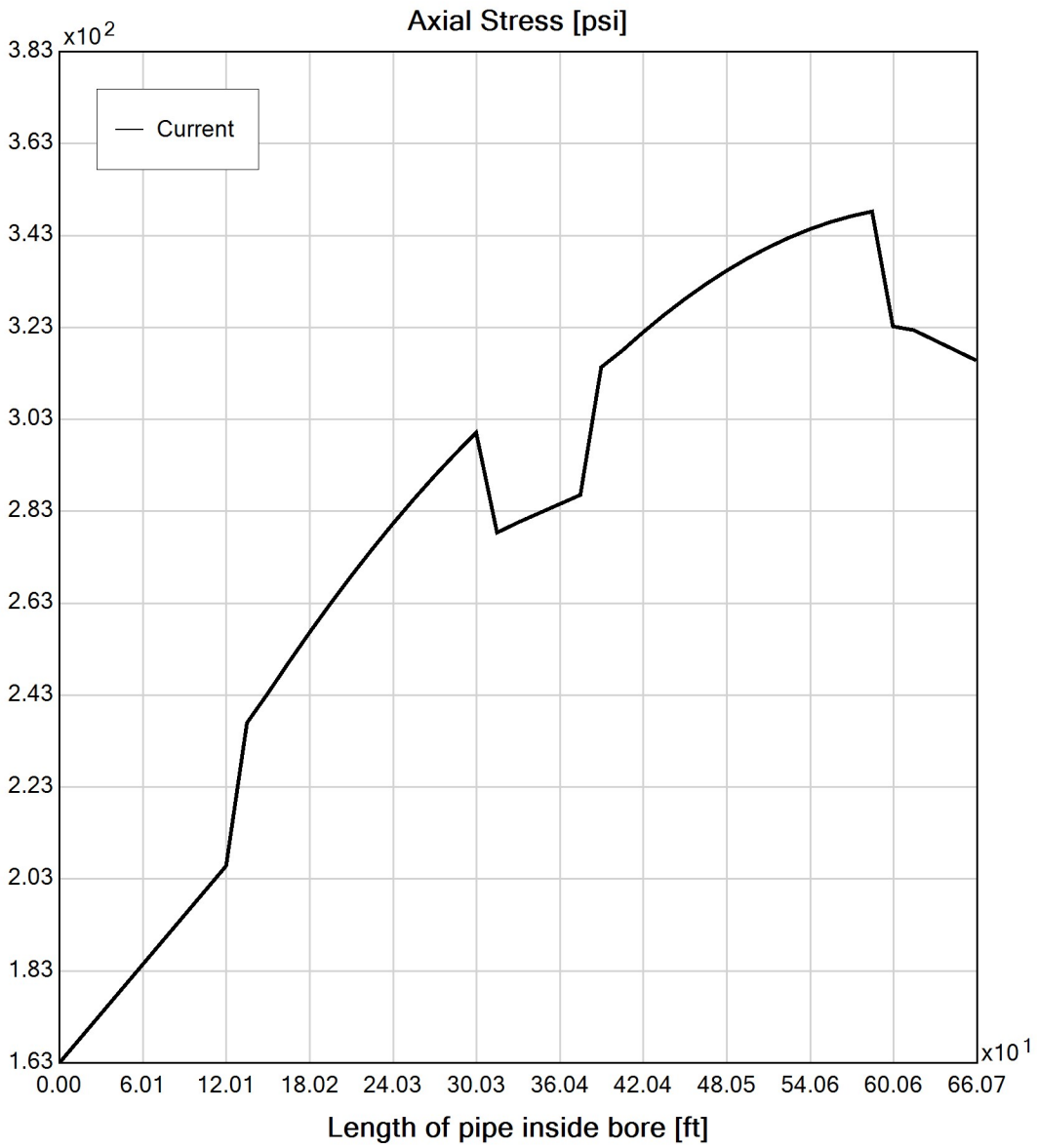

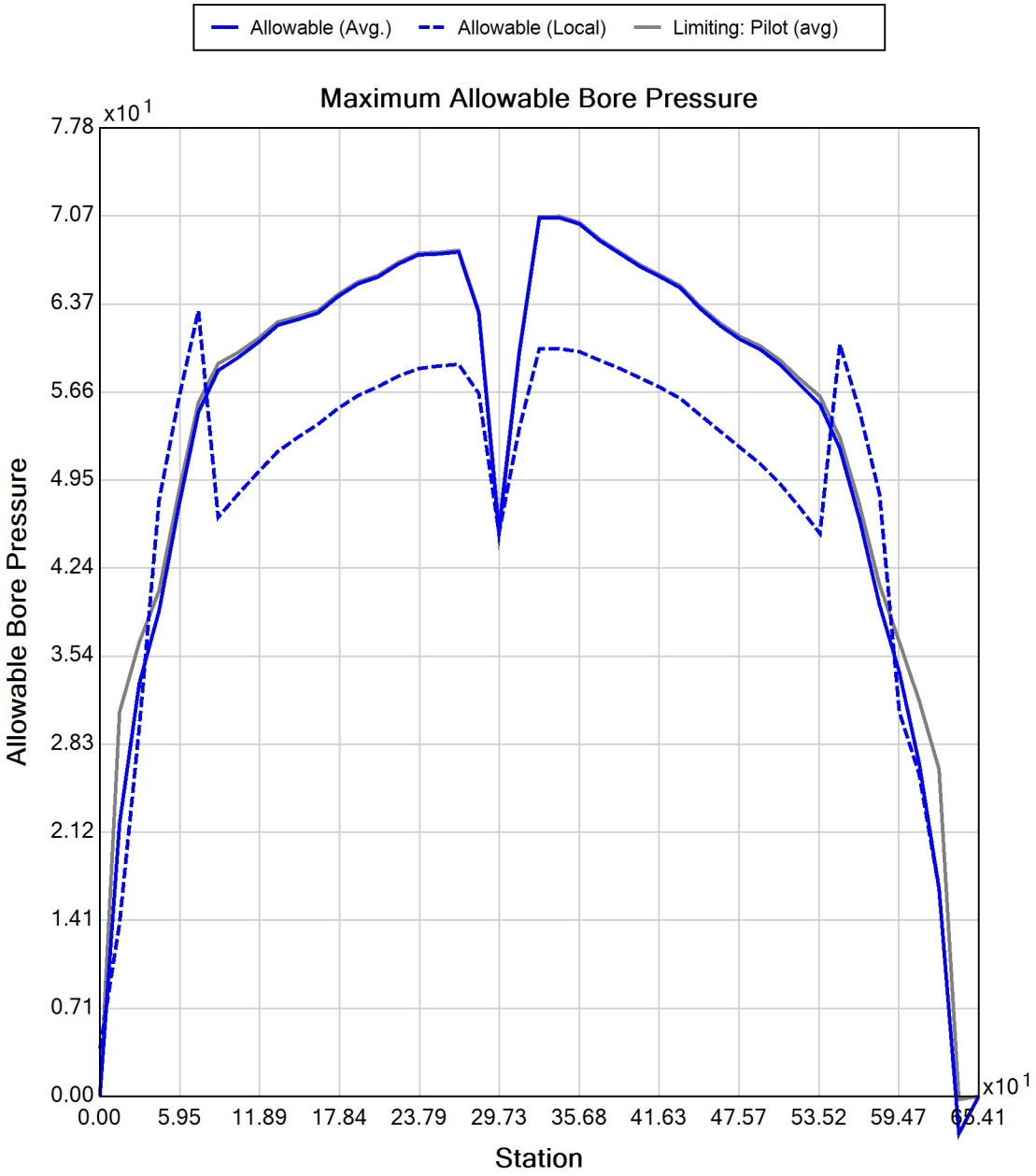

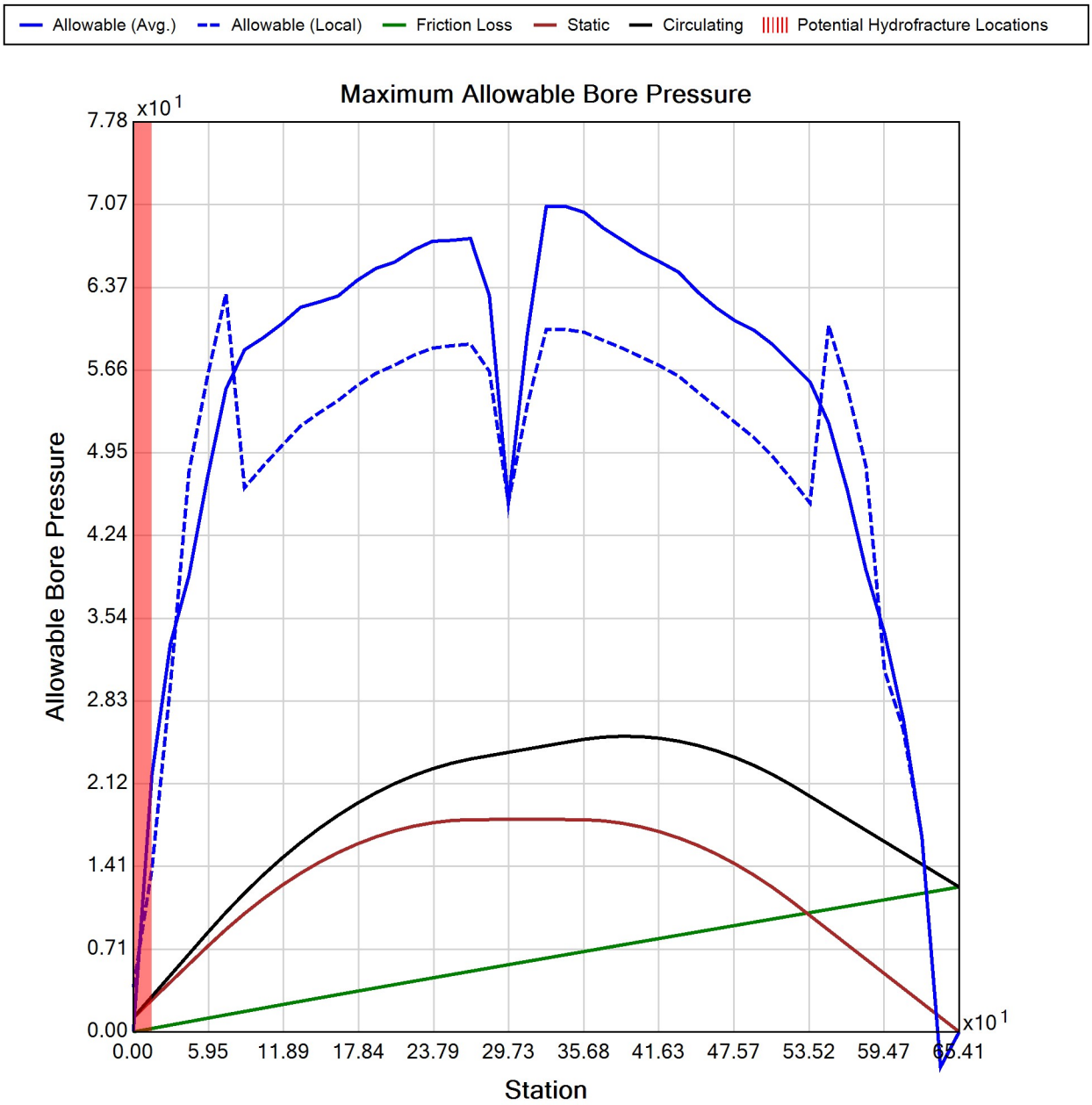

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Input Summary

Start Coordinate	(0.00, 0.00, 141.83) ft
End Coordinate	(640.60, 0.00, 142.08) ft
Project Length	640.60 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: 660.00 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	4.7	19.0
Water Pressure	8.1	8.1
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	12.8	27.0
Deflection		
Earth Load Deflection	1.291	5.161
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	1.320	5.190
Compressive Stress [psi]		
Compressive Wall Stress	57.8	121.7

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	675.4	675.4
Pullback Stress [psi]	385.9	385.9
Pullback Strain	6.711E-3	6.711E-3
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	385.9	390.8
Tensile Strain	6.711E-3	6.896E-3

Net External Pressure = 19.9 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.320	7.5	5.7	OK
Unconstrained Collapse [psi]	24.7	122.7	5.0	OK
Compressive Wall Stress [psi]	57.8	1150.0	19.9	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	34.7	234.9	6.8	OK
Tensile Stress [psi]	390.8	1200.0	3.1	OK

Generated Output

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Project Summary

General:	HDD #16 - 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, 141.83) ft
End Coordinate	(640.60, 0.00, 142.08) ft
Project Length	640.60 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), SM
Depth: 3.00 ft
Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft3]
Phi: 30.00, S.M.: 145.00, Coh: 4.40 [psi]

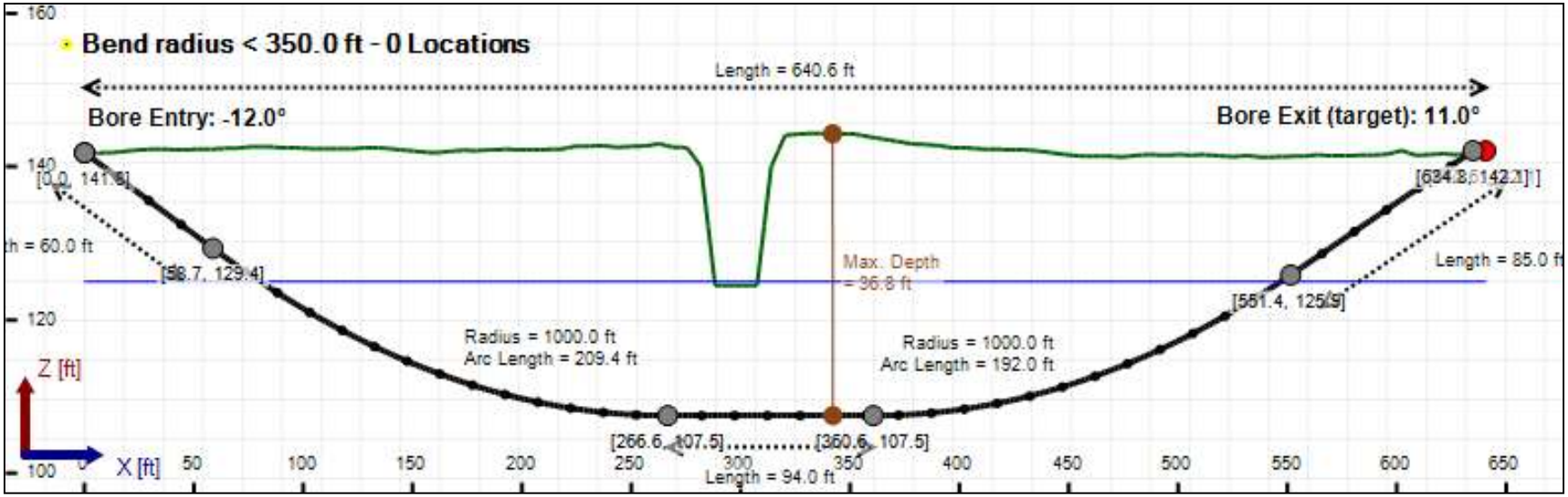
Soil Layer #2 USCS, Silt (M), ML
Depth: 2.00 ft
Unit Weight: 80.0000 (dry), 100.0000 (sat) [lb/ft3]
Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #3 USCS, Clay (C), CL
Depth: 4.00 ft
Unit Weight: 100.0000 (dry), 120.0000 (sat) [lb/ft3]
Phi: 0.00, S.M.: 145.00, Coh: 7.30 [psi]

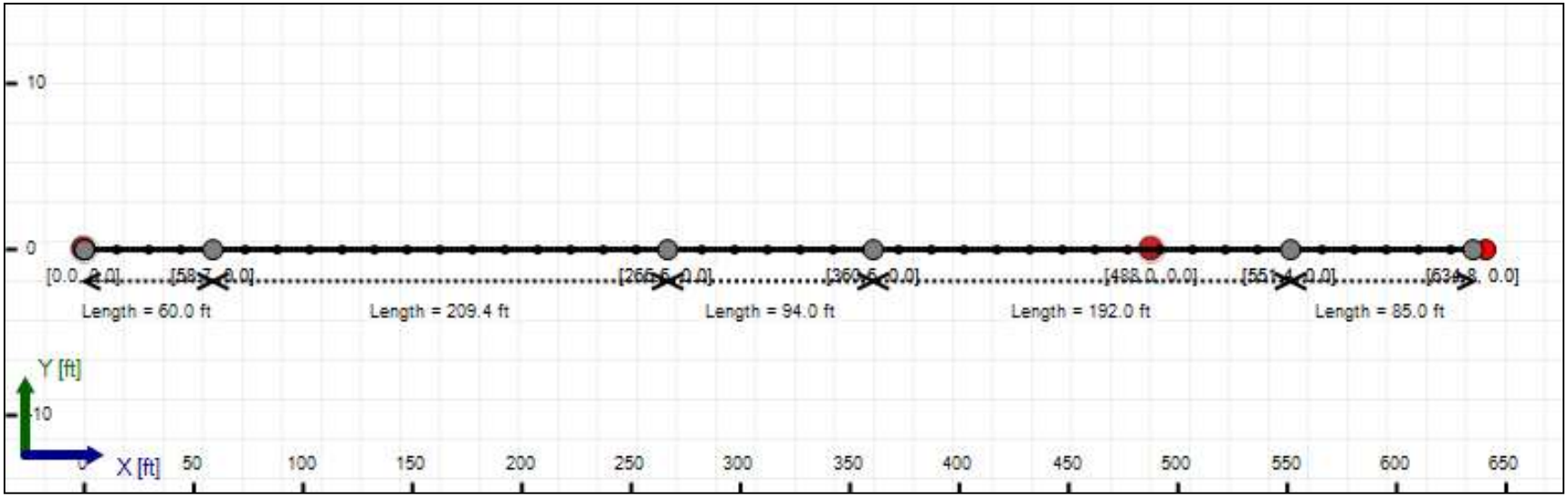
Soil Layer #4 USCS, Sand (S), SM
Depth: 8.00 ft
Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft3]
Phi: 30.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #5 USCS, Clay (C), CH
Depth: 24.00 ft
Unit Weight: 70.0000 (dry), 100.0000 (sat) [lb/ft3]
Phi: 0.00, S.M.: 145.00, Coh: 8.70 [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: 645.00 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	5.3	18.6
Water Pressure	7.6	7.6
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	12.9	26.2
Deflection		
Earth Load Deflection	1.438	5.078
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.570	5.210
Compressive Stress [psi]		
Compressive Wall Stress	57.9	118.0

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	11277.7	11277.7
Pullback Stress [psi]	314.5	314.5
Pullback Strain	5.470E-3	5.470E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	314.5	339.6
Tensile Strain	5.470E-3	6.354E-3

Net External Pressure = 18.9 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.570	7.5	4.8	OK
Unconstrained Collapse [psi]	23.1	120.0	5.2	OK
Compressive Wall Stress [psi]	57.9	1150.0	19.9	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	33.0	236.9	7.2	OK
Tensile Stress [psi]	339.6	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	70.036 psi	63.465 psi
1	8.00 in	12.00 in	69.985 psi	63.051 psi
2	12.00 in	16.13 in	69.912 psi	62.468 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): 20.00 US (liquid) gallon/min

