



## 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.

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## Project Summary

General: CHPE HDD 12A - Conduit 2  
P2  
Start Date: 06-21-2022  
End Date: 06-21-2022

Project Owner: TDI  
Project Contractor: Kiewit  
Project Consultant: CHA/BCE

Designer:  
Description: HDD 12A Conduit 2 10-inch DR 9

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## Input Summary

Start Coordinate	(0.00, 0.00, 141.40) ft
End Coordinate	(1490.00, 0.00, 141.40) ft
Project Length	1490.00 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

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## Soil Summary

Number of Layers: 3

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

Depth: 4.00 ft

Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3]

Phi: 30.00, S.M.: 1.39, Coh: 0.00 [psi]

Soil Layer #2 Rock, Geological Classification, Sedimentary Rocks

Depth: 40.00 ft

Unit Weight: 120.0000 (dry), 140.0000 (sat) [lb/ft3]

Phi: 37.00, S.M.: 1000.00, Coh: 0.00 [psi]

Soil Layer #3 Rock, Geological Classification, Sedimentary Rocks

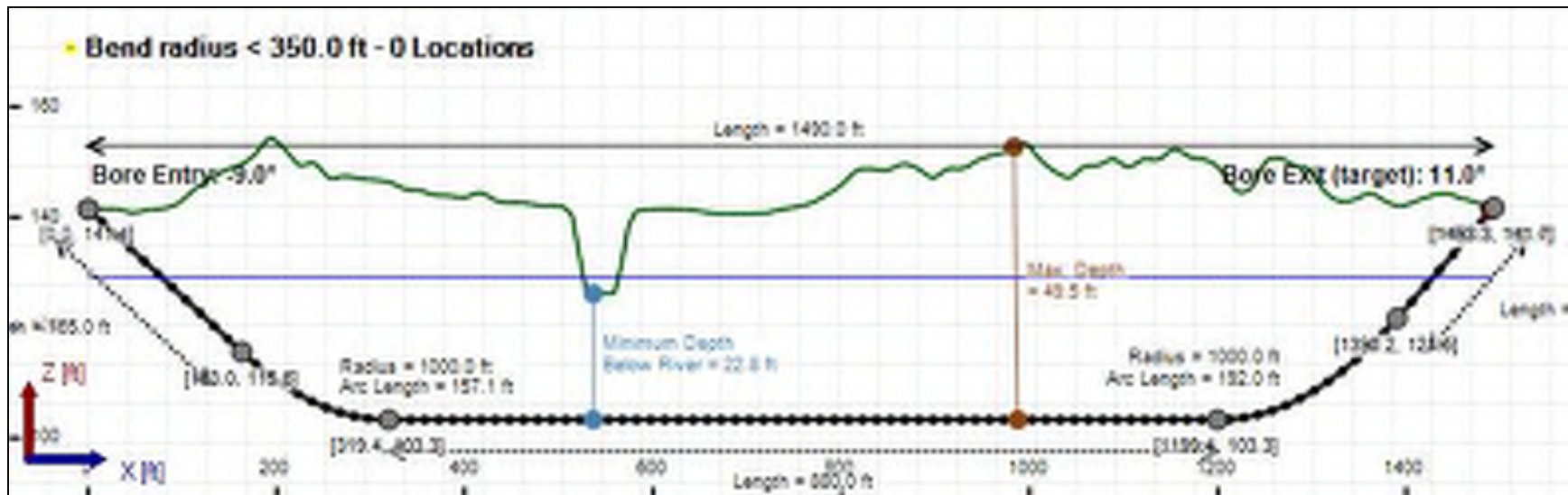
Depth: 20.00 ft

Unit Weight: 120.0000 (dry), 140.0000 (sat) [lb/ft3]

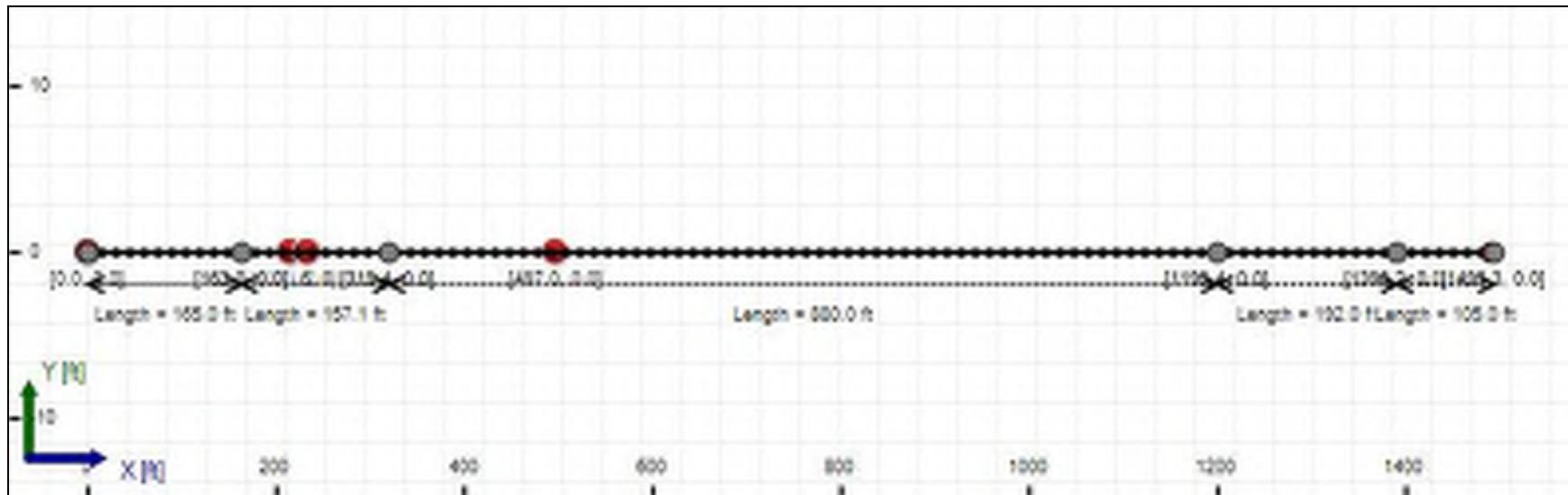
Phi: 37.00, S.M.: 1000.00, Coh: 0.00 [psi]



### Bore Cross-Section View



## Bore Plan View



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## Load Verifier Input Summary:

Pipe Application: Electrical Cable  
Pipe Type: HDPE  
Classification: IPS  
Pipe OD: 10" (10.75")  
Pipe DR: 9  
Pipe Length: 1500.00 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/ft<sup>3</sup>  
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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>

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### In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	5.1	32.4
Water Pressure	11.2	11.2
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	16.2	43.5
<b>Deflection</b>		
Earth Load Deflection	1.442	8.823
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.574	8.955
<b>Compressive Stress [psi]</b>		
Compressive Wall Stress	73.0	196.0

### Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	24022.6	24022.6
Pullback Stress [psi]	670.0	670.0
Pullback Strain	1.165E-2	1.165E-2
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	670.0	689.0
Tensile Strain	1.165E-2	1.243E-2

Net External Pressure = 25.6 [psi ]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

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### In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.574	7.5	4.8	OK
Unconstrained Collapse [psi]	25.1	120.6	4.8	OK
Compressive Wall Stress [psi]	73.0	1150.0	15.7	OK

### Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	35.1	214.4	6.1	OK
Tensile Stress [psi]	689.0	1200.0	1.7	OK

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## 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	199.753 psi	238.537 psi
1	8.00 in	12.00 in	199.438 psi	237.994 psi
2	12.00 in	16.13 in	198.984 psi	237.213 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/ft<sup>3</sup>

Rheological model: Bingham-Plastic

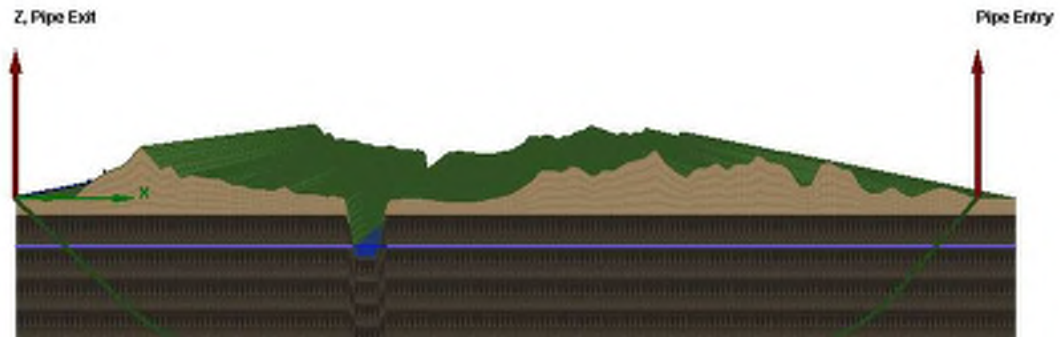
Plastic Viscosity (PV): 25.53

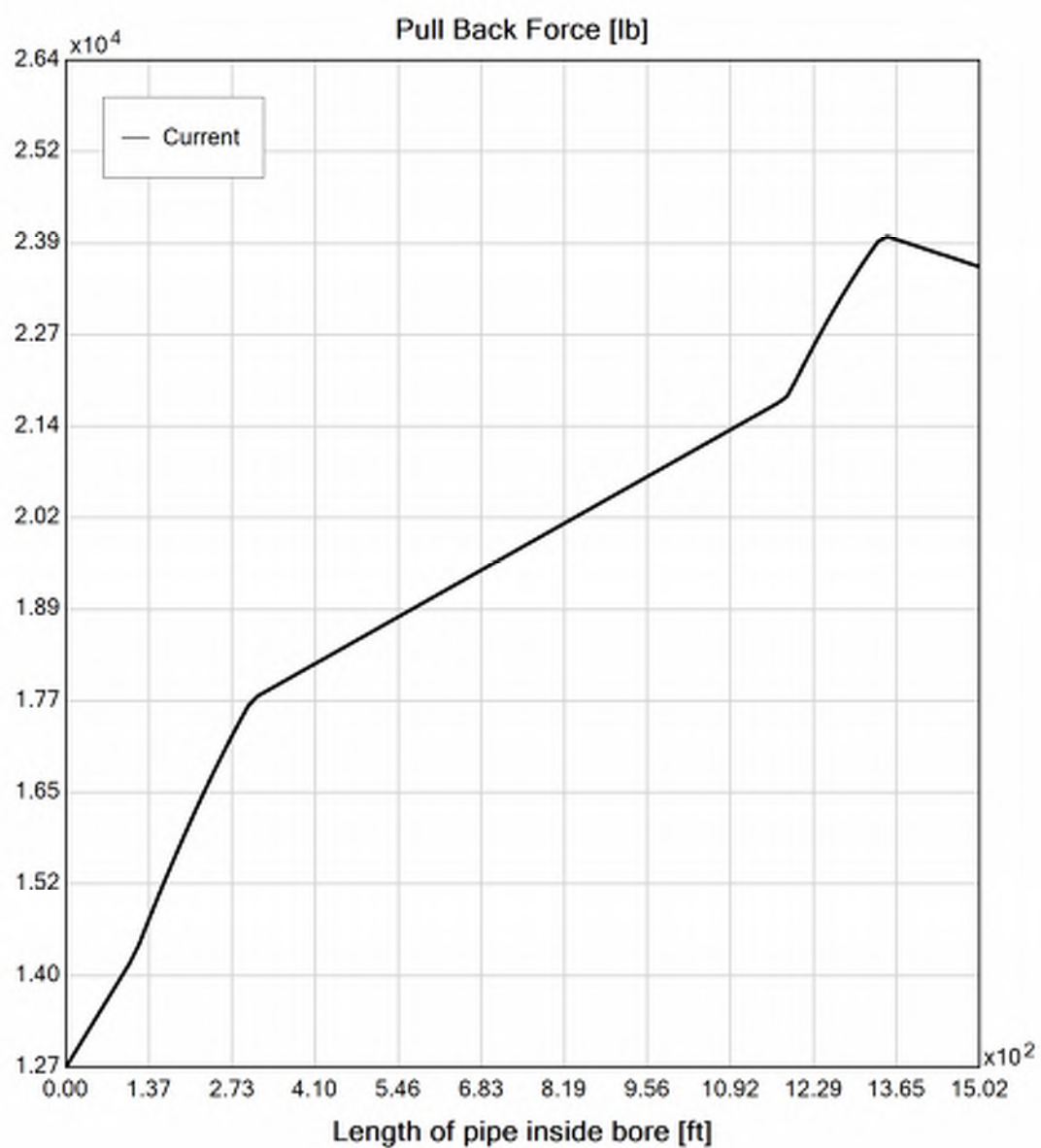
Yield Point (YP): 16.49

Effective Viscosity (cP): 1202.0

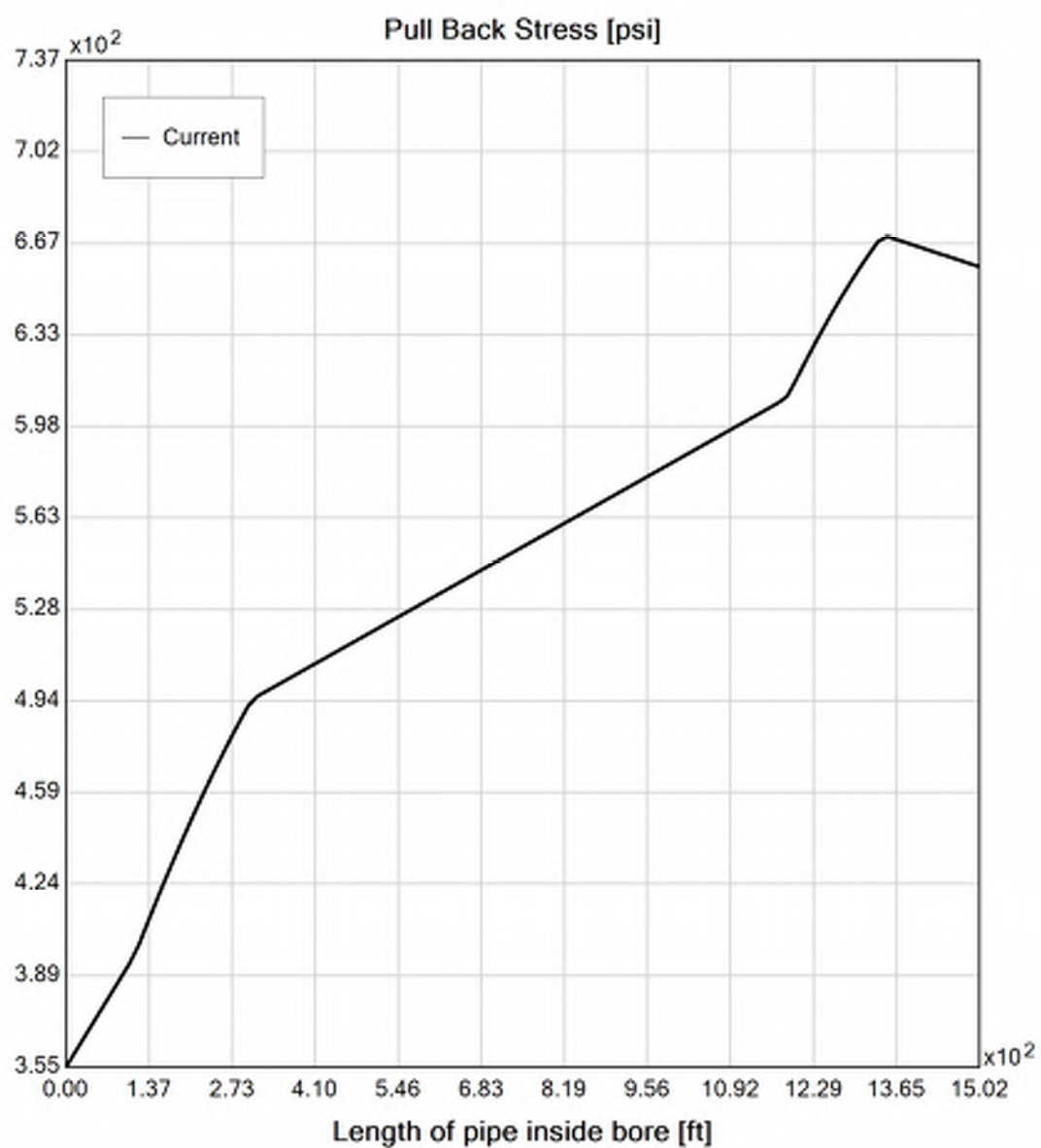
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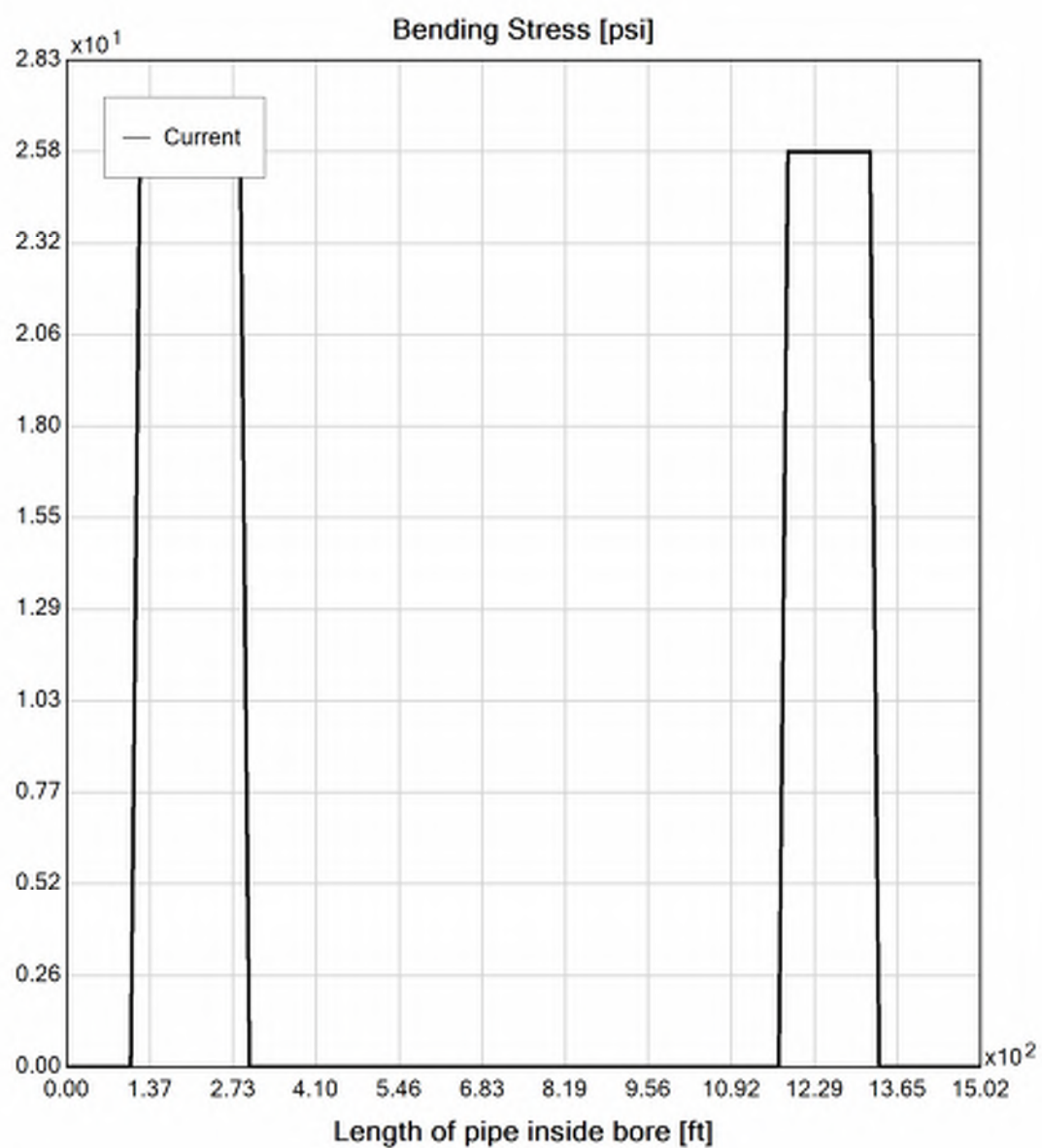
## Virtual Site

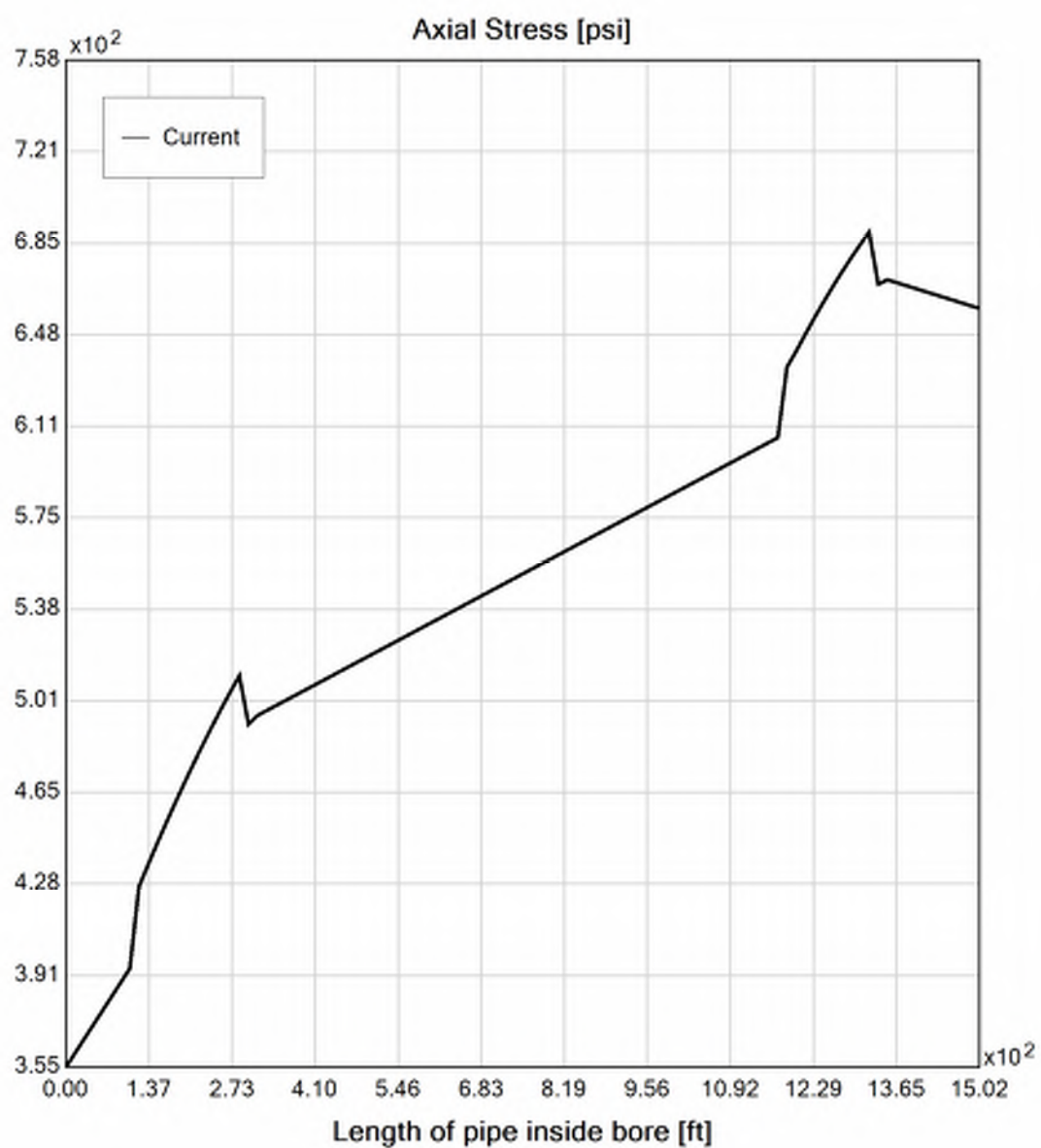


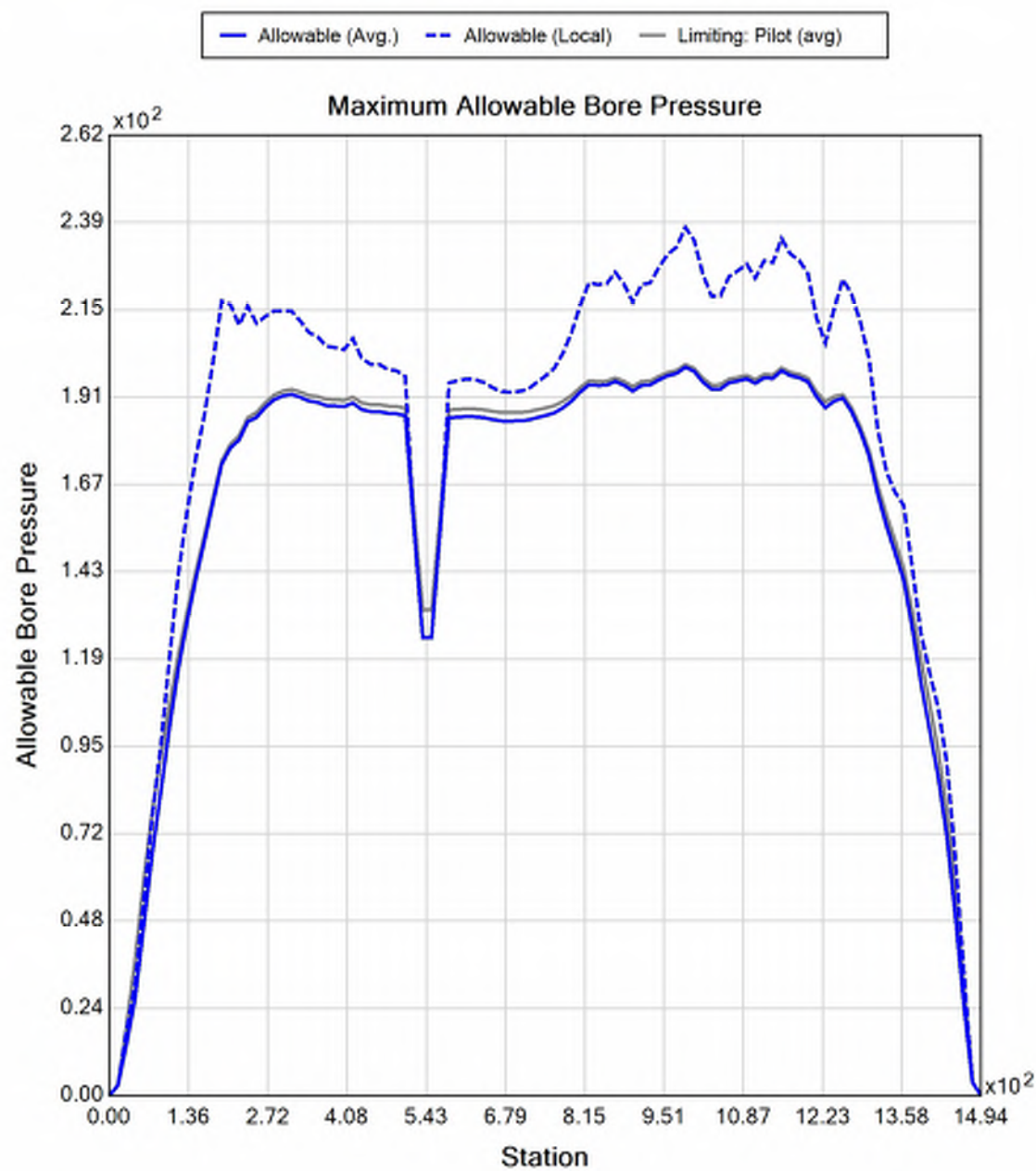


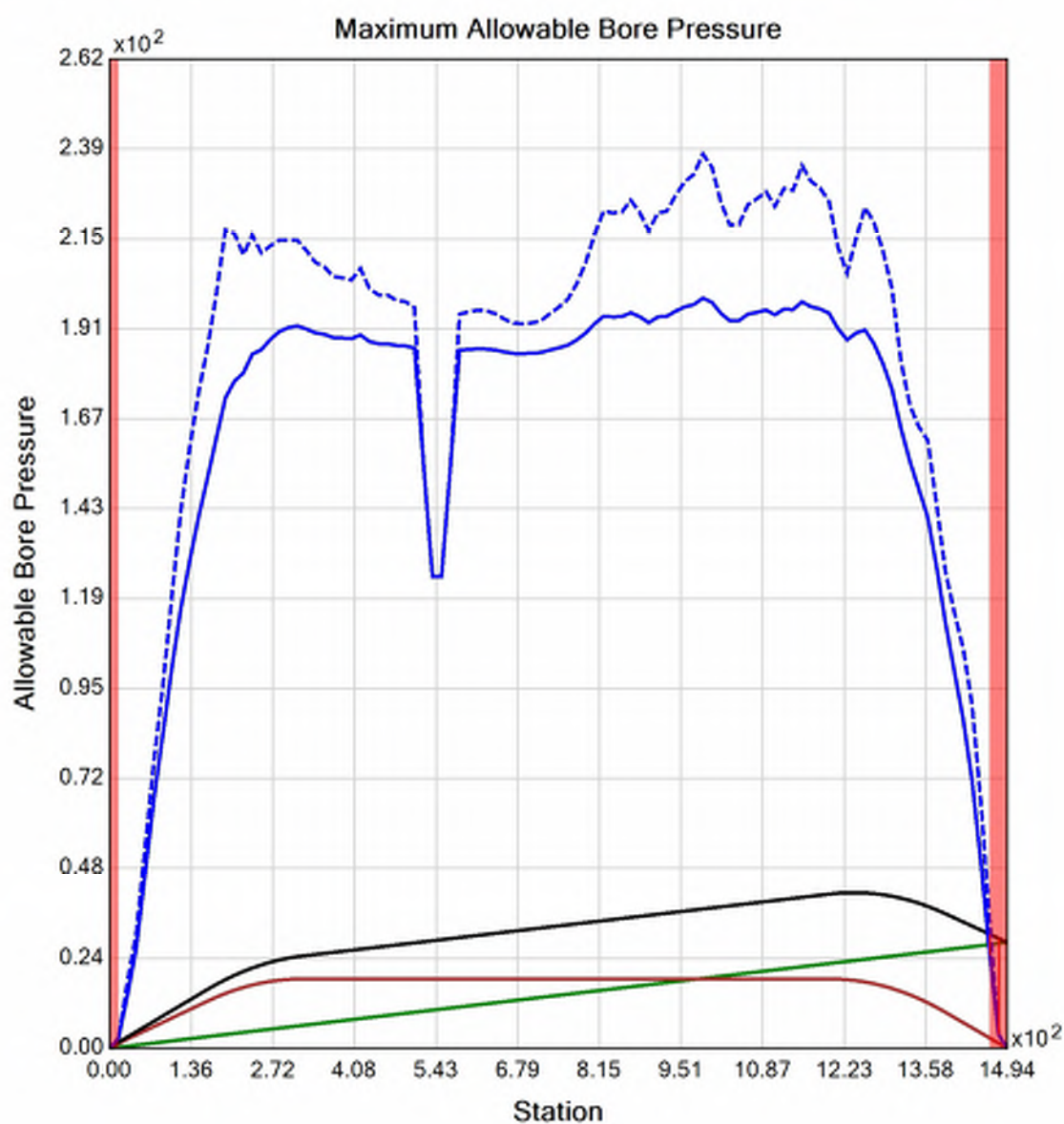














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## Input Summary

Start Coordinate	(0.00, 0.00, 141.40) ft
End Coordinate	(1490.00, 0.00, 141.40) ft
Project Length	1490.00 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

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## Load Verifier Input Summary:

Pipe Application: Electrical Cable  
Pipe Type: HDPE  
Classification: IPS  
Pipe OD: 2" (2.375")  
Pipe DR: 9  
Pipe Length: 1500.00 ft  
Internal Pressure: 0 psi  
Borehole Diameter: 0.531000018119812 ft  
Silo Width: 0.531000018119812 ft  
Surface Surcharge: 0 psi  
Short Term Modulus: 57500 psi  
Long Term Modulus: 28200 psi  
Short Term Poisson Ratio: 0.35  
Long Term Poisson Ratio: 0.45  
Pipe Unit Weight: 59.30500 lb/ft<sup>3</sup>  
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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>



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### In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	2.0	32.4
Water Pressure	11.2	11.2
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	13.2	43.5
<b>Deflection</b>		
Earth Load Deflection	0.657	8.823
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	0.686	8.852
<b>Compressive Stress [psi]</b>		
Compressive Wall Stress	59.2	196.0

### Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	1282.1	1282.1
Pullback Stress [psi]	732.6	732.6
Pullback Strain	1.274E-2	1.274E-2
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	732.6	732.6
Tensile Strain	1.274E-2	1.282E-2

Net External Pressure = 25.6 [psi ]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

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### In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.686	7.5	10.9	OK
Unconstrained Collapse [psi]	25.1	131.1	5.2	OK
Compressive Wall Stress [psi]	59.2	1150.0	19.4	OK

### Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	35.1	212.2	6.1	OK
Tensile Stress [psi]	732.6	1200.0	1.6	OK



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## Project Summary

General:	CHPE HDD 13 - Conduit 1 P2 Start Date: 06-21-2022 End Date: 06-21-2022
Project Owner:	TDI
Project Contractor:	Kiewit
Project Consultant:	CHA/BCE
Designer:	
Description:	HDD 13 Conduit 1 10-inch DR 9

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## Input Summary

Start Coordinate	(0.00, 0.00, 129.00) ft
End Coordinate	(1478.00, 0.00, 132.00) ft
Project Length	1478.00 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

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## Soil Summary

Number of Layers: 2

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

From Assistant

Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3]

Phi: 30.00, S.M.: 200.00, Coh: 0.00 [psi]

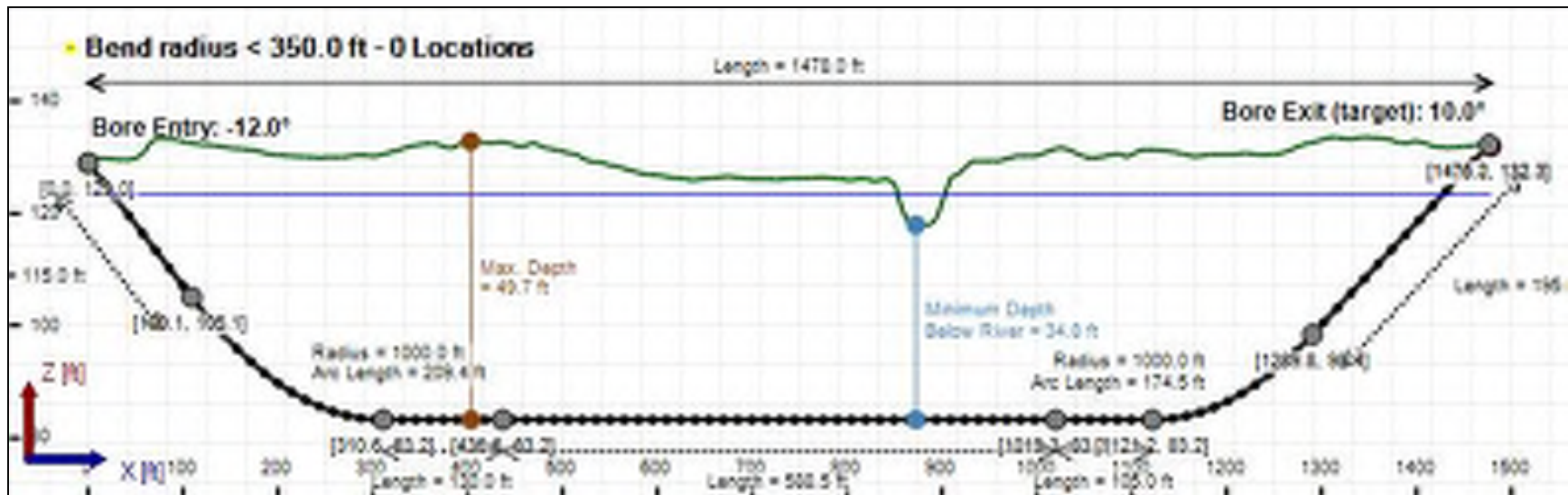
Soil Layer #2 USCS, Sand (S), SP

From Assistant

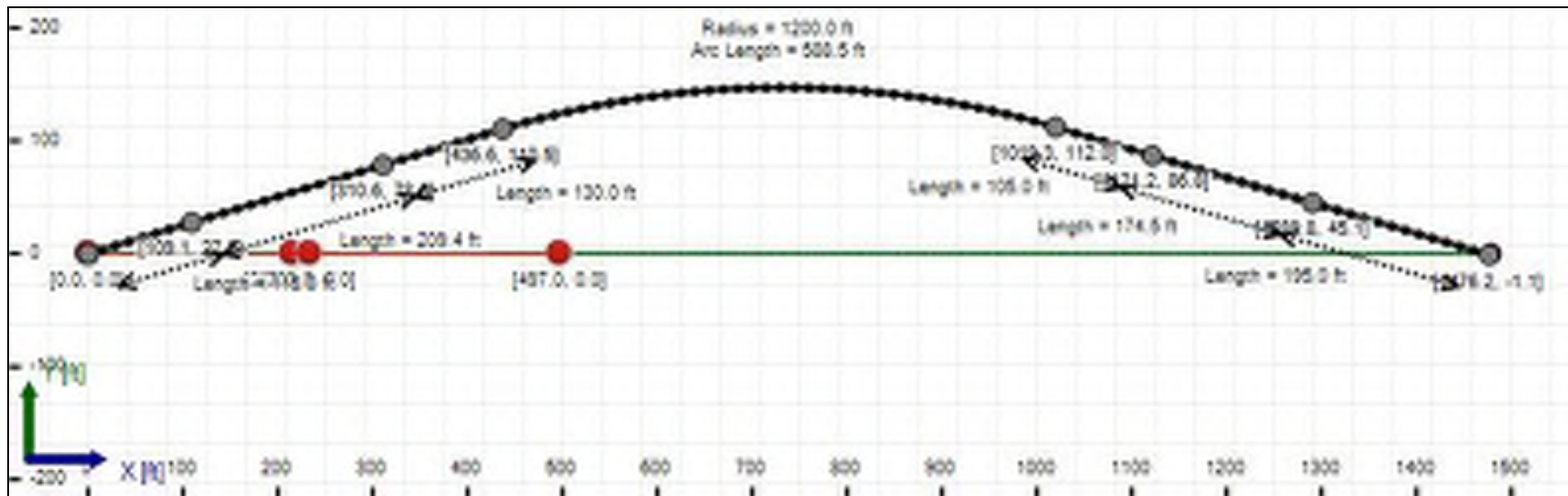
Unit Weight: 109.5552 (dry), 126.6624 (sat) [lb/ft3]

Phi: 30.00, S.M.: 300.00, Coh: 0.00 [psi]

### Bore Cross-Section View



## Bore Plan View





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## Load Verifier Input Summary:

Pipe Application: Electrical Cable  
Pipe Type: HDPE  
Classification: IPS  
Pipe OD: 10" (10.75")  
Pipe DR: 9  
Pipe Length: 1529.99 ft  
Internal Pressure: 0 psi  
Borehole Diameter: 1.34400002161662 ft  
Silo Width: 1.34400002161662 ft  
Surface Surcharge: 0 psi  
Short Term Modulus: 57500 psi  
Long Term Modulus: 28200 psi  
Short Term Poisson Ratio: 0.35  
Long Term Poisson Ratio: 0.45  
Pipe Unit Weight: 59.30500 lb/ft<sup>3</sup>  
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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>

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### In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	3.8	24.9
Water Pressure	17.4	17.4
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	21.2	42.3
<b>Deflection</b>		
Earth Load Deflection	1.116	6.771
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.248	6.904
<b>Compressive Stress [psi]</b>		
Compressive Wall Stress	95.3	190.2

### Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	29060.8	29060.8
Pullback Stress [psi]	810.5	810.5
Pullback Strain	1.410E-2	1.410E-2
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	810.5	833.3
Tensile Strain	1.410E-2	1.494E-2

Net External Pressure = 27.7 [psi ]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

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### In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.248	7.5	6.0	OK
Unconstrained Collapse [psi]	33.3	124.5	3.7	OK
Compressive Wall Stress [psi]	95.3	1150.0	12.1	OK

### Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	43.3	205.3	4.7	OK
Tensile Stress [psi]	833.3	1200.0	1.4	OK

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## 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	122.781 psi	125.100 psi
1	8.00 in	12.00 in	122.681 psi	124.991 psi
2	12.00 in	16.13 in	122.536 psi	124.833 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/ft<sup>3</sup>

Rheological model: Bingham-Plastic

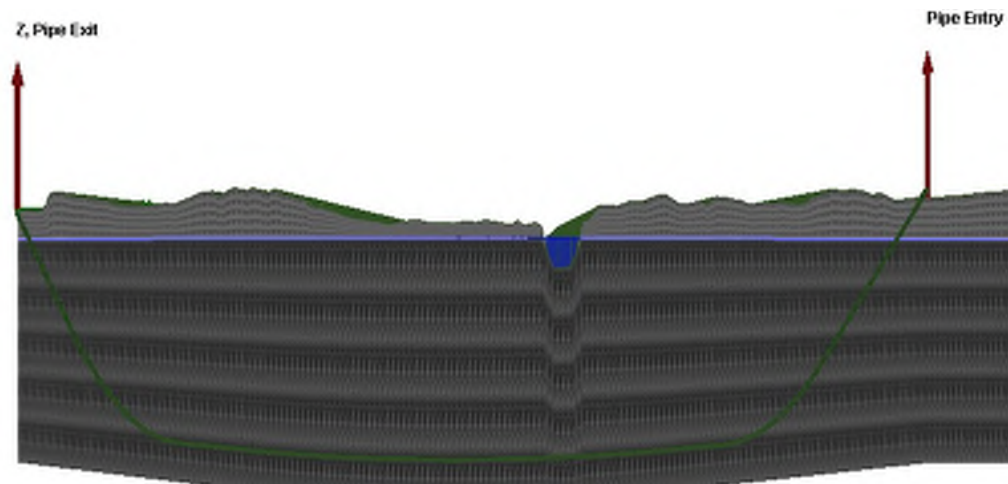
Plastic Viscosity (PV): 25.53

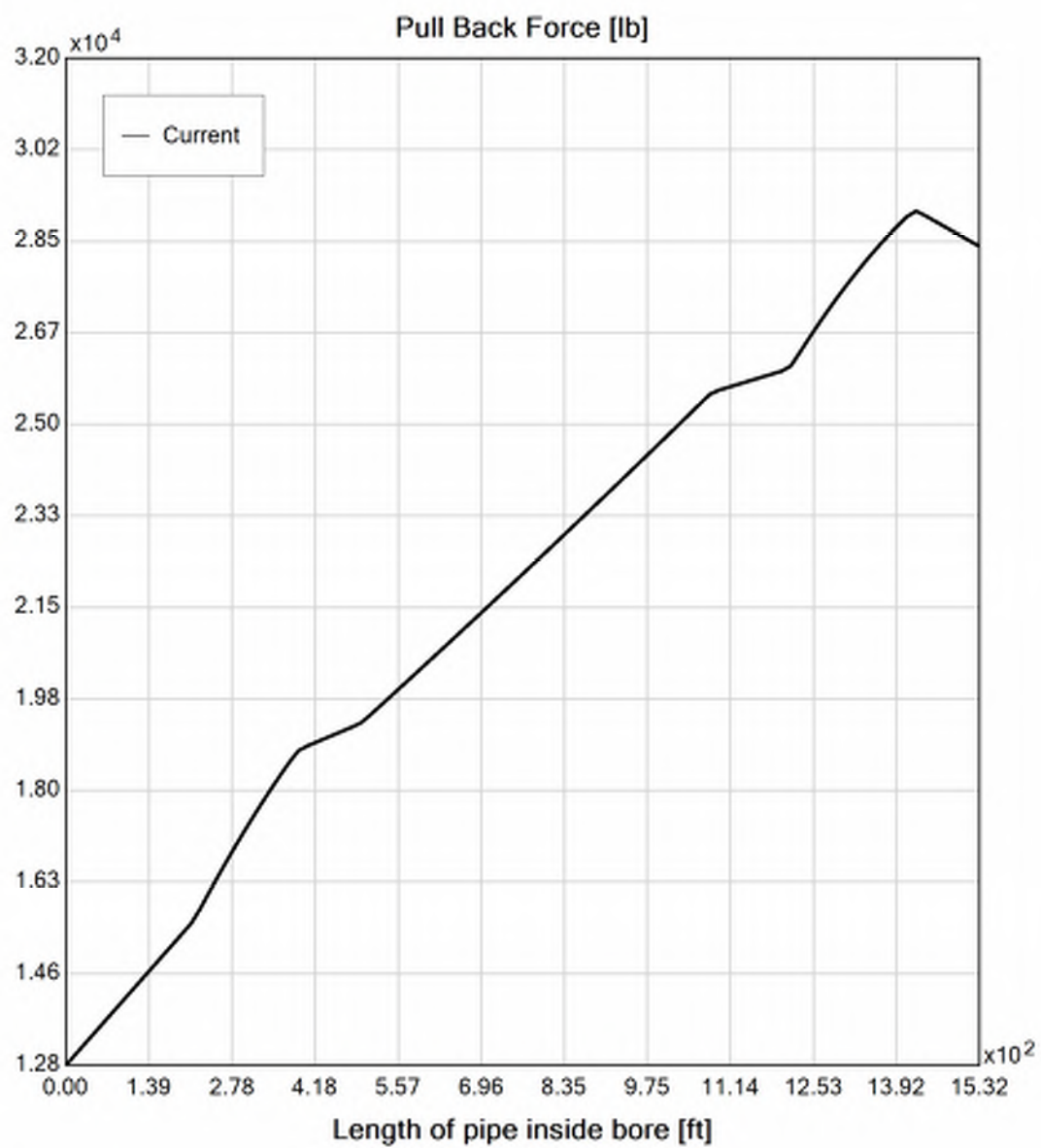
Yield Point (YP): 16.49

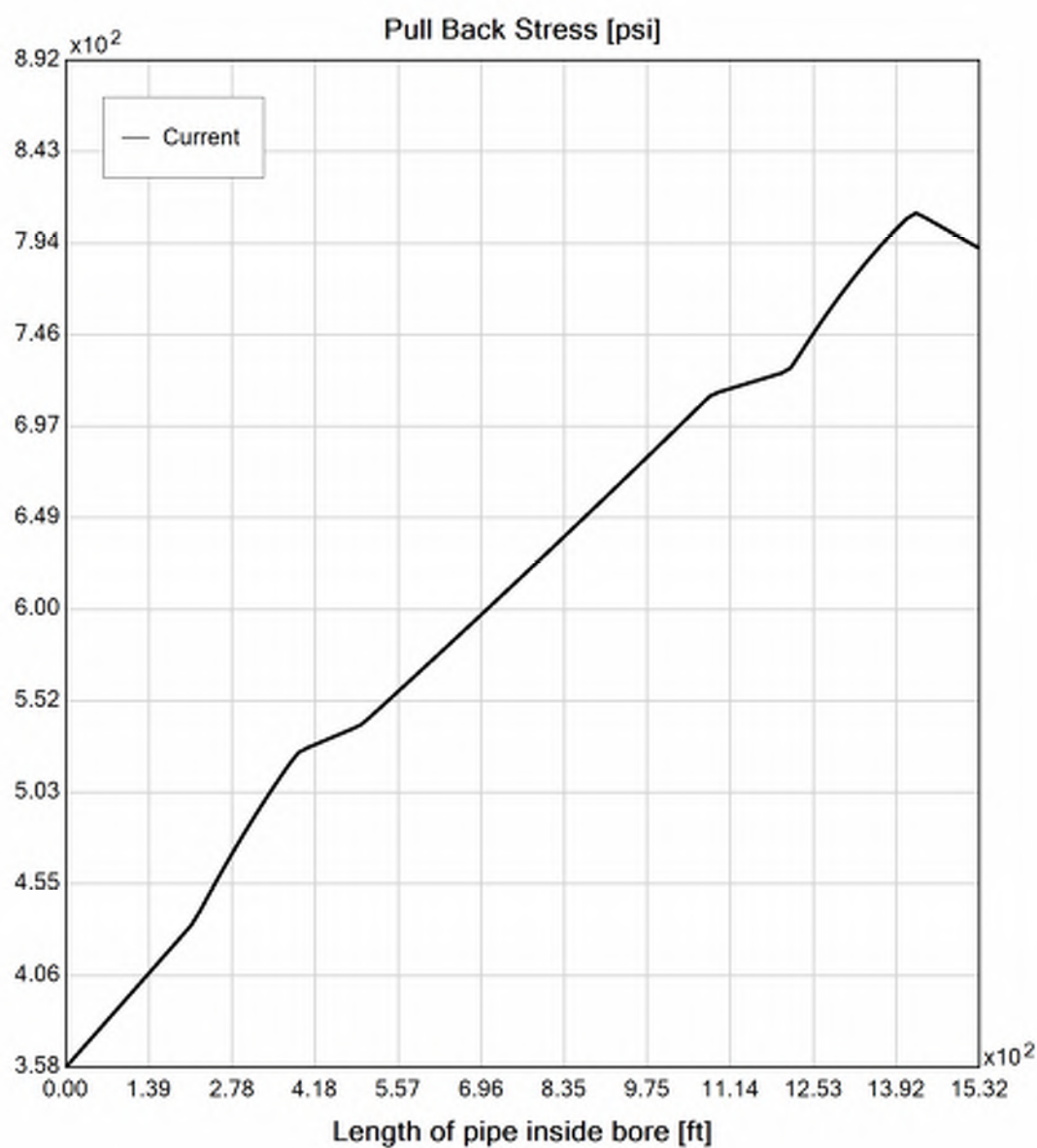
Effective Viscosity (cP): 1202.0

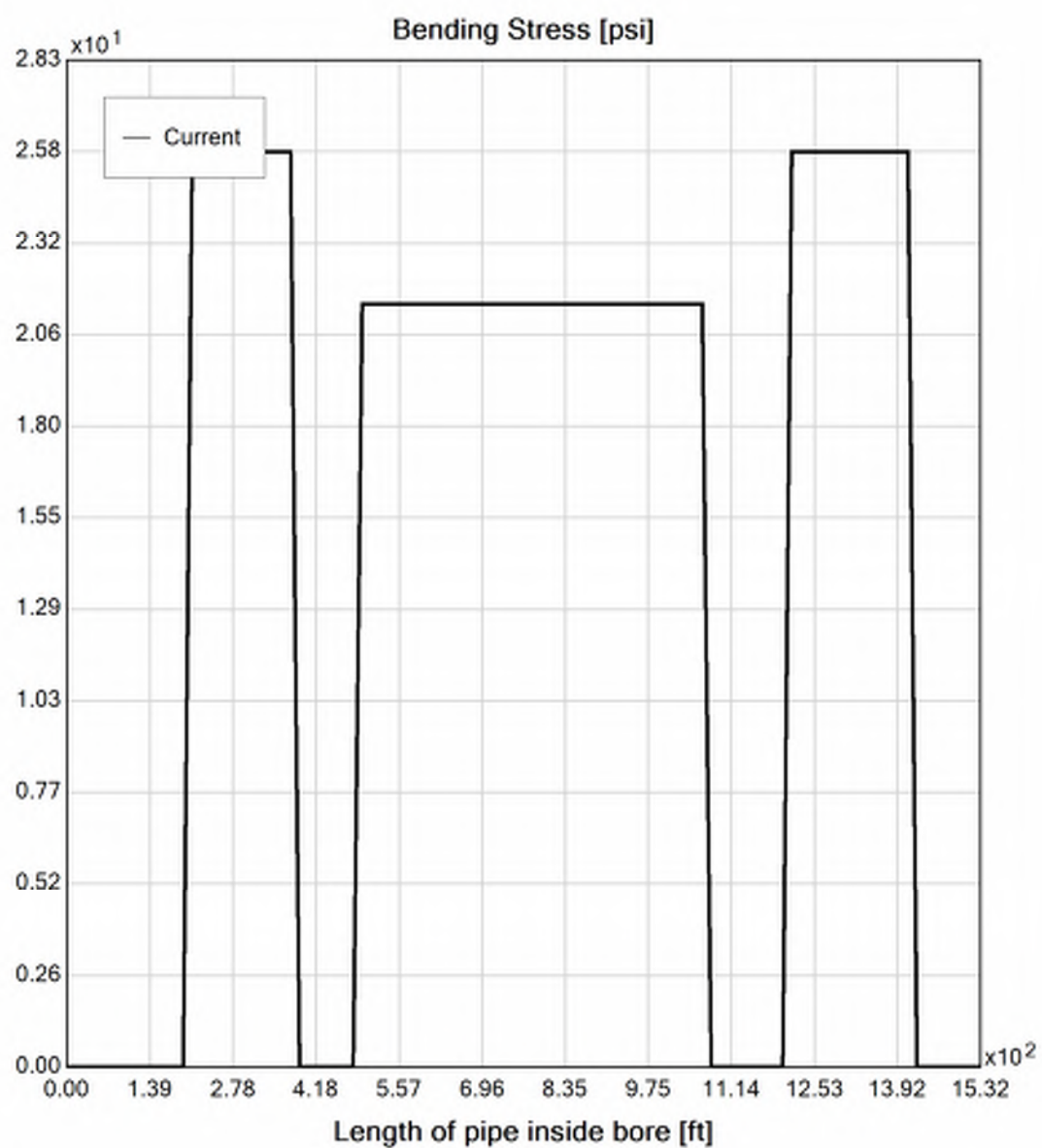
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## Virtual Site

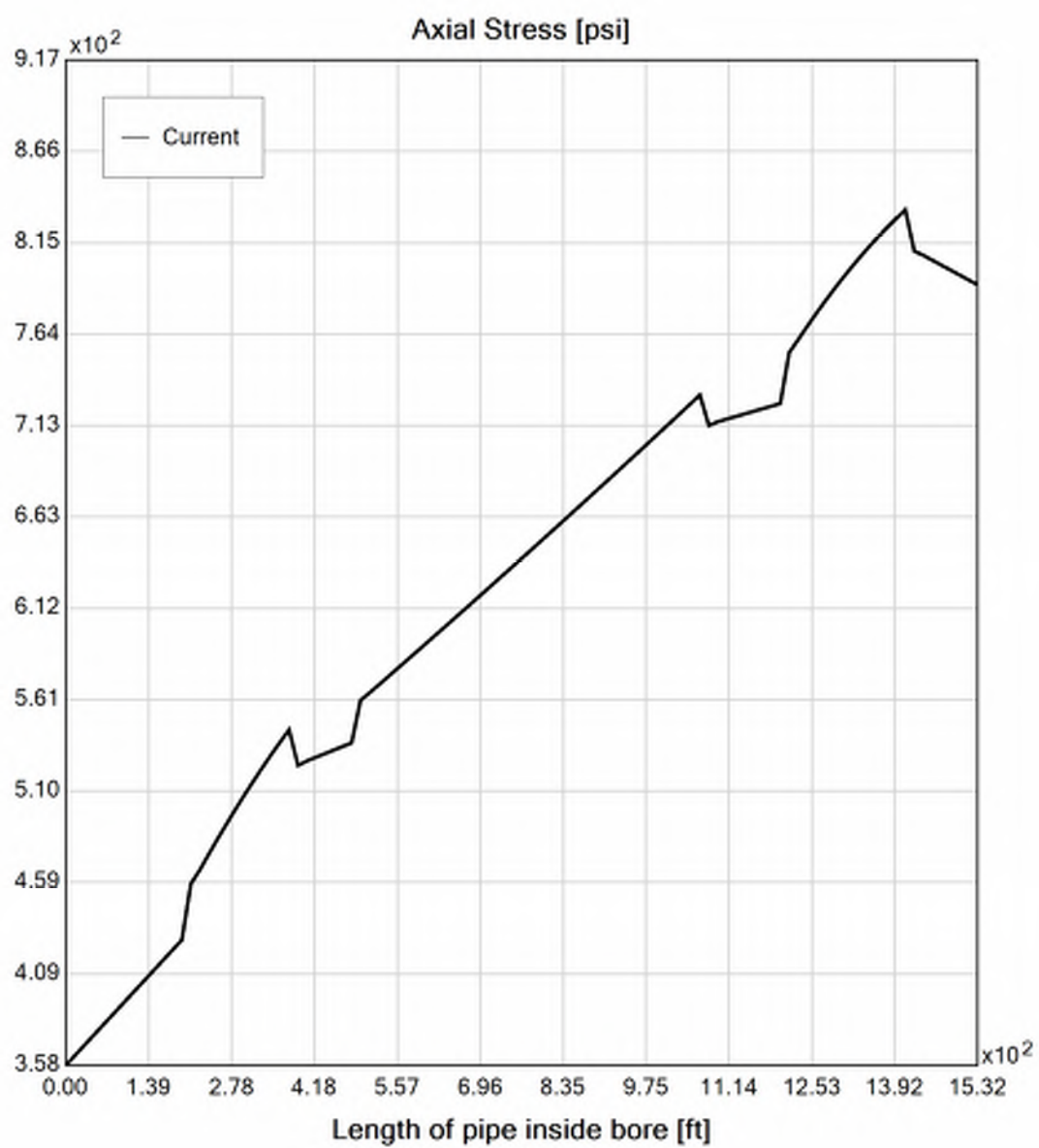


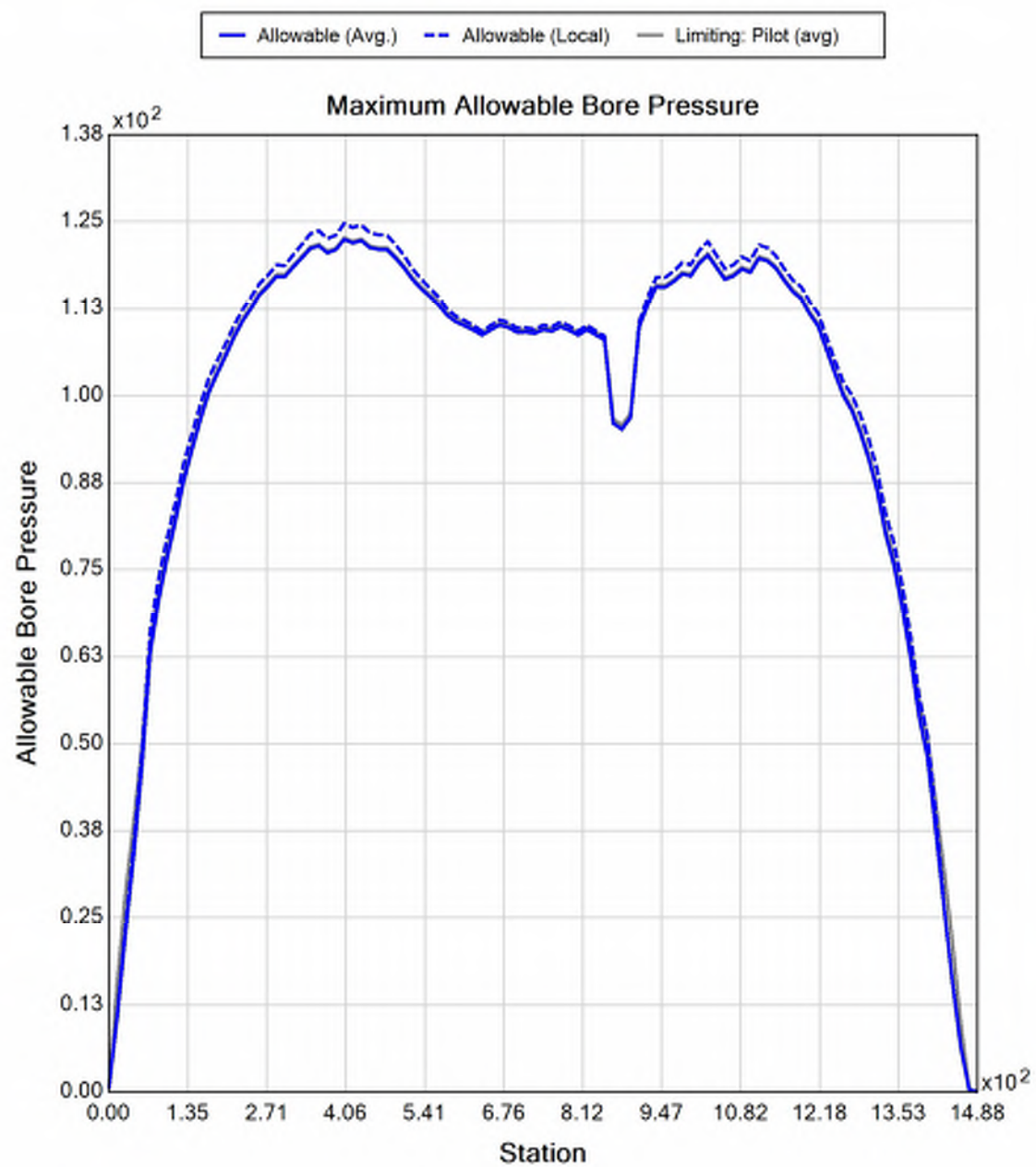


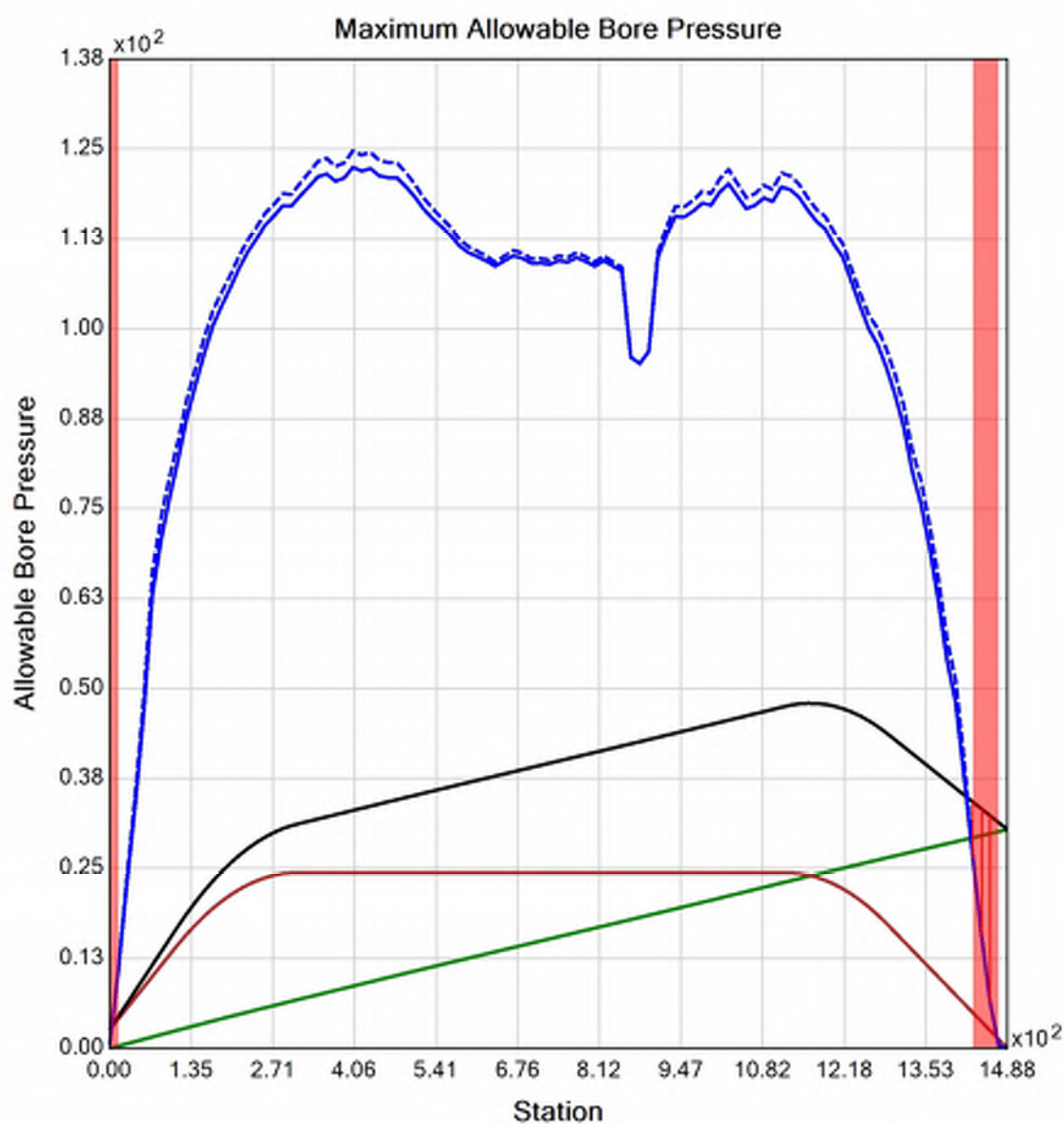














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## Input Summary

Start Coordinate	(0.00, 0.00, 129.00) ft
End Coordinate	(1478.00, 0.00, 132.00) ft
Project Length	1478.00 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

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## Load Verifier Input Summary:

Pipe Application: Electrical Cable  
Pipe Type: HDPE  
Classification: IPS  
Pipe OD: 2" (2.375")  
Pipe DR: 9  
Pipe Length: 1529.99 ft  
Internal Pressure: 0 psi  
Borehole Diameter: 0.531000018119812 ft  
Silo Width: 0.531000018119812 ft  
Surface Surcharge: 0 psi  
Short Term Modulus: 57500 psi  
Long Term Modulus: 28200 psi  
Short Term Poisson Ratio: 0.35  
Long Term Poisson Ratio: 0.45  
Pipe Unit Weight: 59.30500 lb/ft<sup>3</sup>  
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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>

---

### In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	1.5	24.9
Water Pressure	17.4	17.4
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	18.9	42.3
<b>Deflection</b>		
Earth Load Deflection	0.545	6.771
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	0.575	6.801
<b>Compressive Stress [psi]</b>		
Compressive Wall Stress	85.0	190.2

### Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	1528.1	1528.1
Pullback Stress [psi]	873.1	873.1
Pullback Strain	1.518E-2	1.518E-2
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	873.1	875.9
Tensile Strain	1.518E-2	1.533E-2

Net External Pressure = 27.7 [psi ]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

---

### In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.575	7.5	13.1	OK
Unconstrained Collapse [psi]	33.3	132.8	4.0	OK
Compressive Wall Stress [psi]	85.0	1150.0	13.5	OK

### Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	43.3	202.9	4.7	OK
Tensile Stress [psi]	875.9	1200.0	1.4	OK





## Generated Output



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## Project Summary

General:	CHPE HDD 13 - Conduit 2 P2 Start Date: 06-21-2022 End Date: 06-21-2022
Project Owner:	TDI
Project Contractor:	Kiewit
Project Consultant:	CHA/BCE
Designer:	
Description:	HDD 13 Conduit 2 10-inch DR 9

---

## Input Summary

Start Coordinate	(0.00, 0.00, 132.00) ft
End Coordinate	(1478.00, 0.00, 132.00) ft
Project Length	1478.00 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: 2

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

From Assistant

Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3]

Phi: 30.00, S.M.: 200.00, Coh: 0.00 [psi]

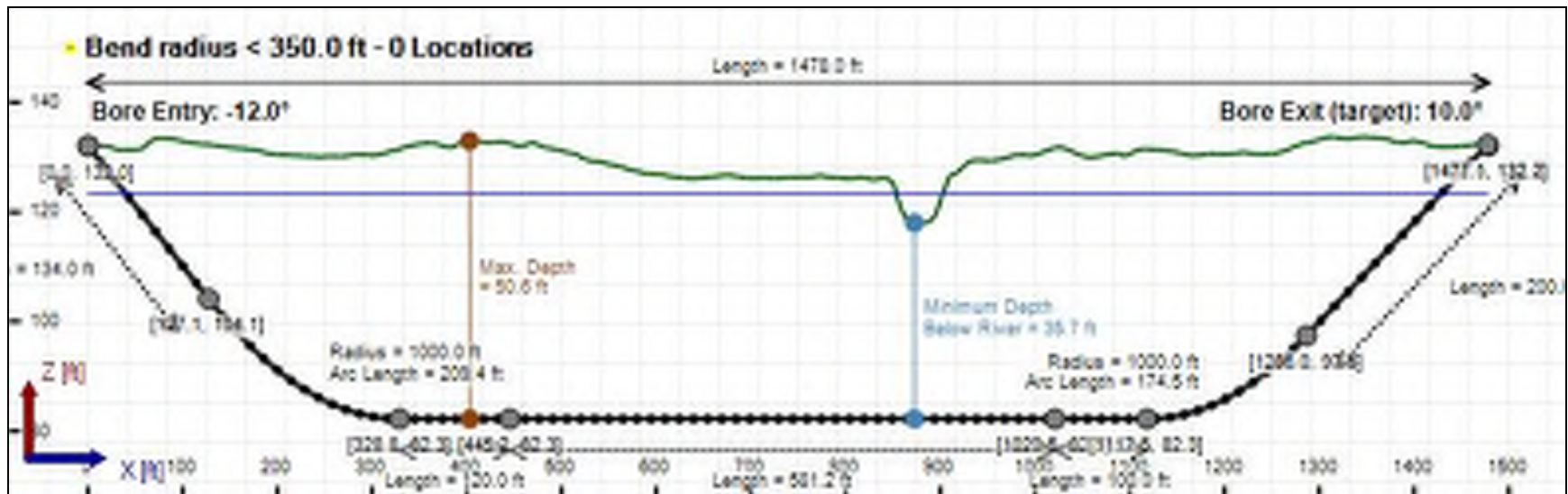
Soil Layer #2 USCS, Sand (S), SP

From Assistant

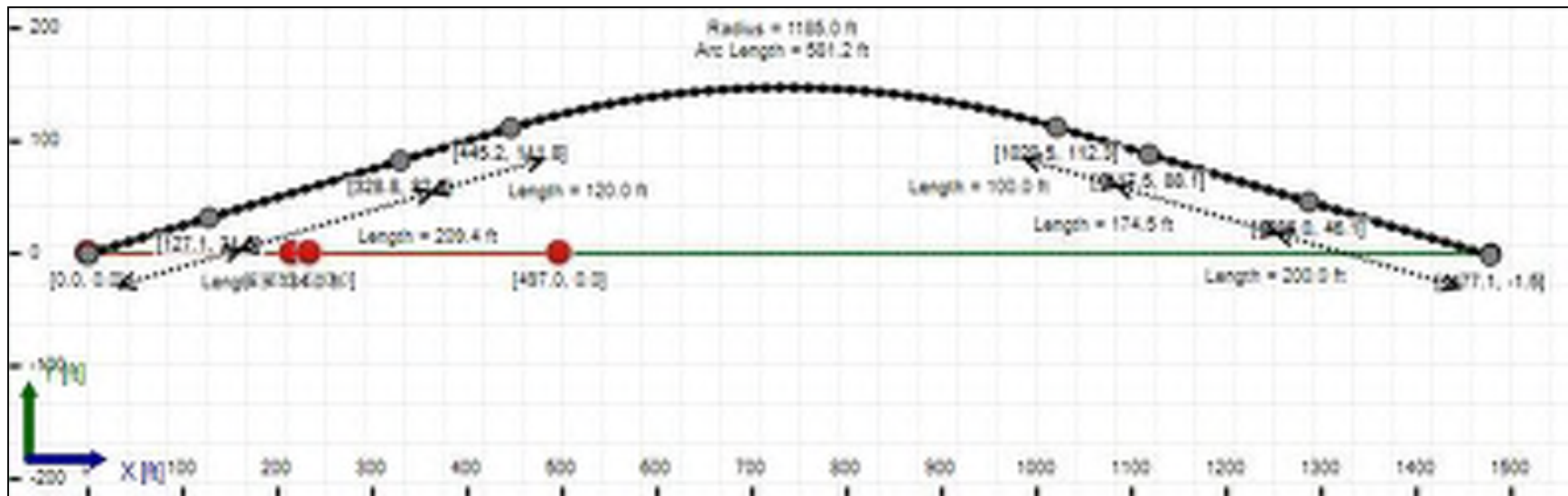
Unit Weight: 109.0000 (dry), 126.6624 (sat) [lb/ft3]

Phi: 30.00, S.M.: 300.00, 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: 1529.99 ft  
Internal Pressure: 0 psi  
Borehole Diameter: 1.34400002161662 ft  
Silo Width: 1.34400002161662 ft  
Surface Surcharge: 0 psi  
Short Term Modulus: 57500 psi  
Long Term Modulus: 28200 psi  
Short Term Poisson Ratio: 0.35  
Long Term Poisson Ratio: 0.45  
Pipe Unit Weight: 59.30500 lb/ft<sup>3</sup>  
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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>

---

### In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	3.8	25.3
Water Pressure	17.8	17.8
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	21.6	43.1
<b>Deflection</b>		
Earth Load Deflection	1.118	6.884
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.250	7.016
<b>Compressive Stress [psi]</b>		
Compressive Wall Stress	97.1	194.0

### Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	29007.3	29007.3
Pullback Stress [psi]	809.0	809.0
Pullback Strain	1.407E-2	1.407E-2
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	809.0	833.4
Tensile Strain	1.407E-2	1.494E-2

Net External Pressure = 27.6 [psi ]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb



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### In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.250	7.5	6.0	OK
Unconstrained Collapse [psi]	33.7	124.5	3.7	OK
Compressive Wall Stress [psi]	97.1	1150.0	11.8	OK

### Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	43.6	205.3	4.7	OK
Tensile Stress [psi]	833.4	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	8.00 in	124.364 psi	126.708 psi
1	8.00 in	12.00 in	124.269 psi	126.603 psi
2	12.00 in	16.13 in	124.130 psi	126.452 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/ft<sup>3</sup>

Rheological model: Bingham-Plastic

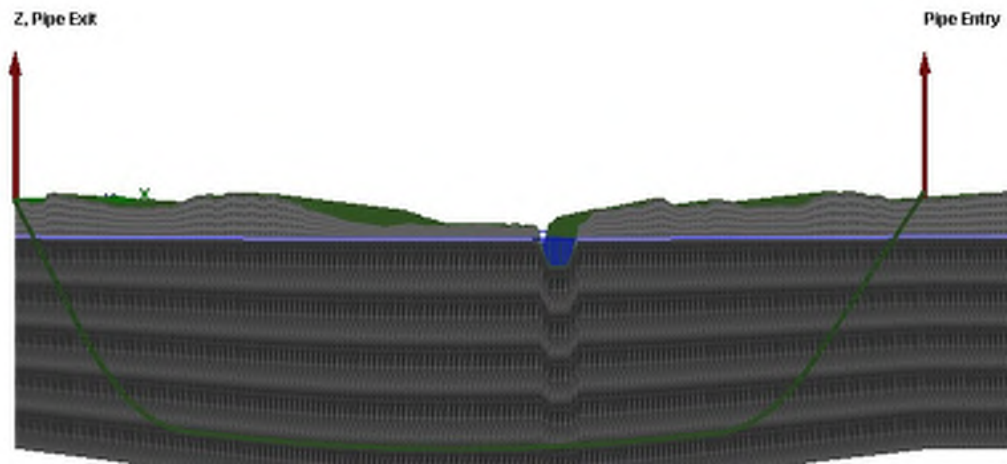
Plastic Viscosity (PV): 25.53

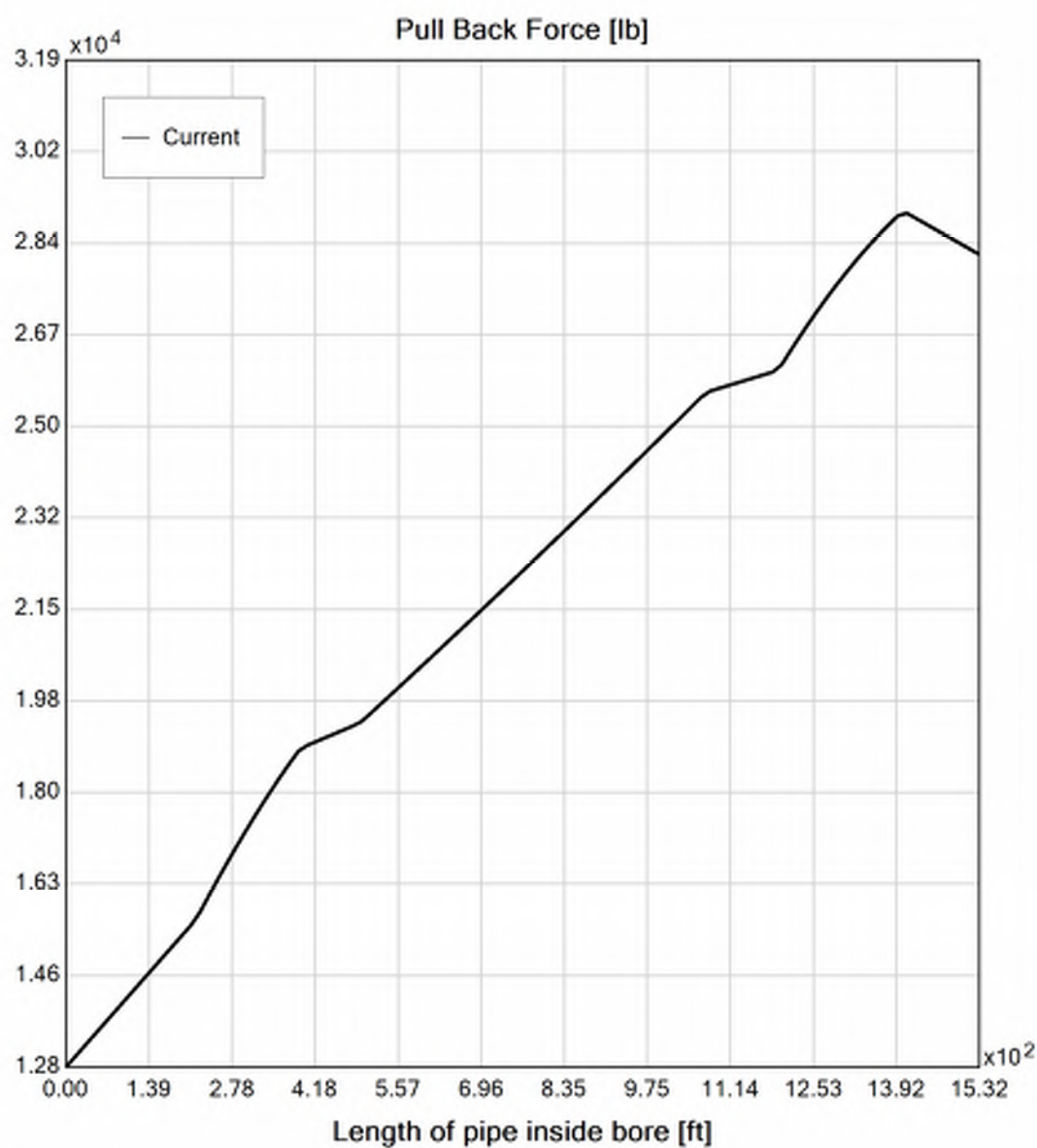
Yield Point (YP): 16.49

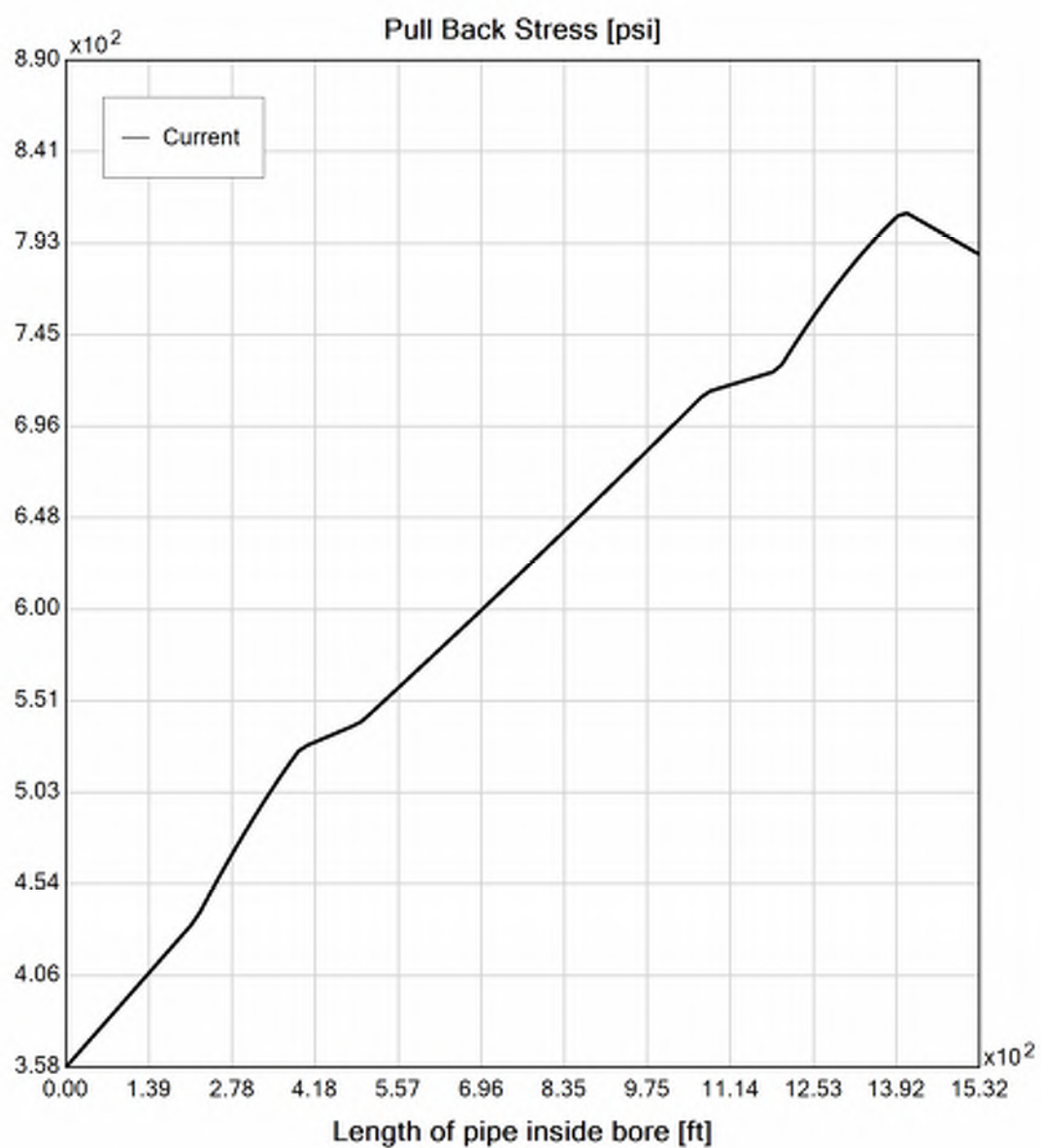
Effective Viscosity (cP): 1202.0

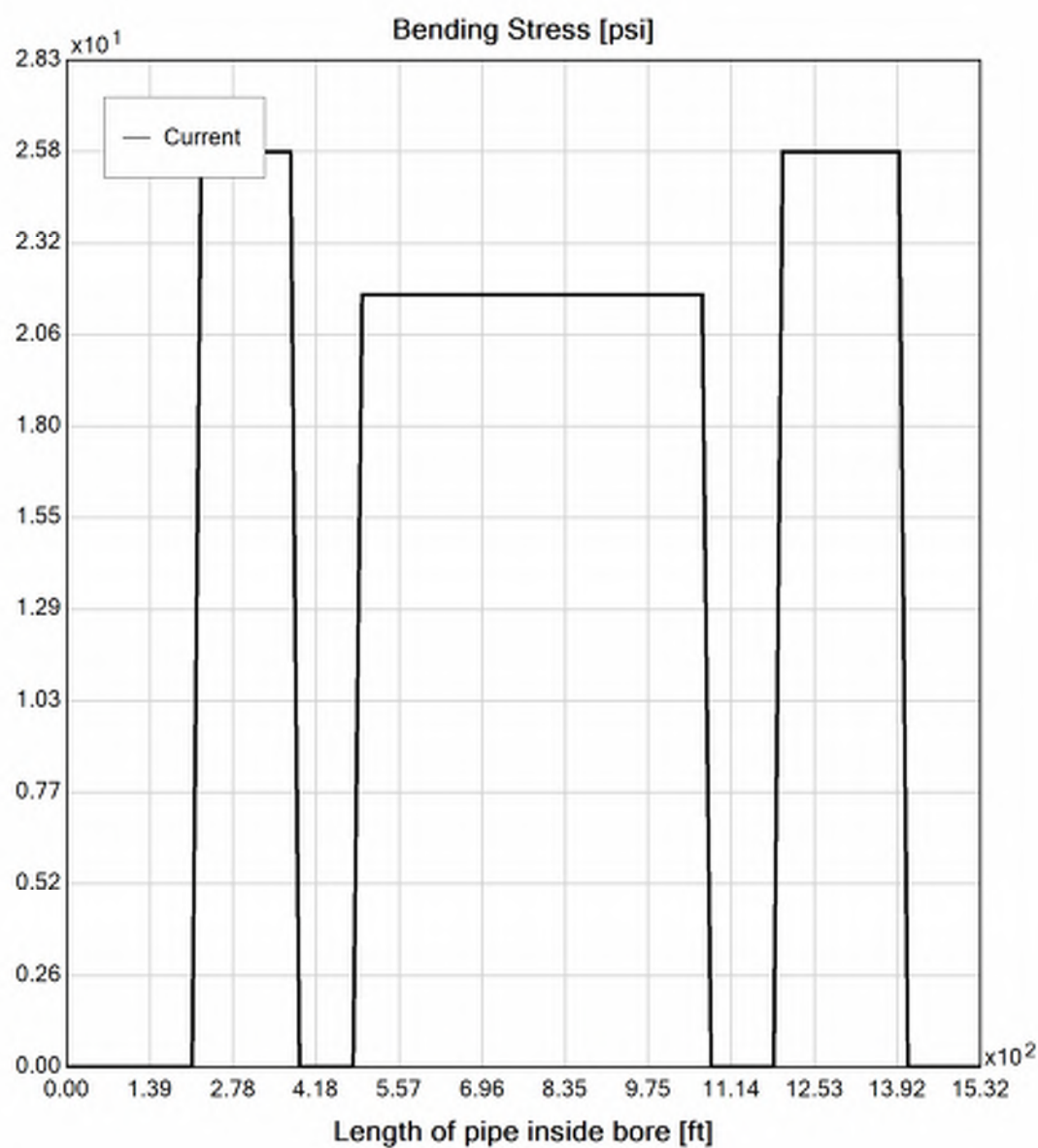
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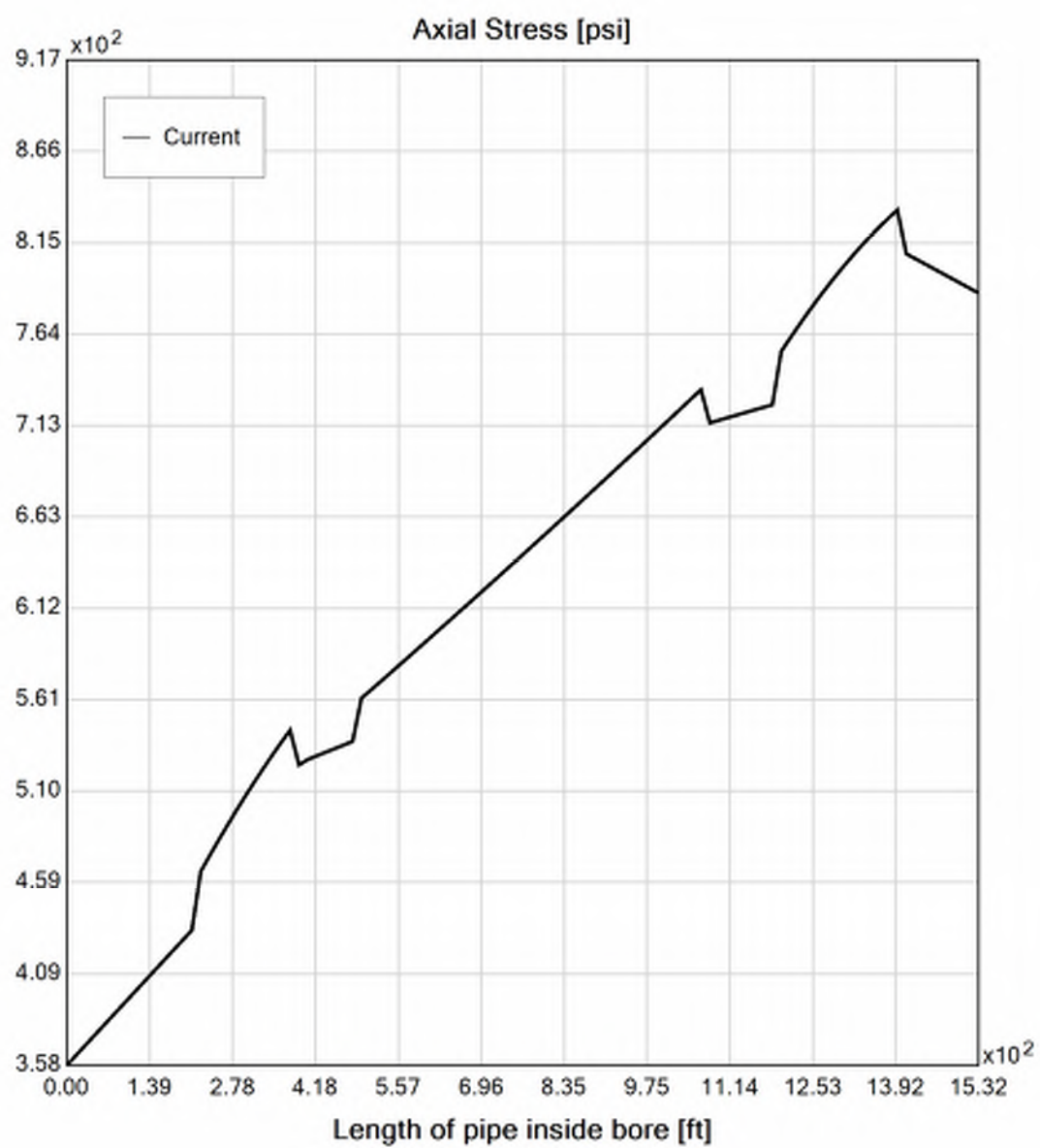
## Virtual Site

