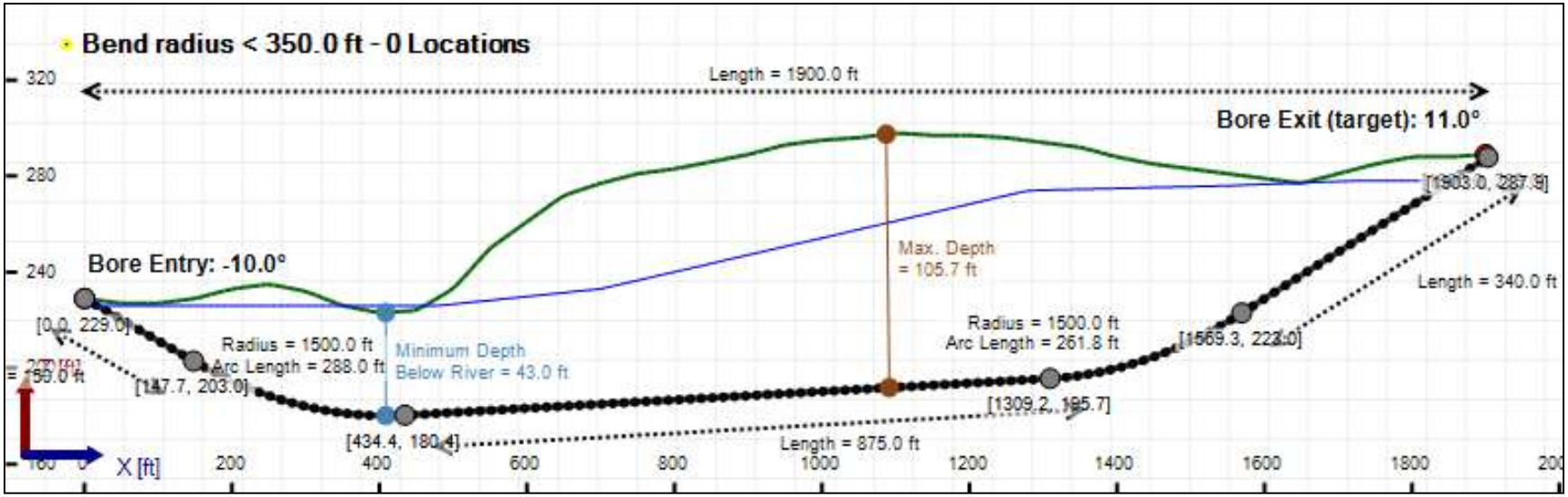
Soil Layer #1 USCS, Sand (S), SP
From Assistant
Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3]
Phi: 30.00, S.M.: 200.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Sand (S), SP
From Assistant
Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft3]
Phi: 34.00, S.M.: 500.00, Coh: 0.00 [psi]

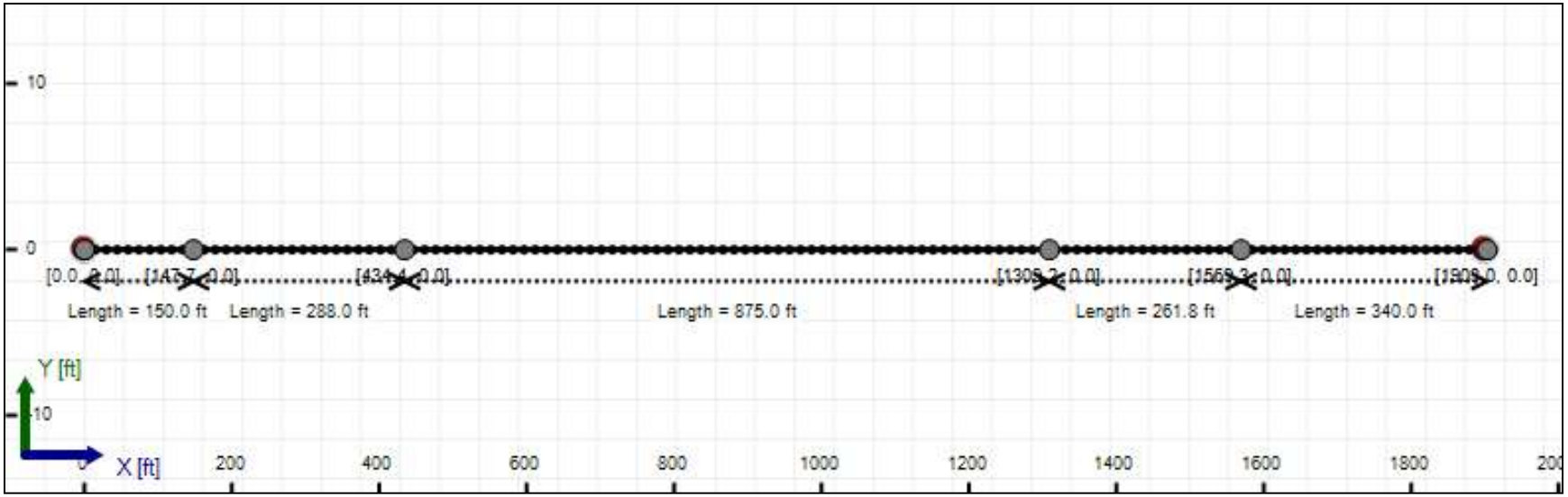
Soil Layer #3 Rock, Geological Classification, Sedimentary Rocks
From Assistant
Unit Weight: 120.0000 (dry), 140.0000 (sat) [lb/ft3]
Phi: 37.00, S.M.: 1000.00, Coh: 0.00 [psi]

Soil Layer #4 Rock, Geological Classification, Sedimentary Rocks
From Assistant
Unit Weight: 160.0000 (dry), 170.0000 (sat) [lb/ft3]
Phi: 37.00, S.M.: 1200.00, Coh: 2000.00 [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: 1920.00 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: 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	4.6	70.2
Water Pressure	42.2	33.3
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	46.8	103.5
Deflection		
Earth Load Deflection	0.746	8.341
Buoyant Deflection	0.074	0.074
Reissner Effect	0	0
Net Deflection	0.820	8.414
Compressive Stress [psi]		
Compressive Wall Stress	164.0	362.3

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	45453.3	45453.3
Pullback Stress [psi]	726.8	726.8
Pullback Strain	1.264E-2	1.264E-2
Bending Stress [psi]	0.0	20.4
Bending Strain	0	3.542E-4
Tensile Stress [psi]	726.8	744.8
Tensile Strain	1.264E-2	1.331E-2

Net External Pressure = 64.2 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 798.4 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.820	7.5	9.1	OK
Unconstrained Collapse [psi]	70.7	307.4	4.3	OK
Compressive Wall Stress [psi]	164.0	1150.0	7.0	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.036	7.5	207.6	OK
Unconstrained Collapse [psi]	80.6	498.9	6.2	OK
Tensile Stress [psi]	744.8	1200.0	1.6	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	1096.496 psi	1260.199 psi
1	8.00 in	12.00 in	1096.271 psi	1260.167 psi
2	12.00 in	16.13 in	1095.944 psi	1260.120 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): 120.00 US (liquid) gallon/min