Drill Fluid Density: 68.700 lb/ft3

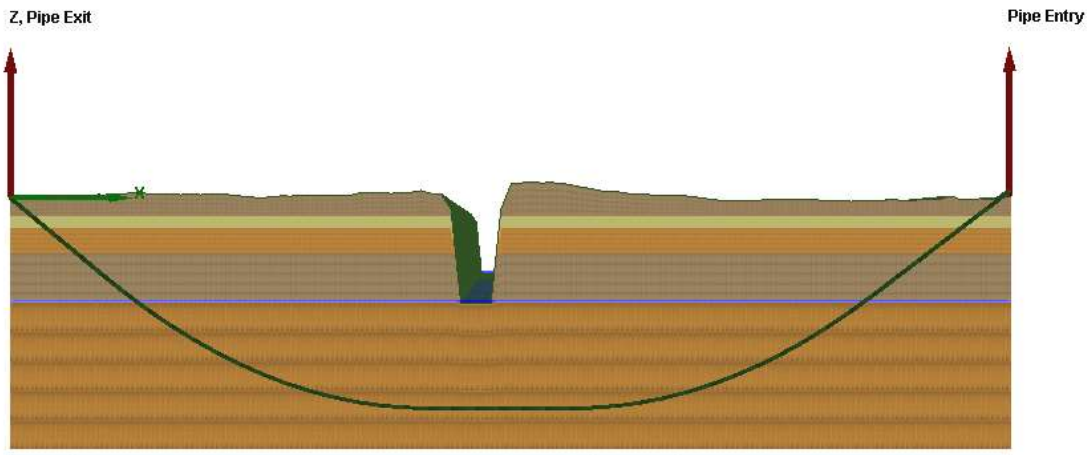
Rheological model: Bingham-Plastic

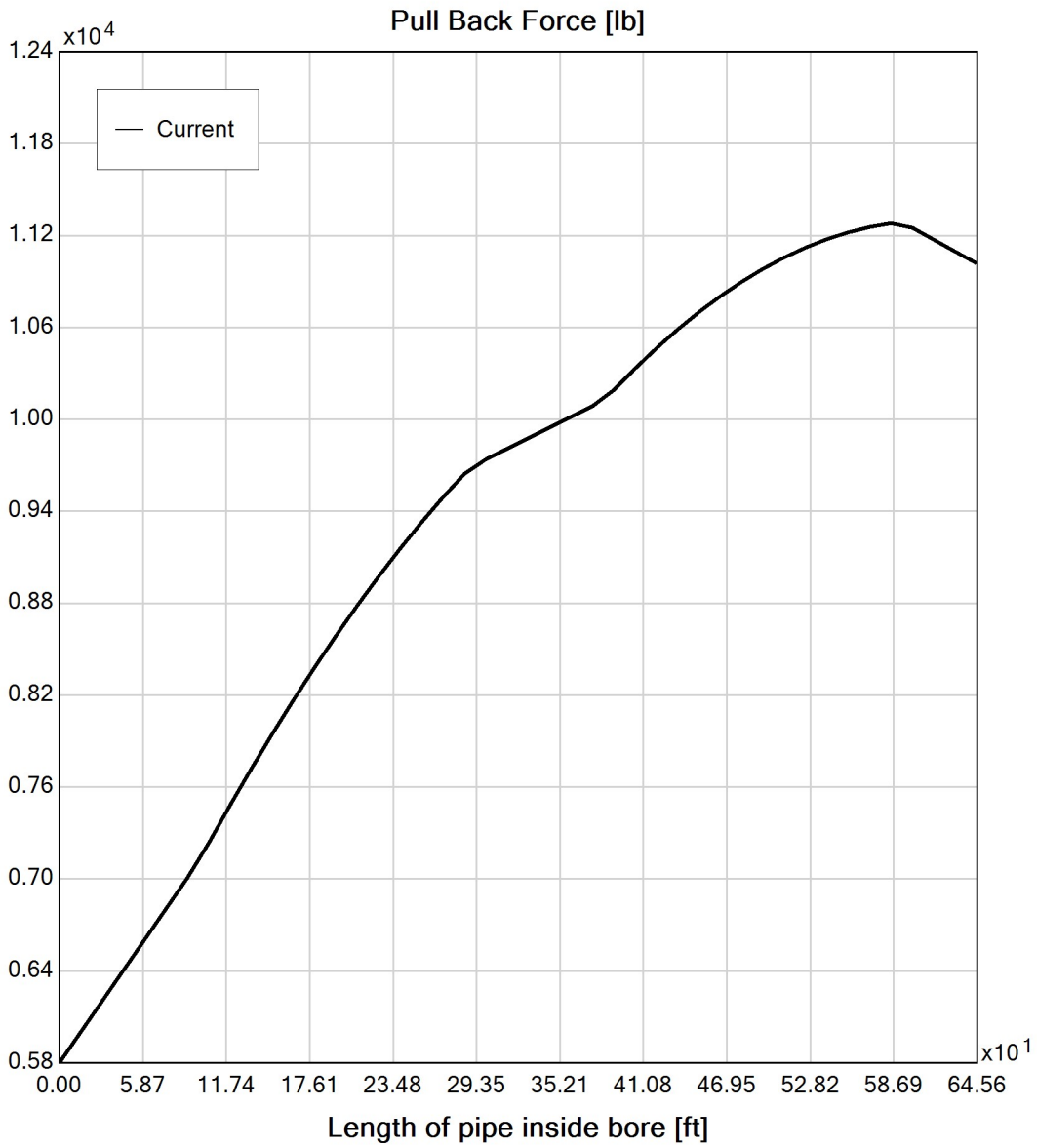
Plastic Viscosity (PV): 25.53

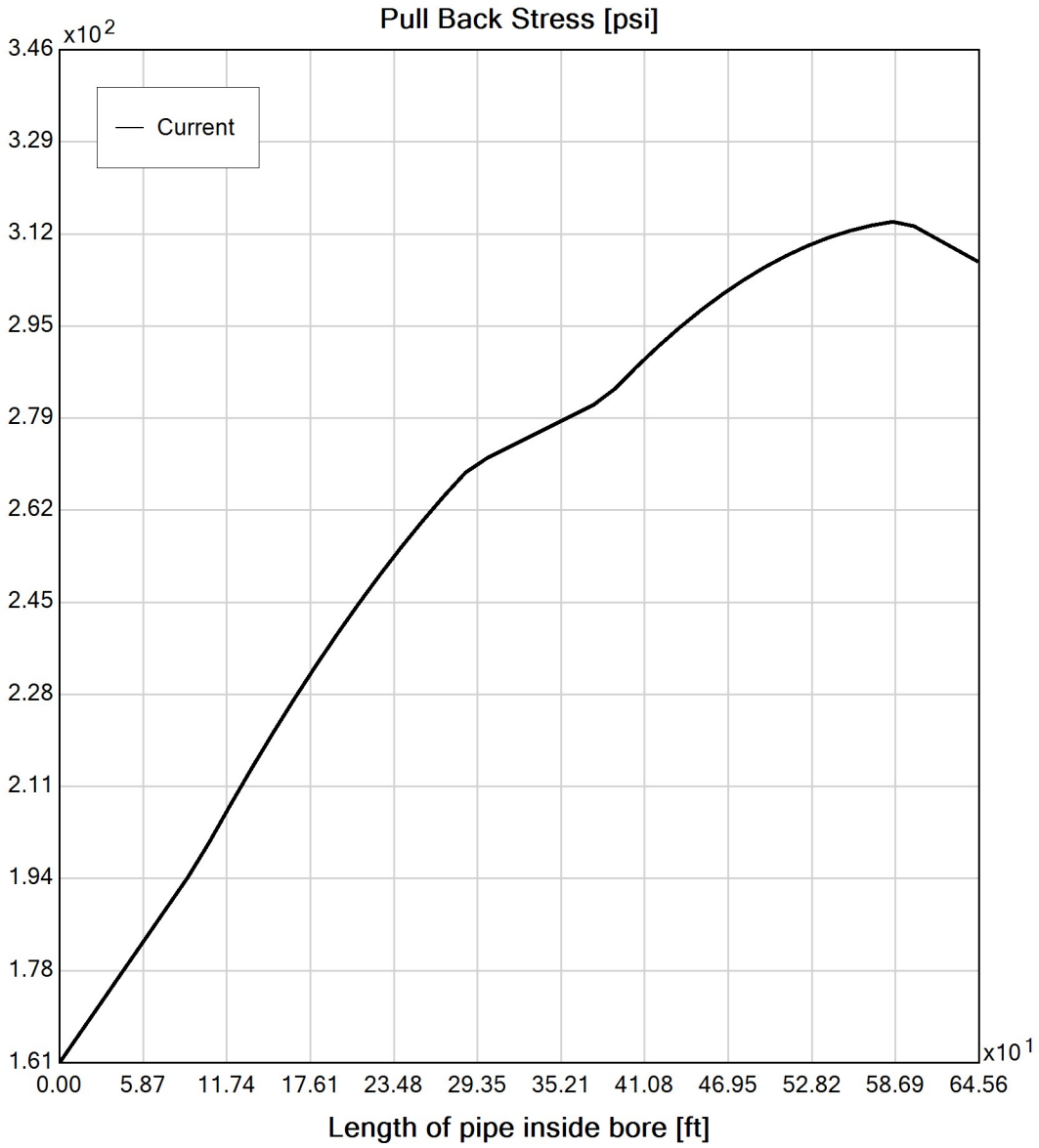
Yield Point (YP): 16.49

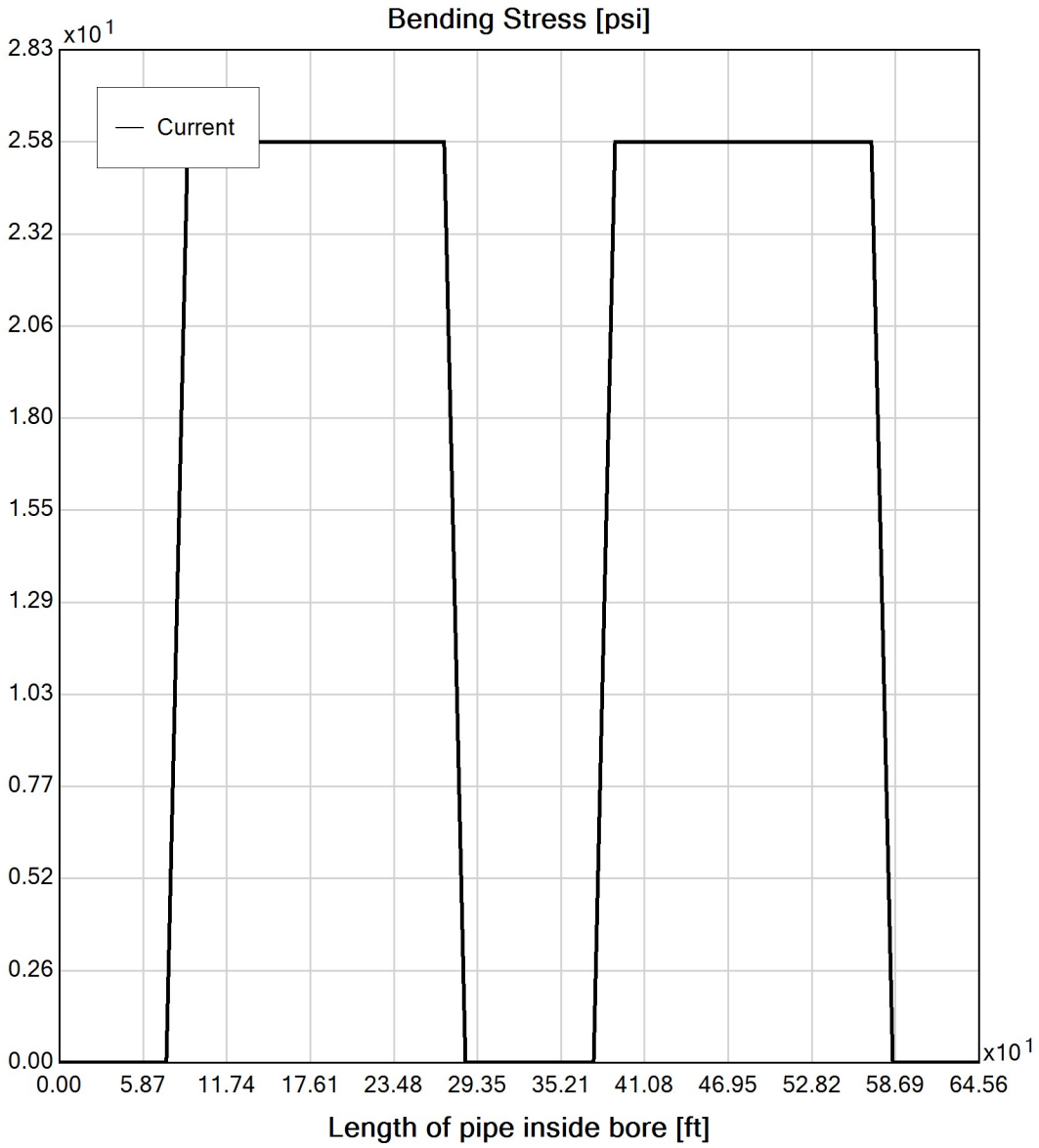
Effective Viscosity (cP): 2378.4

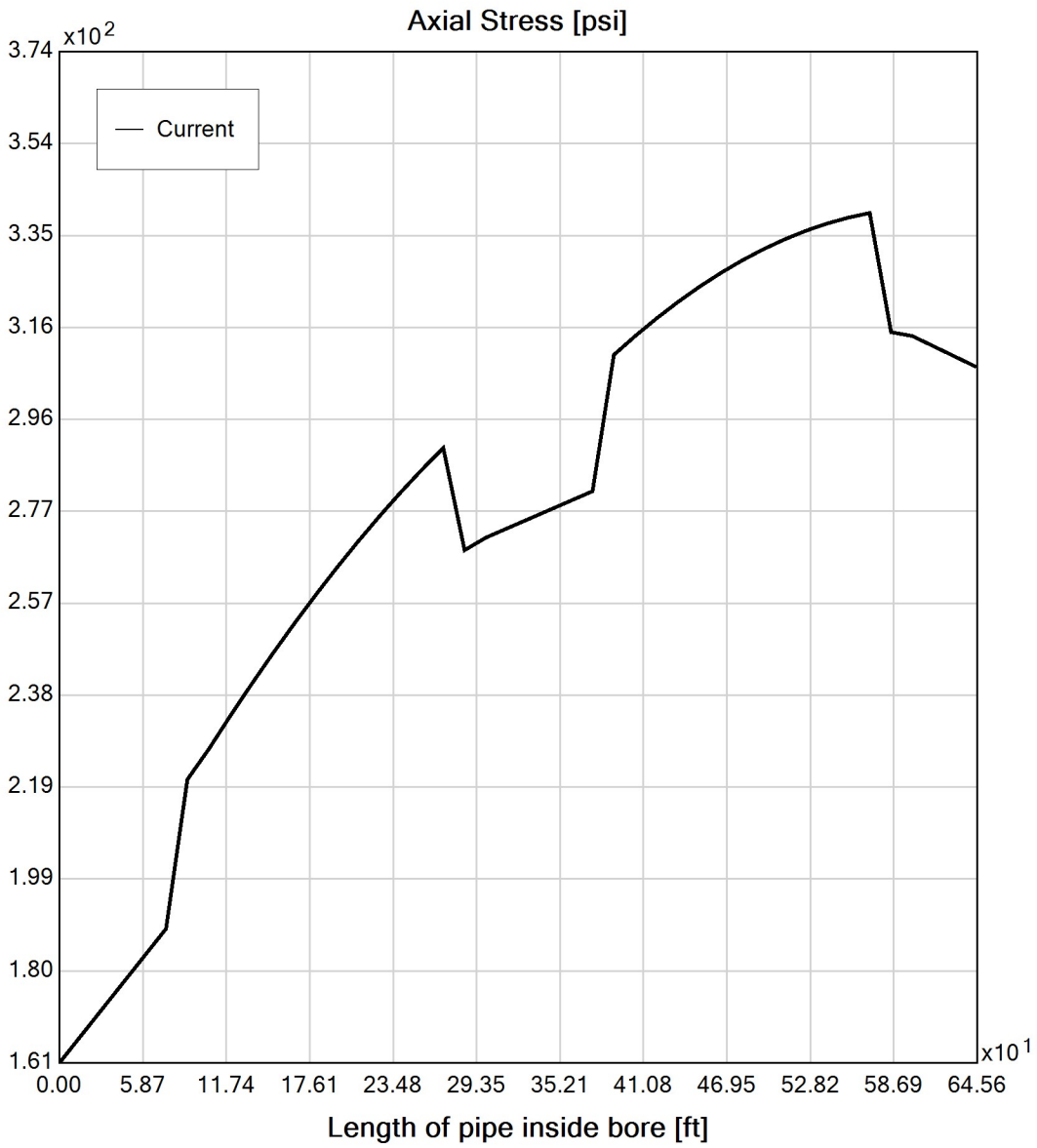
Virtual Site

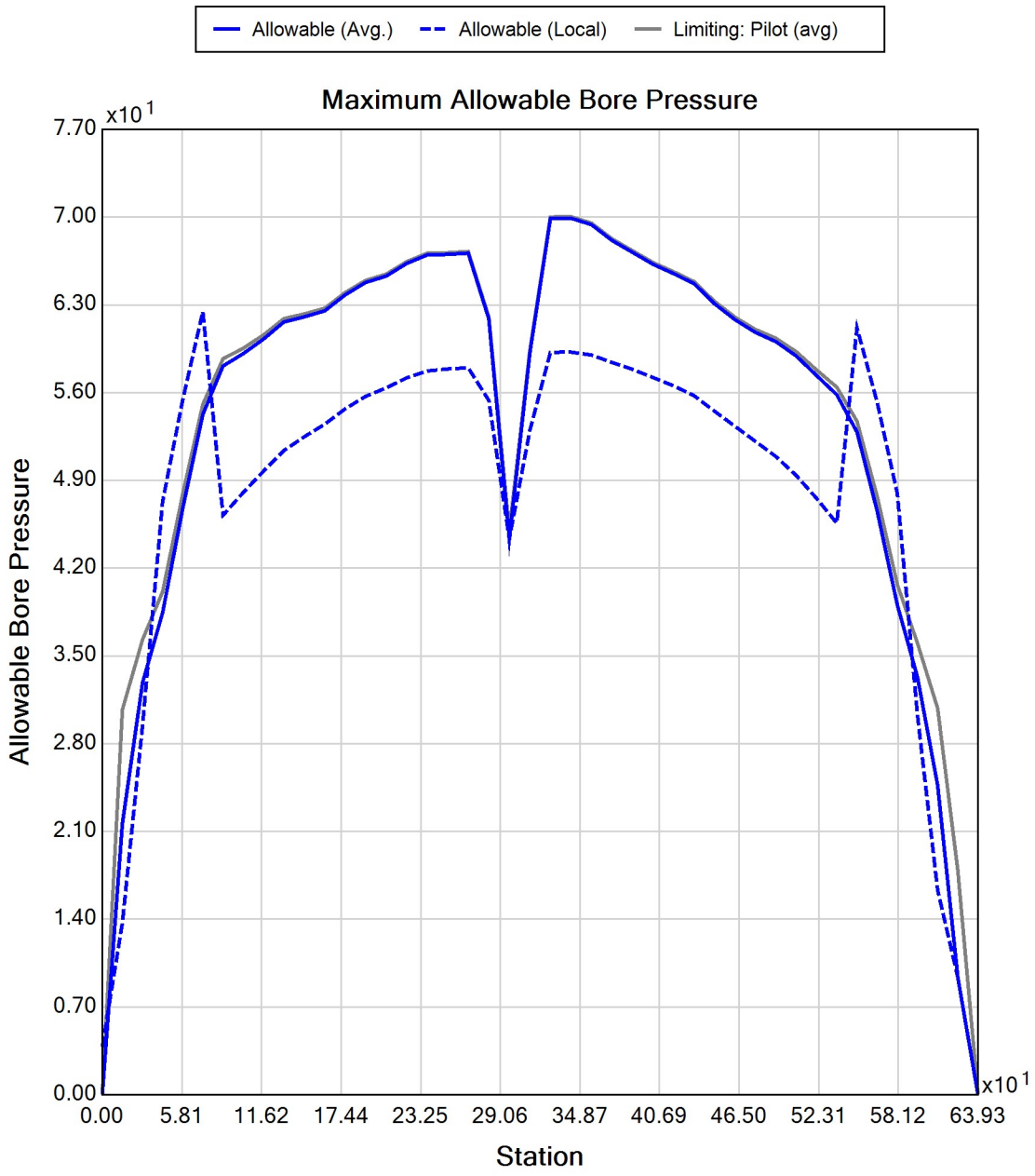


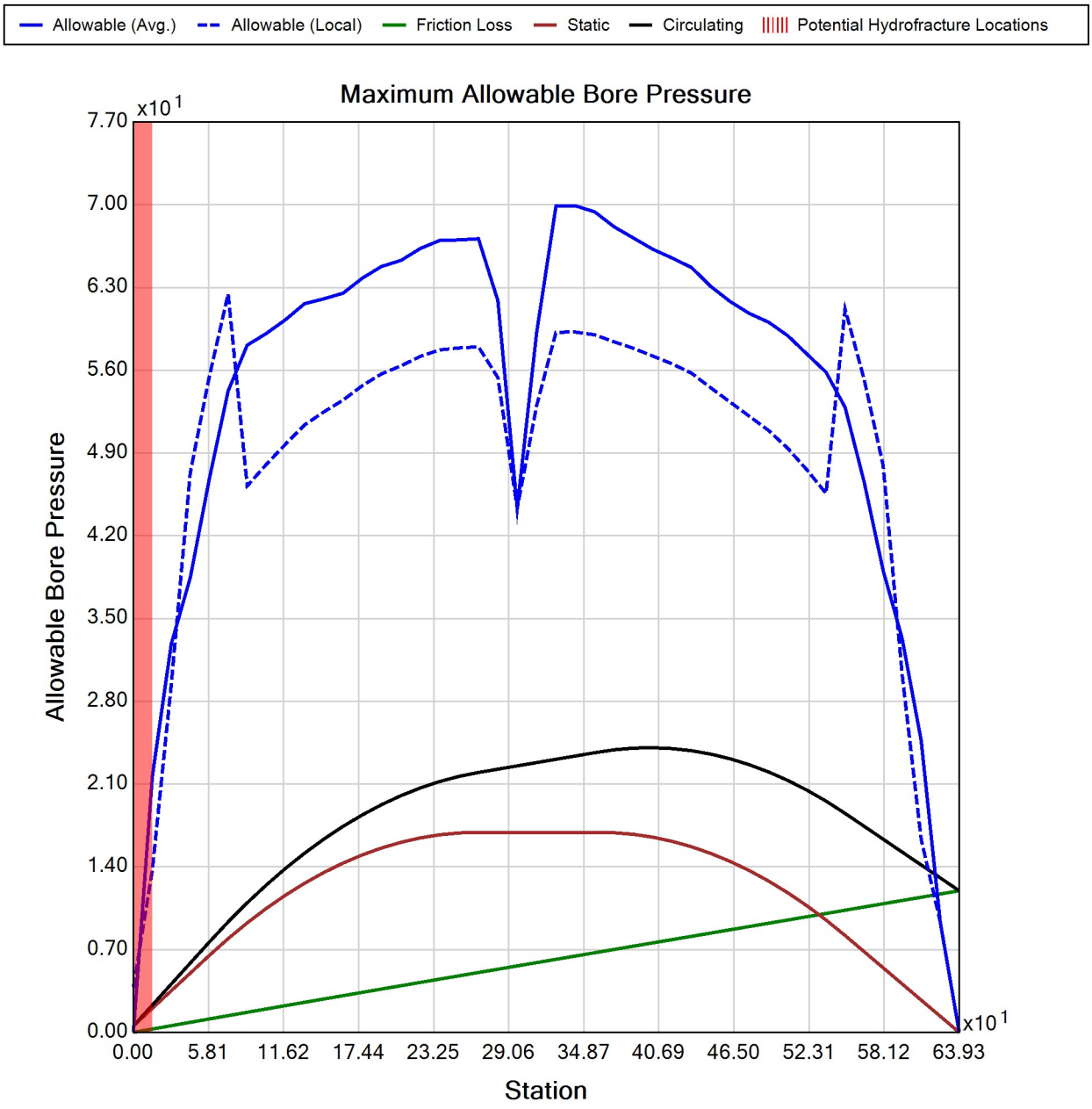












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Input Summary

Start Coordinate	(0.00, 0.00, 141.83) ft
End Coordinate	(640.60, 0.00, 142.08) ft
Project Length	640.60 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: 645.00 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	4.4	18.6
Water Pressure	7.6	7.6
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	12.0	26.2
Deflection		
Earth Load Deflection	1.208	5.078
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	1.237	5.107
Compressive Stress [psi]		
Compressive Wall Stress	54.1	118.0

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	660.1	660.1
Pullback Stress [psi]	377.1	377.1
Pullback Strain	6.559E-3	6.559E-3
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	377.1	382.1
Tensile Strain	6.559E-3	6.745E-3

Net External Pressure = 18.9 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.237	7.5	6.1	OK
Unconstrained Collapse [psi]	23.1	123.6	5.4	OK
Compressive Wall Stress [psi]	54.1	1150.0	21.3	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	33.0	235.2	7.1	OK
Tensile Stress [psi]	382.1	1200.0	3.1	OK

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Project Summary

General:	HDD #17 - Conduit 1
	Start Date: 06-17-2022
	End Date: 06-17-2022
Project Owner:	TDI
Project Contractor:	KIEWIT
Project Consultant:	CHA
Designer:	MCS
	CHA

Description:

Input Summary

Start Coordinate	(0.00, 0.00, 144.20) ft
End Coordinate	(662.00, 0.00, 142.90) ft
Project Length	662.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 7

Soil Layer #1 USCS, Sand (S), SP
Depth: 4.50 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, Clay (C), CL
Depth: 2.50 ft
Unit Weight: 100.0000 (dry), 120.0000 (sat) [lb/ft3]
Phi: 0.00, S.M.: 145.00, Coh: 8.33 [psi]

Soil Layer #3 USCS, Clay (C), CH
Depth: 3.50 ft
Unit Weight: 100.0000 (dry), 120.0000 (sat) [lb/ft3]
Phi: 0.00, S.M.: 145.00, Coh: 8.33 [psi]

Soil Layer #4 USCS, Clay (C), CL
Depth: 3.50 ft
Unit Weight: 100.0000 (dry), 120.0000 (sat) [lb/ft3]
Phi: 0.00, S.M.: 145.00, Coh: 8.30 [psi]

Soil Layer #5 USCS, Clay (C), CL
Depth: 9.50 ft
Unit Weight: 100.0000 (dry), 120.0000 (sat) [lb/ft3]
Phi: 0.00, S.M.: 145.00, Coh: 8.30 [psi]

Soil Layer #6 USCS, Clay (C), CH
Depth: 9.50 ft
Unit Weight: 100.0000 (dry), 120.0000 (sat) [lb/ft3]
Phi: 0.00, S.M.: 145.00, Coh: 8.30 [psi]

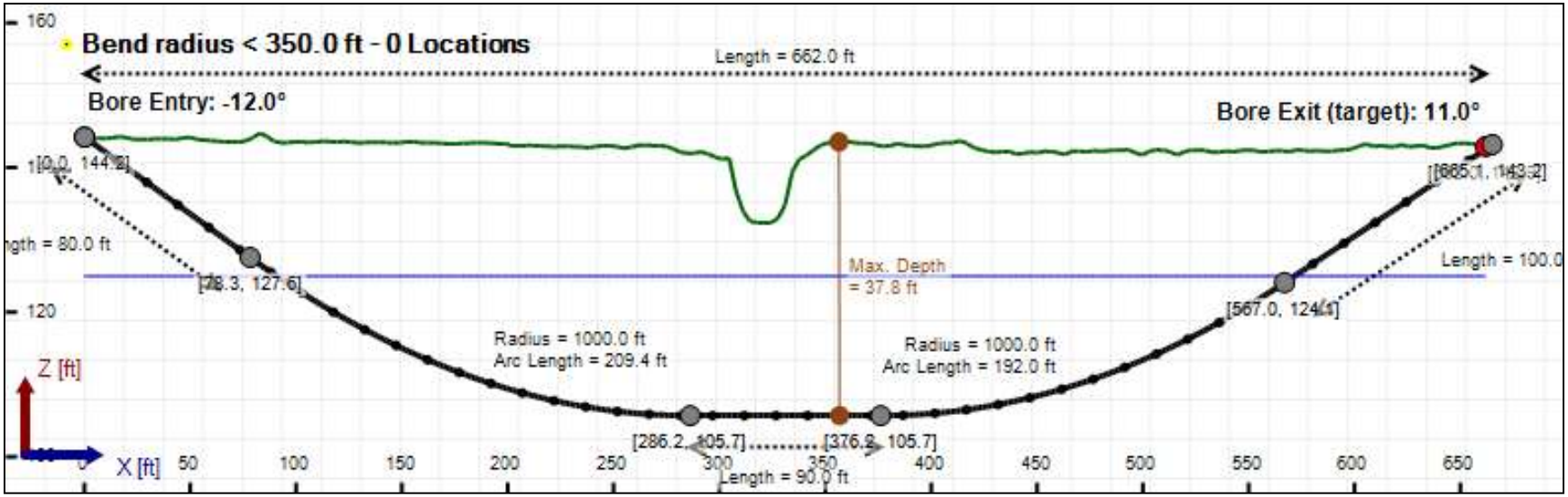
Soil Layer #7 USCS, Clay (C), CL

Depth: 10.00 ft

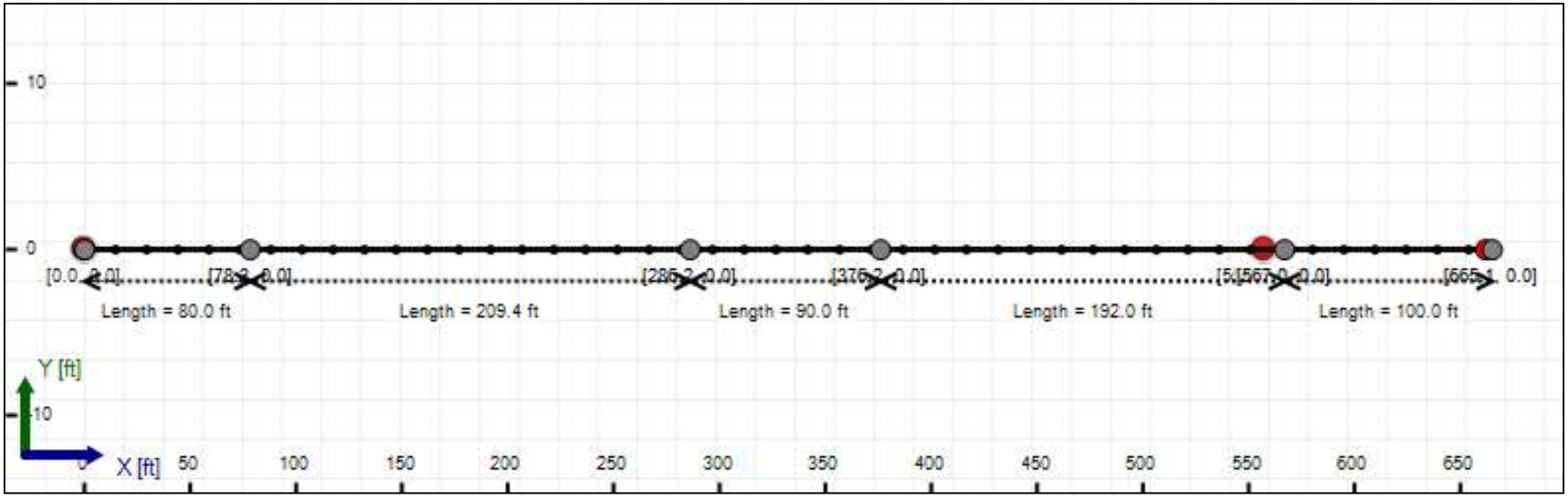
Unit Weight: 100.0000 (dry), 120.0000 (sat) [lb/ft3]

Phi: 0.00, S.M.: 145.00, Coh: 8.30 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 10" (10.75")
Pipe DR: 9
Pipe Length: 675.00 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	13.9	20.7
Water Pressure	8.4	8.4
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	22.3	29.1
Deflection		
Earth Load Deflection	3.783	5.644
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	3.915	5.776
Compressive Stress [psi]		
Compressive Wall Stress	100.1	130.9

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	11799.8	11799.8
Pullback Stress [psi]	329.1	329.1
Pullback Strain	5.723E-3	5.723E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	329.1	354.3
Tensile Strain	5.723E-3	6.609E-3

Net External Pressure = 20.1 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	3.915	7.5	1.9	OK
Unconstrained Collapse [psi]	25.0	97.3	3.9	OK
Compressive Wall Stress [psi]	100.1	1150.0	11.5	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	35.0	236.2	6.7	OK
Tensile Stress [psi]	354.3	1200.0	3.4	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	63.632 psi	61.097 psi
1	8.00 in	12.00 in	63.596 psi	61.041 psi
2	12.00 in	16.13 in	63.543 psi	60.961 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