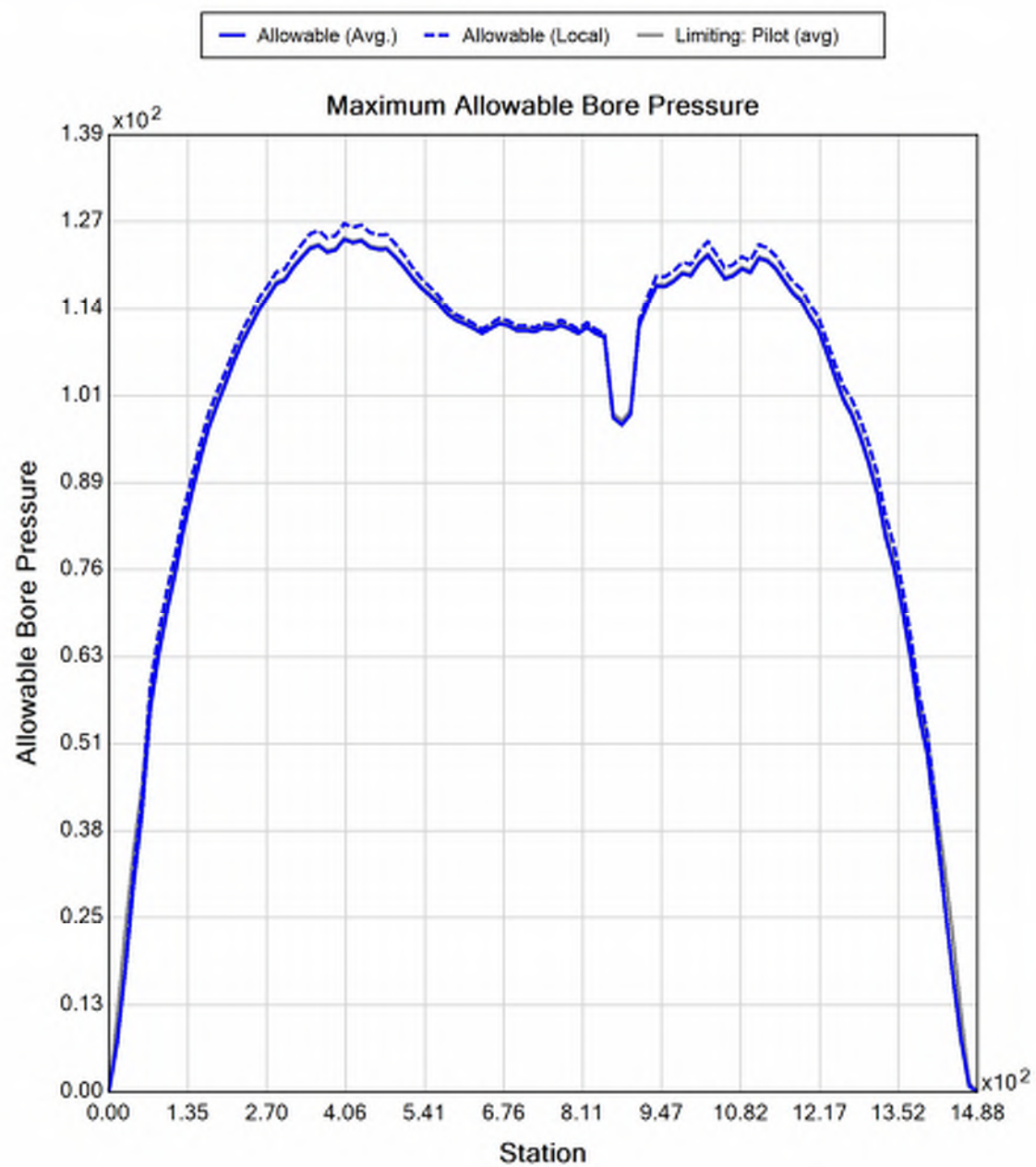




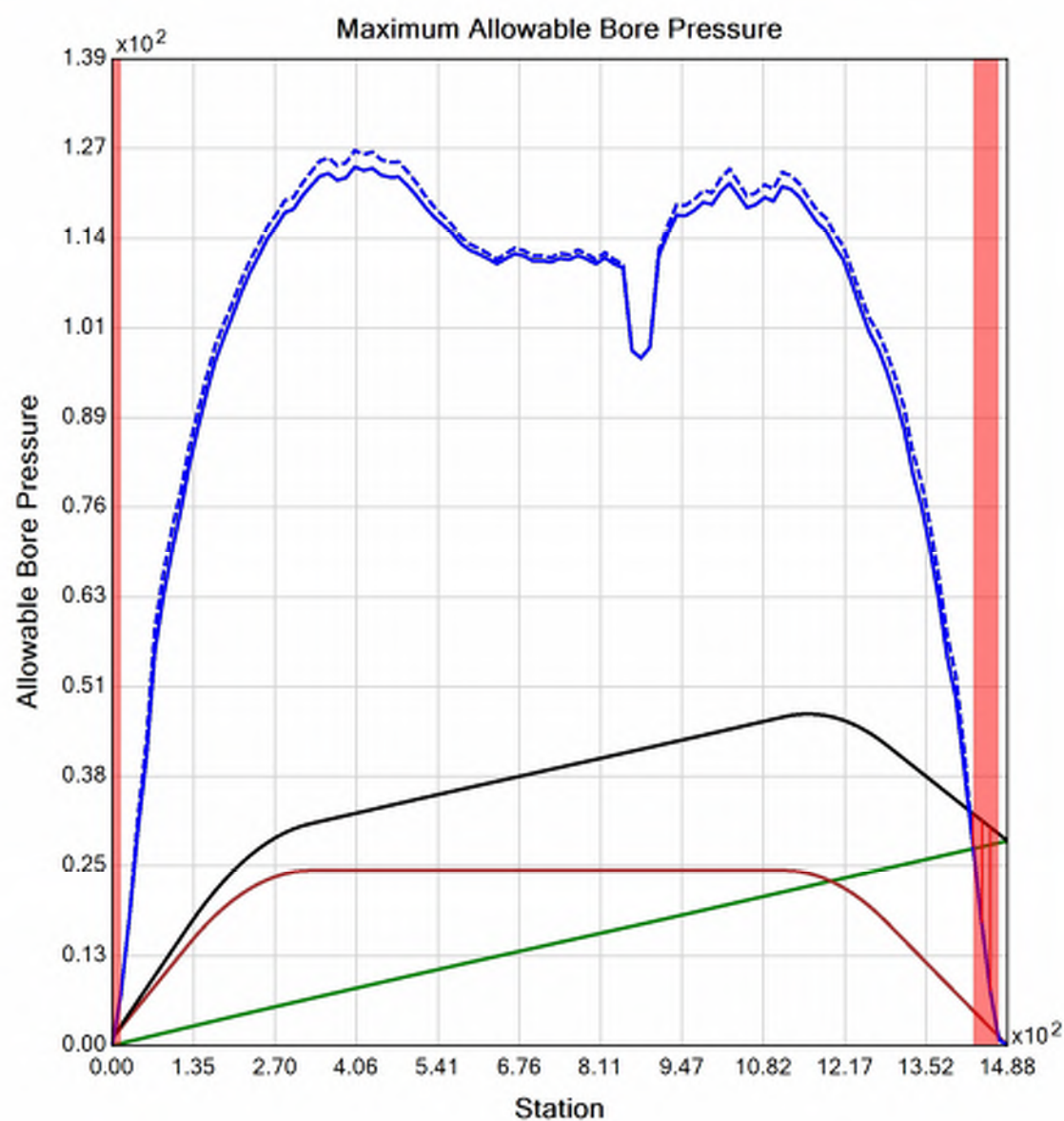














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## Input Summary

Start Coordinate	(0.00, 0.00, 132.00) ft
End Coordinate	(1478.00, 0.00, 132.00) ft
Project Length	1478.00 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: 1529.99 ft  
Internal Pressure: 0 psi  
Borehole Diameter: 0.531000018119812 ft  
Silo Width: 0.531000018119812 ft  
Surface Surcharge: 0 psi  
Short Term Modulus: 57500 psi  
Long Term Modulus: 28200 psi  
Short Term Poisson Ratio: 0.35  
Long Term Poisson Ratio: 0.45  
Pipe Unit Weight: 59.30500 lb/ft<sup>3</sup>  
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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>

---

### In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	1.5	25.3
Water Pressure	17.8	17.8
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	19.3	43.1
<b>Deflection</b>		
Earth Load Deflection	0.551	6.884
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	0.580	6.913
<b>Compressive Stress [psi]</b>		
Compressive Wall Stress	86.9	194.0

### 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	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	871.6	875.9
Tensile Strain	1.516E-2	1.533E-2

Net External Pressure = 27.6 [psi ]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

---

### In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.580	7.5	12.9	OK
Unconstrained Collapse [psi]	33.7	132.8	3.9	OK
Compressive Wall Stress [psi]	86.9	1150.0	13.2	OK

### Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	43.6	202.8	4.6	OK
Tensile Stress [psi]	875.9	1200.0	1.4	OK



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## Project Summary

General: HDD#13A - Conduit 1  
Ref: Washington County, NY  
Whitehall  
Start Date: 06-21-2022  
End Date: 06-21-2022

Project Owner: TDI  
Project Contractor: KIEWIT  
Project Consultant: CHA

Designer: AJB  
CHA

Description:



---

## Input Summary

Start Coordinate	(100.00, 0.00, 136.10) ft
End Coordinate	(1014.80, 0.00, 133.80) ft
Project Length	914.80 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), 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 #2 USCS, Silt (M), ML

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 #3 USCS, Clay (C), CH

From Assistant

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, Clay (C), CL

From Assistant

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

Phi: 0.00, S.M.: 145.00, Coh: 3.13 [psi]

Soil Layer #5 USCS, Sand (S), SP

From Assistant

Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3]

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

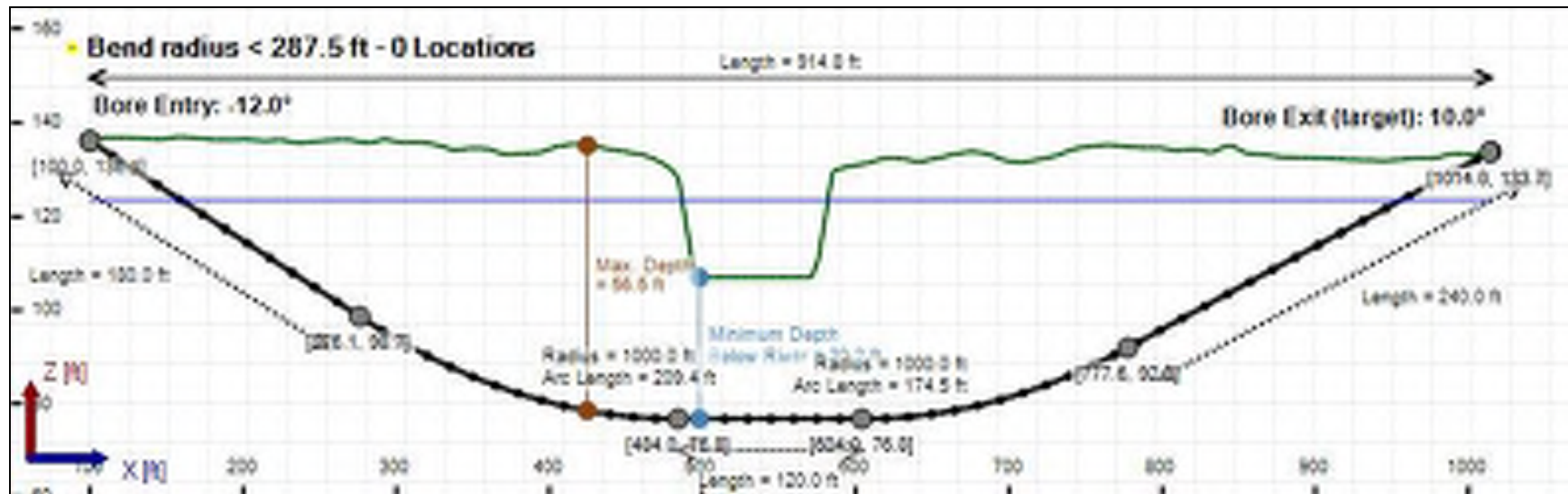
Soil Layer #6 USCS, Clay (C), CH

From Assistant

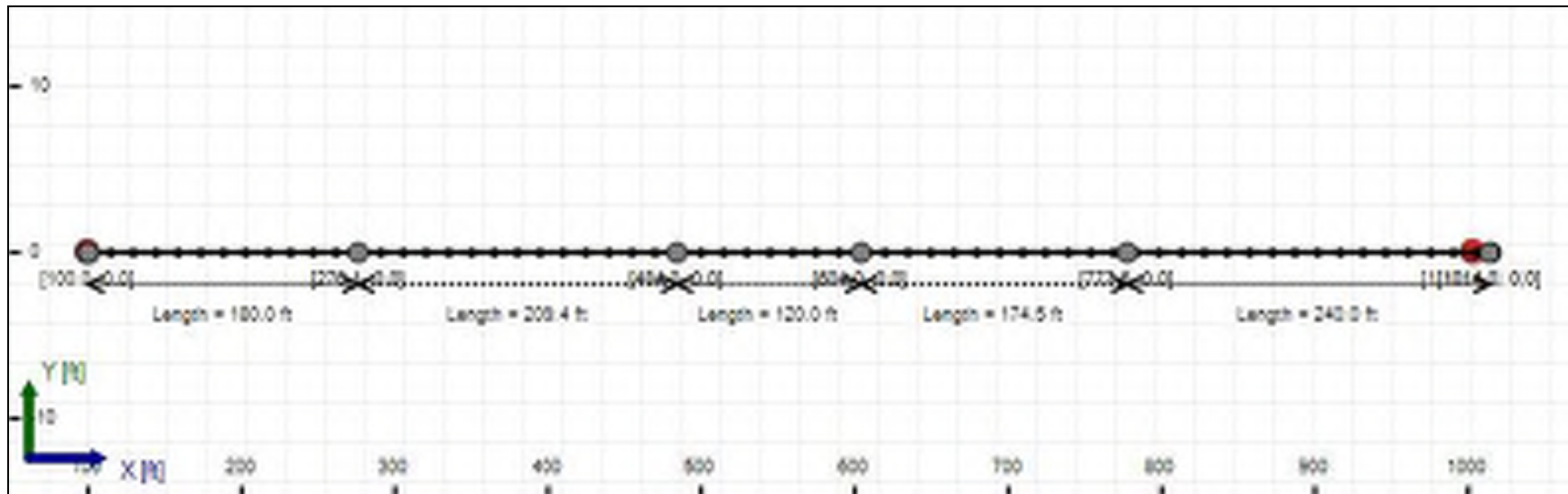
Unit Weight: 70.0000 (dry), 100.0000 (sat) [lb/ft3]

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: 930.00 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/ft<sup>3</sup>  
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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>

---

### In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	5.3	21.3
Water Pressure	20.2	19.5
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	25.6	40.8
<b>Deflection</b>		
Earth Load Deflection	1.449	5.812
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.581	5.944
<b>Compressive Stress [psi]</b>		
Compressive Wall Stress	115.0	183.6

### Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	16322.3	16322.3
Pullback Stress [psi]	455.2	455.2
Pullback Strain	7.917E-3	7.917E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	455.2	479.0
Tensile Strain	7.917E-3	8.778E-3

Net External Pressure = 34.3 [psi ]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

---

### In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.581	7.5	4.7	OK
Unconstrained Collapse [psi]	38.5	119.9	3.1	OK
Compressive Wall Stress [psi]	115.0	1150.0	10.0	OK

### Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	48.5	228.7	4.7	OK
Tensile Stress [psi]	479.0	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	75.064 psi	90.664 psi
1	8.00 in	12.00 in	75.040 psi	90.627 psi
2	12.00 in	16.13 in	75.005 psi	90.573 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/ft<sup>3</sup>

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

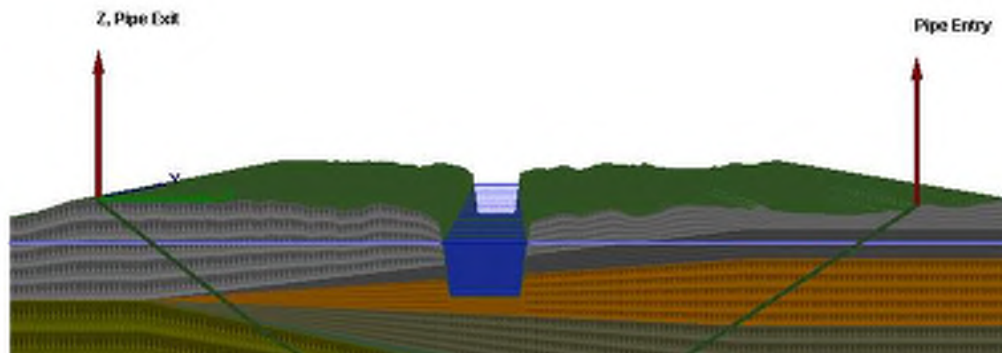
Yield Point (YP): 16.49

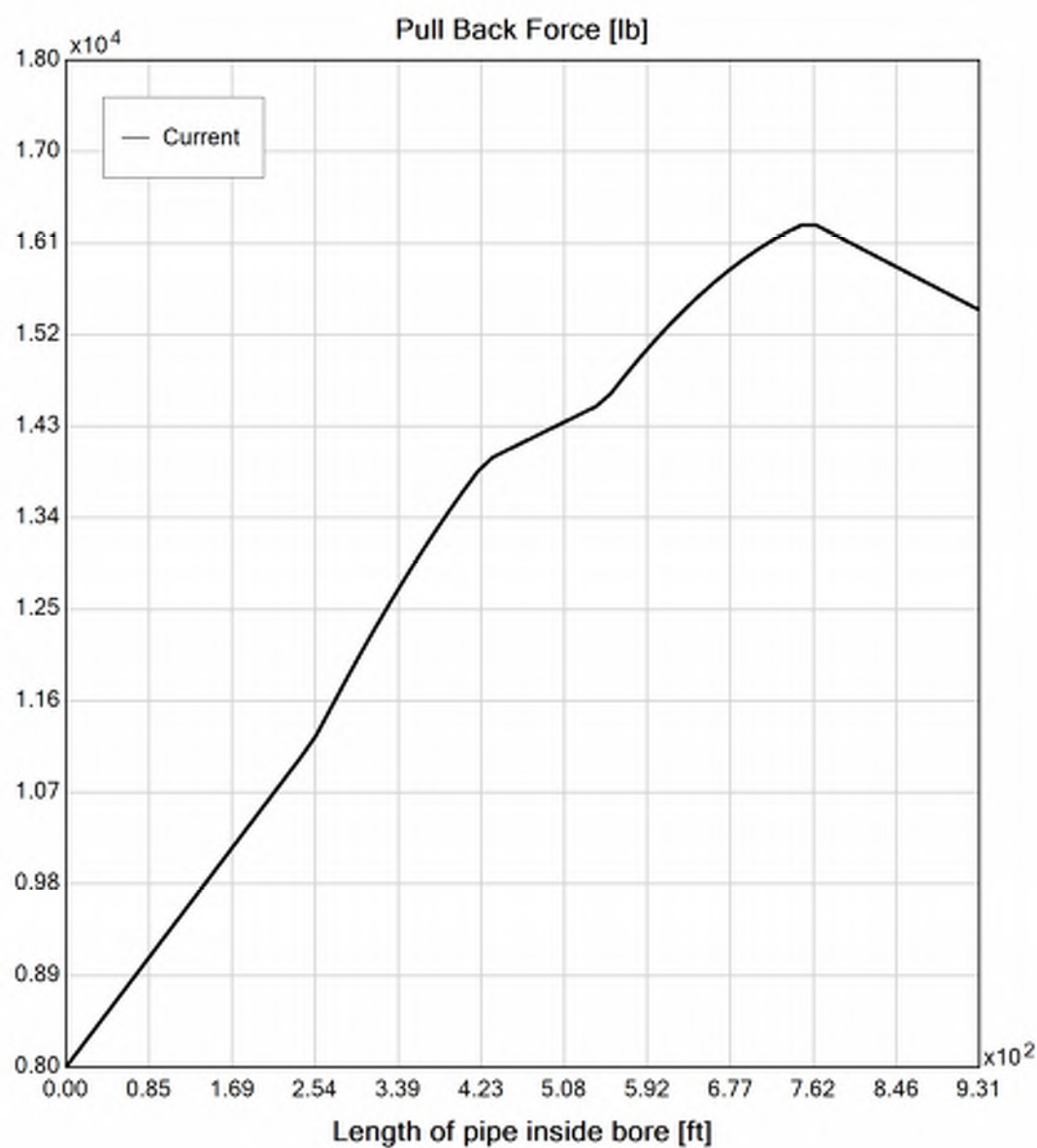
Effective Viscosity (cP): 1468.5

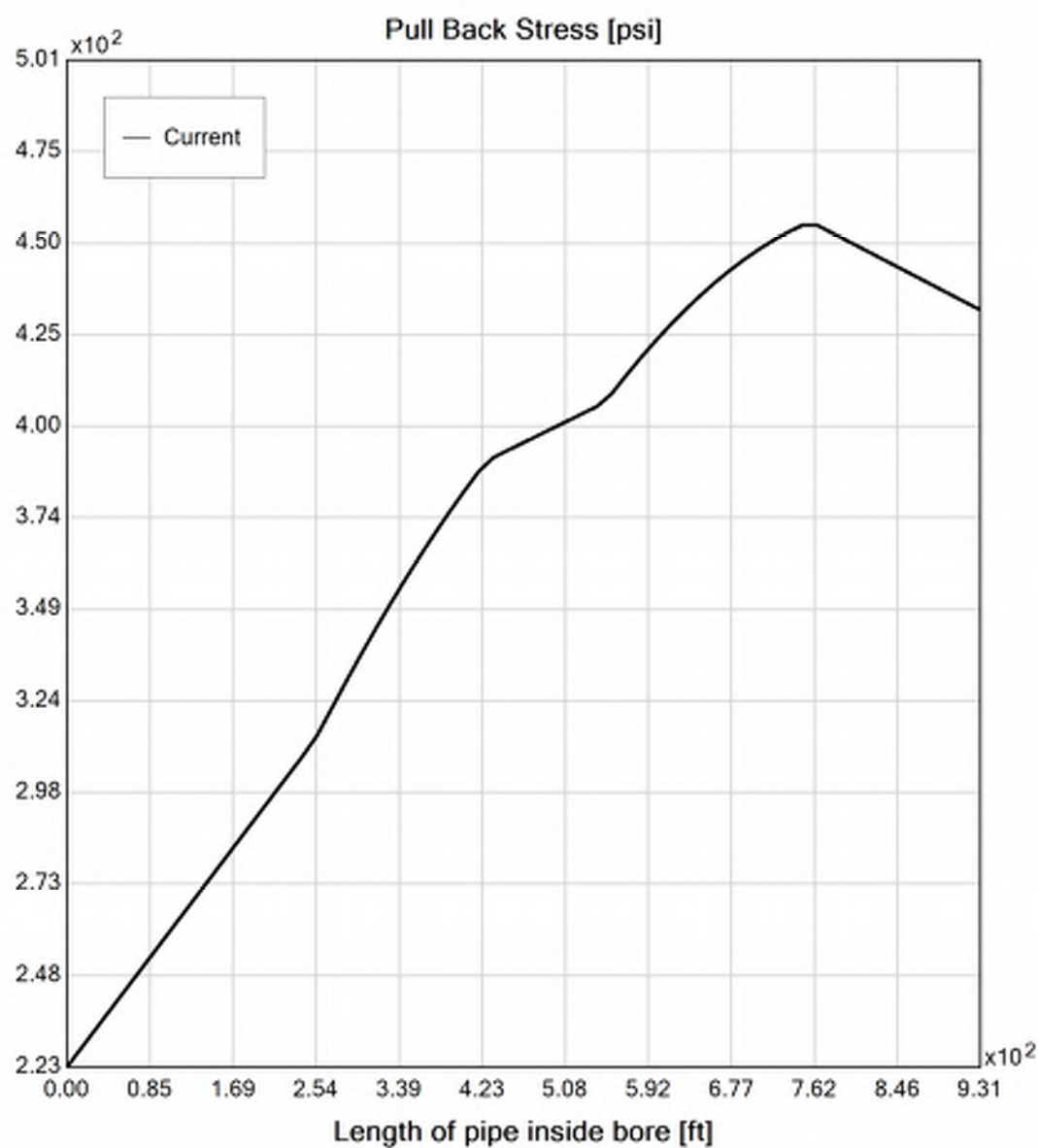


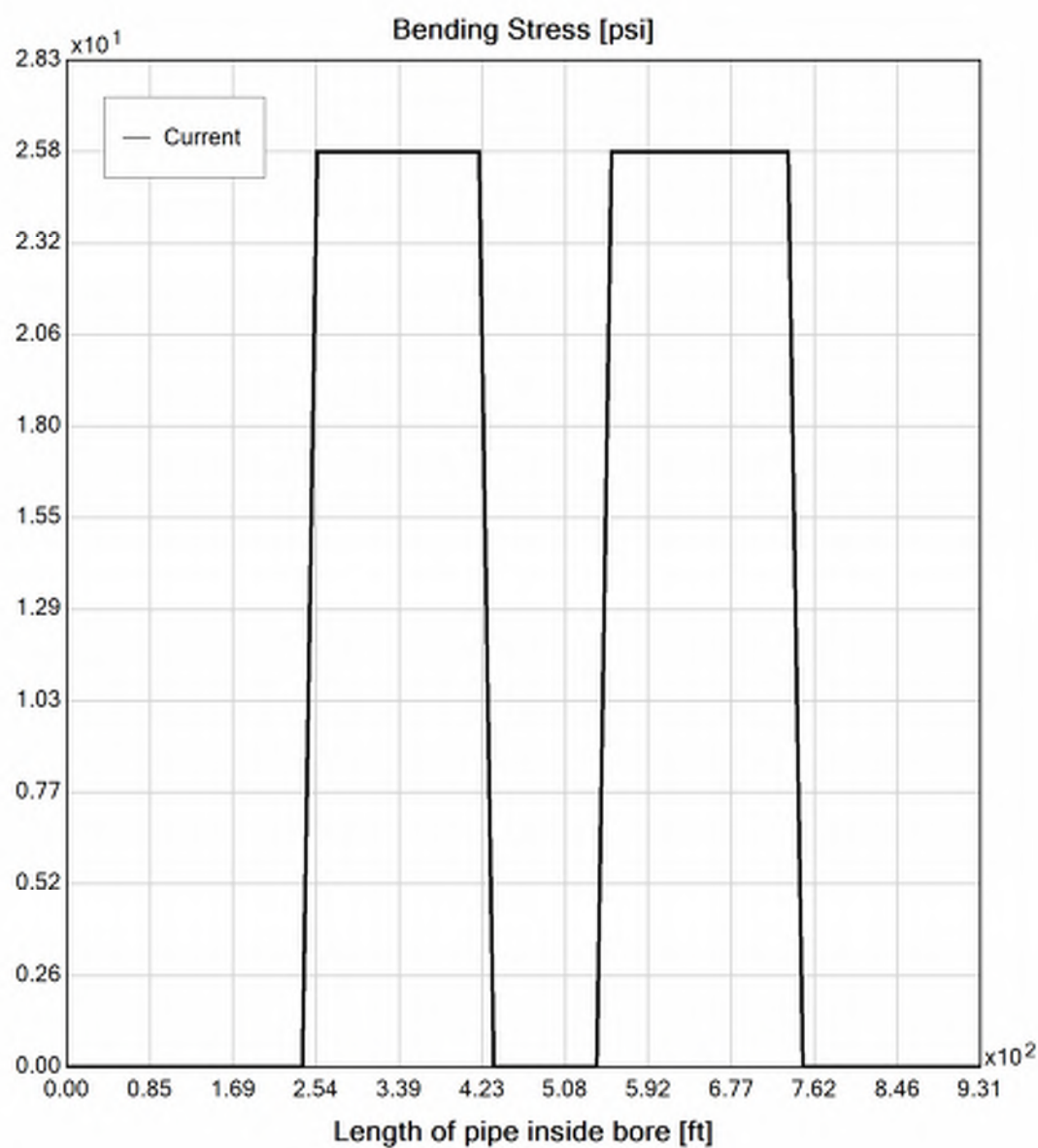
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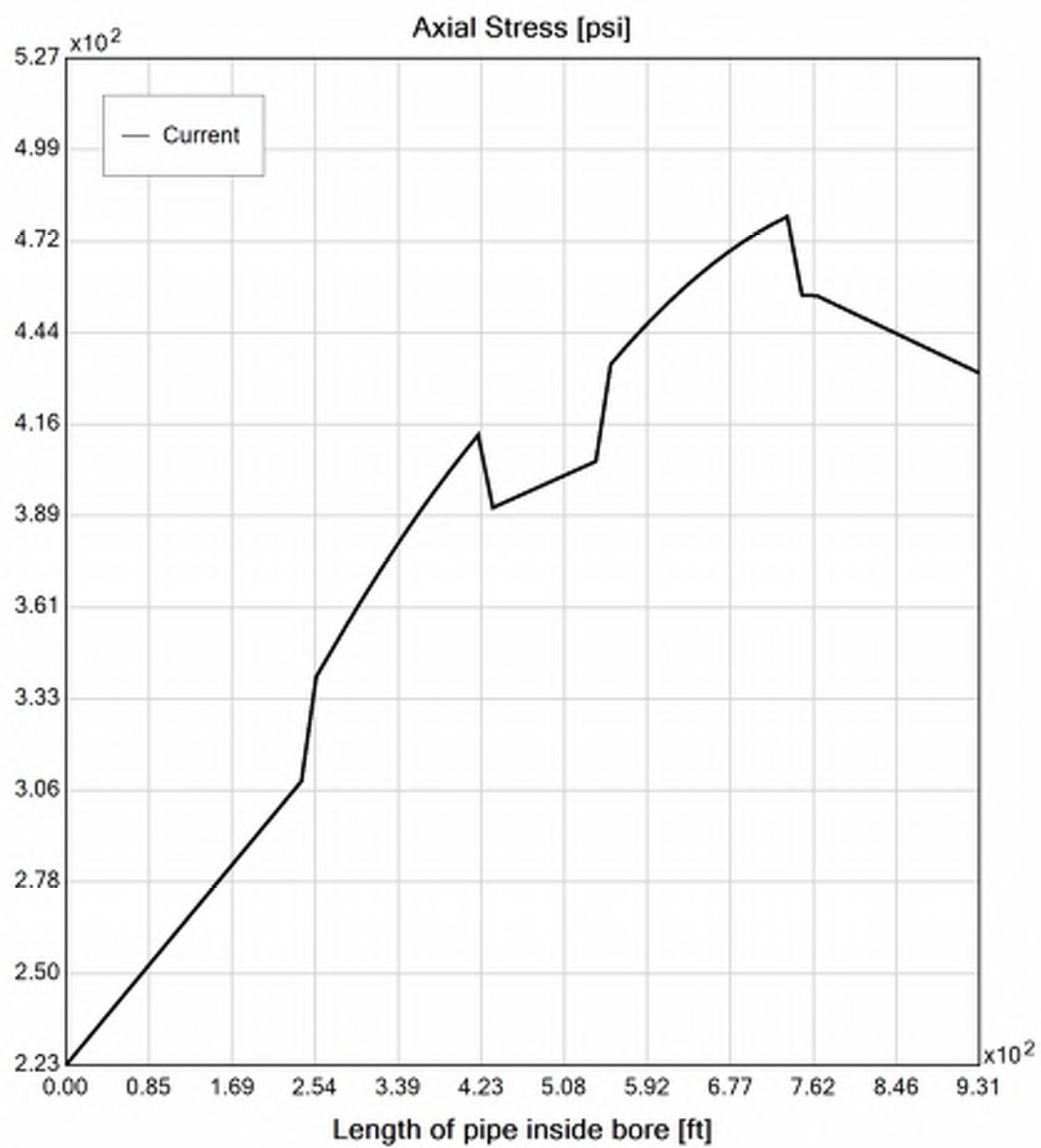
## Virtual Site

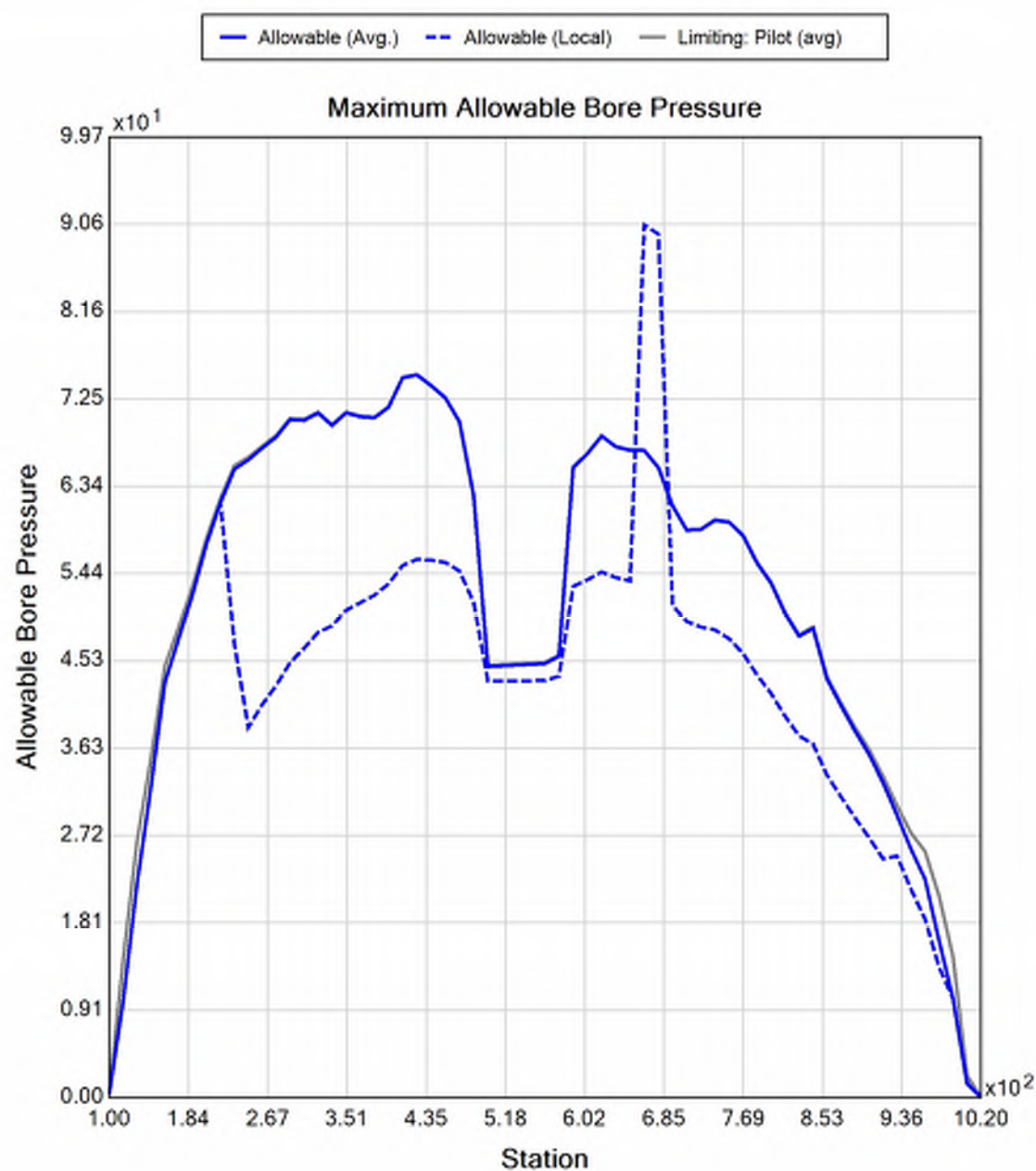


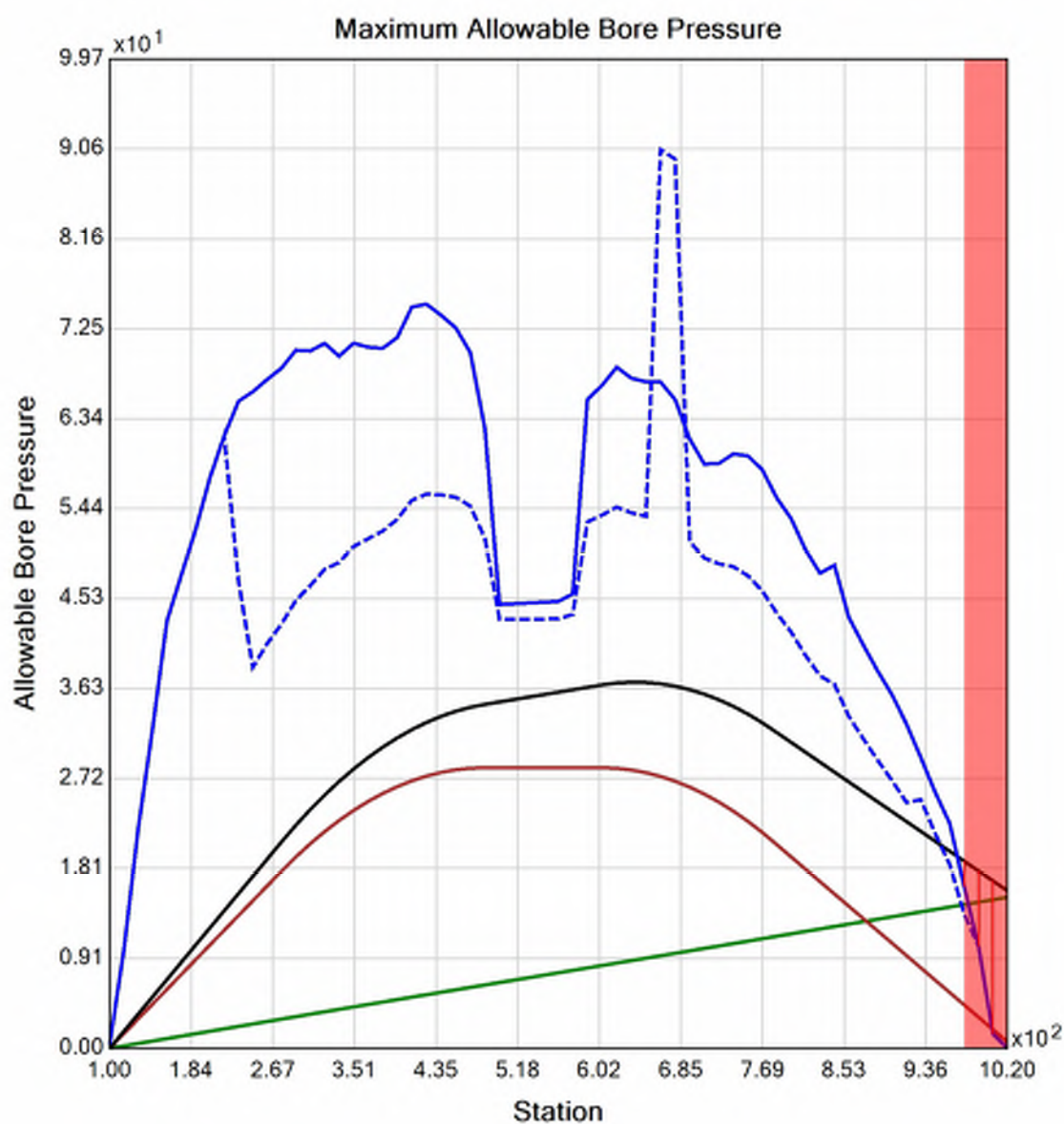














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## Input Summary

Start Coordinate	(100.00, 0.00, 136.10) ft
End Coordinate	(1014.80, 0.00, 133.80) ft
Project Length	914.80 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	2.875 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: 930.00 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/ft<sup>3</sup>  
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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>

---

### In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	3.2	21.3
Water Pressure	20.2	19.5
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	23.4	40.8
<b>Deflection</b>		
Earth Load Deflection	0.858	5.812
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	0.887	5.841
<b>Compressive Stress [psi]</b>		
Compressive Wall Stress	105.2	183.6

### Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	906.3	906.3
Pullback Stress [psi]	517.8	517.8
Pullback Strain	9.006E-3	9.006E-3
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	517.8	521.5
Tensile Strain	9.006E-3	9.169E-3

Net External Pressure = 34.3 [psi ]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

---

### In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.887	7.5	8.5	OK
Unconstrained Collapse [psi]	38.5	127.5	3.3	OK
Compressive Wall Stress [psi]	105.2	1150.0	10.9	OK

### Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	48.5	226.8	4.7	OK
Tensile Stress [psi]	521.5	1200.0	2.3	OK



## 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.

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## Project Summary

General:	CHPE HDD 14 - Conduit 1 P2 Start Date: 02-28-2022 End Date: 02-28-2022
Project Owner:	TDI
Project Contractor:	Kiewit
Project Consultant:	CHA/BCE
Designer:	
Description:	HDD 14 Conduit 1 10-inch DR 9

---

## Input Summary

Start Coordinate	(0.00, 0.00, 129.00) ft
End Coordinate	(707.00, 0.00, 135.46) ft
Project Length	707.00 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

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 #2 USCS, Silt (M), ML

Depth: 2.00 ft

Unit Weight: 70.0000 (dry), 110.0000 (sat) [lb/ft3]

Phi: 0.00, S.M.: 145.00, Coh: 5.56 [psi]

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

Depth: 4.00 ft

Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3]

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

Soil Layer #4 USCS, Clay (C), CL

Depth: 3.00 ft

Unit Weight: 80.0000 (dry), 110.0000 (sat) [lb/ft3]

Phi: 0.00, S.M.: 145.00, Coh: 5.56 [psi]

Soil Layer #5 USCS, Sand (S), SP

Depth: 14.00 ft

Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3]

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

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

Depth: 6.00 ft

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

Phi: 0.00, S.M.: 145.00, Coh: 3.13 [psi]



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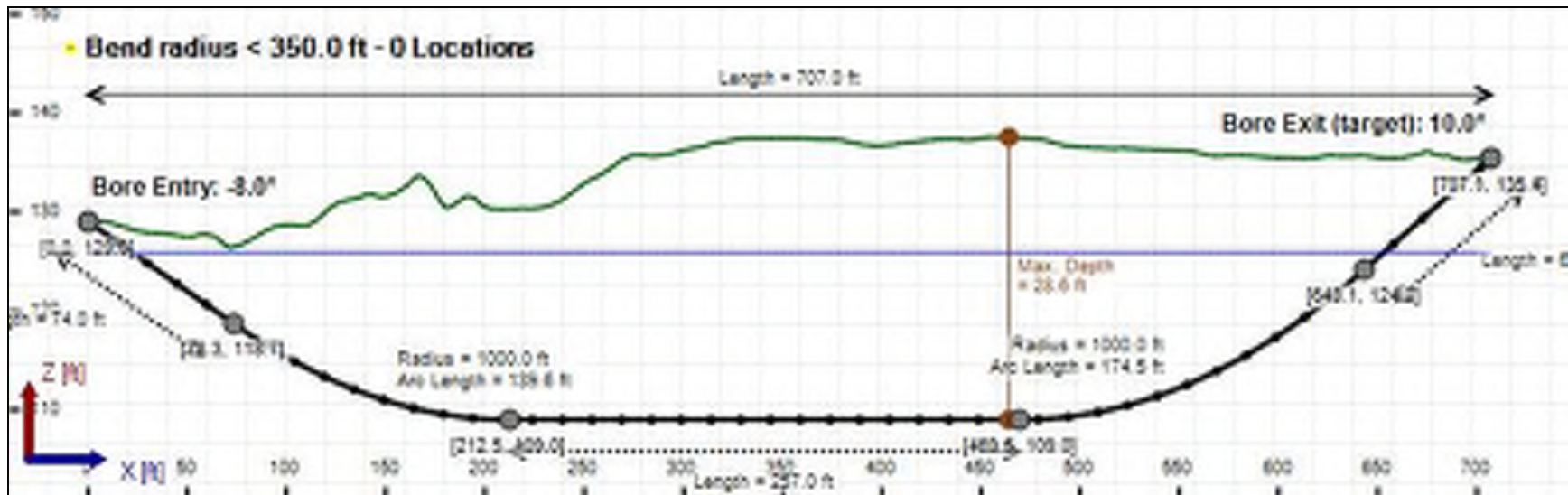
Soil Layer #7 USCS, Silt (M), ML

Depth: 15.00 ft

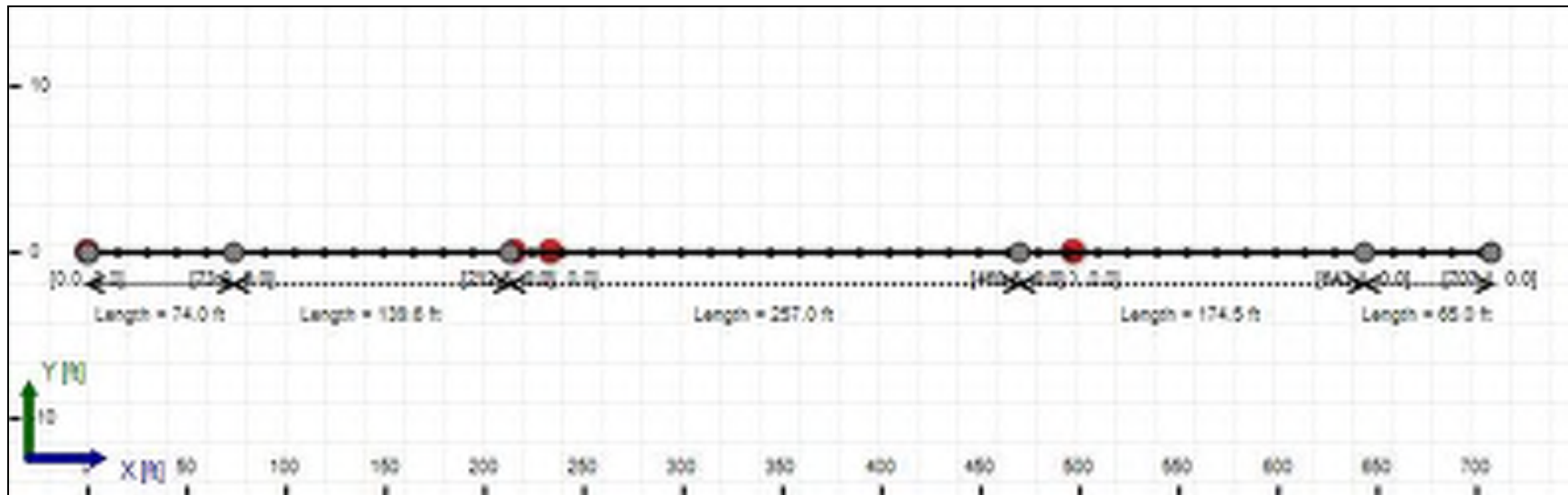
Unit Weight: 80.0000 (dry), 110.0000 (sat) [lb/ft<sup>3</sup>]

Phi: 0.00, S.M.: 145.00, Coh: 5.56 [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: 720.00 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/ft<sup>3</sup>  
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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>

---

### In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	3.8	15.0
Water Pressure	7.3	7.3
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	11.2	22.3
<b>Deflection</b>		
Earth Load Deflection	1.141	4.081
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.274	4.213
<b>Compressive Stress [psi]</b>		
Compressive Wall Stress	50.2	100.5

### Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	12038.5	12038.5
Pullback Stress [psi]	335.7	335.7
Pullback Strain	5.839E-3	5.839E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	335.7	360.6
Tensile Strain	5.839E-3	6.719E-3

Net External Pressure = 20.7 [psi ]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

---

### In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.274	7.5	5.9	OK
Unconstrained Collapse [psi]	18.3	124.3	6.8	OK
Compressive Wall Stress [psi]	50.2	1150.0	22.9	OK

### Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	28.3	235.5	8.3	OK
Tensile Stress [psi]	360.6	1200.0	3.3	OK

---

## Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	66.228 psi	67.567 psi
1	8.00 in	12.00 in	66.092 psi	67.420 psi
2	12.00 in	16.13 in	65.896 psi	67.210 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/ft<sup>3</sup>

Rheological model: Power-Law

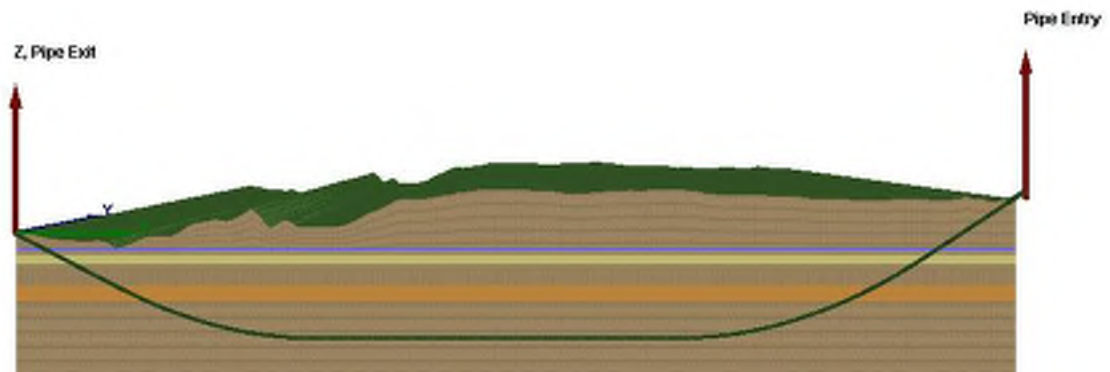
Fluid Consistency Index (K): 63.17

Power Law Exponent (n): 0.14

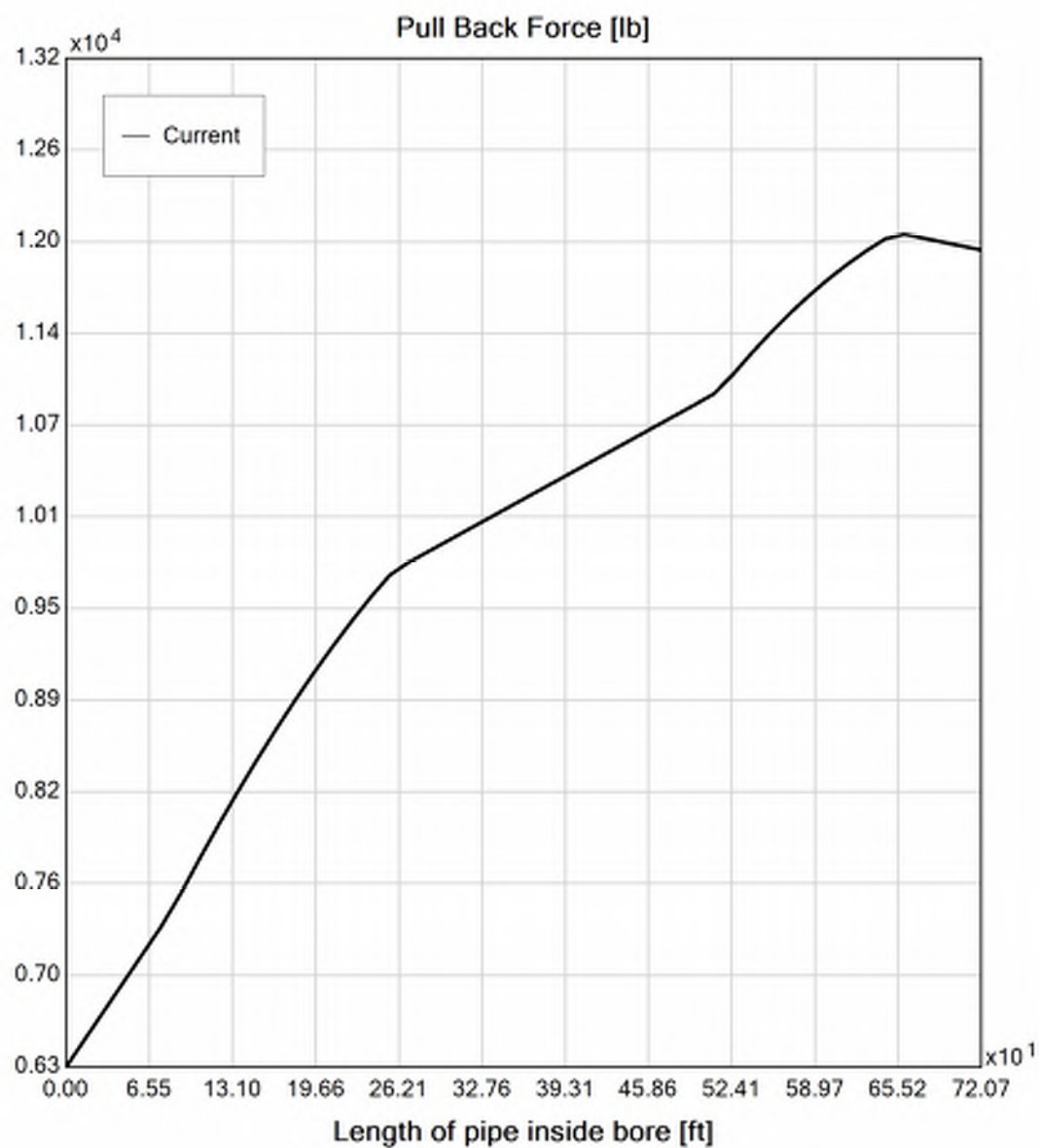
Effective Viscosity (cP): 859.3

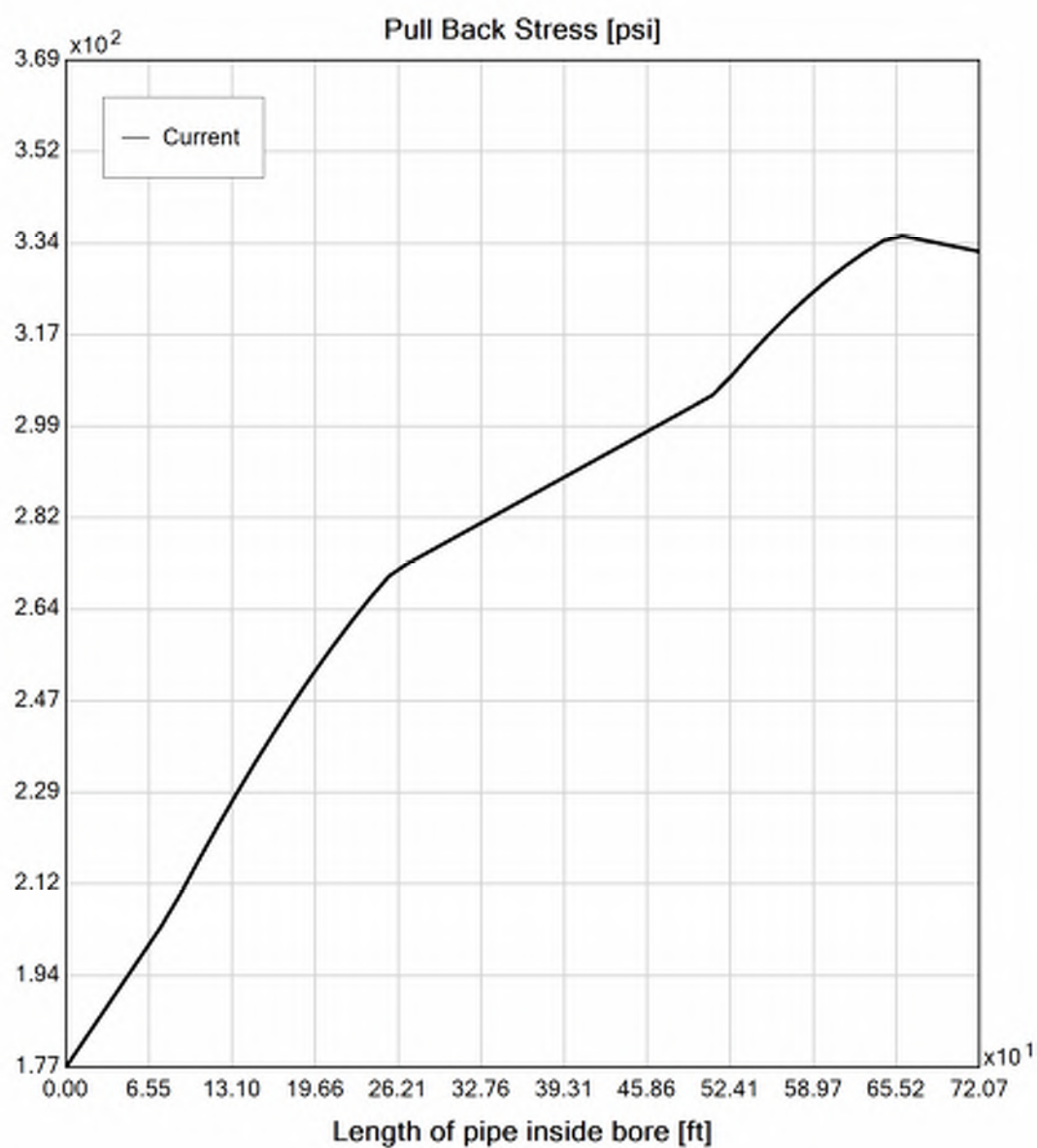
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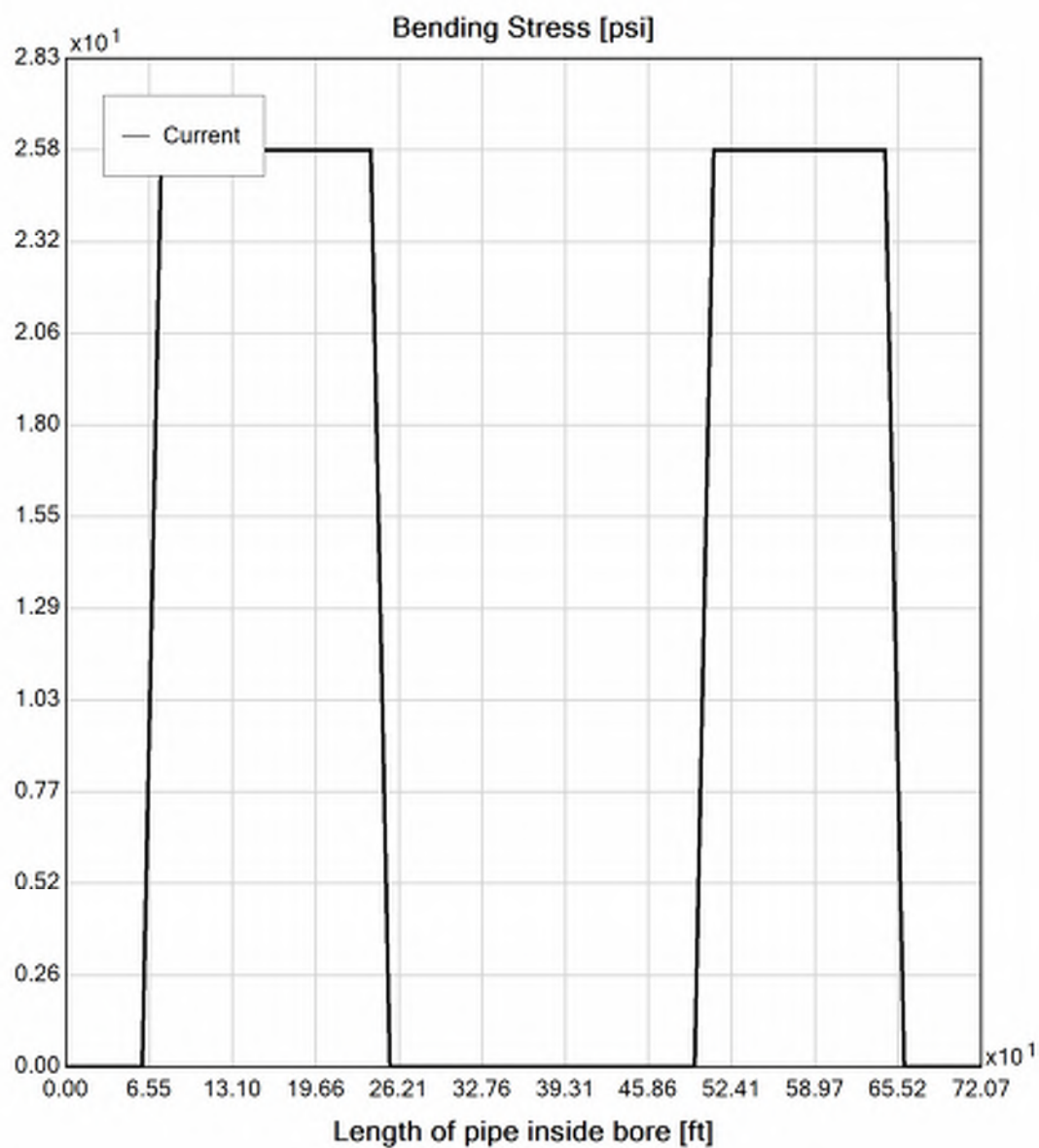
## Virtual Site

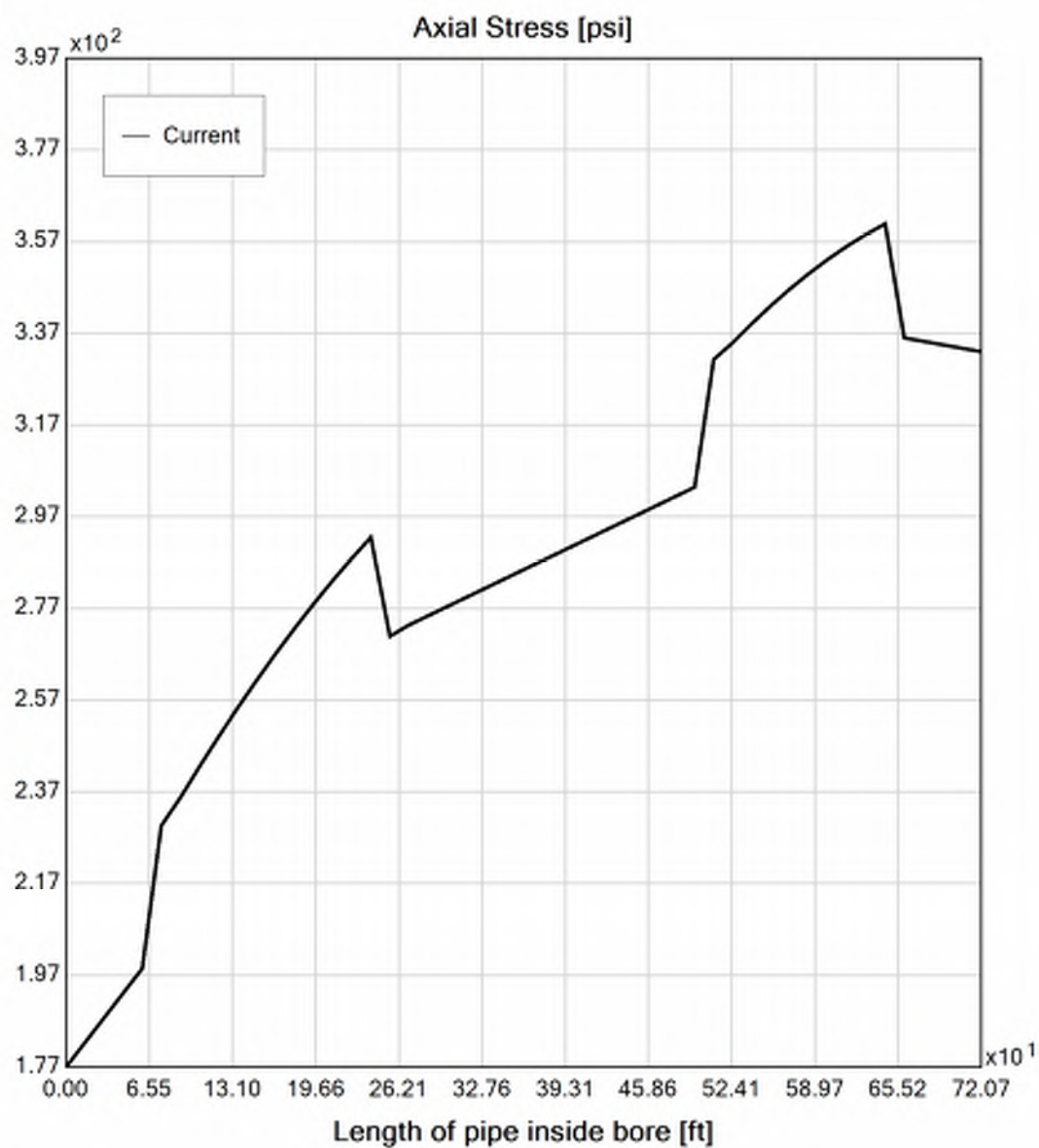


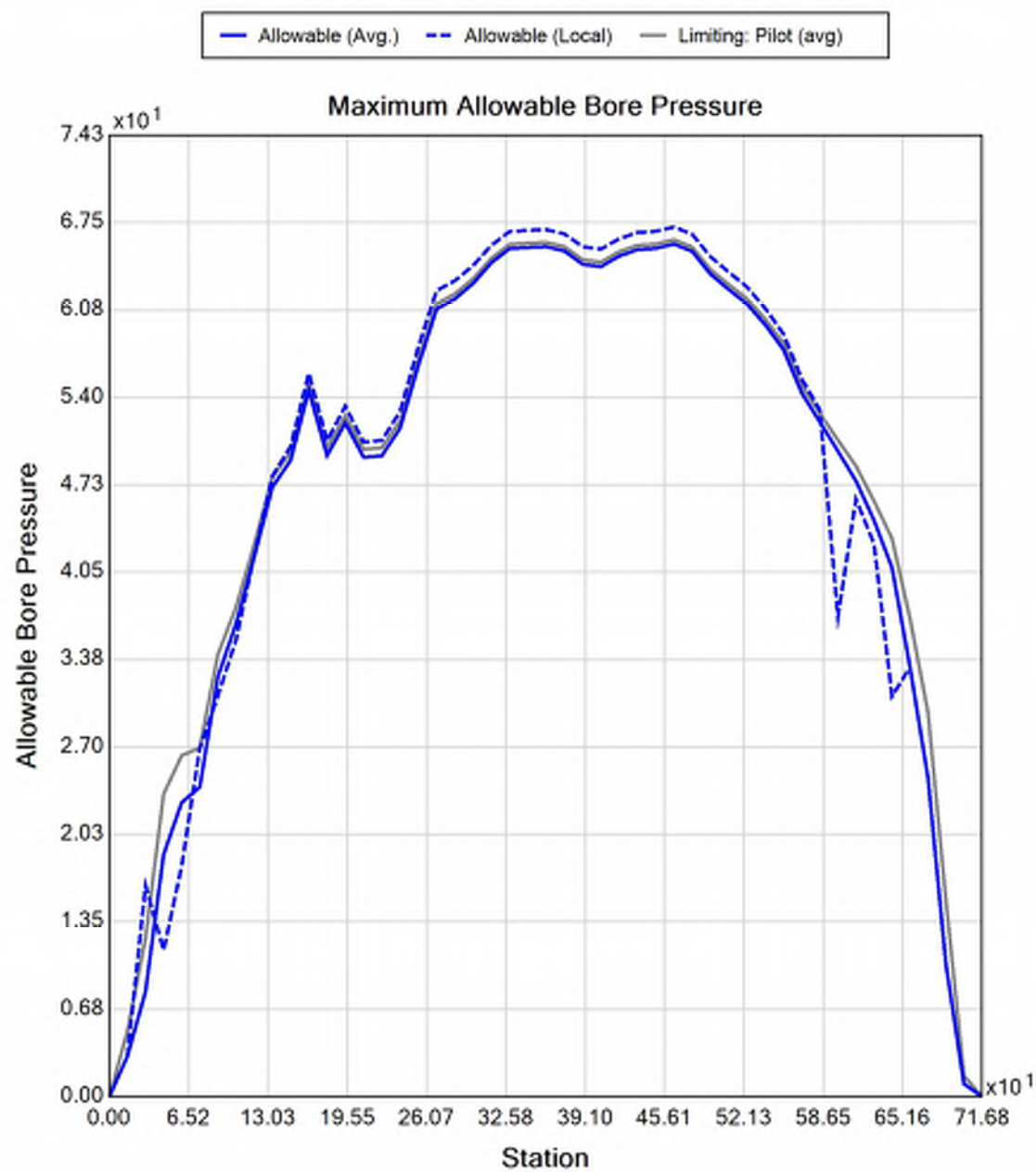


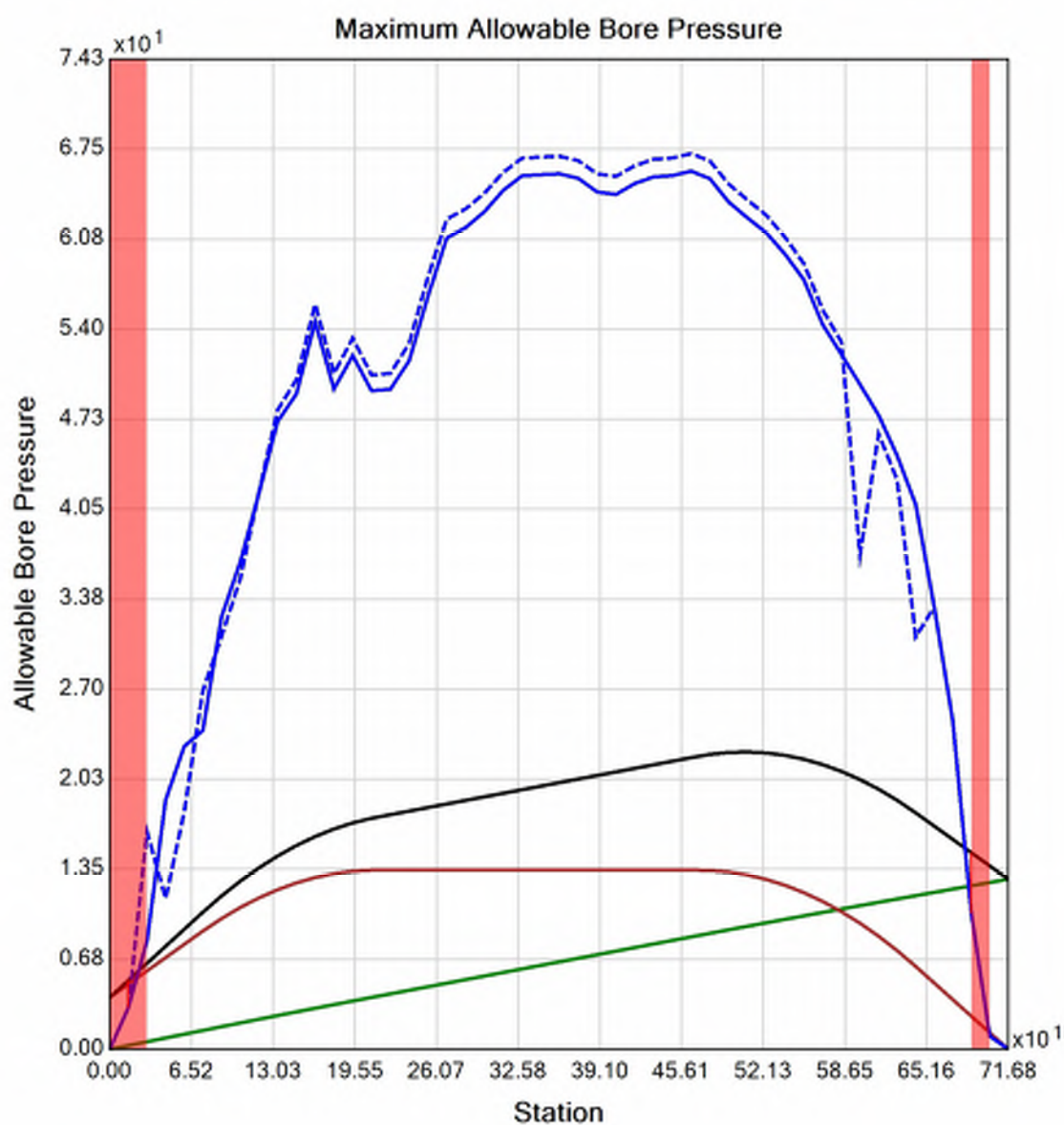














## Generated Output



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## Input Summary

Start Coordinate	(0.00, 0.00, 129.00) ft
End Coordinate	(707.00, 0.00, 135.46) ft
Project Length	707.00 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: 720.00 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/ft<sup>3</sup>  
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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>

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### In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	1.5	15.0
Water Pressure	7.3	7.3
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	8.9	22.3
<b>Deflection</b>		
Earth Load Deflection	0.602	4.081
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	0.631	4.110
<b>Compressive Stress [psi]</b>		
Compressive Wall Stress	40.0	100.5

### Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	697.2	697.2
Pullback Stress [psi]	398.4	398.4
Pullback Strain	6.928E-3	6.928E-3
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	398.4	403.2
Tensile Strain	6.928E-3	7.110E-3

Net External Pressure = 20.7 [psi ]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

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### In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.631	7.5	11.9	OK
Unconstrained Collapse [psi]	18.3	132.7	7.2	OK
Compressive Wall Stress [psi]	40.0	1150.0	28.8	OK

### Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	28.3	233.8	8.3	OK
Tensile Stress [psi]	403.2	1200.0	3.0	OK



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## Project Summary

General:	CHPE HDD 14 - Conduit 2
	Start Date: 02-28-2022
	End Date: 02-28-2022
Project Owner:	TDI
Project Contractor:	Kiewit
Project Consultant:	CHA/BCE
Designer:	
Description:	HDD 14 Conduit 2 10-inch DR 9

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## Input Summary

Start Coordinate	(66.00, 0.00, 130.42) ft
End Coordinate	(883.00, 0.00, 135.46) ft
Project Length	817.00 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

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## Soil Summary

Number of Layers: 7

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

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 #2 USCS, Silt (M), ML

Depth: 2.00 ft

Unit Weight: 70.0000 (dry), 110.0000 (sat) [lb/ft3]

Phi: 0.00, S.M.: 145.00, Coh: 5.56 [psi]

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

Depth: 4.00 ft

Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3]

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

Soil Layer #4 USCS, Clay (C), CL

Depth: 3.00 ft

Unit Weight: 80.0000 (dry), 110.0000 (sat) [lb/ft3]

Phi: 0.00, S.M.: 145.00, Coh: 5.56 [psi]

Soil Layer #5 USCS, Sand (S), SP

Depth: 14.00 ft

Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3]

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

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

Depth: 6.00 ft

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

Phi: 0.00, S.M.: 145.00, Coh: 3.13 [psi]

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Soil Layer #7 USCS, Silt (M), ML

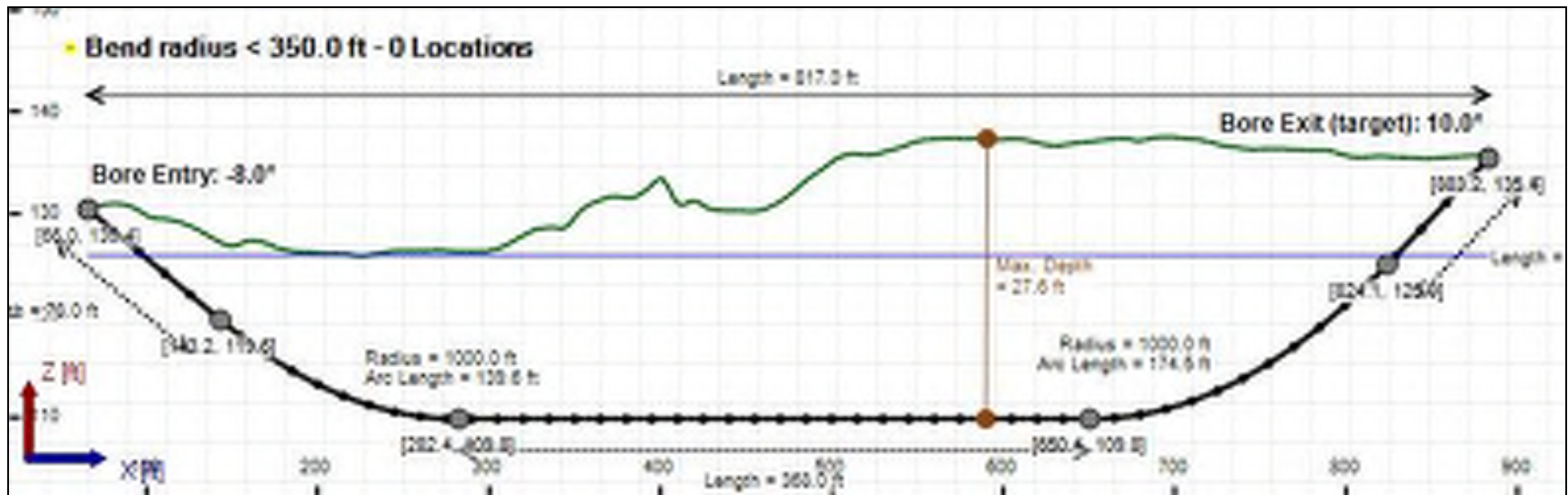
Depth: 15.00 ft

Unit Weight: 80.0000 (dry), 110.0000 (sat) [lb/ft<sup>3</sup>]