Drill Fluid Density: 68.700 lb/ft3

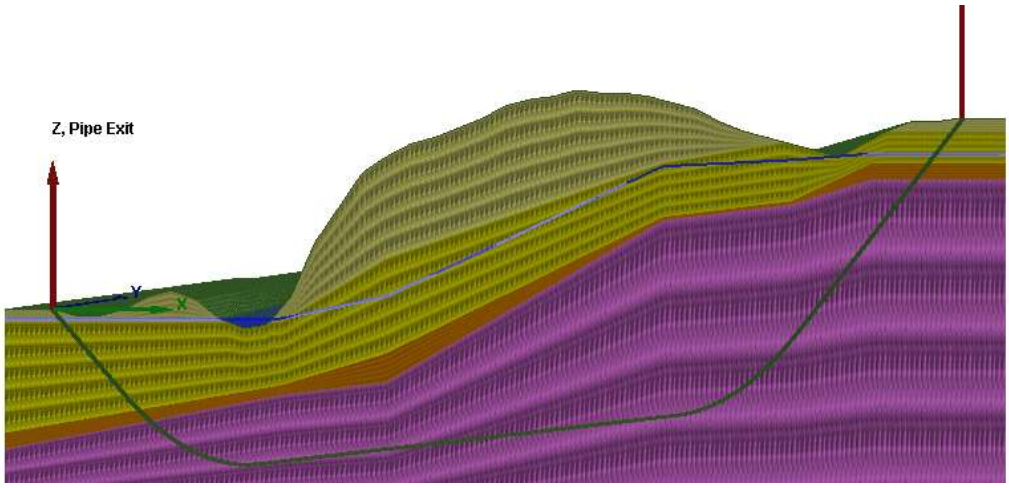
Rheological model: Power-Law

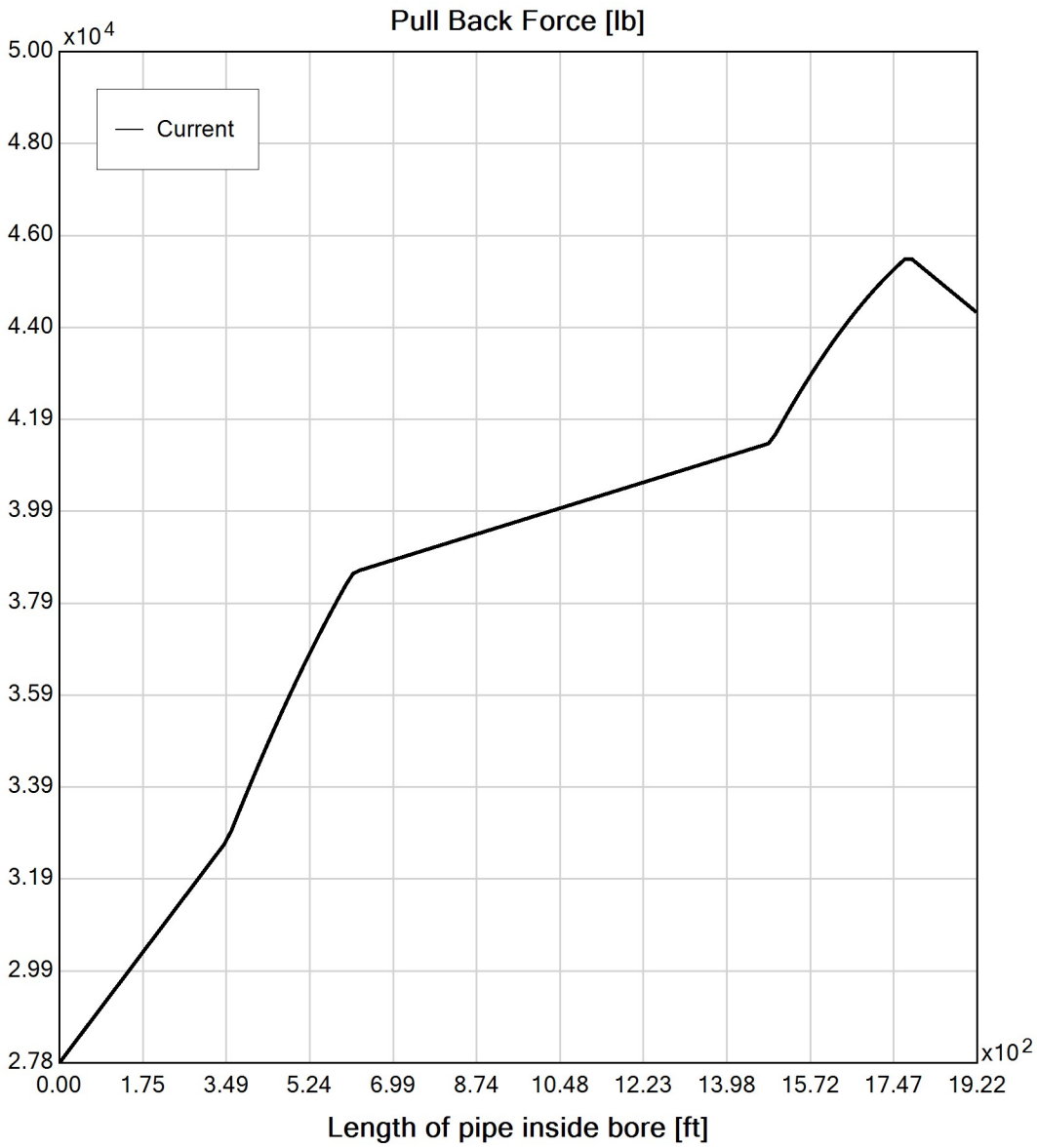
Fluid Consistency Index (K): 63.17

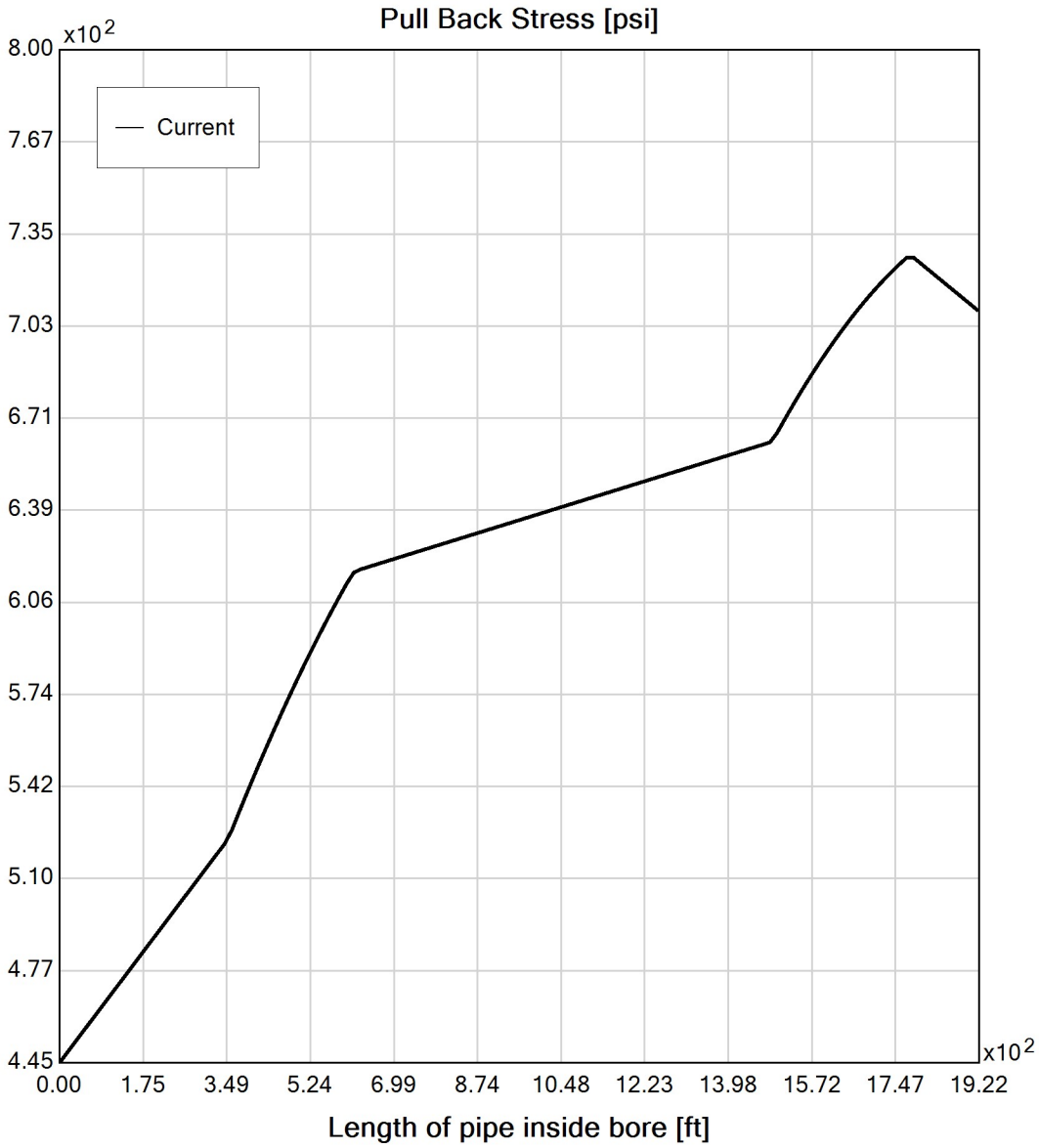
Power Law Exponent (n): 0.14

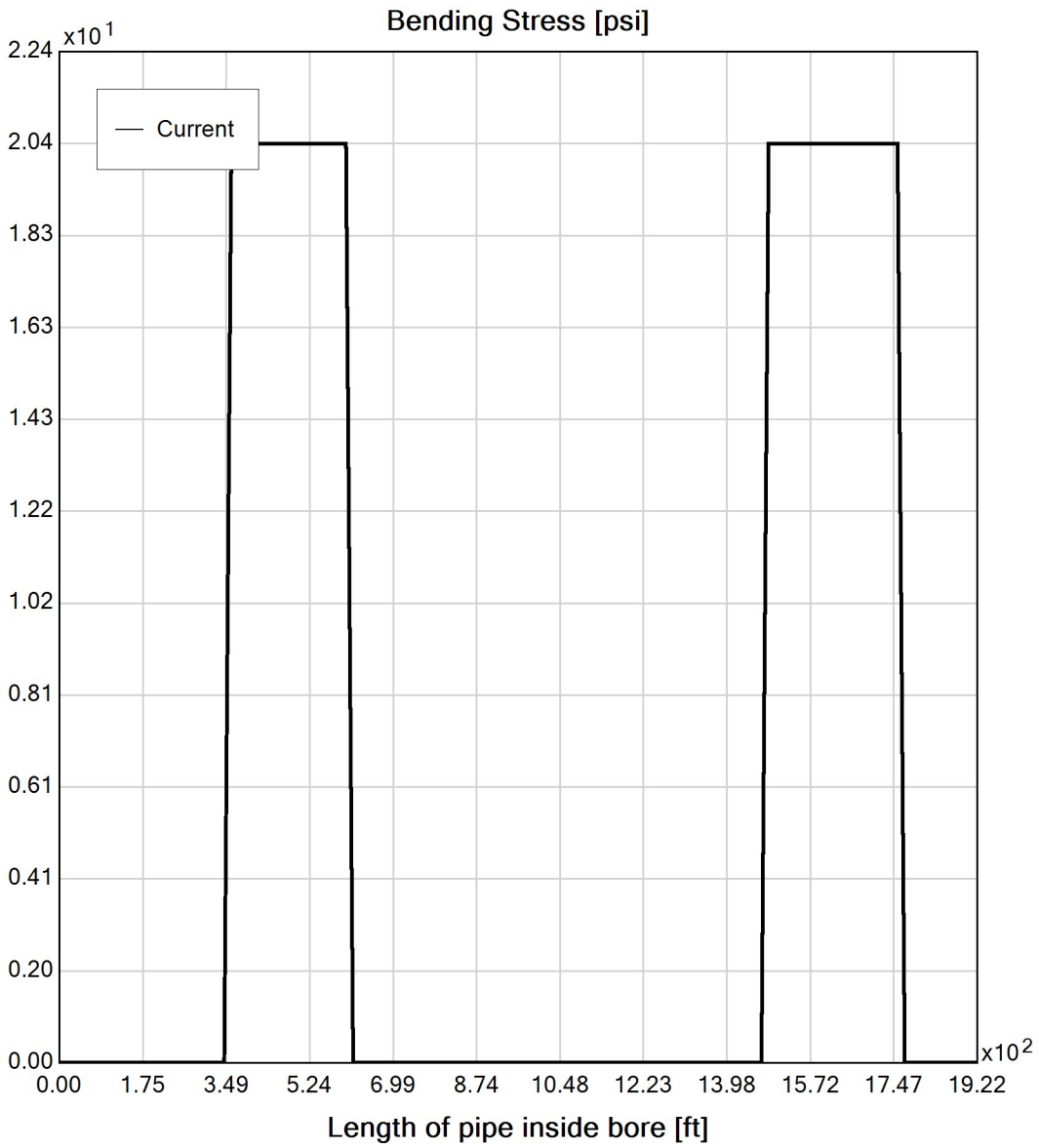
Effective Viscosity (cP): 333.0

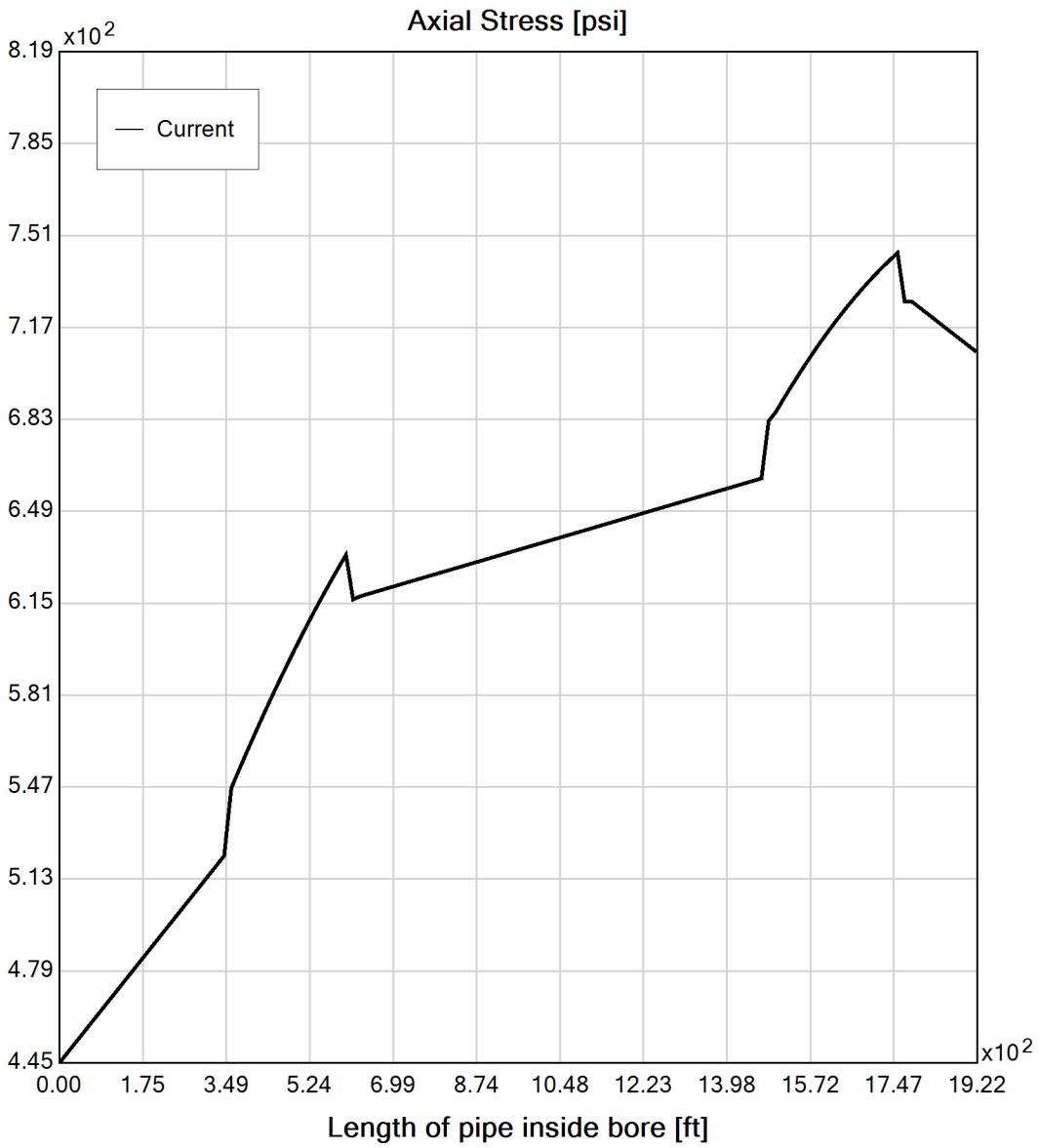
Virtual Site

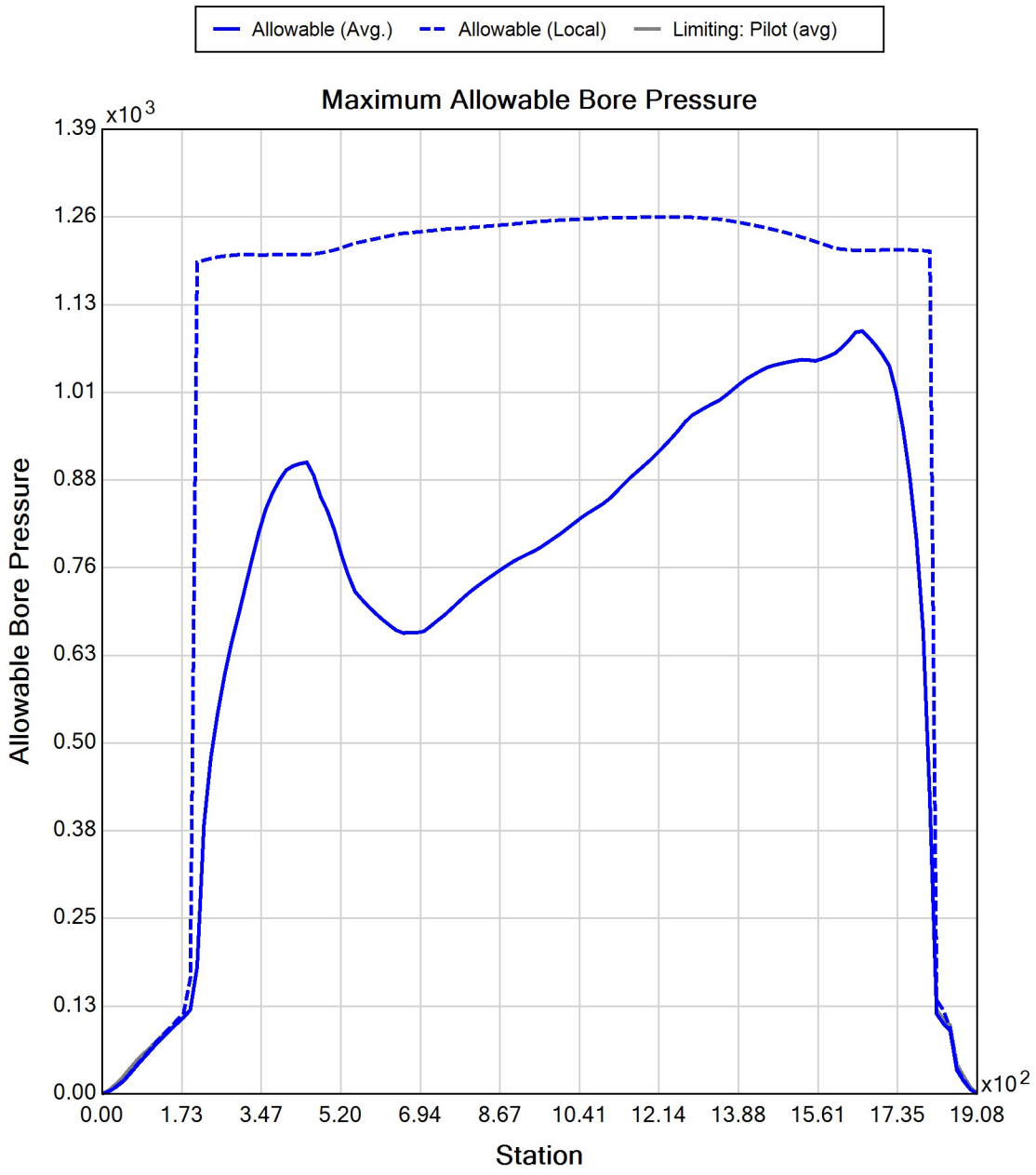


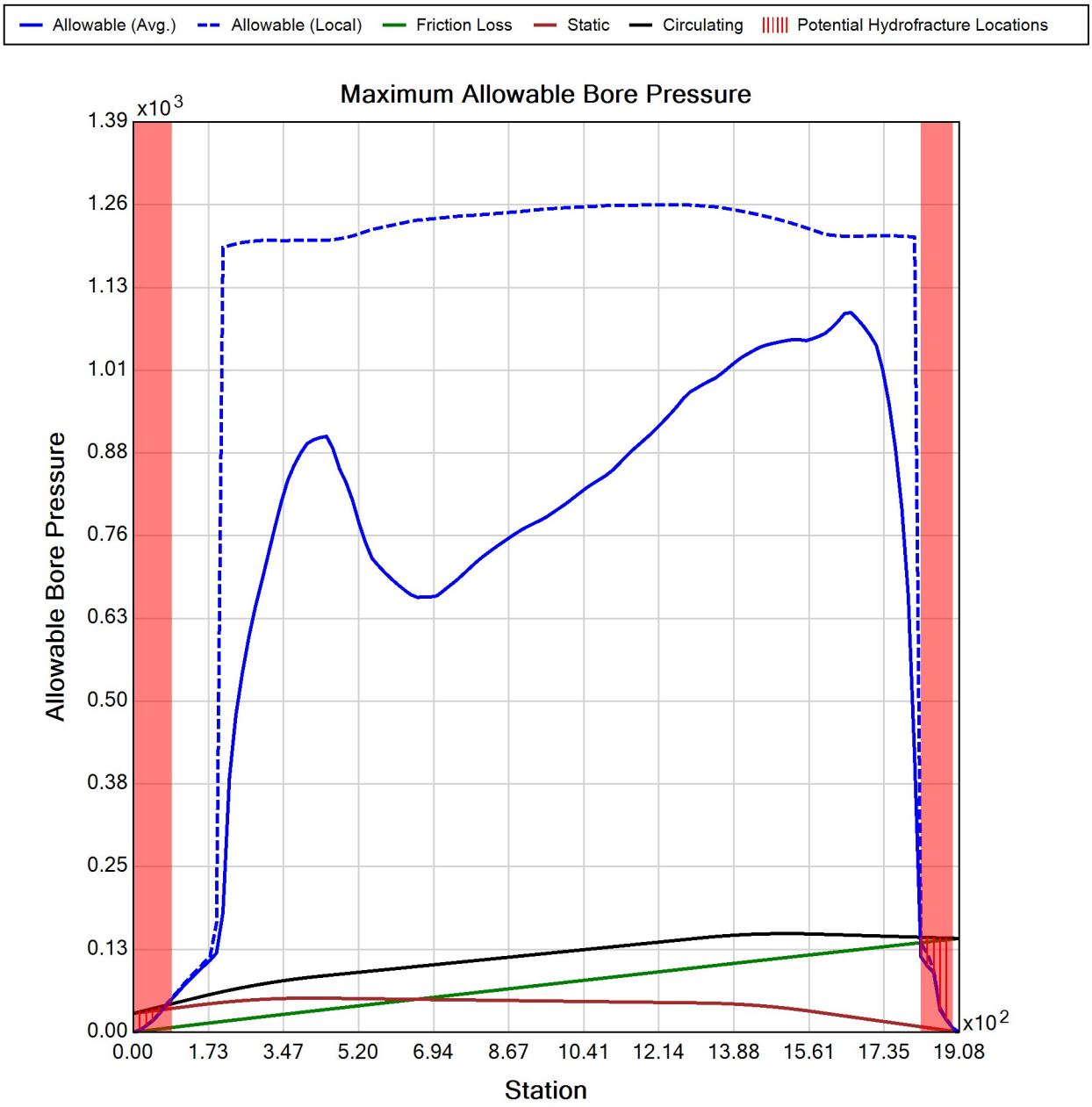












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Input Summary

Start Coordinate	(0.00, 0.00, 229.00) ft
End Coordinate	(1900.00, 0.00, 289.00) ft
Project Length	1900.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	3.500 in
Pipe DR	7.0
Pipe Thickness	0.50 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: 3" (3.5")
Pipe DR: 7
Pipe Length: 1920.00 ft
Internal Pressure: 0 psi
Borehole Diameter: 0.625 ft