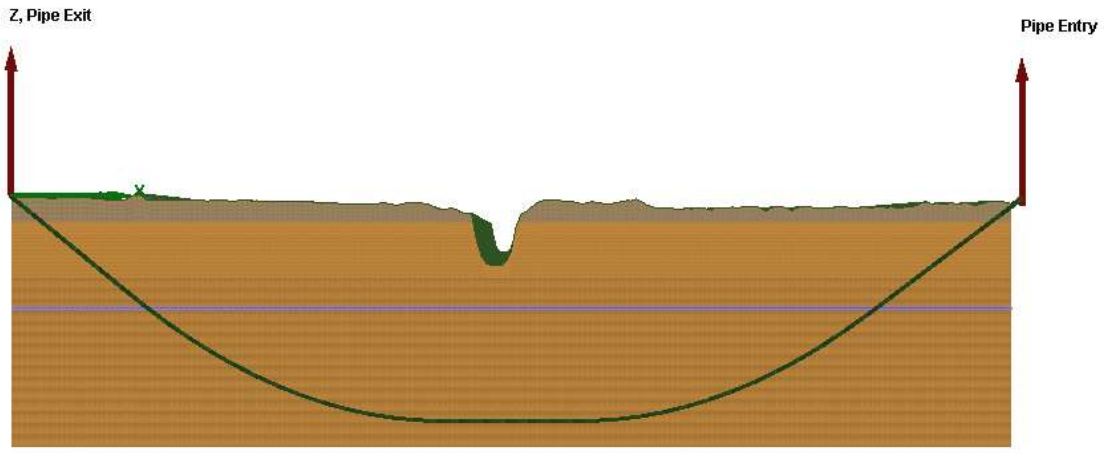
Rheological model: Bingham-Plastic

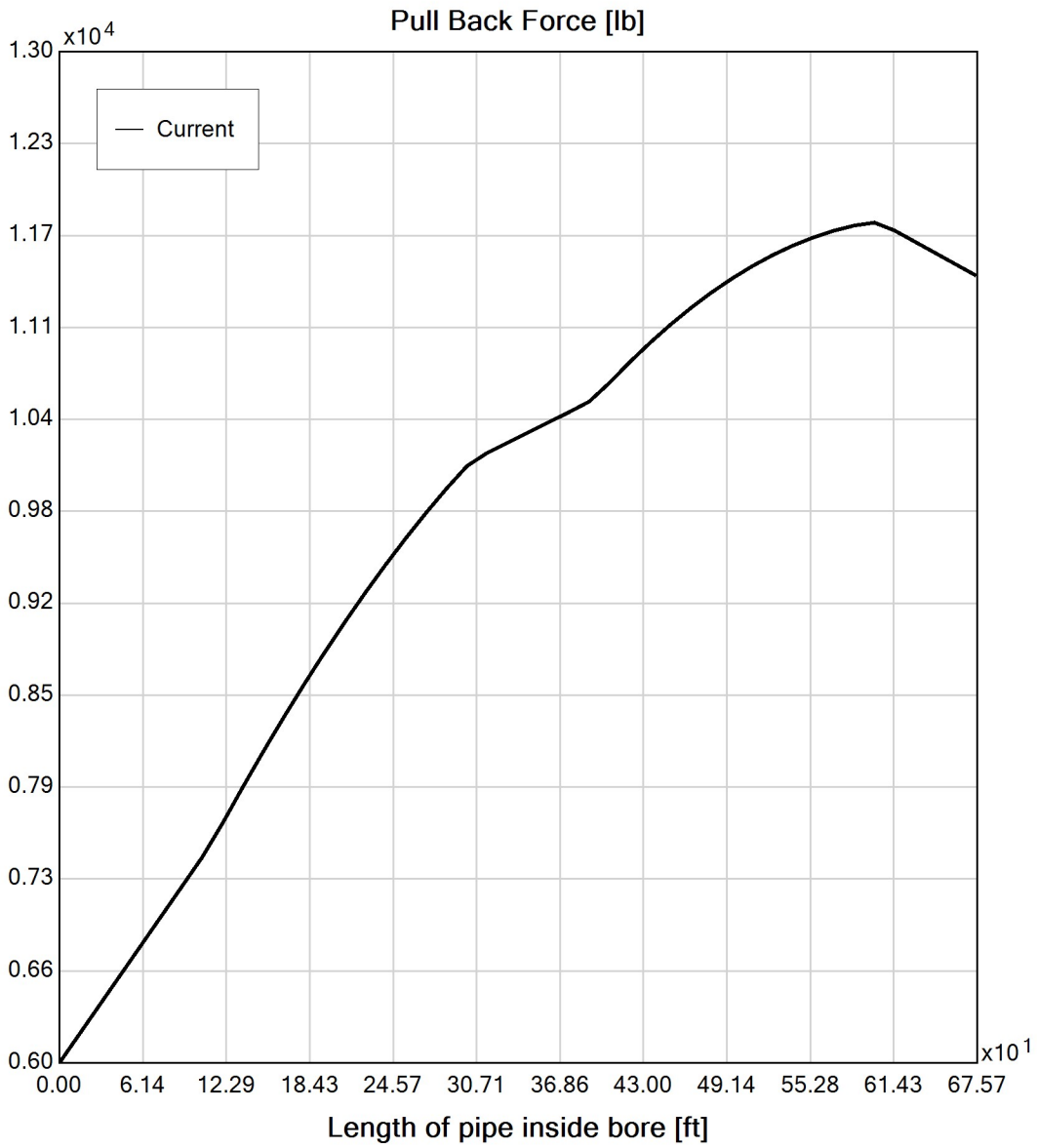
Plastic Viscosity (PV): 25.53

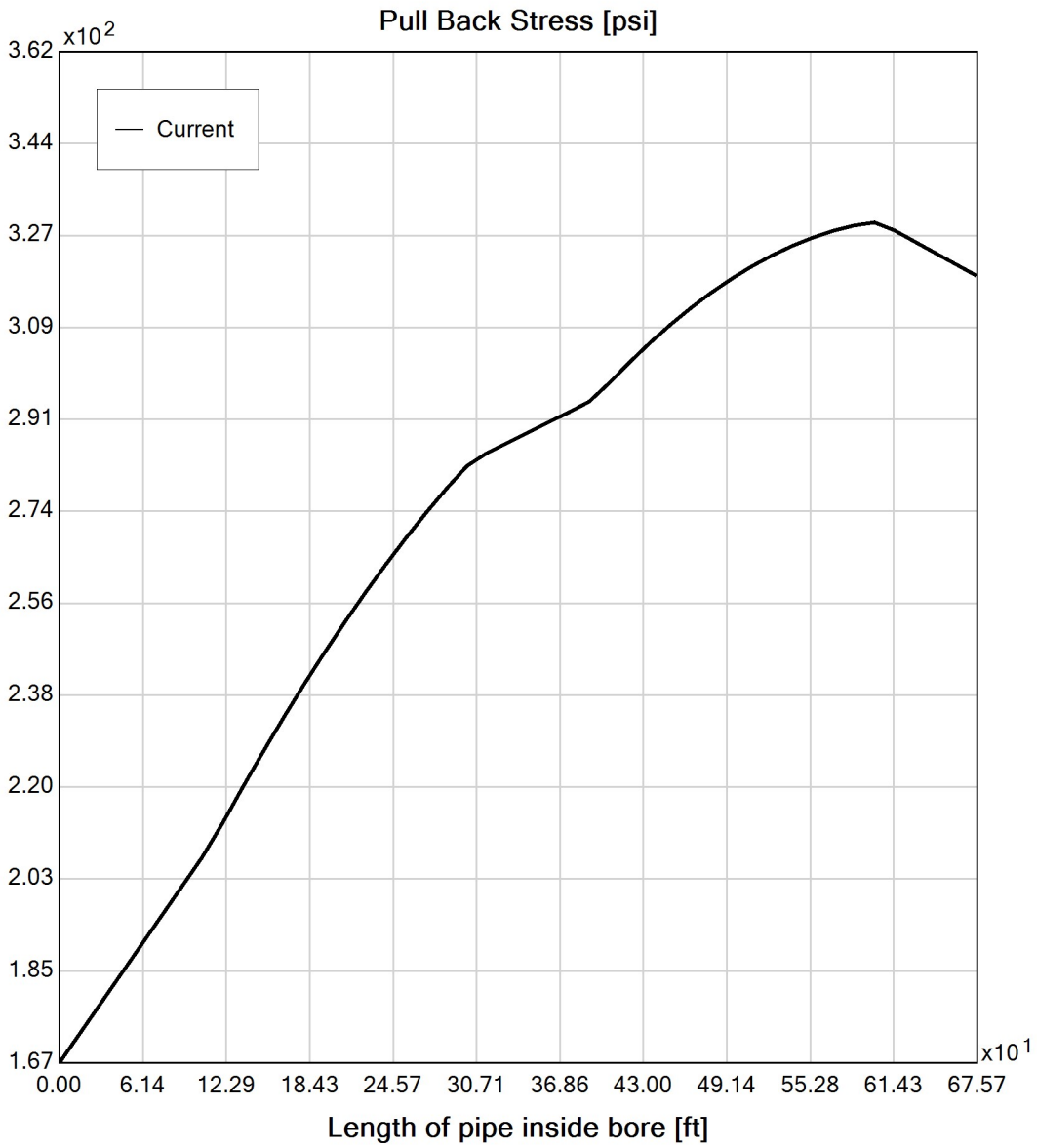
Yield Point (YP): 16.49

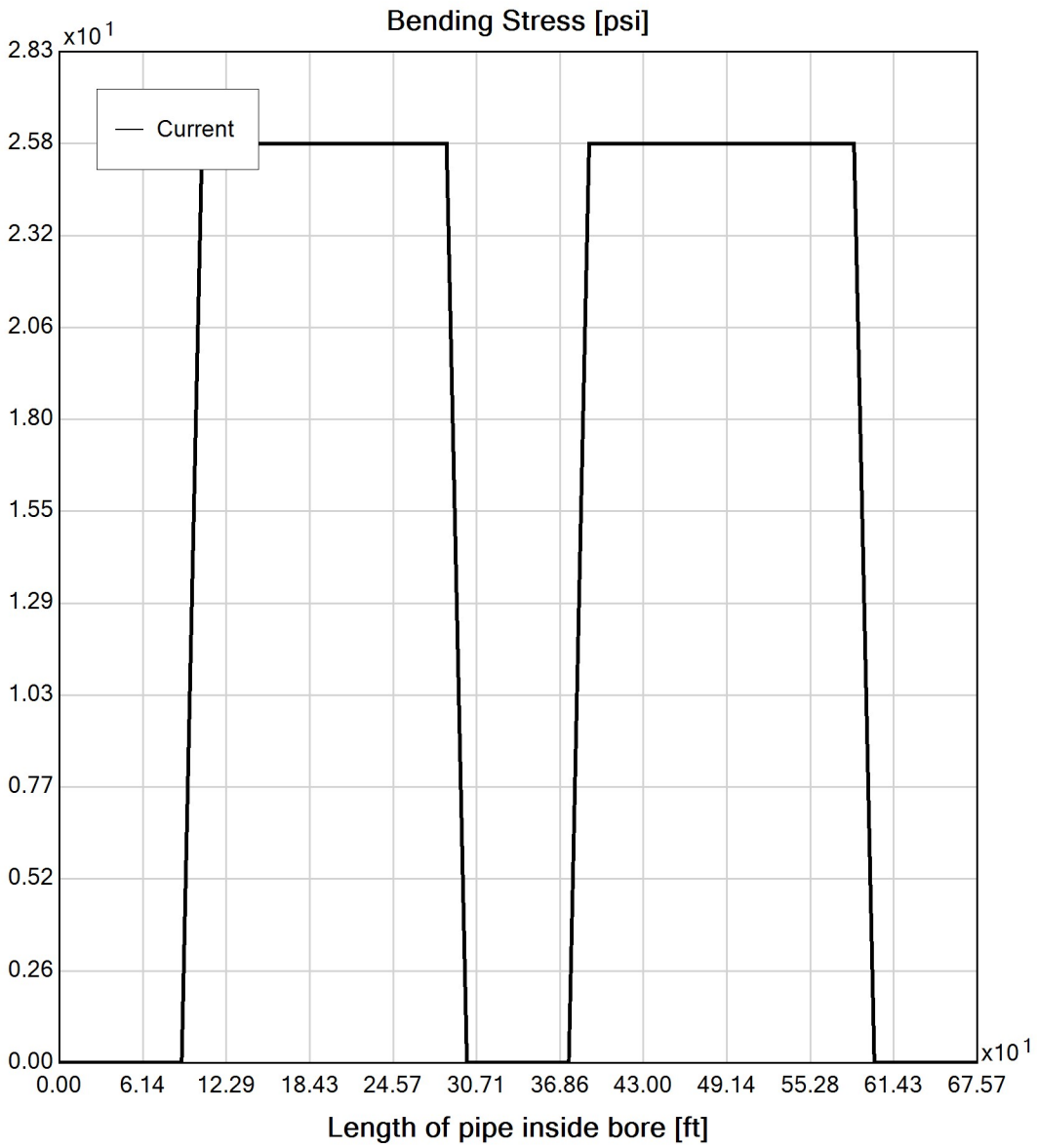
Effective Viscosity (cP): 1202.0

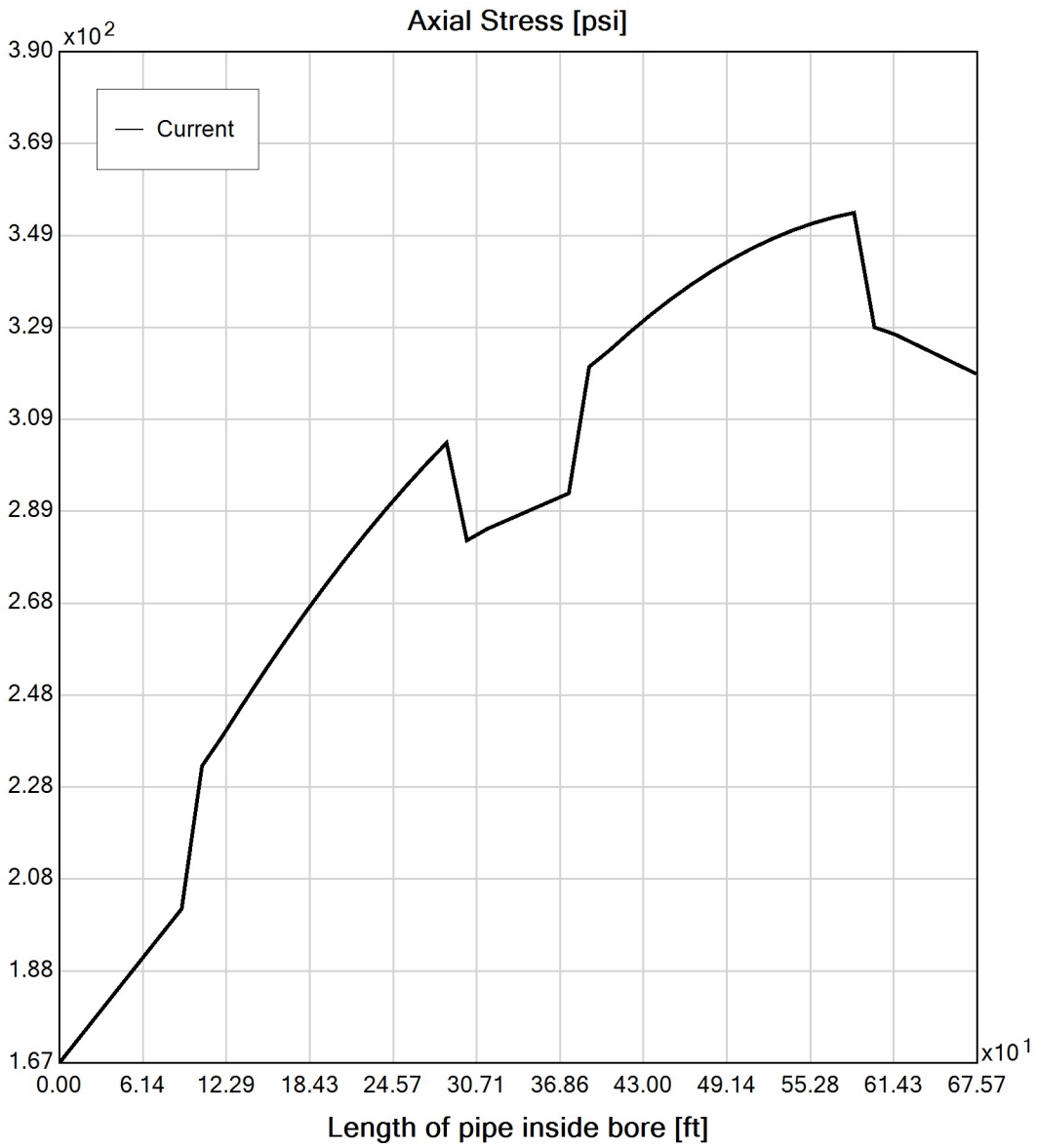
Virtual Site

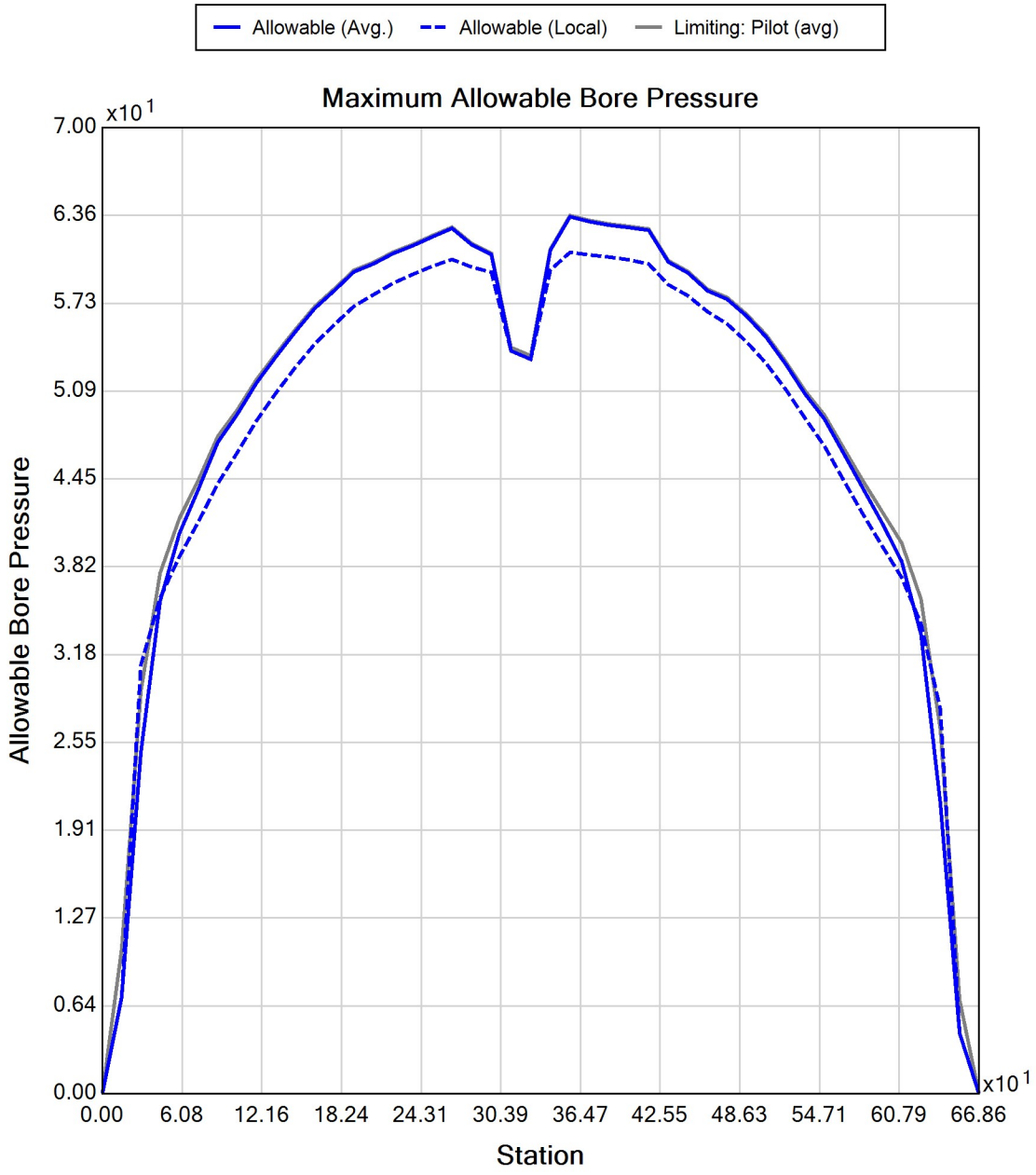


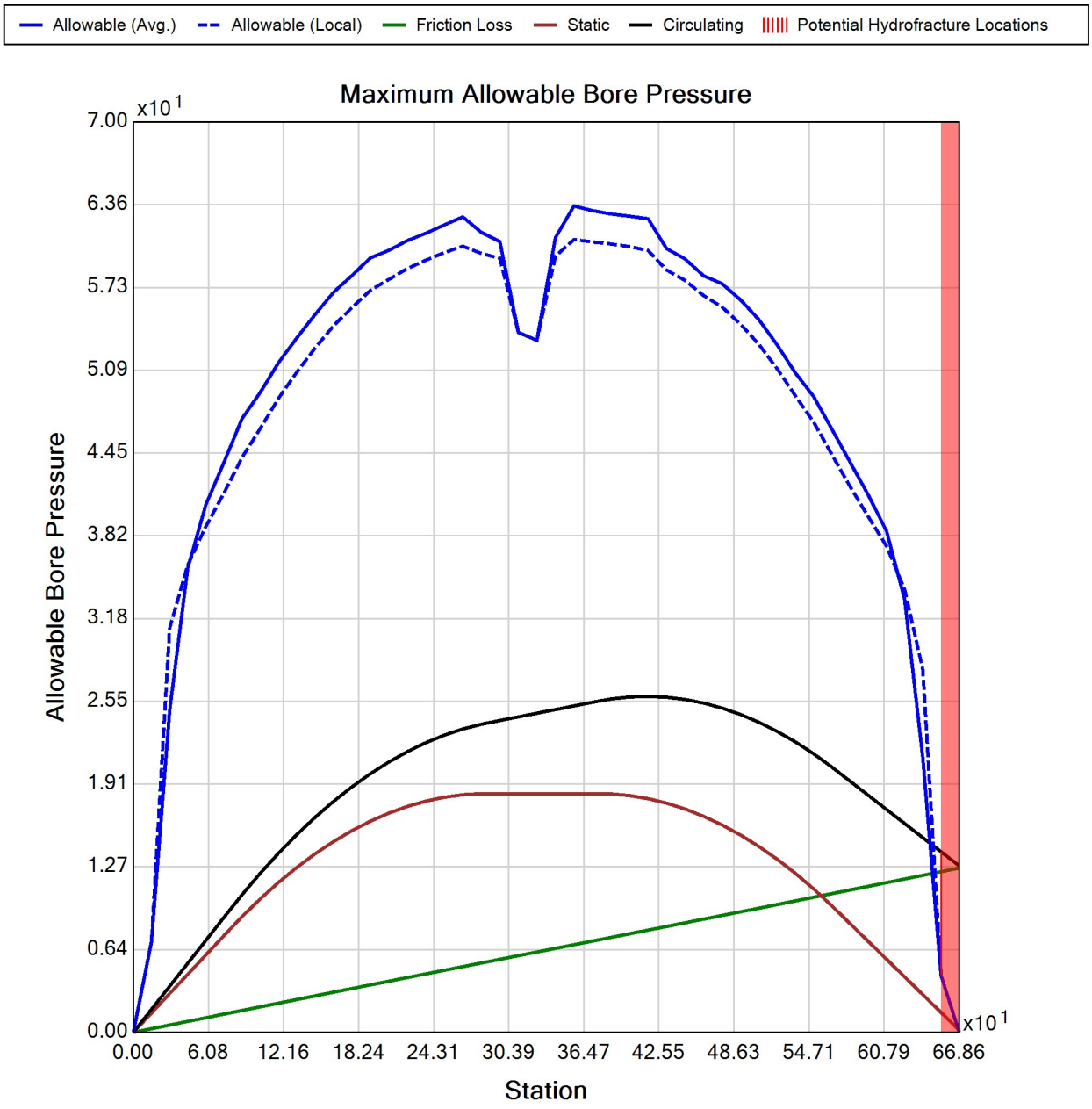












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Input Summary

Start Coordinate	(0.00, 0.00, 144.20) ft
End Coordinate	(662.00, 0.00, 142.90) ft
Project Length	662.00 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: 675.00 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	13.7	20.7
Water Pressure	8.4	8.4
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	22.1	29.1
Deflection		
Earth Load Deflection	3.740	5.644
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	3.769	5.673
Compressive Stress [psi]		
Compressive Wall Stress	99.4	130.9

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	685.5	685.5
Pullback Stress [psi]	391.7	391.7
Pullback Strain	6.812E-3	6.812E-3
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	391.7	396.8
Tensile Strain	6.812E-3	7.000E-3

Net External Pressure = 20.1 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	3.769	7.5	2.0	OK
Unconstrained Collapse [psi]	25.0	98.6	3.9	OK
Compressive Wall Stress [psi]	99.4	1150.0	11.6	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	35.0	234.5	6.7	OK
Tensile Stress [psi]	396.8	1200.0	3.0	OK

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Project Summary

General:	HDD #17 - Conduit 2 Ref: BLANK BLANK Start Date: 06-17-2022 End Date: 06-17-2022
Project Owner:	TDI
Project Contractor:	KIEWIT
Project Consultant:	CHA
Designer:	MCS CHA BLANK BLANK, BLANK BLANK BLANK Phone: BLANK Fax: BLANK BLANK
Description:	BLANK

Input Summary

Start Coordinate	(0.00, 0.00, 144.96) ft
End Coordinate	(575.00, 0.00, 145.00) ft
Project Length	575.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 7

Soil Layer #1 USCS, Sand (S), SP
Depth: 4.50 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, Clay (C), CL
Depth: 2.50 ft
Unit Weight: 100.0000 (dry), 120.0000 (sat) [lb/ft3]
Phi: 0.00, S.M.: 145.00, Coh: 8.33 [psi]

Soil Layer #3 USCS, Clay (C), CH
Depth: 3.50 ft
Unit Weight: 100.0000 (dry), 120.0000 (sat) [lb/ft3]
Phi: 0.00, S.M.: 145.00, Coh: 8.33 [psi]

Soil Layer #4 USCS, Clay (C), CL
Depth: 3.50 ft
Unit Weight: 100.0000 (dry), 120.0000 (sat) [lb/ft3]
Phi: 0.00, S.M.: 145.00, Coh: 8.30 [psi]

Soil Layer #5 USCS, Clay (C), CL
Depth: 9.50 ft
Unit Weight: 100.0000 (dry), 120.0000 (sat) [lb/ft3]
Phi: 0.00, S.M.: 145.00, Coh: 8.30 [psi]

Soil Layer #6 USCS, Clay (C), CH
Depth: 9.50 ft
Unit Weight: 100.0000 (dry), 120.0000 (sat) [lb/ft3]
Phi: 0.00, S.M.: 145.00, Coh: 8.30 [psi]

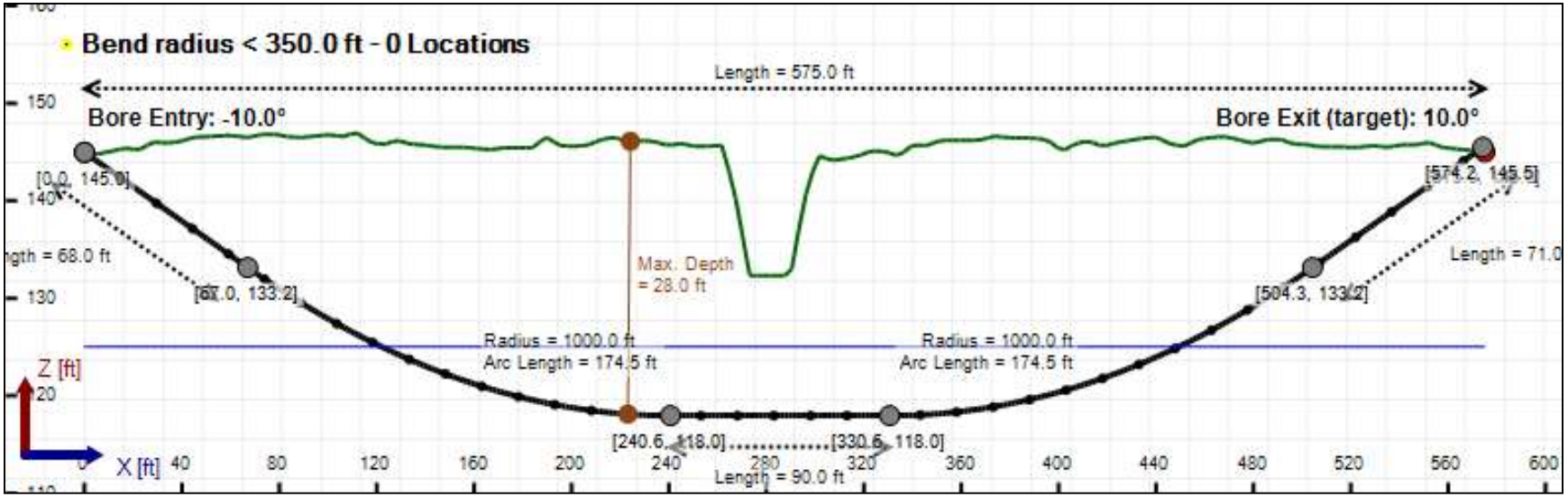
Soil Layer #7 USCS, Clay (C), CL

Depth: 10.00 ft

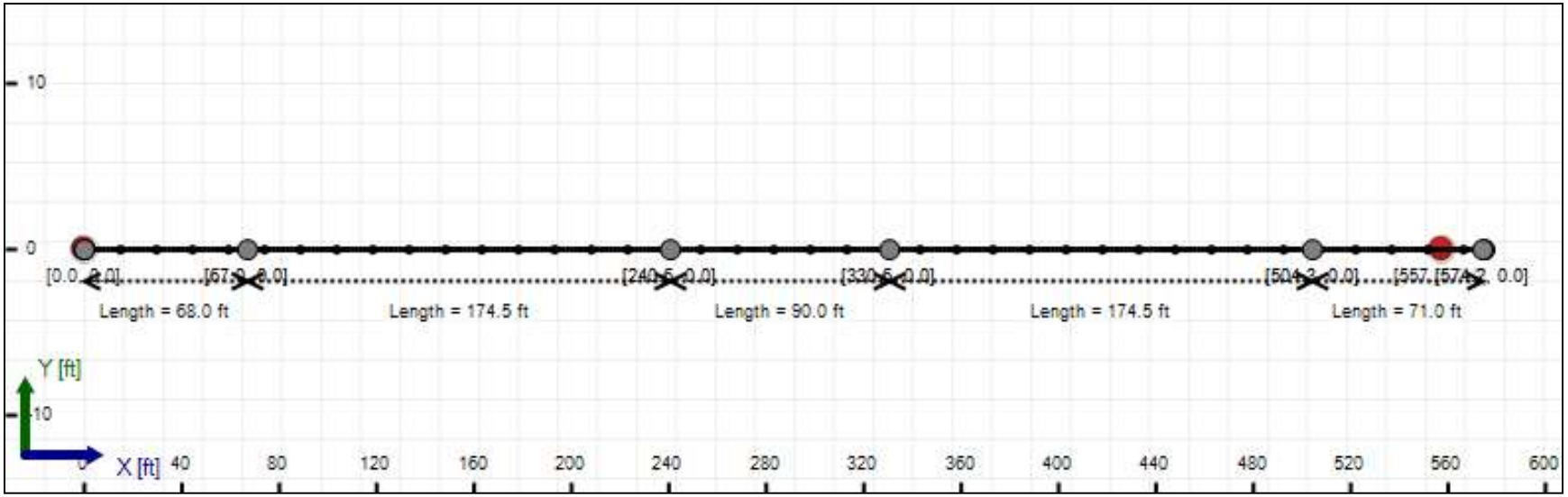
Unit Weight: 100.0000 (dry), 120.0000 (sat) [lb/ft3]

Phi: 0.00, S.M.: 145.00, Coh: 8.30 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 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	12.7	17.6
Water Pressure	3.1	3.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	15.8	20.6
Deflection		
Earth Load Deflection	3.464	4.804
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	3.596	4.937
Compressive Stress [psi]		
Compressive Wall Stress	71.0	92.7

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	9992.2	9992.2
Pullback Stress [psi]	278.7	278.7
Pullback Strain	4.846E-3	4.846E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	278.7	303.8
Tensile Strain	4.846E-3	5.731E-3

Net External Pressure = 17.9 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	3.596	7.5	2.1	OK
Unconstrained Collapse [psi]	18.7	100.1	5.4	OK
Compressive Wall Stress [psi]	71.0	1150.0	16.2	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	28.7	239.0	8.3	OK
Tensile Stress [psi]	303.8	1200.0	4.0	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	56.651 psi	52.585 psi
1	8.00 in	12.00 in	56.572 psi	52.484 psi
2	12.00 in	16.13 in	56.460 psi	52.340 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

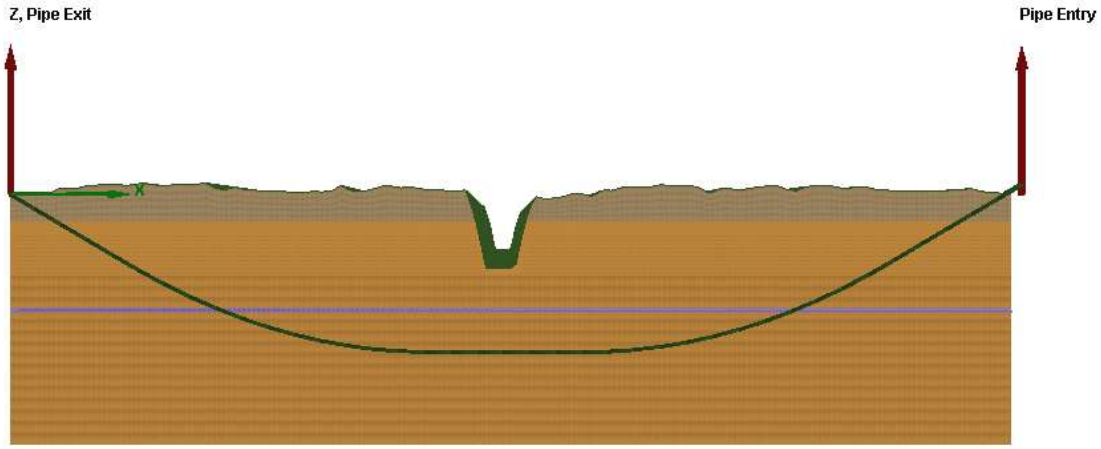
Rheological model: Bingham-Plastic

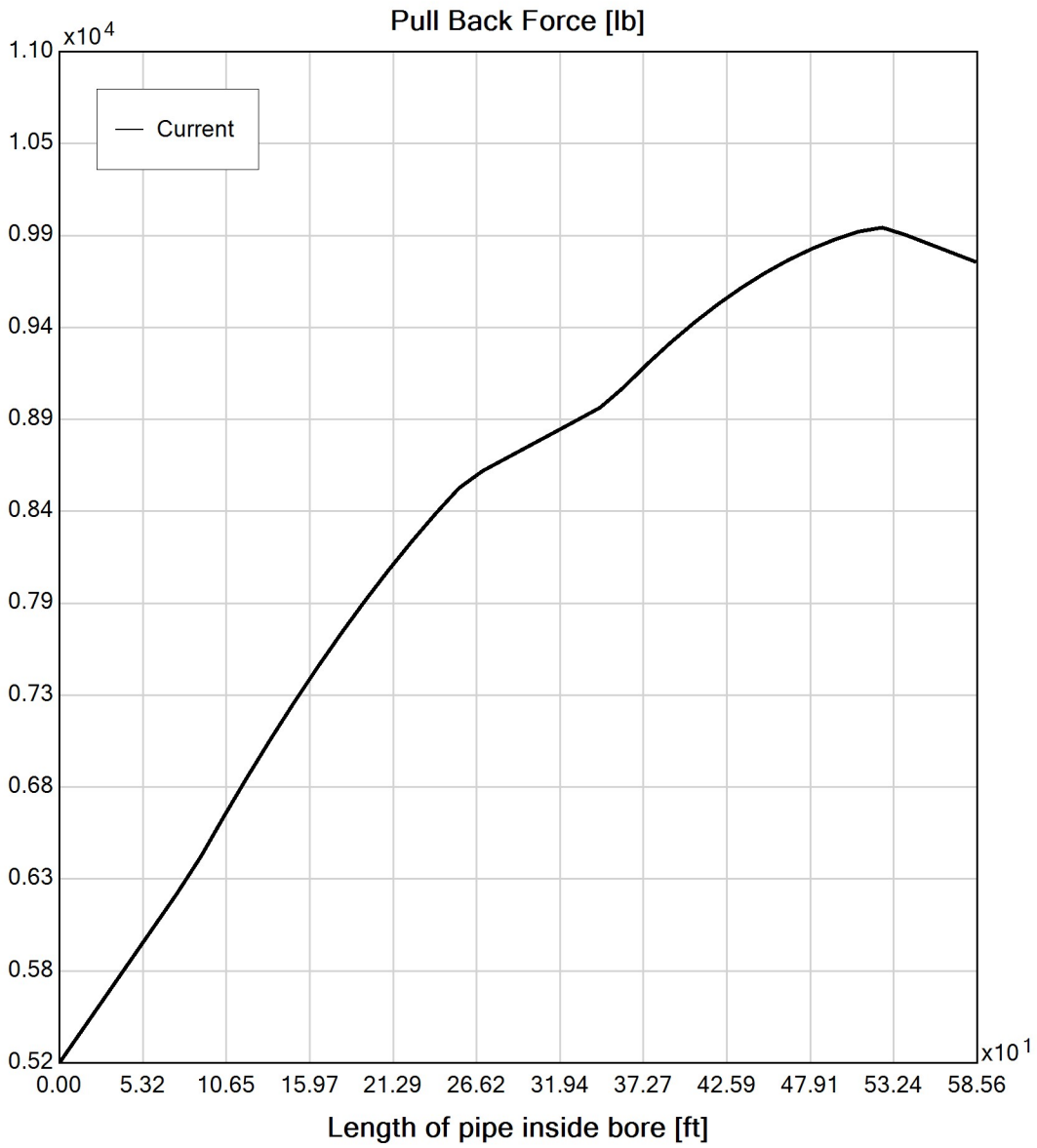
Plastic Viscosity (PV): 25.53

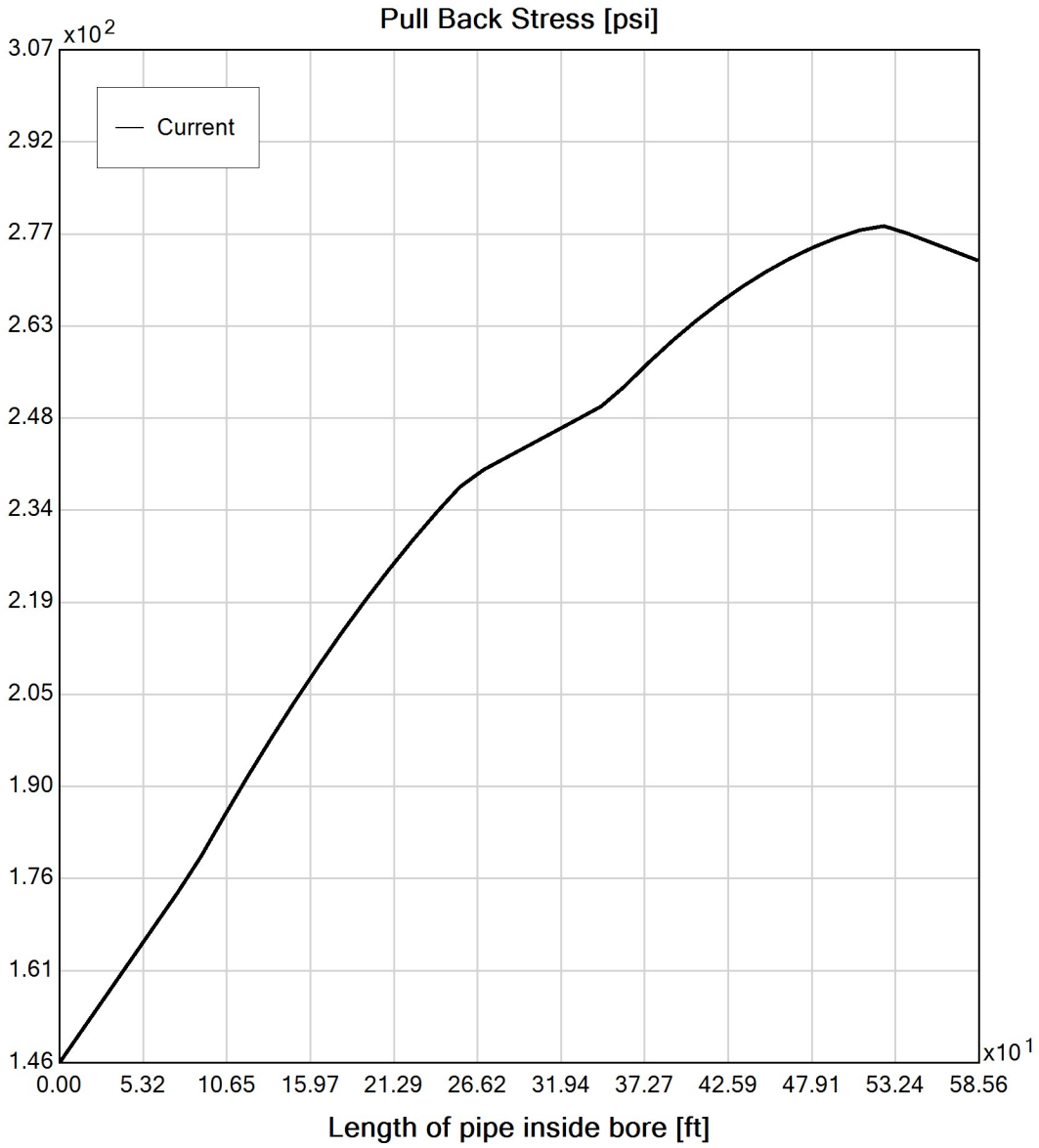
Yield Point (YP): 16.49

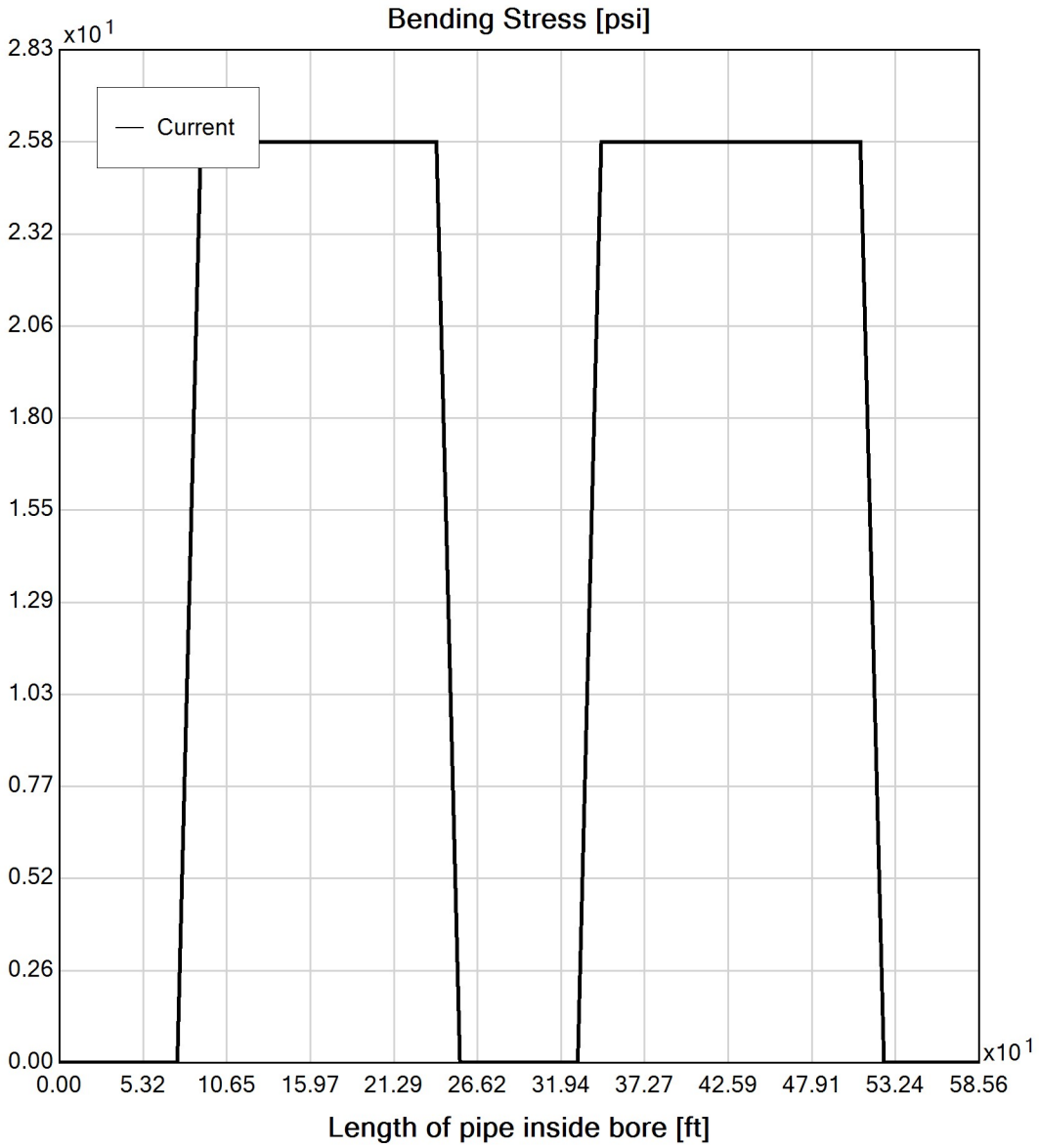
Effective Viscosity (cP): 1202.0

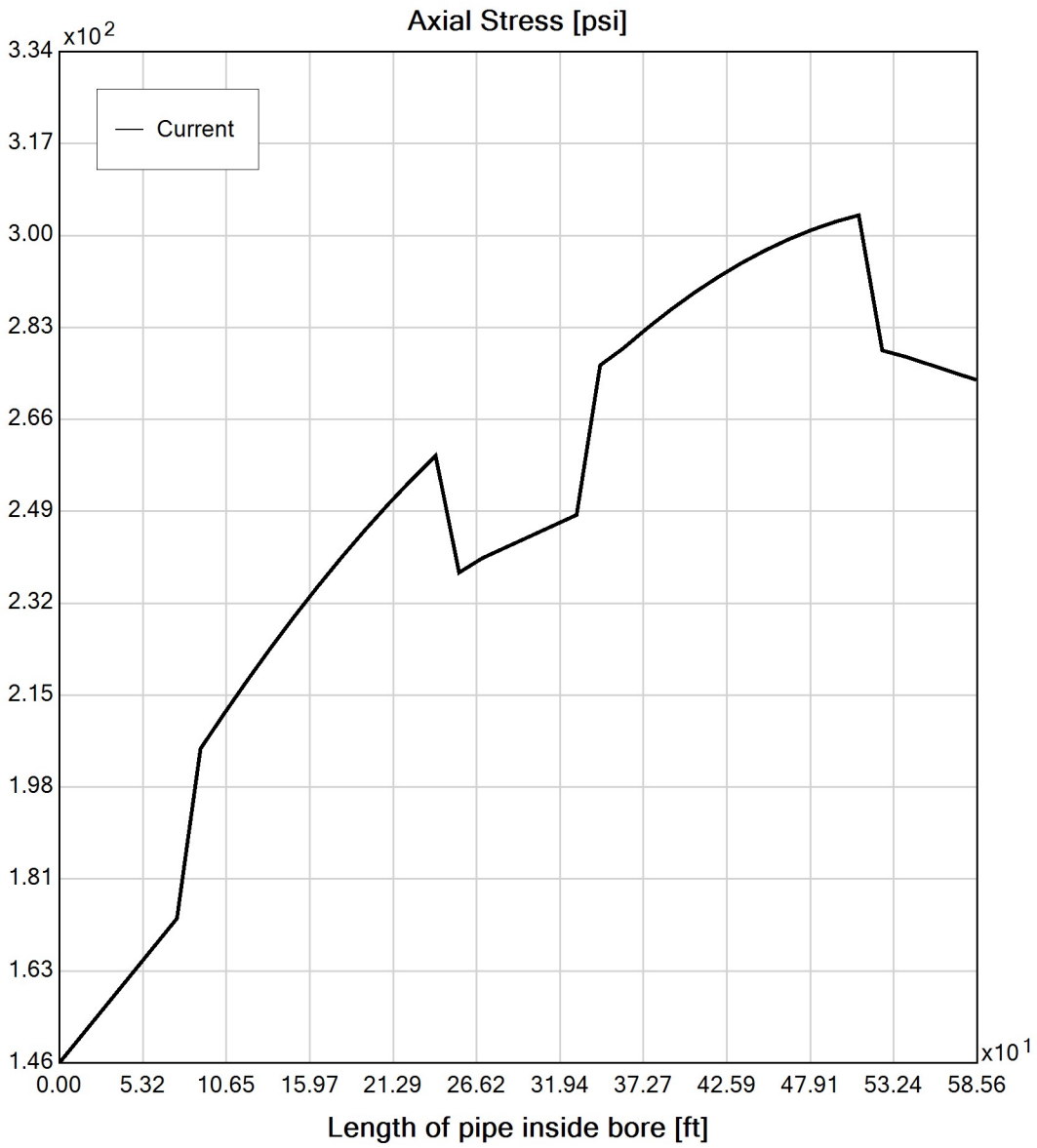
Virtual Site

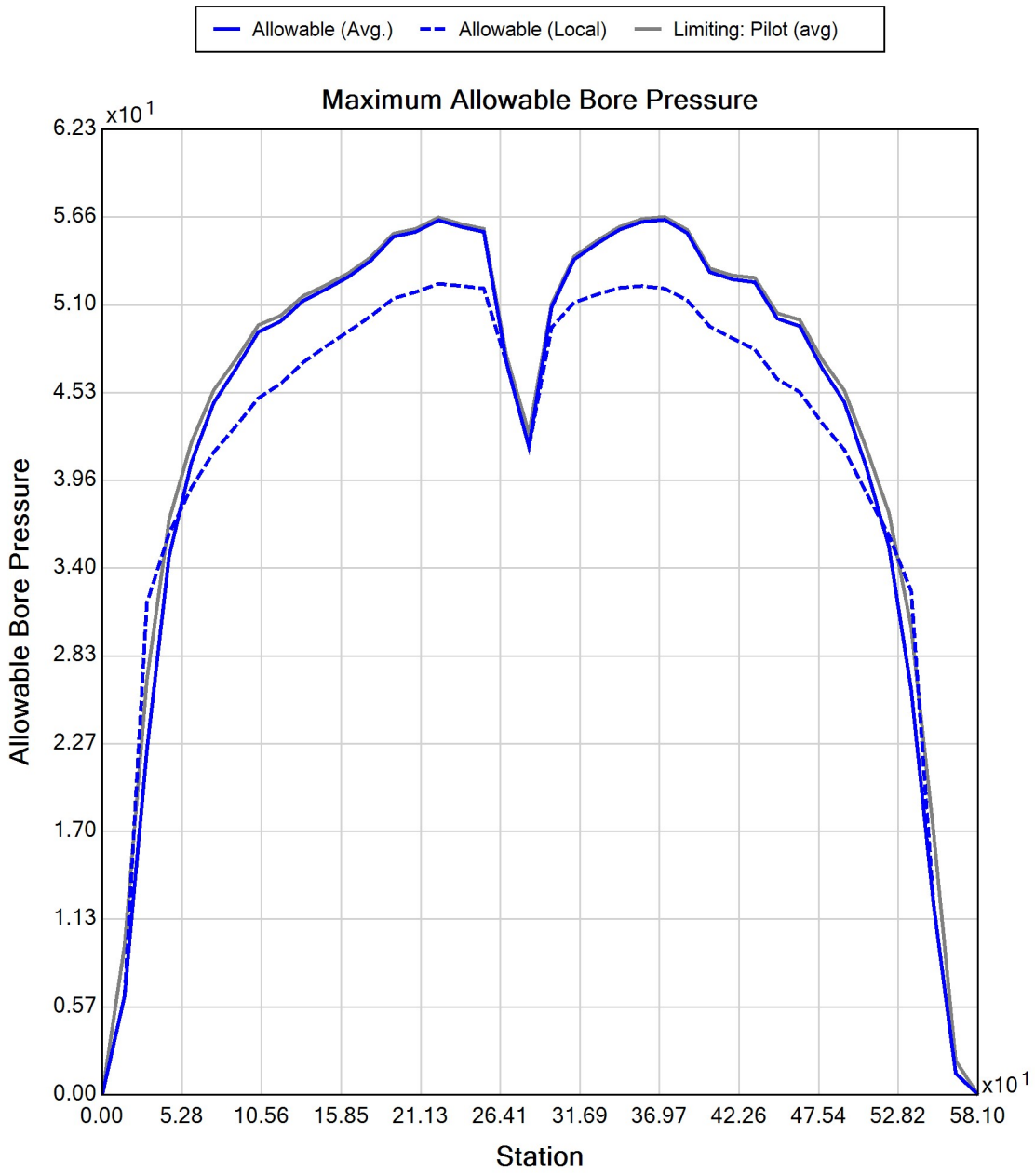


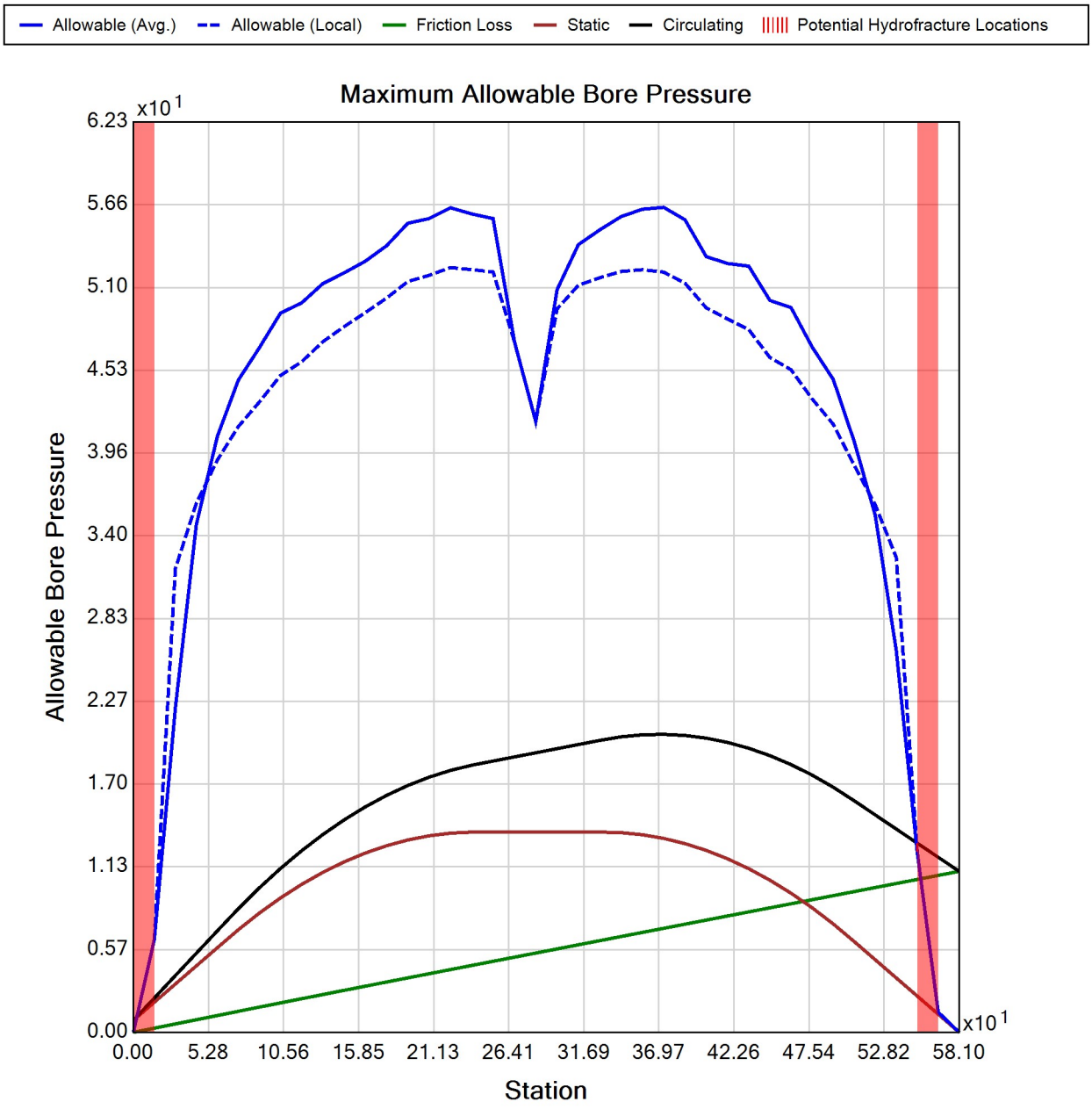












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Input Summary

Start Coordinate	(0.00, 0.00, 144.96) ft
End Coordinate	(575.00, 0.00, 145.00) ft
Project Length	575.00 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	12.7	17.6
Water Pressure	3.1	3.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	15.8	20.6
Deflection		
Earth Load Deflection	3.464	4.804
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	3.493	4.834
Compressive Stress [psi]		
Compressive Wall Stress	71.0	92.7