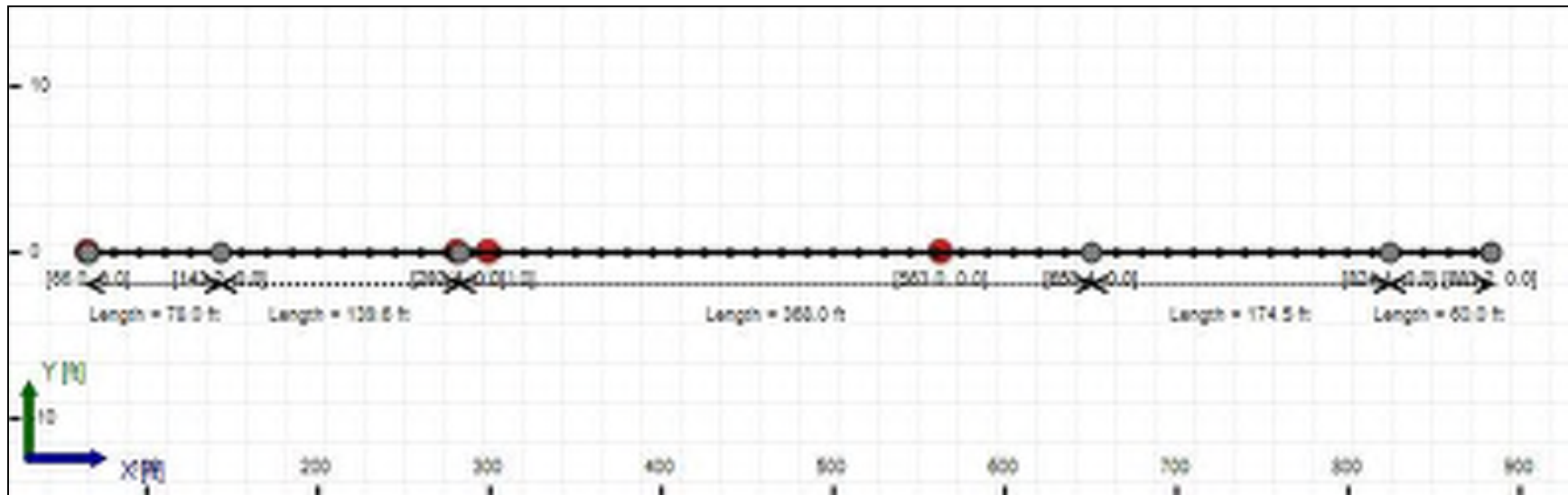
Phi: 0.00, S.M.: 145.00, Coh: 5.56 [psi]



### Bore Cross-Section View



## Bore Plan View



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## Load Verifier Input Summary:

Pipe Application: Electrical Cable  
Pipe Type: HDPE  
Classification: IPS  
Pipe OD: 10" (10.75")  
Pipe DR: 9  
Pipe Length: 825.00 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/ft<sup>3</sup>  
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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>

---

### In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	3.8	14.4
Water Pressure	7.0	7.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	10.7	21.3
<b>Deflection</b>		
Earth Load Deflection	1.119	3.908
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.251	4.041
<b>Compressive Stress [psi]</b>		
Compressive Wall Stress	48.4	95.9

### Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	13476.8	13476.8
Pullback Stress [psi]	375.9	375.9
Pullback Strain	6.537E-3	6.537E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	375.9	398.8
Tensile Strain	6.537E-3	7.383E-3

Net External Pressure = 19.2 [psi ]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

---

### In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.251	7.5	6.0	OK
Unconstrained Collapse [psi]	17.2	124.4	7.2	OK
Compressive Wall Stress [psi]	48.4	1150.0	23.8	OK

### Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	27.2	233.0	8.6	OK
Tensile Stress [psi]	398.8	1200.0	3.0	OK

---

## Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	63.939 psi	65.471 psi
1	8.00 in	12.00 in	63.792 psi	65.311 psi
2	12.00 in	16.13 in	63.581 psi	65.082 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/ft<sup>3</sup>

Rheological model: Bingham-Plastic

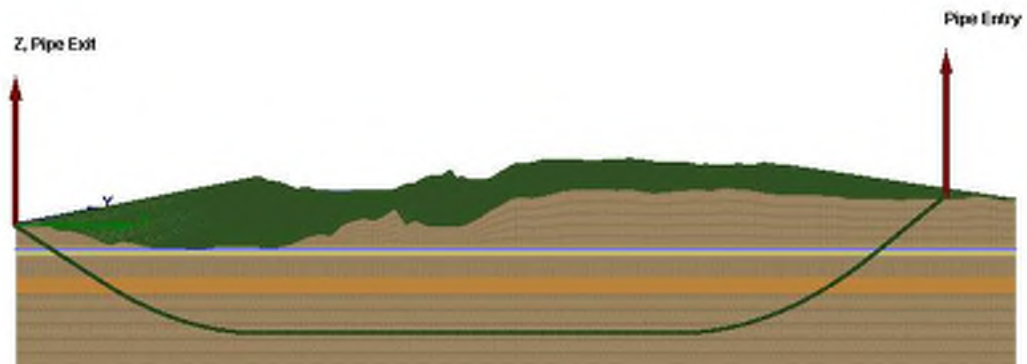
Plastic Viscosity (PV): 25.53

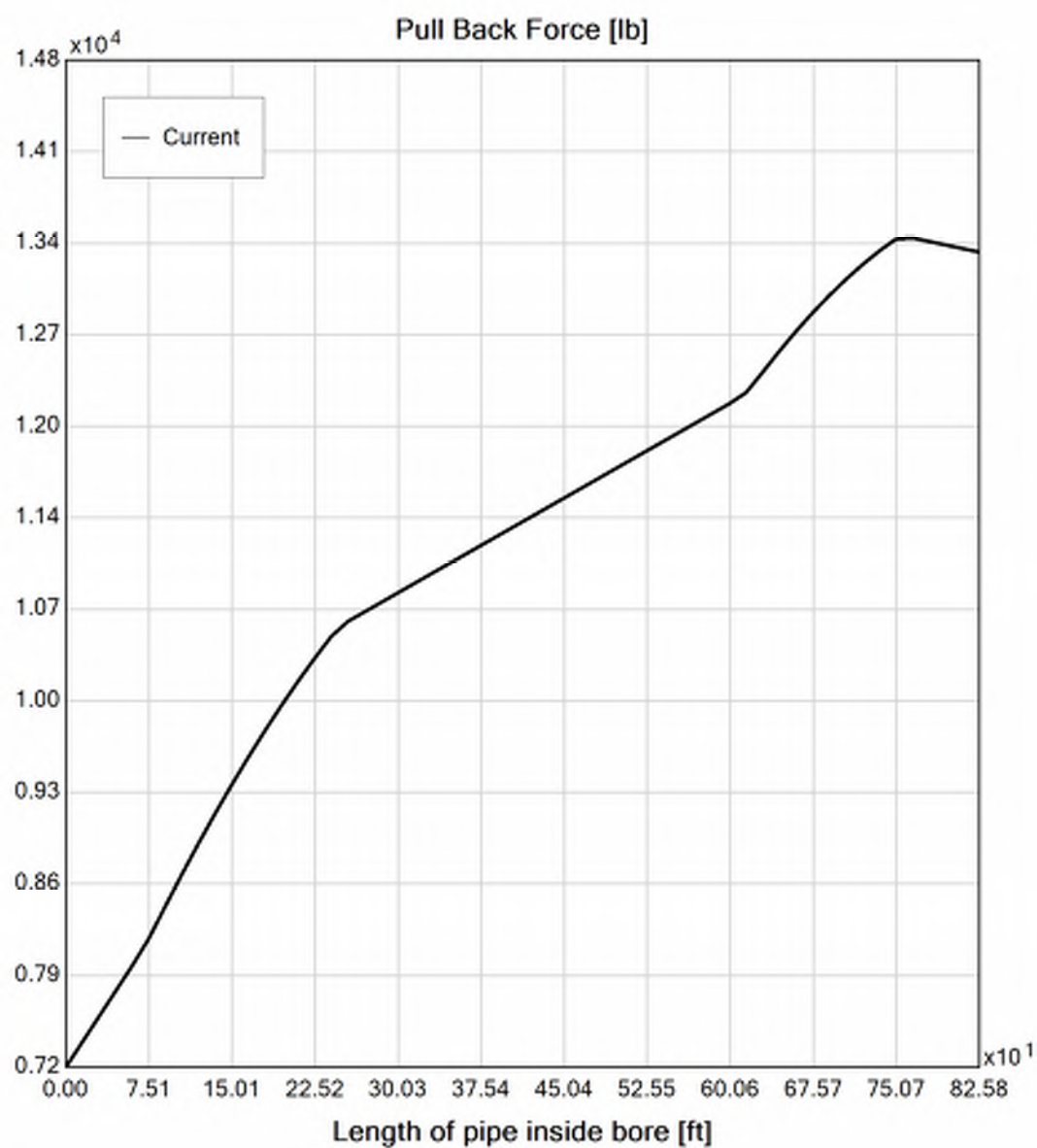
Yield Point (YP): 16.49

Effective Viscosity (cP): 1202.0

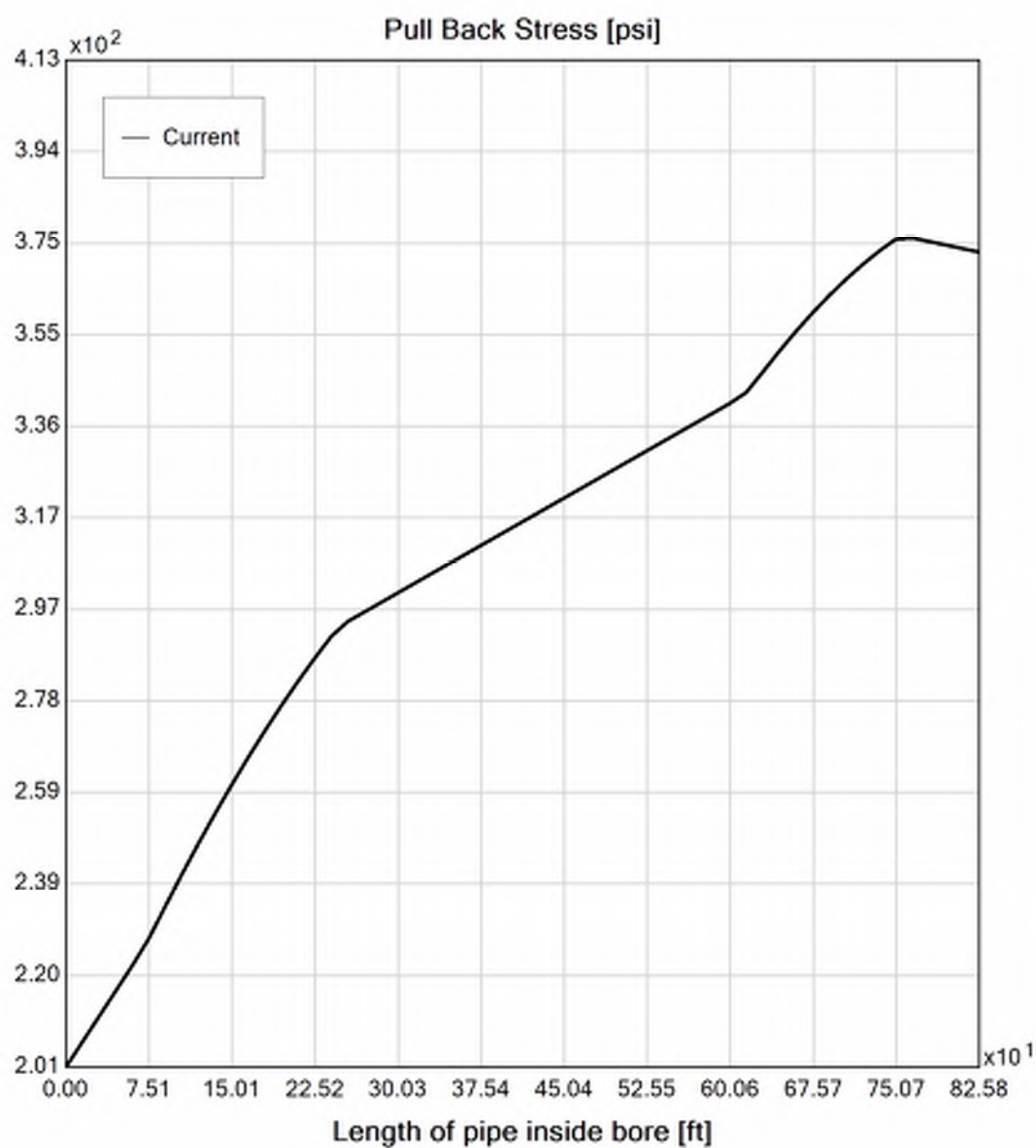
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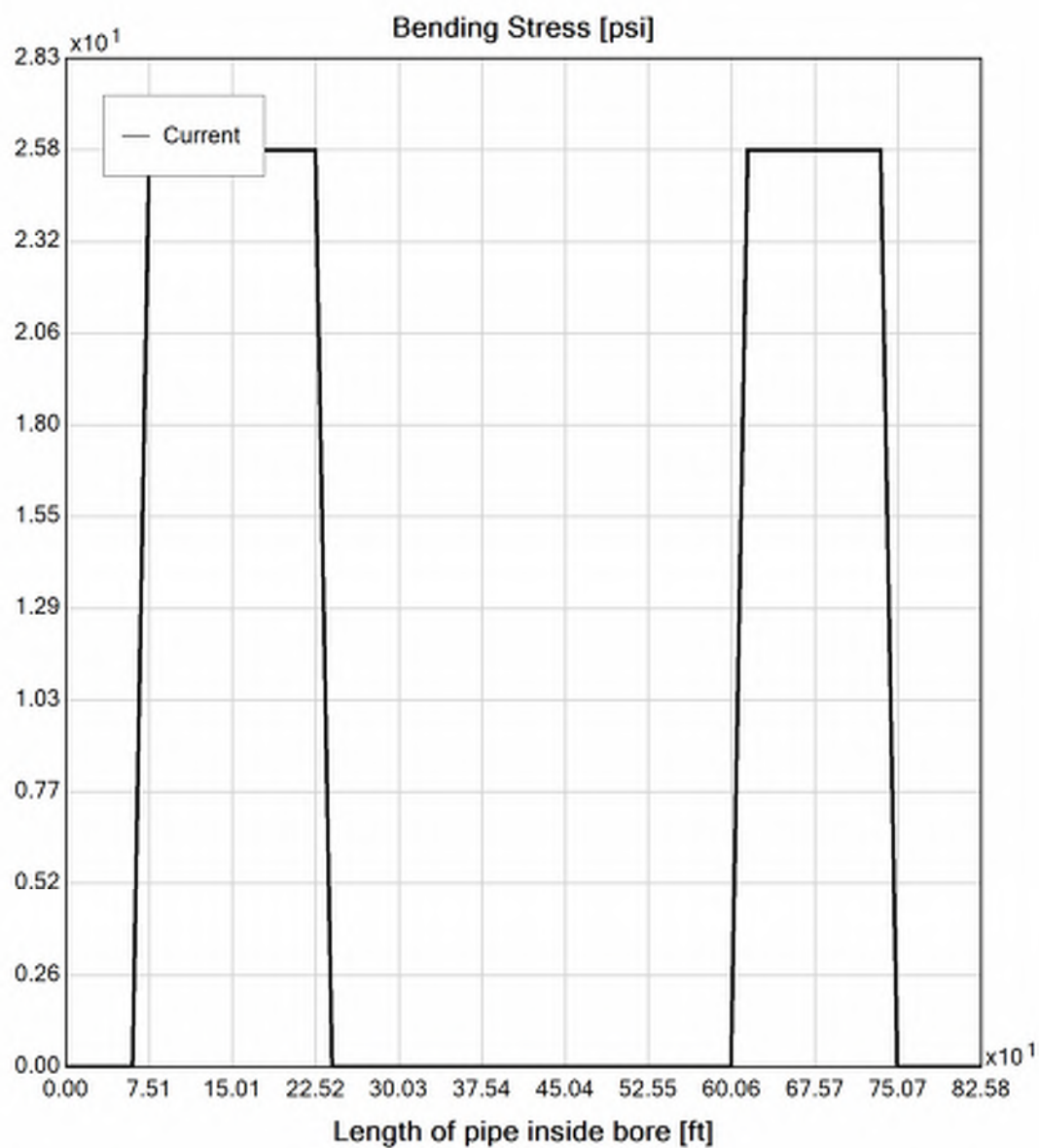
## Virtual Site

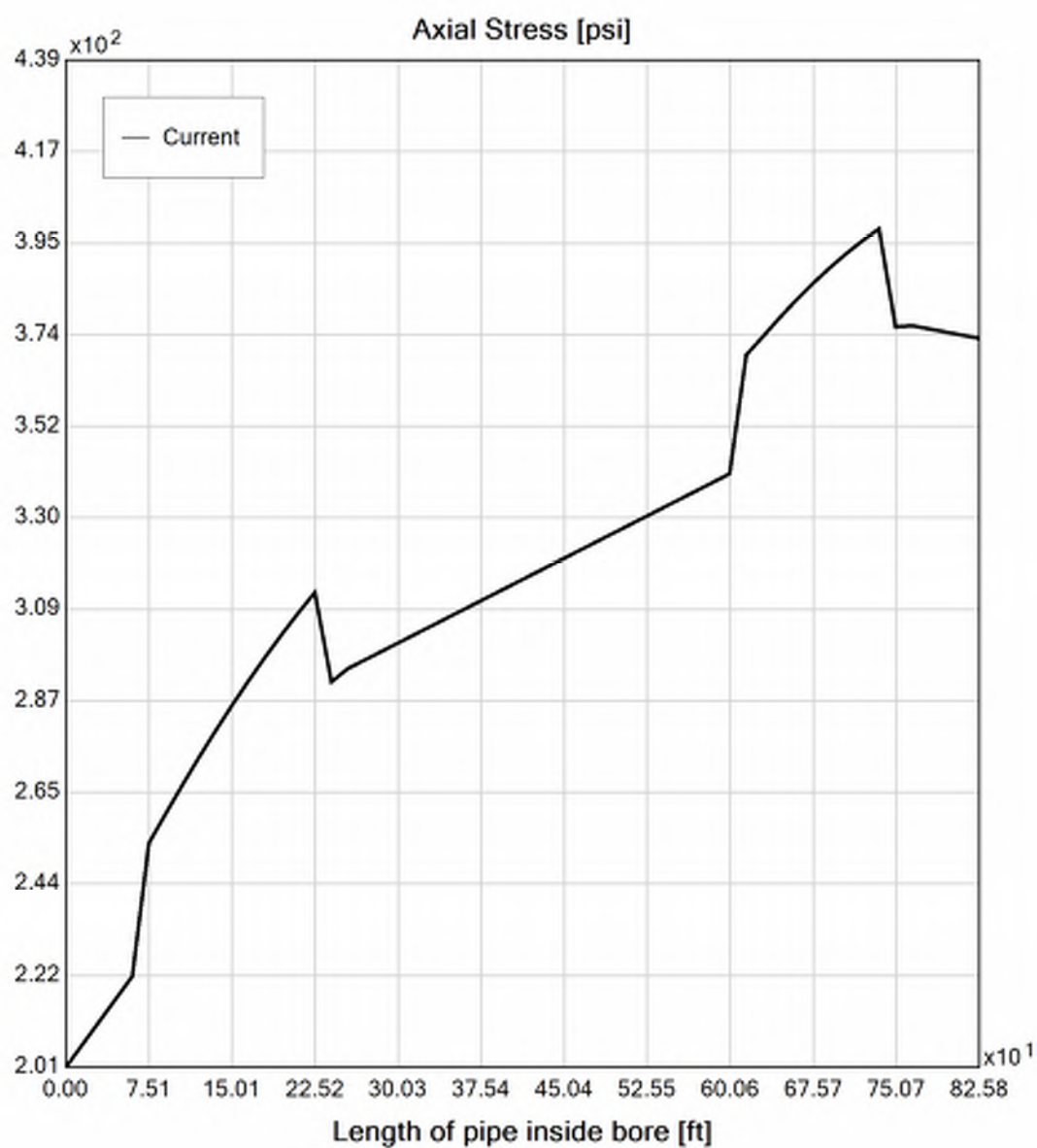


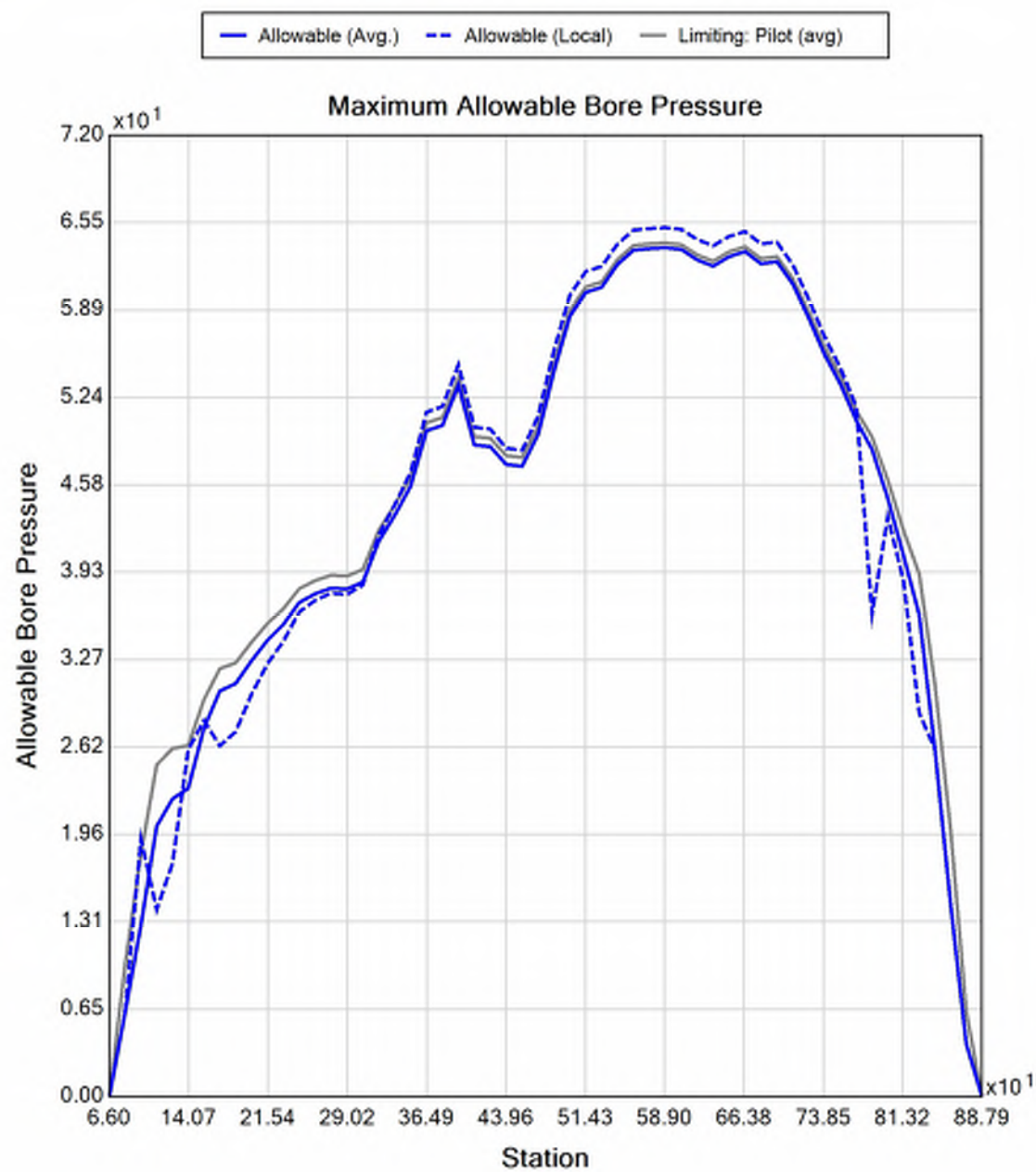


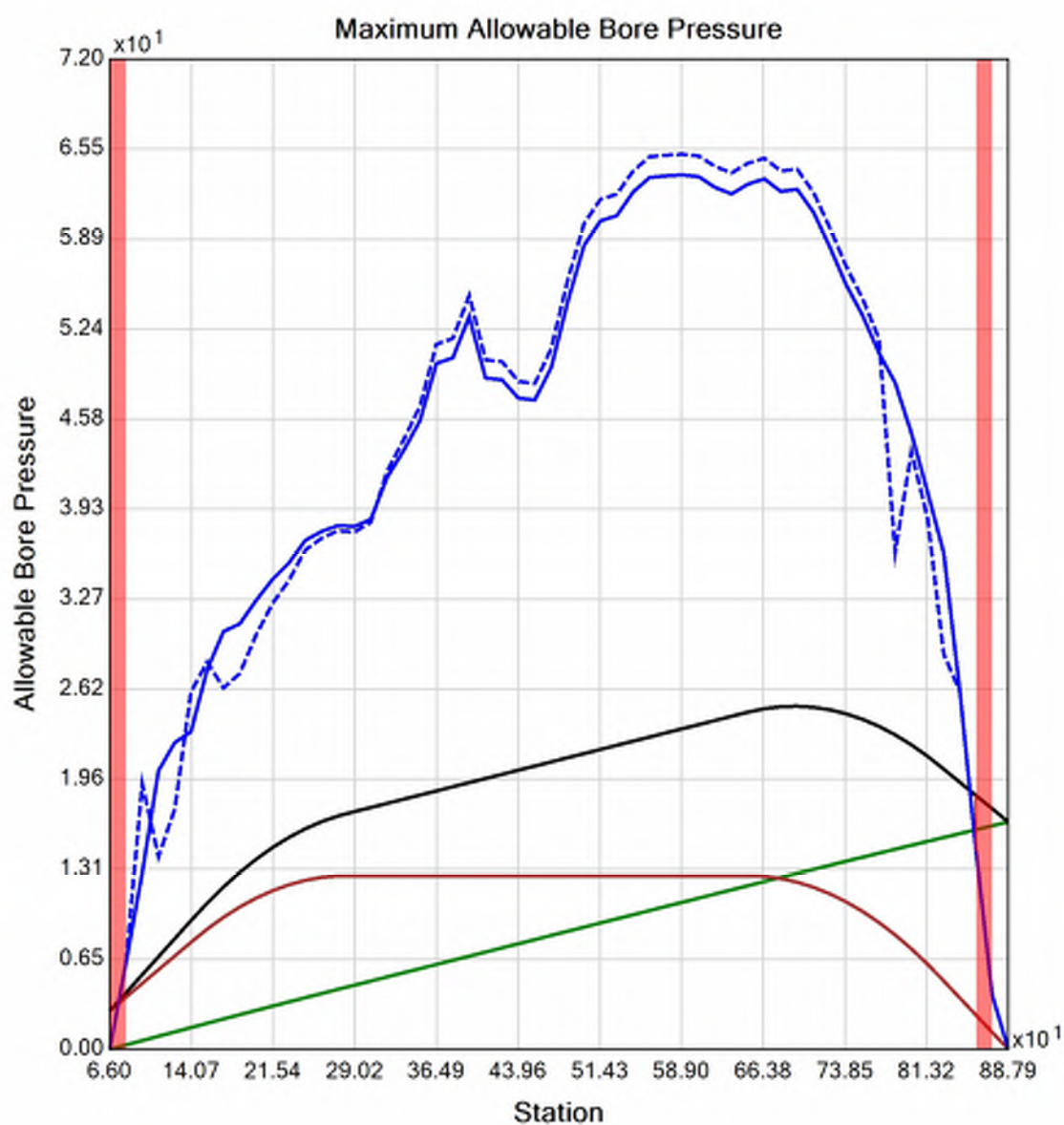














## Generated Output



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---

## Input Summary

Start Coordinate	(66.00, 0.00, 130.42) ft
End Coordinate	(883.00, 0.00, 135.46) ft
Project Length	817.00 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: 825.00 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/ft<sup>3</sup>  
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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>



---

### In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	1.5	14.4
Water Pressure	7.0	7.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	8.5	21.3
<b>Deflection</b>		
Earth Load Deflection	0.589	3.908
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	0.619	3.938
<b>Compressive Stress [psi]</b>		
Compressive Wall Stress	38.2	95.9

### Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	767.4	767.4
Pullback Stress [psi]	438.5	438.5
Pullback Strain	7.625E-3	7.625E-3
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	438.5	441.3
Tensile Strain	7.625E-3	7.774E-3

Net External Pressure = 19.2 [psi ]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

---

### In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.619	7.5	12.1	OK
Unconstrained Collapse [psi]	17.2	132.7	7.7	OK
Compressive Wall Stress [psi]	38.2	1150.0	30.1	OK

### Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	27.2	231.3	8.5	OK
Tensile Stress [psi]	441.3	1200.0	2.7	OK



## Generated Output



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---

## Project Summary

General: CHPE HDD 14A Conduit 1  
P2  
Start Date: 02-28-2022  
End Date: 02-28-2022

Project Owner: TDI  
Project Contractor: Kiewit  
Project Consultant: CHA/BCE

Designer:  
Description: HDD 14A Conduit 1 10-inch DR 9

---

## Input Summary

Start Coordinate	(0.00, 0.00, 128.70) ft
End Coordinate	(612.00, 0.00, 135.90) ft
Project Length	612.00 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: 2

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

Depth: 3.40 ft

Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft<sup>3</sup>]

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

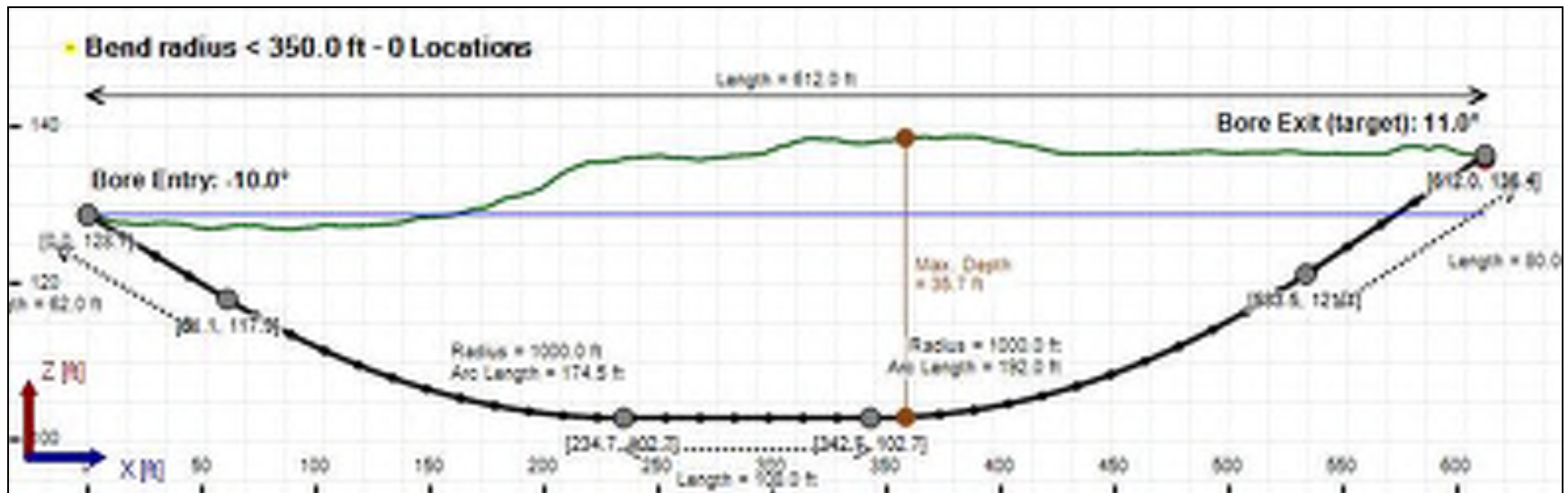
Soil Layer #2 USCS, Clay (C), CH

Depth: 42.00 ft

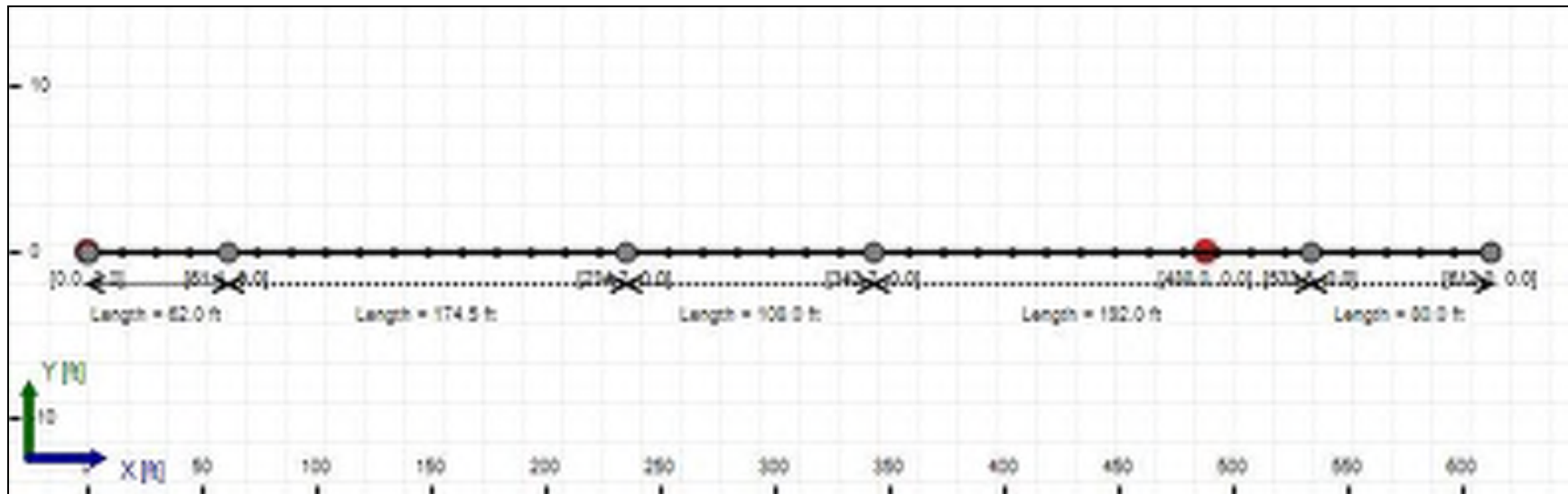
Unit Weight: 89.6832 (dry), 114.3936 (sat) [lb/ft<sup>3</sup>]

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: 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/ft<sup>3</sup>  
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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>

---

### In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	4.7	16.5
Water Pressure	11.3	11.2
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	16.0	27.8
<b>Deflection</b>		
Earth Load Deflection	1.360	4.495
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.492	4.627
<b>Compressive Stress [psi]</b>		
Compressive Wall Stress	71.9	124.9

### Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	11206.0	11206.0
Pullback Stress [psi]	312.5	312.5
Pullback Strain	5.435E-3	5.435E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	312.5	337.0
Tensile Strain	5.435E-3	6.309E-3

Net External Pressure = 23.4 [psi ]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

---

### In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.492	7.5	5.0	OK
Unconstrained Collapse [psi]	23.5	121.7	5.2	OK
Compressive Wall Stress [psi]	71.9	1150.0	16.0	OK

### Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	33.5	236.9	7.1	OK
Tensile Stress [psi]	337.0	1200.0	3.6	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	71.629 psi	60.892 psi
1	8.00 in	12.00 in	71.574 psi	60.829 psi
2	12.00 in	16.13 in	71.496 psi	60.739 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/ft<sup>3</sup>

Rheological model: Bingham-Plastic

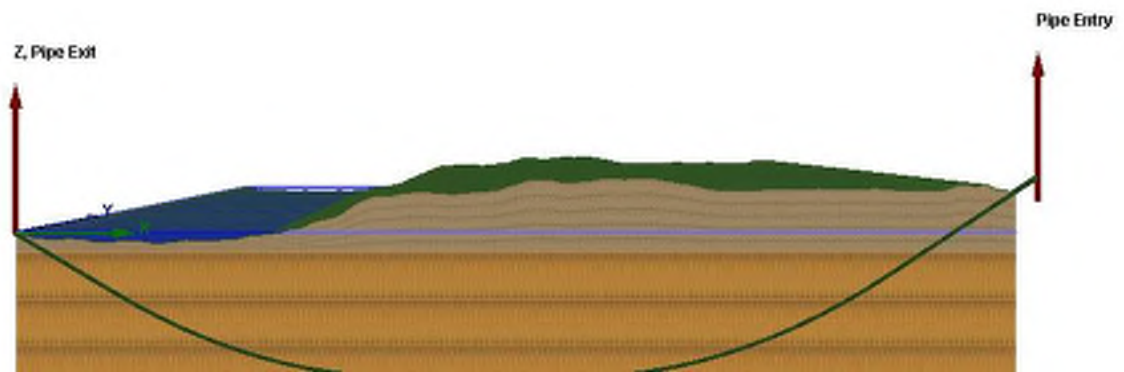
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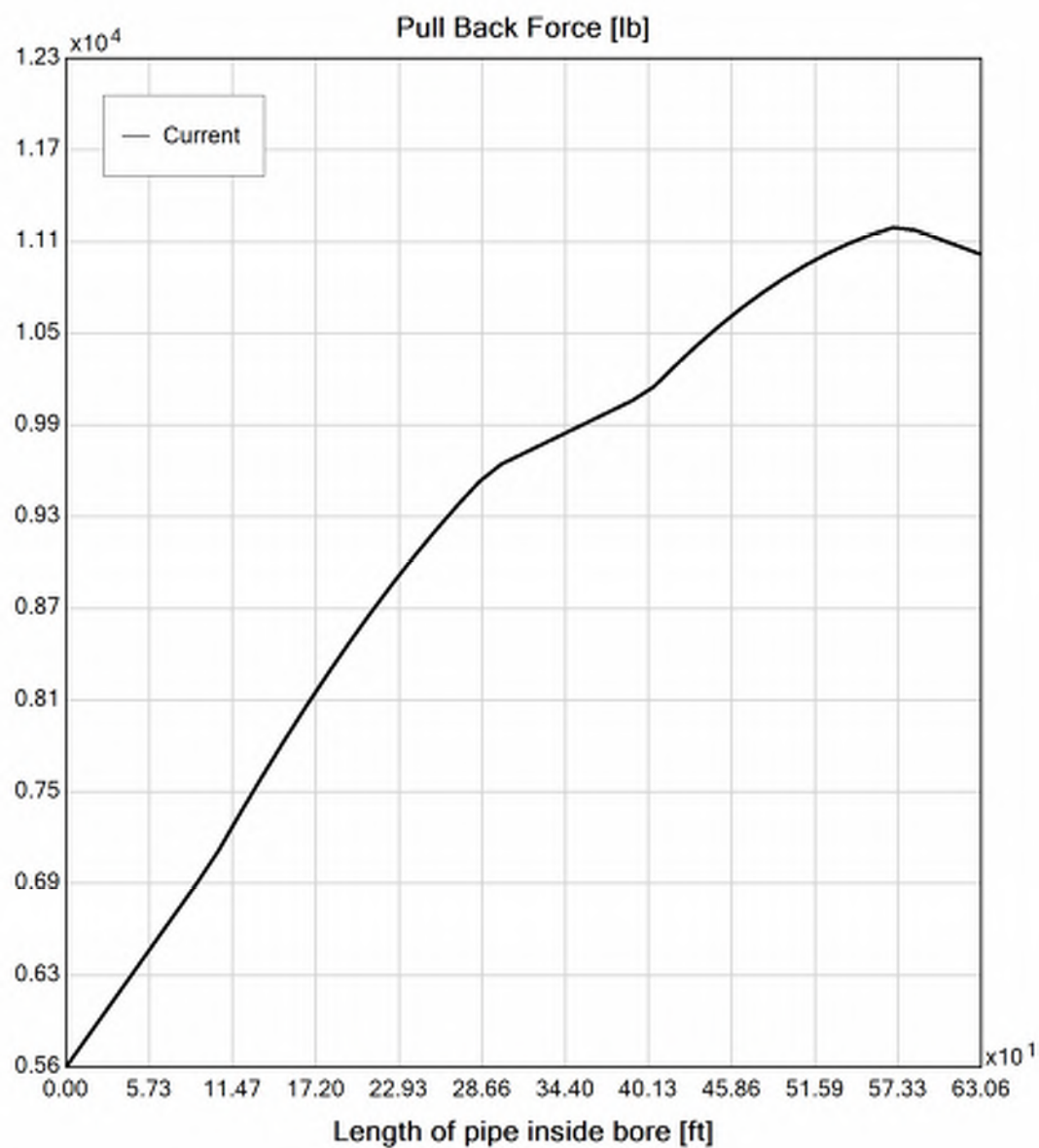
Yield Point (YP): 16.49

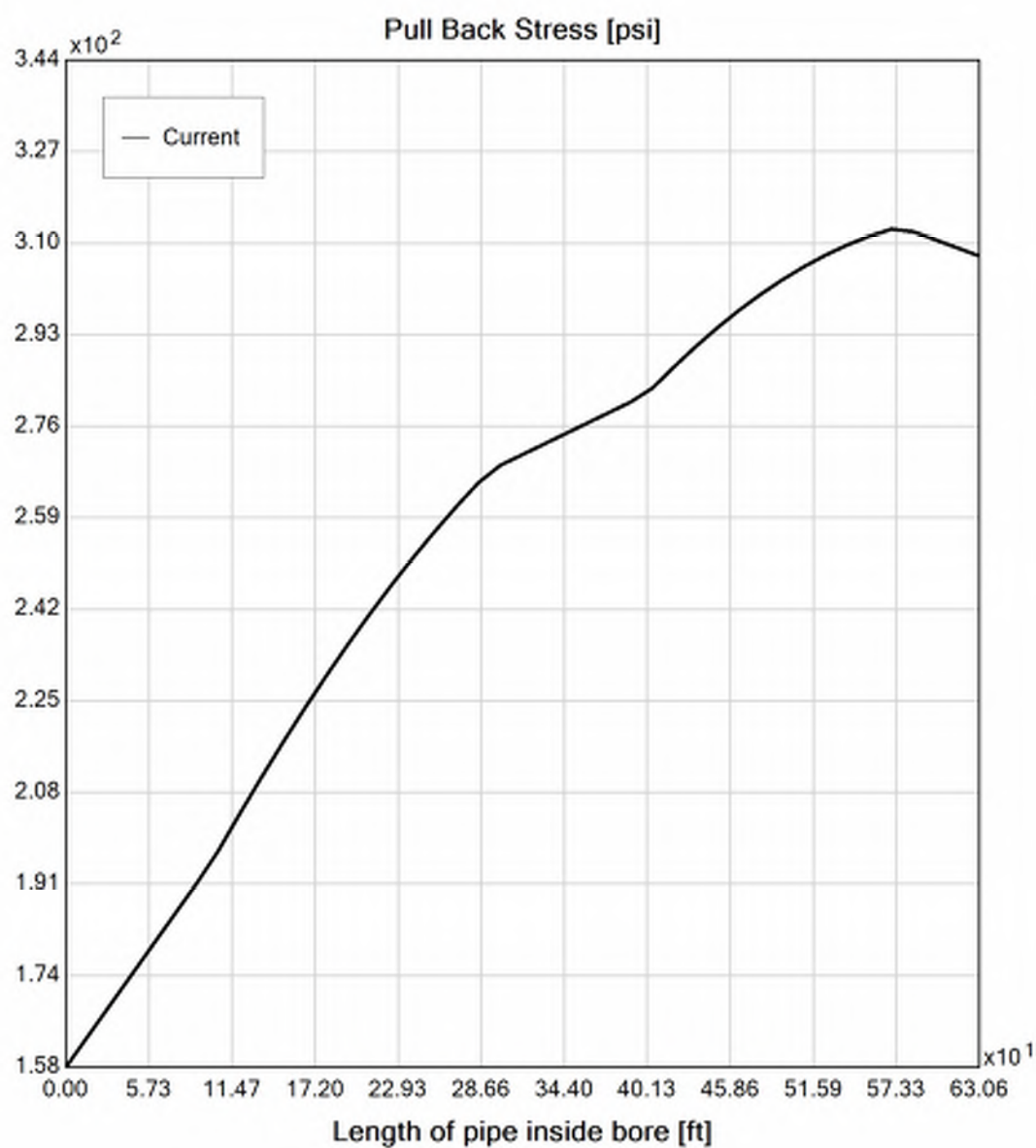
Effective Viscosity (cP): 1202.0

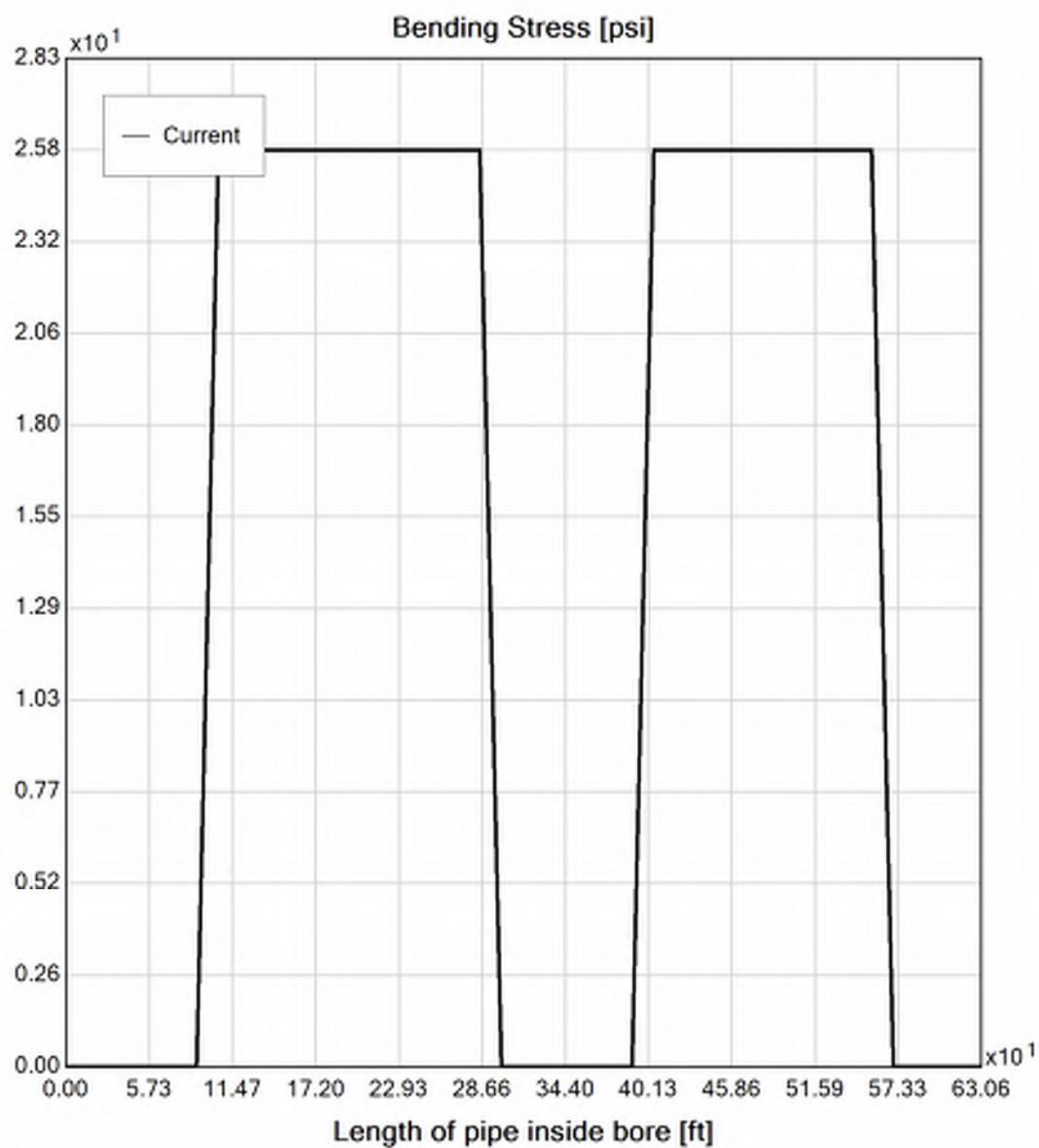
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## Virtual Site

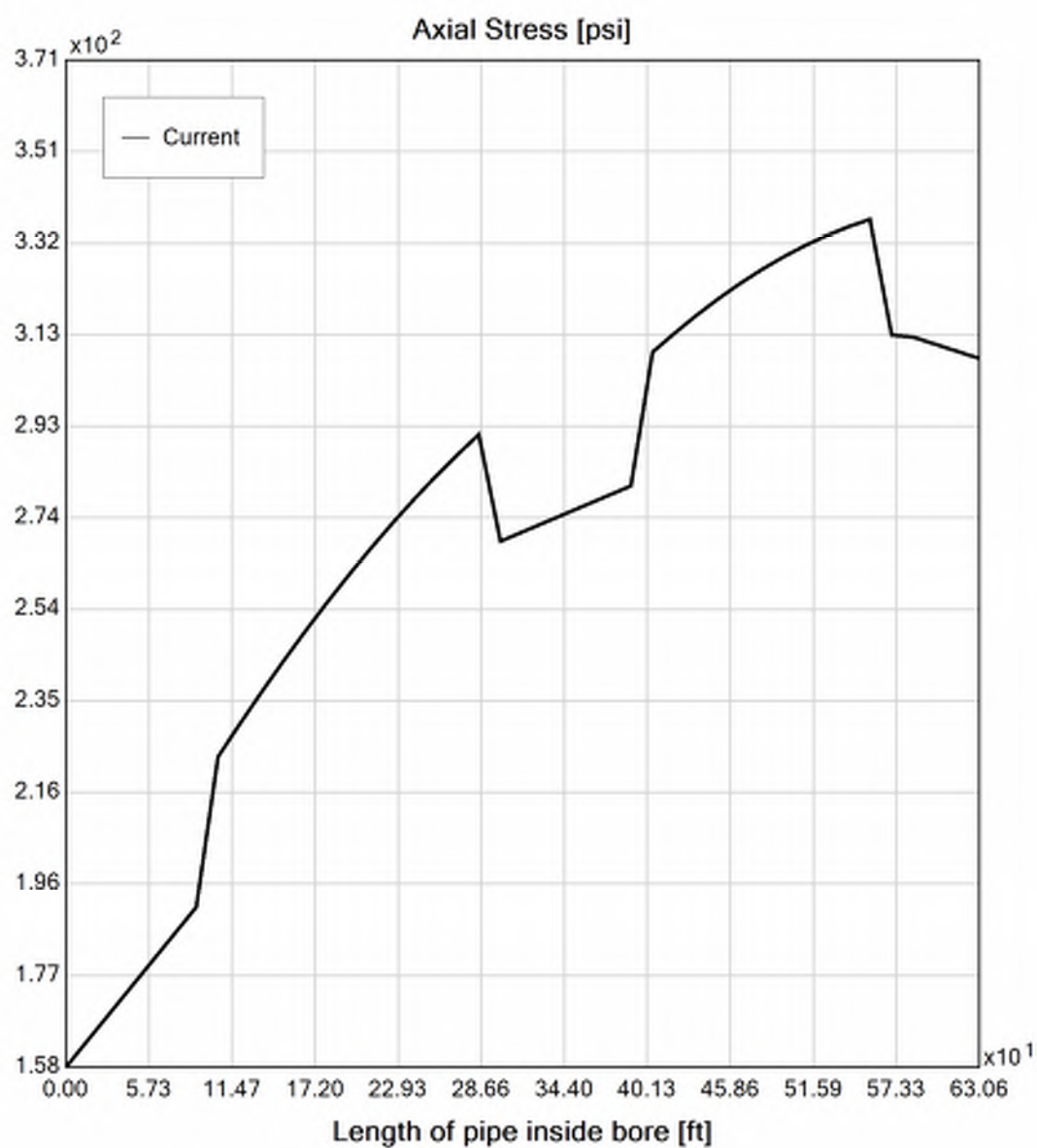


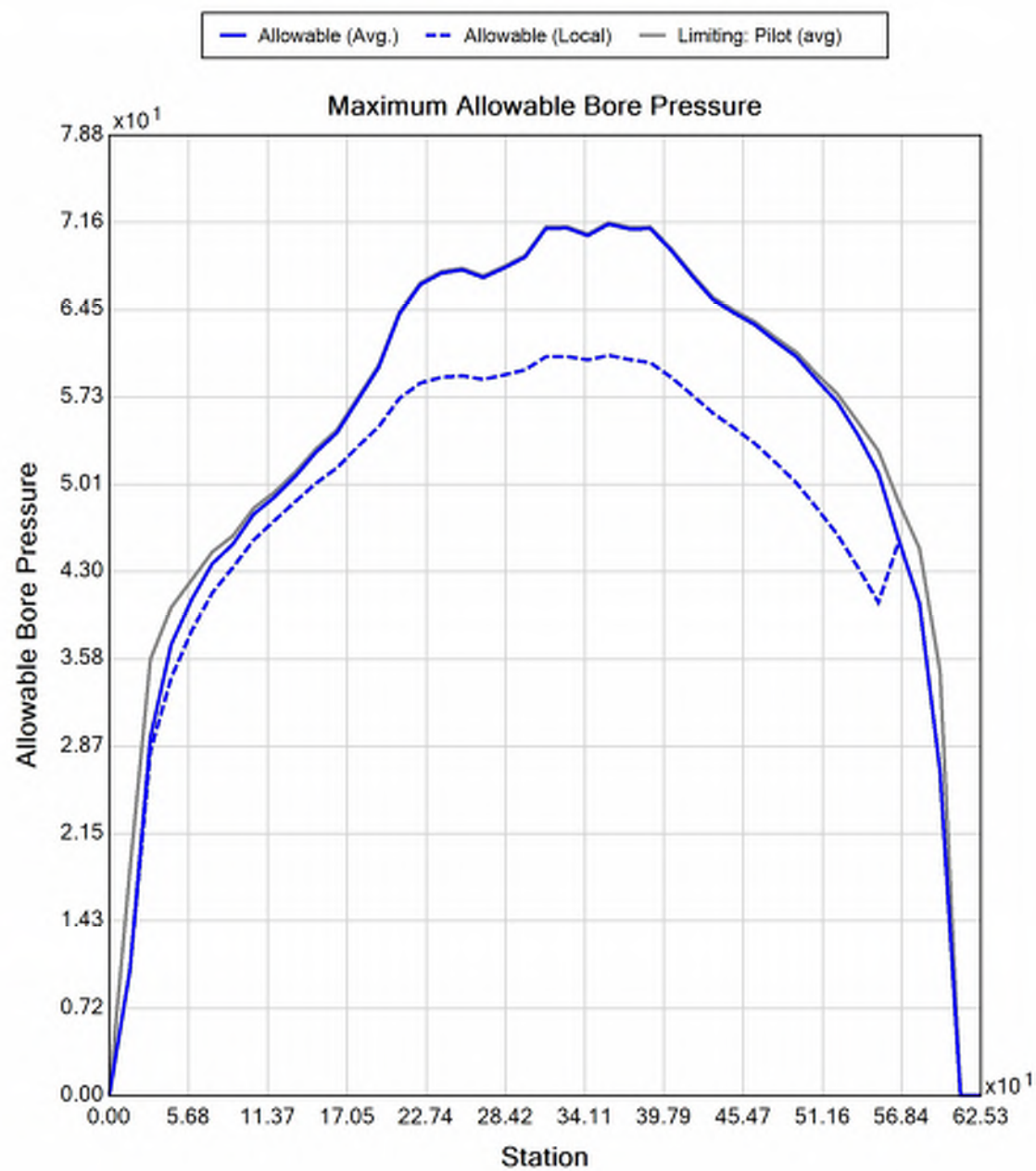


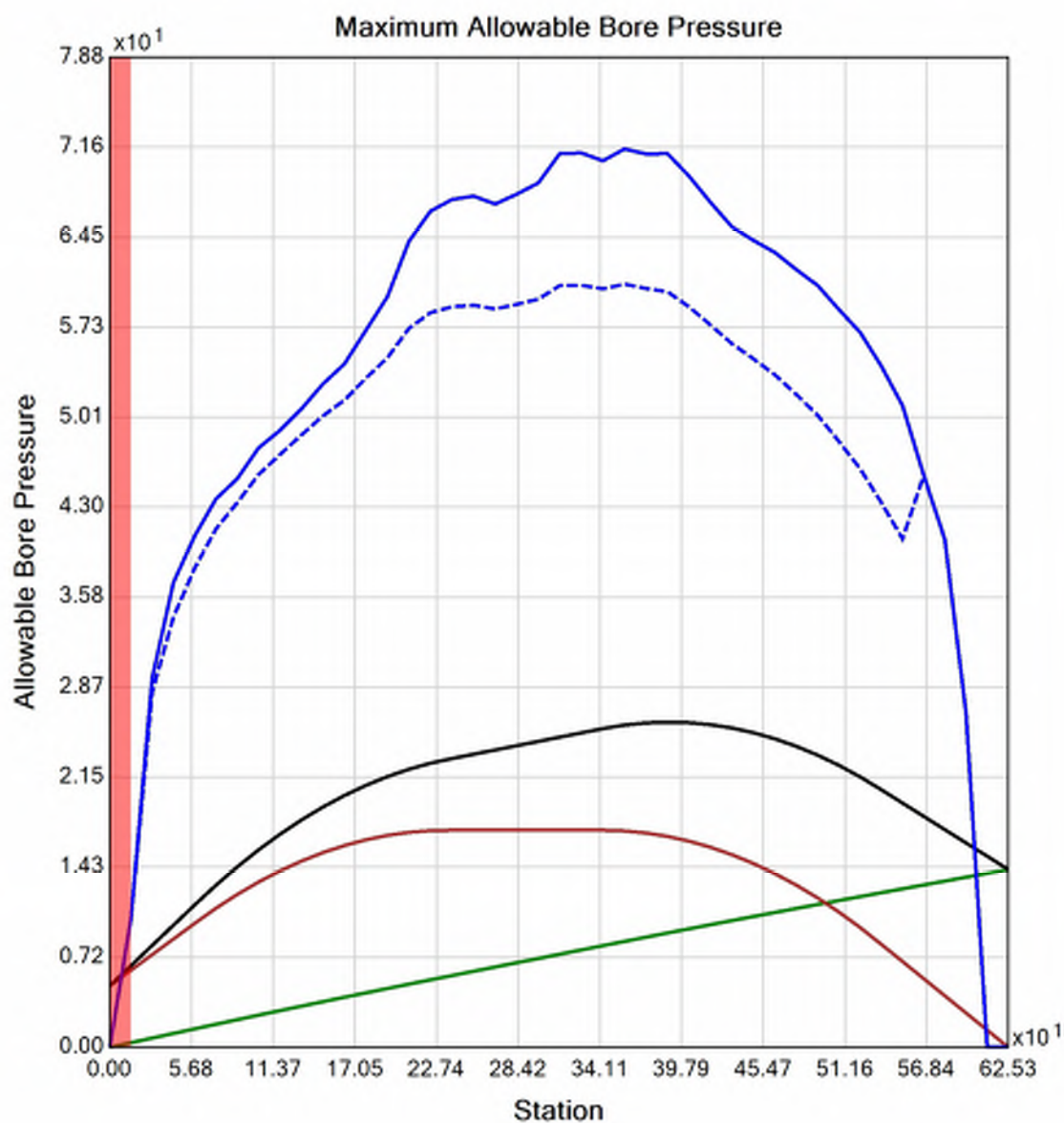














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---

## Input Summary

Start Coordinate	(0.00, 0.00, 128.70) ft
End Coordinate	(612.00, 0.00, 135.90) ft
Project Length	612.00 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/ft<sup>3</sup>  
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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>

---

### In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	2.0	16.5
Water Pressure	11.3	11.2
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	13.3	27.8
<b>Deflection</b>		
Earth Load Deflection	0.833	4.495
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	0.862	4.525
<b>Compressive Stress [psi]</b>		
Compressive Wall Stress	59.6	124.9

### Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	656.6	656.6
Pullback Stress [psi]	375.1	375.1
Pullback Strain	6.524E-3	6.524E-3
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	375.1	379.5
Tensile Strain	6.524E-3	6.700E-3

Net External Pressure = 23.4 [psi ]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

---

### In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.862	7.5	8.7	OK
Unconstrained Collapse [psi]	23.5	131.3	5.6	OK
Compressive Wall Stress [psi]	59.6	1150.0	19.3	OK

### Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	33.5	235.3	7.0	OK
Tensile Stress [psi]	379.5	1200.0	3.2	OK





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---

## Project Summary

General: CHPE HDD 14A Conduit 2  
P2  
Start Date: 02-28-2022  
End Date: 02-28-2022

Project Owner: TDI  
Project Contractor: Kiewit  
Project Consultant: CHA/BCE

Designer:  
Description: HDD 14A Conduit 2 10-inch DR 9

---

## Input Summary

Start Coordinate	(0.00, 0.00, 127.50) ft
End Coordinate	(600.00, 0.00, 134.90) ft
Project Length	600.00 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: 2

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

Depth: 3.40 ft

Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft<sup>3</sup>]

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

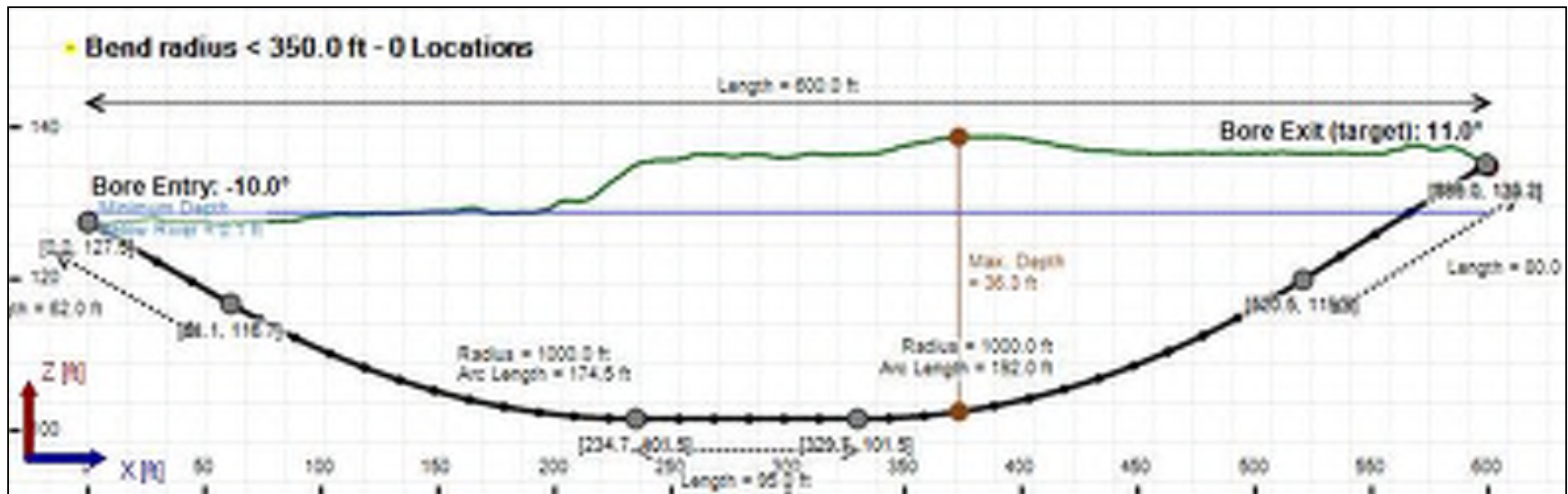
Soil Layer #2 USCS, Clay (C), CH

Depth: 42.00 ft

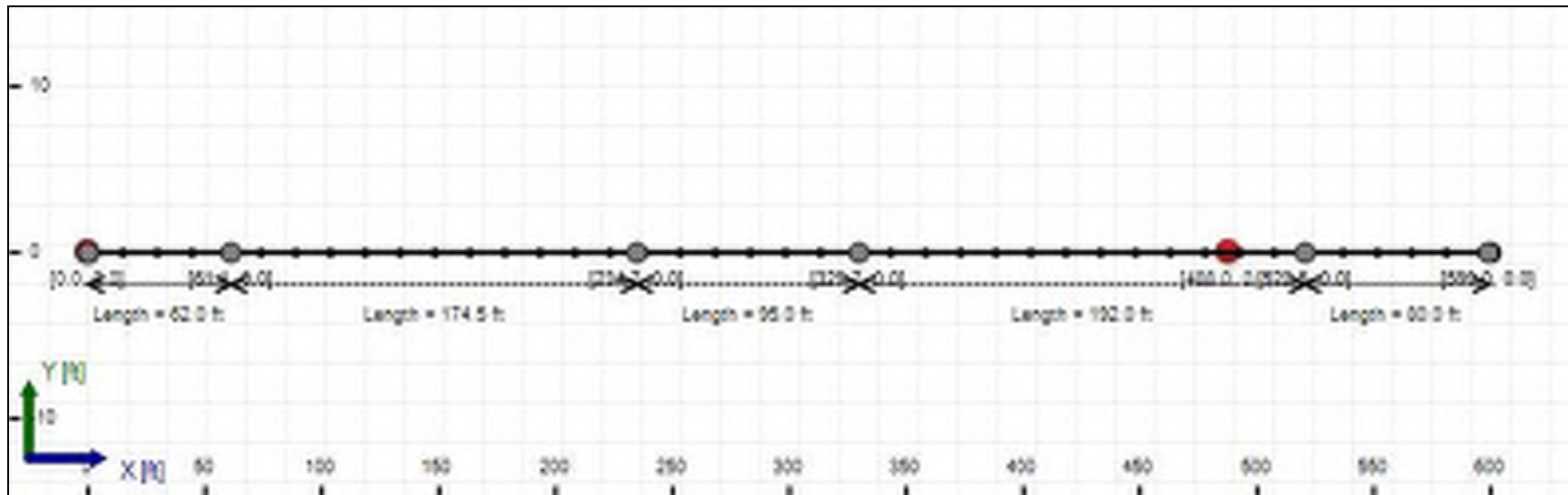
Unit Weight: 89.6832 (dry), 114.3936 (sat) [lb/ft<sup>3</sup>]

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: 615.00 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/ft<sup>3</sup>  
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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>

---

### In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	4.8	16.8
Water Pressure	11.7	11.4
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	16.5	28.2
<b>Deflection</b>		
Earth Load Deflection	1.331	4.569
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.463	4.701
<b>Compressive Stress [psi]</b>		
Compressive Wall Stress	74.1	126.8

### Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	10954.4	10954.4
Pullback Stress [psi]	305.5	305.5
Pullback Strain	5.313E-3	5.313E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	305.5	330.0
Tensile Strain	5.313E-3	6.188E-3

Net External Pressure = 23.2 [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]	23.3	121.8	5.2	OK
Compressive Wall Stress [psi]	74.1	1150.0	15.5	OK

### Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	33.3	237.3	7.1	OK
Tensile Stress [psi]	330.0	1200.0	3.6	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	73.094 psi	61.327 psi
1	8.00 in	12.00 in	73.040 psi	61.266 psi
2	12.00 in	16.13 in	72.961 psi	61.179 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/ft<sup>3</sup>

Rheological model: Bingham-Plastic

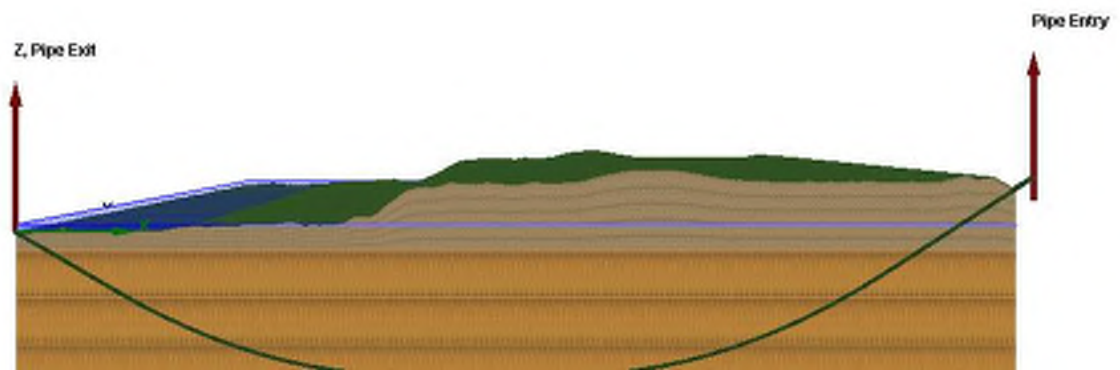
Plastic Viscosity (PV): 25.53

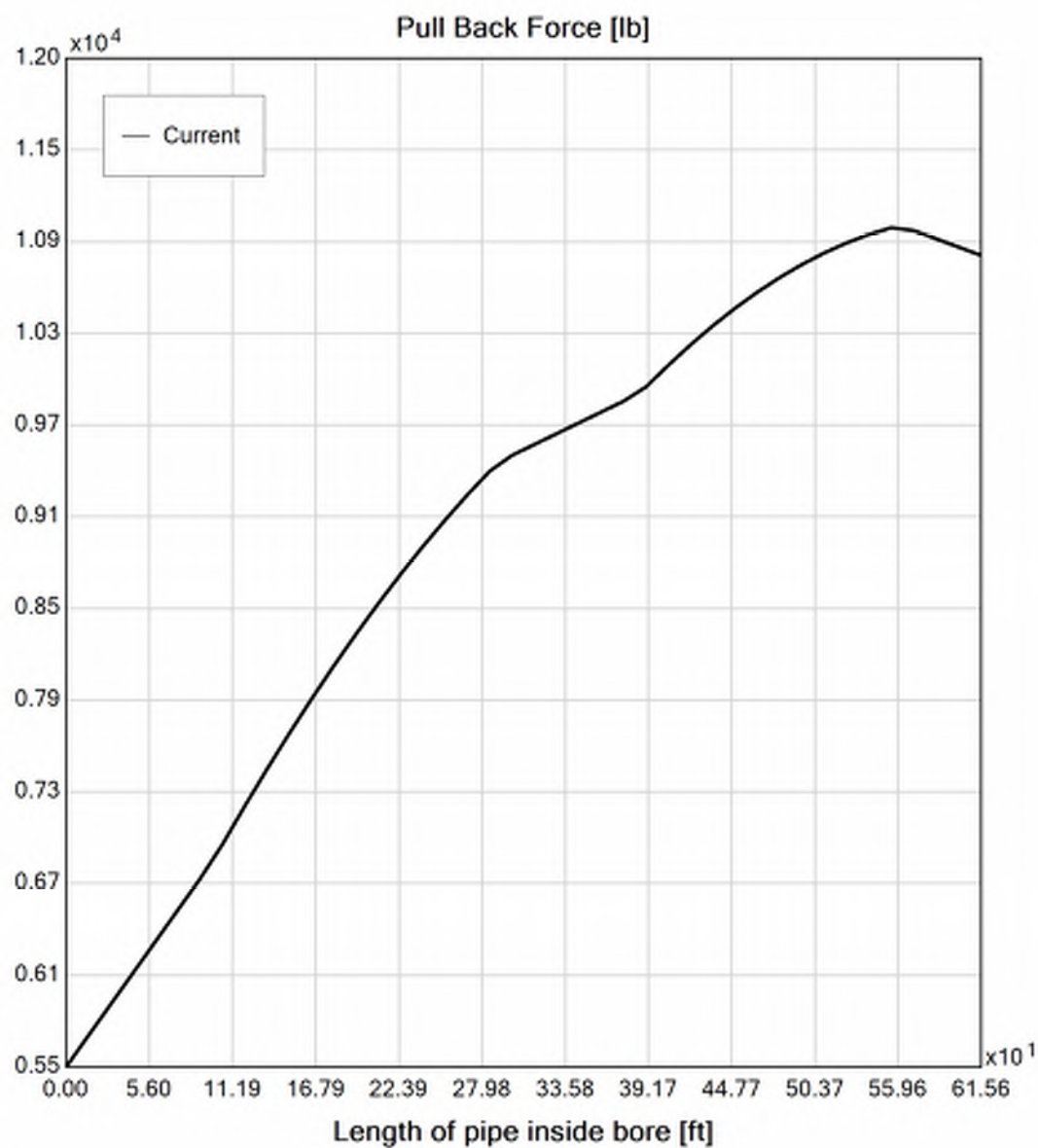
Yield Point (YP): 16.49

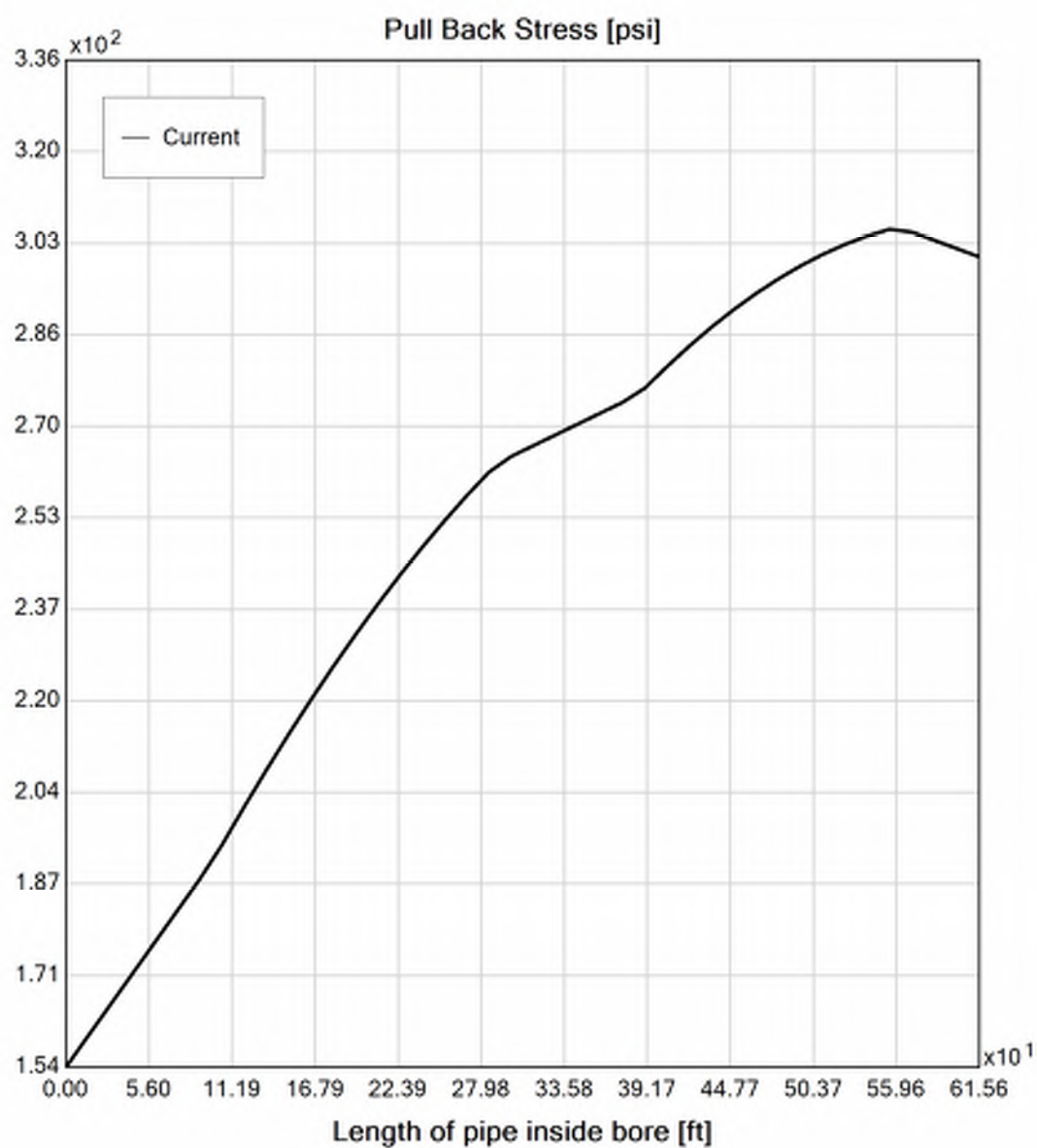
Effective Viscosity (cP): 1202.0

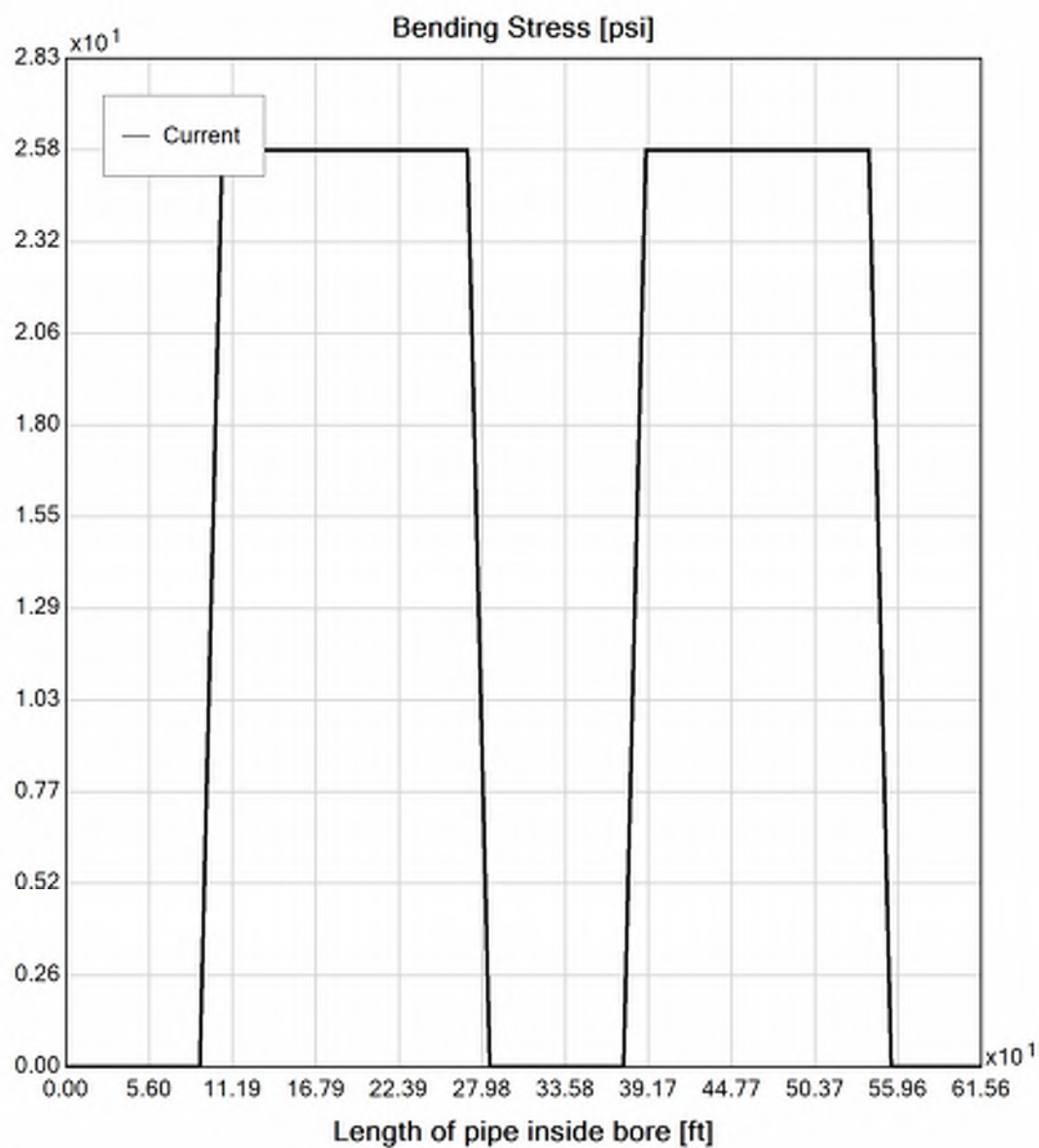
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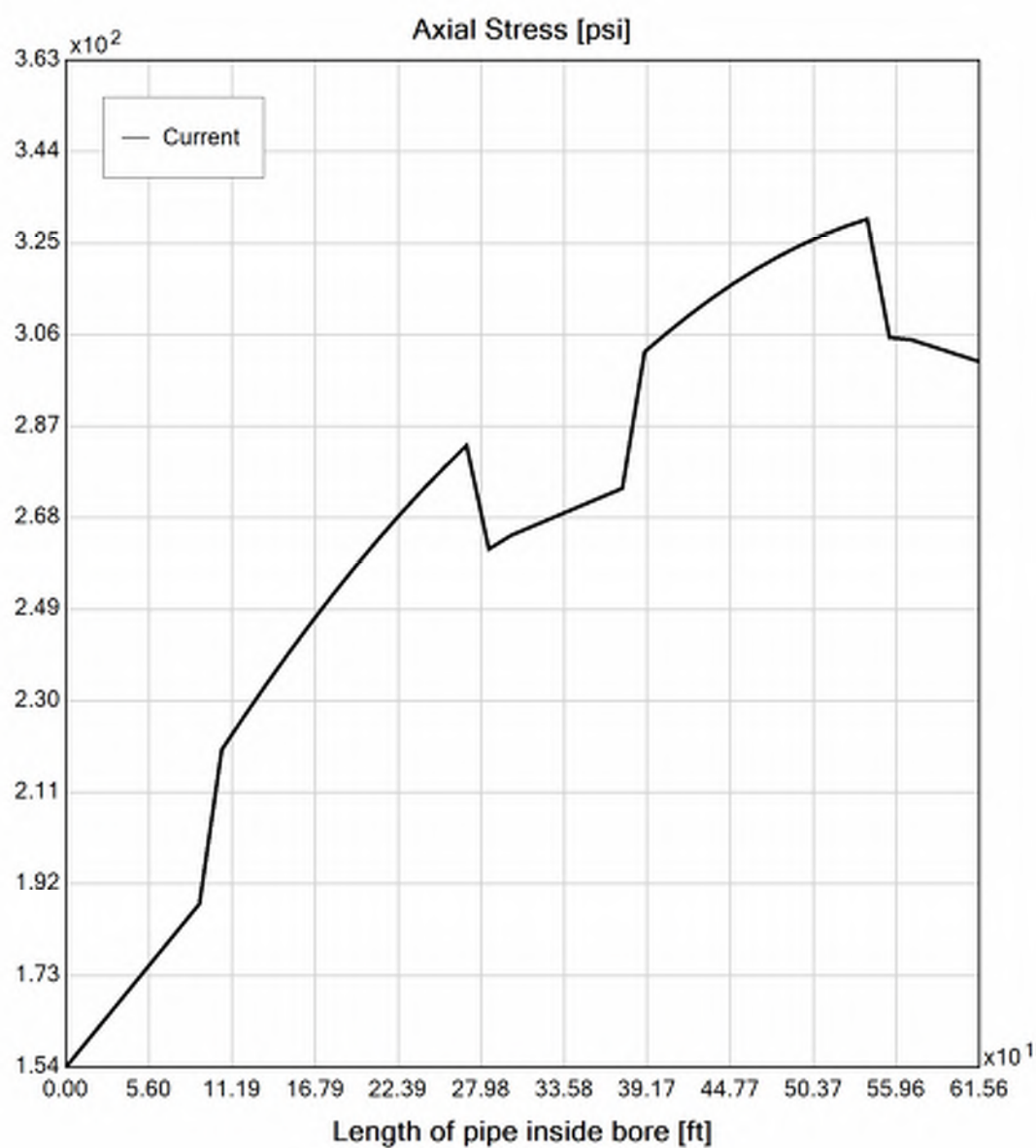
## Virtual Site