Silo Width: 0.625 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	2.5	70.2
Water Pressure	42.2	33.3
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	44.7	103.5
Deflection		
Earth Load Deflection	0.293	8.341
Buoyant Deflection	0.020	0.020
Reissner Effect	0	0
Net Deflection	0.313	8.361
Compressive Stress [psi]		
Compressive Wall Stress	156.5	362.3

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	3537.8	3537.8
Pullback Stress [psi]	750.7	750.7
Pullback Strain	1.306E-2	1.306E-2
Bending Stress [psi]	0.0	5.6
Bending Strain	0	9.722E-5
Tensile Stress [psi]	750.7	754.0
Tensile Strain	1.306E-2	1.321E-2

Net External Pressure = 64.2 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 172.8 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.313	7.5	24.0	OK
Unconstrained Collapse [psi]	70.7	319.6	4.5	OK
Compressive Wall Stress [psi]	156.5	1150.0	7.3	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.010	7.5	756.1	OK
Unconstrained Collapse [psi]	80.6	498.4	6.2	OK
Tensile Stress [psi]	754.0	1200.0	1.6	OK

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Project Summary

General:	CHPE HDD 49 Ref: Ft Edward NY J2105 P3 Start Date: 09-20-2022 End Date: 09-20-2022
Project Owner:	TDI
Project Contractor:	Kiewit
Project Consultant:	CHA/BCE
Designer:	MDB BCE
Description:	HDD 49 12 inch DR 7 new GS Conduit #2

Input Summary

Start Coordinate	(0.00, 0.00, 229.00) ft
End Coordinate	(1900.00, 0.00, 289.00) ft
Project Length	1900.00 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: 4

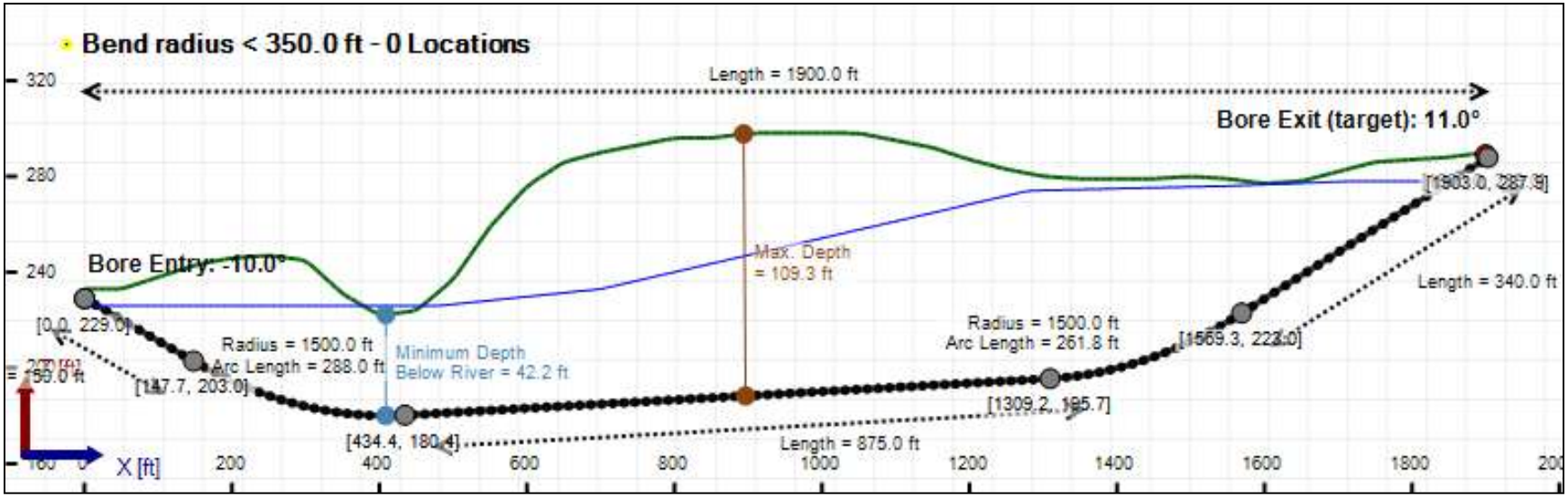
Soil Layer #1 USCS, Sand (S), SP
From Assistant
Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3]
Phi: 30.00, S.M.: 200.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Sand (S), SP
From Assistant
Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft3]
Phi: 34.00, S.M.: 500.00, Coh: 0.00 [psi]