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	597.3	597.3
Pullback Stress [psi]	341.3	341.3
Pullback Strain	5.935E-3	5.935E-3
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	341.3	346.3
Tensile Strain	5.935E-3	6.122E-3

Net External Pressure = 17.9 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	3.493	7.5	2.1	OK
Unconstrained Collapse [psi]	18.7	101.0	5.4	OK
Compressive Wall Stress [psi]	71.0	1150.0	16.2	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	28.7	237.4	8.3	OK
Tensile Stress [psi]	346.3	1200.0	3.5	OK

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Project Summary

General:	HDD #18
	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, 141.72) ft
End Coordinate	(620.76, 0.00, 141.30) ft
Project Length	620.76 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), SM
Depth: 3.00 ft
Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft3]
Phi: 34.00, S.M.: 300.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Organic (O), OH
Depth: 6.00 ft
Unit Weight: 80.0000 (dry), 100.0000 (sat) [lb/ft3]
Phi: 30.00, S.M.: 100.00, Coh: 0.00 [psi]

Soil Layer #3 USCS, Silt (M), ML
Depth: 7.00 ft
Unit Weight: 80.0000 (dry), 100.0000 (sat) [lb/ft3]
Phi: 28.00, S.M.: 50.00, Coh: 0.00 [psi]

Soil Layer #4 USCS, Clay (C), CL
Depth: 7.00 ft
Unit Weight: 80.0000 (dry), 110.0000 (sat) [lb/ft3]
Phi: 0.00, S.M.: 200.00, Coh: 3.10 [psi]

Soil Layer #5 USCS, Sand (S), SP
Depth: 3.50 ft
Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft3]
Phi: 34.00, S.M.: 500.00, Coh: 0.00 [psi]

Soil Layer #6 USCS, Clay (C), CH
Depth: 5.00 ft
Unit Weight: 70.0000 (dry), 100.0000 (sat) [lb/ft3]
Phi: 0.00, S.M.: 200.00, Coh: 3.10 [psi]

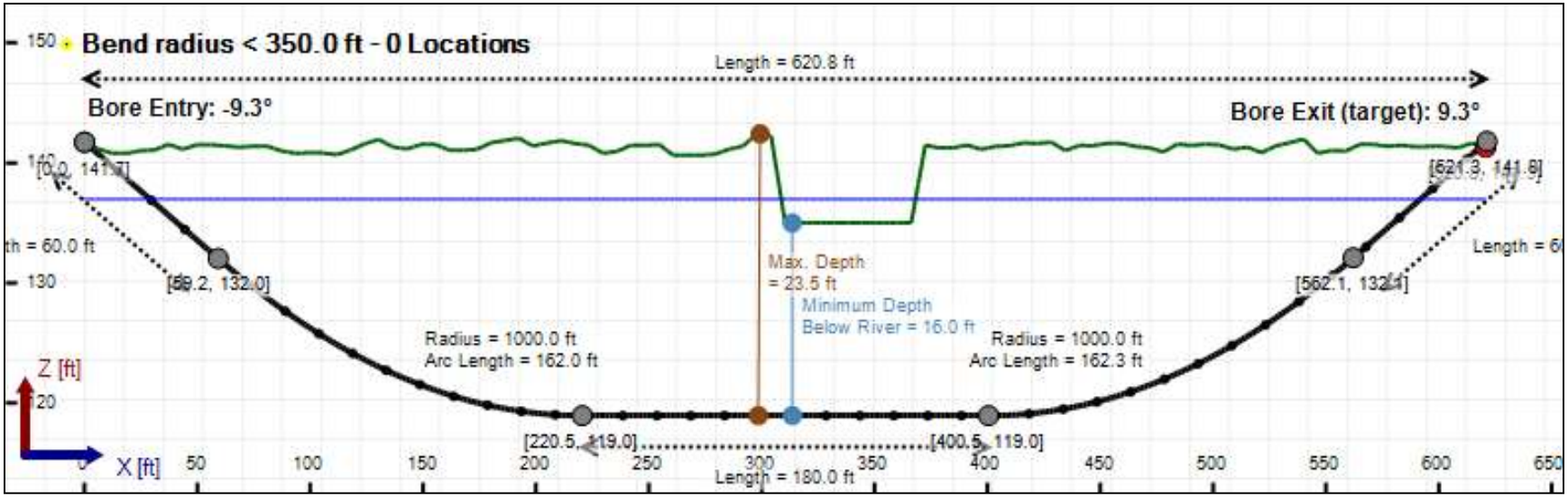
Soil Layer #7 USCS, Clay (C), CH

Depth: 15.00 ft

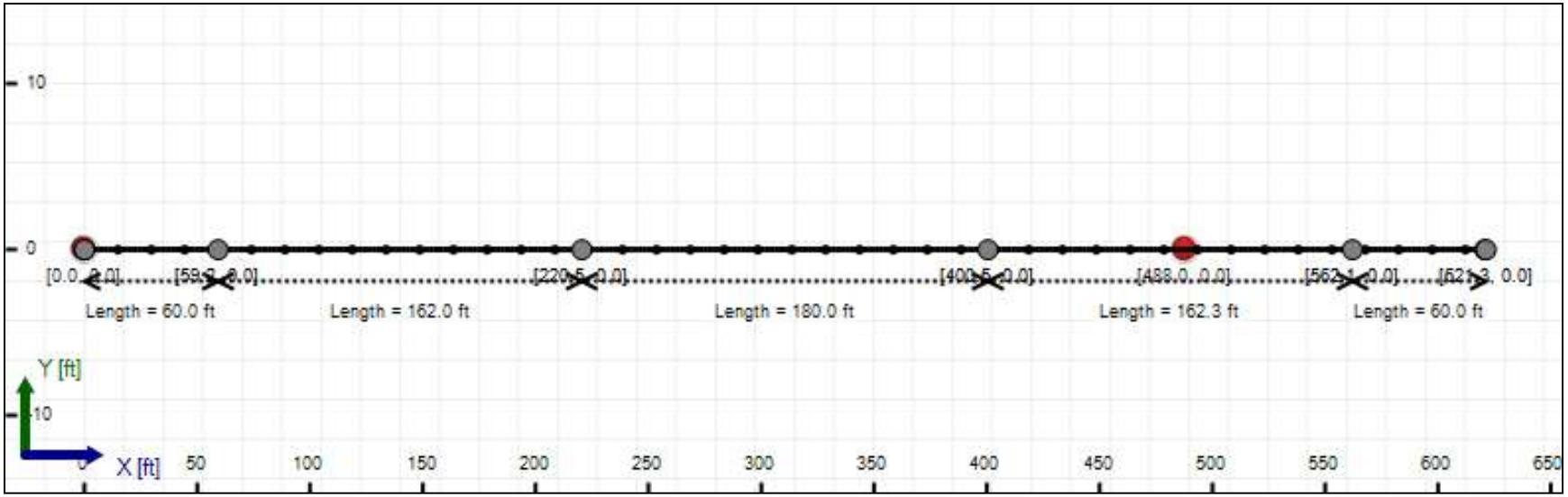
Unit Weight: 70.0000 (dry), 100.0000 (sat) [lb/ft3]

Phi: 0.00, S.M.: 145.00, Coh: 3.12 [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	2.8	9.0
Water Pressure	7.8	7.8
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	10.6	16.8
Deflection		
Earth Load Deflection	0.759	2.446
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	0.891	2.578
Compressive Stress [psi]		
Compressive Wall Stress	47.7	75.6

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	10420.8	10420.8
Pullback Stress [psi]	290.6	290.6
Pullback Strain	5.054E-3	5.054E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	290.6	314.8
Tensile Strain	5.054E-3	5.923E-3

Net External Pressure = 15.4 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.891	7.5	8.4	OK
Unconstrained Collapse [psi]	15.5	127.5	8.3	OK
Compressive Wall Stress [psi]	47.7	1150.0	24.1	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	25.4	238.2	9.4	OK
Tensile Stress [psi]	314.8	1200.0	3.8	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	45.272 psi	32.677 psi
1	8.00 in	12.00 in	45.065 psi	32.491 psi
2	12.00 in	16.13 in	44.773 psi	32.240 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

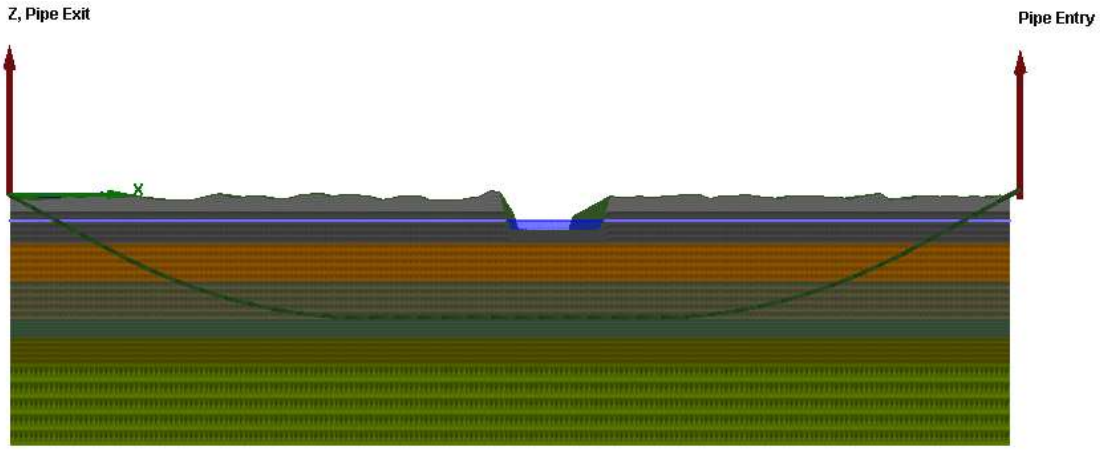
Rheological model: Bingham-Plastic

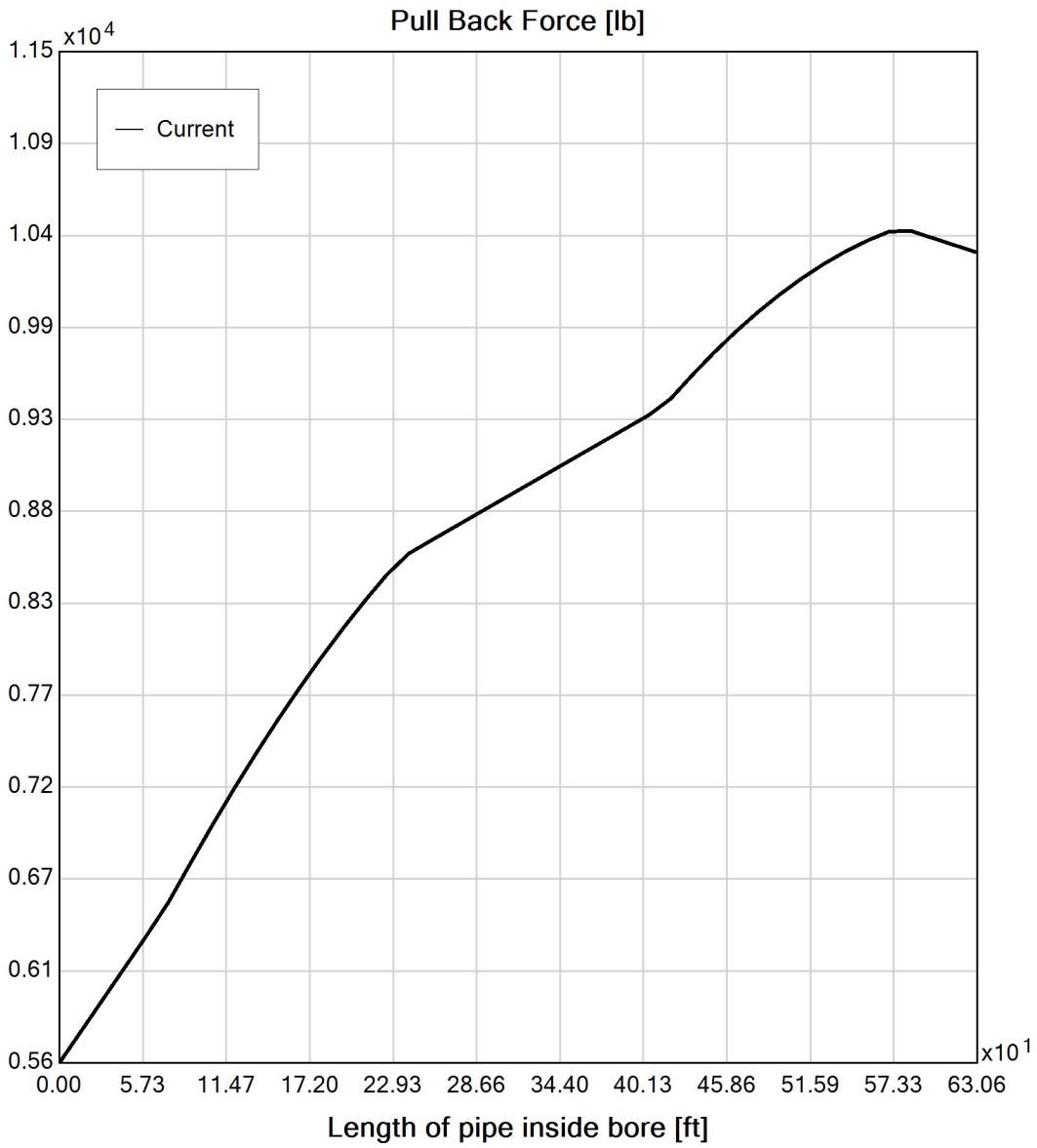
Plastic Viscosity (PV): 25.53

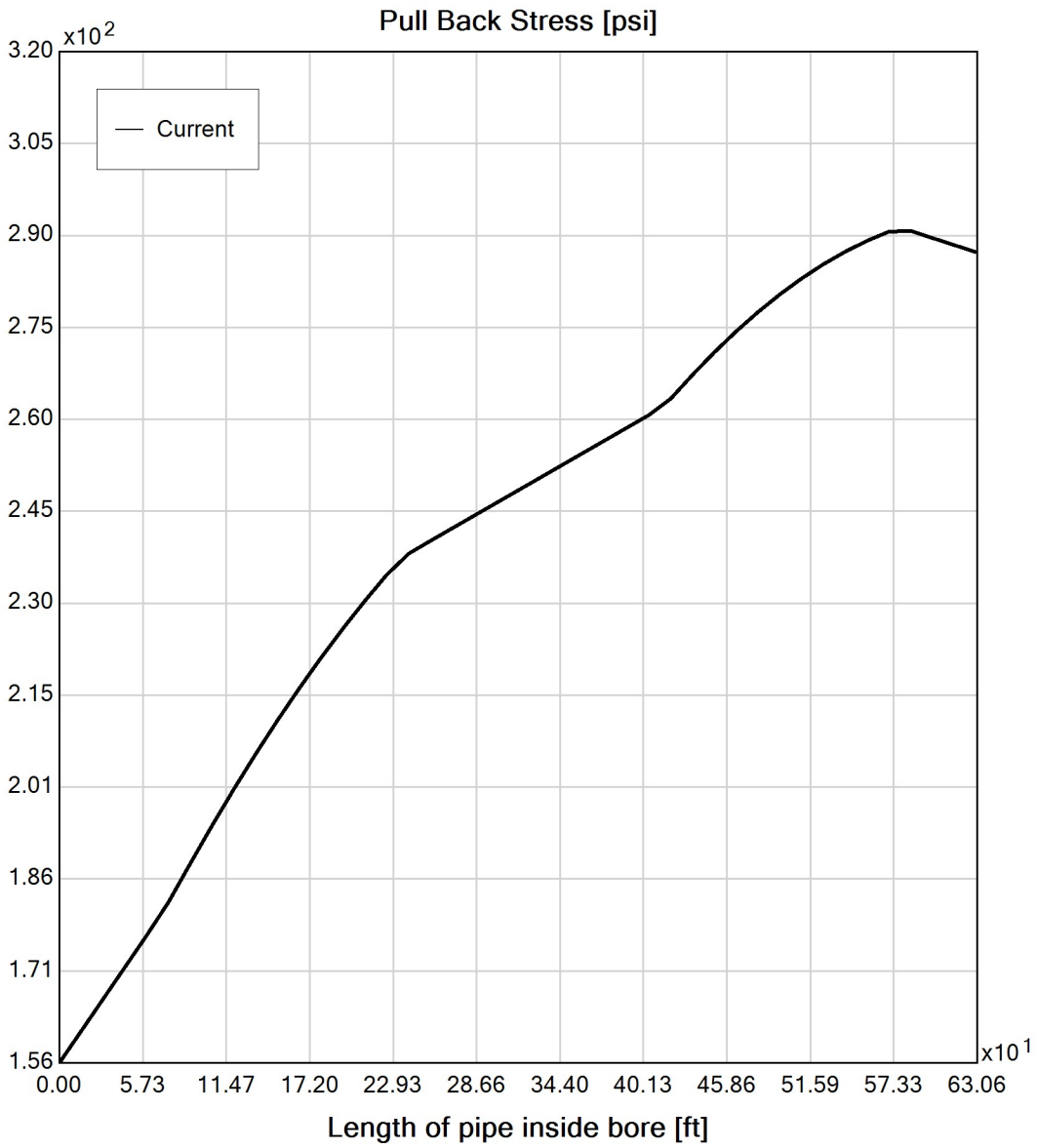
Yield Point (YP): 16.49

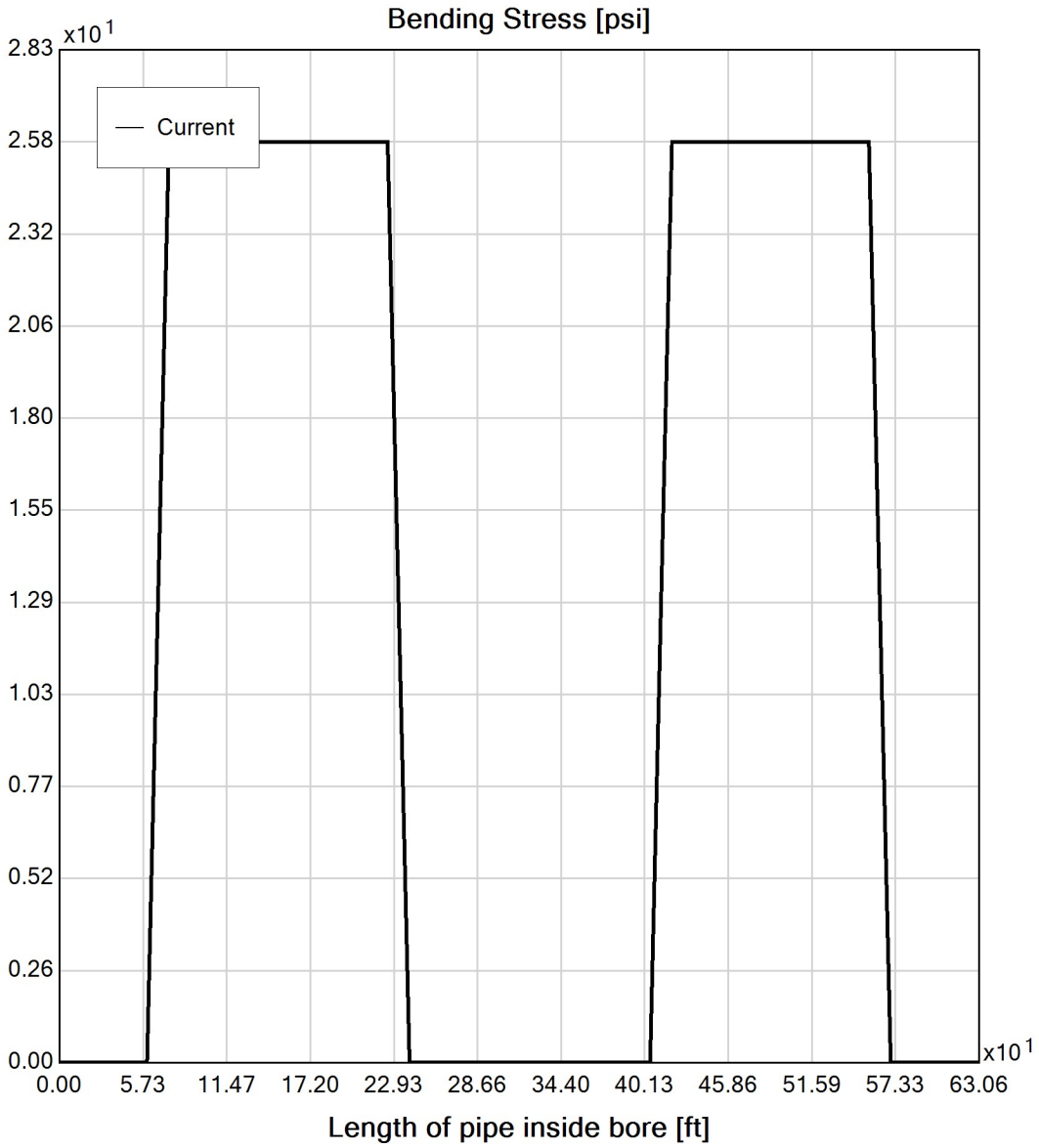
Effective Viscosity (cP): 1202.0

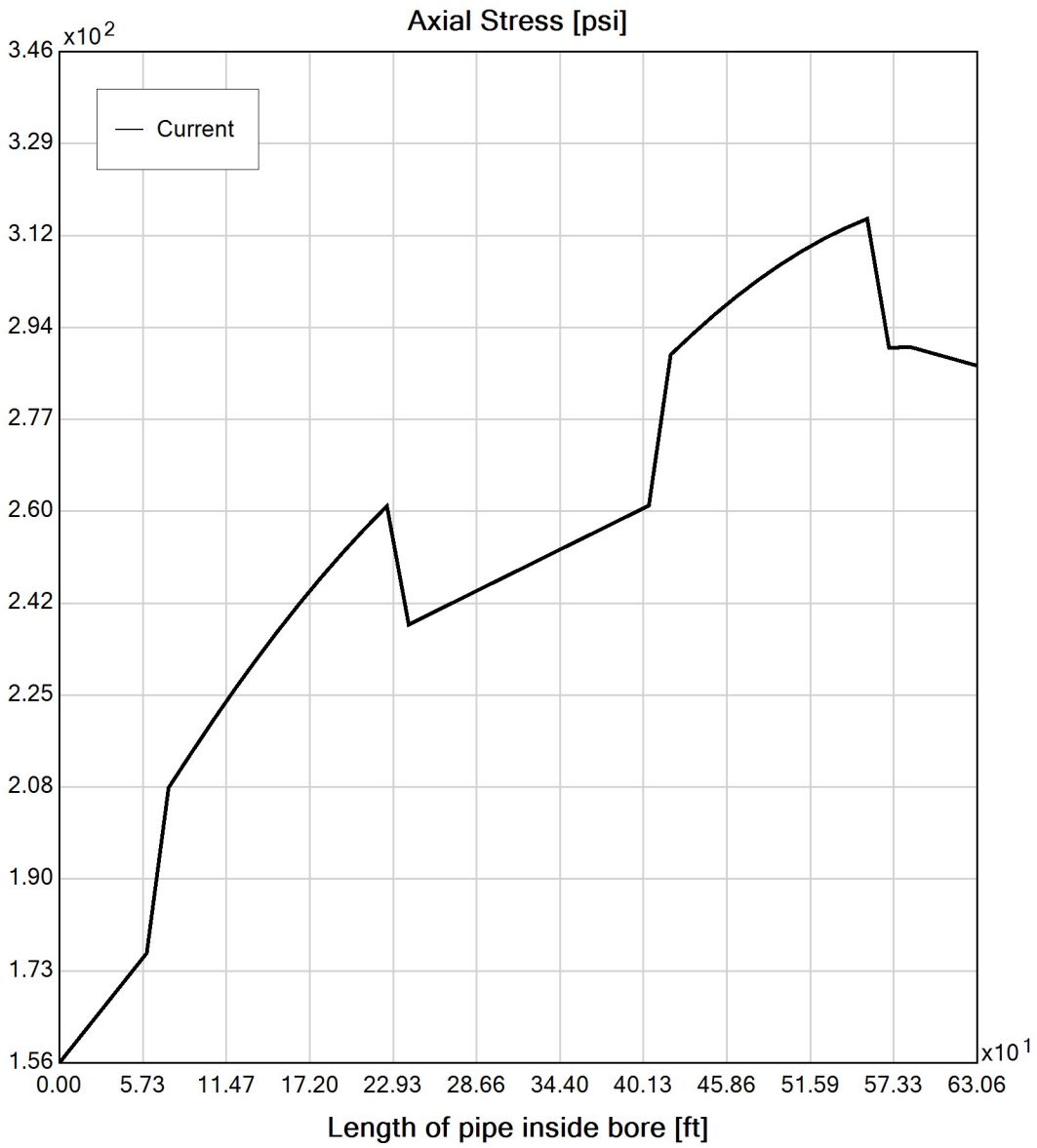
Virtual Site

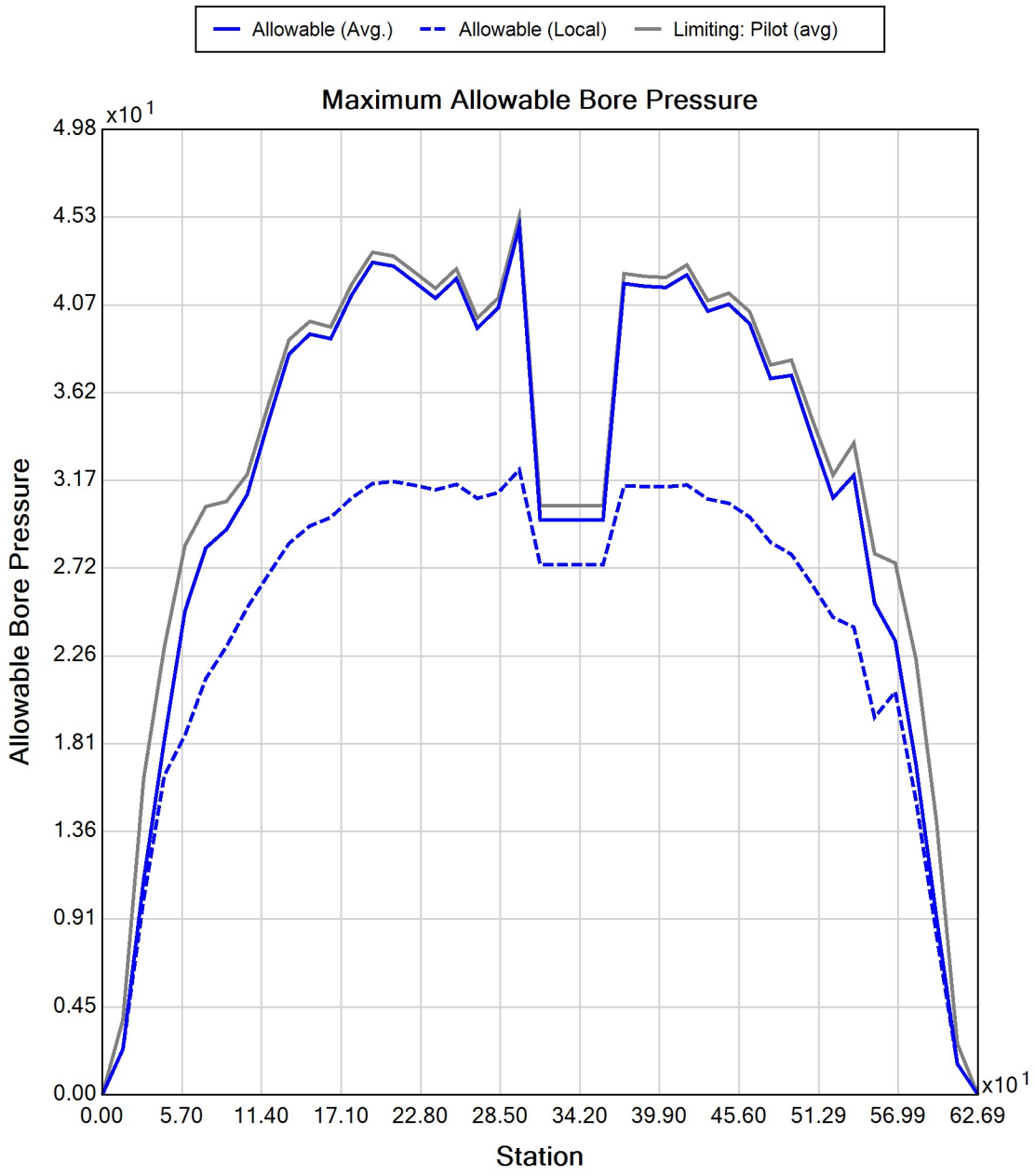


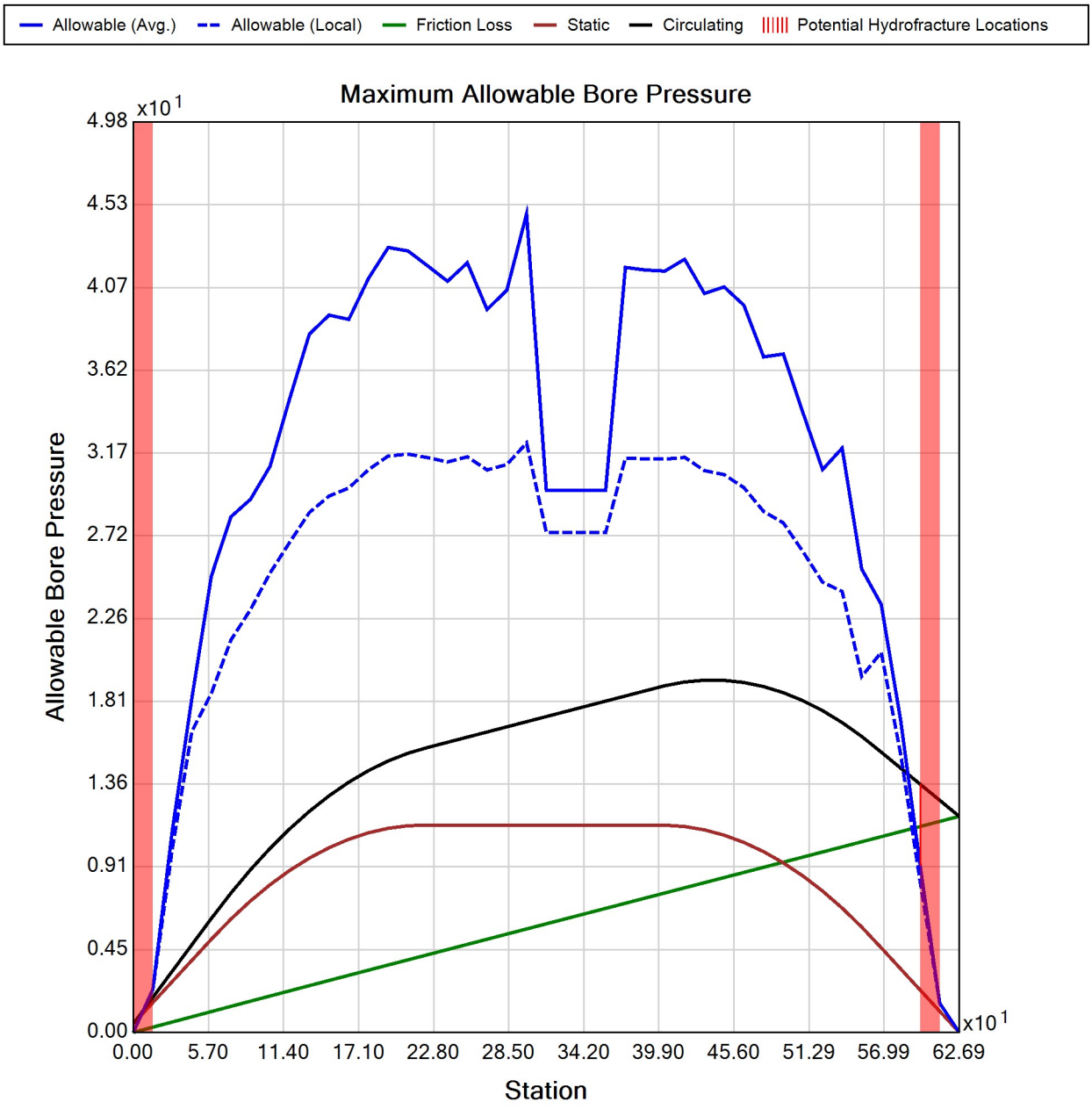












Generated Output

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Input Summary

Start Coordinate	(0.00, 0.00, 141.72) ft
End Coordinate	(620.76, 0.00, 141.30) ft
Project Length	620.76 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	1.2	9.0
Water Pressure	7.8	7.8
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	9.0	16.8
Deflection		
Earth Load Deflection	0.409	2.446
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	0.439	2.476
Compressive Stress [psi]		
Compressive Wall Stress	40.4	75.6