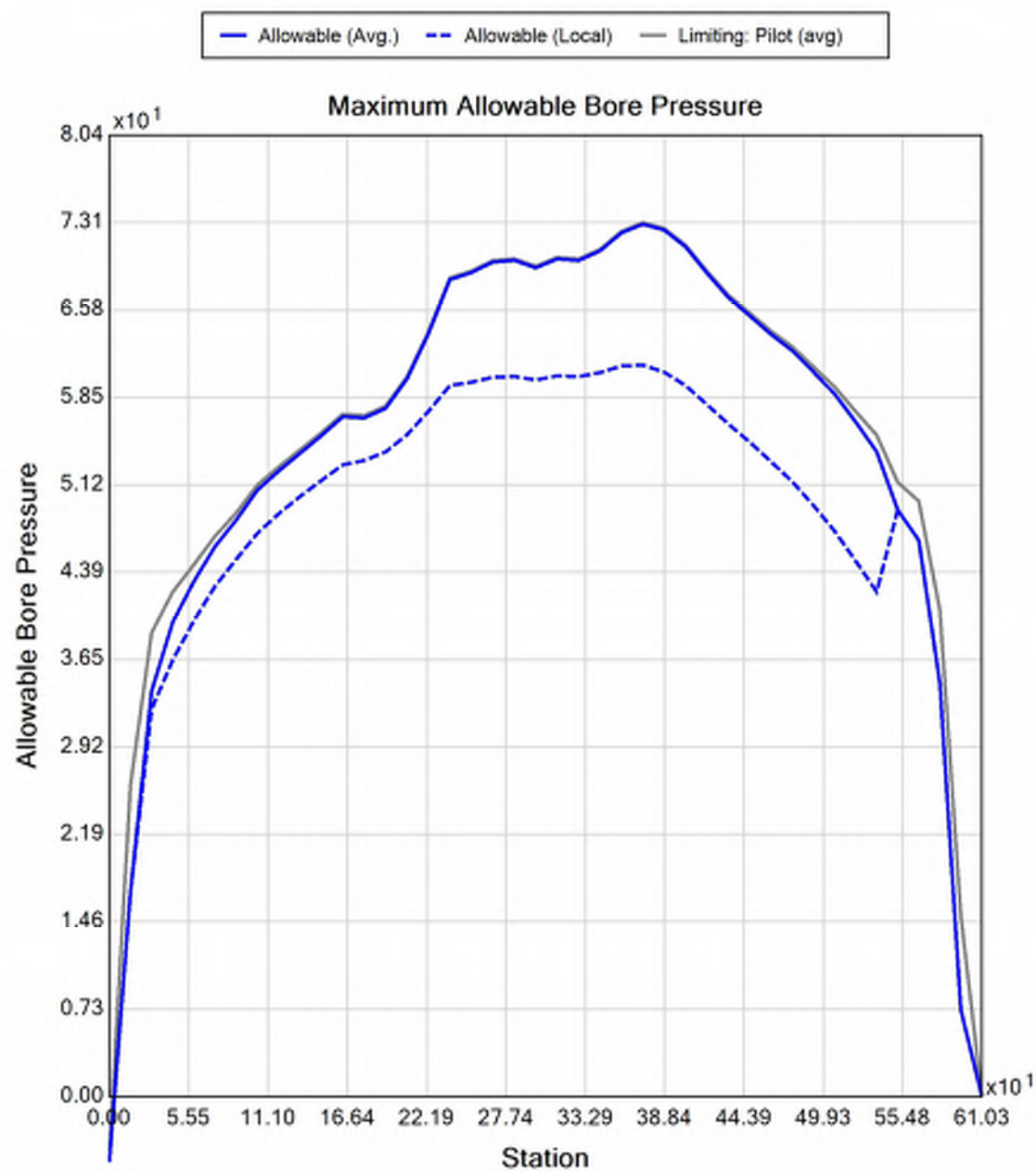




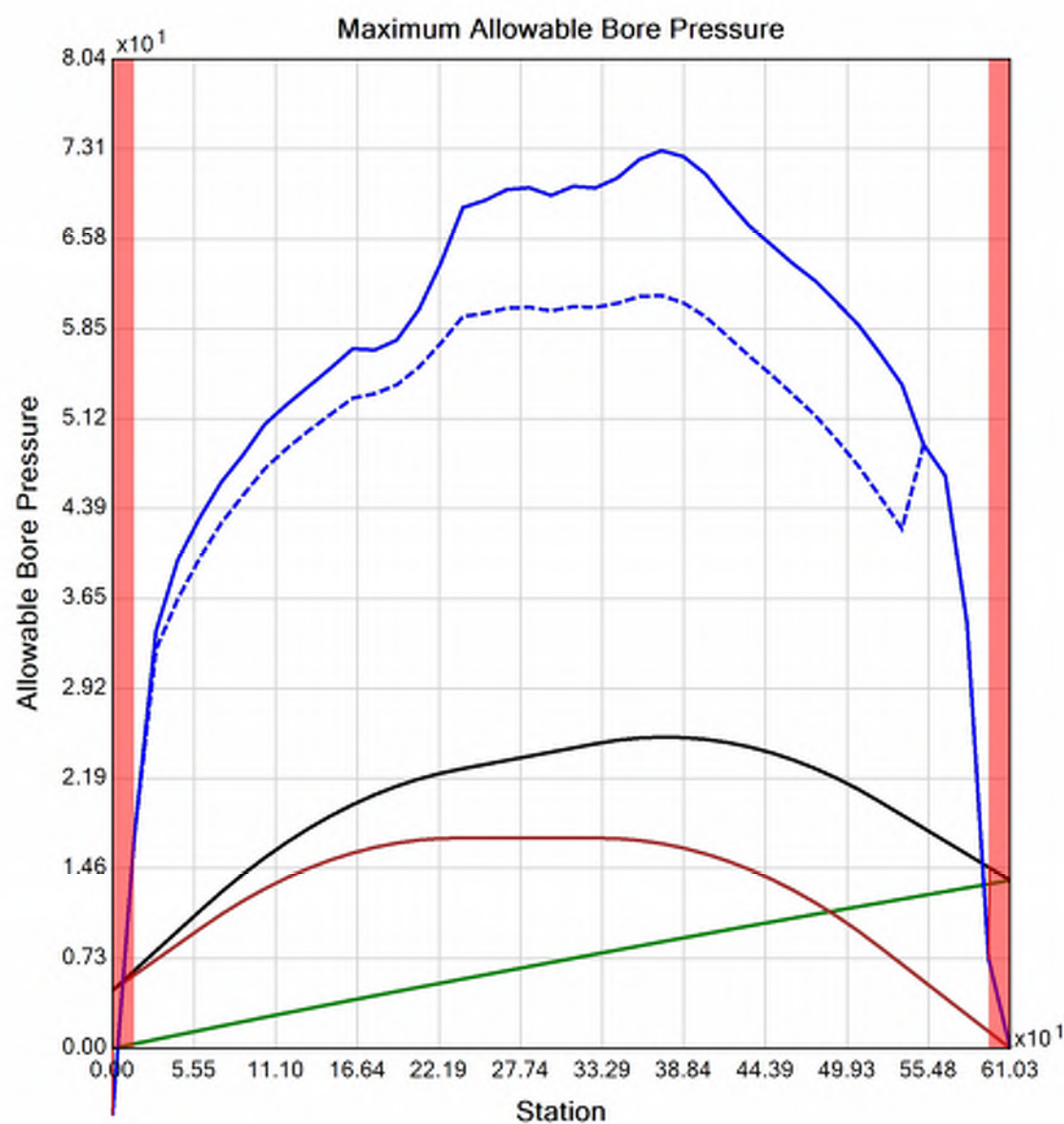














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---

## Input Summary

Start Coordinate	(0.00, 0.00, 127.50) ft
End Coordinate	(600.00, 0.00, 134.90) ft
Project Length	600.00 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: 615.00 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/ft<sup>3</sup>  
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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>

---

### In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	2.2	16.8
Water Pressure	11.7	11.4
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	13.9	28.2
<b>Deflection</b>		
Earth Load Deflection	0.653	4.569
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	0.682	4.598
<b>Compressive Stress [psi]</b>		
Compressive Wall Stress	62.4	126.8

### Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	644.3	644.3
Pullback Stress [psi]	368.1	368.1
Pullback Strain	6.402E-3	6.402E-3
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	368.1	372.6
Tensile Strain	6.402E-3	6.579E-3

Net External Pressure = 23.2 [psi ]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

---

### In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.682	7.5	11.0	OK
Unconstrained Collapse [psi]	23.3	131.2	5.6	OK
Compressive Wall Stress [psi]	62.4	1150.0	18.4	OK

### Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	33.3	235.7	7.1	OK
Tensile Stress [psi]	372.6	1200.0	3.2	OK



## Generated Output



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## Project Summary

General: CHPE HDD 15  
P2  
Start Date: 02-28-2022  
End Date: 02-28-2022

Project Owner: TDI  
Project Contractor: Kiewit  
Project Consultant: CHA/BCE

Designer:  
Description: HDD 15 10-inch DR 9



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## Input Summary

Start Coordinate	(0.00, 0.00, 131.91) ft
End Coordinate	(624.18, 0.00, 131.59) ft
Project Length	624.18 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), SW

Depth: 4.00 ft

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

Phi: 36.00, S.M.: 145.00, Coh: 0.00 [psi]

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

Depth: 4.00 ft

Unit Weight: 80.0000 (dry), 100.0000 (sat) [lb/ft3]

Phi: 0.00, S.M.: 50.00, Coh: 4.40 [psi]

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

Depth: 3.00 ft

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

Phi: 0.00, S.M.: 145.00, Coh: 8.70 [psi]

Soil Layer #4 USCS, Sand (S), SP

Depth: 6.00 ft

Unit Weight: 109.5552 (dry), 125.0000 (sat) [lb/ft3]

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

Soil Layer #5 USCS, Clay (C), CH

Depth: 20.00 ft

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

Phi: 0.00, S.M.: 145.00, Coh: 8.70 [psi]

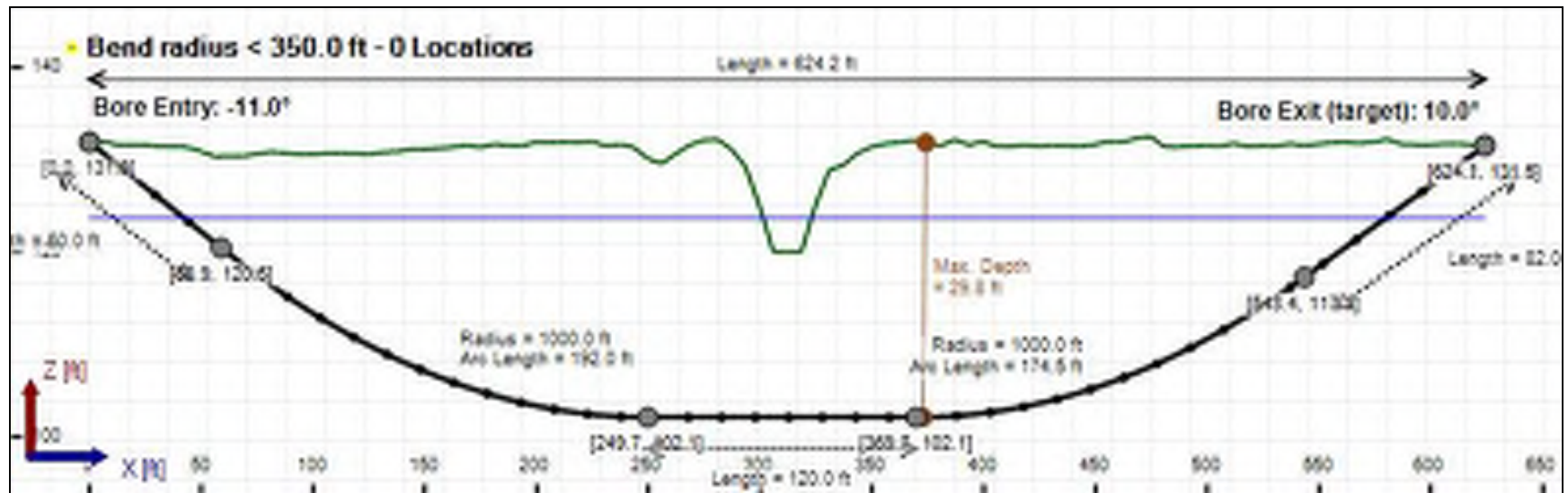
Soil Layer #6 USCS, Silt (M), ML

Depth: 4.00 ft

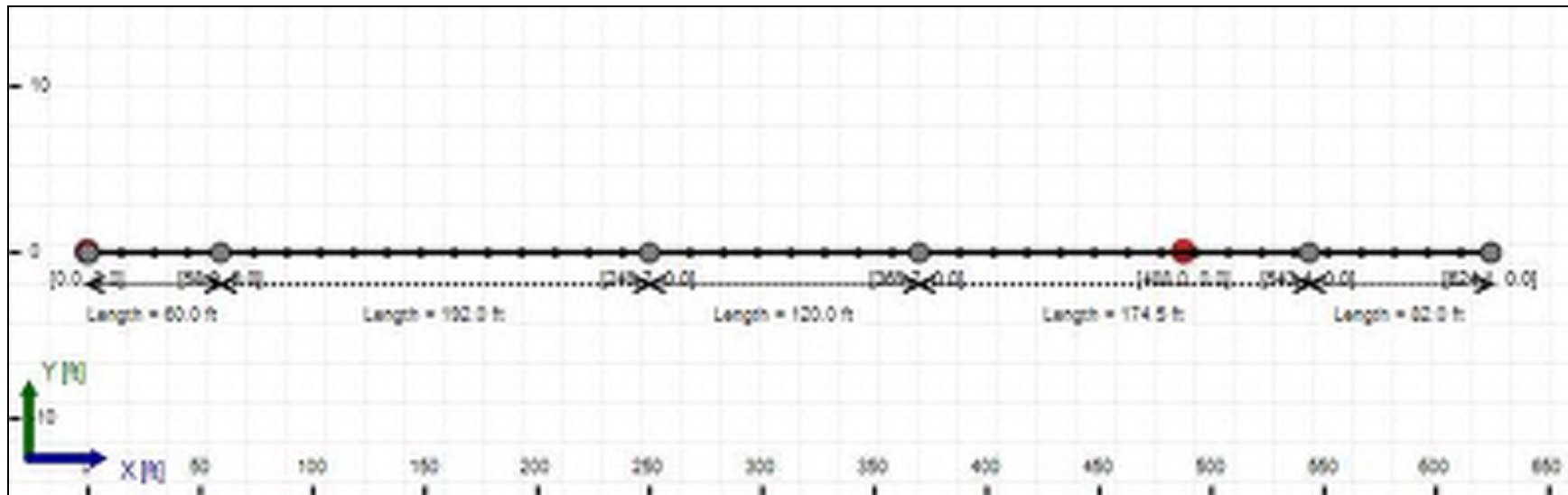
Unit Weight: 80.0000 (dry), 100.0000 (sat) [lb/ft3]

Phi: 0.00, S.M.: 50.00, Coh: 4.40 [psi]

## Bore Cross-Section View



## Bore Plan View



---

## Load Verifier Input Summary:

Pipe Application: Electrical Cable  
Pipe Type: HDPE  
Classification: IPS  
Pipe OD: 10" (10.75")  
Pipe DR: 9  
Pipe Length: 630.00 ft  
Internal Pressure: 0 psi  
Borehole Diameter: 1.34400002161662 ft  
Silo Width: 1.34400002161662 ft  
Surface Surcharge: 0 psi  
Short Term Modulus: 57500 psi  
Long Term Modulus: 28200 psi  
Short Term Poisson Ratio: 0.35  
Long Term Poisson Ratio: 0.45  
Pipe Unit Weight: 59.30500 lb/ft<sup>3</sup>  
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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>

---

### In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	4.0	12.2
Water Pressure	9.4	9.3
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	13.4	21.5
<b>Deflection</b>		
Earth Load Deflection	1.092	3.323
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.224	3.455
<b>Compressive Stress [psi]</b>		
Compressive Wall Stress	60.2	96.8

### Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	10712.4	10712.4
Pullback Stress [psi]	298.8	298.8
Pullback Strain	5.196E-3	5.196E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	298.8	323.6
Tensile Strain	5.196E-3	6.075E-3

Net External Pressure = 17.4 [psi ]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

---

### In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.224	7.5	6.1	OK
Unconstrained Collapse [psi]	19.4	123.8	6.4	OK
Compressive Wall Stress [psi]	60.2	1150.0	19.1	OK

### Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	29.3	237.8	8.1	OK
Tensile Stress [psi]	323.6	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	6.00 in	56.064 psi	54.649 psi
1	6.00 in	12.00 in	55.966 psi	54.529 psi
2	12.00 in	16.13 in	55.861 psi	54.401 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/ft<sup>3</sup>

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

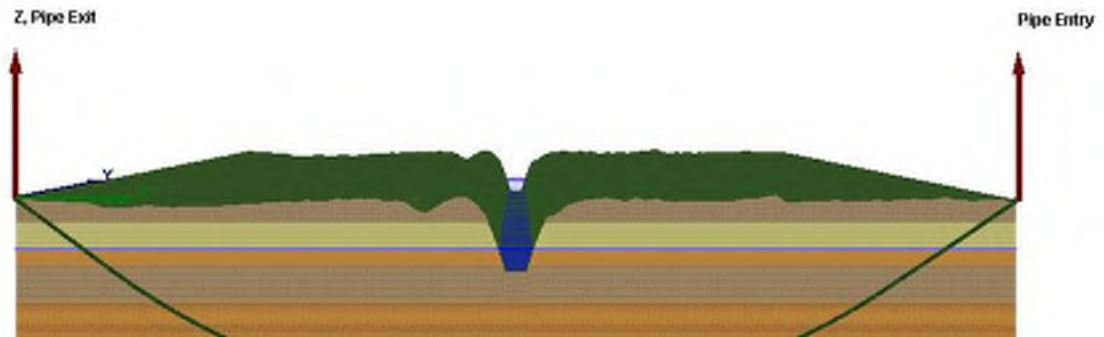
Yield Point (YP): 16.49

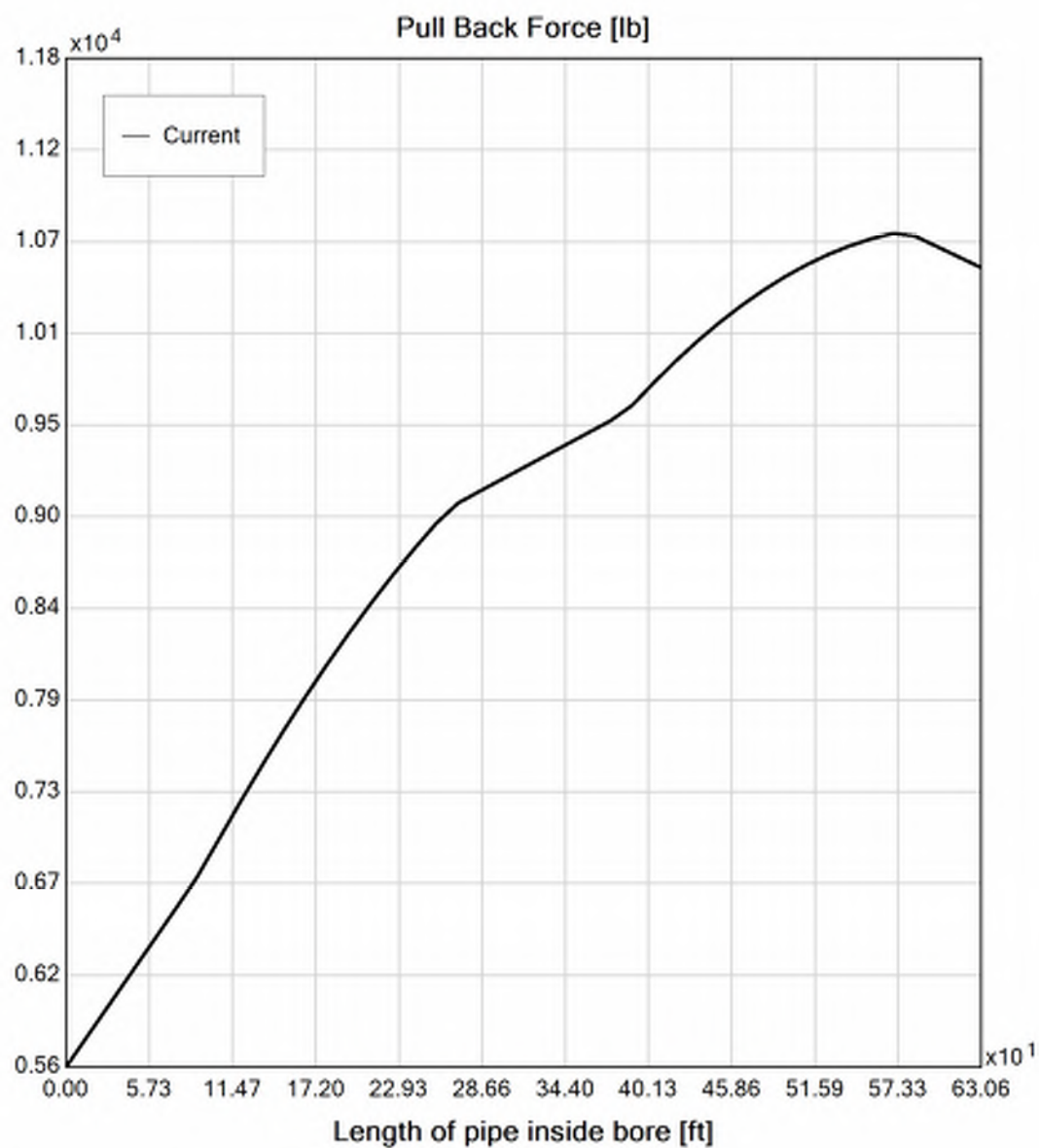
Effective Viscosity (cP): 625.4

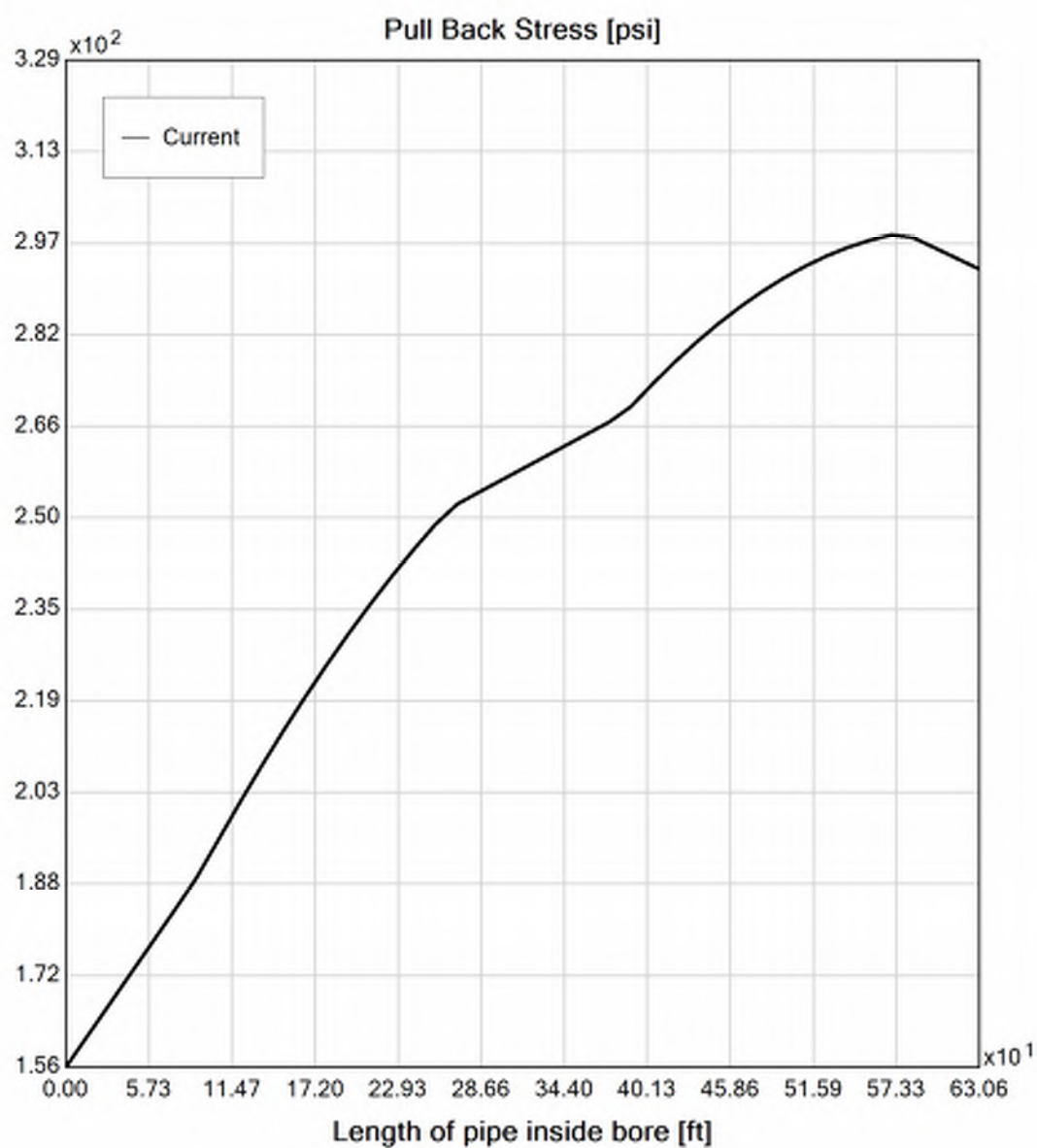


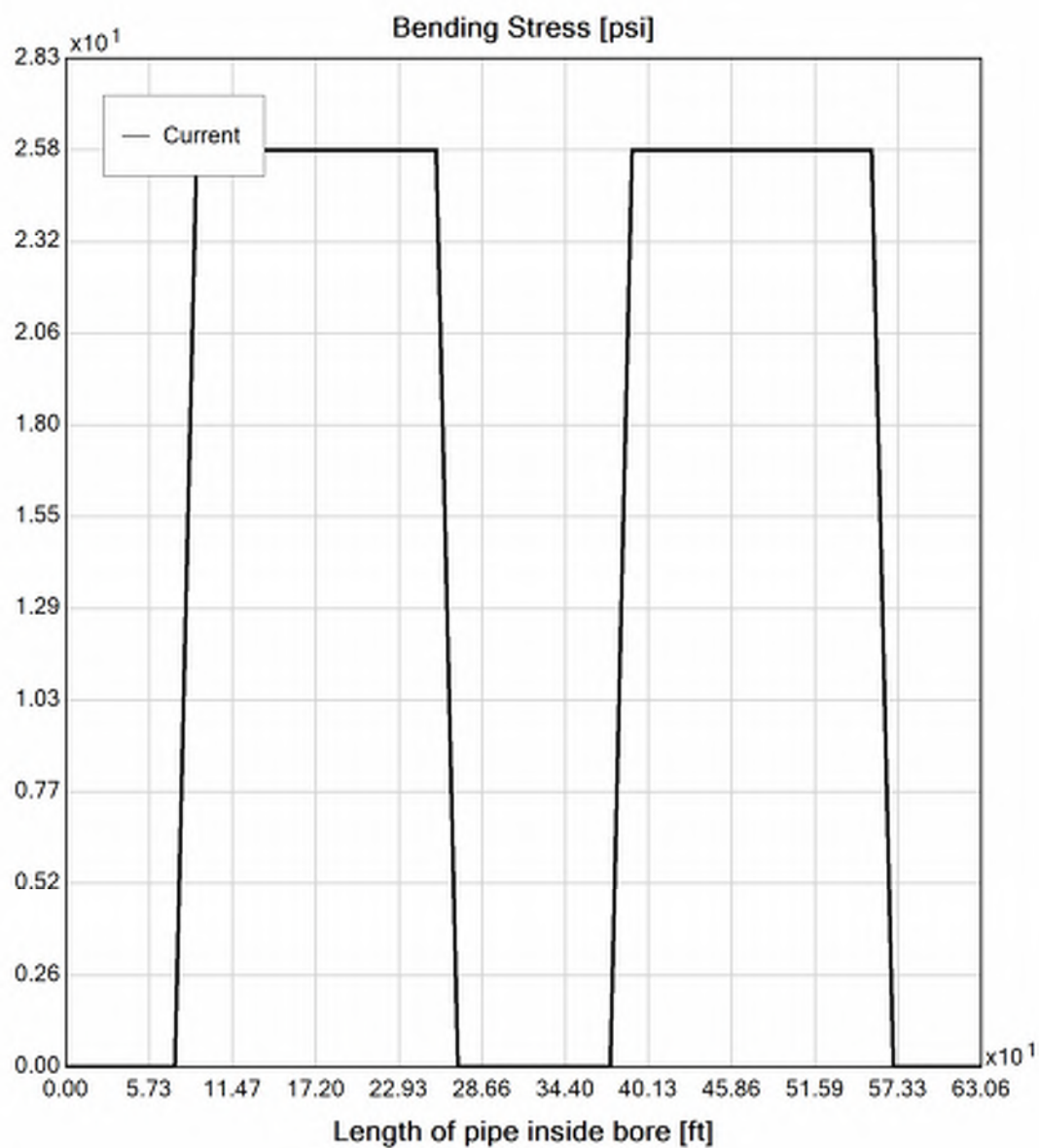
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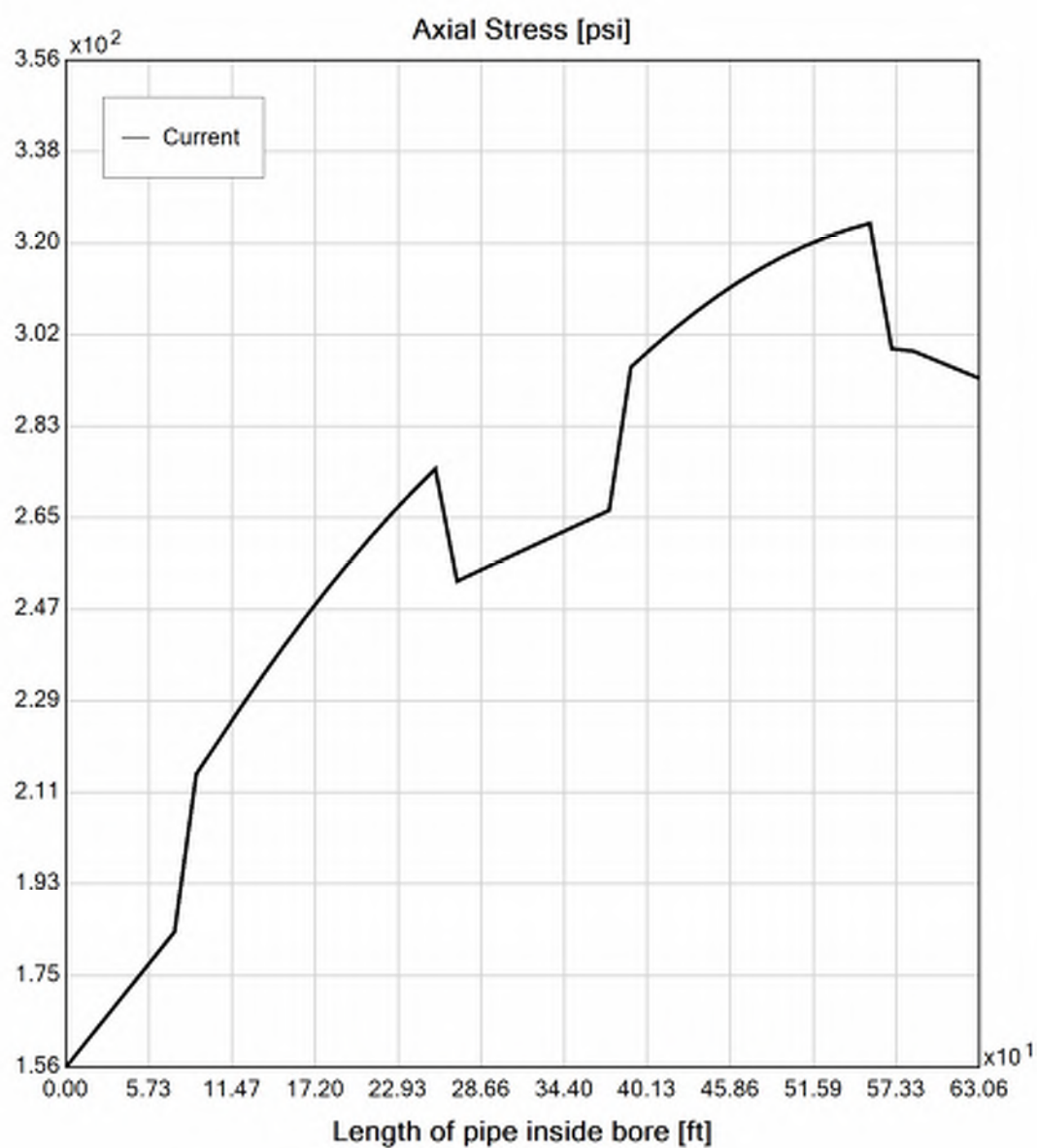
## Virtual Site

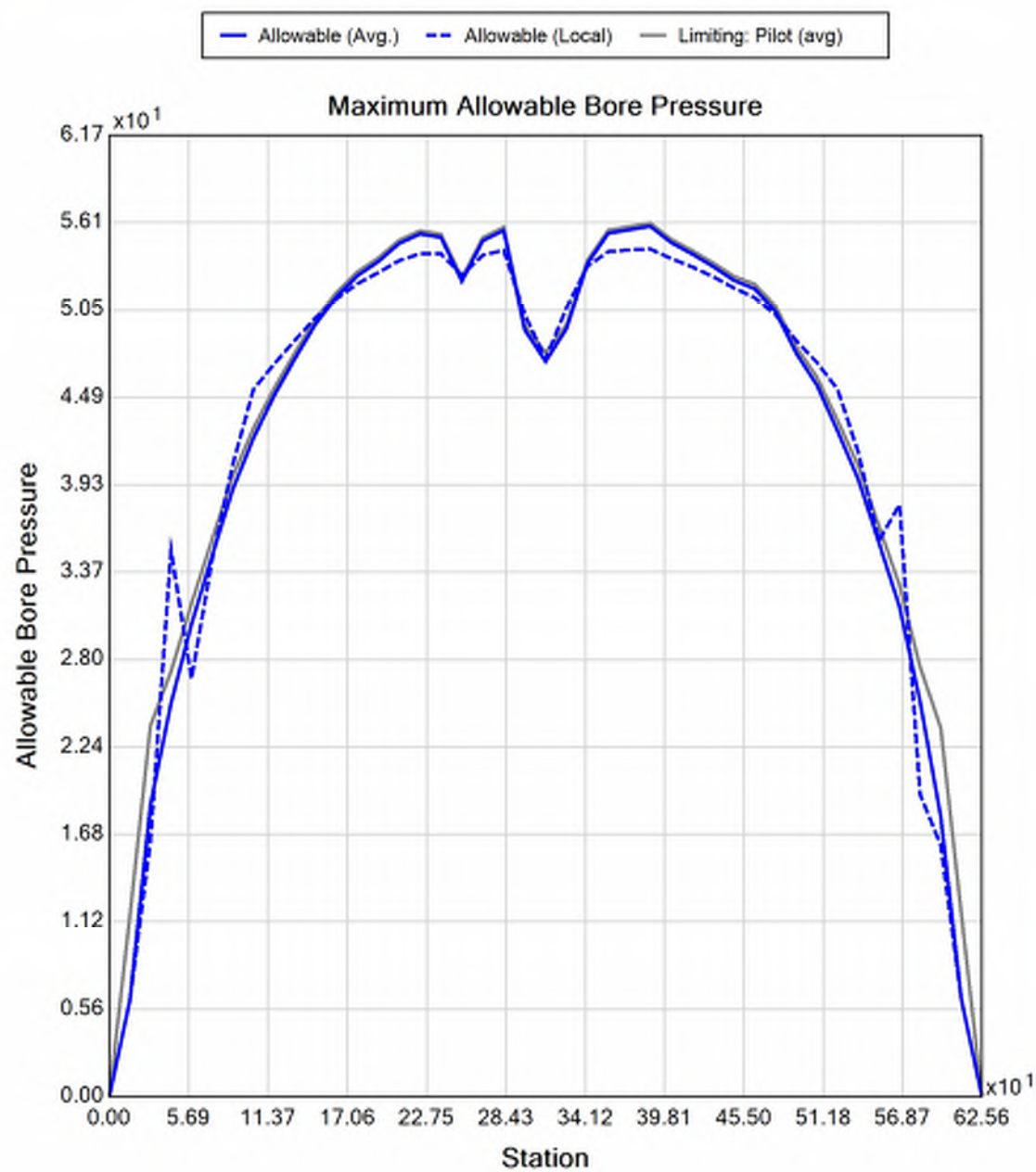


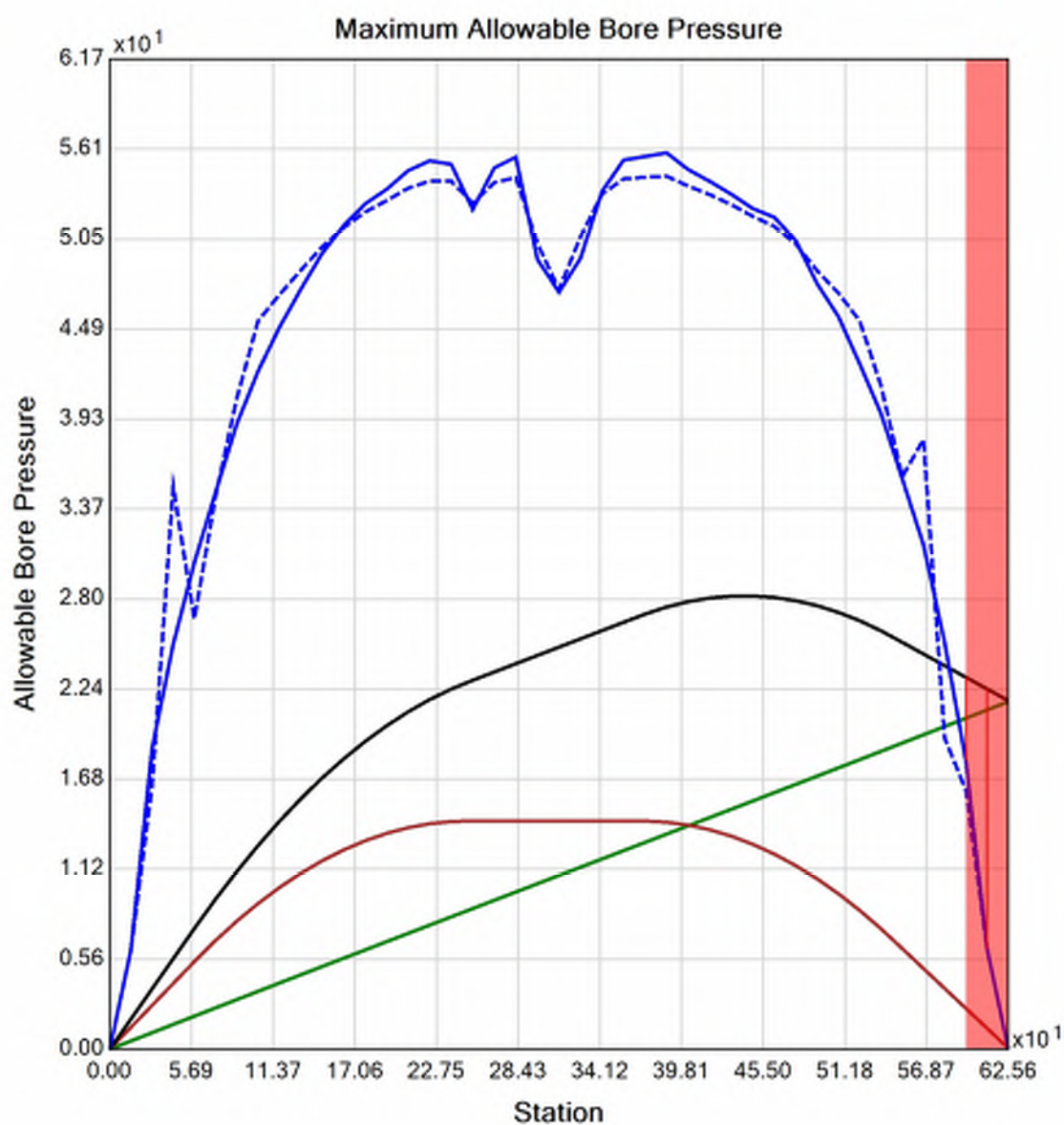














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## Input Summary

Start Coordinate	(0.00, 0.00, 131.91) ft
End Coordinate	(624.18, 0.00, 131.59) ft
Project Length	624.18 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/ft<sup>3</sup>  
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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>

---

### In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	1.8	12.2
Water Pressure	9.4	9.3
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	11.2	21.5
<b>Deflection</b>		
Earth Load Deflection	0.538	3.323
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	0.567	3.352
<b>Compressive Stress [psi]</b>		
Compressive Wall Stress	50.4	96.8

### Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	632.5	632.5
Pullback Stress [psi]	361.4	361.4
Pullback Strain	6.285E-3	6.285E-3
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	361.4	366.1
Tensile Strain	6.285E-3	6.466E-3

Net External Pressure = 17.4 [psi ]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

---

### In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.567	7.5	13.2	OK
Unconstrained Collapse [psi]	19.4	131.7	6.8	OK
Compressive Wall Stress [psi]	50.4	1150.0	22.8	OK

### Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	29.3	236.2	8.0	OK
Tensile Stress [psi]	366.1	1200.0	3.3	OK



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## Project Summary

General: CHPE HDD 16 - Conduit 1  
P2  
Start Date: 02-28-2022  
End Date: 02-28-2022

Project Owner: TDI  
Project Contractor: Kiewit  
Project Consultant: CHA/BCE

Designer:  
Description: CHPE HDD 16 Conduit 1 10-inch DR 9

---

## 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/ft<sup>3</sup>]

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/ft<sup>3</sup>]

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/ft<sup>3</sup>]

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/ft<sup>3</sup>]

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

Soil Layer #5 USCS, Clay (C), CH

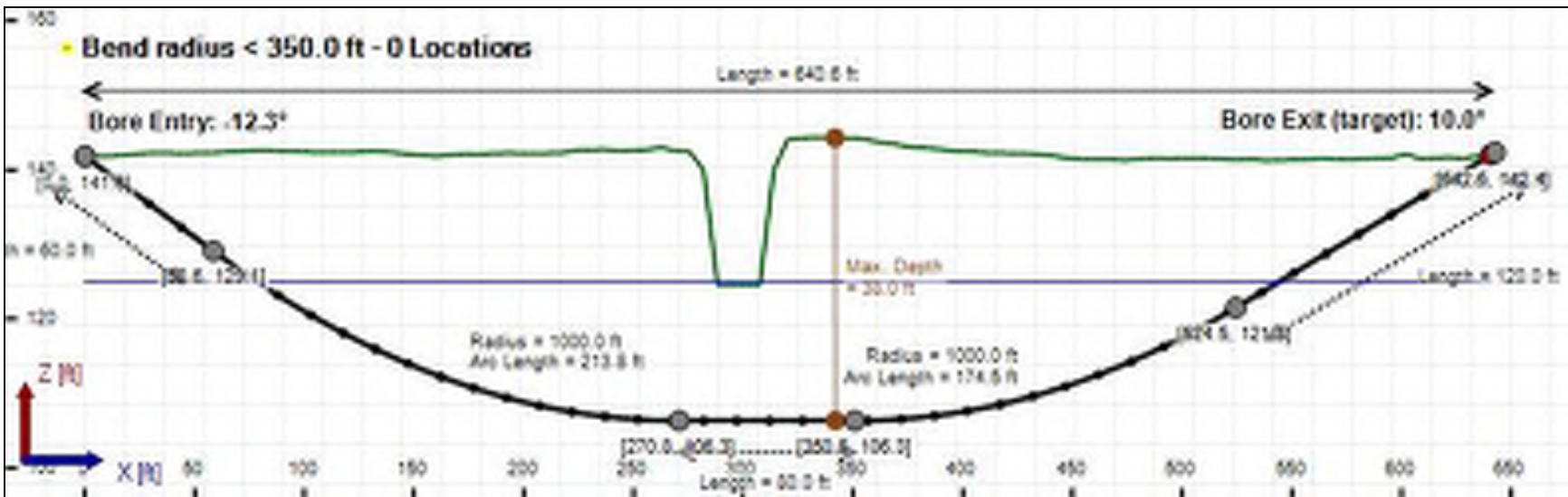
Depth: 24.00 ft

Unit Weight: 70.0000 (dry), 100.0000 (sat) [lb/ft<sup>3</sup>]

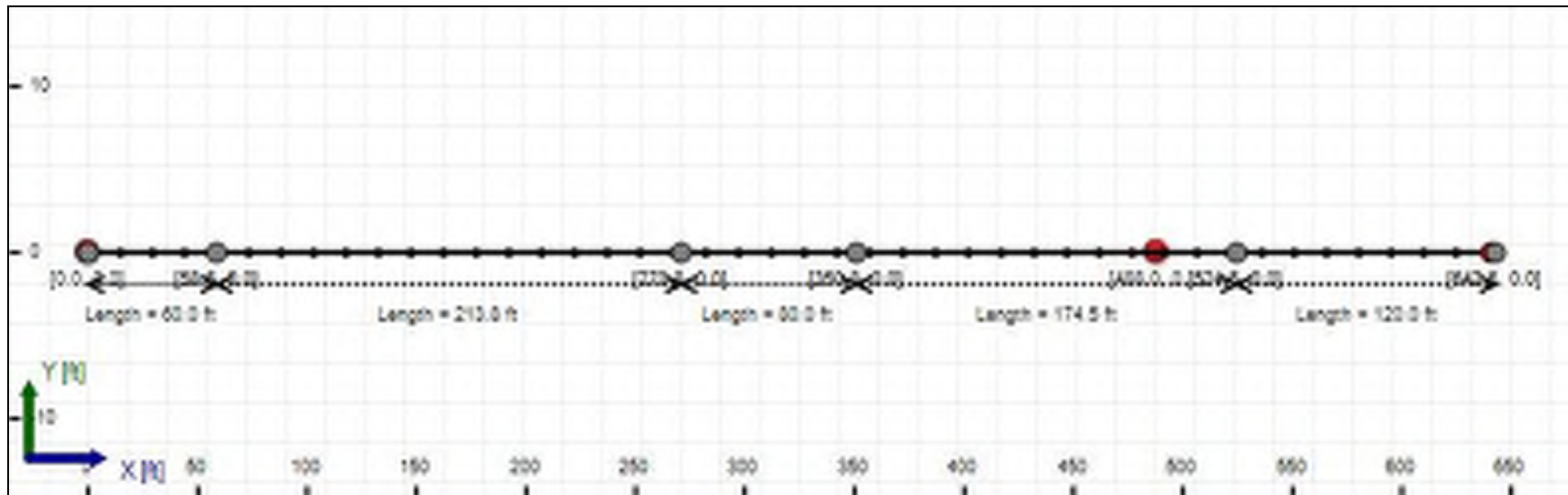
Phi: 0.00, S.M.: 145.00, Coh: 8.70 [psi]



### Bore Cross-Section View



## Bore Plan View



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## Load Verifier Input Summary:

Pipe Application: Electrical Cable  
Pipe Type: HDPE  
Classification: IPS  
Pipe OD: 10" (10.75")  
Pipe DR: 9  
Pipe Length: 660.00 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/ft<sup>3</sup>  
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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>

---

### In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	5.4	19.0
Water Pressure	8.1	8.1
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	13.5	27.0
<b>Deflection</b>		
Earth Load Deflection	1.468	5.161
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.600	5.293
<b>Compressive Stress [psi]</b>		
Compressive Wall Stress	60.7	121.7

### Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	11591.3	11591.3
Pullback Stress [psi]	323.3	323.3
Pullback Strain	5.622E-3	5.622E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	323.3	348.3
Tensile Strain	5.622E-3	6.505E-3

Net External Pressure = 19.9 [psi ]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

---

### In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.600	7.5	4.7	OK
Unconstrained Collapse [psi]	24.7	119.6	4.8	OK
Compressive Wall Stress [psi]	60.7	1150.0	19.0	OK

### Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	34.7	236.6	6.8	OK
Tensile Stress [psi]	348.3	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	70.697 psi	64.078 psi
1	8.00 in	12.00 in	70.650 psi	63.681 psi
2	12.00 in	16.13 in	70.581 psi	63.120 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): 20.00 US (liquid) gallon/min

Drill Fluid Density: 68.700 lb/ft<sup>3</sup>

Rheological model: Bingham-Plastic

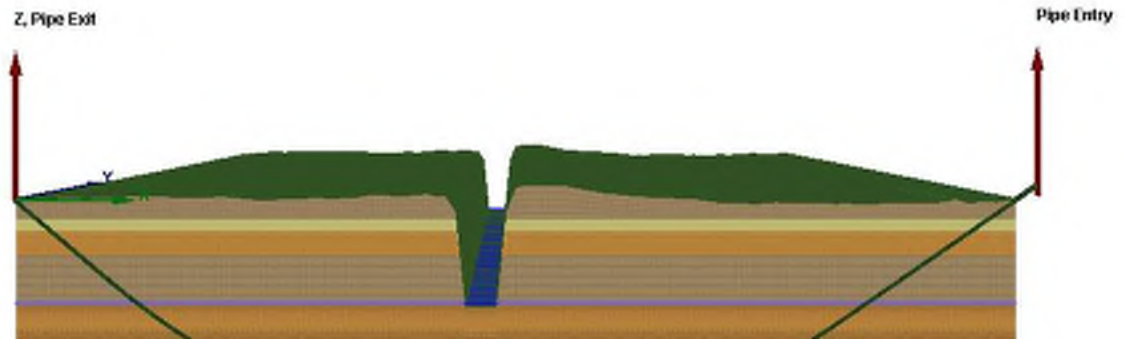
Plastic Viscosity (PV): 25.53

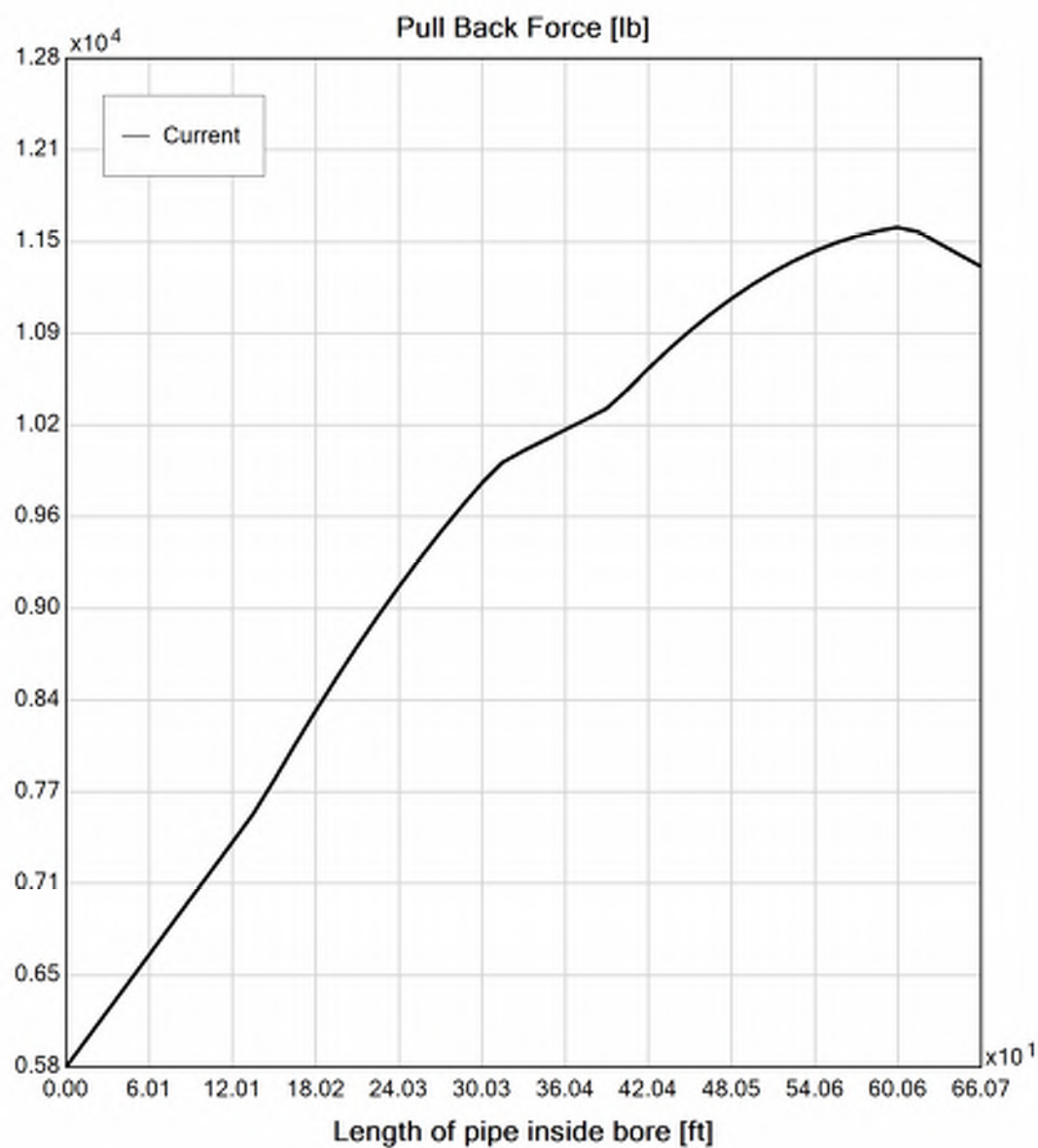
Yield Point (YP): 16.49

Effective Viscosity (cP): 2378.4

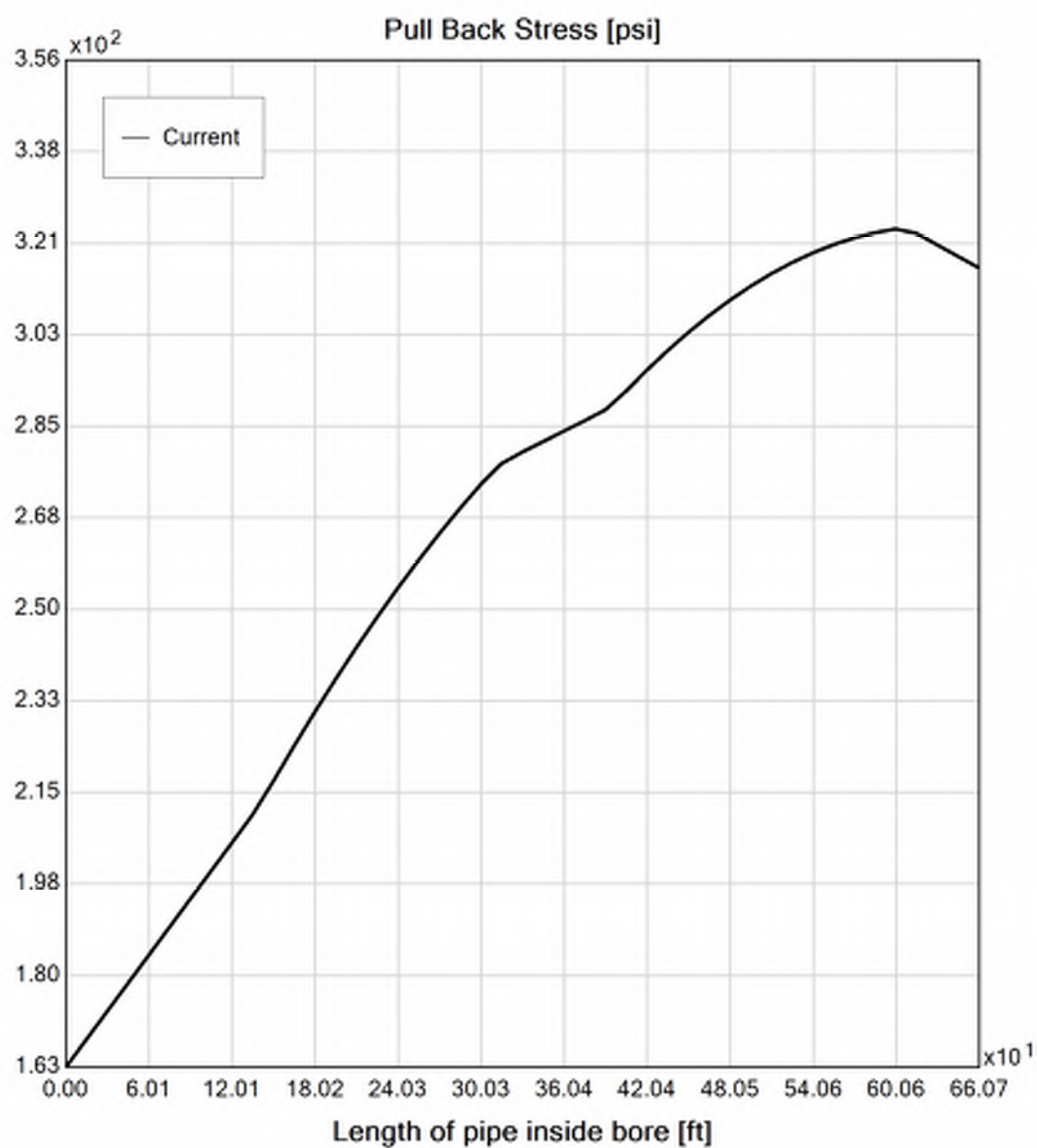
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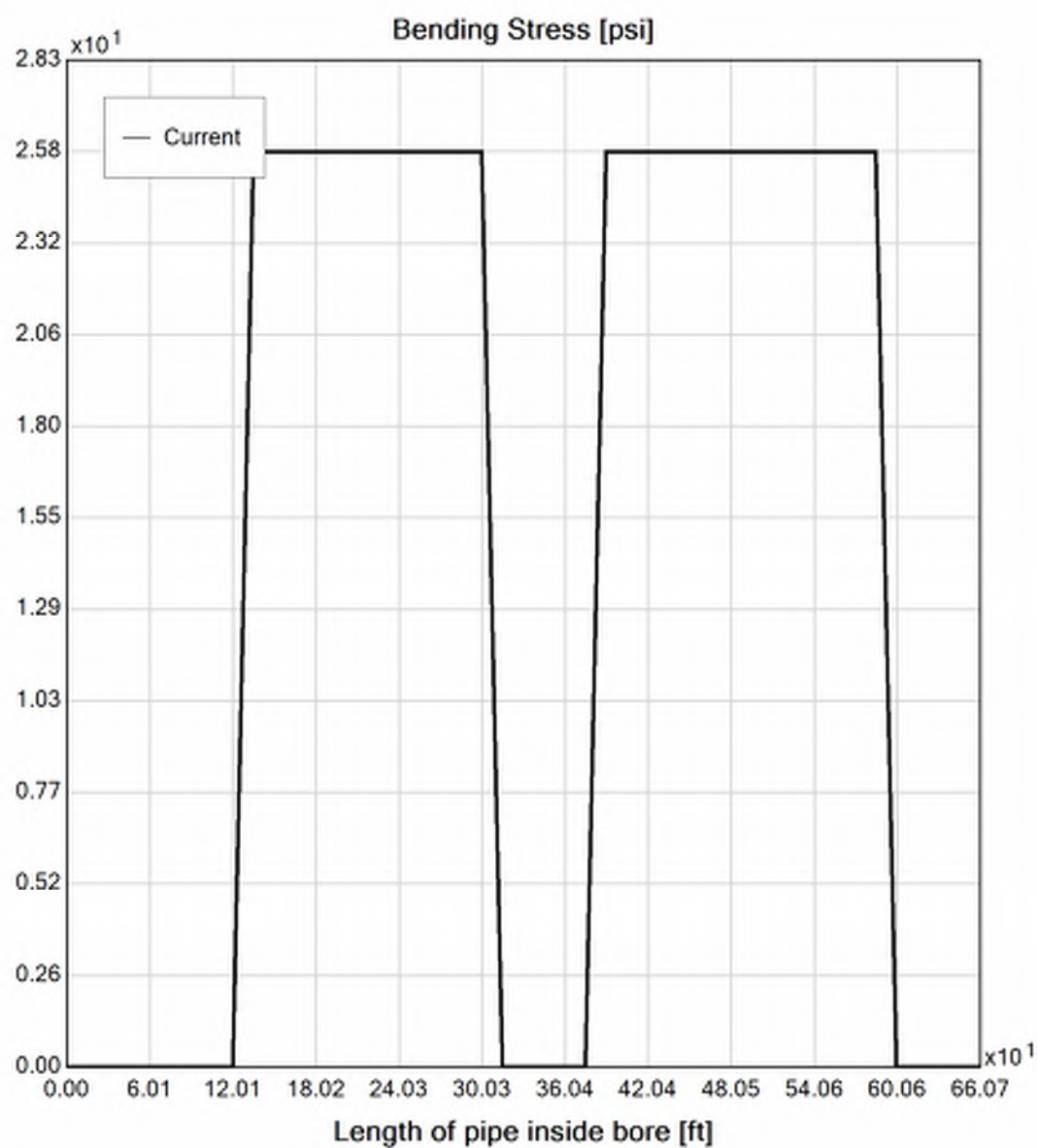
## Virtual Site

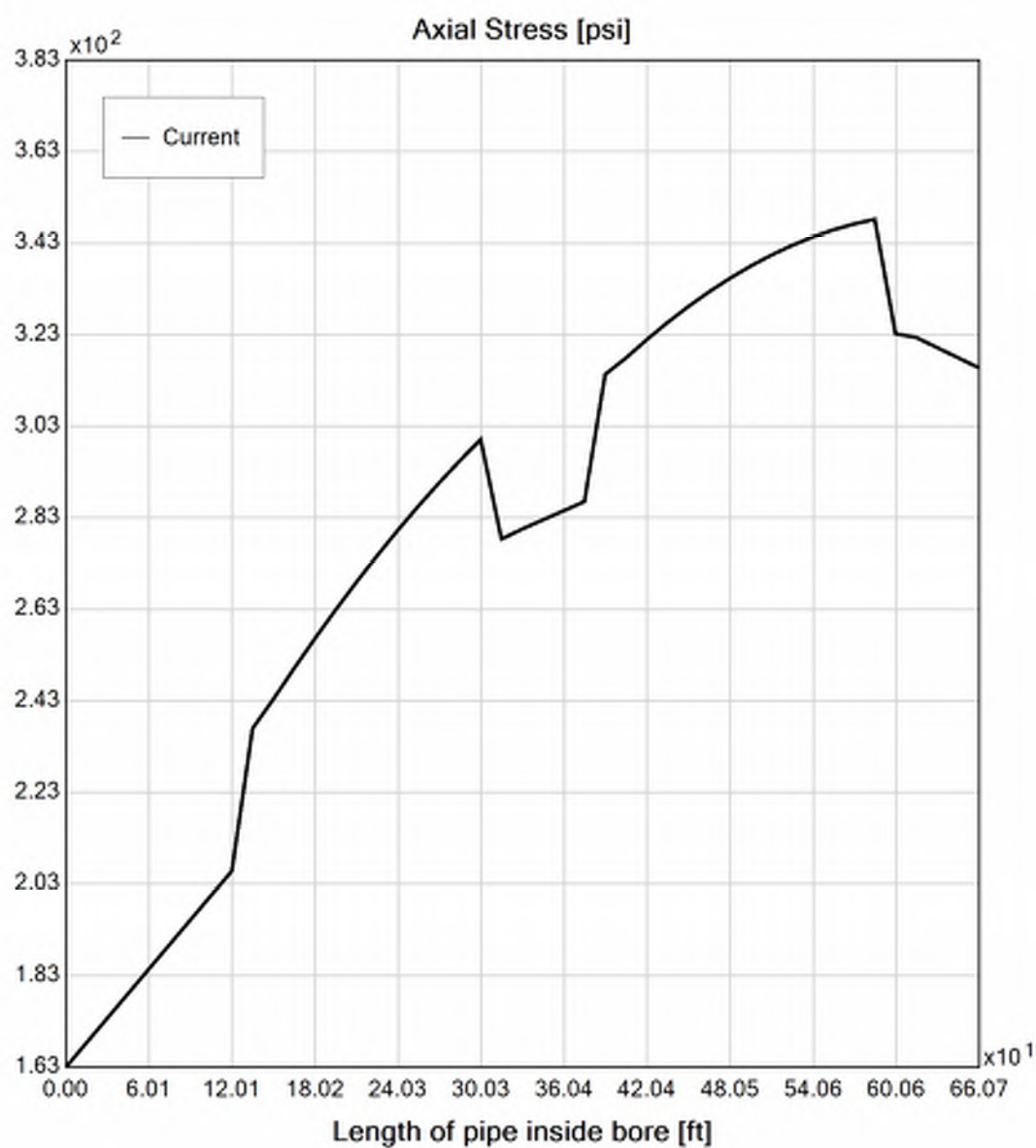


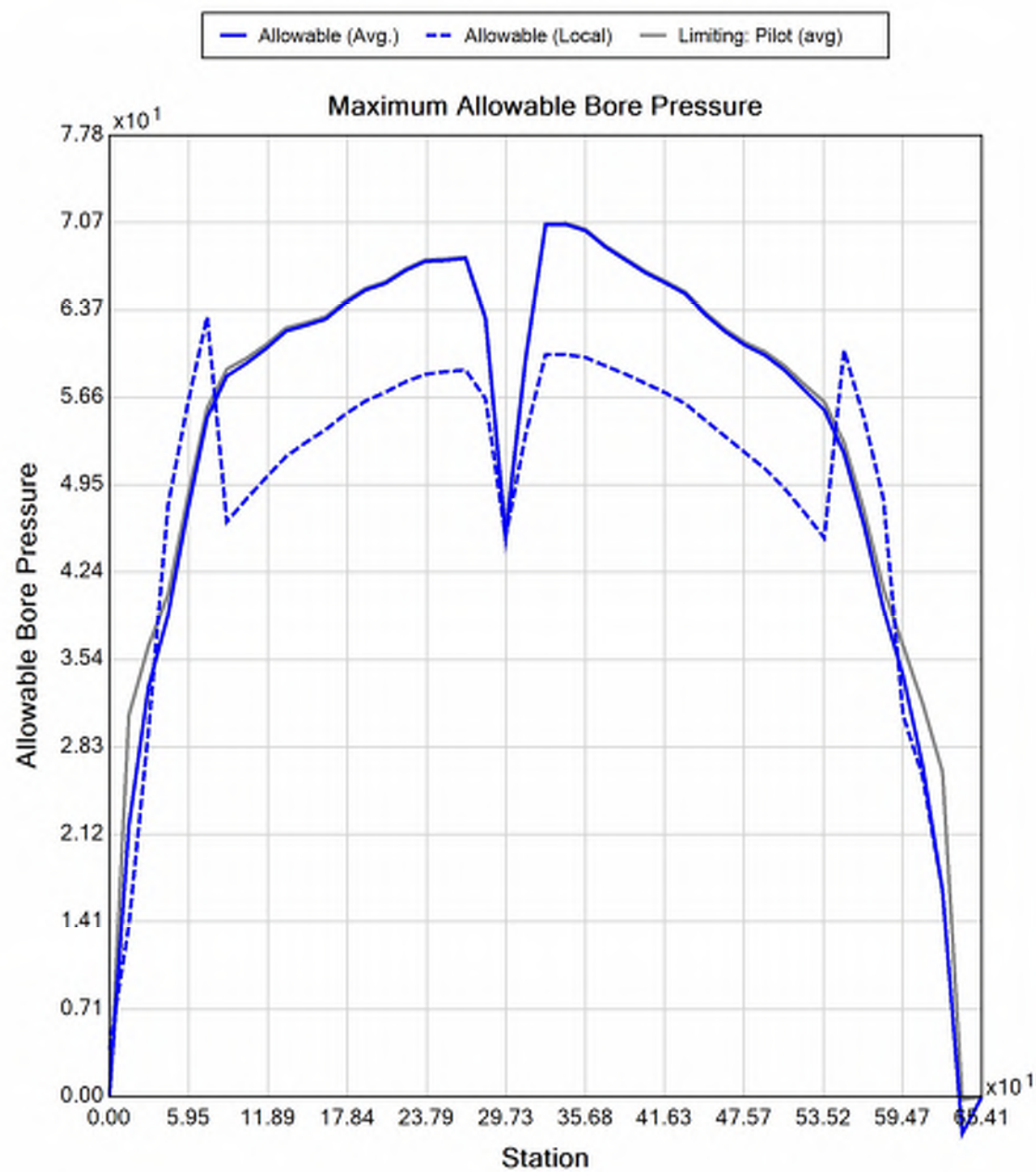




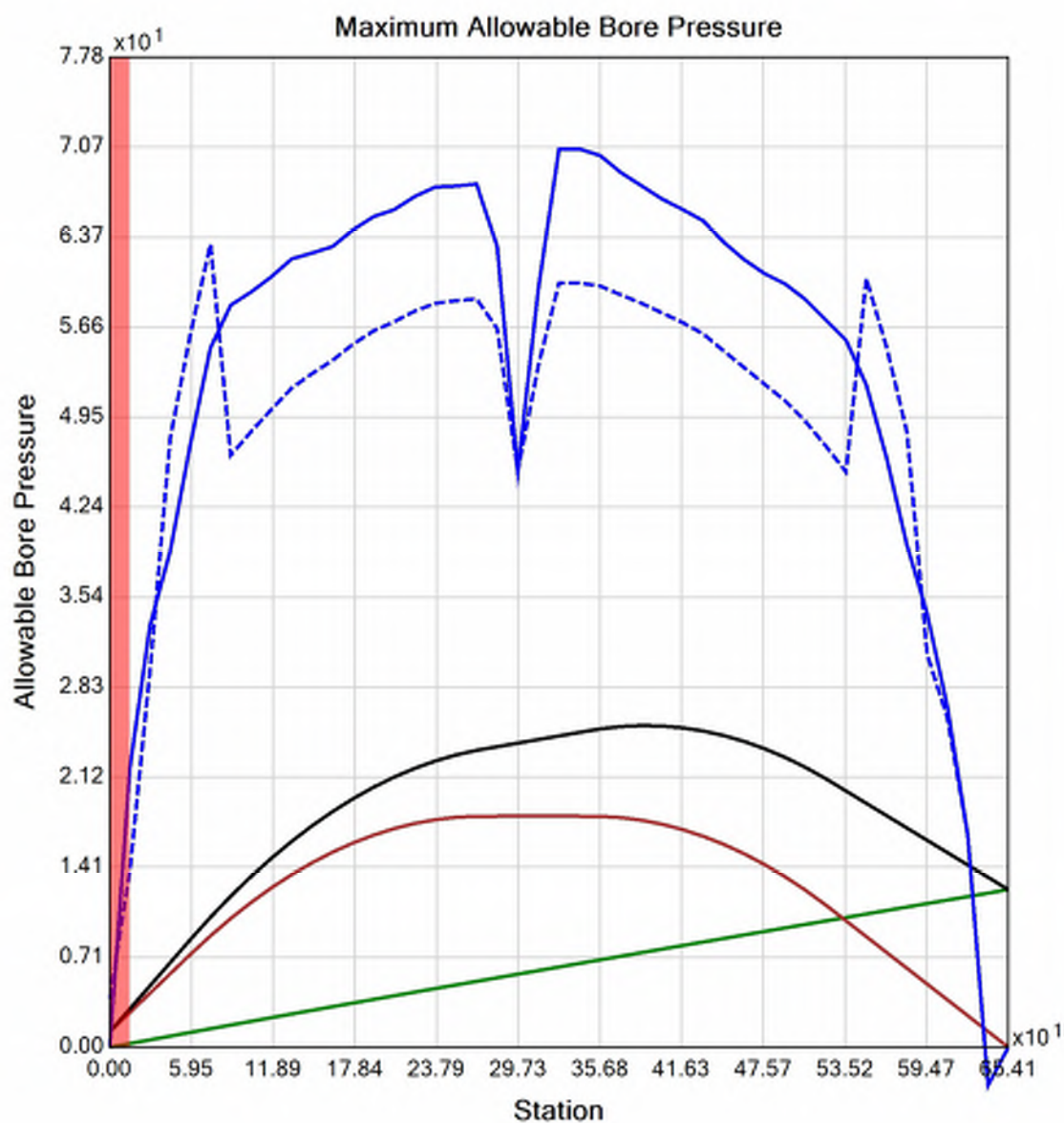








— Allowable (Avg.) 
 - - - Allowable (Local) 
 — Friction Loss 
 — Static 
 — Circulating 
 ||||| Potential Hydrofracture Locations





## Generated Output



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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/ft<sup>3</sup>  
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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>



---

### 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
<b>Deflection</b>		
Earth Load Deflection	1.291	5.161
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	1.320	5.190
<b>Compressive Stress [psi]</b>		
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



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## Project Summary

General: CHPE HDD 16 - Conduit 2  
P2  
Start Date: 02-28-2022  
End Date: 02-28-2022

Project Owner: TDI  
Project Contractor: Kiewit  
Project Consultant: CHA/BCE

Designer:  
Description: CHPE HDD 16 Conduit 2 10-inch DR 9

---

## 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]

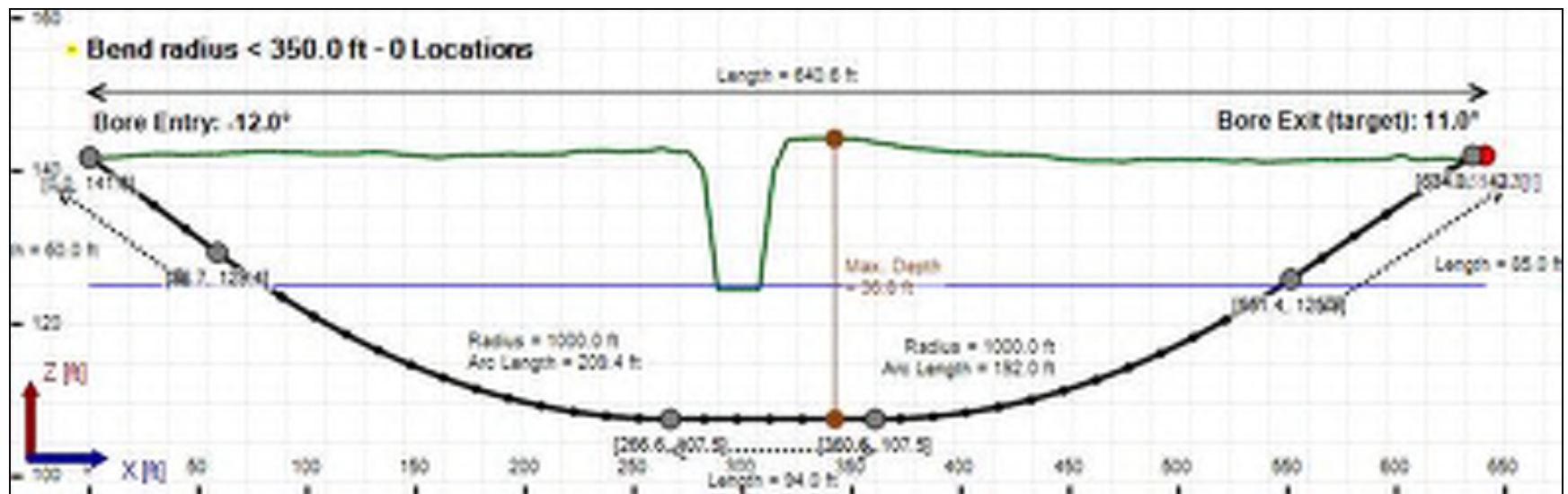
Soil Layer #5 USCS, Clay (C), CH

Depth: 24.00 ft

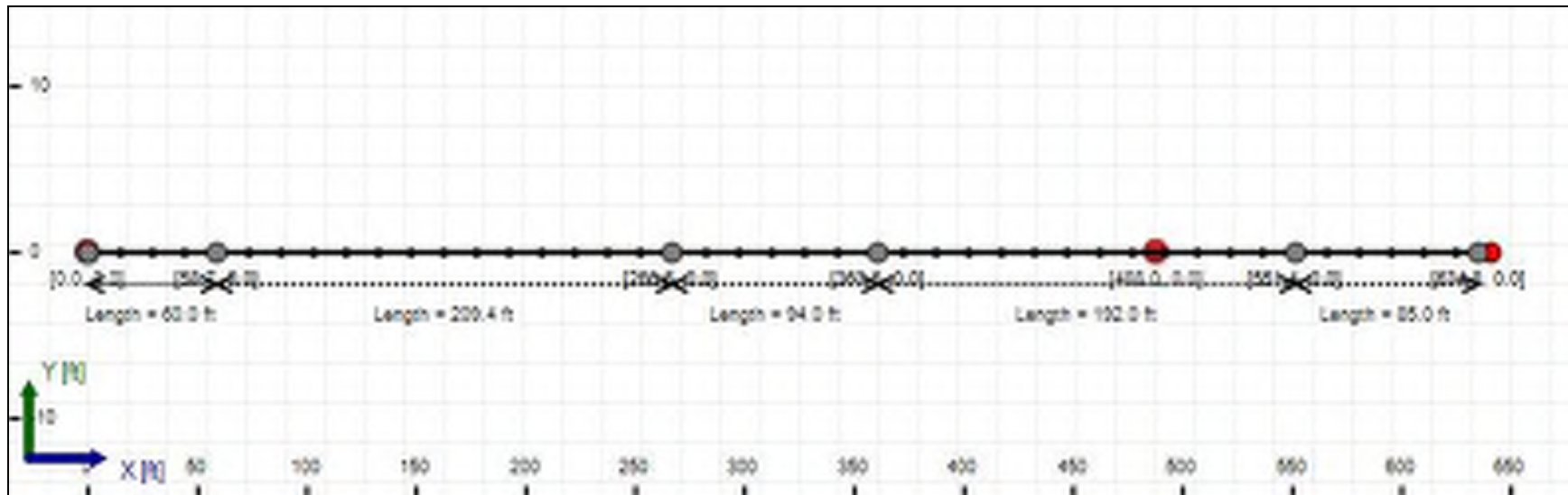
Unit Weight: 70.0000 (dry), 100.0000 (sat) [lb/ft3]

Phi: 0.00, S.M.: 145.00, Coh: 8.70 [psi]

## Bore Cross-Section View



## Bore Plan View





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## 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/ft<sup>3</sup>  
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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>

---

### 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
<b>Deflection</b>		
Earth Load Deflection	1.438	5.078
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.570	5.210
<b>Compressive Stress [psi]</b>		
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/ft<sup>3</sup>