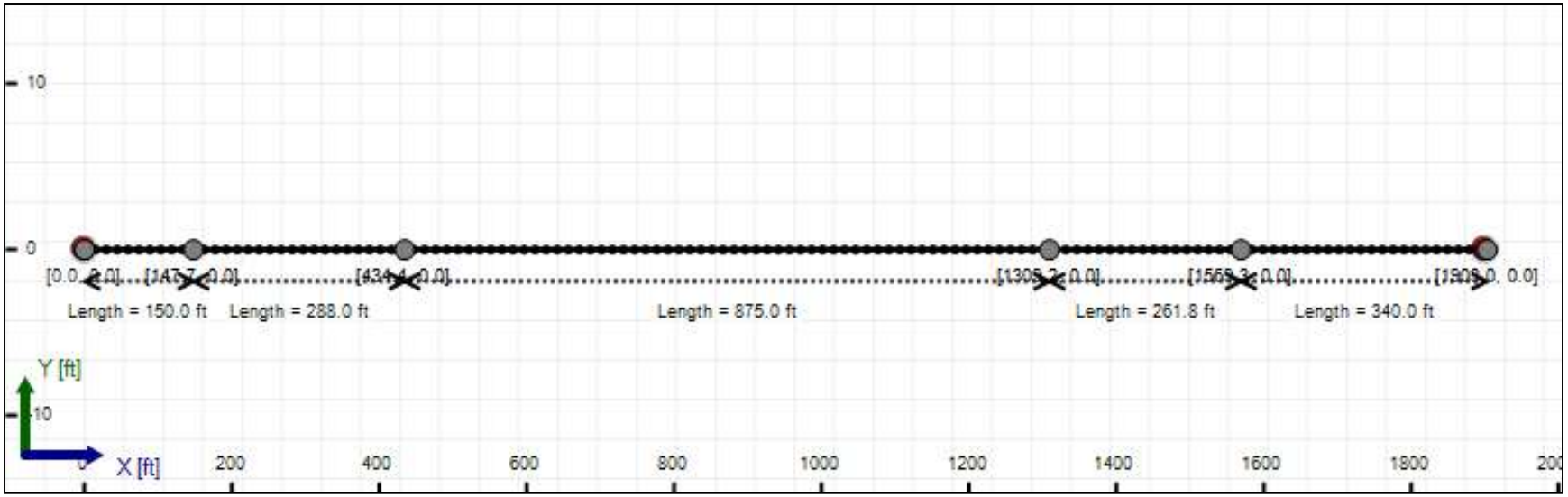
Soil Layer #3 Rock, Geological Classification, Sedimentary Rocks
From Assistant
Unit Weight: 120.0000 (dry), 140.0000 (sat) [lb/ft3]
Phi: 37.00, S.M.: 1000.00, Coh: 0.00 [psi]

Soil Layer #4 Rock, Geological Classification, Sedimentary Rocks
From Assistant
Unit Weight: 160.0000 (dry), 170.0000 (sat) [lb/ft3]
Phi: 37.00, S.M.: 2000.00, Coh: 3000.00 [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: 1920.00 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: 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	4.6	73.2
Water Pressure	42.2	28.8
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	46.8	102.0
Deflection		
Earth Load Deflection	0.748	8.545
Buoyant Deflection	0.074	0.074
Reissner Effect	0	0
Net Deflection	0.822	8.619
Compressive Stress [psi]		
Compressive Wall Stress	164.0	356.9

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	45453.3	45453.3
Pullback Stress [psi]	726.8	726.8
Pullback Strain	1.264E-2	1.264E-2
Bending Stress [psi]	0.0	20.4
Bending Strain	0	3.542E-4
Tensile Stress [psi]	726.8	744.8
Tensile Strain	1.264E-2	1.331E-2

Net External Pressure = 64.2 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 798.4 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.822	7.5	9.1	OK
Unconstrained Collapse [psi]	70.7	307.4	4.3	OK
Compressive Wall Stress [psi]	164.0	1150.0	7.0	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.036	7.5	207.6	OK
Unconstrained Collapse [psi]	80.6	498.9	6.2	OK
Tensile Stress [psi]	744.8	1200.0	1.6	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	1705.396 psi	2074.413 psi
1	8.00 in	12.00 in	1705.317 psi	2074.362 psi
2	12.00 in	16.13 in	1705.203 psi	2074.289 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): 120.00 US (liquid) gallon/min