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	618.2	618.2
Pullback Stress [psi]	353.2	353.2
Pullback Strain	6.143E-3	6.143E-3
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	353.2	357.4
Tensile Strain	6.143E-3	6.314E-3

Net External Pressure = 15.4 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.439	7.5	17.1	OK
Unconstrained Collapse [psi]	15.5	133.9	8.7	OK
Compressive Wall Stress [psi]	40.4	1150.0	28.5	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	25.4	236.5	9.3	OK
Tensile Stress [psi]	357.4	1200.0	3.4	OK

Generated Output

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Project Summary

General:	HDD #19 - Conduit 1 Ref: BLANK BLANK Start Date: 06-20-2022 End Date: 06-20-2022
Project Owner:	TDI
Project Contractor:	KIEWIT
Project Consultant:	CHA
Designer:	MCS CHA BLANK BLANK, BLANK BLANK BLANK Phone: BLANK Fax: BLANK BLANK
Description:	BLANK

Input Summary

Start Coordinate	(0.00, 0.00, 141.86) ft
End Coordinate	(589.00, 0.00, 141.77) ft
Project Length	589.00 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, Clay (C), CL
Depth: 6.00 ft
Unit Weight: 80.0000 (dry), 110.0000 (sat) [lb/ft3]
Phi: 0.00, S.M.: 145.00, Coh: 5.60 [psi]

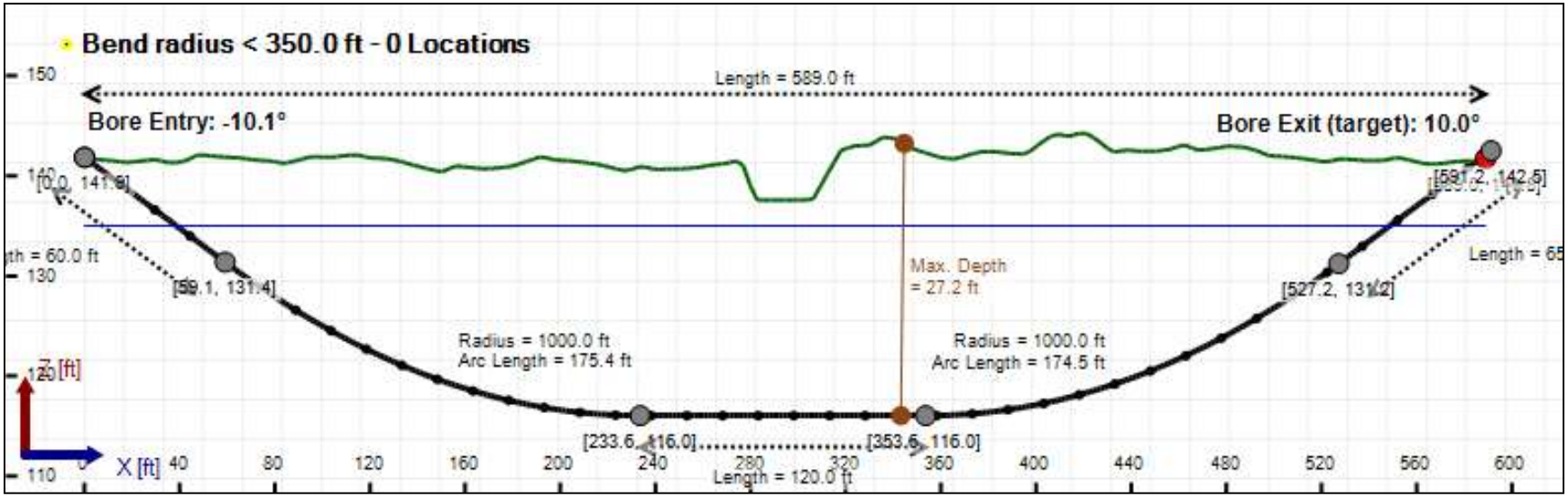
Soil Layer #2 USCS, Clay (C), CH
Depth: 7.50 ft
Unit Weight: 80.0000 (dry), 110.0000 (sat) [lb/ft3]
Phi: 0.00, S.M.: 145.00, Coh: 5.60 [psi]

Soil Layer #3 USCS, Clay (C), CL
Depth: 10.00 ft
Unit Weight: 80.0000 (dry), 110.0000 (sat) [lb/ft3]
Phi: 0.00, S.M.: 145.00, Coh: 5.60 [psi]

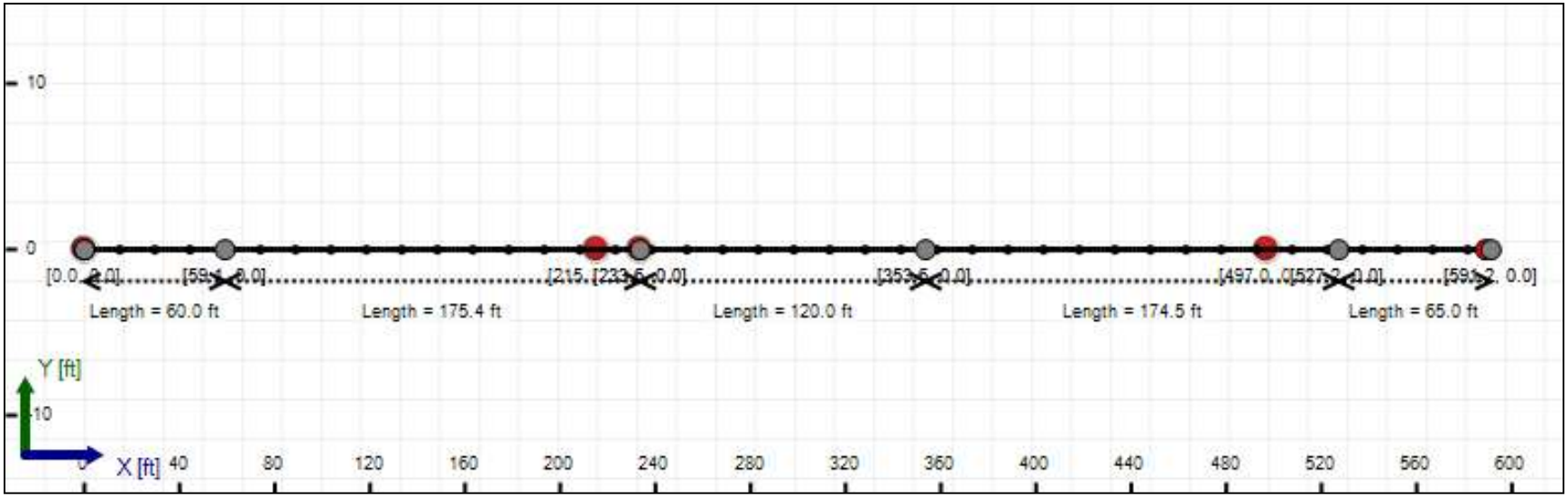
Soil Layer #4 USCS, Silt (M), ML
Depth: 5.00 ft
Unit Weight: 80.0000 (dry), 110.0000 (sat) [lb/ft3]
Phi: 0.00, S.M.: 145.00, Coh: 5.60 [psi]

Soil Layer #5 USCS, Sand (S), SM
Depth: 15.00 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: 600.00 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	11.0	11.0
Water Pressure	8.2	8.2
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	19.2	19.2
Deflection		
Earth Load Deflection	2.987	2.987
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	3.119	3.119
Compressive Stress [psi]		
Compressive Wall Stress	86.3	86.3

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	10173.5	10173.5
Pullback Stress [psi]	283.7	283.7
Pullback Strain	4.934E-3	4.934E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	283.7	308.4
Tensile Strain	4.934E-3	5.811E-3

Net External Pressure = 17.8 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	3.119	7.5	2.4	OK
Unconstrained Collapse [psi]	19.2	104.5	5.4	OK
Compressive Wall Stress [psi]	86.3	1150.0	13.3	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	27.8	238.6	8.6	OK
Tensile Stress [psi]	308.4	1200.0	3.9	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	42.935 psi	42.935 psi
1	8.00 in	12.00 in	42.830 psi	42.830 psi
2	12.00 in	16.13 in	42.682 psi	42.682 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

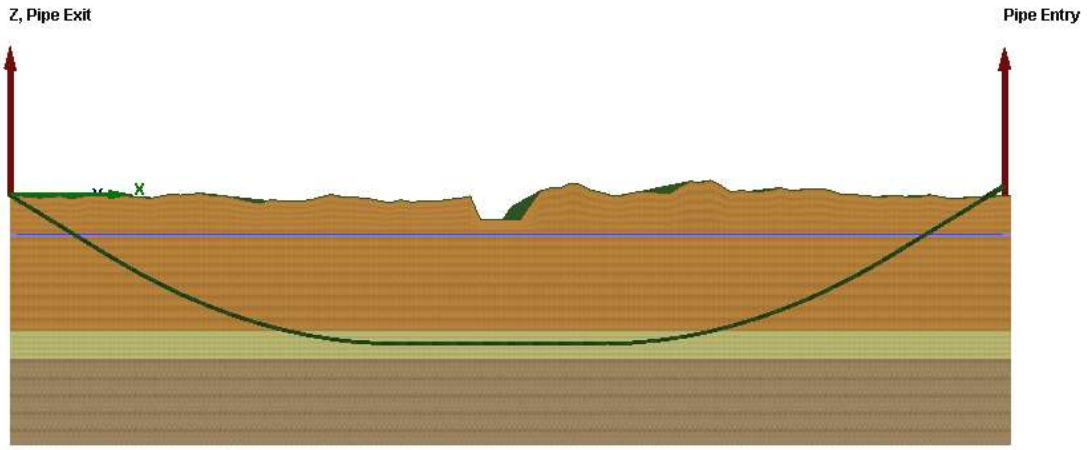
Rheological model: Bingham-Plastic

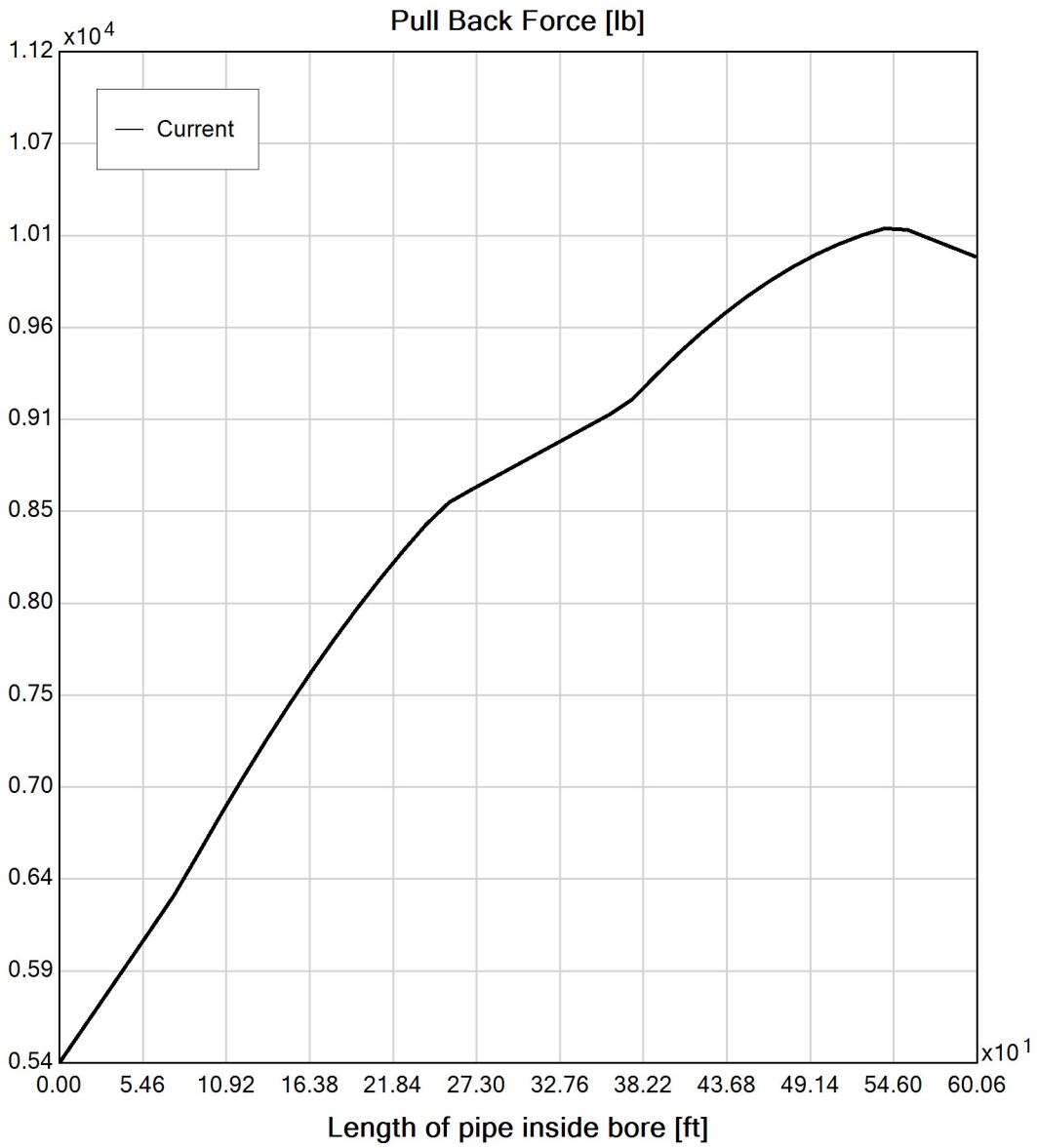
Plastic Viscosity (PV): 25.53

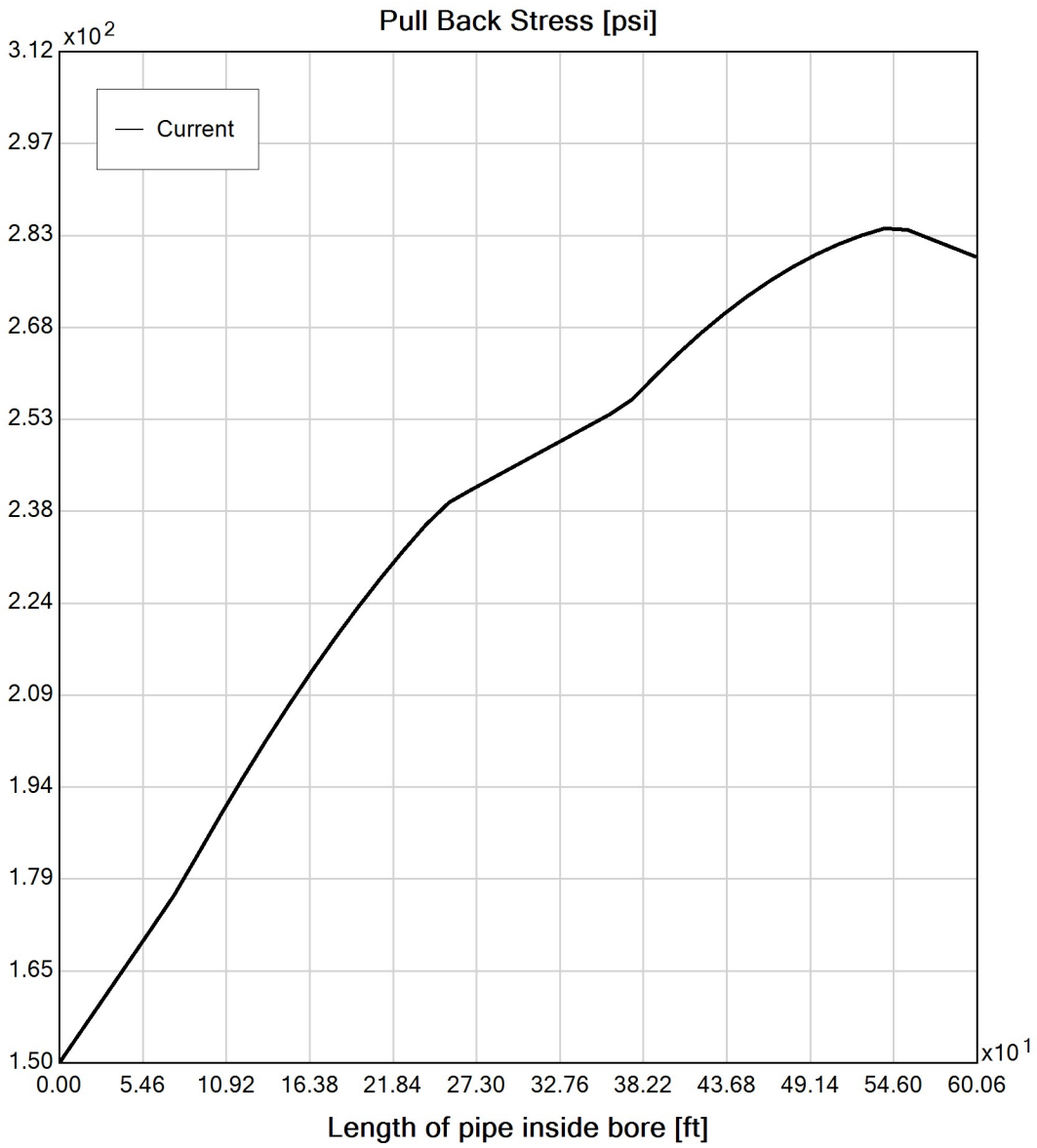
Yield Point (YP): 16.49

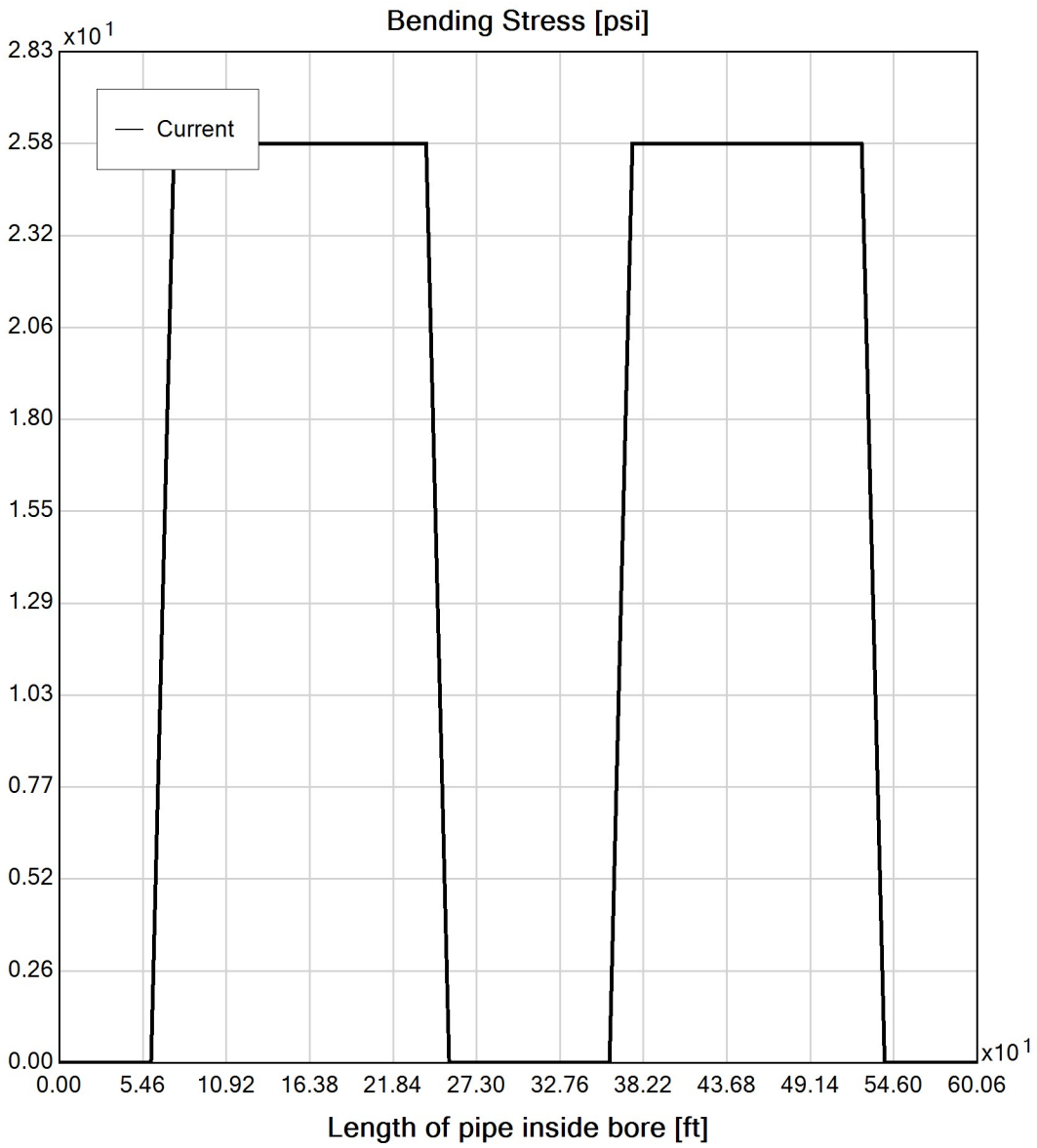
Effective Viscosity (cP): 1202.0

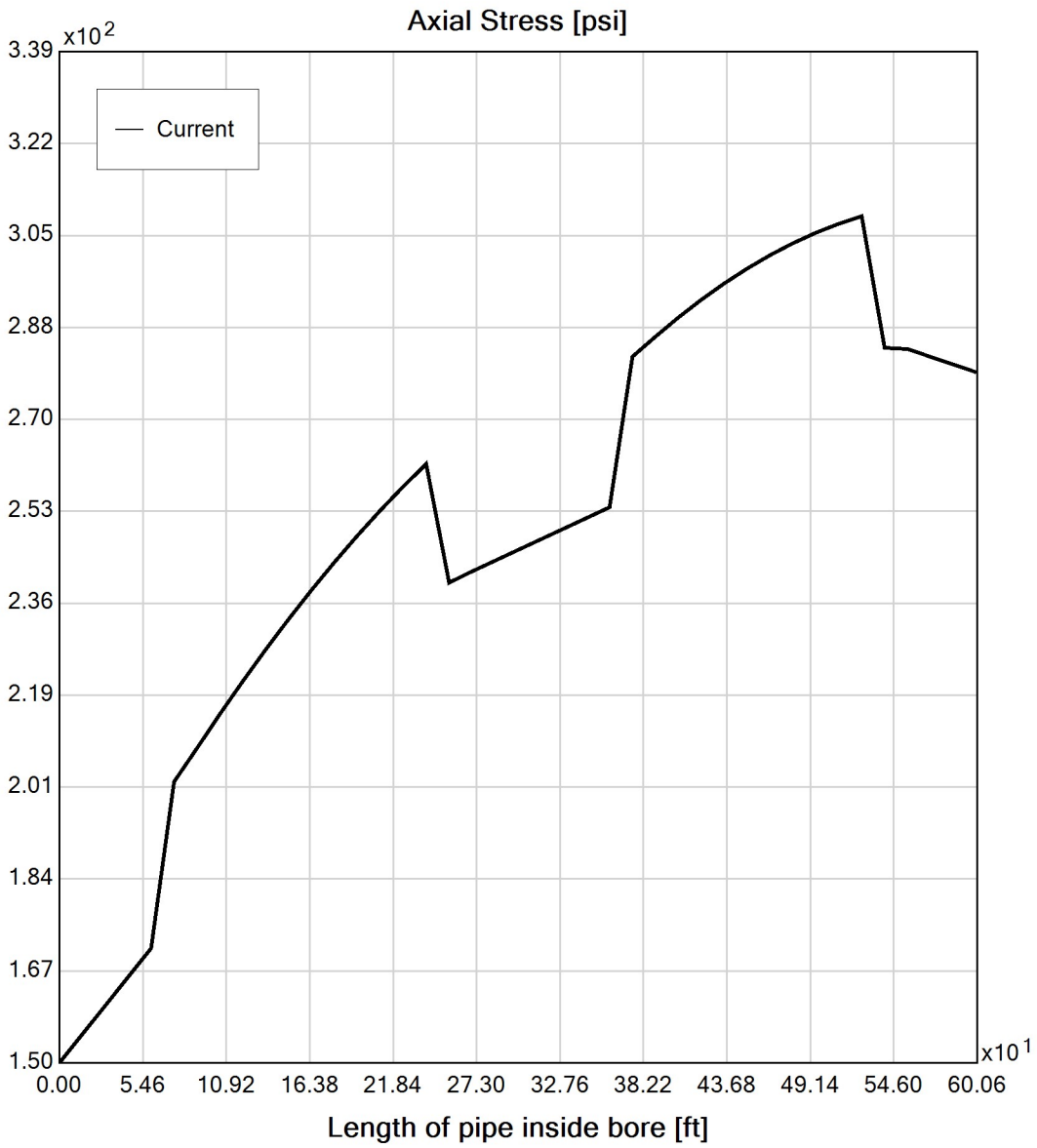
Virtual Site

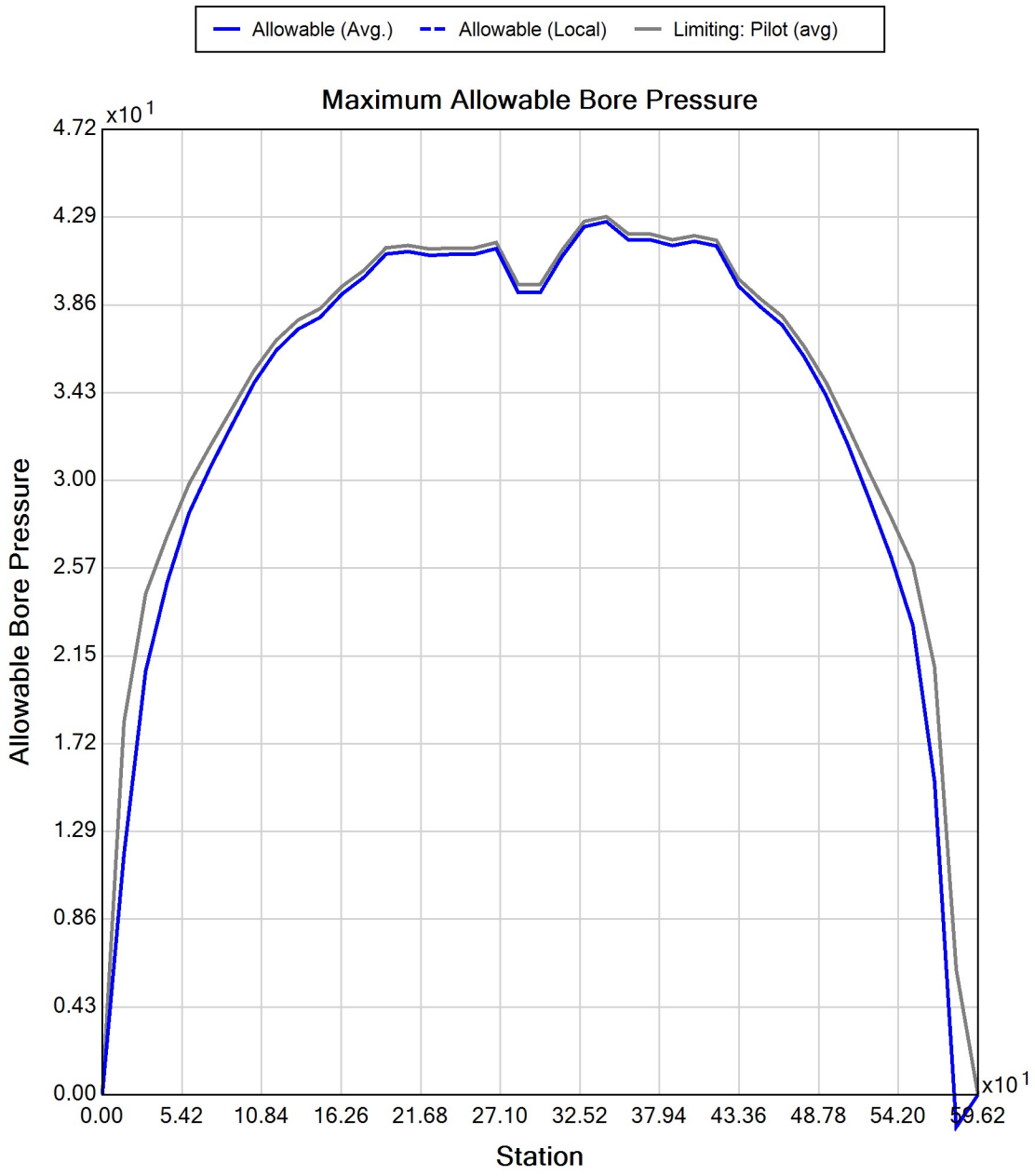


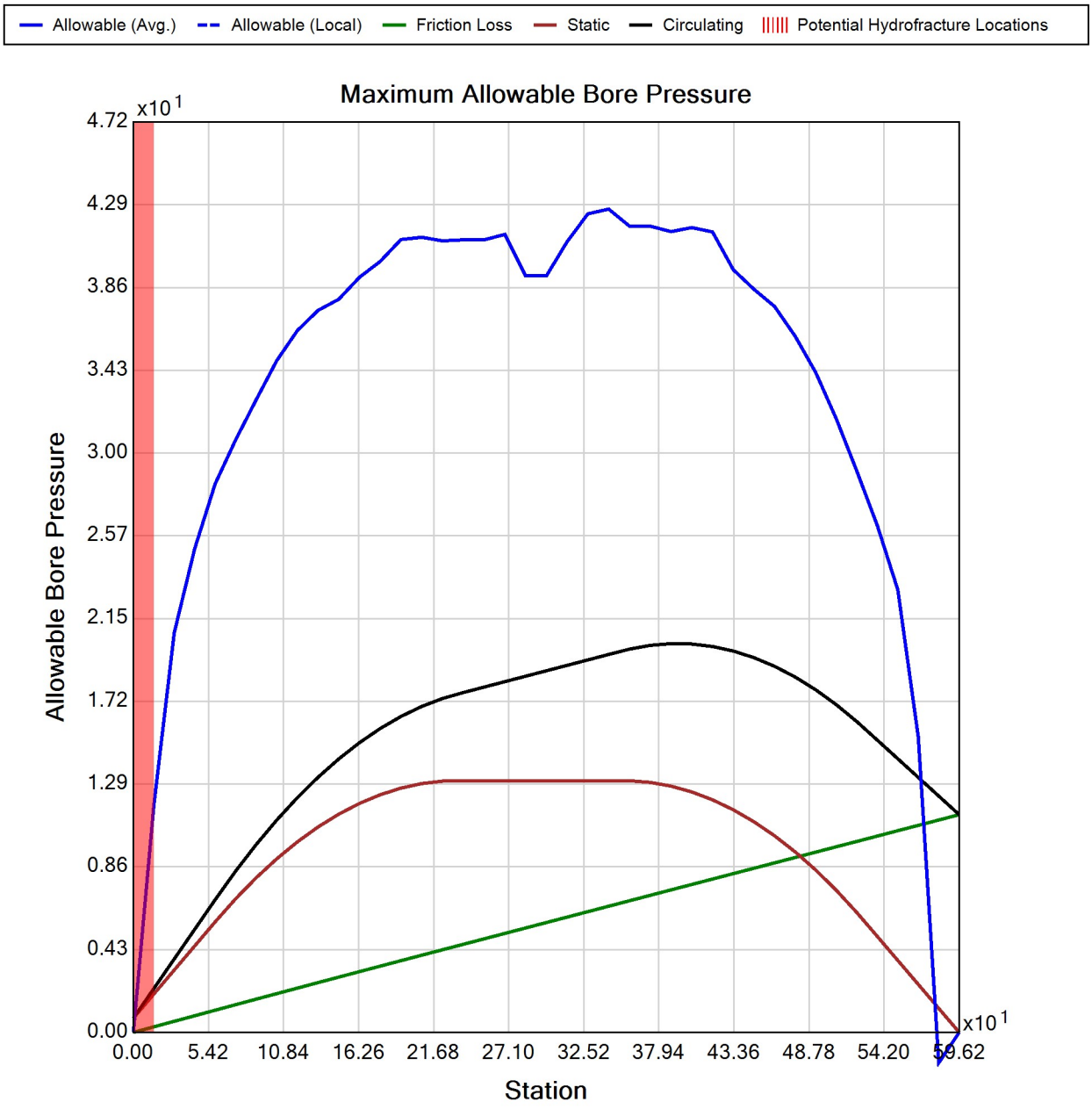












Generated Output

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Input Summary

Start Coordinate	(0.00, 0.00, 141.86) ft
End Coordinate	(589.00, 0.00, 141.77) ft
Project Length	589.00 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: 600.00 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	11.0	11.0
Water Pressure	8.2	8.2
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	19.2	19.2
Deflection		
Earth Load Deflection	2.987	2.987
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	3.017	3.017
Compressive Stress [psi]		
Compressive Wall Stress	86.3	86.3

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	606.2	606.2
Pullback Stress [psi]	346.3	346.3
Pullback Strain	6.023E-3	6.023E-3
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	346.3	350.9
Tensile Strain	6.023E-3	6.202E-3