Rheological model: Bingham-Plastic

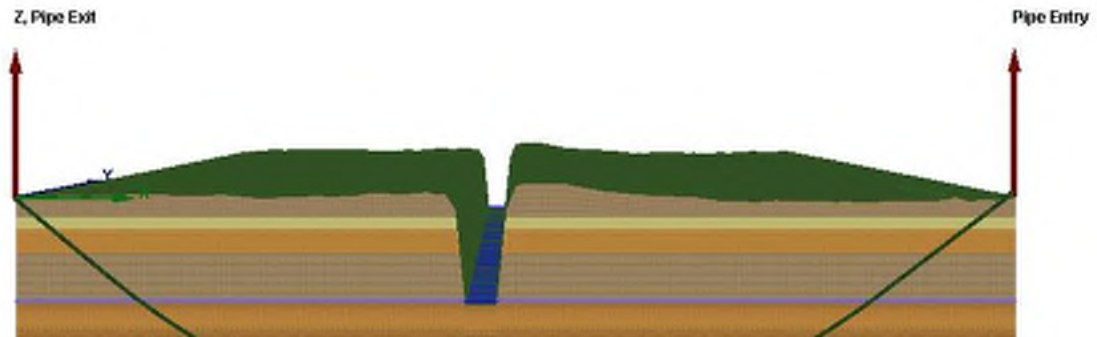
Plastic Viscosity (PV): 25.53

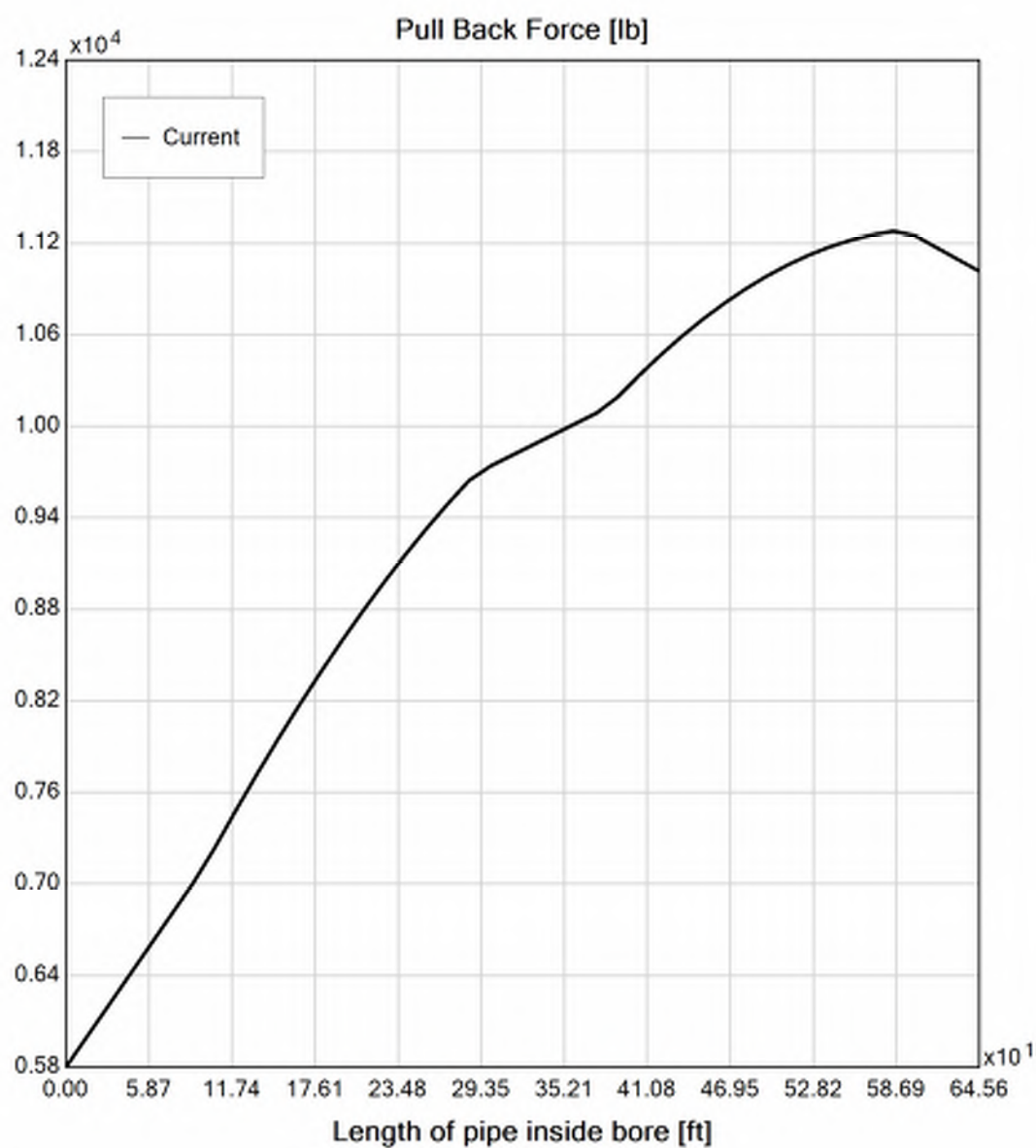
Yield Point (YP): 16.49

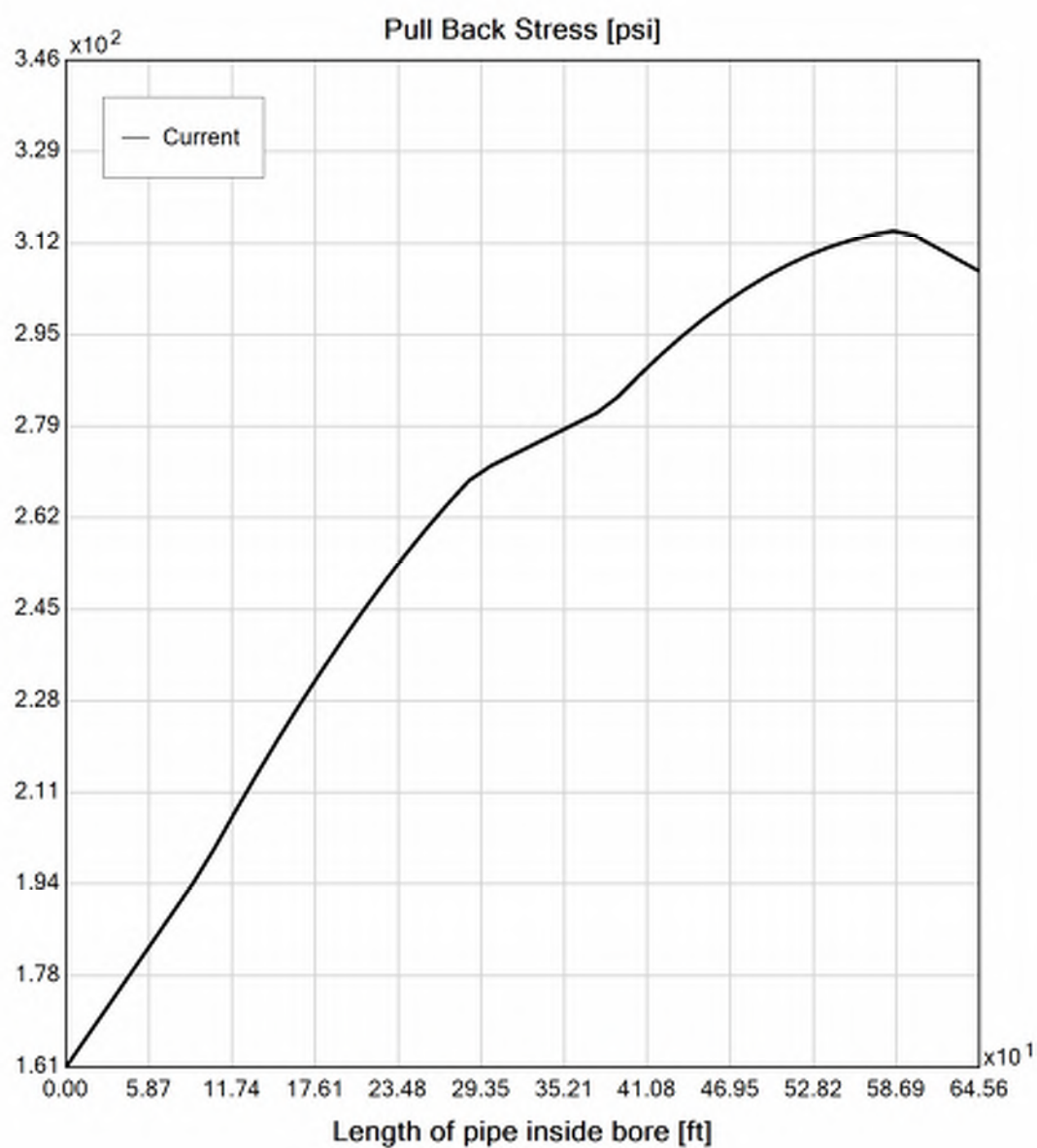
Effective Viscosity (cP): 2378.4

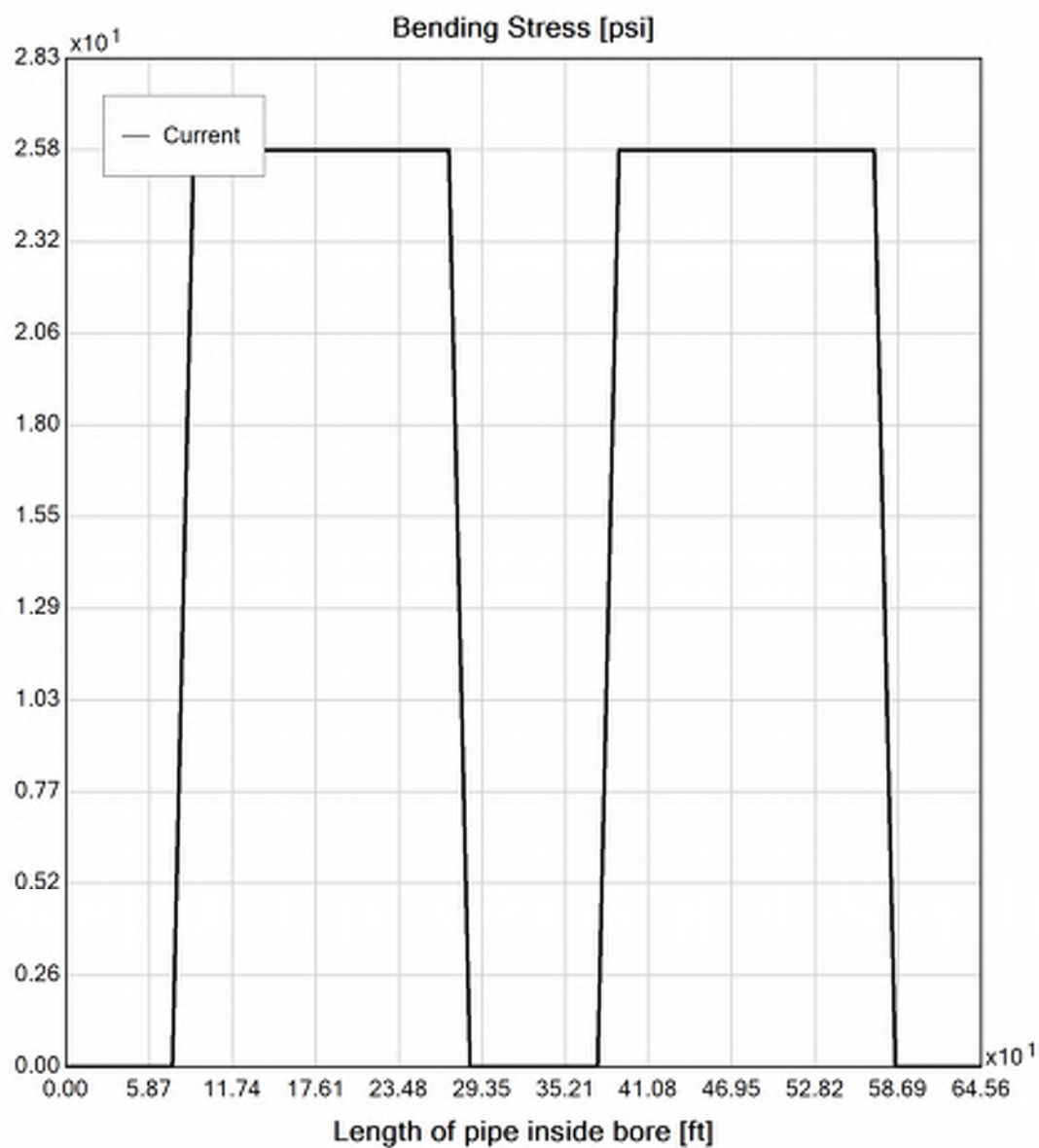
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## Virtual Site

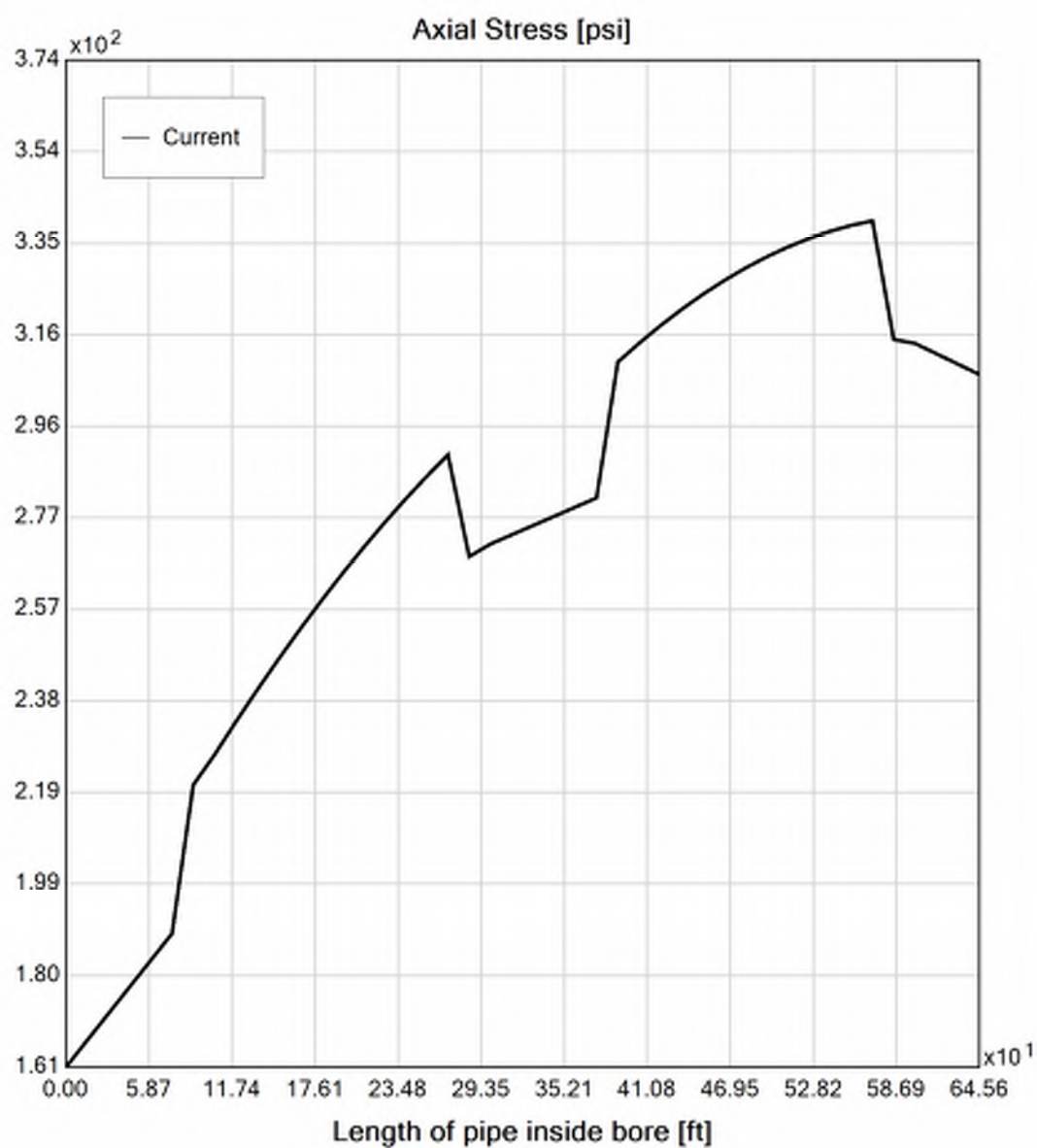


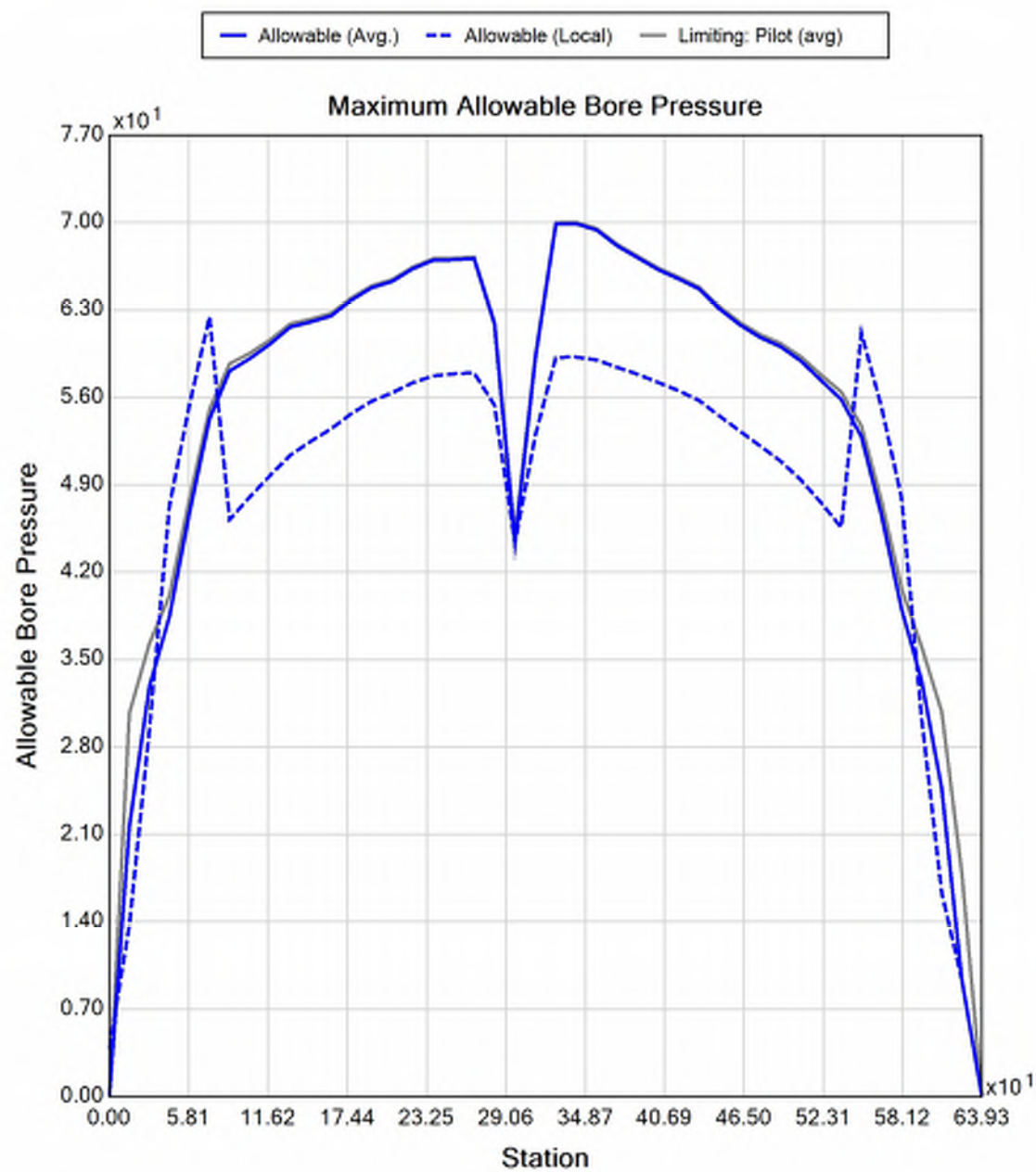


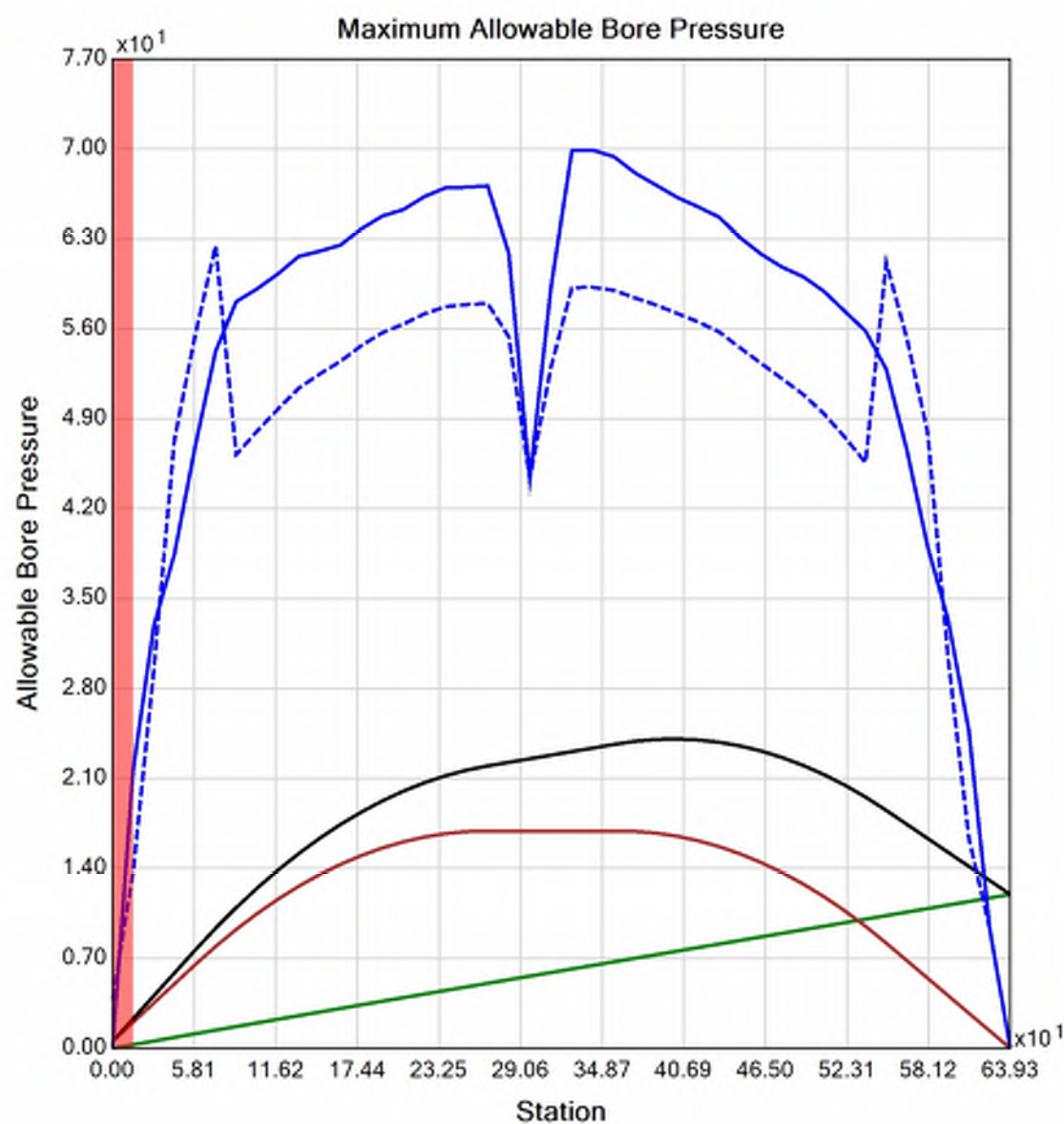














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## Input Summary

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/ft<sup>3</sup>  
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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>

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### 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
<b>Deflection</b>		
Earth Load Deflection	1.208	5.078
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	1.237	5.107
<b>Compressive Stress [psi]</b>		
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

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### 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: CHPE HDD 17 - Conduit 1  
P2  
Start Date: 06-17-2022  
End Date: 06-17-2022

Project Owner: TDI  
Project Contractor: Kiewit  
Project Consultant: CHA/BCE

Designer:  
Description: CHPE HDD 17 Conduit 1 10-inch DR 9

---

## 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]

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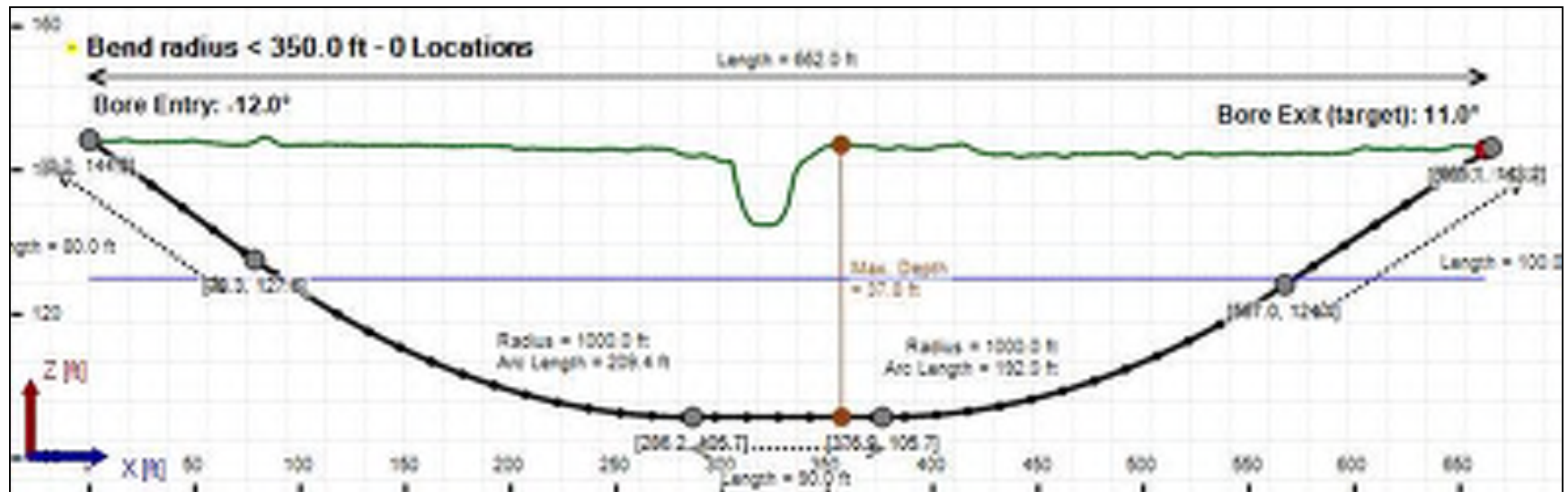
Soil Layer #7 USCS, Clay (C), CL

Depth: 10.00 ft

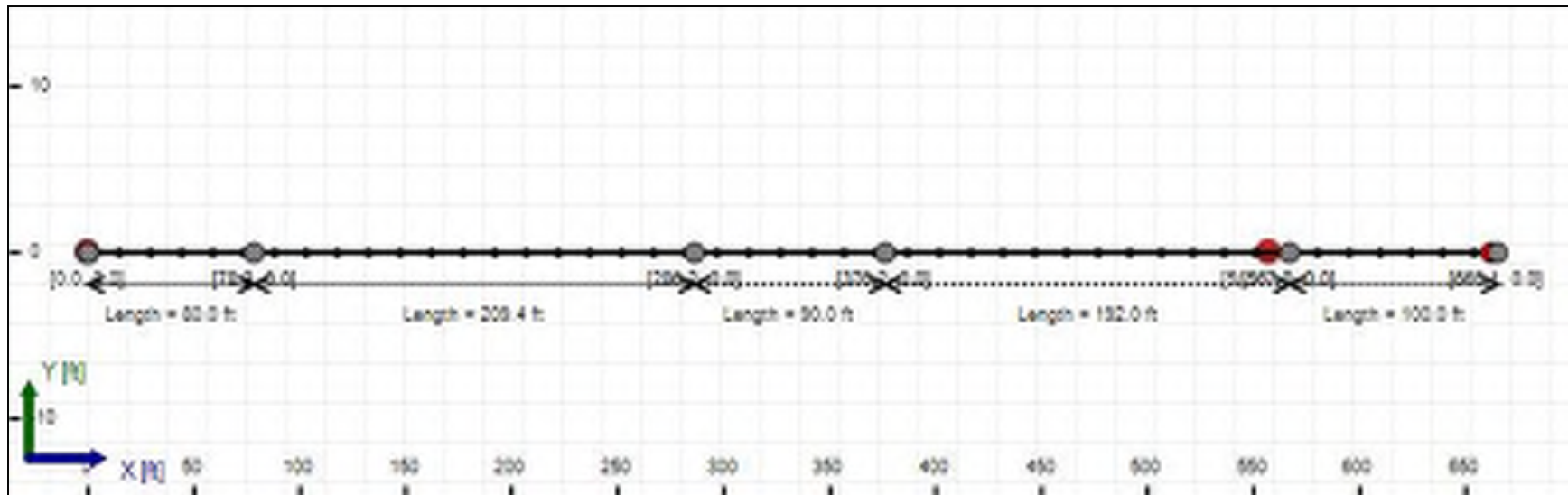
Unit Weight: 100.0000 (dry), 120.0000 (sat) [lb/ft<sup>3</sup>]

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/ft<sup>3</sup>  
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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>



---

### 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
<b>Deflection</b>		
Earth Load Deflection	3.783	5.644
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	3.915	5.776
<b>Compressive Stress [psi]</b>		
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/ft<sup>3</sup>

Rheological model: Bingham-Plastic

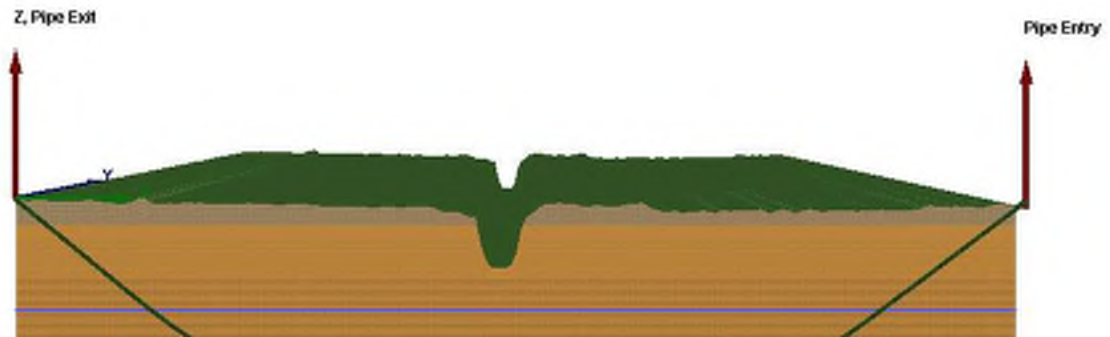
Plastic Viscosity (PV): 25.53

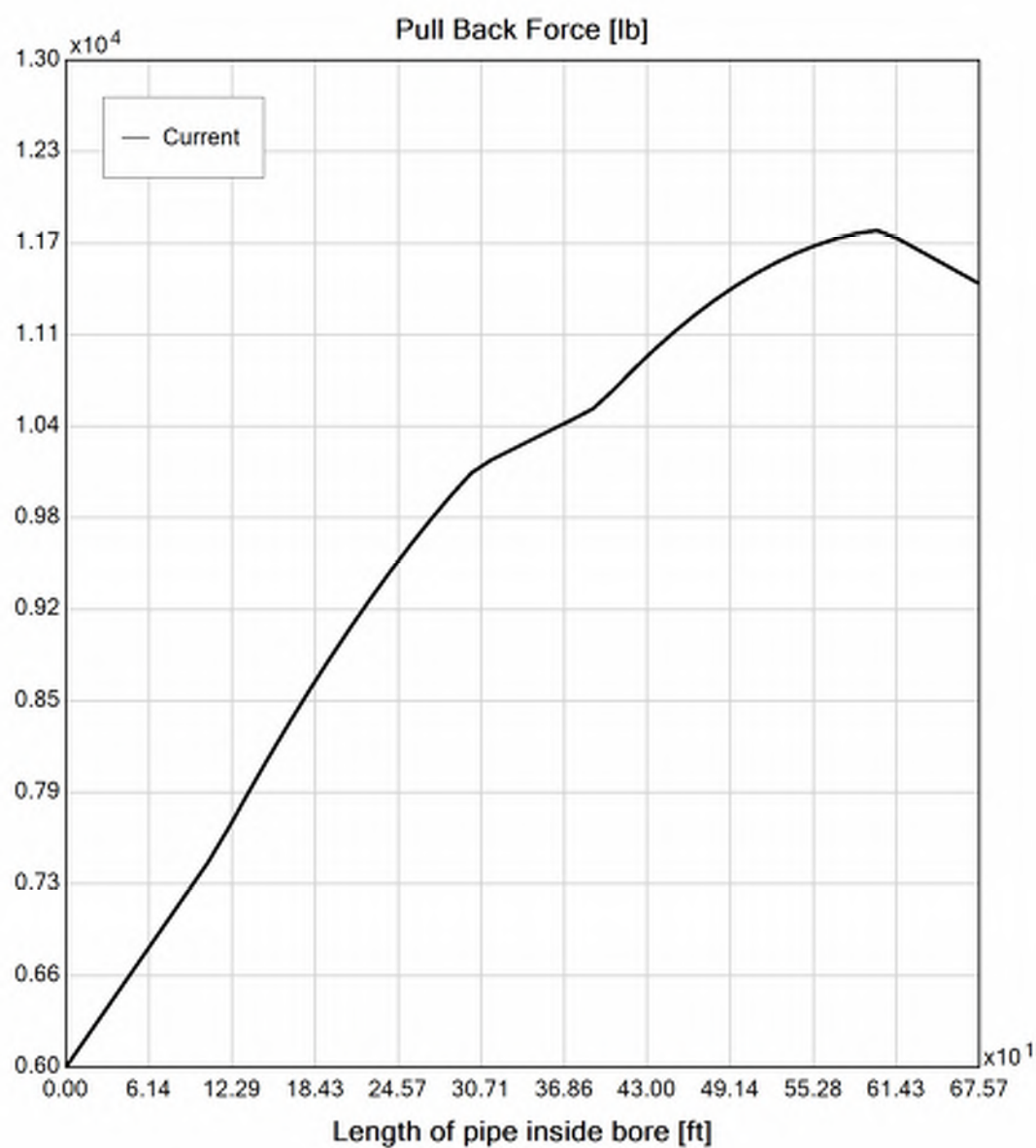
Yield Point (YP): 16.49

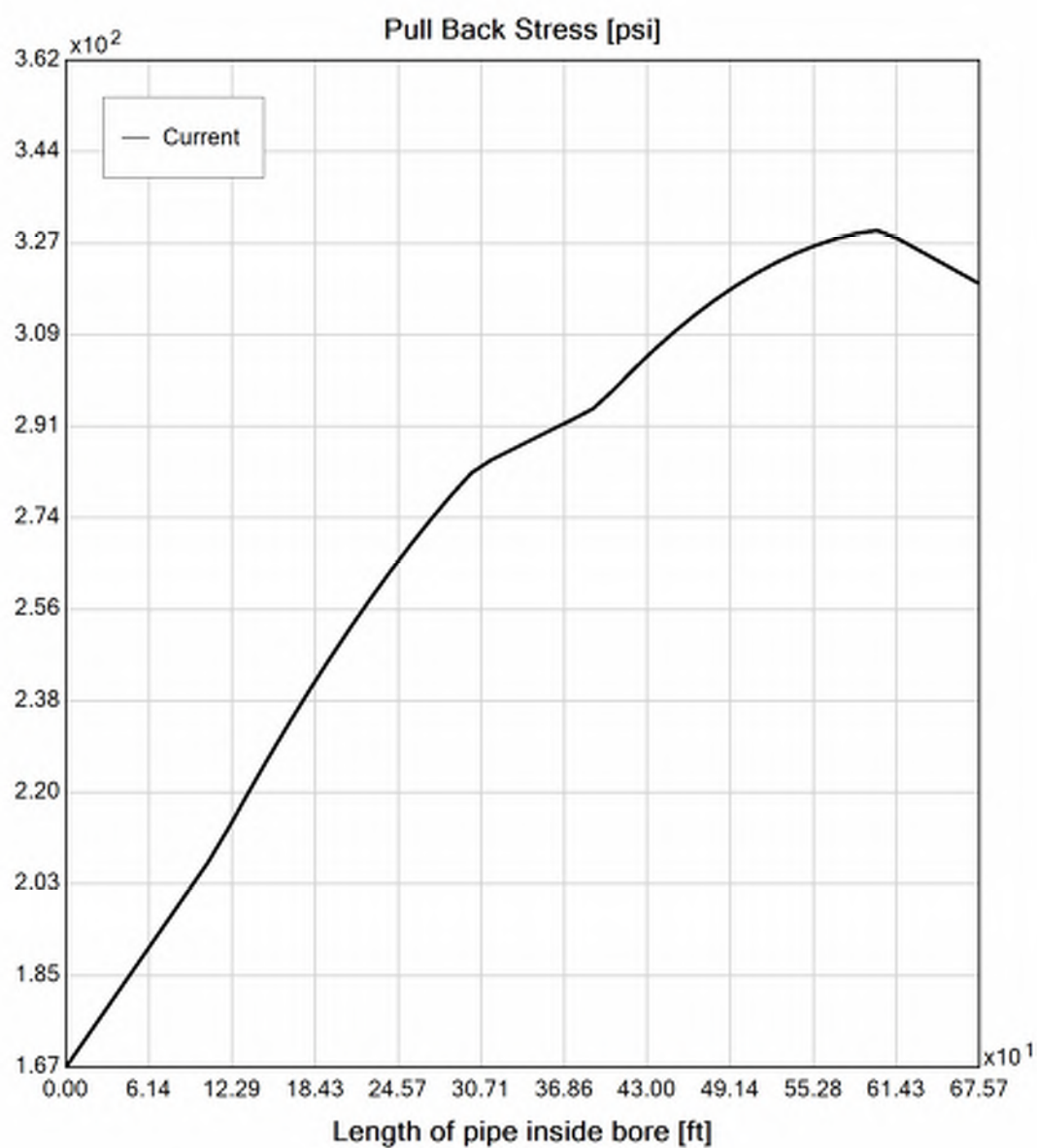
Effective Viscosity (cP): 1202.0

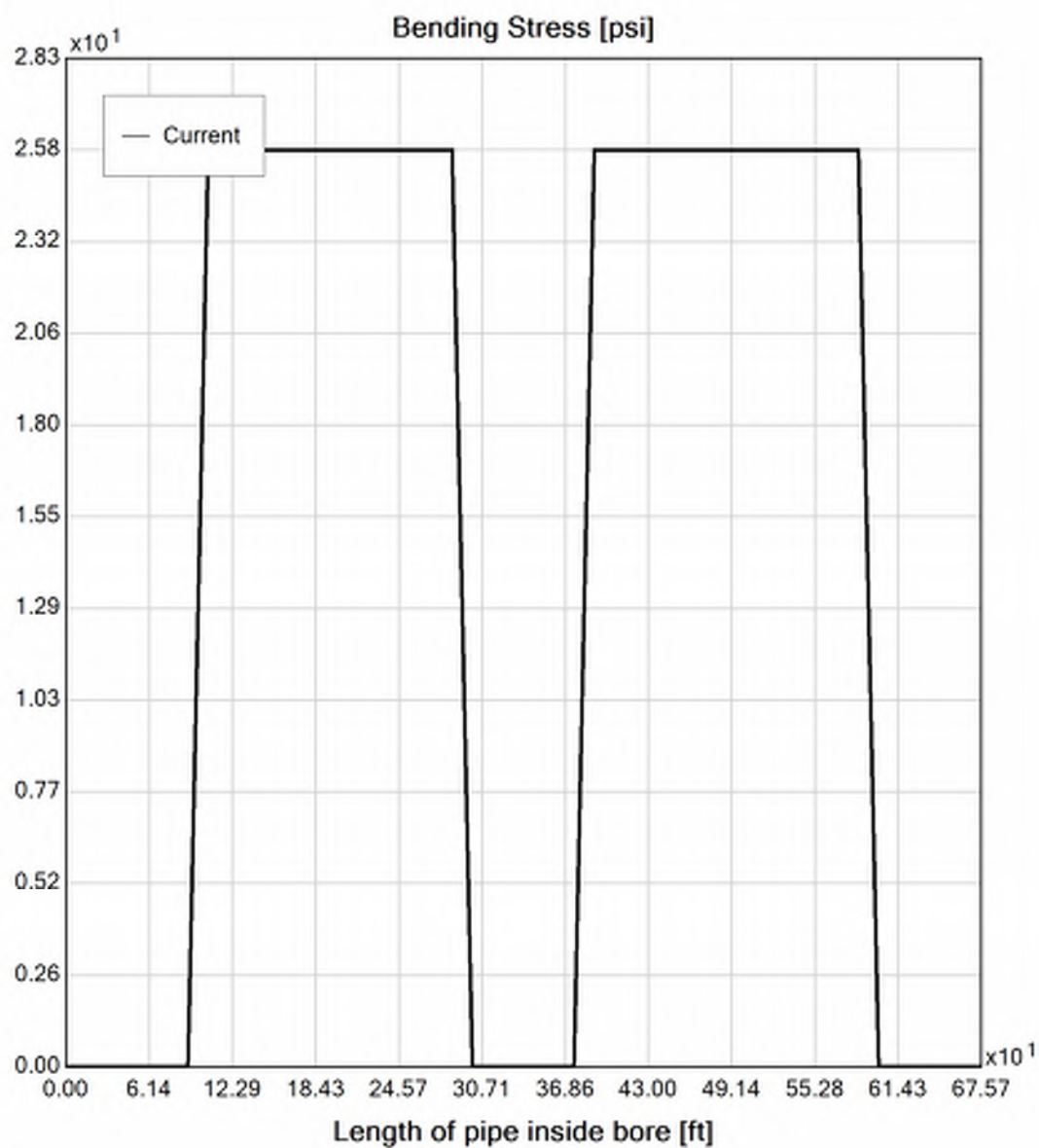
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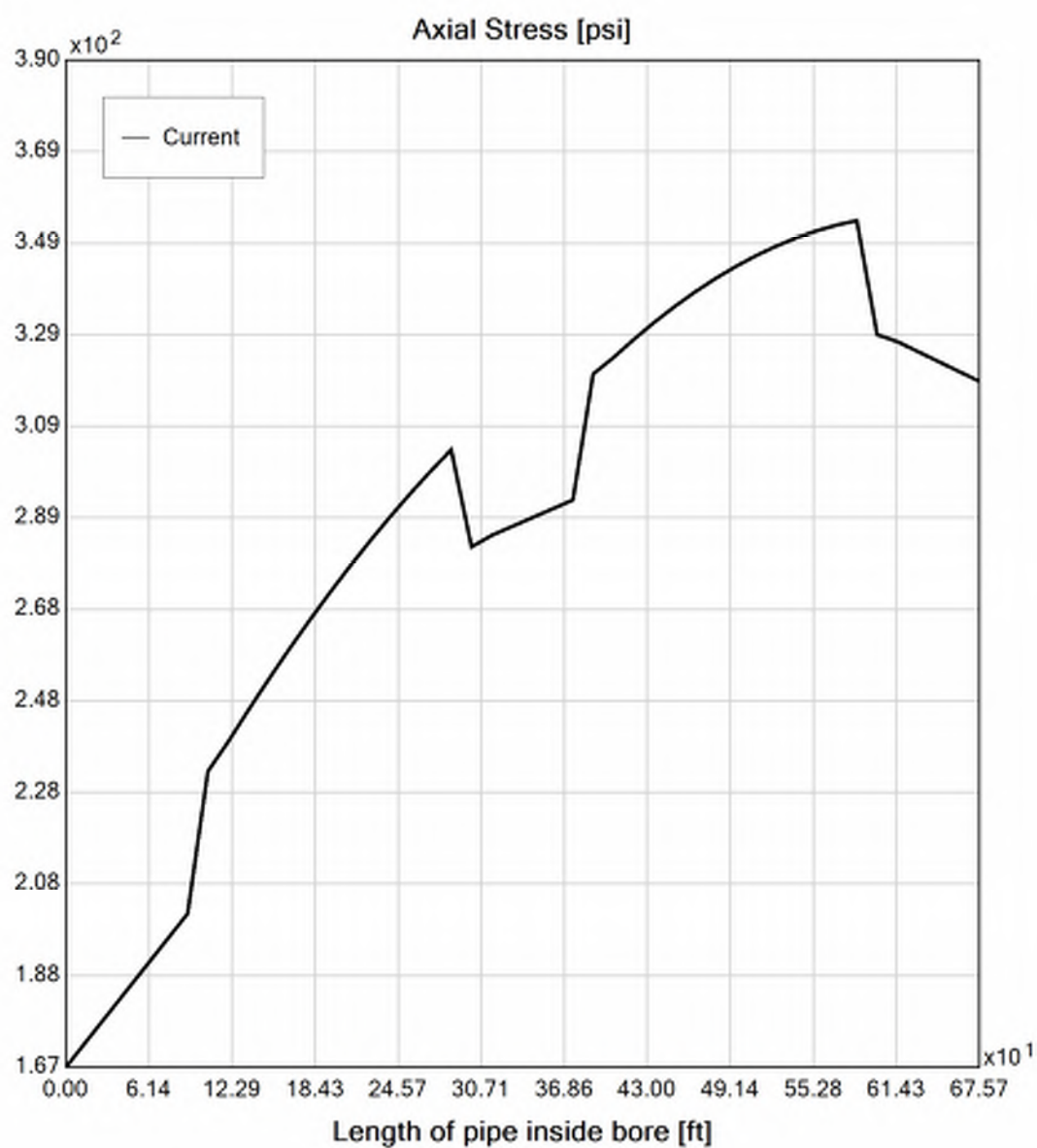
## Virtual Site



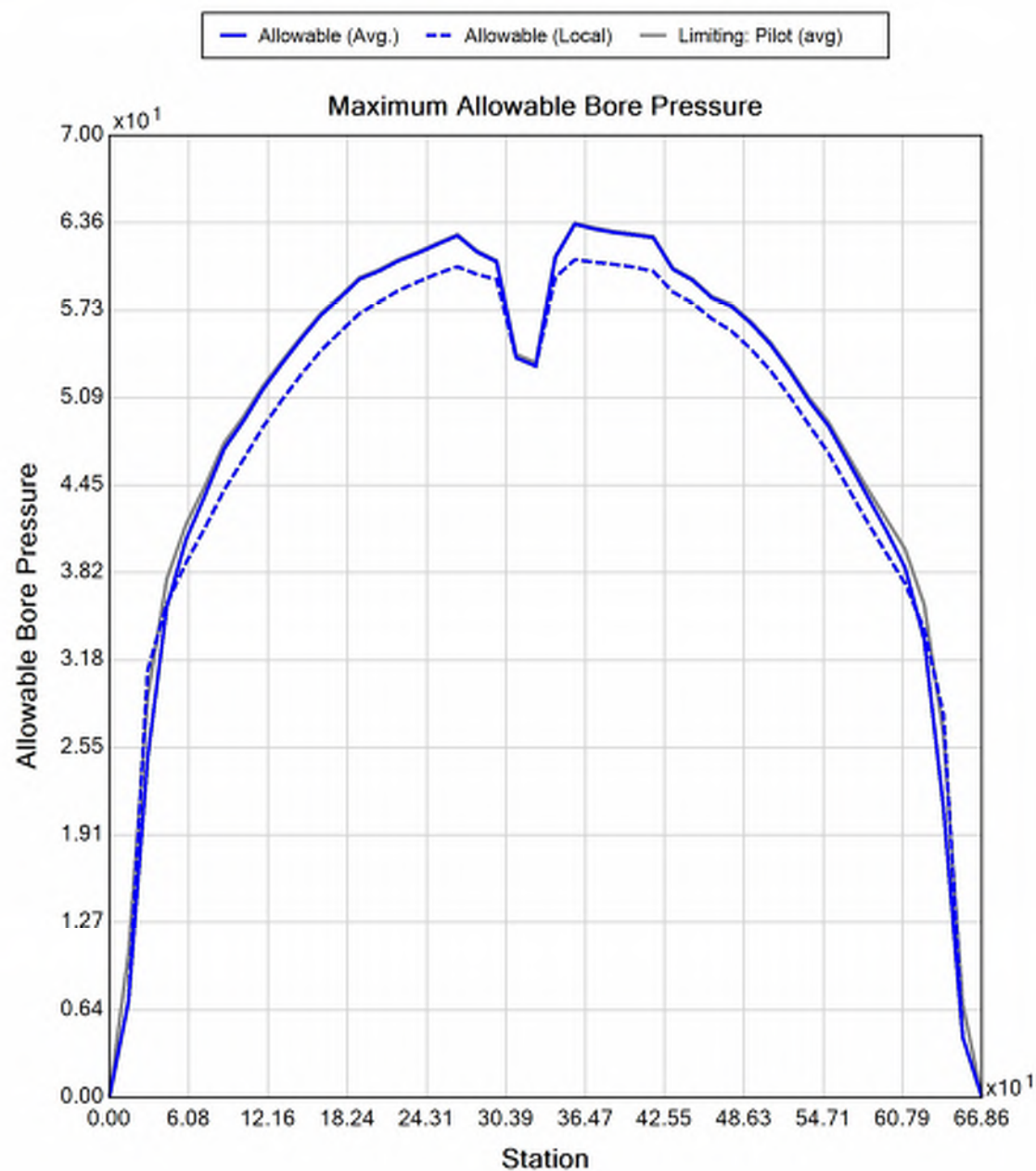


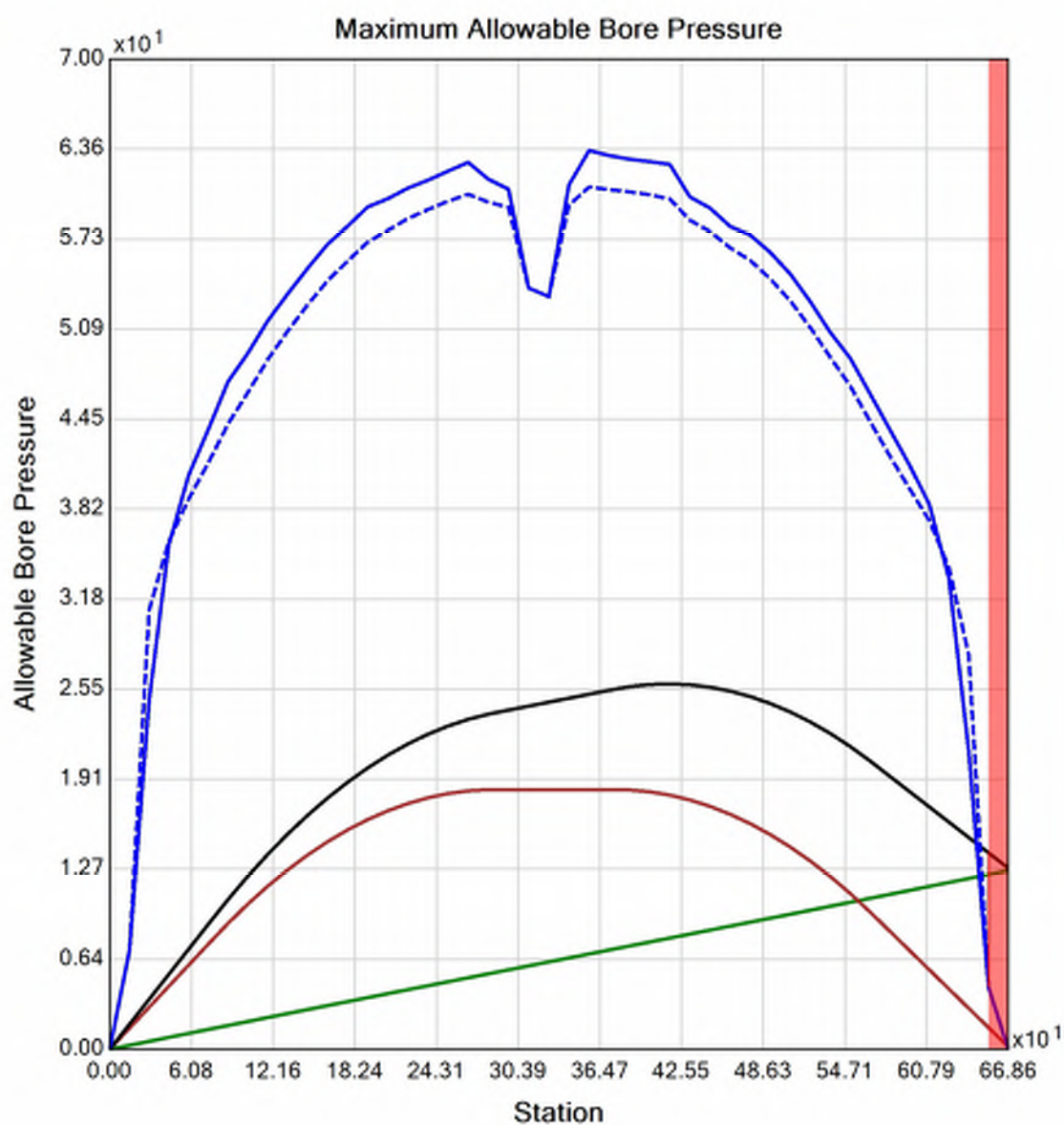














## Generated Output



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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/ft<sup>3</sup>  
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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>

---

### 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
<b>Deflection</b>		
Earth Load Deflection	3.740	5.644
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	3.769	5.673
<b>Compressive Stress [psi]</b>		
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



## Generated Output



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---

## Project Summary

General: CHPE HDD 17 - Conduit 2  
P2  
Start Date: 06-17-2022  
End Date: 06-17-2022

Project Owner: TDI  
Project Contractor: Kiewit  
Project Consultant: CHA/BCE

Designer:  
Description: CHPE HDD 17 Conduit 2 10-inch DR 9

---

## 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]

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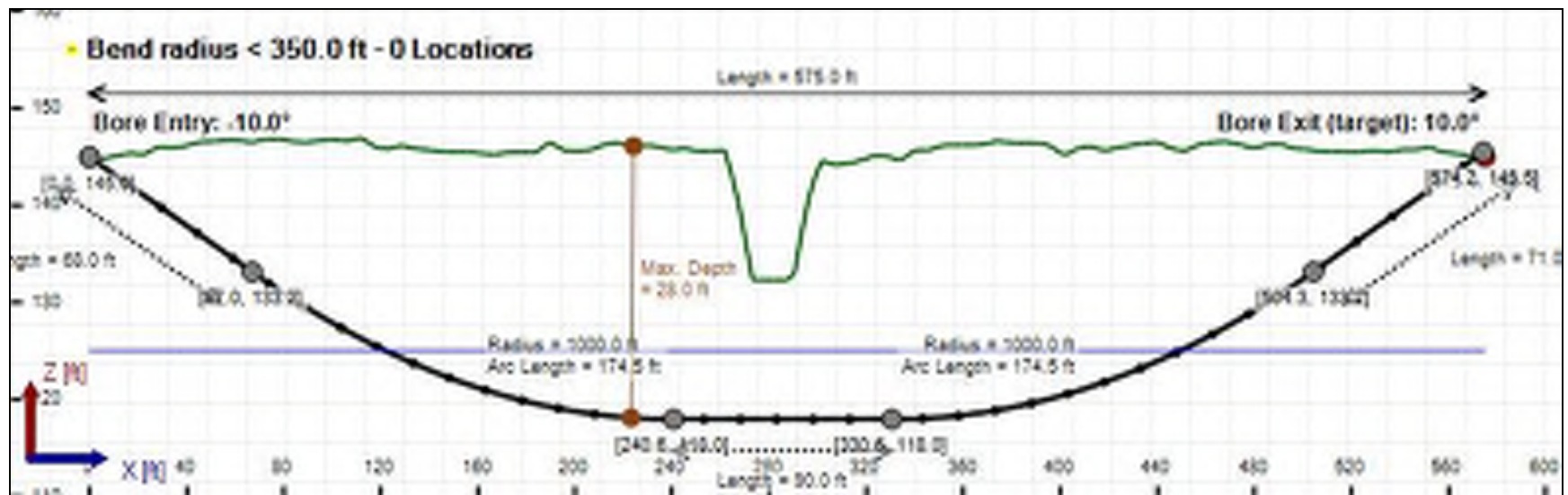
Soil Layer #7 USCS, Clay (C), CL

Depth: 10.00 ft

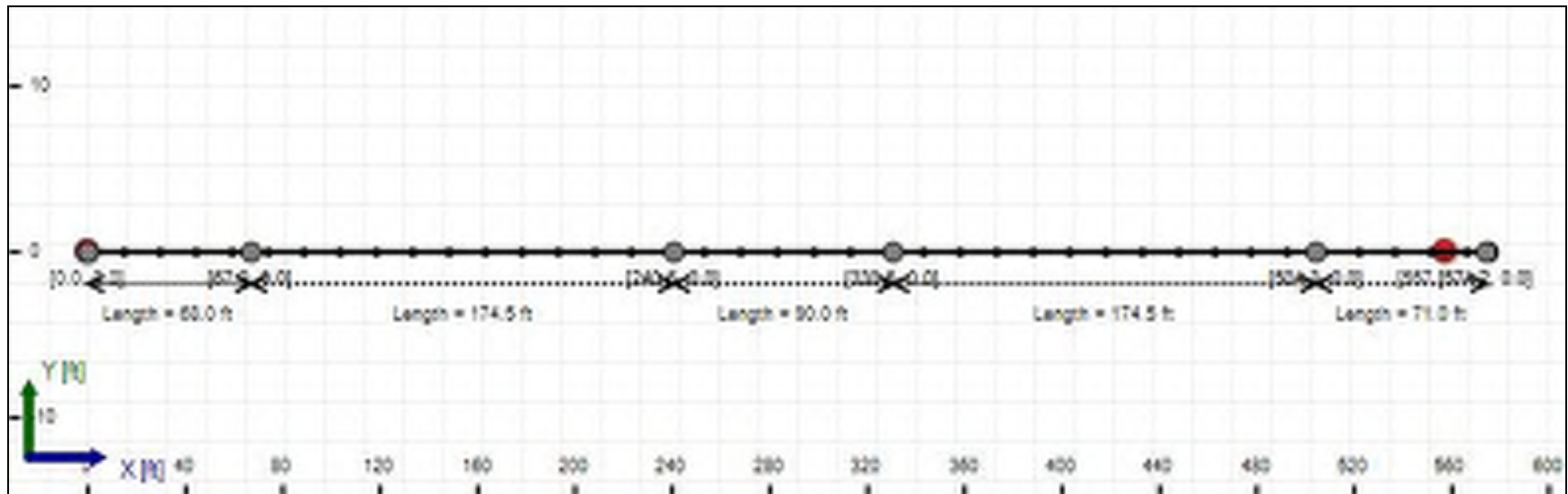
Unit Weight: 100.0000 (dry), 120.0000 (sat) [lb/ft<sup>3</sup>]

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

### Bore Cross-Section View



## Bore Plan View



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## 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/ft<sup>3</sup>  
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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>

---

### 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
<b>Deflection</b>		
Earth Load Deflection	3.464	4.804
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	3.596	4.937
<b>Compressive Stress [psi]</b>		
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/ft<sup>3</sup>

Rheological model: Bingham-Plastic

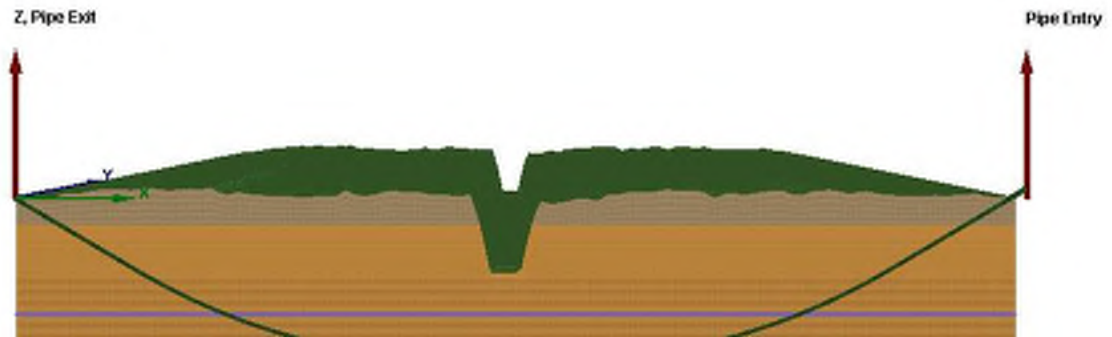
Plastic Viscosity (PV): 25.53

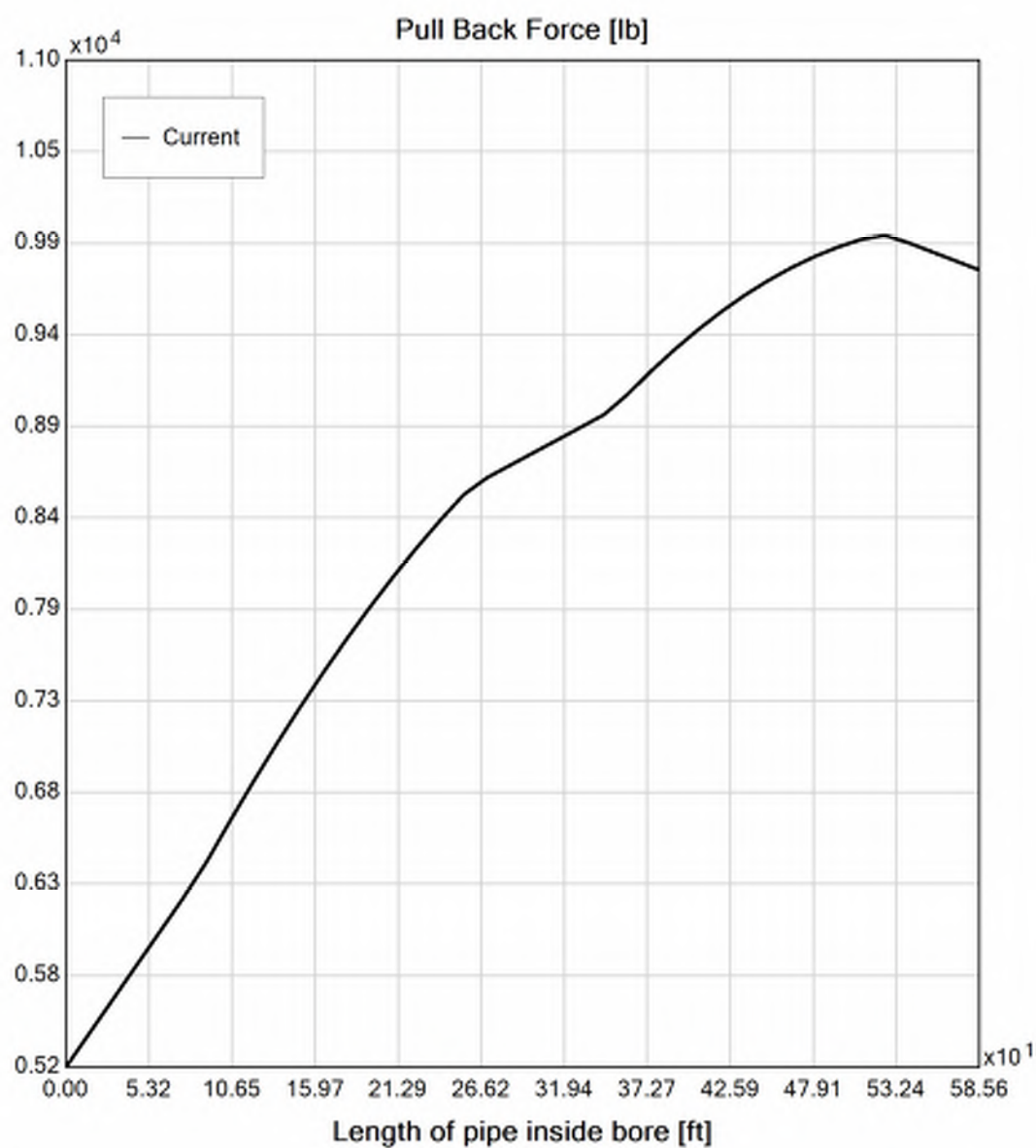
Yield Point (YP): 16.49

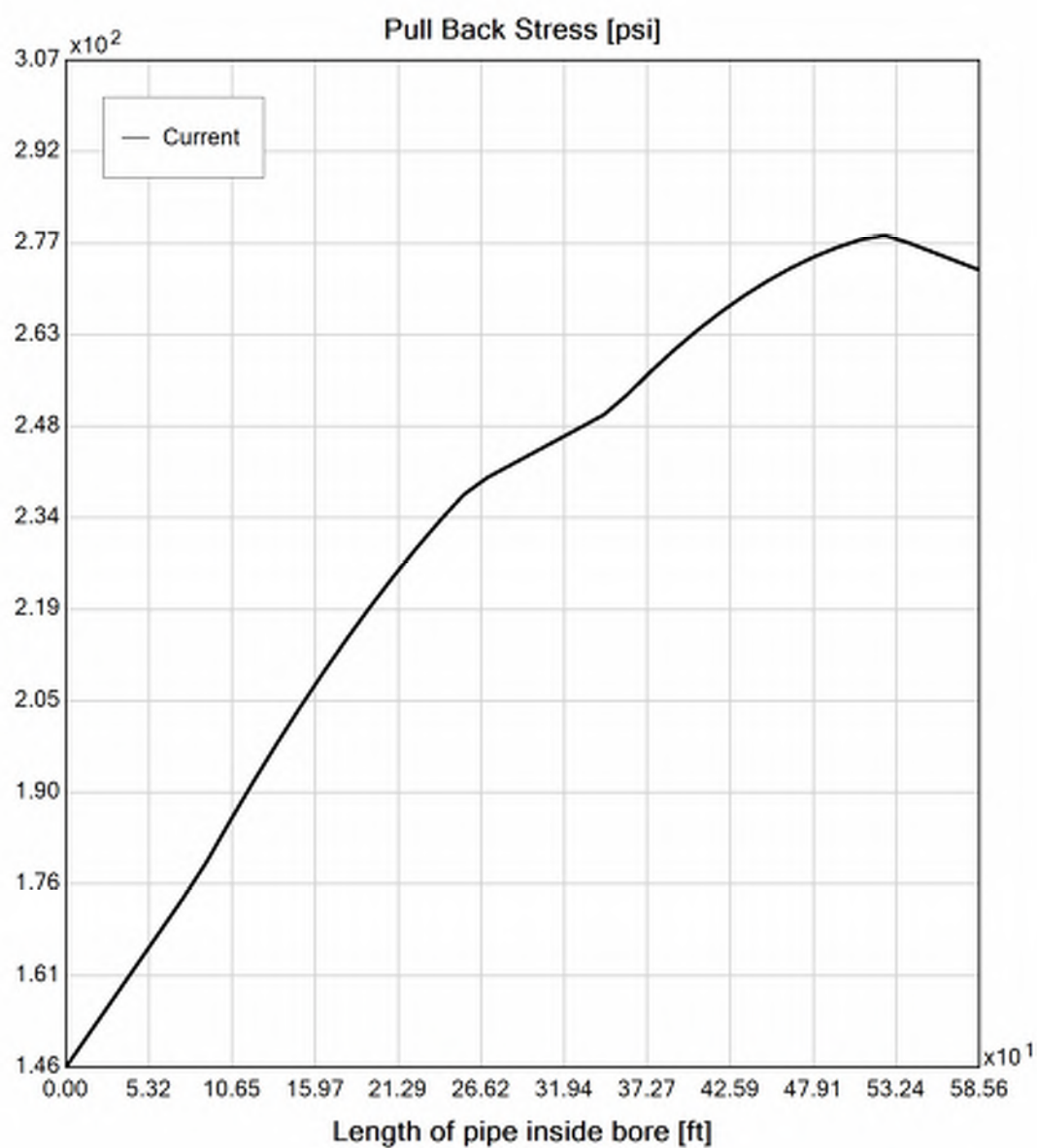
Effective Viscosity (cP): 1202.0

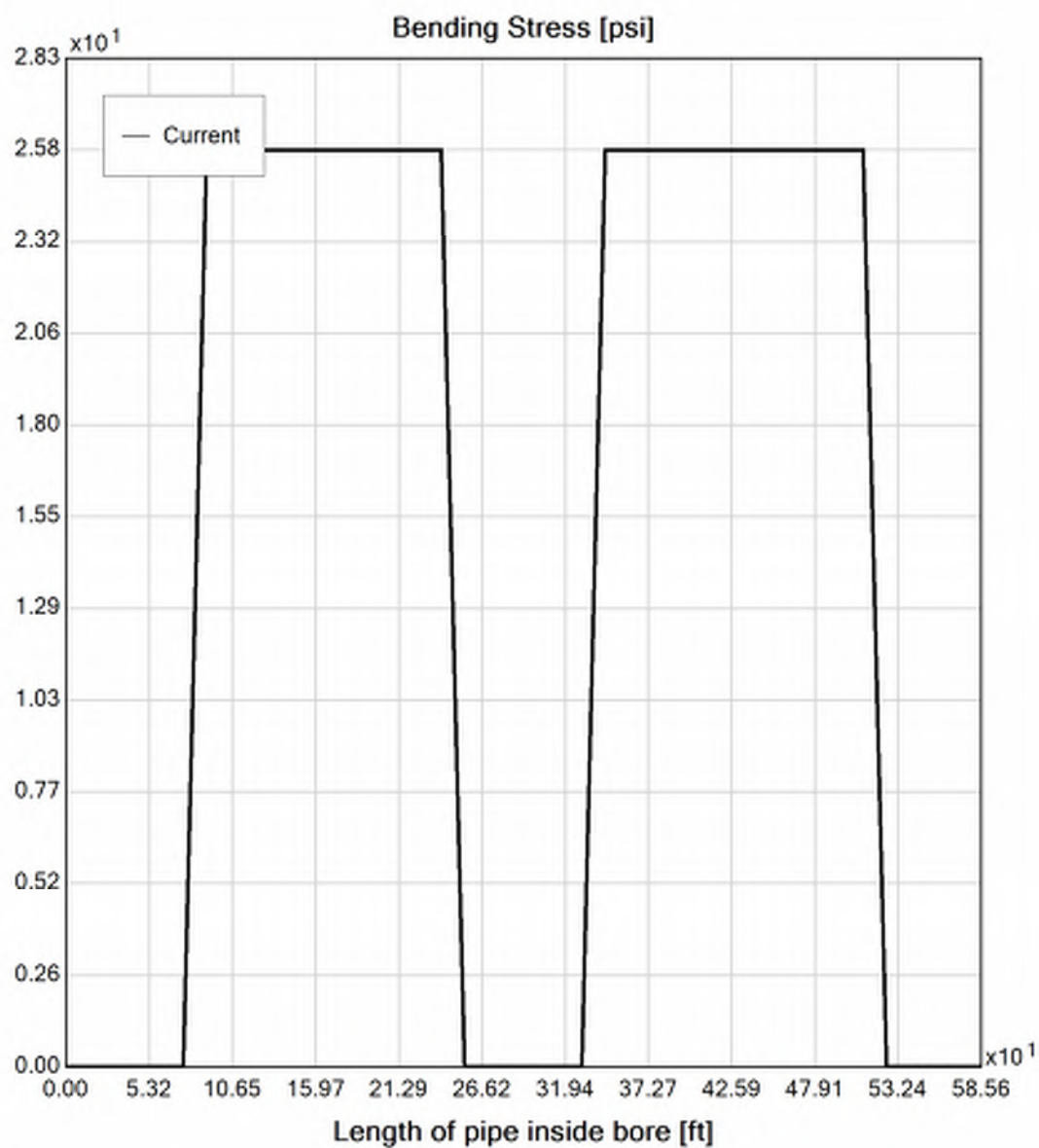
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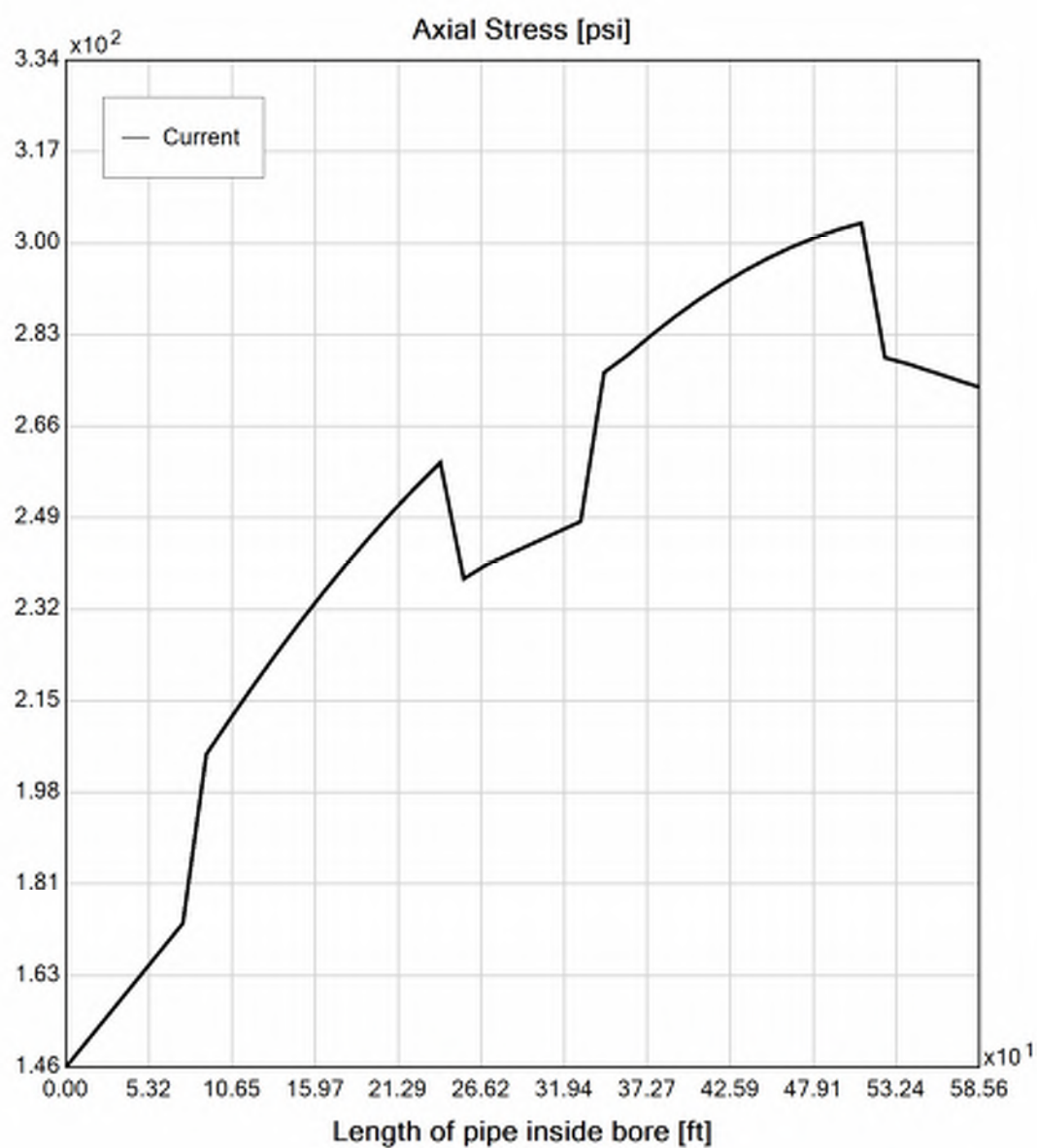
## Virtual Site

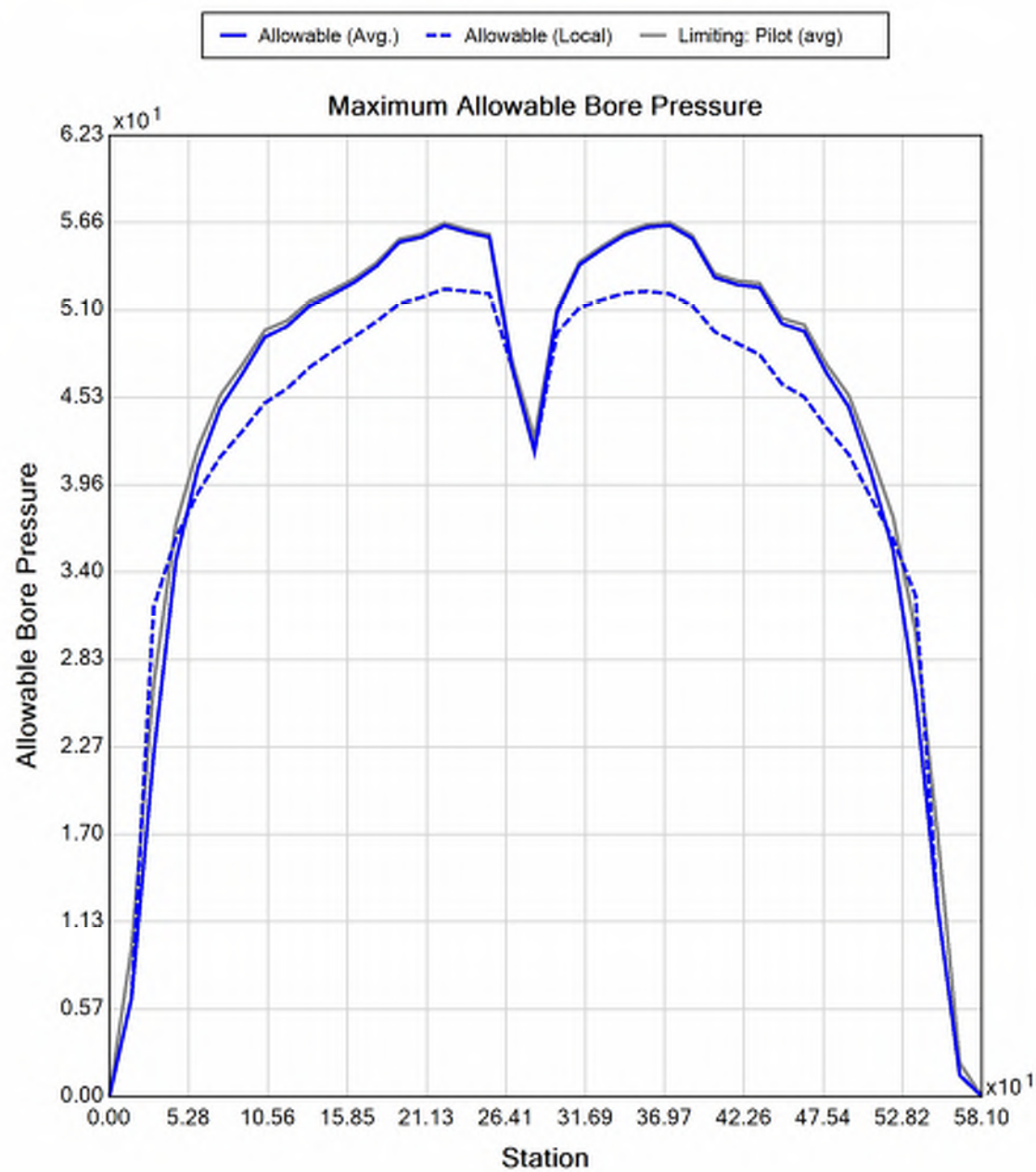




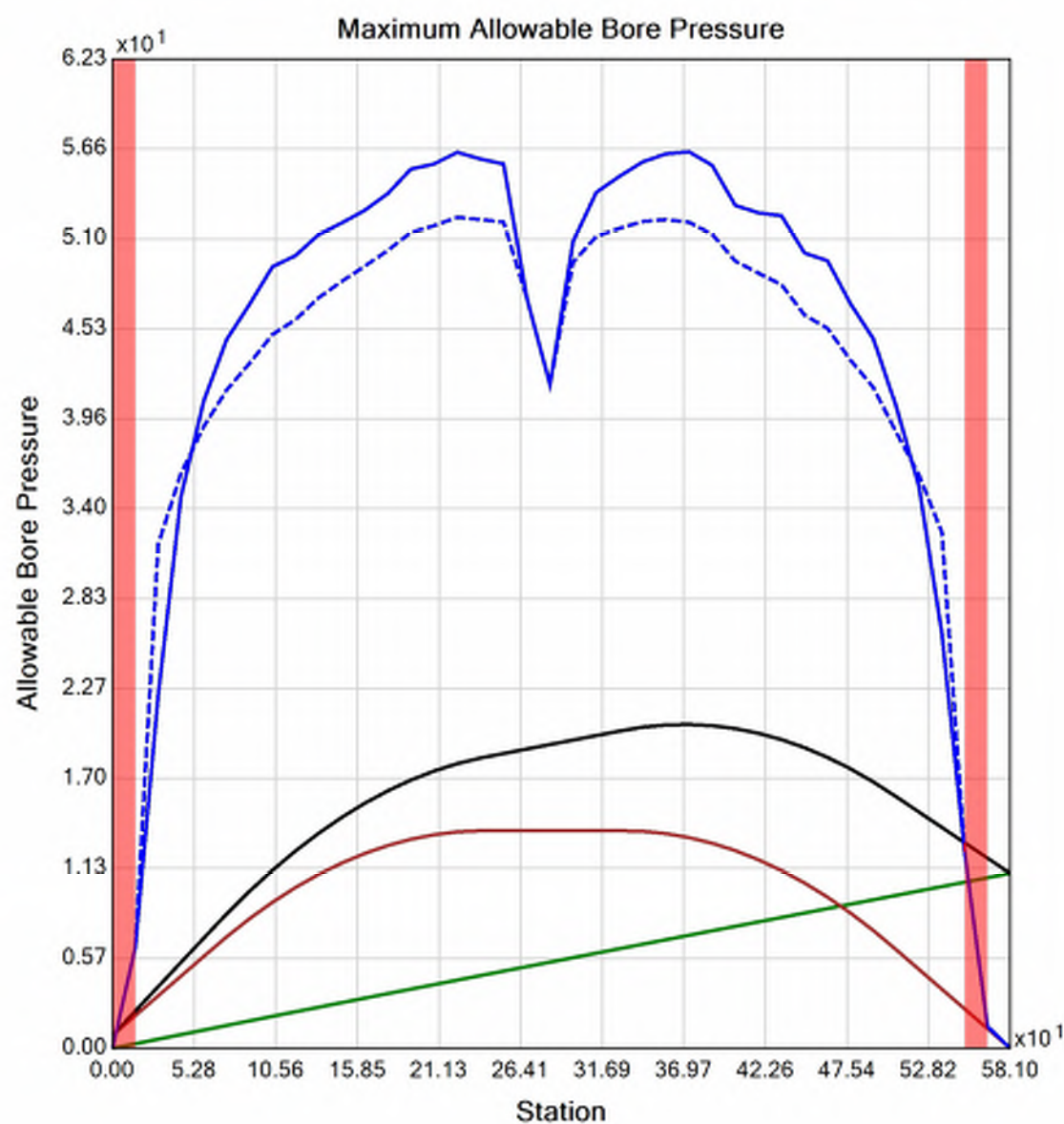














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---

## 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/ft<sup>3</sup>  
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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>

---

### 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
<b>Deflection</b>		
Earth Load Deflection	3.464	4.804
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	3.493	4.834
<b>Compressive Stress [psi]</b>		
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



## Generated Output



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---

## Project Summary

General: CHPE HDD 18  
P2  
Start Date: 02-28-2022  
End Date: 02-28-2022

Project Owner: TDI  
Project Contractor: Kiewit  
Project Consultant: CHA/BCE

Designer:  
Description: HDD 18 10-inch DR 9



---

## 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]

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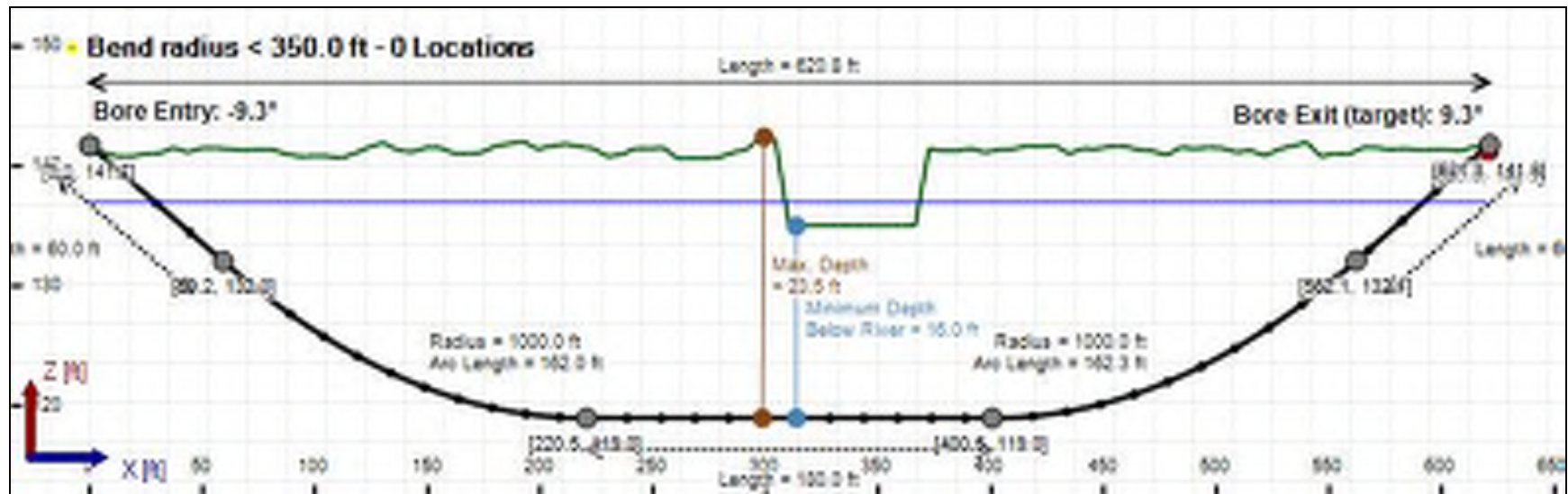
Soil Layer #7 USCS, Clay (C), CH

Depth: 15.00 ft

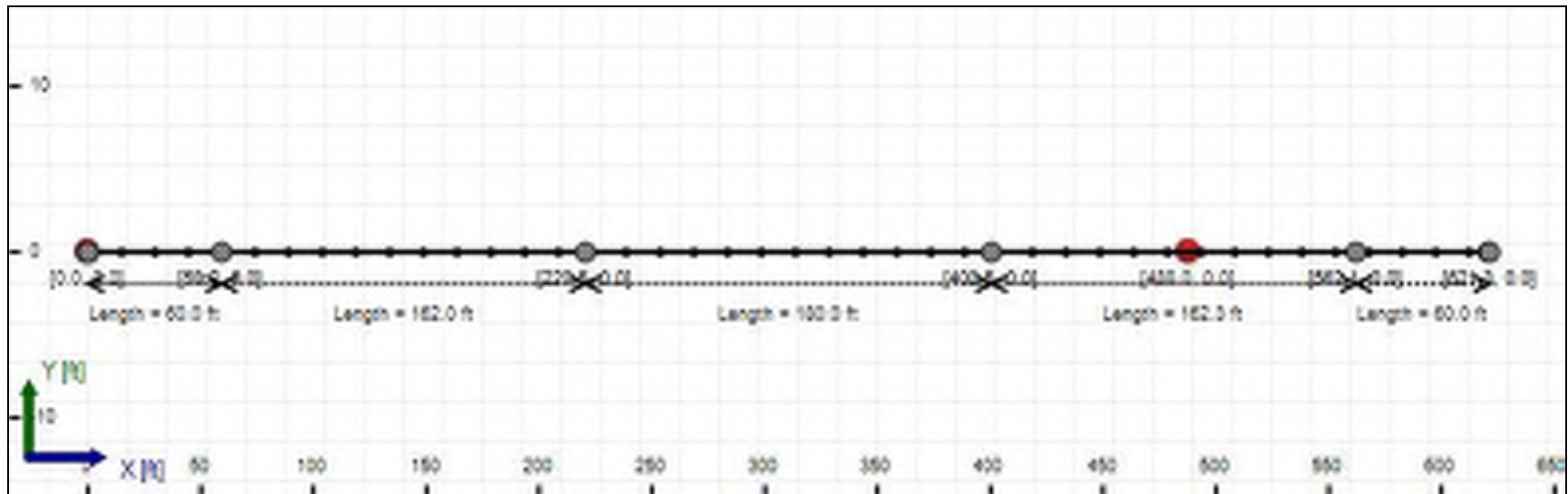
Unit Weight: 70.0000 (dry), 100.0000 (sat) [lb/ft<sup>3</sup>]