Drill Fluid Density: 68.700 lb/ft3

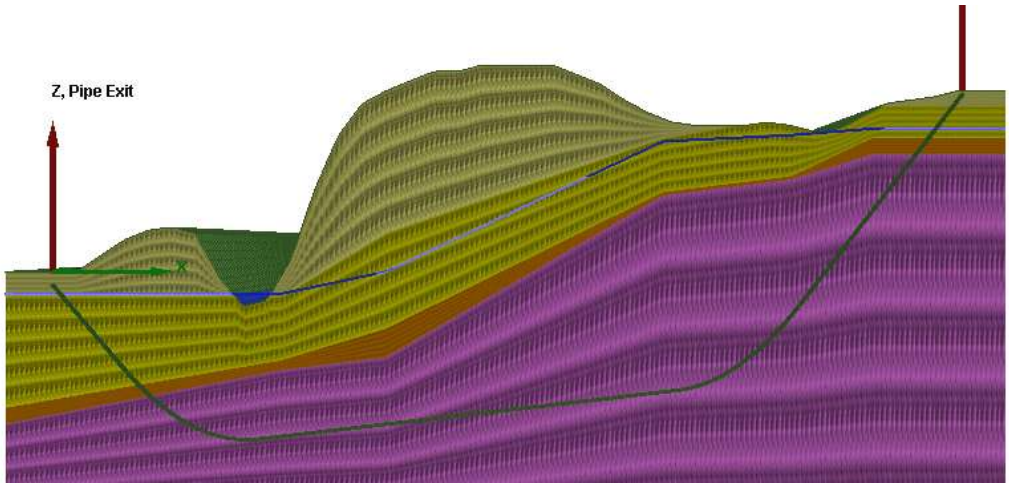
Rheological model: Power-Law

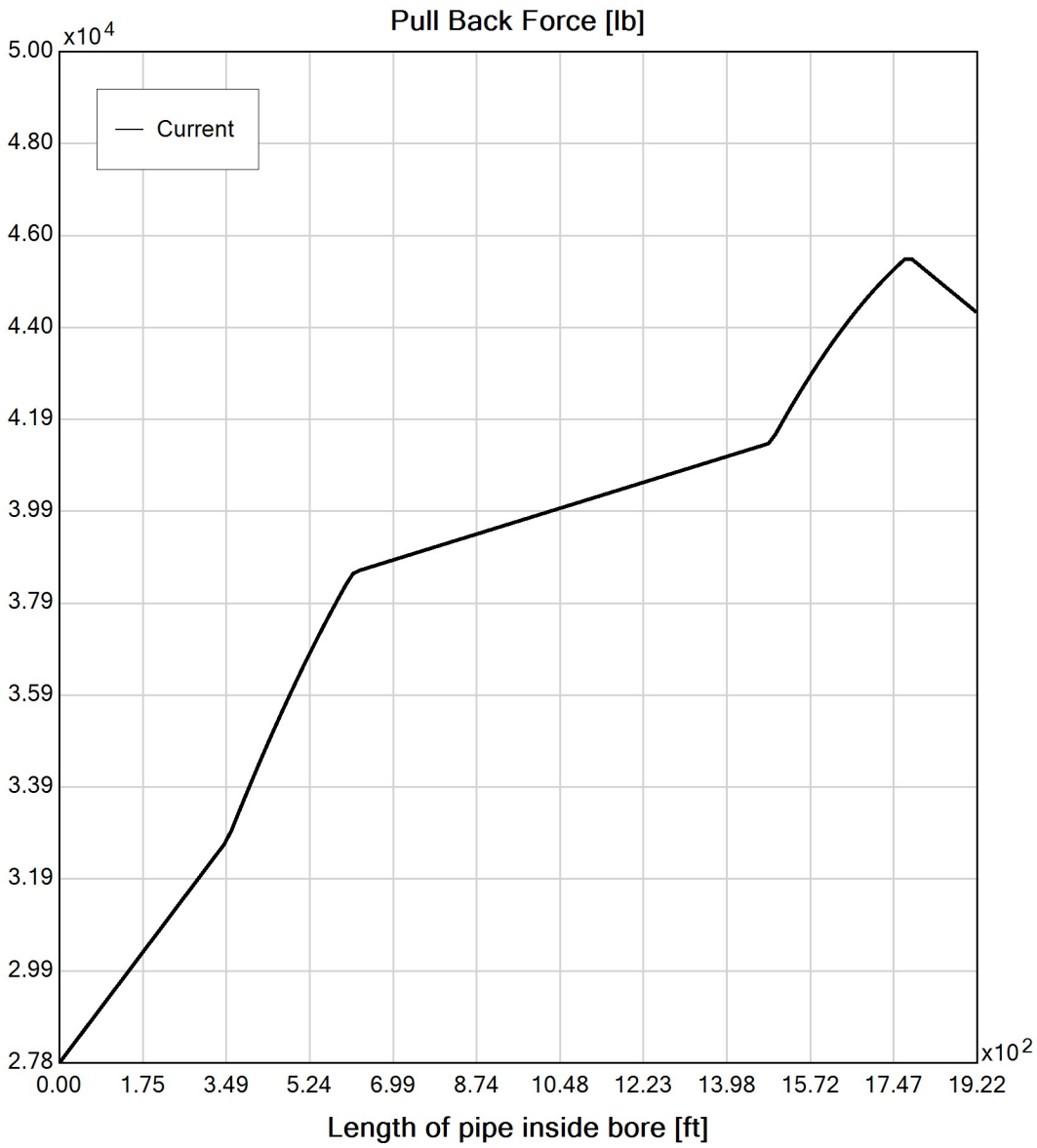
Fluid Consistency Index (K): 63.17

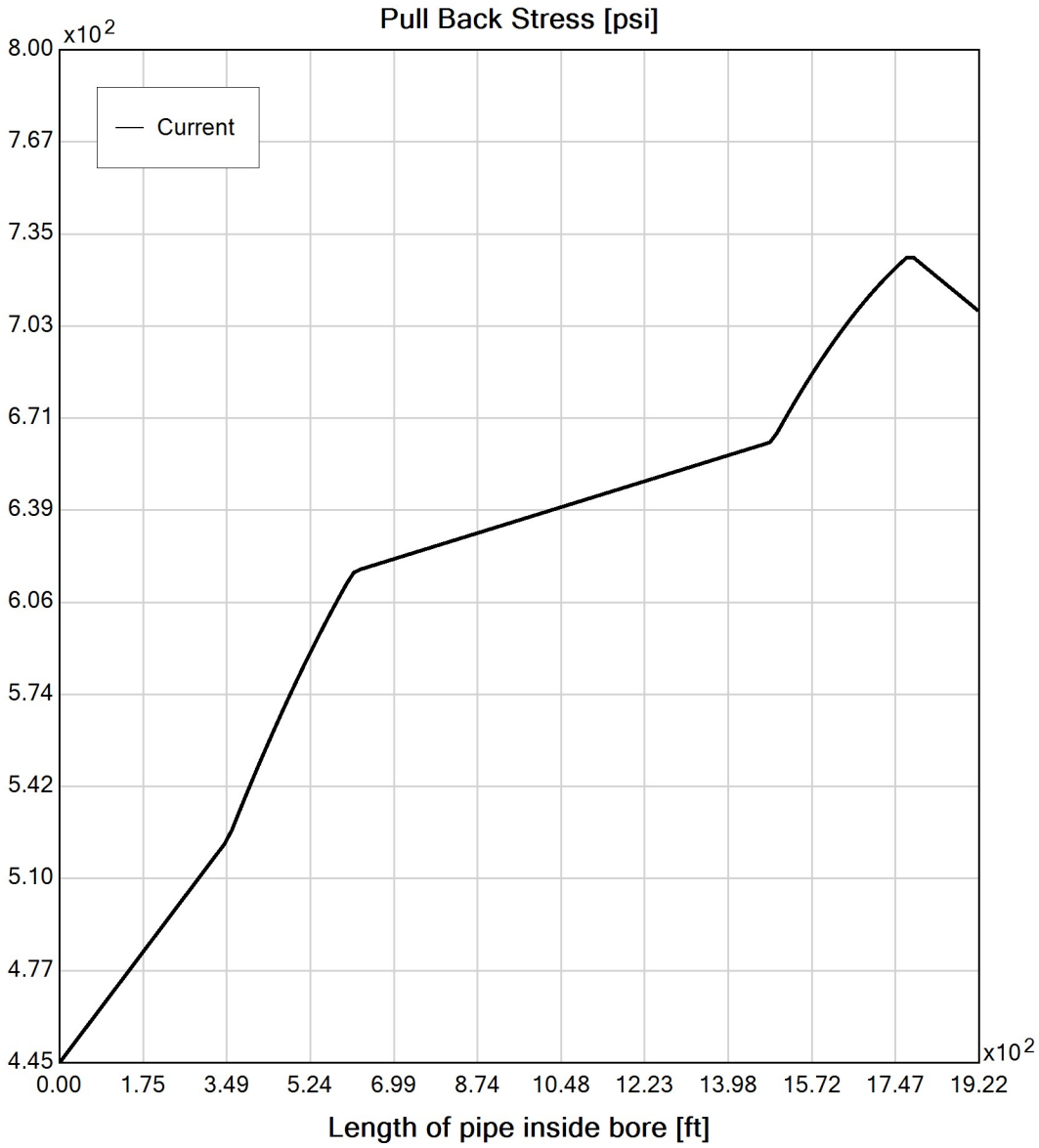
Power Law Exponent (n): 0.14

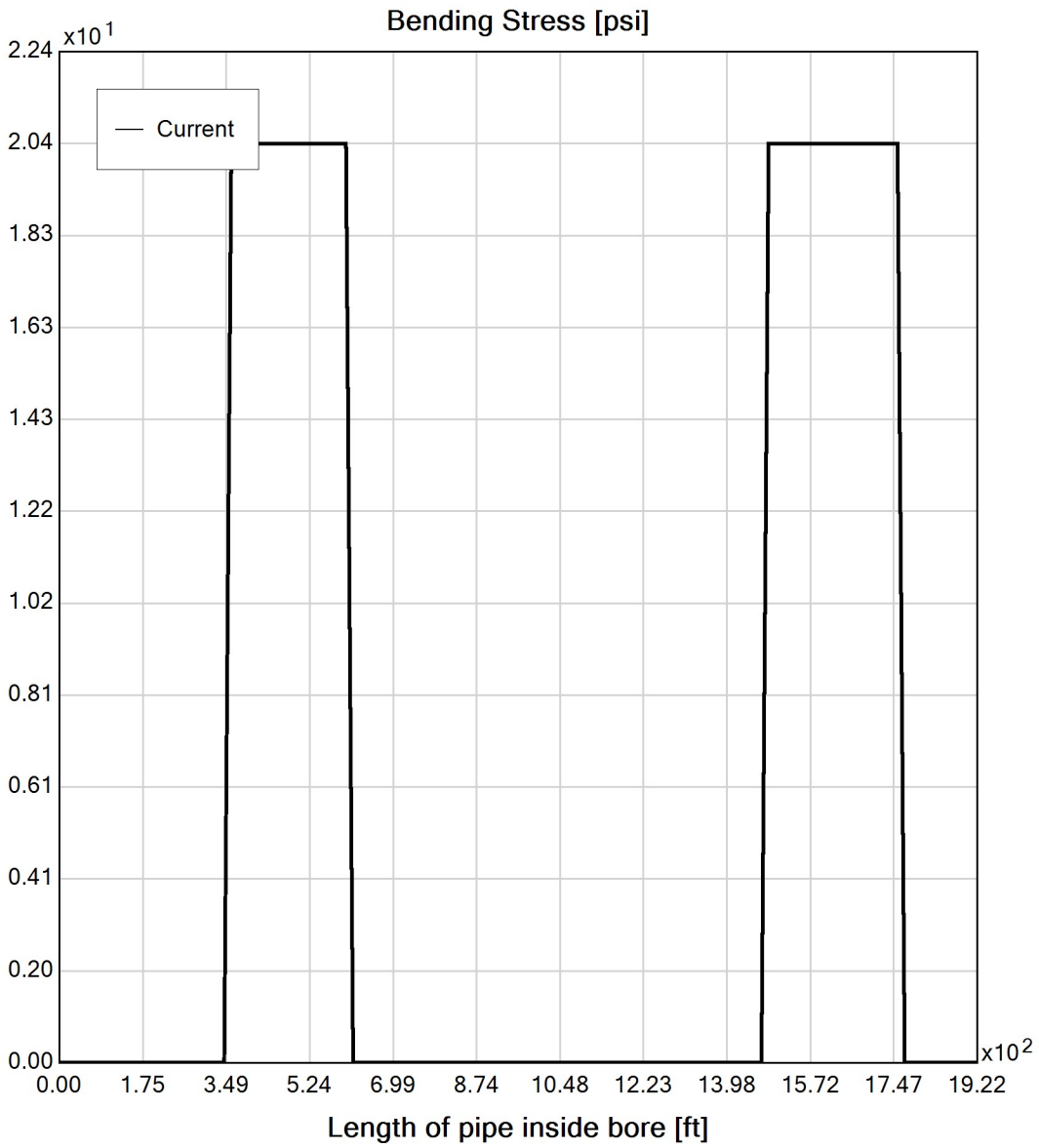