Net External Pressure = 17.8 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	3.017	7.5	2.5	OK
Unconstrained Collapse [psi]	19.2	105.4	5.5	OK
Compressive Wall Stress [psi]	86.3	1150.0	13.3	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	27.8	237.0	8.5	OK
Tensile Stress [psi]	350.9	1200.0	3.4	OK

Generated Output

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Project Summary

General:	HDD #19 - Conduit 2
	Start Date: 06-20-2022
	End Date: 06-20-2022
Project Owner:	TDI
Project Contractor:	KIEWIT
Project Consultant:	CHA
Designer:	MCS
	CHA

Description:

Input Summary

Start Coordinate	(0.00, 0.00, 145.90) ft
End Coordinate	(550.00, 0.00, 144.18) ft
Project Length	550.00 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, Clay (C), CL
Depth: 6.00 ft
Unit Weight: 80.0000 (dry), 110.0000 (sat) [lb/ft3]
Phi: 0.00, S.M.: 145.00, Coh: 5.60 [psi]

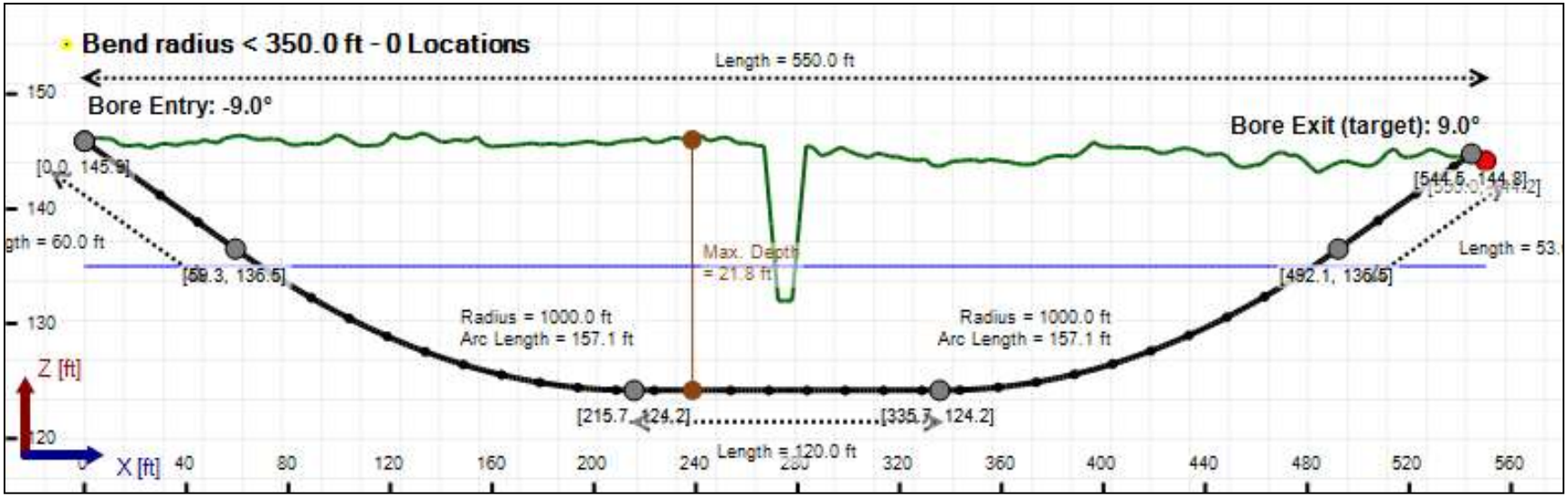
Soil Layer #2 USCS, Clay (C), CH
Depth: 7.50 ft
Unit Weight: 80.0000 (dry), 110.0000 (sat) [lb/ft3]
Phi: 0.00, S.M.: 145.00, Coh: 5.60 [psi]

Soil Layer #3 USCS, Clay (C), CL
Depth: 10.00 ft
Unit Weight: 80.0000 (dry), 110.0000 (sat) [lb/ft3]
Phi: 0.00, S.M.: 145.00, Coh: 5.60 [psi]

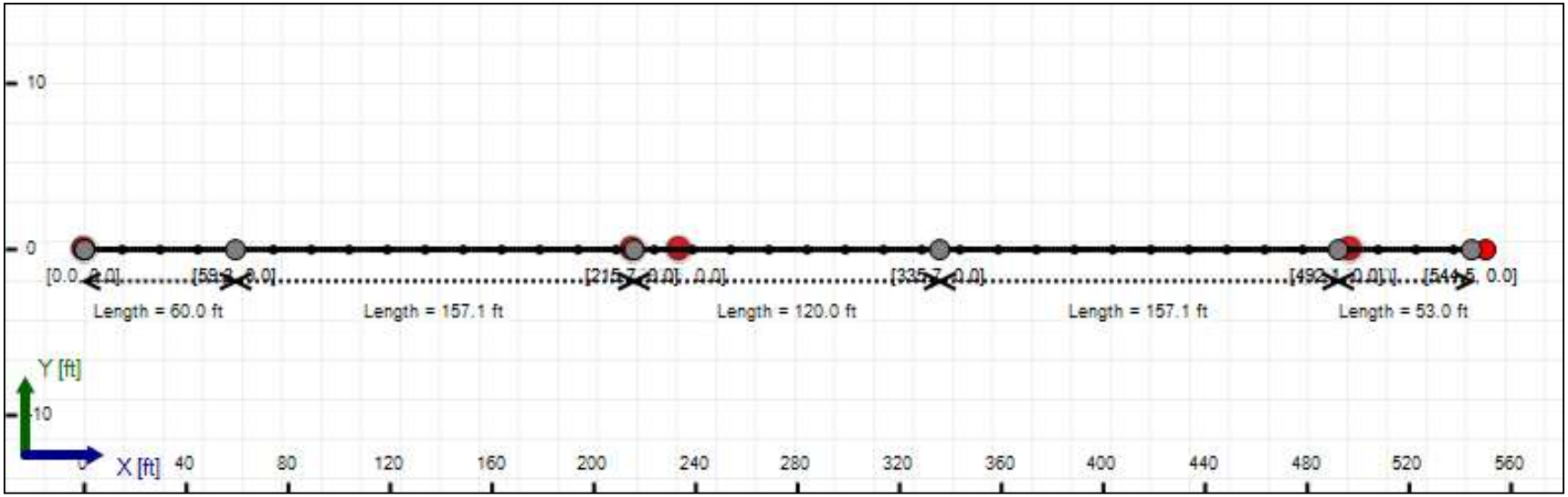
Soil Layer #4 USCS, Silt (M), ML
Depth: 5.00 ft
Unit Weight: 80.0000 (dry), 110.0000 (sat) [lb/ft3]
Phi: 0.00, S.M.: 145.00, Coh: 5.60 [psi]

Soil Layer #5 USCS, Sand (S), SM
Depth: 15.00 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	9.7	9.7
Water Pressure	4.7	4.7
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	14.4	14.4
Deflection		
Earth Load Deflection	2.650	2.650
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	2.782	2.782
Compressive Stress [psi]		
Compressive Wall Stress	64.8	64.8

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	9180.4	9180.4
Pullback Stress [psi]	256.0	256.0
Pullback Strain	4.453E-3	4.453E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	256.0	280.5
Tensile Strain	4.453E-3	5.325E-3

Net External Pressure = 14.7 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	2.782	7.5	2.7	OK
Unconstrained Collapse [psi]	14.4	107.7	7.5	OK
Compressive Wall Stress [psi]	64.8	1150.0	17.7	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	24.2	240.2	9.9	OK
Tensile Stress [psi]	280.5	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	38.110 psi	38.110 psi
1	8.00 in	12.00 in	37.948 psi	37.948 psi
2	12.00 in	16.13 in	37.721 psi	37.721 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

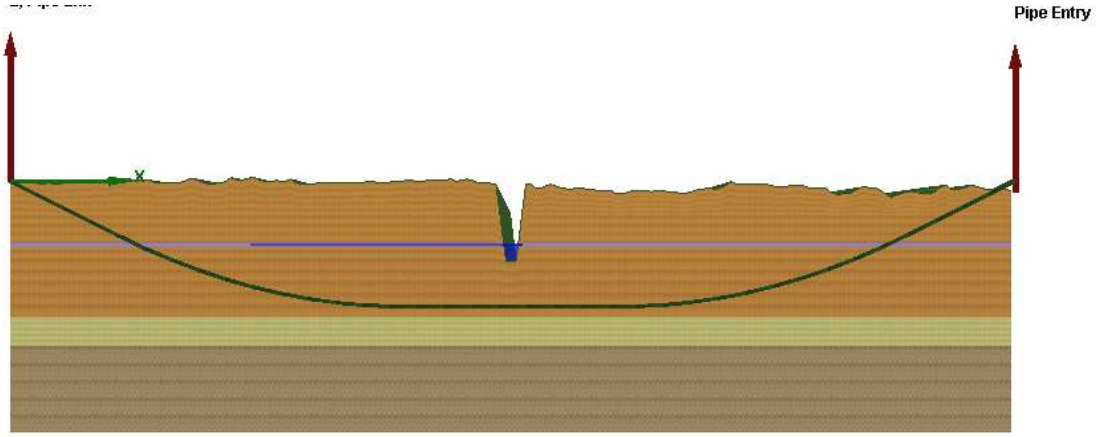
Rheological model: Bingham-Plastic

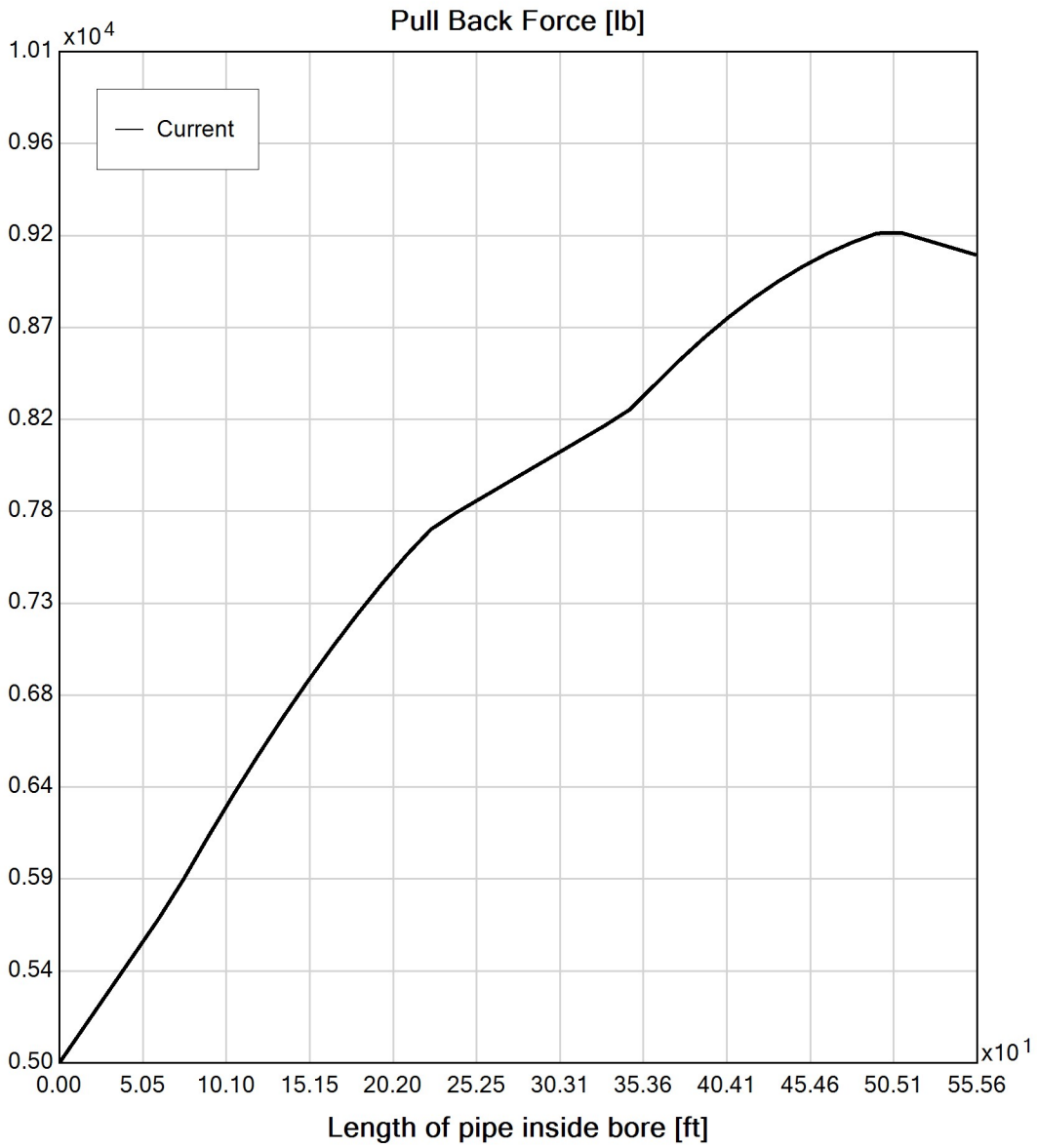
Plastic Viscosity (PV): 25.53

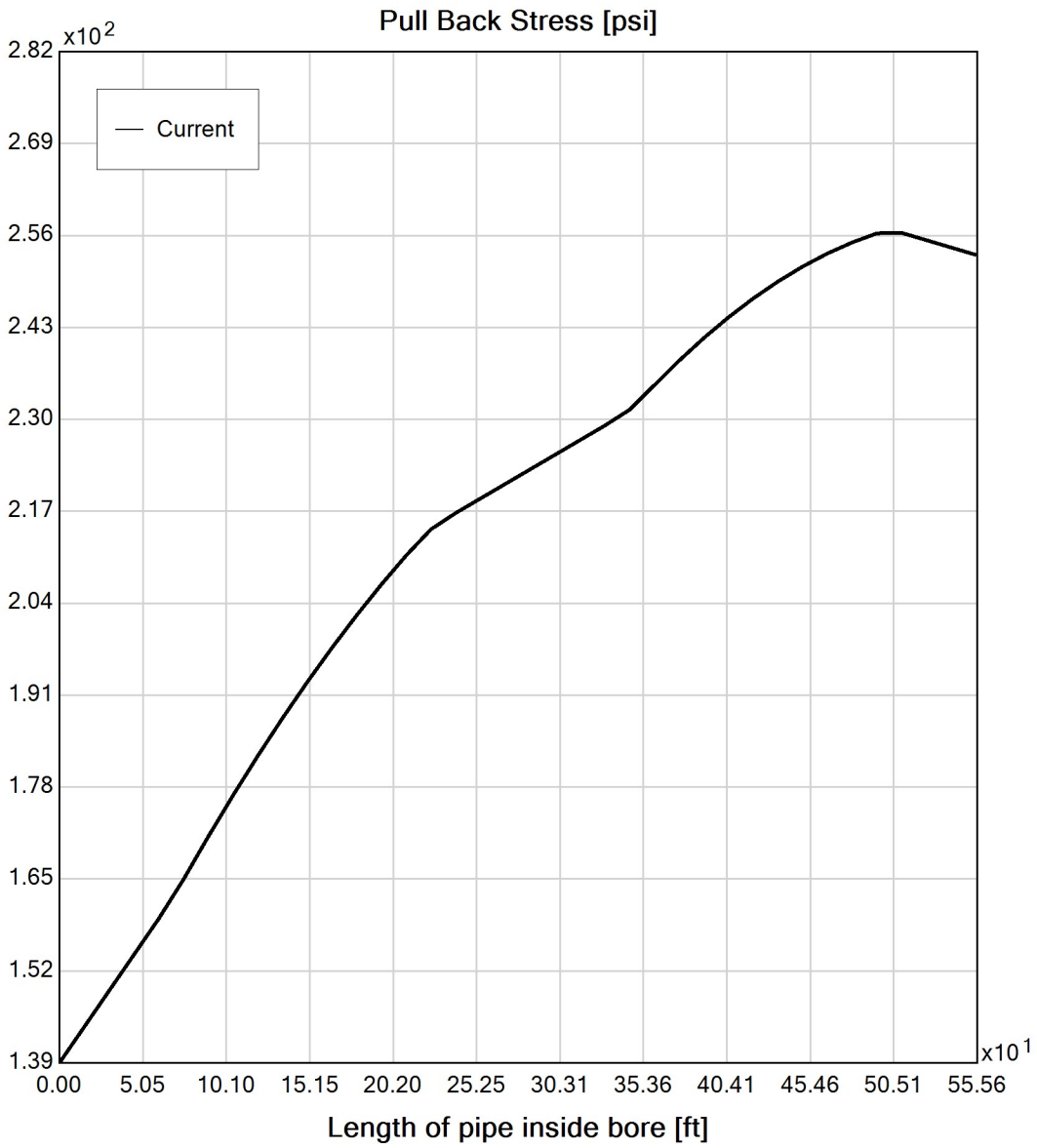
Yield Point (YP): 16.49

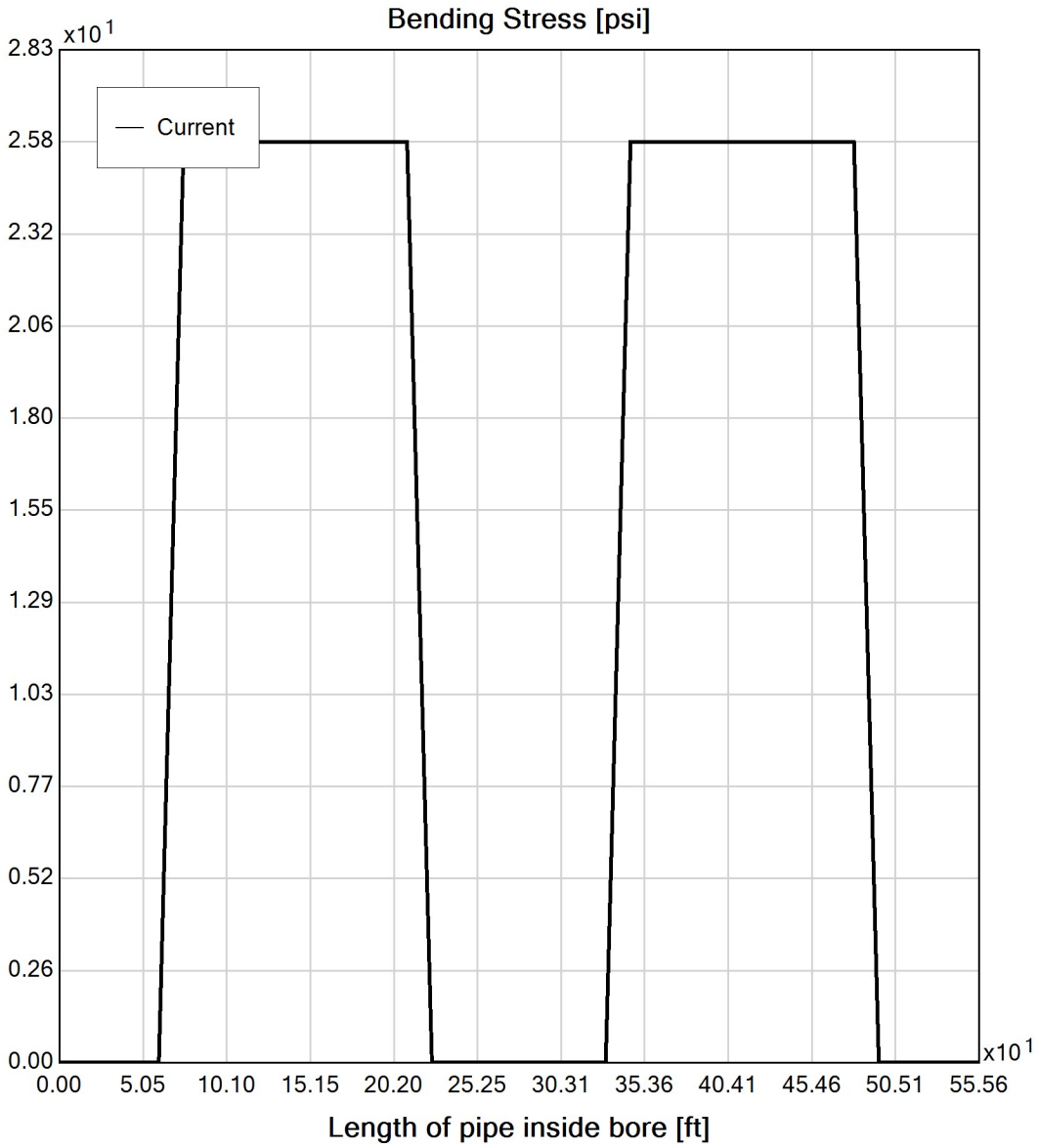
Effective Viscosity (cP): 1202.0

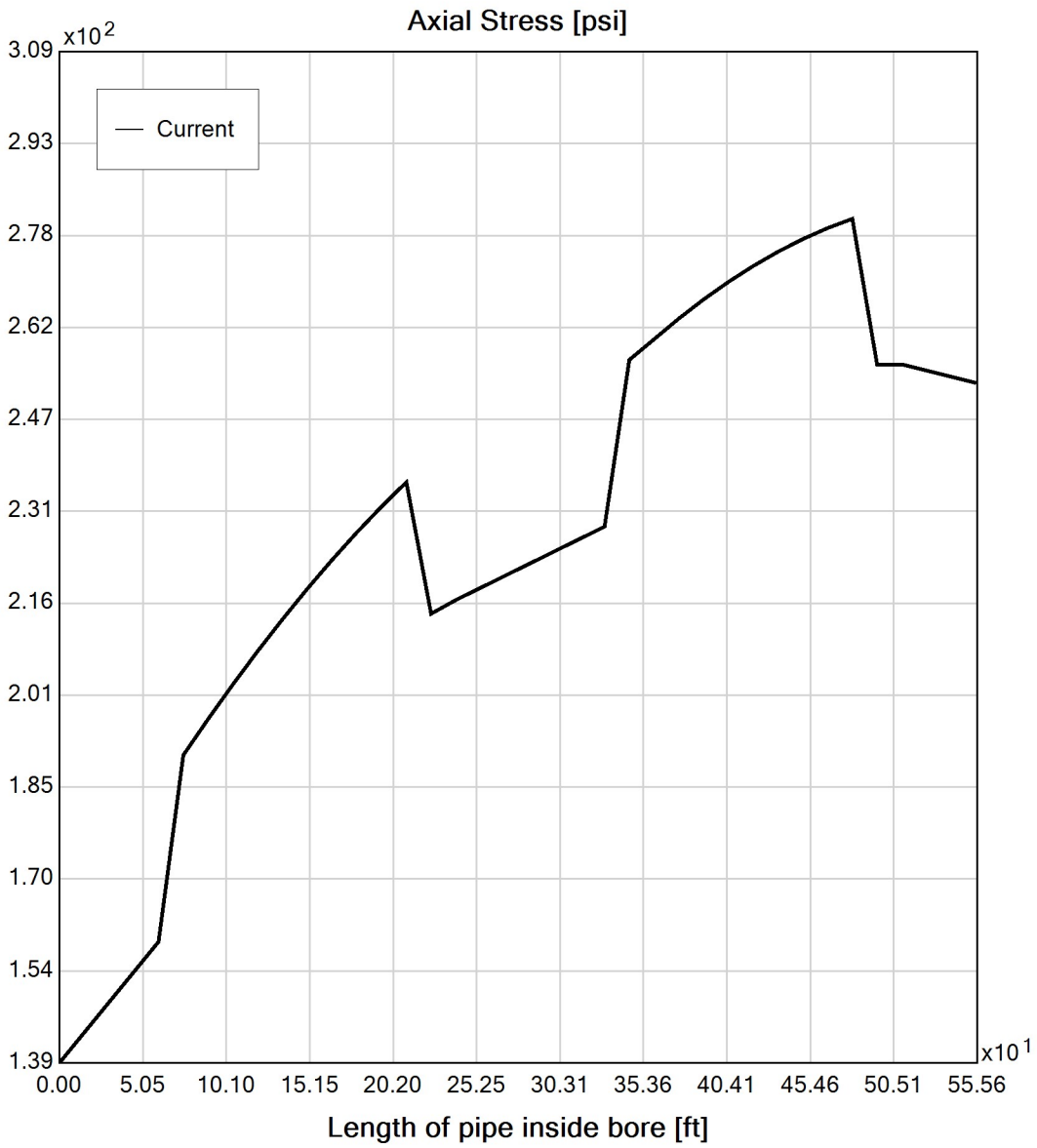
Virtual Site

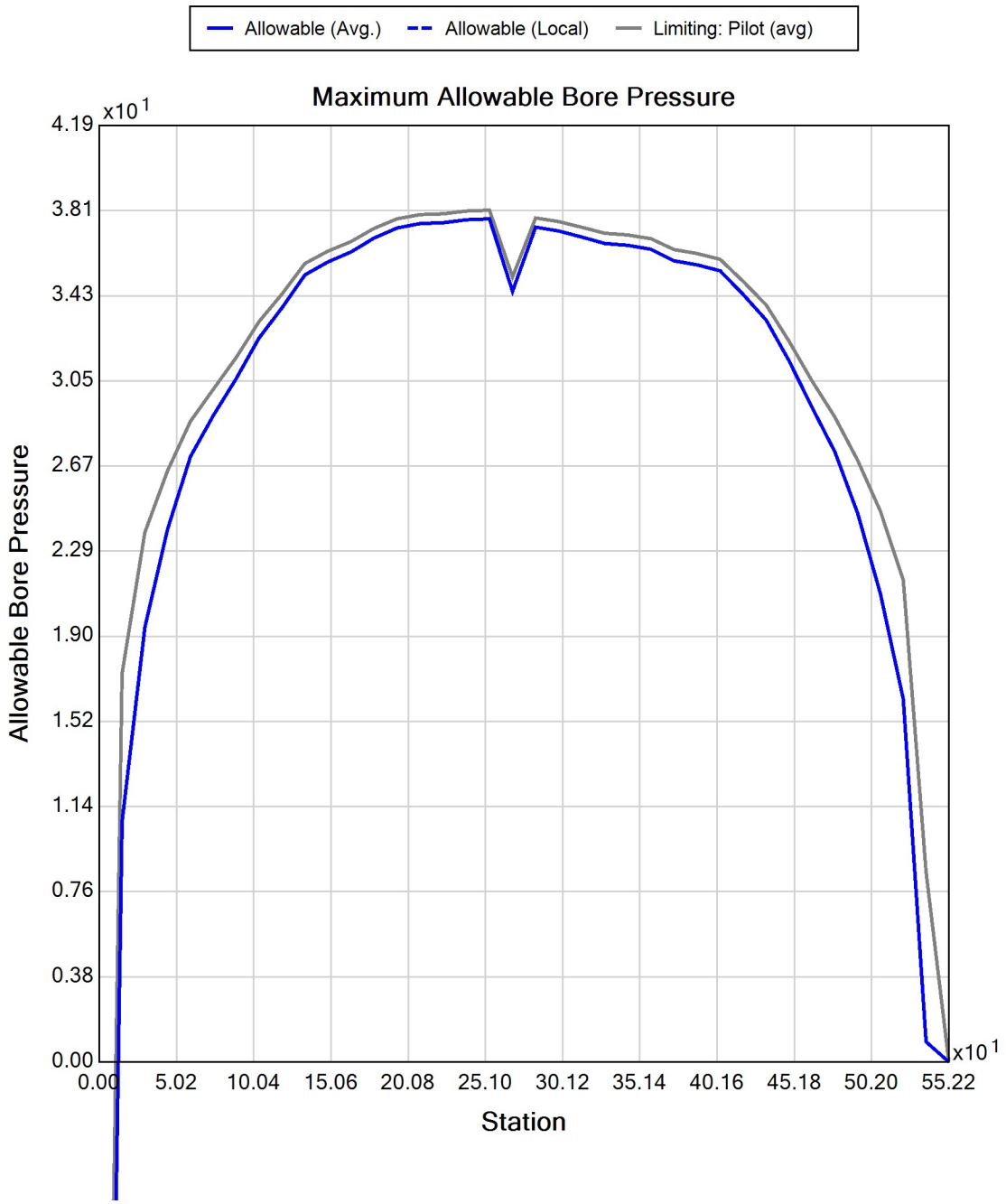


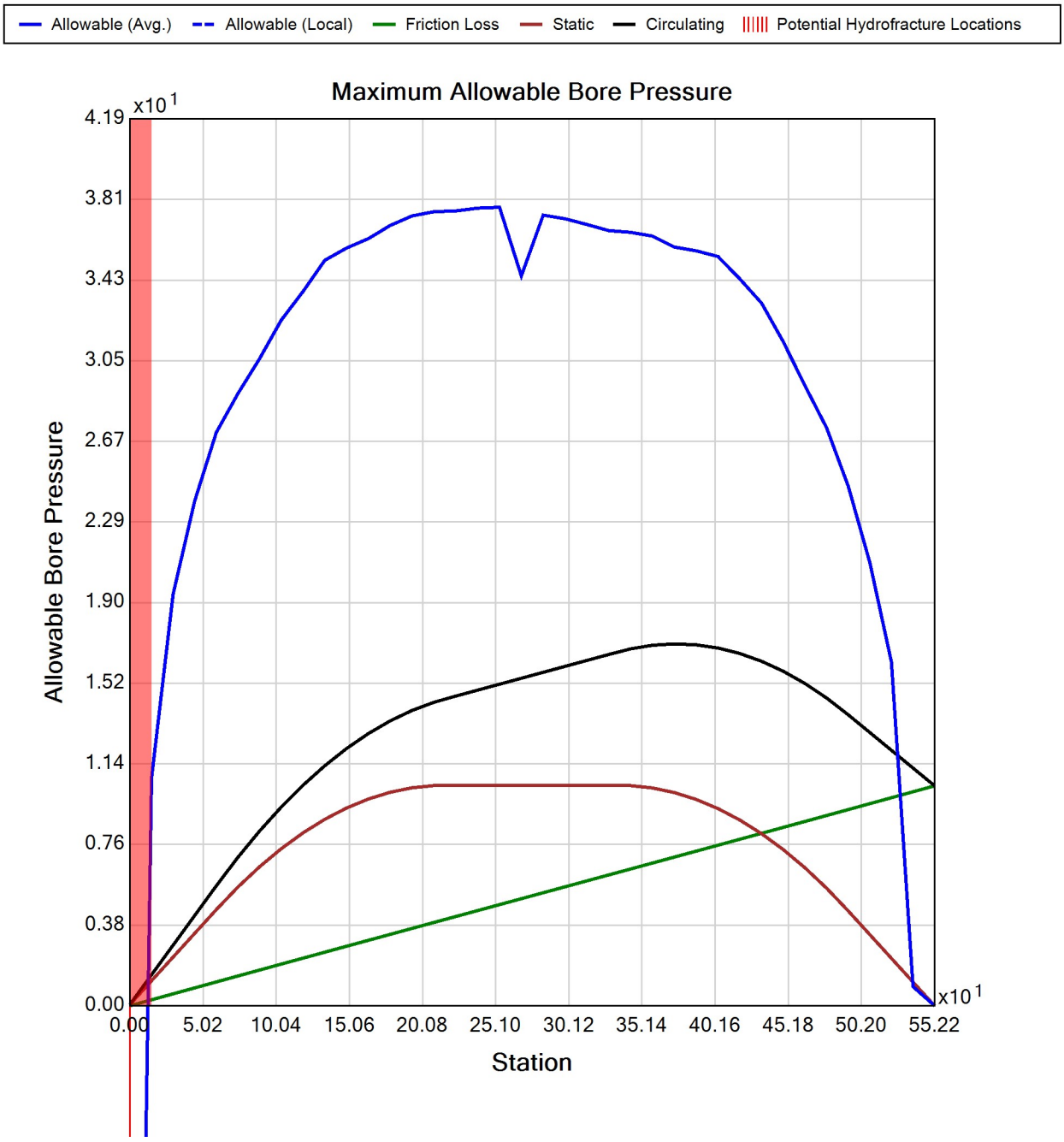












Generated Output

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Input Summary

Start Coordinate	(0.00, 0.00, 145.90) ft
End Coordinate	(550.00, 0.00, 144.18) ft
Project Length	550.00 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	9.7	9.7
Water Pressure	4.7	4.7
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	14.4	14.4
Deflection		
Earth Load Deflection	2.650	2.650
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	2.679	2.679
Compressive Stress [psi]		
Compressive Wall Stress	64.8	64.8

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	557.7	557.7
Pullback Stress [psi]	318.6	318.6
Pullback Strain	5.542E-3	5.542E-3
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	318.6	323.0
Tensile Strain	5.542E-3	5.716E-3

Net External Pressure = 14.7 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	2.679	7.5	2.8	OK
Unconstrained Collapse [psi]	14.4	108.6	7.5	OK
Compressive Wall Stress [psi]	64.8	1150.0	17.7	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	24.2	238.6	9.9	OK
Tensile Stress [psi]	323.0	1200.0	3.7	OK

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Project Summary

General:	HDD #20
	Start Date: 12-10-2021
	End Date: 12-10-2021
Designer:	AJB
	CHA
Description:	

Input Summary

Start Coordinate	(0.00, 0.00, 147.20) ft
End Coordinate	(1200.00, 0.00, 141.00) ft
Project Length	1200.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 6

Soil Layer #1 USCS, Sand (S), SM
Depth: 6.00 ft
Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft3]
Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Sand (S), SM
Depth: 2.00 ft
Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3]
Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

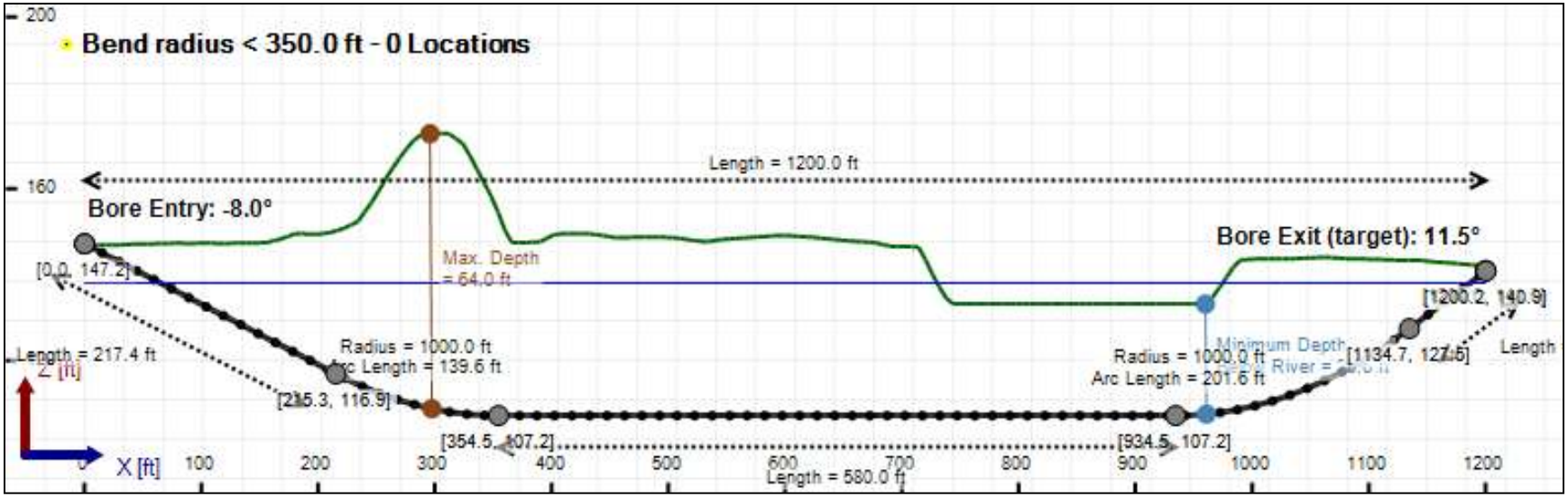
Soil Layer #3 USCS, Clay (C), CH
Depth: 4.00 ft
Unit Weight: 70.0000 (dry), 100.0000 (sat) [lb/ft3]
Phi: 0.00, S.M.: 145.00, Coh: 3.13 [psi]