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/ft<sup>3</sup>  
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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>

---

### 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
<b>Deflection</b>		
Earth Load Deflection	0.759	2.446
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	0.891	2.578
<b>Compressive Stress [psi]</b>		
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/ft<sup>3</sup>

Rheological model: Bingham-Plastic

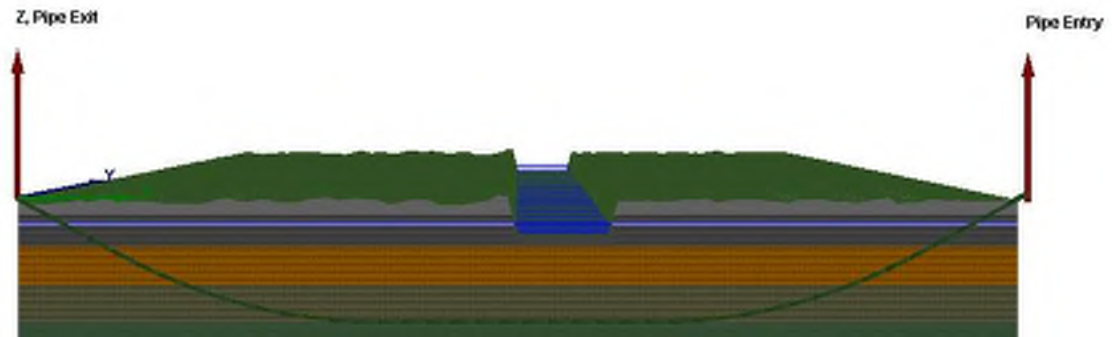
Plastic Viscosity (PV): 25.53

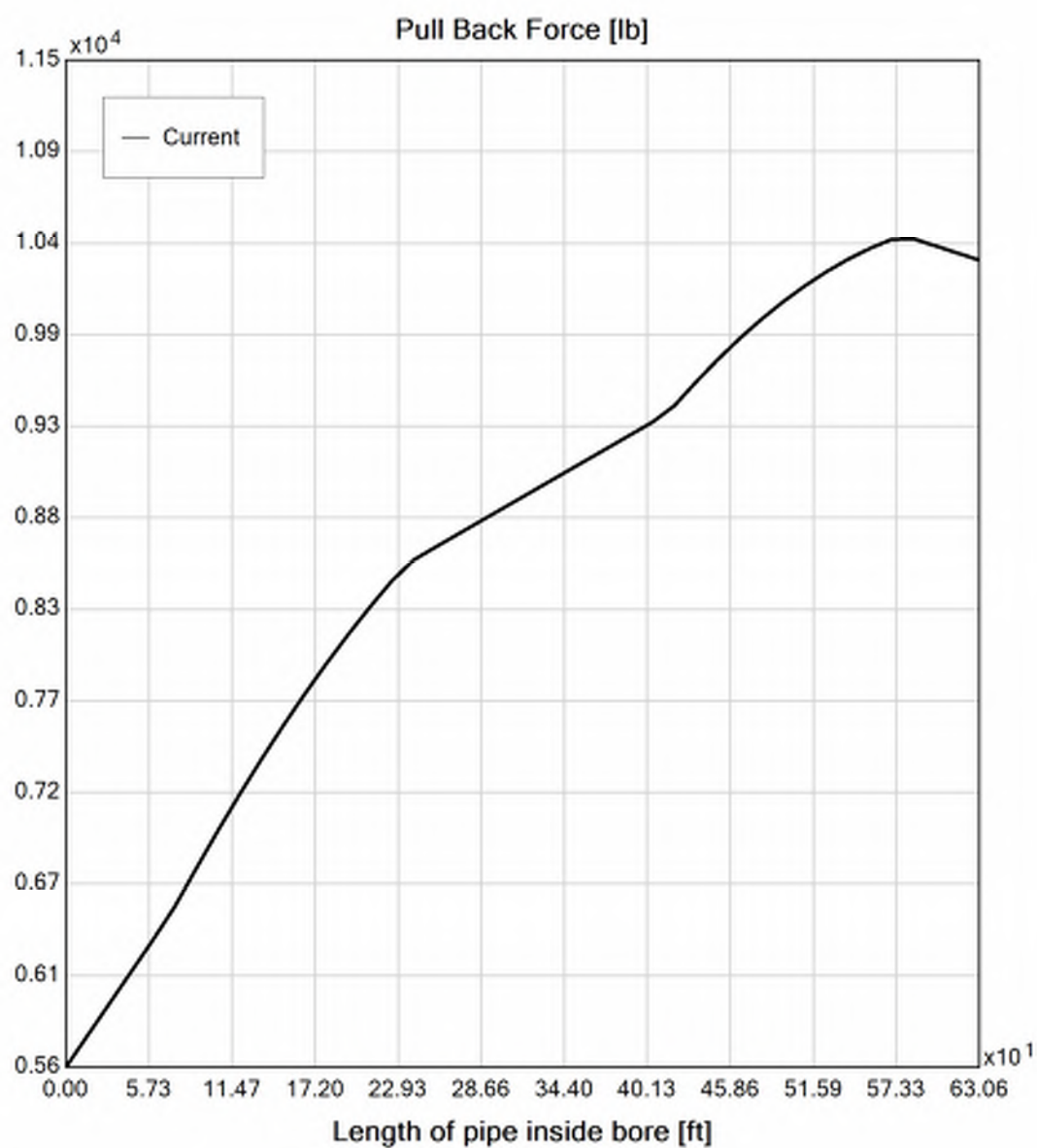
Yield Point (YP): 16.49

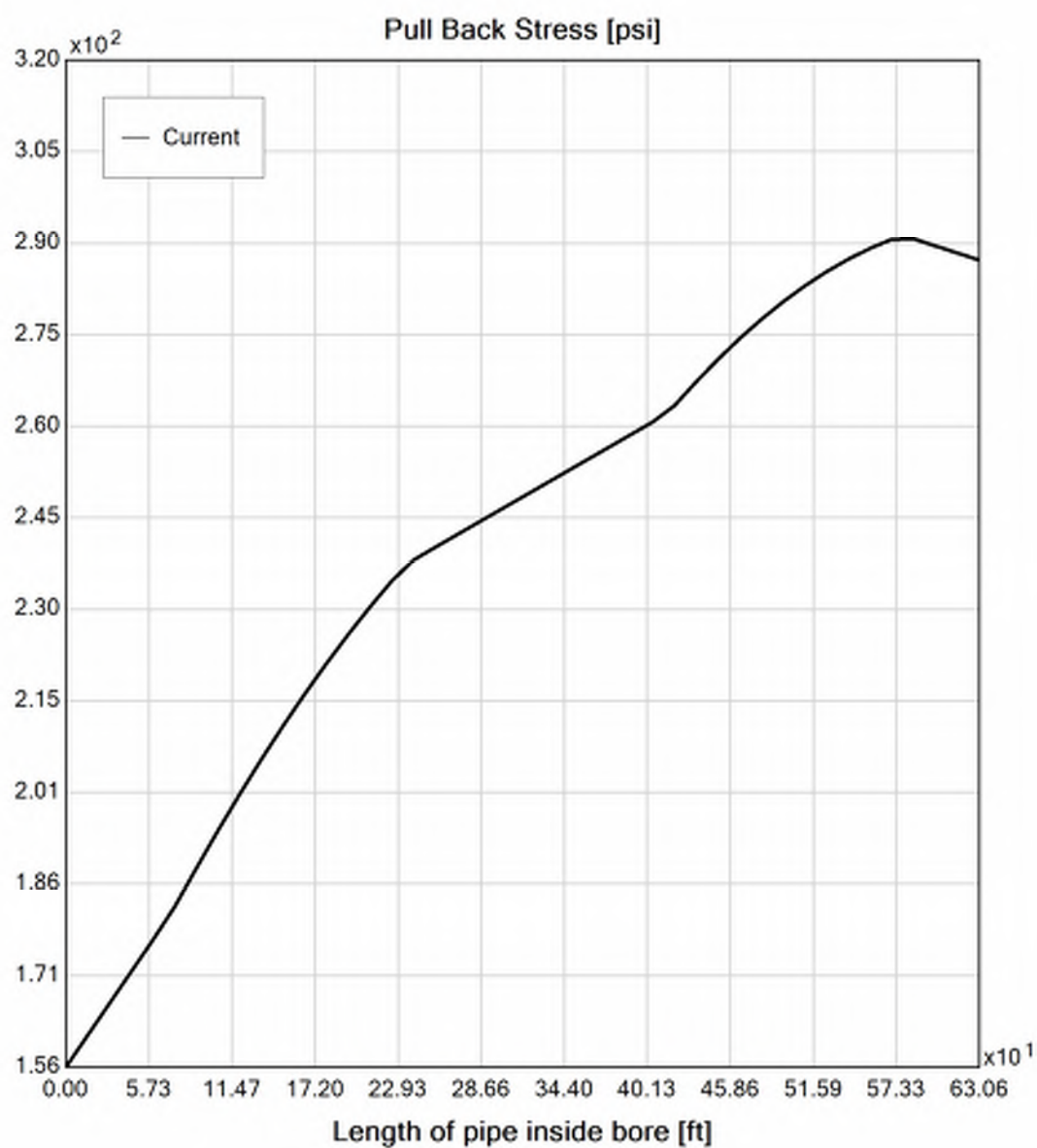
Effective Viscosity (cP): 1202.0

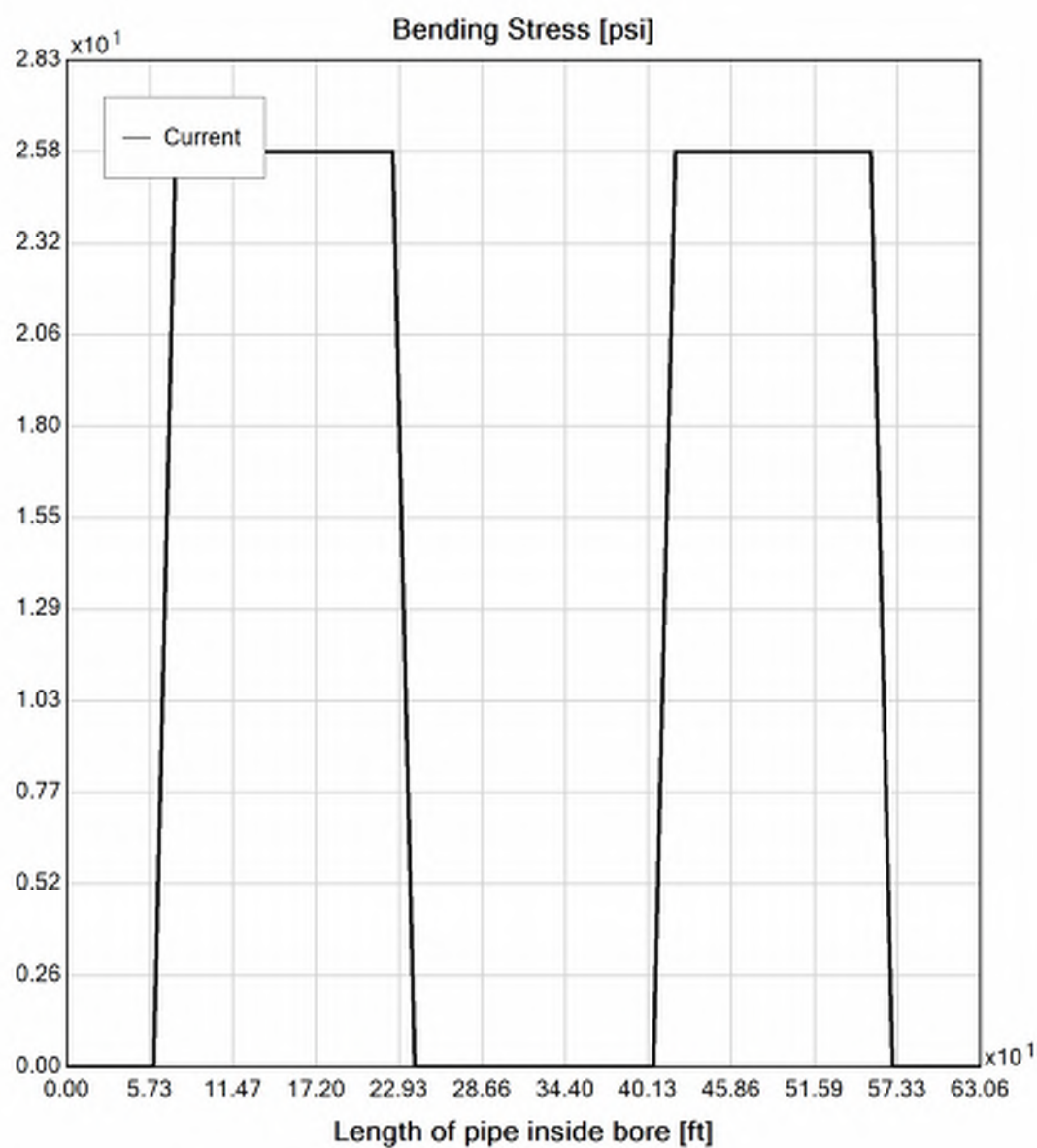
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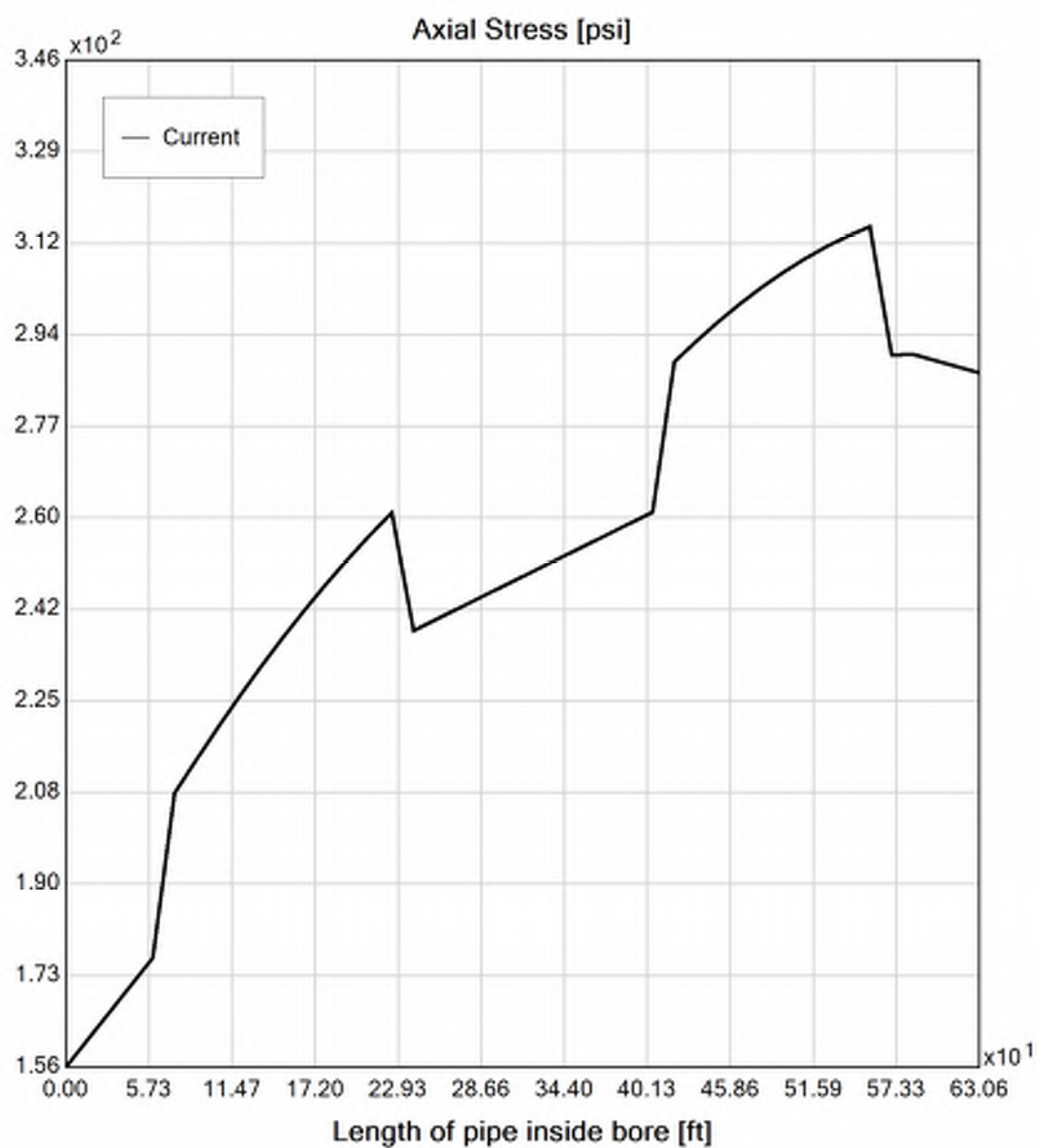
## Virtual Site

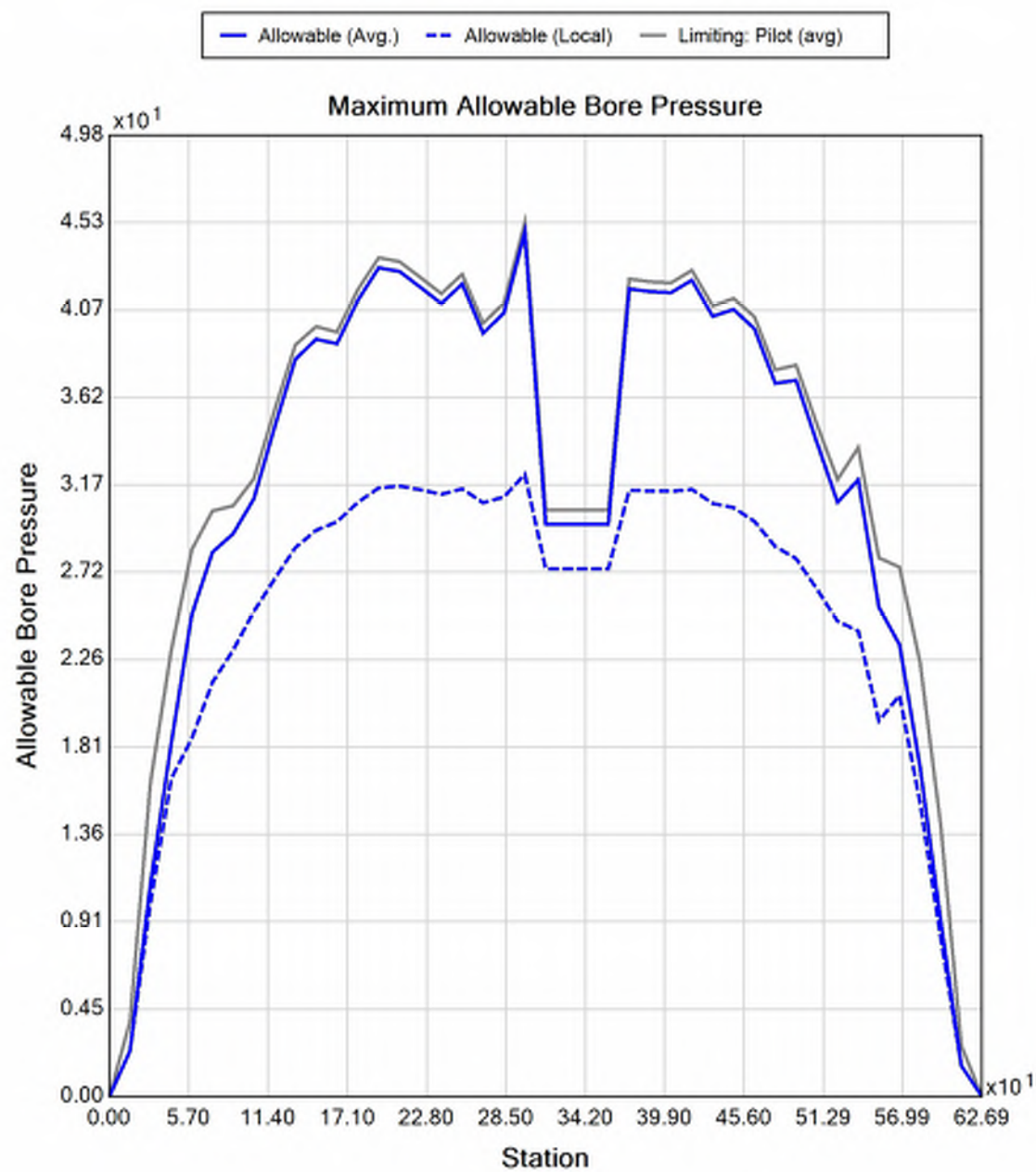


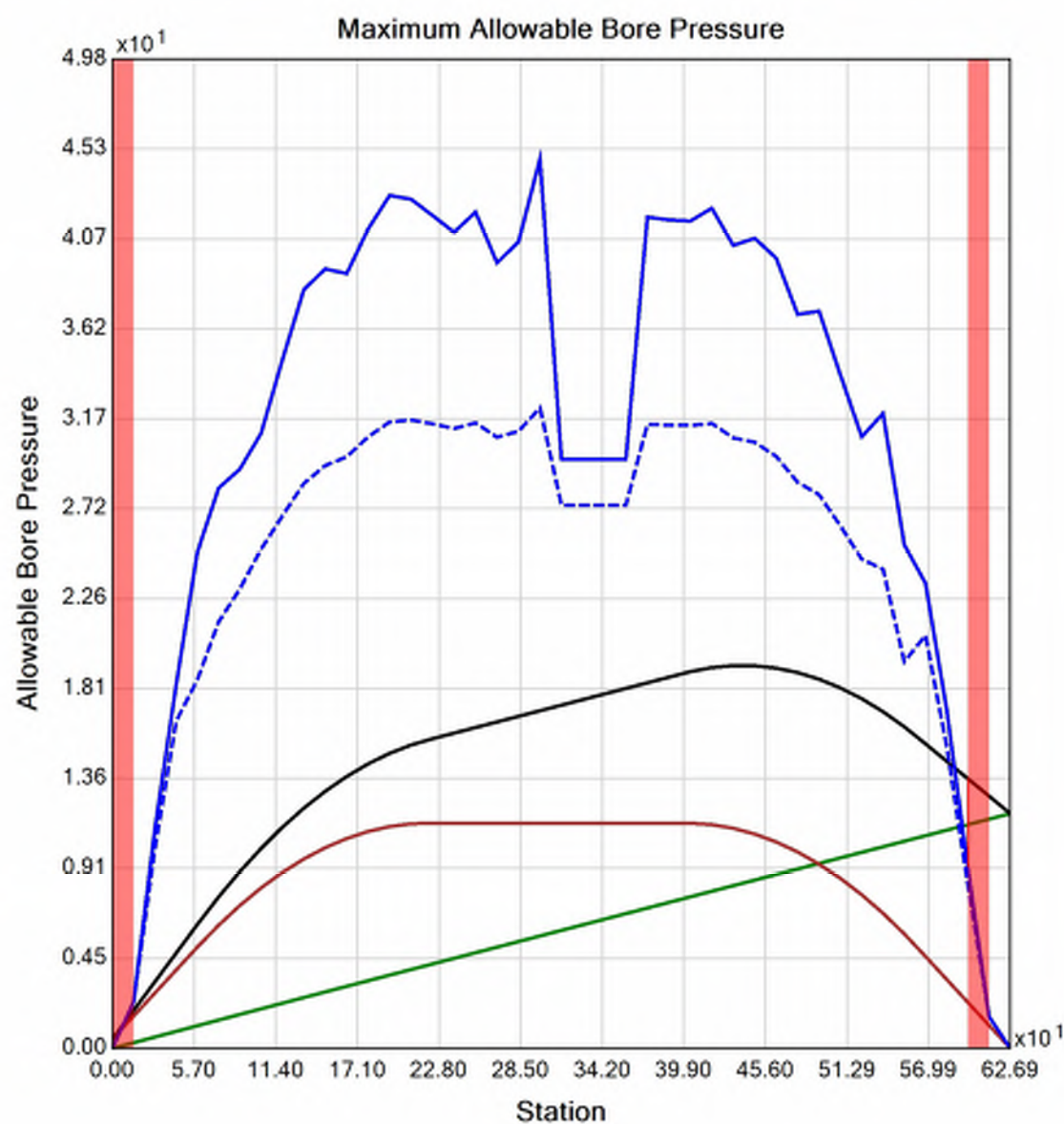
















## Generated Output



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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/ft<sup>3</sup>  
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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>

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### 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
<b>Deflection</b>		
Earth Load Deflection	0.409	2.446
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	0.439	2.476
<b>Compressive Stress [psi]</b>		
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



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## Project Summary

General: CHPE HDD 19  
P2  
Start Date: 06-20-2022  
End Date: 06-20-2022

Project Owner: TDI  
Project Contractor: KIEWIT  
Project Consultant: CHA

Designer: MCS  
CHA

Description: HDD 19 10-inch DR 9

---

## Input Summary

Start Coordinate	(70.00, 0.00, 141.10) ft
End Coordinate	(663.40, 0.00, 141.30) ft
Project Length	593.40 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



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## Soil Summary

Number of Layers: 5

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

Depth: 2.80 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]

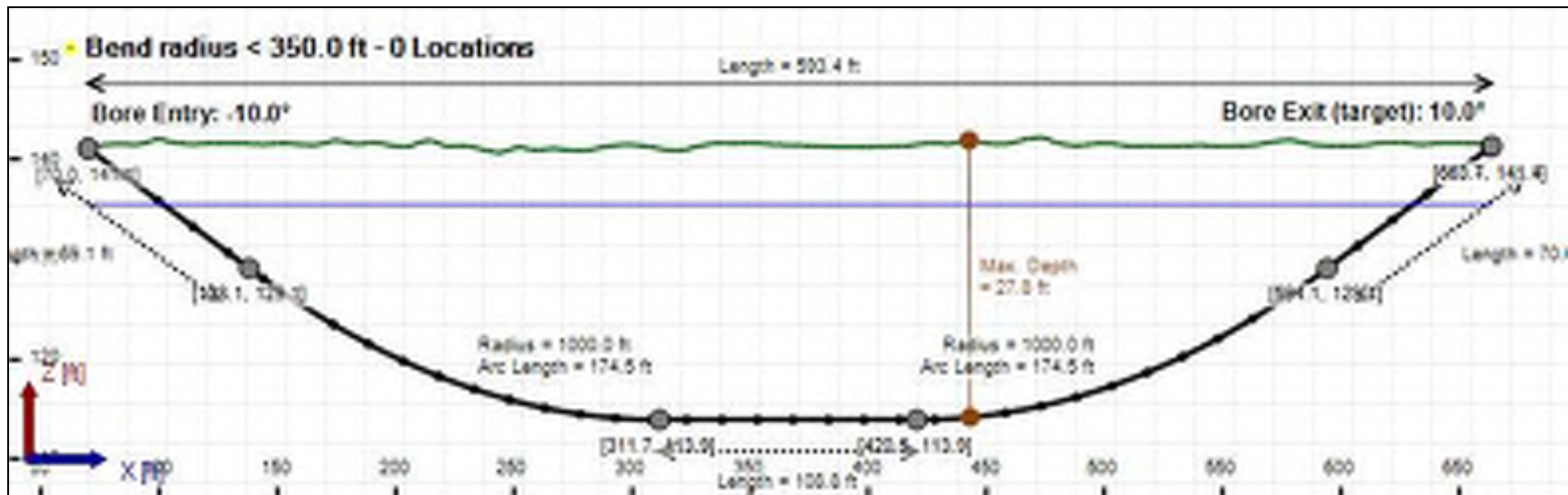
Soil Layer #5 USCS, Sand (S), SM

Depth: 15.00 ft

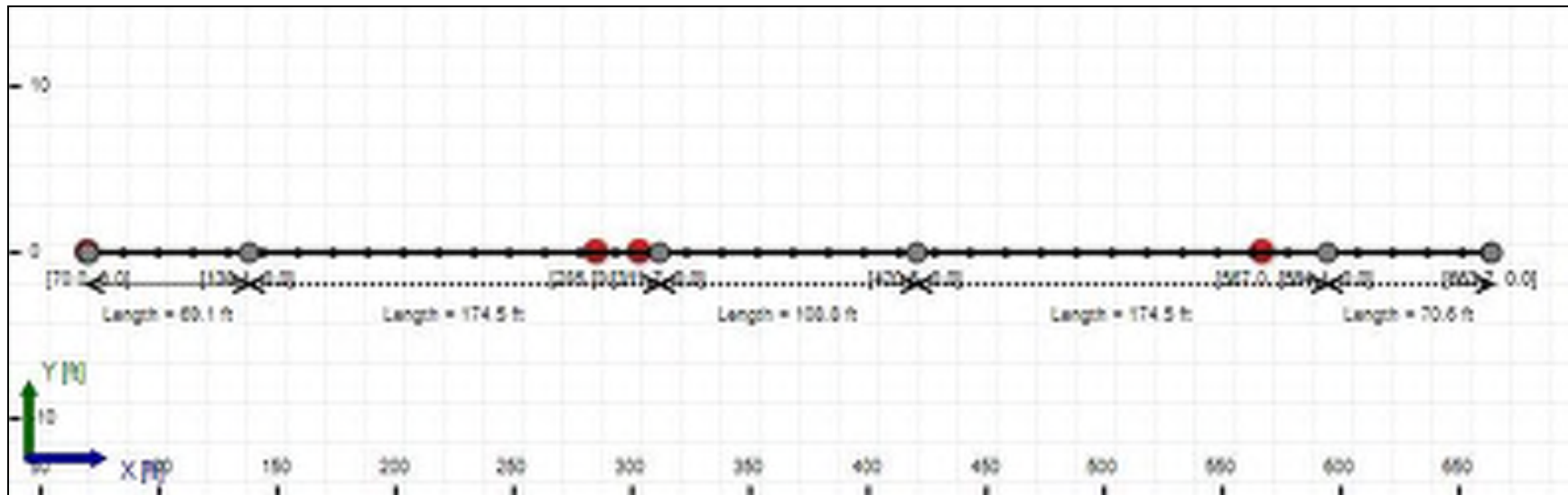
Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft3]

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/ft<sup>3</sup>  
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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>

---

### In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	9.4	10.8
Water Pressure	8.8	9.4
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	18.2	20.1
<b>Deflection</b>		
Earth Load Deflection	2.632	2.942
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	2.764	3.074
<b>Compressive Stress [psi]</b>		
Compressive Wall Stress	81.8	90.5

### Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	10163.0	10163.0
Pullback Stress [psi]	283.4	283.4
Pullback Strain	4.929E-3	4.929E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	283.4	308.6
Tensile Strain	4.929E-3	5.815E-3

Net External Pressure = 17.2 [psi ]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

---

### In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	2.764	7.5	2.7	OK
Unconstrained Collapse [psi]	18.2	108.5	6.0	OK
Compressive Wall Stress [psi]	81.8	1150.0	14.1	OK

### Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	28.1	238.7	8.5	OK
Tensile Stress [psi]	308.6	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	45.246 psi	61.759 psi
1	8.00 in	12.00 in	45.180 psi	61.579 psi
2	12.00 in	16.13 in	45.086 psi	61.321 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/ft<sup>3</sup>

Rheological model: Bingham-Plastic

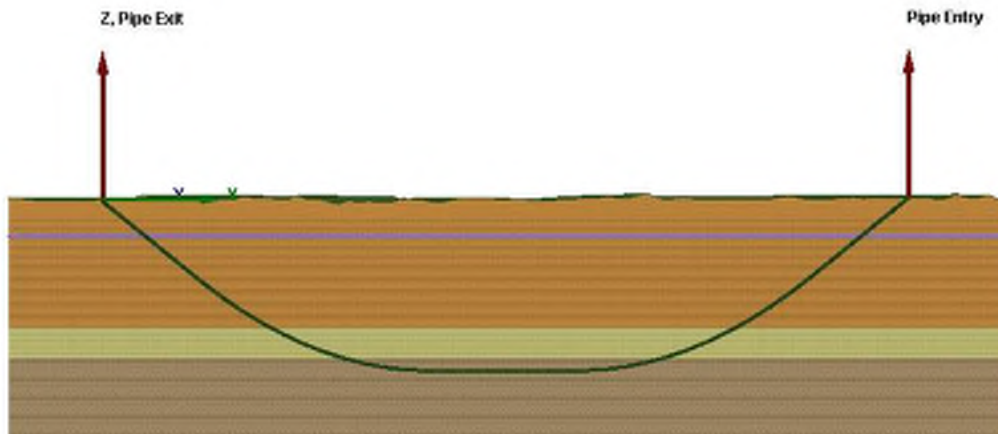
Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

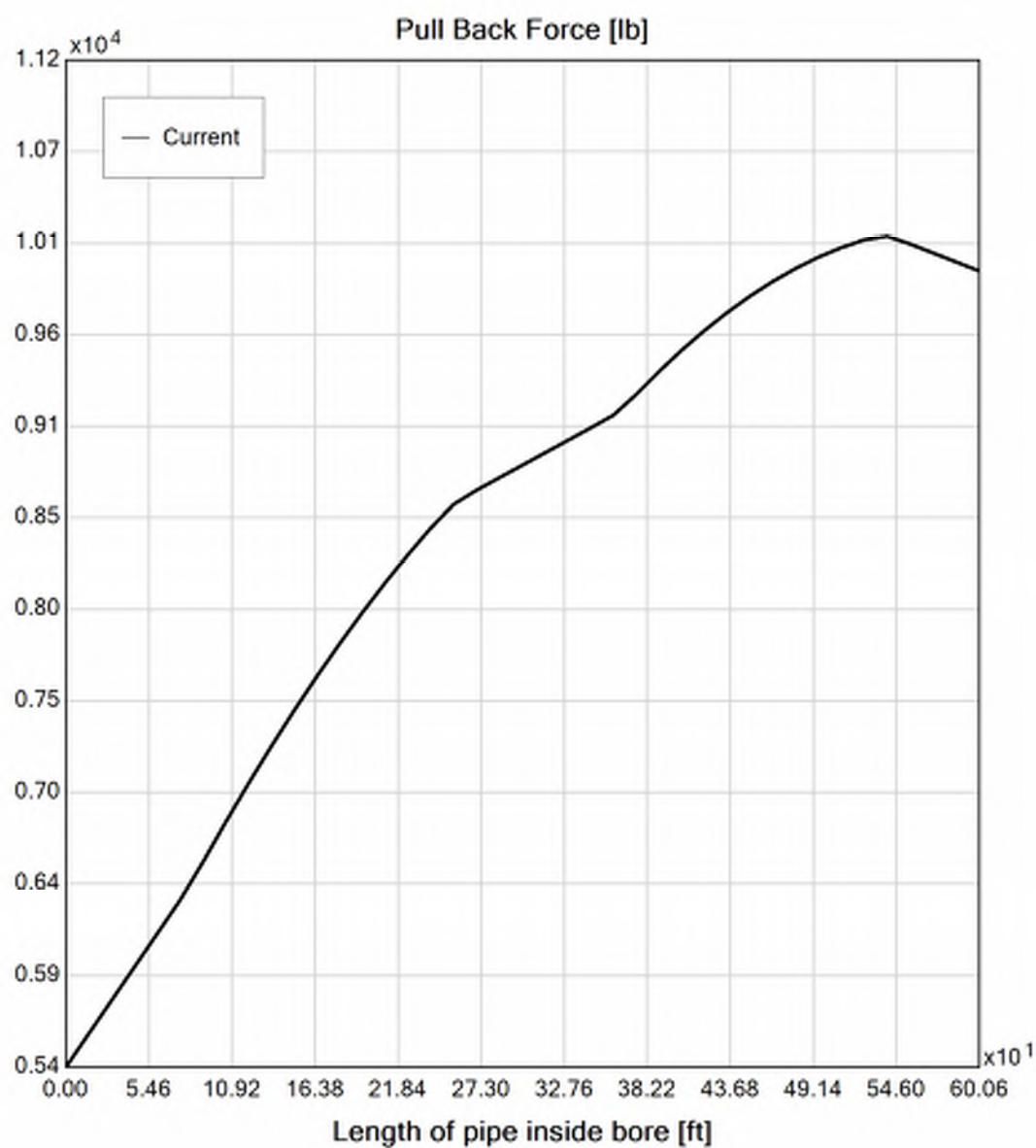
Effective Viscosity (cP): 1202.0

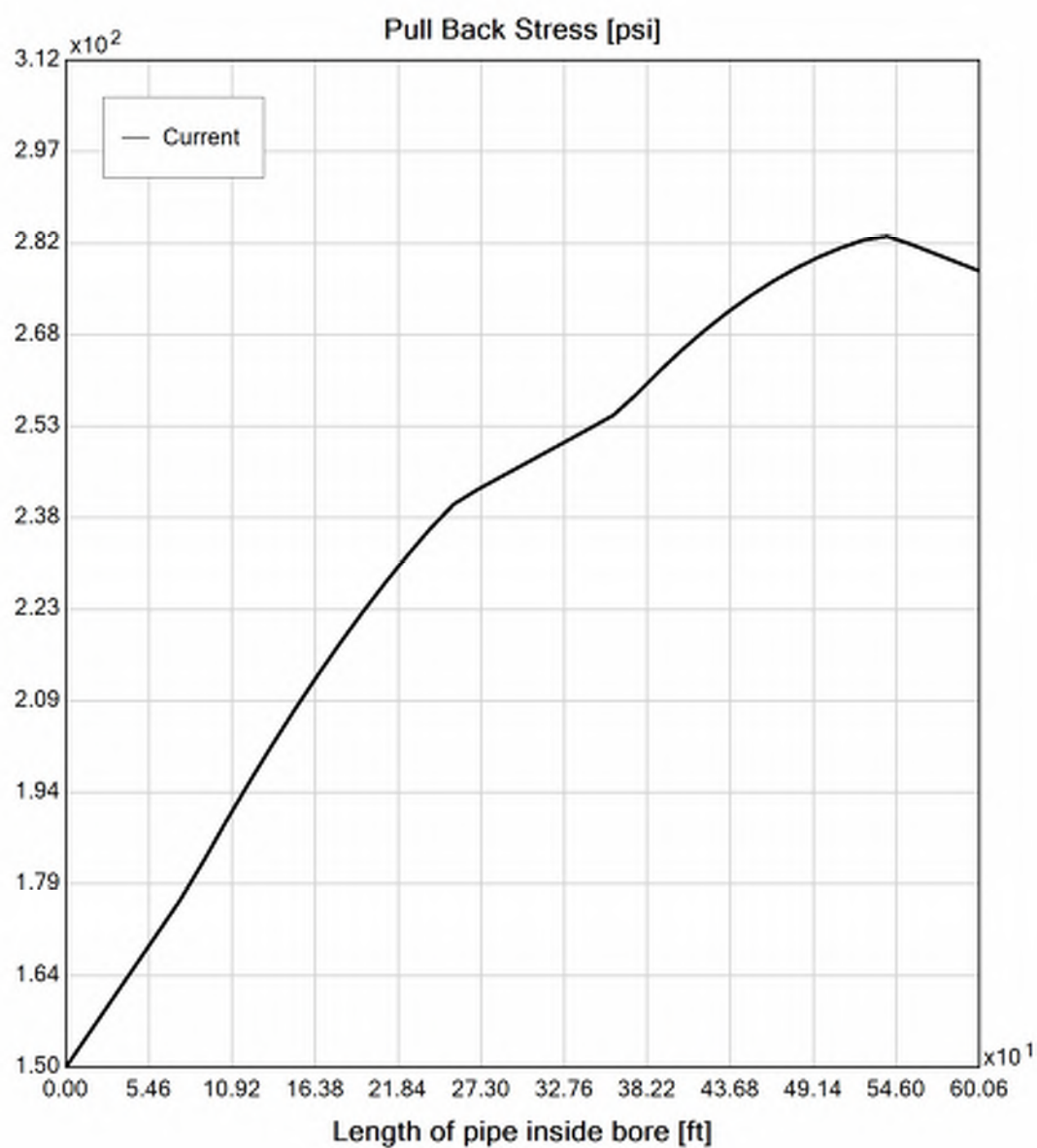
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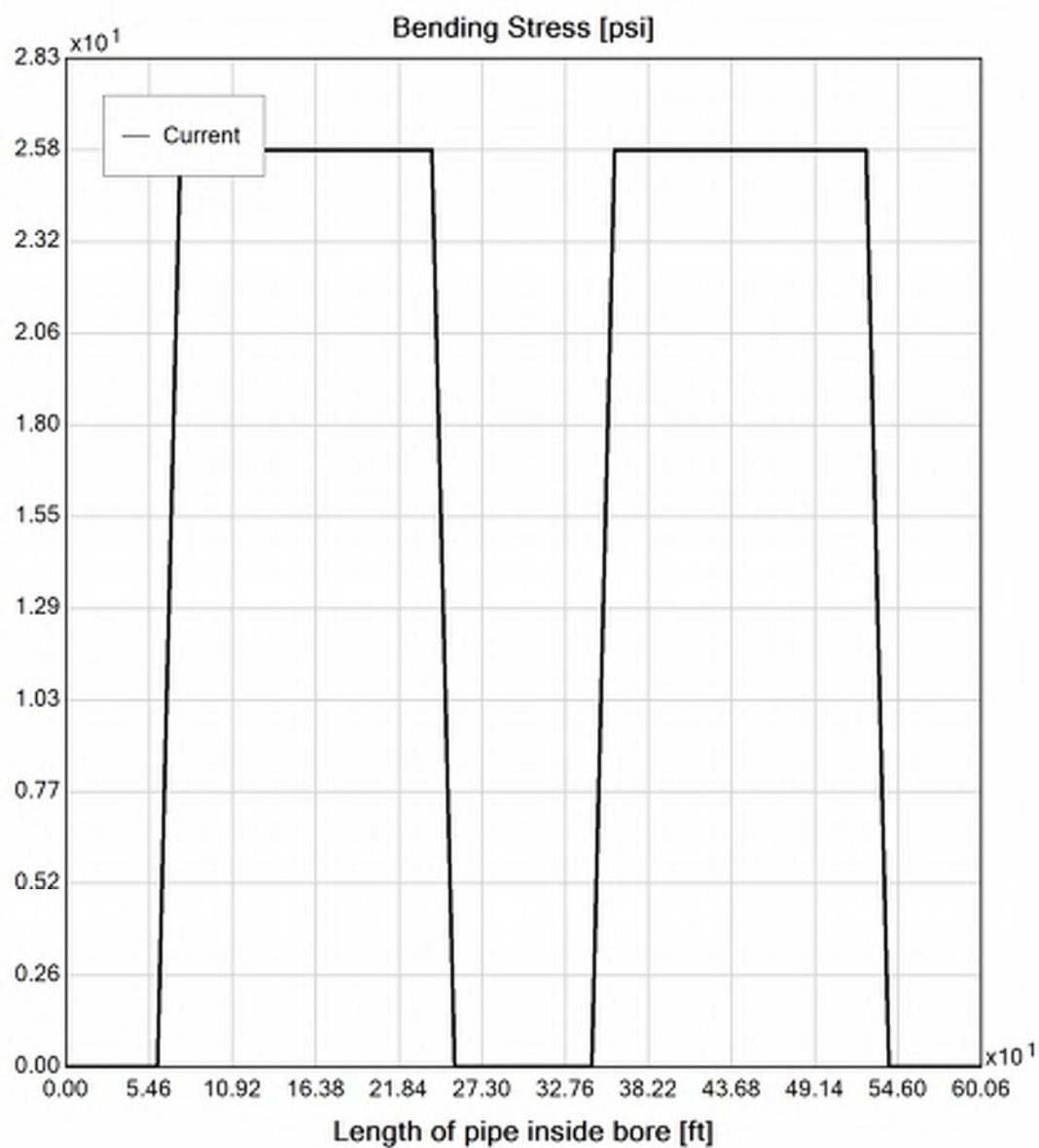
## Virtual Site

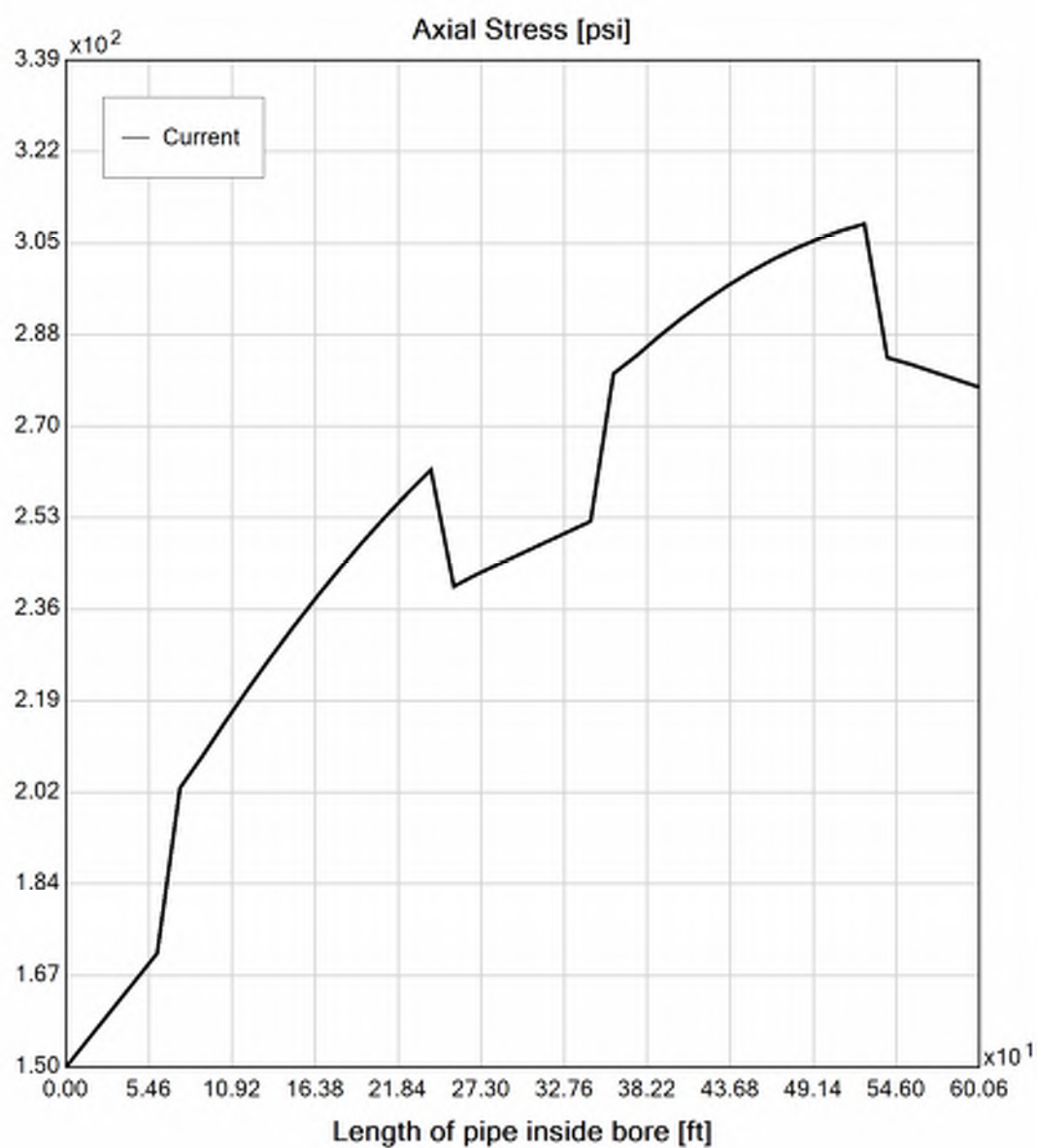


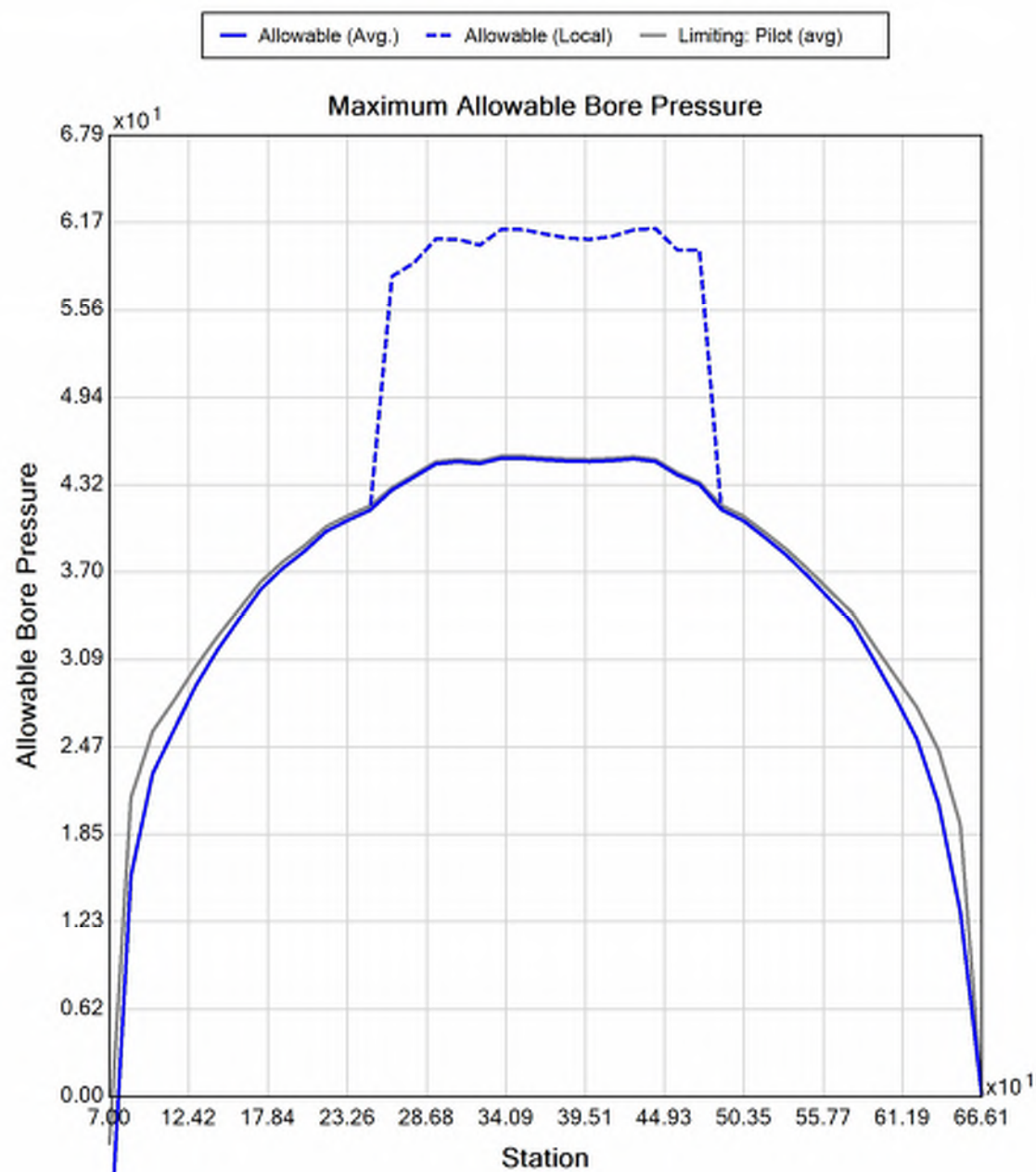


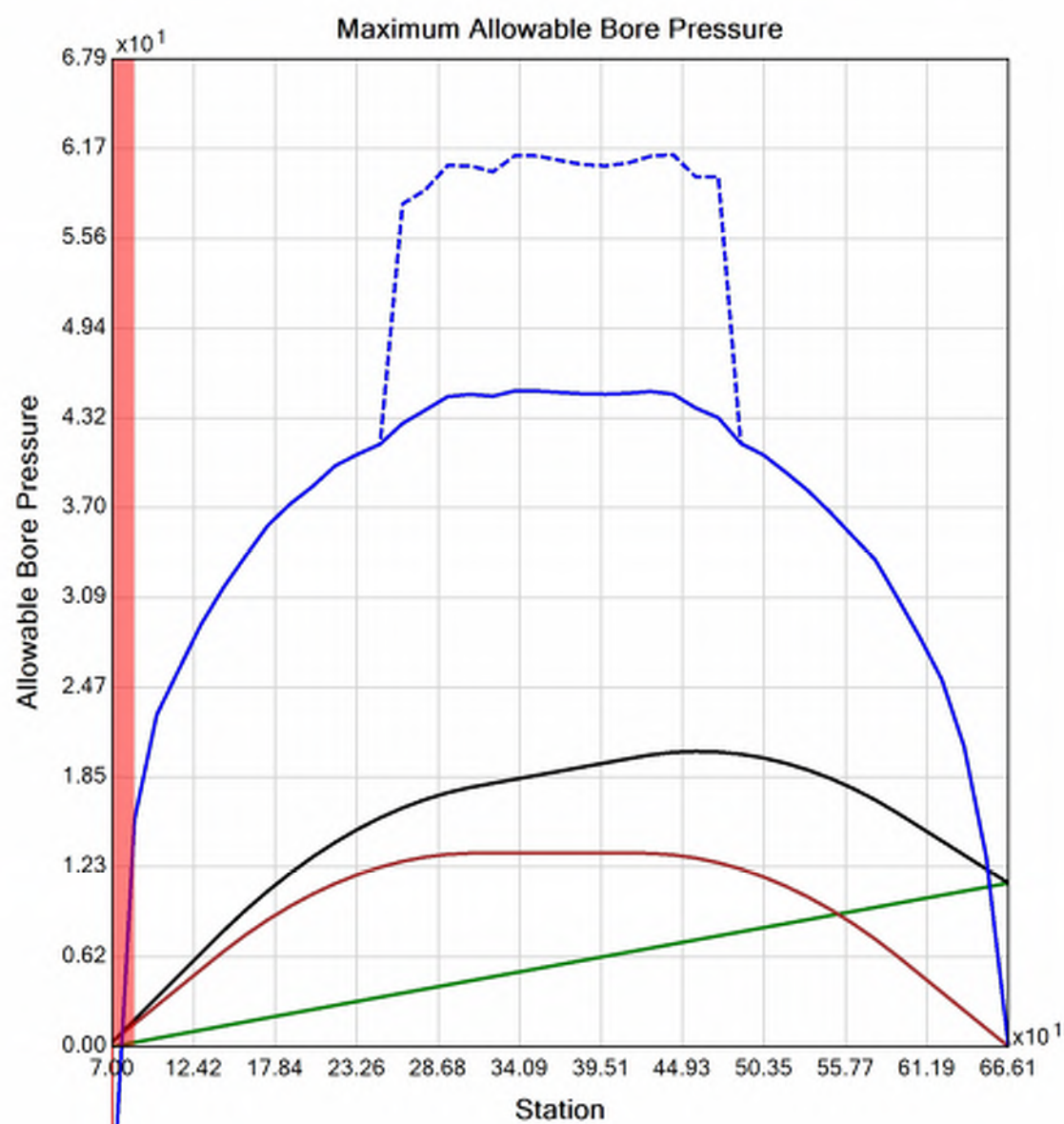
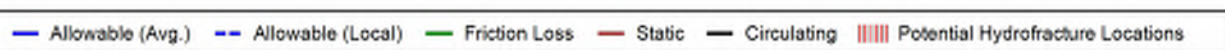














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## Input Summary

Start Coordinate	(70.00, 0.00, 141.10) ft
End Coordinate	(663.40, 0.00, 141.30) ft
Project Length	593.40 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



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## 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/ft<sup>3</sup>  
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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>

---

### In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	9.7	10.8
Water Pressure	8.4	9.4
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	18.0	20.1
<b>Deflection</b>		
Earth Load Deflection	2.632	2.942
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	2.661	2.971
<b>Compressive Stress [psi]</b>		
Compressive Wall Stress	81.2	90.5

### Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	605.6	605.6
Pullback Stress [psi]	346.0	346.0
Pullback Strain	6.018E-3	6.018E-3
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	346.0	351.2
Tensile Strain	6.018E-3	6.206E-3

Net External Pressure = 17.2 [psi ]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

---

### In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	2.661	7.5	2.8	OK
Unconstrained Collapse [psi]	18.0	108.8	6.0	OK
Compressive Wall Stress [psi]	81.2	1150.0	14.2	OK

### Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	28.1	237.1	8.4	OK
Tensile Stress [psi]	351.2	1200.0	3.4	OK



## Generated Output



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## Project Summary

General: CHPE HDD 20  
P2  
Start Date: 12-10-2021  
End Date: 12-10-2021

Project Owner: TDI  
Project Contractor: Kiewit  
Project Consultant: CHA/BCE

Designer:  
Description: HDD 20 10-inch DR 9

---

## Input Summary

Start Coordinate	(100.00, 0.00, 141.00) ft
End Coordinate	(1300.00, 0.00, 147.20) 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: 2.40 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), 100.0000 (sat) [lb/ft3]

Phi: 0.00, S.M.: 145.00, Coh: 3.13 [psi]

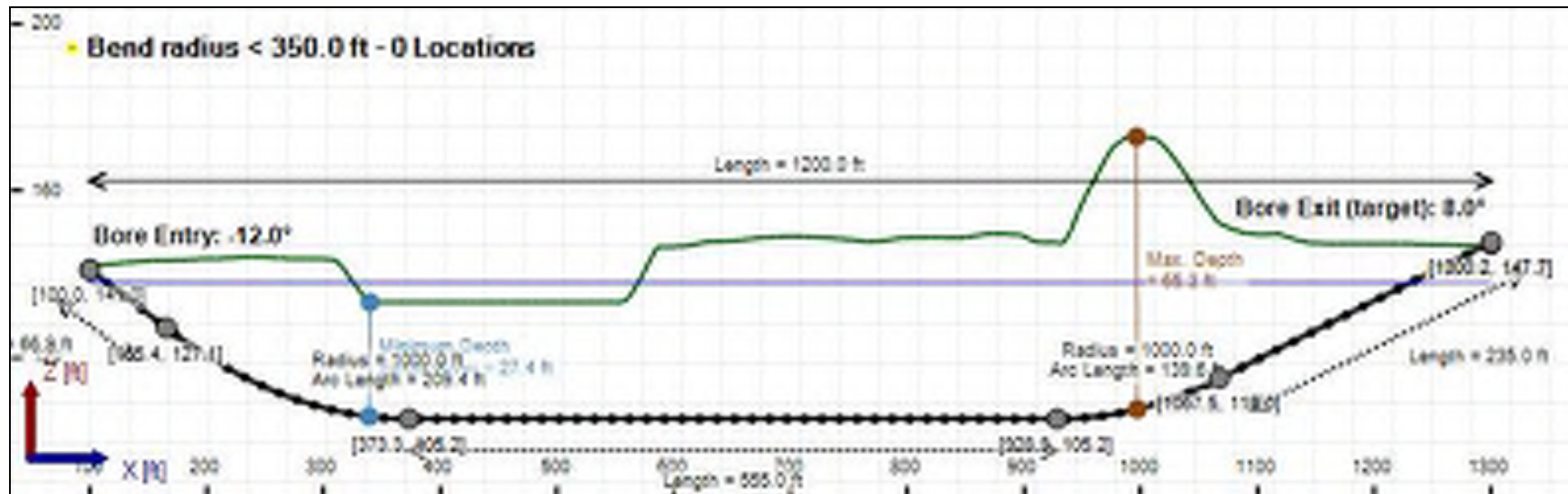
Soil Layer #6 USCS, Clay (C), CH

Depth: 23.00 ft

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

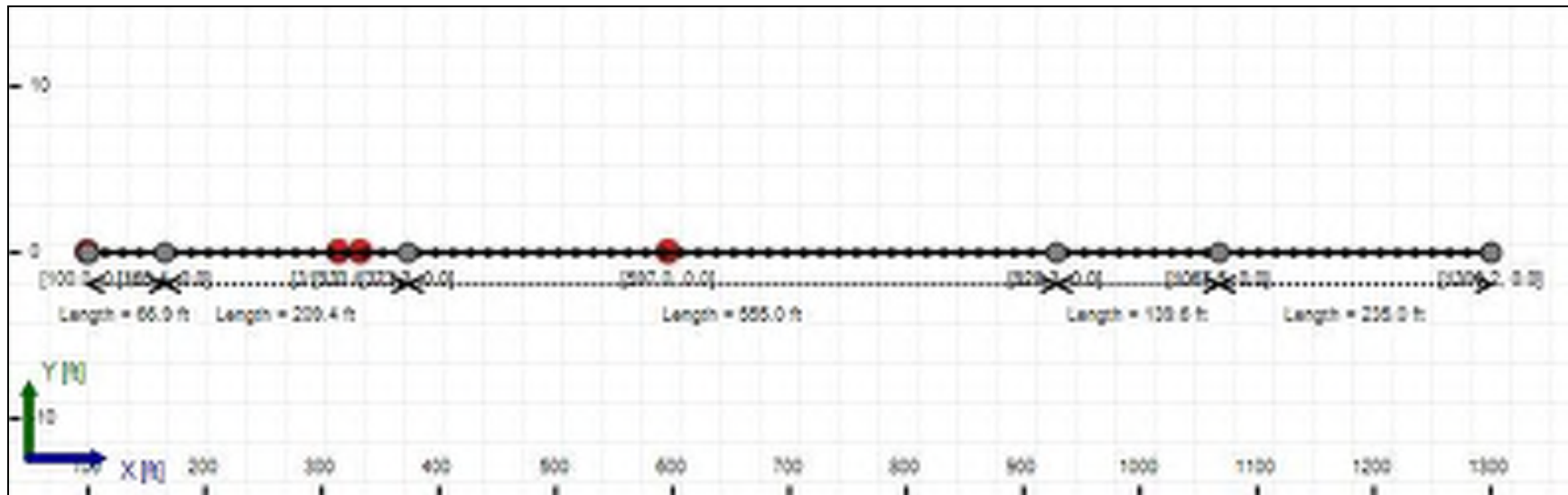
Phi: 0.00, S.M.: 145.00, Coh: 3.13 [psi]

## 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/ft<sup>3</sup>  
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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>

---

### In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	4.0	35.2
Water Pressure	14.2	13.2
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	18.2	48.4
<b>Deflection</b>		
Earth Load Deflection	1.131	9.597
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.263	9.729
<b>Compressive Stress [psi]</b>		
Compressive Wall Stress	82.0	217.9

### Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	20355.1	20355.1
Pullback Stress [psi]	567.7	567.7
Pullback Strain	9.873E-3	9.873E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	567.7	591.0
Tensile Strain	9.873E-3	1.073E-2

Net External Pressure = 23.3 [psi ]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

---

### In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.263	7.5	5.9	OK
Unconstrained Collapse [psi]	28.4	123.7	4.4	OK
Compressive Wall Stress [psi]	82.0	1150.0	14.0	OK

### Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	38.4	222.1	5.8	OK
Tensile Stress [psi]	591.0	1200.0	2.0	OK

---

## Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	107.090 psi	63.570 psi
1	8.00 in	12.00 in	107.070 psi	63.551 psi
2	12.00 in	16.13 in	107.041 psi	63.524 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/ft<sup>3</sup>

Rheological model: Bingham-Plastic

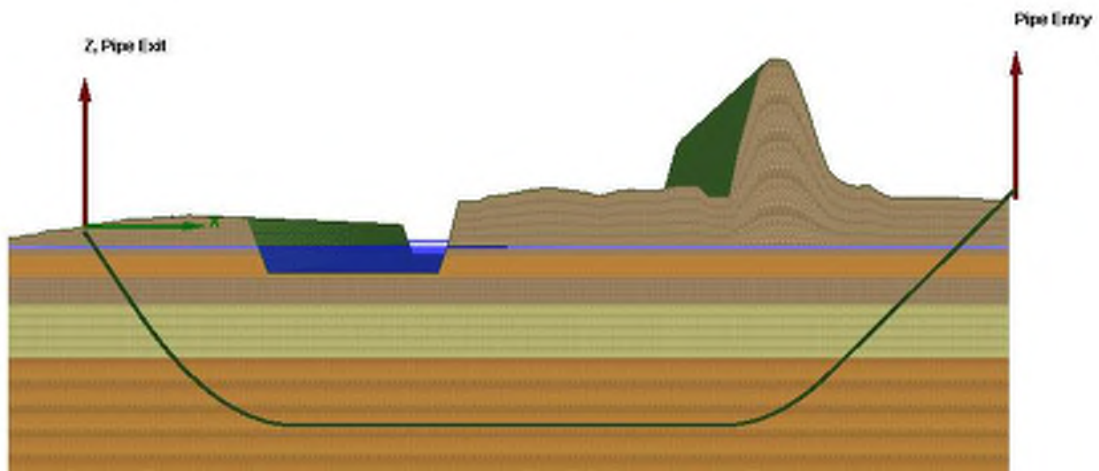
Plastic Viscosity (PV): 25.53

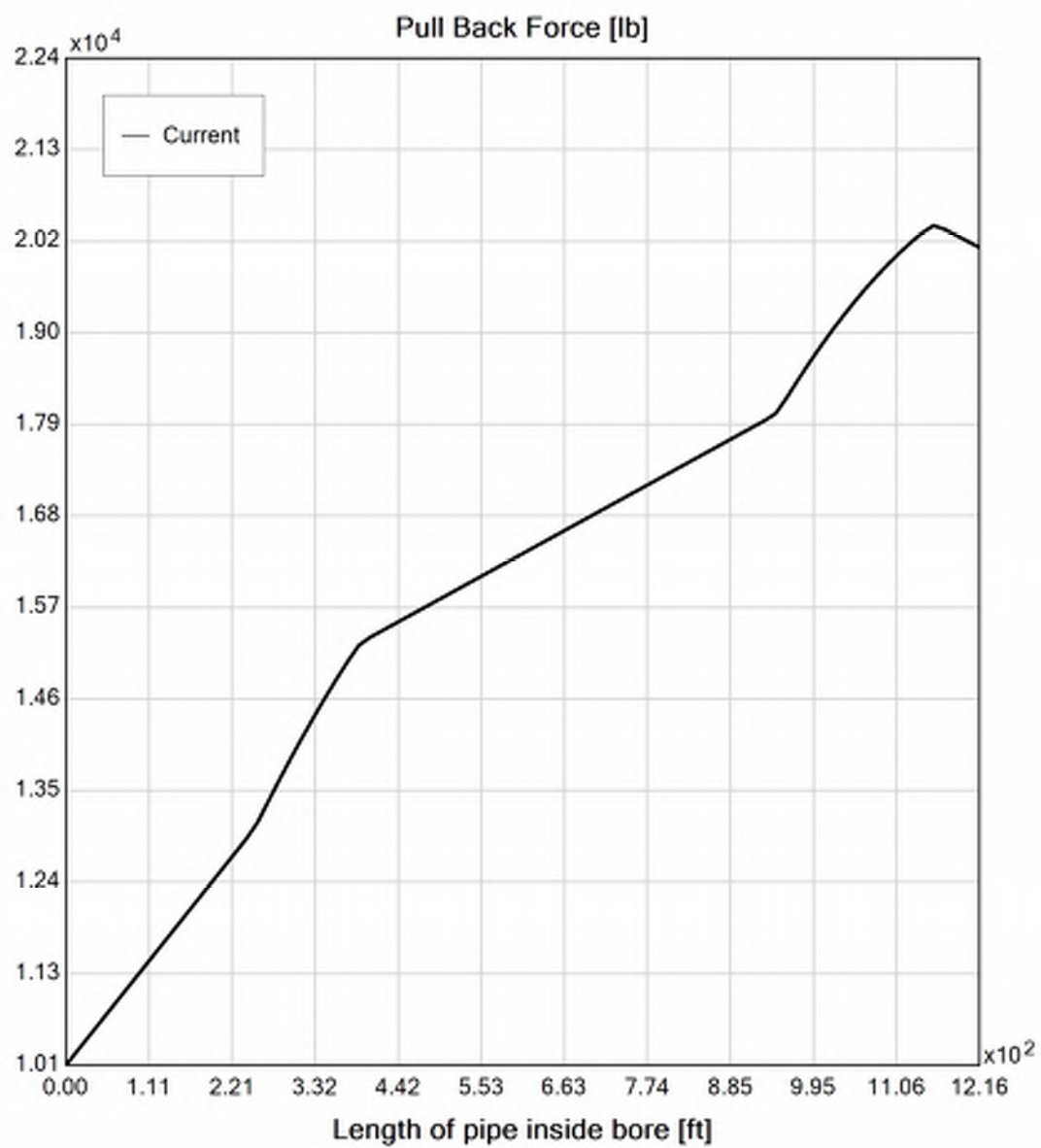
Yield Point (YP): 16.49

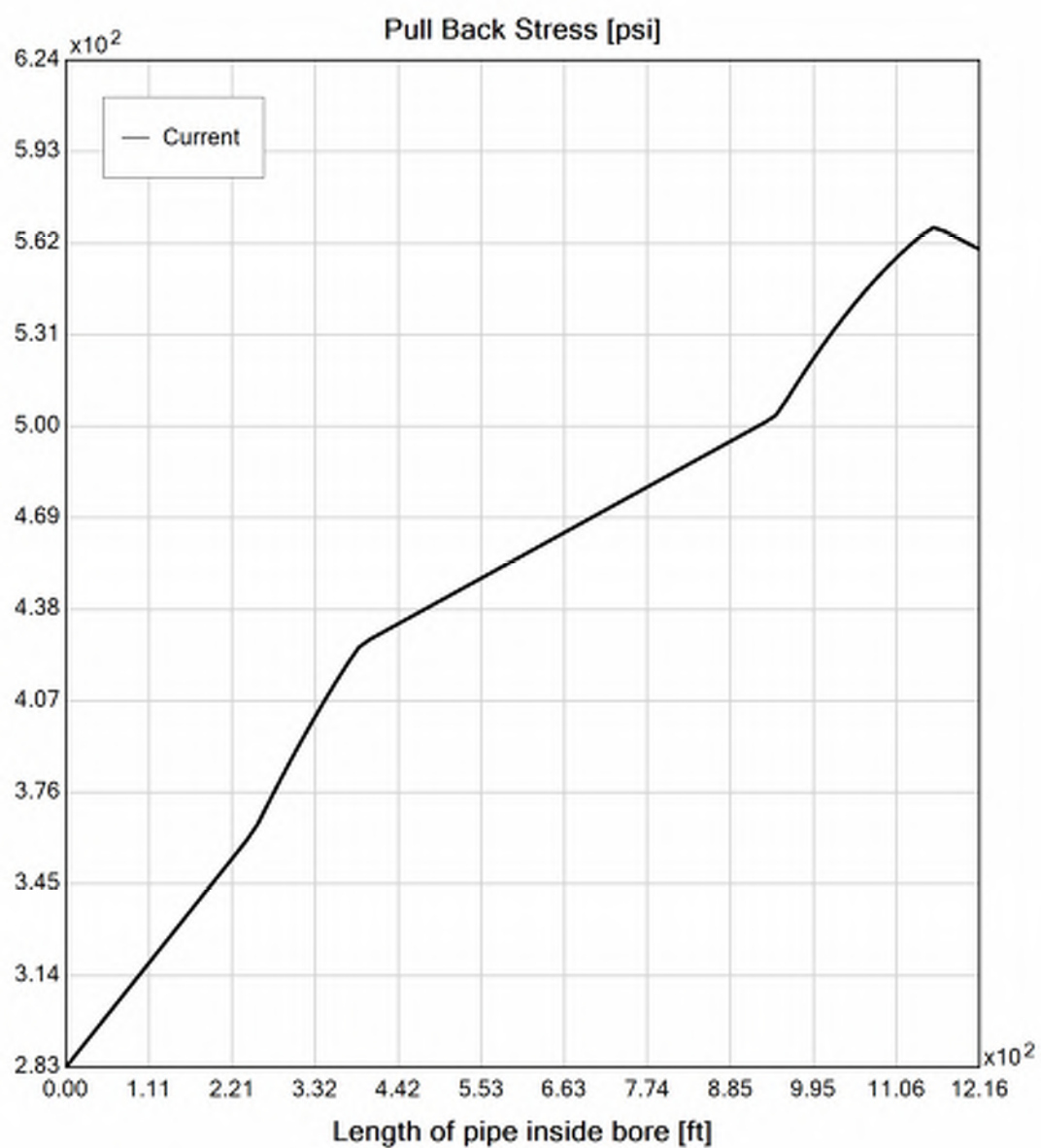
Effective Viscosity (cP): 1202.0

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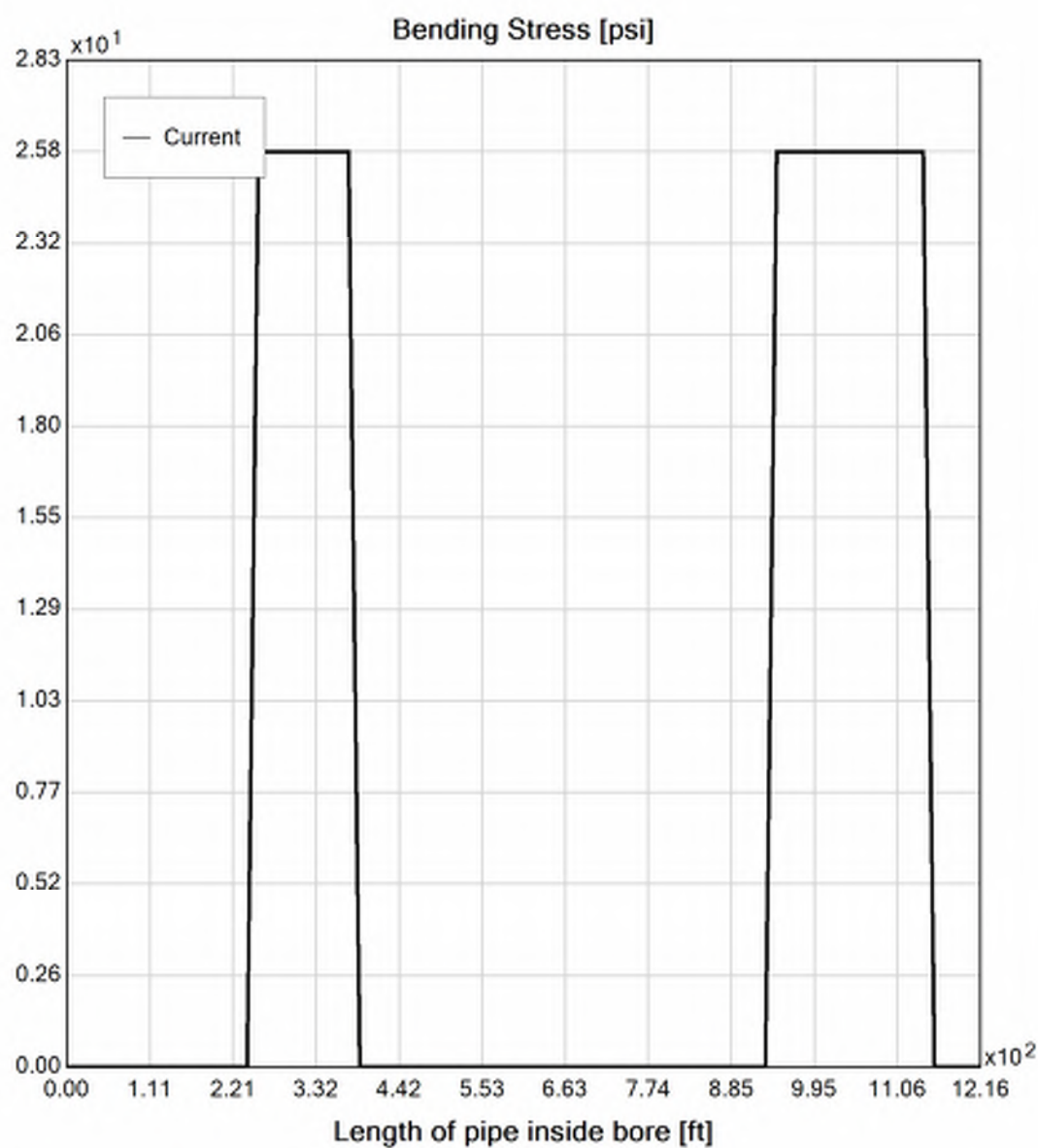
## Virtual Site

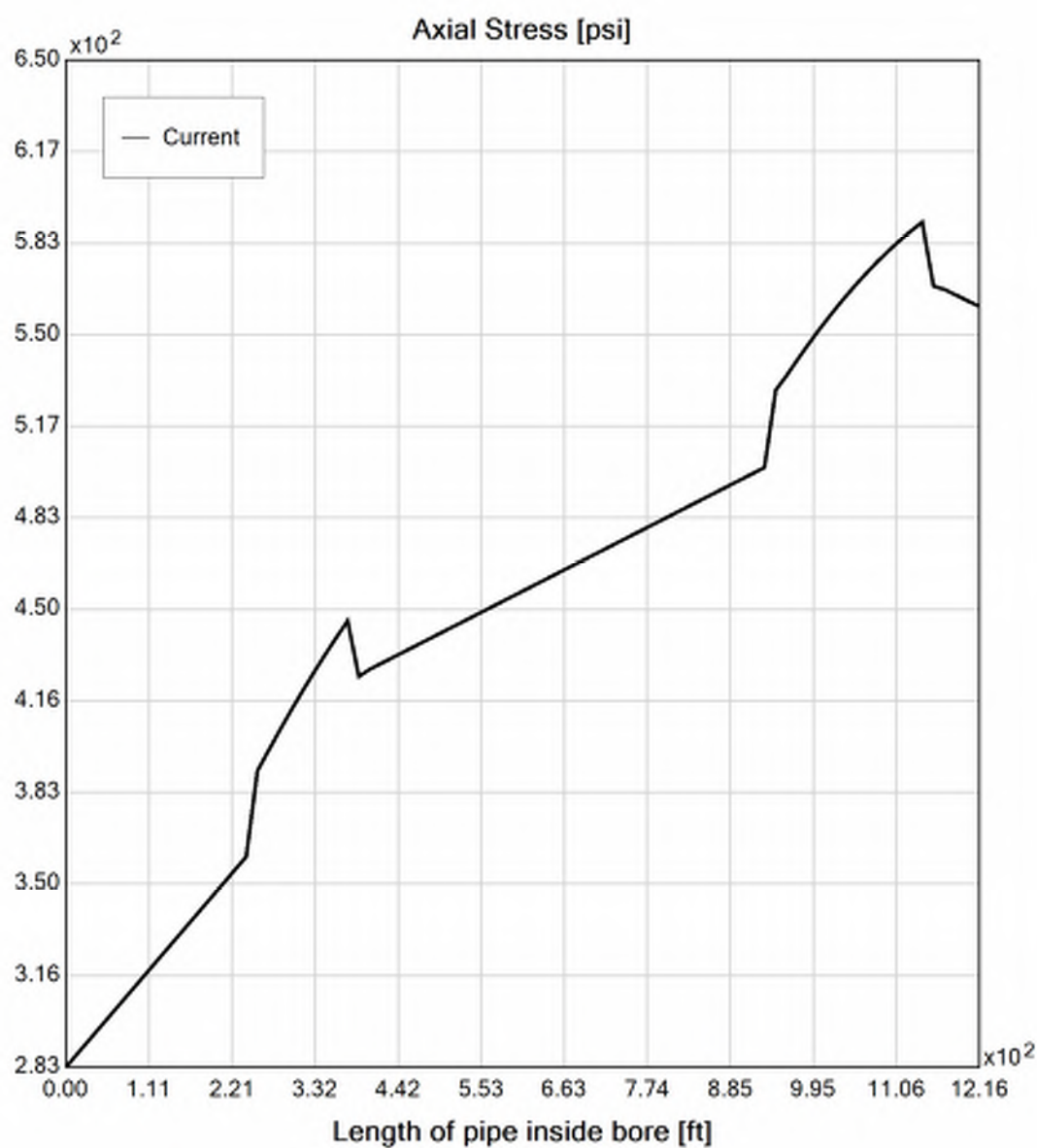


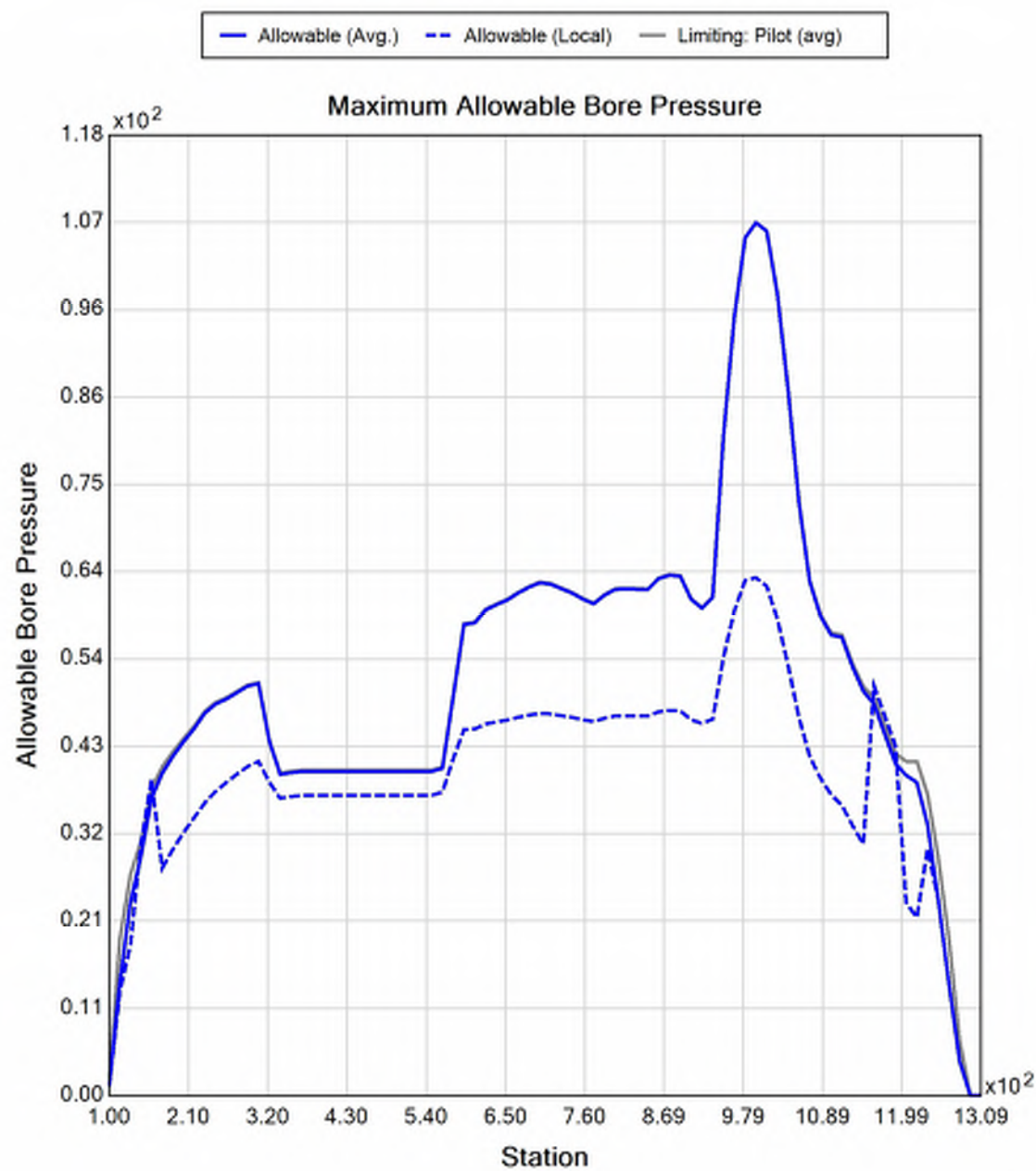


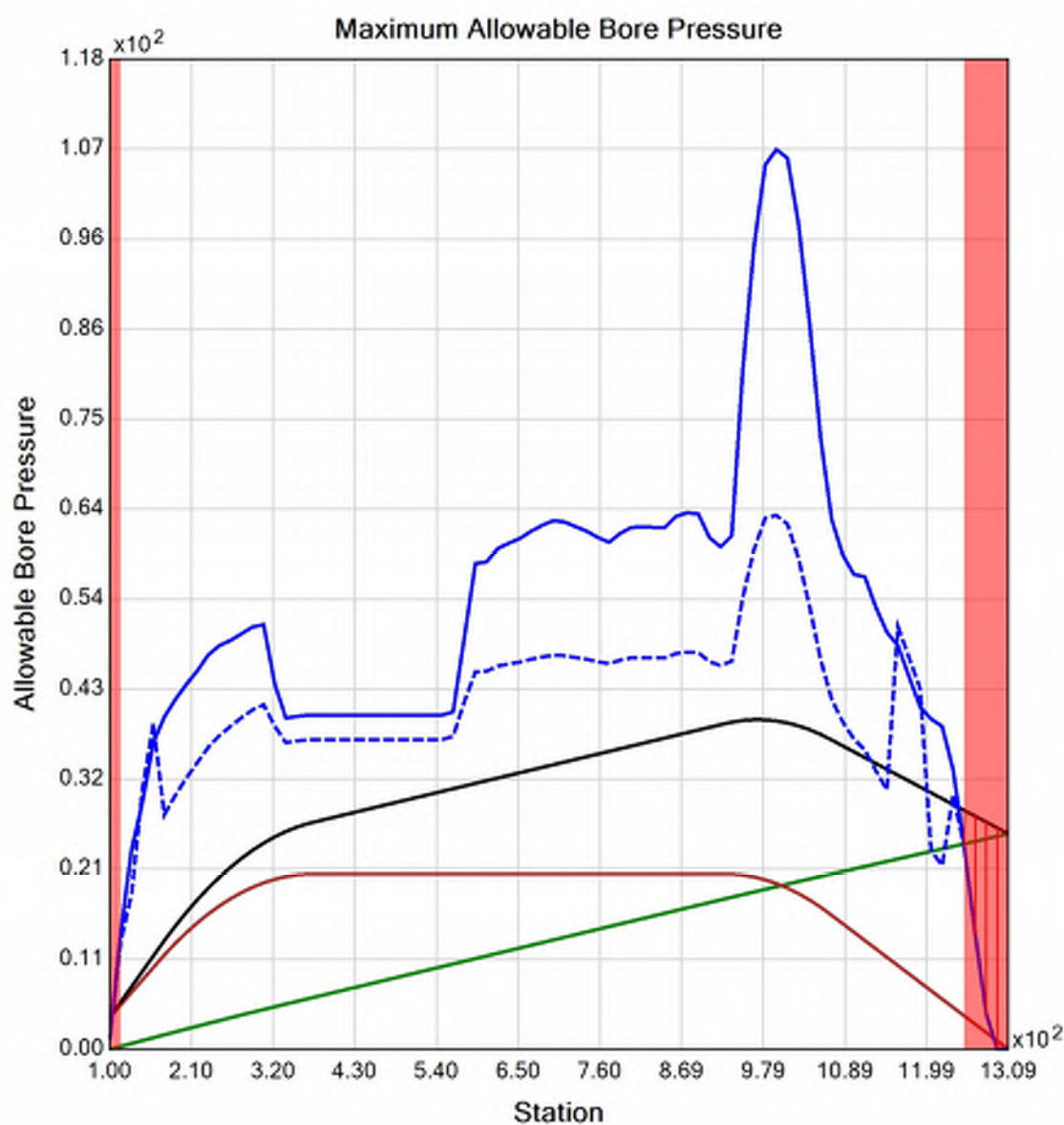














## Generated Output



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## Input Summary

Start Coordinate	(100.00, 0.00, 141.00) ft
End Coordinate	(1300.00, 0.00, 147.20) 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/ft<sup>3</sup>  
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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>