Effective Viscosity (cP): 333.0

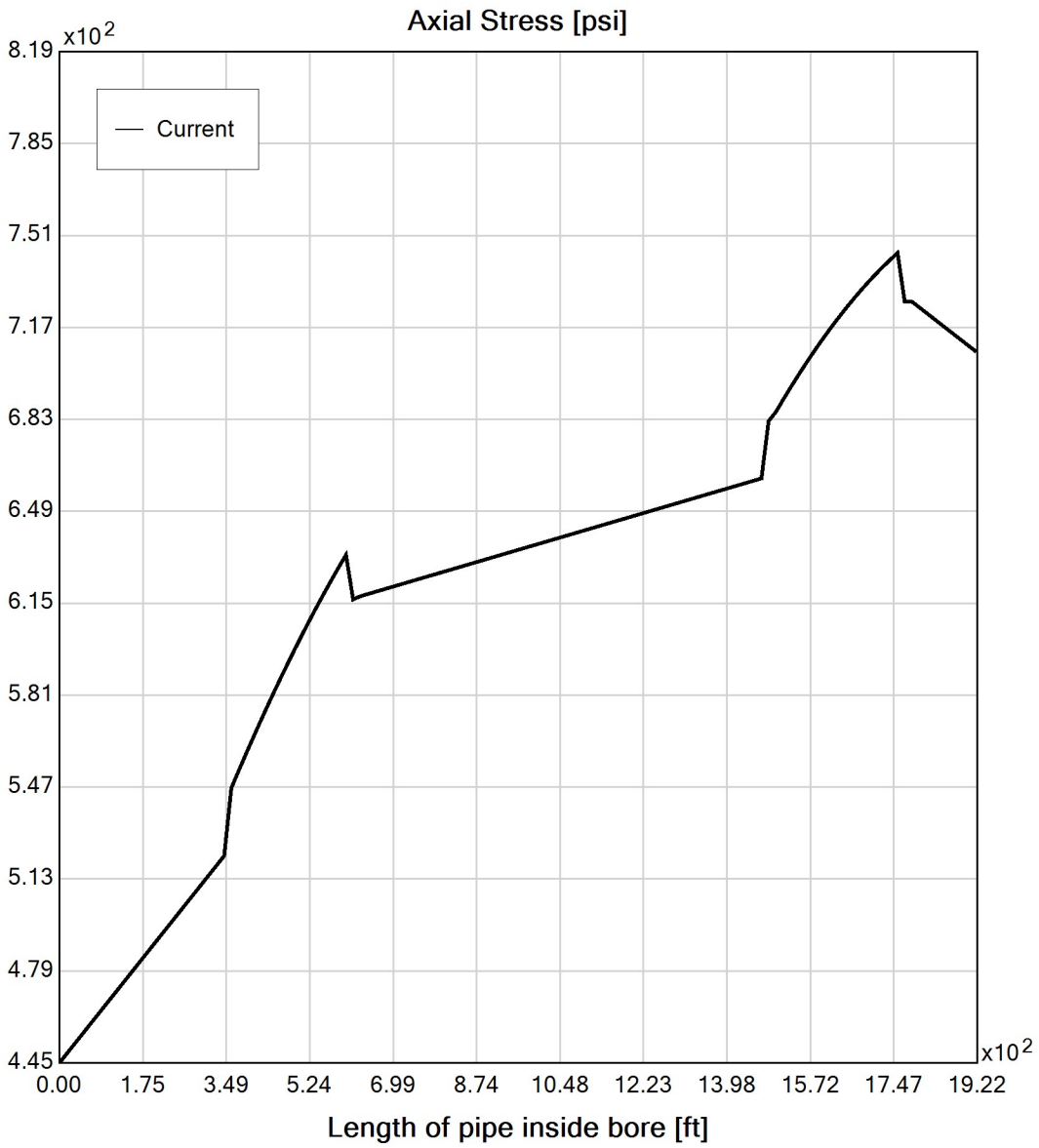
Virtual Site

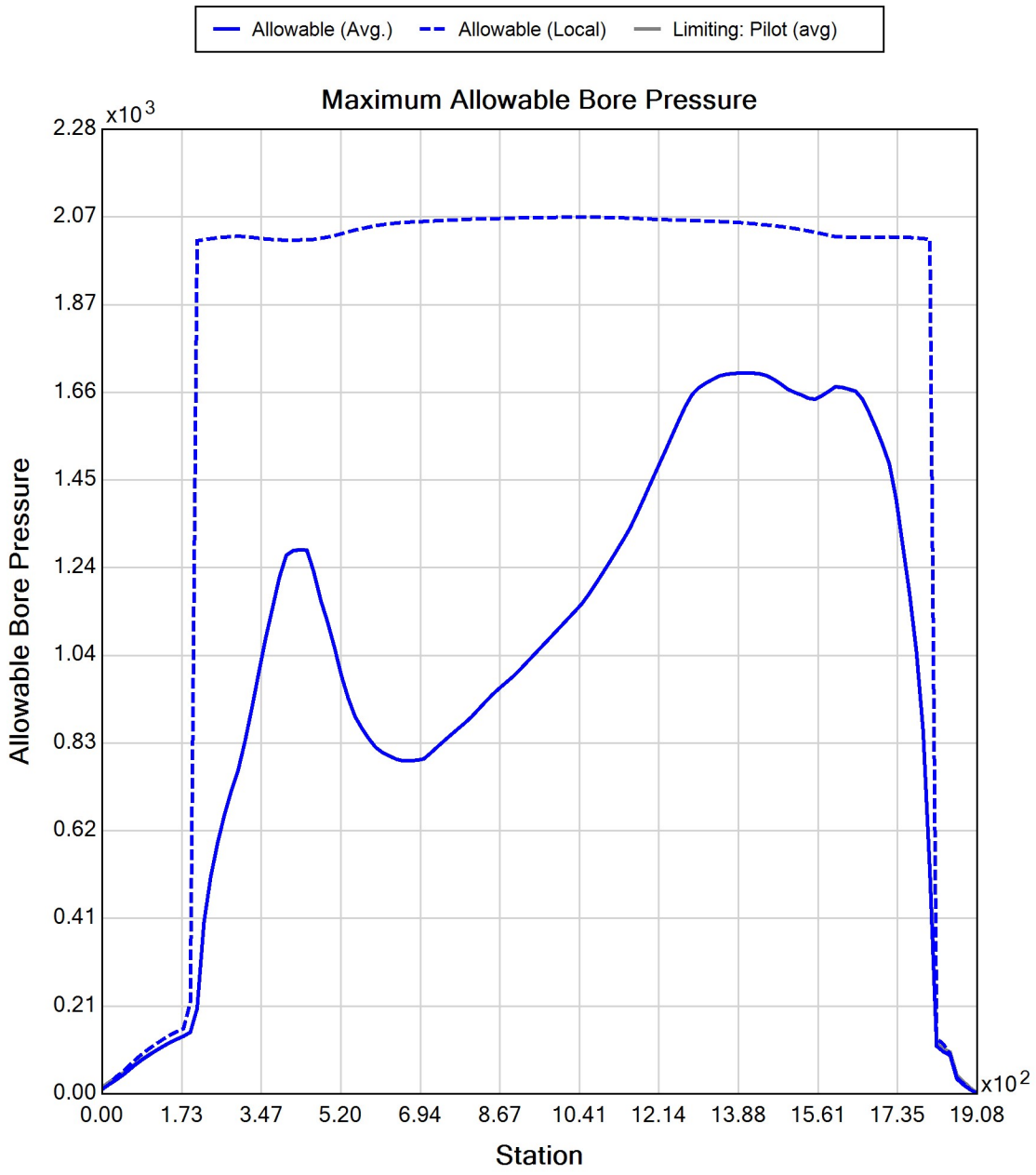


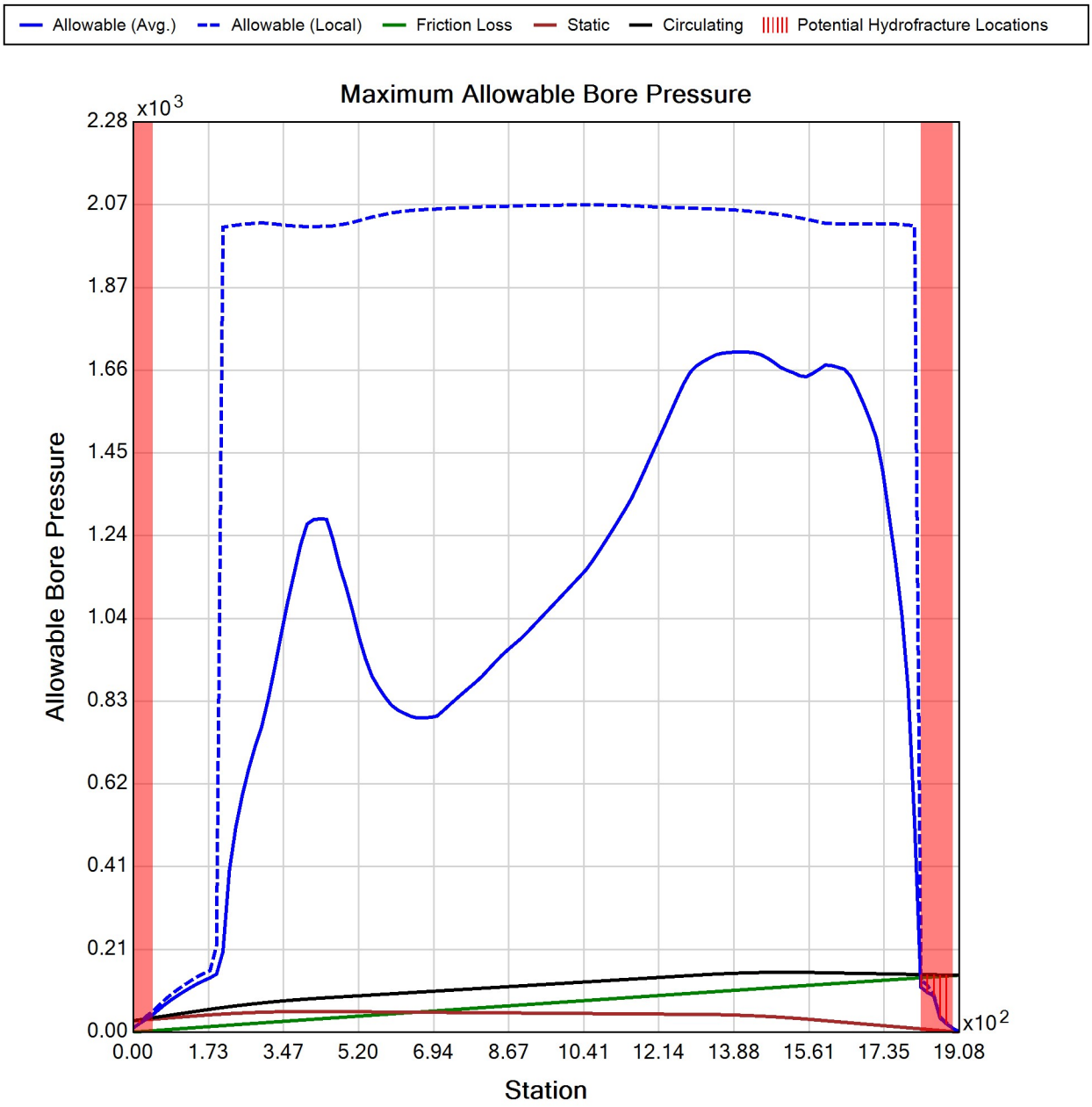












Generated Output

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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.