Soil Layer #4 USCS, Sand (S), SM
Depth: 5.00 ft
Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3]
Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

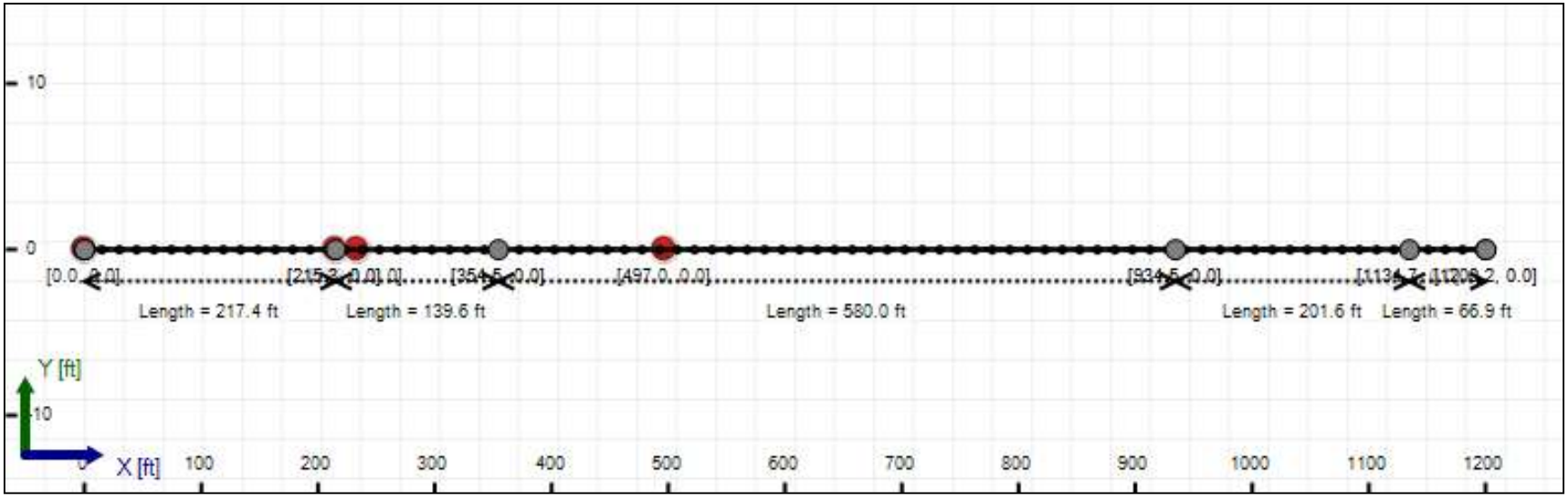
Soil Layer #5 USCS, Silt (M), MH
Depth: 10.00 ft
Unit Weight: 70.0000 (dry), 105.0000 (sat) [lb/ft3]
Phi: 0.00, S.M.: 145.00, Coh: 3.13 [psi]

Soil Layer #6 USCS, Clay (C), CH
Depth: 23.00 ft
Unit Weight: 70.0000 (dry), 105.0000 (sat) [lb/ft3]
Phi: 0.00, S.M.: 145.00, 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: 1215.00 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	35.2
Water Pressure	13.3	13.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	18.3	48.2
Deflection		
Earth Load Deflection	1.338	9.595
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.470	9.727
Compressive Stress [psi]		
Compressive Wall Stress	82.2	216.9

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	19255.7	19255.7
Pullback Stress [psi]	537.0	537.0
Pullback Strain	9.339E-3	9.339E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	537.0	559.4
Tensile Strain	9.339E-3	1.018E-2

Net External Pressure = 29.0 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.470	7.5	5.1	OK
Unconstrained Collapse [psi]	26.0	121.0	4.7	OK
Compressive Wall Stress [psi]	82.2	1150.0	14.0	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	36.0	222.8	6.2	OK
Tensile Stress [psi]	559.4	1200.0	2.1	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	104.761 psi	63.326 psi
1	8.00 in	12.00 in	104.741 psi	63.307 psi
2	12.00 in	16.13 in	104.712 psi	63.279 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: 68.670 lb/ft3

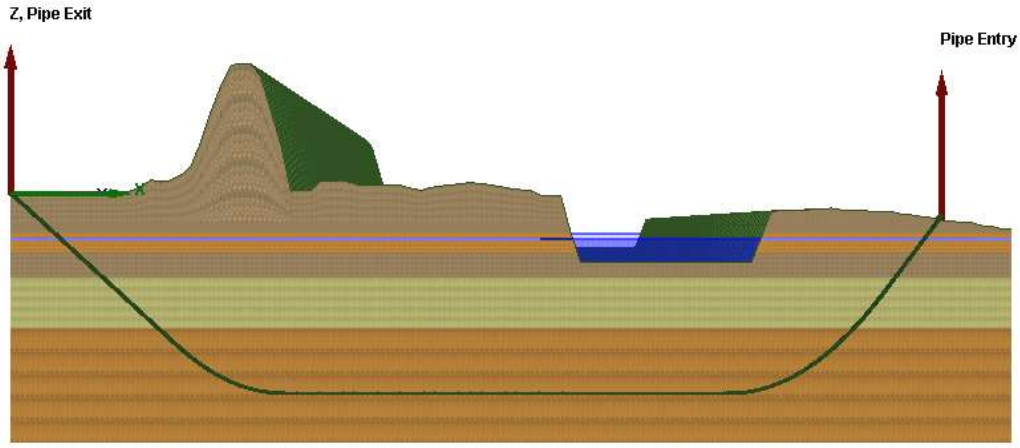
Rheological model: Bingham-Plastic

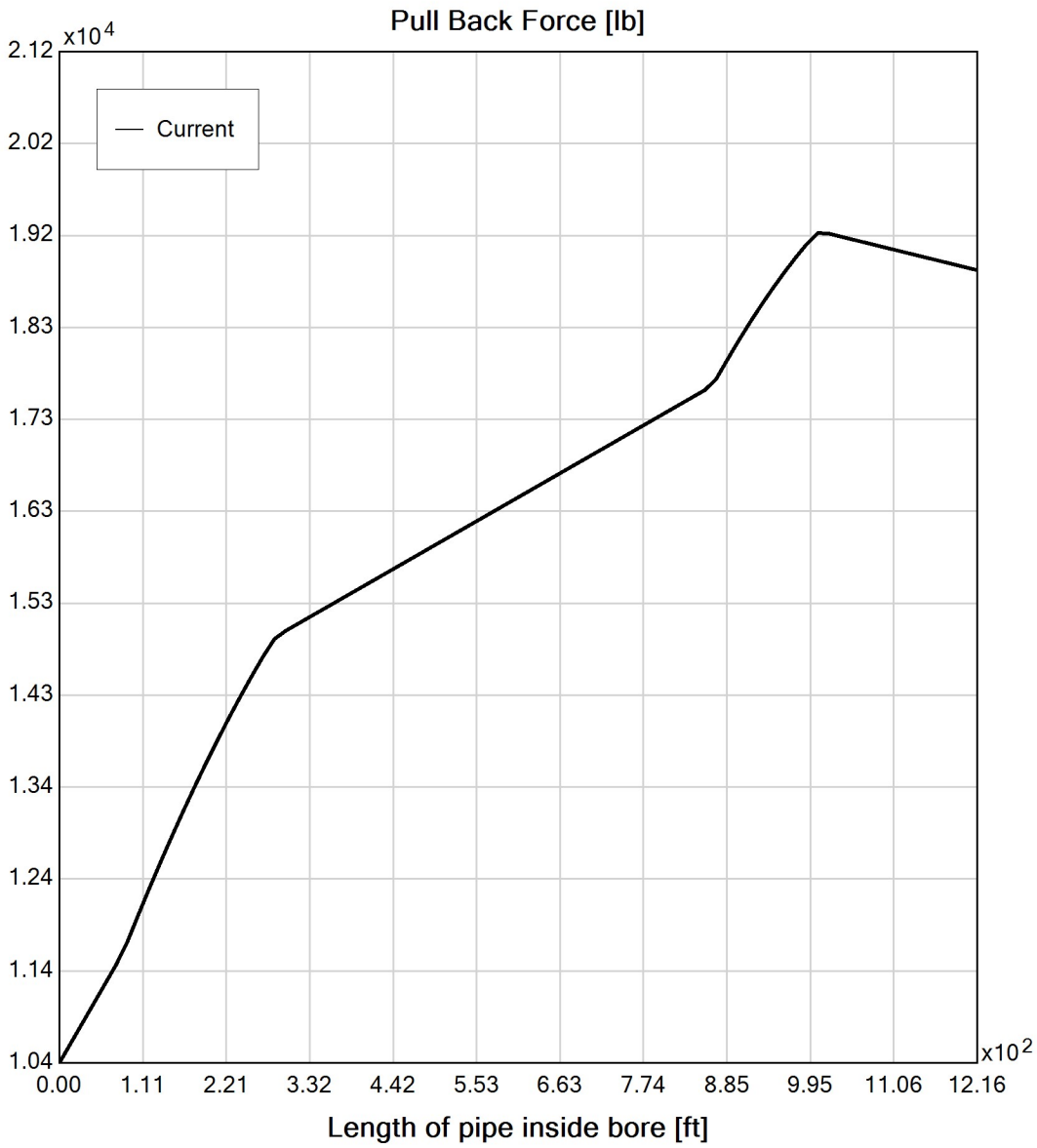
Plastic Viscosity (PV): 25.53

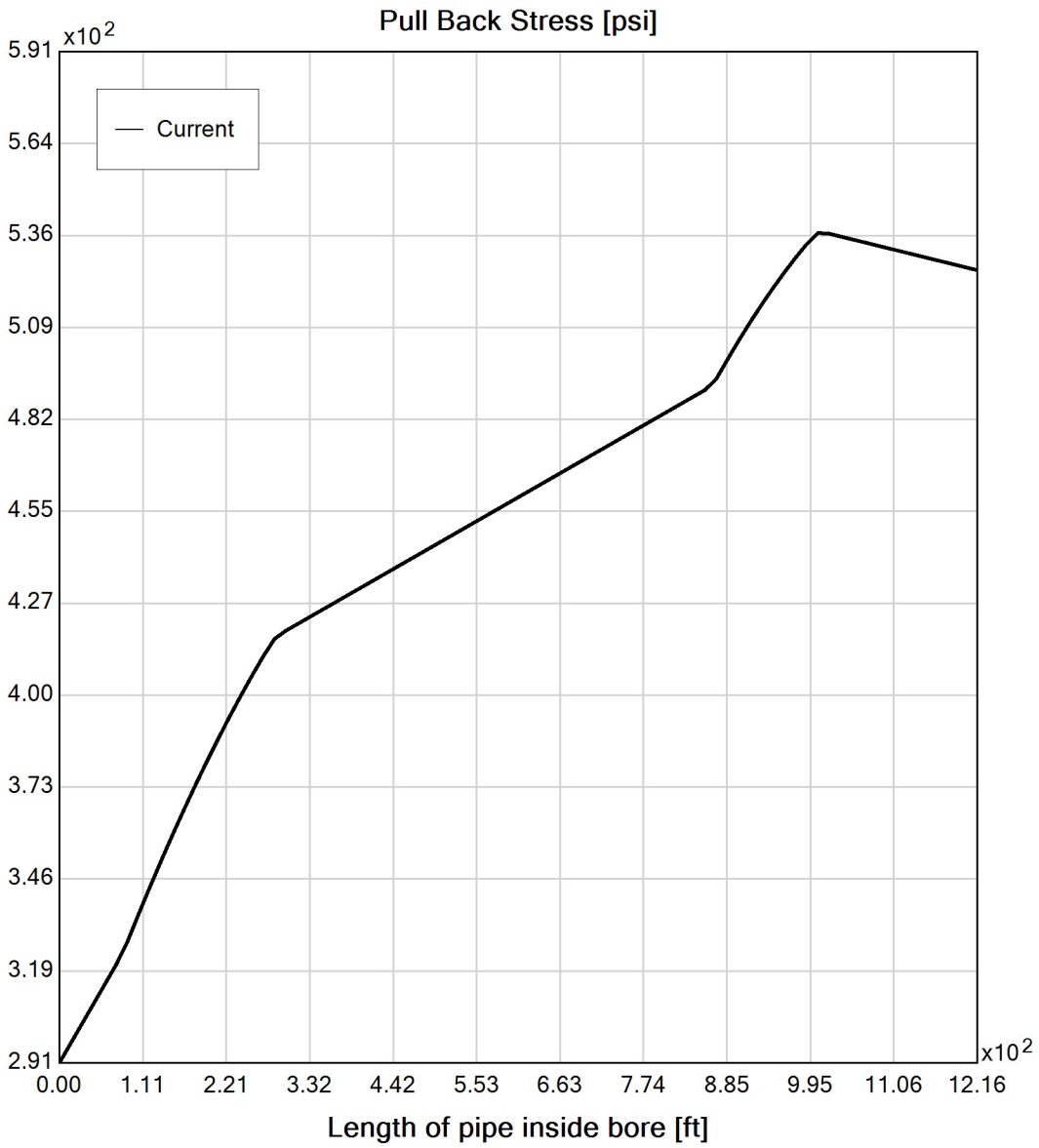
Yield Point (YP): 16.49

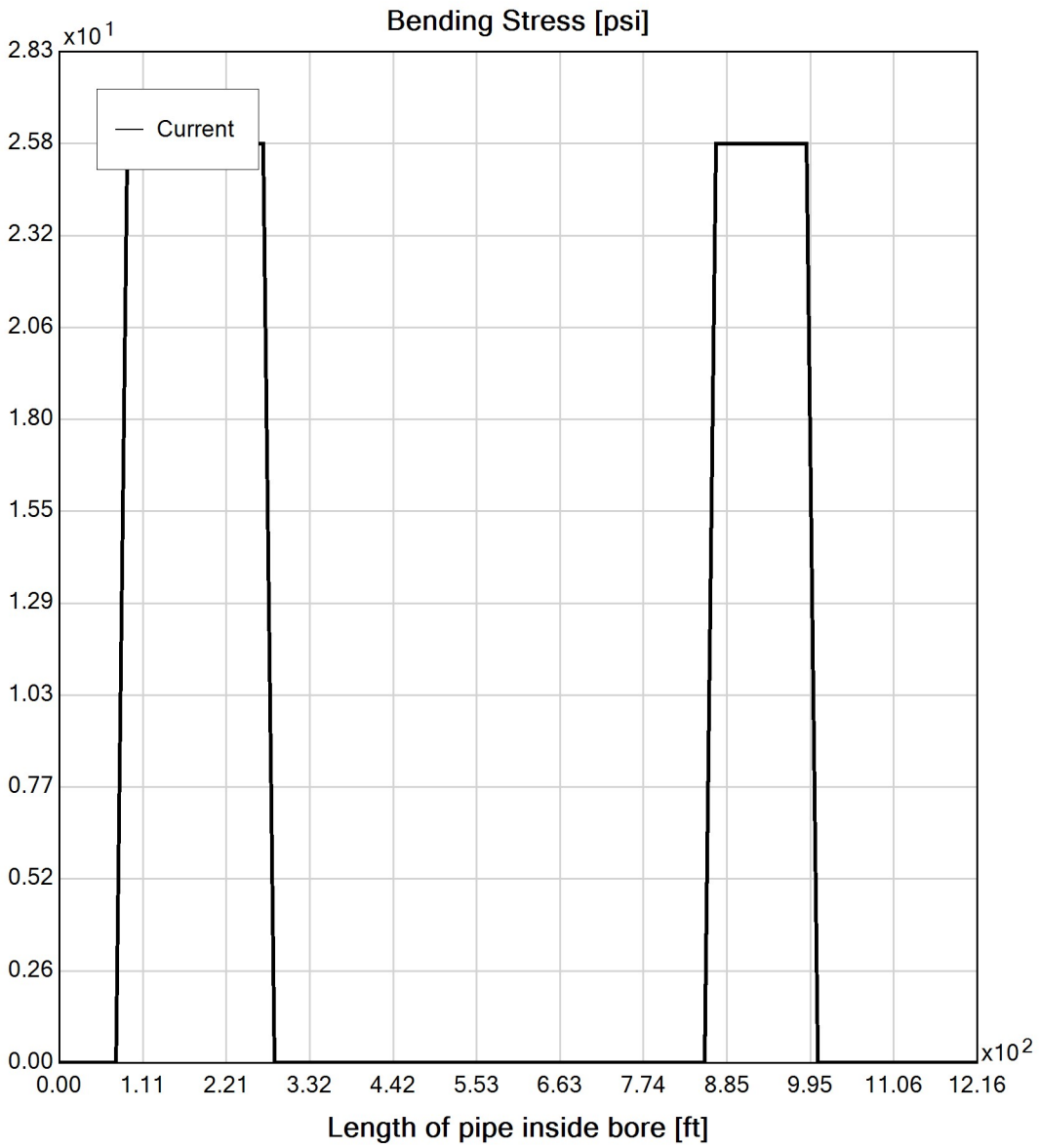
Effective Viscosity (cP): 1202.0

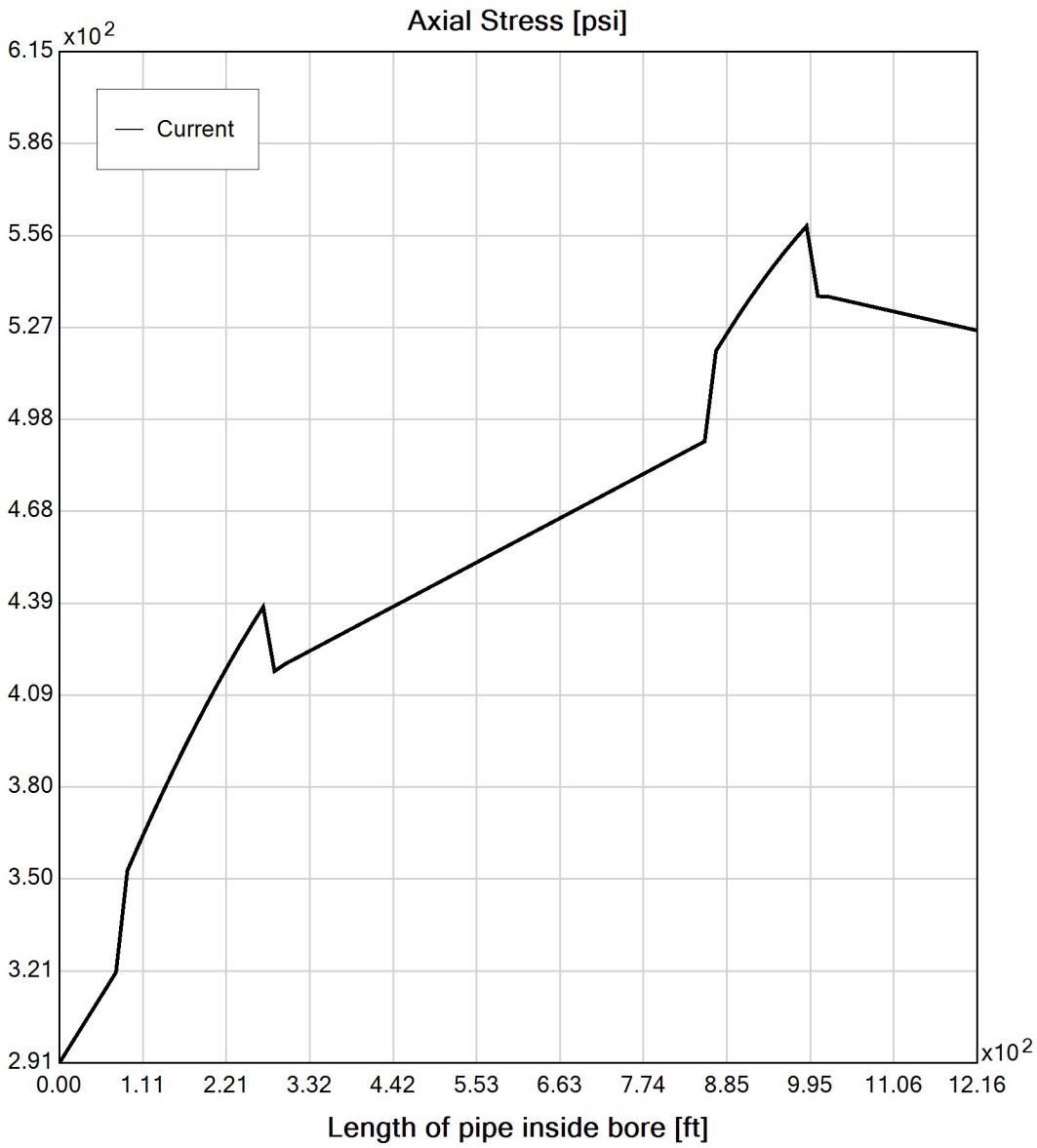
Virtual Site

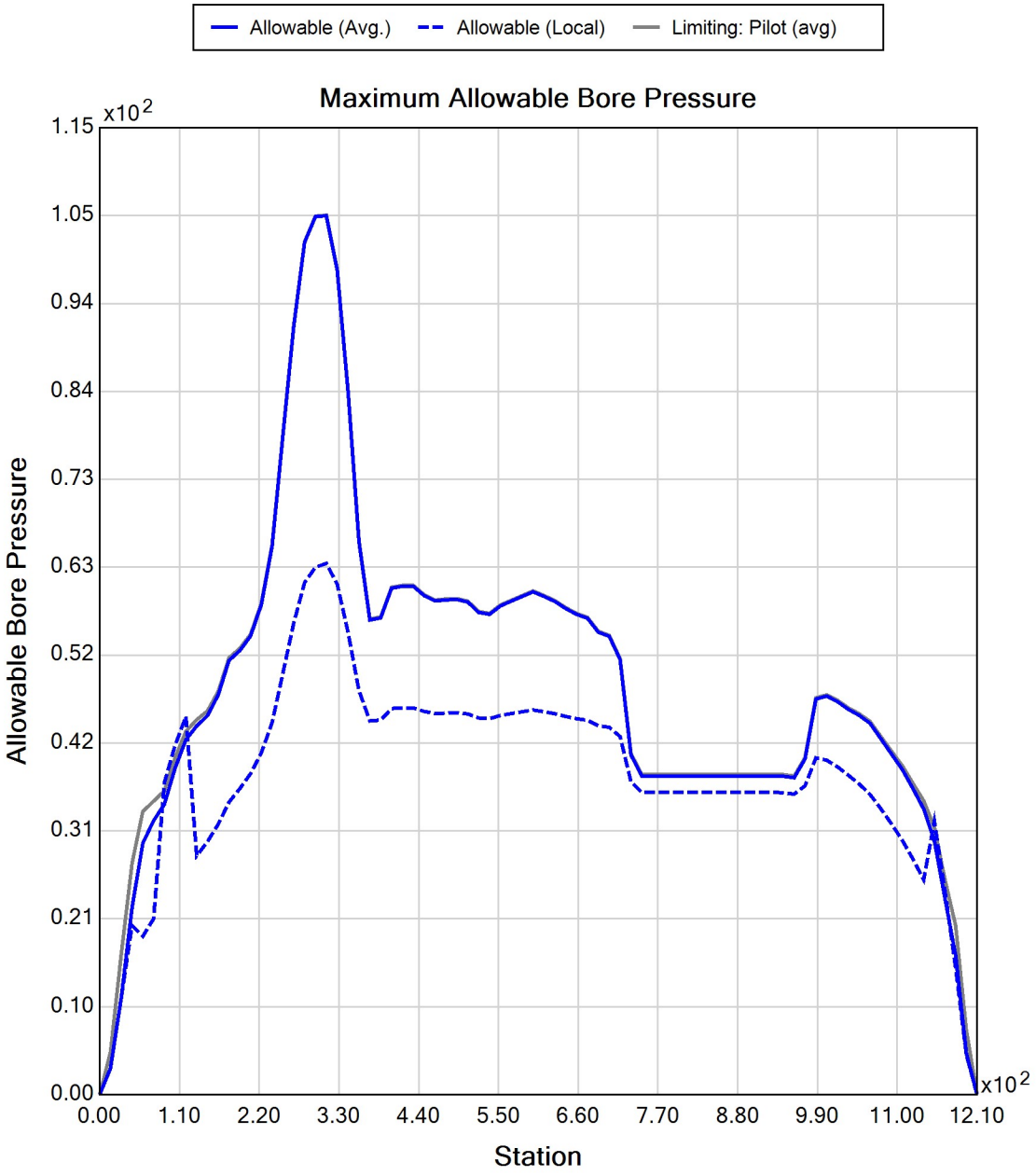


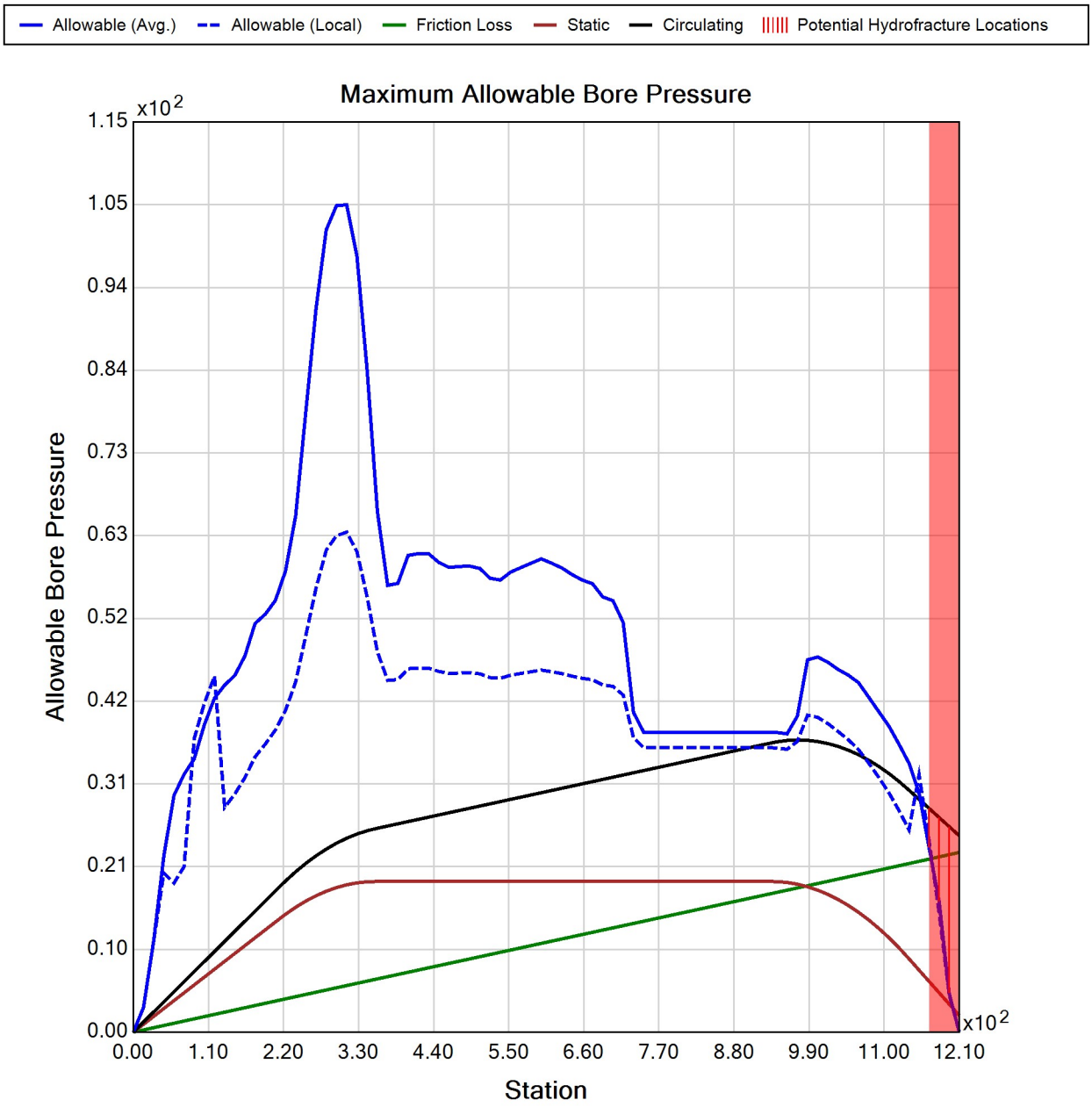












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Input Summary

Start Coordinate	(0.00, 0.00, 147.20) ft
End Coordinate	(1200.00, 0.00, 141.00) ft
Project Length	1200.00 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: 1215.00 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	2.8	35.2
Water Pressure	13.3	13.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	16.1	48.2
Deflection		
Earth Load Deflection	0.760	9.595
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	0.789	9.624
Compressive Stress [psi]		
Compressive Wall Stress	72.6	216.9

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	1049.5	1049.5
Pullback Stress [psi]	599.6	599.6
Pullback Strain	1.043E-2	1.043E-2
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	599.6	602.0
Tensile Strain	1.043E-2	1.057E-2

Net External Pressure = 29.0 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.789	7.5	9.5	OK
Unconstrained Collapse [psi]	26.0	128.7	4.9	OK
Compressive Wall Stress [psi]	72.6	1150.0	15.8	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	36.0	220.8	6.1	OK
Tensile Stress [psi]	602.0	1200.0	2.0	OK

Generated Output

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Project Summary

General:	HDD #21 CHPE Start Date: 09-14-2022 End Date: 09-14-2022
Project Owner:	TDI
Project Contractor:	Kiewit
Project Consultant:	CHA/BCE
Designer:	MDB BCE Amherst, Massachusetts
Description:	South to North 10" DR 9

Input Summary

Start Coordinate	(0.00, 0.00, 134.00) ft
End Coordinate	(1975.00, 0.00, 135.00) ft
Project Length	1975.00 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	2.875 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 6

Soil Layer #1 USCS, Sand (S), SW
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, 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]

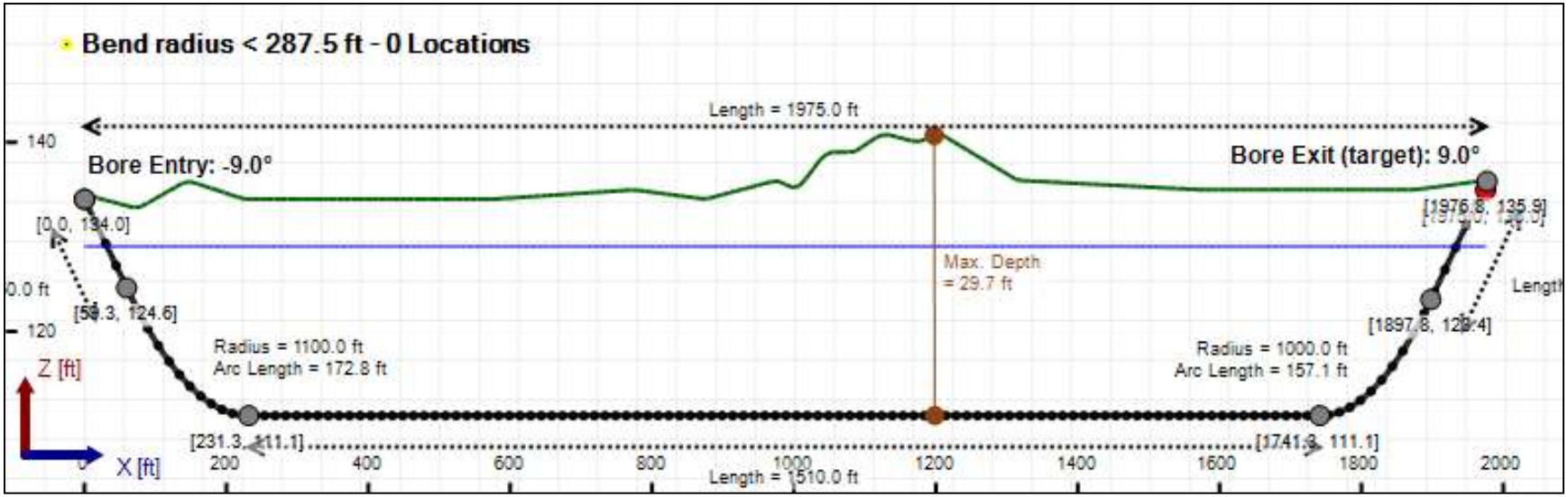
Soil Layer #3 USCS, Organic (O), OL
From Assistant
Unit Weight: 80.0000 (dry), 100.0000 (sat) [lb/ft3]
Phi: 28.00, S.M.: 50.00, Coh: 0.00 [psi]

Soil Layer #4 USCS, Clay (C), CL
From Assistant
Unit Weight: 70.0000 (dry), 100.0000 (sat) [lb/ft3]
Phi: 0.00, S.M.: 200.00, Coh: 3.13 [psi]

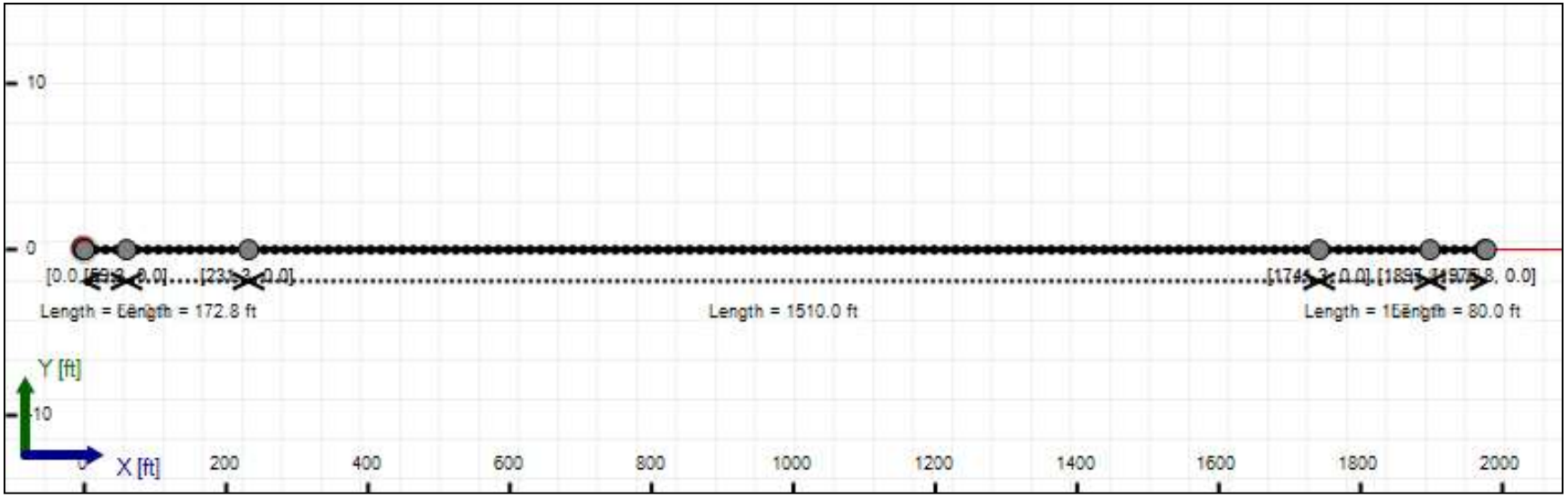
Soil Layer #5 USCS, Gravel (G), GW
From Assistant
Unit Weight: 120.0000 (dry), 140.0000 (sat) [lb/ft3]
Phi: 37.00, S.M.: 1000.00, Coh: 0.00 [psi]