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### In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	1.9	35.2
Water Pressure	14.2	13.2
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	16.2	48.4
<b>Deflection</b>		
Earth Load Deflection	0.601	9.597
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	0.631	9.626
<b>Compressive Stress [psi]</b>		
Compressive Wall Stress	72.7	217.9

### Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	1103.1	1103.1
Pullback Stress [psi]	630.3	630.3
Pullback Strain	1.096E-2	1.096E-2
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	630.3	633.5
Tensile Strain	1.096E-2	1.112E-2

Net External Pressure = 23.3 [psi ]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb



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### In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.631	7.5	11.9	OK
Unconstrained Collapse [psi]	28.4	131.3	4.6	OK
Compressive Wall Stress [psi]	72.7	1150.0	15.8	OK

### Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	38.4	220.0	5.7	OK
Tensile Stress [psi]	633.5	1200.0	1.9	OK



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## Project Summary

General:	CHPE HDD 21 P2 Start Date: 09-14-2022 End Date: 09-14-2022
Project Owner:	TDI
Project Contractor:	Kiewit
Project Consultant:	CHA/BCE
Designer:	
Description:	HDD 21 10-inch DR 9

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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	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

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## 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]

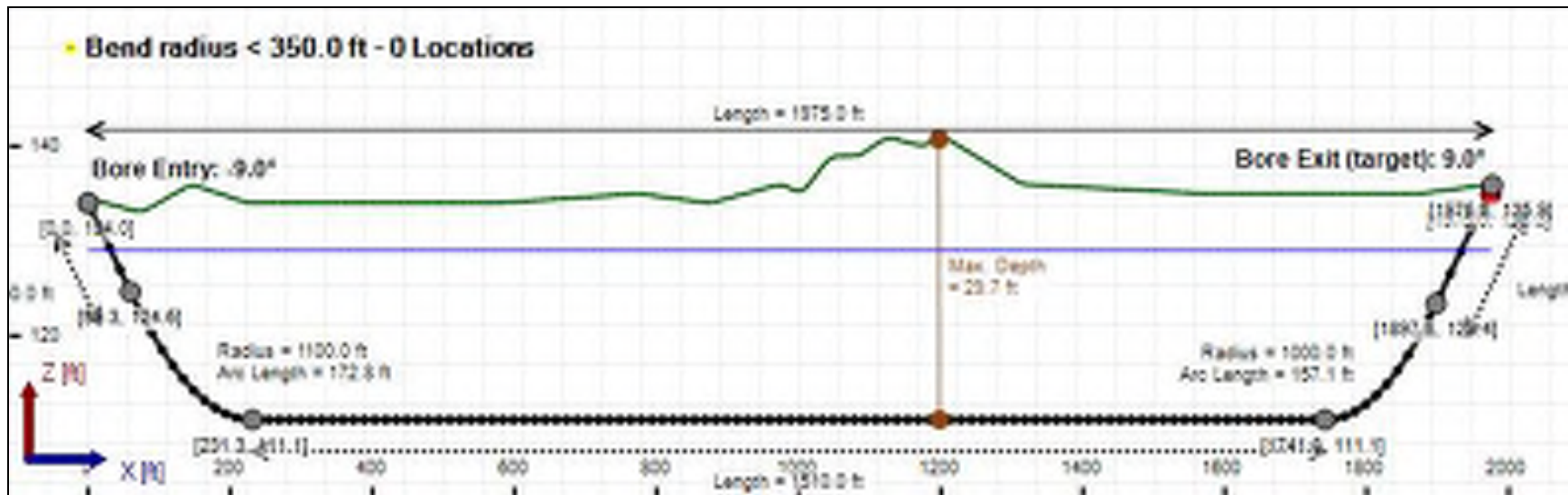
Soil Layer #6 Rock, Geological Classification, Sedimentary Rocks

From Assistant

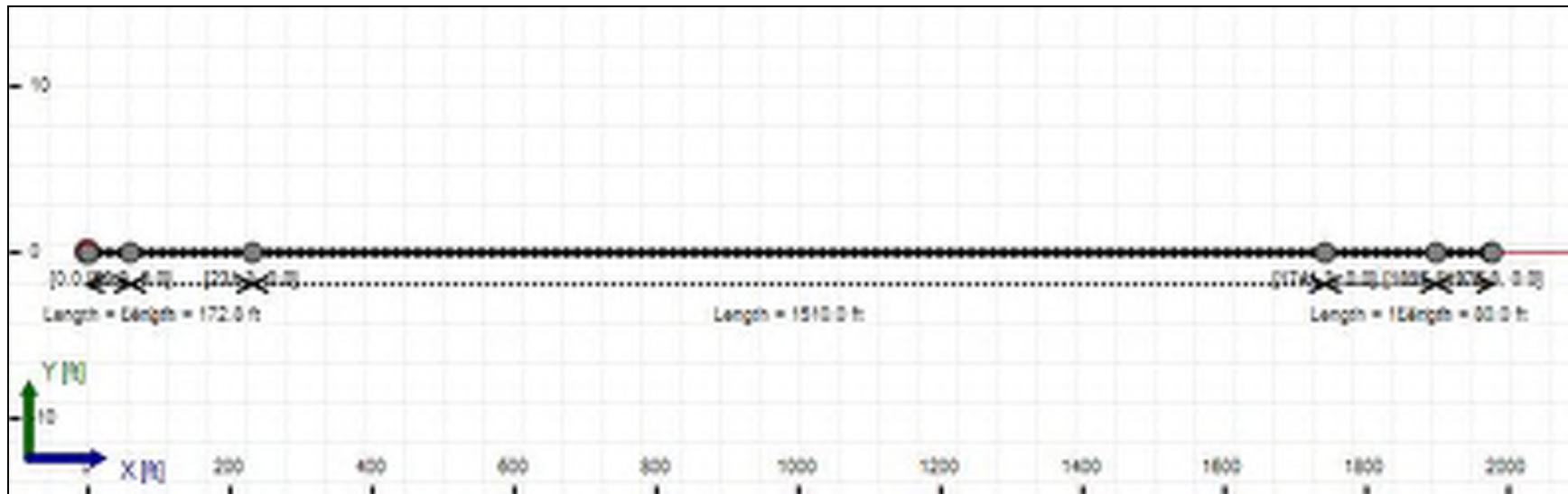
Unit Weight: 165.0000 (dry), 177.0000 (sat) [lb/ft3]

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/ft<sup>3</sup>  
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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>



---

### 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
<b>Deflection</b>		
Earth Load Deflection	2.868	3.703
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	3.000	3.835
<b>Compressive Stress [psi]</b>		
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/ft<sup>3</sup>

Rheological model: Bingham-Plastic

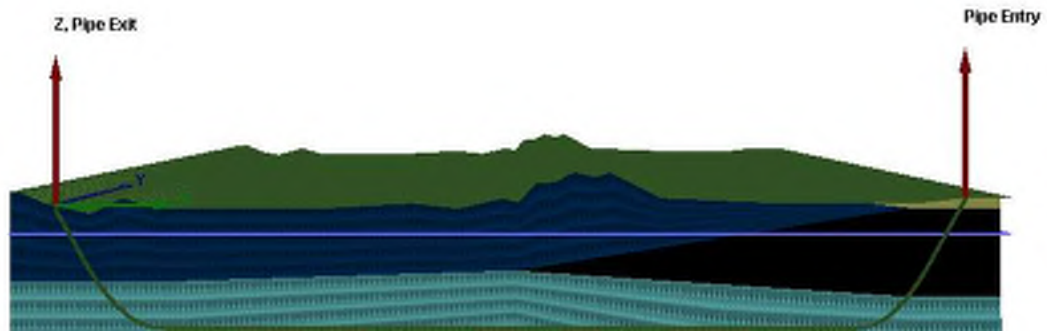
Plastic Viscosity (PV): 25.53

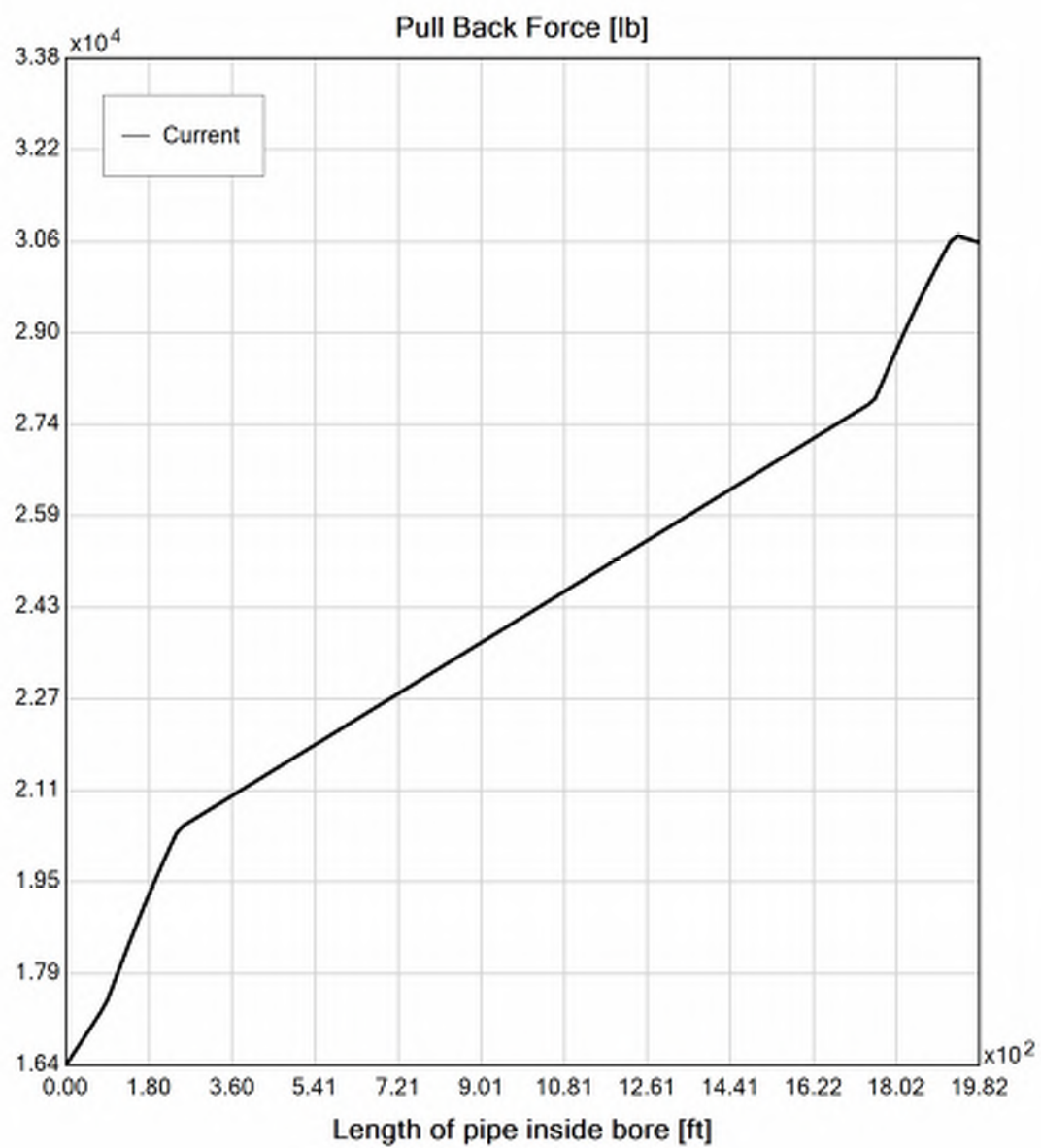
Yield Point (YP): 16.49

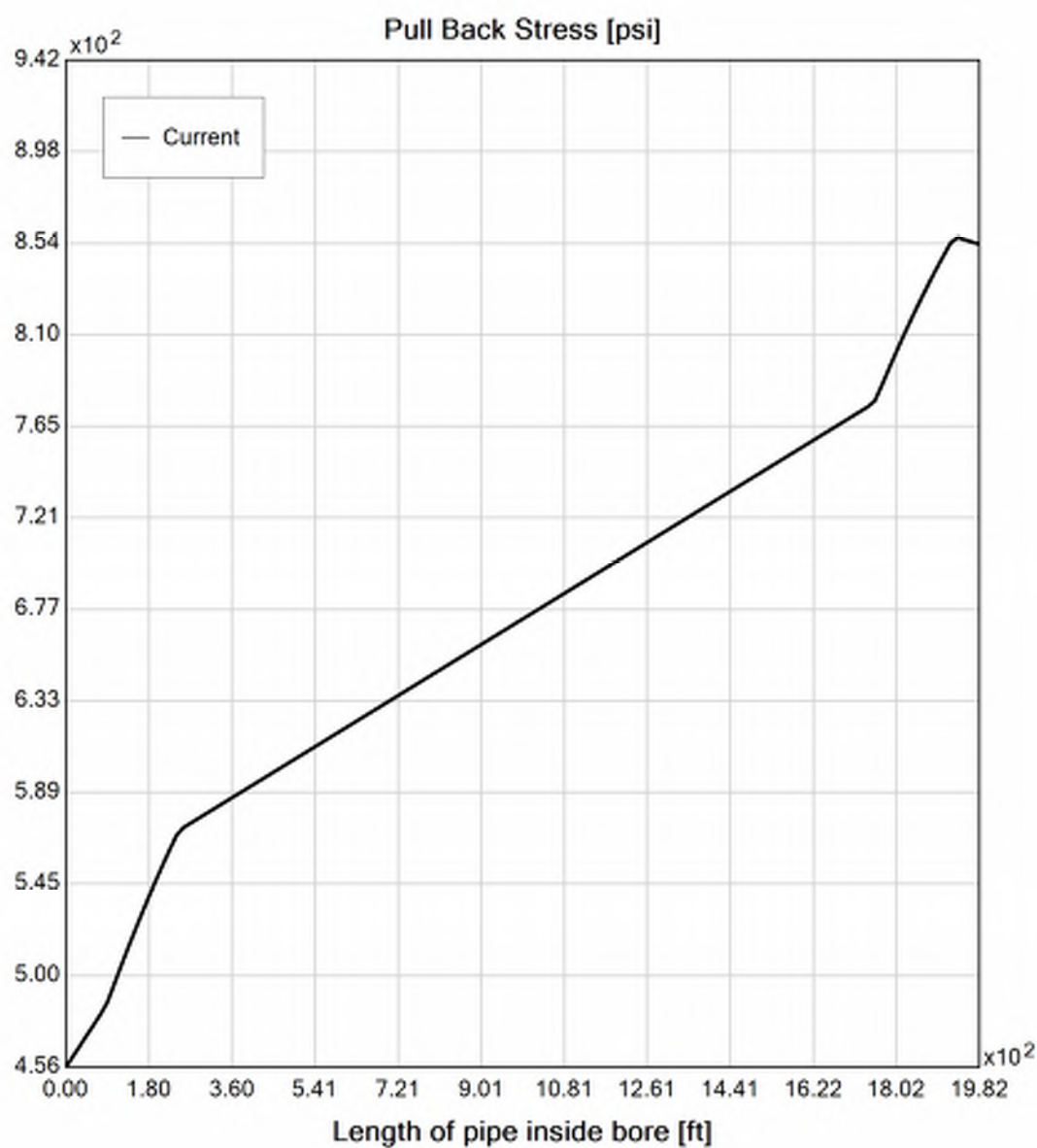
Effective Viscosity (cP): 1207.7

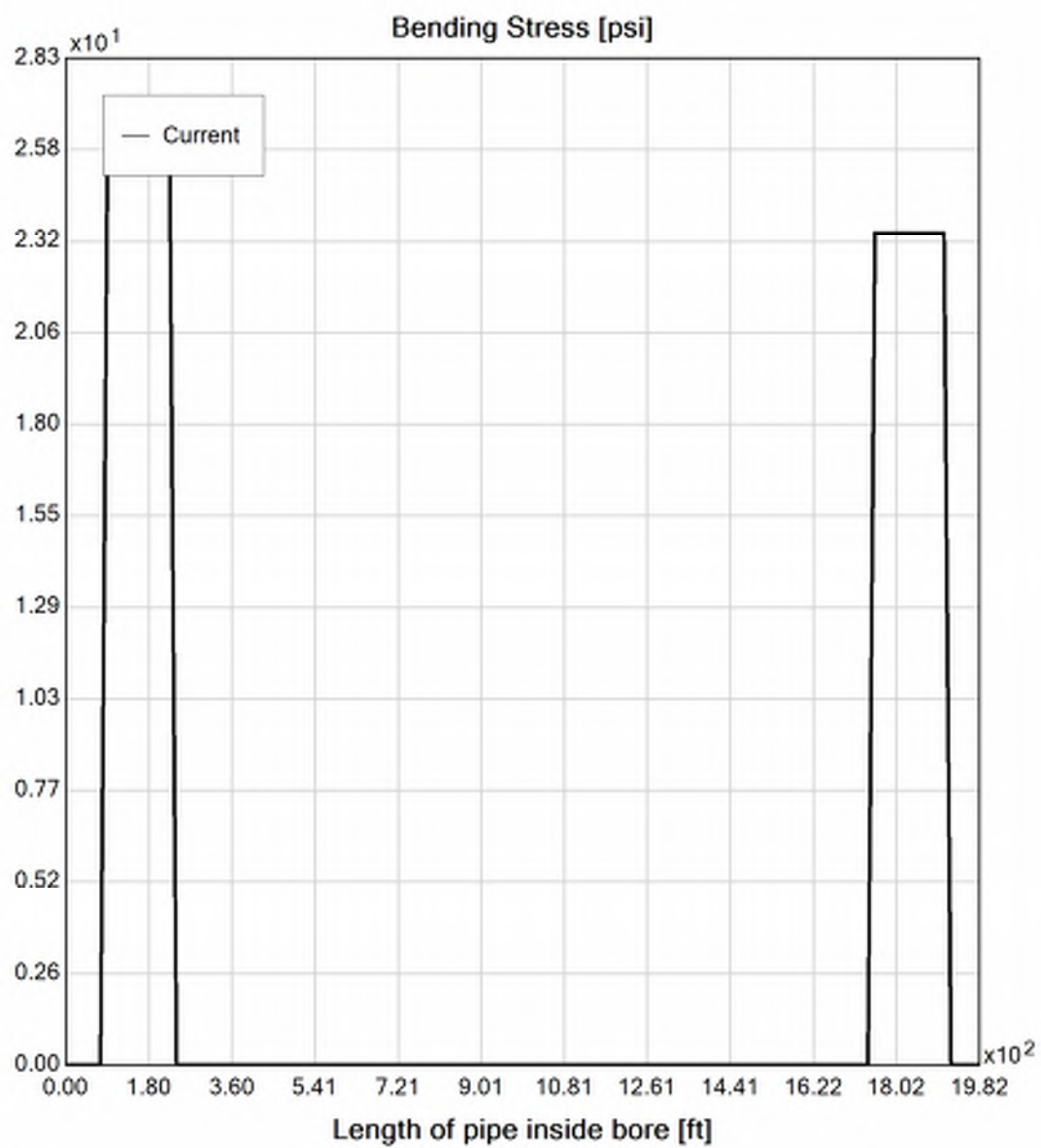
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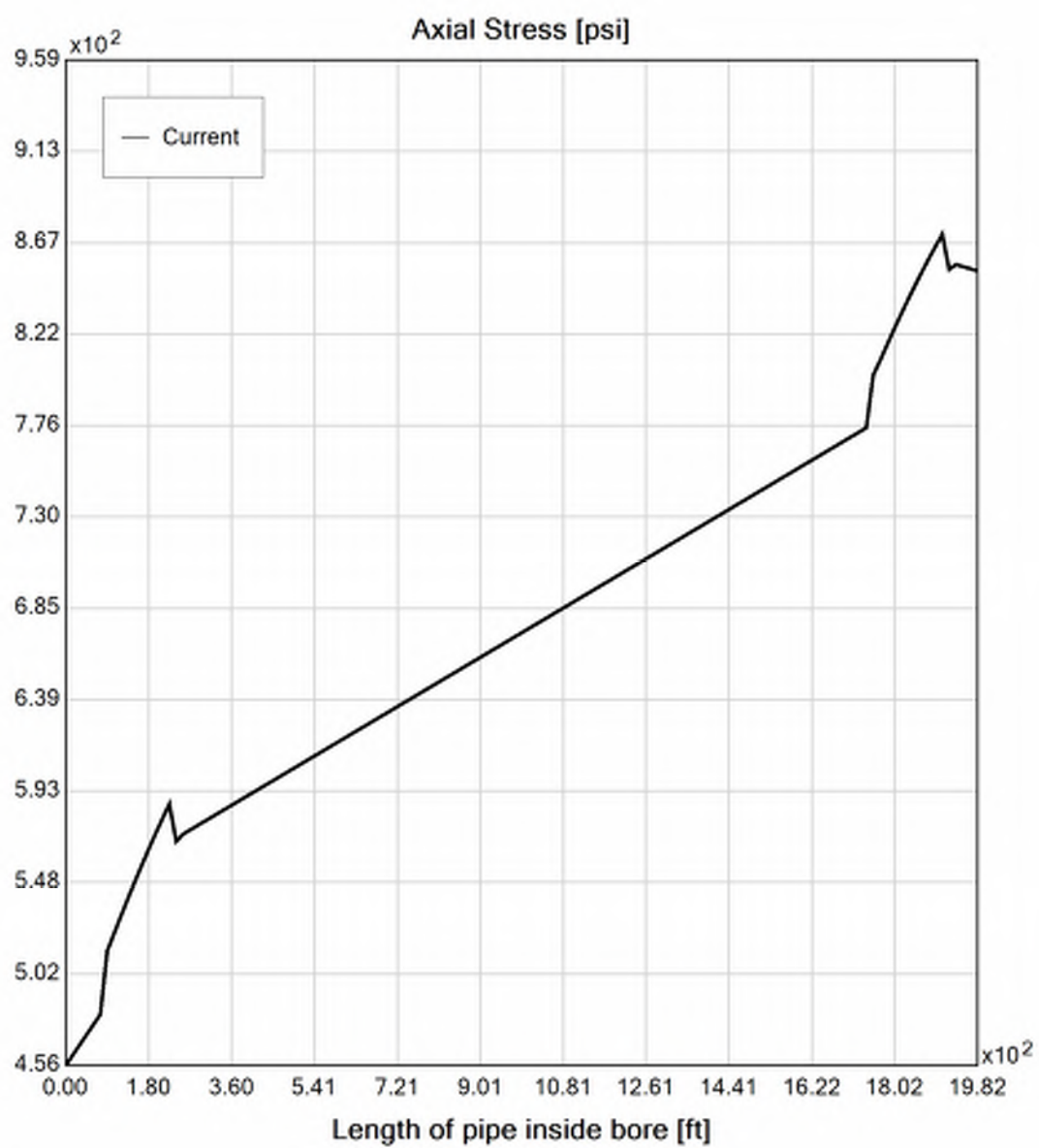
## Virtual Site



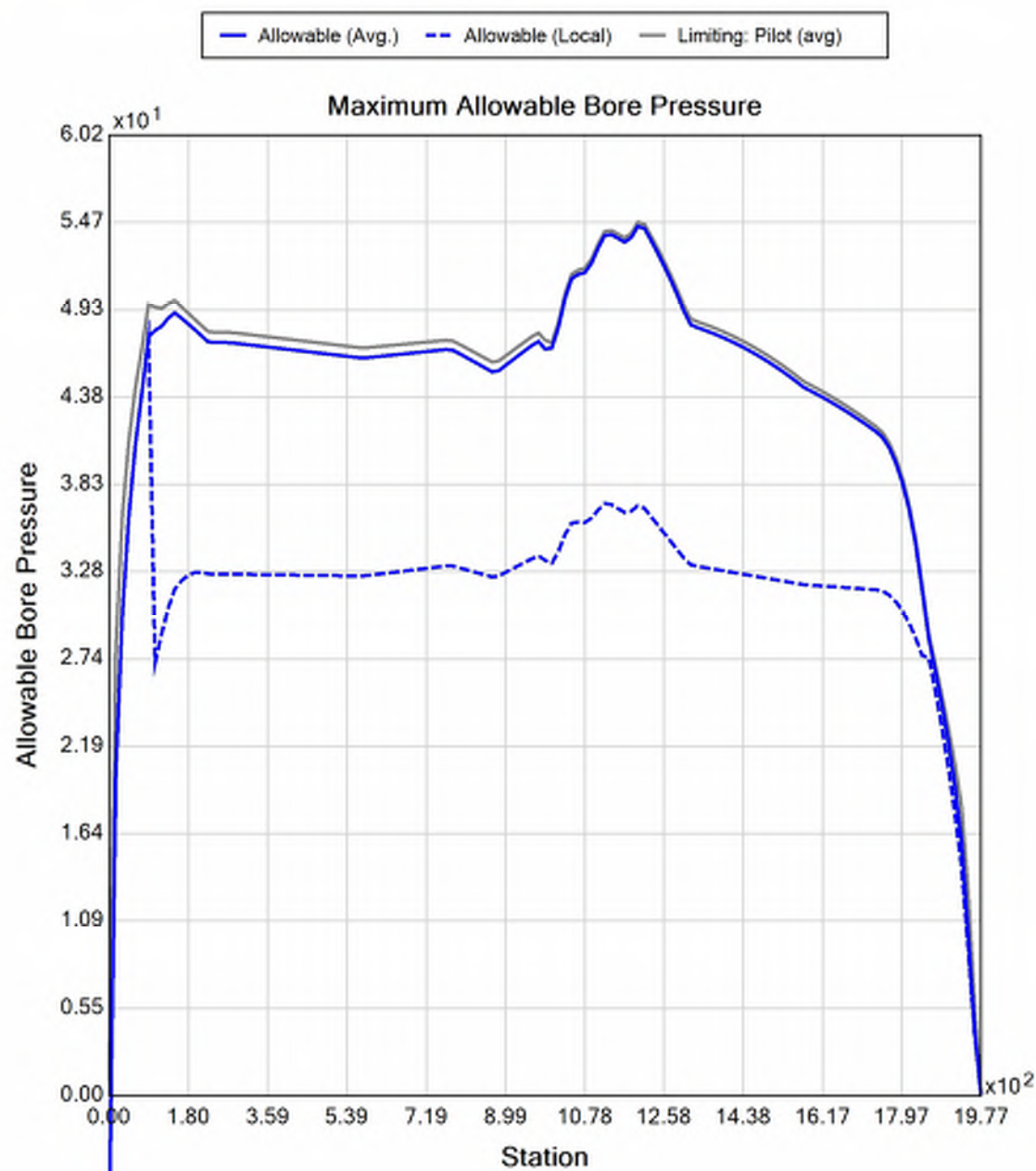


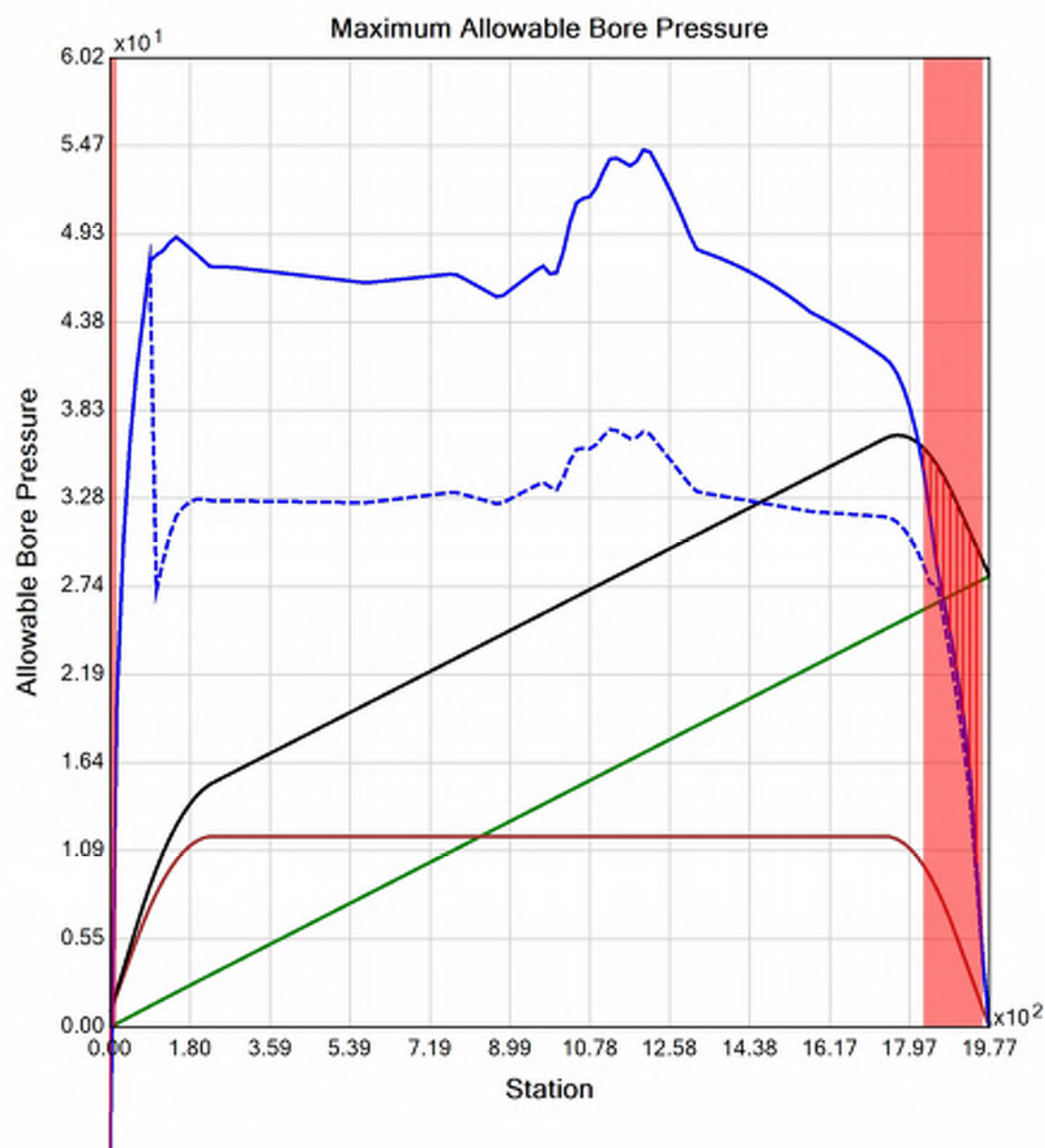














## Generated Output



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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/ft<sup>3</sup>  
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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>

---

### 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	18.2	21.4
<b>Deflection</b>		
Earth Load Deflection	2.848	3.703
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	2.877	3.732
<b>Compressive Stress [psi]</b>		
Compressive Wall Stress	82.0	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 [%]	2.877	7.5	2.6	OK
Unconstrained Collapse [psi]	18.2	106.7	5.9	OK
Compressive Wall Stress [psi]	82.0	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



## Generated Output



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---

## Project Summary

General:	CHPE HDD 21A P2 Start Date: 09-15-2022 End Date: 09-15-2022
Project Owner:	TDI
Project Contractor:	Kiewit
Project Consultant:	CHA/BCE
Designer:	
Description:	HDD 21A 10-inch 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	2.875 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]

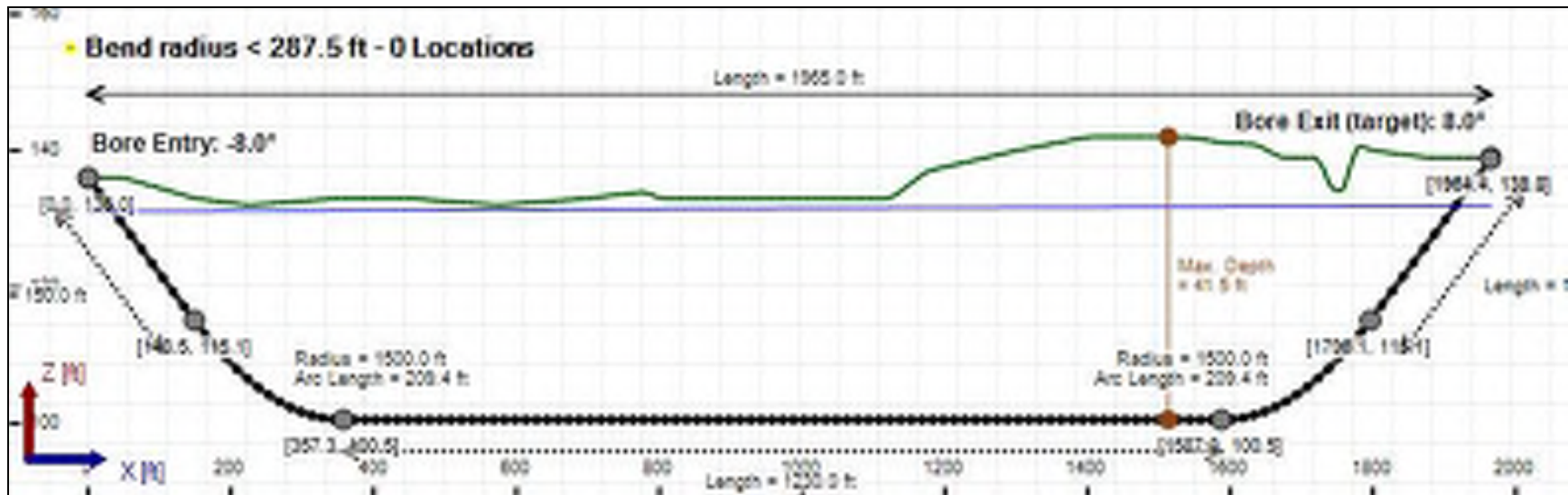
Soil Layer #5 Rock, Geological Classification, Sedimentary Rocks

From Assistant

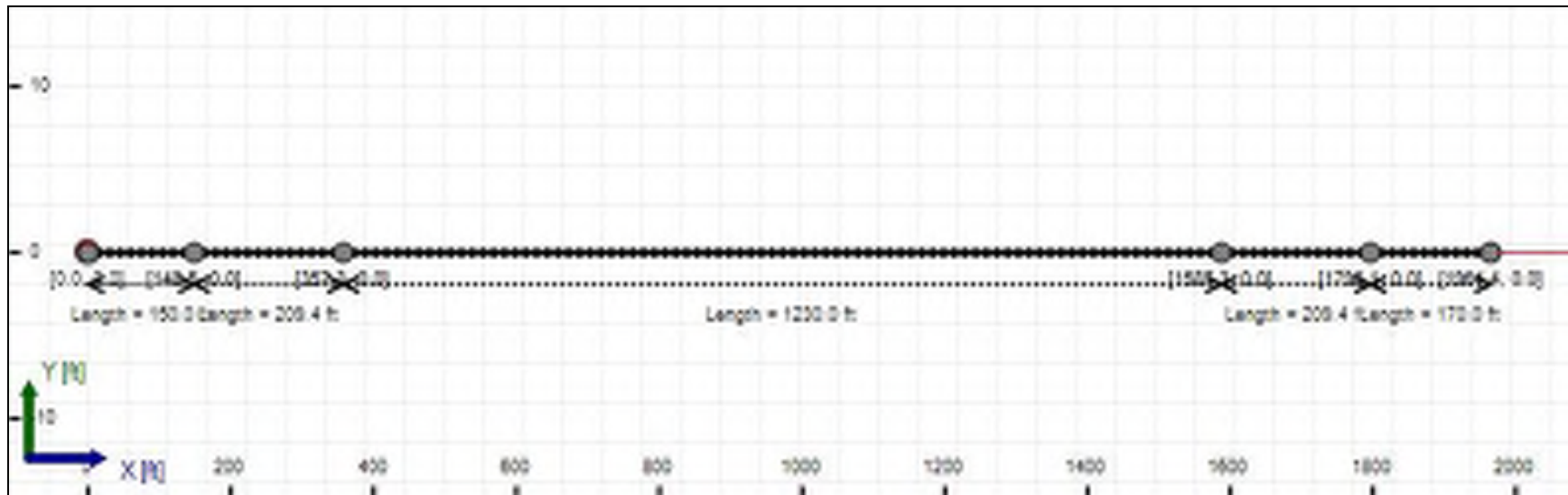
Unit Weight: 165.0000 (dry), 177.0000 (sat) [lb/ft3]

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/ft<sup>3</sup>  
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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>

---

### 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
<b>Deflection</b>		
Earth Load Deflection	2.944	5.418
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	3.076	5.550
<b>Compressive Stress [psi]</b>		
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/ft<sup>3</sup>

Rheological model: Bingham-Plastic

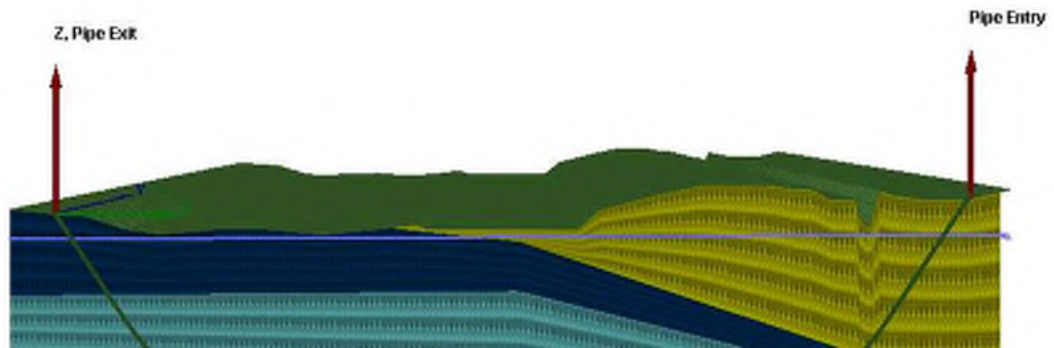
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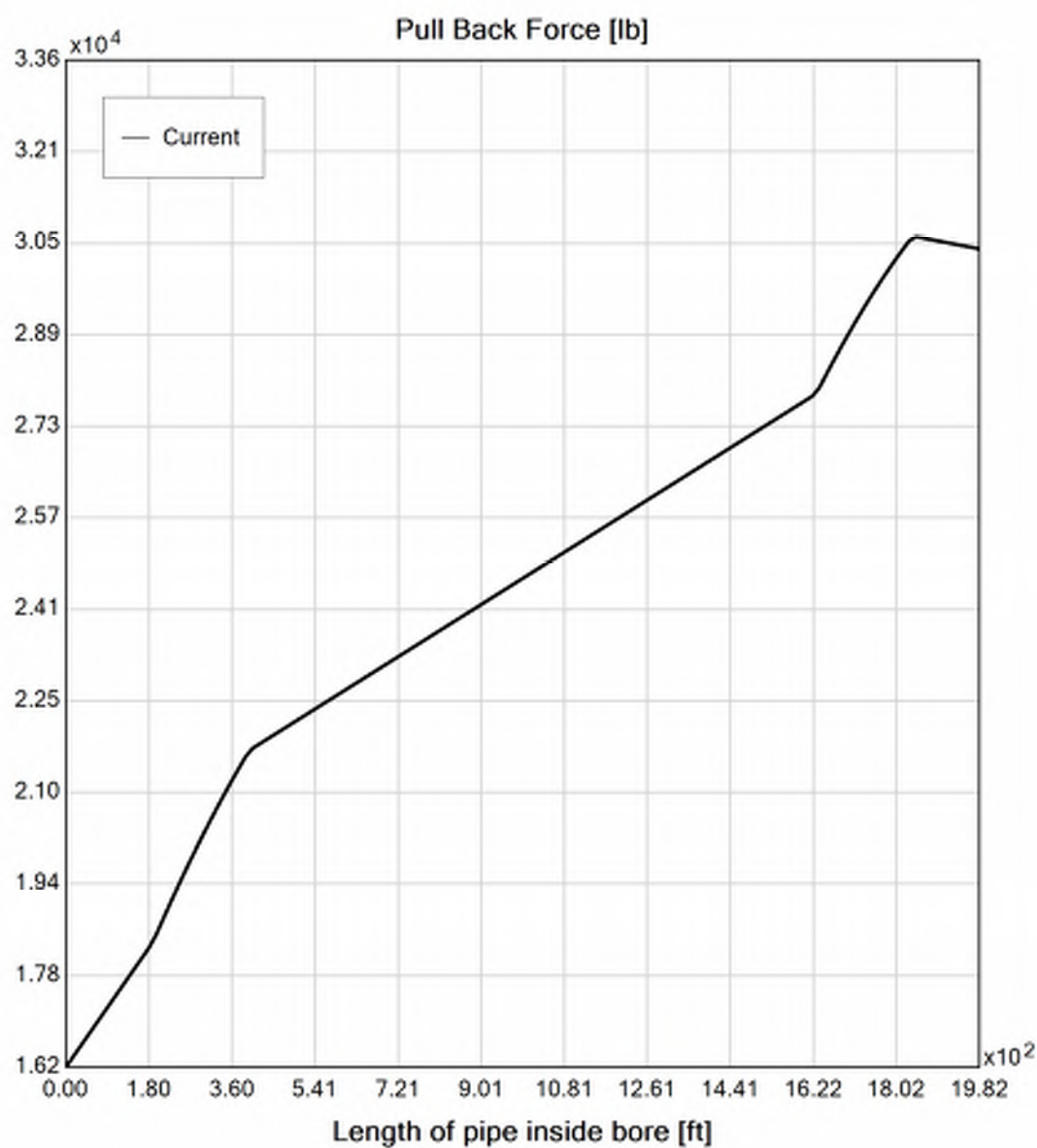
Yield Point (YP): 16.49

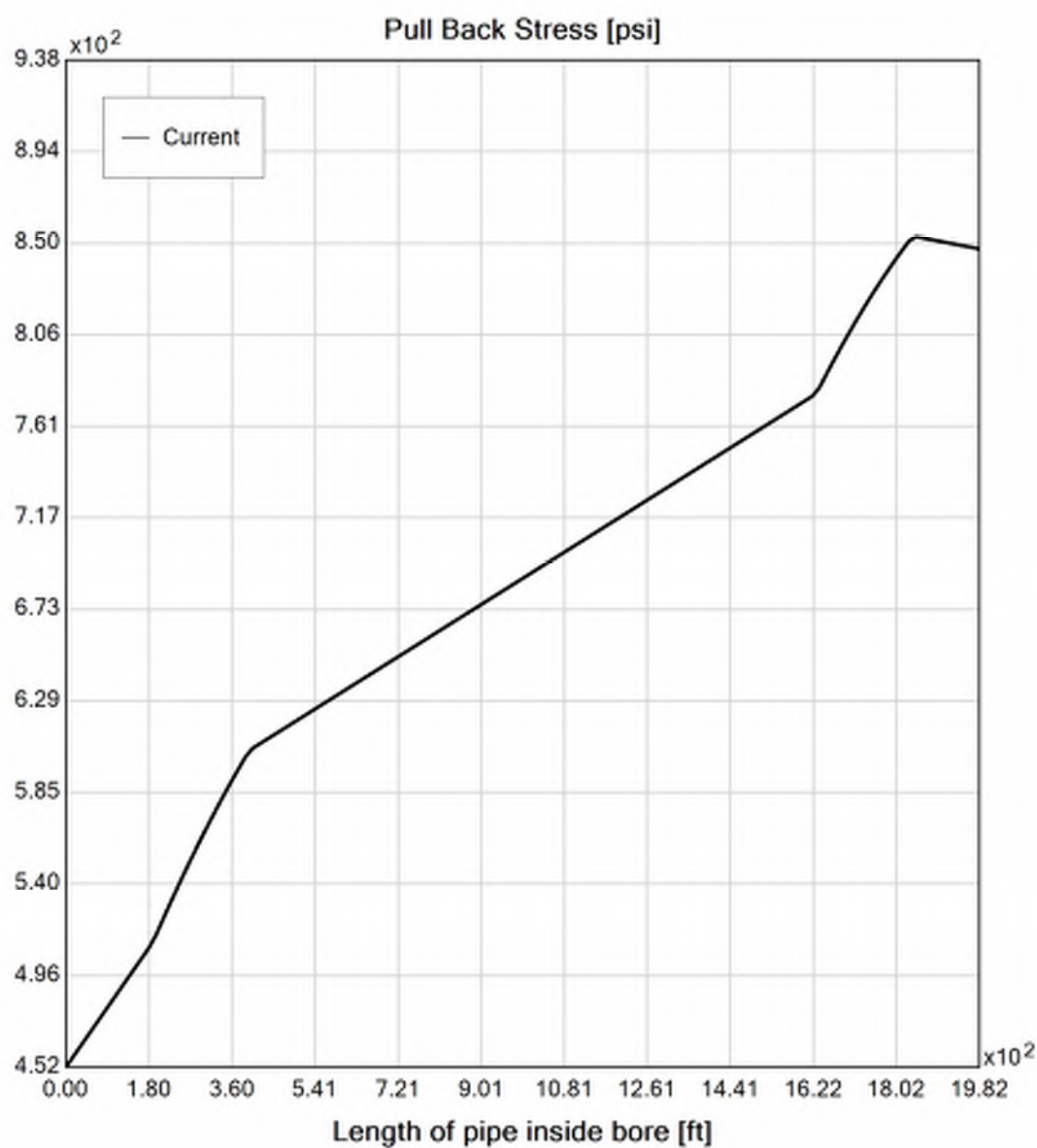
Effective Viscosity (cP): 1397.5

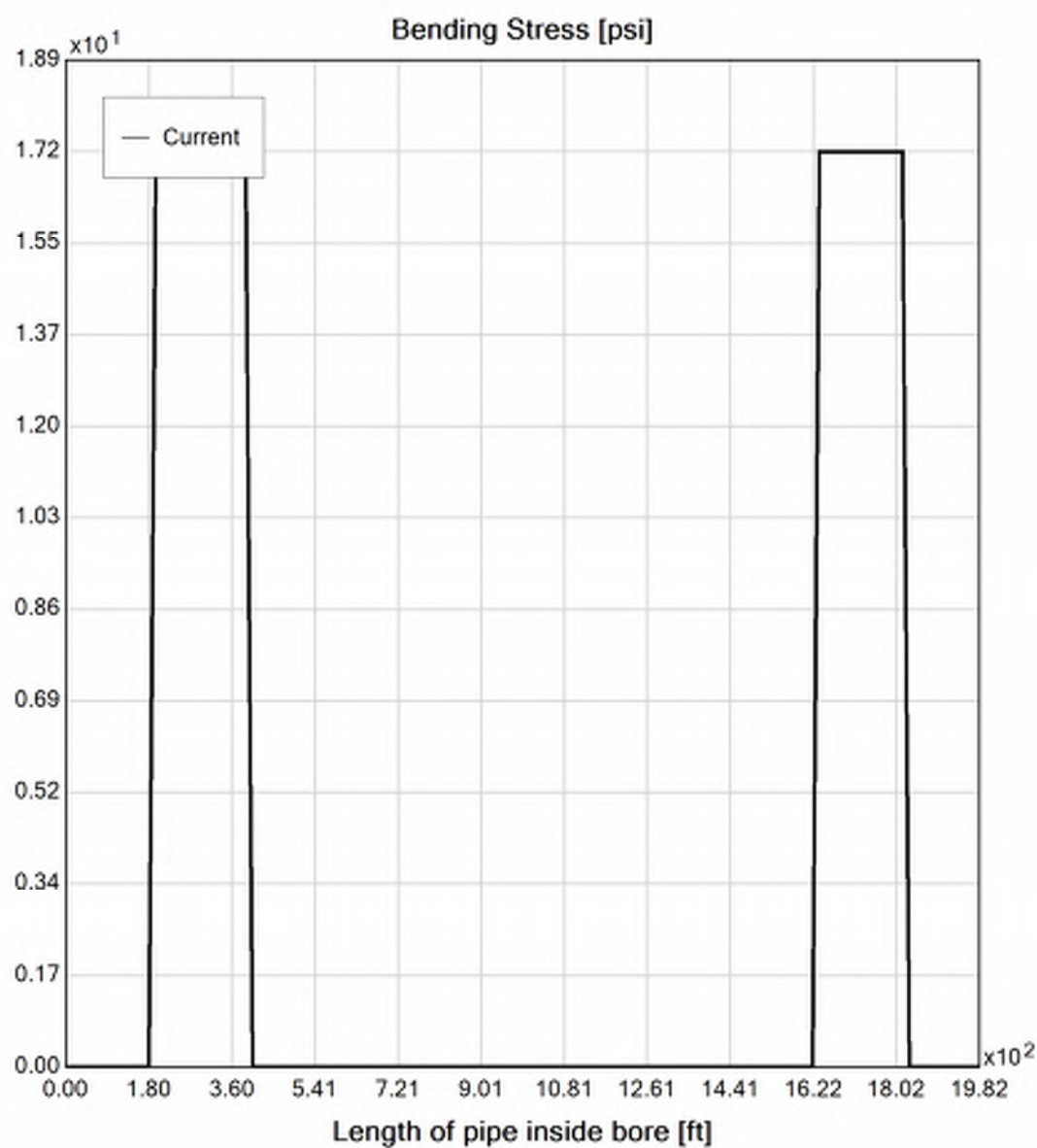
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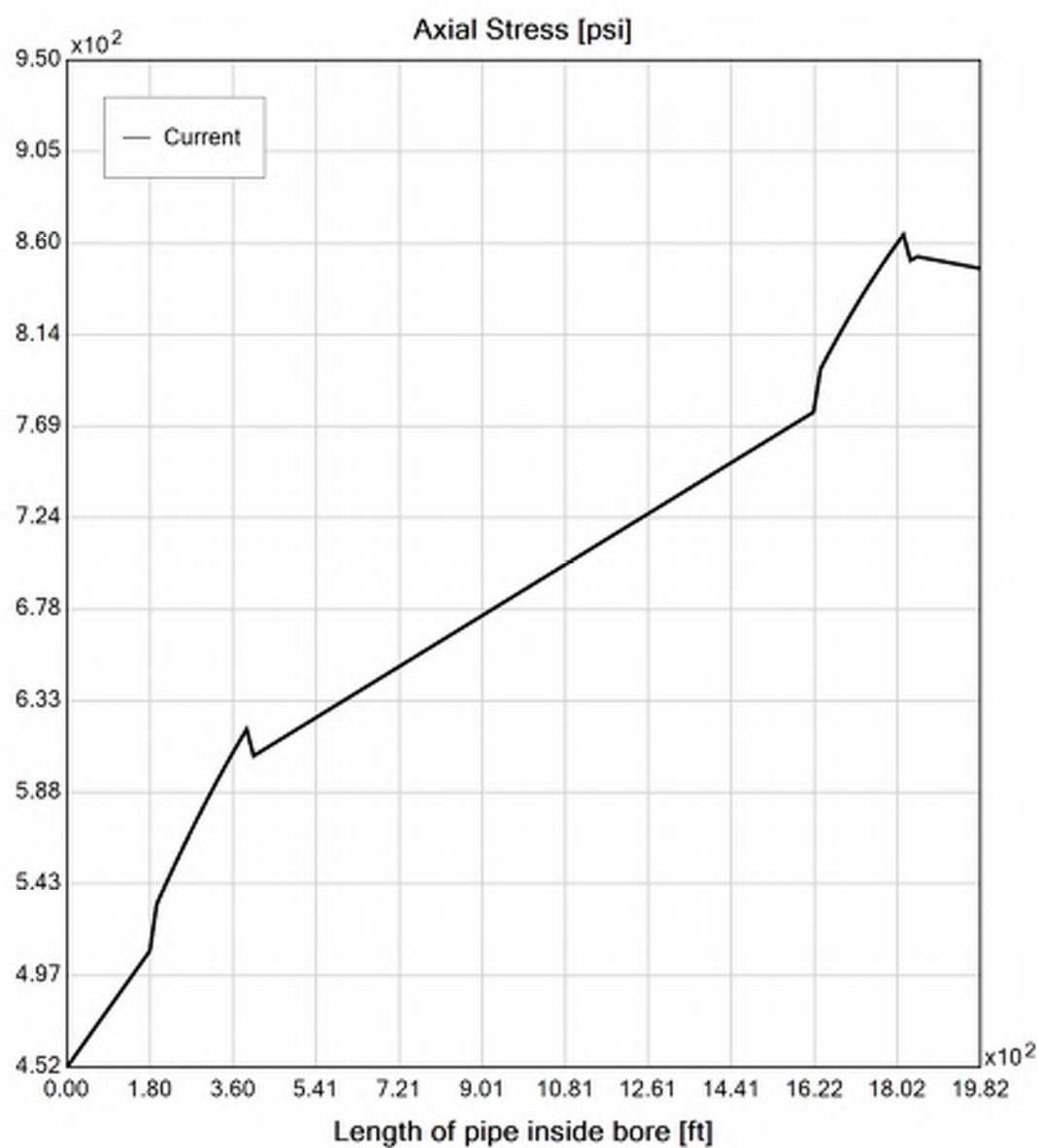
## Virtual Site

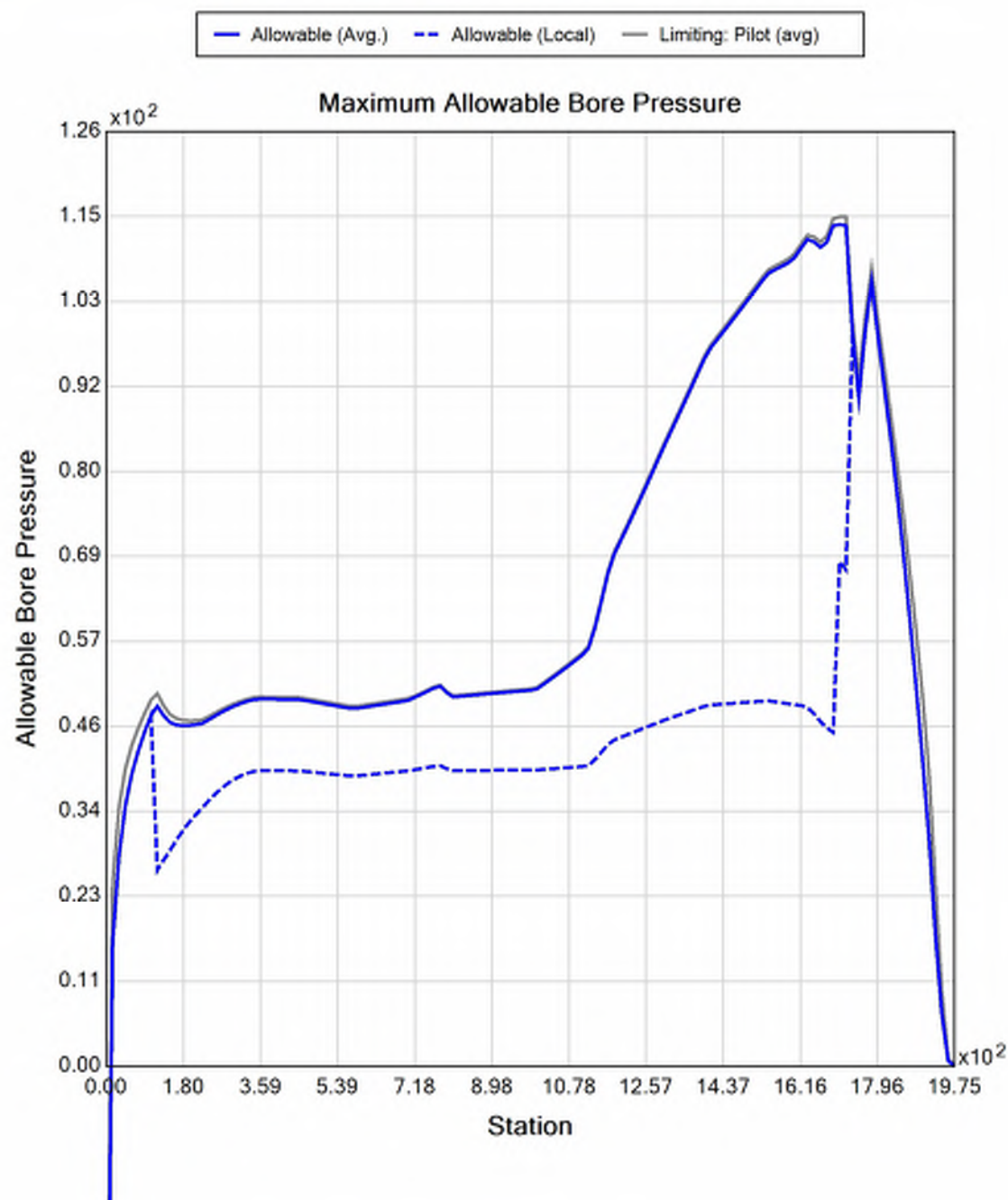


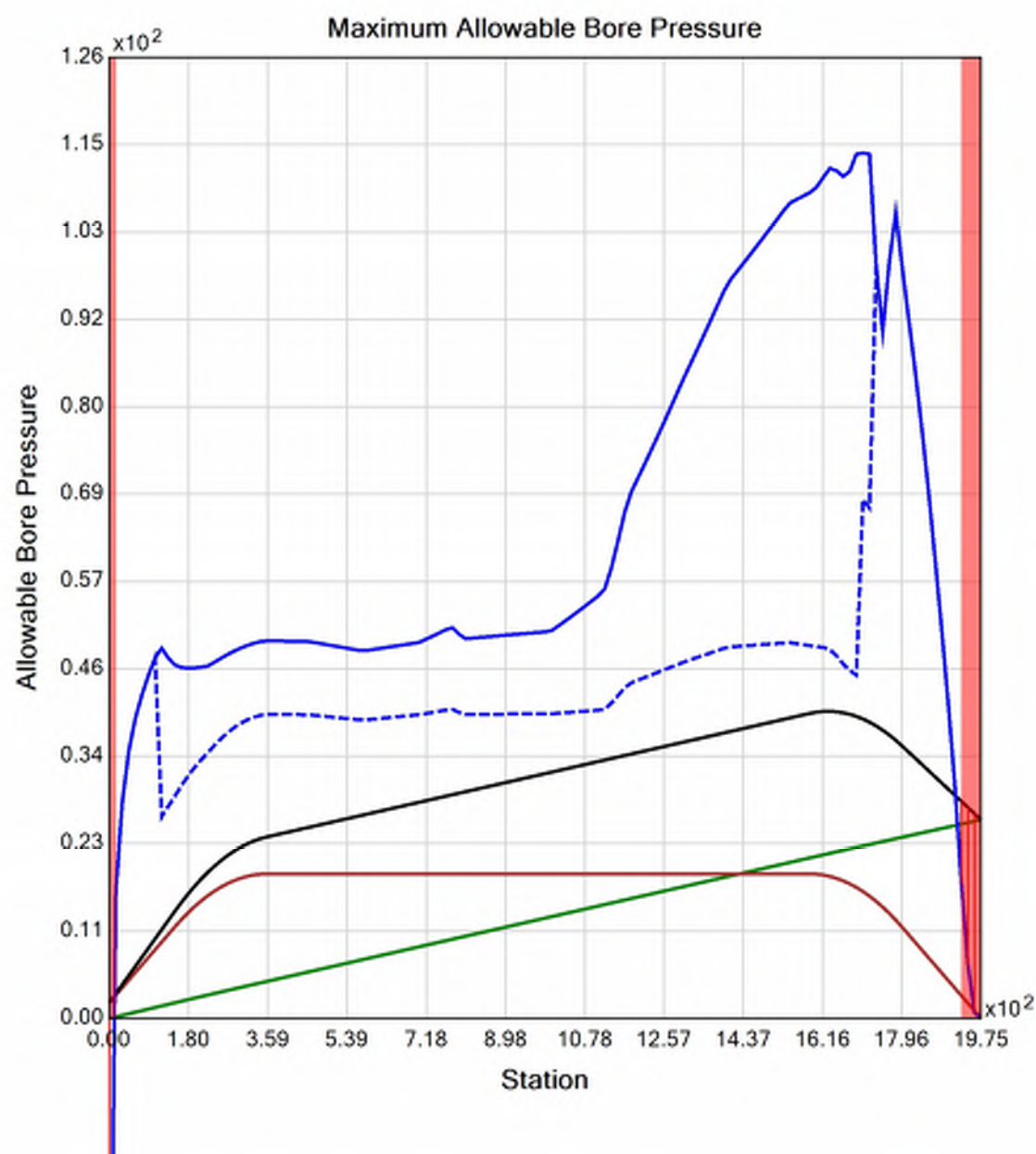
















## Generated Output



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---

## 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	2.375 in
Pipe DR	9.0
Pipe Thickness	0.26 in
Rod Length	15.00 ft
Rod Diameter	2.875 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/ft<sup>3</sup>  
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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>

---

### 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
<b>Deflection</b>		
Earth Load Deflection	2.944	5.418
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	2.973	5.448
<b>Compressive Stress [psi]</b>		
Compressive Wall Stress	108.5	150.5

### Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	1602.5	1602.5
Pullback Stress [psi]	915.6	915.6
Pullback Strain	1.592E-2	1.592E-2
Bending Stress [psi]	0.0	3.8
Bending Strain	0	6.597E-5
Tensile Stress [psi]	915.6	915.6
Tensile Strain	1.592E-2	1.595E-2

Net External Pressure = 25.0 [psi ]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

---

### In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	2.973	7.5	2.5	OK
Unconstrained Collapse [psi]	25.9	105.8	4.1	OK
Compressive Wall Stress [psi]	108.5	1150.0	10.6	OK

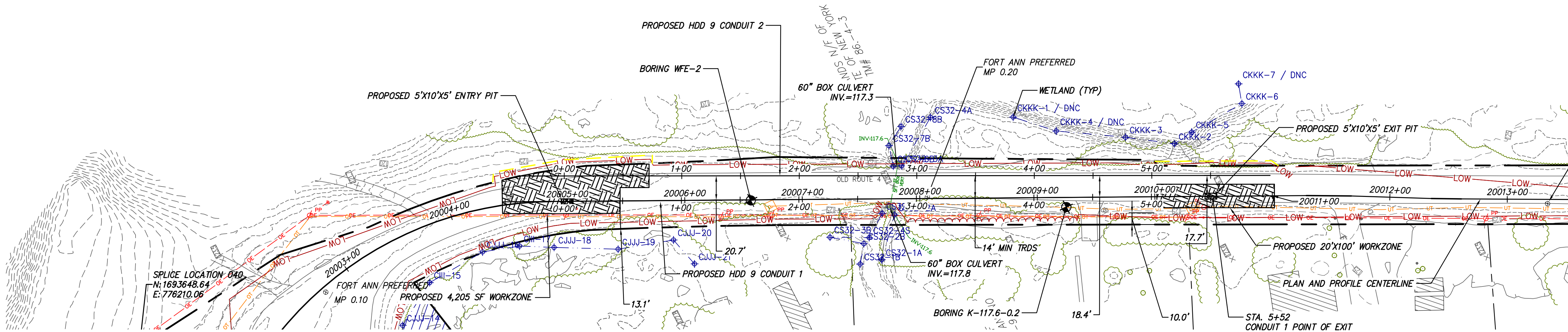
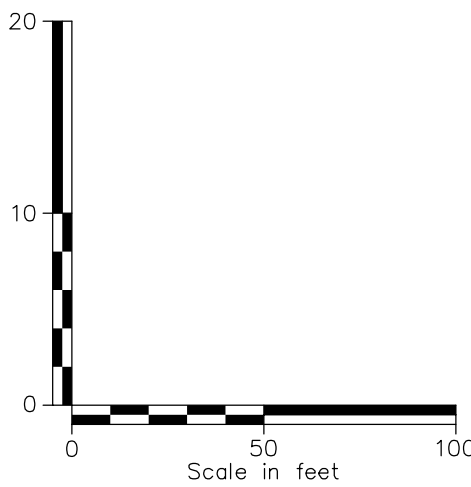
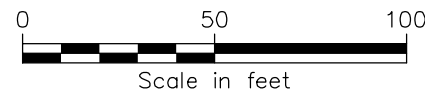
### Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	35.8	198.8	5.5	OK
Tensile Stress [psi]	915.6	1200.0	1.3	OK

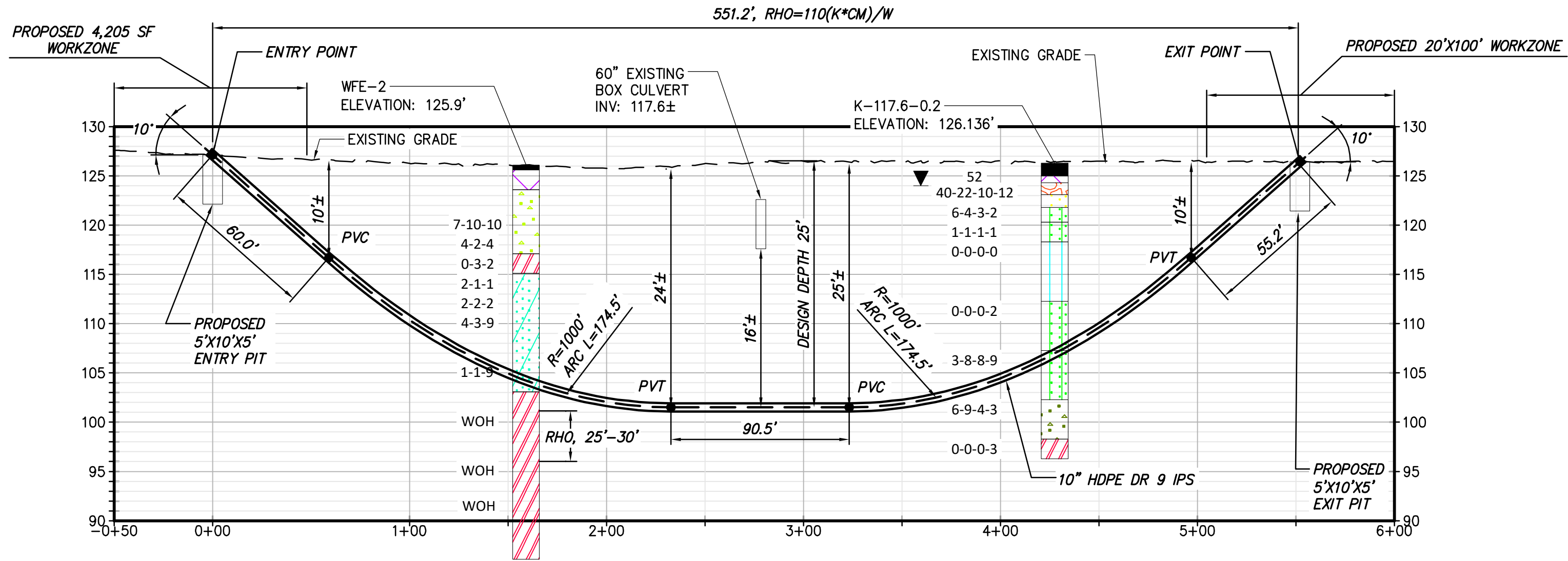
## Appendix E

### HDD Design Drawings

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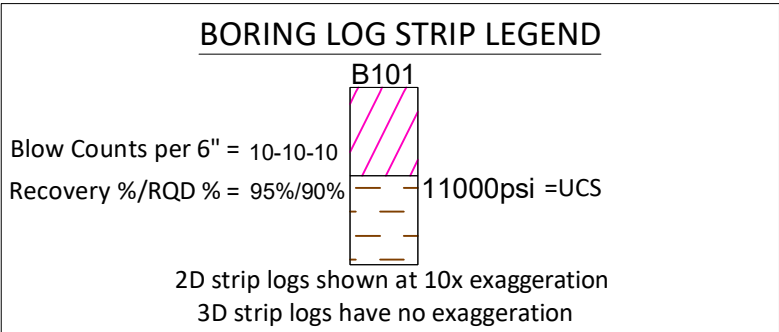


PROPOSED HDD 9 PLAN VIEW  
CONDUIT 1



PROPOSED HDD 9 PROFILE  
CONDUIT 1

NOTE:  
1) DRIVEWAY ACCESS MUST BE MAINTAINED DURING CONSTRUCTION FOR HOMES ON ROUTE 4 PER THE MPT PLAN AND NOTES, C-500 SERIES.



Legend		
	ASPHALT	Asphalt
	Bedrock	Bedrock
	Boulder	Boulder
	CH	Fat CLAY
	CH-MH	SILTY Fat CLAY
	CL	Lean CLAY
	CL-ML	SILTY CLAY
	CONCRETE	Concrete
	FILL	FILL
	GC	CLAYEY GRAVEL
	GC-GM	SILTY CLAYEY GRAVEL
	GM	SILTY GRAVEL
	GP	Poorly Graded GRAVEL
	GP-GC	Poorly Graded Gravel with CLAY
	GP-GM	Poorly Graded GRAVEL with SILT
	GW	Well Graded GRAVEL
	GW-GC	Well Graded GRAVEL with CLAY
	GW-GM	Well Graded GRAVEL with SILT
	Limestone	Limestone
	MH	Elastic SILT
	ML	SILT
	OH	ORGANIC Fat CLAY
	OL	ORGANIC Lean CLAY
	OL/OH	ORGANIC SOIL
	PT	PEAT
	Rock	Rock
	Sandstone	Sandstone
	SC	CLAYEY SAND
	SC-SM	SILT, CLAYEY SAND
	SHALE	Shale
	SILTSTONE	Siltstone
	SM	SILTY SAND
	SP	Poorly Graded SAND
	SP-SC	Poorly Graded SAND with CLAY
	SP-SM	Poorly Graded SAND with SILT
	SW	Well graded SAND
	SW-SM	Well Graded SAND with CLAY
	SW-SM	Well Graded SAND with SILT
	Tpsoll	Topsoll
	USGS 601	Gravel or Conglomerate 1
	USGS 654	Subgrslywacke
	USGS 670	Interbedded Sandstone and Shale
	USGS 702	Quartzite
	USGS 705	Schist
	USGS 705	Schist
	USGS 708	Gneiss
	USGS 708	Gneiss
	USGS 718	Granite 1
	Void	Void
	Water	Water
	Weathered Rock	Undefined
	Water Table during drilling	Water Table during drilling
	Water Table after drilling	Water Table after drilling



IT IS A VIOLATION OF LAW FOR ANY PERSON, UNLESS THEY ARE ACTING UNDER THE DIRECTION OF A LICENSED PROFESSIONAL ENGINEER, ARCHITECT, LANDSCAPE ARCHITECT OR LAND SURVEYOR TO ALTER AN ITEM IN ANY WAY. IF AN ITEM BEARING THE STAMP OF A LICENSED PROFESSIONAL IS ALTERED, THE ALTERING ENGINEER, ARCHITECT, LANDSCAPE ARCHITECT OR LAND SURVEYOR SHALL STAMP THE DOCUMENT AND INCLUDE THE NOTATION "ALTERED BY" FOLLOWED BY THEIR SIGNATURE, THE DATE OF SUCH ALTERATION, AND A SPECIFIC DESCRIPTION OF THE ALTERATION.