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Input Summary

Start Coordinate	(0.00, 0.00, 229.00) ft
End Coordinate	(1900.00, 0.00, 289.00) ft
Project Length	1900.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	3.500 in
Pipe DR	7.0
Pipe Thickness	0.50 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: 3" (3.5")
Pipe DR: 7
Pipe Length: 1920.00 ft
Internal Pressure: 0 psi
Borehole Diameter: 0.625 ft
Silo Width: 0.625 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	2.5	73.2
Water Pressure	42.2	28.8
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	44.7	102.0
Deflection		
Earth Load Deflection	0.293	8.545
Buoyant Deflection	0.020	0.020
Reissner Effect	0	0
Net Deflection	0.314	8.565
Compressive Stress [psi]		
Compressive Wall Stress	156.5	356.9

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	3537.8	3537.8
Pullback Stress [psi]	750.7	750.7
Pullback Strain	1.306E-2	1.306E-2
Bending Stress [psi]	0.0	5.6
Bending Strain	0	9.722E-5
Tensile Stress [psi]	750.7	754.0
Tensile Strain	1.306E-2	1.321E-2

Net External Pressure = 64.2 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 172.8 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.314	7.5	23.9	OK
Unconstrained Collapse [psi]	70.7	319.6	4.5	OK
Compressive Wall Stress [psi]	156.5	1150.0	7.3	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.010	7.5	756.1	OK
Unconstrained Collapse [psi]	80.6	498.4	6.2	OK
Tensile Stress [psi]	754.0	1200.0	1.6	OK

Generated Output

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Project Summary

General:	CHPE HDD 50 Conduit 1
	P3
	Start Date: 12-10-2021
	End Date: 12-10-2021
Project Owner:	TDI
Project Contractor:	Kiewit
Project Consultant:	CHA/BCE
Designer:	AB
	CHA
Description:	HDD 50 Conduit 1 10-inch DR 9

Input Summary

Start Coordinate	(0.00, 0.00, 291.00) ft
End Coordinate	(700.00, 0.00, 280.00) ft
Project Length	700.00 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

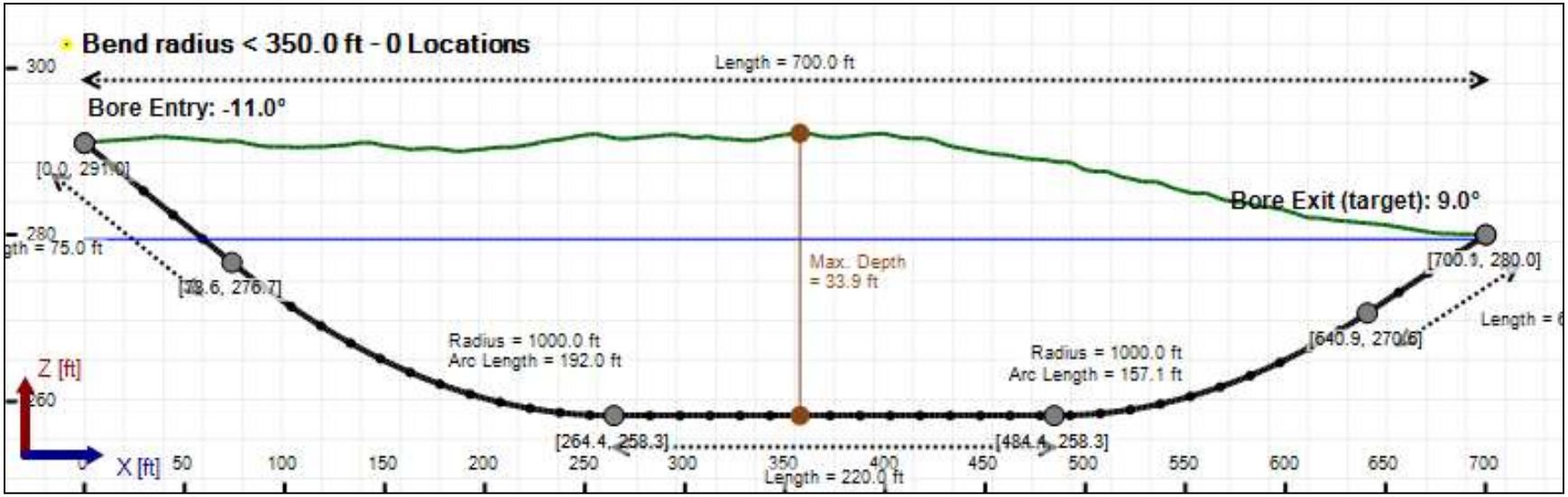
Number of Layers: 3

Soil Layer #1 USCS, Sand (S), SP
Depth: 11.60 ft
Unit Weight: 109.5552 (dry), 125.0000 (sat) [lb/ft3]
Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

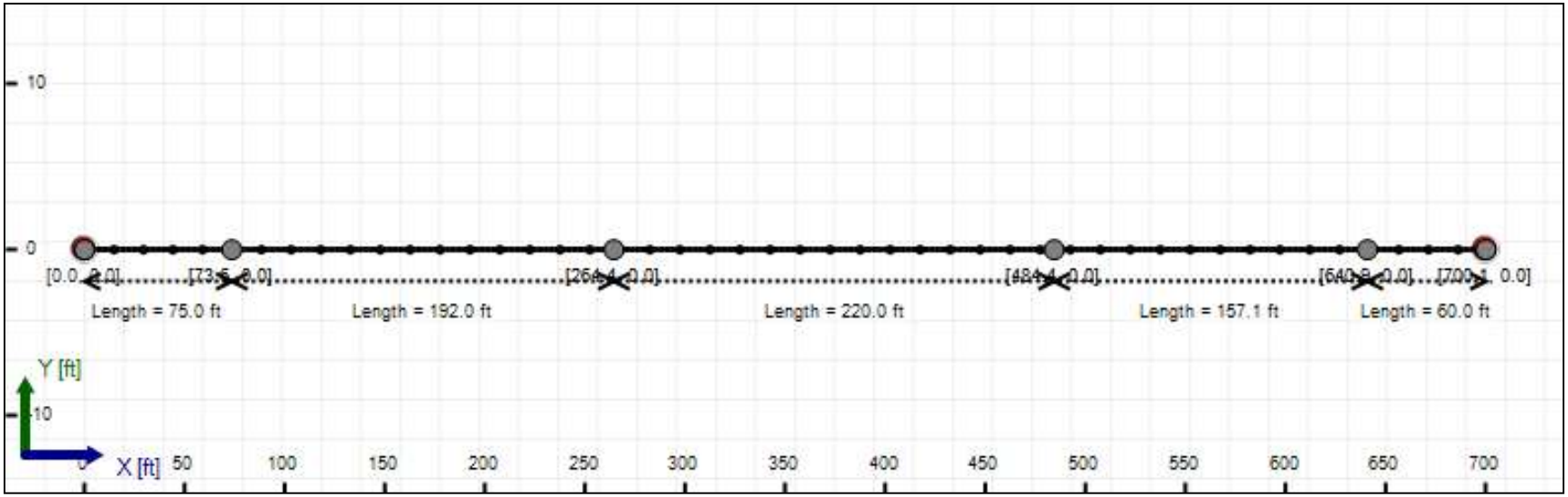
Soil Layer #2 USCS, Gravel (G), GP
Depth: 4.00 ft
Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft3]
Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #3 Rock, Geological Classification, Sedimentary Rocks
Depth: 22.00 ft
Unit Weight: 107.8272 (dry), 177.6384 (sat) [lb/ft3]
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: 705.00 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	5.7	25.1
Water Pressure	9.2	9.2
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	14.9	34.3
Deflection		
Earth Load Deflection	1.557	6.836
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.689	6.968
Compressive Stress [psi]		
Compressive Wall Stress	67.1	154.3

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	11253.5	11253.5
Pullback Stress [psi]	313.8	313.8
Pullback Strain	5.458E-3	5.458E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	313.8	338.5
Tensile Strain	5.458E-3	6.335E-3

Net External Pressure = 19.3 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.689	7.5	4.4	OK
Unconstrained Collapse [psi]	21.3	118.7	5.6	OK
Compressive Wall Stress [psi]	67.1	1150.0	17.1	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	31.2	237.0	7.6	OK
Tensile Stress [psi]	338.5	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	885.316 psi	1332.508 psi
1	8.00 in	12.00 in	884.900 psi	1332.179 psi
2	12.00 in	16.13 in	884.296 psi	1331.701 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