Soil Layer #6 Rock, Geological Classification, Sedimentary Rocks
From Assistant
Unit Weight: 165.0000 (dry), 177.0000 (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: Gas
Pipe Type: HDPE
Classification: IPS
Pipe OD: 10" (10.75")
Pipe DR: 9
Pipe Length: 1980.00 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	10.5	13.6
Water Pressure	7.8	7.8
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	18.3	21.4
Deflection		
Earth Load Deflection	2.868	3.703
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	3.000	3.835
Compressive Stress [psi]		
Compressive Wall Stress	82.4	96.2

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	30710.4	30710.4
Pullback Stress [psi]	856.5	856.5
Pullback Strain	1.490E-2	1.490E-2
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	856.5	871.5
Tensile Strain	1.490E-2	1.556E-2

Net External Pressure = 15.8 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	3.000	7.5	2.5	OK
Unconstrained Collapse [psi]	18.3	105.6	5.8	OK
Compressive Wall Stress [psi]	82.4	1150.0	14.0	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	26.1	201.6	7.7	OK
Tensile Stress [psi]	871.5	1200.0	1.4	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	9.50 in	54.748 psi	49.587 psi
1	9.50 in	14.00 in	54.583 psi	48.272 psi
2	14.00 in	16.13 in	54.484 psi	47.566 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): 80.00 US (liquid) gallon/min

Drill Fluid Density: 68.700 lb/ft3

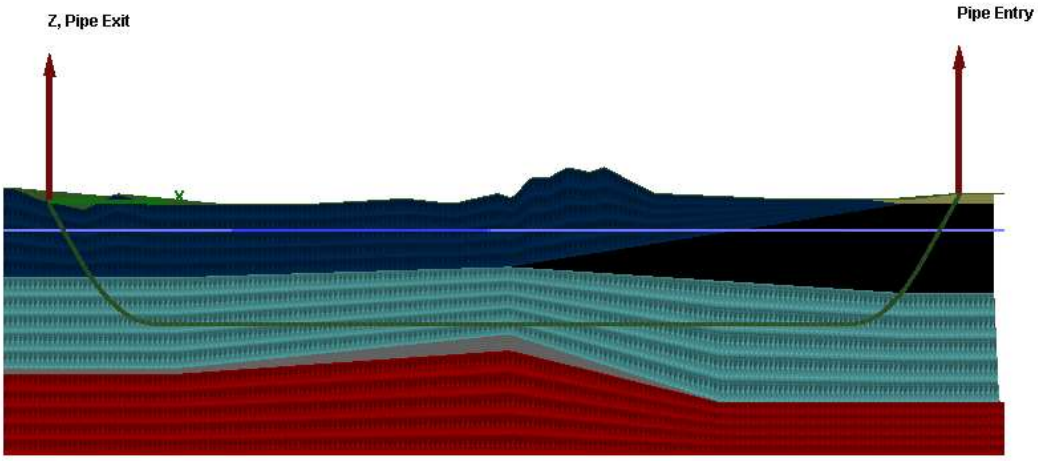
Rheological model: Bingham-Plastic

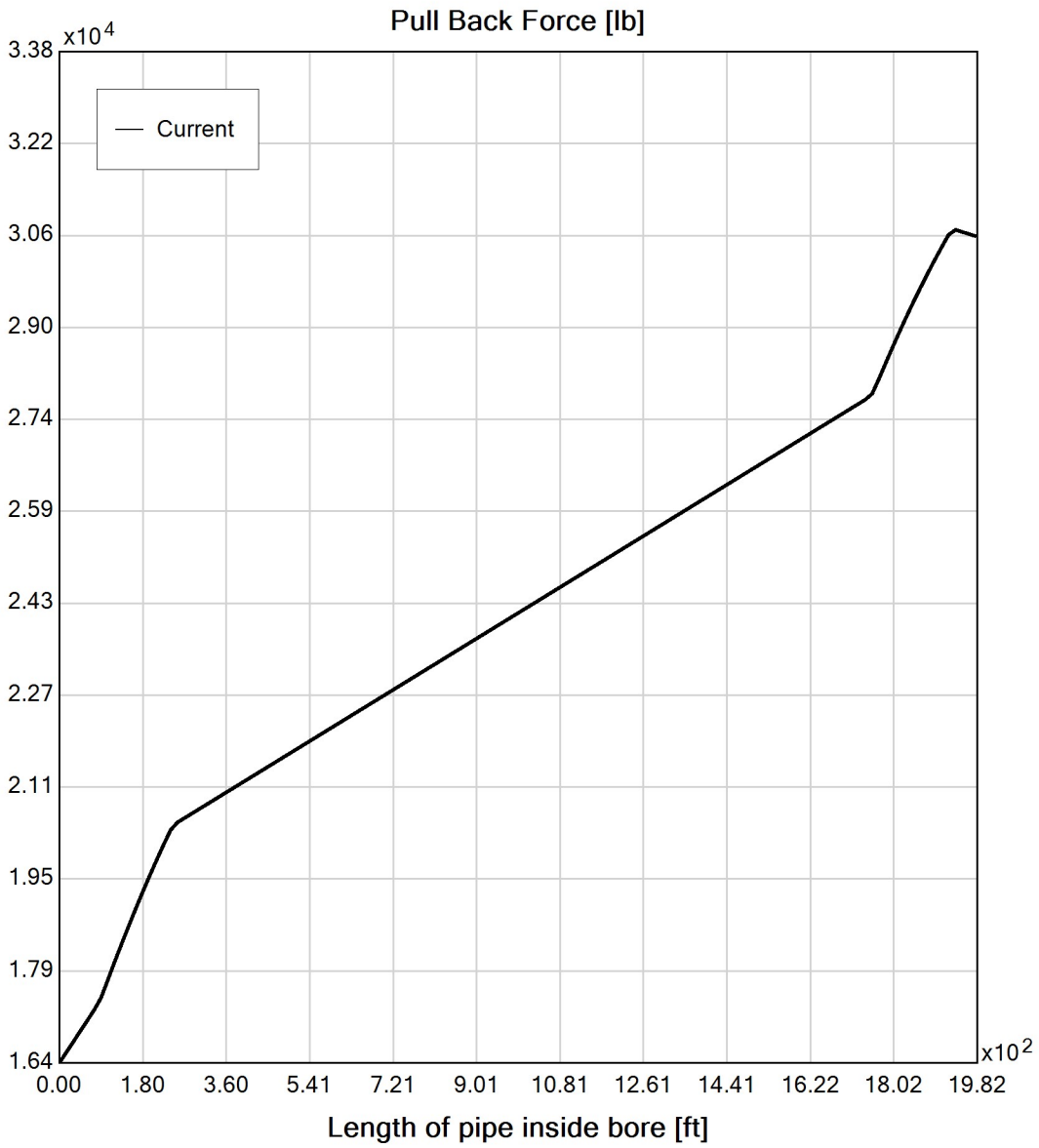
Plastic Viscosity (PV): 25.53

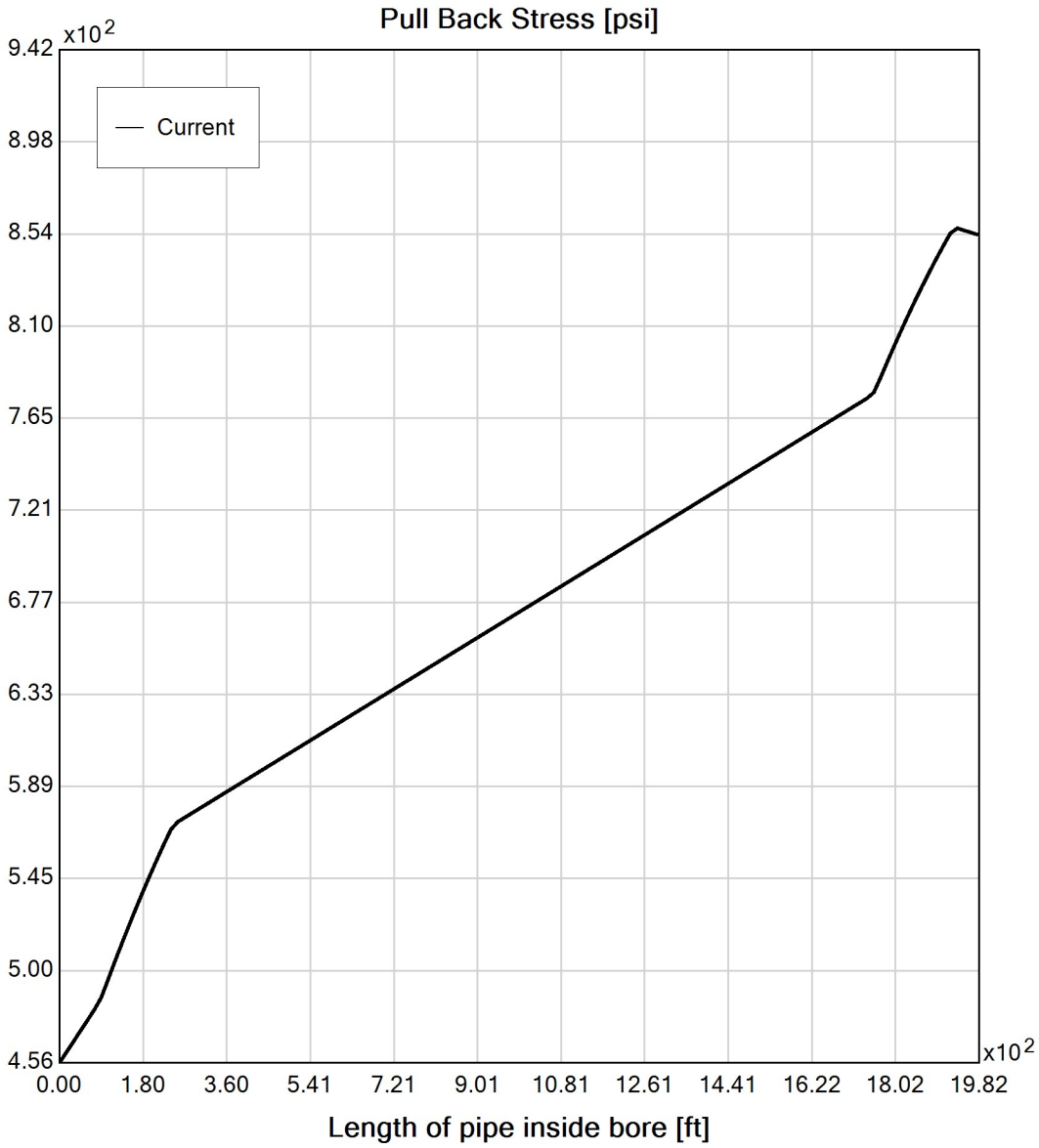
Yield Point (YP): 16.49

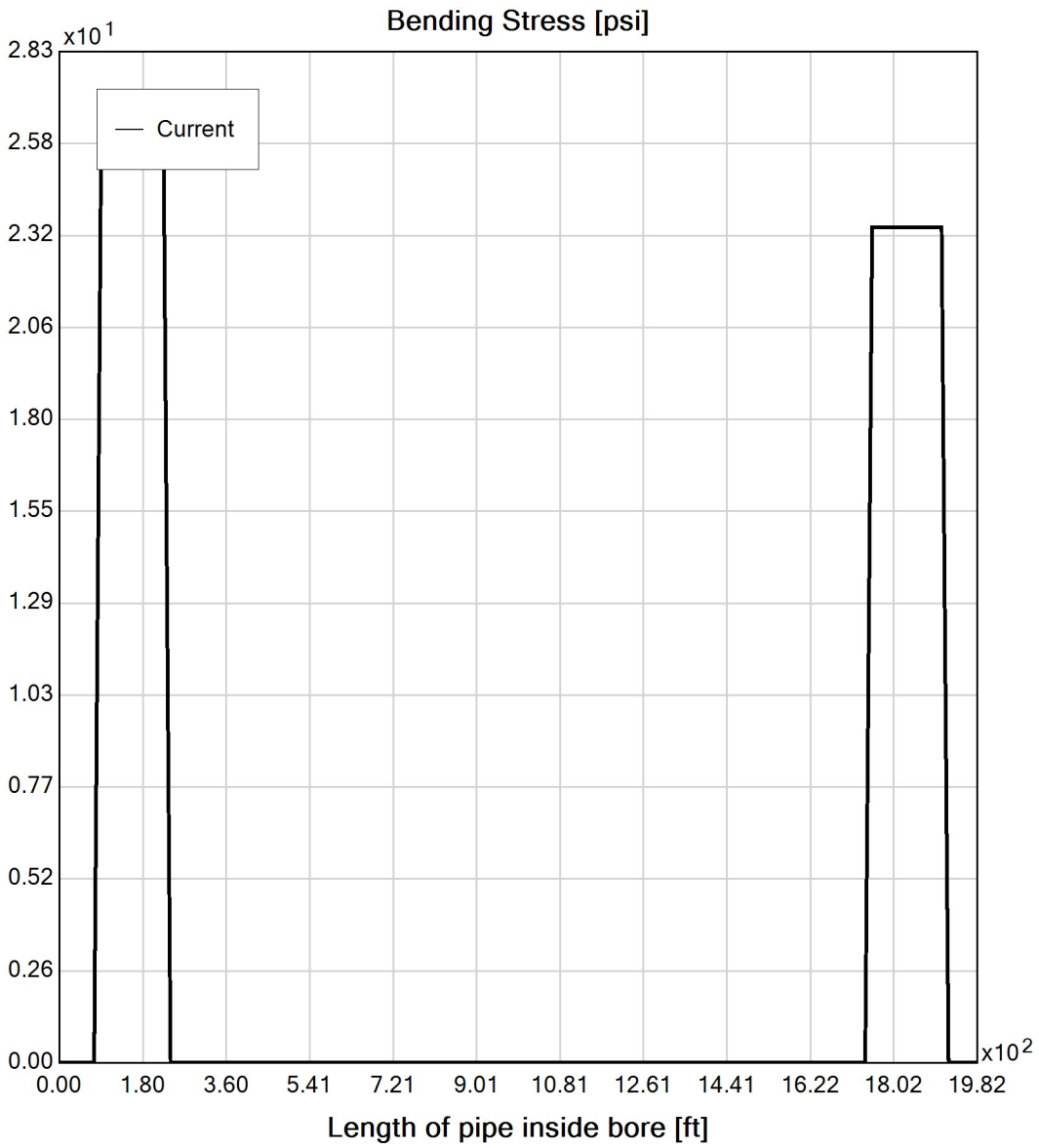
Effective Viscosity (cP): 1397.5

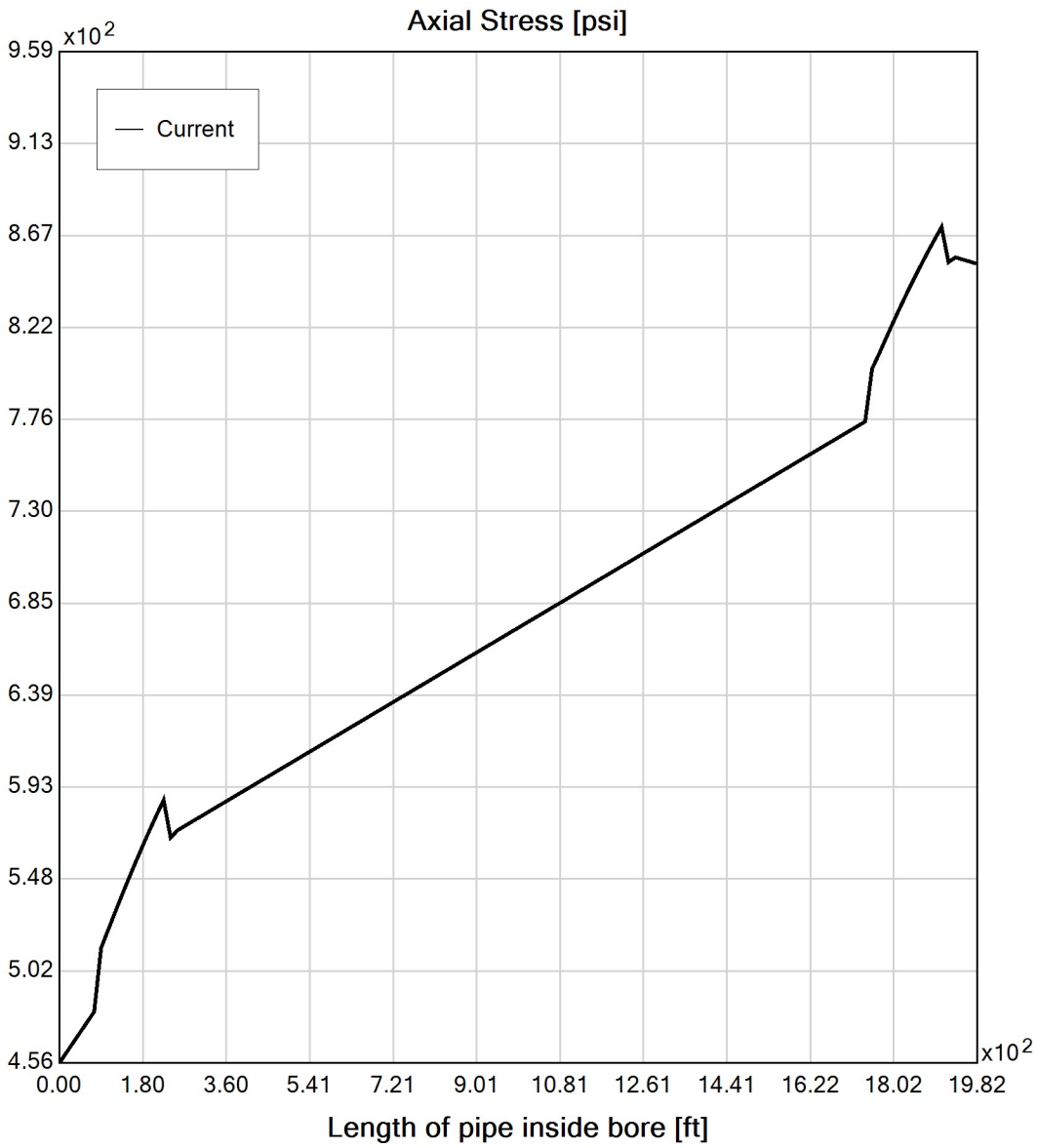
Virtual Site

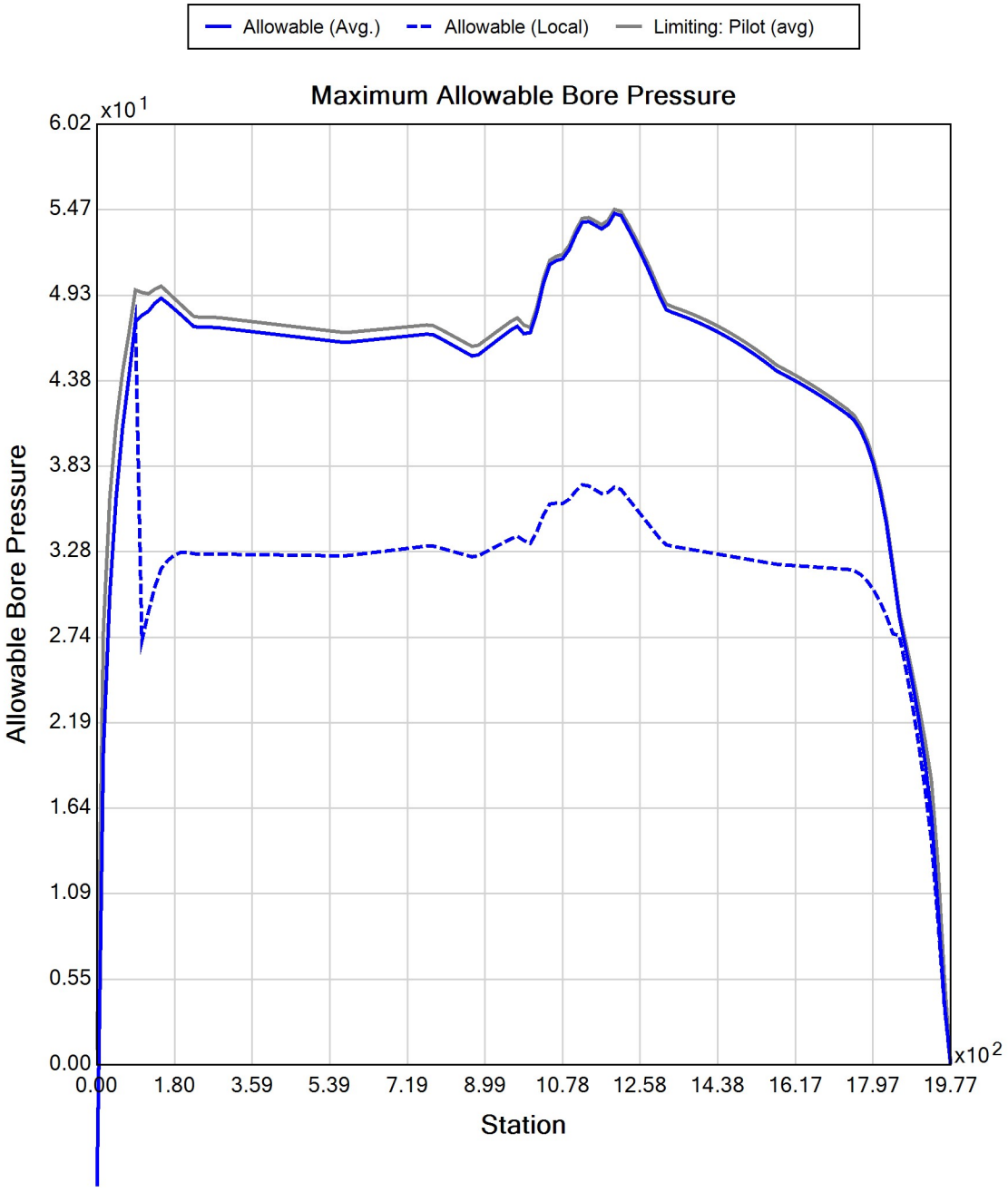


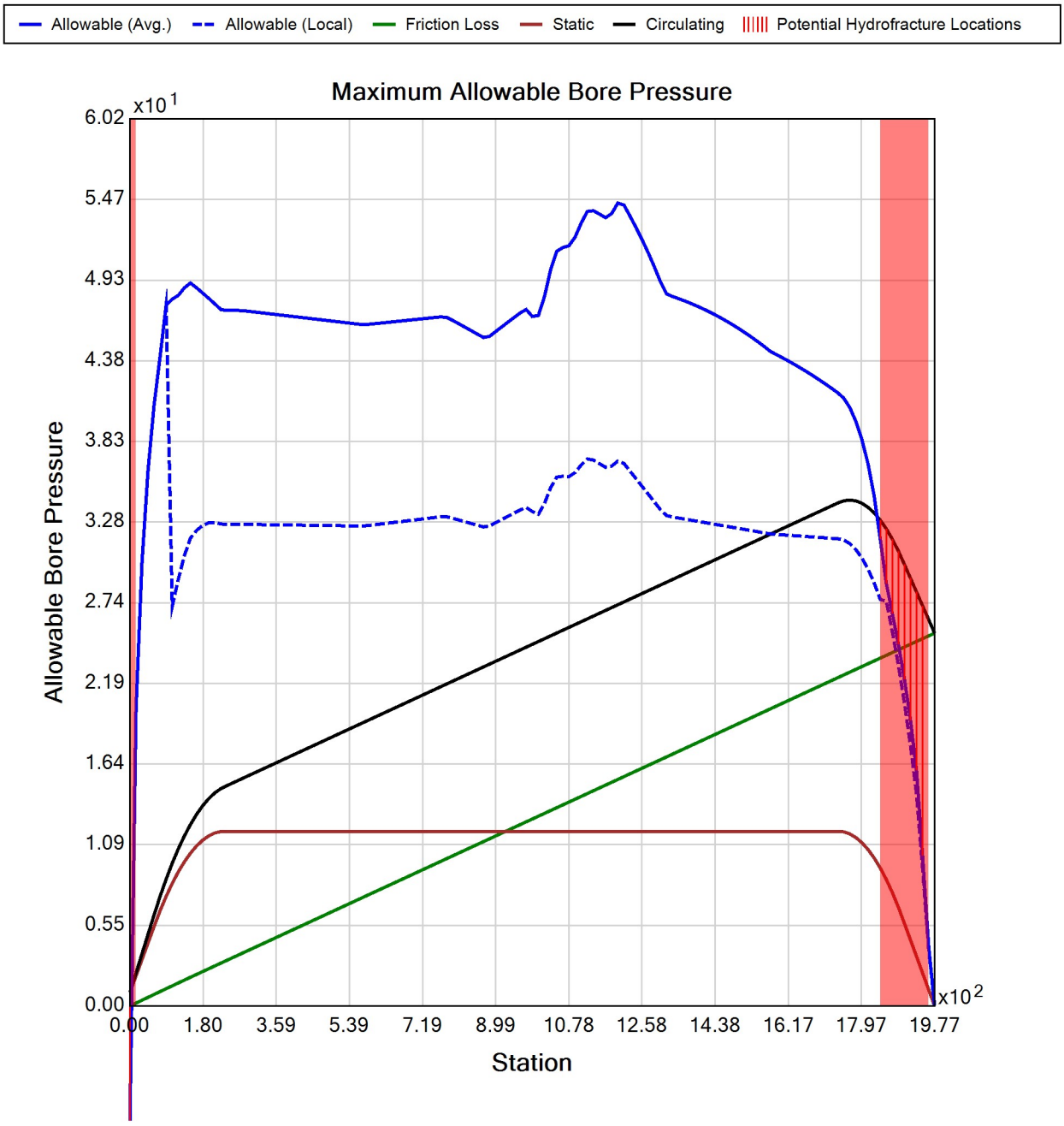












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Input Summary

Start Coordinate	(0.00, 0.00, 134.00) ft
End Coordinate	(1975.00, 0.00, 135.00) ft
Project Length	1975.00 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: Gas
Pipe Type: HDPE
Classification: IPS
Pipe OD: 2" (2.375")
Pipe DR: 9
Pipe Length: 1980.00 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	10.5	13.6
Water Pressure	7.8	7.8
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	18.3	21.4
Deflection		
Earth Load Deflection	2.929	3.703
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	2.958	3.732
Compressive Stress [psi]		
Compressive Wall Stress	82.2	96.2

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	1608.6	1608.6
Pullback Stress [psi]	919.1	919.1
Pullback Strain	1.598E-2	1.598E-2
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	919.1	919.1
Tensile Strain	1.598E-2	1.602E-2

Net External Pressure = 15.8 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	2.958	7.5	2.5	OK
Unconstrained Collapse [psi]	18.3	106.7	5.8	OK
Compressive Wall Stress [psi]	82.2	1150.0	14.0	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	26.1	198.9	7.6	OK
Tensile Stress [psi]	919.1	1200.0	1.3	OK

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Project Summary

General:	HDD #21A
	Start Date: 09-15-2022
	End Date: 09-15-2022
Project Owner:	TDI
Project Contractor:	Kiewit
Project Consultant:	CHA/BCE
Designer:	MDB
	BCE
	Amherst, Massachusetts
Description:	North to South 10" DR 9

Input Summary

Start Coordinate	(0.00, 0.00, 136.00) ft
End Coordinate	(1965.00, 0.00, 139.00) ft
Project Length	1965.00 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), SW
From Assistant
Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft3]
Phi: 34.00, S.M.: 500.00, Coh: 0.00 [psi]

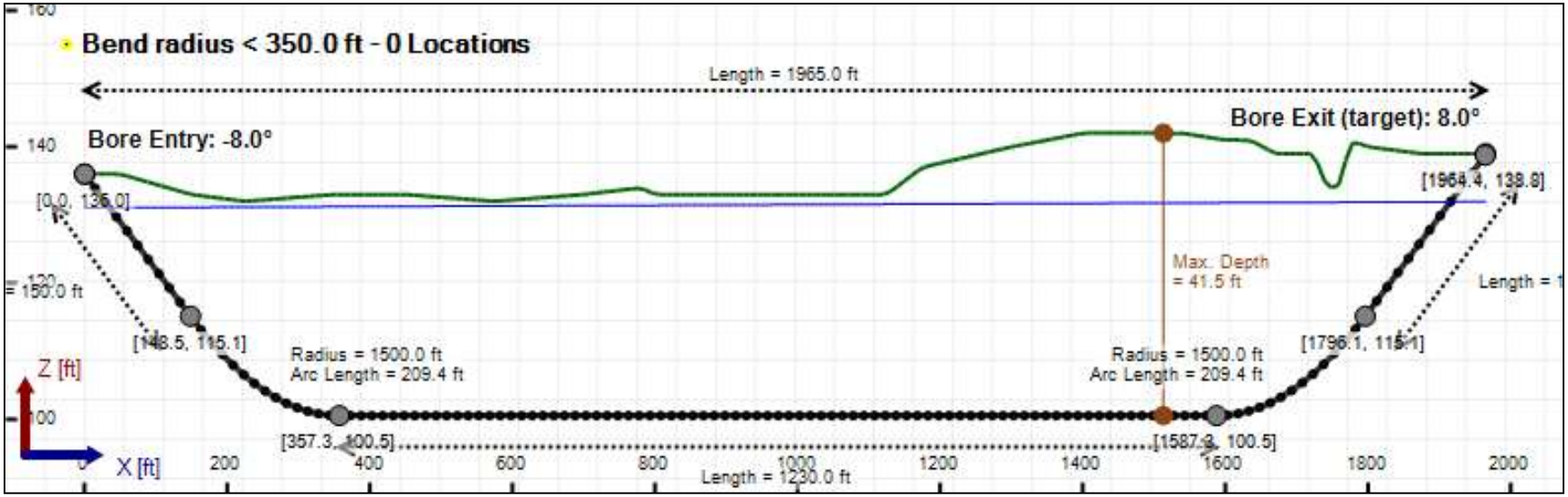
Soil Layer #2 USCS, Clay (C), CL
From Assistant
Unit Weight: 100.0000 (dry), 120.0000 (sat) [lb/ft3]
Phi: 0.00, S.M.: 400.00, Coh: 8.30 [psi]

Soil Layer #3 USCS, Clay (C), CL
From Assistant
Unit Weight: 70.0000 (dry), 100.0000 (sat) [lb/ft3]
Phi: 0.00, S.M.: 200.00, Coh: 3.13 [psi]

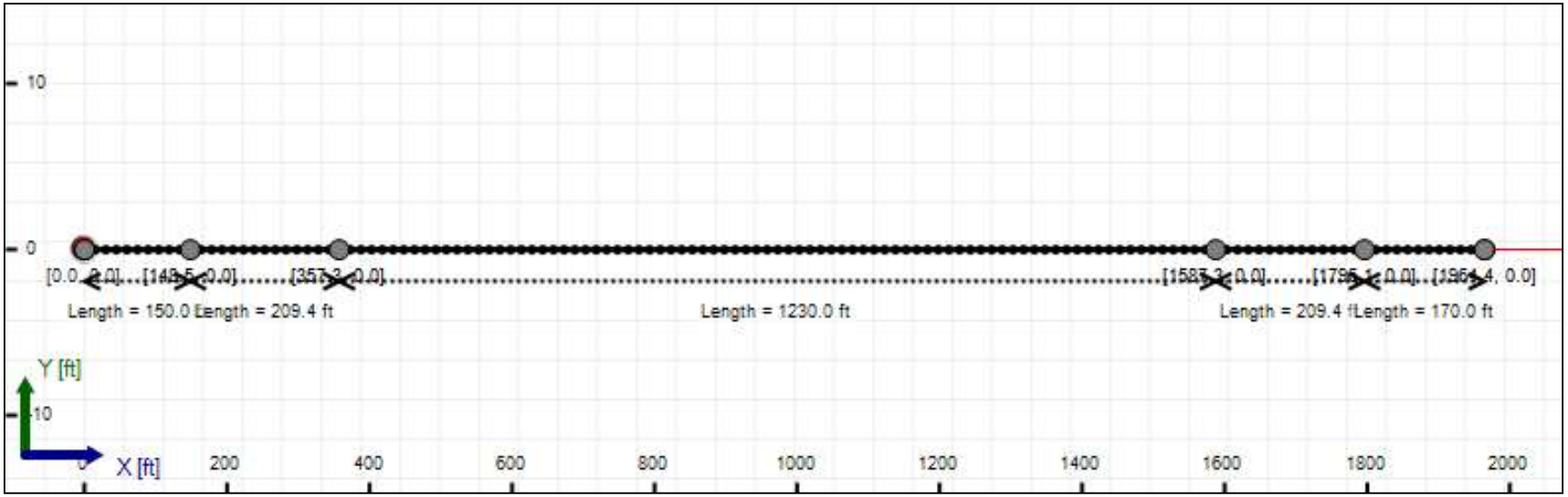
Soil Layer #4 USCS, Gravel (G), GW
From Assistant
Unit Weight: 120.0000 (dry), 140.0000 (sat) [lb/ft3]
Phi: 37.00, S.M.: 1000.00, Coh: 0.00 [psi]

Soil Layer #5 Rock, Geological Classification, Sedimentary Rocks
From Assistant
Unit Weight: 165.0000 (dry), 177.0000 (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: Gas
Pipe Type: HDPE
Classification: IPS
Pipe OD: 10" (10.75")
Pipe DR: 9
Pipe Length: 1980.00 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	10.8	19.9
Water Pressure	13.4	13.5
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	24.1	33.4
Deflection		
Earth Load Deflection	2.944	5.418
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	3.076	5.550
Compressive Stress [psi]		
Compressive Wall Stress	108.5	150.5

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	30586.0	30586.0
Pullback Stress [psi]	853.0	853.0
Pullback Strain	1.483E-2	1.483E-2
Bending Stress [psi]	0.0	17.2
Bending Strain	0	2.986E-4
Tensile Stress [psi]	853.0	863.8
Tensile Strain	1.483E-2	1.532E-2

Net External Pressure = 25.0 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	3.076	7.5	2.4	OK
Unconstrained Collapse [psi]	25.9	104.9	4.1	OK
Compressive Wall Stress [psi]	108.5	1150.0	10.6	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	35.8	201.9	5.6	OK
Tensile Stress [psi]	863.8	1200.0	1.4	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	9.50 in	114.800 psi	107.704 psi
1	9.50 in	14.00 in	114.128 psi	106.581 psi
2	14.00 in	16.13 in	113.735 psi	105.923 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): 80.00 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): 1207.7

Virtual Site