0	03/22/2023	ISSUED FOR CONSTRUCTION SUBMISSION	MCS	JEO
No.	DATE	SUBMITTAL / REVISION DESCRIPTION	DB	APP

CHAMPLAIN HUDSON POWER EXPRESS  
SEGMENT 3 - PACKAGE 2 - FORT ANN TO KINGSBURY  
PLAN AND PROFILE - HDD 9, CONDUIT 1

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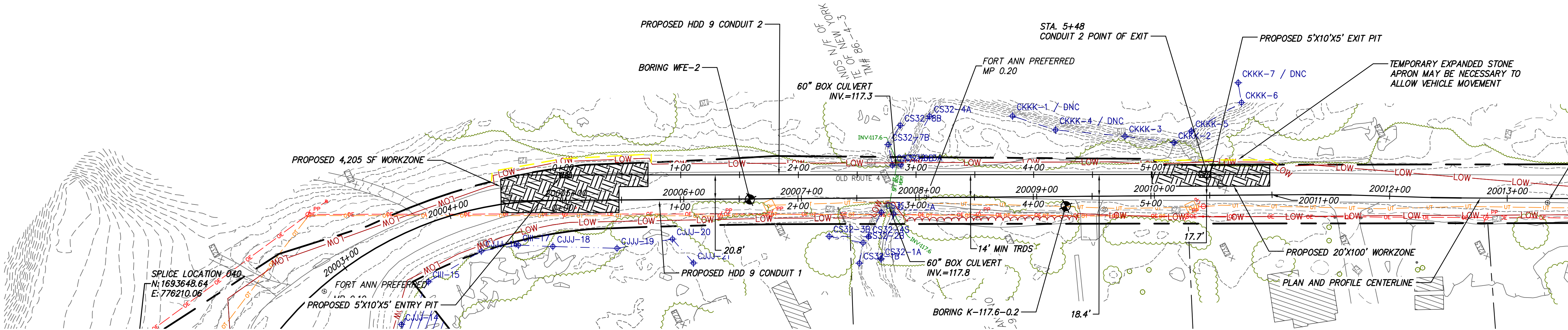
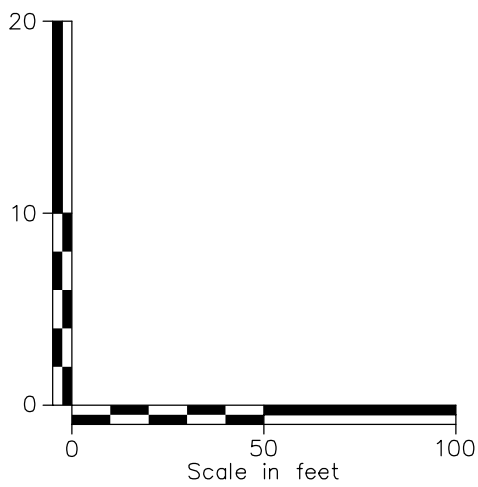
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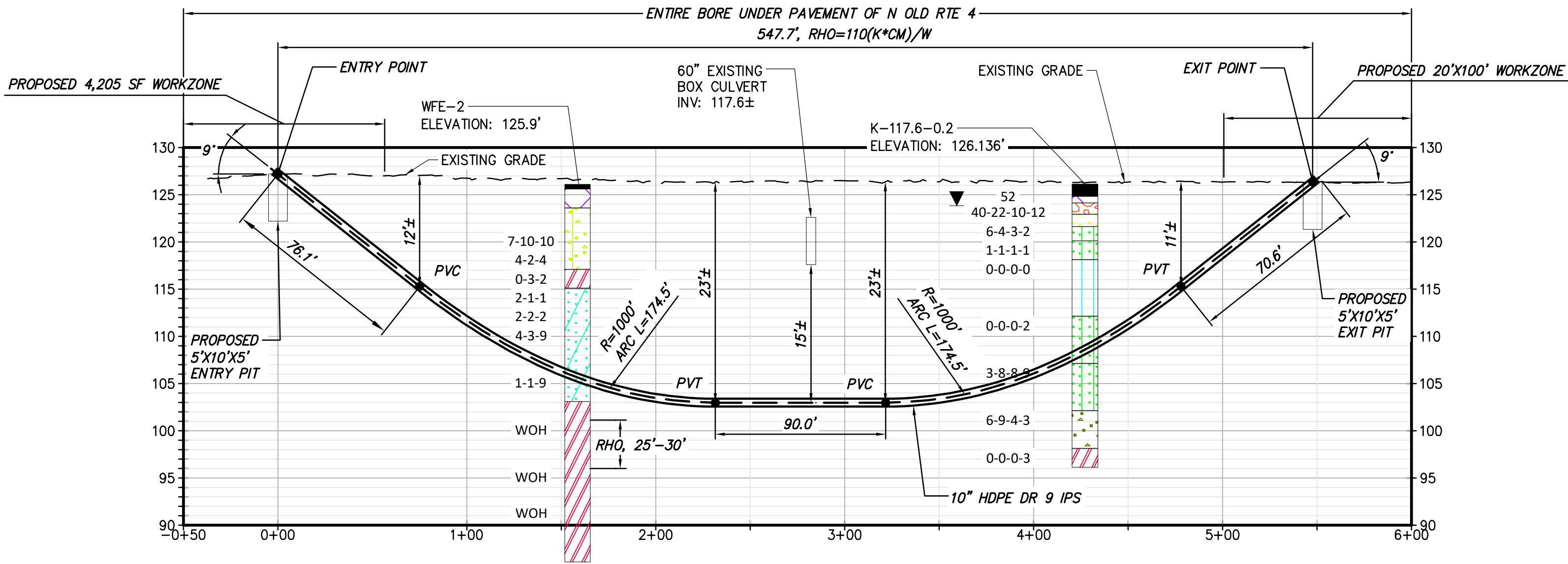
DATE 03/22/2023



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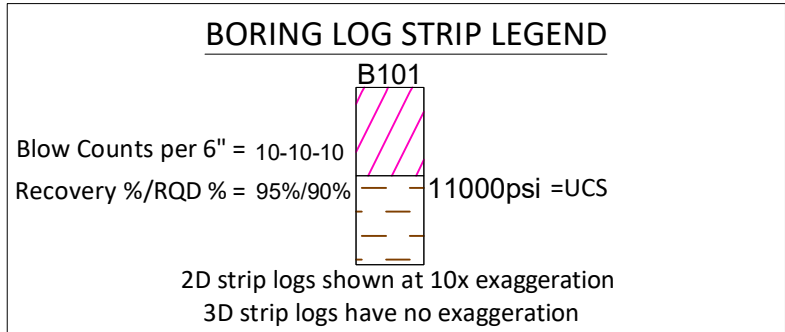


PROPOSED HDD 9 PLAN VIEW  
CONDUIT 2



PROPOSED HDD 9 PROFILE  
CONDUIT 2

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Legend		
	ASPHALT	Asphalt
	Bedrock	Bedrock
	Boulder	Boulder
	CH	Fat CLAY
	CH-MH	SILTY Fat CLAY
	CL	Lean CLAY
	CL-ML	SILTY CLAY
	CONCRETE	Concrete
	FILL	FILL
	GC	CLAYEY GRAVEL
	GC-GM	SILTY CLAYEY GRAVEL
	GM	SILTY GRAVEL
	GP	Poorly Graded GRAVEL
	GP-GC	Poorly Graded Gravel with CLAY
	GP-GM	Poorly Graded GRAVEL with SILT
	GW	Well Graded GRAVEL
	GW-GC	Well Graded GRAVEL with CLAY
	GW-GM	Well Graded GRAVEL with SILT
	Limestone	Limestone
	MH	Elastic SILT
	ML	SILT
	OH	ORGANIC Fat CLAY
	OL	ORGANIC Lean CLAY
	OL/OH	ORGANIC SOIL
	PT	PEAT
	Rock	Rock
	Sandstone	Sandstone
	SC	CLAYEY SAND
	SC-SM	SILT, CLAYEY SAND
	SHALE	Shale
	SILTSTONE	Siltstone
	SM	SILTY SAND
	SP	Poorly Graded SAND
	SP-SC	Poorly Graded SAND with CLAY
	SP-SM	Poorly Graded SAND with SILT
	SW	Well graded SAND
	SW-SM	Well Graded SAND with CLAY
	SW-SM	Well Graded SAND with SILT
	Topsail	Topsail
	USGS 601	Gravel or Conglomerate 1
	USGS 654	Subgrslywacke
	USGS 670	Interbedded Sandstone and Shale
	USGS 702	Quartzite
	USGS 705	Schist
	USGS 705	Schist
	USGS 708	Gneiss
	USGS 708	Gneiss
	USGS 718	Granite 1
	Void	Void
	Water	Water
	Weathered Rock	Undefined
	Water Table	Water Table during drilling
	Delayed Water Table	Water Table after drilling



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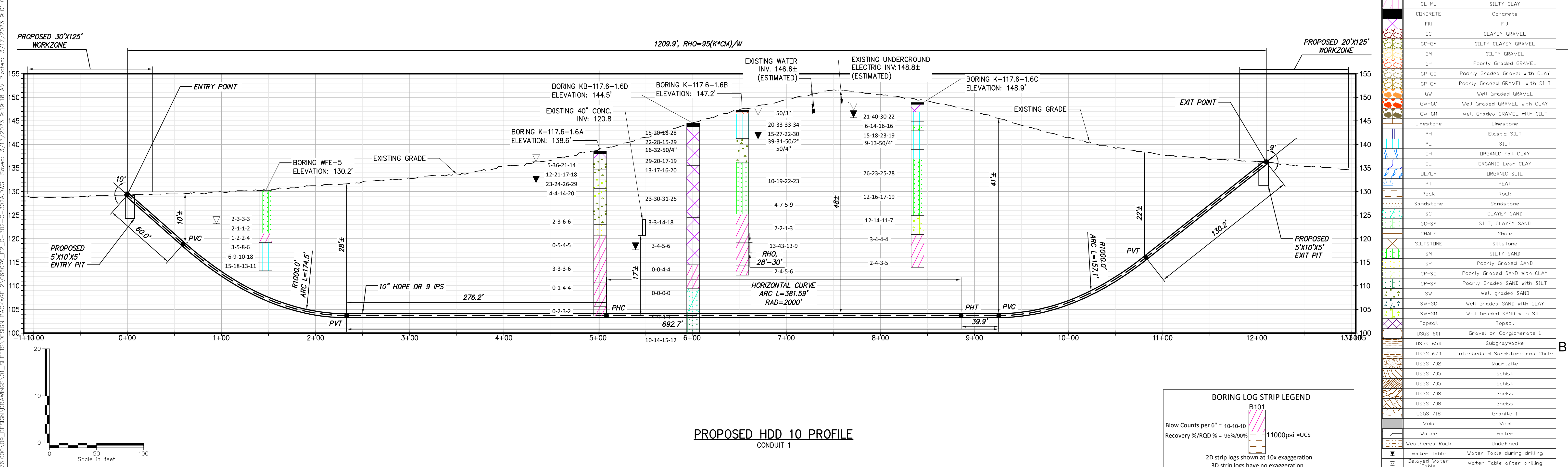
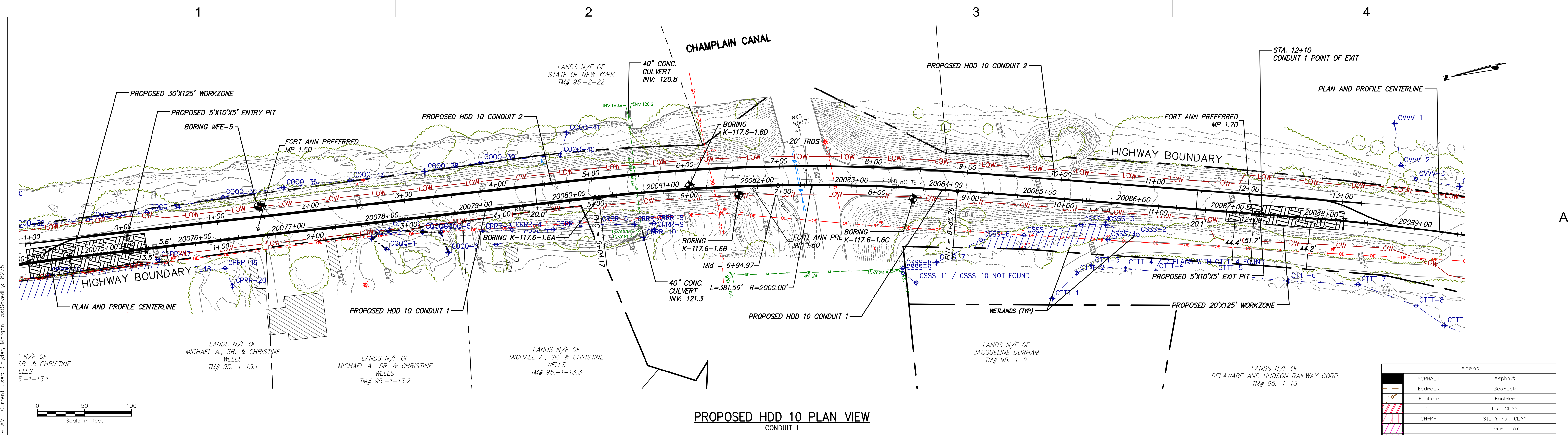
0	03/22/2023	ISSUED FOR CONSTRUCTION SUBMISSION	MCS	JEO
No.	DATE	SUBMITTAL / REVISION DESCRIPTION	DB	APP


CHAMPLAIN HUDSON POWER EXPRESS  
SEGMENT 3 - PACKAGE 2 - FORT ANN TO KINGSBURY  
PLAN AND PROFILE - HDD 9, CONDUIT 2

DRAWN BY: SK DESIGNED BY: SK APPROVED BY: JEO SCALE AS NOTED DATE 03/22/2023


KIEWIT PROJECT NO.	21162
CHA PROJECT NO.	066076
DRAWING NO.	C-301A
DATE	03/22/2023








Champlain Hudson  
Power Express



Kiewit



CHA  
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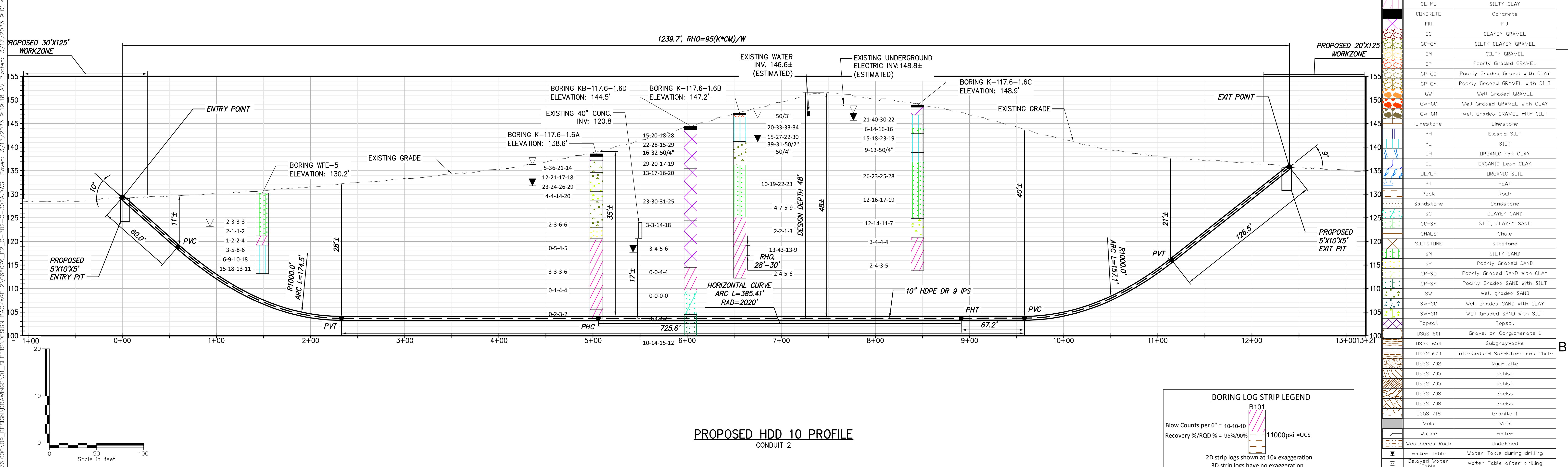
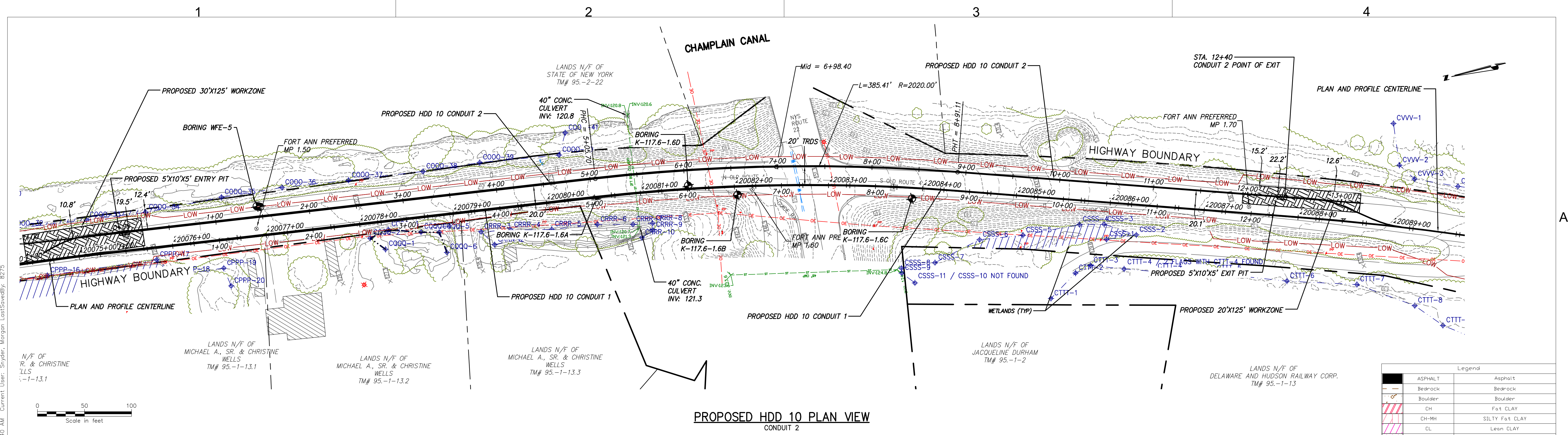
No.	DATE	SUBMITTAL / REVISION DESCRIPTION	DB	APP
0	03/22/2023	ISSUED FOR CONSTRUCTION SUBMISSION	MCS	JEO

CHAMPLAIN HUDSON POWER EXPRESS  
SEGMENT 3 - PACKAGE 2 - FORT ANN TO KINGSBURY  
PLAN AND PROFILE - HDD 10, CONDUIT 1




KIEWIT PROJECT NO. 21162  
CHA PROJECT NO. 066076  
DRAWING NO. C-302

DRAWN BY: MCS  
DESIGNED BY: MCS  
APPROVED BY: JEO  
SCALE: AS NOTED  
DATE: 03/22/2023





Legend	
	Asphalt
	Bedrock
	Boulder
	Fat CLAY
	SILTY Fat CLAY
	Lean CLAY
	SILTY CLAY
	Concrete
	Fill
	CLAYEY GRAVEL
	SILTY CLAYEY GRAVEL
	SILTY GRAVEL
	Poorly Graded GRAVEL
	Poorly Graded Gravel with CLAY
	Poorly Graded GRAVEL with SILT
	Well Graded GRAVEL
	Well Graded GRAVEL with CLAY
	Well Graded GRAVEL with SILT
	Limestone
	Elastic SILT
	SILT
	ORGANIC Fat CLAY
	ORGANIC Lean CLAY
	ORGANIC SOIL
	PEAT
	Rock
	Sandstone
	CLAYEY SAND
	SILT, CLAYEY SAND
	Shale
	Siltstone
	SILTY SAND
	Poorly Graded SAND
	Poorly Graded SAND with CLAY
	Poorly Graded SAND with SILT
	Well graded SAND
	Well Graded SAND with CLAY
	Well Graded SAND with SILT
	Topsoil
	Gravel or Conglomerate 1
	Subgraywacke
	Interbedded Sandstone and Shale
	Quartzite
	Schist
	Schist
	Schist
	Gneiss
	Gneiss
	Granite 1
	Void
	Water
	Undefined
	Water Table during drilling
	Water Table after drilling



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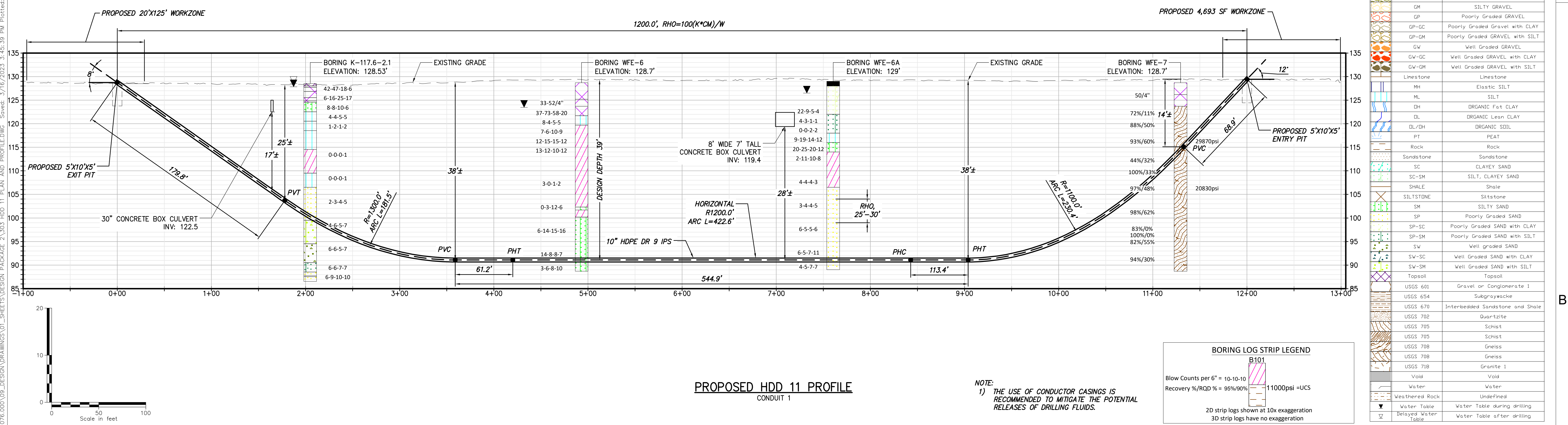
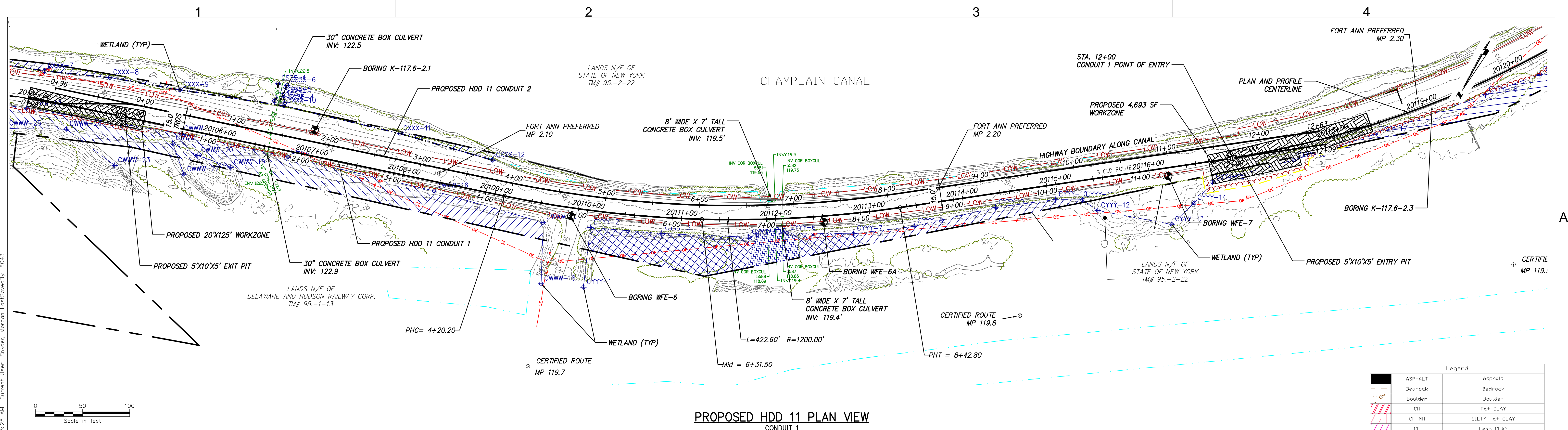
0	03/22/2023	ISSUED FOR CONSTRUCTION SUBMISSION	MCS	JEO
No.	DATE	SUBMITTAL / REVISION DESCRIPTION	DB	APP

DRAWN BY: MCS DESIGNED BY: MCS APPROVED BY: JEO SCALE: AS NOTED DATE: 03/22/2023


CHAMPLAIN HUDSON POWER EXPRESS  
SEGMENT 3 - PACKAGE 2 - FORT ANN TO KINGSBURY  
PLAN AND PROFILE - HDD 10, CONDUIT 2

KIEWIT PROJECT NO. 21162  
CHA PROJECT NO. 066076  
DRAWING NO. C-302A







Legend	
ASPHALT	Asphalt
Bedrock	Bedrock
Boulder	Boulder
CH	Fat CLAY
CH-MH	SILTY Fat CLAY
CL	Lean CLAY
CL-ML	SILTY CLAY
CDNCRETE	Concrete
FRI	FRI
GC	CLAYEY GRAVEL
GC-GM	SILTY CLAYEY GRAVEL
GM	SILTY GRAVEL
GP	Poorly Graded GRAVEL
GP-GC	Poorly Graded Gravel with CLAY
GP-GM	Poorly Graded GRAVEL with SILT
GW	Well Graded GRAVEL
GW-GC	Well Graded GRAVEL with CLAY
GW-GM	Well Graded GRAVEL with SILT
Limestone	Limestone
MH	Elastic SILT
ML	SILT
OH	ORGANIC Fat CLAY
DL	ORGANIC Lean CLAY
DL/OH	ORGANIC SOIL
PT	PEAT
Rock	Rock
Sandstone	Sandstone
SC	CLAYEY SAND
SC-SM	SILT, CLAYEY SAND
SHALE	Shale
SILTSTONE	Siltstone
SM	SILTY SAND
SP	Poorly Graded SAND
SP-SC	Poorly Graded SAND with CLAY
SP-SM	Poorly Graded SAND with SILT
SW	Well graded SAND
SW-SC	Well Graded SAND with CLAY
SW-SM	Well Graded SAND with SILT
Topsoil	Topsoil
USGS 601	Gravel or Conglomerate 1
USGS 654	Subgraywacke
USGS 670	Interbedded Sandstone and Shale
USGS 702	Quartzite
USGS 705	Schist
USGS 708	Gneiss
USGS 708	Gneiss
USGS 718	Granite 1
Void	Void
Water	Water
Weathered Rock	Undefined
Water Table	Water Table during drilling
Delayed Water Table	Water Table after drilling



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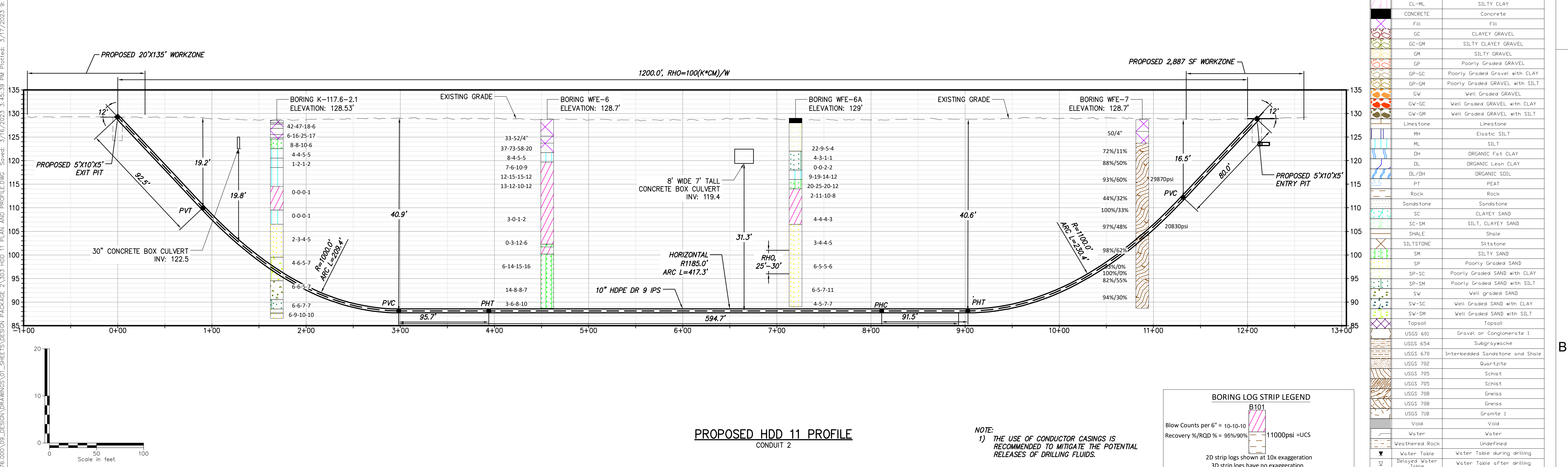
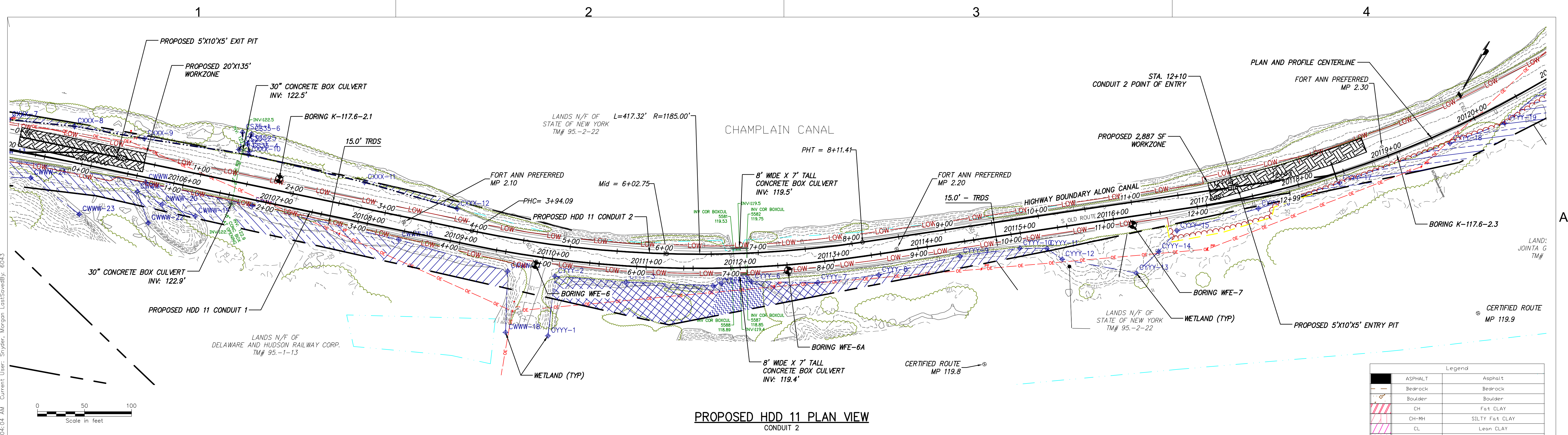
0	03/22/2023	ISSUED FOR CONSTRUCTION SUBMISSION	MCS	JEO
No.	DATE	SUBMITTAL / REVISION DESCRIPTION	DB	APP

CHAMPLAIN HUDSON POWER EXPRESS  
SEGMENT 3 - PACKAGE 2 - FORT ANN TO KINGSBURY  
PLAN AND PROFILE - HDD 11, CONDUIT 1

KIEWIT PROJECT NO. 21162  
CHA PROJECT NO. 068076  
DRAWING NO. C-303

DRAWN BY: JAS  
DESIGNED BY: MB  
APPROVED BY: JEO  
SCALE: AS NOTED  
DATE: 03/22/2023





Legend		
	ASPHALT	Asphalt
	Bedrock	Bedrock
	Boulder	Boulder
	CH	Fat CLAY
	CH-MH	SILTY Fat CLAY
	CL	Lean CLAY
	CL-ML	SILTY CLAY
	CD/CONCRETE	Concrete
	FRI	FRI
	GC	CLAYEY GRAVEL
	GC-GM	SILTY CLAYEY GRAVEL
	GM	SILTY GRAVEL
	GP	Poorly Graded GRAVEL
	GP-GC	Poorly Graded GRAVEL with CLAY
	GP-GM	Poorly Graded GRAVEL with SILT
	GW	Well Graded GRAVEL
	GW-GC	Well Graded GRAVEL with CLAY
	GW-GM	Well Graded GRAVEL with SILT
	Limestone	Limestone
	MH	Elastic SILT
	ML	SILT
	OH	ORGANIC Fat CLAY
	DL	ORGANIC Lean CLAY
	DL/OH	ORGANIC SOIL
	PT	PEAT
	Rock	Rock
	Sandstone	Sandstone
	SC	CLAYEY SAND
	SC-SM	SILT, CLAYEY SAND
	SHALE	Shale
	SILTSTONE	Siltstone
	SM	SILTY SAND
	SP	Poorly Graded SAND
	SP-SC	Poorly Graded SAND with CLAY
	SP-SM	Poorly Graded SAND with SILT
	SW	Well graded SAND
	SW-SC	Well Graded SAND with CLAY
	SW-SM	Well Graded SAND with SILT
	Topsoil	Topsoil
	USGS 601	Gravel or Conglomerate 1
	USGS 654	Subgraywacke
	USGS 670	Interbedded Sandstone and Shale
	USGS 702	Quartzite
	USGS 705	Schist
	USGS 705	Schist
	USGS 708	Gneiss
	USGS 708	Gneiss
	USGS 718	Granite 1
	Void	Void
	Water	Water
	Weathered Rock	Undefined
	Water Table during drilling	Water Table during drilling
	Delayed Water Table	Water Table after drilling

Champlain Hudson Power Express

Kiewit

CHA

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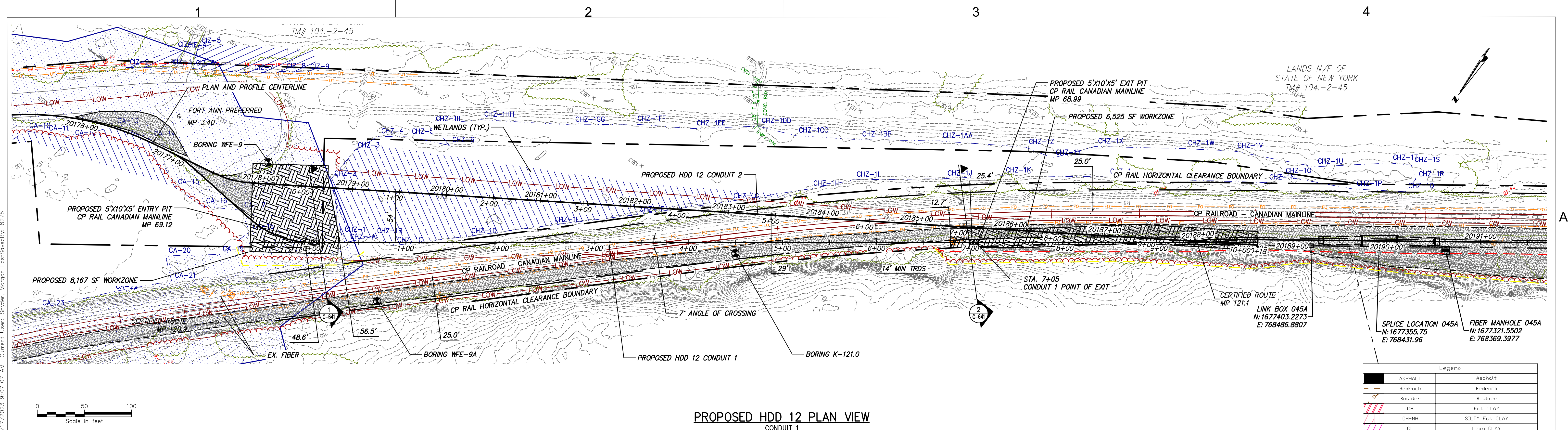
0	03/22/2023	ISSUED FOR CONSTRUCTION SUBMISSION	MCS	JEO
No.	DATE	SUBMITTAL / REVISION DESCRIPTION	DB	APP

CHAMPLAIN HUDSON POWER EXPRESS  
SEGMENT 3 - PACKAGE 2 - FORT ANN TO KINGSBURY  
PLAN AND PROFILE - HDD 11, CONDUIT 2

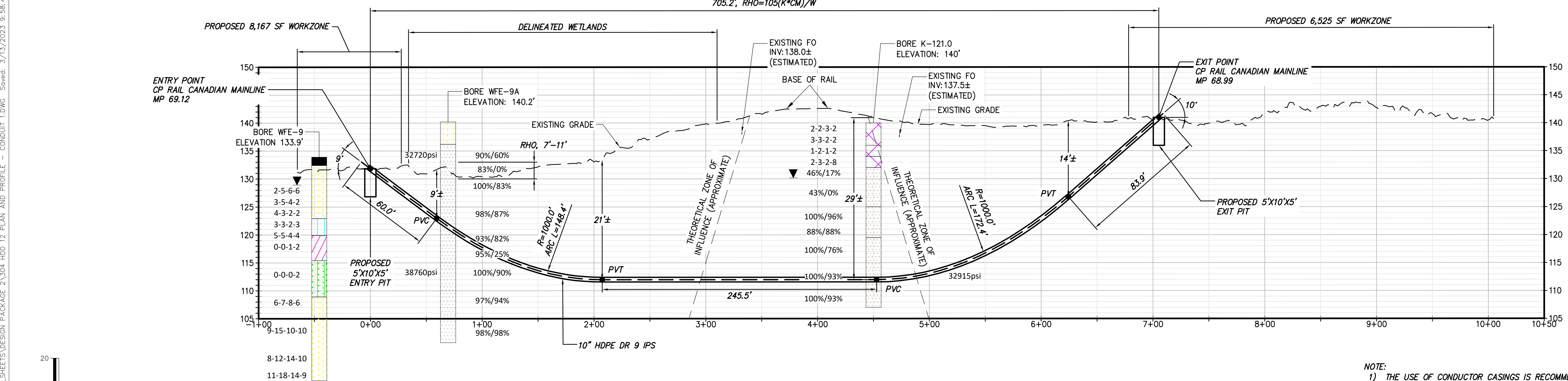
KIEWIT PROJECT NO. 21162  
CHA PROJECT NO. 068076  
DRAWING NO. C-303A

SCALE AS NOTED  
DATE 03/22/2023





PROPOSED HDD 12 PLAN VIEW  
CONDUIT 1



PROPOSED HDD 12 PROFILE  
CONDUIT 1

Legend	
ASPHALT	Asphalt
Bedrock	Bedrock
Boulder	Boulder
CH	Fat CLAY
CH-MH	SILTY Fat CLAY
CL	Lean CLAY
CL-ML	SILTY CLAY
CONCRETE	Concrete
FILL	FILL
GC	CLAYEY GRAVEL
GC-GM	SILTY CLAYEY GRAVEL
GM	SILTY GRAVEL
GP	Poorly Graded GRAVEL
GP-GC	Poorly Graded Gravel with CLAY
GP-GM	Poorly Graded GRAVEL with SILT
GW	Well Graded GRAVEL
GW-GC	Well Graded GRAVEL with CLAY
GW-GM	Well Graded GRAVEL with SILT
Limestone	Limestone
MH	Elastic SILT
ML	SILT
OH	ORGANIC Fat CLAY
DL	ORGANIC Lean CLAY
DL/OH	ORGANIC SOIL
PT	PEAT
Rock	Rock
Sandstone	Sandstone
SC	CLAYEY SAND
SC-SM	SILT, CLAYEY SAND
SHALE	Shale
SILTSTONE	Siltstone
SM	SILTY SAND
SP	Poorly Graded SAND
SP-SC	Poorly Graded SAND with CLAY
SP-SM	Poorly Graded SAND with SILT
SW	Well graded SAND
SW-SC	Well Graded SAND with CLAY
SW-SM	Well Graded SAND with SILT
Topsail	Topsail
USGS 601	Gravel or Conglomerate 1
USGS 654	Subgraywacke
USGS 670	Interbedded Sandstone and Shale
USGS 702	Quartzite
USGS 705	Schist
USGS 705	Schist
USGS 708	Gneiss
USGS 708	Gneiss
USGS 718	Granite 1
Void	Void
Water	Water
Weathered Rock	Undefined
Water Table	Water Table during drilling
Water Table	Water Table after drilling

**NOTE:**  
1) THE USE OF CONDUCTOR CASINGS IS RECOMMENDED TO MITIGATE THE POTENTIAL RELEASES OF DRILLING FLUIDS.

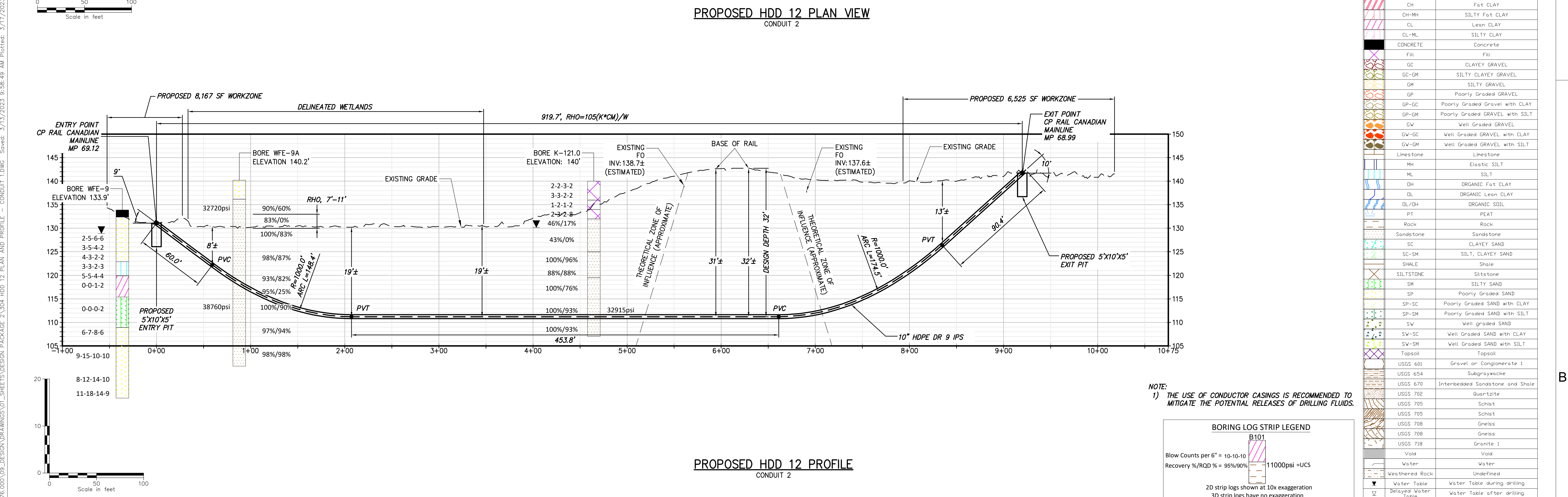
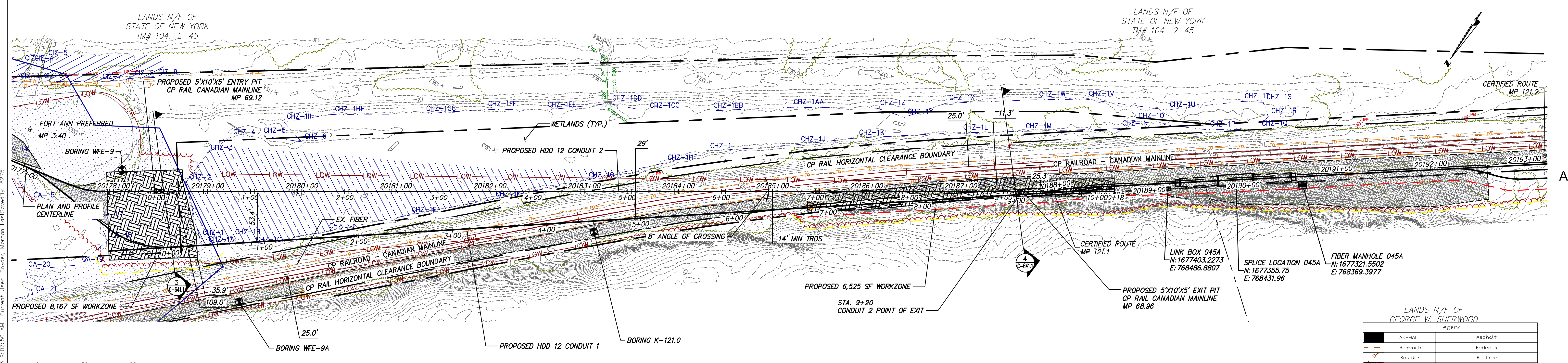
**BORING LOG STRIP LEGEND**


Blow Counts per 6" = 10-10-10  
Recovery %/RQD % = 95%/90%

11000psi = UCS


2D strip logs shown at 10x exaggeration  
3D strip logs have no exaggeration








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CHAMPLAIN HUDSON POWER EXPRESS  
SEGMENT 3 - PACKAGE 2 - FORT ANN TO KINGSBURY  
PLAN AND PROFILE - HDD 12, CONDUIT 2

DRAWN BY: SKDESIGNED BY: SKAPPROVED BY: JEO

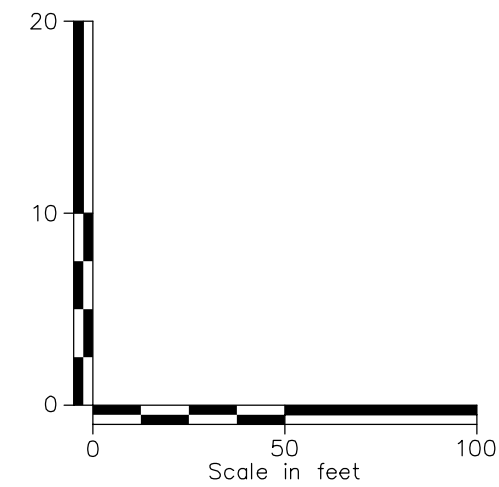
SCALE AS NOTED

KIEWIT PROJECT NO. 21162  
CHA PROJECT NO. 068076  
DRAWING NO. C-304A

DATE 03/22/2023

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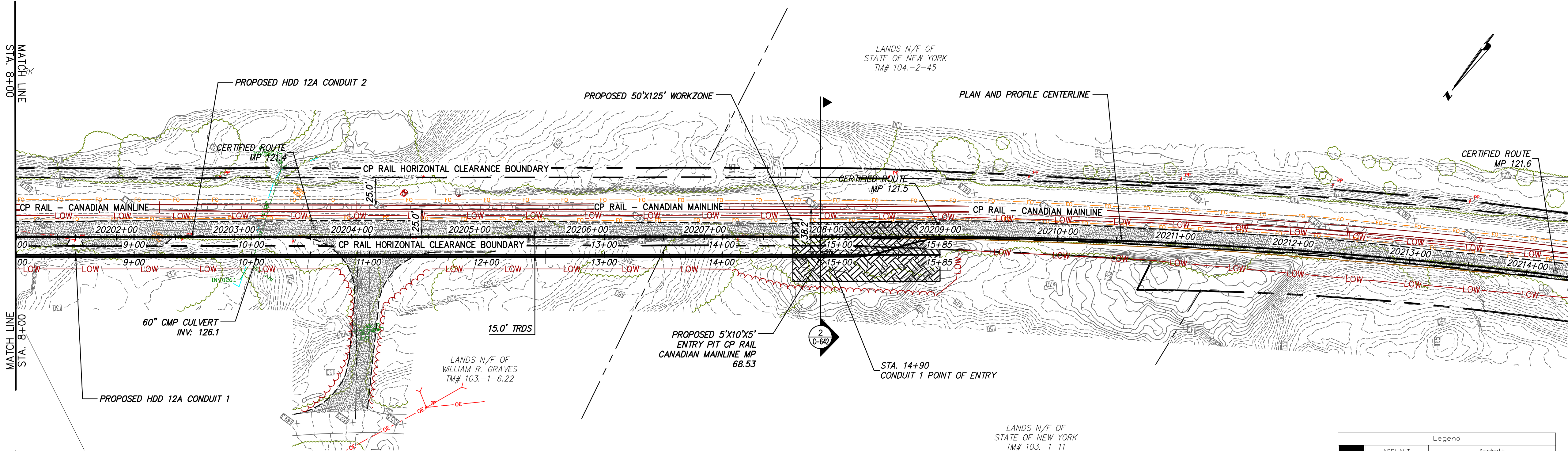


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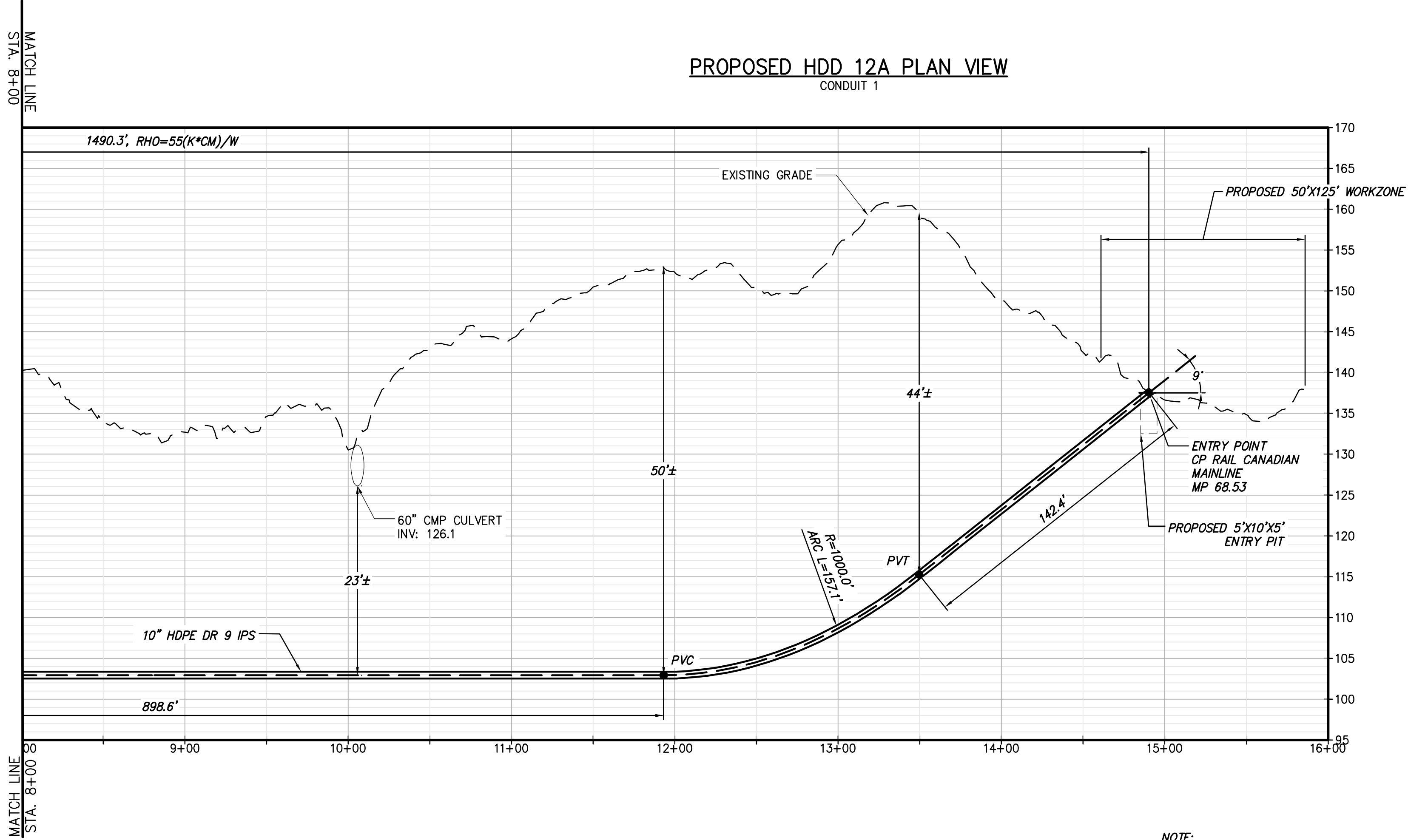
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					21162
					CHA PROJECT NO.
					066076
					DRAWING NO.
					<b>C-305</b>
AS NOTED					DATE
DRAWN BY: JAS	DESIGNED BY: JAS	APPROVED BY: JEO	SCALE	REV. NO.	X
					03/22/2023



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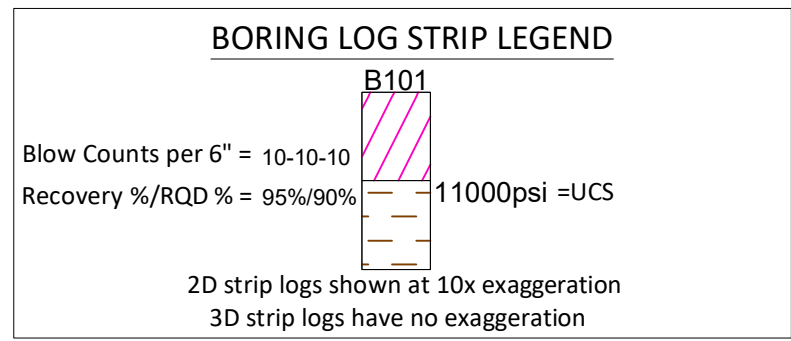


PROPOSED HDD 12A PLAN VIEW  
CONDUIT 1



PROPOSED HDD 12A PROFILE  
CONDUIT 1

NOTE:  
1) THE USE OF CONDUCTOR CASINGS IS  
RECOMMENDED TO MITIGATE THE POTENTIAL  
RELEASES OF DRILLING FLUIDS.



Legend		
	ASPHALT	Asphalt
	Bedrock	Bedrock
	Boulder	Boulder
	CH	Fat CLAY
	CH-MH	SILTY Fat CLAY
	CL	Lean CLAY
	CL-ML	SILTY CLAY
	CONCRETE	Concrete
	FILL	FILL
	GC	CLAYEY GRAVEL
	GC-GM	SILTY CLAYEY GRAVEL
	GM	SILTY GRAVEL
	GP	Poorly Graded GRAVEL
	GP-GC	Poorly Graded Gravel with CLAY
	GP-GM	Poorly Graded GRAVEL with SILT
	GW	Well Graded GRAVEL
	GW-GC	Well Graded GRAVEL with CLAY
	GW-GM	Well Graded GRAVEL with SILT
	Limestone	Limestone
	MH	Elastic SILT
	ML	SILT
	OH	ORGANIC Fat CLAY
	OL	ORGANIC Lean CLAY
	OL/OH	ORGANIC SOIL
	PT	PEAT
	Rock	Rock
	Sandstone	Sandstone
	SC	CLAYEY SAND
	SC-SM	SILT, CLAYEY SAND
	SHALE	Shale
	SILTSTONE	Siltstone
	SM	SILTY SAND
	SP	Poorly Graded SAND
	SP-SC	Poorly Graded SAND with CLAY
	SP-SM	Poorly Graded SAND with SILT
	SW	Well graded SAND
	SW-SC	Well Graded SAND with CLAY
	SW-SM	Well Graded SAND with SILT
	Topsail	Topsail
	USGS 601	Gravel or Conglomerate 1
	USGS 654	Subgraywacke
	USGS 670	Interbedded Sandstone and Shale
	USGS 702	Quartzite
	USGS 705	Schist
	USGS 705	Schist
	USGS 708	Gneiss
	USGS 708	Gneiss
	USGS 718	Granite 1
	Void	Void
	Water	Water
	Weathered Rock	Undefined
	Water Table	Water Table during drilling
	Delayed Water Table	Water Table after drilling



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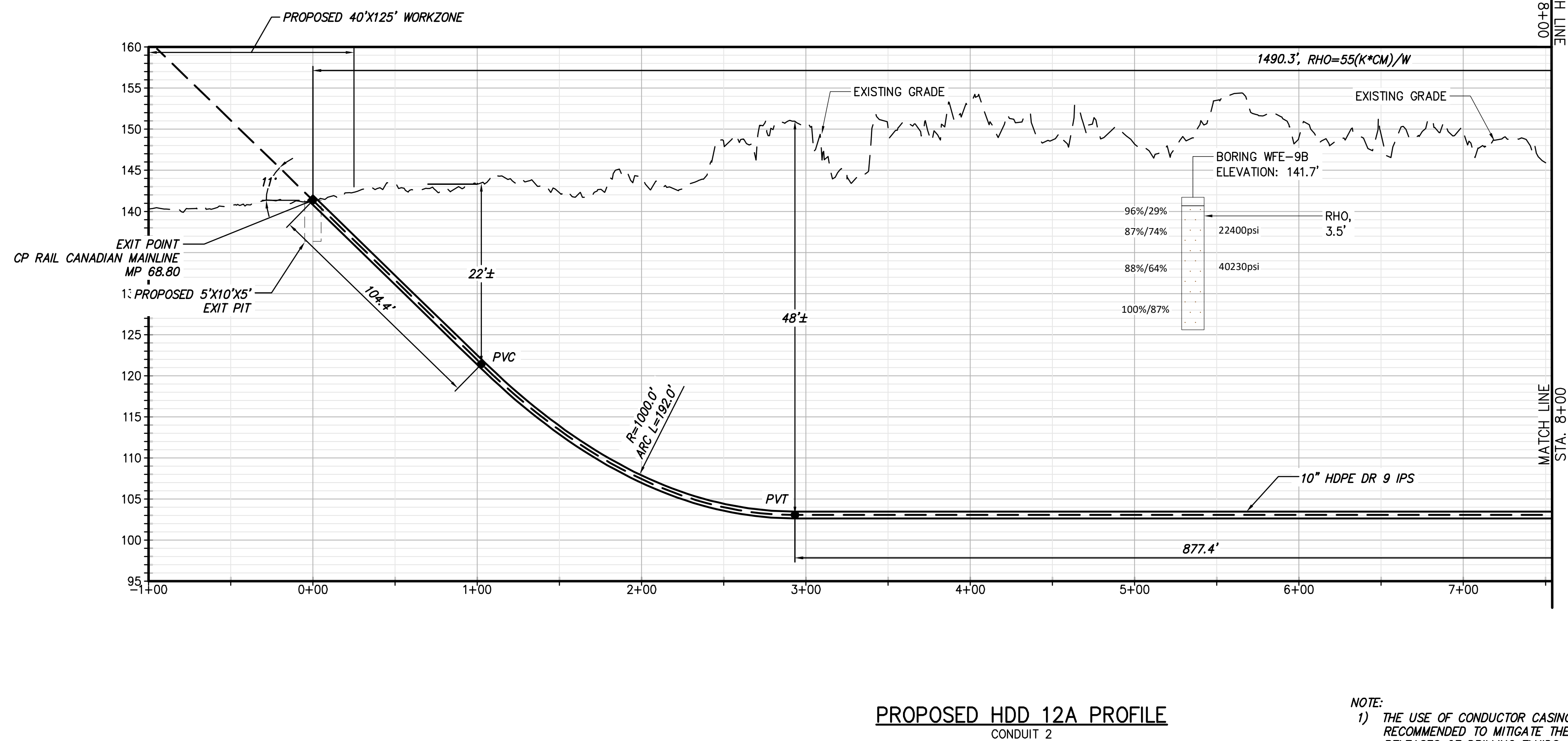
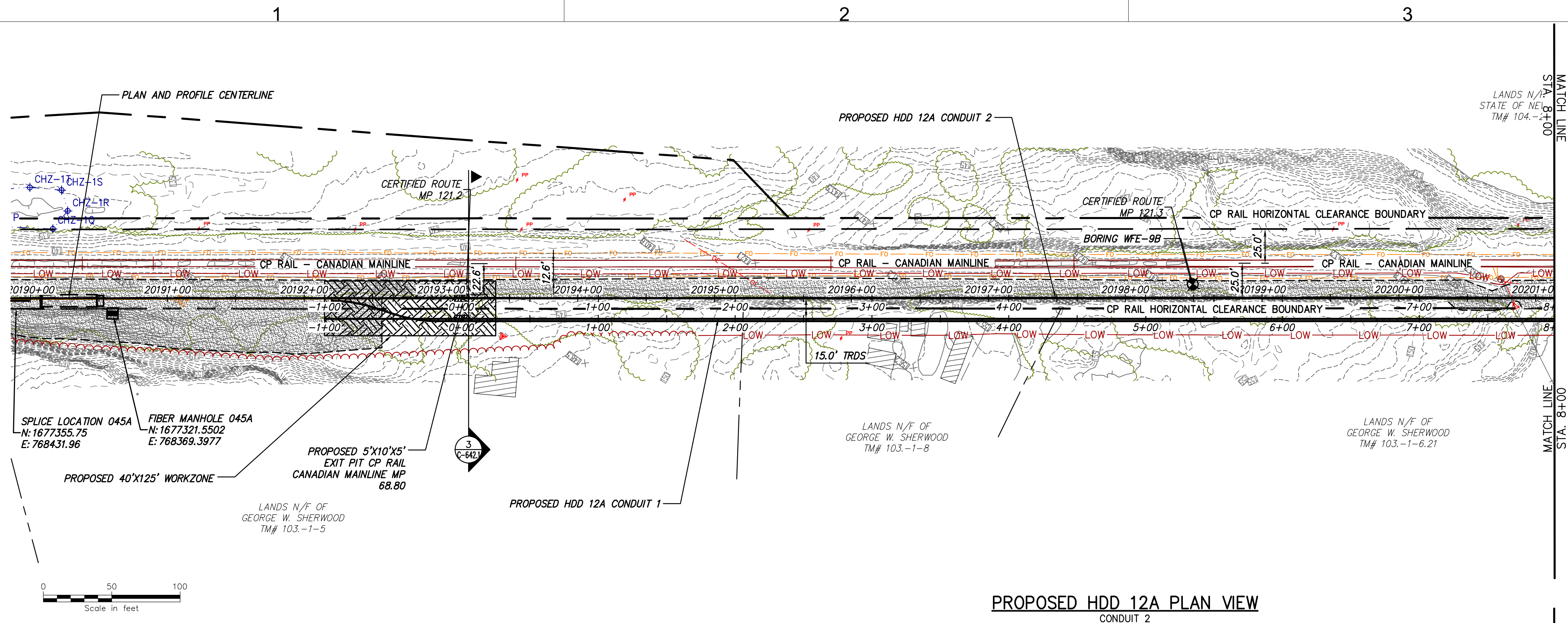
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
































CHAMPLAIN HUDSON POWER EXPRESS  
SEGMENT 3 - PACKAGE 2 - FORT ANN TO KINGSBURY  
PLAN AND PROFILE - HDD 12A, CONDUIT 1

DRAWN BY: JAS DESIGNED BY: JAS APPROVED BY: JEO SCALE AS NOTED  
REV. NO. X

KIEWIT PROJECT NO.	21162
CHA PROJECT NO.	066076
DRAWING NO.	C-305.1
DATE	03/22/2023





Legend		
	ASPHALT	Asphalt
	Bedrock	Bedrock
	Boulder	Boulder
	CH	Fat CLAY
	CH-MH	SILTY Fat CLAY
	CL	Lean CLAY
	CL-ML	SILTY CLAY
	CONCRETE	Concrete
	FIll	FIll
	GC	CLAYEY GRAVEL
	GC-GM	SILTY CLAYEY GRAVEL
	GM	SILTY GRAVEL
	GP	Poorly Graded GRAVEL
	GP-GC	Poorly Graded Gravel with CLAY
	GP-GM	Poorly Graded GRAVEL with SILT
	GW	Well Graded GRAVEL
	GW-GC	Well Graded GRAVEL with CLAY
	GW-GM	Well Graded GRAVEL with SILT
	Limestone	Limestone
	MH	Elastic SILT
	ML	SILT
	DH	ORGANIC Fat CLAY
	DL	ORGANIC Lean CLAY
	DL/DH	ORGANIC SOIL
	PT	PEAT
	Rock	Rock
	Sandstone	Sandstone
	SC	CLAYEY SAND
	SC-SM	SILT, CLAYEY SAND
	SHALE	Shale
	SILTSTONE	Siltstone
	SM	SILTY SAND
	SP	Poorly Graded SAND
	SP-SC	Poorly Graded SAND with CLAY
	SP-SM	Poorly Graded SAND with SILT
	SW	Well graded SAND
	SW-SC	Well Graded SAND with CLAY
	SW-SM	Well Graded SAND with SILT
	Topsoil	Topsoil
	USGS 601	Gravel or Conglomerate 1
	USGS 654	Subgraywacke
	USGS 670	Interbedded Sandstone and Shale
	USGS 702	Quartzite
	USGS 705	Schist
	USGS 705	Schist
	USGS 708	Gneiss
	USGS 708	Gneiss
	USGS 718	Granite 1
	Void	Void
	Water	Water
	Weathered Rock	Undefined
	Water Table	Water Table during drilling
	Delayed Water Table	Water Table after drilling

NOTE:  
1) THE USE OF CONDUCTOR CASINGS IS RECOMMENDED TO MITIGATE THE POTENTIAL RELEASES OF DRILLING FLUIDS.

### BORING LOG STRIP LEGEND

B101

Blow Counts per 6" = 10-10-10

Recovery %/RQD % = 95%/90%

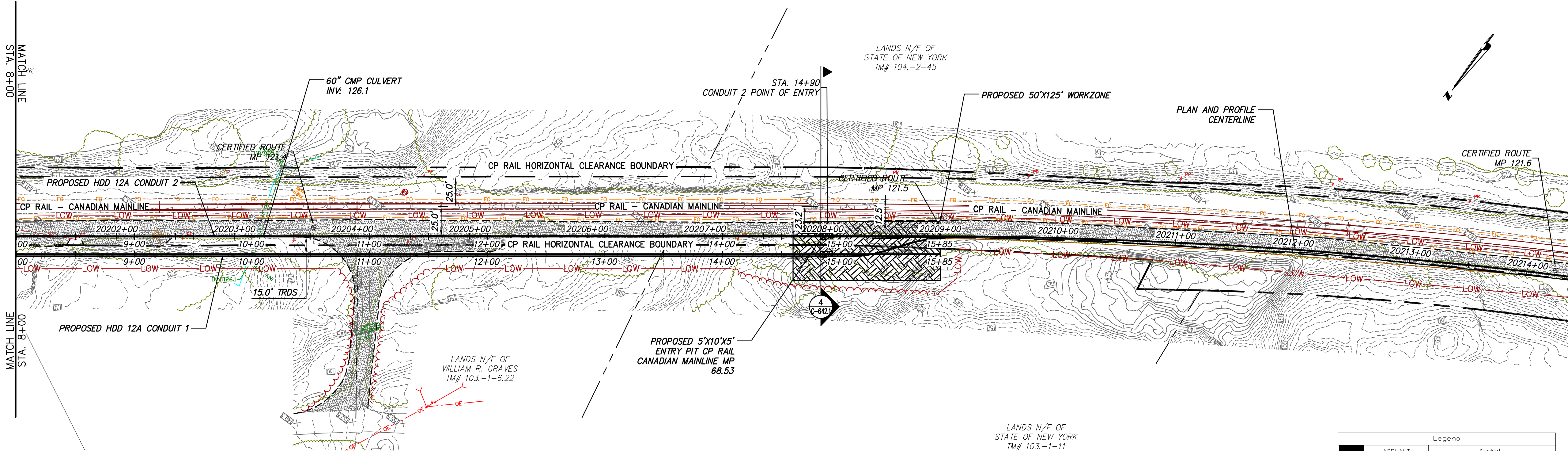
11000psi = UCS

2D strip logs shown at 10x exaggeration  
3D strip logs have no exaggeration

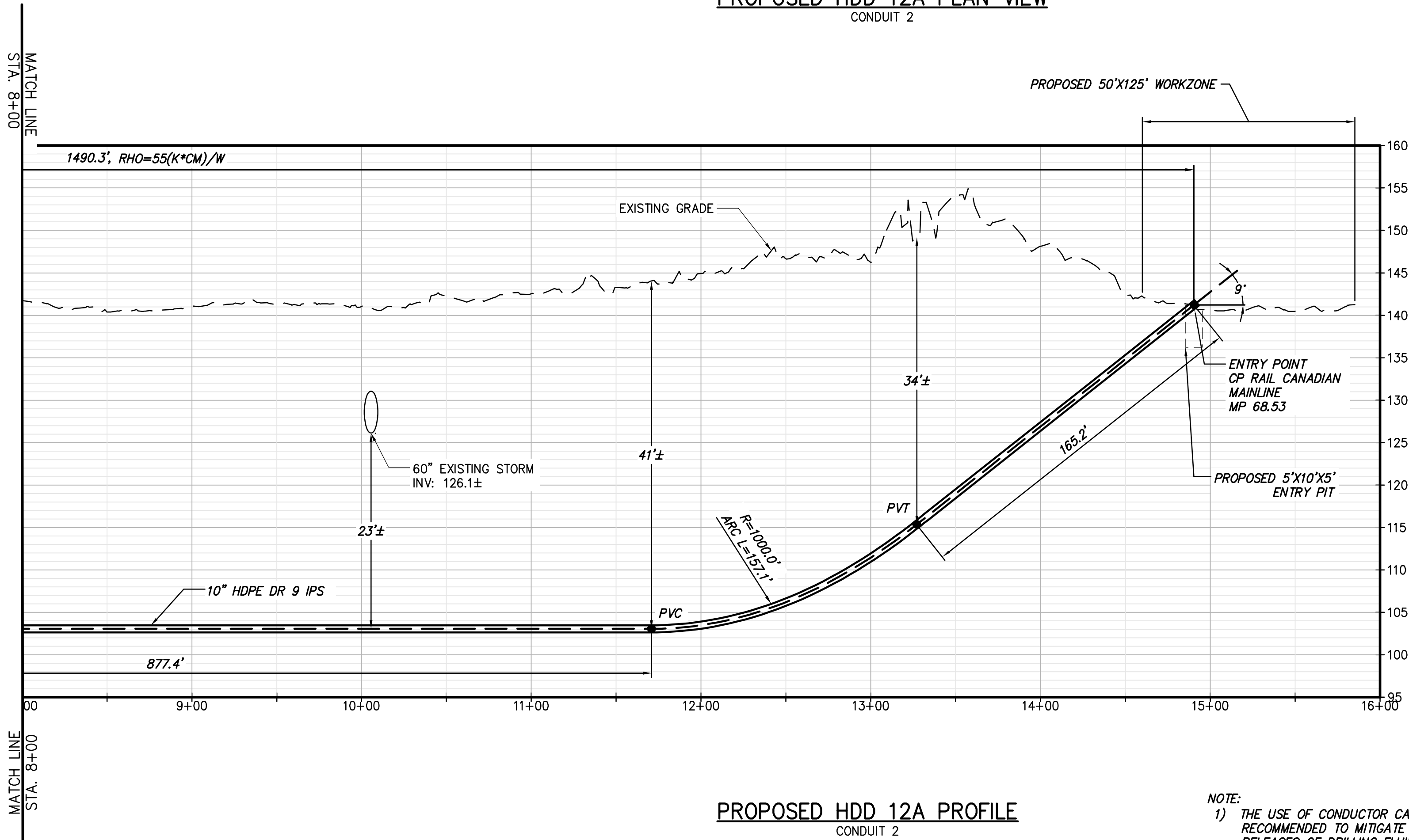
0	03/22/2023	ISSUED FOR CONSTRUCTION SUBMISSION	MCS	JEO
No.	DATE	SUBMITTAL / REVISION DESCRIPTION	DB	APP



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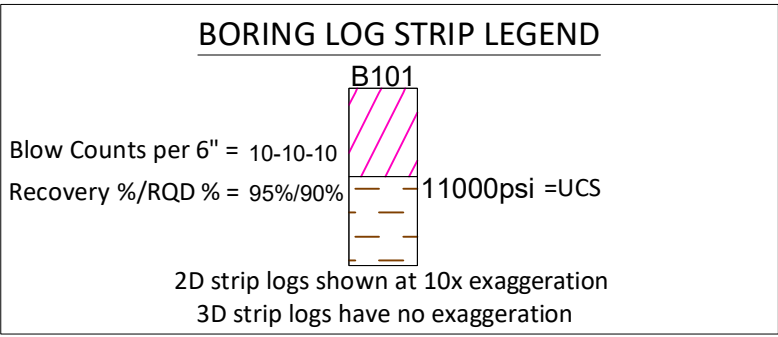


PROPOSED HDD 12A PLAN VIEW  
CONDUIT 2



PROPOSED HDD 12A PROFILE  
CONDUIT 2

NOTE:  
1) THE USE OF CONDUCTOR CASINGS IS  
RECOMMENDED TO MITIGATE THE POTENTIAL  
RELEASES OF DRILLING FLUIDS.



Legend		
	ASPHALT	Asphalt
	Bedrock	Bedrock
	Boulder	Boulder
	CH	Fat CLAY
	CH-MH	SILTY Fat CLAY
	CL	Lean CLAY
	CL-ML	SILTY CLAY
	CONCRETE	Concrete
	FILL	FILL
	GC	CLAYEY GRAVEL
	GC-GM	SILTY CLAYEY GRAVEL
	GM	SILTY GRAVEL
	GP	Poorly Graded GRAVEL
	GP-GC	Poorly Graded Gravel with CLAY
	GP-GM	Poorly Graded GRAVEL with SILT
	GW	Well Graded GRAVEL
	GW-GC	Well Graded GRAVEL with CLAY
	GW-GM	Well Graded GRAVEL with SILT
	Limestone	Limestone
	MH	Elastic SILT
	ML	SILT
	OH	ORGANIC Fat CLAY
	OL	ORGANIC Lean CLAY
	OL/OH	ORGANIC SOIL
	PT	PEAT
	Rock	Rock
	Sandstone	Sandstone
	SC	CLAYEY SAND
	SC-SM	SILT, CLAYEY SAND
	SHALE	Shale
	SILTSTONE	Siltstone
	SM	SILTY SAND
	SP	Poorly Graded SAND
	SP-SC	Poorly Graded SAND with CLAY
	SP-SM	Poorly Graded SAND with SILT
	SW	Well graded SAND
	SW-SC	Well Graded SAND with CLAY
	SW-SM	Well Graded SAND with SILT
	Topsoil	Topsoil
	USGS 601	Gravel or Conglomerate 1
	USGS 654	Subgraywacke
	USGS 670	Interbedded Sandstone and Shale
	USGS 702	Quartzite
	USGS 705	Schist
	USGS 705	Schist
	USGS 708	Gneiss
	USGS 708	Gneiss
	USGS 718	Granite 1
	Void	Void
	Water	Water
	Weathered Rock	Undefined
	Water Table during drilling	Water Table during drilling
	Water Table after drilling	Water Table after drilling



IT IS A VIOLATION OF LAW FOR ANY PERSON, UNLESS THEY ARE ACTING UNDER THE DIRECTION OF A LICENSED PROFESSIONAL ENGINEER, ARCHITECT, LANDSCAPE ARCHITECT OR LAND SURVEYOR TO ALTER AN ITEM IN ANY WAY. IF AN ITEM BEARING THE STAMP OF A LICENSED PROFESSIONAL IS ALTERED, THE ALTERING ENGINEER, ARCHITECT, LANDSCAPE ARCHITECT OR LAND SURVEYOR SHALL STAMP THE DOCUMENT AND INCLUDE THE NOTATION "ALTERED BY" FOLLOWED BY THEIR SIGNATURE, THE DATE OF SUCH ALTERATION, AND A SPECIFIC DESCRIPTION OF THE ALTERATION.

0	03/22/2023	ISSUED FOR CONSTRUCTION SUBMISSION	MCS	JEO
No.	DATE	SUBMITTAL / REVISION DESCRIPTION	DB	APP

CHAMPLAIN HUDSON POWER EXPRESS  
SEGMENT 3 - PACKAGE 2 - FORT ANN TO KINGSBURY  
PLAN AND PROFILE - HDD 12A, CONDUIT 2

DRAWN BY: JAS DESIGNED BY: JAS APPROVED BY: JEO SCALE AS NOTED  
REV. NO. X

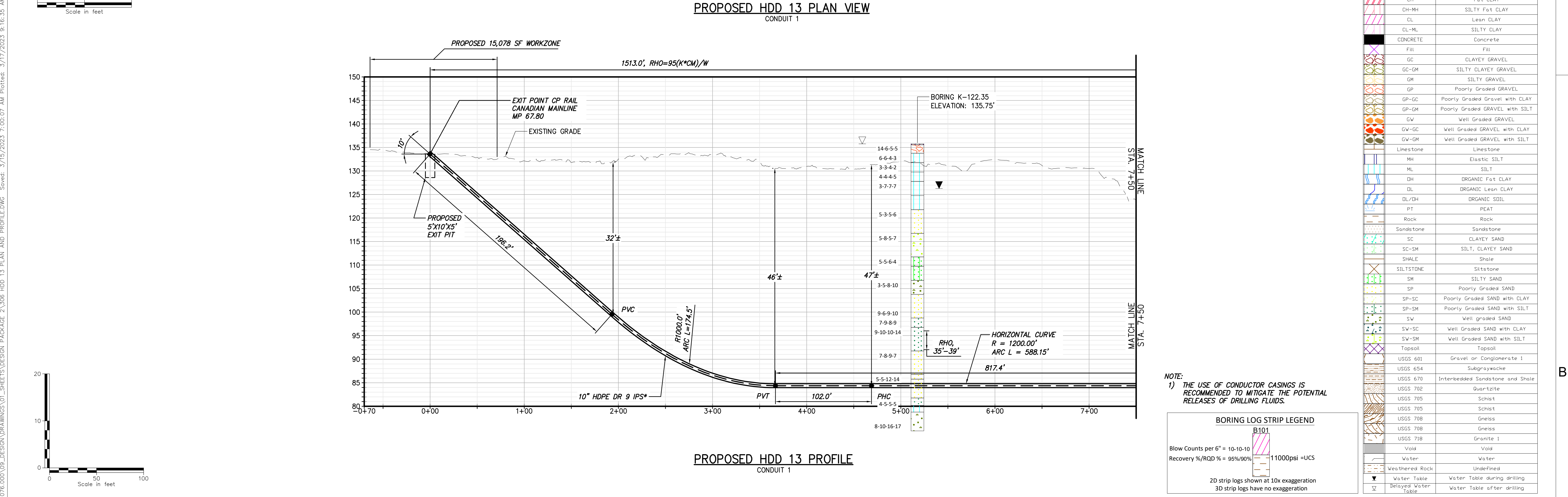
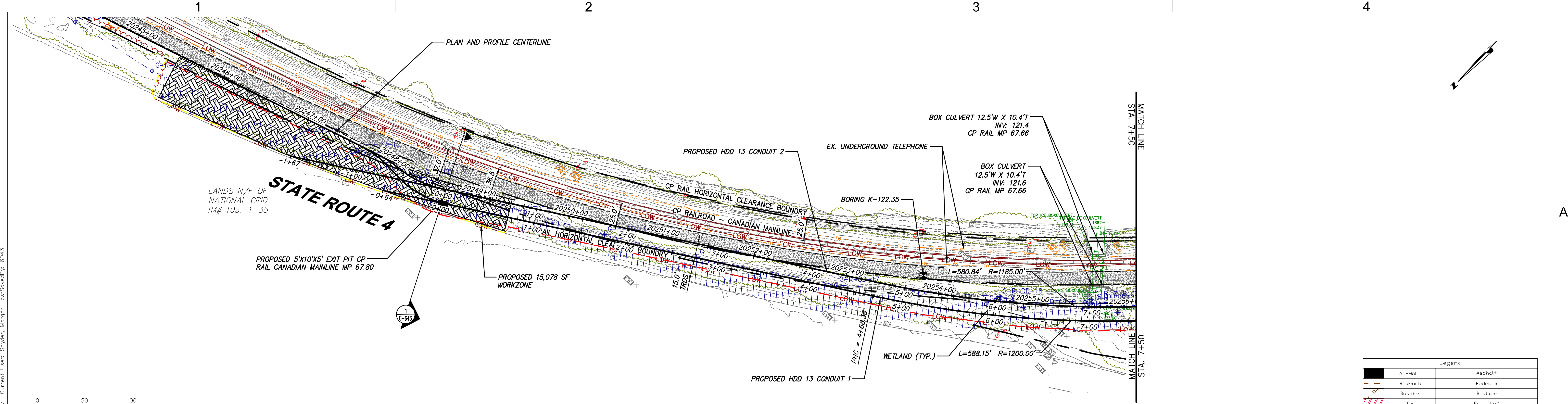
KIEWIT PROJECT NO. 21162  
CHA PROJECT NO. 066076  
DRAWING NO.


C-305A.1

DATE 03/22/2023




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Champlain Hudson  
Power Express



Kiewit



III Winners Circle, PO Box 5269  
Albany, NY 12205-0269  
518.453.4500 • www.chacompanies.com

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No.	DATE	SUBMITTAL / REVISION DESCRIPTION	DB	APP
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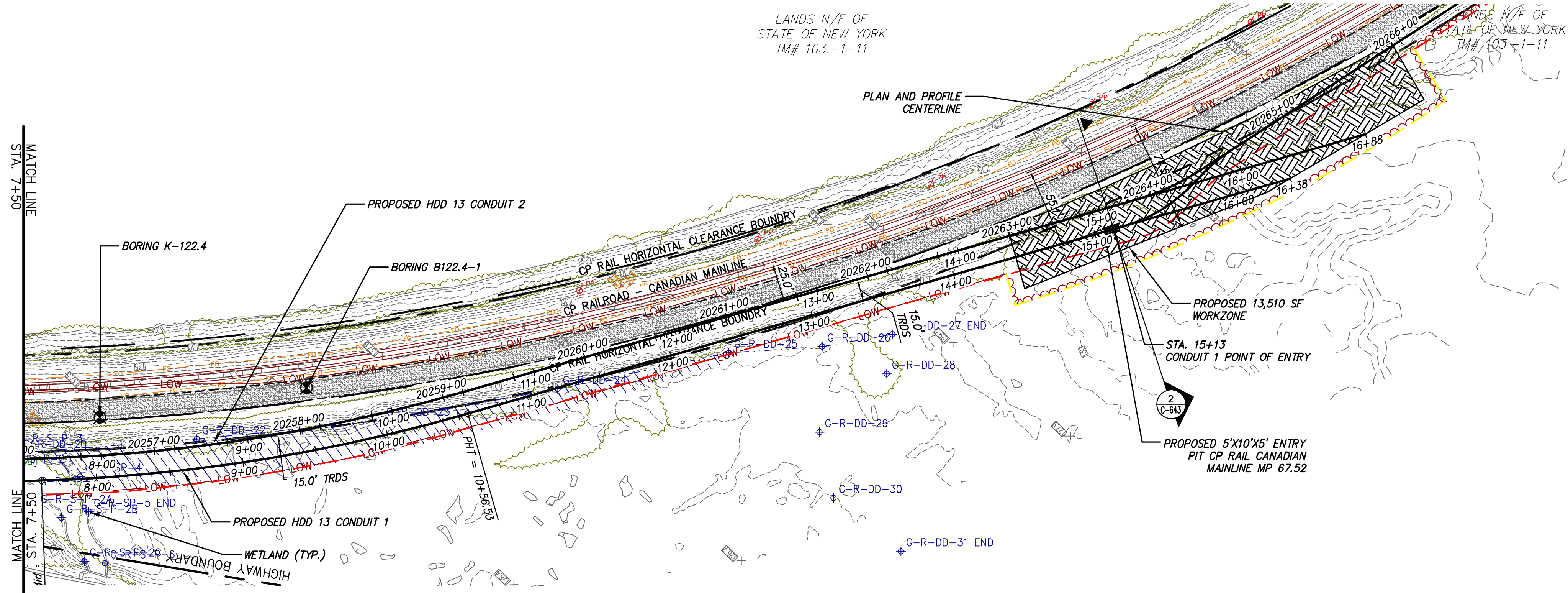
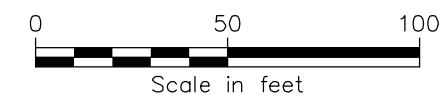
CHAMPLAIN HUDSON POWER EXPRESS  
SEGMENT 3 - PACKAGE 2 - FORT ANN TO KINGSBURY  
PLAN AND PROFILE - HDD 13, CONDUIT 1

DRAWN BY: MAR DESIGNED BY: MAR APPROVED BY: JEO SCALE AS NOTED DATE 03/22/2023

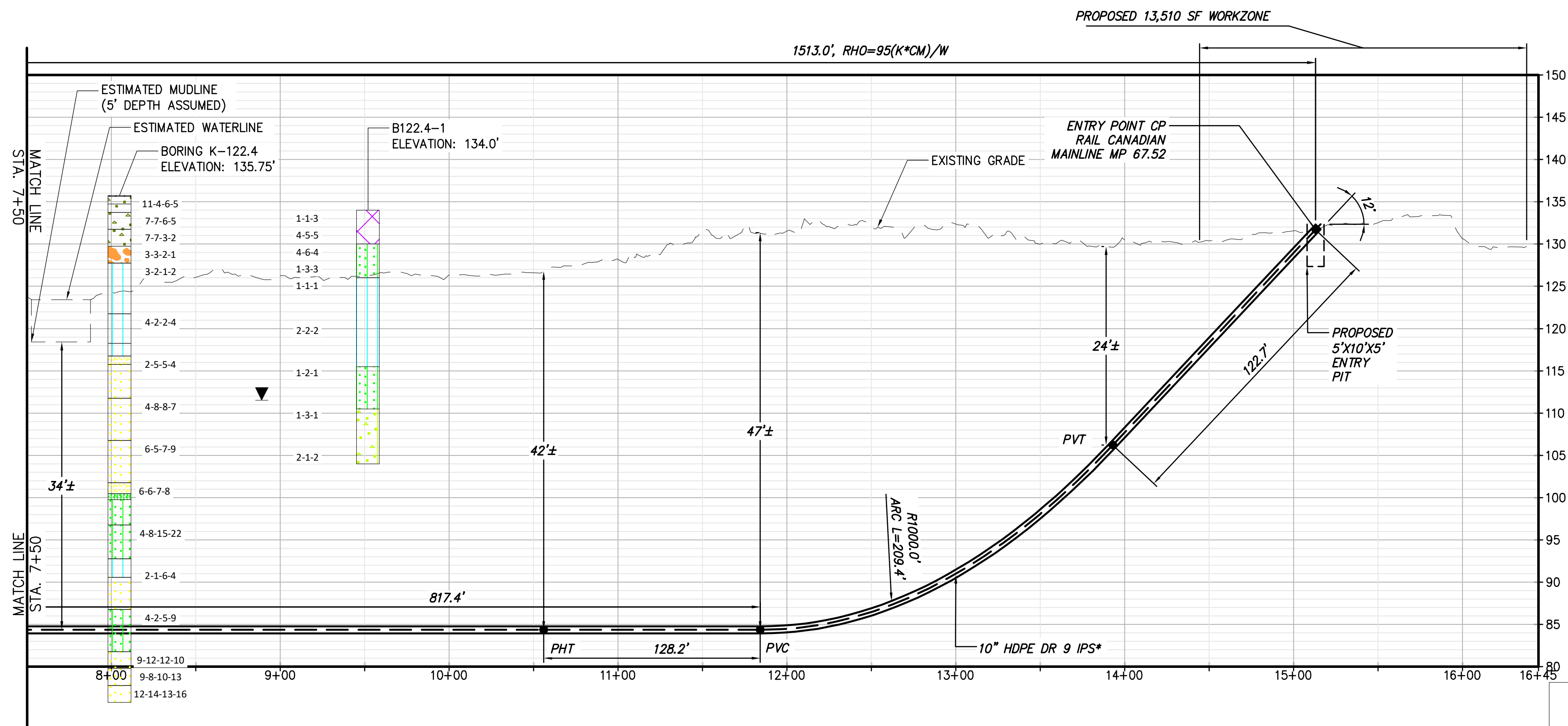
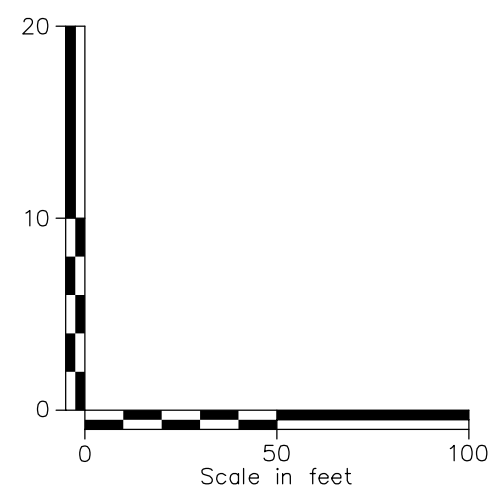
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CHA PROJECT NO. 066076  
DRAWING NO. C-306



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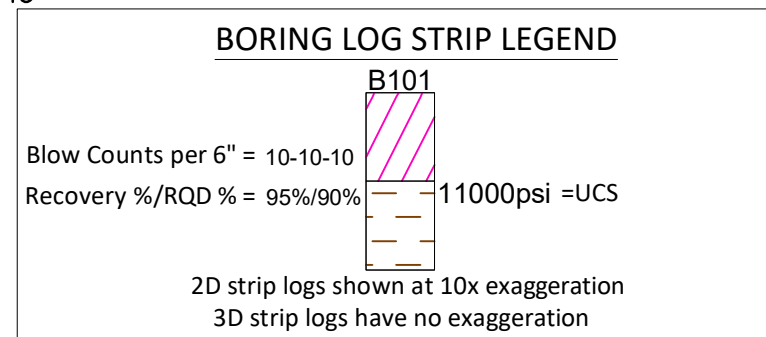
PROPOSED HDD 13 PLAN VIEW  
CONDUIT 1



PROPOSED HDD 13 PROFILE  
CONDUIT 1

Legend	
ASPHALT	Asphalt
Bedrock	Bedrock
Boulder	Boulder
CH	Fat CLAY
CH-MH	SILTY Fat CLAY
CL	Lean CLAY
CL-ML	SILTY CLAY
CONCRETE	Concrete
FILL	Fill
GC	CLAYEY GRAVEL
GC-GM	SILTY CLAYEY GRAVEL
GM	SILTY GRAVEL
GP	Poorly Graded GRAVEL
GP-GC	Poorly Graded Gravel with CLAY
GP-GM	Poorly Graded GRAVEL with SILT
GW	Well Graded GRAVEL
GW-GC	Well Graded GRAVEL with CLAY
GW-GM	Well Graded GRAVEL with SILT
Limestone	Limestone
MH	Elastic SILT
ML	SILT
OH	ORGANIC Fat CLAY
OL	ORGANIC Lean CLAY
OL/OH	ORGANIC SOIL
PT	PEAT
Rock	Rock
Sandstone	Sandstone
SC	CLAYEY SAND
SC-SM	SILT, CLAYEY SAND
SHALE	Shale
SILTSTONE	Siltstone
SM	SILTY SAND
SP	Poorly Graded SAND
SP-SC	Poorly Graded SAND with CLAY
SP-SM	Poorly Graded SAND with SILT
SW	Well graded SAND
SW-SC	Well Graded SAND with CLAY
SW-SM	Well Graded SAND with SILT
Topsail	Topsail
USGS 601	Gravel or Conglomerate 1
USGS 654	Subgraywacke
USGS 670	Interbedded Sandstone and Shale
USGS 702	Quartzite
USGS 705	Schist
USGS 705	Schist
USGS 708	Gneiss
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USGS 718	Granite 1
Void	Void
Water	Water
Weathered Rock	Undefined
Water Table	Water Table during drilling
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No.	DATE	SUBMITTAL / REVISION DESCRIPTION	DB	APP

CHAMPLAIN HUDSON POWER EXPRESS  
SEGMENT 3 - PACKAGE 2 - FORT ANN TO KINGSBURY  
PLAN AND PROFILE - HDD 13, CONDUIT 1

DRAWN BY:	MAR	DESIGNED BY:	MAR	APPROVED BY:	JEO	SCALE	AS NOTED	DATE	03/22/2023
REV. NO.	X								

KIEWIT PROJECT NO.  
21162  
CHA PROJECT NO.  
068076  
DRAWING NO.

C-306.1